

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Ref 1: Exhibit 2, Tab 2, Schedule 1, pp.3-4

Ref 2: Exhibit 1, Tab 8, Schedule 1, Attachment 2 – 2021 Audited Financial Statement (AFS)

Question(s):

In Tables 1 and 2 of Ref 1, the 2021 net book value of PP&E is \$14,095 million. The net book value of PP&E in Notes 7 and 8 of the 2021 AFSs is \$16,438 million. The differences are shown below. Please explain and reconcile the differences.

2021	Ref 2 AFS(\$M)	Ref 1 Exhibit 2 (\$M)	Difference Calculated by OEB Staff (\$M)
Regulated Gross PP&E	20,725		- 981
Gross Intangibles	515		
Total Gross PP&E	21,240	22,221	
Accumulated Depreciation PP&E	- 4,464		3,325
Accumulated Depreciation Intangibles	- 338		
Total Accumulated Depreciation	- 4,802	- 8,127	
Net PP&E	16,438	14,094	2,344

Response:

Please see Table 1 for the reconciliation. A number of items that are included in PP&E within the Audited Financial Statements are not included in Utility PP&E.

Table 1 – Reconciliation of 2021 Audited PP&E and Utility PP&E

Particulars	(\$ millions)	
Net PP&E – Audited Financial Statements		16,438
Exclude items not part of Utility Rate Base:		
Under Construction (CWIP) ¹	(289)	
Spare Parts Inventory ²	(92)	
Purchase Price Discrepancy Balance ³	(399)	
Site Restoration Costs ⁴	(1,543)	
Other ⁵	(20)	
Subtotal	<u>(2,344)</u>	<u>(2,344)</u>
Net PP&E – Utility Rate Base		14,094

¹ CWIP is not included in rate base until costs go into service.

² Spare Parts Inventory is recognized in PP&E for US GAAP presentation however included in working capital for utility purposes.

³ Purchase price discrepancy is a US GAAP requirement resulting from pushdown accounting, not included in rate base for utility purposes.

⁴ Site Restoration Costs are included in accumulated depreciation for utility rate base purposes versus reclassified to a Regulatory Retirement Obligation within the Audited Financial Statements.

⁵ Includes a portion of Base Pressure Gas and General Plant included in Regulated Assets for Audited Financial Statement purposes but allocated to Unregulated for Utility Rate Base purposes.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T1/S1

Question(s):

- a) Please add 2022 Actuals to all excel tables provided in EGI_Rebasing Appl_Exhibit 2 Written Evidence Tables_20221101 where 2022 Estimates are included.
- b) Please identify any changes to the 2023 Bridge Year in-service additions and 2024 Test year in-service additions based on 2022 Actuals.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023. /u

- a) Please see EGI_Updated_Exhibit 2 Embedded Tables_20230706.xlsx for the Excel, for the tables and schedules, updated July 6, 2023 which includes 2022 Actuals. /u
- b) Please see Tables 1 below for a comparison of the 2023 Bridge Year in-service additions compared to the revised 2023 in-service additions as a result of 2022 Actuals and the Capital Update: /u

/u

Table 1
Comparison of 2023 Bridge Year In-Service Additions as Filed vs the Capital Update

Line No.	Particulars (\$ millions)	<u>2023</u> Bridge Year (As Filed)	<u>2023</u> Bridge Year (Updated)	Over/ (Under)
		(a)	(b)	(c) = (b-a)
1	Compression Stations	262.1	362.7	100.6
2	Customer Connections	220.4	286.3	65.9
3	Distribution Pipe	257.5	272.4	14.9
4	Distribution Stations	159.5	58.7	(100.8)
5	Fleet & Equipment	25.5	8.9	(16.6)
6	Growth - Distribution System Reinforcement	51.3	45.4	(5.9)
7	Real Estate & Workplace Services	15.7	32.1	16.4
8	Technology Information Services (TIS)	52.0	33.7	(18.3)
9	Transmission Pipe and Underground Storage	293.7	44.8	(248.9)
10	Utilization	136.5	160.7	24.2
11	Extended Alliance Fixed Overhead	21.7	25.6	3.9
12	Capitalized Overheads	0.0	0.0	0.0
13	Integration Capital	59.4	22.7	(36.7)
14	Community Expansion	12.2	10.6	(1.6)
15	Other	43.5	4.5	(39.0)
16	Total	1,611.0	1,369.1	(241.9)

/u

Summary of key variances for 2023:

- a) Compression Stations – the increase of \$100.6 million is primarily related to the increase in cost estimates for the Dawn to Corunna Replacement Project
- b) Customer Connections – the increase of \$65.9 million is related to an overall increase in forecasted new customer connections compounded with inflationary pressures in construction and material costs
- c) Distribution Pipe – the increase of \$14.9 million is due to increases in pipeline replacement projects, new integrity digs and exposed water way crossing replacements
- d) Distribution Stations – the decrease of \$100.8 million is related the delay of the Lisgar Gate station as the project is rescope, deferral of the Crowland station and deferrals and reductions of other smaller station projects during portfolio reprioritization to manage cost pressures
- e) Fleet and Equipment – the decrease of \$16.6 million is due to savings from reprioritization for vehicles and equipment purchases, partially offset by identification of requirements for new tools and equipment.
- f) Growth – the decrease of \$5.9 million is related to the deferral and downsizing of planned growth projects following review of specific customer connection projects and resultant system constraints
- g) REWS – the increase of \$16.4 million is related to carry forward projects from 2022
- h) TIS – the decrease of \$18.3 million is related to the reductions and deferrals for the reprioritization of the TIS Business Solutions portfolio based on business needs, partially offset by carry over costs from 2022 and new investments
- i) Transmission Pipe and Underground Storage – the decrease of \$248.9 million is primarily related to the deferral of the Panhandle Regional Reinforcement project to in-service in 2024
- j) Utilization – the increase of \$24.2 million is related to carry forward costs for delayed meters ordered for 2022, an increase for meters ordered in 2023 to build inventory for increased customer connections and meter exchange activity, increases in regulators and meter exchange labour costs, associated with a

moderate increase in planned work to catch up on work not complete in 2022, and some other minor increases in the portfolio

- k) Extended Alliance Fixed Overhead – the increase of \$3.9 million is related to the inclusion of third party pre-work blankets in the EA Fixed Overhead asset class
- l) Integration Capital – the decrease of \$36.7 million is primarily related to the deferral of the GTA East and West facility projects to 2026
- m) Community Expansion – the decrease of \$1.6 million is related to adjustments in the timing of execution of NGEF Phase 2 projects
- n) Other – the decrease of \$39.0 million is related to adjustments in the timing of customer driven RNG and CNG projects

Please see Table 2 below for a comparison of the 2024 Test Year in-service additions compared to the revised 2024 in-service additions as a result of 2022 Actuals and the Capital Update:

/u

Table 2
Comparison of 2024 Bridge Year In-Service Additions as Filed vs the Capital Update

Line No.	Particulars (\$ millions)	<u>2024</u> Test Year (As Filed)	<u>2024</u> Test Year (Updated)	Over/ (Under)
		(a)	(b)	(c) = (b-a)
1	Compression Stations	21.0	43.9	22.9
2	Customer Connections	249.2	304.0	54.9
3	Distribution Pipe	341.5	350.7	9.3
4	Distribution Stations	122.6	101.2	(21.4)
5	Fleet & Equipment	35.0	31.5	(3.5)
6	Growth - Distribution System Reinforcement	102.5	75.5	(27.1)
7	Real Estate & Workplace Services	93.7	19.2	(74.5)
8	Technology Information Services (TIS)	83.2	68.9	(14.3)
9	Transmission Pipe and Underground Storage	168.4	52.4	(116.0)
10	Utilization	146.5	152.3	5.8
11	Extended Alliance Fixed Overhead	21.9	39.8	17.9
12	Capitalized Overheads	0.0	0.0	0.0

Table 2
Comparison of 2024 Bridge Year In-Service Additions as Filed vs the Capital Update

Line No.	Particulars (\$ millions)	2024 Test Year (As Filed)	2024 Test Year (Updated)	Over/ (Under)
		(a)	(b)	(c) = (b-a)
13	Integration Capital	0.0	0.0	0.0
14	Community Expansion	30.0	22.2	(7.8)
15	Other	41.1	52.0	10.8
16	Total	1,456.5	1,313.6	(142.9)

Summary of key variances for 2024:

- a) Compression Stations – the increase of \$22.9 million is primarily related to the increase in completion costs for the Dawn to Corunna Replacement Project and various adjustments to the planned work in 2024 as a result of carry forward work from 2023
- b) Customer Connections – the increase of \$54.9 million is related to inflationary pressures in construction and material costs
- c) Distribution Pipe – the increase of \$9.3 million is related to the adjustments to the expected execution of projects due to revised cost estimates, carry forward work and project deferrals
- d) Distribution Stations – the decrease of \$21.4 million is related to deferrals and reductions of station projects during portfolio reprioritization to manage cost pressures
- e) Fleet and Equipment – the decrease of \$3.5 million is due to reductions during reprioritization for vehicles and equipment purchases partially offset by anticipated carry over costs and new equipment and tool investments.
- f) Growth – the decrease of \$27.1 million is primarily due to the deferral of the East Kingston Creekford Road Reinforcement, the cancellation of the Wheatley 1B Panhandle Distribution Reinforcement, and deferral of several smaller growth reinforcement projects, which are partially offset by forecasted carry-over costs from 2023 and new reinforcement projects

- g) REWS – the decrease of \$74.5 million is primarily due to the shift of in-service timing for the Station B to 2025 and the Ottawa SMOC Consolidation to 2026
- h) TIS – the decrease of \$14.3 million is related to the reductions and deferrals for the reprioritization of the TIS Business Solutions portfolio based on business needs partially offset by new investments
- i) Transmission Pipe and Underground Storage – the decrease of \$116.0 million is the result of removal of the forecast for PREP, deferral of the Dawn to Parkway Expansion Project: Kirkwall to Hamilton Loop. and delayed expenditures for the Panhandle Line Replacement
- j) Utilization – the increase of \$5.8 million is related to an increase in meter orders to ensure sufficient inventory for forecasted customer connections and meter exchanges
- k) Extended Alliance Fixed Overhead – the increase of \$17.9 million is related to the renegotiation of the Extended Alliance Contracts
- l) Community Expansion – the decrease of \$7.8 million is related to adjustments in the timing of execution of NGEF Phase 2 projects
- m) Other – the increase of \$10.8 million is related to adjustments in the timing of customer driven RNG and CNG projects

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T1/S1/Attach. 1/p. 3

Question(s):

Please recast the Table to include 2022 Actuals.

Response:

Please see response at Exhibit I.2.1-CCC-36 part a).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T1/S1/Attach. 1/p. 4

Question(s):

Please recast the Table to include 2022 Actuals.

Response:

Please see response at Exhibit I.2.1-CCC-36 part a).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Industrial Gas Users Association (IGUA)

Interrogatory

Preamble:

We would like to identify and understand the particular gas supply plan related costs which impact contract rate customers.

Question(s):

Please list all categories of gas supply costs that are allocated to delivery rates and shared by EGI's contract customers, by customer service type (i.e. T-service, bundled, unbundled, etc.) and associated rate class(es).

Response:

Please see Attachment 1 for a mapping of gas supply plan cost categories to the contract service options. A summary of the service type options available for each contract rate class is provided in Table 1.

Table 1
Summary of Rate Classes by Contract Service Option

Line No.	Service Type	Current Rate Classes		
		EGD	Union North	Union South
		(a)	(b)	(c)
1	Sales Service	Rate 100	Rate 20	Rate M4
2		Rate 110	Rate 25	Rate M5
3		Rate 115	Rate 100	Rate M7
4		Rate 135		Rate M9
5		Rate 145		
6		Rate 170		
7		Rate 200		
8	Bundled Direct Purchase	Rate 100	Rate 20	Rate M4
9		Rate 110	Rate 100	Rate M5
10		Rate 115		Rate M7
11		Rate 135		Rate M9
12		Rate 145		
13		Rate 170		
14		Rate 200		
15	Semi-Unbundled			Rate T1
16				Rate T2
17				Rate T3
18	Unbundled	Rate 125	Rate 20	
19		Rate 300	Rate 25	
20			Rate 100	

Cost of Gas Allocation to Contract Service Option

Line No.	Cost of Gas Category Functional Classification	Contract Service Options			
		Sales Service (a)	Bundled DP (b)	Semi-Unbundled (c)	Unbundled (d)
	<u>Gas Supply Commodity</u>				
1	Gas Supply Commodity	Yes	No	No	No
2	Load Balancing Transport	Yes	Yes	Yes (2)	No (1)
3	Load Balancing Commodity	Yes	Yes	Yes (2)	No (1)
4	Transportation Demand	Yes	Yes	Yes (2)	No (1)
5	Transportation Commodity	Yes	Yes	Yes (2)	No (1)
	<u>Compressor Fuel</u>				
6	Storage Commodity	Yes	Yes	Yes	No (1)
7	Transmission Commodity	Yes	Yes	Yes	No (1)
	<u>Unaccounted For Gas (UFG)</u>				
8	Storage Commodity	Yes	Yes	Yes	No (1)
9	Transmission Commodity	Yes	Yes	Yes	No (1)
10	Distribution Commodity	Yes	Yes	Yes	Yes (3)
	<u>Company Use Gas</u>				
11	Distribution Commodity	Yes	Yes	Yes	Yes
	<u>Market Based Storage</u>				
12	Storage Deliverability	Yes	Yes	Yes	No (1)
13	Storage Space	Yes	Yes	Yes	No (1)
14	Storage Commodity	Yes	Yes	Yes	No (1)
	<u>Parkway Delivery Commitment Incentive</u>				
15	Transmission Dawn Parkway	Yes	Yes	Yes (2)	No (1)
	<u>Other Transportation</u>				
16	Transmission Panhandle/St. Clair	Yes	Yes	Yes (2)	No
17	Distribution High Pressure >4"	Yes	Yes	Yes	Yes

Notes:

- (1) Costs are not allocated to unbundled delivery services but if applicable, are allocated to unbundled storage services based on contracted storage parameters and the average cost of the respective service area.
- (2) Costs are allocated to semi-unbundled service based on the average cost of the respective service area.
- (3) UFG costs are not allocated to Rate 125 unbundled customers with a dedicated service.

ENBRIDGE GAS INC.

Answer to Interrogatory from
London Property Management Association (LPMA)

Interrogatory

Reference:

Exhibit 2, Tab 1, Sch. 1

Question(s):

Please update Table 2 to reflect actual data for 2022 and the evidence corrections and updates noted in EGI's January 27, 2023 letter.

Response:

Please see response at Exhibit I.2.1-CCC-36 Attachment 1.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Pollution Probe (PP)

Interrogatory

Question(s):

- a) Please explain the different in purpose and use between Enbridge's Utility System Plan (USP) and Asset Management Plan (AMP)? Also please explain how these documents are used in a coordinated manner to prioritize asset investment decisions.
- b) When the OEB sets Enbridge capital expenditures (annually or during an incentive rate period), please explain how (if at all) the USP and/or AMP enable Enbridge to specifically prioritize which capital investments should be undertaken over others within the approved capital envelope.

Response:

- a) The Utility System Plan and Asset Management Plan are both requirements under Ontario Energy Board's "Filing Requirements For Natural Gas Rate Applications"¹, Section 2.2.6 and 2.2.6.1. The Utility System Plan is broader in scope than the Asset Management Plan and describes additional planning processes and programs such as Revenue and Volume Forecasts, the Operating and Maintenance Expense Budget Process, Continuous Improvements and Benchmarking which are not covered within the Asset Management Plan. However, these elements may directly influence the Asset Class Strategies provided at Exhibit 2, Tab 6, Schedule 2, pages 58-289.

The prioritization of investment decisions is achieved through the optimization of portfolio solutions. This process is referenced in the Utility System Plan provided at Exhibit 2, Tab 6, Schedule 1, pages 27 and 28, paragraphs 57 and 60; and provided in detail at Exhibit 2, Tab 6, Schedule 2, page 55 of 288, Section 4.3.3. The result of this process, which is undertaken biannually, is the optimized capital portfolio.

- b) Please see Exhibit 2, Tab 6, Schedule 2, pages 45-48 in which the Asset Management Plan describes the decision-making process used to prioritize capital investments. Specifically in Table 4.1-2, the Asset Management Plan describes how investments are categorized as Mandatory, Compliance and Value-Driven. As described within the table, Mandatory and Compliance Investments must be

¹ Filing Requirements For Natural Gas Rate Applications, February 16, 2017.

addressed within their required time-frame, and timing for Value-Driven investments is informed by the Copperleaf Value Framework or the GDS Risk Management Process. When an approved capital envelope is defined, Enbridge Gas prioritizes its capital expenditure following these criteria. As indicated in part a), elements of the USP directly influence Asset Class Strategies. Therefore, the USP serves to indirectly affect the prioritization of capital investments through the Asset Management Plan but is not normally referenced to inform specific capital investment decisions.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Pollution Probe (PP)

Interrogatory

Reference:

Exhibit 2, Tab 1, Schedule 1 Table 2

Question(s):

- a) Over the current rebasing period net regulated capital rate base has grown from \$13.139 billion to \$15.542 billion. Please explain how the OEB MAADs application approval aligns with this net increase. If part of this net increase is beyond the OEB MAADs Decision approval, please explain where the additional increase to rate base over this period has occurred.
- b) Please estimate what portion of the \$15.542 and \$16.184 billion in Table 2 is expected to be in rate base in 2050 (i.e. not fully depreciated by 2050).

Response:

- a) The OEB's MAADs Decision¹ did not approve rate base amounts related to the deferred rebasing term. The Decision did provide direction on rate base amounts to be included in the calculation of the ICM threshold.
- b) Assuming the assets are fully intact without any damages and replacements, the estimate of assets expected to be in rate base in 2050 is \$1.1 billion. This is based on the Net Property, Plant and Equipment balance of \$15,724 million in 2024 and excludes allowance for working capital.

¹ EB-2017-0306, Decision and Order, August 30, 2018.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-1

Question(s):

Please provide a table that shows for each material project that has gone into-service since either Union or EGD's last rebasing year, the:

- a) project name
- b) rate zone
- c) USP investment category (i.e. system access, system renewal etc.)
- d) asset class
- e) year project went in-service
- f) forecasted cost
- g) source of forecasted cost (i.e. ICM application, previous filed AMP or application forecast, internal approved budget etc.)
- h) final costs
- i) cost variance
- j) explanation of cost variance (if variance is +/- 10%).

Please also provide the response in Excel format.

Response:

Please see Attachment 1 for the Excel.

Table 1 - Summary of Material Projects Over \$10 million 2013 to 2022 in \$'s

Line No.	Project Name	Rate Zone	USP Category	Asset Class	In-Service Year	Source of Forecast	Forecasted Cost	Final Costs	Cost Variance	Variance % over/under	Variance Explanation for Projects +/- 10%
1	Ottawa Reinforcement	EGD	System Access	Growth	2013	EB-2012-0099	51,236,000	70,062,162	18,826,162	36.7%	Please refer to PCFR for Project Variance Explanations at: https://www.rds.ont.ca/CMWebDrawer/Record/477849/File/document
2	Ottawa Innes Road Pipeline Replacement Project	EGD	System Renewal	Distribution Pipe	2014	EB-2012-0438/EB-2014-0017/EB-2015-0037	7,254,286	10,742,682	3,488,396	48.1%	Please refer to PCFR for Project Variance Explanations at: https://www.rds.ont.ca/CMWebDrawer/Record/530250/File/document
3	GTA Reinforcement Project	EGD	System Access	Growth	2016	EB-2012-0451	667,400,000	847,400,000	180,000,000	27.0%	Please refer to PCFR for Project Variance Explanations at: https://www.rds.ont.ca/CMWebDrawer/Record/576741/File/document
4	Tecumseh new building	EGD	General Plant	Real Estate & Workplace S	2016	Budget	16,584,666	16,305,456	(279,210)	-1.7%	
5	Ashtonbee Station	EGD	System Access	Growth	2017	EB-2012-0451/EB-2016-0034	14,378,598	22,416,266	8,037,668	55.9%	Please refer to PCFR for Project Variance Explanations at: https://www.rds.ont.ca/CMWebDrawer/Record/619701/File/document
6	Canadian Nuclear Laboratories	EGD	System Access	Growth	2017	EB-2015-0194	15,503,141	15,739,803	236,662	1.5%	
7	5904-2018 CX Pgm	EGD	General Plant	TIS	2018	Budget/AMP	9,800,000	15,307,198	5,507,198	56.2%	Increased scope of work
8	Dow Moore Storage Pool Drilling	EGD	System Renewal	TPUS	2019	EB-2017-0354	8,877,796	10,185,186	1,307,390	14.7%	Please refer to Exhibit 1, Tab 12, Schedule 1, Attachment 2, page 6
9	5904-2018 CX Pgm	EGD	General Plant	Integration Capital	2019	Budget	11,100,000	12,066,293	966,293	8.7%	
10	TOC Site 1 Expansion	EGD	General Plant	Real Estate & Workplace S	2019	Budget	12,700,000	12,836,344	136,344	1.1%	
11	Don River 30" Pipeline Project*	EGD	System Renewal	Distribution Pipe	2020	EB-2019-0194 - ICM	35,400,000	31,013,254	(4,386,746)	-12.4%	Please refer to Exhibit 1, Tab 12, Schedule 1, Attachment 2, page 19
12	Fenelon Falls Community Expansion Project	EGD	System Access	Growth	2020	EB-2017-0147	23,055,488	27,910,741	4,855,253	21.1%	Please refer to Evidence Exhibit 1, Tab 12, Schedule 1, Attachment 1, page 13
13	Kennedy Road Expansion 2020	EGD	General Plant	Real Estate & Workplace S	2020	Budget/AMP	12,000,000	12,848,081	848,081	7.1%	
14	2019 CIS HANA Upgrade	EGD	General Plant	Integration Capital	2020	Budget	9,000,000	14,141,879	5,141,879	57.1%	Increased scope of work due to CIS integration
15	SCOR Meter Area Upgrade (Ph 1-2)*	EGD	System Renewal	Compression Stations	2021-2022	Budget/AMP	53,233,268	52,156,529	(1,076,739)	-2.0%	
16	Asset & Work Management System (AWS)*	EGD	General Plant	Integration Capital	2021-2022	Budget	37,820,211	38,154,113	333,902	0.9%	
17	NPS 2- Replacement Cherry to Bathurst*	EGD	System Renewal	Distribution Pipe	2022	EB-2021-0148 - ICM	129,900,000	87,698,894	(42,201,106)	-32.5%	Variances to be filed in Post Construction Financial Report, additional costs expected in 2023
18	Thunder Bay Pipeline Project	UGL	System Renewal	Distribution Pipe	2013	EB-2012-0226/EB-2012-0227	26,726,000	25,373,153	(1,352,847)	-5.1%	
19	Parkway West Project	UGL	System Access	Compression Stations	2014	EB-2012-0433	219,400,000	231,703,000	12,303,000	5.6%	
20	Brantford-Kirkwall/Parkway D Projects	UGL	System Access	Compression Stations	2015	EB-2013-0074	204,100,000	197,378,000	(6,722,000)	-3.3%	
21	Sudbury Expansion Project	UGL	System Access	Growth	2015	EB-2015-0120	10,825,000	10,298,046	(526,954)	-4.9%	
22	CRES - Ed Centre	UGL	General Plant	REWS	2015	Budget	17,500,000	16,663,401	(836,599)	-4.8%	
23	EAM - Enterprise Asset Management	UGL	General Plant	TIS	2015	Budget	14,263,500	13,634,274	(629,226)	-4.4%	
24	Sarnia Expansion Project	UGL	System Access	TPUS	2015	EB-2014-0333	24,318,000	15,945,947	(8,372,053)	-34.4%	Please refer to PCFR for Project Variance Explanations at: https://www.rds.ont.ca/CMWebDrawer/Record/501564/File/document
25	Leamington Pipeline Expansion Project	UGL	System Access	Growth	2016	EB-2016-0013	12,344,000	11,233,071	(1,110,929)	-9.0%	
26	2016 Dawn-Parkway Growth Project	UGL	System Access	Compression Stations	2016	EB-2014-0261	390,715,000	347,061,000	(43,654,000)	-11.2%	Please refer to PCFR for Project Variance Explanations at: https://www.rds.ont.ca/CMWebDrawer/Record/600177/File/document
27	Burlington-Oakville Pipeline	UGL	System Access	TPUS	2016	EB-2014-0182	119,477,000	83,262,000	(36,215,000)	-30.3%	Please refer to Exhibit 1, Tab 12, Schedule 1, Attachment 1, page 1
28	Panhandle NPS16 Replacement Project	UGL	System Renewal	Distribution Pipe	2016	EB-2013-0420	29,597,000	26,052,842	(3,544,158)	-12.0%	Please refer to PCFR for Project Variance Explanations at: https://www.rds.ont.ca/CMWebDrawer/Record/597409/File/document
29	2017 Dawn-Parkway Project	UGL	System Access	Compression Stations	2017	EB-2015-0200	622,500,000	620,050,000	(2,450,000)	-0.4%	
30	Panhandle Reinforcement	UGL	System Access	TPUS	2017	EB-2016-0186	264,500,000	228,574,000	(35,926,000)	-13.6%	Please refer to Exhibit 1, Tab 12, Schedule 1, Attachment 1, page 10
31	ContraX Modernization	UGL	General Plant	TIS	2017	Budget	39,800,000	40,831,392	1,031,392	2.6%	
32	Sudbury Replacement Project	UGL	System Renewal	Distribution Pipe	2018	EB-2018-0305 - ICM	95,300,000	96,710,071	1,410,071	1.5%	
33	Stratford Reinforcement Project	UGL	System Access	Growth	2019	EB-2018-0305 - ICM	28,540,000	25,002,541	(3,537,459)	-12.4%	Please refer to Exhibit 1, Tab 12, Schedule 1, Attachment 2, page 26
34	Kingsville Transmission*	UGL	System Access	Growth	2019	EB-2018-0305 - ICM	121,400,000	91,553,885	(29,846,115)	-24.6%	Please refer to Exhibit 1, Tab 12, Schedule 1, Attachment 2, page 10
35	Chatham-Kent Rural Project	UGL	System Access	Growth	2019	EB-2018-0188	19,100,000	14,812,202	(4,287,798)	-22.4%	Please refer to Exhibit 1, Tab 12, Schedule 1, Attachment 2, page 23
36	Owen Sound Reinforcement Project*	UGL	System Service	Growth	2020	EB-2019-0183	68,965,000	70,165,009	1,200,009	1.7%	
37	Windsor Line Replacement*	UGL	System Renewal	Distribution Pipe	2021	EB-2019-0194 - ICM	106,805,000	83,123,644	(23,681,356)	-22.2%	Please refer to Exhibit 1, Tab 12, Schedule 1, Attachment 2, page 29
38	London Lines Replacement*	UGL	System Renewal	Distribution Pipe	2021	EB-2020-0181 - ICM	161,100,000	122,270,345	(38,829,655)	-24.1%	Variances to be filed in Post Construction Financial Report
39	Sarnia Industrial Line Reinforcement*	UGL	System Access	TPUS	2021	EB-2020-0181 - ICM	32,900,000	36,966,604	4,066,604	12.4%	Please refer to Exhibit 1, Tab 12, Schedule 1, Attachment 2, page 32
40	CIS Integration*	UGL	General Plant	Integration Capital	2021	Budget	45,000,000	48,792,727	3,792,727	8.4%	
41	North Bay Community Expansion Project	UGL	System Access	Growth	2021	EB-2019-0188	10,095,250	11,861,640	1,766,390	17.5%	Please refer to Exhibit 1, Tab 12, Schedule 1, Attachment 1, page 17
42	Dawn-Cuthbert*	UGL	System Service	TPUS	2022	EB-2021-0148 - ICM	24,200,000	20,046,387	(4,153,613)	-17.2%	Project is in-service, additional project closeout costs expected in 2023.
43	Byron Transmission Reinforcement*	UGL	System Access	Growth	2022	EB-2021-0148 - ICM	20,400,000	24,127,164	3,727,164	18.3%	Initial estimate was created based on the assumption of 1-year project execution; however, the project was extended over 2-years plus resulting in higher contractor cost, inspection cost, IDC & Internal OH. Stopping and tapping cost also not included in original estimate.
44	Kirkland Lake*	UGL	System Renewal	Distribution Pipe	2022	EB-2021-0148 - ICM	20,700,000	27,389,720	6,689,720	32.3%	Higher than estimated construction costs were realized due to complex Horizontal Directional Drill (HDD) installation across Blanche River. HDD had to be redesigned twice after initial attempts to complete crossing failed as a result of challenging geotechnical conditions.
45	Greenstone Pipeline Project*	UGL	System Access	Growth	2022	EB-2021-0205	25,777,789	23,508,093	(2,269,696)	-8.8%	
46	Cost of Gas*	UGL	General Plant	Integration Capital	2022	Budget	26,500,000	17,288,746	(9,211,254)	-34.8%	Change of scope from custom build to migrating EGD into UG SAP platform

(*) Projects include indirect overheads

(1) Final Costs may be different than Post Construction Financial Reporting due to ongoing clean up or restoration costs

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-1

Question(s):

For each expansion or reinforcement project brought into service by the Enbridge (EGI, EGD, Union) between 2013 and 2017 (inclusive) having a total planned addition to rate base of \$5 million or more, including those listed in this exhibit, please provide a table showing:

- a) The contemporaneous forecast (whether in the application for LTC, if any, or the then-current internal forecast) for each year from the forecast date of in-service until 2030 of:
 - i. Total load for the affected customers;
 - ii. Number and types of new customers/connections;
 - iii. Average and peak demand of the affected customers;
 - iv. Design day demand of the affected customers; and
 - v. The percentage of the capacity of the new pipe or other equipment utilized in the year.
 - vi. The actuals for the above metrics for each of the years from the in service year until 2022, and the now-current forecasts of the above metrics for each of the years 2023-2030.
- b) The forecast total cost of the project.
- c) The amount actually added to rate base with respect to the project.
- d) The original forecast of cost-effectiveness of the project.
- e) A recalculation of the cost-effectiveness of the project using the actuals and current forecasts in (b) above, including a copy in Excel format.

Where any of the above includes past data or forecasts, please provide the appropriate reference to public filings, if any.

Response:

- a) Enbridge Gas notes that the items from part a) to be included in the requested table requests 65 to 85 separate cells/data points (depending on the in-service dates) for each of the 13 expansion and reinforcement projects for which information is requested. Enbridge Gas does not have records or information to be able to complete all of these items, for example Enbridge Gas does not track customer adds or demand changes in direct relation to an individual project on an annual basis. The gas system and demands are constantly evolving with new customer demands and or usage adjustments. While partial information about some of the items might be available, the Company does not believe that it will be meaningful to provide incomplete information about some of the requested information for some of the many projects noted in the question for some of the requested 13 to 17 years.
- b-e) Please see Attachment 1 for the Excel.

Project Name	Docket #	Filed (LTC)			Updates			Notes
		PI (Phase 1)	NPV (Phase 1)	Forecast Capex	PI (Phase 1)	NPV (Phase 1)	Actual Capex	
			\$000's	(before CIAC) \$000's		\$000's	\$000's	
Leamington Expansion Pipeline Project	EB-2012-0431	1.00	0	8,200	1.02	257	7,895	
Parkway West Project	EB-2012-0433	N/A	N/A	219,400	N/A	N/A	231,703	
Brantford-Kirkwall/Parkway D Project	EB-2013-0074	1.46	94,035	204,076	1.51	100,150	197,378	
Dawn Parkway 2016 Expansion Project	EB-2014-0261	0.39	(238,466)	390,715	0.41	(210,917)	347,061	
Sarnia Expansion Pipeline Project	EB-2014-0333	1.06	180	24,317	1.06	180	15,946	¹
Burlington Oakville Pipeline Project	EB-2014-0182	N/A	(102,600)	119,477	N/A	(71,594)	83,262	
Sudbury Expansion Project	EB-2015-0120	1.00	0	10,825	1.00	0	10,298	²
Leamington Expansion Pipeline Project (Ph. 2)	EB-2016-0013	1.11	1,538	12,344	1.19	2,485	11,233	
Panhandle Reinforcement Project	EB-2016-0186	0.19	(212,382)	264,468	0.20	(180,273)	228,574	
2017 Dawn Parkway Project	EB-2015-0200	0.43	(344,236)	622,500	0.42	(344,324)	620,050	
Ottawa Reinforcement Project	EB-2012-0099	1.06	15,485	51,236	0.99	(1,687)	70,062	³
GTA Reinforcement Project	EB-2012-0451	1.73	667,432	652,144	1.46	505,490	869,806	^{4,5,6}
Ashtonbee Station (Request to Vary from GTA Project)	EB-2012-0451/EB-2016-0034	N/A	N/A	14,379	N/A	N/A	22,416	⁷

Notes:

- 1 - PI and NPV calculated on the growth portion of the project only - net investment used for feasibility \$2,818,000.
- 2 - PI and NPV calculated on the growth portion of the project only \$6,592,000 less CIAC of \$4,717,000 for a net investment used for feasibility of \$1,875,000.
- 3 - Original filed PI of 1.02 incorrectly reflected service capital commencing a year early; PI of 1.06 reflects updated profile.
- 4 - \$869.8 million in capex inclusive of Ashtonbee to be comparable to filed LTC feasibility.
- 5 - \$652.1 million capex stated in 2013 dollars, consistent with LTC PI calculation. Value excludes \$3.5 million Ashtonbee Station Request to Vary expenditure, approved post LTC approval.
- 6 - GTA Reinforcement Project Capex excluding Ashtonbee is \$847.4 million.
- 7 - Included in GTA Reinforcement Project Feasibility figures.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-1-1, p.5

Question(s):

Based on the forecast capital expenditures included in the AMP, please expand Table 2 to include years 2025 to 2028. Please also provide the response in Excel format.

Response:

Please see Attachment 1. Enbridge Gas does not have a forecast of rate base for 2027 to 2028 as the Company's latest long-range plan extends to 2026.

Table 2
Utility Rate Base & Capital Expenditures

Line No.	Particulars (\$ millions)	Utility	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>2023</u>	<u>2024</u>	<u>2025</u>	<u>2026</u>
			Actual (a)	Actual (b)	Actual (c)	Estimate (d)	Bridge Year (e)	Test Year (f)	Forecast (g)	Forecast (h)
1	Gross Property, Plant and Equipment	EGI	19,765.5	20,582.1	21,539.8	22,663.3	23,874.8	24,902.9	26,177.5	27,458.9
2	Accumulated Depreciation	EGI	(7,188.7)	(7,571.2)	(8,005.9)	(8,417.8)	(8,924.1)	(9,178.9)	(9,973.1)	(10,724.6)
3	Net Property, Plant and Equipment	EGI	12,576.8	13,010.8	13,533.9	14,245.4	14,950.7	15,724.0	16,204.4	16,734.3
4	Working Capital	EGI	562.3	551.2	687.7	855.9	689.4	557.0	534.3	501.2
5	Utility Rate Base	EGI	13,139.0	13,562.0	14,221.6	15,101.3	15,640.1	16,281.1	16,738.7	17,235.5
6	Capital Expenditures	EGI	1,087.4	1,007.4	1,310.8	1,444.3	1,605.7	1,491.3	1,471.1	1,435.6

ENBRIDGE GAS INC.

Answer to Interrogatory from
Vulnerable Energy Consumers Coalition (VECC)

Interrogatory

Reference:

Exhibit 2, Tab 1, Schedule 1, Table 2

Question(s):

Please update Table 2 for 2022 actual results.

Response:

Please see response at Exhibit I.2.1-CCC-36, Attachment 1.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Question(s):

Since the merger application EGI has requested Incremental Capital Module funding in each year with the exception of 2023. Please set out the following in one schedule:

- a) All ICM project requests;
- b) The forecast project amounts and the actual project amounts;
- c) The variance analysis explaining the difference between the forecast amounts and the actual amounts;
- d) The in-service dates for all projects;
- e) For each project the true-up amount being sought;
- f) The impact of each project on the 2024 opening rate base amount.

Response:

- a-d), f) Please see Table 1. Enbridge Gas is unable to provide the opening rate base amounts for the projects that were not approved as ICM as rate base is not tracked or calculated at the project level for projects that were denied approval.
- e) Please see response at Exhibit I.9.2-STAFF-262 for the ICMDA project balances updated for 2022 Actuals.

Table 1
All ICM Project Request 2019 to 2022

[illegible]

Table 1
All ICM Project Request 2019 to 2022

ICM Rates Docket	Requested ICM Project Name	Forecast Costs (\$M)	Actual Cost @ Dec 31, 2022 (\$M)	Variance (\$M)	Variance Explanation	In-Service Date	2024 Opening Rate Base (\$M)
EB-2018-0305	Sudbury Replacement (approved under Capital Pass-Through mechanism)	91.9	96.7	4.8	Construction and labour costs were higher than estimated due to permit conditions and challenges during pipeline installation.	October 2018	n/a
EB-2019-0194	Sarnia Industrial Reinforcement	28.8	36.1	4.6	Increased scope for station work and additional permitting costs.	November 2021	n/a
EB-2021-0148	Dawn to Cuthbert Replacement and Retrofits	23.5	20.0	(3.5)	Project is in-service, additional project Closeout costs expected in 2023.	October 2022	n/a
EB-2021-0148	Byron Transmission Station	20.4	24.1	3.7	Initial estimate was created based on the assumption of 1-year project execution; however, the project was extended over 2-years resulting in higher contractor cost, inspection cost, IDC & Internal OH. Stopping and tapping cost also not included in original estimate.	August 2022	n/a
EB-2021-0148	Kirkland Lake Lateral Replacement	20.7	27.4	6.7	Higher than estimated construction costs were realized due to complex Horizontal Directional Drill (HDD) installation across Blanche River. HDD had to be redesigned twice after initial attempts to complete crossing failed as a result of challenging geotechnical conditions.	October 2022	n/a

Table 1
All ICM Project Request 2019 to 2022

ICM Rates Docket	Requested ICM Project Name	Forecast Costs (\$M)	Actual Cost @ Dec 31, 2022 (\$M)	Variance (\$M)	Variance Explanation	In-Service Date	2024 Opening Rate Base (\$M)
EB-2021-0148	St. Laurent Ottawa North Replacement	86.0	9.0	(77.0)	LTC was not approved for this project.	n/a	n/a

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Greenhouse Vegetable Growers (OGVG)

Interrogatory

Reference:

Exhibit 2 Tab 2 Schedule 1

Question(s):

- a) Please update the forecast 2024 in service additions to reflect changes in the forecast since the application was filed.
- b) Please break out the 2024 in service additions between spending on projects that do not require leave to construct and projects that do require leave to construct.
- c) Please further break out the 2024 in service additions that require leave to construct between spending that has already received leave to construct and spending that has yet to receive leave to construct.
- d) Please calculate the revenue requirement impact of the proposed in-service additions, split between non-leave to construct spending, leave to construct spending that has been granted leave, and leave to construct spending that has not been granted leave.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023. /u

- a) The 2024 in-service additions are updated to \$1,313.6 million. Please see Exhibit I.2.1-CCC-36 for a summary of changes to 2024 in-service additions resulting from the Capital Update. Note that the tables below exclude in-service additions for PREP. /u
- b) Please see Table 1.

Table 1

2024 In-Service Additions (\$ millions)

Requires LTC	\$101.9	/u
Does not require LTC	\$1,211.6	/u
Total 2024 In-Service	\$1,313.6	/u

c) Please see Table 2.

Table 2

2024 In-Service Additions (\$ millions)

Requires LTC - Approved	\$13.8	/u
Requires LTC - Pending Approval	\$88.1	/u
Does not require LTC	\$1,211.6	/u
Total 2024 In-Service	\$1,313.6	/u

d) Please see Table 3.

Table 3
2024 Revenue Requirement

(\$ millions)

Requires LTC – Approved	\$0.0	
Requires LTC - Pending Approval	\$3.0	/u
Does not require LTC	\$7.0	/u
Total 2024 In-Service	\$10.0	/u

Please note that the details in Table 3 were prepared on a best-efforts basis and represent what Enbridge Gas believes to be a reasonable estimate of the 2024 forecast revenue requirement impacts isolated to the 2024 additions broken out in the categories as requested. Enbridge Gas does not prepare and track revenue requirement on a subset of PP&E, which the request is asking for.

In order to prepare an estimate of the revenue requirement impacts as requested, Enbridge Gas attempted to isolate the monthly gross property, plant and equipment and accumulated depreciation impacts of 2024 forecast in-service additions, as well as the associated depreciation, CCA, income tax and cost of capital impacts. The resulting revenue requirement impacts, segregated between the categories requested, are summarized in the table above. Overall, as Table 3 indicates, the 2024 additions have an approximate \$10.0 million impact on the 2024 revenue requirement.

/u

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-2-1, Attach 1, p.3-4

Question(s):

For each table, please provide the individual monthly averages for each year between 2021 and 2024.

Response:

The following response has been updated to reflect the Capital Update provided at /u
Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

Please see Attachment 1.

Gross Property, Plant and Equipment Summary - Average of Monthly Averages
2021

Line No.	Particulars (\$ millions)	Utility	Actual	Opening	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average of Monthly Averages
1	Distribution Plant	EGD(1)	9,643.2	9,508.6	9,522.2	9,537.6	9,586.8	9,573.7	9,625.3	9,596.6	9,673.5	9,602.5	9,708.5	9,752.5	9,784.4	10,001.8	9,643.2
2	Underground Storage Plant	EGD	485.6	478.9	478.9	478.9	478.9	478.9	478.9	478.9	478.9	478.9	478.9	500.3	500.8	552.7	485.6
3	General Plant	EGD	675.7	697.1	696.9	695.5	693.2	693.8	694.1	676.5	690.6	691.7	692.7	693.6	559.7	562.0	675.7
4	Other Plant	EGD	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
5	Total		<u>10,806.2</u>	<u>10,686.3</u>	<u>10,699.6</u>	<u>10,713.7</u>	<u>10,760.6</u>	<u>10,748.1</u>	<u>10,800.0</u>	<u>10,753.7</u>	<u>10,844.7</u>	<u>10,774.9</u>	<u>10,881.7</u>	<u>10,948.1</u>	<u>10,846.5</u>	<u>11,118.2</u>	<u>10,806.2</u>
6	Distribution Plant - South Operations	Union(2)	3,540.8	3,457.2	3,465.3	3,470.7	3,478.4	3,487.1	3,503.3	3,529.0	3,541.1	3,555.8	3,603.6	3,610.7	3,643.3	3,745.4	3,540.8
7	Distribution Plant - Northern/Eastern Operations	Union	2,134.6	2,104.7	2,105.2	2,106.9	2,109.2	2,110.8	2,116.8	2,128.9	2,131.1	2,135.5	2,160.9	2,166.5	2,183.8	2,214.1	2,134.6
8	Transmission Plant	Union	3,767.4	3,741.6	3,741.8	3,742.8	3,743.7	3,743.8	3,749.4	3,755.7	3,758.2	3,759.7	3,778.5	3,788.7	3,834.3	3,883.1	3,767.4
9	Underground Storage Plant	Union	819.7	817.9	818.0	818.0	818.0	818.0	818.7	820.5	821.0	821.1	823.2	823.9	824.3	805.8	819.7
10	Local Storage Plant	Union	32.0	31.8	31.8	31.8	31.8	31.8	31.9	31.9	31.9	31.9	32.0	32.0	32.2	33.6	32.0
11	Intangible Plant	Union	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
12	General Plant	Union	437.5	418.6	418.8	418.8	419.3	419.6	423.0	435.3	466.5	469.0	450.7	448.9	460.9	419.6	437.5
13	Total		<u>10,733.6</u>	<u>10,573.6</u>	<u>10,582.6</u>	<u>10,590.6</u>	<u>10,602.1</u>	<u>10,612.8</u>	<u>10,644.8</u>	<u>10,703.0</u>	<u>10,751.4</u>	<u>10,774.7</u>	<u>10,850.5</u>	<u>10,872.4</u>	<u>10,980.4</u>	<u>11,103.3</u>	<u>10,733.6</u>
14	Distribution Plant	EGI	15,318.6	15,070.6	15,092.7	15,115.2	15,174.3	15,171.5	15,245.4	15,254.5	15,345.7	15,293.8	15,472.9	15,529.6	15,611.5	15,961.2	15,318.6
15	Transmission Plant	EGI	3,767.4	3,741.6	3,741.8	3,742.8	3,743.7	3,743.8	3,749.4	3,755.7	3,758.2	3,759.7	3,778.5	3,788.7	3,834.3	3,883.1	3,767.4
16	Storage Plant	EGI	1,337.3	1,328.7	1,328.7	1,328.7	1,328.7	1,328.7	1,329.5	1,331.4	1,331.8	1,331.9	1,334.0	1,356.3	1,357.3	1,392.2	1,337.3
17	General Plant	EGI	1,113.1	1,115.7	1,115.6	1,114.3	1,112.5	1,113.5	1,117.1	1,111.8	1,157.1	1,160.7	1,143.4	1,142.5	1,020.6	981.6	1,113.1
18	Other Plant	EGI	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
19	Total		<u>21,539.8</u>	<u>21,259.9</u>	<u>21,282.2</u>	<u>21,304.3</u>	<u>21,362.7</u>	<u>21,360.9</u>	<u>21,444.8</u>	<u>21,456.7</u>	<u>21,596.1</u>	<u>21,549.5</u>	<u>21,732.2</u>	<u>21,820.5</u>	<u>21,827.0</u>	<u>22,221.4</u>	<u>21,539.8</u>

Notes:

- (1) EGD rate zone.
- (2) Union rate zones.

Accumulated Depreciation Summary - Average of Monthly Averages

			2021														Average of Monthly Averages
Line No.	Particulars (\$ millions)	Utility	Actual	Opening	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	Distribution Plant	EGD(1)	(3,071.5)	(3,004.8)	(3,021.5)	(3,038.3)	(3,050.2)	(3,040.3)	(3,056.8)	(3,166.4)	(3,074.1)	(3,084.3)	(3,035.2)	(3,097.8)	(3,070.3)	(3,241.4)	(3,071.5)
2	Underground Storage Plant	EGD	(148.5)	(143.9)	(144.7)	(145.4)	(146.2)	(146.9)	(147.7)	(148.4)	(149.2)	(149.9)	(150.7)	(151.6)	(152.5)	(153.6)	(148.5)
3	General Plant	EGD	(504.9)	(505.2)	(509.8)	(513.4)	(517.2)	(521.8)	(526.5)	(513.2)	(519.8)	(523.9)	(526.1)	(528.4)	(405.2)	(401.9)	(504.9)
4	Other Plant	EGD	(1.4)	(1.4)	(1.4)	(1.4)	(1.4)	(1.4)	(1.4)	(1.4)	(1.4)	(1.4)	(1.4)	(1.4)	(1.4)	(1.4)	(1.4)
5	Total		<u>(3,726.3)</u>	<u>(3,655.3)</u>	<u>(3,677.4)</u>	<u>(3,698.5)</u>	<u>(3,714.9)</u>	<u>(3,710.5)</u>	<u>(3,732.4)</u>	<u>(3,829.4)</u>	<u>(3,744.5)</u>	<u>(3,759.5)</u>	<u>(3,713.4)</u>	<u>(3,779.3)</u>	<u>(3,629.4)</u>	<u>(3,798.3)</u>	<u>(3,726.3)</u>
6	Distribution Plant - South Operations	Union(2)	(1,515.5)	(1,476.1)	(1,483.5)	(1,490.5)	(1,497.6)	(1,502.6)	(1,509.0)	(1,515.7)	(1,522.9)	(1,530.2)	(1,537.3)	(1,538.7)	(1,546.3)	(1,548.5)	(1,515.5)
7	Distribution Plant - Northern/Eastern Operations	Union	(980.1)	(950.9)	(955.8)	(960.8)	(965.8)	(970.8)	(975.8)	(980.6)	(985.8)	(990.8)	(995.7)	(998.2)	(1,003.0)	(1,005.9)	(980.1)
8	Transmission Plant	Union	(1,188.6)	(1,145.1)	(1,152.3)	(1,159.6)	(1,166.9)	(1,174.1)	(1,181.4)	(1,188.7)	(1,195.9)	(1,203.1)	(1,210.4)	(1,217.7)	(1,225.0)	(1,231.9)	(1,188.6)
9	Underground Storage Plant	Union	(335.4)	(325.1)	(326.9)	(328.6)	(330.3)	(332.0)	(333.8)	(335.6)	(337.3)	(339.1)	(340.9)	(342.6)	(344.3)	(341.7)	(335.4)
10	Local Storage Plant	Union	(17.8)	(17.3)	(17.4)	(17.5)	(17.6)	(17.7)	(17.7)	(17.8)	(17.8)	(17.8)	(17.9)	(18.0)	(18.1)	(18.2)	(17.8)
11	Intangible Plant	Union	(1.3)	(1.2)	(1.2)	(1.2)	(1.2)	(1.2)	(1.3)	(1.3)	(1.3)	(1.3)	(1.3)	(1.3)	(1.3)	(1.5)	(1.3)
12	General Plant	Union	(240.9)	(228.7)	(233.1)	(237.5)	(241.9)	(246.2)	(250.7)	(253.4)	(256.6)	(261.3)	(235.0)	(232.8)	(237.2)	(181.0)	(240.9)
13	Total		<u>(4,279.6)</u>	<u>(4,144.3)</u>	<u>(4,170.2)</u>	<u>(4,195.8)</u>	<u>(4,221.2)</u>	<u>(4,244.7)</u>	<u>(4,269.7)</u>	<u>(4,293.1)</u>	<u>(4,317.5)</u>	<u>(4,343.6)</u>	<u>(4,338.4)</u>	<u>(4,349.3)</u>	<u>(4,375.2)</u>	<u>(4,328.6)</u>	<u>(4,279.6)</u>
14	Distribution Plant	EGI	(5,567.2)	(5,431.7)	(5,460.8)	(5,489.6)	(5,513.5)	(5,513.7)	(5,541.6)	(5,662.7)	(5,582.8)	(5,605.2)	(5,568.1)	(5,634.8)	(5,619.6)	(5,795.7)	(5,567.2)
15	Transmission Plant	EGI	(1,188.6)	(1,145.1)	(1,152.3)	(1,159.6)	(1,166.9)	(1,174.1)	(1,181.4)	(1,188.7)	(1,195.9)	(1,203.1)	(1,210.4)	(1,217.7)	(1,225.0)	(1,231.9)	(1,188.6)
16	Storage Plant	EGI	(501.6)	(486.3)	(488.9)	(491.5)	(494.0)	(496.6)	(499.2)	(501.8)	(504.2)	(506.9)	(509.5)	(512.2)	(514.9)	(513.5)	(501.6)
17	General Plant	EGI	(745.8)	(733.9)	(742.9)	(750.9)	(759.0)	(768.1)	(777.2)	(766.6)	(776.4)	(785.2)	(761.1)	(761.2)	(642.4)	(582.8)	(745.8)
18	Other Plant	EGI	(2.7)	(2.6)	(2.6)	(2.7)	(2.7)	(2.7)	(2.7)	(2.7)	(2.7)	(2.7)	(2.7)	(2.7)	(2.7)	(2.9)	(2.7)
19	Total		<u>(8,005.9)</u>	<u>(7,799.7)</u>	<u>(7,847.6)</u>	<u>(7,894.3)</u>	<u>(7,936.1)</u>	<u>(7,955.2)</u>	<u>(8,002.0)</u>	<u>(8,122.5)</u>	<u>(8,062.0)</u>	<u>(8,103.0)</u>	<u>(8,051.8)</u>	<u>(8,128.6)</u>	<u>(8,004.6)</u>	<u>(8,126.9)</u>	<u>(8,005.9)</u>

Notes:

- (1) EGD rate zone.
- (2) Union rate zones.

Gross Property, Plant and Equipment Summary - Average of Monthly Averages
2022

Line No.	Particulars (\$ millions)	Utility	Actual	Opening	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average of Monthly Averages	
1	Distribution Plant	EGD(1)	10,180.3	10,006.2	10,024.4	10,059.9	10,104.9	10,120.3	10,137.0	10,155.1	10,188.2	10,205.1	10,254.4	10,296.8	10,331.9	10,564.8	10,180.3	/u
2	Underground Storage Plant	EGD	565.3	552.7	554.7	555.6	555.1	563.2	570.3	565.5	567.8	566.9	567.9	569.1	569.8	602.4	565.3	/u
3	General Plant	EGD	535.5	569.2	569.6	569.0	511.0	522.9	530.3	517.8	535.4	525.5	528.6	529.7	530.1	542.0	535.5	/u
4	Other Plant	EGD	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	/u
5	Total		11,282.7	11,129.8	11,150.4	11,186.2	11,172.7	11,208.0	11,239.2	11,240.0	11,293.0	11,299.2	11,352.5	11,397.3	11,433.5	11,710.9	11,282.7	/u
6	Distribution Plant - South Operations	Union(2)	3,843.6	3,745.4	3,748.7	3,759.2	3,781.9	3,791.0	3,803.7	3,834.1	3,848.8	3,865.4	3,903.5	3,932.8	3,978.5	4,005.6	3,843.6	/u
7	Distribution Plant - Northern/Eastern Operations	Union	2,258.3	2,214.1	2,214.4	2,216.5	2,225.0	2,228.1	2,233.3	2,248.9	2,253.6	2,259.0	2,272.0	2,310.4	2,347.7	2,366.9	2,258.3	/u
8	Transmission Plant	Union	3,919.8	3,883.1	3,881.9	3,882.7	3,887.3	3,888.7	3,892.6	3,900.7	3,905.5	3,925.5	3,932.5	3,969.2	4,012.0	4,033.9	3,919.8	/u
9	Underground Storage Plant	Union	809.6	805.8	805.5	805.5	806.5	806.6	807.1	807.8	808.4	809.3	810.4	815.7	817.4	823.4	809.6	/u
10	Local Storage Plant	Union	33.7	33.6	33.6	33.7	33.6	33.7	33.7	33.7	33.7	33.8	33.8	33.8	33.9	33.8	33.7	/u
11	Intangible Plant	Union	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	/u
12	General Plant	Union	436.6	419.6	419.5	419.6	431.2	432.6	435.1	440.1	443.9	445.7	447.7	448.5	452.9	426.1	436.6	/u
13	Total		11,303.2	11,103.3	11,105.3	11,118.9	11,167.1	11,182.3	11,207.2	11,267.1	11,295.7	11,340.3	11,401.6	11,511.9	11,644.1	11,691.4	11,303.2	/u
14	Distribution Plant	EGI	16,282.2	15,965.7	15,987.5	16,035.6	16,111.8	16,139.3	16,174.1	16,238.1	16,290.7	16,329.5	16,430.0	16,540.0	16,658.1	16,937.4	16,282.2	/u
15	Transmission Plant	EGI	3,919.8	3,883.1	3,881.9	3,882.7	3,887.3	3,888.7	3,892.6	3,900.7	3,905.5	3,925.5	3,932.5	3,969.2	4,012.0	4,033.9	3,919.8	/u
16	Storage Plant	EGI	1,408.6	1,392.2	1,393.8	1,394.8	1,395.2	1,403.4	1,411.1	1,407.0	1,409.9	1,409.9	1,412.0	1,418.6	1,421.1	1,459.6	1,408.6	/u
17	General Plant	EGI	972.1	988.8	989.2	988.6	942.1	955.5	965.4	957.9	979.3	971.2	976.3	978.2	983.0	968.1	972.1	/u
18	Other Plant	EGI	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	/u
19	Total		22,585.9	22,233.0	22,255.7	22,305.1	22,339.8	22,390.3	22,446.4	22,507.2	22,588.7	22,639.4	22,754.1	22,909.2	23,077.5	23,402.3	22,585.9	/u

Notes:

- (1) EGD rate zone.
(2) Union rate zones.

Accumulated Depreciation Summary - Average of Monthly Averages

2022

Line No.	Particulars (\$ millions)	Utility	Actual	Opening	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average of Monthly Averages	
1	Distribution Plant	EGD(1)	(3,323.1)	(3,241.4)	(3,279.0)	(3,275.0)	(3,291.5)	(3,307.4)	(3,321.0)	(3,324.4)	(3,337.4)	(3,333.2)	(3,346.1)	(3,361.9)	(3,365.0)	(3,428.7)	(3,323.1)	/u
2	Underground Storage Plant	EGD	(159.0)	(153.6)	(154.5)	(155.3)	(156.1)	(157.2)	(158.1)	(159.0)	(159.8)	(160.7)	(161.6)	(162.6)	(163.5)	(164.4)	(159.0)	/u
3	General Plant	EGD	(363.4)	(401.8)	(404.4)	(406.3)	(349.2)	(352.6)	(356.0)	(344.9)	(347.3)	(349.8)	(352.6)	(355.4)	(367.3)	(349.2)	(363.4)	/u
4	Other Plant	EGD	(1.5)	(1.4)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	/u
5	Total		<u>(3,846.9)</u>	<u>(3,798.3)</u>	<u>(3,839.3)</u>	<u>(3,838.0)</u>	<u>(3,798.3)</u>	<u>(3,818.6)</u>	<u>(3,836.5)</u>	<u>(3,829.7)</u>	<u>(3,846.0)</u>	<u>(3,845.2)</u>	<u>(3,861.8)</u>	<u>(3,881.4)</u>	<u>(3,897.2)</u>	<u>(3,943.8)</u>	<u>(3,846.9)</u>	/u
6	Distribution Plant - South Operations	Union(2)	(1,589.5)	(1,548.5)	(1,556.6)	(1,564.2)	(1,571.8)	(1,579.3)	(1,584.8)	(1,590.9)	(1,595.5)	(1,601.7)	(1,608.1)	(1,615.0)	(1,621.5)	(1,622.0)	(1,589.5)	/u
7	Distribution Plant - Northern/Eastern Operations	Union	(1,037.2)	(1,005.9)	(1,011.2)	(1,016.6)	(1,021.9)	(1,027.2)	(1,032.6)	(1,037.9)	(1,042.1)	(1,047.3)	(1,052.7)	(1,058.2)	(1,063.7)	(1,064.5)	(1,037.2)	/u
8	Transmission Plant	Union	(1,277.0)	(1,231.9)	(1,239.4)	(1,246.9)	(1,254.5)	(1,262.0)	(1,269.6)	(1,277.1)	(1,284.7)	(1,292.3)	(1,299.9)	(1,307.5)	(1,314.9)	(1,318.0)	(1,277.0)	/u
9	Underground Storage Plant	Union	(351.8)	(341.7)	(343.4)	(345.1)	(346.8)	(348.4)	(350.1)	(351.8)	(353.5)	(355.2)	(356.9)	(358.6)	(360.2)	(361.8)	(351.8)	/u
10	Local Storage Plant	Union	(18.7)	(18.2)	(18.3)	(18.4)	(18.4)	(18.5)	(18.6)	(18.7)	(18.8)	(18.9)	(19.0)	(19.1)	(19.1)	(19.1)	(18.7)	/u
11	Intangible Plant	Union	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	/u
12	General Plant	Union	(197.4)	(181.0)	(184.6)	(188.2)	(185.3)	(189.5)	(193.4)	(197.7)	(201.7)	(206.2)	(210.2)	(214.3)	(218.4)	(176.4)	(197.4)	/u
13	Total		<u>(4,473.1)</u>	<u>(4,328.6)</u>	<u>(4,355.0)</u>	<u>(4,380.9)</u>	<u>(4,400.3)</u>	<u>(4,426.5)</u>	<u>(4,450.7)</u>	<u>(4,475.6)</u>	<u>(4,497.7)</u>	<u>(4,523.0)</u>	<u>(4,548.2)</u>	<u>(4,574.2)</u>	<u>(4,599.4)</u>	<u>(4,563.5)</u>	<u>(4,473.1)</u>	/u
14	Distribution Plant	EGI	(5,949.8)	(5,795.7)	(5,846.8)	(5,855.8)	(5,885.3)	(5,913.8)	(5,938.4)	(5,953.1)	(5,975.0)	(5,982.2)	(6,006.8)	(6,035.1)	(6,050.2)	(6,115.3)	(5,949.8)	/u
15	Transmission Plant	EGI	(1,277.0)	(1,231.9)	(1,239.4)	(1,246.9)	(1,254.5)	(1,262.0)	(1,269.6)	(1,277.1)	(1,284.7)	(1,292.3)	(1,299.9)	(1,307.5)	(1,314.9)	(1,318.0)	(1,277.0)	/u
16	Storage Plant	EGI	(529.5)	(513.5)	(516.2)	(518.8)	(521.3)	(524.1)	(526.8)	(529.5)	(532.1)	(534.8)	(537.5)	(540.2)	(542.8)	(545.3)	(529.5)	/u
17	General Plant	EGI	(560.8)	(582.8)	(589.0)	(594.5)	(534.5)	(542.1)	(549.4)	(542.6)	(548.9)	(555.9)	(562.8)	(569.7)	(585.7)	(525.7)	(560.8)	/u
18	Other Plant	EGI	(3.0)	(2.9)	(2.9)	(2.9)	(3.0)	(3.0)	(3.0)	(3.0)	(3.0)	(3.0)	(3.0)	(3.0)	(3.0)	(3.0)	(3.0)	/u
19	Total		<u>(8,320.1)</u>	<u>(8,126.9)</u>	<u>(8,194.3)</u>	<u>(8,219.0)</u>	<u>(8,198.5)</u>	<u>(8,245.1)</u>	<u>(8,287.2)</u>	<u>(8,305.3)</u>	<u>(8,343.7)</u>	<u>(8,368.2)</u>	<u>(8,410.1)</u>	<u>(8,455.5)</u>	<u>(8,496.6)</u>	<u>(8,507.3)</u>	<u>(8,320.1)</u>	/u

Notes:

- (1) EGD rate zone.
(2) Union rate zones.

Gross Property, Plant and Equipment Summary - Average of Monthly Averages

				2023														
Line No.	Particulars (\$ millions)	Utility	Bridge Year	Opening	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average of Monthly Averages	
1	Distribution Plant	EGD(1)	10,692.5	10,547.4	10,548.5	10,572.7	10,602.9	10,616.5	10,627.9	10,645.8	10,689.1	10,702.2	10,798.4	10,850.6	10,875.9	11,011.9	10,692.5	/u
2	Underground Storage Plant	EGD	655.4	602.4	602.5	602.6	602.8	610.0	616.1	625.6	648.7	655.7	706.9	734.7	748.2	820.6	655.4	/u
3	General Plant	EGD	547.4	542.0	558.0	559.0	529.1	530.8	532.2	535.5	540.9	542.5	554.5	561.0	564.2	581.2	547.4	/u
4	Other Plant	EGD	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	/u
5	Total		11,897.0	11,693.4	11,710.6	11,735.8	11,736.5	11,759.0	11,777.8	11,808.6	11,880.3	11,902.0	12,061.4	12,147.9	12,190.0	12,415.4	11,897.0	/u
6	Distribution Plant - South Operations	Union(2)	4,054.3	3,995.6	4,002.2	4,009.2	4,023.4	4,025.8	4,032.9	4,045.3	4,055.6	4,061.6	4,074.1	4,099.3	4,121.6	4,204.7	4,054.3	/u
7	Distribution Plant - Northern/Eastern Operations	Union	2,400.8	2,374.8	2,377.4	2,378.6	2,381.0	2,382.4	2,386.6	2,393.8	2,399.9	2,403.4	2,410.8	2,425.6	2,438.7	2,487.5	2,400.8	/u
8	Transmission Plant	Union	4,063.1	4,033.9	4,035.0	4,034.4	4,036.4	4,038.2	4,043.7	4,053.3	4,061.3	4,066.0	4,075.6	4,095.2	4,112.5	4,176.9	4,063.1	/u
9	Underground Storage Plant	Union	840.8	823.4	823.7	825.1	825.5	826.6	829.7	835.2	839.8	842.5	848.1	859.3	869.3	906.3	840.8	/u
10	Local Storage Plant	Union	34.5	33.8	33.8	33.8	33.8	33.9	34.0	34.3	34.5	34.6	34.8	35.3	35.7	37.3	34.5	/u
11	Intangible Plant	Union	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	/u
12	General Plant	Union	424.4	426.1	426.5	426.4	427.1	426.9	426.4	425.5	424.7	424.3	423.4	421.5	419.9	413.8	424.4	/u
13	Total		11,819.5	11,689.2	11,700.2	11,709.2	11,728.7	11,735.4	11,755.0	11,789.1	11,817.5	11,834.0	11,868.4	11,937.7	11,999.3	12,228.3	11,819.5	/u
14	Distribution Plant	EGI	17,147.5	16,917.8	16,928.1	16,960.4	17,007.3	17,024.7	17,047.4	17,084.9	17,144.6	17,167.2	17,283.2	17,375.4	17,436.2	17,704.2	17,147.5	/u
15	Transmission Plant	EGI	4,063.1	4,033.9	4,035.0	4,034.4	4,036.4	4,038.2	4,043.7	4,053.3	4,061.3	4,066.0	4,075.6	4,095.2	4,112.5	4,176.9	4,063.1	/u
16	Storage Plant	EGI	1,530.7	1,459.6	1,460.0	1,461.5	1,462.1	1,470.5	1,479.8	1,495.1	1,523.0	1,532.7	1,589.8	1,629.3	1,653.2	1,764.3	1,530.7	/u
17	General Plant	EGI	971.8	968.1	984.4	985.4	956.1	957.6	958.5	960.9	965.6	966.8	977.9	982.5	984.1	995.0	971.8	/u
18	Other Plant	EGI	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	/u
19	Total		23,716.5	23,382.6	23,410.9	23,445.0	23,465.2	23,494.4	23,532.8	23,597.6	23,697.8	23,736.0	23,929.8	24,085.7	24,189.3	24,643.7	23,716.5	/u

Notes:

- (1) EGD rate zone.
- (2) Union rate zones.

Accumulated Depreciation Summary - Average of Monthly Averages

2023																		
Line No.	Particulars (\$ millions)	Utility	Bridge Year	Opening	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average of Monthly Averages	
1	Distribution Plant	EGD(1)	(3,525.4)	(3,426.9)	(3,444.5)	(3,460.1)	(3,475.7)	(3,495.8)	(3,516.5)	(3,535.6)	(3,548.7)	(3,569.1)	(3,569.7)	(3,581.1)	(3,598.9)	(3,590.4)	(3,525.4)	/u
2	Underground Storage Plant	EGD	(169.8)	(164.4)	(165.5)	(166.5)	(167.5)	(168.4)	(169.3)	(170.1)	(170.8)	(171.8)	(172.1)	(172.8)	(173.8)	(173.9)	(169.8)	/u
3	General Plant	EGD	(363.1)	(349.2)	(355.1)	(374.3)	(337.8)	(343.9)	(350.3)	(356.6)	(362.5)	(368.9)	(373.7)	(379.3)	(385.4)	(389.5)	(363.1)	/u
4	Other Plant	EGD	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	(1.5)	/u
5	Total		<u>(4,059.8)</u>	<u>(3,942.1)</u>	<u>(3,966.6)</u>	<u>(4,002.4)</u>	<u>(3,982.4)</u>	<u>(4,009.6)</u>	<u>(4,037.6)</u>	<u>(4,063.8)</u>	<u>(4,083.5)</u>	<u>(4,111.4)</u>	<u>(4,117.0)</u>	<u>(4,134.6)</u>	<u>(4,159.6)</u>	<u>(4,155.3)</u>	<u>(4,059.8)</u>	/u
6	Distribution Plant - South Operations	Union(2)	(1,665.6)	(1,621.8)	(1,627.2)	(1,636.2)	(1,642.8)	(1,651.8)	(1,659.9)	(1,667.1)	(1,674.6)	(1,683.0)	(1,690.2)	(1,695.1)	(1,700.5)	(1,694.7)	(1,665.6)	/u
7	Distribution Plant - Northern/Eastern Operations	Union	(1,094.9)	(1,065.0)	(1,070.3)	(1,076.0)	(1,081.7)	(1,087.2)	(1,092.1)	(1,096.4)	(1,100.9)	(1,106.1)	(1,110.3)	(1,113.0)	(1,116.1)	(1,111.5)	(1,094.9)	/u
8	Transmission Plant	Union	(1,364.6)	(1,318.0)	(1,325.9)	(1,333.6)	(1,341.5)	(1,349.3)	(1,357.0)	(1,364.7)	(1,372.4)	(1,380.2)	(1,387.9)	(1,395.5)	(1,403.1)	(1,410.0)	(1,364.6)	/u
9	Underground Storage Plant	Union	(371.8)	(361.8)	(363.5)	(365.2)	(366.9)	(368.6)	(370.3)	(371.9)	(373.5)	(375.2)	(376.9)	(378.4)	(380.0)	(381.0)	(371.8)	/u
10	Local Storage Plant	Union	(19.7)	(19.1)	(19.2)	(19.3)	(19.4)	(19.5)	(19.6)	(19.7)	(19.7)	(19.8)	(19.9)	(20.0)	(20.0)	(20.0)	(19.7)	/u
11	Intangible Plant	Union	(1.6)	(1.5)	(1.5)	(1.6)	(1.6)	(1.6)	(1.6)	(1.6)	(1.6)	(1.6)	(1.6)	(1.6)	(1.6)	(1.6)	(1.6)	/u
12	General Plant	Union	(191.3)	(176.4)	(180.2)	(183.9)	(187.3)	(190.4)	(192.6)	(193.9)	(195.5)	(197.9)	(199.1)	(198.1)	(197.6)	(182.2)	(191.3)	/u
13	Total		<u>(4,709.4)</u>	<u>(4,563.7)</u>	<u>(4,587.9)</u>	<u>(4,615.8)</u>	<u>(4,641.2)</u>	<u>(4,668.3)</u>	<u>(4,693.1)</u>	<u>(4,715.2)</u>	<u>(4,738.3)</u>	<u>(4,763.8)</u>	<u>(4,785.9)</u>	<u>(4,801.6)</u>	<u>(4,818.9)</u>	<u>(4,801.0)</u>	<u>(4,709.4)</u>	/u
14	Distribution Plant	EGI	(6,285.8)	(6,113.7)	(6,142.0)	(6,172.3)	(6,200.2)	(6,234.8)	(6,268.5)	(6,299.1)	(6,324.3)	(6,358.2)	(6,370.3)	(6,389.2)	(6,415.6)	(6,396.6)	(6,285.8)	/u
15	Transmission Plant	EGI	(1,364.6)	(1,318.0)	(1,325.9)	(1,333.6)	(1,341.5)	(1,349.3)	(1,357.0)	(1,364.7)	(1,372.4)	(1,380.2)	(1,387.9)	(1,395.5)	(1,403.1)	(1,410.0)	(1,364.6)	/u
16	Storage Plant	EGI	(561.3)	(545.3)	(548.2)	(551.1)	(553.9)	(556.5)	(559.2)	(561.7)	(564.1)	(566.8)	(568.8)	(571.2)	(573.8)	(574.9)	(561.3)	/u
17	General Plant	EGI	(554.4)	(525.7)	(535.4)	(558.2)	(525.1)	(534.3)	(542.9)	(550.5)	(558.0)	(566.8)	(572.8)	(577.4)	(583.0)	(571.8)	(554.4)	/u
18	Other Plant	EGI	(3.1)	(3.0)	(3.0)	(3.0)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	/u
19	Total		<u>(8,769.2)</u>	<u>(8,505.8)</u>	<u>(8,554.5)</u>	<u>(8,618.2)</u>	<u>(8,623.6)</u>	<u>(8,677.9)</u>	<u>(8,730.7)</u>	<u>(8,779.0)</u>	<u>(8,821.8)</u>	<u>(8,875.2)</u>	<u>(8,903.0)</u>	<u>(8,936.3)</u>	<u>(8,978.6)</u>	<u>(8,956.3)</u>	<u>(8,769.2)</u>	/u

Notes:

- (1) EGD rate zone.
(2) Union rate zones.

Gross Property, Plant and Equipment Summary - Average of Monthly Averages
2024

Line No.	Particulars (\$ millions)	Utility	Test Year	Opening	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average of Monthly Averages	
1	Distribution Plant	EGI	17,040.0	16,766.0	16,798.7	16,825.2	16,887.8	16,906.1	16,932.2	16,975.8	17,039.5	17,064.9	17,184.3	17,288.3	17,360.3	17,668.3	17,040.0	/u
2	Transmission Plant	EGI	4,856.3	4,828.6	4,832.7	4,836.0	4,840.4	4,841.6	4,845.1	4,851.3	4,856.4	4,859.4	4,865.6	4,878.1	4,889.3	4,930.6	4,856.3	/u
3	Storage Plant	EGI	1,817.2	1,792.9	1,795.8	1,798.2	1,803.7	1,805.4	1,807.7	1,811.5	1,817.2	1,819.5	1,830.0	1,839.3	1,845.7	1,873.0	1,817.2	/u
4	General Plant	EGI	1,019.4	1,011.5	1,012.3	1,013.0	1,015.1	1,015.7	1,016.3	1,017.3	1,019.4	1,020.1	1,024.4	1,027.1	1,028.6	1,036.1	1,019.4	/u
5	Other Plant	EGI	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	/u
6	Total		<u>24,736.3</u>	<u>24,402.4</u>	<u>24,442.9</u>	<u>24,475.7</u>	<u>24,550.3</u>	<u>24,572.0</u>	<u>24,604.6</u>	<u>24,659.2</u>	<u>24,735.9</u>	<u>24,767.1</u>	<u>24,907.7</u>	<u>25,036.1</u>	<u>25,127.2</u>	<u>25,511.4</u>	<u>24,736.3</u>	/u

Accumulated Depreciation Summary - Average of Monthly Averages

		<u>2024</u>															Average of Monthly Averages	
Line No.	Particulars (\$ millions)	Utility	Test Year	Opening	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1	Distribution Plant	EGI	(6,285.4)	(6,019.2)	(6,066.1)	(6,114.0)	(6,153.4)	(6,201.9)	(6,250.5)	(6,296.9)	(6,337.2)	(6,385.9)	(6,412.7)	(6,449.9)	(6,494.6)	(6,505.1)	(6,285.4)	/u
2	Transmission Plant	EGI	(1,688.4)	(1,633.3)	(1,642.5)	(1,651.7)	(1,660.9)	(1,670.1)	(1,679.3)	(1,688.5)	(1,697.7)	(1,706.9)	(1,716.1)	(1,725.2)	(1,734.3)	(1,742.9)	(1,688.4)	/u
3	Storage Plant	EGI	(585.2)	(563.6)	(567.3)	(571.0)	(574.4)	(578.2)	(581.9)	(585.6)	(589.0)	(592.8)	(595.8)	(599.1)	(602.6)	(604.7)	(585.2)	/u
4	General Plant	EGI	(518.9)	(502.5)	(506.4)	(510.9)	(511.4)	(516.4)	(521.2)	(524.7)	(525.5)	(530.5)	(525.0)	(523.7)	(526.0)	(508.9)	(518.9)	/u
5	Other Plant	EGI	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	(3.1)	/u
6	Total		<u>(9,081.0)</u>	<u>(8,721.7)</u>	<u>(8,785.4)</u>	<u>(8,850.6)</u>	<u>(8,903.1)</u>	<u>(8,969.6)</u>	<u>(9,035.9)</u>	<u>(9,098.8)</u>	<u>(9,152.5)</u>	<u>(9,219.2)</u>	<u>(9,252.6)</u>	<u>(9,300.8)</u>	<u>(9,360.6)</u>	<u>(9,364.6)</u>	<u>(9,081.0)</u>	/u

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 3, Schedule 1, p. 4

Question(s):

In order to align the treatment of materials and supplies inventory in Enbridge Gas's 2024 Test Year allowance for working capital, the company proposes to adopt the former Union Gas approach and allocate a portion of total Enbridge Gas materials and supplies to unregulated storage operations and exclude this portion from Enbridge Gas's utility allowance for working capital. Materials and supplies are allocated to unregulated storage operations using a composite rate, based on the proportion of the company's unregulated operating and maintenance (O&M) expenses relative to total O&M expenses.

- a) Please identify the typical items included in materials and supplies
- b) Please provide the composite rate used to allocate a portion of total Enbridge Gas materials and supplies to unregulated storage operations and also provide the quantum of the costs.

Response:

- a) Below is a list of the typical items included in materials and supplies:
 - i. General Materials
 - ii. Construction Materials
 - iii. Storage Inventory
 - iv. Pipe Inventory
 - v. Compressor Parts
 - vi. Meter & Regulatory Parts
- b) Table 1 provides the composite rate used to allocate total Enbridge Gas materials and supplies as well as the quantum (or absolute value) of the costs allocated to unregulated operations in the 2024 Test Year. For further context, also provided is the impact for total Enbridge Gas using the current Union methodology.

	<u>Table 1</u>			
(\$ millions)	Allocator	Union Rate Zones	EGD Rate Zone	EGI Total
Modified Enbridge Methodology	1.89%	0.8	1.3	2.1
Current Union Methodology	2.87%	1.1	2.0	3.1

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 3, Schedule 1, p. 13

Question(s):

Enbridge Gas has noted that the average balance of materials and supply inventory has continuously increased over the 2019 to 2021 years and this trend is expected to continue through the remainder of the deferred rebasing term. Enbridge Gas planned for larger lead times of inventory purchases resulting from supply shortages experienced in 2020 to 2022. For the forecast years 2022 to 2024, Enbridge Gas is expecting an approximate 5% annual increase in average costs as there continues to be an expectation that prices will continue to rise with inflation and the company continues to plan for supply shortages.

- a) Please confirm if supply shortages related to materials and inventory have eased in 2022 compared to the 2019 to 2021 period.
- b) Does Enbridge Gas expect supply shortages to continue in 2024 and beyond? If yes, please provide the basis for this expectation.

Response:

- a) Not confirmed. 2022 did not see an overall improvement in shortages over 2019 to 2021. Shortages were higher in 2022 compared to prior years.
- b) Enbridge Gas expects that shortages will continue into 2024 and beyond. We continue to experience improvement with the supply of most items, however, materials shortages and resourcing continue to impact supply from certain vendors. In addition, many suppliers continue to have longer lead times resulting in the need for the Company to build up inventory levels and mitigate risk of materials shortages. Two primary examples are meters, now at a 100-week lead time (Enbridge Gas is currently looking at orders for 2025), and risers which are at a 44-week lead with no indication that these lead times will improve. These materials categories used to have availability within 8 to 12 weeks and are representative of other materials that

have now doubled or tripled in lead time.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 3, Schedule 2, pp. 2-5

Question(s):

Enbridge Gas has harmonized its lead-lag approach to calculate the Working Cash Allowance requirements. The O&M lead has been set at 44.6 days which is between the previous of 60.9 days for the former EGD and 20.8 days for Union Gas.

Please explain the reasons for the significant different between the O&M lead for EGD and the former Union Gas.

Response:

EGD and Union had different systems, processes, and procedures for handling expenditures, all of which contributed to different lead days.

Some of the key drivers of the variance between EGD and Union's O&M lead days are:

1. Salaries and wages – EGD and Union had different payroll cycles for their employees. EGD had groups that were paid on a semi-monthly basis, and some paid bi-monthly. Union had groups that were paid on a weekly basis, and some paid bi-weekly.
2. Benefits – EGD and Union had different payment cycles for benefit costs. The classification of some of the types of benefits were also different for purposes of the lead-lag days calculation.
3. Payables – EGD and Union had different vendors, systems, policies and procedures for processing payables.
4. Allocated Costs – EGD and Union had different methodologies for Central function costs that were allocated to them.

ENBRIDGE GAS INC.

Answer to Interrogatory from
London Property Management Association (LPMA)

Interrogatory

Reference:

Exhibit 2, Tab 3, Sch. 1

Question(s):

- a) Please update Table 2 to reflect actual data for 2022.
- b) Does the change in the treatment of prepaid expenses noted in paragraph 37 increase or decrease the working capital? Please provide an estimate of the change.
- c) Footnote 7 on page 15 explains the forecast reduction in the DCB payable is related to different contract start and end dates for the Union and EGD rate zones that result in credits in the Union zone and debits in the EGD zone. Does EGI have any plans to harmonize the contract start and end dates across the rate zones? If so, what is the impact on the DCP payable?
- d) In paragraph 40, EGI states that the 2024 average gas in storage inventory is based on the proposed weighted average reference price provided at Exhibit 4, Tab 2, Schedule 2. Does EGI propose to update this component of working capital to reflect the approved weighted average reference price for January 1, 2024, assuming Board approval of the EGI proposal?
- e) How, and when, will EGI update the gas in storage inventory if the OEB does not approve the weighted average reference price proposed by EGI?
- f) What drove the significant reduction in the working cash allowance in the 2022 estimate shown on page 2 of Attachment 1?

Response:

- a) Please see response at Exhibit I.2.1-CCC-36.

- b) The change to prepaid expenses noted in paragraph 37 results in an increase to working capital compared to the 2023 forecast. The 2024 Test Year change is estimated to be \$15.1 million.
- c) Enbridge Gas will continue to allow customers to align pool start and end dates to meet their needs. It is not known when or how customers will choose to consolidate their pools and renewal dates once the harmonized bundled direct purchase service is implemented.
- d) Enbridge will update this component of working capital, gas in storage inventory and any other area impacted by reference price to the final OEB-approved reference price as part its final rate order for approval by the OEB in Q4 2023, to be implemented January 1, 2024.
- e) Please see response to d) above.
- f) The significant reduction in the working capital allowance in the 2022 estimate provided at page 2 of Attachment 1 is due to an error in the forecast used to produce 2022 estimated results¹, whereby O&M expense was not appropriately allocated between the EGD and Union rate zones underpinning each respective working cash allowance calculation. This is correctly reflected with actual data for 2022 as provided in response at Exhibit I.2.1-CCC-36.

¹ Based on 2 months of actuals and 10 months of forecast.

ENBRIDGE GAS INC.

Answer to Interrogatory from
London Property Management Association (LPMA)

Interrogatory

Reference:

Exhibit 2, Tab 3, Sch. 1, Att. 2

Question(s):

- a) Are the expenses shown on line 6 for the Harmonized Sales Tax of \$489.0 only the HST paid by Enbridge on gas costs and O&M?
- b) Please confirm that the O&M portion of the HST only includes O&M that is taxable and excludes items such as wages, salaries, benefits, interest, income taxes and property taxes.
- c) Table 5 in Exhibit 2, Tab 3, Schedule 2, Attachment 1 shows a net reduction in weighted dollar days associated with the HST, yet the table in Exhibit 2, Tab 3, Schedule 1, Attachment 1 shows a net positive addition to rate base. Please explain fully where the significant reduction in cash flow need from the HST revenues collected from customers is reflected in the working cash allowance.
- d) Please provide a version of the table in Exhibit 2, Tab 3, Schedule 1, Attachment 1 that shows the HST broken out into the two components shown in Table 5 of Exhibit 2, Tab 3, Schedule 2, Attachment 1 using the lead/lag days of (24.6) for HST customer billing and 30.9 for GST/HST invoice payment.

Response:

- a) Confirmed.
- b) Confirmed.
- c) The use of brackets in Table 5 of Exhibit 2, Tab 3, Schedule 2, Attachment 1 may be misleading. This table shows lead of 24.6 days associated with HST collected on customer bills and 30.9 days lag associated with HST paid on invoices. This results in a net HST lag of 6.3 days which is added to the working cash allowance as provided at Exhibit 2, Tab 3, Schedule 1, Attachment 2.

- d) Enbridge Gas understands the request to be to reproduce the table in Exhibit 2, Tab 3, Schedule 2, Attachment 2 showing the HST broken out into the two components. Please see Table 1.

Working Cash Allowance

2024 Test Year

2024 Cash Working Capital Requirements

Line No.	Particulars	Revenue (Days) (a)	Expense (Days) (b)	Net (Days) (c) = (a) - (b)	Expenses (\$) (d)	Working Capital Required (\$) (e) = ((c)/365) * (d)
1	Gas Purchases	39.5	39.2	0.3	3,228.0	2.7
2	Operations and Maintenance	39.5	44.6	(5.1)	991.7	(13.9)
3	Property Tax	39.5	(17.5)	57.0	127.2	19.9
4	Interest Expense	39.5	11.5	28.1	418.0	32.3
5	Income Tax	39.5	15.2	24.3	50.4	3.4
				34.0	595.6	55.5
6	Total Gas Purchases & O&M			3.4	4,815.4	44.3
7	Sales Tax	30.9	24.6	6.3	489.0	8.4
	Total Including HST					52.7
8	Federal Carbon	-	24.3	(24.3)	2,775.3	(184.8)
						(132.1)

ENBRIDGE GAS INC.

Answer to Interrogatory from
London Property Management Association (LPMA)

Interrogatory

Reference:

Exhibit 2, Tab 3, Sch. 2, Att. 1, page 16

Question(s):

With respect to the sales tax, the evidence states that *“The GST/HST lag is the time between the date GST/HST is paid on taxable purchases, and the date when Enbridge Gas receives the associated input tax credit. The lag days calculated for invoice payments was 30.9 days. Given this, the mid-point approach was used resulting in a service lead of 15.2 days. With payments being made the last day of the following month the average payment lead was calculated to be 45.5.”*

- a) Please explain how the 30.9 lag days for the invoice payments was calculated and used in Table 5.
- b) Please explain the relevance of the 15.2 service lead and the 45.5 average payment lead noted in the evidence.
- c) Consider the following example. EGI is billed in mid-July for services provided by a third party. EGI pays the invoice in mid-August. Does EGI claim the associated input tax credit for the payment at the end of July or for the payment at the end of August?
- d) Please explain how the HST lead of 24.6 days has been calculated with reference to the various revenue collection lags or otherwise if the collection lags are not used in the calculation of 24.6 days.

Response:

- a) Please see Table 1.

Table 1
Sales Tax (HST) Invoice Payment Lag

<u>Line No.</u>	<u>Particulars (\$M's)</u>	<u>Amount</u> <u>(a)</u>	<u>Lag</u> <u>(Days)</u> <u>(b)</u>	<u>Weighted</u> <u>Dollar Days</u> <u>(c) = (a) x (b)</u>
1	HST Payment: Gas Costs	182.50	37.1	6,764.68
2	HST Payment: O&M	234.39	26.2	6,131.77
3	Total	416.89		12,896.45
4	HST: Invoice Payment Lag		30.9	

Notes

1) Line 4 - HST Invoice Payment Lag of 30.9 days = 12,896.45/416.89

b) The referenced sentences:

Given this, the mid-point approach was used resulting in a service lead of 15.2 days. With payments being made the last day of the following month the average payment lead was calculated to be 45.5

were inadvertently included at this paragraph and are not related to the GST/HST Invoice Payment Lag of 30.9 days provided at Exhibit 2, Tab 3, Schedule 2, Attachment 1, Table 5, line 2. The figures are relevant to the HST Customer Billing Lead of 24.6 days (Table 5, line 1) as explained in part d).

c) Enbridge Gas claims input tax credits when the invoice is recorded. In this example, the input tax credit would be claimed in August.

d) Please see Table 2.

Table 2
Sales Tax (HST) Customer Billing Lead

Line No.	Particulars (\$M's)	Amount (a)	Lead/(Lag) (Days) (b)	Weighted Dollar Days (c) = (a) x (b)
1	HST Collection: Federal Carbon Levy	141.60	(21.2)	3,001.92
2	HST Collection: Regulated Revenue	645.30	(20.8)	13,422.24
3	Total	786.90		16,424.16
4	HST: Billing Lag		(20.9)	
5	HST: Revenue Remittance Lead		45.5	
6	HST: Customer Billing Lead		24.6	

Notes

- 1) Line 4 - HST Billing Lead of 20.9 days = 16,424.16/786.9
- 2) Line 5 - The average days for HST remittances of 45.5 = 15.2 days + 30.3 days, where;
 - 15.2 days midpoint of invoice date to the end of month.
 - 30.3 days from the end of the billing month to date of HST Remittance.
- 3) Line 6 - HST Customer Billing Lead 24.6 days = (20.9)+45.5

ENBRIDGE GAS INC.

Answer to Interrogatory from
London Property Management Association (LPMA)

Interrogatory

Reference:

Exhibit 2, Tab 3, Sch. 2, Att. 1, page 16

Question(s):

- a) Please explain how Table 5 reflects the use of the weighted average approach based on the evidence that states *"Using the weighted average approach, a net HST average of 6.3 days was calculated for the year."*
- b) Please explain why in line 1 of Table 5, the figures in columns (a) and (b) are both negative and so is their product shown in column (c).

Response:

- a) Please see response at Exhibit I.2.3-LPMA-12 part a) and part d).
- b) Please see response at Exhibit I.2.3-LPMA-11 part c).

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-3-1, Attach 1, p.1-2

Question(s):

Please confirm that lines 8 and 9, on p.1, are equivalent to line 2 on p.2, and that lines 11 and 12 on p.1, are equivalent to line 4 on p.2.

Response:

Not confirmed. Enbridge interprets this question to be asking which equivalent lines from page 1 relate to lines 2 and 4 on page 2. Please see Table 1 for this information.

Table 1
Comparison of Working Capital Line Items

<u>Years</u>	<u>Page 2</u>	<u>Page 1</u>
All Years	Line 2 – Customer Security Deposits	Line 2 – EGD Customer Security Deposits Line 9 – Union Customer Security Deposits Line 10 – Union Customer Deposit Interest
2013 Actual to 2023 Bridge Year	Line 4 - DCB Receivable (Payable)	Line 12 – Union ABC Receivable (Payable)
2024 Test Year	Line 4 - DCB Receivable (Payable) ¹	Line 12 – Union ABC Receivable (Payable)

¹ Exhibit 2, Tab 3, Schedule 1, Section 2.4, paragraph 17.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Vulnerable Energy Consumers Coalition (VECC)

Interrogatory

Reference:

Exhibit 2, Tab 3, Schedule 2, Table 2

Question(s):

- a) Please calculate the working capital allowance for 2024 without including the new lead/lag categories (i.e., lines 3, 4 & 5).
- b) Hydro One Distribution's latest proposed net cash working capital requirement for the 2023 test year was 6.1% of OM&A from revenue requirement and cost of power (EB-2021-0110). What is the equivalent percentage for EGI's working capital?
- c) Who is (are) the author(s) of the 2021 Lead-Lag Study filed at Attachment 1. If they are employees of EGI or its affiliates was any independent study of working capital requirements undertaken?

Response:

- a) The new categories were added as they do have a cash impact and inclusion of them is consistent with other utilities approach as well. If lines 3, 4 & 5 were excluded from the calculation, overall Working Capital would be negative \$188.2 million. However, it would also be appropriate to exclude the impact of Federal Carbon line 10 as this is also a new category and doing so Enbridge Gas's working capital requirement would be negative \$3.4 million.
- b) Following the approach taken by Hydro One, taking 2024 net working cash as a percentage of Gas Purchases and Operations and Maintenance, Enbridge Gas's percentage would be (3.11%). If Federal Carbon was excluded Enbridge Gas's percentage would be 1.21%.
- c) As provided in the first paragraph at Exhibit 2, Tab 3, Schedule 2, Attachment 1, page 3, the study was prepared internally by Enbridge Gas staff. This is consistent with the approach taken by EGD and Union for their previous Lead-Lag Studies. An external/independent study was not commissioned.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 1, pp.6-7

Question(s):

Prior to amalgamation, EGD capitalized interest on all capital projects involving the construction of assets using the weighted average cost of debt instead of the OEB's Construction Work in Progress (CWIP) rate. Union Gas capitalized interest only on capital projects involving construction that exceeded the spend and duration of \$1 million and 12 months using the OEB's prescribed CWIP rate. Post amalgamation, Enbridge Gas adopted the OEB's prescribed CWIP rate effective January 1, 2019 and capitalized interest on all capital projects that involve the construction of capital assets in accordance with USGAAP.

Please quantify the annual interest capitalized during the 2024 to 2028 period for capital projects involving construction that does not exceed the spend of \$1 million or 12 months.

Response:

Enbridge Gas is unable to quantify the impact for the 2024 to 2028 forecast period due to the level of detail for projects in the AMP as many of these projects are forecasted on a 'blanket' basis. Enbridge Gas can confirm that the average IDC for Union rate zones projects over the 2019 to 2023 deferred rebasing term recorded in the APCDA deferral account was approximately \$1.8 million annually and would expect a similar trend to continue in the forecast years, all things being equal. Please see Exhibit 9, Tab 2, Schedule 1, Attachment 3.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Ref 1: Exhibit 2, Tab 4, Schedule 1, pp.3-6

Ref 2: Exhibit 9, Tab 2, Schedule 1, pp.7-8

Question(s):

It states that after the amalgamation, Enbridge Gas identified differences in the historical capitalization treatment for certain costs between EGD and Union Gas due to how EGD and Union Gas applied USGAAP to specific costs. USGAAP Accounting Standard Codification (ASC) 360 – Property, Plant, and Equipment requires these costs to be expensed as incurred, while ASC 980 – Regulated Operations allows the programs and costs to be capitalized if approved by a regulator. The costs Enbridge Gas identified with different capitalization treatments were capitalized by EGD in accordance with ASC 980 and expensed as incurred by Union Gas in accordance with ASC 360.

- a) Please explain whether there were costs Union Gas capitalized in accordance with ASC 980, but would have been expensed in accordance with ASC 360 if ASC 980 were not applied.
 - i. If yes, please identify and explain the types of these costs, and quantify the annual revenue requirement impact for each type of cost from January 1, 2019, to December 31, 2023.
- b) Please also explain whether there were costs EGD capitalized in accordance with ASC 980, but would have been expensed in accordance with ASC 360 if ASC 980 were not applied, beyond those already identified in the Accounting Policy Changes Deferral Account resulting from harmonization.
 - i. If yes, please identify and explain the types of these costs, and quantify the annual revenue requirement impact for each type of cost from January 1, 2019, to December 31, 2023.
- c) Please explain whether Enbridge Gas has proposed to capitalize any costs that would be expensed in accordance with ASC 360 if ASC 980 is not applied.

- i. If yes, please identify and explain the types of these costs, and quantify the annual revenue requirement for each type of cost from 2024 to 2028.

Response:

a-b) Prior to amalgamation both EGD and Union Gas did capitalize some costs in accordance with ASC 980, based on regulatory approval. These costs would have been expensed in accordance with ASC 360, had ASC 980 not applied. The remaining undepreciated balances for these assets are included in the opening 2024 rate base.

Since amalgamation in 2019, other than the capitalization of indirect overheads, noted below, Enbridge Gas has not capitalized costs in accordance with ASC 980, that would have otherwise been expensed in accordance with ASC 360.

Indirect overheads are not capitalized under US GAAP. Both EGD and Union Gas had OEB approved overhead capitalization policies that supported capitalization under ASC 980. Enbridge Gas has proposed a combined methodology for 2024 that continues this treatment.

It should be noted that there is a portion of Enbridge Gas's overheads that are direct in nature but are being capitalized as indirect because Enbridge Gas's current processes are not designed for these costs to be directly capitalized to specific capital projects. These direct in nature costs can be capitalized under US GAAP by applying the guidance in ASC 360.

Enbridge Gas is unable to isolate and quantify the revenue requirement for this subset of costs due to the lack of visibility within the current system that pools all direct and indirect overhead costs and does not segregate this detail at a capitalization level.

- c) Other than the capitalization of overheads, as noted in part a-b), Enbridge Gas has not proposed to capitalize any further costs that would be expensed in accordance with ASC 360 if ASC 980 is not applied.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, p.7

Question(s):

It states that a new harmonized overhead capital policy was implemented on January 1, 2020.

- a) Please confirm that the harmonized policy was implemented on January 1, 2020 prospectively and not applied retroactively to January 1, 2019. If confirmed,
 - i. please explain whether Enbridge Gas had the option of applying the policy changes retroactively. If yes, please explain the rationale for Enbridge Gas's selected implementation date.
 - ii. Please explain whether Enbridge Gas is able to quantify the approximate revenue requirement impact of the harmonized policy being implemented on January 1, 2019 instead of January 1, 2020? If yes, please quantify.
- b) If not confirmed, please explain why the 2019 impact from the harmonized policy is not reflected in the Accounting Policy Changes Deferral Account.

Response:

- a) Confirmed, the change in methodology was applied prospectively.
 - i. Enbridge Gas does not view this accounting change to be a change in policy and therefore is required to apply it prospectively.
 - ii. Enbridge Gas is unable to apply the harmonized approach prior to 2020, when it was implemented, as the data does not exist. Please see response at Exhibit I.2.4-SEC-103 part a) for further information.
- b) Please see response at part a).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, pp.13-14, 21

Question(s):

Enbridge Gas noted that the inputs to the harmonized methodology are updated annually to ensure that the overhead capitalization rates closely reflect the underlying capital activity.

Furthermore, Enbridge Gas intends to eliminate the use of regulatory overhead asset accounts for Union Gas and adopt the EGD approach of presenting capitalized overheads within PPE asset classes.

- a) Please explain if Enbridge Gas performs any year-end review or analysis to determine if the capitalized overhead amounts are appropriate. If yes, please describe the review or analysis, and the results of the most recent review or analysis.
- b) It states that overhead capitalization rates for 2024 is based on 2021 actuals and is identical to those used for the 2023 budget. Please explain whether Enbridge Gas considered using an average of prior year actuals instead of only using 2021 actuals, and explain Enbridge Gas's rationale for only using 2021 actuals.
 - i. Please quantify the capitalized amount if capitalization amounts were based on an average of 2020, 2021 and 2022 actual rates and compare this capitalized amount with the proposed one.
- c) With regards to eliminating the use of regulatory overhead asset accounts, please explain whether Enbridge Gas will still be able to quantify the total amount of overhead capitalized if required.
 - i. If no, please explain why Enbridge Gas does not feel that this information is necessary.

Response:

- a) Overhead capitalization rates are determined for the upcoming year during the budget process. This process replaces the overly administrative, time-consuming, and costly process of time sheeting for support departments. For certain components of the harmonized methodology, such as the Business Costs category activity analysis, the inputs from the prior year are reviewed as an initial step in determining the overhead capitalization rates for the new year. Capitalized overhead is trued up based on actual O&M costs each month. Monthly variance analysis is performed to confirm variances compared to budget.
- b) Within Enbridge Gas's capitalization model for the 2023 budget, only regional operations capitalization rates are based on 2021 actuals. Business unit capitalization rates are based on future estimates of activity performed. The rationale for using one-year actuals instead of a three-year average is that since amalgamation the regional operations groups have undergone multiple organizational changes therefore the historical information dated three to four years back will not be comparable to the current organization structure. Also, at the time the 2023 and 2024 budget was developed, 2022 actuals were not available and 2021 actuals were the most recent and relevant data available. Enbridge Gas will continue to monitor the overhead capitalization process and will update if needed to reflect the most accurate rates.
 - i. Since the regional operations capitalization rates were the only rates based on 2021 actuals, the 2024 overhead capitalization for this group was recalculated using the actual capitalization rates from 2020, 2021 and 2022. The recalculated regional operations capitalization using the three-year average is \$114.5 million. This is \$3.7 million lower than the current calculated 2024 overhead capitalization amount of \$118.2 million. This variance is mainly due to increased direct capital spend relative to direct O&M spend in Operations in 2021 compared to 2020 as result of increased customer connections work.
- c) Enbridge Gas will be able to quantify the total amount of capitalized overhead as the amounts will be gathered into a single overhead capital project prior to being allocated and unitized to plant accounts as provided at Exhibit 2, Tab 4, Schedule 2, pages 19 to 21.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Ref 1: Exhibit 2, Tab 4, Schedule 2, pp.15-19

Ref 2: EB-2018-0305, Exhibit JT 1.7, May 8, 2019

Question(s):

Table 2 in Reference 1 shows how cost categories from the prior EGD and Union Gas methodologies align with the harmonized cost categories. Table 3 in the noted reference provides the capitalized amount and capitalization rate under the historical method and harmonized method for 2024. Table 4 provides the O&M/capital expenditure amounts using the historical and harmonized overhead capitalization methodologies for 2020 to 2023.

- a) Please indicate whether there are cost categories that were not included in EGD and Union Gas's capitalization of indirect overheads but are proposed to be included in the harmonized capitalization policy.
 - i. If yes, please list the cost categories, quantify the costs capitalized and explain why these costs are included for capitalization.
- b) Please indicate whether there were cost categories included in EGD and Union Gas's capitalization of indirect overhead that are proposed to be excluded in the harmonized capitalization policy.
 - ii. If yes, please list the cost categories, quantify the costs no longer capitalized and explain why these costs should not be included for capitalization.
- c) Please provide Table 3 annually for 2020 to 2024, with the historical capitalized amount and capitalization rate broken down for each of EGD and Union Gas. If there are material changes to the 2024 amounts presented in Table 3 as a result of finalizing the 2022 financial results, please provide updated 2024 amounts.
- d) Table 3 shows the combined historical capitalization rate for EGD and Union Gas using the historical method. The total combined historical capitalization rate is 22.7%. In Reference 2, it states that EGD and Union Gas allocated indirect overheads on a percentage basis to all capital projects. Union Gas's allocation rate

for the noted ICMs was 14.8% and EGD's allocation rate for the noted ICM was 36.4%. Please reconcile these rates to the rates shown in Table 3 or the response to Part c) above.

Response:

- a) Cost categories represent a grouping based on the inherent nature of the cost. This categorization allows for the application of cost drivers which are determined by the nature of the underlying causal activity that ultimately determines the degree of capitalization. Both the historical methodologies and the harmonized methodology account for all O&M costs in their respective cost categories.

There are components of the harmonized cost categories that for one of EGD or Union were either 1) not capitalized under the historical methodologies but are now fully or partially capitalized or 2) fully or partially capitalized under the historical methodologies but are no longer capitalized. For EGD, pension, which historically was not capitalized, is now partially capitalized via the harmonized methodology's burden rate, consistent with the treatment of Union's pension burdening. Also, approximately 10% of EGD locate costs historically were capitalized and are no longer capitalized for consistency with Union's treatment of like costs. For Union, a portion of fleet depreciation related to capital work had historically been capitalized, however is longer capitalized for consistency with treatment at EGD.

- b) Please see response to part a).
- c) Please see Attachment 1 for Table 3 for 2020 to 2024, consistent with Exhibit 2 Tab 4 Schedule 2 paragraph 37. The calculation of capitalized overhead using prior methodologies was performed by applying the combined EGD and Union capitalization rates based on the proportion of capitalization for each department to the eligible costs. The tables in Attachment 1 are presented for the integrated utility only given that the legacy view is no longer tracked and therefore unavailable.
- d) The rate in reference 1 (Exhibit 2, Tab 4, Schedule 2, Table 3, column b), is an aggregate rate calculated by taking overhead capitalization, based on EGD and Union's historical methodologies, as a proportion of 2024 gross utility O&M.

The rates in reference 2 (EB-2018-0305, Exhibit JT1.7) represent the proportion of capitalized overheads that were allocated to ICM projects for 2019. In general, indirect overheads are allocated equally across all eligible regulated projects including both ICM and non-ICM projects .

A direct correlation does not exist between these rates since the rate in reference 1 is a function of gross utility O&M whereas the rates in reference 2 are a function of

capital expenditures. Therefore, the rates serve distinct purposes and are unreconcilable to each other.

Table 1
Comparison of Overhead Capitalization Methodologies - 2020 Actual

		<u>Historical Method</u>		<u>EGI Harmonized Method</u>		<u>Variance</u>
Line		Capitalized	Capitalization	Capitalized	Capitalization	Capitalized
No.	Particulars (\$ millions)	Amount	Rate	Amount	Rate	Amount
		(a)	(b)	(c)	(d)	(c) - (a)
1	Operations Costs	87.2	32.6%	83.0	31.0%	(4.2)
2	Business Units Costs	42.2	10.9%	36.5	9.4%	(5.7)
3	Shared Services Costs	47.4	21.7%	50.6	23.2%	3.2
4	Pension & Benefits Costs	41.9	23.9%	54.2	31.0%	12.3
5	Total	218.7	20.9%	224.3	21.4%	5.7

Table 2
Comparison of Overhead Capitalization Methodologies - 2021 Actual

		<u>Historical Method</u>		<u>EI Harmonized Method</u>		<u>Variance</u>
Line		Capitalized	Capitalization	Capitalized	Capitalization	Capitalized
No.	Particulars (\$ millions)	Amount	Rate	Amount	Rate	Amount
		(a)	(b)	(c)	(d)	(c) - (a)
1	Operations Costs	93.7	34.2%	96.1	35.1%	2.4
2	Business Units Costs	45.5	11.1%	39.9	9.8%	(5.6)
3	Shared Services Costs	46.4	20.8%	41.5	18.7%	(4.8)
4	Pension & Benefits Costs	42.5	21.2%	56.7	28.3%	14.2
5	Total	228.0	20.6%	234.2	21.2%	6.2

Table 3
Comparison of Overhead Capitalization Methodologies - 2022 Actual

		<u>Historical Method</u>		<u>EGI Harmonized Method</u>		<u>Variance</u>
Line		Capitalized	Capitalization	Capitalized	Capitalization	Capitalized
No.	Particulars (\$ millions)	Amount	Rate	Amount	Rate	Amount
		(a)	(b)	(c)	(d)	(c) - (a)
1	Operations Costs	116.8	36.9%	108.8	34.4%	(7.9)
2	Business Units Costs	52.5	11.8%	43.5	9.8%	(9.0)
3	Shared Services Costs	57.7	22.2%	59.9	23.1%	2.3
4	Pension & Benefits Costs	50.6	22.8%	57.5	25.9%	6.9
5	Total	277.5	22.4%	269.7	21.7%	(7.7)

Table 4
Comparison of Overhead Capitalization Methodologies - 2023 Bridge Year

Line No.	Particulars (\$ millions)	<u>Historical Method</u>		<u>EGI Harmonized Method</u>		<u>Variance</u>
		Capitalized Amount (a)	Capitalization Rate (b)	Capitalized Amount (c)	Capitalization Rate (d)	Capitalized Amount (c) - (a)
1	Operations Costs	114.8	34.7%	115.5	34.9%	0.8
2	Business Units Costs	56.0	11.0%	52.5	10.3%	(3.6)
3	Shared Services Costs	61.4	21.3%	70.0	24.3%	8.5
4	Pension & Benefits Costs	52.2	29.6%	63.2	35.8%	10.9
5	Total	284.4	21.8%	301.1	23.1%	16.6

Table 5
Comparison of Overhead Capitalization Methodologies - 2024 Test Year

Line No.	Particulars (\$ millions)	<u>Historical Method</u>		<u>EGI Harmonized Method</u>		<u>Variance</u>
		Capitalized Amount (a)	Capitalization Rate (b)	Capitalized Amount (c)	Capitalization Rate (d)	Capitalized Amount (c) - (a)
1	Operations Costs	121.9	36.0%	118.2	35.0%	(3.6)
2	Business Units Costs	56.1	10.6%	54.5	10.3%	(1.6)
3	Shared Services Costs	63.8	20.5%	72.6	23.3%	8.8
4	Pension & Benefits Costs	53.2	30.0%	65.1	36.8%	11.9
5	Total	295.1	21.8%	310.4	22.9%	15.4

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, p 17 and Table 4, p. 19

Question(s):

Enbridge Gas's harmonized methodology results in total overhead capitalization of \$310.5 million for the 2024 Test Year, which represents an overhead capitalization rate of 23.8%.

- a) Please provide the capitalization overhead amount, capitalization rate and actual O&M expenses for 2021 and 2022. Also, please provide the total O&M expenses that were actually incurred for 2021 and 2022, irrespective of whether they were capitalized or not.
- b) Enbridge Gas has provided the impact of the harmonized methodology for the years 2020 to 2023 and the amount recorded in the Accounting Policy Changes Deferral Account. Please confirm that the amounts recorded for the years 2020 to 2023 are based on the harmonized methodology submitted in this proceeding. If not, please provide a detailed explanation of the methodology used to calculate overhead capitalization for the 2020 to 2023 period.

Response:

- a) Actual overhead capitalization amounts, O&M before and after capitalization and the related capitalization rates for both 2021 and 2022 are detailed in Table 1:

Table 1

	<u>2021</u>	<u>2022</u>
<u>Particulars (\$ millions)</u>	<u>Actual</u>	<u>Actual</u>
	<u>(a)</u>	<u>(b)</u>
Utility O&M Prior to Capitalization	1,154.8	1,272.6
Overhead Capitalization	<u>(234.2)</u>	<u>(269.7)</u>
Utility O&M	<u>920.6</u>	<u>1002.6</u>
Capitalization Rate	<u>20.3%</u>	<u>21.2%</u>

b) Confirmed.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, p.20

Question(s):

The Union Gas approach of allocating capitalized overheads based on forecasted capital additions by asset class was adopted for both the legacy EGD and Union Gas rate zones. The approach was implemented in 2021 for the EGD rate zone and resulted in a \$1 million increase in depreciation expense. The amount was not recorded in the Accounting Policy Changes Deferral Account as it was a change in estimate and not a change in policy.

- a) Please further explain how the change in allocation approach is a change in estimate and not a change in policy.
- b) Please indicate if there are other changes in accounting where Enbridge Gas assessed whether the change represented a change in policy or estimate and Enbridge Gas concluded that it was a change in estimate. If such circumstances existed, please list and explain each of the changes and provide the rationale on why these changes were changes in estimates and not changes in policies.

Response:

- a) EGD, Union and Enbridge Gas have always had a policy of capitalizing overheads. Subsequent to the implementation of the Harmonized Overhead Capitalization Methodology in 2020, in 2021 Enbridge Gas reviewed the allocation of these overheads related to EGD rate zone assets and the resulting change in depreciation was as a result of a change in how overheads are apportioned to a larger scope of assets.

Based on this, Enbridge Gas concluded that the resulting increase in depreciation was a change in depreciation estimate. However, Enbridge Gas does recognize that the depreciation impact was caused by integration related accounting changes and should have been recognized as a debit (receivable) in the APCDA in 2021. The

Company proposes to include this amount for 2021 as a true-up to its cumulative APCDA balance in 2023, along with the impacts for 2022 and 2023.

- b) Enbridge Gas can and does encounter situations that result in changes in estimates as part of normal course of accounting operations. Under US GAAP guidance, within Accounting Standards Codification 250-10-20: generally, *a change in accounting estimate results from incorporating new information or modifying the estimating techniques affecting the carrying amount of assets or liabilities as of the date the change is made*. Aside from the above item and all other items recognized in actuals and on a forecast basis through the APCDA, no other changes in estimates have been identified that were caused by the amalgamation.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Ref 1: Exhibit 2, Tab 4, Schedule 2, p.12

Ref 2: Exhibit 2, Tab 4, Schedule 2, Attachment 1 - EY Report

Question(s):

It states that for Shared Services Costs, a single overhead capitalization rate was calculated by taking a weighted average of Operations Costs and Business Costs rates and non-capitalizable costs (groups that do not support capital activity).

- a) Please explain why non-capitalizable costs are included in the calculation of the overhead capitalization rate for Shared Services Costs.
- b) Please provide the capitalization rate for Shared Services costs from 2019 to 2024.
- c) Please confirm that the 2020 capitalization rate for Shared Services cost per Appendix II of the EY Report is 19.5%. If not confirmed, please provide the 2020 capitalization rate for Shared Services in the EY Report.

Response:

- a) The Shared Services Costs category contains groups that support overall business activities of Enbridge Gas. Therefore, to determine a weighted average overhead capitalization rate that is a fair reflection of Shared Services support of capital activity, all cost categories need to be inputs to the calculation. Excluding costs for groups not involved in capital activity would inflate the Shared Services overhead capitalization rate.
- b) Table 1 provides the Capitalization Rate for Shared Services.

Table 1

Year	Rate
2019	N/A*
2020	19.5%
2021	23.5%
2022	23.2%
2023	23.8%
2024	23.8%

* Prior to the implementation of the harmonized overhead capitalization methodology, the Shared Services Category did not exist for the purposes of calculating overhead capitalization.

c) Confirmed. Please see Exhibit 2, Tab 4, Attachment 1, Page 24.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, Attachment 1, Overhead Capitalization Study

Question(s):

Enbridge Gas retained EY to assist management in its determination of the company's harmonized capitalization methodology. As part of the overhead capitalization study, EY reviewed best practices with peers in the study.

- a) Please provide the Terms of Reference included in the Request for Proposal.
- b) The study notes that EY reviewed best practices. Please provide more information on the peers researched as part of the study without identifying the individual companies. Were any of the peers regulated utilities? How did their capitalization rate compare to what Enbridge Gas has requested in this application?
- c) Did Enbridge Gas incorporate all the best practices that have been outlined in pages 17-18 of the study? If not, please identify the deviations.

Response:

- a) Enbridge Gas did not issue a Request for Proposal. Please see Exhibit I.1.2-CCC-3, Attachment 1.
- b) The following response was provided by Ernst & Young LLP (EY):

Please see Exhibit 2, Tab 4, Schedule 2, Attachment 1, EY Report, pages 17 to 18 titled "VIII. Industry Best Practices", of the evidence. This reference outlines several areas of importance which were identified based on our review of best practices through our understanding and discussion with peers in the industry. EY works with many regulated and unregulated utilities, which would be considered peers to Enbridge Gas. Leveraging knowledge of Enbridge Gas peers, the methodology, principles applied, and cost causality was consistent with peers, including the capitalization rate requested in the application.

- c) Yes, Enbridge Gas did incorporate all the best practices noted in the referenced attachment. On pages 17 to 18 of the Overhead Capitalization Study, EY has noted how Enbridge Gas incorporated each best practice into the harmonized methodology, except for the “annual or bi-annual road show” which is a communication related best practice. Enbridge Gas can confirm that communication and training was provided to the business upon implementing the harmonized methodology, with communication continuing annually during the budget cycle as part of input update process (please see Exhibit 2, Tab 4, Schedule 2, paragraph 32).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Ref 1: Exhibit 2, Tab 4, Schedule 2, Attachment 1 - EY Report

Ref 2: Exhibit 1, Tab 8, Schedule 2, p.3

Ref 3: Exhibit 2, Tab 4, Schedule 1, Attachment 1 - Enterprise Wide Policy, p.23

Ref 4: Exhibit 2, Tab 4, Schedule 2, pp.11, 17

Question(s):

As noted in the EY Report, EY used a combined approach of relying on accounting guidance, cost causation linkage, discussion with Enbridge Gas personnel, and understanding industry best practices. Page 11 of the EY Report indicates that EY provided alternatives and best practices within the industry.

- a) Please discuss the alternatives EY provided and explain the rationale for the overhead capitalization methodology Enbridge Gas adopted.
- b) Please indicate whether Enbridge Gas has compared its overhead capitalization methodology and rates with industry peers. If yes, please discuss the results of this comparison.
- c) On page 17 of Reference 4, Table 3 shows that compared with the capitalized amounts of \$295.1 million from using the historical method, the capitalized amounts of \$310.5 million from using the harmonized method has increased by \$15.4 million. Please provide the revenue requirement impact of the increase in \$15.4 million capitalized amount, considering the impact to OM&A and depreciation.
- d) In Reference 2, Enbridge Gas indicated that it believes that it is appropriate to continue to use USGAAP for ratemaking purposes in this application and for the next IR term. One of the differences between USGAAP and IFRS is that IFRS does not allow for administration and other general overheads to be capitalized while USGAAP does. Please indicate which of Enbridge Gas's four cost categories (e.g. Shared Services cost) administration and other general overheads would be capitalized.
 - i. Please approximate the amount of administration and other general overheads included in 2024 that would not be eligible for capitalization under IFRS?

- e) In the Enterprise Wide Capitalization Policy in Reference 3, Appendix 3 indicates that general and administrative costs which are not directly attributable to capital projects are expensed as incurred. This would include items such as office support services, human resources, IT, accounting, legal, and executive costs which are not chargeable to a capital project. On page 4 of Reference 4, it defines Shared Services Cost as services from Finance, Legal, Real Estate and Workplace Services, Technology and Information Services. A single capitalization rate was calculated for Shared Services Cost. Please reconcile the capitalization of Shared Services Costs with the Enterprise Wide Capitalization policy which requires costs that are not directly attributable to projects be expensed.
- f) Please explain whether Enbridge Gas has incurred incremental costs to implement the harmonized capitalization policy. If yes, please quantify and explain how these incremental costs are treated for regulatory purposes. If it is included in this application for recovery, please provide the reference to this.

Response:

The following response was provided by Ernst & Young LLP (EY):

- a) EY held discussions with Enbridge Gas management on the alternative overhead capitalization methodologies based on accounting guidance, cost causation linkage, discussion with Enbridge Gas personnel, and an understanding of industry best practices. EY provided a vast array of alternative methodologies for Enbridge Gas management to evaluate in determining the harmonized overhead capitalization methodology to adopt.

EY shared alternative methodologies which ranged from a fully direct costing approach, where costs would be directly charged to projects, to a broader costing method where costs would be pooled into a category such as Operations, IT, HR, etc. based on their nature and then have a rate applied per pool.

Specific rationale for the chosen harmonized overhead capitalization methodology has been documented in the EY Report provided at Exhibit 2, Tab 4, Schedule 2, Attachment 1, in the following sections as noted below:

- i. The types of costs discussed in Section III (pages 6 to 9)
- ii. Accounting guidance considered in Section VI (page 13)
- iii. The cost causality linkage discussed in Section VII (pages 15 to 16)
- iv. Industry best practices discussed in Section VIII (pages 17 to 18)

The following responses were provided by Enbridge Gas:

The goal of the harmonization of the overhead capitalization methodologies was to align treatment and process across EGD and Union, simplify the process, provide flexibility, transparency and efficiency. The premise was that like costs and assets needed to be treated the same to allow for better and more efficient management decision making.

Aligned with the guiding principles noted above, the adopted methodology resulted in a simplification of the process by reducing the number of overhead capitalization rates from 412, under the legacy methodologies, to 25. This allows for better visibility and transparency of results and drivers. Further, there were effectively 4 models used to allocate overheads under the old methodologies, that have now been harmonized under one, which is considered much more efficient to maintain and is aligned with best practices. With this simplicity comes the flexibility required to adapt to the changing needs of the business so that if time sheeting is implemented, for example, or there is an organizational change, the model is more easily able to accommodate such changes.

- b) No, Enbridge Gas has not compared its overhead capitalization methodology and rates with industry peers.
- c) The revenue requirement impact in 2024 of the \$15.4 million increase in capitalization is a reduction to revenue requirement of approximately \$13.2 million considering the impacts to O&M, depreciation, rate base and income taxes.
- d) Please see response at Exhibit I.1.8-STAFF-18.
- e) The full statement in Reference 3, Appendix 3 states, "For clarity, general and administrative costs may only be Capitalized in accordance with Section 7.5 – Overhead-related Costs (Some G&A Costs may be Capitalized according to rate regulated rules or guidelines)." This reference reconciles the Enterprise-Wide Capitalization Policy's recognition of the ability to capitalize applicable Shared Service costs. In addition, further clarification regarding Enbridge Gas's Overhead Capitalization Study is provided at Exhibit I.1.2.4-EP-9.
- f) Costs to implement the harmonized overhead capitalization policy amounted to \$0.2 million and were expensed as incurred in 2020. There are no further implementation costs included in the 2024 Test Year Forecast related to the harmonized overhead capitalization policy.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, Attachment 1, Overhead Capitalization Study, Appendix II

Question(s):

In the Appendix, EY has summarized the capitalization rates. For the “Director Group”, please explain the higher capitalization rate for Eastern Region (66.0%) and Toronto Region operations (70%) as compared to the Northern (44.4%), Southeast (45.2%) and Southwest (40.4%) operations.

Response:

The overhead costs relating to regional operations groups are capitalized using a ratio of direct internal capital costs to total non-overhead costs for each region. In the Toronto and Eastern regions, there is a higher proportion of direct internal capital cost compared to the Northern, Southeast and Southwest regions. This suggests the Toronto and Eastern regions are experiencing higher development growth relative to the Northern, Southeast and Southwest regions. Please see Exhibit 2, Tab 4, Schedule 1, Capitalization of Overhead –EY Study, page 7 on the specific calculation formula and explanation.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Ref 1: Exhibit 2, Tab 4, Schedule 3, pp.6-8

Ref 2: Exhibit 2, Tab 4, Schedule 2, p.14

Question(s):

In Reference 1, it states that the average burden rate is the sum of the incentive, benefits and pension burden rates. Table 1 in Reference 1 provides the burden rate for 2019 to 2022. Table 1 in Reference 2 shows the weighted average burden rate for Pension and Benefit Costs for 2024 to be 41.7%.

- a) Please provide a breakdown of the burden rates in Table 2 of Reference 1 to separate out the Pension and Benefit Costs burden rate from 2019 to 2022.
- b) Please provide the annual weighted average burden rate for Pension and Benefit Costs from 2019 to 2024.

Response:

- a) Table 2 of Reference 1 has been updated with the requested breakdown of the Enbridge Gas burden rates for 2019 to 2022. Due to changes resulting from utility amalgamation, assumptions were required to align Enbridge Gas grades to the Union organizational levels (see Table notes).

Table 2 Reference 1 - Updated

Union Gas (2013) and EGI (2019 to 2022) Burden Rates by Organization Level

Line No.	Particulars	Utility	2013	Utility	2019	2020	2021	2022
	Organization Level							
1	Clerical	Union	45.20%	EGI	43.9%	45.0%	44.4%	44.8%
2	Technical	Union	45.20%	EGI	42.1%	42.3%	41.0%	41.2%
3	Hourly	Union	45.60%	EGI	38.2%	38.0%	37.8%	38.1%
4	Management	Union	52.40%	EGI	48.6%	48.5%	46.8%	46.9%

Notes: Assumptions for 2019-2022

Clerical – includes weighted average of grades E300-E320

Technical – includes weighted average of grades E400-E420

Hourly – includes unionized employees

Management – includes weighted average of grades E500-E600

- b) Given that the harmonized capitalization model was not implemented until 2020, the weighted average burden calculation was not performed in 2019 as the previous EGD and Union capitalization policies were in use. The 2020 weighted average burden rate was 42.2%, 2021 weighted average burden rate was 42.5%, 2022 weighted average burden rate was 41.4%, the 2023 and 2024 weighted average burden rate is 41.7%.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 1, pp. 5-6

Question(s):

Enbridge Gas has indicated that through consultation with internal stakeholders and in consideration of the asset class strategies, management of risk, ability to complete mandatory work, Customer Engagement Survey results and total in-service capital spend, a constraint of \$1.2 billion with a 2% escalation factor was recommended. Enbridge Gas noted that the constraint of \$1.2 billion is required to safely operate and maintain the natural gas system, respond to demand growth, invest in low-carbon solutions and ensure on-going reliability and service to customers.

- a) Enbridge Gas noted that a constraint of \$1.2 billion along with a 2% escalation factor was recommended. Please identify who recommended the constraint.
- b) The determination of the constraint seems to be a subjective determination. Please describe any quantitative or econometric analysis that is conducted to support the determination of the constraint on total in-service capital spend.

Response:

- a-b) Please see response at Exhibit I.2.5-FRPO-30 part a) for a description of how the constraint was established.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T4/S2/p. 19

Question(s):

Please provide the O&M impact in 2024 due to the change in Overhead Capitalization methodology in the same format as Table 4.

Response:

Please see Table 4.

Table 4

Change in Overhead Capitalization Methodology - O&M Impact

Line No.	Particulars (\$ millions)	Utility	2024
			Test Year
			(a)
1	EGI Harmonized Methodology	EGI	(310.5)
2	Historical Methodology	EGI	(295.1)
3	O&M Impact	EGI	(15.4)

Notes:

(1) Negative amounts represent a decrease to Operating & Maintenance (O&M) expense and an increase to capital expenditures

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibits 2, Tab 4, Schedule 1 and Exhibit 2, Tab 5, Schedule 3, and Exhibit 9, Tab 2, Schedule 1, Page 14, *Table 9 OH Capitalization – Annual Revenue Requirement Impact*

Preamble:

Energy Probe is concerned that there has been double recovery of indirect overheads through ICM projects.

Question(s):

- a) Please file a table that lists all of the EGI ICM projects approved by the OEB, showing the OEB approved cost, actual cost, indirect overheads approved for the OEB, actual indirect overheads incurred, and actual indirect overheads recovered through ICM rate riders.
- b) What was the total amount of actual indirect overheads that were capitalized to all projects both ICM and non-ICM during since EGI became eligible for ICM funding of capital projects. Please show amounts for ICM and non-ICM projects separately.
- c) What were the total O&M expenditures of EGI departments whose costs were partially recovered through allocation of indirect overheads to capital projects.
- d) How can the OEB be assured that there has been no double recovery of indirect overheads through ICM projects that have also been recovered through allocations to non-ICM capital projects?

Response:

- a) Please see Table 1. Note that actual indirect overheads recovered through ICM rate riders are not distinctly identified within rates. Please refer to Exhibit 9, Tab 2, Schedule 1 for total ICM rate rider revenue by project. Also note that a portion of the costs for Cherry to Bathurst have been deferred to 2023, the amount shown in the table does not reflect final project spend.

Table 1

	<u>OEB Approved</u>			<u>Actual Spend (December 31, 2022)</u>		
\$ Million	Direct Capital	Indirect Overheads	Total Project	Direct Capital	Indirect Overheads	Total Project
Stratford Reinforcement	1.5	0.3	1.8	1.5	0.3	1.8
Kingsville Transmission Reinf.	101.5	16.7	118.2	76.3	15.5	91.8
Windsor Line Replacement	71.3	11.6	82.9	60.9	13.3	74.2
London Lines Replacement	102.1	21.9	124.0	81.1	19.0	100.2
Don River 30" Pipeline	21.6	8.4	30.0	22.8	7.0	29.8
Cherry to Bathurst	102.9	23.8	126.7	70.1	17.1	87.2

b) Overheads capitalized during 2019 to 2022 when Enbridge Gas was eligible for ICM recovery:

Table 2

(\$ millions)	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>Total</u>	
ICM Overhead	19.9	10.6	23.1	17.6	71.2	
Non-ICM Overhead	218.6	212.5	211.9	261.1	904.1	/u
Total Overhead	238.6	223.1	235.0	278.7	975.3	/u

c) In 2024, the total O&M expenditures of Enbridge Gas departments whose costs were partially recovered through allocation of indirect overheads to capital projects is \$1,033 million. Please see Table 3.

Table 3

Line No	Particulars	\$Millions
1	2024 Test Year Utility O&M	1,046
2	Overhead Capitalization	310
3	2024 Test Year Utility O&M before Capitalization	1,356
4	Less Department not subject to overhead capitalization (1)	(323)
5	Total	1,033

Note:

(1) Includes Energy Conservation, Customer Care, Business Development, Energy Transition, Gas Supply

- d) There is no double recovery of indirect overheads through ICM projects that have also been recovered through allocations to non-ICM projects. On an actual basis, overhead allocations are applied based on the percentage of total indirect overheads over the amount of total direct capital. In the event that the actual spend for an ICM project is below the approved ICM recovery amount, inclusive of overhead allocations, the variance in spend (i.e., the decrease vs approved) is recorded in the ICM Deferral Account.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 1, Attachment 1, Page 10, Section 7.5 *Overhead Related Costs*

Preamble:

“Certain overhead Costs are allowable for Capitalization. Please refer to the *Overhead Capitalization Memorandum* for additional guidance.”

Question(s):

Is the Overhead Capitalization Memorandum in evidence. If it is, please provide the reference. If it is not, please file it.

Response:

As it relates to Enbridge Gas, the Overhead Capitalization Memorandum reference in the Enterprise-Wide Capitalization Policy refers to the Enbridge Gas Overhead Capitalization Study provided at Exhibit 2, Tab, 4, Schedule 2, Attachment 1.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 1, Attachment 1, Page 10, Section 7.7 *Allowance for Funds Used During Construction (AFUDC) and Capitalized Interest*

Preamble:

“AFUDC consists of two components, an equity component and an interest component (AIDC). The equity component is a non-cash item that may be Capitalized under rate regulated accounting when permitted by the regulator.”

Question(s):

Please confirm that the OEB does not allow utilities to capitalize the equity component?

Response:

Confirmed. It is Enbridge Gas’s understanding that the OEB only allows interest during construction (IDC) carrying charges to be capitalized in relation to construction work in progress and does not allow carrying charges inclusive of a return on equity component to be utilized. As such, allowance for funds used during construction (AFUDC), which is comprised of a return on equity and interest component, would not be allowed.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, Paragraph 26, Pages 10 and 11

Preamble:

“The Business Costs category includes certain departments/groups within Enbridge Gas that support core operations. Although their work can be linked to capital activity, it cannot be directly associated with any particular asset or asset group. Examples of these support areas include Engineering, Asset Management, System Improvement, and Integrity. Time spent on work was determined to be an appropriate driver given the varied nature of these groups and their activities. Time analysis is necessary to appropriately identify the relationship between the functions of these groups and capital activities.”

Question(s):

- a) Please explain how the time analysis was performed. Did each employee fill out a time sheet? If time sheets were used, please file a copy of a time sheet that was used for the analysis of time spent by employees in the Engineering group. If time sheets were not used, please explain why not.
- b) Does the proportion of time spent on capital projects and maintenance projects remain constant from year to year? For example, in a year with more capital work do employees spend less time on maintenance projects?

Response:

- a) Managers in the groups belonging to the business costs category identify all the activities carried out by their teams. Each employee's time, excluding assumptions for vacation and time directly charged to capital projects, is allocated among the various activities in an activity template. Individual employees are not required to populate time sheets; however, managers can seek their input as needed. The activities are classified as Capital or O&M based on US GAAP and OEB guidance.

Please see Attachment 1 for a sample activity template for the Engineering group.

- b) Time spent on activities related to capital and O&M can fluctuate from year to year depending on a number of factors including the scope of the Company's capital and O&M portfolios and the resources (i.e., company labour vs contract labour) that perform the work. An increase in "capital work" (which can be defined by different metrics including number of projects, resource inputs or expected total cost), does not necessarily result in employees spending less time on O&M work, especially if contract labour is expected to perform the increased "capital work". The activity analysis, outlined in the response to part a) is performed annually and would account for year-to-year variability.

				Activities and Classification (Note 1)												Hours Reconciled?
No.	Employee Name	Role	Annual Hours	Model Distribution System	Monitor Distribution System	Support Operations on Capital Projects	Support Operations on O&M projects	Emergency Support/ Exercises/ Gas loss	Long Range/Municipal Planning	Implementation and Support of Long Range Plan After Project Approval	Capital Projects (i.e. coordination, and planning support on approved	General Admin (Training, staff development, Conferences, Hiring...etc.)	Vacation hours	Add Activities	Expand to Add Activities	Must State Yes
1	(blank)	Advisor Network Planning	1,896	550	80	566	80	80	-	-	-	380	160			Yes
Total			1,896	550	80	566	80	80	-	tja	-	380	160	-	-	Yes

1,896

Note 1: These categorizations will be categorized into capital and O&M by our team. Please ensure the activities are granular such that they can be categorized between capital and O&M.

NOTES

Assumptions

Assumption for annual hour column: 365(days/yr) - 104(weekend days) - 12 (Stats) - 12 (SDO) = 237 days (1896 hou
Co-Op term is 10 months and no vacation: 10mths x 30 days - 10 Stats - 80 Weekends = 210 days (1680 hours)
Four vacant positions will be filled by end of Q2 2022
There are currently two different job ladders within the department that will be merged into one, hence the different job titles but no impact on hours projected under work types

General Comments

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, Paragraph 27, Page 11

Preamble:

“To determine overhead capitalization for the Business Costs category, the following time analysis methodology is conducted annually: a) Managers in the groups identified in this cost category identify all the activities carried out by their teams. Each employee’s time is allocated among the various activities in an activity template. The activities are classified as Capital or O&M based on US GAAP and OEB guidance.”

Question(s):

- a) Is the analysis conducted on a forecast basis? If the answer is yes, are actual results compared to forecast? Please explain your answer.
- b) Please file a sample copy of a completed activity template for an employee in the Engineering group.

Response:

- a) Please see response at Exhibit I.4.4-STAFF-54, part a).
- b) Please see response at Exhibit I.2.4-EP-11, Attachment 1.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, Paragraph 28, Page 11

Preamble:

“The Shared Services Costs category contains groups that support overall business activities including general functions required to complete capital projects. Examples of these services are Finance, Legal, Real Estate and Workplace Services, TIS, etc. Human Resources employee labour costs and related expenses are included in this category, and Pension and Benefits costs are treated separately. (See Pension and Benefits Costs below).”

Question(s):

Does the proportion of time spent on capital projects by employees in Finance, Legal, Real Estate and Workplace Services, TIS, etc. remain constant from year to year irrespective of the level of work on capital projects?

Response:

The harmonized overhead capitalization methodology recognizes that Shared Services support overall business activities including general functions required to complete capital projects. A weighted average overhead capitalization rate of the groups they support is used as fair reflection of Shared Services support of capital activity (please see Exhibit 2, Tab 4, Schedule 2, paragraph 29). Therefore, Shared Services support of capital activity would fluctuate based on the overall business's involvement in capital activity.

Individual Shared Services employees working in groups responsible for capital projects (i.e., TIS) can experience year to year fluctuations in direct labour charged to capital projects. However, employee labour charged directly to capital projects would be excluded from overhead capitalization.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, Paragraph 29, Page 12

Preamble:

“For Shared Services Costs, a single overhead capitalization rate was calculated by taking a weighted average of Operations Costs and Business Costs rates and noncapitalizable costs (groups that do not support capital activity). A single rate was determined to be most appropriate for overhead capitalization as the groups in this cost category support all of the business activities of Enbridge Gas.”

Question(s):

Please file a spreadsheet showing the calculation of the single overhead capitalization rate for 2024 capital projects showing all sources of data inputs.

Response:

Please see Attachment 1.

Enbridge Gas
Indirect Cost Allocation Modelling - Shared Services Summary

ENTERPRISE WIDE SHARED SERVICES RATE

Cost Bucket	Rate	Total Cost	Weighted Average Rate
Operations (Note 1)	49.9%	213,889,070	16.9%
Business Unit (Note 2)	22.0%	198,464,976	6.9%
100% O&M (Note 3)	0.0%	219,124,674	0.0%
Total		631,478,719	23.8%

NOTES

All cost amounts are from the 2022 Budget.

Note 1

This operations rate is weighed based on the operations regions and operations support costs (excluding any direct capital and O&M). These costs that are charged directly to capital or O&M are not considered to be back office costs, rather they are direct labour costs for projects and therefore are excluded from this weighting.

Operations Indirect Gross Costs

Operations and Operations Support costs	280,123,982
Less: Direct O&M in Operations and Operations Support costs	- 66,234,913
Less: Direct Capital in Operations and Operations Support costs	-
Total	213,889,070

Operations Indirect Capitalization

Operations and Operations Support Indirect Capitalization	106,766,035
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Operations Indirect Cap Rate

Rate	49.9%
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Note 2

This business units rate is weighed based on the total business costs, all of which are considered to be back office costs.

Business Unit Indirect Gross Costs

Business Unit costs	198,464,976
Less: Direct O&M in Business Unit	-
Less: Direct Capital in Business Unit	-
Total	198,464,976

Business Unit Indirect Capitalization

Business Unit Indirect Capitalization	43,727,772
---------------------------------------	------------

Business Unit Indirect Cap Rate

Rate	22.0%
------	-------

Note 3

This 100% O&M group costs reflect back office groups that have no capital activity.

100% O&M Indirect Gross Costs

100% O&M cost	219,124,674
Total	219,124,674

100% O&M Indirect Capitalization

Business Unit Indirect Capitalization	-
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100% O&M Indirect Cap Rate

Rate	0.0%
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ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, Paragraph 31, Page 13

Preamble:

“Enbridge Gas’s harmonized overhead capitalization methodology calculates a weighted average burden rate of 41.7% for the 2024 Test Year budget. The weighted average burden rate more appropriately capitalizes pension and benefits costs because it is applied to the capitalized labour.”

Question(s):

Please explain how the capitalization policy differentiates between capital projects that are constructed by Enbridge employee labour and capital projects that are constructed by contractor labour particularly as it relates to capitalization of Enbridge indirect costs. In your answer, please provide replies to the following questions.

- a) Is the 41.7% burden rate applied to the compensation costs of permanent Enbridge Gas employees who are working on capital projects?
- b) What burden rate is applied to the compensation costs of short-term contract Enbridge Gas employees who are working on capital projects?
- c) What burden rate is applied to the labour costs of employees of construction contractors who are working on capital projects for Enbridge Gas?

Response:

- a) Yes, the 41.7% burden rate is applied to permanent Enbridge Gas employee labour that has been directly charged to capital projects to appropriately reflect the entire compensation cost associated with these employees.
- b) Compensation costs of short-term contract Enbridge Gas employees who are working on capital projects are identifiable via invoicing and directly assigned to the appropriate capital projects. Furthermore, the amounts charged to Enbridge Gas for

this labour represent the full cost to the Company and are not subject to the harmonized overhead capitalization methodology. Therefore, no burden rate is applied.

- c) Compensation costs of construction contractors who are working on capital projects are identifiable via invoicing and directly assigned to the appropriate capital projects. Furthermore, the amounts charged to Enbridge Gas for this labour represent the full cost to the Company and are not subject to the harmonized overhead capitalization methodology. Therefore, no burden rate is applied.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, Paragraph 32, Page 14

Preamble:

“To ensure that the overhead capitalization rates closely reflect the underlying capital activity, the inputs to harmonized methodology are updated annually. Calculations are carried out on the latest actuals and applied to the prospective year.”

Question(s):

Please explain how ICM projects are treated and how they impact overhead capitalization rates of non-ICM projects in the same year. Are some of the indirect overhead costs that would have been allocated to non-ICM projects be allocated to a project that is incremental to the budget and may obtain ICM approval? Please discuss.

Response:

Overhead capitalization rates can be impacted by ICM projects. The extent of the impact is dependent on a group's (for example, Engineering and Storage & Transmission Operations department within the Business Costs category) involvement with ICM projects. Employee labour charged directly to ICM projects (or non-ICM projects) would be excluded from overhead capitalization.

In general, indirect overheads are allocated equally across all eligible regulated projects including both ICM and non-ICM projects. Therefore, ICM projects would be allocated indirect overheads that would have otherwise been allocated to non-ICM projects (or assets).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, Paragraph 31, Page 16

Preamble:

“By aligning cost categories and assigning appropriate drivers, the harmonized methodology better accounts for the geographical diversity of Enbridge Gas’s operations and provides a consistent approach in determining how each department or function supports capital activity.”

Question(s):

- a) Please explain what is meant by the term “geographical diversity” as it applies to overhead capitalization.
- b) Please explain how the harmonized methodology better accounts for geographical diversity.

Response:

- a) Geographic diversity is an attribute of the harmonized methodology's Operations Costs category which consists of groups that support Enbridge Gas’s core field operations within the Company’s seven geographic regions. Enbridge Gas recognizes that the level of capital activity within geographical regions may differ based on the geographical diversity, both in geographic features (i.e., urban and rural) and infrastructure.
- b) The harmonized methodology implements separate allocation rates for each geographical region to best reflect the capitalizable portion of overhead within the Operations Costs category. In Exhibit 2, Tab 4, Schedule 2, Attachment 1, page 17, Ernst & Young notes that geographical considerations are an industry best practice.

Regional capital expenditure as a proportion of total regional expenditure (i.e., combined capital and O&M) was determined to be an appropriate cost driver as it represents the actual allocation of labour and material resources by Enbridge Gas to

capital projects versus O&M in each geographical region. This is an improvement over historical allocation rates, most notably for EGD where Operations rates within Departmental Labour Costs were the same across regions.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, Paragraph 39 and Table 3, Page 17

Question(s):

Please provide more detail behind the quantities shown for Operations Costs in Line 1 of Table 3 by showing the amounts for Regional Operations, OSG and VP Admin discussed in Paragraph 39 including the number of FTE's whose costs are included in each of these categories.

Response:

Please see Table 1 for the details behind the Operations costs requested above.

Table 1
2024 Test Year Operations Costs Breakdown

Line No.	Particulars (\$ millions)	<u>Historical Method</u>		<u>EGI Harmonized Method</u>		<u>Variance</u>
		Capitalized Amount	Capitalization Rate	Capitalized Amount	Capitalization Rate	Capitalized Amount
		(a)	(b)	(c)	(d)	(c) - (a)
1	Regional Operations	64.3	37.7%	54.6	32.0%	(9.7)
2	Operations Services & Governance	54.0	36.8%	59.3	40.4%	5.3
3	VP Admin Ops	3.6	17.1%	4.4	20.6%	0.7
4	Operations Costs	121.9	36.0%	118.2	35.0%	(3.6)

The number of FTEs in the Test Year in each of these categories are included in Table 2.

Table 2
2024 Test Year FTE by Regional Costs

Line No.	Particulars	FTE
1	Regional Operations	1257
2	Operations Services & Governance	610
3	VP Admin Ops	9

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, Table 3, Page 17 and Paragraph 41, Page 18

Question(s):

Please provide more detail behind the quantities shown for Shared Services Costs in Line 3 of Table 3 by showing the amounts for each of the departments or groups included in Shared Services Costs including the number of FTE's whose costs are included in each of these departments or groups.

Response:

Please see Table 1 for the shared services cost breakdown. The number of FTEs whose costs are included in each of these departments is not available, CF Costs are allocated amounts to Enbridge Gas as part of the Central Functions Cost Allocation Methodology. FTE details are not available for these allocations.

Table 1
2024 Shared Services Overhead Capitalization Costs

Line No.	Particulars (\$ millions)	<u>Historical Method</u>		<u>EGI Harmonized Method</u>		<u>Variance</u>
		Capitalized Amount	Capitalization Rate	Capitalized Amount	Capitalization Rate	Capitalized Amount
		(a)	(b)	(c)	(d)	(e) = (c - a)
1	Aviation	0.0	20.5%	0.0	23.4%	0.0
	Corporate					
2	Development Office	0.5	20.5%	0.6	23.4%	0.1
3	EAWM	0.4	20.5%	0.4	23.4%	0.1
4	Executive & Other	0.2	20.5%	0.3	23.4%	0.0
5	Finance	7.5	20.5%	8.6	23.4%	1.0
6	REWS	5.9	20.5%	6.7	23.4%	0.8
7	Human Resources	5.3	20.5%	6.0	23.4%	0.7
	Information					
8	Technology	28.7	20.5%	32.6	23.4%	4.0
9	Legal	3.1	20.5%	3.6	23.4%	0.4
	Public Affairs and					
10	Communication	1.4	20.5%	1.5	23.4%	0.2
11	Safety and Reliability	1.5	20.5%	1.8	23.4%	0.2
	Supply Chain					
12	Management	2.5	20.5%	2.9	23.4%	0.3
13	Depreciation	5.2	20.5%	6.0	23.4%	0.7
14	Insurance	1.5	20.5%	1.7	23.4%	0.2
	Total Gross EGI CF					
15	excluding Benefits	63.8		72.7		8.8
16	Capitalization Rate	20.5%		23.4%		

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, Table 3, Page 17 and Paragraph 46, Page 20

Preamble:

“As such, the Union approach of allocating capitalized overheads based on forecasted capital additions by asset class was adopted for both the EGD and Union rate zones.”

Question(s):

- a) How would an un-forecasted capital addition be treated? Would no capitalized overheads be allocated to an un-forecasted capital addition, or would the capitalized overheads be reduced on forecasted capital additions in order to allocate some capitalized overheads to the un-forecasted addition?
- b) How would a cancelled forecasted project be treated? Would the capitalized overheads that would have been allocated to the cancelled project be allocated to the remaining projects so that each of the remaining projects would be allocated more capitalized overheads?

Response:

- a) The allocation of overheads is determined by the February forecast cycle. These allocation percentages are applied to actuals at the asset class level for the remainder of the year. The allocation of overheads will apply to the entire group of additions for a given asset class and is not allocated specifically at the project level. This will include all projects regardless of whether they are forecasted or un-forecasted.
- b) As described in part a), the overhead allocation is applied to additions at the asset class level. A project that is cancelled would be treated similarly to the example in part a) as this would be considered as change to the forecast.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, Attachment 1, E&Y Report, page 4

Question(s):

Please confirm that E&Y was not engaged by Enbridge Gas to present independent Expert Evidence as specified by Rule 13A of the OEB Rules of Practice and Procedure. Please explain your answer.

Response:

Confirmed. Enbridge Gas describes EY's engagement at Exhibit 2, Tab 4, Schedule 2, paragraph 18.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, Attachment 1, E&Y Report, pages 8 and 10

Preamble:

“Corporate allocations are comprised of charges that reflect EGI’s net share of the costs incurred by other subsidiaries or corporate to support EGI”.

Question(s):

- a) Did E&Y review the total costs of other subsidiaries and corporate to determine if the amount allocated to EGI is appropriate?
- b) Is the Shared Services amount of \$21,656,247 shown on in the table on Page 10 the EGI’s net share of the costs incurred by other subsidiaries or corporate to support EGI. If the answer is no, what is the net amount?

Response:

The following response was provided by Ernst & Young LLP (EY):

- a) EY was not engaged to review the individual costs of other subsidiaries and corporate to determine if the amount allocated to Enbridge Gas is appropriate. In performing the work EY was engaged to complete, EY obtained an understanding of the nature and categories of the corporate allocations to the extent provided, in order to consider the appropriate capitalization rate. EY relied on Enbridge Gas’s definition of corporate allocations and existing accounting for corporate allocations from Enbridge Inc and other subsidiaries. EY did not perform any audit, review, examination or any other form of attestation over the figures provided by Enbridge Gas.
- b) All amounts found in the table on page 10 represent the calculated overhead capitalization amounts using costs budgeted for Enbridge Gas in 2020. Enbridge Gas’s net share of the costs incurred by other subsidiaries or corporate for the purpose of the E&Y study was \$110.95 million. When the capitalization rate of

19.52% is applied to this amount, it results in \$21.66 million in overhead capitalization.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, Attachment 1, *E&Y Report*, pages 11 and 21-25

Preamble:

“2. Documented all cost centres and calculated the overhead percentage for each one based on raw data provided by the Company. EY further segmented the cost centres into the various departments within the organization;”

Question(s):

- a) Are the percentages shown on pages 21 to 25 the overhead percentages calculated by E&Y?
- b) Did EGI provide E&Y the overhead percentages calculated by EGI staff? If the answer is yes, are the percentages calculated by E&Y the same as the percentages overhead percentages calculated by EGI?

Response:

The following response was provided by Ernst & Young LLP (EY):

- a) The percentages shown in Exhibit 2, Tab 4, Schedule 2, Attachment 1, EY Report, pages 21 to 25 are capitalization rates calculated by EY under the harmonized capitalization methodology.
- b) No, Enbridge Gas did not provide EY with overhead percentages calculated by Enbridge Gas staff under the harmonized capitalization methodology.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, Attachment 1, *E&Y Report*, page 11

Preamble:

“4. Assisted management by providing alternative and best practices within industry;”

Question(s):

Please file any documents or memoranda that E&Y provided to management regarding best practices within industry.

Response:

The following response was provided by Ernst & Young LLP (EY):

Please see Exhibit 2, Tab 4, Schedule 2, Attachment 1, EY Report, pages 17 to 18, section titled “VIII. Industry Best Practices”, of the originally filed evidence, which outlines several areas of importance which were identified based on our review of best practices through our understanding and experience with peers in the industry. In addition, EY held discussions with Enbridge Gas management on best practices within industry, which were further included in the report. No further documents or memorandums were provided by EY to management.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2 Attachment 1, *E&Y Report*, pages 19 and 20

Preamble:

“Based on our observations, the application of this harmonized model considers the applicable accounting framework and the enterprise-wide capitalization policy. In addition, interviews conducted with managers and staff provide management with an understanding of capital activity, to allow for an allocation based on an expected time analysis.”

Question(s):

- a) Please confirm that E&Y has found that EGI is complying with the enterprise-wide capitalization policy.
- b) Please confirm that E&Y was not engaged to review the enterprise-wide capitalization policy.
- c) Is the “enterprise-wide capitalization policy” the document shown as a PDF attachment “EGI Enterprise Wide Capitalization Policy” on page 20?

Response:

The following response was provided by Ernst & Young LLP (EY):

- a) EY was not engaged to determine if EGI was complying with the enterprise-wide capitalization policy. As part of EY’s review and understanding of management’s historical and future capitalization policies EY used the enterprise capitalization policy to obtain further context on policies and processes where required.
- b) EY was not engaged to review the enterprise-wide capitalization policy.

- c) Yes, the enterprise-wide capitalization policy is the document shown as a PDF in Exhibit 2, Tab 4, Schedule 2, Attachment 1, EY Report, page 20. The version included in the EY report was version 2.0, which subsequently has been updated to version 3.0 by Enbridge Inc. and can be found at Exhibit 2, Tab 4, Schedule 1, Attachment 1.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 3, Page 7, Table 1

Preamble:

“Note (2) 2022 rates are used to determine the 2023 Bridge Year burden rate and the 2024 Test Year burden rate provided at Exhibit 2, Tab 4, Schedule 2, Table 1”

Question(s):

- a) Please explain why and how the 2022 burden rates were used to determine the 2024 burden rates.
- b) What are the drivers that cause the burden rates to vary from year to year?

Response:

- a) 2022 burden rates represented the best available information at the time of developing the 2024 Test Year Forecast. Please see Exhibit 2, Tab 4, Schedule 2, pages 12 to 14 for an explanation on how the burden rates are used in the harmonized overhead capitalization methodology.
- b) The drivers that cause the burden rates to vary from year-to-year are provided in Exhibit 2, Tab 4, Schedule 3, pages 5 to 6 (paragraphs 14 to 15).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Pollution Probe (PP)

Interrogatory

Question(s):

Prior to amalgamation, both EGD and Union had separate overhead capitalization policies which were approved by the OEB. The amalgamation of EGD and Union required Enbridge to review all existing accounting policies to identify where alignment was required. Enbridge is requesting OEB approval to capitalize indirect overheads for the Rebasing period.

Please outline what the impact would be over the rebasing period if the OEB does not allow Enbridge to capitalize indirect overheads as requested.

Response:

Exhibit 2, Tab 4, Schedule 2, Table 3 outlines the impact for 2024 Test Year. Applying the historical method would reduce overhead by \$15.4 million and increase OM&A by the same amount. For 2025 through 2028 an overhead and OM&A estimate is not available as part of this filing, however using the 2024 Forecast as a base assumption, the estimated 2025 to 2026 impact to OM&A and overhead is outlined in Table 1.

Table 1

Line No.	Particulars (\$ millions)	2025	2026
1	OM&A	16.0	16.4
2	Overhead	(16.0)	(16.4)

ENBRIDGE GAS INC.

Answer to Interrogatory from
Pollution Probe (PP)

Interrogatory

Reference:

The capitalization of indirect overheads was one such area of alignment to provide a harmonized approach for the Company that meets the guidelines specified by the OEB Uniform System of Accounts for Class A Gas Utilities, and US GAAP. [Exhibit 2, Tab 4, Schedule 2, Page 2]

Question(s):

- a) Please provide the specific guideline language Enbridge is referring to above.
- b) Please confirm that capitalization of indirect overheads under US GAAP is only allowed when a regulatory decision in place to enable that approach (i.e. if the OEB does not provide put it in place as a regulatory approval Enbridge would not be able to capitalized indirect overheads under US GAAP). If that is not correct, please explain.
- c) Please confirm what amount and portion of annual capital costs are related to indirect overheads.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

- a) The specific guidance language Enbridge Gas is referring to is provided at Exhibit 2, Tab 4, Schedule 2, Attachment 1, page 13.
- b) Confirmed. Outside the application of ASC 980 and the referenced regulatory approval, indirect overheads are not capitalized under US GAAP. However, it should be noted that a portion of Enbridge Gas's indirect overheads are indeed direct in nature but are being capitalized as indirect because Enbridge Gas's processes do not allow for these costs to be directly capitalized to specific capital projects. These costs can be capitalized under US GAAP by applying the guidance in ASC 360.

- c) Indirect overheads are calculated as a percentage of direct capital costs. As direct capital fluctuates from year to year, so does the portion of indirect overheads. Please see Table 1 for a summary of overheads and the allocation % from 2023 to 2025.

Table 1

(\$ millions)	2023 Bridge Year	2024 Test Year	2025 Forecast	
Direct Capital(1)	1,066	1,057	1,237	/u
Total Overhead(2)	306	278	323	/u
Overhead %	28.71%	26.27%	26.10%	/u

Notes:

- (1) Core and Integration capital. Integration capital applies to 2023 only.
Excludes amounts for PREP: \$17.6 million in 2023, \$154.3 million in 2024 and \$5.3 million in 2025 /u
- (2) Total overheads are inclusive of allocations from O&M, loadings, and interest during construction. Excludes amounts for PREP: \$5.1 million in 2023, \$40.6 million in 2024 and \$1.4 million in 2025 /u

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-4-2, p.17

Question(s):

With respect to capitalized overheads:

- a) Please provide a table (or tables) that show, using a similar breakdown as provided in Table 3 (i.e. operations, business unit, shared services, pension and benefits costs), for each year between 2013 and 2024. both capitalized amounts and capitalization rates, for each utility (Union, EGD, EGI).
- b) Please provide a table that shows for each year, between 2013 and 2024, by category of capitalized overheads (operations, business unit, shared services, pension and benefits costs), the amounts charged to OM&A, for each utility (Union, EGD, EGI).
- c) For each category of capitalized overheads (operations, business unit, shared services, pension and benefits costs), please provide the amount of costs approved (or included in rates) in each of Union and EGD's 2013 rebasing application, broken down into amounts capitalized and amounts charged to OM&A. Please provide a citation for the source of the information (i.e. application, rate order, etc).

Response:

- a) The harmonized overhead capitalization methodology requires the amalgamated O&M structure to group costs into the appropriate cost categories. Furthermore, the Business Cost category requires an activity analysis that is performed each year based on the O&M and capital work expected for the year. As such, this harmonized approach cannot be applied to years prior to 2020 when it was implemented.

Please see response at Exhibit I.2.4-STAFF-55 for Exhibit 2, Tab 4, Schedule 2, Table 3 for 2020 to 2024.

- b) For years prior to 2020, please see response at part a). Please see Table 1 for 2020 to 2024 amounts charged to OM&A for Enbridge Gas.

Table 1
EGI O&MA Costs Breakdown by Category

Line No.	Particulars (\$ millions)	<u>2020</u> <u>Actual</u>	<u>2021</u> <u>Actual</u>	<u>2022</u> <u>Actual</u>	<u>2023</u> <u>Bridge</u>	<u>2024</u> <u>Test Year</u>
1	Operations Costs	184.9	177.6	207.7	215.3	219.9
2	Business Unit Costs	351.3	368.3	399.9	455.2	475.5
3	Shared Services Costs	167.3	181.1	200.0	218.1	238.3
4	Pension & Benefit Costs	120.8	143.7	164.2	113.5	112.1
5	Total	824.3	870.7	971.7	1,002.2	1,045.8

- c) Please see response at part a).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Vulnerable Energy Consumers Coalition (VECC)

Interrogatory

Reference:

Exhibit 2, Tab 4, Schedule 2, Table 3, page 17

Question(s):

- a) EGI shows the harmonized capitalization amount in 2024 to in the amount of \$310.5 million. Please confirm (or correct) that this amount is based on the 2024 O&M and Capital budgets used in the calculation of 2024 rates.
- b) Does EGI propose to make future adjustments in rates to account for the fact that actual capitalized overheads during the IRM rate period (i.e., 2025-2028) will change in relationship to the actual capital projects completed in any given year? If yes, please explain how these adjustments are to be made.
- c) Who is (are) the author(s) of the Overhead Capitalization Study at Attachment 1? If they are employees of EGI or its affiliates was any independent study of capitalization policy undertaken?

Response:

- a) Confirmed.
- b) No. Under the requested price cap methodology requested for the 2025 to 2028 period of the IRM term, Enbridge Gas does not propose to make adjustments in rates to reflect annual updates to overhead capitalization rates.
- c) Ernst & Young LLP (EY) is the author of the study (please see Exhibit 2, Tab 4, Schedule 2, Attachment 1, pages 4 and 5 for further information). EY was retained by Enbridge Gas to assist management in its determination of the Company's harmonized overhead capitalization methodology. An independent study of the methodology was not undertaken.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 2, p. 2, Table 1

Question(s):

In Table 1, Enbridge Gas provided a list of Utility Capital Expenditures by Asset Class for the period 2024 to 2028.

One of the spending categories is classified as "Other" with \$41.1 million spend in 2024. Please identify the type of spending that is included in this category.

Response:

/u

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

The total for the 'Other' spending category is \$124.6 million. This spending category includes \$94.6 million in customer driven Renewable Natural Gas (RNG) projects and \$30.0 million in customer driven Compressed Natural Gas (CNG) projects.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 3, pp. 6-7

Question(s):

The GTA Reinforcement project involved the construction of two segments of underground pipeline and associated facilities. The GTA project was \$171.4 million over budget due to several factors including escalation of the construction bid price, increased costs associated with greater construction complexity and increased overall duration due to longer permit acquisition times.

- a) Please provide clarification regarding escalation of the construction bid price. Did the bid price escalate after the contract was awarded? If yes, please provide reasons for escalation of the bid price.
- b) Please provide a breakdown of the cost components that exceeded the initial budget and explain the variance.

Response:

- a) Please see the GTA Project Post Construction Financial Report, pages 7-14¹.
- b) Please see the GTA Project Post Construction Financial Report, pages 5 and 15 – 27² for further sub-categorization and detailed explanation of the major variances by cost category.

¹ EB-2012-0451, June 30, 2017, <https://www.rds.oeb.ca/CMWebDrawer/Record/576741/File/document>

² Ibid

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 3, Table 5, p. 11

Question(s):

In Table 5, Enbridge Gas provided a list of capital pass-through projects for the period 2013 to 2018 for the former Union Gas.

One of the capital pass-through projects included the Parkway West Reliability Project. The project with an actual spend of \$228.4 million exceeded the overall budget by \$25.3 million.

- a) Please provide reasons for the significant variance between the budgeted and actual spend.
- b) Please confirm the contingency amount that was budgeted for the project and explain how it was accounted for in the overall spend.

Response:

- a) Note the corrected approved LTC amount for the Parkway West Reliability Project is \$219.4 million, reducing the overspend to \$9 million compared to budget. The variance of \$9 million is a result of various matters over the duration of the project including increased labour and material costs due additional cleanup work as well as increased costs for commissioning, third party engineering, environmental, permitting and timing of finalizing contractor costs.
- b) The amount of contingency included in the OEB-approved budget of \$219.4 million was \$21.6 million and was used to offset the increased costs provided in response at part a).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 3, Table 10, p. 29

Question(s):

Table 5 provides a comparison of utility capital expenditures for 2022 and 2023.

Please update the table including providing actual capital expenditures for 2022. Please also update the explanation of any variances that have not been provided in the evidence.

Response:

Please see response at Exhibit I.2.1-CCC-36, Attachment 1 for the update to Table 10 (corrected reference for the comparison of expenditures for 2022 and 2023).

Please also see response at Exhibit I.2.5-LPMA-14 part b) for an explanation of the variances year-over-year.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 3, p. 35

Question(s):

Enbridge Gas has provided a description of some integration projects. The GTA West Site project will dispose of the Brampton Colony Court, Burlington Mainway and Milton facilities and construct a new asset with an estimated in-service of 2023. The GTA East Site project will dispose of the Coburg and Peterborough site and construct a new consolidated facility with an estimated in-service of 2023. The facility projects are being implemented to efficiently combine the operations teams.

- a) Please identify any other realignment projects that have the potential of consolidating existing facilities within the Enbridge Gas franchise area.
- b) Please provide the estimated savings in annual operating costs as a result of the consolidation projects noted above.

Response:

- a) Along with the two noted consolidations, three other active consolidations involving eight facilities are in progress:
 - i. Prichard/Ancaster/Stoney Creek consolidation will dispose of the Prichard Facility and leverage existing Ancaster/Stoney Creek facilities to efficiently combine the operations teams.
 - ii. Ottawa/South Merivale Operations Centre (SMOC) will consolidate into one new facility to efficiently combine the operations teams.
 - iii. New London consolidation will consolidate London/St. Thomas/Simcoe into one new facility to efficiently combine the operations teams.

- b) The Prichard/Ancaster/Stoney Creek consolidation will save approximately \$45,000 annually. The Ottawa/South Marivale Operations Centre consolidation will save approximately \$450,000 annually. The new London site is still in early development and potential savings have not been determined.

In addition to the quantitative benefits noted above, there are many qualitative benefits of these facilities' alignment initiatives, as well as facility condition challenges that need to be resolved. This facility consolidation brings the Company's operational teams and work crews together to facilitate collaboration. There are also a number of site-specific challenges that must be addressed for the Company to operate efficiently and effectively. Please see response at Exhibit I.2.6-CME-24 for further information on the facility condition analysis.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T5/S1/p. 3

Question(s):

With respect to Figure 1, please provide a breakdown of the Base Capital, Special Projects, Integration Capital and Other Capital amounts by year for the years 2013 to 2024.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023. /u

Please see Figure 1 and Attachment 1 for the breakdown of the updated Figure 1.

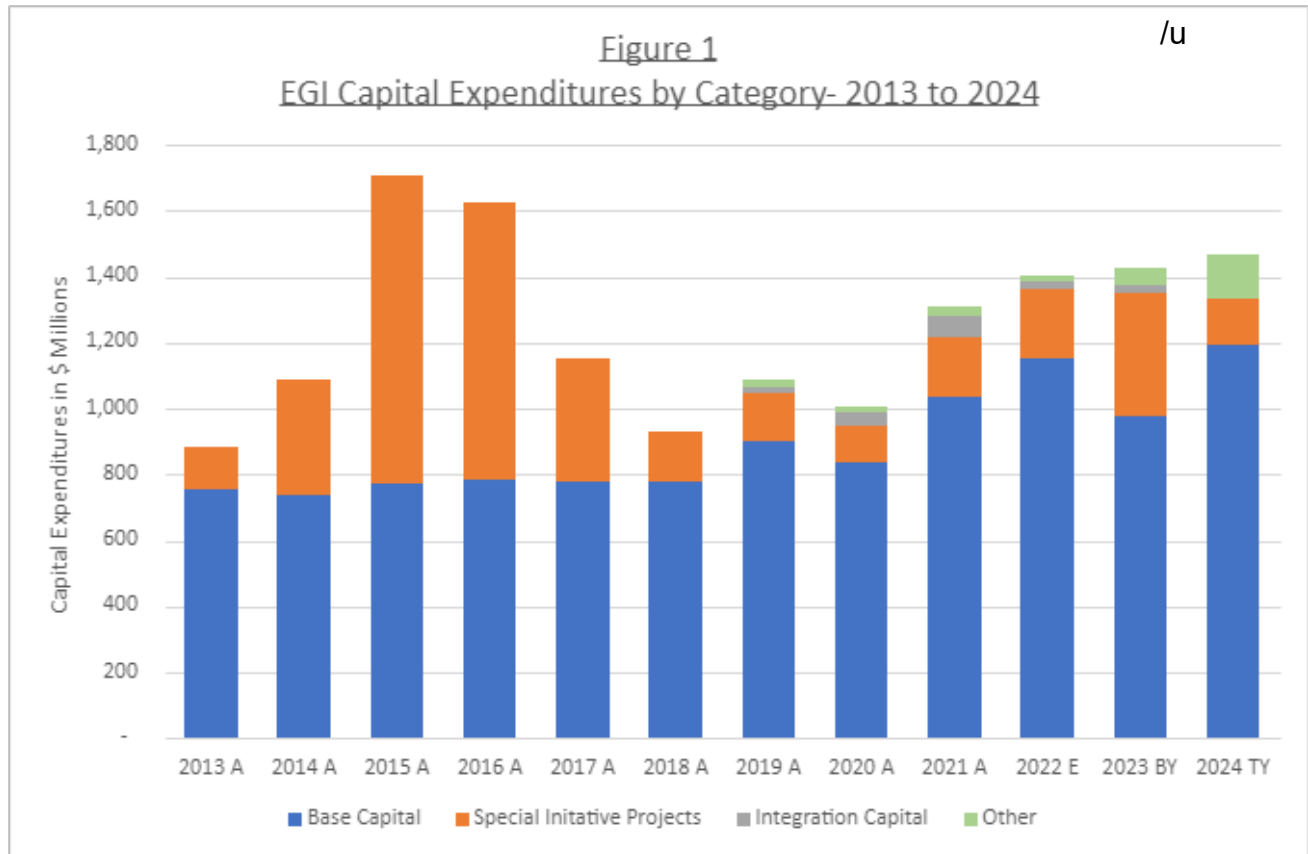


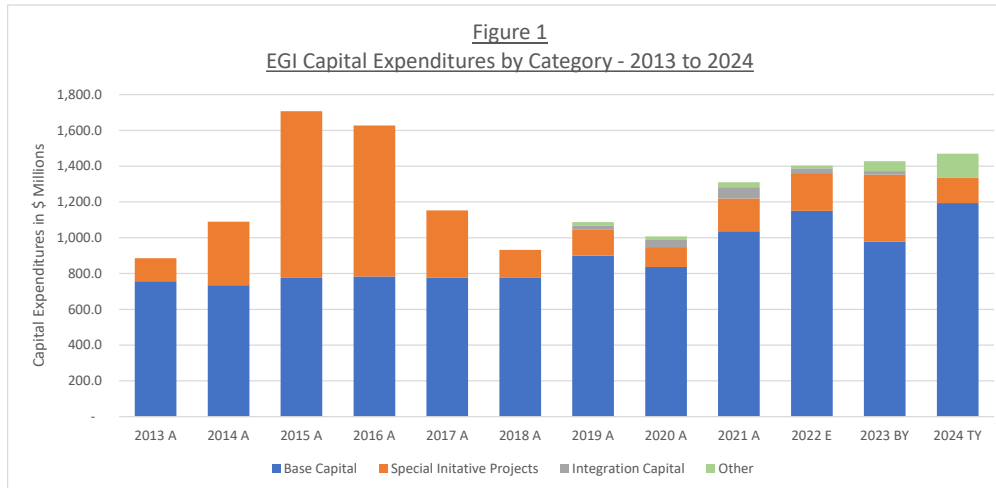
Figure 1 - Support
Utility Capital Expenditures - EGI by Category of Spend

Line No	Particulars (\$ millions)	<u>2013</u> OEB	<u>2013</u>	<u>2014</u>	<u>2015</u>	<u>2016</u>	<u>2017</u>	<u>2018</u>	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>2023</u>	<u>2024</u>
		Approved	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Bridge Year	Test Year
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)
1	Base Capital	653.8	757.2	734.9	775.4	784.0	777.6	776.3	900.1	836.9	1,036.4	1,150.2	978.8	1,194.0 /u
2	Special Initiative Projects	143.8	128.8	354.3	931.3	843.9	374.8	156.2	144.5	110.4	183.5	210.9	373.6	140.5 /u
3	Integration Capital								21.7	39.8	63.0	26.5	20.0	0.0 /u
4	Other								21.0	20.0	27.9	15.3	54.9	135.8 /u
5	Total	797.6	886.0	1,089.2	1,706.7	1,627.9	1,152.4	932.5	1,087.4	1,007.2	1,310.8	1,402.9	1,427.2	1,470.3 /u

Notes:

- (1) Special Initiative Projects include CPT, Leave to Construct and ICM.
- (2) Total capital expenditures excludes Panhandle Regional Expansion Project amounts of \$34.2 million in 2022, \$22.7 million in 2023 and \$194.9 million in 2024.

	2013 BA	2013 A	2014 A	2015 A	2016 A	2017 A	2018 A	2019 A	2020 A	2021 A	2022 E	2023 BY	2024 TY
Base Capital	653.8	757.2	734.9	775.4	784.0	777.6	776.3	900.1	836.9	1,036.4	1,150.2	978.8	1,194.0
Special Initiative Projects	143.8	128.8	354.3	931.3	843.9	374.8	156.2	144.5	110.4	183.5	210.9	373.6	140.5
Integration Capital								21.7	39.8	63.0	26.5	20.0	-
Other								21.0	20.0	27.9	15.3	54.9	135.8
Total	797.6	886.0	1,089.2	1,706.7	1,627.9	1,152.4	932.5	1,087.4	1,007.2	1,310.8	1,402.9	1,427.2	1,470.3



ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T5/S1/p. 4

Question(s):

The evidence states, "Special Projects include certain significant Leave to Construct (LTC) projects for EGD, investments approved under the Union's CPT mechanism, and projects approved for ICM treatment under Enbridge Gas's ICM mechanism." Please provide a further breakdown of Special Project spending into the above categories for each of the years in Figure 1 on page 3.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023. /u

Please see the table at Attachment 1 and note the following assumptions:

- i. Leave to Construct projects for the 2013 to 2018 period include the GTA and Ottawa Reinforcement projects only in alignment with ESM tables for the same time period
- ii. Other includes the WAMS project
- iii. ICM projects are based on rate applications for 2019 through to 2022 and not on the approved ICM projects in the proceedings.

Utility Capital Expenditures - Special Projects by Category

Line No	Particulars (\$ millions)	<u>2013</u> OEB Approved	<u>2013</u> Actual	<u>2014</u> Actual	<u>2015</u> Actual	<u>2016</u> Actual	<u>2017</u> Actual	<u>2018</u> Actual	<u>2019</u> Actual	<u>2020</u> Actual	<u>2021</u> Actual	<u>2022</u> Actual	<u>2023</u> Bridge Year	<u>2024</u> Test Year
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)
1	Capital Pass Through	80.0	52.6	154.6	352.6	690.8	368.0	156.2	12.2	0.7	0.0	0.0	0.0	0.0
2	Leave to Construct	63.3	76.2	180.1	551.1	114.8	4.8	0.0	25.4	51.0	39.8	50.5	338.6	140.5 /u
3	ICM								106.9	58.7	127.4	105.3	34.0	0.0 /u
4	Other	0.5	0.0	19.6	27.6	38.3	2.0	0.0	0.0	0.0	16.3	55.0	1.0	0.0 /u
5	Total	143.8	128.8	354.3	931.3	843.9	374.8	156.2	144.5	110.4	183.5	210.9	373.6	140.5 /u

Notes:

(1) Total capital expenditures excludes Panhandle Regional Expansion Project amounts of \$34.2 million in 2022, \$22.7 million in 2023 and \$194.9 million in 2024.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T5/S2/p. 2

Question(s):

With respect to Table 1:

- a) Please provide the Interest During Construction (IDC) amounts by year by asset class;
- b) Please provide the Overhead amounts by year by asset category;
- c) Please provide the contribution amounts by year by asset class;
- d) Please define EA Fixed Overheads;
- e) Please provide the forecast contingency amounts for the years 2024 to 2028 by asset class.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

- a) Please see Table 1 for the Interest During Construction (IDC) amounts by year by asset class.

Table 1
Utility IDC by Asset Class

Line No.	Particulars (\$ millions)	Utility	<u>2024</u>	<u>2025</u>	<u>2026</u>	<u>2027</u>	<u>2028</u>	
			Test Year (a)	Forecast (b)	Forecast (c)	Forecast (d)	Forecast (e)	
1	Compression Stations	EGI	0.52	0.64	0.53	0.61	0.10	/u
2	Customer Connections	EGI	3.98	3.33	3.39	2.59	1.49	/u
3	Distribution Pipe	EGI	4.10	5.61	3.58	2.12	1.82	/u
4	Distribution Stations	EGI	0.94	1.37	1.15	0.54	0.63	/u
5	Fleet & Equipment	EGI	0.35	0.44	0.50	0.40	0.30	/u
	Growth - Distribution							/u
6	System Reinforcement	EGI	0.75	2.13	0.49	0.27	0.06	
	Real Estate & Workplace							/u
7	Services	EGI	0.94	0.88	1.24	0.25	0.31	
	Technology Information							/u
8	Services (TIS)	EGI	1.65	1.11	0.98	0.49	0.32	
	Transmission Pipe and							/u
9	Underground Storage	EGI	0.68	1.45	2.18	1.49	0.84	
10	Utilization	EGI	1.79	2.09	2.23	1.38	0.97	/u
11	Community Expansion	EGI	-	-	-	-	0.33	/u
12	Integration Capital	EGI	-	-	-	-	-	
13	EA Fixed O/H	EGI	0.82	0.75	0.78	0.68	0.20	/u
14	Other	EGI	0.00	0.01	0.02	0.06	0.72	/u
15	Total		16.53	19.81	17.05	10.89	8.09	/u

(1) IDC for PREP has been removed

b) Please see Table 2.

Table 2
Utility OH Capital Expenditures by Asset Class

Line No.	Particulars (\$ millions)	Utility	<u>2024</u> Test Year	<u>2025</u> Forecast	<u>2026</u> Forecast	<u>2027</u> Forecast	<u>2028</u> Forecast	
			(a)	(b)	(c)	(d)	(e)	
1	Compression Stations	EGI	9.7	13.4	12.1	28.9	5.1	/u
2	Customer Connections	EGI	65.4	53.0	64.8	65.2	68.5	/u
3	Distribution Pipe	EGI	76.2	88.7	71.0	63.6	86.6	/u
4	Distribution Stations	EGI	17.8	23.9	26.1	19.9	31.8	/u
5	Fleet & Equipment	EGI	6.7	7.5	10.0	11.6	14.3	/u
6	Growth - Distribution System Reinforcement	EGI	18.4	42.2	10.7	11.5	2.8	/u
7	Real Estate & Workplace Services	EGI	13.6	13.0	23.2	8.0	15.4	/u
8	Technology Information Services (TIS)	EGI	22.3	16.7	18.0	11.6	14.8	/u
9	Transmission Pipe and Underground Storage	EGI	14.7	30.3	49.8	67.3	46.4	/u
10	Utilization	EGI	32.6	34.1	43.4	38.8	46.1	/u
11	Other	EGI	0.2	0.1	0.4	3.1	0.1	/u
12	Total		<u>277.5</u>	<u>323.0</u>	<u>329.5</u>	<u>329.6</u>	<u>332.1</u>	<u>/u</u>

(1) Overheads are inclusive of indirect overheads, loadings and IDC /u

(2) Excludes overheads for PREP of \$40.6 million in 2024 and \$1.4 million in 2025 /u

- c) Enbridge Gas is unable to provide this level of detail for the forecast years as the Asset Management Plan forecasts are established net of contributions.
- d) EA Fixed Overhead refers to the overheads of Extended Alliance partners Aecon, NPL, and Lakeside, and includes items such as management and administration personnel; office costs such as heat, hydro and maintenance, insurance, information technology, communications, and training.
- e) Please see Table 3 for contingency amounts for 2024 through 2028. Please note, some contingency amounts will be embedded in direct capital forecasts and may not be reflected in the values below. For more specific information on how contingency values are established, please see response at Exhibit I.2.6-SEC-122.

Table 3 /u

Asset Class	2024 Contingency	2025 Contingency	2026 Contingency	2027 Contingency	2028 Contingency
Compression Stations	\$ 804,244	\$ 2,717,500	\$ 63,000	\$ -	\$ -
Customer Connections	\$ -	\$ -	\$ -	\$ -	\$ -
Distribution Pipe	\$ 12,582,781	\$ 11,917,028	\$ 1,804,007	\$ 5,060,546	\$ 5,114,729
Distribution Stations	\$ 8,129,765	\$ 2,853,739	\$ 1,613,794	\$ 389,419	\$ -
Growth	\$ 7,986,310	\$ 25,717,491	\$ 2,818,277	\$ 6,197,220	\$ 1,445,673
LNG	\$ 35,000	\$ -	\$ -	\$ -	\$ -
Transmission Pipe & Underground Storage	\$ 18,104,836	\$ 15,912,800	\$ 14,645,483	\$ -	\$ -
Grand Total	\$ 47,642,936	\$ 59,118,558	\$ 20,944,541	\$ 11,647,185	\$ 6,560,402

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T5/S3/p. 13

Question(s):

With respect to Table 6:

- a) Please provide the Interest During Construction (IDC) amounts by year and by asset class;
- b) Please provide the Overhead amounts by year and by asset class;
- c) Please provide the contribution amounts by year and by asset class;
- d) Please provide the contingency amounts by year and by asset class;
- e) For each of the particulars in the Table 6, (Lines 1-16), please provide the forecast amounts for each of the years 2019 to 2022

Response:

The following response has been updated to reflect the Capital Update provided at /u
Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

- a) Please see Table 1 for the Interest During Construction (IDC) amounts by year by asset class.

Table 1
Utility IDC by Asset Class

/u

Line No.	Particulars (\$ millions)	Utility	2019	2020	2021	2022	2023	2024
			Actuals	Actuals	Actuals	Actuals	Estimate	Test Year
			(a)	(b)	(c)	(d)	(e)	(f)
1	Compression Stations	EGI			0.37	1.28	4.22	0.52
2	Customer Connections	EGI			0.80	1.96	3.76	3.98
3	Distribution Pipe	EGI			1.70	4.01	2.85	4.10
4	Distribution Stations	EGI			1.54	3.08	0.88	0.94
5	Fleet & Equipment	EGI			-	0.00	0.11	0.35

Table 1
Utility IDC by Asset Class

6	Growth - Distribution System Reinforcement	EGI	0.48	1.29	0.62	0.75
7	Real Estate & Workplace Services	EGI	0.50	0.81	0.92	0.94
8	Technology Information Services (TIS)	EGI	0.02	0.03	0.67	1.65
9	Transmission Pipe and Underground Storage	EGI	0.52	1.09	0.80	0.68
10	Utilization	EGI	0.04	0.01	2.01	1.79
11	Community Expansion	EGI	0.02	0.06	-	-
12	Integration Capital	EGI	0.46	0.13	0.30	-
13	EA Fixed O/H	EGI	0.17	1.16	0.45	0.82
14	Other	EGI	0.02	0.07	0.01	0.00
15	Total		5.17	5.03	6.65	14.97
					17.58	16.53

Note:

(1) IDC for PREP has been removed

b)

/u

Table 2
Utility OH Capital Expenditures by Asset Class

Line No	Particulars (\$ millions)	Utility	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>2023</u>	<u>2024</u>
			Actuals (a)	Actuals (b)	Actuals (c)	Actuals (d)	Forecast (e)	Forecast (f)
1	Compression Stations	EGI	-	-	7.9	21.6	73	9.7
2	Customer Connections	EGI	-	-	49.7	59.8	65.2	65.4
3	Distribution Pipe	EGI	-	-	81.5	95.0	53.8	76.2
4	Distribution Stations	EGI	-	-	17.2	19.5	15.3	17.8
5	Fleet & Equipment	EGI	-	-	5.3	6.1	2.0	6.7
6	Growth - Distribution System Reinforcement	EGI	-	-	9.1	13.5	12.5	18.4
7	Real Estate & Workplace Services	EGI	-	-	13.8	13.1	14.4	13.6
8	Technology Information Services (TIS)	EGI	-	-	4.4	5.7	10.8	22.3
9	Transmission Pipe and Underground Storage	EGI	-	-	15.1	12.0	17.7	14.7
10	Utilization	EGI	-	-	15.4	19.6	36.5	32.6
11	Capitalized Overheads	EGI	215.2	220.9	-	-	-	-
12	Integration Capital	EGI	-	-	15.1	7.0	4.6	-
13	Other	EGI	-	-	0.2	0.1	0.1	0.2
Total			215.2	220.9	234.6	272.9	306.1	277.5

Notes:

- (1) Overheads are inclusive of indirect overheads, loadings and IDC.
- (2) Excludes PREP overheads of \$6.8M in 2022, \$5.1M in 2023 and \$40.6 million in 2024.
- (3) 2019 to 2020 actuals were under the previous overhead capitalization process, which cannot be allocated by Asset Class.

c) Please see response at Exhibit I.2.5-CCC-42 part c) regarding the CIAC forecasts for 2023 and 2024. Please see Table 3 for all other years:

Table 3

Asset Class	2019A	2020A	2021A	2022A	2023 Bridge Year	2024 Test Year
Compression Stations	-	-	-	-	-	-
Customer Connections	(24,673,191)	(17,618,053)	(16,262,020)	(19,937,404)	-	-
Distribution Pipe	(57,367,782)	(63,584,028)	(18,764,312)	(33,952,330)	-	-
Distribution Stations	(1,040,814)	(48,798)	(197,459)	(706,615)	-	-
Fleet & Equipment	-	-	-	-	-	-
Growth - Distribution System Reinforcement	(11,768,910)	(11,661,269)	(4,046,973)	(15,600,859)	-	-
Real Estate & Workplace Services	-	-	-	-	-	-
Technology Information Services	-	-	-	-	-	-
Transmission Pipe and Underground Storage	(293,183)	-	-	-	-	-
Utilization	(12,847)	-	-	-	-	-
Extended Alliance Fixed Overhead	-	-	-	-	-	-
Capitalized Overheads	-	-	-	-	-	-
Integration Capital	-	-	-	-	-	-
Community Expansion	(5,836,988)	(13,702,138)	(2,790,928)	(4,502,160)	-	-
Other	(1,000,000)	-	-	(302,655)	-	-
Total Contributions	(101,993,714)	(106,614,286)	(42,061,692)	(75,002,023)	-	-

- d) Please see Table 4 for contingency amounts for 2023 and 2024. Contingency for prior years would be converted to direct capital as actuals or released and removed from actuals. Please note, some contingency amounts will be embedded in direct capital forecasts and may not be reflected in the values below. For more specific information on how contingency values are established, please see response at Exhibit I.2.6-SEC-122.

/u

Table 4

Asset Class	2023 Contingency	2024 Contingency
Compression Stations	\$ 3,197,284.45	\$ 804,244.23
Distribution Pipe	\$ 6,683,243.68	\$ 12,582,781.25
Distribution Stations	\$ 3,171,114.57	\$ 8,129,764.52
Growth	\$ 3,652,438.17	\$ 7,986,310.24
Utilization	\$ 69,130.00	\$ -
LNG	\$ 9,000.00	\$ 35,000.00
Transmission Pipe & Underground Storage	\$ 1,407,068.32	\$ 18,104,835.84
Grand Total	\$ 18,189,279.19	\$47,642,936.08

e)

2.5.3 Table 6
Utility Capital Expenditures Forecast by Asset Class

Line No.	Particulars (\$ millions)	Utility	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022</u>
			Forecast	Forecast	Forecast	Forecast
			(a)	(b)	(c)	(d)
1	Compression Stations	EGI	34.5	17.3	47.5	87.7
2	Customer Connections	EGI	152.5	185.3	212.9	220.7
3	Distribution Pipe	EGI	191.1	295.7	483.2	458.5
4	Distribution Stations	EGI	35.4	45.9	94.5	106.6
5	Fleet & Equipment	EGI	18.7	17.6	22.6	30.6
6	Growth - Distribution System Reinforcement	EGI	188.6	79.8	64.8	52.6
7	Real Estate & Workplace Services	EGI	20.8	34.7	104.7	118.7
8	Technology Information Services (TIS)	EGI	67.8	46.1	39.6	39.4
9	Transmission Pipe and Underground Storage	EGI	14.5	16.4	73.7	102.5
10	Utilization	EGI	75.9	67.9	110.8	120.3
11	Capitalized Overheads	EGI	214.8	220.0	0.0	0.0
12	EA Fixed OH	EGI	18.3	18.0	18.2	21.3
13	Integration Capital	EGI	16.0	0.0	103.0	41.6
14	Community Expansion	EGI	27.4	18.7	30.9	20.7
15	Other	EGI	9.3	17.7	21.7	22.9
16	Total		<u>1,085.7</u>	<u>1,081.0</u>	<u>1,428.1</u>	<u>1,444.3</u>

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T5/S3/p. 28-32

Question(s):

- a) Please provide a revised Table 10 to compare the 2023 Bridge Year to 2022 Actuals.
- b) Please provide the variance analysis of Lines 1-15 in revised Table 10 in part (a) for the 2023 Bridge Year compared to 2022 Actuals.

Response:

- a) Please see response at Exhibit I.2.1-CCC-36, Attachment 1.
- b) Please see response at Exhibit I.2.5-LPMA-14 part b).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T5/S3/p. 14-36

Question(s):

At pages 14-36, EGI provides a Year-over-Year Variance Analysis of Capital Expenditures 2019 to 2024 that compares costs in a certain year to the previous year:

- a) Please provide a variance analysis for the period 2019 to 2022 that provides an explanation of the variances of actuals versus budget/planned amounts;
- b) Please provide a variance analysis of planned compared to actual volume of work completed/delivered for each of the years 2019 to 2022 by asset class.

Response:

- a) Please Tables 1 to 4 below and their corresponding variance explanations.

Table 1
2019 Utility Capital Expenditures by Asset Class

Line No	Particulars (\$ millions)	Utility	<u>2019</u>	<u>2019</u>	2019 Actual Over/(Under) 2019 Forecast
			Actuals (a)	Forecast (b)	(c) = (a-b)
1	Compression Stations	EGI	25.5	34.5	(9.0)
2	Customer Connections	EGI	190.4	152.5	38.0
3	Distribution Pipe	EGI	175.1	191.1	(16.0)
4	Distribution Stations	EGI	39.7	35.4	4.3
5	Fleet & Equipment	EGI	26.3	18.7	7.6
6	Growth - Distribution System Reinforcement	EGI	144.1	188.6	(44.5)
7	Real Estate & Workplace Services	EGI	42.0	20.8	21.2
8	Technology Information Services (TIS)	EGI	48.9	67.8	(19.0)
9	Transmission Pipe and Underground Storage (TPUS)	EGI	20.3	14.5	5.8
10	Utilization	EGI	99.3	75.9	23.4
11	Capitalized Overheads	EGI	215.2	214.8	0.4
12	EA Fixed OH	EGI	17.8	18.3	(0.5)
13	Integration Capital	EGI	21.7	16.0	5.7
14	Community Expansion	EGI	17.1	27.4	(10.3)
15	Other	EGI	3.9	9.3	(5.4)
16	Total		<u>1,087.4</u>	<u>1,085.7</u>	<u>1.7</u>

Compression Stations is lower by \$9 million due to deferral of Meter Area Upgrade Phase 1 to from 2019 to 2020.

Customer Connections is higher by \$38 million due to the change in CIAC policy from the decision in EB-2019-0305 and the resulting accrual of CIAC refund.

Distribution Pipe is lower by \$16 million due to deferred spend for NPS 20 & 30 Don River Replacement and Windsor Line Replacement to 2020, as well as reclassification of Integrity and Class Location from Transmission Pipe & Underground Storage

Distribution Stations is higher by \$4.3 million due to additional Gate & Feeder, and District Stations brought forward to 2020 including Pickering Gate, Clements & Martin Grove.

Fleet & Equipment is higher by \$7.6 million due to the advancement of purchases and the implementation of a harmonized approach to vehicle selection across the rate zones.

Growth is lower by \$44.5 million due to deferral of Kingsville project spend and reduced spend for Stratford project.

REWS is higher by \$21.2 million due to Technology & Operations Centre land purchases for Sites 1 and 2.

TIS is lower by \$19 million due to CIS Hana project shifting to Integration Capital, lower Customer Experience project, as well as lower costs for Contrax and Service Suite projects.

TPUS is lower by \$5.8 million due to reclassification of Integrity and Class Location costs to Distribution Pipe.

Utilization is higher by \$23.4 million due to the advancement of meter purchases planned for 2020.

Capitalized Overheads has an immaterial variance to budget

EA Fixed OH has an immaterial variance to budget

Integration Capital is higher by \$5.7 million due to CIS project reclassified to Integration Capital, and higher spend for HANA and SCADA.

Community Expansion is lower by \$10.3 million due to delayed project execution to 2020.

Other is lower by \$5.4 million due to lower spend for RNG projects.

Table 2
2020 Utility Capital Expenditures by Asset Class

Line No	Particulars (\$ millions)	Utility	<u>2020</u>	<u>2020</u>	2020 Actual Over/(Under) 2020 Forecast
			Actuals (a)	Forecast (b)	(c) = (a-b)
1	Compression Stations	EGI	26.5	17.3	9.2
2	Customer Connections	EGI	178.7	185.3	(6.7)
3	Distribution Pipe	EGI	192.8	295.7	(102.9)
4	Distribution Stations	EGI	61.4	45.9	15.4
5	Fleet & Equipment	EGI	20.2	17.6	2.7
6	Growth - Distribution System Reinforcement	EGI	70.0	79.8	(9.8)
7	Real Estate & Workplace Services	EGI	38.3	34.7	3.7
8	Technology Information Services (TIS)	EGI	22.7	46.1	(23.4)
9	Transmission Pipe and Underground Storage (TPUS)	EGI	33.5	16.4	17.1
10	Utilization	EGI	62.9	67.9	(5.0)
11	Capitalized Overheads	EGI	220.9	220.0	0.9
12	EA Fixed OH	EGI	19.5	18.0	1.5
13	Integration Capital	EGI	39.8	0.0	39.8
14	Community Expansion	EGI	20.9	18.7	2.2
15	Other	EGI	(0.9)	17.7	(18.6)
16	Total		1,007.2	1,081.0	(73.8)

Compression Stations is higher by \$9 million driven by deferral of Meter Area Upgrade Phase 1 from 2019 to 2020.

Customer Connections is lower by \$6.7 million as a result of lower customer additions due to COVID-19.

Distribution Pipe is lower by \$102.9 million due to Windsor Line spend deferred to 2021, reduced scope for the Steel Mains Replacement program as well as Integrity Management Program.

Distribution Stations is higher by \$15.4 million due to higher spend for Victoria Square, Hamilton Gate rebuild, Oxford Gate Rebuild, and Blackhorse Gate Rebuild.

Fleet & Equipment is higher by \$2.7 million due to the harmonized approach to vehicle selection implemented in 2019. **Growth** is lower by \$9.8 million due to Owen Sound Reinforcement clean-up work deferred to 2021 and reduced costs for Kingsville restoration work

REWS is higher by \$3.7 million due to the land purchases for the new London site, Kennedy Road Expansion, and Station B new building.

TIS is lower by \$23.4 million due to reduction of project work and forecast for WAMS Stabilization and IS Application, driven by modifications to the TIS Roadmap.

TPUS is higher by \$17.1 million due to higher spend Wilkesport Maximum Operation Pressure Remediation and other Integrity projects.

Utilization is lower by \$5.0 million due to lower meter purchases and regulator refits.

Capitalized Overheads has an immaterial variance to budget as a result of higher overheads due to the implementation of the new overhead capitalization methodology offset by lower O&M expenses in 2020.

EA Fixed OH has an immaterial variance to budget.

Integration Capital is higher by \$39.8 million due to CIS Integration, Cost of Gas project, and carryover costs for 2019 CIS HANA Upgrade.

Community Expansion is higher by \$2.2 million due to carry-over of costs from 2019.

Other lower by \$18.6 million due to lower spend for RNG projects.

Table 3
2021 Utility Capital Expenditures by Asset Class

Line No	Particulars (\$ millions)	Utility	<u>2021</u>	<u>2021</u>	2021 Actual Over/(Under) 2021 Forecast
			Actuals (a)	Budget (b)	(c) = (a-b)
1	Compression Stations	EGI	42.3	47.5	(5.2)
2	Customer Connections	EGI	260.7	212.9	47.8
3	Distribution Pipe	EGI	447.2	483.2	(36.1)
4	Distribution Stations	EGI	91.2	94.5	(3.3)
5	Fleet & Equipment	EGI	26.7	22.6	4.1
6	Growth - Distribution System Reinforcement	EGI	48.5	64.8	(16.2)
7	Real Estate & Workplace Services	EGI	70.5	104.7	(34.2)
8	Technology Information Services (TIS)	EGI	22.8	39.6	(16.8)
9	Transmission Pipe and Underground Storage	EGI	79.5	73.7	5.8
10	Utilization	EGI	80.7	110.8	(30.1)
12	Capitalized Overheads	EGI	0.0	0.0	0.0
11	EA Fixed Overhead	EGI	25.4	18.2	7.2
13	Integration Capital	EGI	87.5	103.0	(15.5)
14	Community Expansion	EGI	17.4	30.9	(13.5)
15	Other	EGI	10.5	21.7	(11.2)
16	Total		1,310.8	1,428.1	(117.2)

Compression Stations is lower by \$5.2 million due to lower spend for improvement and replacement.

Customer Connections is higher by \$47.8 million due to higher customer additions and cost per customer.

Distribution Pipe is lower by \$36.1 million due to deferral of spend for Lake Shore KOL, London Lines, and St. Laurent projects.

Distribution Stations has no significant variances.

Fleet & Equipment is higher by \$4.1 million due one-time purchase of TDW ProStopp tools.

REWS is lower by \$34.2 million due to lower spend for various sites including Station B new building, New Site No. 2 & 4, Brampton Operations Centre, Riverview Regional Ops Centre, and 50 Keil Renovations Phase 3 projects.

TIS is lower by \$16.8 million due to Microsoft software moving to cloud and reductions to meter reading devices replacement.

TPUS is higher by \$5.8 million due to higher Integrity program spend.

Utilization is lower by \$30.1 million due to lower meter purchases and reg refits.

EA Fixed Overhead is higher by \$7.2 million due to EA overhead increases and incremental payments for dispatch and COVID-related costs.

Integration Capital is lower by \$15.5 million due to lower spend for Cost of Gas and timing of execution for other integration projects including Leak and Corrosion System Integration, Estimating and Forecasting Accuracy and Customer Connections.

Community Expansion is lower by \$13.5 million due to timing of project execution

Other is lower by \$11.2 million due to lower RNG projects.

Table 4

2022 Utility Capital Expenditures by Asset Class

Line No	Particulars (\$ millions)	Utility	<u>2022</u>	<u>2022</u>	2022 Actual Over/(Under) 2022 Forecast
			Actuals (a)	Estimate (b)	(c) = (a-b)
1	Compression Stations	EGI	106.8	87.7	19.1
2	Customer Connections	EGI	297.0	220.7	76.3
3	Distribution Pipe	EGI	477.5	458.5	19.0
4	Distribution Stations	EGI	97.1	106.6	(9.4)
5	Fleet & Equipment Growth - Distribution System	EGI	30.6	30.6	(0.1)
6	Reinforcement	EGI	69.4	52.6	16.8
7	Real Estate & Workplace Services	EGI	64.4	118.7	(54.3)
8	Technology Information Services (TIS)	EGI	28.1	39.4	(11.4)
9	Transmission Pipe and Underground Storage	EGI	96.8	102.5	(5.7)
10	Utilization	EGI	98.4	120.3	(21.9)
12	Capitalized Overheads	EGI	-	-	-
11	EA Fixed Overhead	EGI	27.0	21.3	5.7
13	Integration Capital	EGI	28.7	41.6	(12.9)
14	Community Expansion	EGI	14.2	20.7	(6.5)
15	Other	EGI	1.1	22.9	(21.8)
16	Total		1,437.1	1,444.3	(7.2)

Compression Stations is higher by \$19.1 million due to higher spend for Dawn to Corunna, Parkway Plant C replacement, and Meter Area Upgrade Phase 2 projects.

Customer Connections is higher by \$76.3 million due to the actual costs required to connect customers being higher compared to the AMP budgeting process for this asset class sub-program.

Distribution Pipe is higher by \$19 million due to higher spend for Kirkland Lake, carry-over costs for London Lines Replacement, and Sudbury Lateral projects.

Distribution Stations is lower by \$9.4 million due to Gate, Feeder & A stations (Leamington North Gate, Parkway Gate, Bayview Feeder, and Albion Feeder).

Fleet & Equipment has no significant variance.

Growth is higher by \$16.8 million due to higher spend for Greenstone Mine project, Ingersoll Transmission, Byron Transmission, and Staples Reinforcement projects.

REWS is lower by \$54.3 million due to deferral of Station B new Building, New Site No. 4, Kennedy Road Expansion, and SMOC projects.

TIS is lower by \$11.4 million due to deferral of Green Button, Truck Modern Replacement, Content Management Enhancement, and GIS Integration placeholder.

TPUS is lower by \$5.7 million due to lower spend for Dawn Cuthbert Replacement, and Sarnia Expansion projects.

Utilization is lower by \$21.9 million due to lower MXGI's, meter purchases and regulator refit.

EA Fixed Overhead is higher by \$5.7 million due to EA overhead increases and incremental fuel subsidies.

Integration Capital is lower by \$12.9 million due to lower spend for REWS GTA East and GTA West Site, Cost of Gas, and Customer Connection projects.

Community Expansion is lower by \$6.5 million due to timing of project execution

Other is lower by \$21.8 million due to lower spend for RNG projects.

- b) Because of the nature of much of the work within Enbridge Gas's capital budget, some programs within each asset class budget will have historically been, and in some cases are currently forecasted using a top-down approach or semi-top down approach. In these cases, budgets are established using historical expenditures augmented with any tacit knowledge about expected changes in the coming year as a basis for forecasting the volume of work and required capital funding. Additionally, with newer programs such as the Facilities Integrity Management Program (see below), Enbridge Gas is still working to understand costs to complete station inspections well enough to be able to provide bottom-up estimates for each unit of work completed. Therefore, a planned volume of work will not be available for these programs for the purposes of a variance analysis of work completed to plan. The following provides a list of programs for where this is the case and the approach taken for budgeting:

Distribution Pipe:

- Relocation Program (Exhibit 2, Tab 6, Schedule 2, page 108, Section 5.2.3.6.2.5): This work is driven entirely by third party project work, much of which has not been disclosed to Enbridge Gas or finalized when budgets are set
- TIMP Digs (Exhibit 2, Tab 6, Schedule 2, page 107, Section 5.2.3.6.1.1): Digs are forecasted using total historical dig costs for previous ILI projects, but not based on estimated number of digs which is dependent on ILI findings and cannot be easily predicted.
- Depth of Cover Program (Exhibit 2, Tab 6, Schedule 2, page 107, Section 5.2.3.6.1.2): Survey findings dictate remedial actions which cannot be predicted, so budgets are set based on historical findings and planned survey activities.
- Emergency Replacement Program (Exhibit 2, Tab 6, Schedule 2, page 108, Section 5.2.3.6.2.2): Emergency response fund for damaged or leaking pipelines that need immediate remedial action, forecasted entirely based on historical expenditures.
- Service Replacement Program (Exhibit 2, Tab 6, Schedule 2, page 108, Section 5.2.3.6.2.4): Driven entirely by reactive response to damaged or leaking services, and therefore budgeted based on historical expenditures.

Distribution Stations:

- Odourization System Strategy (Exhibit 2, Tab 6, Schedule 2, page 138, Section 5.2.4.6.1.4): Budgets typically forecasted based on historical information without detailed cost estimates for upcoming work completed.
- Telemetry Strategy (Exhibit 2, Tab 6, Schedule 2, page 139, Section 5.2.4.6.1.5): Budgets typically forecasted based on historical information without detailed cost estimates for upcoming work to be completed.
- Facilities Integrity Management Program (Exhibit 2, Tab 6, Schedule 2, page 139, Section 5.2.4.6.1.6): Relatively new program where initial budgets have been based on high level assumptions. As awareness of costs becomes more refined, budgets can be more directly tied back to estimated units of work to be completed at the time budgets are set.
- Header Station Replacement Program (Exhibit 2, Tab 6, Schedule 2, page 140, Section 5.2.4.6.2.2): Budgets typically forecasted based on historical information without detailed cost estimates for upcoming work to be completed. Program is given a blanket budget from which to draw. Units of work not currently tracked.
- Customer Station Replacement Program (Exhibit 2, Tab 6, Schedule 2, page 140, Section 5.2.4.6.3.1): Budgets typically forecasted based on historical information without detailed cost estimates for upcoming work to be completed. Program is given a blanket budget from which to draw. Units of work not currently tracked.
- Inside Regulator Room Program (Exhibit 2, Tab 6, Schedule 2, page 140, Section 5.2.4.6.3.2): Budgets typically forecasted based on historical information

without detailed cost estimates for upcoming work to be completed. Program is given a blanket budget from which to draw. Units of work not currently tracked.

- PFM Rebuild Program (Exhibit 2, Tab 6, Schedule 2, page 140, Section 5.2.4.6.3.3): New program where rebuild targets and planned units of work have not been fully established. Program is given a blanket budget from which to draw. Future program costs estimates based on total annual capital expenditure to date.
- Station Painting Program (Exhibit 2, Tab 6, Schedule 2, page 141, Section 5.2.4.6.4.1): Budgets typically forecast based on historical information without detailed cost estimates for upcoming work to be completed. Program is given a blanket budget from which to draw.

Compression/LNG

- High Performance Coating Program (Exhibit 2, Tab 6, Schedule 2, page 192, Section 5.3.5.4.10): Budgets typically forecast based on historical information without detailed cost estimates for upcoming work to be completed.
- Strategic Land Purchases (Exhibit 2, Tab 6, Schedule 2, page 193): Opportunity based purchases where landowners express interest to sell. Program is given a blanket budget from which to draw.
- Run to Failure Based Programs (Exhibit 2, Tab 6, Schedule 2, page 194, Table 5.3.5-3): Reactive expenditures provided a blanket budget from which to draw.

Transmission Pipe and Underground Storage

- Wellhead Upgrades (Exhibit 2, Tab 6, Schedule 2, page 197): Budgets forecasted based on historical information without detailed cost estimates for upcoming work to be completed. Program is given a blanket budget from which to draw.
- Well Testing and Acid Stimulation (Exhibit 2, Tab 6, Schedule 2, page 197): Budgets forecasted based on historical information without detailed cost estimates for upcoming work to be completed. Program is given a blanket budget from which to draw.
- TIMP Digs (See Distribution Pipe above)
- Depth of Cover Program (See Distribution Pipe above)
- Strategic Land Purchases (See Compression above)
- Run to Failure Based Programs (Exhibit 2, Tab 6, Schedule 2, page 202, Table 5.3.6-1): Reactive expenditures provided a blanket budget from which to draw

Real Estate and Workplace Services

- Building Systems Program (Exhibit 2, Tab 6, Schedule 2, page 222, Section 5.4.7.2): Budgets typically forecast based on historical information without detailed cost estimates for upcoming work to be completed. Program is given a blanket budget from which to draw.

- Workplace Furnishing Replacements Blanket (Exhibit 2, Tab 6, Schedule 2, page 223, Section 5.4.7.5): Budgets typically forecast based on historical information without detailed cost estimates for upcoming work to be completed. Program is given a blanket budget from which to draw.

Fleet and Equipment

- Vehicle and Heavy Equipment Replacement Strategies (Exhibit 2, Tab 6, Schedule 2, page 231, Section 5.5.8.1/2): Budgets have historically been forecast based on historical information without detailed cost estimates for upcoming work to be completed. Program is given a blanket budget from which to draw.
- Tools Replacement Program (Exhibit 2, Tab 6, Schedule 2, Page 231, Section 5.5.8.3): Budgets have historically been forecast based on historical information without detailed cost estimates for upcoming work to be completed. Program is given a blanket budget from which to draw.

Technology and Information Services

- Laptops and Desktop Renewal Strategy, Desktop Sustainment Equipment Strategy, Mobile Device Renewal Strategy (Exhibit 2, Tab 6, Schedule 2, page 247, Section 5.6.8.2.1/2, Page 248 and Section 5.6.8.4.1): Budgets have historically been forecast based on historical information. Program is given a blanket budget from which to draw as required.

In addition to the programs described above, Enbridge Gas does not currently measure volume of work completed each year for every project for which a discrete investment has been created as part of the budgeting process. For example, for construction projects that span multiple years, the Company does not currently collect centralized metrics to establish whether the planned percentage of the projects within an asset class were completed in each of the years. For some larger projects progress will be tracked through project monitoring and control systems. However, in these cases, work is tracked relative to schedule milestones rather than fiscal targets. During the Execute Annual Portfolio Plan stage of the Asset Investment Planning and Management Process (AIPM) described in Exhibit 2, Tab 6, Schedule 2, page 54, Enbridge Gas monitors spend to plan by asset class and investment. Additionally, during the Performance Review stage of the AIPM process, Enbridge Gas evaluates which planned investments saw capital spend versus unplanned investments. While this cannot be directly correlated to units of work completed, it helps project execution teams identify areas for improvement in project planning and execution. Please see response at Exhibit I.2.6-SEC-123 Attachment 2 for an example of how lookback data is used.

There is, however, some capital work for which Enbridge Gas can quantify specific units of work planned and compare units of work completed. These include programs for

which work is easily unitized such as anode installations (see Table 1), Meter Exchanges and Regulator Refit (see Table 2), and customer connections (see Table 3).

Distribution Pipe: Anodes

Table 5
Anode installations

	Forecasted units	Completed Units
2019	-	3,871
2020	-	3,470
2021	-	3,998
2022	5,030	2,915

Distribution Pipe – Anodes Variance explanation and comments:

- Forecasted units prior to 2022 were based on a historical spend of previous years completion rates
- Forecast for 2022 was increased based on harmonization in Cathodic protection standard but lower completion rates are a result of work deferrals

Utilization

Table 6
Regulator Refit (Meter exchanges)

	Forecasted Program meters	Completed	Forecasted Other exchanges	Completed others
2017-2019 3 yr avg	91,863	92,855	28,741	29,657
2020	101,554	101,182	26,493	33,294
2021	95,718	91,466	28,639	19,523
2022	143,296	112,642	22,487	20,701

Utilization Variance Explanation:

The main contributor to the variances of 2019 to 2022 forecast to completed units for the Regulator Refit program is reduced completion rates due to the pandemic (challenges in establishing and maintaining customer appointments for meter exchanges) creating a backlog into 2021 and 2022. The supply chain disruptions for

meter and regulator availability continues to be a significant factor in the completion timelines for this work

Customer Connections

Table 7
Customer Connections

		2019		2020		2021		2022	
		Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual
Apartment Ensuite	New Construction	4,429	6,297	4,902	5,303	5,550	1,741	4,869	1,150
	Conversion		1		2	1	6		250
	Sub Total	4,429	6,298	4,902	5,305	5,551	1,747	4,869	1,400
Apartment Traditiona	New Construction	35	27	30	17	43	15	23	422
	Conversion		3	7	2	7	2		246
	Sub Total	35	30	37	19	50	17	23	668
Commercial	New Construction	2,730	2,526	2,585	1,959	2,472	1,874	1,961	1,135
	Conversion	570	467	536	425	559	474	431	851
	Sub Total	3,300	2,993	3,121	2,384	3,031	2,348	2,392	1,986
Industrial	New Construction	47	40	39	19	37	49	24	20
	Conversion	1	1		1		9		32
	Sub Total	48	41	39	20	37	58	24	52
Residential	New Construction	35,234	28,730	34,389	30,106	32,027	33,280	29,819	37,583
	Conversion	7,572	6,102	8,939	5,535	5,647	5,032	6,105	4,128
	Sub Total	42,806	34,832	43,328	35,641	37,674	38,312	35,924	41,711
TOTAL		50,618	44,194	51,427	43,369	46,343	42,482	43,232	45,817

Customer Connection variances are typically driven by the following:

- (a) Number of attachments estimated using econometric vs actual requests
- (b) Home/building construction schedules and readiness to connect relative to plan
- (c) Construction delays due to resource constraints

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S1/p. 37

Question(s):

Table 3 provides the alignment of sections of EGI's AMP to the OEB's Chapter 5 requirements for Electricity Distribution Rate Applications. Chapter 5 requires that appendices 2-AA – Capital Projects Table and 2-AB – Capital Expenditure Summary Table be completed.

- a) Please provide a Capital Projects Table in the same format as Appendix 2-AA.
- b) Please complete a Capital Expenditure Summary Table in the same format as Appendix 2-AB.

Response:

- a) Please see the following responses regarding historical material capital projects: Exhibit I.2.1-SEC-98, Exhibit I.2.6-SEC-114, Exhibit I.1.4-PP-2, Exhibit I.2.2-CCC-35 and Exhibit I.2.4-EP-8. For material projects in plan for 2023 to 2032, please see Exhibit 2, Tab 6, Schedule 2, Appendix A.
- b) Please see response at Exhibit I.2.5-SEC-107. In Exhibit I.2.5-SEC-107, the historical capital expenditures are categorized by asset class because the historical data prior to the 2019 amalgamation does not map to the requested Appendix 2-AB format. Enbridge Gas historical variances from 2019 onward are filed through Enbridge Gas's annual Utility Earnings and Disposition of Deferral and Variance Account Balances applications. Enbridge Gas variances prior to 2019 are not available due to the different rate mechanisms and associated reporting requirements for EGD and Union.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Canadian Manufacturers & Exporters (CME)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 1, p. 4 of 6

Question(s):

At page 4, EGI stated that “Base capital expenditures represent the ongoing capital requirements to maintain the safe and reliable operations of the Enbridge Gas system and to economically attach new customers.” In contrast, EGI stated that “Special Projects include certain significant Leave to Construct (LTC) projects for EGD, investments approved under the Union’s CPT mechanism, and projects approved for ICM treatment under Enbridge Gas’s ICM mechanism.”

- a) How does base capital expenditures relate to unplanned work? For instance, if there was an emergent issue that did not require a leave to construct, CPT or ICM treatment, would that be considered “base capital expenditure” even though it was not previously included in or contemplated with base capital expenditure?
- b) Conversely, if a leave to construct project or project eligible for ICM treatment were known in advance, and represented a capital requirement to maintain safe operations, would that project still be considered a special project rather than base capital expenditure?

Response:

- a) Please see response at Exhibit I.2.6-CME-21 part b) which describes how Enbridge Gas prioritizes capital investment that was not considered in the assumptions used for the 10-year capital plan.
- b) In the 2024 to 2028 capital plan, all projects requiring a Leave to Construct (LTC), many of which are a capital requirement to maintain safe operations, are considered base capital. Projects eligible for ICM treatment would initially be treated as base capital, however if Enbridge Gas is unable to remain within optimization constraints a project may be excluded from base and be requested for ICM recovery through the annual rate filings.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Canadian Manufacturers & Exporters (CME)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 2, p. 4 of 12

Question(s):

At page 4, EGI stated that “The investment identification process identified more requirements than could be accommodated within the optimization target established for 2024.”

- a) Please clarify what EGI means by saying it identified more requirements. Are the projects in question mandatory projects that are required to be completed, whether as a result of regulation, safety concerns, or other necessity, or does this statement simply signify that there were more potential capital projects than could be accommodate within the target established?

Response:

- a) The requirements provided at Exhibit 2, Tab 5, Schedule 2, page 4, paragraph 8 refer to value driven projects or investments that Enbridge Gas would have preferred to undertake in 2024, had a financial constraint not been applied. The investments that were optimized into later years in the Asset Management Plan as a result of the constraint would not be investments which are considered as part of the Mandatory or Compliance categories, and therefore would not have been required to address any immediate regulatory non-compliances, significant safety concerns, or other matters that required immediate response. For descriptions of Value-Driven, Mandatory or Compliance investments, please see Exhibit 2, Tab 6, Schedule 2, page 46, Table 4.1-2.

Yes, the statement signifies that there were more potential projects than could be accommodated within the established target.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Canadian Manufacturers & Exporters (CME)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 2, p. 8 of 12

Question(s):

At page 8, EGI stated that “The Distribution Integrity Management Program (DIMP) and Transmission Integrity Management Program (TIMP) identify system integrity and reliability risks with Enbridge Gas’s pipeline assets which are then prioritized based on risk to determine the timing of investments.”

- a) Please clarify what EGI means by saying the risks are prioritized based on risk. Are projects prioritized based on the severity of the consequence, the likelihood of occurrence, or the total overall risk if not addressed?
- b) How does this prioritization work within the budget constraint system? For instance, are projects that have a higher risk mitigated/\$ given priority within the budget constraint for inclusion, or is total risk a factor that requires an investment’s inclusion within the budget constraint at a certain point. Please explain fully.

Response:

- a) Risk considers the likelihood of an event occurring and the consequences should the event occur. When prioritizing capital investments driven by risk, Enbridge Gas considers overall risk, including the combination of likelihood and consequence.

Additional detail on Enbridge Gas’s Risk Management is provided at Exhibit 2, Tab 6, Schedule 2, pages 50 to 53.

- b) In the context of capital investments, the Integrity Management Program consists of both compliance driven and value driven investments, as defined at Exhibit 2, Tab 6, Schedule 2, page 46, Table 4.1-2. Compliance driven investments must be addressed within their required time frame, and are not prioritized among other value-driven work. They are instead treated as fixed costs in the optimization process provided at Exhibit 2, Tab 6, Schedule 2, pages 55 to 62, Section 4.3.3.

Value-driven investments are prioritized as provided at Exhibit 2, Tab 6, Schedule 2, page 55, Section 4.3.3, which states “the EGI portfolio is optimized and analyzed by varying the net direct capital per year, highlighting the effects of project timing, option selection and value. The results from these scenarios are reviewed with asset managers to find the combination of investment options and start dates that best meet business needs within specified constraints.” Risk would be one of the value measures used as part of the optimization and review process. For a complete list of value measures, please see Exhibit 2, Tab 6, Schedule 2, pages 47 to 48, Table 4.1-3.

As provided at Exhibit 2, Tab 6, Pages 50, Section 4.2.1, risks may be identified through various sources. Some risks will require capital investment to treat them within a specified timeline. In cases where the risk exceeds the established upper-risk threshold, the investment is treated as mandatory and must be addressed within the required time frame, as provided at Exhibit 2, Tab 6, page 46, Table 4.1-2, under the mandatory category of investments.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Canadian Manufacturers & Exporters (CME)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 3, p. 7 of 36

Question(s):

At page 7, EGI provided a description of the GTA Reinforcement Project, the WAMS Project, and the Ottawa Reinforcement Project.

- a) Please file the Post Construction Financial Report for the GTA Project in this proceeding.
- b) With respect to the WAMS project, please confirm whether there is a Post Construction Financial Report, or an equivalent report, that provides details regarding the cost and schedule overruns and/or lessons learned. If such a report exists, please file it in this proceeding.
- c) Please file the Post Construction Financial Report for the Ottawa Reinforcement Project.

Response:

- a) The GTA Project Post Construction Financial Report is publicly available on the OEB website.¹
- b) There was no Post Construction Financial Report filed for the WAMS project. Within EGD's 2014-2018 IRM Decision, the OEB indicated that EGD was to report on the status, progress and cost versus schedule of the WAMS project². EGD provided details regarding the cost versus schedule of the WAMS project as part of a status update report filed in the 2016 Deferral and Variance Account clearance proceeding.³ Please see Attachment 1.

¹ EB-2012-0451, June 30, 2017, <https://www.rds.oeb.ca/CMWebDrawer/Record/576741/File/document>

² EB-2012-0459, OEB Decision and Order, p.81.

³ EB-2017-0102.

- c) The Ottawa Reinforcement Project Post Construction Financial Report is publicly available on the OEB website.⁴

⁴ EB-2012-0099, May 6, 2015, <https://www.rds.oeb.ca/CMWebDrawer/Record/477849/File/document>

WAMS

—

Will Akkermans

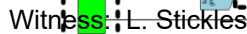
Witness: L. Stickles



Background

Witness: L. Stickles

- [REDACTED]
- Work and Asset Management Solution (WAMS) is a fundamental business tool and foundational to providing safe and reliable service to our utility customers.
- WAMS replaced existing obsolete technology that supported approximately one million work requests every year and stored asset records associated with servicing over two million customers.
- Existing Technology was problematic because it was based on an operating system that was no longer supported by the software vendor after 2015. Over 1,800 people use the related data, processes and technologies.
- WAMS went live in October, 2016 and since go-live, we have had positive users experiences:
 - 306,284 work orders processed
 - 179,952 invoices processed



WAMS Implementation spend

— At the end of 2016, Project implementation actual cost was \$90.1M and spend was over by \$20.4M compared to IR budget of \$69.7M. Major drivers for the overage are:

- Longer duration of solution design.
- Increased solution testing scope to ensure quality and minimize operational disruption at Go-Live.
- Training and change management of 1,800+ users took longer than expected.
- Additional Go-live readiness runs and checks.

Witness: L. Stickles

Examples of benefits being realized



- | | |
|---|--|
| — Technology obsolescence risk mitigated | |
| — Increased percentage of automated invoicing | |
| — Improved governance with AFE process | |
| — Better tracking of restorations | |
| — Improved insight to progressing work | |
| — Post go-live solution review underway | |

Witness: L. Stickles

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 2, Page 6; Exhibit 2, Tab 6, Schedule 1, p. 53-55; Exhibit 2, Tab 6, Schedule 2, s. 5.1.6 & 5.1.9.3

Preamble:

These questions relate primarily to the accuracy of the customer growth forecast, the forecast community expansion spending, and the USP and AMP sections noted above.

Question(s):

- a) Please provide table of all projects approved in phase 1 of the Natural Gas Expansion Program that have not been completed with columns for: the community's name, the expected number of customer connections, the NGEF funding, the total capital costs, whether the project is still expected to proceed, the expected in-service date (if applicable), and the expected date of an OEB application (if applicable).
- b) Please provide table of all projects approved in phase 2 of the Natural Gas Expansion Program that have not been completed with columns for: the community's name, the expected number of customer connections, the NGEF funding, the total capital costs, whether the project is still expected to proceed, the expected in-service date (if applicable), and the expected date of an OEB application (if applicable).

Response:

- a) Table 1 provides requested information for all projects approved in NGEF phase 1 of the Natural Gas Expansion Program that have not been completed.

Table 1

Project Name	Awarded Funding (\$)	Total Estimated Capital Cost (\$)	Forecast Attachment total	Forecast LTC filing date	Forecast in service date	Project expected to proceed?
Hiawatha First Nation	3,140,000	5,286,857	213	2025-2026 *	2026-2027 *	To be determined through further discussions with Chief and Council – community approval required
Cornwall Island – Akwesasne	3,450,000	8,418,045	354	2025-2026 *	2026-2027 *	To be determined through further discussions with Chief and Council - community approval required

* Enbridge Gas has been consulting with communities on both projects since 2018; the projects are still in the early consultation stage working with Chief and Council to obtain community approval in order to proceed with planning activities.

b) Table 2 provides requested information for all projects approved in NGEP phase two of the Natural Gas Expansion Program that have not been completed.

Table 2

Project Name	Awarded Funding (\$)	Total Estimated Capital Cost (\$)	Forecasted Attachment total	Actual LTC filed date	Actual In-service date	Project expected to proceed?
Perth East (Brunner)	814,850	1,293,836	44	NA	May 17 2022	Yes
Stanley's Old Maple Lane Farm	376,205	820,779	11	NA	May 18 2022	Yes
Kenora District – Hwy 594	956,804	1,551,582	30	NA	Aug 19 2022	Yes
Burk's Falls	1,237,071	1,663,917	41	NA	Nov 4, 2022,	Yes
Haldimand Shores	2,827,923	4,048,709	112	March 11 2022	February 8,2023	Yes
Bobcaygeon	68,029,650	116,714,815	3,978	May 2 ,2022 *	2025	Yes
Hidden Valley	1,899,859	3,463,661	110	Dec 20 2022	2023	Yes
Mohawks of the Bay of Quinte	8,080,907	10,715,495	179	Dec 20 2022	2023	Yes
Selwyn	1,674,964	4,502,425	87	Jan 18 2023	2024	Yes
Neustadt	5,128,997	7769155	219	2023	2024	Yes
Prince Edward County (Cherry Valley)	5,206,389	7883379	152	2032	2024	Yes
Sandford	4,392,566	6631637	140	2023	2024	Yes
Eganville	26,169,413	36757345	674	2023	2026	Yes
East Gwillimbury (North and East)	8,373,365	15563359	422	2023	2026***	Yes
Boblo Island	1,915,672	2776579	92	2023	2024	Yes
Merrickville-Wolford	2,465,037	4024120	67	2024	2025	Yes
St Charles	6,385,185	8602563	162	2024	2025	Yes
Glendale Subdivision	2,352,112	3753588	77	2024	2026	Yes
Chute-a-Blondeau	4,446,983	9038505	318	2024	2026	Yes
Tweed	3,800,656	5091557	62	2024	2026	Yes

Project Name	Awarded Funding (\$)	Total Estimated Capital Cost (\$)	Forecasted Attachment total	Actual LTC filed date	Actual In-service date	Project expected to proceed?
Lanark and Balderson	12,673,429	19199846	334	2025	2026	Yes
Red Rock First Nation (Lake Helen Reserve)	3,295,103	4081700	77	2025	2026	Yes
Caledon (Humber Station)	5,048,975	7010026	100	2025	2026	Yes
Severn (Washago)	19,204,171	28859544	723	2025	2027	Yes
Cedar Springs	2,517,260	3479788	103	2025	2026	Yes

**In Abeyance*

*** subject to LTC approval timelines and resource availability*

**** will be constructed in phases over a few years*

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 2, Page 6; Exhibit 2, Tab 6, Schedule 1, p. 53-55; Exhibit 2, Tab 6, Schedule 2, s. 5.1.6 & 5.1.9.3

Preamble:

These questions relate primarily to the accuracy of the customer growth forecast, the forecast community expansion spending, and the USP and AMP sections noted above.

Question(s):

- a) Is the price of gas and/or the incentives available for electric heat pumps impacting the customer attachments in community expansion projects? Please explain the answer.
- b) To help us explore the question in (a), please complete the following tables and prepare a chart for each showing the trendline. For the second table, please divide the annual forecast by 12 to generate a monthly forecast figure.

Customer Attachments in Community Expansion Locations by Month				
	Jan 2020	Feb 2020	...	Dec 2022
Number of customer attachments				

Customer Attachments in Community Expansion Locations by Month Percent of Forecast				
	Jan 2020	Feb 2020	...	Dec 2022
Number of customer attachments as % of forecast				

Response:

- a) Enbridge Gas has not completed any specific analysis to confirm if the price of gas and/or the incentives available for electric heat pumps are impacting the customer attachments in community expansion projects.
- b) Please see response at Exhibit I.1.12-FRPO-21.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 3, Page 7

Preamble:

“The project reduced the dependence on the Parkway Gate Station, improved supply chain diversity, reduced upstream supply risks and reduced expected gas supply costs by \$1.6 billion over the 2015 to 2025 period. The GTA project was \$171.4 million over budget due to several factors including escalation of the construction bid price, increased costs associated with greater construction complexity and increased overall duration due to longer permit acquisition times. However, the forecasted reduction of gas supply costs and overall benefits delivered by the execution of the project outweigh the cost overruns. Additional details regarding project costs were filed in the Post Construction Financial Report for the GTA Project5.”

Question(s):

- a) Please estimate the actual gas supply cost benefits from the GTA project from 2015 to 2022 and reconcile that with the forecast in the GTA project application. Please explicitly account for the evidence of TransCanada in that case showing that avoided tariffs from the mainline would, fully or partly, be ultimately borne to ratepayers by future rate increases.

Response:

- a) Please see response at Exhibit I.2.5-EP-27 part d).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 3, Table 3, Page 5, and Paragraph 12, Pages 6 and 7

Preamble:

“However, the forecasted reduction of gas supply costs and overall benefits delivered by the execution of the project outweigh the cost overruns. Additional details regarding project costs were filed in the Post Construction Financial Report for the GTA Project.”

Question(s):

- a) Please file the document *GTA Project Post Construction Financial Report*, June 30, 2017, that was filed under docket EB-2012-0451 so that it is on the record in this proceeding.
- b) Please reconcile the GTA Project costs shown in Lines 4,5, and 6 of Table 3 with the Major Cost Variances table on page 5 of the *GTA Project Post Construction Financial Report, June 30, 2017*.
- c) For the GTA Project, what was the dollar amount of indirect overheads in the OEB approved total project cost estimate and what was the total dollar amount of indirect overheads allocated to the project in the actual total project costs?
- d) What were the forecasted gas supply costs and what are the actual gas supply costs as the direct result of the GTA Project? Please provide dollar amounts with backup information.

Response:

- a) The GTA Project Post Construction Financial Report is publicly available on the OEB website.¹.

¹ EB-2012-0451, June 30, 2017 <https://www.rds.oeb.ca/CMWebDrawer/Record?q=casenumbr%3aEB-2012-0451&sortBy=recRegisteredOn-&pageSize=400&start=1>

- b) Please see response at Exhibit I.2.5-EP-28 part b).
- c) Indirect overheads were not specifically identified in the OEB-approved total project cost estimate. Similarly, all costs (direct and indirect) were charged directly to the project. The Company did not charge a specific allocation of indirect overheads to the project and so is unable to produce the comparison requested.
- d) The referenced evidence included forecasted gas supply cost savings that were originally estimated to be \$1.6 billion over the 2015 to 2025 period. In the GTA Project proceeding, the gas supply savings were calculated by comparing two forecasted scenarios: an Increased Firm Transportation Scenario whereby EGD continued to meet growing demands using long-haul transportation from Empress, and an Expected Contracting with GTA Project Facilities Approved scenario whereby demands are met using the GTA Project facilities in addition to short-haul transportation from Dawn and Niagara. The original calculation of savings was filed in EB-2012-0451, Exhibit A, Tab 3, Schedule 5, Attachment (updated 2013-05-15), and is included as Attachment 1.

Since the GTA Project was ultimately approved and put into service, the market conditions that underpinned the original savings calculation have changed significantly and actual prices at Dawn and Empress and long haul TCPL tolls are not reflective of what might have occurred had the GTA facilities not been constructed.

Therefore, using historical actual toll and price information to calculate the theoretical “actual” cost of the Increased Firm Transportation Scenario cannot be done reasonably.

In order to be responsive, Enbridge Gas has completed a simplistic update to the original benefits calculation using actual average commodity prices and transportation tolls and fuel charges for the period 2016² to 2022 and an update to the forecasted average commodity prices and transportation and fuel charges for the period 2023 to 2025. No change to the originally assumed demand or planned load factors have been included in this simplistic update. Please see Attachment 2. Using these updated commodity and toll assumptions, the gas supply benefits to the Enbridge CDA as a result of the GTA project relative to the Increased Firm Transportation scenario are estimated to be \$1.1 billion.

² The planned in-service date of the contracts contemplated in each of the scenarios was November 1, 2015, however, these contracts became effective at different time periods between November 1, 2015 and January 1, 2016. Due to this transition period occurring over a number of months, the updated estimate of gas supply savings in Attachment 2 begins on January 1, 2016.

During the GTA Reinforcement Project proceeding, there was significant discussion about the amount of long-haul transportation capacity that would not be filled throughout each year should the Increased Firm Transportation Scenario be implemented. Various scenarios were produced that showed the impact of updating these load factor assumptions along with varying assumptions of commodity prices in each of the scenarios could increase the savings from the originally forecasted \$1.6 billion to as high as \$2.8 billion.³ Meeting seasonal needs with the GTA Project facilities and short haul from Dawn and Niagara rather than long haul capacity would likely result in reforecasted savings that are higher than the \$1.1 billion shown in Attachment 2.

³ EB-2012-0451, Exhibit J6.X

Attachment – Gas Supply Benefits Calculations and Assumptions

Table A1: Toll Assumptions

<u>Toll Assumptions</u>	<u>Demand Toll (\$/GJ)</u>	<u>Commodity Toll (\$/GJ)</u>
FT Empress-EGD CDA ¹	1.677	0.000
Dawn-EGD CDA ¹	0.252	0.000
Peaking 1 ²	0.682	Iroquois + \$0.00
Peaking 2 ²	0.731	Iroquois + \$0.19
Peaking 3 ²	0.926	Dawn + CDA Transport + \$0.24
M12 Dawn-Parkway ³	0.091	0.000
Niagara-Parkway Enbridge CDA ⁴	0.164	0.000
Union Parkway Belt-Bram West CDA ⁴	0.093	0.000
¹ 2013-2017 Review and Variance tolls as provided by TransCanada on May 1, 2013 in NEB Hearing Order RH-003-2011. ² Pricing based on peaking RFP responses for 12'-13' winter service. ³ Toll provided in EB-2013-0074 Union Gas Brantford-Kirkwall/Parkway D Project application. ⁴ 2013-2017 Review and Variance tolls as provided by TransCanada based on costs and billing determinants provided in the Review and Variance Application filed on May 1, 2013.		

Table A2: Fuel Ratio Assumptions

Fuel Ratio Assumptions (%)	January	February	March	April	May	June	July	August	September	October	November	December
Empress-EGD CDA ¹	4.500	5.050	5.000	2.800	1.350	1.000	0.950	1.350	1.100	1.650	2.400	3.500
Dawn-EGD CDA ¹	0.590	0.510	0.760	0.400	0.240	0.000	0.150	0.180	0.020	0.090	0.360	0.360
M12 Dawn-Parkway ²	1.086	1.033	0.972	0.802	0.567	0.463	0.451	0.355	0.352	0.697	0.840	0.945
Niagara-Parkway Enbridge CDA ³	0.420	0.310	0.550	0.300	0.160	0.000	0.120	0.130	0.000	0.030	0.280	0.220
Union Parkway Belt-Bram West CDA ⁴	0.250	0.150	0.250	0.180	0.100	0.000	0.070	0.080	0.000	0.000	0.120	0.110

¹ Actual fuel ratios from June 2012 to May 2013.

² Fuel ratios per M12 rate schedule effective April 1, 2013. Dawn to Parkway (TCPL).

³ Actual fuel ratios from June 2012 to May 2013. Assumes Niagara to EGD CDA fuel ratios.

⁴ Actual fuel ratios from June 2012 to May 2013. Assumes Union Parkway Belt to EGD CDA fuel ratios.

Table A3: Commodity Price Assumptions

<u>Commodity Price Assumptions - Annual Average (\$/GJ)¹</u>	<u>Empress</u>	<u>Dawn</u>	<u>Niagara</u>	<u>Iroquois</u>	<u>EGD CDA</u>
2015	3.69	4.40	4.30	5.51	4.65
2016	3.85	4.44	4.40	5.62	4.70
2017	4.02	4.57	4.55	5.77	4.83
2018	4.42	4.75	4.72	5.95	5.00
2019	4.47	4.94	5.01	6.00	5.20
2020	4.52	5.03	5.08	6.05	5.28
2021	4.56	5.07	5.12	6.09	5.32
2022	4.60	5.10	5.16	6.12	5.36
2023	4.64	5.15	5.20	6.17	5.40
2024	4.68	5.15	5.24	6.21	5.40
2025	4.72	5.19	5.28	6.24	5.44

¹Commodity prices based on forward curves from OpenLink as at May 6, 2013.

Table A4: GTA Project Benefits Calculations (\$ millions)

		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Increased Firm Transportation Scenario												
Service Path	TCPL FT - EGD											
Contract Demand	Empress-EGD CDA											
	294,494											
		30.1	180.8	180.3	180.3	180.3	180.8	180.3	180.3	180.3	180.8	180.3
	Demand Charges											
	Fuel Charges	2.1	10.8	11.2	12.3	12.4	12.6	12.7	12.8	12.9	13.1	13.1
	Commodity Cost	69.2	415.3	432.5	474.9	480.6	487.2	490.3	487.2	499.1	504.8	507.1
	Total Cost	101.4	606.9	624.0	667.5	673.3	680.6	683.2	687.4	692.3	698.6	700.5
Service Path	Peaking Supplies -EGD											
Contract Demand	Empress-EGD CDA											
	105,506											
		0.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Demand Charges											
	Fuel Charges	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Commodity Cost	0.0	6.2	6.4	6.5	6.2	6.3	6.4	6.4	6.5	6.5	6.5
	Total Cost	0.1	7.2	7.3	7.5	7.2	7.3	7.3	7.4	7.4	7.4	7.5
Service Path	TCPL FT - Direct Purchase											
Contract Demand	Empress-EGD CDA, Dawn-EGD CDA											
	200,000											
		16.8	100.8	100.5	100.5	100.5	100.8	100.5	100.5	100.5	100.8	100.5
	Demand Charges											
	Fuel Charges	1.1	6.0	6.2	6.8	6.9	7.0	7.0	7.1	7.1	7.2	7.3
	Commodity Cost	48.6	291.2	302.2	327.6	333.7	338.7	340.8	343.5	346.7	350.0	351.6
	Total Cost	66.5	397.9	408.9	434.9	441.1	446.5	448.3	451.1	454.3	458.0	459.3
	A-Total Cost	168.0	1,012.0	1,040.3	1,109.9	1,121.6	1,134.4	1,138.8	1,145.9	1,154.0	1,164.1	1,167.3
Expected Contracting With GTA Project Facilities Approved												
Service Path	Union M12 - EGD											
Contract Demand	Dawn-Parkway											
	200,000											
		1.1	6.7	6.6	6.6	6.6	6.7	6.6	6.6	6.6	6.7	6.6
	Demand Charges											
	Fuel Charges	0.2	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3
	Commodity Cost	25.8	158.6	162.8	168.9	176.0	179.4	180.3	181.6	183.2	183.8	184.5
	Total Cost	27.2	166.4	170.7	176.8	183.9	187.4	188.3	189.6	191.1	191.8	192.5
Service Path	TCPL FT - EGD											
Contract Demand	Niagara Falls-Enbridge Parkway CDA											
	200,000											
		2.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
	Demand Charges											
	Fuel Charges	0.1	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	Commodity Cost	53.5	321.9	331.8	344.6	365.6	372.2	374.1	376.7	379.9	383.8	385.3
	Total Cost	55.6	334.6	344.5	357.3	378.4	385.0	386.8	389.5	392.6	396.6	398.1
Service Path	Union M12 - Direct Purchase											
Contract Demand	Dawn-Parkway											
	200,000											
		1.1	6.7	6.6	6.6	6.6	6.7	6.6	6.6	6.6	6.7	6.6
	Demand Charges											
	Fuel Charges	0.5	2.3	2.4	2.5	2.6	2.6	2.7	2.7	2.7	2.7	2.7
	Commodity Cost	54.7	325.3	333.9	346.5	360.9	368.0	369.9	372.6	375.7	377.1	378.5
	Total Cost	56.3	334.3	343.0	355.7	370.2	377.3	379.2	381.9	385.1	386.4	387.9
Service Path	TCPL FT - EGD & Direct Purchase											
Contract Demand	Parkway to Bram West CDA											
	800,000											
		4.5	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2
	Demand Charges											
	Fuel Charges	0.1	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	Commodity Cost	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total Cost	4.6	27.8	27.7	27.7	27.8	27.8	27.8	27.8	27.8	27.9	27.8
	B-Total Cost	143.7	863.1	885.8	917.5	960.2	977.5	982.1	988.8	996.6	1,002.7	1,006.2
	Savings (A-B)	24.3	148.9	154.5	192.3	161.4	156.9	156.7	157.1	157.4	161.4	161.1

Notes:

- Transportation tolls from 2016 - 2022 are the actual annual average transportation tolls.
- Transportation tolls from 2023 - 2025 are assumed to be equal to the 2022 actual annual average tolls.

Table 2A3: Commodity Price Assumptions

<u>Commodity Price Assumptions -</u> <u>Annual Average (\$/GJ)</u>	<u>Empress</u>	<u>Dawn</u>	<u>Niagara</u>
2016	2.17	3.23	2.48
2017	2.65	3.97	3.44
2018	2.87	3.83	3.92
2019	2.60	3.21	3.20
2020	2.16	2.45	2.26
2021	3.68	4.37	4.07
2022	6.37	7.82	7.39
2023	5.26	6.65	6.27
2024	4.49	5.71	5.33
2025	4.44	5.52	5.14
Notes:			
- Commodity prices from 2016 - 2022 are actual average market settlement prices			
- Commodity prices for 2023 - 2025 are the annual average forecast commodity prices from the Jan 2023 QRAM, using 21 day strip average as of Dec 1, 2022			

Table 2A4: GTA Project Benefits Calculations (\$ millions)

			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Increased Firm Transportation Scenario												
Service	TCPL FT - EGD	Demand Charges	213.8	217.4	207.6	167.7	164.4	153.6	146.8	146.8	147.2	146.8
Path	Empress-EGD CDA	Fuel Charges	10.0	9.1	13.0	10.9	7.6	15.5	30.0	24.7	21.2	20.9
Contract Demand	294,494	Commodity Cost	233.5	285.0	308.6	279.4	233.0	395.6	684.3	564.9	484.1	477.3
		Total Cost	457.4	511.5	529.2	458.0	405.1	564.8	861.1	736.4	652.5	645.0
Service	Peaking Supplies -EGD	Demand Charges	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Path	Empress-EGD CDA	Fuel Charges	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Contract Demand	105,506	Commodity Cost	6.2	6.4	6.5	6.2	6.3	6.4	6.4	6.4	6.5	6.5
		Total Cost	7.2	7.3	7.5	7.2	7.3	7.3	7.4	7.4	7.4	7.5
Service	TCPL FT - Direct Prurchase	Demand Charges	120.6	122.5	116.5	93.8	91.9	87.0	83.4	83.4	83.6	83.4
Path	Empress-EGD CDA, Dawn-EGD CDA	Fuel Charges	5.6	5.1	7.2	6.1	4.3	8.7	16.7	13.8	11.8	11.6
Contract Demand	200,000	Commodity Cost	175.0	213.9	224.4	199.2	162.7	279.4	487.1	405.1	347.6	340.7
		Total Cost	301.2	341.4	348.2	299.1	258.8	375.0	587.2	502.3	443.1	435.7
		A-Total Cost	765.7	860.3	884.9	764.4	671.2	947.2	1,455.7	1,246.1	1,103.0	1,088.2
Expected Contracting With GTA Project Facilities Approved												
Service	Union M12 - EGD	Demand Charges	7.0	8.2	8.9	8.9	8.7	8.8	8.8	8.8	8.9	8.8
Path	Dawn-Parkway	Fuel Charges	0.9	1.1	1.1	0.9	0.7	1.3	2.3	1.9	1.7	1.6
Contract Demand	200,000	Commodity Cost	115.0	141.1	136.3	114.2	87.2	155.4	277.9	236.4	203.6	196.1
		Total Cost	122.9	150.3	146.2	124.0	96.6	165.4	289.0	247.1	214.2	206.5
Service	TCPL FT - EGD	Demand Charges	20.8	20.9	18.2	13.4	13.0	16.1	16.1	16.1	16.1	16.1
Path	Niagara Falls-Enbridge Parkway CDA	Fuel Charges	0.7	1.2	1.4	0.7	0.4	0.9	2.2	1.8	1.6	1.5
Contract Demand	200,000	Commodity Cost	181.8	251.2	286.1	233.8	165.7	297.4	539.4	457.9	390.1	375.5
		Total Cost	203.2	273.3	305.7	247.9	179.1	314.3	557.6	475.7	407.7	393.1
Service	Union M12 - Direct Purchase	Demand Charges	7.0	8.2	8.9	8.9	8.7	8.8	8.8	8.8	8.9	8.8
Path	Dawn-Parkway	Fuel Charges	1.8	2.2	2.2	1.8	1.4	2.6	4.7	4.0	3.4	3.3
Contract Demand	200,000	Commodity Cost	236.3	289.7	279.9	234.5	179.2	319.2	570.8	485.5	418.3	402.7
		Total Cost	245.0	300.1	290.9	245.2	189.3	330.5	584.3	498.2	430.5	414.9
		B-Total Cost	571.1	723.6	742.9	617.1	465.0	810.2	1,430.8	1,221.1	1,052.4	1,014.5
		Savings (A-B)	194.6	136.6	142.0	147.3	206.2	137.0	24.8	25.0	50.5	73.7

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 3, Table 3, Page 5

Question(s):

- a) Please file the document *Ashtonbee Station Post-Construction Financial Report on Costs and Variances, September 13, 2018*, that was filed under docket EB-2016-0034 so that it is on the record in this proceeding.
- b) Are the costs for the Ashtonbee Station included in GTA project costs in Table 3? If the answer is no, where are they shown on Table 3? If the answer is yes, please show the costs of Ashtonbee Station separated from other GTA Project costs.
- c) For the Ashtonbee Station Project, what was the dollar amount of indirect overheads in the OEB approved total project cost estimate and what was the total dollar amount of indirect overheads allocated to the project in the actual total project costs?

Response:

- a) The document titled "Ashtonbee Station Post-Construction Financial Report on Costs and Variances, September 13, 2018" is publicly available on the OEB website.¹
- b) The costs for the Ashtonbee Station are included in the GTA Project costs in Table 3. Please see the table below with the breakdown of actual costs for both GTA Project and Ashtonbee Station in relation to Table 3.

¹ EB-2016-0034, September 13, 2018,
<https://www.rds.oeb.ca/CMWebDrawer/Record?q=casenummer:EB-2016-0034&sortBy=recRegisteredOn-&pageSize=400#form1>.

Table 3

Project Particulars (\$ millions)	2011-2012	2013	2014	2015	2016	2017	2018	Total
OEB-Approved Budget - GTA Project (Includes Ashtonbee & Buttonville)	0.5	19.3	307	359.7	3.5*	0.0	0.0	690.0
EGD Actual Expenditure - GTA Project (Includes Buttonville engineering design costs incurred up to when it was removed from scope)	12.4	13.7	172.4	551.1	97.0	0.8	0.0	847.4
EGD Actual Expenditure - Ashtonbee		0.6	0.0	0.0	17.8	4.0		22.4
Total over/(under) spend		(5.0)	(134.6)	191.4	111.3	4.8	0.0	179.8

*\$3.5 million are the incremental costs estimated to be directly attributable to the site location change for Ashtonbeeee Station, as per request to vary under case number EB-2016-0034 and also identified in Table 1 – Total Project Costs, page 2 of the Post Construction Financial Report for Ashtonbee Station.

c) Please see response at Exhibit I.2.5-EP-27 part c).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 3, Table 3, Page 5, and Paragraph 13, Pages 7 and 8.

Preamble:

“However, the benefits delivered by implementing the WAMS tool outweighed the cost overruns”.

Question(s):

- a) Did Enbridge ever file with the OEB a post-construction financial report on costs and variances of the WAMS project? If the answer is yes, please file it so that it is on the record in this proceeding. If the answer is no, please prepare such a report for the WAMS project, similar in format to the reports for the Ashtonbee Station and the GTA project and file it.
- b) For the WAMS Project, what was the dollar amount of indirect overheads in the OEB approved total project cost estimate and what was the total dollar amount of indirect overheads allocated to the project in the actual total project costs?
- c) What were the forecasted benefits and what are the actual benefits realized as the direct result of the WAMS Project? Please provide dollar amounts with backup information.

Response:

- a) Please see response at Exhibit I.2.5-CME-15 part b).
- b) The OEB-approved total cost estimate of \$70.1M was inclusive of Interest During Construction (IDC) but excluded Administrative and General (A&G) and Departmental Labour Cost (DLC) overhead allocations. The actual costs included \$8.1 million in A&G and \$4.1 million in IDC.
- c) Please see response at Exhibit I.2.5-FRPO-34.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 3, Table 3, Page 5, and Paragraph 14, Page 8

Question(s):

- a) Please file the document *EB-2012-0099 Ottawa Reinforcement Project Post-Construction Financial Report on Costs and Variances, May 6, 2015*, so that it is on the record in this proceeding.
- b) Please reconcile the Ottawa Reinforcement Projects costs shown on lines 10 and 11 of Table 3 with the costs shown in Table 1 of *EB-2012-0099 Ottawa Reinforcement Project Post-Construction Financial Report on Costs and Variances, May 6, 2015*.

Response:

- a) The document titled "Ottawa Reinforcement Project Post Construction Financial Report, May 6, 2015" is publicly available on the OEB Website¹.
- b) Line 10 in Table 3 provided at Exhibit 2, Tab 5, Schedule 3 shows a total approved budget of \$49.1 million with note 1 at the bottom of Table 3 stating "the approved LTC for Ottawa reinforcement was \$51 million". The difference in these amounts is the reflection of budgeted spend for the project in 2011 and 2012 in the amount of \$1.9 million. Line 11 in Table 3 shows an EGD actual expenditure of \$70.1 million. The Post-Construction Report Table 1 shows the total budgeted costs as \$51,236,000 and actuals as \$70,062,162. The difference in the information stated between the two above tables for the approved budget and actual expenditure is simply due to the rounding off in Table 3 to \$51 million (in Note 1) and \$70.1 million respectively.

¹ EB-2012-0099, May 6, 2015, <https://www.rds.oeb.ca/CMWebDrawer/Record/477849/File/document>

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 5, Schedule 1, pg. 5-6 & Table 1

Preamble:

EGI evidence states: *Through consultation with internal stakeholders and in consideration of the asset class strategies, management of risk, ability to complete mandatory work, Customer Engagement Survey results and total in-service capital spend, a constraint of \$1.2 billion with a 2% escalation factor was recommended. Enbridge Gas is not able to complete mandatory work or support the demand for growth at a constraint below \$1.2 billion.*

We would like to understand more about this assessment.

Question(s):

Please file the study, summary report or memo from which the \$1.2B constraint was determined.

- a) If there is no documentation of an assessment that lead to a \$1.2B value, please provide a summary of how that value was determined.

Response:

- a) Please see response at Exhibit I.2.5-FRPO-30 part a).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 5, Schedule 1, pg. 5-6 & Table 1

Preamble:

EGI evidence states: *Through consultation with internal stakeholders and in consideration of the asset class strategies, management of risk, ability to complete mandatory work, Customer Engagement Survey results and total in-service capital spend, a constraint of \$1.2 billion with a 2% escalation factor was recommended. Enbridge Gas is not able to complete mandatory work or support the demand for growth at a constraint below \$1.2 billion.*

We would like to understand more about this assessment.

Question(s):

Please file the study, summary report or memo from which EGI determined that \$1.2B constraint was not sufficient to complete mandatory work or support demand.

- a) If there is no documentation of an assessment that lead to a \$1.2B value, please provide a summary of how EGI determined that \$1.2B was not sufficient.
- b) If not contained in the study, report or memo, please provide a list of all projects or programs over \$20M that are mandatory or growth related.
 - i. For each project or program, please describe the impact of deferring one or more years.
 - ii. For program, please provide the 2018 to 2022 spending.

Response:

- a) There is no study, summary report, or memo from which Enbridge Gas determined that a constraint below \$1.2 billion was not sufficient to complete mandatory work or support demand. As provided at Exhibit 2, Tab 6, Schedule 2, page 253, Enbridge

Gas looked at scenarios between the 2023 Materiality Threshold of ~\$1.4 billion and the historical average spend of ~\$1.17 billion. Optimization constraints lower than \$1.2 billion (i.e. \$1.1 billion) cause the optimization to fail as they do not accommodate all investments with fixed timing. Therefore, it was through iterative scenario modelling that Enbridge Gas determined that \$1.2 billion with a 2% escalation factor was the appropriate minimum constraint.

- b) Table 1 outlines projects and programs with a 2023 to 2032 forecast greater than \$20 million inclusive of overheads. The planning groups provided at Exhibit 2, Tab 6, Schedule 2, Table 6.1-1 were used to categorize and determine the mandatory and growth-related investments (including “Mandatory – Fixed Timing”, “Mandatory – Optimize”, “Significant Investments (>\$10M) – Fixed Timing” categories). Enbridge Gas is assessing applicable investments to determine if IRPAs can provide a feasible alternative to these investments. When an investment is chosen to proceed with an IRP Plan, reductions to the required capital are anticipated, as the majority of IRPA spend is often classified as O&M.

Table 1
2023-2032 Projects and Programs forecast > \$20 Million Inclusive of Overheads

Investment Code	Investment Name	2023-2032 Forecast with Overheads	Investment Type	Impact of deferral for 1 or more years
Customer Connections				
3402	Area 10 – Apartment Ensuite – New Construction	33,932,813	Program (EGI)	Inability to provide new or upgraded services to customers in accordance with EBO 188
3406	Area 10 – Commercial – New Construction	88,357,565	Program (EGI)	
3407	Area 10 – Commercial – Replacement	20,036,048	Program (EGI)	
3408	Area 10 – Residential – Replacement	98,154,218	Program (EGI)	
3700	Area 10 – Residential – New Construction	118,460,850	Program (EGI)	
3726	Area 20 – Commercial – New Construction	43,123,319	Program (EGI)	

Investment Code	Investment Name	2023-2032 Forecast with Overheads	Investment Type	Impact of deferral for 1 or more years
3729	Area 20 – Residential – New Construction	65,585,877	Program (EGI)	
3730	Area 20 – Residential – Replacement	30,865,248	Program (EGI)	
3735	Area 30 – Commercial – New Construction	46,840,812	Program (EGI)	
3738	Area 30 – Residential – New Construction	77,074,340	Program (EGI)	
3739	Area 30 – Residential – Replacement	42,584,538	Program (EGI)	
3744	Area 40 – Commercial – New Construction	40,540,507	Program (EGI)	
3747	Area 40 – Residential – New Construction	52,089,891	Program (EGI)	
3748	Area 40 – Residential – Replacement	62,612,624	Program (EGI)	
3756	Area 50 – Residential – New Construction	89,321,709	Program (EGI)	
3757	Area 50 – Residential – Replacement	61,102,549	Program (EGI)	
3761	Area 60 – Commercial – New Construction	25,177,089	Program (EGI)	
3762	Area 60 – Industrial – New Construction	34,475,558	Program (EGI)	
3764	Area 60 – Residential – New Construction	237,751,447	Program (EGI)	
3765	Area 60 – Residential – Replacement	169,789,900	Program (EGI)	

Investment Code	Investment Name	2023-2032 Forecast with Overheads	Investment Type	Impact of deferral for 1 or more years
3769	Area 80 – Commercial – New Construction	23,213,667	Program (EGI)	
3772	Area 80 – Residential – New Construction	53,055,300	Program (EGI)	
48306	WIND: Generic Greenhouse Windsor	81,077,243	Program (EGI)	
48347	LOND: Company Program – New Business – Scattered Mains – Contractor	38,833,990	Program (EGI)	
48396	WATE: Company Program – New Business – Scattered Mains – Contractor	29,699,613	Program (EGI)	
48427	HAMI: Company Program – New Business – Scattered Mains – Contractor	37,827,801	Program (EGI)	
48452	HALT: Company Program – New Business – Scattered Mains – Contractor	37,840,249	Program (EGI)	
48471	KING: 22-21-001 Company Program – New Business – Scattered Mains – Contractor	27,108,231	Program (EGI)	
500415	WIND: Company Program – Customer Connections	50,761,394	Program (EGI)	
500418	LOND: Company Program - Customer Connections	108,963,296	Program (EGI)	
500419	BRAN: Company Program – Customer Connections	31,915,261	Program (EGI)	
500420	WATE: Company Program – Customer Connections	88,065,710	Program (EGI)	
500421	HAMI: Company Program - Customer Connections	43,466,496	Program (EGI)	

Investment Code	Investment Name	2023-2032 Forecast with Overheads	Investment Type	Impact of deferral for 1 or more years
500422	HALT: Company Program – Customer Connections	40,491,554	Program (EGI)	
500423	KING: Company Program - Customer Connections	68,257,533	Program (EGI)	
500425	SUDB: Company Program – Customer Connections	29,806,515	Program (EGI)	
500427	NBAY: Company Program – Customer Connections	48,587,762	Program (EGI)	
Compression Stations				
48715	Dawn C Compression Lifecycle	163,382,650	Project (EGI)	Impacts will depend on occurrence of equipment failure. Current equipment is obsolete, and the original equipment manufacturer does not have a long term support strategy as stated in Exhibit 2, Tab 6, Schedule 2, Page 189 of 288.
Distribution Pipe				
48288	WIND: Dist-Repl-Contr-Mains Municipal	71,550,345	Program (EGI)	Delaying municipal infrastructure projects can have impacts for the municipality with schedule delays, potential inflationary drivers, availability and coordination of work schedules and crews with potential for increased project costs, and carrying costs for any
48348	LOND: Dist-Repl-Contr-Mains Municipal	45,104,908	Program (EGI)	
48397	WATE: Dist-Repl-Contr-Mains Municipal	105,647,508	Program (EGI)	
48428	HAMI: Dist-Repl-Contr-Mains Municipal	42,151,611	Program (EGI)	
48453	HALT: Dist-Repl-Contr-Mains Municipal	38,392,868	Program (EGI)	

Investment Code	Investment Name	2023-2032 Forecast with Overheads	Investment Type	Impact of deferral for 1 or more years
102420	Relocation Program – Area 20	39,569,299	Program (EGI)	procured material. This delay can also affect the collaborative working relationships that currently exist with the municipalities in which Enbridge Gas operates.
102422	Relocation Program – Area 40	42,520,689	Program (EGI)	
102423	Relocation Program – Area 50	31,261,154	Program (EGI)	
502013	Relocation Program – Engineering Construction	22,737,340	Program (EGI)	
Distribution Stations				
48744	Distribution Operations Station Painting	26,848,160	Program (EGI)	As stated in the asset class strategy in Exhibit 2, Tab 6, Schedule 2, Section 5.2.4.6.4.2 (page 141), “High performance paint reduces the probability of leaks and piping /equipment failure due to significant corrosion”. Therefore, delaying expenditures in this area increases the likelihood of reduced equipment lifespans and potential increased renewal costs earlier in the asset’s lifecycle.
Growth				
1024	NW 6581 Ottawa Reinforcement Phase 2 SRP	71,584,955	Project (EGI)	Unless an IRPA is considered to be

Investment Code	Investment Name	2023-2032 Forecast with Overheads	Investment Type	Impact of deferral for 1 or more years
30523	SRP_North_Parry Sound_Seguin Trail_Reinforcement_NPS6_8 500m_4960kPa	23,764,847	Project (EGI)	technically or economically feasible, or updates to growth forecast change the need to proceed, deferral of one or more years may result in lost sustainment of system pressures and unplanned customer outages for those systems experiencing growth.
30542	SRP_Southeast_Owen Sound_County Rd 40_Reinforcement_NPS12_1 1800m_4670kPa	34,094,285	Project (EGI)	
100703	SRP_LUG East_Kingston_Creekford Rd_Reinforcement_NPS8_62 00m_6895kPa	28,702,886	Project (EGI)	
736075	WIND: Wheatley-1B – Panhandle Distribution Reinforcement – Wheatley Lateral Replacement and Reinforcement	21,106,551	Project (EGI)	Please note, as referenced in Exhibit I.2.6-ED-106, and Exhibit I.2.6-ED-107, Projects 100703 and 736075 respectively have been deferred and cancelled.
736259	Hamilton Industrial Reinforcement	132,907,739	Project (EGI)	
Utilization				
23228	Meter Purchases- New Customer Additions	66,275,270	Project (EGI)	Meter Purchases – New and SMC-Meter & Regulator Additions South: Inability to purchase meters to support customer attachments in accordance with EBO 188. Meter Purchases MXGI's – MXOT's and SMC Meter & Regulator Replacements –
48500	SMC-Meter & Regulator Additions South	41,354,891	Project (EGI)	
738580	Meter Purchases- MXGI's, MXG's, MXOT's	115,594,243	Project (EGI)	
738583	SMC_Meter & Regulator Replacements – South	53,923,496	Project (EGI)	

Investment Code	Investment Name	2023-2032 Forecast with Overheads	Investment Type	Impact of deferral for 1 or more years
				South: non-compliance and penalties under the Electricity and Gas Inspection Act (see Exhibit 2, Tab 6, Schedule 2, Page 150 of 288, Table 5.2.5-3.)
TIS				
736942	Contract Market Systems – Technology Obsolescence	68,414,861	Project (EGI)	As outlined in Exhibit 2, Tab 6, Schedule 2, Appendix A, page 47, this project supports Enbridge Gas's critical contract markets, including Large Volume (LV) Distribution, Storage and Transmission (S&T), Direct Purchase (DP), Gas Management, Gas Procurement & Accounting processes. Many of these systems are 20-30 years old and are built using technology that is or will become unsupported in the near future and require upgrading. Failure to refresh aging systems and applications increases the risks of non-compliance, ,

Investment Code	Investment Name	2023-2032 Forecast with Overheads	Investment Type	Impact of deferral for 1 or more years
				<p>service outages, degraded performance, business and customer interruptions, increased costs, difficulty in acquiring support and diminished ability to address cybersecurity risks</p> <p>In addition, delaying this project would delay the implementation of harmonized services to the contract market, delay improvements in customer experience, and defer operational efficiencies through the elimination of duplicate / manual work.</p>
Transmission Pipe & Underground Storage				
48654	Dawn Parkway Expansion Project (Kirkwall-Hamilton NPS 48)	245,855,289	Project (EGI)	Inability to meet market demands in the projected in-service year.
49758	Panhandle Regional Expansion Project	219,431,846	Project (EGI)	
100699	Dawn Parkway Expansion Project (Dawn-Enniskillen NPS 48)	339,185,787	Project (EGI)	

Investment Code	Investment Name	2023-2032 Forecast with Overheads	Investment Type	Impact of deferral for 1 or more years
735972	PREP: NPS 36 looping to Comber Transmission	95,914,556	Project (EGI)	
736923	Panhandle Regional Expansion Project – Leamington Interconnect	69,934,844	Project (EGI)	

- ii) Table 2 outlines programs with a 2023 to 2032 forecast greater than \$20 million inclusive of overheads and the 2018 to 2022 historical spend. Note: the asset class historical spend profiles from 2018 to 2020 do not include associated overheads. The 2018 and 2019 historical actuals are mapped to the asset program as they do not map to the discrete investment ID.

Table 2

Investment Code	Investment Name	2023-2032 Forecast	2018 Actuals	2019 Actuals	2020 Actuals	2021 Actuals	2022 Actuals
Customer Connections							
3402	Area 10 - Apartment Ensuite - New Construction	33,932,813			2,411,339	3,201,658	3,214,220
3406	Area 10 - Commercial - New Construction	88,357,565			2,418,583	6,480,794	8,369,500
3407	Area 10 - Commercial - Replacement	20,036,048			1,255,108	3,746,454	1,897,876
3408	Area 10 - Residential - Replacement	98,154,218			4,945,848	9,261,131	9,297,469
3700	Area 10 - Residential -	118,460,850			12,530,237	15,544,866	16,112,959

Investment Code	Investment Name	2023-2032 Forecast	2018 Actuals	2019 Actuals	2020 Actuals	2021 Actuals	2022 Actuals
	New Construction						
3726	Area 20 - Commercial - New Construction	43,123,319			1,464,881	4,050,548	4,084,773
3729	Area 20 - Residential - New Construction	65,585,877			5,286,064	8,228,575	8,141,974
3730	Area 20 - Residential - Replacement	30,865,248			2,483,291	1,469,870	2,923,651
3735	Area 30 - Commercial - New Construction	46,840,812			1,883,394	2,151,966	4,436,905
3738	Area 30 - Residential - New Construction	77,074,340			8,273,162	11,082,924	9,494,024
3739	Area 30 - Residential - Replacement	42,584,538			2,312,164	2,854,680	4,033,738
3744	Area 40 - Commercial - New Construction	40,540,507			1,788,471	2,007,544	3,840,121
3747	Area 40 - Residential - New Construction	52,089,891			5,928,562	9,671,700	6,937,803

Investment Code	Investment Name	2023-2032 Forecast	2018 Actuals	2019 Actuals	2020 Actuals	2021 Actuals	2022 Actuals
3748	Area 40 - Residential - Replacement	62,612,624			4,280,460	5,785,209	5,930,860
3756	Area 50 - Residential - New Construction	89,321,709			6,047,845	10,774,824	10,538,726
3757	Area 50 - Residential - Replacement	61,102,549			2,231,627	5,300,125	5,787,821
3761	Area 60 - Commercial - New Construction	25,177,089			5,741,640	4,674,953	2,390,077
3762	Area 60 - Industrial - New Construction	34,475,558			-	2,681,298	3,265,631
3764	Area 60 - Residential - New Construction	237,751,447			20,191,970	28,978,071	28,531,614
3765	Area 60 - Residential - Replacement	169,789,900			7,624,981	11,388,779	16,083,020
3769	Area 80 - Commercial - New Construction	23,213,667			925,661	1,212,806	2,198,870
3772	Area 80 - Residential - New Construction	53,055,300			8,047,335	8,048,011	6,342,609

Investment Code	Investment Name	2023-2032 Forecast	2018 Actuals	2019 Actuals	2020 Actuals	2021 Actuals	2022 Actuals
48306	WIND: Generic Greenhouse Windsor	81,077,243			-	-	7,856,067
48347	LOND: Company Program - New Business - Scattered Mains - Contractor	38,833,990			-	-	3,578,580
48396	WATE: Company Program - New Business - Scattered Mains - Contractor	29,699,613			-	-	2,642,056
48427	HAMI: Company Program - New Business - Scattered Mains - Contractor	37,827,801			-	-	3,673,013
48452	HALT: Company Program - New Business - Scattered Mains - Contractor	37,840,249			-	-	3,674,222
48471	KING: 22-21-001	27,108,231			-	-	4,478,032

Investment Code	Investment Name	2023-2032 Forecast	2018 Actuals	2019 Actuals	2020 Actuals	2021 Actuals	2022 Actuals
	Company Program - New Business - Scattered Mains - Contractor						
500415	WIND: Company Program - Customer Connections	50,761,394			7,406,880	14,571,943	4,861,718
500418	LOND: Company Program - Customer Connections	108,963,296			9,292,981	12,115,097	9,354,836
500419	BRAN: Company Program - Customer Connections	31,915,261			4,465,052	4,949,330	3,098,916
500420	WATE: Company Program - Customer Connections	88,065,710			9,036,683	10,644,208	8,551,026
500421	HAMI: Company Program - Customer Connections	43,466,496			6,710,327	8,814,167	3,824,092
500422	HALT: Company Program -	40,491,554			4,983,116	7,745,234	4,028,349

Investment Code	Investment Name	2023-2032 Forecast	2018 Actuals	2019 Actuals	2020 Actuals	2021 Actuals	2022 Actuals
	Customer Connections						
500423	KING: Company Program - Customer Connections	68,257,533			7,230,682	11,796,116	7,143,838
500425	SUDB: Company Program - Customer Connections	29,806,515			3,150,606	5,159,851	2,894,160
500427	NBAY: Company Program - Customer Connections	48,587,762			4,487,316	6,142,482	4,717,787
Customer Connections		-	2018 - 146,019,260 2019 - 190,424,281				
48288	WIND: Dist-Repl-Contr-Mains Municipal	71,550,345			3,901,952	6,645,225	6,451,221
48348	LOND: Dist-Repl-Contr-Mains Municipal	45,104,908			2,733,598	4,612,936	6,784,561
48397	WATE: Dist-Repl-Contr-Mains Municipal	105,647,508			4,428,337	9,245,295	6,636,563
48428	HAMI: Dist-Repl-Contr-	42,151,611			372,421	4,775,402	4,230,190

Investment Code	Investment Name	2023-2032 Forecast	2018 Actuals	2019 Actuals	2020 Actuals	2021 Actuals	2022 Actuals
	Mains Municipal						
48453	HALT: Dist-Repl-Contr-Mains Municipal	38,392,868			2,511,276	3,424,094	3,384,152
102420	Relocation Program - Area 20	39,569,299			1,943,395	5,022,282	1,863,277
102422	Relocation Program - Area 40	42,520,689			1,970,709	3,082,676	2,235,933
102423	Relocation Program - Area 50	31,261,154			1,600,792	2,189,897	2,111,714
502013	Relocation Program - Engineering Construction	22,737,340			-	6,697,019	1,762,014
DP - Relocations	DP - Relocations	-	2018 - 3,418,449 2019 - 26,910,702				
23228	Meter Purchases-New Customer Additions	66,275,270			7,993,543	9,043,646	7,066,591
48500	SMC-Meter & Regulator Additions South	41,354,890.59			2,355,897	12,216,642	3,576,570
UTIL - Meters (growth)		-	2018 - 5,059,559 2019 - 7,995,418				

Investment Code	Investment Name	2023-2032 Forecast	2018 Actuals	2019 Actuals	2020 Actuals	2021 Actuals	2022 Actuals
738580	Meter Purchases-MXGI's, MXG's, MXOT's	115,594,243			-	-	-
738583	SMC_Meter & Regulator Replacement s - South	53,923,496			-	-	-
UTIL - Meters (mtc)		-	2018 - 11,805,637 2019 - 18,655,975				
Utilization		-	2018 - 47,367,310 2019 - 58,419,480				

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 5, Schedule 1, pg. 5

Preamble:

EGL evidence states: *Capital projects that supported the integration of EGD and Union were excluded from the respective AMP's and the revenue requirement for these projects was funded through synergy savings during the deferred rebasing term.*

Question(s):

Is EGL applying to put those integration funded projects into rate base? Please explain fully.

Response:

Please see response at Exhibit I.1.9-STAFF-22 part b).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 5, Schedule 3, pg. 7 and Table 3
& EB-2012-0451 FRPO Final Submissions 20131116
& Enbridge Gas Distribution Inc. ("Enbridge") – GTA Project Ontario Energy Board ("Board") Docket No. EB-2012-0451 - Conditions of Approval – Post Construction Financial Report

Preamble:

EGI evidence states: *The project reduced the dependence on the Parkway Gate Station, improved supply chain diversity, reduced upstream supply risks and reduced expected gas supply costs by \$1.6 billion over the 2015 to 2025 period. The GTA project was \$171.4 million over budget due to several factors including escalation of the construction bid price, increased costs associated with greater construction complexity and increased overall duration due to longer permit acquisition times. However, the forecasted reduction of gas supply costs and overall benefits delivered by the execution of the project outweigh the cost overruns. Additional details regarding project costs were filed in the Post Construction Financial Report for the GTA Project.*

In the second reference on pages 12-13, FRPO submitted: The need to reduce the pressure in these lines is important but the weight of evidence would suggest that it is not urgent. Of all of the projects in this combined proceeding, we would view Segment B as being least critical from a strict time point of view. One factor that was insufficiently canvassed in this proceeding is the inflationary effect that would be caused if all of the proposed projects were being constructed simultaneously. Both utilities have evidenced that these are the biggest projects that they have undertaken. Combining these projects along with TCPL's King's North would put enormous pressure on the costs to deliver these projects, especially the cost of skilled labour. In our view, one possible constructive recommendation at this juncture would be a condition added to Segment B that indicates if the quoted prices for construction more than 20% above the estimated costs for the project that the company re-tender for the next year of construction possibly phasing in a two to three year construction project to spread the scarce resources. This approach would allow a staged reduction of pressure in the lines reaching their desired goal over a multiple year period.

Page 7 of the Post Construction Report referenced above indicates that the majority of over-run was a result of bid prices relative to estimate.

Question(s):

When the contractor bids came in significantly higher than the estimates filed with Board in the Leave-to-Construct proceeding, did Enbridge Gas Distribution (EGD) consider phasing construction and deferring Segment B to move construction away from this peak period?

- a) If not, why not?
 - i. Did EGD inform the Board to seek acceptability of these escalated costs?
 - ii. Please file EGD's criteria at the time on acceptability of escalated costs on major projects.
- b) If phasing was considered, please file documentation of the considerations involved in the potential deferral.

Response:

- a) EGD did not consider phasing construction and deferring Segment B due to the fact that the proposed pipelines and facilities would only meet the full set of objectives outlined in the GTA Reinforcement Project Application¹ if constructed and operated together. EGD weighed the needs and system benefits of the project as described the GTA Reinforcement Project Application² to meet the needs of the growing GTA region while considering factors such as the growing constraints evidenced within the existing gas system, the future growth and demand that would be required to meet the needs of the expanding GTA and the cost of project deferral. The market trends at the time for the construction of pipelines and related infrastructure to deliver the system suggested that this cost would not be abated anytime in the foreseeable future. If anything, these costs were on a rising trajectory, which has materialized and continues to increase today compounded by factors such as ongoing inflationary pressures. In any event it would be conjectural to assume that the potential costs from concurrent execution is lower than the potential costs of mobilization, demobilization and remobilization. EGD believes it acted prudently in constructing the pipeline when it was necessary and before costs rose even further in the market. Delaying the construction of any segment of the pipeline at the time would have resulted in additional economic and social cost to ratepayers, and not met the objectives of the GTA Project.

¹ EB-2012-0451, Exhibit A, Tab 3, Schedule 1

² EB-2012-0451, Exhibit A, Tab 3, Schedule 6, pages 8 to 9

- i. As stated in the GTA Project Post-Construction Financial Report³,

“The Company has discussed the potential of [project cost] variance during the [LTC] proceeding

‘...While the contingency and escalation models account for some portion of these risks, variability in the final cost outcome is almost a certainty. Inclusive of contingency, which is expected to be spent, there is equal probability that the final project costs will be over or under the estimate...’

and kept the Board apprised of the projected difference during and after construction.”

Please see the above-noted section of the Post-Construction Financial Report and references included therein to the numerous forms of communications provided by EGD to the OEB, and more specifically the November 6, 2015 and April 1, 2015 updates, to keep the OEB apprised of cost increases to the project.

- ii. EGD followed its governance process to obtain the required approvals for the escalated costs on the GTA Project. EGD obtained GTA Project Incremental Funding approval from the Enbridge Board of Directors in February 2015, to increase the Major Capital Appropriation for the project by \$69 million for a total cost of up to \$756 million (both amounts being inclusive of interest during construction (IDC)). EGD also proceeded to obtain GTA Project Incremental Funding approval from the Enbridge Board of Directors on November 4, 2015, to increase the Major Capital Appropriation for the project by \$176 million for a total cost of up to \$932 million (both amounts being inclusive of IDC).

- b) Please see response at part a).

³ EB-2012-0451, Conditions of Approval – Post Construction Financial Report (June 30, 2017), Section 5, p. 26.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 5, Schedule 3, pg. 7 and Table 3
& EB-2012-0451 FRPO Final Submissions 20131116
& Enbridge Gas Distribution Inc. ("Enbridge") – GTA Project Ontario Energy Board ("Board") Docket No. EB-2012-0451 - Conditions of Approval – Post Construction Financial Report

Preamble:

EGI evidence states: *The project reduced the dependence on the Parkway Gate Station, improved supply chain diversity, reduced upstream supply risks and reduced expected gas supply costs by \$1.6 billion over the 2015 to 2025 period. The GTA project was \$171.4 million over budget due to several factors including escalation of the construction bid price, increased costs associated with greater construction complexity and increased overall duration due to longer permit acquisition times. However, the forecasted reduction of gas supply costs and overall benefits delivered by the execution of the project outweigh the cost overruns. Additional details regarding project costs were filed in the Post Construction Financial Report for the GTA Project.*

In the second reference on pages 12-13, FRPO submitted: The need to reduce the pressure in these lines is important but the weight of evidence would suggest that it is not urgent. Of all of the projects in this combined proceeding, we would view Segment B as being least critical from a strict time point of view. One factor that was insufficiently canvassed in this proceeding is the inflationary effect that would be caused if all of the proposed projects were being constructed simultaneously. Both utilities have evidenced that these are the biggest projects that they have undertaken. Combining these projects along with TCPL's King's North would put enormous pressure on the costs to deliver these projects, especially the cost of skilled labour. In our view, one possible constructive recommendation at this juncture would be a condition added to Segment B that indicates if the quoted prices for construction more than 20% above the estimated costs for the project that the company re-tender for the next year of construction possibly phasing in a two to three year construction project to spread the scarce resources. This approach would allow a staged reduction of pressure in the lines reaching their desired goal over a multiple year period.

Page 7 of the Post Construction Report referenced above indicates that the majority of over-run was a result of bid prices relative to estimate.

Question(s):

Has EGI performed an analysis of what the actual savings in gas supply costs have been up until the end of 2022?

a) If so, please file.

Response:

Please see response at Exhibit I.2.5-EP-27 part d).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 5, Schedule 3, pg. 7 and Table 3
& EB-2012-0451 FRPO Final Submissions 20131116
& Enbridge Gas Distribution Inc. ("Enbridge") – GTA Project Ontario Energy Board ("Board") Docket No. EB-2012-0451 - Conditions of Approval – Post Construction Financial Report

Preamble:

EGI evidence states: *The project reduced the dependence on the Parkway Gate Station, improved supply chain diversity, reduced upstream supply risks and reduced expected gas supply costs by \$1.6 billion over the 2015 to 2025 period. The GTA project was \$171.4 million over budget due to several factors including escalation of the construction bid price, increased costs associated with greater construction complexity and increased overall duration due to longer permit acquisition times. However, the forecasted reduction of gas supply costs and overall benefits delivered by the execution of the project outweigh the cost overruns. Additional details regarding project costs were filed in the Post Construction Financial Report for the GTA Project.*

In the second reference on pages 12-13, FRPO submitted: The need to reduce the pressure in these lines is important but the weight of evidence would suggest that it is not urgent. Of all of the projects in this combined proceeding, we would view Segment B as being least critical from a strict time point of view. One factor that was insufficiently canvassed in this proceeding is the inflationary effect that would be caused if all of the proposed projects were being constructed simultaneously. Both utilities have evidenced that these are the biggest projects that they have undertaken. Combining these projects along with TCPL's King's North would put enormous pressure on the costs to deliver these projects, especially the cost of skilled labour. In our view, one possible constructive recommendation at this juncture would be a condition added to Segment B that indicates if the quoted prices for construction more than 20% above the estimated costs for the project that the company re-tender for the next year of construction possibly phasing in a two to three year construction project to spread the scarce resources. This approach would allow a staged reduction of pressure in the lines reaching their desired goal over a multiple year period.

Page 7 of the Post Construction Report referenced above indicates that the majority of over-run was a result of bid prices relative to estimate.

Question(s):

For the WAMS project, please file documentation of the quantification of actual realized benefits from the implementation of the project.

Response:

As indicated in an interrogatory response in EB-2017-0102¹, the company is not able to provide the quantification of actual realized benefits from the implementation of the WAMS project as they span several areas and are difficult to quantify. Examples of benefits being realized were provided in the WAMS status update report² filed in the same proceeding. Please see Exhibit I.2.5-CME-15, Attachment 1.

¹ EB-2017-0102, Exhibit I.D.EGDI.EP.9, July 14, 2017.

² EB-2017-0102, Exhibit D, Tab 3, Schedule 1, May 9, 2017.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 5, Schedule 3, pg.13

Question(s):

Please file a revised version of Table 6 breaking down the respective expenditures by utility rate zones of EGD and Union.

Response:

The following response has been updated to reflect the Capital Update provided at /u Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023

Please see Table 6.

Table 6 - EGD
Utility Capital Expenditures by Asset Class

Line No.	Particulars (\$ millions)	Utility	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>2023</u>	<u>2024</u>	
			Actual	Actual	Actual	Actual	Bridge Year	Test Year	
			(a)	(b)	(c)	(d)	(e)	(f)	
1	Compression Stations	EGI	17.6	9.2	26.8	73.4	199.0	22.3	/u
2	Customer Connections	EGI	136.0	117.5	172.0	183.8	183.6	189.6	/u
3	Distribution Pipe	EGI	68.0	58.5	151.0	205.2	99.1	173.5	/u
4	Distribution Stations	EGI	24.3	33.7	43.4	54.8	40.5	39.3	/u
5	Fleet & Equipment	EGI	12.9	11.3	15.3	15.0	4.6	14.4	/u
6	Growth - Distribution System Reinforcement	EGI	17.4	8.4	13.4	10.2	16.4	23.4	/u
7	Real Estate & Workplace Services	EGI	30.9	22.2	64.7	48.7	55.5	48.0	/u
8	Technology Information Services (TIS)	EGI	30.6	13.8	12.7	18.2	38.4	87.5	/u
9	Transmission Pipe and Underground Storage	EGI	13.9	12.7	32.7	9.1	7.6	25.0	/u
10	Utilization	EGI	40.9	31.3	34.8	44.6	82.4	77.0	/u
11	EA Fixed Overhead	EGI	14.6	15.7	19.5	22.2	17.6	34.1	/u
12	Capitalized Overheads	EGI	136.2	131.9	0.0	0.0	0.0	0.0	/u
13	Integration Capital	EGI	12.9	19.2	20.3	21.8	18.5	0.0	/u
14	Community Expansion	EGI	16.7	20.2	13.5	9.3	15.1	7.2	/u
15	Other	EGI	3.9	1.6	10.1	1.6	20.7	86.1	/u
16	Total		<u>576.7</u>	<u>507.2</u>	<u>630.4</u>	<u>718.0</u>	<u>798.8</u>	<u>827.2</u>	/u

Table 6 - Union
Utility Capital Expenditures by Asset Class

Line No.	Particulars (\$ millions)	Utility	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>2023</u> Bridge Year	<u>2024</u> Test Year	
			Actual (a)	Actual (b)	Actual (c)	Actual (d)	(e)	(f)	
1	Compression Stations	EGI	7.9	17.3	15.5	33.4	122.8	24.0	/u
2	Customer Connections	EGI	54.4	61.1	88.7	113.2	102.6	114.5	/u
3	Distribution Pipe	EGI	107.1	134.3	296.1	272.3	138.4	183.6	/u
4	Distribution Stations	EGI	15.5	27.7	47.8	42.3	27.0	44.2	/u
5	Fleet & Equipment	EGI	13.4	8.9	11.4	15.5	4.3	17.1	/u
6	Growth - Distribution System Reinforcement	EGI	126.7	61.6	35.1	59.2	38.8	61.9	/u
7	Real Estate & Workplace Services	EGI	11.1	16.1	30.3	17.9	7.5	15.0	/u
8	Technology Information Services (TIS)	EGI	18.2	9.0	10.1	9.9	8.7	15.0	/u
9	Transmission Pipe and Underground Storage	EGI	6.4	20.8	46.8	53.5	71.3	44.2	/u
10	Utilization	EGI	58.4	31.6	45.9	53.7	78.4	75.3	/u
11	EA Fixed Overhead	EGI	3.2	3.7	5.9	4.8	8.0	5.7	/u
12	Capitalized Overheads	EGI	79.0	89.0	0.0	0.0	0.0	0.0	
13	Integration Capital	EGI	8.8	20.6	42.7	4.7	1.5	0.0	/u
14	Community Expansion	EGI	0.4	0.7	3.8	4.9	5.5	4.0	/u
15	Other	EGI	0.0	(2.5)	0.3	(0.5)	13.6	38.5	/u
16	Total		510.6	500.0	680.4	684.9	628.4	643.0	/u

(1) Total capex excludes PREP amounts of \$34.2 million in 2022, \$22.7 million in 2023, and \$194.9 million in 2024.

/u

ENBRIDGE GAS INC.

Answer to Interrogatory from
London Property Management Association (LPMA)

Interrogatory

Reference:

Exhibit 2, Tab 5, Sch. 3

Question(s):

- a) Please update Table 6 to reflect actual data for 2022 and the corrections noted in EGI's letter of January 27, 2023.
- b) Please update Tables 9 and 10 to reflect actual data for 2022. Please explain any significant changes in the variance explanations.

Response:

/u

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

- a) Please see Exhibit 2, Tab 5, Schedule 3, page 14, updated July 6, 2023 for updates to Table 6.
- b) Please see Exhibit 2, Tab 5, Schedule 3 pages 25 to 32, updated July 6, 2023 for updates to Tables 9 and 10 and the relevant variance explanations.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Pollution Probe (PP)

Interrogatory

Reference:

“Of the 2,278 investments that were evaluated through Enbridge Gas’s IRP Binary Screening, 878 investments passed the screening, relating to \$10.4 billion worth of projects that will progress to the technical evaluation.”

Question(s):

- a) In Enbridge’s stakeholder consultation it indicated that only a portion of the projects in the AMP have been screened for IRP purposes. Please indicate when the remaining projects will be screened and how that will be communicated to the OEB and stakeholders.
- b) Please explain what passing the screening means and what Enbridge’s process is for technical evaluation of projects that passed the screening.
- c) For the projects moving forward to an IRP alternatives assessment (e.g. economic evaluation), please provide an estimated date for when the assessment will be complete for each project.
- d) Is it correct that $2,278 - 878 = 1,400$ projects in the IRP failed the Binary screening and what is the next steps for those projects?
- e) Please provide a copy of the completed screenings for all projects screened out of the 2,278 investments.

Response:

- a) Enbridge Gas is targeting to complete technical evaluations for those projects in the AMP that passed the binary screening at the time of the October 31, 2022 Rebasing filing, by Q3 2023.
- b) An addendum to the Enbridge Gas AMP will be filed by Q4 2023 which will include IRP updates.

- c) The Binary Screening is intended to screen out projects falling under the categories of projects that do not warrant IRP evaluation as noted in the OEB's IRP Decision in EB-2020-0091, pages 47 to 49.

Projects that have passed the Binary Screening will then undergo technical evaluation, which assesses the technical feasibility and likelihood of each IRP alternative (IRPA) eliminating, reducing or deferring the project scope. IRPAs include CNG, Market Based Supply Side, Demand Response, enhanced targeted energy efficiency (ETEE) and other technologies that can reduce or shift peak hour consumption.

Please see response at Exhibit I.2.6-STAFF-81 for information on the process used to complete a technical evaluation for projects that passed the Binary Screening.

- d) Enbridge Gas does not have an estimated date for when an economic evaluation will be completed for each project. Enbridge Gas is targeting completion of the economic evaluations for AMP projects that have passed technical evaluation by the end of Q4 2023. The economic evaluation will be completed using the DCF+ Guide filed with the first non-IRP pilot as directed by the OEB's IRP Decision; however, this timing is dependent on the number of economic evaluations to be completed, the complexity of the economic evaluations, the timing of the IRP Plan applications and the timing of the DCF+ Guide review.
- e) The number of gas carrying projects passing Binary Screening was 886, and 1,392 projects failed the Binary Screening. In responding to this question, Enbridge Gas realized that "878" in the referenced section was a typo. If during the AMP's update process there is a material change to the scope of a project that has previously failed a Binary Screening, the project will undergo another Binary Screening and technical evaluation. In addition, projects that fail the Binary Screening will have their scopes confirmed at the detailed design phase before filing an LTC application, if applicable, and if the scope has changed materially another Binary Screening and technical evaluation will be completed. In addition, if there is potential for other IRPAs to be implemented due to changes in the IRP framework, these projects will be re-evaluated.
- f) Please see response at Exhibit I.2.6-STAFF-82.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Pollution Probe (PP)

Interrogatory

Question(s):

Enbridge has indicated that RNG projects may not be included in the AMP or undergo the IRP considerations as part of the AMP process [EB-2022-0203, Exhibit I.PP.3]. Please identify which RNG projects are excluded/included from the AMP and related process. Please explain why RNG projects are excluded.

Response:

RNG projects are excluded from the Asset Management Plan as they are not part of Enbridge Gas's regulated operations.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Pollution Probe (PP)

Interrogatory

Question(s):

- a) Please provide the scope and/or Terms of Reference for the IRP Technical Working Group.
- b) Please provide the Enbridge scorecard, objectives and progress to-date related to Integrated Resource Planning (IRP) in alignment with the OEB's EB-2020-0091 Decision and related IRP Framework.

Response:

- a) Please see Attachment 1 for the Terms of Reference for the IRP Technical Working Group.
- b) Table 1 provides Enbridge Gas's progress to date related to the OEB directives in the OEB's IRP Decision¹.

Table 1

Directive Item	Directive	Status
Interruptible rates	The OEB directs Enbridge Gas to study its interruptible rates to determine how they might be modified to increase customer adoption of this alternative service.	Completed and filed with Enbridge Gas Rebasing Application EB-2022-0200 Exhibit 8, Tab 4, Schedule 7

¹ EB-2020-0091.

Directive Item	Directive	Status
Documentation of demand side IRPAs	The OEB concludes that a document on best available information for demand-side alternatives would promote more timely development of IRP Plans and directs Enbridge Gas to include a listing in its annual IRP Report. The OEB agrees with Enbridge Gas that supply-side alternatives require case-by-case examination and therefore are not required to be included in the listing.	Completed – list included in 2021 IRP Annual Report. Updates will be included in the 2022 Annual Report Appendix B Integrated Resource Plan Alternatives.
Asset Management Plan	The OEB directs that the AMP include information about Enbridge Gas' system needs. This includes providing the status of consideration of IRP Plans regarding meeting system needs, the result of the binary screening, and details on the evaluation.	Completed and filed with Enbridge Gas Rebasng Application EB-2022-0200 Exhibit 2, Tab 6, Schedule 2, Appendix B
DCF+ test enhancement	The OEB directs Enbridge Gas to study improvements to the DCF+ test for IRP and, as applicable, file an enhanced DCF+ test for approval as part of the first non-pilot IRP Plan.	In progress Natural Gas Integrated Resource Planning (IRP) Ontario Energy Board (oeb.ca)
IRP Website	The OEB also directs the establishment of a website by Enbridge Gas to facilitate the broad sharing of information on IRP stakeholder engagement efforts.	Phase 1 – Completed Phase 2 - Completed
Technical Working Group	Establishment of a TWG with the OEB directing that membership should include Enbridge Gas, OEB staff, independent experts, and experienced non-utility stakeholders	Completed Natural Gas Integrated Resource Planning (IRP) Ontario Energy Board (oeb.ca)

Directive Item	Directive	Status
IRP Deferral accounts	The OEB directs Enbridge Gas to prepare a Draft Accounting Order for the two IRP Costs deferral accounts, consistent with the direction in this decision.	Completed

**Integrated Resource Planning
Technical Working Group
Terms of Reference**

February 17, 2022

1.0 Background and Objective

The OEB's July 22, 2021 [Decision and Order](#) established an Integrated Resource Planning (IRP) Framework for Enbridge Gas. Integrated resource planning involves consideration of both traditional facility solutions and alternative supply- or demand-side solutions to meet Enbridge Gas's identified natural gas system needs. The IRP Framework provides direction on the OEB's requirements for IRP for Enbridge Gas.

The IRP Framework requires the OEB to establish an Integrated Resource Planning Technical Working Group. The Working Group is expected to be in operation for a minimum of two years, during the implementation of this first-generation IRP Framework.

The Working Group will be led by OEB staff with an objective to provide input on IRP issues that will be of value to both Enbridge Gas in implementing IRP, and to the OEB in its oversight of the IRP Framework. Enbridge Gas retains the sole responsibility to make final system planning decisions and bring forward project applications to the OEB for approval.

2.0 Priorities and Scope of Work

The OEB expects that the first priorities of the Working Group will be:

- Consideration of IRP pilot projects to better understand how IRP can be implemented to avoid, delay or reduce facility projects. Enbridge Gas is expected to select and deploy two IRP pilot projects by the end of 2022.
- Enhancements or additional guidance in using the Discounted Cash Flow-plus economic evaluation methodology to assess and compare the costs and benefits of using either facility solutions or IRP alternatives to meet system needs.

On an annual basis, the Working Group will also be expected to review and comment on a draft of Enbridge Gas's annual report on its IRP activities. The Working Group will file a report to the OEB in the same proceeding Enbridge Gas's annual IRP report is filed. The Working Group report should include any comments on Enbridge Gas's annual IRP report including material concerns that remain unresolved by the Working Group, and may also describe other activities undertaken by the Working Group in the previous year.

Other potential areas of work for the Working Group may include addressing:

- Learnings from natural gas IRP in other jurisdictions
- Performance metrics for IRP
- Accounting treatment of IRP costs
- Treatment of stranded assets in system planning
- Other activities relevant to the IRP Framework, as identified by the Working Group or as directed by the OEB

3.0 Membership

The Working Group includes representatives from OEB staff and Enbridge Gas, non-utility members, and observers. OEB staff, Enbridge Gas, and observer organizations are expected to select their own representatives, while non-utility members are selected by the OEB as individuals, not representatives of specific organizations. The Working Group will have approximately 10 members plus OEB staff. Working Group members are selected based on relevant demonstrable technical expertise that relates to and informs the activities to be addressed by the Working Group. The OEB has ultimate authority regarding the selection and status of Working Group members.

4.0 Term

The term of the Working Group is expected to be for an initial period of two years.

5.0 Roles and Responsibilities

All IRP Working Group Members, Including Non-Utility Members

All Working Group members will:

- Attend and actively participate at meetings as appropriate
- Treat each other with courtesy and respect.
- Share their expertise and knowledge as they relate to the topic areas being discussed and provide comments for consideration.
- Abide by the OEB's rules on the treatment of confidential items brought forth for discussion, including requirements of a confidentiality agreement.
- Follow up on action items or take on additional work as assigned.

OEB Staff Members

OEB staff will co-ordinate the activities of the Working Group. OEB staff representatives have the following additional responsibilities:

- Establish priority activities and a workplan, with input from Working Group members, taking account of any direction provided by the OEB.
- Chair meetings of the Working Group or designate a member of the Working Group to chair the meeting, if required.

IRP Working Group – Terms of Reference

- Provide (or ensure the appropriate Working Group member provides) any materials for discussion in advance of meetings.
- Co-ordinate attendance through online meeting invitations.
- Circulate an agenda in advance of the meeting noting the purpose of each item (for discussion, for information, etc.).
- Record key meeting outcomes with an action items list and follow up to ensure action items are completed as assigned to Working Group members.
- Confirm any decisions and/or action items at close of the meeting and provide targeted timelines for each action item.
- Co-ordinate the development of any materials authored by the Working Group, and disseminate such materials on behalf of the Working Group, including posting materials on the OEB website, providing updates to OEB management, and/or filing in OEB proceedings, as appropriate.
 - This includes filing a report on the Working Group's activities on an annual basis, in the same proceeding in which Enbridge Gas's annual IRP report is filed.

Enbridge Gas Members

Enbridge Gas representatives have the following additional responsibilities:

- Provide relevant information to the Working Group regarding Enbridge Gas's current and planned IRP activities.
 - This includes providing a draft of Enbridge Gas's annual IRP report to the Working Group far enough in advance of planned filing to the OEB to give the Working Group adequate time to review and comment.
- Provide updates to Enbridge Gas on the Working Group's activities for Enbridge Gas's information and consideration.
 - Enbridge Gas is expected to consider the activities of the Working Group to inform subsequent applications to the OEB related to IRP, such as IRP Plan/Leave to Construct applications, rates applications, and applications to clear balances in IRP-related deferral accounts.

Non-Utility Members

In addition to the responsibilities described above, non-utility members will provide input and advice based on their experience and technical expertise and not advocate specific commercial interests or on behalf of parties they have represented before the OEB in various proceedings.

Observers

Working Group observers will:

- Attend Working Group meetings.
- Provide input on matters when solicited/as appropriate and/or if it pertains to their area of expertise/ experience.

Any materials authored by the IRP Working Group and filed with the OEB will not be considered to represent the views of Working Group observers, or their organizations.

The Working Group includes observers from the Independent Electricity System Operator (due to its experience with Integrated Resource Planning in the electricity sector) and EPCOR Natural Gas Limited Partnership (due to its interest in gaining an understanding of the applicability of IRP to its natural gas distribution operations).¹

6.0 Meeting Frequency, Preparation, and Public Reporting

It is anticipated that the Working Group will meet on approximately a monthly basis initially. It is anticipated that meetings will typically be held by video conference.

Frequency of meetings going forward and the timing of any deliverables for the Working Group will be determined in consultation with the Working Group members. Members may be asked to take on additional work between meetings, depending on their experience and the tasks at hand.

A summary of key outcomes from each meeting held will be prepared and shared with meeting participants to review for accuracy. Once they are reviewed and approved by members of the Working Group, the OEB will post the key outcomes and related meeting materials on its website (unless confidential treatment of materials has been requested), to allow stakeholders to follow the Working Group's progress.

7.0 Issues Resolution

The IRP Working Group will attempt to achieve consensus on IRP-related issues where appropriate. Any materials authored by the Working Group will reflect the Working Group's shared conclusions and not necessarily the views of the OEB, as well as identify areas where consensus was not reached, documenting differing perspectives as necessary.

8.0 Confidentiality

To support the OEB's objectives of transparency and openness, materials sent to or authored by the Working Group will generally be considered non-confidential and placed on the OEB website, with confidential treatment only on an exception basis.² Enbridge Gas or other Working Group members may indicate that certain materials that

¹ As a rate-regulated natural gas distributor, EPCOR will also be responsible for paying a small portion of any costs awarded to IRP Working Group members.

² Drafts of materials in the process of being developed by the Working Group may not be placed on the public record until finalized, even if not considered confidential.

they provide to the Working Group should be treated as confidential information. If necessary, Enbridge Gas may request that specific members not participate in review or discussion of issues of a commercially sensitive nature. Working Group members that wish to review confidential materials will sign a confidentiality agreement, which will apply to all information that contains confidential information that they receive as a member of the Working Group. For the purposes of the Working Group, OEB staff will accommodate requests from members for confidential treatment of materials they provide, but the OEB will not make a formal determination on confidentiality, unless this matter is raised at a later date in a proceeding before the OEB.

9.0 Participant Costs

Cost awards will be available under Section 30 of the Ontario Energy Board Act, 1998 to eligible persons in relation to their participation in the Working Group. The OEB will initiate a cost awards process on a regular basis to ensure that members are compensated for their contributions to the Working Group. Maximum cost claims will be set based on meeting hours (default maximum cost award of 2.0 times meeting time to take into consideration preparation and follow-up time) and volume of documentation to review in preparation for or between meetings (maximum incremental cost award will vary).

Additionally, individual Working Group members or a subset of Working Group members may agree to take on additional tasks, and, with approval from the OEB, will be eligible to claim cost awards for the time to complete those additional tasks. OEB staff will provide guidance regarding costs as appropriate.

IRP Working Group – Terms of Reference**Appendix A: IRP Technical Working Group Members**

Name	Role
Michael Parkes	OEB staff representative (Working Group chair)
Stephanie Cheng	OEB staff representative
Chris Ripley	Enbridge Gas representative
Amrit Kuner	Enbridge Gas representative
Amber Crawford, Association of Municipalities of Ontario	Non-utility member
John Dikeos, ICF Consulting Canada Inc.	Non-utility member
Tammy Kuiken, DNV	Non-utility member
Cameron Leitch, EnWave Energy Corporation	Non-utility member
Chris Neme, Energy Futures Group	Non-utility member
Dwayne Quinn, DR Quinn & Associates Ltd.	Non-utility member
Jay Shepherd, Shepherd Rubenstein Professional Corporation	Non-utility member
Kenneth Poon, EPCOR Natural Gas LP	Observer
Steven Norrie, Independent Electricity System Operator	Observer

As representatives and membership may change from time to time, this list will be updated at least annually.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Pollution Probe (PP)

Interrogatory

Question(s):

Enbridge indicated that Phase 1 of the Low Carbon Energy Project (LCEP) is complete and that Phase 2 is in planning. Enbridge also indicates that an additional \$8.9 million of system reinforcement costs are included in this application related to accommodating hydrogen blending.

- a) Enbridge Gas estimates that the GHG reductions associated with using blended gas having 2% hydrogen by volume in the BGA would be between 97-120 tonnes of carbon dioxide equivalent (tCO₂e) per year. [EB-2019-0294 Decision, page 1]. Please provide the actual annualized tonnes of carbon dioxide equivalent (tCO₂e) avoided from the LCEP and provide the calculations used to determine the avoided emission compared to those if blending had not occurred.
- b) Please provide the current (i.e. most recent) blending percentage rate and the average blending percent since the LCEP project was commissioned.
- c) Enbridge Gas agreed with the reporting requirements proposed by OEB staff. Enbridge Gas agreed that some reporting will be appropriate in the context of the upcoming rebasing proceeding, providing the OEB and parties with interim information about the Project before full reporting is provided. Reporting on the ongoing customer communication is required to ensure that customers report on their experience with the blended gas and the performance of their equipment. The OEB makes these reporting commitments a condition of proceeding with the Project. [EB-2019-0294 Decision, page 14]. Given Enbridge is asking to accelerate Phase 2 of the project. Please provide a copy of the final report for Phase 1.

Response:

- a) 2022 is the first full year for which GHG emissions savings can be calculated. The emissions savings from January 1, 2022, to December 31, 2022 are 86.30 tCO₂e. Avoided emissions were deduced by calculating the avoided volume of natural gas due to hydrogen injection based on energy consumed by downstream network.

$$\text{Emissions Avoided (tCO}_2\text{e)} = \text{NG Avoided (m}^3\text{)} * 0.001932 \text{ (tCO}_2\text{e/m}^3\text{)}$$

NG Avoided (m3) = Energy Consumed Equivalent in NG (m3) – Actual NG Consumed (m3)

- b) A current blend rate cannot be provided as the plant blends at a variable rate which changes continuously up to 2% hydrogen. Since the LCEP was commissioned until January 2023, the blend percentage averaged 1.13%.
- c) The OEB imposed several conditions related to the LCEP¹One of those conditions was condition 2, which indicated that “After 5 years of operational experience, Enbridge Gas shall file a report with the OEB that, at a minimum, includes the following:”² Condition 2 goes on to list the items to be included in that report. As the pilot has just completed the first year of full operations (October 1, 2021, to October 1, 2022) a final report is not available, and cannot be produced until the pilot has run its course.

In the Low Carbon Energy Project³ proceeding Enbridge Gas indicated that some reporting on the LCEP would be appropriate in the context of this Rebasing Application. Exhibit 4, Tab 2, Schedule 6, pages 12 to 14, provides an update on Phase 1 of the LCEP.

Further reporting will be provided in the context of the leave to construct application for LCEP phase 2, which Enbridge Gas expects to file with the OEB likely in late 2023 or early 2024.

¹ EB-2019-0294, Decision and Order, Schedule B, October 29, 2020.

² Ibid.

³ EB-2019-0294.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

EB-2022-0157

Question(s):

On February 1, 2022, as part of EB-2022-0157, Enbridge wrote to update the OEB on developments with its leave to construct application of the Panhandle Regional Expansion Project. Enbridge wrote: "Following the receipt of the new cost information, Enbridge Gas re-assessed the capacity position of the Panhandle System based on actual 2022 attachments and their system locations, as well as updated 2023 customer demand. As a result, the Company now anticipates that incremental demand for Winter 2023/2024 can be accommodated and that the Project's in-service date can be deferred one year from November 1, 2023 to November 1, 2024.":

- a) Please provide details regarding the difference between the capacity position and forecast 2022 attachments (and system locations) as compared to 2022 actuals.
- b) Please provide the updated 2023 customer demand and how that differs from the forecast.
- c) Please explain any implications for the customer forecast numbers that underlie this application because of update provided in EB-2022-0157.
- d) Please provide the 2024 test year revenue requirements impacts, including all sub-components, of a delay in the in-service of the Panhandle Regional Expansion Project from November 1, 2023 to November 1, 2024.
- e) Please explain, what if any, adjustments to the Applicant's capital plan will occur in 2023 and 2024, as a result of the delay of the Panhandle Regional Expansion Project.

Response:

As per Enbridge Gas's letter dated February 1, 2022, "The Company continues to assess the Project cost information, the capacity position of the Panhandle System, and future customer demand" and has not yet completed those assessments at this time.

a-b) The capacity position based on the 2022 forecast was 713 TJ/d for Winter 2022/2023. Based on current actual information the system capacity for Winter 2022/2023 is forecast to increase to 737 TJ/d. The customer demand based on the 2023 forecast was 744 TJ/d. Based on updated demands received so far, the current customer demand for Winter 2023/2024 is estimated to be 734 TJ/d. Customers have been connecting in locations that are more hydraulically favorable than assumed in the forecast, which has provided a benefit to the system.

c) Enbridge Gas is conducting an expression of interest (EOI) to validate the demand forecast. Material impacts to the customer forecast are not anticipated. At this time, Enbridge Gas is currently working with customers to confirm market demand in the Panhandle market area. Please see response at part a) and b).

Based on executed contracts, Enbridge Gas expects that the proposed 19 km NPS 36 pipeline will be required to meet demand in 2024. The EOI results will inform facility requirements (scope and timing) including beyond 2024.

d) As noted above the Company continues to assess the project, and therefore at this time has not completed an analysis of any potential revenue requirement impacts.

e) Enbridge Gas is not proposing to change the 2024 forecasted rate base as set out in this Application. Instead, it will make the necessary adjustments to planned work to stay within the overall capital envelope that has been presented for 2023 and 2024.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-5-2, p.2

Question(s):

With respect to Table 1:

- a) Please provide a revised version of Table 1 that includes years 2013 to 2023. Please also provide the response in Excel format.
- b) Please provide a similar table included in part (a) on an in-service addition basis. Please also provide the response in Excel format.

Response:

- a) Please see response at Exhibit I.2.5-SEC-107, Attachment 1.
- b) Please see response at Exhibit I.2.5-SEC-108, Attachment 1.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-5-2, p.6

Question(s):

Please provide the amount forecast to spend on community expansion projects each year between 2023 and 2028.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023. /u

Please see Table 1.

Table 1
2023-2028 Forecasted Community Expansion Spend

\$ millions	2023	2024	2025	2026	2027	2028
Community Expansion	20.6	11.2	19.6	20.5	21.5	7.3

 /u

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-5-3, p.13

Question(s):

Please provide a revised version of Table 6 that includes the combined EGD and Union capital expenditures for each year between 2013 and 2018, and forecast Enbridge capital expenditures for each year between 2025 and 2028. Please also provide the response in Excel format.

Response:

/u

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

Please see Attachment 1 for the Excel. Enbridge Gas is unable to provide 2013 actual data in this format due to a lack of compatibility with the historical data.

Table 1
Utility Capital Expenditures by Asset Class

Line No.	Particulars (\$ millions)	Utility(1)	<u>2013</u>	<u>2014</u>	<u>2015</u>	<u>2016</u>	<u>2017</u>	<u>2018</u>	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>2023</u>	<u>2024</u>	<u>2025</u>	<u>2026</u>	<u>2027</u>	<u>2028</u>
			Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Bridge Year	Test Year	Forecast	Forecast	Forecast	Forecast
			(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)
1	Compression Stations	EGI		13.9	26.8	19.9	22.6	10.6	25.5	26.5	42.3	106.8	321.8	46.3	64.3	50.3	127.6	19.2 /u
2	Customer Connections	EGI		175.4	162.0	154.8	147.0	151.1	190.4	178.7	260.7	297.0	286.3	304.1	248.1	256.9	254.0	250.1 /u
3	Distribution Pipe	EGI		119.6	120.5	144.0	144.2	139.8	175.1	192.8	447.2	477.5	237.5	357.1	414.4	282.7	250.2	316.4 /u
4	Distribution Stations	EGI		27.2	32.6	38.7	39.0	38.1	39.7	61.4	91.2	97.1	67.5	83.5	113.1	105.5	79.0	116.3 /u
5	Fleet & Equipment	EGI		28.6	22.1	7.8	18.9	15.3	26.3	20.2	26.7	30.6	8.9	31.5	35.4	40.1	45.7	52.3 /u
6	Growth - Distribution System Reinforcement	EGI		20.2	20.3	42.3	26.6	36.4	144.1	70.0	48.5	69.4	55.1	85.2	200.0	43.4	46.0	10.3 /u
7	Real Estate & Workplace Services	EGI		24.9	36.3	30.3	17.4	21.2	42.0	38.3	95.0	66.6	63.0	63.0	61.3	92.0	32.0	56.4 /u
8	Technology Information Services (TIS)	EGI		48.5	46.8	42.6	50.1	56.6	48.9	22.7	22.8	28.1	47.1	102.4	78.0	71.0	44.9	54.1 /u
9	Transmission Pipe and Underground Storage	EGI		12.1	26.8	13.0	21.5	18.5	20.3	33.5	79.5	62.6	79.0	69.2	144.8	201.5	268.4	169.9 /u
10	Utilization	EGI		66.9	71.7	73.3	74.6	75.2	99.3	62.9	80.7	98.4	160.7	152.3	160.1	172.6	152.0	168.4 /u
11	EA Fixed Overhead	EGI		13.7	17.0	17.3	17.1	15.8	17.8	19.5	25.4	27.0	25.6	39.8	40.8	41.9	43.0	23.2 /u
12	Capitalized Overheads	EGI		197.8	200.2	212.5	209.8	207.0	215.2	220.9	-	-	-	-	-	-	-	- /u
13	Integration Capital	EGI		-	-	-	-	-	21.7	39.8	63.0	26.5	20.0	-	-	-	-	- /u
14	Community Expansion	EGI		-	-	-	7.8	4.1	17.1	20.9	17.4	14.2	20.6	11.2	19.6	20.5	21.5	7.3 /u
15	GTA	EGI		172.4	551.1	114.8	4.8	-	-	-	-	-	-	-	-	-	-	-
16	WAMS	EGI		19.3	27.5	35.7	2.0	-	-	-	-	-	-	-	-	-	-	-
17	CPT	EGI		154.6	352.6	690.8	367.9	156.1	-	-	-	-	-	-	-	-	-	- /u
18	Other	EGI		3.0	0.3	1.2	2.5	0.2	3.9	(0.9)	10.5	1.1	34.3	124.6	43.9	28.3	28.0	35.7 /u
19	Union Unregulated	EGI		(9.2)	(7.9)	(11.0)	(21.2)	(13.4)	-	-	-	-	-	-	-	-	-	-
20	Total		886.0	1,089.2	1,706.7	1,627.9	1,152.4	932.5	1,087.4	1,007.2	1,310.8	1,402.9	1,427.2	1,470.3	1,623.8	1,406.7	1,392.3	1,279.5 /u

- (1) 2013 to 2018 represents the combined values of EGD and Union.
- (2) Total capital expenditures excludes Panhandle Regional Expansion Project amounts of \$34.2 million in 2022, \$22.7 million in 2023, \$194.9 million in 2024 and \$6.7 million in 2025.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-5-3, p.13

Question(s):

Please provide a version of the table requested in 2.5-SEC-107, on an in-service addition basis. Please provide the response in Excel format.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

Please see Attachment 1 for the Excel.

Table 1
Utility In-Service Capital Expenditures by Asset Class

Line No.	Particulars (\$ millions)	Utility	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>2023</u>	<u>2024</u>	<u>2025</u>	<u>2026</u>	<u>2027</u>	<u>2028</u>
			Actual	Actual	Actual	Actual	Bridge Year	Test Year	Forecast	Forecast	Forecast	Forecast
			(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
1	Compression Stations	EGI	11.5	40.5	51.8	62.6	362.7	43.9	53.5	17.8	26.8	18.7 /u
2	Customer Connections	EGI	157.8	221.7	268.6	282.2	286.3	304.0	248.4	257.8	254.1	250.1 /u
3	Distribution Pipe	EGI	209.4	127.0	387.2	505.2	272.4	350.7	356.2	299.9	250.2	316.4 /u
4	Distribution Stations	EGI	32.8	100.2	82.7	68.4	58.7	101.2	133.6	91.4	92.6	116.7 /u
5	Fleet & Equipment	EGI	28.8	20.3	25.3	35.1	8.9	31.5	35.4	40.1	45.7	52.3 /u
6	Growth - Distribution System Reinforcement	EGI	134.9	77.2	49.7	90.7	45.4	75.5	219.9	34.2	56.9	12.7 /u
7	Real Estate & Workplace Services	EGI	41.3	19.4	96.5	58.8	32.1	19.2	72.9	203.7	23.2	88.5 /u
8	Technology Information Services (TIS)	EGI	51.6	34.0	21.5	37.7	33.7	68.9	53.4	143.1	44.9	54.1 /u
9	Transmission Pipe and Underground Storage	EGI	10.8	42.9	95.0	57.9	44.8	52.4	174.8	177.1	292.6	130.7 /u
10	Utilization	EGI	133.0	65.4	90.2	93.9	160.7	152.3	160.2	173.0	152.0	168.4 /u
11	EA Fixed Overhead	EGI	25.9	27.0	19.8	28.2	25.6	39.8	40.8	41.9	43.0	23.2 /u
12	Capitalized Overheads	EGI	180.5	200.6	-	-	-	-	-	-	-	-
13	Integration Capital	EGI	18.8	18.7	50.9	67.4	22.7	-	-	-	-	- /u
15	Other	EGI	15.5	30.8	11.5	4.3	10.6	22.2	13.8	26.8	24.4	7.3 /u
16	Community Expansion	EGI	8.9	9.7	2.1	3.2	4.5	52.0	61.6	28.3	28.0	36.1 /u
17	Union Unregulated Allocations		(3.6)	(7.2)	(12.9)	(36.2)	-	-	-	-	-	-
16	Total		1,057.8	1,028.2	1,239.9	1,359.3	1,369.1	1,313.6	1,624.7	1,535.0	1,334.4	1,275.2 /u

Excludes in-service additions for PREP of \$252M in 2024 and \$6.8M in 2025. /u

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-5-3, p.13

Question(s):

SEC seeks to understand in what year capital expenditures were incurred for 2024 for in-service additions. Please complete the attached Excel file 4.4-SEC-109.

Response:

/u

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

Please see Attachment 1. Enbridge Gas renamed the provided Excel file as Exhibit I.2.5-SEC-109.

<u>Asset Class</u>	<u>2024 In-Service</u>	<u>Capital Expenditures In-Serviced in 2024</u>			
		<u><2022</u>	<u>2022</u>	<u>2023</u>	<u>2024</u>
Compression Stations	43.2				43.2 /u
Customer Connections	304.0				304.0 /u
Distribution Pipe	350.7	2.4	8.4	2.3	337.5 /u
Distribution Stations	101.2	01.2	9.5	8.7	81.8 /u
Fleet & Equipment	31.5				31.5 /u
Growth - Distribution System Reinforcement	75.5	0.7	2.6	5.7	66.4 /u
Real Estate & Workplace Services	19.2	.5	1.0	.6	17.1 /u
Technology Information Services (TIS)	68.9				68.9 /u
Transmission Pipe and Underground Storage	52.4	-	.1	.3	52.1 /u
Utilization	152.3				152.3 /u
EA Fixed O/H	39.8				39.8 /u
Capitalized Overheads	-				-
Integration Capital	-				-
Community Expansion	22.2				22.2 /u
Other	52.7				52.7 /u
Total	1313.6	4.8	21.6	17.6	1269.6 /u

<u>OEB Categories</u>	<u>2024 In-Service</u>	<u>Capital Expenditures In-Serviced in 2024</u>			
		<u><2022</u>	<u>2022</u>	<u>2023</u>	<u>2024</u>
System Access	434.7	-	-	-	434.7 /u
System Renewal	530.6	2.6	14.6	10.0	503.4 /u
System Service	227.2	1.7	6.0	7.0	212.4 /u
General Plant	121.1	.5	1.0	.6	119.0 /u
Total	1313.6	4.8	21.6	17.6	1269.6 /u

Please complete shaded areas

Note that PREP has been excluded from the 2024 in-service forecast.

/u

ENBRIDGE GAS INC.

Answer to Interrogatory from
Vulnerable Energy Consumers Coalition (VECC)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 2, Table 1Schedule 3, Table 6

Question(s):

a) Please update Table 6 for 2022 actual results.

Response:

a) Please see response at Exhibit I.2.5-CCC-36 Part a).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Vulnerable Energy Consumers Coalition (VECC)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 3

Question(s):

- a) Please provide a construction status update of the Dawn to Corunna Replacement project which includes the most recent project GANTT chart.

Response:

- a) Please see Attachment 1 for the most recent Gantt chart for the Dawn to Corunna Replacement Project. Right of way clearing has commenced, permit acquisition and material delivery is underway.

[illegible]

ENBRIDGE GAS INC.

Answer to Interrogatory from
Vulnerable Energy Consumers Coalition (VECC)

Interrogatory

Reference:

Exhibit 2, Tab 5, Schedule 2, page 7/ Tab 6, Schedule 2, Appendix B, page 46 of 123.

Question(s):

- a) Please provide the annual LCEP capital and OM&A expense for each year 2021 through 2026.
- b) Please explain the difference between the \$7 million in spending noted at Exhibit 4 (page 7) and the \$9,050,523 at noted in Exhibit 2 Appendix B (page 46).
- c) Please explain the difference between the \$12 million for the Grid Study noted in Exhibit 4 and the \$15,523,163 “Comprehensive techno-economic feasibility study of blending hydrogen” noted in Exhibit 2 Appendix B.
- d) What is the economic benefit to ratepayers of this project?

Response:

- a) OM&A costs for Phase 1 of the LCEP were immaterial in 2021 and 2022 and are expected to continue to be immaterial from 2024 to 2026. OM&A expenses for Phase 2 of the LCEP were not forecasted due to their immaterial nature. Capital costs for each year between 2021 and 2026 including overhead allocations are provided in Table 1.

Table 1
Hydrogen Blending Capital Costs 2021 to 2026

Projects (\$)	2021	2022	2023	2024	2025	2026	/u
Hydrogen Blending Phase 1	5,785,163	152,382	-	-	-	-	
Hydrogen Blending Phase 2	-	-	-	1,922,065	5,166,940	1,961,519	

- b) Please see response at Exhibit I.2.6-STAFF-83.
- c) Please see response at Exhibit I.1.10-STAFF-26 part b).

- d) Phase 1 of the LCEP is a pilot project. Enbridge Gas identified the benefits of the project in EB-2019-0294, Exhibit B, Tab 1 pages 6 to 9. For LCEP Phase 1, Enbridge Gas recognized that there would have been a cost to ratepayers which is why Enbridge Gas sought government funding, implemented the rate rider, bore the associated cost, and proposed the hydrogen pricing approved in that application. Enbridge Gas has taken a similar approach with seeking third party funding to support Phase 2 of the LCEP.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 1, p.4, EB-2020-0091 decision, July 22, 2021 (chapter 10)

Question(s):

Enbridge Gas proposes to file an AMP every two years, and an update or addendum to the AMP in the intervening years, in the annual rates case or as directed by the Integrated Resource Planning (IRP) Framework. Enbridge Gas indicates that it will not be requesting any approvals of the AMP (or AMP update/addendum).

- a) For system needs identified in the AMP that do not require OEB approval in the form of a Leave to Construct application (should a facility solution be chosen), or an IRP Plan (should an IRP alternative be chosen), please confirm that Enbridge Gas would make a final determination on the preferred approach to meeting this system need on its own, taking account of updated information in its IRP assessment as appropriate.
- b) Please provide an update on Enbridge Gas's implementation of the broader Stakeholder Engagement Process (chapter 10 of the IRP decision) to gather more information prior to making a determination on the preferred approach to meeting system needs in the AMP, particularly the intent to use Stakeholder Days to discuss needs/constraints identified in the AMP and the plans to address such items through IRP, and the use of an IRP website to facilitate the broad sharing of information on IRP stakeholdering efforts.
- c) Please confirm that the updated AMP information filed on an annual basis would include the most recent results of Enbridge Gas's IRP Assessment Process for system needs, including reporting on those system needs where a negative binary screening or technical/economic evaluation resulted in no further assessment of IRPAs, as required by the IRP Decision.

Response:

- a) Confirmed.

- b) Enbridge Gas is planning its first regional engagement sessions for early Q2 2023. These sessions are being held at this time for two reasons. First, this timing allowed for the 2023 to 2032 AMP to be completed and optimized, and it allowed for Enbridge Gas to complete binary screenings and some technical evaluations prior to the stakeholder engagement sessions. This ensures that a meaningful overview of both the regions' needs, and some potential non-pipe alternatives can be provided. Secondly, the Ontario municipal elections were held in October 2022, which meant that many key municipal stakeholders were unavailable to participate in stakeholder sessions in the fall/winter 2022 and in early 2023. Municipalities' awareness, support and involvement in these sessions is critical, and so delaying them to allow for their participation was determined to be prudent. In preparation for the regional stakeholder engagement sessions Enbridge Gas met with the IESO to obtain lessons learned and advice on how to run successful regional engagement sessions.

Throughout 2022, Enbridge Gas also focused stakeholder engagement efforts on municipalities. Enbridge Gas attended the 2022 Association of Municipalities of Ontario ("AMO") conference in August, the Ontario Professional Planners Institute conferences in September, and the Rural Ontario Municipalities of Ontario (ROMA) conference in January 2023 to raise awareness amongst municipalities about natural gas integrated resource planning (IRP) and how they can be further involved in the regional planning process. Enbridge Gas has also been working with AMO to increase awareness of natural gas IRP and regional planning with notifications in their organization's Watchfile Newsletter.¹ Further, when requested, Enbridge Gas met with individual stakeholder groups who have indicated an interest in learning more about natural gas IRP and Enbridge Gas's energy transition activities. For example, in November 2022, Enbridge Gas met with representatives of the Three Fires Group to provide an overview of both natural gas IRP and the Pathways to Net-Zero Emissions in Ontario Report provided at Exhibit 1, Tab 10, Schedule 5, Attachment 2.

In addition, initial geotargeted stakeholder engagement to support the IRP Pilots has begun in both the Parry Sound and Southern Lake Huron areas, and these engagements will continue through the first half of 2023. As part of these engagements Enbridge Gas has held meetings with the local municipalities, local electricity distribution companies, Hydro One and the IESO to discuss alignment on forecasts and potential IRPA opportunities. Upon completion of these meetings, Enbridge Gas will start both public geotargeted engagement activities and Indigenous engagement in the pilot regions.

¹ Watchfile Newsletter, February 13, 2023, <https://www.amo.on.ca/about-us/watchfile-newsletter>

In December 2021, an Enbridge Gas IRP website went live.² The website allows individuals to learn about Enbridge Gas's IRP activities and to register, by region, for email updates on the area and for the region's stakeholder engagement sessions. The IRP website was recently updated to provide information on the IRP Pilots in the Parry Sound and Southern Lake Huron areas. The IRP website will be the primary source of information including dates for the regional engagement sessions, IRP pilot webinars, as well as information on how to sign up and participate.

c) Confirmed.

² Enbridge Gas. Regional Planning & Engagement. Sustainability.
<https://www.enbridgegas.com/sustainability/regional-planning-engagement>

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 1, pp. 35-48, Tables 4, 5 and 6

Question(s):

Enbridge Gas's projected spend totals \$6.9 billion from 2024 to 2028 and \$13.8 billion from 2023 to 2032.

- a) In Tables 4, 5 and 6, Enbridge Gas has provided a list of several large projects such as Dawn C Compression, Hamilton Industrial Reinforcement, Dawn to Parkway Expansion, Looping to Comber Transmission and Panhandle Line Replacement. Please confirm that the cost of these projects will be recovered from Enbridge Gas customers over the next 40 to 50 years.
- b) Does Enbridge Gas expect to see a significant reduction in the consumption of natural gas in Ontario within the next 20 years? If yes, please describe the steps that Enbridge Gas has taken or intends to take to ensure that ratepayers are not burdened with cost recovery related to stranded assets.
- c) Please explain how these projects would be considered essential and prudent considering Canada's carbon reduction goals.

Response:

- a) Not confirmed. Based on proposed depreciation rates filed in this proceeding, Enbridge Gas expects to recover the cost of these projects over the next 40 to 60 years.
- b) Enbridge Gas expects that meeting emissions reduction targets over the next 20 years will require significant changes in the use of natural gas; however, it is not known at this time what those changes might be due to several key factors. First, factors that could increase the volume of gas flowing through the system include fuel switching from higher emitting fuels to natural gas and displacement of natural gas by blended fuels like hydrogen. Secondly, some customers could maintain their current natural gas consumption and pair it with CCUS or RNG. Thirdly, the adoption

of emissions reduction energy solutions like hybrid heating would reduce customers' annual natural gas consumption; however, it may not reduce Enbridge Gas's design day demand or design hour demand, which is what is used to determine project needs. Finally, Enbridge Gas's existing 150,000 kms of underground energy infrastructure provides resiliency at low cost; therefore, existing customers could retain their peak capacity for resiliency products like gas generators or gas fireplaces, even if they replace their gas appliances with electric, and efficiency gains could be offset by growth in customers seeking resiliency.

Resiliency must be a key consideration in the energy transition; therefore, it would be prudent for the capabilities of the gas system to be factored into a pathway to net-zero. Response at Exhibit I.1.10-SEC-28 further describes the resiliency benefits of the gas system. All of the factors noted above would be consistent with emissions reductions. Response at Exhibit I.1.10-STAFF-34 part a) describes the steps Enbridge Gas is taking to mitigate the risk to ratepayers from future stranded assets.

- c) As described in response at Exhibit I.1.10-STAFF-34, Enbridge Gas will ensure a high certainty of demand during the regulatory plan period for the projects it is advancing and is taking steps to mitigate the risk of stranded assets as a result of energy transition. Projects that require Leave to Construct applications will demonstrate project need and prudence through the regulatory process including the consideration of IRPAs.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 1, pp. 39-48, Tables 4, 5 and 6

Question(s):

Based on the 2023 to 2032 capital expenditure forecast, Enbridge Gas does not anticipate seeking Incremental Capital Module (ICM) recovery for these projects. Please confirm that Enbridge Gas does not intend to seek ICM recovery (if the OEB approves an IRM framework that includes ICM eligibility) for any of the projects listed in Tables 4, 5 and 6 (Tab 6, Schedule 1).

Response:

Confirmed, Enbridge Gas does not intend to request ICM recovery for any projects listed in tables 4, 5 and 6 from Exhibit 2, Tab 6, Schedule 1, on the basis that the forecasted materiality threshold (assuming the OEB approves the proposals set out in the 2024 Rebasing Application) is expected to exceed the capital budget included in the AMP. However, a change in the actual materiality threshold calculation or a change in the capital forecast may result in a future application for ICM recovery of significant projects that meet the ICM eligibility criteria of need, materiality and prudence.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, Asset Management Plan (AMP), pp. 66-75

Question(s):

The 2022-2032 customer connections capital expenditure was informed by the 2022 Long Range Plan (LRP) forecast without Energy Transition assumptions. When the 2022 LRP including Energy Transition forecast was produced, Enbridge Gas compared it to the 2022 LRP forecast without Energy Transition assumptions. The comparison showed that the Energy Transition assumptions reduced the capital expenditure forecast by \$60,000 in 2024 and by \$44 million over the 2024-2028 rebasing period. Enbridge Gas clarified that the AMP capital expenditures have not been revised to reflect the forecast with Energy Transition assumptions as the impact was minimal.

- a) Please confirm that Enbridge Gas has not reflected the impact of Energy Transition in the proposed capital expenditures over the 2024 to 2028 period or in the proposed rate base for the 2024 Test Year. Please discuss your response.
- b) Please provide the basis for the reduction of \$44 million in capital expenditures over the 2024 to 2028 period to reflect Energy Transition assumptions.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

- a) Enbridge Gas has not reflected the estimated impact of energy transition in the proposed Customer Connections Asset Class capital expenditures over the 2024 to 2028 period. However, for Distribution System Forecasting, energy transition assumptions are reflected (Exhibit 2, Tab 6, Schedule 2, page 69, Section 5.1.5.1). There are no impacts in any of the other asset classes.

For the 2024 Test Year, the total discrepancy in the capital forecast relating to Energy Transition assumptions not being considered in the Customer Connections Asset Class is \$1.8 million.

/u

- b) The difference in the assumed capital expenditures required for customer connections are tabulated in Table 1.

Table 1
2024-2028 Customer Connections Capital Requirements
with and without Energy Transition

	<u>2024</u>	<u>2025</u>	<u>2026</u>	<u>2027</u>	<u>2028</u>	<u>Total</u>
Required Capital without Energy Transition	238,675,320	238,545,114	239,078,774	239,387,911	235,132,110	1,190,819,229
Required Capital with Energy Transition	236,832,600	234,769,423	233,697,979	234,745,169	230,502,934	1,170,548,105
Total Additional Capital Reflected in AMP	1,842,720	3,775,691	5,380,795	4,642,742	4,629,176	20,271,124

/u
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The reduction in capital was determined based on the difference between the customer attachment forecasts with and without energy transition assumptions, please see response at Exhibit I.2.6-ED-94, part b).

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ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, AMP, pp.68-69

Question(s):

Enbridge Gas discusses its distribution system reinforcement investments and forecasting methodology. Enbridge Gas notes that it creates a reinforcement plan to sustain the 10-year customer growth forecast.

Does the same 10-year planning horizon typically apply for transmission system reinforcement projects? Has Enbridge Gas considered using a shorter planning horizon for sizing reinforcement projects given uncertainties in future demand arising from energy transition?

Response:

Yes, the same 10-year growth forecast is used to determine the assets required for the transmission system reinforcement projects.

Yes, Enbridge Gas always considers a shorter planning horizon (typically 3 to 5 years) to serve customer demands on transmission systems, however, the diameter of the pipeline is chosen using a long-term forecast.

Future projects are evaluated on an annual basis and can be reduced in length or delayed if growth is less than forecast.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, AMP, section 5.1.9.3, p. 73

Question(s):

In 2020, Enbridge Gas submitted several project proposals seeking funding under Phase 2 of the Government of Ontario's Natural Gas Expansion Program. In 2021, the Government of Ontario awarded Enbridge Gas approximately \$214 million to support 27 Phase 2 projects. At the time it filed its project proposals, the total estimated capital cost of the 27 projects was approximately \$335 million. As a result, Enbridge Gas's net capital investment at that time was estimated to be approximately \$121 million.

Capital expenditures associated with the 27 Community Expansion projects are not included in Enbridge Gas's AMP capital expenditures.

The Community Expansion projects are subject to a 10-year rate stability period.

Based on correspondence (General EB-2022-0001, [OEB letter to Enbridge Gas regarding East Perth/Brunner](#)) and leave to construct applications (Haldimand Shores EB-2022-0088, Bobcaygeon EB-2022-0111, Mohawks of the Bay of Quinte EB-2022-0248) filed with the OEB, OEB staff observes that the estimated capital costs of several of Enbridge Gas's projects have changed since the original estimates were made in 2020.

In the case of the Hamilton Airport Expansion Project (EB-2022-0001, [Enbridge Gas letter to the OEB regarding the Hamilton Airport Expansion Project](#)), the current estimated net capital cost is lower than the original estimate. Based on a letter filed regarding its Hamilton Airport Expansion Project (EB-2022-0001, [Enbridge Gas letter to the OEB responding to questions about the Hamilton Airport Expansion Project](#)), Enbridge Gas appears to propose to include in rate base the original net capital cost associated with any Community Expansion projects that will be in-service prior to the end of 2024.

- a) Please confirm that Enbridge Gas proposes to include in rate base the original net capital cost associated with each of the 27 Community Expansion projects that will

be in-service prior to the end of 2024. Also, please provide a list of the community expansion projects that will be in-service prior to the end of 2024.

- b) Please provide the original estimated net capital cost and most up-to-date estimated net capital cost for the 27 Community Expansion projects.
- c) For projects where the current estimated net capital cost is lower than the original net capital cost estimate, please confirm that Enbridge Gas intends to include a capital cost in rate base that it does not believe will be incurred on an actual basis (i.e., the incremental net capital cost set out in the original estimate relative to the latest estimate).
- d) Based on information currently available to Enbridge Gas, please comment on how many of the 27 Community Expansion projects are likely to have updated net capital costs that are lower than originally estimated and the magnitude of the variances.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

- a) Enbridge Gas proposes to include within 2024 Test Year Forecast rate base the original net capital cost for 12 community expansion projects and 1 economic development project that have been, or were forecast to be, placed into service by the end of 2024 (as of the date of preparing the Capital Update). Table 1 provides the updated in-service dates of projects included in the 2024 Test Year Forecast rate base, as reflected within the Capital Update.

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Table 1
Community Expansion and Economic Development Projects – In-Service Dates

Community Expansion and Economic Development Projects	In-Service Date
Stanley's Old Maple Farm	2022
Dryden – Kenora	2022
Brunner - Perth East	2022
Burk's Falls	2022
Haldimand Shores	2023
Selwyn	2024
Hidden Valley - Huntsville	2023
Mohawks of the Bay of Quinte	2023
Sanford	2024
Neustadt	2024
Boblo Island	2024
Cherry Valley - Prince Edward	2024
Hamilton Airport Expansion	2023/2024

/u

- b) Table 2 lists the original estimated net capital cost and the revised estimate of net capital cost for the 25 community expansion and 2 economic development projects that were granted funding from the Government of Ontario in 2021:¹

Table 2
Community Expansion and Economic Development Projects – Capital Costs

Community Expansion and Economic Development Projects	Original estimated net capital cost	Current estimated net capital cost	Variance
Perth East (Brunner)	\$1,395,501	\$478,986	(\$916,515)
Kenora District (Hwy 594)	\$594,778	\$594,778	\$0
Stanley's Old Maple Lane Farm	\$444,574	\$444,574	\$0
Burks Falls	\$416,846	\$416,846	\$0
Haldimand Shores	\$1,122,181	\$1,220,786	\$98,605
Bobcaygeon	\$47,485,165	\$48,685,165	\$1,200,000
Hidden Valley (Huntsville)	\$911,858	\$1,563,802	\$651,944

¹ <https://ero.ontario.ca/notice/019-3191>.

Mohawks of the Bay of Quinte	\$1,107,771	\$2,634,588	\$1,526,817
Selwyn	\$4,366,187	\$2,827,461	(\$1,538,726)
Neustadt	\$2,640,158	\$2,640,158	\$0
Prince Edward County (Cherry Valley)	\$2,676,990	\$2,676,990	\$0
Sandford	\$2,239,071	\$2,239,071	\$0
Eganville	\$10,587,932	\$10,587,932	\$0
East Gwillimbury (North and East)	\$7,189,994	\$7,189,994	\$0
Boblo Island	\$860,907	\$860,907	\$0
Merrickville- Wolford	\$1,559,083	\$1,559,083	\$0
St Charles	\$2,217,378	\$2,217,378	\$0
Glendale Subdivision	\$1,401,476	\$1,401,476	\$0
Chute-a-Blondeau	\$4,591,522	\$4,591,522	\$0
Tweed	\$1,290,901	\$1,290,901	\$0
Lanark and Balderson	\$6,526,417	\$6,526,417	\$0
Red Rock First Nation (Lake Helen Reserve)	\$786,597	\$786,597	\$0
Caledon (Humber Station)	\$1,961,051	\$1,961,051	\$0
Severn (Washago)	\$9,655,373	\$9,655,373	\$0
Cedar Springs	\$962,528	\$962,528	\$0
Hamilton Airport Expansion	\$9,662,947 (1)	\$9,074,490	(\$588,457)
Grimsby-Lincoln Expansion	\$7,204,818	\$7,204,818	\$0

/u

(1) Reflects the updated estimates of net capital costs per EB-2022-0001, [Enbridge Gas letter to the OEB regarding the Hamilton Airport Expansion Project, which supported the project's amended level of NGEF funding](#).

/u

Enbridge Gas is continuing to update project capital cost estimates for the projects set out in Table 2 that are planned to be placed into service after 2023 and will provide updated estimates to the OEB as part of future applications requesting an order of the OEB granting leave to construct, or as otherwise required.

c-d) Enbridge Gas confirms that for community expansion and economic development projects that have been placed into-service, or are forecast to be in-service, and are in the midst of a rate stabilization period during a rebasing year, the Company has or intends to include the original net capital cost in rate base. This applies equally to projects where the actual or current estimated costs are higher or lower than the original forecast. In the Rebasing Application following a project's rate stabilization period, the Company intends at that time to include the residual actual project capital costs in rate base, subject to approval of the OEB. This proposal is consistent with the Company proposals and OEB determinations in prior applications, including the

Company's SES/TCS/HAF Approval Application². In Section 3.3 of the Decision and Order³ in this Application.

"The OEB finds that inclusion of the forecasted capital costs in the rate base at the next rebasing before the end of the RSP is consistent with the Generic Decision's requirement for a Community Expansion Project and would achieve the desired goal that Enbridge Gas bear the risk of any capital cost overrun during the RSP. The OEB also finds that the treatment of actual capital costs at the time of rebasing following the rate stabilization period is appropriately the jurisdiction of the panel reviewing the rate rebasing case."

While two community expansion projects currently have net capital costs tracking lower than originally estimated (Brunner and Selwyn), both projects are expected to continue to incur costs associated with attaching customers (beyond their official in-service timing) during their respective 10-year rate stabilization period(s). Given the anticipated ongoing capital costs, and consistent with the OEB's previous findings in this regard, the Company is proposing to include the original net capital cost in rate base at this time and to deal with any variance to the same as part of a future rebasing proceeding following the rate stabilization period.

In addition, the Hamilton Airport (economic development) Expansion Project has net capital costs tracking lower than were originally estimated (in support of the amended NGEF funding). As noted in Exhibit JT6.3, the current net capital estimate for Hamilton Airport Expansion was inadvertently used in the 2024 rate base forecast, instead of the original net capital estimate. See Exhibit JT6.3 for additional details.

/u

² EB-2020-0094.

³ Ibid.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, AMP, pp. 86-111 and p. 119

Question(s):

The steel main reliability model forecasts the number of annual leaks will increase steadily over the next 20 years. By 2040, Enbridge Gas predicts that the number of leaks will have increased by approximately 10-fold. The significant increase in corrosion leaks is forecast to take place as a portion of the mains population approaches 100 years of age. This occurs between 2037 and 2057.

Enbridge Gas has developed a Proactive Vintage Steel Replacement Program to mitigate the predicted future risk that results from some of Enbridge Gas's oldest steel mains reaching the end of their useful life and beginning to fail. The goal of the Proactive Vintage Steel Replacement Program is to avoid the risk that these aging assets pose by renewing them. Enbridge Gas's selection process identifies approximately 5,100 km of the 17,423 km of Vintage Steel mains for renewal based on their predicted future risk. The Proactive Vintage Steel Replacement Program proposes renewing these targeted mains over a 20-year term.

- a) Please provide the total costs associated with the Proactive Vintage Steel Replacement Program for the year 2023-2032.
- b) Please provide the estimated cost of replacing the 5,100 km of Vintage Steel mains over the 20-year term.
- c) Please indicate if Enbridge Gas intends to replace all vintage steel mains over an extended period or if some pipelines will be abandoned?
- d) Considering the government's carbon reduction programs and the goal to significantly reduce greenhouse gas emissions, has Enbridge Gas assessed the possibility of abandoning some of the Vintage Steel Mains under a low carbon environment and meeting the needs through electrification or other alternatives? If not, please explain why.

- e) Please indicate if Enbridge Gas has conducted any simulation or analysis to assess the impact on its distribution system if some of the Vintage Steel Mains identified for replacement are abandoned. If no such analysis has been done, please indicate if Enbridge Gas intends to do so.
- f) If the vintage steel mains are replaced, does Enbridge Gas expect the assets to be used and useful for the next 40 years?

Response:

- a) Between 2023 and 2032 it is estimated that the Proactive Vintage Steel Replacement Program spend will be approximately \$1.208 billion, as per Exhibit 2, Tab 6, Schedule 2, page 119, Table 5.2.3-4: Distribution Pipe Capital Summary (\$ millions). Please note that the referenced table also includes non-programmatic replacement spend in the years 2023 to 2026.
- b) The estimated spend for the 20-year program is approximately \$5.6 billion based on historical pipeline replacement costs. This estimate is based on replacing 253 km/year once the program has ramped up to its optimal pace.
- c) Enbridge Gas intends to replace all vintage steel mains over an extended period of time; however, it will continue to assess the risk of stranded assets due to energy transition, as described in response at Exhibit I.1.10-STAFF-34 part a) and adjust its plan as required. Based on current reliability forecasts from the DIMP Risk Model, most of the Vintage Steel mains population outside of the 5,100 km that has been targeted in the first 20 years are predicted to remain in the Low-Risk region (please see Exhibit 2, Tab 6, Schedule 2, page 110, Figure 5.2-49: Vintage Steel Mains Selection Process) well into future years. Vintage Steel Mains will be targeted for replacement if their condition degrades to the point where risk escalates to a level that requires mitigation, as provided at Exhibit 2, Tab 6, Schedule 2, page 109, Section 5.2.3.6.3.2.
- d-f) Enbridge Gas has not assessed the possibility nor completed any simulations or analysis to assess the impact on its distribution system if some of the mains targeted for replacement under the Vintage Steel Main Replacement program are abandoned. Please see response at Exhibit I.2.6-STAFF-70 part b) for additional details.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, AMP, p. 185

Question(s):

Enbridge Gas has stated that several compressors may become exposed to obsolescence risk over the next 10 years. With 15 compressor units exceeding 50 years of age within the next 10 years, the risk of declining reliability and parts availability is increasing.

- a) Please confirm if Enbridge Gas intends to replace all 15 compressors over the next 10 years. If yes, what is the estimated cost of replacing the 15 compressors?
- b) Considering the Government of Canada's commitment to reducing GHG emissions by 40% below 2005 levels by 2030, how has Enbridge Gas determined that all old compressors need to be replaced under a declining load scenario?
- c) Please confirm that if volumes decline by 10% in 2030, all 15 compressors would still need to be replaced. Please explain your response.

Response:

- a) No, not all 15 compressors will be replaced. Enbridge Gas intends to replace 9 compressors over the next 10 years. Seven compressors at the Corunna Compressor Station will be replaced by the Dawn to Corunna Pipeline project as described in EB-2022-0086 (\$206.4 million excluding overheads)

Two additional compressors have been identified for Life Cycle Replacement and Enbridge Gas is undertaking an Asset Health Review as described in Exhibit 2, Tab 6, Schedule 2, page 183, paragraph 4. This review will support a third-party Reliability, Availability and Maintainability study to quantify risks associated with asset failures. These activities will support detailed alternatives analysis and final scoping which will inform the project cost estimate, timing, and business case. Details on these projects are described in the AMP at the following references:

- i. Exhibit 2, Tab 6, Schedule 2, page 189, Section 5.3.5.4.1 Compression Modernization, Waubuno Compression Life Cycle; and Exhibit 2, Tab 6, Schedule 2, Appendix A, page 8 of 59, Waubuno Compression Life Cycle (\$15.6 million excluding overheads).
 - ii. Exhibit 2, Tab 6, Schedule 2, page 189 Section 5.3.5.4.1 Compression Modernization, Dawn C Compression Life Cycle; and Exhibit 2, Tab 6, Schedule 2, Appendix A, page 4, Dawn C Compression Life Cycle (\$125.0 million excluding overheads).
- b) These projects are essential to ensuring that Enbridge Gas's system can safely and reliably deliver energy through the energy transition. Please see response at I.2.6-STAFF-70 for further discussion on this topic.
- c) If volumes decline 10% by 2030, the need to replace the 9 compressors identified in part a) above would not change. All 9 compressors targeted for retirement are storage compressors.

Seven compressors at the Corunna Compressor Station will be replaced by the Dawn to Corunna Pipeline project in 2023. The impact of risks relating to demand reduction and stranded assets was explored as part of the EB-2022-0086 proceeding. In that proceeding at Exhibit I.PP.9, part a), Exhibit I.ED.15, part d), and Exhibit I.ED.18, parts d-e) Enbridge Gas provided multiple interrogatory responses on these topics:

Enbridge Gas determined that utility customer design day demand would need to decrease by approximately 27% (approximately 1.1 PJ) before it would consider reducing any amount of cost-based storage as Enbridge Gas would seek to reduce other load balancing assets first.¹

Enbridge Gas determined that utility customer design day demand would need to decrease by 27% (approx. 1.1 PJ) before the Company would consider reducing any amount of cost-based storage. In other words, design day demand would need to be reduced by more than 27% before the fundamental economics of the Project would begin to change in a significant way relative to other market-based alternatives.²

... the proposed Project is based on current demand and the Company's 5-year Gas Supply Plan, which reflects increasing demand for storage in the future and prioritizes the same over a number of alternatives. The Company has no basis to believe that the proposed pipeline will be undersubscribed or stranded.³

The Waubuno compressor is used to fill the Waubuno pool and is proposed for abandonment in 2024. Waubuno Compression Life Cycle project proposes to

¹ EB-2022-0086, Exhibit I.PP.9, part a).

² EB-2022-0086, Exhibit I.ED.15, part d).

³ EB-2022-0086, Exhibit I.ED.18 parts d-e).

replace the Waubuno compressor with a NPS 20 1.5 km connection to the Dawn to Corunna NPS 36 pipeline. If this compressor was not replaced with the Waubuno Compressor Life Cycle project, the maximum injection pressure would be limited to the MOP of the NPS 10 line between Dawn and Waubuno. The pool line between Dawn and Waubuno has a MOP of 6,890 compared to the Waubuno Pool's maximum operating pressure of 8,570 kPa. If this compressor was not replaced with the Waubuno Compressor Life Cycle project, 3.5 PJ of capacity in the Waubuno storage pool would be lost.

C Plant is located at Dawn and is primarily utilized for storage pool withdrawals. C Plant compresses storage gas at Dawn from 1,380 kPa and 4,830 kPa. Since the compressor is used to withdraw gas from the bottom portion of each storage pool the unit will be required as long as Enbridge Gas continues to operate storage.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, AMP, pp. 211-218

Question(s):

In its AMP, Enbridge Gas noted that it has a total of 92 properties as part of its real estate inventory. The facility assessment results in Section 5.4.5.4 indicate that a number of facilities have been categorized as obsolete and scheduled for renovation or new build.

- a) Considering the amalgamation of EGD and Union Gas, and the flexible work environment post COVID, does Enbridge Gas see any opportunities for disposing of or consolidating the obsolete facilities? Please provide a detailed response.
- b) Has Enbridge Gas done any cost-benefit analysis of operating with fewer facilities? If no, why not?

Response:

- a) In response to amalgamation, ongoing optimization, and a changing flexible work environment post-COVID, Enbridge Gas is actively reviewing opportunities for facilities consolidation. Five active consolidations currently in progress are noted below.

Administration facilities such as VPC in Toronto and 50 Keil Drive in Chatham have returned to full capacity, and where appropriate, have implemented a hybrid work model. These administrative assets are optimized with a mixture of required on-premises roles and hybrid roles. Enbridge Gas continues to pursue options supporting workplace flexibility while sustaining the importance of in-person collaboration. Enbridge Gas will monitor and measure utilization while also watching the marketplace for broadly adopted practices to inform Enbridge Gas's future workplace strategies. This will ensure a pragmatic and cost-effective transition of the real estate footprint.

- i. Prichard/Ancaster/Stoney Creek consolidation will dispose of the Prichard Facility and leverage the existing Ancaster/Stoney Creek facilities to efficiently combine the operations teams.
 - ii. Ottawa/South Merivale Operations Centre (SMOC) will consolidate into one new facility to efficiently combine the operations teams.
 - iii. New London consolidation will consolidate London/St. Thomas/Simcoe into one new facility to efficiently combine the operations teams.
 - iv. GTA West amalgamation will consolidate Brampton/Burlington and Milton facilities into one new facility to efficiently combine the operations teams.
 - v. GTA East amalgamation will consolidate Cobourgh/Peterborough facilities into one new facility to efficiently combine the operations teams.
- b) Yes, cost-benefit analyses have been completed to review impacts of amalgamation, and the ongoing optimization of operational overlap has provided opportunities for consolidation of the Company's facilities' footprint. This has led to operational savings, such as the savings provided in response at Exhibit I.2.5-STAFF-68.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, AMP, pp. 240-248

Question(s):

The Technology and Information Services assets include a number of key applications that provide critical functionality to Enbridge Gas employees and customers. Packaged applications include commercial off the shelf software. Developed applications are custom built solutions by Enbridge Gas to meet business requirements.

Please provide a list of all software and applications that have been discontinued as a result of replacement, but their net book value is being included into rate base. Also, please provide the reasons for their replacement.

Response:

Any discontinued applications were fully depreciated and have no net book value included in 2024 Rate Base.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, AMP, p. 256

Question(s):

The capital plan was optimized from 2023 to 2032 using the Optimize Portfolio of Solutions step in the Asset Management Process (outlined in section 4.3.3). The optimized result and significant projects (Net Base Capex > \$10M) were reviewed with all asset managers and business stakeholders. The evidence notes that Enbridge Gas removed an average of \$100 million per year of capital spend over the 10-year plan. This reduction was achieved through using optimization to assign timing to investments in order to maximize the value of the portfolio and through reductions Enbridge Gas made in consultation with internal stakeholders.

- a) Please provide a list of all projects (Net Base Capex > \$10M) that were removed for 2023 and 2024.
- b) Please clarify whether the projects removed during the 10-year plan have been deferred or cancelled. For projects that have been cancelled, please provide a list of such projects for the 2023 to 2032 timeframe.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

- a) Through the 2023-2032 Optimization process the following projects with an estimated cost greater than \$10 million (Net Base Capex) that were removed from the 2023 and 2024 forecast include:

/u

48732	Waubuno Compression Lifecycle
735540	LOND - 12F-501 Payne Kimball Rebuild
734670	SARN: 13F-501 Sarnia Industrial
101136	New London Site

The following projects with an estimated cost greater than \$10 million (Net Base Capex) were removed from the 2023 and 2024 Capital Plan as part of the 2024 Budget Update process:

/u

100703	SRP_LUG East_Kingston_Creekford Rd_Reinforcement_NPS8_6200m_6895kPa	/u
48715	Dawn C Compression Lifecycle	/u
503369	Lisgar Station	/u
3610	Crowland Storage Transfer	/u
7660	VPM - Erin Township	/u
100339	A10: Wilson Avenue, Toronto, VSM Replacement	/u
1938	NPS 10 Glenridge Avenue, St. Catharines	/u
3642	Ottawa - Land Purchase (Forecast moved to new building construction Investment # 737374)	/u
501813	Kennedy Road Expansion	/u
100295	Div_04: NPS 8 Port Stanley, London, Replacement	/u
100086	Panhandle Line Replacement	/u

- b) Projects removed from the 10-year plan during the optimization and review process would be considered as deferred and may be brought back into the 10-year planning horizon during subsequent optimization and reviews in future planning cycles.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, AMP, p. 271

Question(s):

The total average capital spend for the Distribution Pipe asset class is forecast to be \$361 million over the 10-year capital plan. Enbridge Gas provided a figure (6.2-5) that shows 4 years of historical spend and the projected 10-year spend profile. The 2022 forecast data was produced before Enbridge Gas's 2023-2032 capital plan was created and before the OEB's St. Laurent Leave to Construct Decision (EB-2020-0293) was received.

Please provide an updated figure and table with the amounts that reflects 2022 actuals and the OEB's St. Laurent Leave to Construct Decision.

Response:

Please see the requested information in Figure 1 and Table 1. Please note that the deferral of St. Laurent did not significantly change the total capital expenditure in 2022 as there were significant increasing integrity management costs resulting from In-Line Inspection and Hydrotechnical Hazard survey findings.

Figure 1

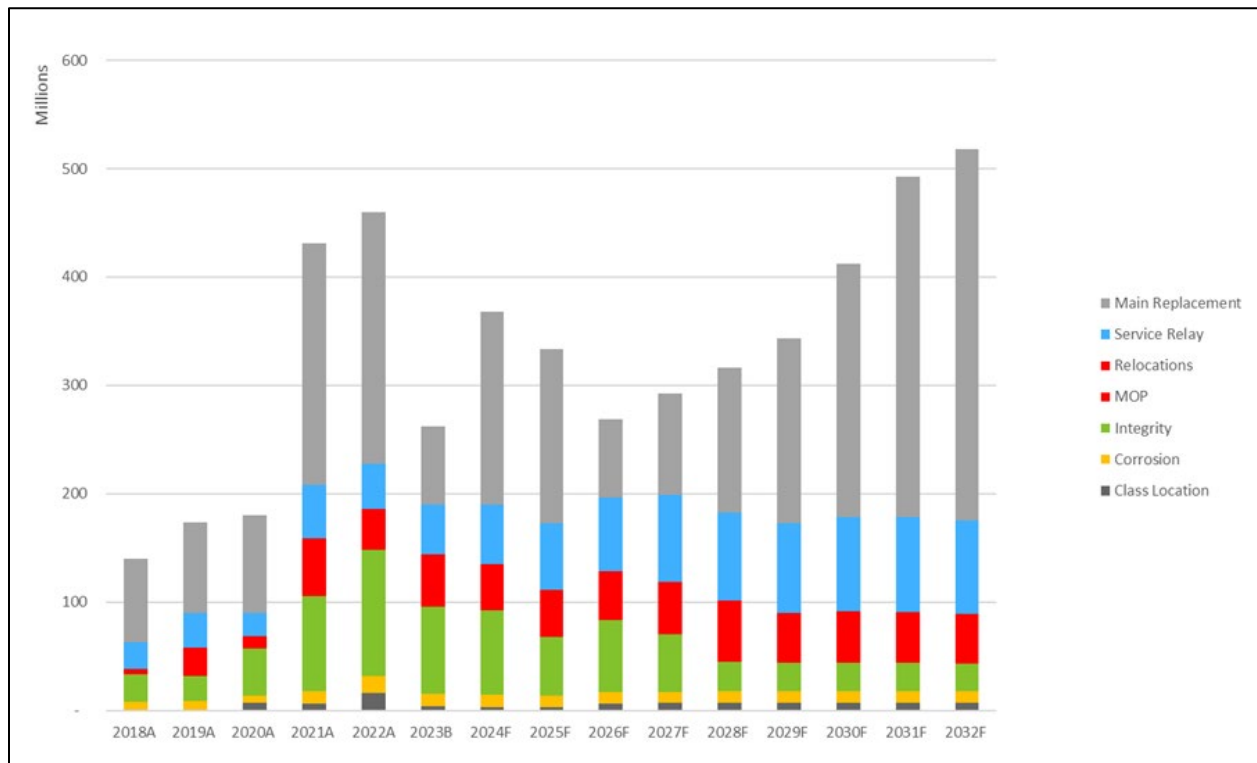


Table 1

FY	2018A	2019A	2020A	2021A	2022A	2023B	2024F	2025F	2026F	2027F	2028F	2029F	2030F	2031F	2032F
Class Location	0.0 M	0.0 M	6.7 M	6.4 M	15.7 M	3.5 M	2.6 M	2.6 M	6.5 M	6.9 M	6.9 M	6.8 M	7.1 M	7.0 M	6.8 M
Corrosion	7.8 M	8.6 M	6.7 M	11.4 M	15.7 M	11.6 M	11.5 M	10.6 M	10.2 M	10.3 M	10.4 M	10.8 M	10.9 M	11.0 M	11.1 M
Integrity	25.3 M	22.7 M	43.5 M	87.7 M	116.7 M	80.3 M	78.4 M	54.6 M	67.0 M	52.8 M	27.7 M	26.1 M	26.0 M	25.7 M	24.9 M
MOP	1.4 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M
Relocations	3.4 M	26.9 M	12.0 M	53.0 M	37.6 M	48.6 M	42.9 M	43.7 M	44.4 M	48.6 M	56.4 M	46.2 M	47.8 M	47.3 M	45.9 M
Service Relay	24.7 M	31.4 M	21.4 M	49.2 M	42.4 M	45.7 M	54.4 M	60.9 M	68.3 M	80.6 M	81.6 M	82.7 M	86.9 M	87.6 M	86.8 M
Main Replacement	77.1 M	84.3 M	89.6 M	223.4 M	231.5 M	72.3 M	178.5 M	160.9 M	72.4 M	93.1 M	133.5 M	170.6 M	233.4 M	313.9 M	342.7 M

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, p.280, 284, Appendix B; Exhibit 7, Tab 1, Schedule 2, pp.6-7; EB-2020-0091 decision, July 22, 2021, p. 35

Question(s):

Enbridge Gas discusses its IRP assessment results and technical evaluation project review.

- a) Please provide more details on Enbridge Gas's current procedure as to how Enbridge Gas evaluates the technical viability of potential Integrated Resource Planning Alternatives (IRPAs) to reduce peak demand to the degree required to meet the identified system need. Specifically, please describe: which investment categories Enbridge Gas considers to be driven in part or in full by peak demand (and thus not automatic failures in the technical evaluation); how Enbridge Gas determines the level of peak demand reduction required to meet a system need; how Enbridge Gas assesses the technical potential of geotargeted energy efficiency to meet a system need; how Enbridge Gas assesses the technical potential of other types of IRPAs (e.g., demand response, supply-side alternatives) to meet a system need.
- b) Do the investment categories considered to be driven by peak demand for the purposes of the IRP assessment align with Enbridge Gas's cost allocation methodology (Exhibit 7), which categorizes functionalized assets and operating costs as demand, commodity, and customer? Please describe and explain the rationale for any differences – i.e., if there are assets that are categorized (in part or in full) as demand costs (capacity-related costs) for the purposes of cost allocation, but not considered to be driven by peak demand for the purposes of the IRP assessment.
- c) Appendix B shows the status of IRP assessments for all system needs that are direct customer connections as "planned" but notes the concern that "EGI (Enbridge Gas) is mandated to provide new or upgraded natural gas services to feasible residential and commercial/industrial customers." Does Enbridge Gas expect that these system needs will therefore be an automatic failure in the technical evaluation? What is Enbridge Gas's approach to receiving connection requests, regarding informing

customers of options to use energy sources other than natural gas, and how, if at all, is Enbridge Gas implementing the optional approach noted in the IRP decision that “Enbridge Gas can also seek opportunities to work with the IESO or local electricity distributors to facilitate electricity-based energy solutions to address a system need/constraint, as an alternative to IRPAs or facility projects undertaken by Enbridge Gas”?

Response:

- a) In Enbridge Gas’s technical evaluation, the investment categories Enbridge Gas considers to be driven in part or in full by design hour/day demand include projects with the asset class of “growth” or “distribution pipeline.”

Enbridge Gas determines the level of design hour/day demand reduction required to meet a system need by calculating:

- Total customer design hour/day demand for natural gas based on existing customer design demands plus forecasted customer growth in design hour/day minus projected reductions in the system design hour/day.
- Total current design hour/day capacity that can be provided by the existing natural gas infrastructure within the project area.

The difference between these two factors determines the design hour/day demand capacity required to meet the system needs.

Enbridge Gas assesses the technical potential of IRPAs to meet a system need as follows:

- Enhanced targeted energy efficiency (ETEE)’s technical potential is assessed by comparing the required design hour/day demand reduction to the achievable design hour/day demand reduction potential in the project’s area of impact. The achievable potential is calculated by modelling the ETEE’s design hour/day impacts, which includes the estimated impact ETEE has on design hour/day as well as customer participation uptake. As learnings are gained in the IRP Pilot projects, they will be applied to the ETEE’s achievable potential modelling.
- Compressed natural gas (CNG) is being assessed by choosing a potential CNG location near the system’s low-pressure location and calculating injection volumes that offset the system need.

- Market-based supply side is assessed by determining the availability of higher pressures or capacity from a third-party source to impact the project scope.

Following the above noted IRPA technical evaluations, Enbridge Gas applies the following technical evaluation guidance criteria:

- CNG is intended as a bridging solution in conjunction with ETEE to meet system needs rather than a permanent solution. The exception is when CNG is used as a limited peaking service.
- All IRPAs must be operationally prudent, meaning system reliability is maintained and that bottlenecks in the system, which could restrict the ability to do maintenance, are prevented.

In addition to the technical evaluation approaches noted above for each IRPA, Enbridge Gas also reviewed each of the investment categories and determined that there were several project categories that fail the technical evaluation and, therefore, did not progress to a more detailed IRPA evaluation. The investment categories that failed and the associated reasons are as follows:

- Customer Connections
 - Please see part c) below for the rationale for failing the Customer Connections category.
- Compression Stations
 - Compression Station related projects are required to maintain existing deliverability and throughput. This is necessary to maintain security of supply and stable natural gas pricing during supply disruptions. Please see response at Exhibit I.2.6-ED-99 for the reasons IRPAs cannot be implemented to reduce Enbridge Gas's capacity and, therefore, cannot reduce its compression and deliverability assets.
- Storage Pools & Wells
 - Storage Pools & Well related projects are required to maintain existing deliverability and throughput. This is necessary to maintain security of supply and stable natural gas pricing during supply disruptions. Please see the response at Exhibit I.2.6-ED-99 for the reasons IRPAs cannot be implemented to reduce Enbridge Gas's capacity and therefore cannot reduce its compression and deliverability assets.

- Hydrogen Related
 - Hydrogen related projects are required, as no IRPA can replace the hydrogen feasibility assessments and hydrogen blending initiatives
- Miscellaneous – these are projects with:
 - Nominal pipe size (NPS) of 2 that cannot be further downsized as this is the smallest size of gas main used by Enbridge Gas and the pipe cannot be retired. IRP evaluation is not required as this is the smallest size gas main used by Enbridge Gas.
 - Scopes that, through the Technical Evaluation Project Review, were identified as projects that could potentially be downsized to NPS 2; however, after further review it was determined that it was not possible to downsize to a NPS 2 for segments of trunk main to maintain system resiliency and avoid the introduction of bottlenecks into the system.
 - A condition driven investment at a station, and an IRPA is not applicable as it cannot delay or materially reduce the scope of such projects.
 - A leave to construct regulatory process complete, with an OEB approval of the proposed project scope.
 - The construction phase has already started.
- b) Yes, the investment categories for gas-carrying assets considered to be driven by design hour/day demand for the purposes of the IRP assessment are classified as demand-related costs in Enbridge Gas's Cost Allocation Study.
- c) Enbridge Gas serves new or upgraded natural gas service requests from residential and commercial/industrial customers under E.B.O 188 on the understanding that these customers are sufficiently informed about the available energy and technology solutions and that they have chosen the alternative that best suits their needs. The capital dollars within the Customer Connections budget accounts for the costs to serve new customers, including materials and installation of distribution mains, services, and regulating equipment.

As noted when the AMP was filed in October 2022, the Customer Connection capital spend passed the binary screening. During the technical evaluation stage, Enbridge Gas conducted further analysis on the customer connection capital spend to understand the applicability of IRPAs. Enbridge Gas notes that as part of the IRP Technical Working Group (TWG), some members expressed an interest in further

understanding the IRPA applicability to the customer connection capital spend. In its technical evaluation, Enbridge Gas determined that implementing an IRPA could not reduce the size of the distribution mains, services or regulating equipment, as these cannot be downsized any further. In addition, there are no non-gas IRPAs available within the current IRP Framework that can be offered to avoid the customer connection service being requested.

In general, and for specific projects, Enbridge Gas has initiated discussions with the IESO and LDCs to discuss their integrated resource plans and whether there are any partnership opportunities for both its IRP Pilot Plans, as well as for its future non-pilot IRP plans. At this time, Enbridge Gas has been focused on assessing projects in its AMP and has not looked beyond program partnership opportunities, as it agrees with the OEB's observation in the IRP Decision EB-2020-0091, page 36, "While in the longer term, there may be an opportunity to have integrated resource planning with the optimal fuel choice between all energy sources, the OEB concludes that this would be an excessively challenging requirement during the first-generation IRP Framework."

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, p.285

Question(s):

Enbridge Gas indicates that a technical evaluation has not yet been completed for all system needs in the AMP, and that it will provide an updated version of Appendix B in 2023 to document the progress of IRP evaluations for system needs.

- a) Please clarify when this update will be provided, in relation to the schedule for this proceeding.
- b) Please confirm that, for all projects in the 2023-2032 AMP that passed the binary IRP screening, Enbridge Gas would complete a technical evaluation of IRPAs, prior to implementing a solution (whether the default facility solution in the AMP or an IRPA). If not confirmed, please provide additional details as to the circumstances under which Enbridge Gas might implement the default facility solution without a technical evaluation of IRPAs, and the number/cost of projects that might be affected.
- c) With reference to Appendix B, please provide a list of the projects that would fall into the indicated focus areas used to prioritize technical evaluations (investments with in-service dates of 2028 and prior, with highest costs and/or geographic areas with the highest forecast growth).

Response:

- a) Please see Attachment 1 for an updated Appendix B as of March 8, 2023. Enbridge Gas expects to complete the remaining IRP technical evaluations by Q3 2023 for projects that have passed the Binary Screening in the AMP filed Oct 2022 and this analysis will incorporate the Capital Update provided at Exhibit 2, Tab 5, Schedule 4 filed June 16, 2023. /u
- b) Confirmed.

c) Please see Table 1.

Table 1

Investment #	Investment Name	ISD	Sum 2023-2032F OH
100339	A10: Wilson Avenue, Toronto, VSM Replacement	2025	\$45,700,000
10293	St. Laurent Phase 3 - North/South (NPS12/16 Steel)	2024	\$53,347,180
100703	SRP_LUG East_Kingston_Creekford Rd Reinforcement_NPS8_6200m_6895kPa	2024	\$42,098,723
10294	St. Laurent Phase 4 - East/West (NPS12 Steel)	2025	\$19,091,854
11443	NPS 12 Martin Grove Rd Main Replacement: Lavington to St. Albans Rd.	2026	\$18,292,755
1938	NPS 10 Glenridge Avenue, St. Catharines	2026	\$11,804,455
736302	Wardsville Line - Southwest - London - 1797	2028	\$9,480,042
10292	St. Laurent Phase 3 - Montreal to Rockcliffe (Plastic)	2024	\$9,362,568
101343	A60: Sparks St, Ottawa, Replacement	2024	\$9,355,195
10288	St. Laurent Phase 4 - Lower Section (Plastic)	2025	\$8,982,404
10290	St. Laurent Phase 3 - Coventry/Cummings/St. Laurent (Plastic)	2024	\$8,973,156
30563	SRP_Southwest_Bluewater_New STN & Reinforcement_NPS4_7200m_3450kPa	2025	\$6,839,676
103429	Oshawa LP Replacement Phase 3 Masson St	2026	\$6,747,236
4160	Vintage Steel: NPS 12 SC HP on Parliament St, Carlton St to Front St	2023	\$6,169,492
30507	SRP_LUG East_Kingston_284010	2024	\$4,851,200

	02STN & Reinforcement_NPS12 _1000m_1210kPa		
735949	AR40: VSM Replacement - Wilson Rd S Oshawa Ph 2 Olive to King	2026	\$4,500,000
735948	AR40: VSM Replacement - Wilson Rd S Oshawa Ph 1 Bloor to Olive	2026	\$4,500,000
103427	Oshawa LP Replacement Phase 2 King St	2026	\$3,964,861
100517	Oshawa LP Replacement Phase 1 Olive Ave	2024	\$3,601,027
30275	Adelaide St N - Southwest - London - 1527	2027	\$2,740,938
30279	Briscoe St W 2 - Southwest - London - 1736	2027	\$2,537,140
30278	Briscoe St W - Southwest - London - 1735	2027	\$2,231,056
30359	Irene Cres - Eastern - Area 60 - 1141	2028	\$2,119,188
30345	Drummond St W - Eastern - Area 60 - 1142	2028	\$1,793,079
30010	Delaware Ave - Southwest - Windsor - 1364	2028	\$1,788,629
30555	SRP_Southwest_Kettle Point_Ravenswood Line_Reinforcement_N PS4_2000m_3450kPa	2027	\$1,700,000
30037	Spring Garden Rd - Southwest - Windsor - 1658	2028	\$1,595,328
30196	Windsor Dr-Ajax-1193	2027	\$1,577,340
7743	NW 6587 L'Original Reinforcement SRP	2025	\$1,364,373
49794	WATE: Listowel System Reinforcement, Proj# 07-21-705	2023	\$2,265,000
30558	SRP_Southwest_Londo n_Byron Baseline_Reinforcemen t_NPS8_700m_420kPa	2023	\$1,352,580

30536	SRP_Southeast_Camb ridge_Guelph Ave_Reinforcement_N PS6_1000m_420kPa	2026	\$1,126,161
30529	SRP_Southeast_Brantf ord_Maple Grove Rd_Reinforcement_NP S6_830m_420kPa	2027	\$953,409
49079	SRP_Southeast_Guelp h_Victoria Rd S_Reinforcement_NPS 6_1500m_420kPa	2026	\$923,960
30548	SRP_Southeast_South ampton_South St_Reinforcement_NPS 6_600m_550kPa	2028	\$702,995
30532	SRP_Southeast_Bresla u_Sawmill Rd_Reinforcement_NP S4_500m_3450kPa	2027	\$574,342
30528	SRP_Southeast_Baden _Peel St_Reinforcement_NPS 6_400m_420kPa	2028	\$468,663
30522	SRP_LUG East_Winchester_Main St_Reinforcement_NPS 4_550m_1724kPa	2028	\$450,000
736761	NW 6579 Kemptville Reinforcement SRP	2026	\$409,500
736762	NW 6463 Embrun Reinforcement SRP	2026	\$325,000
736524	NW 4793 Carnwith Dr. Brooklin Reinforcement SRP	2024	\$245,000
736680	NW 6429 Rockland IP Reinforcement SRP	2024	\$182,000
734081	King: 22-22-507 Second Street East - Tie NPS4 1210kPa Main Together	2025	\$145,000
736682	NW 6544 Bank St. Reinforcement SRP	2024	\$136,500
736760	NW 6652 Bunker Rd. Reinforcement SRP	2028	\$97,500
49758	Panhandle Regional Expansion Project	2023	\$197,457,874
100901	Dawn to Corunna	2023	\$147,778,280
10088	NPS 20 Lake Shore Replacement (Cherry to Bathurst)	2022	\$109,336,299

734634	Dawn to Corunna (Dawn Tie-in)	2023	\$42,032,164
734670	SARN: 13F-501 Sarnia Industrial	2027	\$26,200,000
3610	CROWLAND STORAGE TRANSFER	2023	\$19,335,824
736075	WIND: Wheatley-1B - Panhandle Distribution Reinforcement - Wheatley Lateral Replacement and Reinforcement	2024	\$16,500,000
100295	NPS 8 Port Stanley Replacement	2024	\$15,221,496
503369	Lisgar Station	2023	\$14,563,300
735335	GTAW Parkway Gate Station Rebuild Phase 2	2023	\$12,300,000
735540	LOND - 12F-501 Payne Kimball Rebuild	2026	\$10,700,000
8567	St John Sideroad Feeder Station	2023	\$9,710,900
103426	BRAN: 16U-601 Brantford Gate Station, Station Rebuild (Capital Maintenance), Proj# 57-22-701	2023	\$8,370,000
734674	LOND: 14O-503R Highbury and Cheapside Dist Stn	2024	\$7,500,000
103429	Oshawa LP Replacement Phase 3 Masson St	2026	\$6,747,236
101086	HAMI-Hamilton Gate 3	2024	\$6,720,000
49805	SRP_Southwest_Hens all Trans_14N- 302STN_Rebuild	2023	\$6,600,000
734689	LOND: 14R-104 Beachville Domtar Trans Stn	2024	\$6,600,000
500705	NW 5301 Barrie - Collingwood Pressure Increase SRP	2022	\$6,321,428
735038	HAMI: Hamilton Takeoff & Carlisle Gate, Rebuild	2026	\$6,000,000
735048	HAMI :CALEDONIA TRANSMISSION STN, Rebuild	2027	\$6,000,000
3605	BAYVIEW FEEDER	2024	\$5,636,385

3614	BOND HEAD GATE	2026	\$5,300,000
734697	SARN: 13F-503 Churchill Rd. Trans Stn	2027	\$5,100,000
735043	HAMI: Jarvis trans, full rebuild	2026	\$5,000,000
1013	MARKHAM GATE	2027	\$4,750,000
7777	WINSTON CHURCHILL AND STEELES FEEDER	2027	\$4,675,586
1011	SCHOMBERG GATE	2024	\$4,666,886
7769	KEELE AND STEELES/CNR FEEDER	2025	\$4,477,004
7751	KEMPTVILLE GATE	2025	\$4,450,000
103427	Oshawa LP Replacement Phase 2 King St	2026	\$3,964,861
7749	BOWMANVILLE GATE	2025	\$3,850,000
3455	Harmer District Station	2028	\$3,826,340
503183	Albion Feeder Station Control Valve Upgrade	2023	\$3,783,389
7758	THORNTON GATE	2024	\$3,650,000
23230	Black Creek Rd and River Trail, Fort Erie - VPM Aldyl-A MP lined in steel	2023	\$3,601,775
100517	Oshawa LP Replacement Phase 1 Olive Ave	2024	\$3,601,027
7752	NIAGARA GATE	2024	\$3,573,518
3620	MOUNTAIN RD GATE	2026	\$3,507,212
734695	LOND: 15Q-603 C C Trans Stn	2027	\$3,360,000
7753	NOBLETON GATE	2026	\$3,340,000
7754	OSHAWA GATE	2025	\$3,250,000
1148	BATHURST GATE	2025	\$3,200,000
503332	WIND - 06B-403 California Ave station rebuild	2024	\$3,200,000
30150	Maple St N-Timmins- 1535	2028	\$3,187,352
23147	Toronto Island NPS 2 Feed Relocation	2025	\$3,020,000
3622	SUMMERSTOWN GATE	2026	\$2,750,000
30275	Adelaide St N - Southwest - London - 1527	2027	\$2,740,938

734628	TIMM: Smooth Rock Falls CMS, TBS, and DRS Relocations/Retirements	2025	\$2,700,000
734683	SARN: 12F-205 Novacor Moore Trans	2028	\$2,700,000
7756	RUGBY GATE	2025	\$2,605,565
30279	Briscoe St W 2 - Southwest - London - 1736	2027	\$2,537,140
102119	Brockville Gate Extension	2025	\$2,456,364
101626	WIND - 05A-203 LaSalle Boismier Ave - Heater replacement	2025	\$2,400,000
30122	Joymar Dr 1 - GTA West - Area 20 - 1670	2027	\$2,299,219
1043	CAWTHRA AND QUEENSWAY DISTRICT	2024	\$2,249,999
30192	Simcoe Street-40-Kawartha Lakes-1060	2028	\$2,236,662
30278	Briscoe St W - Southwest - London - 1735	2027	\$2,231,056
101277	Replacement - Vintage PE Lined Mains - Peterborough	2023	\$2,229,162
2142	Sudbury Section 1 Sturgeon River	2023	\$2,225,000
30169	Ruggles Ave - GTA East - Area 30 - 1706	2027	\$2,210,527
503334	CHAT - 07G-601 Chatham North Gate	2026	\$2,171,574
3608	BROCKVILLE GATE	2025	\$2,034,722
100996	13P-101R Sovereign & Gore	2024	\$2,028,470
30269	Div. 06 - Tillsonburg - Potters Rd - Southeast - Waterloo - 1375	2028	\$2,005,200
100917	TBAY: 33-22-700 Dryden TBS, Glycol and Odorant Upgrades	2023	\$2,000,000
100918	TBAY: 33-23-700 Arthur St TBS, Thunder Bay, Station Rebuild	2024	\$2,000,000
100920	TIMM: Hearst TBS, Rebuild	2023	\$2,000,000
734941	TIMM: Iroquois Falls TBS, Station Rebuild	2028	\$2,000,000

735054	HALT: Burlington Gate, boiler	2028	\$2,000,000
30267	Div. 06 - Tillsonburg - Brownsville Rd - Southeast - Waterloo - 1391	2027	\$1,836,470
48993	SANDWICH YARD DRAINAGE	2023	\$1,800,000
30345	Drummond St W - Eastern - Area 60 - 1142	2028	\$1,793,079
30010	Delaware Ave - Southwest - Windsor - 1364	2028	\$1,788,629
101158	TIMM: 45-22-700 Goldcorp Dome Mine SMS, Rebuild	2023	\$1,725,691
101073	NE: 42601002 - Englehart TBS, Relocation	2025	\$1,700,000
7778	WOODBINE & CNR FEEDER	2024	\$1,662,676
100497	VSM - Firestone Road - 2" ST - PH1	2023	\$1,651,758
30037	Spring Garden Rd - Southwest - Windsor - 1658	2028	\$1,595,328
8258	Woodington Rd NFalls 1" ST Replacement	2023	\$1,593,285
734660	CHAT: 09F-501 Wallaceburg Baseline	2025	\$1,585,550
30196	Windsor Dr-Ajax-1193	2027	\$1,577,340
7766	DURHAM 23 FEEDER	2024	\$1,502,050
101345	HAMI - Hillcrest Station	2027	\$1,500,000
503415	Bellville Yard Station	2024	\$1,500,000
16586	TALISMAN PRODUCTION	2025	\$1,489,338
101199	KING - Cornwall East TBS rebuild	2024	\$1,480,000
733809	Parliament & Winchester Station Replacement - Execution Phase	2023	\$1,472,270
101627	CHAT - 07G-201 Baldoon Transmission - Station Rebuild	2023	\$1,460,000
734684	SARN: 13O-402 Westmount Gate	2026	\$1,457,000
735155	LOND: 21L-201 Goderich Gate	2028	\$1,457,000

7666	VSM - Major Mackenzie and Yonge	2024	\$1,404,000
3624	VICTORIA SQUARE GATE	2024	\$1,355,628
7710	McCowan Ave HP Reinforcement	2022	\$1,355,576
502697	WIND - 05B-201 Windsor McGregor Line - rebuild	2026	\$1,342,079
502699	WIND - 05A-601 Front & Malden full rebuild	2025	\$1,314,578
30502	NW 2201 Proton Station IP Reinforcement SRP	2023	\$1,140,305
736690	Station Rebuild 14164A Lakeshore & Stadium SRP	2023	\$988,409
30537	SRP_Southeast_Camb ridge_Pinebush Rd_Reinforcement_NP S6_470m_420kPa	2023	\$493,500
30574	SRP_Southwest_Tecumseh_Manning_Reinforcement_NPS6_250m_420kPa	2023	\$249,999
734081	King: 22-22-507 Second Street East - Tie NPS4 1210kPa Main Together	2025	\$145,000
49164	NBAY: Upgrade Maplewood PRS (43801127)	2023	\$9,608
48654	Dawn Parkway Expansion Project (Kirkwall-Hamilton NPS 48)	2026	\$192,984,965
736259	Hamilton Industrial Reinforcement	2025	\$133,500,000
735972	PREP: NPS 36 looping to Comber Transmission	2028	\$70,000,000
736923	Panhandle Regional Expansion Project - Leamington Interconnect	2024	\$55,278,330
100086	Panhandle Line Replacement	2024	\$29,820,279
30542	SRP_Southeast_Owen Sound_County Rd 40_Reinforcement_NP S12_11800m_4670kPa	2025	\$26,400,000

503350	Moulton Replacement BU	2025	\$14,452,000
7660	VPM - Erin Township	2026	\$11,113,408
30579	SRP_Southwest_Wonderland_New STN & MOP Upgrade	2026	\$9,999,999
100778	King - Chesterville, Customer, Finch Reinforcement	2023	\$9,550,000
30566	SRP_Southwest_Woodstock_Reinforcement & Reinforcement_NPS6_8200m_1900kPa	2024	\$9,099,999
16748	Erin IP System Reinforcement	2028	\$5,606,677
30500	NW 2103 Dundalk XHP Reinforcement SRP	2024	\$5,400,000
736074	WIND: Staples-1A Panhandle Distribution Reinforcement - Ontario Hwy 77 and Mersea Rd 7 Reinforcement	2023	\$5,000,000
1147	KEELE AND FINCH FEEDER	2025	\$4,072,333
30538	SRP_Southeast_Jarvis_12W-102STN_Rebuild	2026	\$3,400,000
30136	Arthur St W -Thunder Bay-1496	2027	\$3,013,879
734672	SRP_Southwest_Kerwood_12K-301STN_Rebuild	2026	\$3,000,000
30330	2nd Ave - Eastern - Area 60 - 1197	2028	\$2,966,547
100849	HAMI: NPS 10 Dominion Line Power Line Rd, Ancaster	2026	\$2,924,565
30423	Garden Alley 2-Ganonoque-1494	2028	\$2,883,492
501824	Huntmar Drive Reinforcement	2023	\$2,846,695
2522	Rodinea Road	2023	\$2,834,425
30123	Joymar Dr 2 - GTA West - Area 20 - 1671	2027	\$2,500,799
8262	VSM - Preston St - LP	2026	\$2,481,448
30518	SRP_LUG East_Picton_28103006 STN_Rebuild	2024	\$2,349,999

100688	WIND: Riverside Aldyl A - Ph 2, Windsor, Replacement	2028	\$2,200,000
49859	CHAT: Tweedsmuir LP, Chatham, Replacement	2027	\$2,195,000
49814	WIND: Tecumseh Rd E - Ph 2, Windsor, Replacement	2028	\$2,175,000
30405	Div. 16 - Hamilton - Crooks St 1 - Hamilton - 1745	2028	\$2,150,531
30117	Elizabeth St S 1 - GTA West - Area 20 - 1667	2028	\$2,054,205
30092	Ross St - Area 50 - 1210	2028	\$2,029,146
49747	WIND: Tecumseh Rd W, Windsor, Replacement	2028	\$1,950,000
103420	30: VSM - Major Mackenzie, Cedar to Newkirk, Replacement	2026	\$1,938,306
30131	Sproule Dr 2 - GTA West - Area 20 - 1677	2028	\$1,816,243
101359	SRP_Southwest_Winds or_05A- 201STN_Rebuild	2023	\$1,716,772
30243	Div. 06 - Brantford - Dundas St E - Southeast - Waterloo - 1303	2028	\$1,622,848
30525	SRP_North_Timmins_ Hwy 655_Reinforcement_N PS6_850m_6895kPa	2024	\$1,599,999
30033	Rholaine Dr - Southwest - Windsor - 1299	2028	\$1,586,443
30213	Hilda St 2 - Northeast - 1698	2028	\$1,563,685
49743	WIND: Riverside Aldyl A - Ph 1, Windsor, Replacement	2027	\$1,550,000
30333	Ainsley Dr - Eastern - Area 60 - 1723	2027	\$1,532,011
48994	WIND: Laird & Centre MIP, Essex, Replacement	2028	\$1,495,000
30470	King St W - Eastern - 1799	2027	\$1,494,763
30162	Ashlar Rd - GTA East - Area 30 - 1489	2028	\$1,463,423

30211	Georgina Ave 2 - Northeast - 1695	2028	\$1,459,993
30539	SRP_Southeast_Jarvis_12W-201STN_Rebuild	2023	\$1,449,999
30057	Hillcrest Ave STC - Area 80 - 1176	2028	\$1,440,516
501482	SRP_LUG East_Odessa_2840500 1STN_Rebuild	2023	\$1,439,390
30556	SRP_Southwest_London_13O-402STN_Rebuild	2023	\$1,411,501
30524	SRP_North_Sault Ste Marie_45103001STN_Rebuild	2024	\$1,401,999
49742	CHAT: Ridgetown LP, Ridgetown, Replacement	2027	\$1,375,000
49816	WIND: Mersea Rd 2 - Ph 2, Leamington, Replacement	2023	\$1,357,500
736024	A:10 Dawlish Ave & Valleyanna Dr	2023	\$1,330,000
48928	BRAN - Schafer Side Rd. Repl. BU - Norfolk	2023	\$1,320,420
30260	Div. 06 - Norfolk County - Andy's Corners - Norfolk County Rd 21 - Southeast - Waterloo - 1325	2028	\$1,317,130
17243	NW 2225 Terra Cotta IP Reinforcement SRP	2028	\$1,301,356
503058	SRP_GTA West_Oakville_18Y-109RSTN_Rebuild	2023	\$1,200,000
49179	SRP_Southeast_Port Rowan_Lakeshore Rd_Reinforcement_NP S6_2000m_860kPa	2024	\$1,149,999
736070	WIND: LEAM-3 Panhandle Distribution Reinforcement - Essex Road 37 Reinforcement	2026	\$1,100,000
736073	WIND: LEAM-7 Panhandle Distribution Reinforcement - Mersea Road 8 Reinforcement	2023	\$1,100,000
30559	SRP_Southwest_Mt. Brydges_12M-303RSTN_Rebuild	2023	\$1,057,038

30503	NW 5346 Midhurst Reinforcement SRP	2024	\$1,041,339
30545	SRP_Southeast_Port Elgin_29N-101STN_Rebuild	2024	\$1,028,499
30530	SRP_Southeast_Breslau_19T-601RSTN_Rebuild	2028	\$981,131
100831	WATE: 21U-101 Fergus Second Stage, Fergus, Station Rebuild (Load Growth), Proj#	2023	\$915,000
30552	SRP_Southwest_Essex_05B-401RSTN_Rebuild	2023	\$904,815
100936	TIMM: West Timmins System Reinforcement (McBride North and Shirley/Riverside Stations)	2023	\$900,000
49105	WATE: Baden Dist Stn, Baden, Growth	2025	\$818,321
736532	NW 3723 Jane St. Reinforcement SRP	2024	\$786,500
48998	WATE - Breslau System Reinforcement	2022	\$702,261
735034	SRP_GTA West_Lowville_18X-101STN_Rebuild	2024	\$700,000
30540	SRP_Southeast_Kitchener_Bleams_Reinforcement_NPS12_10m_6160kPa	2023	\$650,000
30578	SRP_Southwest_Windsor_Howard_Reinforcement_NPS6_1800m_420kPa	2026	\$650,000
30504	NW 5446 Hwy 26 and Keith Reinforcement SRP	2024	\$585,737
30505	NW 5422 Robins Point Rd. Reinforcement SRP	2024	\$560,301
736389	A30: Interchange Way Reinf	2023	\$500,500
30551	SRP_Southwest_Embrico_15Q-301STN_Rebuild	2023	\$405,366
30580	SRP_Southwest_Woodstock_Oxford Road 17_Reinforcement_NPS6_1100m_420kPa	2023	\$403,407

30541	SRP_Southeast_Listow el_21Q- 103RSTN_Rebuild	2024	\$320,700
30572	SRP_Southwest_Talbot ville_11O- 173STN_Rebuild	2023	\$309,289
30513	SRP_LUG East_Customer_29401 011STN_Rebuild	2023	\$300,000
736264	King: 22-25- 508Brighton Reinforcement - Main Street	2025	\$294,133
49149	WATE - Mount Forest System Reinforcement	2027	\$280,000
48497	King - 22-20-709 McConnell Ave & Tollgate Rd PRS	2024	\$275,000
736688	NW 8521 Feeder Rd E Station Reinforcement SRP	2023	\$250,959
30517	SRP_LUG East_Grafton_2740500 1STN_Rebuild	2027	\$249,999
102520	King: 22-25-504 Tweed Reinforcement - McClellan and Pomeroy	2025	\$220,000
30512	SRP_LUG East_Colborne_274010 05STN_Rebuild	2025	\$200,000
30519	SRP_LUG East_Tweed_27805090 STN_Rebuild	2026	\$200,000
736665	Station Rebuild 42183A Brock and 3rd Conc SRP	2023	\$180,500
30564	SRP_Southwest_Oil Springs_11H- 201RSTN_Rebuild	2023	\$154,790
30509	SRP_LUG East_Barriefield_28403 029STN_Rebuild	2023	\$150,000
30515	SRP_LUG East_Deseronto_28103 002STN_Rebuild	2023	\$150,000
30526	SRP_Southeast_Ancas ter_16W- 601STN_Rebuild	2024	\$141,999
30510	SRP_LUG East_Belleville_278021 32STN_Rebuild	2024	\$99,999

502817	TIMM 45-22-502 Shirley St @ Riverside Rd NPS4 Reinforcement - Timmins	2023	\$90,929
736679	NW 6544 Sherwood Drive Crossing SRP	2024	\$78,000
30508	SRP_LUG East_Barriefield_28403 028STN_Rebuild	2028	\$56,000
30514	SRP_LUG East_Customer_29401 037STN_Rebuild	2023	\$56,000
30521	SRP_LUG East_Winchester_2930 1008STN_Rebuild	2024	\$56,000
502816	TIMM 45-21-501 St Jean @ Shirley NPS4 Reinforcement - Timmins	2023	\$50,122
30568	SRP_Southwest_Sarni a_13F- 324RSTN_Rebuild	2023	\$41,527
736764	NW 6518 Barrhaven Reinforcement SRP	2028	\$26,000
736758	NW 6466 Carp Pressure Increase SRP	2024	\$20,000
736759	NW 6462 Russell Pressure Increase and Reinforcement SRP	2024	\$20,000
30576	SRP_Southwest_Winds or_05B- 205RSTN_Rebuild	2026	\$18,180
49104	WATE: Starlight Dist Stn, Meaford, Growth	2025	\$11,598

/u

Region	Operating Area (EGI)	Asset Class	Binary Screening (Pass/ Fail)	Cause of Binary Fail	Investment Code	Investment Name	In Service Date	223-232 Forecast (Includes overhead allocation)	Investment Description - Binary Screening - Pass	Technical Evaluation Completion Status	Technical Evaluation Results	Technical Evaluation Comments	Economic Evaluation Completion Status	Economic Evaluation Results	Economic Evaluation - IRPAs Considered	IRP Plan Completion Status	IRP Plan - IRPAs Considered
Eastern	60 - Ottawa	Growth	Pass		7743	NW 6587 L'Original Reinforcement SRP	2025	\$ 1,883,892	Victoria St - Eastern - Area 60 - 1138 Vintage steel pipes exhibit increased failures as they age as steel mains are susceptible to external corrosion when barriers of pipe coatings and cathodic protection are compromised. The current pipe replacement rate (mains and services) is inadequate to prevent the average age of the population from increasing and hence reaching the end of their useful life. EGI has determined that a long-term proactive replacement program targeting higher-risk steel pipes installed on or before 1970 (vintage steel) is required to manage the increasing number of expected leaks that create increasing risk for the organization. Comments: There is potential for road restrictions due to congested area. Issue/Concern: Reinforcement projects broadly involve the installation of new or modification of existing gas distribution assets to maintain minimum required system pressure to maintain the capacity to meet customer demand. These projects are primarily driven by customer growth and system reliability considerations. Failure to implement reinforcement projects in a timely manner could lead to a potential inability to support increasing demands of existing customers and the addition of future customers. ▪ Project Purpose/Need: This reinforcement is to add capacity within legacy Enbridge Gas Distribution's pipe network to: o Satisfy the current contractually allowable demand of the Large Volume Contract (LVC) customer Ivaco Rolling Mills, which is 6,800 m3/h o Support customer growth of the downstream High Pressure Polyethylene (HPPE) network This geographic area sits at the eastern tail end of XHP network 6587, which is fed exclusively by Lancaster gate to the southeast. ▪ Pressure Issue/Concern : The minimum system pressure was forecasted to be infeasible by 2020. ▪ Customer Growth Issue/Concern: As of 2017, there are 2,039 customers on this network. Without reinforcement, a forecasted 24 customers may not be able to be added. ▪ Risk if Not Completed: System risk without the reinforcement o EGI may not be able to satisfy contractual demand of a large-volume customer along with supporting forecasted customer growth	Completed	Pass	CNG, ETEE - CNG potentially could defer project scope, ETEE potentially could eliminate (with CNG as bridging solution), reduce or defer project scope.					
Eastern	60 - Ottawa	Growth	Pass		736680	NW 6429 Rockland IP Reinforcement SRP	2024	\$ 233,211	Issue/Concern/Opportunity: Increase pressures that are below new system min in multiple locations. Pressure less than the 20 psi minimum in multiple locations on the network. Reinforcements are required to bring the system within standards. The system is single-fed and is located at the tail end of the XHP 6580 network that is primarily fed by the Ottawa Gate Station. Assets: Install 30m of 1 1/4" PE IP on Du Chateau Ave from Woods St to 30 m S of Woods St Install 55m of 2" PE IP on Lalonde St from Laurier St to 55 m N of Laurier St Install 100m of 2" PE IP On Notre Dame St from Laurier St to Alma St	Completed	Pass	CNG, ETEE - CNG potentially could defer project scope, ETEE potentially could reduce or defer project scope.					
Eastern	60 - Ottawa	Growth	Pass		736682	NW 6544 Bank St. Reinforcement SRP	2024	\$ 174,908	Related Proeram: Not aoolicable Issue/Concern/Opportunity: Reinforcement required to resolve operational issues and bring pressures above the 20 psig minimum sytem pressures and support future growth. The system being reinforced is in Ottawa central with high potential for growth. Current system pressures are below the minimum system pressures. Network is double-fed by Ottawa Gate and Richmond Gate Station Assets: 90m NPS 2 PE IP on Bank St. from Ardington Ave to Flora St. Related Program: Not applicable	Completed	Pass	CNG, ETEE - CNG potentially could defer project scope, ETEE potentially could eliminate or defer project scope.					
Eastern	60 - Ottawa	Growth	Pass		736760	NW 6652 Bunker Rd. Reinforcement SRP	2028	\$ 134,332	Issue/Concern/Opportunity: Reinforcement required to resolve operational issues and pressure lowpoints on the network below the 20 psig minimum system pressure and support growth. Network sits near the end of the XHP 6581 NW that is fed by Ottawa Gate and Richmond Gate Station. Pressure are forecasted to be below the minimum system pressures by 2027 Assets: -240 m NPS 2 PE IP on Bunker Rd. from Marina Dr. to 240m W of Marina Dr.	Completed	Pass	CNG, ETEE - CNG potentially could defer project scope, ETEE potentially could eliminate, reduce or defer project scope.					
Eastern	60 - Ottawa	Growth	Pass		736761	NW 6579 Kemptville Reinforcement SRP	2026	\$ 533,940	Related Program: Not applicable Issue/Concern/Opportunity:Reinforcement required to resolve operational issues and pressure lowpoints on the network below the 20 psig minimum system and support growth. Estimated 2 weeks of Aecon and 2 days for TFS. Also estimating to buy district station in 2025. System pressures are forecasted to be below the minimum system pressure by 2026. Network is single-fed exclusively by Kemptville Gate Station Assets: - 50 m NPS 2 SC XHP road crossing at Country Rd. 43 and Rideau St. - 40 m NPS 2 PE IP road crossing at Country road 43 and Rideau St. -20 m NPS 1 1/4 PE IP road crossing at Thomas St. and Asa St. -New district station near the intersection of Country Rd. 43 and Rideau St. to feed the Kemptville community Related Proeram: Not aoolicable	Completed	Pass	CNG, ETEE - CNG potentially could defer project scope, ETEE potentially could reduce project scope with CNG as a bridging solution.					

Region	Operating Area (EGI)	Asset Class	Binary Screening (Pass/ Fail)	Cause of Binary Fail	Investment Code	Investment Name	In Service Date	223 -232 Forecast (Includes overhead allocation)	Investment Description - Binary Screening - Pass	Technical Evaluation Completion Status	Technical Evaluation Results	Technical Evaluation Comments	Economic Evaluation Completion Status	Economic Evaluation Results	Economic Evaluation - IRPAs Considered	IRP Plan Completion Status	IRP Plan - IRPAs Considered
Eastern	60 - Ottawa	Growth	Pass		736762	NW 6463 Embrun Reinforcement SRP	2026	\$ 424,996	Issue/Concern/Opportunity: Reinforcement to support imminent and significant growth in the area. Network is currently operating under 20psi Assets: NPS 4 PE IP along the south side of Ste Therese Blvd in Embrun Related Program: Growth investment # 737580 Station upgrades and relocation is required for additional capacity.	Completed	Pass	CNG, ETEE - CNG potentially could defer project scope, ETEE potentially could reduce project scope with CNG as a bridging solution.					
Eastern	Div_22 - Kingston	Growth	Pass		30507	SRP_LUG East_Kingston_284010025TN & Reinforcement_NPS12_1000m_1210kPa	2024	\$ 6,217,387		Completed	Pass	CNG, ETEE - Potentially could reduce or defer project scope.					
Eastern	Div_22 - Kingston	Growth	Pass		30522	SRP_LUG East_Winchester_Main St_Reinforcement_NPS4_550m_1724kPa	2028	\$ 619,279	A 4-inch looping from outlet of Winchester TBS is required.	Completed	Pass	CNG, ETEE - CNG potentially could reduce or defer project scope, ETEE potentially could eliminate, reduce or defer project scope.					
Eastern	Div_22 - Kingston	Growth	Pass		100703	SRP_LUG East_Kingston_Creekford Rd_Reinforcement_NPS8_6200m_6895kPa	2024	\$ 28,702,886	Issue/Concern/Opportunity: Kingston lateral replacement to be completed from Westbrook CMS to Woodbine TBS to account for forecast growth, and to address Class Location and depth of cover issues which exist on the current Kingston lateral. Assets: Kingston Lateral Replacement Related Program: N/A	Completed	Pass	CNG, ETEE - Potentially could reduce or defer project scope.					
GTA East	40 - Whitby	Distribution Pipe	Pass		735948	AR40: VSM Replacement - Wilson Rd S Oshawa Ph 1 Bloor to Olive	2026	\$ 5,731,466	Issue/Concern/Opportunity: There is vintage 12-inch steel high-pressure (HP) main with several potential maintenance risks. Justification: Main was ranked as HI 5 in recent Asset Health Review (AHR). It was installed in 1957, has multiple service connections with corrosion risk and possible unknown compression couplings. Assets: There is 950 m 12-inch ST HP main and approximately 30 services in Phase 1 Bloor St. to Olive Ave. Related Investments: Not applicable.	Completed	Pass	ETEE - Potentially could reduce project scope.					
GTA East	40 - Whitby	Distribution Pipe	Pass		735949	AR40: VSM Replacement - Wilson Rd S Oshawa Ph 2 Olive to King	2026	\$ 5,846,848	Issue/Concern/Opportunity: There is vintage 12-inch steel high-pressure (HP) main with several potential maintenance risks. Justification: Main was ranked as HI 5 in recent Asset Health Review (AHR). It was installed in 1957, has multiple service connections with corrosion risk and possible unknown compression couplings. Assets: 1,247m 12-inch ST HP main and approximately 30 services in Phase 2 Olive Ave. to Bloor St. Related Investments: Not applicable.	Completed	Pass	ETEE - Potentially could reduce project scope.					
GTA East	40 - Whitby	Growth	Pass		736524	NW 4793 Carnwith Dr. Brooklin Reinforcement SRP	2024	\$ 301,124	Issue/Concern/Opportunity: Pipe reinforcement of 520 m of NPS 4 PE along Carnwith Dr. W. is required due to system pressures below new minimum allowable system pressure. Assets: Pipe Related Investments: Not applicable	Completed	Pass	CNG, ETEE - Potentially could defer project scope.					
Southeast	80 - Niagara	Distribution Pipe	Pass		1938	NPS 10 Glenridge Avenue, St. Catharines	2026	\$ 15,332,118	Issue/Concern: General Concerns: Vintage steel pipes exhibit increased failures as they age as steel mains are susceptible to external corrosion when barriers of pipe coatings and cathodic protection are compromised. The current pipe replacement rate (mains and services) is inadequate to prevent the average age of the population from increasing and hence reaching the end of their useful life. EGI has determined that a long-term proactive replacement program targeting higher-risk steel pipes installed on or before 1970 (Vintage Steel) is required to manage the increasing number of expected leaks that create increasing risk for the organization. Site-Specific Concerns: This project looks to replace approximately 8.7 km of mostly 1954 to 1960s vintage NPS 10 intermediate pressure (IP) pipe with sections of NPS 12 and NPS 8 spliced in over the years as repairs. A 2019 Depth of Cover (DOC) survey found that 366 (33%) survey locations had less than 90 cm of cover, and 90 survey locations (8%) had DOC<60 cm, with one location found having exposed pipe due to creek erosion. Poor depth of cover leads to increased third-party damages (as has been seen with blow-off valves). Other risk factors include black coal tar pipe coatings used on 1959/1960 vintage NPS 10 pipe which show evidence of degradation, yielding to corrosion. There are many unusual fittings (Stop-and-Go) and unusual construction practices (such as using unrestrained compression couplings to tie in service connections) that can lead to difficult emergency responses. For example, a recent leak repair took 24 days to complete at a cost of almost \$500K due to complications from DOC, components, and construction practices. Unrestrained compression couplings (CC) have been the source of leaks due to ground settlement and increase the risk of pull-out. The river crossing at Twelve Mile Creek is very difficult to access due to steep creek banks and heavy vegetation, making it difficult to perform cathodic protection and leak surveys. It will pose as a significant concern for any required emergency response. The numerous transitions from NPS 8 to NPS 10 to NPS 12 also creates concern and difficulties for operational work to be completed. There are two main line valves that are suspected to be tied in with unrestrained CCs as per an Integrity Assessment for suspect CC locations. Cathodic protection for some of the NPS 10 segments has been historically poor, showing as much as 25% of historical readings over the last 20 years below minimum required levels.	Completed	Pass	ETEE - Potentially could reduce project scope.					
Southeast	Div_07 - Waterloo	Growth	Pass		30528	SRP_Southeast_Baden_Peel St_Reinforcement_NPS6_400m_420kPa	2028	\$ 644,963	New reinforcement main along Bleams Rd. E. is required.	Completed	Pass	CNG, ETEE - Potentially could reduce or defer project scope.					
Southeast	Div_07 - Waterloo	Growth	Pass		30529	SRP_Southeast_Brantford_Maple Grove Rd_Reinforcement_NPS6_830m_420kPa	2027	\$ 1,323,087	Pipe reinforcement required to maintain system pressures due to growth	Completed	Pass	CNG , ETEE - CNG could defer project and ETEE could reduce or defer project.					
Southeast	Div_07 - Waterloo	Growth	Pass		30532	SRP_Southeast_Breslau_Sawmill Rd_Reinforcement_NPS4_500m_3450kPa	2027	\$ 797,040	High Pressure (HP) reinforcement along Sawmill Rd. is required.	Completed	Pass	CNG, ETEE - Potentially could reduce or defer project scope.					
Southeast	Div_07 - Waterloo	Growth	Pass		30536	SRP_Southeast_Cambridge_Guelph Ave_Reinforcement_NPS6_1000m_420kPa	2026	\$ 1,467,640	Reinforce existing main along Guelph Ave. in Cambridge with 1,000 m NPS 6 PE.	Completed	Pass	CNG, ETEE - Potentially could reduce or defer project scope.					
Southeast	Div_07 - Waterloo	Growth	Pass		30547	SRP_Southeast_Southampton_30N-501STN_Rebuild	2030	\$ 1,335,240	Increase capacity.	Completed	Pass	CNG, ETEE - Potentially could reduce or defer project scope.					

ENBRIDGE GAS INC.

Answer to Interrogatory from
Ontario Energy Board Staff (STAFF)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, Appendix B; Exhibit 4, Tab 2, Schedule 6, p. 14

Question(s):

In Exhibit 2.6.2, Appendix B, the estimated capital cost of the Hydrogen Blending Phase 2 project (investment code 736974) is given as \$9.05 million. In Exhibit 4-2-6 the estimated capital cost of the Hydrogen Blending Phase 2 project is given as \$7 million.

Please provide the current estimated capital cost of the Hydrogen Blending Phase 2 project.

Response:

The current estimated cost of the project excluding overheads is \$7 million, as provided at Exhibit 4, Tab 2, Schedule 6, page 15. The \$7 million does not include overhead allocations, whereas the \$9.05 provided at Exhibit 2, Tab 6, Schedule 2, Appendix B, page 46 includes overhead allocations.

There is no update to the cost estimate as filed at this time.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Building Owners and Managers Association (BOMA)

Interrogatory

Reference:

2-6-2 section 5.1

Preamble:

Distribution System Reinforcement projects involve the installation or modification of existing gas distribution assets to maintain minimum required system pressures, maintain distribution capacity and meet growing natural gas demands. These projects are primarily driven by increased customer demand, customer growth and system reliability considerations. The IRP Assessment Process is used to evaluate the preferred solution to meet the specific system needs.

Question(s):

Please describe how IRP considers the potential for reductions in gas demand due to DSM and/or DER when evaluating investments in distribution system reinforcement.

Response:

DSM reductions are included in the general service volume forecast as provided at Exhibit 3, Tab 2, Schedule 7, page 3. Distribution system needs are informed by design hour demand, and the customer forecast. Adjustments to the design hour demand used within Enbridge Gas's hydraulic model are provided at Exhibit 1, Tab 10, Schedule 4, Table 3, and were based on the output results of the Reference Case scenario from the Energy Transition Scenario Analysis (ETSA) Project, which includes DSM among other critical drivers. Energy transition adjustments to the customer forecast are provided at Exhibit 1, Tab 10, Schedule 4, Table 2. The IRP assessment process uses the same demand forecast.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 17

Question(s):

Copperleaf was used to optimize the 1,500 EGD RZ investments and 1,901 Union RZ investments in the initial pre-optimized request for capital:

- a) Please confirm the initial pre-optimized request for capital covered the 10-year period 2023 to 2032;
- b) Of the 1,500 investments, please provide the number of EGD rate zone investments prioritized for the period 2023 to 2032;
- c) Of the 1,901 investments, please provide the number of Union rate zone investments prioritized for the period 2023 to 2032;
- d) Please provide the total number of investments in the final capital plan for the period 2023 to 2032;
- e) Please provide the pre-optimized and optimized value of the capital plan;
- f) Please provide the total number of capital investments in 2024;
- g) Please provide a breakdown of the capital investments in 2024 in the following categories: mandatory, compliance, executing and value-driven.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023. /u

- a) Confirmed.

b) Of the 1,500 EGD rate zone investments, 1,384 were prioritized for the 2023 to 2032 period.

c) Of the 1,901 Union rate zones investments, 1703 were prioritized for the 2023 to 2032 period.

d) The updated 2023 to 2032 capital plan has 3,418 investments. /u

e) The pre-optimized value of the capital plan over the 2023 to 2032 timeframe was \$14.3 billion including overheads. The optimized value of the capital plan over the 2023 to 2032 timeframe was \$13.3 billion including overheads. With the updated 2024 Budget the capital plan over the 2023 to 2032 timeframe is \$13.8 billion including overheads. /u /u

f) The total original number of capital investments in 2024 is 660. This number has increased to 755 for the 2024 Budget. Please see response to part g). /u

g) The breakdown of 2024 capital investments and budget investments per the planning groups in Exhibit 2, Tab 6, Schedule 2, Table 6.1-1 is provided below.

Table 6.1-1

Investment Category	Count of 2024 Investments – Original Capital Plan	Count of 2024 Investments – Capital Update	
Compliance - Fixed Timing	136	166	
Compliance - Re-Optimize	2	0	
Executing - Re-Optimize	18	25	
Mandatory - Fixed Timing	308	353	/u
Significant Investments (>\$10M) - Fixed Timing	1	0	
Value Driven - Fixed Timing	67	119	
Value Driven - Value Framework	125	89	
Overheads	3	3	
Grand Total	660	755	/u

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 46

Question(s):

An investment's value is quantified through Copperleaf's value framework or evaluated via the GDS Risk Management process. Certain investments were prioritized through EGI's Risk Management Process. Please provide the number and percentage of investments in 2024 prioritized through EGI's Risk Management Process.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

13 investments were prioritized through GDS's Risk Management Process for the 2024 Budget. This represents 1.7% of the total number of investments identified for the 2024 Budget.

/u

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 47

Question(s):

The evidence indicates value measures are used to quantify an investment's value. Value measures are investment attributes that are evaluated objectively based on risk or opportunity to determine how the investment delivers value to Enbridge and the ratepayer. These value measures are placed on an economic scale to assist in optimization. An investment's net value is used to determine both its independent merit and its standing among other investments in a constrained optimization process:

- a) Please provide project/program examples to illustrate how the value measures in Table 4.1-3 are used to quantify investment value;
- b) Please provide the economic scale used in optimization;
- c) Please provide the relative weightings of each value Measure in Table 4.1-3;
- d) Please provide the total investment value of each project/program in 2024

Response:

- a) For the overall process on assessing and comparing net values between investments, see the response at Exhibit I.2.6-CME-18.

Value Measures

Value measures set out in Exhibit 2, Tab 6, Schedule 2, Table 4.1-3 can be divided into the following categories:

- Risk value measures – Used to capture the value of an investment in avoiding undesirable events. It is a positive contributor to an investment's net value.

- Benefits value measures – Use to capture the value of an investment in bringing in benefits such as cost saving to the company or customers. It is a positive contributor to an investment's net value.

As mentioned in response at Exhibit I.2.6-CME-18 part a), value measures are calculated using value models in the Copperleaf Value Framework. Quantitative data for frequencies, probabilities and consequence impacts are used in value models to determine value measures as streams of value which can be defined as fixed or varying over time.

Value measures can be financial or non-financial:

- Financial value measures are estimated based on potential financial losses or gain in cash flow, or avoided expenses.
- Non-financial value measures, which cannot be tied directly to financial gains or losses, are correlated with tangible qualities that can be converted into monetary values in either value units or CA\$. This approach allows them to be combined with financial value measures and investment cost through the net present value (NPV) calculation to determine the total investment value as described in response at Exhibit I.2.6-CME-18 part a). As correlations between non-financial value measures and tangible qualities are not always fully recognized or may be difficult to quantify, such an approach may not reflect the full value of non-financial value measures.

It is also important to note that NPV calculation relies on accurate forecasting of future cash flow and constant discount rate, which could fluctuate due to various reasons, such as gas prices, weather patterns and regulatory policies. Hence, the Copperleaf value framework and optimization are not the only input to investment decision making by Enbridge Gas.

Value Models

Value models can be divided into the following types:

- **Risk matrix-based value model** – This value model incorporates the Enbridge risk matrix (see Exhibit 2, Tab 6, Schedule 2 Figure 4.2-4 and Exhibit I.2.6-SEC-121 for the risk matrix) and is used to quantify risk value measures. The value of each risk is evaluated based on the definitions provided for likelihood (defined as frequency) and consequence (per Y-axis and X-axis of the matrix).

The values shown in the risk matrix are then computed by multiplying the representative value of the consequence level (see Table [REDACTED]) by the representative value of the frequency level (See Table [REDACTED]). For example, if a “4”

consequence has a representative value of 3200, and a “5” frequency event has a frequency of 0.01. The result is that a “4” consequence event with a “5” frequency of occurrence is valued at 32 Value Units. Please note that the specific values represent commercially sensitive information and therefore have been redacted in both tables as filed on the public record, as further explained in the confidentiality request accompanying the Company’s interrogatory responses.

Table 1
Consequence Scale (in value unit)

Consequence Level	1	2	3	4	5	6	7
Financial	■	■	■	■	■	■	■
Public Health & Safety	■	■	■	■	■	■	■
Employee and contractor Safety	■	■	■	■	■	■	■
Environmental	■	■	■	■	■	■	■
Operational	■	■	■	■	■	■	■
Reputational	■	■	■	■	■	■	■

Table 2
Frequency Levels - All Risk Types

Frequency Level	Range (per yr.)	Representative Value (Per yr.)
■	■	■
■	■	■
■	■	■
■	■	■
■	■	■
■	■	■
■	■	■
■	■	■

- **Equation based value model** – This value model quantifies data for frequencies, probabilities, and impacts (whether positive or negative), which are then combined to calculate value measures.
- **External model** – Values are calculated outside Copperleaf in value units or CA\$ which are then uploaded into Copperleaf.

Examples

The following examples illustrate how value measures are quantified for investments.

Distribution Pipe – Erin Mills and Leanne Vital (See Exhibit 2, Tab 6, Schedule 2, Appendix B, Page 22)

Issue and proposed solution: 12" HP vital main installed in the 1950's. The main has a 1" HP live stub that is around 20m that requires abandonment, and there may be contaminated soil along the pipeline. Corrosion has also affected the coating and may impact crews' ability to access pipe in case of emergency. The proposed solution is to relocate to the west side of Erin Mills, contingent on how widespread the contamination extends.

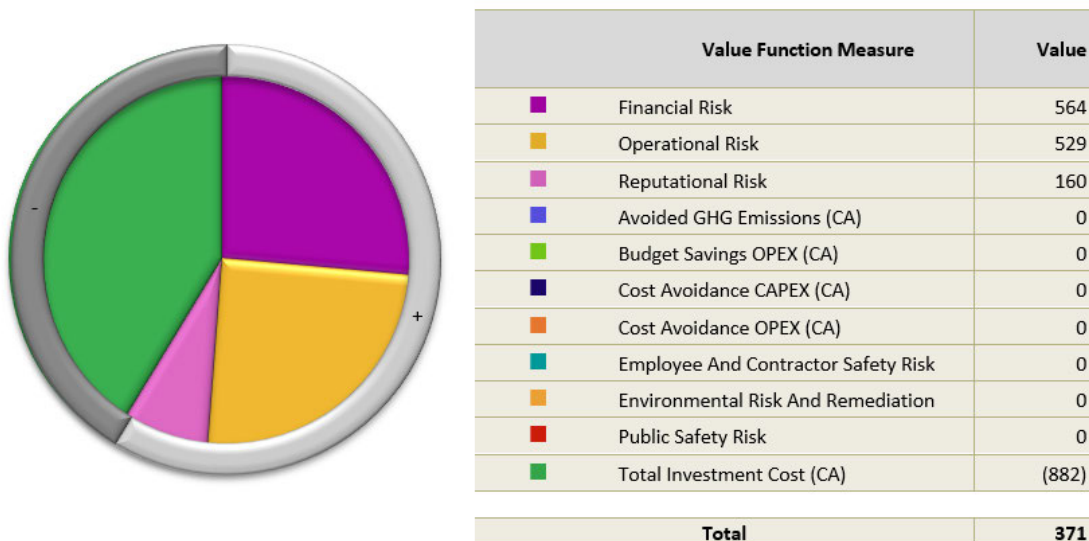
Based on inputs from relevant stakeholders, relocating the line could mitigate risks associated with accelerated corrosion degradation leading to leaks. Such corrosion and leaks could require complex repair due to the location of the pipe (off-ramp of a highway) and potential closure of a main road with significant disruption and customer outage as it is a single feed line.

By applying a risk matrix-based value model, the following key risks were identified which could be mitigated by the investment:

- Financial risk: Cost associated with emergency repair and to address contaminated soil in the area
- Operational risk: Interruption of customer services due to emergency repair
- Reputational risk: Disruption or inconvenience affecting nearby area due to repair

It was determined that there were no significant CAPEX and OPEX savings. Following the assessment, the risk matrix-based model was applied in Copperleaf to determine risk value measures, which were then incorporated with the investment cost (as negative value) by applying the NPV calculation. The net values and total net value of the investment are shown below.

Figure 1: Distribution Station – HAMI: Caledonia Transmission Station, Rebuild



This investment addresses a wide range of issues, as discussed in Exhibit 2, Tab 6, Schedule 2, Appendix B, page 70 (see Investment Code 735048). Based on stakeholder input, a station rebuild was proposed. Due to the maturity level of analytical techniques and available data at the time of the value assessment, not all issues could be fully assessed. The value assessment focused on cost saving and risks associated with corrosion and frost heave on piping leading to leaks and potential disruption to customers (it is a single feed station).

Similar to the distribution pipe example above, a risk matrix-based value model was used. The following key risks were identified for mitigation through the investment:

- Financial risk: Cost associated with emergency repair of the station
- Operational risk: Customer interruption due to emergency repair

In addition, the following key benefits were identified in relation to the investment:

- Avoided GHG (greenhouse gas) emissions: As there were historical leaks at the station, the proposed solution would minimize emissions
- Budget savings (OPEX): Reducing leaks at the station would lower OPEX spend

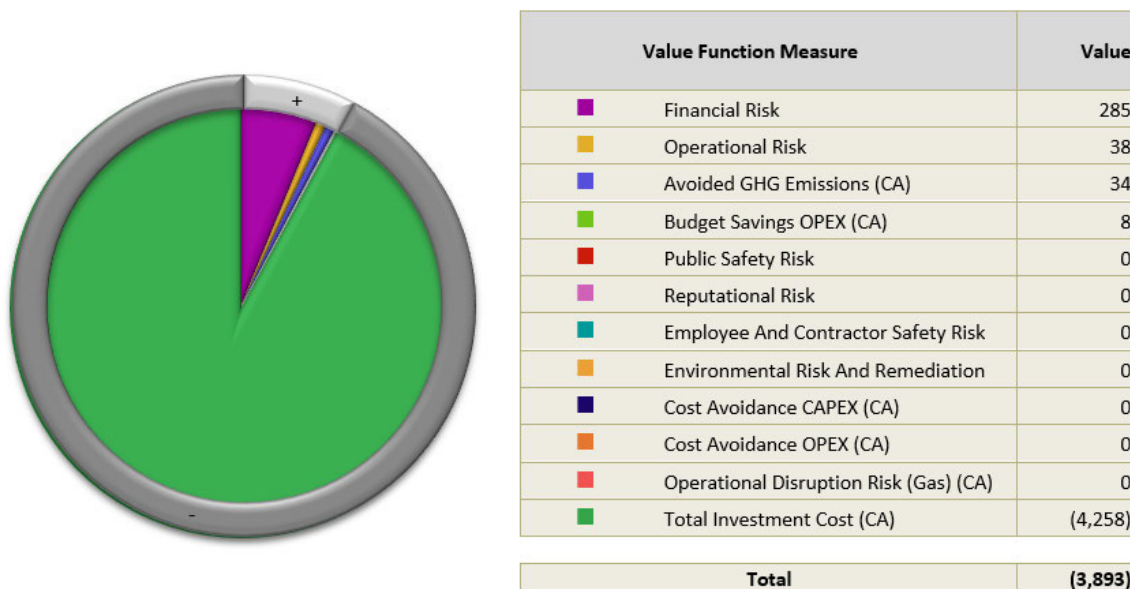
Following the assessment, the following risk models were applied in Copperleaf to estimate value measures:

- the risk matrix-based model to determine risk value measures; and

- equation-based value model to estimate the amount of GHG emissions which could be avoided based on historical leaks (with a monetary value tie-in to carbon pricing, as further described in part c below) and quantify potential OPEX saving based on experience.

All value measures were then incorporated with the investment cost (as negative value) by applying the NPV calculation. The net values and total net value of the investment are shown below.

Figure 2



- b) See part a) and Exhibit I.2.6-CME-18 part a) for a discussion regarding the NPV calculation to combine value measures and investment cost into total net value for each investment. This approach allows all value measures to be placed on an economic scale (i.e., value unit) to assist in optimization.
- c) As demonstrated in part a), relative weighting between value measures is not the approach taken to determine value measures. Value measures use quantitative data for frequencies, probabilities and consequence impacts directly, such that risks and benefits are calculated using value models in the Copperleaf Value Framework. In addition to the consequence scales shown in Table that are being used in the risk matrix-based value model, the following factors are used for equation-based value models.

GHG (greenhouse gas) value model – Captures the environmental benefit of the reduction of GHG emissions. A corresponding monetary value is derived with reference certain modeling assumptions around the price of carbon (per tonne of

CO2 equivalent, as shown in Table) and the estimated CO2 emissions per MWh of electricity (shown in Table). The main output of the model is an Avoided GHG value measure.

Table 3
CO2e Value (in CA\$)

Province	Units	Year				
		2019	2020	2021	2022	2023+
Ontario	CA\$	\$20	\$30	\$40	\$50	\$50

Table 4
eGRID factors for gCO2e per MWh Value

Province	g CO2e / MWh
Ontario	36,000

Financial Benefits and Cost Value model – Measures the financial benefits or cost to the organization in the form of annual CAPEX and OPEX cost saving/increases, cost avoidances or revenue impacts. For gas carrying assets, these are usually estimations based on financial history and tacit knowledge.

For REWS and TIS investments, high level estimations on cost avoidance are determined by multiplying a cost avoidance factor (see Table) with total net capital (TNC) to represent the saving over the useful life of the investment. Cost avoidance factors are based on similar historic projects and allow a reasonable estimate of the potential benefit or cost avoidances resulting from an investment.

Table 5
REWS & TIS investment cost avoidance factors

Asset Class	Project Type	Cost Avoidance Factor
TIS	Financial Business Solutions	31%
	Gas Storage Business Solutions	25%
	Integrity Business Solutions	23%
	Operations Business Solutions	8%
	CIS Improvement Projects	12%
	Desktop Sustainment Projects	17%
REWS	Building Systems Projects	9%

Energy Efficiency value model – Evaluates investments that bring measurable financial benefits in the form of annual power savings and reduced CO2 emissions.

The GHG emission value model is utilized here. For energy savings, either gas or electricity savings per year are estimated and multiplied by the default unit cost saving in Copperleaf.

Employee Productivity value model – Calculates financial benefits from increasing employee efficiency measured by hours saved per employee. The model incorporates employee cost per hour and probability of repurposing to calculate employee the productivity value measure. Probability of repurposing captures the degree to which a person who no longer must perform certain tasks will be able to repurpose that time to perform other work that would otherwise have had to be staffed by someone else.

- d) The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

Please see Attachment 1.

Investment Code	Investment Name	Total Investment Value - Value Units All Years - Current June 2023	
48478	KING: 22-YY-023 Dist Company Mains Leakage	(1,248)	/u
48289	WIND: Dist-Repl-Contr-Mains Leakage	(3,748)	/u
736505	SCOR: K711 MOD Hdr Valves-Replace	2,497	/u
501524	SSOM:K-801 Isolation Valves - Replace	(719)	/u
100901	Dawn to Corunna	(11,437)	/u
734640	CNG - Kennedy Upgrade/Redesign	(474)	/u
9552	NGT Existing customer Maintenance Capital - (Until 2026)	(970)	/u
9553	NGT Maintenance Capital for company/fleet NG refueling stations (2021 to 2032)	(2,437)	/u
2368	NGV Rental VRA's - (Until 2025)	(345)	/u
3608	BROCKVILLE GATE	(1,681)	/u
735335	GTAW Parkway Gate Station Rebuild Phase 2	(5,697)	/u
7777	WINSTON CHURCHILL AND STEELES FEEDER	(6,578)	/u
503183	Albion Feeder Station Control Valve Upgrade	325	/u
1043	CAWTHRA AND QUEENSWAY DISTRICT	(1,542)	/u
102672	Campbellford Replacement Phase 4 Kent St	1,010	/u
502369	A50: Big Bay Point VPM Aldyl A	(1,379)	/u
1702	Bloor St. W. & The Kingsway Replacement	(252)	/u
736572	Shallow Main - High Street from Dunlop to Park St	(186)	/u
735949	AR40: VSM Replacement - Wilson Rd S Oshawa Ph 2 Olive to King	(3,348)	/u
100506	HR - 1040 Bridletowne Circle	2,542	/u
10288	St. Laurent Phase 4 - Lower Section (Plastic)	(10,955)	/u
10293	St. Laurent Phase 3 - North/South (NPS12/16 Steel)	(84,457)	/u
4160	Vintage Steel: NPS 12 SC HP on Parliament St, Carlton St to Front St	(6,383)	/u
502423	A20: Homark Dr., Mississauga - 1" ST Replacement	(1,775)	/u
10294	St. Laurent Phase 4 - East/West (NPS12 Steel)	(36,314)	/u
7604	A10: Kipling Ave & Lake Shore Blvd W, Etobicoke, PH2 Replacement	5,569	/u
23147	Toronto Island NPS 2 Feed Relocation	(2,092)	/u
7649	HR - 201 Bridletowne Circle	2,735	/u
10292	St. Laurent Phase 3 - Montreal to Rockcliffe (Plastic)	(2,583)	/u
10290	St. Laurent Phase 3 - Coventry/Cummings/St. Laurent (Plastic)	(3,473)	/u

Investment Code	Investment Name	Total Investment Value - Value Units All Years - Current June 2023	
734548	VSM-HWY 7 Dufferin St Perth	(802)	/u
4764	AMP Fitting Replacement - Area 30	(13,489)	/u
4760	AMP Fitting Replacement - Area 10	(35,216)	/u
4768	AMP Fitting Replacement - Area 80	(11,006)	/u
4766	AMP Fitting Replacement - Area 40	(7,557)	/u
4763	AMP Fitting Replacement - Area 20	(23,945)	/u
4765	AMP Fitting Replacement - Area 50	(3,673)	/u
4767	AMP Fitting Replacement - Area 60	(19,542)	/u
11127	Copper Service Replacement - Area 20	(1,183)	/u
14063	Copper Service Replacement - Area 80	(505)	/u
14147	Copper Service Replacement - Area 40	(371)	/u
4792	Copper Service Replacement - Area 10	(211)	/u
502879	EAGLESON & EMERALD MEADOWS DISTRICT	(195)	/u
101153	6B435A - CORKSTOWN & WESTDALE DISTRICT	(30)	/u
735187	14887A GLAMORGAN & KENNEDY DISTRICT	(202)	/u
735304	2885749 Taunton and Gillett	(206)	/u
735172	30988A CONCESSION 2 & TWMARC DISTRICT	(180)	/u
735188	17461A CAVERLY & MARTINGROVE DISTRICT	(118)	/u
101149	6B796A - WOODROFFE & EARL MULLIGAN DISTRICT	(51)	/u
735173	32564A - MILL RD & KING SIDEROAD DISTRICT	172	/u
735301	33300A ISLINGTON & HWY # 407 HP DIST	227	/u
735300	31335A GILBERT& YONGE DISTRICT (AURO	251	/u
735168	44512A YANKEE LINE & RUSSELL DISTRICT	(199)	/u
18889	KIPLING & NORTH QUEEN DISTRICT	(270)	/u
735303	35053A Dufferin Langstaff (Langstaff & 407)	319	/u
501280	A10: Cibola and Chippewa Toronto Islands, Replacement	(430)	/u
735302	33525A Bathurst & Rutherford hp-ip	334	/u
101146	6B621A - BANTREE & EDINBURGH DISTRICT	(54)	/u
18811	SHEPPARD & KENNEDY DISTRICT	5	/u
18818	BAY & SCOLLARD DISTRICT LP	(659)	/u
18887	DELORAIN & YONGE DISTRICT	(58)	/u

Investment Code	Investment Name	Total Investment Value - Value Units All Years - Current June 2023	
18816	BRIMLEY & ELESHERE DISTRICT	(230)	/u
735182	2936953 MEADOWVALE & GENERATION DISTRICT	(165)	/u
735183	2936745 MARKHAM & VERNE DISTRICT	(87)	/u
101001	14365A - BIRMINGHAM & KIPLING DISTRICT	(503)	/u
18888	HARVIE & MORRISON DISTRICT	(420)	/u
18844	SHEPPARD AVE E & GRAND MARSHALL DISTRICT	(105)	/u
18962	(O)-ELLESMERE / BUDEA	(123)	/u
18964	CALEDONIA & RAITHERM DISTRICT	(318)	/u
735164	6B631A MCCARTHY DR AND HUNT CLUB RD	(135)	/u
736975	Enbridge Gas Distribution System Hydrogen Feasibility Study	(10,438)	/u
3640	Station B New Building	12,711	/u
102621	2024 LEG Rate Zone Targeted GHG & Energy Reductions	154	/u
737786	Brockville Operations Centre - New Build	(4,307)	/u
102209	OWP Replacement	1,673	/u
736081	General Service Rebasing Changes	(7,052)	/u
735733	Cost & Schedule Management (Ecosys)	2,435	/u
735986	Enbridge Incident and Safety Smarthub	1,254	/u
102291	Contract Market Harmonization	(3,643)	/u
735558	PowerSpring (Telemetry) Replacement 2022 - 2023	(503)	/u
735518	Customer Attachment, Construction Upgrades and Releases - 2024	4,042	/u
102010	Distribution Protection Upgrades & Releases - 2024	1,931	/u
101943	WAMS Stabilization & Releases (2024 - LEGD & LUG)	12,584	/u
735771	Maximo Major Upgrade 2024	31,321	/u
102364	Records Management Technology Obsolescence (2024-2026)	(9,106)	/u
737248	AWS Ph3 2024	22,776	/u
736926	Gas Cost Recovery Harmonization	(2,351)	/u
102285	ConTrax Program 2024	578	/u
736046	GDS OT Cyber Security Integrity 2024	1,055	/u
48223	Siemens Valve Controllers Replacement - Parkway D	1,556	/u
101576	Siemens Valve Controllers Replacement - Lobo D	1,561	/u
48277	Dawn D Siemens MCC replacement	248	/u

Investment Code	Investment Name	Total Investment Value - Value Units All Years - Current June 2023	
48274	Dawn G Siemens MCC replacement	107	/u
48732	Waubuno Compression Lifecycle	(4,014)	/u
48667	CNG Stations - Project #4	(377)	/u
101198	KING: 22-24-704 College and Sidney DRS (27801009) Rebuild	(393)	/u
101627	CHAT - 07G-201 Baldoon Transmission - Station Rebuild	49	/u
502429	WIND-03D-301 Leamington North Gate Station	(5,532)	/u
734689	LOND: 14R-104 Beachville Domtar Trans Stn	(8,161)	/u
101197	KING: 22-22-701 Cobourg East TBS (27301068) Lineheater	(1,190)	/u
101359	SRP_Southwest_Windsor_05A-201STN_Rebuild	(1,740)	/u
502506	Hamilton IRR Program	(436)	/u
733885	Operations Services Central IRR Program	(1,814)	/u
502503	London/Sarnia IRR Program	(610)	/u
502505	WATE: Waterloo/Brantford IRR Program	(696)	/u
502509	Eastern (LUG) IRR Program	(309)	/u
502504	Windsor/Chatham IRR Program	(278)	/u
48577	NBAY & SUDB: Plan(T)-Dist-Stn Measuring/Corrosion Stn	(367)	/u
503020	HALT: Dalebrook Drive Dist Station, LP	149	/u
503019	HALT: Roylen Rd & Ripley Crt Station, LP	86	/u
48456	HALT: Plan(T)-Dist-Stn Measuring/Corrosion Stn	(279)	/u
735035	Halt: Ninth/Britannia, Rebuild	(423)	/u
100514	HALT-Hall Rd Station Georgetown	(569)	/u
48291	WIND: Plan(T)-Dist-Stn Measuring/Corrosion Stn	(2,387)	/u
48473	KING: 22-YY-007 Plan(T)-Dist-Stn Measuring/Corrosion Stn	(1,048)	/u
48352	LOND: Plan(T)-Dist-Stn Measuring/Corrosion Stn	(1,720)	/u
48504	TBAY & TIMM: Plan(T)-Dist-Stn Measuring/Corrosion Stn	(504)	/u
49057	WATE: 19R-501R Wellesley Distribution Station, Wellesley Twp, Station Rebuild (Load Growth), Capacity Restore, Proj# 07-21-703	(630)	/u
48418	WATE: 19V-105R Stone & Gordon Vault Station, Guelph, Full Rebuild (Capital Maintenance), Corrosion and Leakage Proj# 07-19-702	21	/u
100613	WATE: 18U-601 Avenue Rd Station, Cambridge, Heater Replacement & SCADA Upgrade (Capital Maintenance), Proj# 07-22-701	(305)	/u

Investment Code	Investment Name	Total Investment Value - Value Units All Years - Current June 2023	
100617	WATE: 18U-504 Cambridge East Distribution Station, Cambridge, Station Rebuild (Obsolete Heater)	(309)	/u
48431	HAMI: Plan(T)-Dist-Stn Measuring/Corrosion Stn	(179)	/u
101072	NE: 43501002 - Coniston DRS, Rebuild	(41)	/u
101158	TIMM: 45-22-700 Goldcorp Dome Mine SMS, Rebuild	(1,451)	/u
101129	HAMI: 16W-204R Binkley Station, Hamilton, Vault Station Rebuild	373	/u
733531	LOND - Waterloo St at Horton St Leakage BU- London	(68)	/u
48930	HAMI: Lock St E, Dunnville, BU Replacement	(213)	/u
48846	SARN - Errol Rd E Leakage - Sarnia BU	(1,307)	/u
48508	THUN: Dist-Repl-Compy-Mains Leakage	(3,663)	/u
48515	THUN: Indirect Materials-Replacements	(74)	/u
100744	King: 22-23-600 Collins Bay NPS10 Shallow Pipe	4,330	/u
48429	HAMI: Dist-Repl-Contr-Mains Leakage	(2,490)	/u
101631	HAMI: Crestview Replacement, Ancaster, Leakage	129	/u
501005	HAMI: PSLM Maintenance	(840)	/u
48454	HALT: Dist-Repl-Contr-Mains Leakage	(764)	/u
501003	LOND: PSLM Maintenance	(973)	/u
48381	BRAN: Dist-Repl-Contr-Mains Leakage	(1,810)	/u
48575	NE: Dist-Repl-Contr-Mains Leakage	(2,052)	/u
501006	WATE: PSLM Maintenance	(1,129)	/u
48572	TIMM: Indirect Materials-Replacements	(140)	/u
101177	WIND: Tecumseh Rd E - Ph6, Windsor, Replacement	3,476	/u
48349	LOND: Dist-Repl-Contr-Mains Leakage	(2,123)	/u
49721	CHAT: Base Line, Wallaceburg, Replacement	(436)	/u
733836	SARN - Oil Heritage Rd and Douglas Line Exposed Main	(124)	/u
102128	Kirkland Lake Lateral Replacement	24,281	/u
735034	SRP_GTA West_Lowville_18X-101STN_Rebuild	(263)	/u
734672	SRP_Southwest_Kerwood_12K-301STN_Rebuild	(7,736)	/u
49911	Hagar Site Drainage Improvements	(353)	/u
100492	Dryden Operations Centre	(2,573)	/u
501930	Dawn EOC MCR - COVID Impacts	(3,590)	/u

Investment Code	Investment Name	Total Investment Value - Value Units All Years - Current June 2023	
100607	Thunder Bay Regional Operations Centre	(49)	/u
102586	2024 LUG Rate Zone Targeted GHG & Energy Reductions	154	/u
101426	UG – TIS Hardware Sustainment Fund - 2024	(376)	/u
101398	UG Mobility Sustainment 2024	1,420	/u
734832	UG - TIS Hardware Replacement - 2024	6,067	/u
102132	Gas Storage HMI Upgrade 2022 - 2024	179	/u
100052	BODS Upgrade 2023	50	/u
102304	Enterprise Contact Center	1,519	/u
736974	Hydrogen Blending Phase 2	(5,802)	/u
736973	Hydrogen for Compression Facilities Feasibility Assessment	(1,123)	/u
736972	Hydrogen Fuel Heating Systems Feasibility Assessment	(1,598)	/u

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 56

Question(s):

EGI indicates the capital portfolio is captured in Microsoft Excel as well as Copperleaf. Please provide the Microsoft Excel version of the capital portfolio.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023. /u

Please see Attachment 1 for the Excel version of Enbridge Gas's regulated capital portfolio.

[illegible]

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 75

Question(s):

- a) Please provide the Growth Capital Summary in the same format as Table 5.1.10-1 for the years 2019 to 2022 and provide an excel version of the table.
- b) Please confirm expenditures are net of contributions and include interest during construction.

Response:

- a) Please see Table 5.1.10-1 below and Attachment 1 for the Excel.
- b) The growth capital spend is net of contributions for all years. IDC is included in 2019 expenditures and excluded in 2020 to 2022.

Table 5.1.10-1

Growth Table 5.1.10-1

Asset Class Strategy/Investment Name	Asset Program	2019A	2020A	2021A	2022A
Customer Additions under EBO 188	Customer Connections	190.4	178.4	260.0	296.8
Hydrogen Strategy	Hydrogen Blending	-	0.3	-	0.8
Enbridge Gas Distribution System Hydrogen Feasibility Study	Hydrogen Blending	-	-	-	-
Distribution System Reinforcement under EBO 188	System Reinforcement	58.6	17.5	43.0	66.8
Rideau Reinforcement	System Reinforcement	-	-	-	-
Hamilton Industrial Reinforcement	System Reinforcement	-	-	-	0.3
East Kingston Creekford Road Reinforcement	System Reinforcement	-	0.1	0.1	0.7
North Parry Sound Seguin Trail Reinforcement	System Reinforcement	-	-	-	-
Southeast Owen Sound County Rd 40 Reinforcement	System Reinforcement	0.6	46.3	4.6	0.4
Wheatley 1B Panhandle Distribution Reinforcement - Wheatley Lateral Replacement and Reinforcement	System Reinforcement	-	-	-	-
Stratford Reinforcement	System Reinforcement	19.8	0.3	(0.1)	-
Kingsville Transmission Reinforcement	System Reinforcement	65.1	8.0	0.5	(0.1)
Total		334.5	251.0	308.1	365.6

Growth Table 5.1.10-1

Asset Class Strategy/Investment Name	Asset Program	2019A	2020A	2021A	2022A
Customer Additions under EBO 188	Customer Connections	190.4	178.4	260.0	296.8
Hydrogen Strategy	Hydrogen Blending	-	0.3	-	0.8
Enbridge Gas Distribution System Hydrogen Feasibility Study	Hydrogen Blending	-	-	-	-
Distribution System Reinforcement under EBO 188	System Reinforcement	58.6	17.5	43.0	66.8
Rideau Reinforcement	System Reinforcement	-	-	-	-
Hamilton Industrial Reinforcement	System Reinforcement	-	-	-	0.3
East Kingston Creekford Road Reinforcement	System Reinforcement	-	0.1	0.1	0.7
North Parry Sound Seguin Trail Reinforcement	System Reinforcement	-	-	-	-
Southeast Owen Sound County Rd 40 Reinforcement	System Reinforcement	0.6	46.3	4.6	0.4
Wheatley 1B Panhandle Distribution Reinforcement - Wheatley Lateral Replacement and Reinforcement	System Reinforcement	-	-	-	-
Stratford Reinforcement	System Reinforcement	19.8	0.3	(0.1)	-
Kingsville Transmission Reinforcement	System Reinforcement	65.1	8.0	0.5	(0.1)
Total		334.5	251.0	308.1	365.6

Note - Overheads included for 2021 & 2022 only

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 109

Question(s):

With respect to the Vintage Steel Replacement Program, EGI indicates that its selection process identifies approximately 5,100 km of the 17,423 km of Vintage Steel mains for renewal based on their predicted future risk. The Proactive Vintage Steel Replacement Program proposes renewing these targeted mains over a 20-year term. This would equate to renewing about 253 km/year after ramping up to full pace.

- a) Please provide the date of the first year of the Vintage Steel Replacement Program; and
- b) Please provide the number of km renewed per year for each of the years 2019 to 2032.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023. /u

- a) The Vintage Steel Replacement Program has projects in the proposed plan from 2023 onwards as provided at Exhibit 2, Tab 6, Section 2, Table 5.2.3-4, page 119.
- b) For past years 2019 to 2020, the following table outlines an estimated number of total kilometers of steel mains replaced by year installed.

Table 1

Steel Mains by Year Installed	Abandoned per year (km)*			
	2019	2020	2021	2022
LEGD Vintage Steel (<= 1970)	29.8	23.4	20.8	22.6
LUG Vintage Steel (<= 1970)	49.1	70.2	61.2	90.0
Grand Total	79.0	93.5	82.0	112.6

* Note that these figures have been extracted from Enbridge Gas's mapping system and have not been subject to a full quality review due to timing constraints for this response.

For years 2020 to 2032, the total estimated kilometers to be replaced are as follows:

Table 2

Steel Mains by Year Installed	Abandoned per year (km)**									
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
EGI Total Vintage Steel (<= 1970)	8.1	8.5	6.3	13.1	17.6	59.3	89.5	115.8	159.9	255.9

/u

**Accuracy of lengths provided for 2023 to 2026, expected to have a +/- 10% margin of error.

[illegible]

c)

Table 2

Year	Leaks	Replacements	Total Replacements
2019	1,226	6,017	7,243
2020	1,383	2,022	3,405
2021	989	4,583	5,572
Grand Total	3,598	12,622	16,220

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 119

Question(s):

Please provide the Distribution Pipe Capital Summary in the same format as Table 5.2.3-4 for the years 2019 to 2022 and provide an excel version of the table.

Response:

Please see response at Exhibit I.2.6-1-SEC-129, Attachment 1.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 133

Question(s):

With respect to the condition assessments for Station Components, the evidence states, "Utilizing the aggregated ranking of each sub-system based on their criticality to the station level, Figure 5.2-67 helps to illustrate the findings of the condition assessments and provides insight into the mitigation levels required for the current replacement program. Note that the section of the chart marked as Unknown reflects the assets that were not part of the station condition assessments completed as of March 2021." Please provide the percentage of assets that were not part of the station condition assessments.

Response:

The percentage of Distribution System Station assets in the EGD rate zone that were not included in the condition assessments provided at Exhibit 2, Tab 6, Schedule 2, Figure 5.2-67 is approximately 52%, calculated using the following information:

- i. Total population from the inventory in Table 5.2.4-1, page 124, is 5,007; and
- ii. the "Unknown" population in Figure 5.2-67 was 2,586.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 137

Question(s):

With respect to Customer Stations, the evidence states "Figure 5.2-71 helps to illustrate the findings of the condition assessments and provides insight into the mitigation levels required for the current replacement program. Note that the assets reflected as Unknown were not part of this initial condition assessment." Please provide the percentage of assets that were not part of the station condition assessments.

Response:

The percentage of Distribution Customer Station assets in the EGD rate zone that were not included in the condition assessments indicated in Figure 5.2-71 is approximately 66.4%, calculated using the following information:

- i. Total population from the inventory in Table 5.2.4-1 (page 124) is 12,936, and
- ii. the "Unknown" population in Figure 5.2-71 is 8,594.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 137

Question(s):

With respect to Stations with Auxiliary Equipment Replacement, the evidence states, "This strategy targets the replacement and/or rebuild of station components at sites prioritized based on condition, age and observations identified through site inspections and SMA reviews. Station investments are selected based on value framework assessment results and compliance/design standards." Please provide the value framework assessment results for the station investments in 2024.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023. /u

Please see Table 1 for the values assessment results related to the 2024 investments that make up the \$26.0 million provided in the update to Exhibit I.2.6-CCC-71 part b) /u
Please see response at Exhibit I.2.6.CCC-49 which discusses value measures.

Table 1

Investment Name	Value Score - Value Units - June 2023	
BROCKVILLE GATE	(1,681)	/u
NOBLETON GATE	(2,494)	/u
Electrical Upgrades + Repair	(452)	/u
Instrument Upgrades + Support	(521)	/u
WINSTON CHURCHILL AND STEELES FEEDER	(6,578)	/u
Albion Feeder Station Control Valve Upgrade	325	/u
ERX Related Materials + Activities	(391)	/u
KEELE AND FINCH FEEDER	(3,453)	/u
CAWTHRA AND QUEENSWAY DISTRICT	(1,542)	/u
KING: 22-24-704 College and Sidney DRS (27801009) Rebuild	(393)	/u
CHAT - 07G-201 Baldoon Transmission - Station Rebuild	49	/u
WIND-03D-301 Leamington North Gate Station	(5,532)	/u
LOND: 14R-104 Beachville Domtar Trans Stn	(8,161)	/u
WATE: 23R-601 Teviotdale Transmission Station, Station Rebuild (Capital Maintenance), Frost Heave Glycol Pool, Proj# 07-20-715	(433)	/u
BRAN: 12S-202 Fernlea Farm Distribution Station, CWT install/glycol line removal, SCADA Proj# 06-22-701	(709)	/u
King - under rated valves Napanee TBS 28101001	(107)	/u
WIND 05A-201 Turkey Creek	(1,740)	/u

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 142

Question(s):

With respect to the Stations with Auxiliary Equipment Replacement Strategy, EGI plans to increase spending in 2024 to \$46.1 million compared to \$35.9 million in 2023:

- a) Please provide the average spend for the years 2018 to 2022;
- b) Please explain the increase in spending in 2024.

Response:

- a) Please see response at Exhibit I.2.6-SEC-131, Attachment 1. As provided at that response 2018 data are not available. The average spend from 2019 to 2022 is \$44.5 million per year.
- b) The increase in 2024 planned spend can be attributed to two main reasons which are discussed below:
 - i. Increases in material and execution costs observed in 2022 and 2023 have increased the forecasted costs. Please see response at Exhibit I.2.3-STAFF-49 part b) for additional context.
 - ii. There is a need to spread out projects beyond 1 calendar year with the design and material procurement in year 1, followed by an execution year, and if needed a restoration year for some of the larger investments in the asset class.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 142

Question(s):

Please provide the Distribution Stations Capital Summary in the same format as Table 5.2.4-8 for the years 2019 to 2022 and provide an excel version of the table.

Response:

Please see response at Exhibit I.2.6-SEC-131, Attachment 1.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 172

Question(s):

Please provide the Utilization Capital Summary in the same format as Table 5.2.5-9 for the years 2019 to 2022 and provide an excel version of the table.

Response:

The Utilization Capital Summary for 2019 to 2022 is provided in Table 1. Please see Attachment 1 for the Excel.

Table 1
Utilization Capital Summary 2019 to 2022

Asset Class Strategy	Program Name	2019	2020	2021	2022
Meter Purchases	Meters (growth)	13.9M	11.4M	22.7M	09.7M
Meter Purchases	Meters (mtc)	44.7M	27.9M	27.8M	33.8M
AMI Pilot	Monitoring Systems	0.0M	0.0M	0.2M	0.3M
MXGI Program	Regulator Refit	40.3M	22.9M	30.1M	54.8M
Targeted Inspection and Remediation Program	Remediation	0.5M	0.7M	0.0M	-0.2M
Total		99.3M	62.9M	80.7M	98.4M

EGI Utilization Summary

Asset Class Strategy	Program Name	2019	2020	2021	2022
Meter Purchases	Meters (growth)	13.9M	11.4M	22.7M	09.7M
Meter Purchases	Meters (mtc)	44.7M	27.9M	27.8M	33.8M
AMI Pilot	Monitoring Syste	0.0M	0.0M	0.2M	0.3M
MXGI Program	Regulator Refit	40.3M	22.9M	30.1M	54.8M
Targeted Inspection ar Remediation		0.5M	0.7M	0.0M	-0.2M
Total		99.3M	62.9M	80.7M	98.4M

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 172

Question(s):

With respect to the Meter Purchases - Meters (mtc), EGI plans to increase spending in 2024 to \$66.8 million compared to \$58.6 million in 2023:

- a) Please provide the average spend for the years 2019 to 2022.
- b) Please explain the increase in spend in 2024.

Response:

- a) Please see Table 1.

Table 1
(\$ millions)

Asset Class Strategy	Program Name	2019	2020	2021	2022	4-Yr Avg
Meter Purchases	Meters (mtc)	44.7	27.9	27.8	33.8	33.5

- b) There are two main factors to the increase in spend forecast in 2024.

The first reason is harmonization of practices for meter population management, resulting in a more levelized yearly workload as shown in EGD's forecasted meter exchange program as provided at Exhibit 2, Tab 6, Schedule 6, Table 5.2.5-4. Levelling will aid in managing the peaks and valleys that existed in the historical EGD meter population management strategy. More importantly, levelling is necessary to manage a substantial projected increase in upcoming meter expiries that would otherwise pose significant resource challenges and risk to completion of mandated exchanges in 2025 and 2026. Please see Exhibit 2, Tab 6, Schedule 6, Table 5.2.5-7 for planned program pacing. This new harmonized strategy would mean an increase in meter exchanges for the EGD meter population, requiring an increase in meter purchases to manage the additional workload in 2024.

The second reason is a supply chain constraint which began in Q3 of 2021. One of the three Measurement Canada approved residential diaphragm meter suppliers ceased production of their 200 series diaphragm meters, which left a gap in the supply chain for the largest sector of Enbridge Gas's market. That supplier was moving towards newer technology of ultrasonic measurement. To continue to have a multiple sourcing strategy to avoid the supply chain interruptions and increased demand that were seen during the pandemic, Enbridge Gas began the evaluation of the new ultrasonic meter, and with an anticipated Measurement Canada approval, planned to include this new residential meter type in the meter population. This new meter would be an equivalent to the diaphragm meter with significant enhancements, measurement technology improvements, as well as having built-in AMI technologies as provided at Exhibit 2, Tab 7, Schedule 2. The ultrasonic meters will increase the costs of residential meters but is necessary to address current and future supply chain shortages which would otherwise impede Enbridge Gas's ability to remain compliant to the Electricity and Gas Inspection Act as provided at Exhibit 2, Tab 6, Schedule 2, page 150 of 288, Table 5.2.5-3. As identified in Table 5.2.5-3, failure to remain compliant will result in monetary penalties for Enbridge Gas.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 194

Question(s):

Please provide the Compression Stations Capital Summary in the same format as Table 5.3.5-3 for the years 2019 to 2022 and provide an excel version of the table.

Response:

Please see response at Exhibit I.2.6-SEC-135, Attachment 1.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 202

Question(s):

With respect to Well Casing Inspection, Maintenance & Replacements:

- a) Please provide the average spend for the years 2019 to 2022;
- b) Please explain the increase in spend in 2024 compared to 2023.

Response:

- a) Please see Table 1 for the average spend from 2019 to 2022 for Well Casing Inspection, Maintenance and Replacements.

Table 1

	2019A (\$)	2020A (\$)	2021A* (\$)	2022A *(\$)	Average Spend (\$)
Well Casing					
TPS – Integrity	-	-	19,223	60,450	19,918
TPS – Improvements	6,870,425	1,324,382	4,415,499	653,998	3,316,076
TPS - Land/Structures - Improvements	-	-	61,260	42,560	25,955
TPS – Replacements	210,325	1,525,430	1,154,017	2,530,760	1,355,133
Total	7,080,751	2,849,811	5,649,999	3,287,767	4,717,082

*Note - Overheads included for 2021 & 2022 only

b) The increase in spend in 2024 compared to 2023 is due to work planned in 2024. Specific projects are outlined below:

- Two replacement wells at the Seckerton Pool – This work is being completed to recover the deliverability lost from wells that have been abandoned in the Seckerton pool.
- Two replacement wells at the Waubuno Pool – This work is being completed to recover the deliverability lost from completed and planned well abandonments in the Waubuno pool.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 202

Question(s):

Please provide the Transmission Pipe and Underground Storage Capital Summary in the same format as Table 5.3.6-1 for the years 2019 to 2022 and provide an excel version of the table.

Response:

Please see response at Exhibit I.2.6-SEC-136, Attachment 1.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 209

Question(s):

Please provide the LNG Asset Class Capital Summary in the same format as Table 5.3.7-1 for the years 2019 to 2022 and provide an excel version of the table.

Response:

Please see response at Exhibit I.2.6-1 SEC-139 part a).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/6/2/p. 224

Question(s):

- a) Please describe the impact if the Kennedy Road Expansion project is deferred for 5 years;
- b) Please provide the value framework assessment results for this project.

Response:

- a) Consequences of the deferral of the Kennedy project is derived from facility condition assessment, which is described in further detail in the response at Exhibit I.2.6-SEC-137. Deferral of the new Kennedy Rd. facility will impact operational effectiveness and increase costs. Concerns and potential impacts include:
 - physical and functional condition of the building is obsolete;
 - site and building are too small;
 - existing site hinders operational effectiveness leading to loss of productivity and can contribute to motor vehicle incidence;
 - energy efficiency of the building asset; and
 - impacts to advancing gender equality and barrier free accessibility.
- b) Please see response at Exhibit I.2.6-FRPO-45 for the C55 Value assessment.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/6/2/p. 224

Question(s):

Please provide the Real Estate and Workplace Services Capital Summary in the same format as Table 5.4.8-1 for the years 2019 to 2022 and provide an excel version of the table.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

Please see Table 1 outlining the 2019 to 2022 Historical Actuals and updated 2023 to 2032 Forecast spend for the Real Estate and Workplace Services Asset Class. Please note the asset class historical spend profiles in 2019 and 2020 do not include associated overheads. The 2019 historical actuals do not map directly to the asset class strategy, as the strategy categorization was not in place at the time, therefore 2019 data has been categorized as "Mapping to Strategy not Available". An Excel version has been provided in Attachment 1.

Table 1
REWS Capital Summary (\$ millions) with 2019-2022 Historical Actuals – EGI

Asset Class Strategy/Investment Name	Asset Program	2019 Actuals	2020 Actuals	2021 Actuals	2022 Actuals	2023	2024	2025	
Property Upgrade Strategy	Furniture/Structures & Improvements	0.0	1.3	31.2	26.4	13.3	9.9	16.1	/u
Kennedy Road Expansion		0.0	0.0	2.6	0.0	0.0	0.0	0.0	/u
SMOC/Coventry Facility Consolidation		0.0	0.0	0.0	0.0	33.0	13.3	0.0	/u
Station B New Building		0.0	2.2	1.2	10.9	13.0	25.6	0.0	/u
VPC Core and Shell		0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
New London Site		0.0	0.0	1.6	0.3	0.0	0.0	11.9	/u
Kelfield Operations Centre - Land Purchase		0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
Kelfield Operations Centre - New Building		0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
Thorold Regional Office - Building & Site		0.0	0.0	0.0	0.0	0.1	0.8	7.9	/u
Dawn Administrative Centre		0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
Sudbury Regional Operations Centre		0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
Building New Facilities		0.0	5.4	1.9	0.0	0.0	0.0	0.0	/u
Building Systems Program		0.0	2.1	6.6	5.3	1.3	6.8	0.0	/u
Renovating existing facilities; maintenance of current site		0.0	17.5	38.8	16.4	0.9	4.7	0.0	/u
GHG and Energy Reductions Program		0.0	0.2	0.2	0.2	0.1	0.9	0.0	/u
Micro-Operations Depot Revitalization Program		0.0	0.0	0.4	1.1	0.3	0.3	0.0	/u
Workplace Furnishings Replacement Program		0.0	0.2	0.3	0.9	0.2	0.6	0.0	/u
Mapping to Strategy not Available		42.1	0.0	0.0	0.0	0.0	0.0	0.0	/u
GTA West		0.0	0.0	26.2	2.8	0.5	0.0	25.4	/u
GTA East		0.0	0.0	0.0	0.0	0.3	0.0	0.0	/u
Total		42.1	28.8	110.9	64.3	63.0	63.0	61.3	/u

Table 1
REWS Capital Summary (\$ millions) with 2019-2022 Historical Actuals – EGI (Continued)

Asset Class Strategy/Investment Name	Asset Program	2026	2027	2028	2029	2030	2031	2032	
Property Upgrade Strategy	Furniture/Structures & Improvements	24.0	9.3	13.7	11.4	11.6	0.7	0.3	/u
Kennedy Road Expansion		0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
SMOC/Coventry Facility Consolidation		0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
Station B New Building		0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
VPC Core and Shell		0.0	0.0	0.0	13.1	13.9	8.4	0.0	/u
New London Site		17.2	20.4	0.0	0.0	0.0	0.0	0.0	/u
Kelfield Operations Centre - Land Purchase		0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
Kelfield Operations Centre - New Building		0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
Thorold Regional Office - Building & Site		10.6	2.1	0.0	0.0	0.0	0.0	0.0	/u
Dawn Administrative Centre		0.0	0.0	16.3	0.0	0.0	0.0	0.0	/u
Sudbury Regional Operations Centre		9.2	0.0	0.0	0.0	0.0	0.0	0.0	/u
Building New Facilities		0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
Building Systems Program		0.0	0.0	8.4	8.3	8.8	0.2	8.8	/u
Renovating existing facilities; maintenance of current site		0.0	0.0	1.4	0.0	0.0	0.0	0.0	/u
GHG and Energy Reductions Program		0.0	0.0	1.0	0.9	1.0	0.0	0.9	/u
Micro-Operations Depot Revitalization Program		0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
Workplace Furnishings Replacement Program		0.0	0.0	0.7	0.7	0.8	0.0	0.8	/u
Mapping to Strategy not Available		0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
GTA West		16.7	0.0	0.0	0.0	0.0	0.0	0.0	/u
GTA East		14.5	0.0	0.0	0.0	0.0	0.0	0.0	/u
Total		92.3	31.9	41.5	34.5	35.9	9.3	10.8	/u

Updated Table 1
REWS Capital Summary (\$ millions) with 2019-2022 Historical Actuals - EGI

Line No.	Particulars		2019 Actuals*	2020 Actuals*	2021 Actuals	2022 Actuals	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
1	Asset Class Strategy/Investment Name	Asset Program															/u
3	Property Upgrade Strategy		0.0	1.3	31.2	26.4	13.3	9.9	16.1	24.0	9.3	13.7	11.4	11.6	0.7	0.3	/u
4	Kennedy Road Expansion		0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
5	SMOC/Coventry Facility Consolidation		0.0	0.0	0.0	0.0	33.0	13.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
6	Station B New Building		0.0	2.2	1.2	10.9	13.0	25.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
7	VPC Core and Shell		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.1	13.9	8.4	0.0	/u
8	New London Site		0.0	0.0	1.6	0.3	0.0	0.0	11.9	17.2	20.4	0.0	0.0	0.0	0.0	0.0	/u
9	Kelfield Operations Centre - Land Purchase		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
10	Kelfield Operations Centre - New Building		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
11	Thorold Regional Office - Building & Site		0.0	0.0	0.0	0.0	0.1	0.8	7.9	10.6	2.1	0.0	0.0	0.0	0.0	0.0	/u
12	Dawn Administrative Centre		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.3	0.0	0.0	0.0	0.0	/u
13	Sudbury Regional Operations Centre		0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.2	0.0	0.0	0.0	0.0	0.0	0.0	/u
14	Building New Facilities		0.0	5.4	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
15	Building Systems Program		0.0	2.1	6.6	5.3	1.3	6.8	0.0	0.0	0.0	8.4	8.3	8.8	0.2	8.8	/u
16	Renovating existing facilities; maintenance of cu		0.0	17.5	38.8	16.4	0.9	4.7	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	/u
17	GHG and Energy Reductions Program		0.0	0.2	0.2	0.2	0.1	0.9	0.0	0.0	0.0	1.0	0.9	1.0	0.0	0.9	/u
18	Micro-Operations Depot Revitalization Program		0.0	0.0	0.4	1.1	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
19	Workplace Furnishings Replacement Program		0.0	0.2	0.3	0.9	0.2	0.6	0.0	0.0	0.0	0.7	0.7	0.8	0.0	0.8	/u
20	Mapping to Strategy not Available		42.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	/u
21	GTA West	Furniture/Structures & Improvements	0.0	0.0	26.2	2.8	0.5	0.0	25.4	16.7	0.0	0.0	0.0	0.0	0.0	0.0	/u
22	GTA East		0.0	0.0	0.0	0.0	0.3	0.0	0.0	14.5	0.0	0.0	0.0	0.0	0.0	0.0	/u
21	Total		42.1	28.8	110.9	64.3	63.0	63.0	61.3	92.3	31.9	41.5	34.5	35.9	9.3	10.8	/u

*Asset class historical spend profiles in 2019 and 2020 do not include associated overheads

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 231

Question(s):

- a) With respect to the Vehicle Replacement Strategy, please complete the following table of vehicle replacements for the years 2018 to 2032:

# Replacements	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Light-Duty															
Medium-Duty															
Heavy-Duty															
Total															

- b) For each of the vehicles replaced in part a) please provide the age in months, km, and hours of use at the time of replacement.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

- a) Table 1 includes actual replacements from 2018 to 2022, and forecasted replacements from 2023 to 2032 based on the Capital Update:

Table 1

# Replacements	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Light-Duty	98	127	89	51	129	51	235	198	198	198	198	198	198	198	198	/u
Medium-Duty	19	36	47	32	32	0	27	25	25	25	25	25	25	25	25	/u
Heavy-Duty	3	12	11	19	6	0	18	12	12	12	12	12	12	12	12	/u
Total	120	175	147	102	167	51	280	235	235	235	235	235	235	235	235	/u

- b) The average age in months and km at time of replacement for each vehicle type, between 2018 and 2022, is provided in Table 2:

Table 2

Average at time of replacement	Age in months	Milage in km
Light-Duty	138	200,184
Medium- Duty	156	162,308
Heavy-Duty	178	154,066

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 233

Question(s):

Please provide the Fleet and Equipment Capital Summary in the same format as Table 5.5.9-1 for the years 2019 to 2022 and provide an excel version of the table.

Response:

Please see response at Exhibit I.2.6-SEC-138.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/p. 250

Question(s):

Please provide the Technology and Information Services Capital Summary in the same format as Table 5.6.9-1 for the years 2019 to 2022 and provide an excel version of the table.

Response:

Please see response at Exhibit I.2.6-1 SEC -139 part c).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2

Question(s):

Please provide excel versions of the following Tables: Table 5.1.10-1

- a) Table 5.2.3-4
- b) Table 5.2.4-8
- c) Table 5.2.5-9
- d) Table 5.3.5-3
- e) Table 5.3.6-1
- f) Table 5.3.7-1
- g) Table 5.4.8-1
- h) Table 5.5.9-1

Response:

/u

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

- a-h) An excel file of the requested tables is provided at Attachment 1. Please note that Enbridge Gas identified discrepancies in the table numbers with some table numbers not actually having been used. In response Enbridge Gas has provided the Capital Expenditure Summary Tables associated with Sections 5.2.1, 5.2.3, 5.2.4, 5.2.5, 5.3.5, 5.3.6, 5.3.7, 5.4 and 5.5 of the Asset Management Plan provided at Exhibit 2, Tab 6, Schedule 2. Figures 5.12 and 5.13 have been included as well.

Table 5.1.10-1 Growth Capital Summary (\$ Millions) - EGI

Line No.	Particulars	Asset Program	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	10-Year
1	Asset Class Strategy/Investment Name												
2	Customer additions under EBO 188	Customer Connections	286.3 M	304.0 M	248.4 M	257.8 M	254.1 M	247.4 M	229.5 M	227.2 M	217.4 M	200.2 M	2472.2 M
3	Hydrogen Strategy	Hydrogen Blending	1.7 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	1.7 M
4	Hydrogen Blending		0.0 M	3.8 M	5.1 M	2.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	10.9 M
5	Enbridge Gas Distribution System Hydrogen Feasibility Study		2.4 M	5.8 M	6.0 M	1.2 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	15.3 M
6	Distribution System Reinforcement under EBO 188	System Reinforcement	45.4 M	52.2 M	35.7 M	20.9 M	13.2 M	13.4 M	7.1 M	10.6 M	13.7 M	7.7 M	219.9 M
7	Hamilton Reinforcement Project		3.9 M	11.5 M	103.8 M	6.6 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	125.8 M
8	NW 6581 Ottawa Reinforcement Phase 2 SRP		0.0 M	0.0 M	0.0 M	0.0 M	0.4 M	7.4 M	61.9 M	0.7 M	0.4 M	0.0 M	70.7 M
9	SRP LUG East Kingston Creekford Rd Reinforcement NPS8 6200m 6895kPa		0.0 M	0.0 M	0.0 M	10.7 M	32.4 M	2.2 M	0.0 M	0.0 M	0.0 M	0.0 M	45.3 M
10	SRP Southeast Owen Sound County Rd 40 Reinforcement NPS12 11800m 4670kPa		0.7 M	2.7 M	28.5 M	1.8 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	33.6 M
11	SRP Southwest Wonderland New STN & MOP Upgrade		0.0 M	0.0 M	20.5 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	20.5 M
12	SRP Southwest Woodstock Reinforcement & Reinforcement NPS6 8200m 1900kPa		0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	12.2 M	0.0 M	0.0 M	0.0 M	12.2 M
13	HAMI: Caledonia Transmission Station Rebuild (15X-401)		0.8 M	9.2 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	10.0 M
14	Total		341.1 M	389.2 M	448.1 M	301.0 M	300.1 M	270.4 M	310.6 M	238.5 M	231.4 M	207.9 M	3038.3 M

Table 5.2.3-4: Distribution Pipe Capital Summary (\$ Millions) – EGI

Line No.	Particulars	Program Name	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	10-Year
1	Asset Class Strategy												
2	TIIMP Retrofits and Digs	Integrity	3.9 M	0.0 M	0.0 M	2.1 M	2.7 M	2.7 M	2.6 M	2.8 M	2.8 M	2.8 M	22.5 M
3	Inspection Program Integrity Retrofits and Digs		82.5 M	106.2 M	47.8 M	65.1 M	47.5 M	21.7 M	21.3 M	21.8 M	22.0 M	20.8 M	456.6 M
4	Depth of Cover Program		0.0 M	0.4 M	5.1 M	3.4 M	4.3 M	3.0 M	1.6 M	0.7 M	0.7 M	0.7 M	19.9 M
5	Class Location Program	Class Location	3.6 M	2.5 M	2.5 M	6.6 M	6.7 M	9.6 M	9.1 M	6.8 M	6.9 M	6.4 M	60.9 M
6	Corrosion Prevention Program	Corrosion	4.8 M	20.2 M	10.6 M	11.2 M	10.9 M	11.2 M	11.4 M	11.2 M	11.5 M	11.4 M	114.5 M
7		Main Replacement	0.3 M	1.6 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	1.9 M
8	Emergency Replacement Program	Main Replacement	1.5 M	4.8 M	4.9 M	0.0 M	0.0 M	5.6 M	5.5 M	5.9 M	6.1 M	6.2 M	40.4 M
9	General Replacement Program	Main Replacement	19.8 M	22.5 M	5.7 M	3.3 M	19.2 M	32.6 M	18.2 M	18.5 M	29.1 M	16.9 M	185.8 M
		MOP	0.0 M	0.0 M	.0 M	6.6 M	6.7 M	6.8 M	6.7 M	6.8 M	6.9 M	6.4 M	47.0 M
10	Service Replacement Program	Service Relay	34.3 M	37.0 M	35.7 M	37.4 M	35.6 M	36.1 M	35.4 M	37.8 M	37.9 M	37.8 M	365.1 M
11	Relocation Program	Relocations	36.5 M	40.9 M	43.4 M	43.5 M	44.7 M	45.7 M	45.4 M	47.5 M	46.8 M	44.5 M	439.0 M
12	Bare and Unprotected Program	Main Replacement	2.1 M	6.8 M	0.0 M	10.6 M	8.3 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	27.8 M
13	Vintage Steel Replacement Program		3.7 M	8.1 M	8.1 M	0.3 M	20.2 M	105.1 M	142.5 M	188.3 M	290.0 M	466.5 M	1232.8 M
14	St. Laurent Phase 3 - North/South (NPS12/16 Steel)		0.0 M	12.2 M	103.3 M	6.4 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	121.8 M
15	St. Laurent Phase 3 - Coventry/Cummings/St. Laurent (Plastic)		0.0 M	23.4 M	1.7 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	25.0 M
16	St. Laurent Phase 4 - East/West (NPS12 Steel)		0.0 M	51.2 M	2.7 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	53.9 M
17	St. Laurent Phase 4 - Lower Section (Plastic)		0.0 M	0.5 M	9.1 M	0.5 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	10.2 M
18	NPS 20 Lake Shore Replacement (Cherry to Bathurst)		34.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	34.0 M
19	NPS 12 Martin Grove Rd Main Replacement: Lavington to St. Albans Rd.		0.0 M	0.0 M	3.2 M	26.1 M	1.4 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	30.6 M
20	Moulton Replacement BU		0.0 M	0.8 M	17.4 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	18.2 M
21	Copper Services Replacement Program	Service Relay	0.0 M	2.4 M	0.9 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	3.3 M
22	AMP Fitting Replacement Program		10.3 M	15.4 M	24.3 M	44.0 M	41.7 M	47.0 M	45.8 M	49.3 M	50.8 M	51.4 M	379.9 M
23	A10: Wilson Avenue, Toronto, VSM Replacement	Main Replacement	.0 M	.0 M	69.8 M	4.0 M	.0 M	.7 M	2.6 M	28.4 M	1.4 M	.0 M	107.0 M
24	A60: Sparks St. Ottawa, Replacement		.1 M	.1 M	.0 M	11.7 M	.5 M	.0 M	.0 M	.0 M	.0 M	.0 M	12.5 M
25	Div .04: NPS 8 Port Stanley, London, Replacement		.0 M	.0 M	18.9 M	.0 M	.0 M	.0 M	.0 M	.0 M	.0 M	.0 M	18.9 M
26	Total		237.5 M	357.0 M	415.0 M	283.0 M	250.2 M	327.9 M	348.3 M	425.9 M	512.9 M	671.8 M	3829.6 M

Table 5.2.4-8: Distribution Stations Capital Summary (\$ Millions) – EGI

Line No.	Particulars												
1	Asset Class Strategy	Program Name	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	10-Year
2		Gate, Feeder & A Stations	13.6 M	26.0 M	13.2 M	50.9 M	48.0 M	62.2 M	57.2 M	58.9 M	58.6 M	56.4 M	445.0 M
3	Stations with Auxiliary Equipment Replacement Strategy	Station Rebuilds & B and C Stations	1.5 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	1.8 M	15.4 M	0.0 M	18.7 M
4	Lisgar Station	Gate, Feeder & A Stations	0.1 M	0.0 M	20.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	20.1 M
5	Crowland Station		4.9 M	0.0 M	22.8 M	0.6 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	28.2 M
6	Compliance Remediation Strategy		1.0 M	0.4 M	0.0 M	0.0 M	0.7 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	2.0 M
7	Obsolete Heating Equipment Strategy	Gate, Feeder & A Stations	1.7 M	0.1 M	3.6 M	1.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.6 M	0.0 M	7.0 M
8		Gate, Feeder & A Stations	0.1 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.1 M
9	Odourization System Strategy	Station Rebuilds & B and C Stations	3.3 M	6.1 M	0.4 M	4.5 M	3.7 M	3.3 M	3.9 M	3.1 M	2.6 M	2.4 M	33.5 M
10	Telemetry Strategy	Gate, Feeder & A Stations	2.0 M	1.4 M	0.0 M	2.0 M	0.0 M	5.1 M	4.6 M	4.7 M	4.9 M	4.9 M	29.8 M
11		Station Rebuilds & B and C Stations	0.1 M	0.1 M	0.0 M	0.1 M	0.0 M	0.1 M	0.1 M	0.1 M	0.1 M	0.1 M	0.9 M
12	Facilities Integrity Management Program	Integrity Initiatives	0.4 M	7.0 M	8.3 M	6.3 M	6.2 M	6.3 M	6.2 M	6.4 M	6.4 M	6.1 M	59.5 M
13	Distribution System Station Replacement Strategy	Station Rebuilds & B and C Stations	17.3 M	22.9 M	40.8 M	32.2 M	16.0 M	26.1 M	25.4 M	26.8 M	19.0 M	26.1 M	252.6 M
14	Header Station Replacement Program		1.5 M	0.8 M	0.0 M	0.0 M	0.0 M	1.3 M	1.2 M	1.3 M	1.3 M	1.3 M	8.7 M
15	Customer Station Replacement Program		1.4 M	0.6 M	0.0 M	1.3 M	0.0 M	1.4 M	1.3 M	1.4 M	1.4 M	1.4 M	10.2 M
16	Inside Regulator Room Program	Inside Regulator & ERR Program	1.9 M	2.5 M	2.5 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	7.0 M
17	CNG Strategy	CNG	2.5 M	3.4 M	1.4 M	1.0 M	1.0 M	1.1 M	1.1 M	1.1 M	1.2 M	1.2 M	14.9 M
18	Station Painting Program	Station Rebuilds & B and C Stations	0.0 M	1.9 M	0.0 M	2.7 M	0.0 M	2.7 M	2.7 M	2.7 M	2.8 M	2.6 M	18.0 M
19	GTAW Parkway Gate Station Rebuild Phase 2	Gate, Feeder & A Stations	1.9 M	9.4 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	11.3 M
20	St. John's Sideroad Feeder Station Relocation		11.9 M	0.4 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	12.2 M
21	Stations Painting Program		0.0 M	0.5 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.5 M
22	Brampton Gate Station Rebuild	Station Rebuilds & B and C Stations	0.1 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.1 M
23	Distribution Station Replacement Program		0.1 M	0.0 M	0.0 M	2.2 M	3.5 M	4.3 M	7.1 M	7.4 M	3.3 M	7.3 M	35.1 M
24	Sarnia Industrial Station 2029 Rebuild		0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	2.7 M	10.8 M	1.4 M	0.0 M	0.0 M	14.8 M
25	Total		67.5 M	83.5 M	113.0 M	104.9 M	79.0 M	116.6 M	121.5 M	117.0 M	117.7 M	109.8 M	1030.6 M

Table 5.2.5-9 Utilization Capital Summary (\$ Millions) - EGI

Line No.	Particulars												
1	Asset Class Strategy	Program Name	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	10-Year
2	Meter Purchases	Meters (growth)	18.0 M	16.5 M	17.0 M	18.5 M	19.2 M	20.2 M	20.3 M	21.8 M	22.7 M	22.8 M	196.9 M /u
3		Meters (mtc)	73.1 M	74.2 M	76.5 M	83.1 M	70.2 M	91.1 M	91.1 M	98.1 M	102.4 M	102.7 M	862.5 M /u
4	AMI Pilot	Monitoring Systems	3.3 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	3.4 M /u
5	MXGI Program	Regulator Refit	65.0 M	60.2 M	64.8 M	69.4 M	60.3 M	74.8 M	74.4 M	79.0 M	81.7 M	80.7 M	710.4 M /u
6	Targeted Inspection and Remediation Program	Remediation	1.4 M	1.4 M	1.8 M	2.1 M	2.3 M	2.6 M	2.5 M	2.7 M	2.7 M	2.6 M	22.1 M /u
7	Total		160.7 M	152.3 M	160.2 M	173.0 M	152.0 M	188.7 M	188.3 M	201.6 M	209.5 M	208.8 M	1795.2 M /u

Table 5.3.5-3 Compression Stations Capital Summary (\$ Millions) - EGI

Line No.	Particulars		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	10-Year
1	Asset Class Strategy/Investment Name	Asset Program											
2	Dawn C Compression Lifecycle		0.3 M	0.0 M	15.3 M	32.2 M	100.8 M	17.8 M	0.0 M	0.0 M	0.0 M	0.0 M	166.3 M
3	Dawn to Corunna		186.5 M	13.8 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	200.3 M
4	Dawn to Corunna (Dawn Tie-in)		105.8 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	105.8 M
5	Waubuno Compression Lifecycle		0.3 M	2.4 M	26.4 M	0.1 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	29.2 M
6	Foundation Block Replacements	Replacements	3.5 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	3.1 M	6.6 M
7	Facilities Integrity Management Program	Integrity	0.8 M	0.6 M	0.3 M	0.1 M	0.1 M	0.1 M	0.1 M	0.1 M	0.1 M	0.1 M	2.1 M
8	Overhauls	Overhauls	2.2 M	7.6 M	9.7 M	6.4 M	4.7 M	6.7 M	0.4 M	0.5 M	1.0 M	4.4 M	43.6 M
9		Replacements	1.0 M	1.9 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	2.9 M
10	Valve Replacements	Replacements	1.8 M	1.7 M	0.2 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	3.7 M
11		Growth	1.1 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	1.1 M
12		Improvements	0.7 M	0.0 M	0.4 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	1.2 M
13	Condition-based Replacements	Replacements	3.5 M	4.1 M	1.2 M	2.5 M	1.4 M	1.5 M	1.1 M	1.1 M	2.0 M	1.1 M	19.5 M
14	Time-Based Replacement	Improvements	2.0 M	1.5 M	0.4 M	0.8 M	0.6 M	0.6 M	0.6 M	0.6 M	0.6 M	0.6 M	8.2 M
15		Replacements	0.5 M	0.6 M	0.9 M	1.7 M	1.2 M	3.2 M	1.4 M	1.0 M	1.1 M	1.1 M	12.8 M
16	Run-to-Failure Based Programs	Improvements	5.8 M	6.4 M	1.3 M	0.4 M	0.6 M	1.0 M	1.4 M	0.6 M	0.4 M	0.4 M	18.3 M
17		Land/Structures - Improvements	0.7 M	0.5 M	0.4 M	1.1 M	0.2 M	0.4 M	0.2 M	0.3 M	0.2 M	0.2 M	4.2 M
18		Replacements	1.9 M	1.1 M	4.1 M	0.0 M	0.3 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	7.5 M
19		Improvements	0.3 M	0.3 M	0.0 M	0.4 M	0.1 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	1.1 M
20	Siemens Valve Controller Replacement	Replacements	0.6 M	1.5 M	1.2 M	0.8 M	0.1 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	4.2 M
21	High Performance Coating	Improvements	1.6 M	0.0 M	0.7 M	0.7 M	0.7 M	0.8 M	0.8 M	0.8 M	0.8 M	0.7 M	7.6 M
22	GHG Emissions Reductions	Replacements	0.1 M	1.5 M	0.3 M	1.3 M	1.3 M	1.4 M	1.3 M	1.4 M	1.4 M	1.3 M	11.3 M
23	STCO Strategic Land Purchases	Land/Structures - Improvements	0.3 M	0.0 M	0.7 M	0.0 M	3.3 M	3.4 M	3.4 M	3.4 M	3.4 M	3.2 M	21.2 M
24	Total		321.3 M	45.5 M	63.6 M	48.5 M	115.3 M	36.8 M	10.7 M	9.6 M	10.9 M	16.2 M	678.5 M

Table 5.3.6-1 Transmissoin Pipe and Underground Storage Capital Summary (\$ Millions) - EGI

Line No.	Particulars												
1	Asset Class Strategy/ Investment Name	Program Name	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	10-Year
2		Improvements	0.0 M	0.3 M	0.0 M	0.6 M	0.7 M	1.6 M	0.7 M	1.6 M	0.8 M	1.5 M	8.0 M
3		Integrity	0.6 M	0.3 M	0.3 M	0.3 M	0.3 M	0.3 M	0.3 M	0.3 M	0.3 M	0.3 M	3.1 M
4		Land/Structures - Improvements	0.0 M	0.4 M	0.1 M	0.1 M	0.1 M	0.1 M	0.1 M	0.1 M	0.1 M	0.1 M	1.1 M
5	Well Casing Inspection, Maintenance & Replacements	Replacements	1.8 M	0.2 M	5.9 M	0.9 M	3.1 M	3.2 M	3.1 M	3.2 M	3.1 M	3.1 M	27.5 M
6		Improvements	0.5 M	3.3 M	0.0 M	2.3 M	0.3 M	1.3 M	0.3 M	1.3 M	0.3 M	1.3 M	11.0 M
7	Wellhead Upgrades	Integrity	0.0 M	0.3 M	0.3 M	0.4 M	0.4 M	0.4 M	0.4 M	0.4 M	0.4 M	0.4 M	3.6 M
8	Well Testing and Acid Stimulations	Improvements	0.0 M	0.1 M	0.0 M	0.3 M	0.3 M	0.3 M	0.3 M	0.3 M	0.3 M	0.3 M	2.4 M
9	Well Accessibility	Land/Structures - Improvements	0.0 M	0.1 M	0.0 M	0.1 M	0.1 M	0.1 M	0.1 M	0.1 M	0.1 M	0.1 M	0.7 M
10	TIMP Retrofits and Digs		23.3 M	36.3 M	19.1 M	22.2 M	25.4 M	21.4 M	15.5 M	16.0 M	17.8 M	15.5 M	212.5 M
11	Depth of Cover Program	Integrity	3.9 M	2.0 M	6.5 M	4.9 M	4.9 M	5.1 M	5.0 M	5.1 M	5.1 M	4.8 M	47.3 M
12	Class Location Program	Class Location	0.3 M	2.8 M	2.8 M	18.7 M	7.0 M	7.2 M	7.1 M	7.2 M	7.2 M	6.8 M	66.9 M
13	MOP Verification Program		0.8 M	0.0 M	0.0 M	5.3 M	5.4 M	5.5 M	5.3 M	5.5 M	5.6 M	5.4 M	38.8 M
14	Panhandle Line Replacement		0.0 M	1.4 M	32.0 M	4.5 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	37.9 M
15	Time-Based Replacement	Replacements	0.1 M	0.6 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.8 M
16		Improvements	0.2 M	4.4 M	1.8 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	6.4 M
17		Land/Structures - Improvements	0.0 M	0.3 M	0.3 M	0.3 M	0.3 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	1.1 M
18	Run-to-Failure Based Programs	Replacements	0.3 M	0.7 M	0.0 M	0.5 M	0.5 M	0.5 M	0.5 M	0.5 M	0.3 M	0.3 M	3.8 M
19	STCO Strategic Land Purchases	Land/Structures - Improvements	0.0 M	0.0 M	0.0 M	0.0 M	2.7 M	2.7 M	2.6 M	2.8 M	2.8 M	2.8 M	16.4 M
20	GHG Emissions Reductions	Improvements	0.0 M	1.0 M	1.9 M	0.1 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	2.9 M
21	Dawn Parkway Expansion Project (Dawn-Enniskillen NPS 48)		0.0 M	0.0 M	0.0 M	0.0 M	32.8 M	67.1 M	199.2 M	33.7 M	0.0 M	0.0 M	332.8 M
22	Dawn Parkway Expansion Project (Kirkwall-Hamilton NPS 48)		0.0 M	1.3 M	0.0 M	50.9 M	177.4 M	21.8 M	0.0 M	0.0 M	0.0 M	0.0 M	251.4 M
23	Panhandle Regional Expansion Project		22.7 M	194.9 M	6.8 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	224.3 M
24	Panhandle Regional Expansion Project - Dawn Facilities		38.9 M	5.4 M	46.8 M	0.9 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	92.0 M
25	Panhandle Regional Expansion Project - Leamington Interconnect		0.1 M	0.2 M	26.7 M	85.1 M	6.6 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	118.8 M
26	PREP: NPS 36 looping to Comber Transmission		0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	9.5 M	18.8 M	57.5 M	9.7 M	0.0 M	95.5 M
27	Growth	Growth	0.4 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.4 M
28	Condition-based Replacements		0.0 M	0.1 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.1 M
29	PCRW:Wells-Upgrade	Replacements	1.7 M	7.7 M	0.0 M	2.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	11.4 M
30	Cathodic Protection	Integrity	6.1 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	6.1 M
31	Total		101.6 M	263.9 M	151.1 M	200.4 M	268.4 M	148.0 M	259.4 M	135.6 M	53.9 M	42.6 M	1625.1 M

Table 5.3.7-1: Liquefied Natural Gas Capital Summary (\$ Millions) - EGI

Line No.	Particulars												
1	Asset Class Strategy/Investment Name	Program Name	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	10-Year
2	Hagar LNG Tank Boil Off Gas Recovery System	Improvements	0.0 M	0.0 M	0.0 M	1.2 M	11.9 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	13.1 M
3	Hagar KVGR and Cycle Mix Cooler	Replacements	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	2.1 M	22.7 M	24.7 M
4	Hagar Cold Box	Integrity	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	3.4 M	11.0 M	14.4 M
5	Valve Replacements	Replacements	0.1 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.1 M
6	Time-Based Replacement	Replacements	0.0 M	0.1 M	0.0 M	0.3 M	0.3 M	1.7 M	0.3 M	0.3 M	0.3 M	0.3 M	3.4 M
Improvements		0.1 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.1 M	
Land/Structures - Improvements		0.0 M	0.2 M	0.5 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.7 M	
9	Run-to-Failure Based Programs	Replacements	0.0 M	0.1 M	0.0 M	0.0 M	0.1 M	0.1 M	0.1 M	0.1 M	0.1 M	0.1 M	0.9 M
10	GHG Emissions Reductions	Improvements	0.0 M	0.4 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.4 M
11	Facilities Integrity Management Program	Integrity	0.3 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.3 M
12	Hagar JVG Compressor Upgrade	Replacements	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	2.1 M	18.8 M	20.9 M
13	Total		0.5 M	0.7 M	0.5 M	1.5 M	12.3 M	1.8 M	0.4 M	0.4 M	8.0 M	52.8 M	79.0 M

Table 5.4.8-1: REWS Capital Summary (\$ Millions) - EGI

Line No.	Particulars	Asset Program	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	10-Year	
1	Asset Class Strategy/Investment Name													
2	Property Upgrade Strategy	Furniture/Structures & Improvements	7.1 M	9.8 M	0.0 M	9.2 M	0.0 M	13.7 M	11.4 M	11.6 M	0.7 M	0.3 M	63.7 M	/u
4	GHG and Energy Reductions Program		0.0 M	0.9 M	0.0 M	0.0 M	0.0 M	1.0 M	0.9 M	1.0 M	0.0 M	0.9 M	4.7 M	/u
5	Micro-Operations Depot Revitalization Program		0.3 M	0.6 M	0.0 M	0.0 M	0.0 M	17.7 M	0.0 M	0.0 M	0.0 M	0.0 M	18.6 M	/u
6	Workplace Furnishings Replacement Program		0.2 M	0.6 M	0.0 M	0.0 M	0.0 M	0.7 M	0.7 M	0.8 M	0.0 M	0.8 M	3.8 M	/u
7	Building Systems Program		2.1 M	6.8 M	0.0 M	0.0 M	0.0 M	8.4 M	8.3 M	8.8 M	0.2 M	8.8 M	43.3 M	/u
8	Brockville Operations Centre - New Build		6.2 M	4.5 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	10.7 M	/u
9	GTA East - New Build - Peterborough		0.3 M	0.0 M	0.0 M	14.5 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	14.7 M	/u
10	GTA West - New Build - Halton Hills		0.5 M	0.0 M	25.4 M	16.7 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	42.7 M	/u
11	Kennedy Road New Build		0.2 M	0.0 M	16.1 M	24.0 M	9.3 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	49.6 M	/u
12	New London Site		0.0 M	0.0 M	11.9 M	17.2 M	20.4 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	49.5 M	/u
13	Ottawa - New Building		33.0 M	13.3 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	46.3 M	/u
14	Station B New Building		13.0 M	25.6 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	38.6 M	/u
15	Thorold Operations Centre - New Building		0.1 M	0.8 M	7.9 M	10.6 M	2.1 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	21.5 M	/u
16	VPC Core and Shell		0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	13.1 M	13.9 M	8.4 M	0.0 M	35.4 M	/u
17	Total		63.0 M	63.0 M	61.3 M	92.3 M	31.9 M	41.5 M	34.5 M	35.9 M	9.3 M	10.8 M	443.4 M	/u

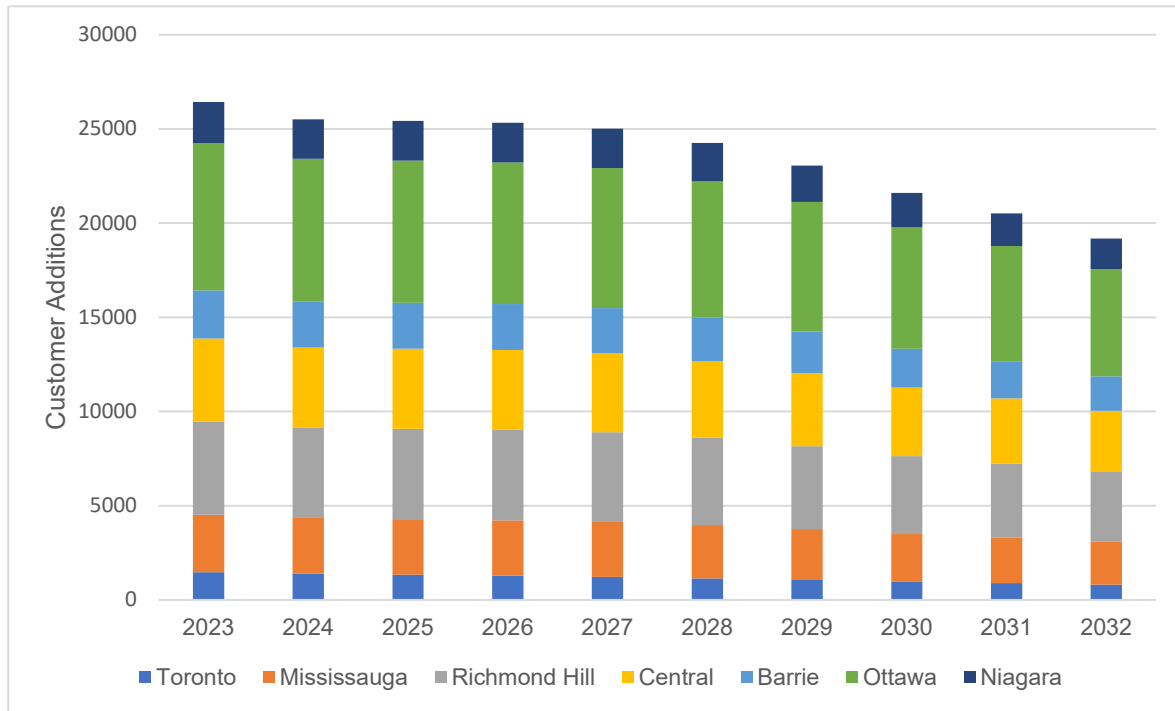
Table 5.5.9-1 Fleet and Equipment Capital Summary (\$ Millions) - EGI

Line No.	Particulars		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	10-Year
1	Asset Class Strategy	Program Name											
2	Heavy Equipment Replacement Program	Equipment & Materials	2.5 M	8.9 M	9.5 M	11.6 M	13.2 M	13.7 M	13.6 M	14.4 M	15.1 M	14.8 M	117.3 M
3	Tools Replacement Program	Tools	2.7 M	5.9 M	8.9 M	3.3 M	3.8 M	3.9 M	3.9 M	4.1 M	4.2 M	4.1 M	44.7 M
4	Vehicle Replacement Strategy	Vehicles	3.8 M	16.7 M	17.0 M	25.2 M	28.8 M	27.9 M	27.6 M	29.2 M	30.7 M	30.1 M	236.9 M
5	Total		8.9 M	31.5 M	35.4 M	40.1 M	45.7 M	45.5 M	45.1 M	47.7 M	50.0 M	49.1 M	398.9 M

Table 5.6.9-1: TIS Capital Summary (\$ Millions) - EGI

Line No.	Particulars	Asset Program	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	10-Year
1	Asset Class Strategy/Investment Name												
2	Developed and Packaged Applications Renewal Strategy	TIS Business Solutions	25.2 M	38.3 M	23.0 M	25.0 M	25.1 M	34.2 M	31.2 M	30.1 M	31.0 M	26.5 M	289.7 M
3	Application Infrastructure Renewal Strategy		1.5 M	3.1 M	0.6 M	1.0 M	2.9 M	2.9 M	2.7 M	3.1 M	2.8 M	2.9 M	23.5 M
4	Contract Market Harmonization		2.7 M	6.4 M	6.4 M	3.7 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	19.2 M
5	Contract Market Systems - Technology Obsolescence		10.7 M	22.8 M	22.7 M	13.6 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	69.8 M
6	General Service Rebased Changes		0.0 M	15.4 M	2.5 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	17.9 M
7	Records Management Upgrade		0.0 M	1.0 M	11.0 M	11.6 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	0.0 M	23.6 M
8	Field Device Renewal Strategy		1.1 M	0.0 M	0.0 M	5.3 M	0.0 M	0.0 M	0.0 M	0.0 M	2.8 M	0.0 M	9.2 M
9	Laptop/Desktop Renewal Strategy	TIS Infrastructure	1.5 M	5.1 M	7.1 M	4.6 M	4.8 M	8.2 M	4.8 M	5.1 M	5.3 M	8.5 M	55.0 M
10	Desktop Sustainment Equipment Strategy		1.0 M	1.1 M	1.1 M	1.2 M	1.2 M	1.3 M	1.3 M	1.4 M	1.4 M	1.4 M	12.5 M
11	Core Infrastructure and Security Renewal Strategy		3.1 M	2.5 M	3.1 M	4.0 M	3.4 M	3.4 M	3.1 M	4.1 M	4.1 M	3.5 M	34.2 M
12	Developed and Packaged Applications Renewal Strategy		0.0 M	0.0 M	0.0 M	0.9 M	1.4 M	0.9 M	0.8 M	0.8 M	0.8 M	0.9 M	6.6 M
13	Mobile Device Renewal Strategy		0.2 M	0.4 M	0.5 M	0.6 M	0.6 M	0.6 M	0.6 M	0.7 M	0.7 M	0.7 M	5.5 M
14	Field Device Renewal Strategy		0.2 M	6.4 M	0.0 M	0.0 M	5.4 M	5.2 M	2.0 M	0.0 M	0.0 M	11.2 M	30.4 M
15	Total		47.1 M	102.4 M	78.1 M	71.4 M	44.9 M	56.7 M	46.5 M	45.3 M	48.9 M	55.6 M	597.0 M

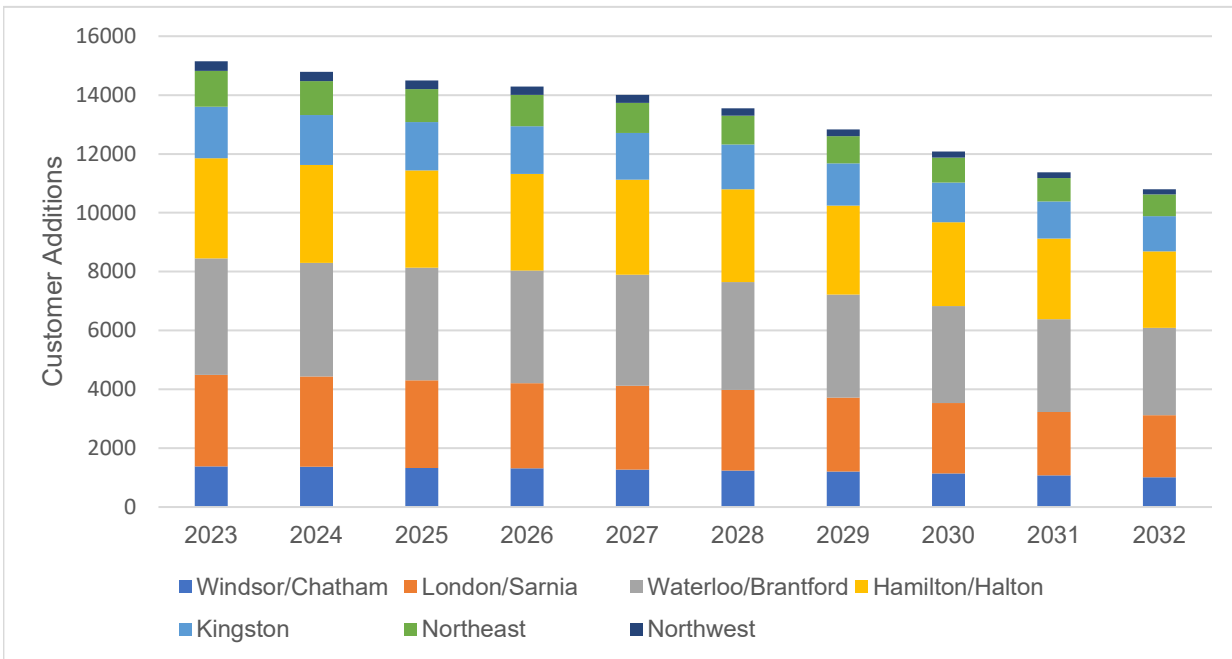
Figure 5.1-2: 10-Year Customer Growth Forecast - EGD Rate Zone



2023 the number of customer adds for EGD rate zone went up slightly by 385 customer adds

2024 the number of customer adds for EGD razte zone remained relatively the same

Figure 5.13: 10-Year Customer Growth Forecast - Union Rate Zones



For 2023, Union Rate zones the number of customer adds saw a small drop of 109

For 2024, Union rate zones dropped by 106 adds, similar to what was seen in the 2023 forecast

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2/Appendix A

Question(s):

Appendix A includes descriptions of discrete investments with a Net Base Capex greater than \$10M in 2023 to 2032.

- a) Please define Net Base Capex.
- b) Please explain why the capital amounts by year for the investments in Appendix A do not correspond to the capital amounts for the same projects in the capital tables in the AMP (Table 5.1.10-1, Table 5.2.3-4, Table 5.2.4-8, Table 5.2.5-9, Table 5.3.5-3, Table 5.3.6-1, Table 5.3.7-1, Table 5.4.8-1, Table 5.5.9-1).

Response:

- a) Net Base Capex refers to the required capital expenditure for a given investment, less contributions (both contributions in aid of construction and other contributions), less dismantlement costs, less overhead allocations.
- b) Capital amounts in Table 5.1.10-1, Table 5.2.3-4, Table 5.2.4-8, Table 5.2.5-9, Table 5.3.3-3, Table 5.3.6-1, Table 5.3.7-1, Table 5.4.8-1 and Table 5.5.9-1 include overhead allocations; while the amounts for projects identified in Appendix A do not.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Consumers Council of Canada (CCC)

Interrogatory

Reference:

Ex. 2/T6/S2

Question(s):

EGI identified the investment requirements and needs and then rationalized the expenditures with a constraint. Please identify the specific projects and programs that could be deferred if the OEB imposed the following:

- a) A 10% reduction in in-service additions in 2024;
- b) A 15% reduction in in-service additions in 2024.

What would be the impact on the 2024 Revenue Requirement if the OEB reduced the in-service additions by 10%, 15% and 20%?

Response:

a-b) Please see Attachment 1.

The following provides a description of how reductions were achieved by Asset Class and Asset Class Strategy impacts.

Distribution Pipe

- All three scenarios would result in 100% reduction to the AMP Fitting Replacement Program, Bare and Unprotected Steel Program, and Copper Services Replacement or Service Relay Program. Each of the AMP Fitting Replacement and Copper Service replacement programs have a proactive and reactive component. The result of deferring these programs would be an increased number of leaks in 2024, as provided at Exhibit 2, Tab 6, Schedule 2, page 117, Figure 5.2-61. According to reliability modelling, there could be as many as 638 leaks per year requiring reactive response. Ultimately, the response to such leaks would be replacement as there is no approved repair option for these services. As such, there would be little reduction in total capital spent on these strategies. The Bare and Unprotected Steel mains

program addresses pipe which has high likelihood of leakage and in many cases is already leaking. As described in Exhibit 2, Tab 2, Schedule 6, page 109, Section 5.2.3.6.3.1, the majority of these mains exist in urban areas, and would see an increased number of leaks requiring reactive repairs in 2024 if Enbridge Gas pauses its replacement program. This would lead to increased operational, health and safety risk. In the case of all 3 of these programs, 100% reduction would not support safe and reliable outcomes.

- Cancellation or reduction of scope to multiple Vintage Steel pipeline replacements would be necessary. As the pipelines in 2024 have already been prioritized through regional input based on known condition issues and proximity to homes or other buildings, it is expected that an increase in reactive leakage repair would be required for these projects. Depending on the pipe condition at leak locations, repair may not be an option and small scale capital replacements may be necessary. In some cases, the proposed reduction in scope for each project may not be feasible due to network configurations and requirements for specific tie-in locations.

Compressor Stations

- 50, 75 and 100% reductions to condition-base replacement programs for compressor station components that have been found to be in poor condition upon inspection. This will impact the safe and reliable operation of Enbridge Gas's compressor stations.
- 40, 45 and 52% reductions to Run to Failure replacement programs for equipment components. Reductions to this program carry some degree of risk in that the forecasts are built on historical failure data, and some of the funds removed from the forecast may still be required to address any failures that actually occur in order to ensure safe and reliable operation of compressor equipment. Given the time available to respond to this IR, Enbridge Gas is making an assumption that the reductions would be achievable. However, this assumption carries some inherent risk.
- 67% reduction to the Siemens Valve Controller Replacement Program across all 3 scenarios; impacting compressor reliability for the most critical compressors in Enbridge Gas's fleet.
- 53%, 71% and 88% reductions to time-based replacements, resulting in increased risk of premature equipment where components are scheduled for replacement based on failure history.

- 5, 25 and 50% reductions to GHG emission reduction projects which could result in non-compliance with the Multi Sector Air Pollutants Regulations should leaks be discovered through annual leak surveys and require remediation.

Distribution Stations

- 33% reduction to CNG strategy under all 3 scenarios which would require an increased expenditure for fleet vehicles where CNG stations are relied upon for refueling.
- 100% reduction to compliance remediation strategy under all 3 scenarios which could result in non-compliances identified through inspections not being remediated per compliance dates and equipment tag outs or fines, and could potentially have an impact on personal or societal safety.
- 100% reduction to customer station replacement strategy under all 3 scenarios which may result in leaks near customer buildings or failure of pressure control equipment, and increased exposure to the risks as identified in Exhibit 2, Tab 6, Schedule 2, Section 5.2.4.5.3.
- 2%, 16% and 30% reductions to the Distribution Station Replacement strategy, resulting in potential equipment failures that can result in leaks and failure of pressure control equipment, and an increase in the risks identified in Exhibit 2, Tab 6, Schedule 2, Section 5.2.4.4.3.
- 100% reduction to the Facilities Integrity Management Program under all 3 scenarios which will impact the ability to fully inspect stations prioritized for remedial work within the AMP and to determine the appropriate scope to address risk at these stations.
- 100% reduction to the Header Station Replacement Program under all 3 scenarios which could result in increased failures of pressure control equipment, and increased exposure to the risks identified in Exhibit 2, Tab 6, Schedule 2, Section 5.2.4.5.3.
- 100% reduction to the Odourization System Strategy under all 3 scenarios, which could lead to inadequate or over-odourization of downstream pipeline systems or loss of odourant containment which can result in significant resource impacts for both Enbridge Gas and Emergency Services. This would carry both an O&M and reputational risk for Enbridge Gas. Under-odourization may also occur, which creates significant health and safety risk to Enbridge Gas's customers and the communities it serves as well as higher risk of non-compliance that may result in penalties and fines.

- 93% reduction to the Station Painting Program for all 3 scenarios which will result in shortening of asset life for those stations which are experiencing corrosion due to coating damage.
- 4%, 16% and 27% reductions to the Station with Auxiliary Equipment Strategy, resulting in the deferral of necessary stations replacements and increase to risks as identified in Exhibit 2, Tab 6, Schedule 2, Section 5.2.4.5.3.
- 56% reduction to the Telemetry Strategy in all cases which would result in increased failures of devices used to provide data and control Enbridge Gas's most critical assets.

Growth

- 100% reduction to Hydrogen Strategy resulting in Enbridge Gas's inability to qualify for government grants and to achieve targeted GHG reductions.
- 15, 30, and 45% reductions to Growth Reinforcement projects, resulting in risk of customer outages, increased service calls, potential property damage and safety concerns as homes may lose heat during times of peak demand.

Transmission Pipe & Underground Storage (TPUS)

- 50, 75 and 100% reductions to the Time-Based Replacement Strategy, resulting in risk of equipment failure, reactive replacement of components, and temporary or longer term outages of TPUS assets.
- 50, 75 and 100% reductions to the Well Testing and Acid Stimulation strategy, resulting in lost deliverability and potential increased cost of gas through on-demand purchasing.
- 23, 38 and 52% reductions to Well Casing Inspection and Maintenance and Replacement strategy, resulting in higher risk of non-compliance and potential loss of containment.

Fleet and Equipment

- 33, 44, and 54% reductions to the Heavy Work Equipment strategy, resulting in higher safety and reliability risks, increased O&M costs, increased downtime and decreased resale value.
- 19% reduction in the Tools Strategy resulting in safety risk to employees and customers.

- 18%, 31% and 44% reductions to the Vehicle Replacement Strategy, resulting in higher safety and reliability risks, increased O&M costs, increased downtime and decreased resale value.

Real Estate

- 13, 19 and 24% reductions to the Property Upgrade Strategy, resulting in: work environments that do not provide universal, barrier free workplaces, failure to comply with applicable building code standards, constrained parking areas with risk of vehicular collisions, and reduced operational productivity.
- 12, 13, and 13% reductions to the Building Systems Program, resulting in potential failure of weather proofing, heating, cooling and lighting systems which will increase risk for employee health and safety and reduce productivity.
- 14, 21 and 28% reductions to the GHG and Energy Reductions Program, which will decrease Enbridge Gas's ability to meet GHG reduction targets.
- 12, 18 and 24% reductions to the Workplace Furnishings Replacement Strategy which will impact employee ergonomics, work environment inclusivity, and efficiency of workspace.
- 0, 25 and 50% reductions to Program Micro Operations Depot Revitalization Program. This would result in ongoing employee exposure to physical health and safety risk due to the condition of these aging facilities.

Technology and Information Services

- 25, 31 and 37% reductions to Developed and Packaged Applications Renewal Strategy, which will increase risk to compliance, security, operational safety and employee productivity due to inability to adequately support customers, maintain appropriate levels of cyber security, and manage work and records.

If the OEB reduced the in-service additions in 2024 by 10%, 15% or 20%, revenue requirement would increase by approximately \$3.0 million, \$3.7 million or \$5.1 million in each scenario respectively.

The revenue requirement impacts are driven by the following:

- Small decreases in carrying charges and depreciation that result from the removal of assets that were primarily forecast to be placed into service in the latter part of the year;

- Larger decrease to CCA tax deductions, which are not dependent on when assets close into service, which drives higher taxes.

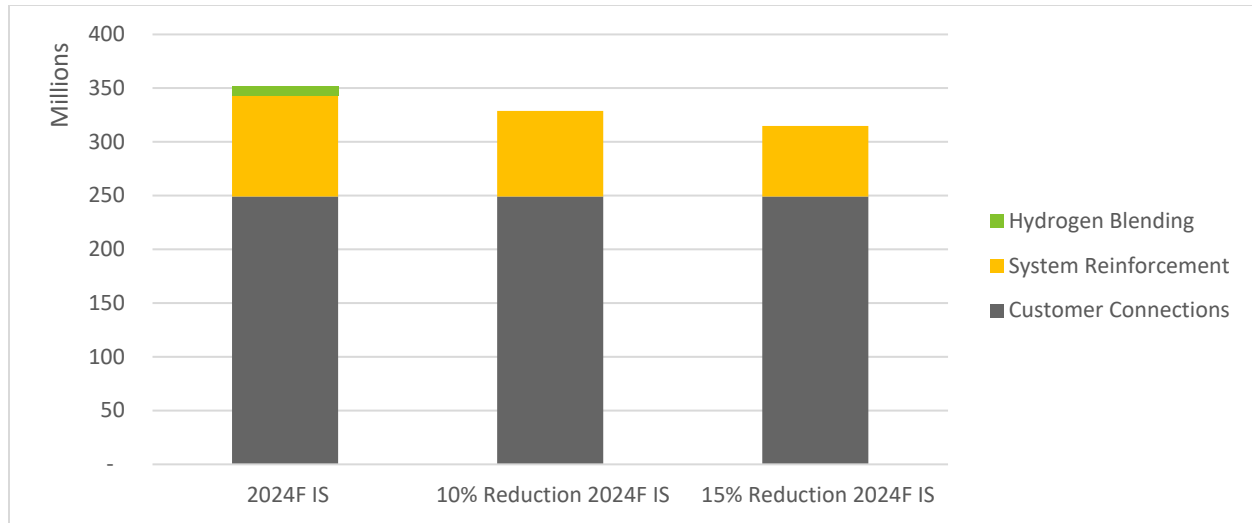


Figure 1 CCC 73: 2024 In-Service EGI Growth with Program Reductions

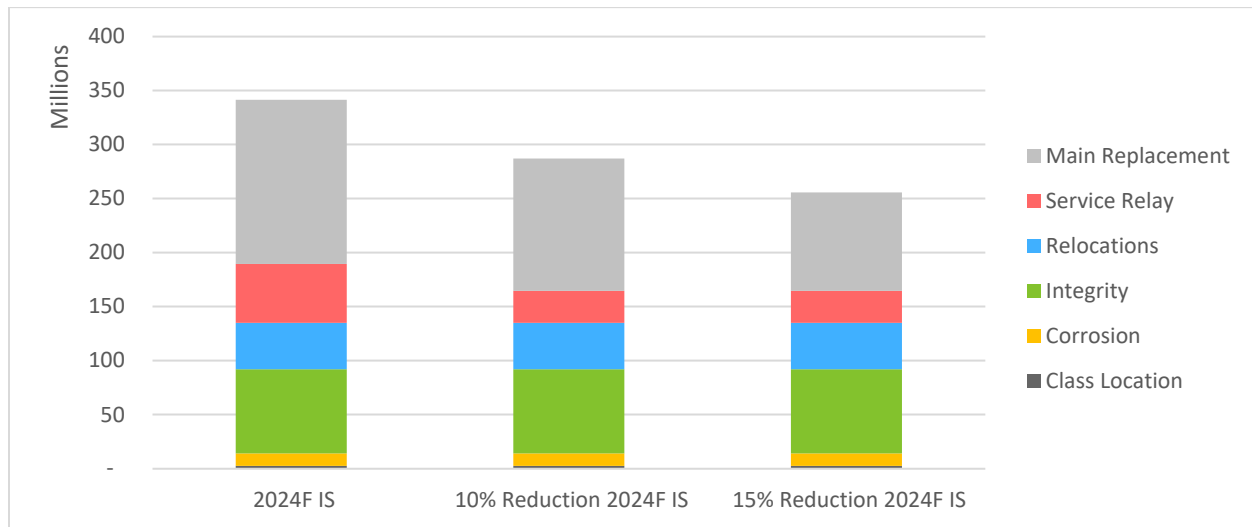


Figure 2 CCC 73: 2024 In-Service EGI Distribution Pipe with Program Reductions

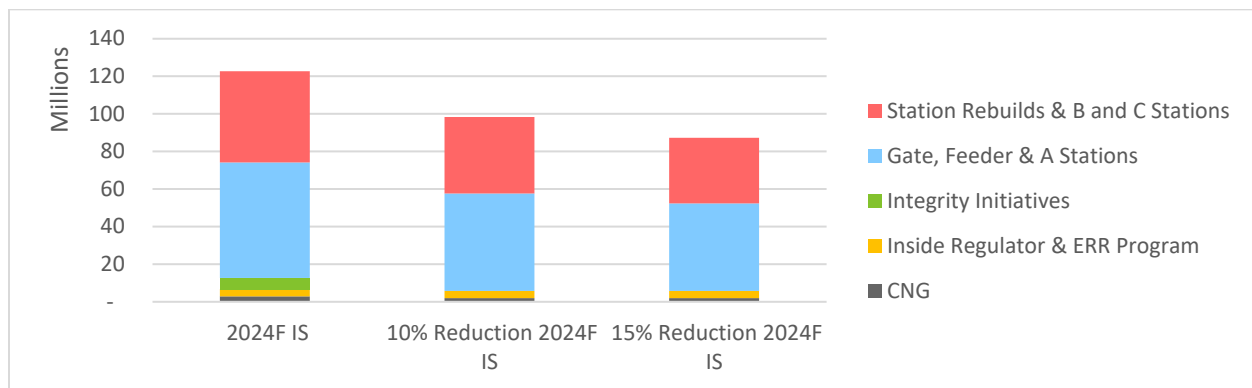


Figure 3 CCC 73: 2024 In-Service EGI Distribution Stations with Program Reductions

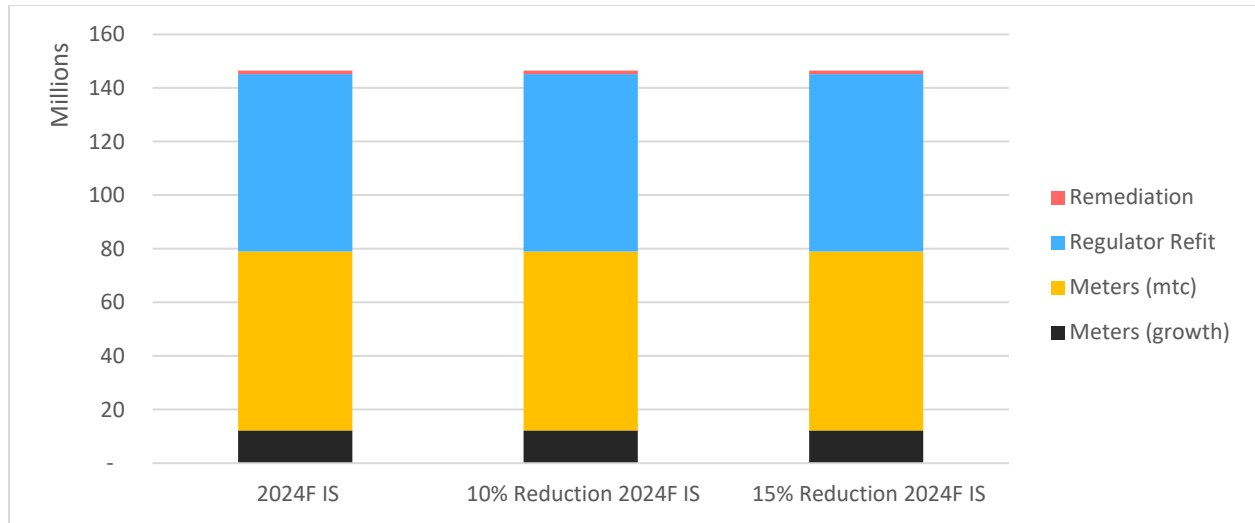


Figure 4 CCC 73: 2024 In-Service EGI Utilization with Program Reductions

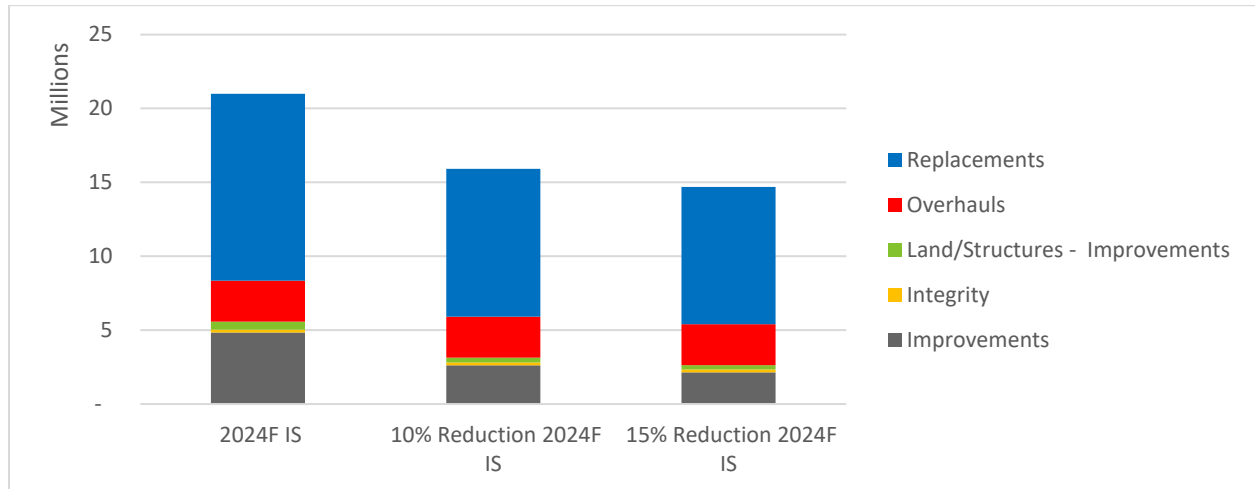


Figure 5 CCC 73: 2024 In-Service EGI Compression Stations with Program Reductions

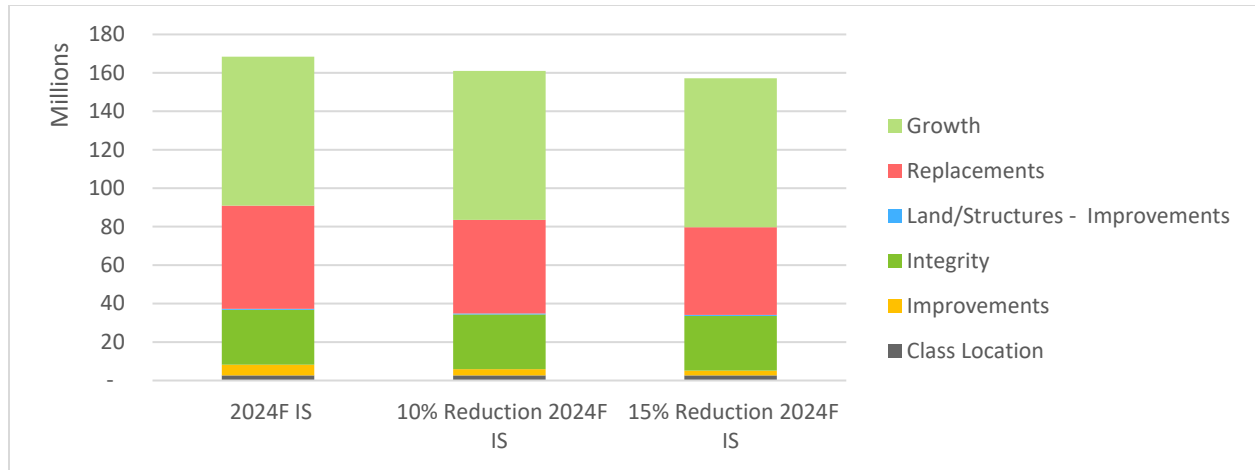


Figure 6 CCC 73: 2024 In-Service EGI Transmission Pipe and Underground Storage with Program Reductions

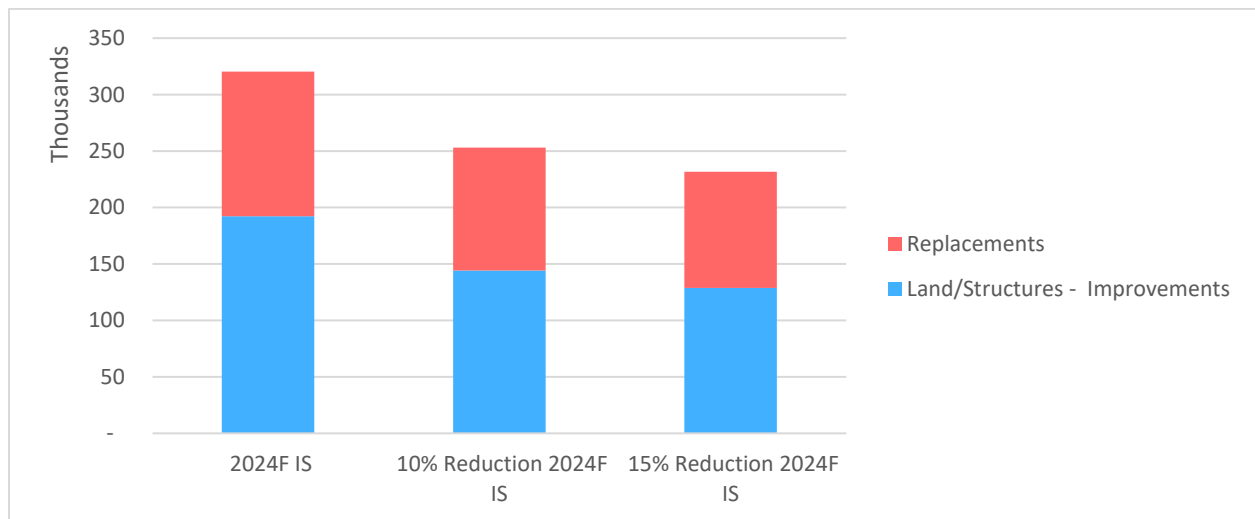


Figure 7 CCC 73: 2024 In-Service EGI Liquefied Natural Gas with Program Reductions

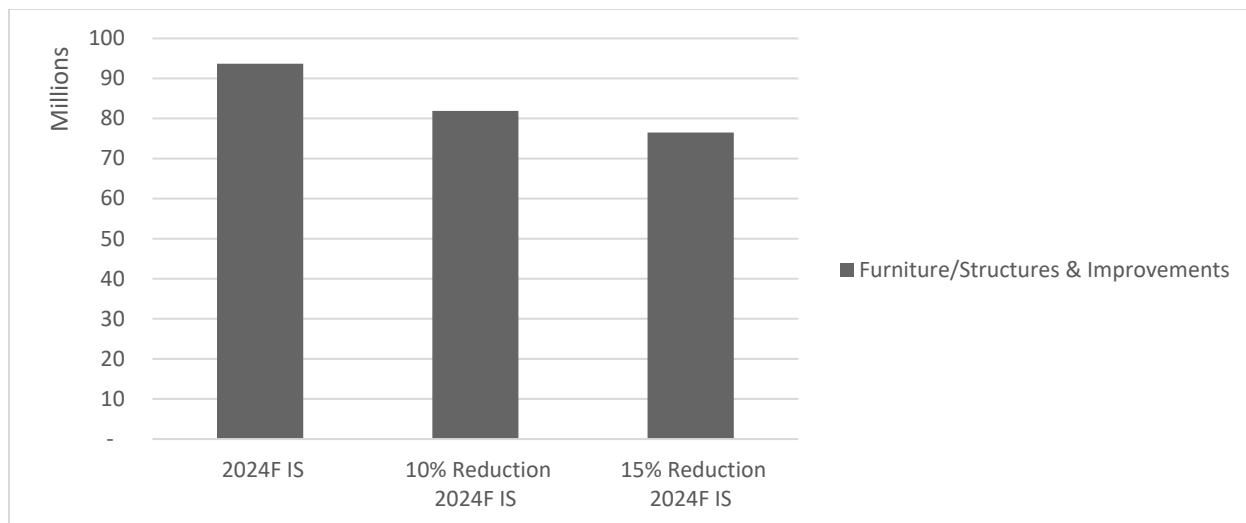


Figure 8 CCC 73: 2024 In-Service EGI REWS with Program Reductions

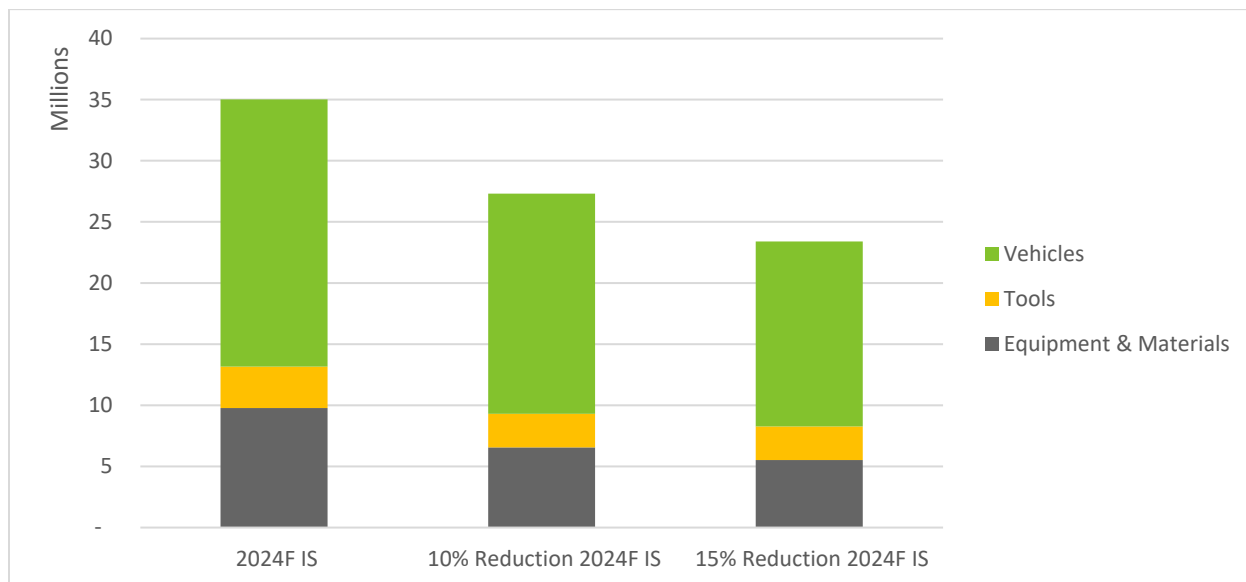


Figure 9 CCC 73: 2024 In-Service EGI Fleet and Equipment with Program Reductions

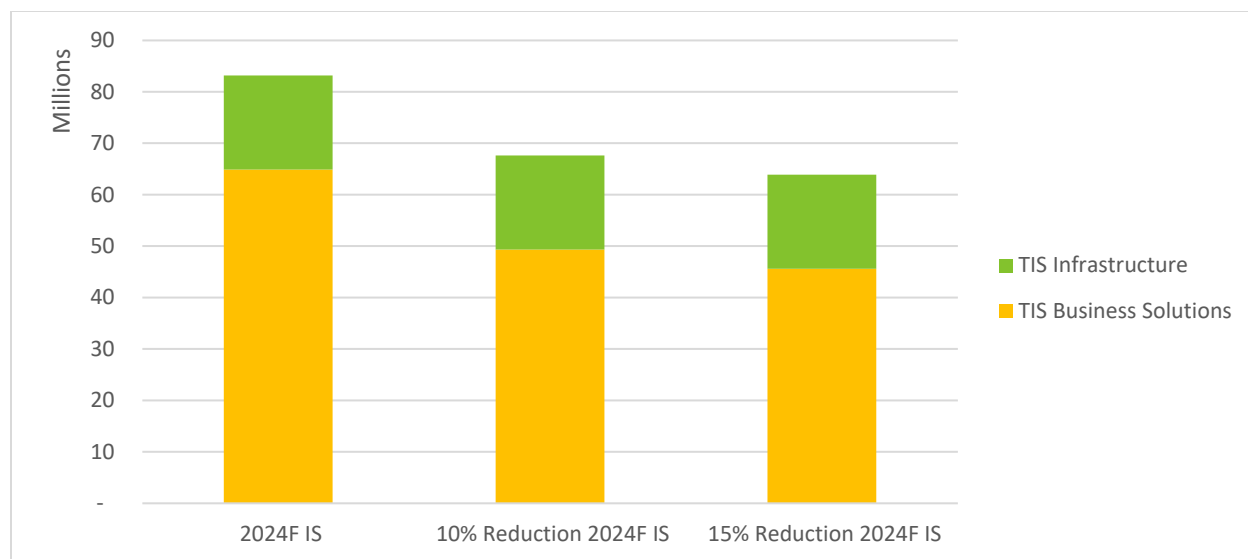


Figure 10 CCC 73: 2024 In-Service EGI TIS with Program Reductions

ENBRIDGE GAS INC.

Answer to Interrogatory from
Canadian Manufacturers & Exporters (CME)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 1, p. 24 of 55

Question(s):

At page 24, EGI stated “In addition, productivity and efficiency initiatives are identified to help manage cost increases.”

- a) Please clarify how these identified productivity and efficiency initiatives relate to the \$20.7 million in unidentified productivity that EGI is committing to as part of its application. Are these initiatives in addition to the \$20.7 million, or are these initiatives simply the identification of initiatives that would roll up into the \$20.7 million in currently unidentified productivity savings?

Response:

- a) Embedded (unidentified) productivity is included with identified productivity initiatives in the total productivity savings of \$31.0 million for the 2023 Bridge Year and \$35.2 million for the 2024 Test Year. Embedded productivity accounts for \$13.9 million net O&M (\$20.7 million Gross O&M) and \$18.1 million net O&M (\$28.5 million Gross O&M) in the 2023 Bridge Year and 2024 Test Year, respectively.

Please see response at Exhibit I.4.4-CME-32 and Exhibit 4, Tab 4, Schedule 2, Table 2, and paragraphs 15 to 18 for the figures noted in this response and further information.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Canadian Manufacturers & Exporters (CME)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, p. 44 of 288

Question(s):

- a) When was the last time EGI had a third party review its asset management processes?
- b) Does EGI believe there is any value to an outside review going forward? Please explain fully.

Response:

- a) Enbridge Inc. undertook an enterprise wide asset management maturity assessment in 2020, in which Enbridge Gas was a participant. Please see response at Exhibit I.2.6-SEC-110, Attachment 1 for details.
- b) Yes, Enbridge Gas sees value in outside review going forward to support continual process improvement and maturation of our asset management program and practices. Enbridge Gas uses the maturity assessment process followed to produce the report referenced in part a) of this response to track its progress towards goals of continuing to mature and advance its asset management processes.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Canadian Manufacturers & Exporters (CME)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, p. 47 of 288

Question(s):

At page 47, EGI stated “The Copperleaf value framework is an analytical framework that complements risk assessments, allows for comparison of dissimilar investments and enables portfolio optimization.”

- a) Please describe how the Copperleaf value framework allows for comparison of dissimilar investments for value measures. Are each of the applicable value measures converted into dollars, or another uniform measurement?
- b) As CME understands it, Copperleaf investments are ranked based on net value. How are GDS Risk Management Investments and Copperleaf investments integrated together within the overall budget restraint?

Response:

- a) The Copperleaf Value Framework contains multiple value models, and each value model calculates one or more value measures for an investment, as provided at Exhibit 2, Tab 6, Schedule 2, page 47, Table 4.1-3. The unit of each value measure is either in CA\$ or a value unit which is equivalent to \$1,000 CA\$.

The suite of value models in the value framework are created in different themes to capture value measures which are aligned with Enbridge Strategic Priorities and Asset Management Strategies as provided at Exhibit 2, Tab 6, Schedule 2, page 40, Figure 4.1-2. More than one value model can apply to an investment to evaluate its total net value.

When an investment need is identified, the Asset Investment Planning and Management (AIPM) process, as provided at Exhibit 2, Tab 6, Schedule 2, page 54, Figure 4.3-1, is triggered. If the investment is deemed to be value-driven, the assignment of value models to the investment would take place in the Solution Planning & Value Assessment stage (as provided at Exhibit 2, Tab 6, Schedule 2,

page 54, Section 4.3.2) of the AIPM process as part of the value assessment. The selection of value models for the investment depends on:

- Asset class of the investment and the relevant asset management strategy
- Cost, risk and benefits associated with the investment
- Best available data
- Maturity of analytical techniques

For examples illustrating how the value measures are used, please see the response at Exhibit I.2.6-CCC-49.

As provided at Exhibit 2, Tab 6, Schedule 2, Page 55, the outcome of the value assessment is the total investment value which is the combination of value measures and investment cost. A net present value (NPV) calculation is used to combine value measures and investment cost. This approach allows all value driven investments to be comparable to each other on the same economic scale.

- b) For the purposes of this response, what are described as Copperleaf investments in the question will be assumed to be Value Driven investments as described in Exhibit 2, Tab 6, Schedule 2, page 46, Table 4.1-2. These investments consider multiple value measures including risk, as described in part a), and are prioritized through the optimization and review processes described in Exhibit 2, Tab 6, Schedule 2, pages 55 to 56, Section 4.3.3, among Mandatory and Compliance investments, which are time-constrained. While some Value Driven investments are supported through the Risk Analysis process described in Exhibit 2, Tab 6, Schedule 2, pages 50 to 52, there are cases when the risk exceeds the upper threshold. In these cases, where a capital investment is required to treat the risk, that investment is categorized as Mandatory and is time constrained with other Mandatory and Compliance driven investments. The three categories of investments are integrated by fixing the Mandatory and Compliance driven investments based on their time constraints, and then allowing the Value-Driven investments to be optimized within the remaining space within the capital constraint.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Canadian Manufacturers & Exporters (CME)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, p. 48 of 288

Question(s):

At page 48, EGI stated “Asset data enables the evaluation of existing assets, determines patterns, supports costing of solution options and identifies meaningful information to inform life cycle management strategies.”

- a) For each major category of assets owned by EGI, please confirm whether or not EGI has complete asset data, or only partial asset data for each category.
- b) To the extent that EGI has incomplete asset data for any class of assets, please outline the scope of how much asset data is missing, the reason for the missing data, and EGI view of how the missing data impacts EGI lifecycle management strategies.

Response:

- a) For purposes of this response, “missing data” will be interpreted to mean data that is expected to be identified in the system of record associated with an asset that is not present. In general, it is highly likely that in gas carrying asset classes (including Distribution Pipe, Transmission and Underground Storage, Compression, Liquified Natural Gas, and Utilization) there are some pieces of asset data that are missing. Among the Real Estate, Technology and Information Services and Fleet asset classes, all data necessary to inform the lifecycle management strategies is available.

Missing data is not comprehensively measured across all asset classes and all asset data systems for existing assets to be able to quantify the amount of data that is considered missing. Although there are cases where data completeness is measured, this is not done across the entire asset base. There are a number of data completeness measures that are in place to confirm completeness of data at the time of asset installation and creation in the system of record.

- b) Data completeness is not comprehensively measured by asset class to be able to quantify how many data elements are missing. On a project-by-project basis, data needs are identified and where there are gaps which create barriers to being able to achieve the objectives of a particular project, work is initiated to gather the necessary data where possible.

Enbridge Gas has been gathering data on its assets for many decades. As analytics needs have evolved over time, Enbridge Gas continually updates its minimum data capture requirements. Most core data sets are available within Enbridge Gas systems; however, as analytical tools and assessments become more sophisticated, data needs may change and lead to the initiation of additional data gathering. In these cases, the additional data is not considered “missing”; rather, it simply has never been collected or entered into the system of record.

The reason for data being missing or not identified in the system of records in some cases is a result of historical data governance practices which have continued to become more robust. In some cases, a certain set of data or data element was not considered to play a significant role in decision making and as a result there was little need or focus on gathering it. As assessment techniques evolve and improve over time, data that was previously considered less important may become critical to support new analysis techniques. With greater focus on data-driven decision making, improved data governance processes have been implemented to monitor the completeness and accuracy of the data.

The impact of missing data on lifecycle strategies will depend on how sophisticated the assessment is and how much uncertainty exists. Where asset data is not available, there are strategies that can be employed to overcome this challenge, including:

1. gathering the necessary data and updating the system(s) of record;
2. leveraging external data sets (e.g., International Association of Oil and Gas Producers (IOGP), Pipeline and Hazardous Materials Safety Administration (PHMSA), Offshore and Onshore Reliability Data (OREDA) sources) to supplement internal data sets.

It is important to note that regardless of the level of completeness of the data set and the extent to which any data gap can be managed, asset assessments and evaluations take into account the quantity and quality of the data available. Models are built to make appropriate use of available data and due consideration is given to the limitations of the assessment based on the limitations of the data. These models inform the predicted condition of the asset, which then informs the maintenance, replacement, and renewal strategies for the different asset classes. The issue of missing data means that as new data becomes available, there may be opportunities

to adjust these strategies in the future by responding to more comprehensive condition data.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Canadian Manufacturers & Exporters (CME)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, p. 54 of 288

Question(s):

At page 54, EGI stated “Capital investment needs enter the AIPM process via EGI’s asset investment planning tool (Copperleaf). An investment need is either a risk or opportunity to the organization.”

- a) Please describe the difference between investments needs responding to risks, or responding to opportunities. For instance, are opportunities simply process improvements or investments that drive productivity, rather than mitigate risks?
- b) Please describe how EGI’s Copperleaf program and/or its asset investment processes more broadly integrate risk investments and opportunity investments within the budget constraint. For instance, are risk investments preferred over opportunity investments, or are both measured in terms of cost/benefit analysis?

Response:

- a) Investment needs responding to risks are intended to reduce the likelihood or negative impact of uncertainty on the organization’s objectives, while investment needs responding to opportunities are those investments required to pursue the organization’s objectives. Such objectives may include improvements in employee productivity, avoided greenhouse gas, cost avoidance, and other business improvements. Please see Exhibit 2, Tab 6, Schedule 2, page 47-48 of 288, Table 4.1-3 for a complete listing of value measures considered within the Copperleaf Value Framework.
- b) Please see response at Exhibit I.2.6.CME-18 part a) which describes how value driven investments which are supported by different value measures can be compared and prioritized to produce an Optimized scenario. Preference is not given to any specific value driver within the Value Framework and investments are measured in terms of a cost/benefit analysis.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Canadian Manufacturers & Exporters (CME)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, p. 54 of 288; Schedule 1, pp. 39-41 of 55

Question(s):

At Schedule 2, page 54, EGI stated “Depending on the required timing to address the identified investment need with a solution, an investment may be considered for portfolio optimization or may be considered emergent, where it is approved off-cycle from budgeting activities; emergent investments require capital within the current year and are reviewed case-by-case by the asset manager and Asset Management Governance.”

- a) Please describe how EGI’s investment optimization processes account for ICM eligible projects. For example, are ICM eligible projects treated separately from other projects, are they provided with a different weighting or scoring within Copperleaf, or treated differently within the investment optimization process?
- b) At page 39 of 55, EGI provides a list of potential ICM projects, and states that it does not anticipate asking for ICM treatment for those projects based on the 2023-2032 capital expenditure forecast. However, EGI goes on to state that they may be part of an ICM application if changes to the capital expenditure forecast were made. Please describe EGI’s process for changing capital expenditure forecasts and how those relate to the ICM projects. For instance, how does EGI determine which investments are moved from being supported by existing rates to not being supported by existing rates. Please explain fully.

Response:

- a) There is no distinction between the treatment of ICM eligible projects and non-ICM eligible projects in the optimization process.
- b) As provided at Exhibit 2, Tab 6, Schedule 2, page 18, Section 1.5, the 10-year capital plan is based on the best available information at the time of completion. Key assumptions that were made to determine the capital forecast are listed within Section 1.5. In most cases, when assumptions change and result in the forecasted

capital for a given year being less than what is required to complete all of Enbridge Gas's objectives, Enbridge Gas will reprioritize the portfolio, following the processes and principles provided at Exhibit 2, Tab 6, Schedule 2, pages 45-57 to work within the capital constraint. In the event that significant capital investments become necessary in the planning horizon that have specific time constraints that are driven by market, regulatory or other requirements, Enbridge Gas will attempt to reoptimize the capital plan. If optimization fails due to the constraint, as provided at Exhibit 2, Tab 6, Schedule 2, page 17 of 288, Enbridge Gas would have to remove these investments from the constraint, at which point different recovery treatments would have to be evaluated.

Enbridge Gas determines the capital budgets and forecasts based on the requirements to maintain the safe and reliable operation of the system and support the demand for growth. If Enbridge Gas is unable to meet these needs under the ICM materiality threshold, attempts will be made to pace or defer projects. If after that, the budget still exceeds the materiality threshold, ICM treatment is considered for discrete projects that meet the requirements of need, materiality and prudence as outlined in the OEB ICM policy. Enbridge Gas tries to accommodate all projects including those that are ICM eligible below the ICM materiality threshold.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Canadian Manufacturers & Exporters (CME)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, p. 85 of 288, Figure 5.2-4

Question(s):

At Figure 5.2-4, EGI provides a chart comparing EGD and Union digs for the 2015-2021 period.

- a) Why are digs so much more frequent in the Union Rate Zones than for the EGD Rate Zone?

Response:

- a) The number of historical integrity digs vary for a number of reasons. Some of these reasons include differing dig criteria for EGD and Union, the types of lines that are inspected each year and their associated condition and the type of inspection method. The predominant reason resulting in a larger number of historical Integrity digs in the Union rate zones is the relative size of the corresponding transmission system. The Union rate zones has an inventory of transmission piping approximately five times greater by length than the EGD rate zone. Please see Exhibit 2, Tab 6, Schedule 2, page 81, Table 5.2.3-1 for details on the relative size of each rate zone's transmission system.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Canadian Manufacturers & Exporters (CME)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, p. 47 of 288

Question(s):

At page 47, EGI stated: "Value measures are investment attributes that are evaluated objectively based on risk or opportunity to determine how the investment delivers value to Enbridge and the ratepayer. These value measures are placed on an economic scale to assist in optimization. An investment's net value is used to determine both its independent merit and its standing among other investments in a constrained optimization process."

- a) Please provide a list of all projects that were ranked according to their "net value", what their net value score was, and provide an indication of which projects were within the budgetary constraint, and which are not within the budgetary constraint.

Response:

- a) Please see Attachment 1 for the requested table.

As provided at Exhibit 2, Tab 6, Schedule 2, pages 55-56 of 288, the recommended portfolio is produced through iterative adjustments applied after optimization to consider other timing and resource constraints not applied in Copperleaf. Therefore, value is not the sole driver of setting priorities, but will provide an appropriate starting point to develop the final capital portfolio.

For additional information on value measures and value framework, please see response at Exhibit I.2.6-CME-18 and Exhibit I.2.6-CCC-49.

2023-2032 Optimization	AMP Asset Class	Investment Name	Value Score
Optimized - Kept within budgetary constraints	Distribution Pipe	000071, NRP - Wellington D2 - 2023 - 2025 - 1651	(351)
Optimized - Kept within budgetary constraints	Distribution Pipe	000715, NRP - Wellington B - 2031 - 2033 - 1604	(935)
Optimized - Kept within budgetary constraints	Distribution Pipe	000724, NRP - HNS Grove B1, 2030 - 2032 - 1605	(519)
Optimized - Kept within budgetary constraints	Distribution Pipe	121 – 151 L'Amoreaux Dr Steel Header Replacements	2,434
Optimized - Kept within budgetary constraints	Distribution Pipe	2nd Ave - Eastern - Area 60 - 1197	(1,904)
Optimized - Kept within budgetary constraints	Distribution Pipe	2nd Ave PTC - Area 80 - 1180	(1,542)
Optimized - Kept within budgetary constraints	Distribution Pipe	30: VSM - Major Mackenzie, Cedar to Newkirk, Replacement	14,129
Optimized - Kept within budgetary constraints	Distribution Pipe	30: VSM - Major Mackenzie, Sussex To Newkirk, Replacement	18,600
Optimized - Kept within budgetary constraints	Distribution Pipe	3665 Flamewood Replacement Copper Relay	(415)
Optimized - Kept within budgetary constraints	Distribution Pipe	3rd Ave - Eastern - Area 60 - 1226	(1,249)
Optimized - Kept within budgetary constraints	Distribution Pipe	4th Ave E - Northeast - 1302	(664)
Optimized - Kept within budgetary constraints	Distribution Pipe	4th Ave S-Kenora-1562	(1,799)
Optimized - Kept within budgetary constraints	Distribution Pipe	A:10 Dawlish Ave & Valleyanna Dr	(1,255)
Optimized - Kept within budgetary constraints	Distribution Pipe	A10: Wilson Avenue, Toronto, VSM Replacement	(59,835)
Optimized - Kept within budgetary constraints	Distribution Pipe	A10: Kipling Ave & Lake Shore Blvd W, Etobicoke, PH2 Replacement	5,584
Optimized - Kept within budgetary constraints	Distribution Pipe	A60: Sparks St, Ottawa, Replacement	(4,945)
Optimized - Kept within budgetary constraints	Distribution Pipe	Aberdeen St - Southwest - Windsor - 1356	(693)
Optimized - Kept within budgetary constraints	Distribution Pipe	Adelaide St - Eastern - Area 60 - 1218	(799)
Optimized - Kept within budgetary constraints	Distribution Pipe	Adelaide St N (EXECUTE 2024 - MUNICIPAL WORK PLANNED FOR 2025) - St	(1,756)
Optimized - Kept within budgetary constraints	Distribution Pipe	Ainsley Dr - Eastern - Area 60 - 1723	(1,064)
Optimized - Kept within budgetary constraints	Distribution Pipe	Alder St 1 (MORATORIUM UNTIL 2026) - Northeast - 1715	(757)
Optimized - Kept within budgetary constraints	Distribution Pipe	Alder St 2 (MORATORIUM UNTIL 2026) - Northeast - 1716	(694)
Optimized - Kept within budgetary constraints	Distribution Pipe	Ann St (MORATORIUM UNTIL 2026) - Eastern - Area 60 - 1100	(493)
Optimized - Kept within budgetary constraints	Distribution Pipe	AR40: VSM Replacement - Wilson Rd S Oshawa Ph 1 Bloor to Olive	(3,209)
Optimized - Kept within budgetary constraints	Distribution Pipe	AR40: VSM Replacement - Wilson Rd S Oshawa Ph 2 Olive to King	(3,348)
Optimized - Kept within budgetary constraints	Distribution Pipe	Arthur St - Cornwall - Eastern - 1727	(1,491)
Optimized - Kept within budgetary constraints	Distribution Pipe	Arthur St W (EXECUTE 2024) -Thunder Bay-1496	(2,110)
Optimized - Kept within budgetary constraints	Distribution Pipe	Ashlar Rd - GTA East - Area 30 - 1489	(878)
Optimized - Kept within budgetary constraints	Distribution Pipe	Atikokan Steep Rock Mine Valve Nest Retirement	(52)
Optimized - Kept within budgetary constraints	Distribution Pipe	Augustus St - Cornwall - Eastern - 1729	(1,153)
Optimized - Kept within budgetary constraints	Distribution Pipe	Axminster Dr - GTA East - Area 30 - 1490	(1,087)
Optimized - Kept within budgetary constraints	Distribution Pipe	Bannerman Crt. and Nordic Crt, Whitby	890
Optimized - Kept within budgetary constraints	Distribution Pipe	Base Line - Southwest - Windsor - 1623	-
Optimized - Kept within budgetary constraints	Distribution Pipe	Base Line 2 - Southwest - Windsor - 1347	-
Optimized - Kept within budgetary constraints	Distribution Pipe	Base Line Rd E - Southwest - London - 1461	(1,761)
Optimized - Kept within budgetary constraints	Distribution Pipe	Bay St-Timmings-1561	(1,783)
Optimized - Kept within budgetary constraints	Distribution Pipe	Bayview & St. Leonards Compression Couplings	189
Optimized - Kept within budgetary constraints	Distribution Pipe	Bayview & Steeles CC Replacement	(26)
Optimized - Kept within budgetary constraints	Distribution Pipe	Beckwith St N - Eastern - Area 60 - 1198	(917)
Optimized - Kept within budgetary constraints	Distribution Pipe	Bell St - Eastern - Area 60 - 1052	(745)
Optimized - Kept within budgetary constraints	Distribution Pipe	Belle River Rd - Southwest - Windsor - 1366	-
Optimized - Kept within budgetary constraints	Distribution Pipe	Bloor St. W. & The Kingsway Replacement	(346)
Optimized - Kept within budgetary constraints	Distribution Pipe	Borthwick Ave (MORATORIUM UNTIL 2025) - Eastern - Area 60 - 1139	(1,135)
Optimized - Kept within budgetary constraints	Distribution Pipe	BRAN - Churchill (Connaught to Argyle) Repl. BU - Delhi	145
Optimized - Kept within budgetary constraints	Distribution Pipe	BRAN - Connaught Ave. (Hwy 3 to Delcrest) Repl. BU - Delhi	(56)
Optimized - Kept within budgetary constraints	Distribution Pipe	BRAN - Otterville Rd. (James to Middleton) Repl. BU - Otterville	(423)
Optimized - Kept within budgetary constraints	Distribution Pipe	BRAN - Schafer Side Rd. Repl. BU - Norfolk	(1,150)
Optimized - Kept within budgetary constraints	Distribution Pipe	BRAN - Water St. Repl. BU - Vittoria	30
Optimized - Kept within budgetary constraints	Distribution Pipe	BRAN -Northern Ave. (Adams to Connaught) Repl. BU - Delhi	(306)

Optimized - Kept within budgetary constraints	Distribution Pipe	Briarsdale Dr STC - Area 80 - 1174	(1,018)
Optimized - Kept within budgetary constraints	Distribution Pipe	Bridge St W-Napanee-1602	(2,016)
Optimized - Kept within budgetary constraints	Distribution Pipe	Briscoe St W (EXECUTE 2024) - Southwest - London -1735	(1,517)
Optimized - Kept within budgetary constraints	Distribution Pipe	Briscoe St W 2 (EXECUTE 2024) - Southwest - London - 1736	(1,662)
Optimized - Kept within budgetary constraints	Distribution Pipe	Broadway_GTA West_Area 20_1249	(1,295)
Optimized - Kept within budgetary constraints	Distribution Pipe	Brock St - Eastern - Area 60 - 1485	(1,202)
Optimized - Kept within budgetary constraints	Distribution Pipe	Burleigh Hill Dr STC - Area 80 - 1131	(815)
Optimized - Kept within budgetary constraints	Distribution Pipe	Bush Line Leakage Replacement Phase 1 & 2	(677)
Optimized - Kept within budgetary constraints	Distribution Pipe	Cabana Rd W - Southwest - Windsor - 1353	-
Optimized - Kept within budgetary constraints	Distribution Pipe	Caddy St-Peterborough-1179	(1,356)
Optimized - Kept within budgetary constraints	Distribution Pipe	Callie Ave - Southwest - Windsor - 1377	-
Optimized - Kept within budgetary constraints	Distribution Pipe	Campbellford Replacement Phase 3 Front St	1,121
Optimized - Kept within budgetary constraints	Distribution Pipe	Campbellford Replacement Phase 5 Pellissier St & Bridge St	1,128
Optimized - Kept within budgetary constraints	Distribution Pipe	Carling Ave - Eastern - Area 60 - 1104	(627)
Optimized - Kept within budgetary constraints	Distribution Pipe	Cattell Dr NFalls- Area 80 - 1170	(906)
Optimized - Kept within budgetary constraints	Distribution Pipe	Cedar Alley-Ganonoque-1455	(1,121)
Optimized - Kept within budgetary constraints	Distribution Pipe	Centre St - Eastern - Area 60 - 1085	(535)
Optimized - Kept within budgetary constraints	Distribution Pipe	CHAT: Base Line, Wallaceburg, Replacement	(469)
Optimized - Kept within budgetary constraints	Distribution Pipe	CHAT: Ridgetown LP, Ridgetown, Replacement	1,539
Optimized - Kept within budgetary constraints	Distribution Pipe	CHAT: St Clair St, Tilbury, Replacement	1,153
Optimized - Kept within budgetary constraints	Distribution Pipe	CHAT: Tweedsmuir LP, Chatham, Replacement	20,320
Optimized - Kept within budgetary constraints	Distribution Pipe	CHAT: Water St & Talbot Trail, Chatham-Kent, Replacement	(74)
Optimized - Kept within budgetary constraints	Distribution Pipe	Cheapside St - Southwest - London - 1453	(994)
Optimized - Kept within budgetary constraints	Distribution Pipe	Cheapside St 2 - Southwest - London -1534	(1,600)
Optimized - Kept within budgetary constraints	Distribution Pipe	Christena Cres 1 - Ajax - Area 40 - 1702	(1,263)
Optimized - Kept within budgetary constraints	Distribution Pipe	Church St South_2 - GTA East - Area 30 - 1382	(2,566)
Optimized - Kept within budgetary constraints	Distribution Pipe	Clarke Rd (EXECUTE 2025 - MUNICIPAL WORK PLANNED FOR 2025) - South	(1,367)
Optimized - Kept within budgetary constraints	Distribution Pipe	Clarkson Rd 1 (EXECUTE 2025 - ROAD REHABILITATION WORK PLANNED FC	(861)
Optimized - Kept within budgetary constraints	Distribution Pipe	Colborne St W 1 - Northeast - 1682	(535)
Optimized - Kept within budgetary constraints	Distribution Pipe	Colborne St W 2 - Northeast - 1683	(620)
Optimized - Kept within budgetary constraints	Distribution Pipe	Collier St (MORATORIUM UNTIL 2026) - Area 50 - 1216	(368)
Optimized - Kept within budgetary constraints	Distribution Pipe	Concord St Isolated Steel Replace with Main St PE, Ottawa	(464)
Optimized - Kept within budgetary constraints	Distribution Pipe	County Road 46 - Southwest - Windsor - 1352	-
Optimized - Kept within budgetary constraints	Distribution Pipe	Courthouse Sq - Southwest - London - 1802	(625)
Optimized - Kept within budgetary constraints	Distribution Pipe	Creston Ave (EXECUTE 2024) - Southwest - London - 1734	(321)
Optimized - Kept within budgetary constraints	Distribution Pipe	Darlington Bay Bridge - NPS 2 Replacement	(497)
Optimized - Kept within budgetary constraints	Distribution Pipe	Delaware Ave - Southwest - Windsor - 1364	(1,109)
Optimized - Kept within budgetary constraints	Distribution Pipe	Dexter Dr WELL - Area 80 - 1169	(1,437)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 06 - Brant - Broadway St W - Southeast - Waterloo - 1378	(1,823)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - Abigail Ave - Southeast - Waterloo - 1309	(470)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - Balmoral Dr - Southeast - Waterloo - 1291	(644)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - Dundas St E - Southeast - Waterloo - 1303	(914)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - Elgin St - Southeast - Waterloo - 1296	(1,638)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - Ewing Dr - Southeast - Waterloo - 1316	(618)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - Franklin St - Southeast - Waterloo - 1388	(1,709)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - Greenwich St - Southeast - Waterloo - 1332	(1,481)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - St George St - Southeast - Waterloo - 1312	(1,755)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - St George St 2 - Southeast - Waterloo - 1386	(2,077)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - Toll Gate Rd - Southeast - Waterloo - 1314	(1,133)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 06 - Norfolk County - Andy's Corners - Norfolk County Rd 21 - Southea	(657)

Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 06 - Norfolk County - Tillsonburg - 3rd Concession Rd N - Southeast - V	(1,425)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 06 - Tillsonburg - Brownsville Rd - Southeast - Waterloo - 1391	(1,287)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 06 - Tillsonburg - Potters Rd - Southeast - Waterloo - 1375	(1,266)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 06 - Tillsonburg - Quarter Town Line - Southeast - Waterloo - 1383	(1,434)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 06 - Tillsonburg - Victoria St - Southeast - Waterloo - 1324	(793)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 16 - Haldimand - Caledonia - Argyle St S - Hamilton - 1486	(1,517)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 16 - Haldimand - Canborough - Smithville Rd - Hamilton - 1488	(1,293)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 16 - Haldimand - Dunnville - Central Lane - Hamilton - 1361	(1,311)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 16 - Haldimand - Fisherville - Erie Ave N 1 - Hamilton - 1728	(1,455)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 16 - Haldimand - Fisherville - Erie Ave N 2 - Hamilton - 1730	(399)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 16 - Hamilton - Centennial Pkwy N - Hamilton - 1747	(1,089)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 16 - Hamilton - Crooks St 1 - Hamilton - 1745	(1,337)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 16 - Hamilton - Crooks St 2 - Hamilton - 1746	(974)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 16 - Hamilton - Oak Ave - Hamilton - 1818	(682)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 16 - Hamilton - Province St N - Hamilton - 1416	(539)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 16 - Hamilton - Rosemary Ave - Hamilton - 1731	(421)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 16 - Hamilton - Wentworth St S 2 - Hamilton - 1743	(422)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 17 - Halton - Burlington - Guelph Line - Hamilton - 1429	(2,591)
Optimized - Kept within budgetary constraints	Distribution Pipe	Div. 17 - Halton - Oakville - 6th Line - Hamilton - 1413	(1,741)
Optimized - Kept within budgetary constraints	Distribution Pipe	Dominion Ave 2-Kapuskasing-1540	(882)
Optimized - Kept within budgetary constraints	Distribution Pipe	Dominion Ave-Kapuskasing-1499	(1,956)
Optimized - Kept within budgetary constraints	Distribution Pipe	Downie St 1 - Southwest - London - 1806	(1,306)
Optimized - Kept within budgetary constraints	Distribution Pipe	Downie St 3 - Southwest - London - 1808	(813)
Optimized - Kept within budgetary constraints	Distribution Pipe	Drummond St W - Eastern - Area 60 - 1142	(1,144)
Optimized - Kept within budgetary constraints	Distribution Pipe	Ducharme St - Southwest - Windsor - 1301	(1,496)
Optimized - Kept within budgetary constraints	Distribution Pipe	Dunning Ave - GTA East - Area 30 - 1710	(817)
Optimized - Kept within budgetary constraints	Distribution Pipe	Durham St W - Kawartha Lakes - Area 40 - 1687	(1,844)
Optimized - Kept within budgetary constraints	Distribution Pipe	E Centre St - Southwest - London - 1412	(794)
Optimized - Kept within budgetary constraints	Distribution Pipe	Edgar St - Southwest - Windsor - 1277	(602)
Optimized - Kept within budgetary constraints	Distribution Pipe	Elgin Mills Rd E - GTA East - Area 30 - 1351	(3,059)
Optimized - Kept within budgetary constraints	Distribution Pipe	Elinor St - Southwest - Windsor - 1279	(269)
Optimized - Kept within budgetary constraints	Distribution Pipe	Elizabeth St S 1 - GTA West - Area 20 - 1667	(1,288)
Optimized - Kept within budgetary constraints	Distribution Pipe	Elizabeth St S 2 - GTA West - Area 20 - 1668	(1,244)
Optimized - Kept within budgetary constraints	Distribution Pipe	Elm Ave - Southwest - Windsor - 1295	(374)
Optimized - Kept within budgetary constraints	Distribution Pipe	Elm St E - Eastern - Area 60 - 1147	(831)
Optimized - Kept within budgetary constraints	Distribution Pipe	Elm St W - Eastern - Area 60 - 1726	(447)
Optimized - Kept within budgetary constraints	Distribution Pipe	Elmsley St N - Eastern - Area 60 - 1725	(624)
Optimized - Kept within budgetary constraints	Distribution Pipe	Elworthy Ave (MORATORIUM UNTIL 2026) - Southwest - London - 1446	2,109
Optimized - Kept within budgetary constraints	Distribution Pipe	Emery St E (MORATORIUM UNTIL 2026) - Southwest - London - 1472	(1,720)
Optimized - Kept within budgetary constraints	Distribution Pipe	Emily St - Eastern - Area 60 - 1101	(813)
Optimized - Kept within budgetary constraints	Distribution Pipe	Erie St STC - Area 80 - 1159	(699)
Optimized - Kept within budgetary constraints	Distribution Pipe	Erin Mills and Leanne Vital	493
Optimized - Kept within budgetary constraints	Distribution Pipe	Euclid Ave-Peterborough-1106	(1,611)
Optimized - Kept within budgetary constraints	Distribution Pipe	Fairview Line Replacement	(476)
Optimized - Kept within budgetary constraints	Distribution Pipe	Farah Ave - Northeast - 1288	(537)
Optimized - Kept within budgetary constraints	Distribution Pipe	Ferguson Ave 1 - Northeast - 1686	(747)
Optimized - Kept within budgetary constraints	Distribution Pipe	Ferguson Ave 2 - Northeast - 1688	(949)
Optimized - Kept within budgetary constraints	Distribution Pipe	Ferris Ln - Area 50 - 1201	(1,041)
Optimized - Kept within budgetary constraints	Distribution Pipe	Finlayson St-Thunder Bay-1563	(1,147)
Optimized - Kept within budgetary constraints	Distribution Pipe	First Ave - Eastern - Area 60 - 1175	(1,249)

Optimized - Kept within budgetary constraints	Distribution Pipe	Flanders Ave STC - Area 80 - 1809	(1,797)
Optimized - Kept within budgetary constraints	Distribution Pipe	Flora St - Eastern - Area 60 - 1151	(857)
Optimized - Kept within budgetary constraints	Distribution Pipe	Food City Plaza STC - Area 80 - 1161	(215)
Optimized - Kept within budgetary constraints	Distribution Pipe	Forkes Rd E PTC - Area 80 - 1132	(1,211)
Optimized - Kept within budgetary constraints	Distribution Pipe	Front St - Southwest - London - 1393	(483)
Optimized - Kept within budgetary constraints	Distribution Pipe	Front St (MORATORIUM UNTIL 2025) -Belleville-1592	(2,206)
Optimized - Kept within budgetary constraints	Distribution Pipe	Galt St 1 - Northeast - 1690	(579)
Optimized - Kept within budgetary constraints	Distribution Pipe	Galt St 2 - Northeast - 1691	(895)
Optimized - Kept within budgetary constraints	Distribution Pipe	Garden Alley 2-Ganonoque-1494	(1,824)
Optimized - Kept within budgetary constraints	Distribution Pipe	Geneva St STC - Area 80 - 1187	(2,846)
Optimized - Kept within budgetary constraints	Distribution Pipe	George St - Eastern - Area 60 - 1088	(675)
Optimized - Kept within budgetary constraints	Distribution Pipe	George St-Hearst-1558	(1,873)
Optimized - Kept within budgetary constraints	Distribution Pipe	Georgina Ave 2 - Northeast - 1695	(931)
Optimized - Kept within budgetary constraints	Distribution Pipe	Giles Blvd E - Southwest - Windsor - 1282	(564)
Optimized - Kept within budgetary constraints	Distribution Pipe	Glenora Dr - Southwest - London - 1517	(1,206)
Optimized - Kept within budgetary constraints	Distribution Pipe	Gordon St_GTA West_Area 20_1227	(957)
Optimized - Kept within budgetary constraints	Distribution Pipe	Grant St - Eastern - Area 60 - 1098	(908)
Optimized - Kept within budgetary constraints	Distribution Pipe	Greenwood Ave - Southwest - London - 1428	(194)
Optimized - Kept within budgetary constraints	Distribution Pipe	Haggert Ave_GTA West_Area 20_1477	(1,508)
Optimized - Kept within budgetary constraints	Distribution Pipe	Halt: Harrop drive, Milton, BU Replacement	(295)
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI - Haldimand road 55 - Walpole	8
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI - HWY 6 - Walpole	208
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI - Main at Leland - Hamilton	213
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI- Rainham Road - Walpole	(314)
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI- Upper Wellington - Hamilton	81
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI: 295 Dundas St E Shallow Main Waterdown	37
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI: Conc 3/Walpole Rd, Walpole, BU Replacement	-
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI: Fleming Ave, Dundas, BU Replacement	(76)
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI: Haldimand Rd 20, Walpole, BU Replacement	239
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI: Jackson Street Leakage, Hamilton, Leakage	463
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI: Lloyminn/Crestview, Ancaster, Replacement	92
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI: Main St E, Dunnville, BU Replacement	146
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI: Osler Dr @ Rail Trail, Dundas, BU Replacement	110
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI: Port Maitland/Secord Rd, Dunnville, BU Replacement	277
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI: Rainham Rd Ph1, Dunn, BU Replacement	(769)
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI: Rainham Rd Ph2, Dunn, BU Replacement	(722)
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI: Rifle Range Rd, Hamilton, BU Replacement	24
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI: Rymer Rd, Sherbrooke, BU Replacement	262
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI: Seneca Dr, Ancaster, BU Replacement	60
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI:Upper Gage Ave, Hamilton, BU Replacement	(486)
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI-Haldimand Trail - Dunn	32
Optimized - Kept within budgetary constraints	Distribution Pipe	Hamilton Rd - Southwest - London - 1408	(1,164)
Optimized - Kept within budgetary constraints	Distribution Pipe	HAMI-South Coast - Walpole	277
Optimized - Kept within budgetary constraints	Distribution Pipe	Hanley Cres - Southwest - Windsor - 1350	(1,025)
Optimized - Kept within budgetary constraints	Distribution Pipe	Hart St-Timmins (MORATORIUM UNTIL 2025) -1559	(1,717)
Optimized - Kept within budgetary constraints	Distribution Pipe	Havelock St - Eastern - Area 60 - 1215	(1,536)
Optimized - Kept within budgetary constraints	Distribution Pipe	Hemlock St-Timmins-1569	(970)
Optimized - Kept within budgetary constraints	Distribution Pipe	Herriott St - Eastern - Area 60 - 1089	(618)
Optimized - Kept within budgetary constraints	Distribution Pipe	Hickory St-Ganonoque-1454	(906)
Optimized - Kept within budgetary constraints	Distribution Pipe	Highgate Rd - Eastern - Area 60 - 1166	(470)

Optimized - Kept within budgetary constraints	Distribution Pipe	Hilda St 1 - Northeast - 1696	(864)
Optimized - Kept within budgetary constraints	Distribution Pipe	Hilda St 2 - Northeast - 1698	(1,002)
Optimized - Kept within budgetary constraints	Distribution Pipe	Hillcrest Ave STC - Area 80 - 1176	(925)
Optimized - Kept within budgetary constraints	Distribution Pipe	Hixon St LINC - Area 80 - 1153	(694)
Optimized - Kept within budgetary constraints	Distribution Pipe	Howard Ave 1 - Kawartha Lakes - Area 40 - 1692	(455)
Optimized - Kept within budgetary constraints	Distribution Pipe	Howard Ave 2 - Kawartha Lakes - Area 40 - 1694	(634)
Optimized - Kept within budgetary constraints	Distribution Pipe	HR - 1021 Midland Ave	2,779
Optimized - Kept within budgetary constraints	Distribution Pipe	HR - 1040 Bridletowne Circle	2,704
Optimized - Kept within budgetary constraints	Distribution Pipe	HR - 160-260 Chester Lee Blvd	(363)
Optimized - Kept within budgetary constraints	Distribution Pipe	HR - 200-250 Bridletowne Circle	2,706
Optimized - Kept within budgetary constraints	Distribution Pipe	HR - 201 Bridletowne Circle	2,912
Optimized - Kept within budgetary constraints	Distribution Pipe	Invergordon Ave, Toronto 3" PE Replacement	(306)
Optimized - Kept within budgetary constraints	Distribution Pipe	Irene Cres - Eastern - Area 60 - 1141	(1,355)
Optimized - Kept within budgetary constraints	Distribution Pipe	James St - Eastern - Area 60 - 1112	(1,121)
Optimized - Kept within budgetary constraints	Distribution Pipe	James St W - Eastern - Area 60 - 1184	(1,061)
Optimized - Kept within budgetary constraints	Distribution Pipe	Janet St 1 - Northeast - 1699	(806)
Optimized - Kept within budgetary constraints	Distribution Pipe	Janet St 2 - Northeast - 1700	(707)
Optimized - Kept within budgetary constraints	Distribution Pipe	Jeffrey St - Area 50 - 1199	(805)
Optimized - Kept within budgetary constraints	Distribution Pipe	Joymar Dr 1 (EXECUTE 2024 - ROAD REHABILITATION WORK PLANNED FOI	(1,584)
Optimized - Kept within budgetary constraints	Distribution Pipe	Joymar Dr 2 (EXECUTE 2024 - ROAD REHABILITATION WORK PLANNED FOI	(1,727)
Optimized - Kept within budgetary constraints	Distribution Pipe	King - Collins Bay NPS10 Shallow Pipe	4,327
Optimized - Kept within budgetary constraints	Distribution Pipe	King - King Street East Replacement (Prescott)	825
Optimized - Kept within budgetary constraints	Distribution Pipe	King St W - Eastern - 1799	(955)
Optimized - Kept within budgetary constraints	Distribution Pipe	King St W (MORATORIUM UNTIL 2026) - Northeast - 1239	3
Optimized - Kept within budgetary constraints	Distribution Pipe	King: Bath and Gardiners Valve Replacement (Kingston)	(52)
Optimized - Kept within budgetary constraints	Distribution Pipe	King: Thin Wall and Copper Pipe Replacement (Various Locations in Area)	(221)
Optimized - Kept within budgetary constraints	Distribution Pipe	Laforest Ave - Northeast - 1270	(559)
Optimized - Kept within budgetary constraints	Distribution Pipe	Laird Ave - Southwest - Windsor - 1371	-
Optimized - Kept within budgetary constraints	Distribution Pipe	Lake Ave E - Eastern - Area 60 - 1145	(1,447)
Optimized - Kept within budgetary constraints	Distribution Pipe	Lanoue St - Southwest - Windsor - 1354	(570)
Optimized - Kept within budgetary constraints	Distribution Pipe	Lavinia St FE - Area 80 - 1171	(1,239)
Optimized - Kept within budgetary constraints	Distribution Pipe	LePage Ave (EXECUTE BY 2025 - PAVING PROPOSED BETWEEN 2022_2025	(1,670)
Optimized - Kept within budgetary constraints	Distribution Pipe	Lockhart St NOTL - Area 80 - 1189	(429)
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - Belgrave BU - London	-
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - Cheapside, Gammage & Linwood BU - London	(567)
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - Church & Water BU - Beachville	183
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - Fellner & Langmuir, Ashland & Wilton BU - London	(478)
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - 7113 to 7079 Longwoods Rd. - London	(5)
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - Breck Ave. & Eastgate Cres. - London	(72)
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - Dalmage & Wood BU - London	49
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - Elworthy & Edward BU - London	-
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - Jacqueline BU - London	(727)
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - Kent & Central BU - London	15
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - Parkway & Huron BU - London	-
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - PH 2 Stevenson & Brydges BU - London	(184)
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - Riverside Dr & Wharncliffe BU - London	458
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - SCLAIR Pipe Replacement- Mount Brydges	(354)
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - Talbot Line BU - Talbotville	51
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - Tecumseh Ave BU - London	48
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - Waterloo St at Horton St Leakage BU- London	65

Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - Waterloo St. BU - London	(274)
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND - Wharnccliffe & Baseline BU - London	57
Optimized - Kept within budgetary constraints	Distribution Pipe	LOND-Sycamore & St Julien - London	418
Optimized - Kept within budgetary constraints	Distribution Pipe	Lundys Lane Reg. Road 20 Niagara Falls	(388)
Optimized - Kept within budgetary constraints	Distribution Pipe	Madawaska St - Eastern - Area 60 - 1072	(1,186)
Optimized - Kept within budgetary constraints	Distribution Pipe	Mahe St 1 - Northeast - 1701	(803)
Optimized - Kept within budgetary constraints	Distribution Pipe	Mahe St 2 - Northeast - 1703	(362)
Optimized - Kept within budgetary constraints	Distribution Pipe	Main St (EXECUTE 2024 - STREETScape PLANNED FOR 2023_2024)_GTA W	(1,638)
Optimized - Kept within budgetary constraints	Distribution Pipe	Main St (EXECUTE 2024) - Ganonoque - Eastern - 1737	(888)
Optimized - Kept within budgetary constraints	Distribution Pipe	Main St (MORATORIUM UNTIL 2025) - Area 50 - 1223	(579)
Optimized - Kept within budgetary constraints	Distribution Pipe	Main St E - Eastern - Area 60 - 1172	(1,143)
Optimized - Kept within budgetary constraints	Distribution Pipe	Malden Rd 2 - Southwest - Windsor - 1660	(952)
Optimized - Kept within budgetary constraints	Distribution Pipe	Manse Alley-Ganonoque-1466	(1,720)
Optimized - Kept within budgetary constraints	Distribution Pipe	Maple St N-Timmins-1535	(2,046)
Optimized - Kept within budgetary constraints	Distribution Pipe	Market St - Area 50 - 1221	(1,018)
Optimized - Kept within budgetary constraints	Distribution Pipe	Marks St S-Thunder Bay-1537	(2,362)
Optimized - Kept within budgetary constraints	Distribution Pipe	Mary St 1 - Northeast - 1708	(969)
Optimized - Kept within budgetary constraints	Distribution Pipe	Matchedash St N 1 (MORATORIUM UNTIL 2026) - Northeast - 1719	(204)
Optimized - Kept within budgetary constraints	Distribution Pipe	Matchedash St N 2 (MORATORIUM UNTIL 2026) - Northeast - 1720	(110)
Optimized - Kept within budgetary constraints	Distribution Pipe	McCain St PTC - Area 80 - 1136	(845)
Optimized - Kept within budgetary constraints	Distribution Pipe	McCann St - Eastern - Area 60 - 1160	(1,902)
Optimized - Kept within budgetary constraints	Distribution Pipe	McGill St-Trenton-1596	(874)
Optimized - Kept within budgetary constraints	Distribution Pipe	McGonigal St E - Eastern - Area 60 - 1041	(857)
Optimized - Kept within budgetary constraints	Distribution Pipe	Meadowvale & Sheppard CC Replacement	77
Optimized - Kept within budgetary constraints	Distribution Pipe	Moffatt St - Eastern - Area 60 - 1195	(1,136)
Optimized - Kept within budgetary constraints	Distribution Pipe	Montgomery Pl - Eastern - Area 60 - 1228	(1,239)
Optimized - Kept within budgetary constraints	Distribution Pipe	Morand St 2 - Southwest - Windsor - 1657	(611)
Optimized - Kept within budgetary constraints	Distribution Pipe	Mornington Ave - Southwest - London - 1531	(3,068)
Optimized - Kept within budgetary constraints	Distribution Pipe	Moulton Replacement BU	(11,735)
Optimized - Kept within budgetary constraints	Distribution Pipe	NBAY: 247 Whitewood Ave, New Liskeard Main Relocation	(4)
Optimized - Kept within budgetary constraints	Distribution Pipe	NE: Hwy 11 and Barnett, North Bay, Grasshopper Valves Replacement	298
Optimized - Kept within budgetary constraints	Distribution Pipe	NE: Ski Club Rd., North Bay	(224)
Optimized - Kept within budgetary constraints	Distribution Pipe	NE: Whittaker St., Sudbury, Replacement	22
Optimized - Kept within budgetary constraints	Distribution Pipe	Neff St PTC - Area 80 - 1165	(523)
Optimized - Kept within budgetary constraints	Distribution Pipe	Niagara Wine Route 2 NOTL- Area 80 - 1191	(761)
Optimized - Kept within budgetary constraints	Distribution Pipe	North Alley-Ganonoque-1468	(859)
Optimized - Kept within budgetary constraints	Distribution Pipe	North St - Eastern - Area 60 - 1087	(1,112)
Optimized - Kept within budgetary constraints	Distribution Pipe	NPS 10 Glenridge Avenue, St. Catharines	(8,637)
Optimized - Kept within budgetary constraints	Distribution Pipe	NPS 12 Martin Grove Rd Main Replacement: Lavington to St. Albans Rd.	(13,859)
Optimized - Kept within budgetary constraints	Distribution Pipe	NW_Lateral Clamp Cut Outs_ATIKOKAN	(597)
Optimized - Kept within budgetary constraints	Distribution Pipe	Oak St - Eastern - Area 60 - 1133	(1,159)
Optimized - Kept within budgetary constraints	Distribution Pipe	Oak St 1 - Area 50 - 1654	(848)
Optimized - Kept within budgetary constraints	Distribution Pipe	Ogden St-Thunder Bay-1568	(2,150)
Optimized - Kept within budgetary constraints	Distribution Pipe	Old Lakeshore Rd - Southwest - London - 1572	(1,517)
Optimized - Kept within budgetary constraints	Distribution Pipe	Ontario Rd - Southwest - London - 1803	(431)
Optimized - Kept within budgetary constraints	Distribution Pipe	Oshawa LP Replacement Phase 1 Olive Ave	(2,829)
Optimized - Kept within budgetary constraints	Distribution Pipe	Oshawa LP Replacement Phase 2 King St	(2,877)
Optimized - Kept within budgetary constraints	Distribution Pipe	Oshawa LP Replacement Phase 3 Masson St	(5,164)
Optimized - Kept within budgetary constraints	Distribution Pipe	Othello Ave - Eastern - Area 60 - 1096	(551)
Optimized - Kept within budgetary constraints	Distribution Pipe	Paliser Cres S - GTA East - Area 30 - 1389	(1,430)

Optimized - Kept within budgetary constraints	Distribution Pipe	Pillette Rd - Southwest - Windsor - 1320	(1,457)
Optimized - Kept within budgetary constraints	Distribution Pipe	Pine St - Area 50 - 1205	(1,005)
Optimized - Kept within budgetary constraints	Distribution Pipe	Poplar Ave 1 - Ajax - Area 40 - 1680	(1,637)
Optimized - Kept within budgetary constraints	Distribution Pipe	Poplar Ave 2 - Ajax - Area 40 - 1681	(1,041)
Optimized - Kept within budgetary constraints	Distribution Pipe	Pr#57, NRP - 2024 - Collins Street - Collingwood - 1614	(288)
Optimized - Kept within budgetary constraints	Distribution Pipe	Pr#58, NRP - 2023 - High Street - Collingwood - 1653	(892)
Optimized - Kept within budgetary constraints	Distribution Pipe	Pr#62, NRP - 2025 - Cameron Street - Collingwood - 1616	(297)
Optimized - Kept within budgetary constraints	Distribution Pipe	Presley St 1 - Northeast - 1713	(1,145)
Optimized - Kept within budgetary constraints	Distribution Pipe	Presley St 2 - Northeast - 1714	(791)
Optimized - Kept within budgetary constraints	Distribution Pipe	Prince Albert St - Eastern - Area 60 - 1099	(842)
Optimized - Kept within budgetary constraints	Distribution Pipe	Prince Arthur Blvd-Thunder Bay-1538	(1,437)
Optimized - Kept within budgetary constraints	Distribution Pipe	Prince St-Bowmanville-1450	(958)
Optimized - Kept within budgetary constraints	Distribution Pipe	Princess St W 1 (MORATORIUM UNTIL 2026) - Northeast - 1721	(369)
Optimized - Kept within budgetary constraints	Distribution Pipe	Prospect St-Bowmanville-1086	(516)
Optimized - Kept within budgetary constraints	Distribution Pipe	Queen Mary St - Eastern - Area 60 - 1103	(1,174)
Optimized - Kept within budgetary constraints	Distribution Pipe	Queen St E - Southwest - London - 1804	(1,235)
Optimized - Kept within budgetary constraints	Distribution Pipe	Queen St LINC - Area 80 - 1150	(964)
Optimized - Kept within budgetary constraints	Distribution Pipe	Queen St N - Eastern - Area 60 - 1158	(1,424)
Optimized - Kept within budgetary constraints	Distribution Pipe	Queen St S 1 (EXECUTE 2026 - ROAD REHABILITATION WORK PLANNED FO	(1,020)
Optimized - Kept within budgetary constraints	Distribution Pipe	Queen St S 2 (EXECUTE 2026 - ROAD REHABILITATION WORK PLANNED FO	(764)
Optimized - Kept within budgetary constraints	Distribution Pipe	Randolph Ave - Southwest - Windsor - 1334	(1,060)
Optimized - Kept within budgetary constraints	Distribution Pipe	Red Maple Dr Lincoln - 1-inch steel main replacement	176
Optimized - Kept within budgetary constraints	Distribution Pipe	Regent St - Kawartha Lakes - Area 40 - 1697	(371)
Optimized - Kept within budgetary constraints	Distribution Pipe	Regional Rd 65 West Lincoln	(127)
Optimized - Kept within budgetary constraints	Distribution Pipe	Replacement - Vintage PE Lined Mains - Peterborough	(498)
Optimized - Kept within budgetary constraints	Distribution Pipe	Rholaine Dr - Southwest - Windsor - 1299	(979)
Optimized - Kept within budgetary constraints	Distribution Pipe	Ridge Rd North Fort Erie	(751)
Optimized - Kept within budgetary constraints	Distribution Pipe	Ridout St S (EXECUTE 2024) - Southwest - London - 1470	(875)
Optimized - Kept within budgetary constraints	Distribution Pipe	River View Line - Southwest - Windsor - 1381	(136)
Optimized - Kept within budgetary constraints	Distribution Pipe	Riverside Dr E - Southwest - Windsor - 1357	(803)
Optimized - Kept within budgetary constraints	Distribution Pipe	Rochester St - Eastern - Area 60 - 1222	(989)
Optimized - Kept within budgetary constraints	Distribution Pipe	Rose St STC - Area 80 - 1134	(306)
Optimized - Kept within budgetary constraints	Distribution Pipe	Ross St - Area 50 - 1210	(1,271)
Optimized - Kept within budgetary constraints	Distribution Pipe	Ross St (MORATORIUM UNTIL 2025) - Southwest - London - 1560	(450)
Optimized - Kept within budgetary constraints	Distribution Pipe	Rourke Line Rd - Southwest - Windsor - 1373	(1,113)
Optimized - Kept within budgetary constraints	Distribution Pipe	Ruggles Ave - GTA East - Area 30 - 1706	(1,504)
Optimized - Kept within budgetary constraints	Distribution Pipe	Rupert Ave - GTA East - Area 30 - 1815	(1,674)
Optimized - Kept within budgetary constraints	Distribution Pipe	Sarah St - Eastern - Area 60 - 1188	(949)
Optimized - Kept within budgetary constraints	Distribution Pipe	SARN - Oil Heritage Rd and Douglas Line Exposed Main	(97)
Optimized - Kept within budgetary constraints	Distribution Pipe	SARN - Christina St at Highbury Pk Leakage - Sarnia BU	(12)
Optimized - Kept within budgetary constraints	Distribution Pipe	SARN - Eastlawn Ave and Kember Ave Leakage - Sarnia BU	(587)
Optimized - Kept within budgetary constraints	Distribution Pipe	SARN - Errol Rd E Leakage - Sarnia BU	(535)
Optimized - Kept within budgetary constraints	Distribution Pipe	SARN - Errol Rd W & Newell St. Leakage - Sarnia BU	(412)
Optimized - Kept within budgetary constraints	Distribution Pipe	SARN - Highway Dr and Lynwood Ave - Sarnia BU	(104)
Optimized - Kept within budgetary constraints	Distribution Pipe	SARN - Lakeshore Rd. and Modeland Rd Leakage - Sarnia BU	(298)
Optimized - Kept within budgetary constraints	Distribution Pipe	SARN - Smith Line Leakage - Sombra BU	-
Optimized - Kept within budgetary constraints	Distribution Pipe	SARN- Brigden Rd and Duncan St Leakage - Moore Twp	252
Optimized - Kept within budgetary constraints	Distribution Pipe	SARN-Point Edward LP Leakage - Sarnia BU	(468)
Optimized - Kept within budgetary constraints	Distribution Pipe	Seagull Dr 1 - GTA West - Area 20 - 1674	(1,150)
Optimized - Kept within budgetary constraints	Distribution Pipe	Seagull Dr 2 - GTA West - Area 20 - 1675	(1,399)

Optimized - Kept within budgetary constraints	Distribution Pipe	Second St - Area 50 - 1194	(1,205)
Optimized - Kept within budgetary constraints	Distribution Pipe	Seventh Ave N-Kenora-1546	(1,497)
Optimized - Kept within budgetary constraints	Distribution Pipe	Seventh St S-Kenora-1542	(1,308)
Optimized - Kept within budgetary constraints	Distribution Pipe	Shallow Main - High Street from Dunlop to Park St	(81)
Optimized - Kept within budgetary constraints	Distribution Pipe	Sheppard & Markham Compression Couplings	19
Optimized - Kept within budgetary constraints	Distribution Pipe	Sheppard Ave & Brimley Rd (Compression Couplings)	201
Optimized - Kept within budgetary constraints	Distribution Pipe	Shurie Rd LINC - Area 80 - 1154	(348)
Optimized - Kept within budgetary constraints	Distribution Pipe	Simcoe Street-40-Kawartha Lakes-1060	(1,415)
Optimized - Kept within budgetary constraints	Distribution Pipe	Sixth Ave-Timmins-1566	(1,687)
Optimized - Kept within budgetary constraints	Distribution Pipe	Southdale Rd E - Southwest - London - 1434	(1,839)
Optimized - Kept within budgetary constraints	Distribution Pipe	Spring Garden Rd - Southwest - Windsor - 1658	(884)
Optimized - Kept within budgetary constraints	Distribution Pipe	Spring St - Eastern - Area 60 - 1047	(745)
Optimized - Kept within budgetary constraints	Distribution Pipe	Sproule Dr 1 - GTA West - Area 20 - 1676	(1,376)
Optimized - Kept within budgetary constraints	Distribution Pipe	Sproule Dr 2 - GTA West - Area 20 - 1677	(1,165)
Optimized - Kept within budgetary constraints	Distribution Pipe	Spruce St-Kapuskasing-1565	(2,180)
Optimized - Kept within budgetary constraints	Distribution Pipe	SSM: Goulais Rd Main replacement SSM	(73)
Optimized - Kept within budgetary constraints	Distribution Pipe	St Anne Blvd - Southwest - Windsor - 1319	-
Optimized - Kept within budgetary constraints	Distribution Pipe	St Paul St - Area 50 - 1220	(891)
Optimized - Kept within budgetary constraints	Distribution Pipe	Stanley Ave - Eastern - Area 60 - 1069	(569)
Optimized - Kept within budgetary constraints	Distribution Pipe	Stratford-Daly Ave with Birmingham to Worsley-1756	(48)
Optimized - Kept within budgetary constraints	Distribution Pipe	Stratford-Huron St-Matilda to Douglas Phase 2-1758	(1,212)
Optimized - Kept within budgetary constraints	Distribution Pipe	Stratford-Mercer St from Caledonia to Britannia-1757	(156)
Optimized - Kept within budgetary constraints	Distribution Pipe	Stratford-Mowat St from W. Gore to Brydges-1760	(314)
Optimized - Kept within budgetary constraints	Distribution Pipe	SUD: Copper Cliff Replacement	(402)
Optimized - Kept within budgetary constraints	Distribution Pipe	SUDB: Bancroft Dr and Bellevue Ave, Valves Replacement	181
Optimized - Kept within budgetary constraints	Distribution Pipe	SUDB: Gagnon St Lateral, Azilda	(78)
Optimized - Kept within budgetary constraints	Distribution Pipe	SUDB: Regent St grasshopper, Sudbury	457
Optimized - Kept within budgetary constraints	Distribution Pipe	SUDB: RR 15 Property Line, Chelmsford, Replacement	(144)
Optimized - Kept within budgetary constraints	Distribution Pipe	Summer St NFalls- Area 80 - 1137	(662)
Optimized - Kept within budgetary constraints	Distribution Pipe	Summerville Ave - Eastern - Area 60 - 1484	(1,329)
Optimized - Kept within budgetary constraints	Distribution Pipe	Swan Dr STC- Area 80 - 1163	(1,540)
Optimized - Kept within budgetary constraints	Distribution Pipe	Talbot Rd - Southwest - Windsor - 1369	(1,089)
Optimized - Kept within budgetary constraints	Distribution Pipe	Tanguay Ave - Northeast - 1280	(373)
Optimized - Kept within budgetary constraints	Distribution Pipe	Taylor Mills Dr S - GTA East - Area 30 - 1435	(1,606)
Optimized - Kept within budgetary constraints	Distribution Pipe	TBAY: 33-22-601 Atikokan Lateral Leak Dwnst of Sapawe Mill	(413)
Optimized - Kept within budgetary constraints	Distribution Pipe	Tecumseh Rd W 2 - Southwest - Windsor - 1492	(1,210)
Optimized - Kept within budgetary constraints	Distribution Pipe	Tecumseth St - GTA East - Area 30 - 1362	(1,636)
Optimized - Kept within budgetary constraints	Distribution Pipe	THUN: PSLM Maintenance	(136)
Optimized - Kept within budgetary constraints	Distribution Pipe	Tilbury South Line Replacement	(1,068)
Optimized - Kept within budgetary constraints	Distribution Pipe	TIMM: Xstrata (Kidd Creek) Smelter SMS Service Retirement	(474)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Bayford to Dubray Replacement Standardization - Network # 1	(748)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Browns Line and Jellicoe Replacement- Network # 123_368_37	(1,854)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Dubray to Cornelius Replacement Standardization - Network #	(344)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Keelesgate and Cuffley Replacement Standardization - Network #	(787)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Toro to Cataford Replacement Standardization - Network # 161	(648)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Albright and Roseland Replacement- Network # 123_368_373	(965)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Alderbrae Replacement - Network # 123_368_373	(360)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Aldercrest to Lunness North Replacement - Network # 123_368	(958)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Allanford and Pender Replacement - Network # 455	(1,374)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Amethyst and Cass Replacement - Network # 455	(1,942)

Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Anewen and Kenewen Replacement - Network # 455	(553)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Aragon and Malamute Replacement - Network # 455	(982)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Araman and Earlton Replacement - Network # 455	(1,374)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Bay Mills and Birchmount Replacement - Network # 455	(258)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Bay Mills and Birchmount Services Replacement - Network # 45	(1,162)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Belleglade and Palms Replacement Standardization - Network #	(465)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Bellman to N Carson Replacement- Network # 123_368_373	(1,026)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Bertrand and Birchmount Replacement - Network # 455	(736)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Beta and Aldercrest Replacement - Network # 123_368_373	(846)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Beta and Gamma North Replacement - Network # 123_368_373	(822)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Birchmount & Foxbridge Replacement - Network # 277	(1,313)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Birchmount North Ellesmere Replacement - Network # 455	(924)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Birchmount South Sheppard Replacement - Network # 455	(1,658)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Bradstock to Verobeach Replacement Standardization - Networ	(161)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Brookbanks and Valley Woods Replacement - Network # 455	(1,261)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Browns and Finsbury Replacement- Network # 123_368_373	(890)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Browns and Owen Replacement- Network # 123_368_373	(491)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Browns Evans Gair Replacement- Network # 123_368_373	(719)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Browns Line at Horner Replacement- Network # 123_368_373	(746)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Carnforth and Wyndcliff Replacement - Network # 455	(1,449)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Colingwood and Dempster Replacement - Network # 455	(996)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Combermere Replacement - Network # 455	(1,530)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Coral Gable Replacement Standardization - Network # 152_154	(869)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Delma and Ecker Replacement- Network # 123_368_373	(886)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Delta and Gamma Replacement - Network # 123_368_373	(756)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Delta North Replacement - Network # 123_368_373	(413)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Eccleston and Tinder Replacement - Network # 455	(802)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Eltham and Delma Replacement- Network # 123_368_373	(934)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Elvaston Replacement - Network # 455	(941)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Evans Ave Replacement- Network # 123_368_373	(1,208)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Evans Industrial Replacement- Network # 123_368_373	(396)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Fenelon and Graydon Hall Replacement - Network # 455	(664)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Fenside and Lynedock Replacement - Network # 455	(2,111)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Foch and Woodbury Replacement- Network # 123_368_373	(879)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Foxbridge-Roeback Replacement - Network # 277	(881)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Gaydon and Highbury Replacement Standardization - Network #	(1,025)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Groveland and Lacewood Replacement - Network # 455	(658)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Gulfstream and Franson Replacement Standardization - Networ	(917)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Hallmark to Lunness Replacement - Network # 123_368_373	(861)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Horner and Carson Replacement - Network # 123_368_373	(725)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Horner and Orianna Replacement- Network # 123_368_373	(531)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Horner from Browns Line Replacement - Network # 123_368_3	(944)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Ionview South Replacement - Network # 455	(1,064)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Kingsdown and Ranstone Replacement - Network # 455	(1,305)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Knighton and Prestbury Replacement - Network # 455	(1,312)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Lanor and Valermo Replacement - Network # 123_368_373	(869)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Larabee and Tetbury Replacement - Network # 455	(752)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Lauretide and Silverdale Replacement - Network # 455	(627)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Lilac and Griffith Replacement Standardization - Network # 152	(788)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Mitcham and Fulham Replacement - Network # 123_368_373	(923)

Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Moorecroft and Sedgewick Replacement - Network # 455	(722)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Mooregate and Treverton Replacement - Network # 455	(664)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Moraine Hill and Sunmount Replacement - Network # 455	(1,421)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - North Sloane Replacement - Network # 455	(1,331)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Parkwoods Village Replacement - Network # 455	(1,198)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Pharmacy and Dewey Replacement - Network # 455	(645)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Rimilton Replacement - Network # 123_368_373	(543)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Roywood and York Mills Replacement - Network # 455	(1,786)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Savona and Bisset Replacement- Network # 123_368_373	(834)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Scarden and Tourmaline Replacement - Network # 455	(1,017)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Silvercrest to Aldercrest Replacement- Network # 123_368_373	(303)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Sloane and Ruscica Replacement - Network # 455	(1,060)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - St Lucie Replacement Standardization - Network # 152_154	(1,111)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Starview and Weston Replacement Standardization - Network #	(947)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Sunset and Burlington Replacement- Network # 123_368_373	(865)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Sweeney Replacement - Network # 455	(1,916)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Three Valley Dr Replacement - Network # 455	(1,077)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Tiffany and Woodthorpe Replacement - Network # 455	(401)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Treverton & Stratton Replacement - Network # 455	(725)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Truxford and Overbank Replacement - Network # 455	(889)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Valentine and York Mills Replacement - Network # 455	(900)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Verobeach Replacement Standardization - Network # 152_154	(945)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Victoria Park Ivordale Replacement - Network # 455	(912)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Wallingford Replacement - Network # 455	(1,092)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Westhead Replacement- Network # 123_368_373	(869)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Westin and Jasmine Replacement Standardization - Network #	(610)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Wigmore and Draycott Replacement - Network # 455	(1,111)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Willowmount & Birchmount Replacement - Network # 277	(880)
Optimized - Kept within budgetary constraints	Distribution Pipe	TOR10YR - Yorkdale and Wallasey Replacement Standardization - Network	(929)
Optimized - Kept within budgetary constraints	Distribution Pipe	Toronto Island NPS 2 Feed Relocation	(2,092)
Optimized - Kept within budgetary constraints	Distribution Pipe	Trenton Ave - Eastern - Area 60 - 1181	(770)
Optimized - Kept within budgetary constraints	Distribution Pipe	Tulloch Dr-Ajax-1594	(1,487)
Optimized - Kept within budgetary constraints	Distribution Pipe	Victoria Ave-Ganonoque-1457	(1,271)
Optimized - Kept within budgetary constraints	Distribution Pipe	Victoria St - Eastern - Area 60 - 1138	(885)
Optimized - Kept within budgetary constraints	Distribution Pipe	Victoria St STC- Area 80 - 1148	(481)
Optimized - Kept within budgetary constraints	Distribution Pipe	Viewmount Dr Main Lowering	(184)
Optimized - Kept within budgetary constraints	Distribution Pipe	Vista Dr_GTA West_Area 20_1529	(1,521)
Optimized - Kept within budgetary constraints	Distribution Pipe	VPM - 310 Cathcart St Header - Aldyl A	(121)
Optimized - Kept within budgetary constraints	Distribution Pipe	VSM - Bromsgrove Header	-
Optimized - Kept within budgetary constraints	Distribution Pipe	VSM - Firestone Road - 2" ST - PH1	(1,525)
Optimized - Kept within budgetary constraints	Distribution Pipe	VSM - Major Mackenzie and Yonge	-
Optimized - Kept within budgetary constraints	Distribution Pipe	VSM - Preston St - LP	(1,858)
Optimized - Kept within budgetary constraints	Distribution Pipe	VSM-HWY 7 Dufferin St Perth	(896)
Optimized - Kept within budgetary constraints	Distribution Pipe	Walker Rd - Southwest - Windsor - 1333	(1,269)
Optimized - Kept within budgetary constraints	Distribution Pipe	Wardsville Line - Southwest - London - 1797	(6,179)
Optimized - Kept within budgetary constraints	Distribution Pipe	WATE - Glen Morris (Selkirk to Stanley) Repl. BU - Cambridge	103
Optimized - Kept within budgetary constraints	Distribution Pipe	WATE - Hamilton St. Repl. BU - Cambridge	(301)
Optimized - Kept within budgetary constraints	Distribution Pipe	Welland St PTC- Area 80 - 1173	(519)
Optimized - Kept within budgetary constraints	Distribution Pipe	Wellington Rd (EXECUTE 2025 - BRT DESIGNS EXPECTED 2025) - Southwest	(1,556)
Optimized - Kept within budgetary constraints	Distribution Pipe	Wellington St - GTA East - Area 30 - 1417	(1,546)

Optimized - Kept within budgetary constraints	Distribution Pipe	Wellington St - Kawartha Lakes - Area 40 - 1678	(1,524)
Optimized - Kept within budgetary constraints	Distribution Pipe	Weston Rd & Imogene Compression Couplings	207
Optimized - Kept within budgetary constraints	Distribution Pipe	Wickstead Ave (MORATORIUM UNTIL 2026) - Northeast - 1510	(1,139)
Optimized - Kept within budgetary constraints	Distribution Pipe	William St - Eastern - Area 60 - 1092	(748)
Optimized - Kept within budgetary constraints	Distribution Pipe	Wilson St E - Eastern - Area 60 - 1094	(927)
Optimized - Kept within budgetary constraints	Distribution Pipe	Wilton Grove Rd - Southwest - London - 1395	(1,417)
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Bayshore Dr, Leamington, Replacement	387
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Bertha Ave, Windsor, Replacement	1,007
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Caille Ave, Lakeshore, Replacement	988
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: County Rd 2 & Riverside Rd, Lakeshore, Replacement	1,229
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: County Rd 27 Ph 1, Lakeshore, Replacement	529
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: County Rd 27 Ph 2, Lakeshore, Replacement	483
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: County Rd 31 & Essex County Rd 2, Lakeshore, Replacement	874
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Devonshire Rd, Windsor, Replacement	1,176
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Glenwood Line & Port Rd, Chatham-Kent, Replacement	(151)
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Lacasse (St Denis to Tecumseh Rd E), Windsor, Replacement	1,706
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Laird & Centre MIP, Essex, Replacement	270
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Laird IP, Essex, Replacement	892
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Maidstone Ave & Talbot St, Essex, Replacement	1,187
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Mersea Rd 2 - Ph 2, Leamington, Replacement	(514)
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Oak St - Ph 2, Leamington, Replacement	(222)
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: PSL Maintenance	(390)
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Riverside Aldyl A - Ph 1, Windsor, Replacement	1,455
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Riverside Aldyl A - Ph 2, Windsor, Replacement	919
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Riverside Dr (Arlington to Kensington), Windsor, Replacement	-
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Tecumseh Rd E - Ph 2, Windsor, Replacement	1,538
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Tecumseh Rd E - Ph3, Windsor, Replacement	2,610
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Tecumseh Rd E - Ph4, Windsor, Replacement	4,007
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Tecumseh Rd E - Ph6, Windsor, Replacement	4,007
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Tecumseh Rd W, Windsor, Replacement	1,525
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Trenton St, Windsor, Replacement	(157)
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Woodslee Ph 1, Lakeshore, Replacement	909
Optimized - Kept within budgetary constraints	Distribution Pipe	WIND: Woodslee Ph 2, Lakeshore, Replacement	1,075
Optimized - Kept within budgetary constraints	Distribution Pipe	Windsor Ave (EXECUTE BY 2025 - MUNICIPAL WORK PLANNED FOR 2025) -	(1,369)
Optimized - Kept within budgetary constraints	Distribution Pipe	Windsor Dr-Ajax-1193	(1,076)
Optimized - Kept within budgetary constraints	Distribution Pipe	Woodside Dr - Eastern - Area 60 - 1178	(1,353)
Optimized - Kept within budgetary constraints	Distribution Pipe	Wortley Rd - Southwest - London - 1474	(499)
Optimized - Kept within budgetary constraints	Distribution Pipe	Yonge St - Area 50 - 1206	(1,055)
Optimized - Kept within budgetary constraints	Distribution Pipe	Yonge St - GTA East - Area 30 - 1358	(1,720)
Optimized - Kept within budgetary constraints	Distribution Pipe	Yonge St 2 - GTA East - Area 30 - 1707	(751)
Optimized - Kept within budgetary constraints	Distribution Pipe	Z1193, NRP - HNS Brock Park B, 2024 - 2025 - 1613	(840)
Optimized - Kept within budgetary constraints	Distribution Pipe	Z74, NRP - HNS Queens Park B, 2023 - 2025 - 1652	(1,060)
Optimized - Kept within budgetary constraints	Distribution Stations	(O)-ELLESMERE / BUDEA	(123)
Optimized - Kept within budgetary constraints	Distribution Stations	12377A PURPLE DUSK TRAIL & NELSON DISTRICT	(111)
Optimized - Kept within budgetary constraints	Distribution Stations	12696A BROOKFIELD AND DONINO DISTRICT	(190)
Optimized - Kept within budgetary constraints	Distribution Stations	130-113R Bathurse & Talbot	552
Optimized - Kept within budgetary constraints	Distribution Stations	13P-101R Sovereign & Gore	(1,257)
Optimized - Kept within budgetary constraints	Distribution Stations	14378A - TRETHEWAY & CLEARVIEW DISTRICT	(204)
Optimized - Kept within budgetary constraints	Distribution Stations	14435A BIRMINGHAM & NINTH DISTRICT	(219)
Optimized - Kept within budgetary constraints	Distribution Stations	14887A GLAMORGAN & KENNEDY DISTRICT	(201)

Optimized - Kept within budgetary constraints	Distribution Stations	150-401R Bryanston Gate	(904)
Optimized - Kept within budgetary constraints	Distribution Stations	15R-604R Young & Peel LP Stn	(99)
Optimized - Kept within budgetary constraints	Distribution Stations	17461A CAVERLY & MARTINGROVE DISTRICT	(116)
Optimized - Kept within budgetary constraints	Distribution Stations	17904A Rathburn and Dorlen District	(401)
Optimized - Kept within budgetary constraints	Distribution Stations	190-101 Dublin Gate	(655)
Optimized - Kept within budgetary constraints	Distribution Stations	20702A DIXIE & BRITANNIA DISTRICT	(97)
Optimized - Kept within budgetary constraints	Distribution Stations	20782B DERRY & TOMKEN IP DISTRICT	(97)
Optimized - Kept within budgetary constraints	Distribution Stations	21102A - BRESLER & AIRPORT	(89)
Optimized - Kept within budgetary constraints	Distribution Stations	21116A - DERRY & HISTORIC TRAIL	(89)
Optimized - Kept within budgetary constraints	Distribution Stations	2885749 Taunton and Gillett	(206)
Optimized - Kept within budgetary constraints	Distribution Stations	2936745 MARKHAM & VERNE DISTRICT	(92)
Optimized - Kept within budgetary constraints	Distribution Stations	2936953 MEADOWVALE & GENERATION DISTRICT	(162)
Optimized - Kept within budgetary constraints	Distribution Stations	30988A CONCESSION 2 & TWMARC DISTRICT	(249)
Optimized - Kept within budgetary constraints	Distribution Stations	31335A GILBERT& YONGE DISTRICT (AURO	266
Optimized - Kept within budgetary constraints	Distribution Stations	31428A - RAM FOREST & WESLEY CORNERS	(237)
Optimized - Kept within budgetary constraints	Distribution Stations	3226575 SHEPPARD & MORNINGSIDE DISTRICT	(170)
Optimized - Kept within budgetary constraints	Distribution Stations	32311A - WILLIAM & PRESTON LAKE DISTRICT	(237)
Optimized - Kept within budgetary constraints	Distribution Stations	32564A - MILL ST & KING SIDEROAD DISTRICT	144
Optimized - Kept within budgetary constraints	Distribution Stations	32717A - WESTON RD & KING RD DISTRICT	-
Optimized - Kept within budgetary constraints	Distribution Stations	33171A - MAJOR MACKENZIE & VELLORE WOODS DISTRICT (VAUGHAN)	(70)
Optimized - Kept within budgetary constraints	Distribution Stations	33300A ISLINGTON & HWY # 407 HP DIST	184
Optimized - Kept within budgetary constraints	Distribution Stations	33525A Bathurst & Rutherford hp-ip	333
Optimized - Kept within budgetary constraints	Distribution Stations	33534A STEELES & BAYVIEW DISTRICT	1,060
Optimized - Kept within budgetary constraints	Distribution Stations	35053A Dufferin Langstaff (Langstaff & 407)	332
Optimized - Kept within budgetary constraints	Distribution Stations	44512A YANKEE LINE & RUSSELL DISTRICT	(215)
Optimized - Kept within budgetary constraints	Distribution Stations	50356A COUNTY RD #55 HWY #9 DISTRICT (NEW TECUSETH)	-
Optimized - Kept within budgetary constraints	Distribution Stations	61061A PEMBROKE W. DISTRICT	-
Optimized - Kept within budgetary constraints	Distribution Stations	61128A - CAMPBELL & MCNABB DISTRICT	(140)
Optimized - Kept within budgetary constraints	Distribution Stations	6B435A - CORKSTOWN & WESTDALE DISTRICT	(27)
Optimized - Kept within budgetary constraints	Distribution Stations	6B562A - CAMPEAU & TERON DISTRICT HP (O.P.P.)	103
Optimized - Kept within budgetary constraints	Distribution Stations	6B602A STARTOP DISTRICT XHP	240
Optimized - Kept within budgetary constraints	Distribution Stations	6B631A MCCARTHY DR AND HUNT CLUB RD	(152)
Optimized - Kept within budgetary constraints	Distribution Stations	6B758A - EAGLESON & HAZELDEAN DISTRICT	(62)
Optimized - Kept within budgetary constraints	Distribution Stations	BATHURST GATE	(1,865)
Optimized - Kept within budgetary constraints	Distribution Stations	BAY & SCOLLARD DISTRICT LP	(658)
Optimized - Kept within budgetary constraints	Distribution Stations	BAYVIEW & BYNG DISTRICT	(389)
Optimized - Kept within budgetary constraints	Distribution Stations	BAYVIEW & SHEPPARD DISTRICT	(132)
Optimized - Kept within budgetary constraints	Distribution Stations	BAYVIEW FEEDER	(4,532)
Optimized - Kept within budgetary constraints	Distribution Stations	Bellville Yard Station	(1,341)
Optimized - Kept within budgetary constraints	Distribution Stations	BOND HEAD GATE	(3,900)
Optimized - Kept within budgetary constraints	Distribution Stations	BOWMANVILLE GATE	(3,040)
Optimized - Kept within budgetary constraints	Distribution Stations	BRAMALEA & ADVANCE BLVD. DISTRICT	(97)
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 09T-303R Church St & Erie Ave LP	351
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 09T-306R Front Street Avenue LP	304
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 11U-601R Pt Ryerse Young & Rolph W Hill LP	384
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 11V-101 Port Dover South Distribution Station, Port Dover, Station I	(27)
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 11V-202R Pt Dover Nelson & George St LP	355
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 11V-204R Pt Dover Clinton & St Patrick LP	356
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 11V-401R Pt Ryerse Commercial St LP	4,265
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 12R-302R Victoria St & Niagara St Station LP	351

Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 12R-303R Tillson Ave Dist Station LP	355
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 12R-607R Tillson Ave, South of Hyman LP	384
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 12S-101 Tillsonburg Potter's Road Distribution Station, Tillsonburg, S	(19)
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 12S-202 Fernlea Farm Distribution Station, Delhi, Station Rebuild (C	(186)
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 12T-506R Delhi Queen & Church Stn LP	384
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 12U-501 Simcoe Queen St South of Hwy 3 (2nd Stage) LP	355
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 12U-504 Simcoe Hunt Street South Distribution Station, Simcoe, Sta	(1)
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 12U-602R Simcoe Union & Talbot Stn LP	355
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 12U-606R Simcoe Metcalfe & Robinson LP	3,944
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 12U-607R Simcoe Queen St S & Grove LP	384
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 12U-609R Simcoe South & John St LP	4,265
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 13U-603R Waterford Temperence & Leamon LP	384
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 14S-601 Norwich Brick Gate Stn. FIMP	(85)
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 15U-301R St Paul & Dublin LP	384
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 15U-308R Brantford Grand & Jubilee LP	383
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 15V-406R Mohawk Brighton LP	384
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 15V-408R Brighton & Superior LP	383
Optimized - Kept within budgetary constraints	Distribution Stations	BRAN: 16U-601 Brantford Gate Station, Station Rebuild (Capital Mainten	(7,066)
Optimized - Kept within budgetary constraints	Distribution Stations	BRIMLEY & ELESMERE DISTRICT	(247)
Optimized - Kept within budgetary constraints	Distribution Stations	BROCKVILLE GATE	(1,681)
Optimized - Kept within budgetary constraints	Distribution Stations	Buttonville Interconnect	(61)
Optimized - Kept within budgetary constraints	Distribution Stations	CALEDONIA & RAITHERM DISTRICT	(342)
Optimized - Kept within budgetary constraints	Distribution Stations	CATHCART & STEWART DISTRICT	1,627
Optimized - Kept within budgetary constraints	Distribution Stations	CAWTHRA AND QUEENSWAY DISTRICT	(1,593)
Optimized - Kept within budgetary constraints	Distribution Stations	CFB Station Retirement	(48)
Optimized - Kept within budgetary constraints	Distribution Stations	CHAT - 07G-601 Chatham North Gate	(1,665)
Optimized - Kept within budgetary constraints	Distribution Stations	CHAT - 07H-601 Burke Line - Heater Replacement	(123)
Optimized - Kept within budgetary constraints	Distribution Stations	CHAT - 07J-301 Ridgetown North Transmission - Replace heater	(45)
Optimized - Kept within budgetary constraints	Distribution Stations	CHAT - 08H-302C Greenhill Produce - rebuild and heater addition	8
Optimized - Kept within budgetary constraints	Distribution Stations	CHAT - 09G-502 Tupperville Trans - heater replacement	(604)
Optimized - Kept within budgetary constraints	Distribution Stations	CHAT: 06J-103 Blenheim North Gate	(167)
Optimized - Kept within budgetary constraints	Distribution Stations	CHAT: 07H-501 MAYNARD LINE	(279)
Optimized - Kept within budgetary constraints	Distribution Stations	CHAT: 07K-409 MCKINLAY RD STATION	(597)
Optimized - Kept within budgetary constraints	Distribution Stations	CHAT: 09F-501 Wallaceburg Baseline	(978)
Optimized - Kept within budgetary constraints	Distribution Stations	CNG Stations - Project #4	(2,414)
Optimized - Kept within budgetary constraints	Distribution Stations	COUNTY RD #55 HWY #9 DISTRICT (NEW TECUSETH)	-
Optimized - Kept within budgetary constraints	Distribution Stations	CROWLAND STORAGE TRANSFER	(18,540)
Optimized - Kept within budgetary constraints	Distribution Stations	DELOIRINE & YONGE DISTRICT	(58)
Optimized - Kept within budgetary constraints	Distribution Stations	DOWNSVIEW FEEDER	(292)
Optimized - Kept within budgetary constraints	Distribution Stations	DURHAM 23 FEEDER	(781)
Optimized - Kept within budgetary constraints	Distribution Stations	EASTGATE AND DIXIE DISTRICT	(477)
Optimized - Kept within budgetary constraints	Distribution Stations	FINCH & HALESLIA DISTRICT	(200)
Optimized - Kept within budgetary constraints	Distribution Stations	GRASSYBROOK & MCKENNY DISTRICT	(92)
Optimized - Kept within budgetary constraints	Distribution Stations	HALT - Centennial and Guelph Line Vault Station	160
Optimized - Kept within budgetary constraints	Distribution Stations	HALT - Dundas and Meadowridge	4
Optimized - Kept within budgetary constraints	Distribution Stations	HALT - York and Broadway	(297)
Optimized - Kept within budgetary constraints	Distribution Stations	HALT: Customer Station,Windsor, Maintenance	35
Optimized - Kept within budgetary constraints	Distribution Stations	HALT: Affinia Canada Corp, Rebuild	(97)
Optimized - Kept within budgetary constraints	Distribution Stations	HALT: Burlington Gate, boiler	(1,314)
Optimized - Kept within budgetary constraints	Distribution Stations	HALT: EC Drury School,Rebuild	(28)

Optimized - Kept within budgetary constraints	Distribution Stations	HALT: Milton Hydro Dist Inc, Rebuild	(113)
Optimized - Kept within budgetary constraints	Distribution Stations	HALT: Morgan Thermal Ceramics, Maintenance	(28)
Optimized - Kept within budgetary constraints	Distribution Stations	Halt: Ninth/Britannia, Rebuild	(425)
Optimized - Kept within budgetary constraints	Distribution Stations	HALT: Saputo, rebuild	160
Optimized - Kept within budgetary constraints	Distribution Stations	HALT-440 Harrop	90
Optimized - Kept within budgetary constraints	Distribution Stations	HALT-Lynden Gate Stn	2,379
Optimized - Kept within budgetary constraints	Distribution Stations	HALT-Milton TBS	(487)
Optimized - Kept within budgetary constraints	Distribution Stations	HALT-Third Line and QEW Vault Station	137
Optimized - Kept within budgetary constraints	Distribution Stations	HALT-Winston Churchill & 10 Side Rd	(44)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI - Bancroft and Nash Vault Station	137
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI - Clappison's Corners	137
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI - Diltz Rd IP North	(307)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI - Ferrie and Wellington Vault Station	137
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI - Hillcrest Station	(965)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI - Industrial St Vault Station	137
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI - King St E Stn - Dundas	137
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI - Six Nations	(19)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI - South Bend & Upper James Stn - Hamilton	137
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI - US Steel Blast Furnace Atm Tank Replacement - Walpole	(522)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI : CALEDONIA TRANSMISSION STN, Rebuild	(3,893)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI: 12Z-301 Port Maitland Rymer Station, Haldimand, Heater Installatic	(447)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI: Birmingham and Burlington, Maintenance	(263)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI: Cascade & Lanark Station Rebuild, Vault	(274)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI: Empire Steel, Maintenance	(56)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI: Hamilton Gate 2, Noise Issues	(738)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI: Hamilton Takeoff & Carlisle Gate, Rebuild	(3,722)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI: Jarvis trans, full rebuild	-
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI: Kenora & Bancroft Station Rebuild, Vault	203
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI: KIRKWALL/DOMINION, Full Rebuild	(3,615)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI: Mye Canada, Maintenance	(28)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI: Saint Gobain Abrasives, maintenance	(113)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI: SE Corner of HWY 5 & 6, Maintenance	90
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI: Temple Canada, Maintenance	(28)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI: Voith Fabrics, Maintenance	(56)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI: VOORTMAN STN, heater Replacement	(347)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI: WATERDOWN NORTH DISTR'N STN, Boiler	(767)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI: Woodward bio gas, reinforcement	(284)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI-Hamilton Gate 3	(3,292)
Optimized - Kept within budgetary constraints	Distribution Stations	HAMI-Summit Trans Stn,	(225)
Optimized - Kept within budgetary constraints	Distribution Stations	Harmer District Station	(2,515)
Optimized - Kept within budgetary constraints	Distribution Stations	HARVIE & MORRISON DISTRICT	(420)
Optimized - Kept within budgetary constraints	Distribution Stations	KEELE AND FINCH FEEDER	(3,342)
Optimized - Kept within budgetary constraints	Distribution Stations	KEELE AND STEELES/CNR FEEDER	(1,136)
Optimized - Kept within budgetary constraints	Distribution Stations	KEMPTVILLE GATE	(3,738)
Optimized - Kept within budgetary constraints	Distribution Stations	KING - Cornwall East TBS rebuild	(1,372)
Optimized - Kept within budgetary constraints	Distribution Stations	King - corrosion Diamond Head Park PRS 27301037	(68)
Optimized - Kept within budgetary constraints	Distribution Stations	KING - Under rated valve Trenton TBS 27601001	(156)
Optimized - Kept within budgetary constraints	Distribution Stations	KING: 22-22-704 College and Sidney DRS (27801009) Rebuild	1,224
Optimized - Kept within budgetary constraints	Distribution Stations	KING: Belleville Sidney St TBS (27801001) Valve Upgrades	(188)
Optimized - Kept within budgetary constraints	Distribution Stations	KING: Ingredion Cardinal (18800003) Rebuild	(603)

Optimized - Kept within budgetary constraints	Distribution Stations	LEEDS GATE	(629)
Optimized - Kept within budgetary constraints	Distribution Stations	LESLIE & STEELES DISTRICT	(98)
Optimized - Kept within budgetary constraints	Distribution Stations	Lisgar Station	(16,320)
Optimized - Kept within budgetary constraints	Distribution Stations	LOND - 12F-501 Payne Kimball Rebuild	(4,156)
Optimized - Kept within budgetary constraints	Distribution Stations	LOND - 17K-601R Grand Bend Northgate	(293)
Optimized - Kept within budgetary constraints	Distribution Stations	LOND - Mitchell Station Rebuild - London	(204)
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 10M-503R Main and Shackleton	3,845
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 11O-306R Wellington and Fifth Reg Stn	212
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 13O-109R Edith and Mt. Pleasant	264
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 13O-123R Napier and Blackfriars Reg Stn	229
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 13O-206R London Baseline Reg Station	(774)
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 13O-210R Hale and Burslem	3,845
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 13O-212R Highbury and Brydges	3,845
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 13O-401 White Oaks	(309)
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 14O-503R Highbury and Cheapside Dist Stn	(5,614)
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 14O-510R Curry and Oxford	252
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 14O-603I 3M Customer Station Rebuild	(186)
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 14O-619I 3M Customer Station Rebuild; 528	(186)
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 14R-104 Beachville Domtar Trans Stn	(5,085)
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 15J-401 Forest Gate Transmission Station	(240)
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 15Q-603 Canada Cement Trans Stn	(2,397)
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 15R-608R Walter and Fyfe Reg Stn	229
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 16O-301 St. Mary's Gate	(309)
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 17M-601 Centralia Stn	117
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 19O-601 Mitchell Gate	(266)
Optimized - Kept within budgetary constraints	Distribution Stations	LOND: 21L-201 Goderich Gate	(927)
Optimized - Kept within budgetary constraints	Distribution Stations	MARKHAM GATE	(3,216)
Optimized - Kept within budgetary constraints	Distribution Stations	MCCOWAN AND SHEPPARD DISTRICT	(381)
Optimized - Kept within budgetary constraints	Distribution Stations	McCreedy West Stn., Sudbury	(10)
Optimized - Kept within budgetary constraints	Distribution Stations	MISSISSAUGA RD & HWY. #7 DISTRICT	(89)
Optimized - Kept within budgetary constraints	Distribution Stations	MOUNTAIN RD GATE	(2,552)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: Callander TBS, Boiler Replacement	(64)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: Earlton TBS, Boiler Replacement	(68)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: Eloy TBS, Boiler Replacement	(147)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: Emsdale CMS, Boiler Replacement	(64)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: Englehart TBS, Boiler Replacement	(110)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: Ferguson Road, Boiler Replacement	(68)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: Haileybury TBS, Boiler Replacement	(131)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: Madill TBS _ Huntsville, Boiler Replacement	(101)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: Mattawa TBS, Boiler Replacement	(70)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: Muskoka Falls TBS, Boiler Replacement	(135)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: New Liskeard TBS, Boiler Replacement	(103)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: Ravensglen TBS, Boiler Replacement	(152)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: Ski Club/Trout Lake TBS, Boiler Replacement	(171)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: South River TBS, Boiler Replacement	(70)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: Sturgeon Falls TBS, Boiler Replacement	(106)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: TCPL Co-gen North Bay, Boiler Replacement	(101)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: Warren TBS, Boiler Replacement	(66)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: West Ferris TBS, Boiler Replacement	(66)
Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: West St TBS, Boiler Replacement	(125)

Optimized - Kept within budgetary constraints	Distribution Stations	NBAY: Widdifield TBS, Boiler Replacement	(70)
Optimized - Kept within budgetary constraints	Distribution Stations	NE: 45103001 - Airport Rd TBS and DRS, Boiler Replacement	(269)
Optimized - Kept within budgetary constraints	Distribution Stations	NE: 13403001 - Vale Totten Mine, Rebuild	(615)
Optimized - Kept within budgetary constraints	Distribution Stations	NE: 42601002 - Englehart TBS, Relocation	(1,391)
Optimized - Kept within budgetary constraints	Distribution Stations	NE: 42801004 - Cobalt TBS, Rebuild	(419)
Optimized - Kept within budgetary constraints	Distribution Stations	NE: 43201030 - Coniston Primary, Control Valve Modifications	(172)
Optimized - Kept within budgetary constraints	Distribution Stations	NE: 43202054 Inco Smelter, Station Modifications	50
Optimized - Kept within budgetary constraints	Distribution Stations	NE: 43202063 - Vale Engineering & Exploration, Rebuild/Relocation	(110)
Optimized - Kept within budgetary constraints	Distribution Stations	NE: 43202064 Vale Divisional Shops PRS Replacement	35
Optimized - Kept within budgetary constraints	Distribution Stations	NE: 43202154 - Bil-Mur PRS, Rebuild	(131)
Optimized - Kept within budgetary constraints	Distribution Stations	NE: 43501002 - Coniston DRS, Rebuild	(350)
Optimized - Kept within budgetary constraints	Distribution Stations	NE: 43601001 - Balls Dr TBS, Rebuild	(530)
Optimized - Kept within budgetary constraints	Distribution Stations	NE: 44702001 - Rutherglen TBS, Rebuild	(301)
Optimized - Kept within budgetary constraints	Distribution Stations	NE: 45101001 - Sault Primary, Control Valve Modifications	(99)
Optimized - Kept within budgetary constraints	Distribution Stations	NE: 45101125 - Essar #7 BF SMS, Gear Operator Replacement	88
Optimized - Kept within budgetary constraints	Distribution Stations	NE: 45401095 - Great Northern Rd TBS, Boiler Replacement	(194)
Optimized - Kept within budgetary constraints	Distribution Stations	NE: Espanola DRS & Domtar SMS, Station Rebuild	(732)
Optimized - Kept within budgetary constraints	Distribution Stations	NEILSON RD FEEDER	(372)
Optimized - Kept within budgetary constraints	Distribution Stations	NGT Existing customer Maintenance Capital - (+2027)	(1,190)
Optimized - Kept within budgetary constraints	Distribution Stations	NGV Rental VRA's - (2026-2032)	(601)
Optimized - Kept within budgetary constraints	Distribution Stations	NIAGARA GATE	(3,103)
Optimized - Kept within budgetary constraints	Distribution Stations	NOBLETON GATE	(2,494)
Optimized - Kept within budgetary constraints	Distribution Stations	ONTARIO & DEERE DISTRICT LP	3,254
Optimized - Kept within budgetary constraints	Distribution Stations	OSHAWA GATE	(2,786)
Optimized - Kept within budgetary constraints	Distribution Stations	PETAWAWA GATE	(235)
Optimized - Kept within budgetary constraints	Distribution Stations	REPLIN & LAWRENCE DISTRICT	(50)
Optimized - Kept within budgetary constraints	Distribution Stations	SANDALWOOD GATE	129
Optimized - Kept within budgetary constraints	Distribution Stations	SARN: 11H-201R Oil Spring Reg Stn	212
Optimized - Kept within budgetary constraints	Distribution Stations	SARN: 12F-106I Suncor Hydrogen/Air Products	(1,077)
Optimized - Kept within budgetary constraints	Distribution Stations	SARN: 12F-201I Suncor Ethanol	(176)
Optimized - Kept within budgetary constraints	Distribution Stations	SARN: 12F-205 Novacor Moore Trans	(1,784)
Optimized - Kept within budgetary constraints	Distribution Stations	SARN: 13F-220R Vidal St	(3,768)
Optimized - Kept within budgetary constraints	Distribution Stations	SARN: 13F-323R McPlank	(286)
Optimized - Kept within budgetary constraints	Distribution Stations	SARN: 13F-402 Shell Canada	(228)
Optimized - Kept within budgetary constraints	Distribution Stations	SARN: 13F-501 Sarnia Industrial	(6,786)
Optimized - Kept within budgetary constraints	Distribution Stations	SARN: 13F-503 Churchill Rd. Trans Stn	(3,666)
Optimized - Kept within budgetary constraints	Distribution Stations	SARN: 13O-402 Westmount Gate	(1,117)
Optimized - Kept within budgetary constraints	Distribution Stations	SARN: 14F-503R Point Edward Victoria and St. Clair Reg Stn	192
Optimized - Kept within budgetary constraints	Distribution Stations	SCHOMBERG GATE	(2,493)
Optimized - Kept within budgetary constraints	Distribution Stations	SHEPPARD AVE E & GRAND MARSHALL DISTRICT	(108)
Optimized - Kept within budgetary constraints	Distribution Stations	SIGNET & FINCH FEEDER	(199)
Optimized - Kept within budgetary constraints	Distribution Stations	SPADINA & MACPHERSON DISTRICT	(529)
Optimized - Kept within budgetary constraints	Distribution Stations	SSM: Blind River TBS, Boiler Replacement	(95)
Optimized - Kept within budgetary constraints	Distribution Stations	SSM: Elliot Lake TBS, Boiler Replacement	(98)
Optimized - Kept within budgetary constraints	Distribution Stations	SSM: Goulais Ave TBS Algoma 4, Boiler Replacement	(611)
Optimized - Kept within budgetary constraints	Distribution Stations	SSM: Goulais Ave TBS Algoma 4, Station Modifications	(26)
Optimized - Kept within budgetary constraints	Distribution Stations	ST. PAUL & SANDFIELD DISTRICT (ALEXANDRIA)	(156)
Optimized - Kept within budgetary constraints	Distribution Stations	SUD: Azilda DRS, Boiler Replacement	(62)
Optimized - Kept within budgetary constraints	Distribution Stations	SUD: Barrydowne, Boiler Replacement	(93)
Optimized - Kept within budgetary constraints	Distribution Stations	SUD: Chelmsford, Boiler Replacement	(68)

Optimized - Kept within budgetary constraints	Distribution Stations	SUD: Coniston TBS, Boiler Replacement	(70)
Optimized - Kept within budgetary constraints	Distribution Stations	SUD: Copper Cliff TBS, Boiler Replacement	(64)
Optimized - Kept within budgetary constraints	Distribution Stations	SUD: Frood TBS, Boiler Replacement	735
Optimized - Kept within budgetary constraints	Distribution Stations	SUD: Inco North Mine SMS, Boiler Replacement	(62)
Optimized - Kept within budgetary constraints	Distribution Stations	SUD: Inco Smelter SMS, Boiler Replacement	(179)
Optimized - Kept within budgetary constraints	Distribution Stations	SUD: Kelly Lake TBS, Boiler Replacement	(73)
Optimized - Kept within budgetary constraints	Distribution Stations	SUD: Kukagami TBS, Boiler Replacement	(62)
Optimized - Kept within budgetary constraints	Distribution Stations	SUD: Lasalle TBS, Boiler Replacement	(93)
Optimized - Kept within budgetary constraints	Distribution Stations	SUD: Maley Dr TBS, Boiler Replacement	562
Optimized - Kept within budgetary constraints	Distribution Stations	SUD: Walden TBS, Boiler Replacement	(70)
Optimized - Kept within budgetary constraints	Distribution Stations	SUMMERSTOWN GATE	(2,138)
Optimized - Kept within budgetary constraints	Distribution Stations	TALISMAN PRODUCTION	(976)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: 33-23-700 Arthur St TBS, Thunder Bay, Station Rebuild	(1,670)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: 500 Toledo St MUB Rebuild	(145)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Arthur St at Cooper Rd PRS Rebuild	(391)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Balmertown - Goldcorp SMS, Boiler Replacement	(101)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Balsam St TBS Filter	(83)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Belrose PCS, Boiler Replacement	(426)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Burwood Rd TBS Filter	(48)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Clark & Niven DRS Rebuild	(88)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Dewe St DRS Relocation	(313)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Dryden Domtar SMS, Station Modifications	(113)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: English River PCS Station Rebuild	(860)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Fisher 621 PRS Rebuild Program	(575)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Geraldton TBS, Boiler Replacement	(65)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Ignace TBS, Boiler Replacement	(68)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Kenora Airport Rd, Boiler Replacement	(65)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Kenora TBS, Boiler Replacement	(106)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Kraft SMS Retirement	(90)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Longlac TBS, Heater Replacement	(179)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: McIlvaine TBS, Boiler Replacement	(68)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Mountdale at Francis DRS Rebuild	(290)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: New Station at Mercury Ave & Maple Station Retirement (Atikokan)	(289)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Nipigon TBS, Boiler Replacement	(66)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Paquette Road Station Rebuild	(567)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Vermillion Bay PCS, Boiler Replacement	(129)
Optimized - Kept within budgetary constraints	Distribution Stations	TBAY: Wright at O'Brien DRS Pipe Supports	(11)
Optimized - Kept within budgetary constraints	Distribution Stations	THORNTON GATE	(3,204)
Optimized - Kept within budgetary constraints	Distribution Stations	THOROLD TOWNLINE GATE	(601)
Optimized - Kept within budgetary constraints	Distribution Stations	THUN: Gorevale Road PRS Station Relocation	(313)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: 45-22-700 Goldcorp Dome Mine SMS, Rebuild	(1,534)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: 45-22-702 Kirkland Lake (Northland) Power SMS Rebuild	(1,050)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: 45-23-700 2881 Hwy 655 TBS Low-Piping Modifications	(304)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: 45-23-701 Porcupine Primary Low-Piping Modifications	(304)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Cochrane TBS, Boiler Replacement	(101)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Dalton TBS (Mcbride St S.), Station Rebuild and Boiler Replacemen	(423)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Evergreen Greenhouse SMS Retirement	(5)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Fauquier TBS Rebuild	(357)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Glencore Concentrator SMS, Boiler Replacement	(137)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Glencore Mine SMS, Boiler Replacement	(109)

Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Hallnor Mine PRS Retirement	(28)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Hwy 655 TBS, Boiler Replacement	(108)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Iroquois Falls TBS, Station Rebuild	(1,302)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Kapuskasing TBS, Boiler Replacement	(261)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Kirkland Lake CMS (Kenogami) - Long-Term Odorant Solution	(386)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Kirkland Lake TBS, Boiler Replacement	(103)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Malette Kraft SMS Retirement	(21)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Matheson TBS, Boiler Replacement	(70)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Mattice TBS Rebuild	(386)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Moneta TBS, Boiler Replacement	(95)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Monteith CMS	(790)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Munoro Mine SMS Retirement	(17)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Opasatika TBS Rebuild	(386)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Porcupine PCS, Boiler Replacement	(97)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Schumacher TBS, Boiler Replacement	(68)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Smooth Rock Falls CMS, TBS, and DRS Relocations/Retirements	(1,489)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: South Porcupine/Crawford TBS, Boiler Replacement	(152)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Swastika TBS, Station Rebuild	(320)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Tembec Spruce Falls SMS, Rebuild	(1,341)
Optimized - Kept within budgetary constraints	Distribution Stations	TIMM: Val Gagne TBS Rebuild	(357)
Optimized - Kept within budgetary constraints	Distribution Stations	TOWNLINE & RUSHOLME DISTRICT	(17)
Optimized - Kept within budgetary constraints	Distribution Stations	VICTORIA SQUARE GATE	(395)
Optimized - Kept within budgetary constraints	Distribution Stations	VINELAND GATE	(495)
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 09T-307R Ellis & Alley St LP	355
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 12T-102 Norwich-Middleton Town Stn. FIMP	(85)
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 17T-201 New Dundee Gate Stn FIMP	(85)
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 17T-202 N.Dumphries Trans. Stn FIMP	(78)
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 17T-202 North Dumfries Distribution Station, North Dumfries, Stati	(87)
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 17U-211R Stanley @ Glenmorris LP	383
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 17U-214R Middleton St at Waterworks LP	383
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 18S-401 Markdale Stn. FIMP	(95)
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 18T-402 Mannheim Trans Stn	(72)
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 18U-205R Hungerford & Walker LP	4,265
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 18U-220R Bechtel & Millvue LP	384
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 18U-403R Agnes & William LP	4,265
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 18U-407R Church & Sherring LP	384
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 18U-418R 122 Dolph St N LP	383
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 18U-504 Cambridge East Distribution Station, Cambridge, Station R	(152)
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 18U-506R Bishop & King LP	383
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 19S-201 Heidelberg Gate FIMP	(72)
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 19U-201 Guelph West Gate Stn. FIMP	(140)
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 19U-601R Rozelle Rd. Dist. Stn FIMP	(85)
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 21S-601 Fergus 1st Trans Stn FIMP	(135)
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 22S-402 Moorefield Dist. Stn. FIMP	(85)
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 22T-501R Alma Distribution Station, Alma, Station Rebuild (Capital	(246)
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 23Q-301 Harriston Gate Station, Harriston, Station Rebuild (Capital	(343)
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 23R-602 Rothsay Trans Stn,FIMP	(124)
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 30N-501 Southhampton Gate Stn. FIMP	(72)
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: 30Q-105C Sutherland Downs Pit FIMP	(72)
Optimized - Kept within budgetary constraints	Distribution Stations	WATE: Mt Elgin Dist Stn, Mt Elgin, Station	(48)

Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 03B-102R County Rd 20 & Concession Rd 3 - Heater addition	(166)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 03D-322C Leamington Hospital - rebuild	(189)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 03E-104C Thiessen Flower Shop - rebuild	(123)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 04A-302R Texas Rd	136
Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 04B-401R Howard and Pike - Rebuild with Heater	(122)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 04D-601R Albuna Station rebuild	(467)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 05A-203 LaSalle Boismier Ave - Heater replacement	(1,970)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 05A-304R Sprucewood IP - Replace heater	(285)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 05A-601 Front & Malden full rebuild	(1,052)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 05B-201 Windsor McGregor Line - rebuild	(714)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 05B-401R Smith Ind Park - Station Rebuild with Heater	(148)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 06B-314R Isabelle Place LP - rebuild	279
Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 06B-401 Grand Marais - reg repl & liquid tank	146
Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 06B-403 California Ave station rebuild	(2,861)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 06B-517R Ypres LP - rebuild	3,850
Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 06B-548I Customer Paint - Heater Replacement	(144)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 06C-401 Manning Rd station rebuild	(408)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 06C-502 Patillo Rd station rebuild	(475)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND - 06D-401 Belle River Gate - Replace heater	(233)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND: 04E-438C Protolight Farms	(144)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND: 05B-205R Howard & Outer	(130)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND: 06A-605R Matchette & Prince	(646)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND: 06B-404 Bruce Ave	(732)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND: 06B-502 WALKER RD	(247)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND: 06B-607I Customer/Nemak Station Rebuild	(608)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND: 06C-602 Puce Transmission	(111)
Optimized - Kept within budgetary constraints	Distribution Stations	WIND: 07H-402R Peter St Station LP	3,849
Optimized - Kept within budgetary constraints	Distribution Stations	WOODBINE & CNR FEEDER	(1,240)
Optimized - Kept within budgetary constraints	Distribution Stations	YONGE AND STEELES FEEDER	(84)
Optimized - Kept within budgetary constraints	Distribution Stations	YORKGATE & FINCH DISTRICT	(180)
Optimized - Kept within budgetary constraints	Growth	A30: Interchange Way Reinf	(448)
Optimized - Kept within budgetary constraints	Growth	Brockville Gate Extension	(2,050)
Optimized - Kept within budgetary constraints	Growth	Erin IP System Reinforcement	3,635
Optimized - Kept within budgetary constraints	Growth	Huntmar Drive Reinforcement	(2,743)
Optimized - Kept within budgetary constraints	Growth	King - Chesterville, Customer, Finch Reinforcement	(241)
Optimized - Kept within budgetary constraints	Growth	NBAY: Upgrade Maplewood PRS (43801127)	(9)
Optimized - Kept within budgetary constraints	Growth	NW 6581 Ottawa Reinforcement Phase 2 SRP	(16,735)
Optimized - Kept within budgetary constraints	Growth	Rodinea Road	(456)
Optimized - Kept within budgetary constraints	Growth	SRP_GTA West_Lowville_18X-101STN_Rebuild	(263)
Optimized - Kept within budgetary constraints	Growth	SRP_Southwest_Kerwood_12K-301STN_Rebuild	(2,272)
Optimized - Kept within budgetary constraints	Growth	SRP_Southwest_Windsor_05A-201STN_Rebuild	(1,656)
Optimized - Kept within budgetary constraints	Growth	THUN: Rosslyn Rd at Sideroad 20 Reinforcement Project	(65)
Optimized - Kept within budgetary constraints	Growth	TIMM 45-21-501 St Jean @ Shirley NPS4 Reinforcement - Timmins	(48)
Optimized - Kept within budgetary constraints	Growth	TIMM 45-22-502 Shirley St @ Riverside Rd NPS4 Reinforcement - Timmins	(88)
Optimized - Kept within budgetary constraints	Growth	TIMM: West Timmins System Reinforcement (McBride North and Shirley/R	(724)
Optimized - Kept within budgetary constraints	Growth	WATE: 21U-101 Fergus Second Stage, Fergus, Station Rebuild (Load Growt	(250)
Optimized - Kept within budgetary constraints	Growth	WATE: Listowel System Reinforcement, Proj# 07-21-705	(1,352)
Optimized - Kept within budgetary constraints	Compression Stations	Dawn E Siemens MCC replacement	261
Optimized - Kept within budgetary constraints	Compression Stations	SCOR:60004-Fdn Blk-Replace	2,219
Optimized - Kept within budgetary constraints	Compression Stations	SCOR:60011-Fdn Blk-Replace	847

Optimized - Kept within budgetary constraints	Compression Stations	Siemens Valve Controllers Replacement - Dawn I & Parkway D	1,694
Optimized - Kept within budgetary constraints	Compression Stations	Siemens Valve Controllers Replacement - Lobo D & Dawn H	1,018
Optimized - Kept within budgetary constraints	LNG	Hagar Cold Box	(4,828)
Optimized - Kept within budgetary constraints	LNG	Hagar JVG Compressor Upgrade	(12,100)
Optimized - Kept within budgetary constraints	LNG	Hagar KVGR and Cycle Mix Cooler	(14,443)
Optimized - Kept within budgetary constraints	LNG	Hagar LNG Tank Boil Off Gas Recovery System	(3,815)
Optimized - Kept within budgetary constraints	LNG	Hagar MCC Building - Upgrades	(171)
Optimized - Kept within budgetary constraints	LNG	Hagar Obsolete Electrical-Replace	(354)
Optimized - Kept within budgetary constraints	LNG	Hagar Obsolete Instrumentation-Replace	(354)
Optimized - Kept within budgetary constraints	LNG	Hagar Obsolete Mechanical - Replace	(354)
Optimized - Kept within budgetary constraints	LNG	Hagar Pipeduct Refurbishment	2,431
Optimized - Kept within budgetary constraints	LNG	Hagar Site Drainage Improvements	(354)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	50 Keil Renovations - Phase 4	(2,076)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	50 Keil Renovations - Phase 5	(1,922)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	50 Keil Renovations - Phase 6	(1,521)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	555 Riverview Regional Operations Centre	(3,527)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Ancaster Operations Centre	(706)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Arnprior Operations Centre Obsolescence	142
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Brantford Regional Operations Centre	(2,954)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Dawn Administrative Centre	(6,576)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Hamilton - Pritchard Rd. Operations Centre	(623)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Hamilton Facility Decommissioning	(290)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Kelfield Operations Centre - Land Purchase	(19,163)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Kelfield Operations Centre - New Building	(15,088)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Leamington Operations Centre	255
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	MSB Demolition & New Administrative Parking	2,353
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	New London Site	(26,457)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	North Bay Regional Operations Centre	(2,207)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Operations Centre Retirement No. 4	(130)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Oshawa Operations Depot Improvements	721
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Owen Sound Operations Centre	(524)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Simcoe Operations Centre	711
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Sudbury Regional Operations Centre	(4,950)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Thorold Regional Office - Building & Site	-
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Thunder Bay Regional Operations Centre	(1,585)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Timmins Operations Centre	(496)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	TIS Technology and Innovation Lab	(447)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Union Rate Zones Micro Operations Sites Program	12,627
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	VPC Core and Shell	(12,944)
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	VPC-Link and stairwells	1,165
Optimized - Kept within budgetary constraints	Real Estate & Workplace Services	Woodstock Operations Centre	23
Optimized - Kept within budgetary constraints	TIS	Attachment Growth Program	(697)
Optimized - Kept within budgetary constraints	TIS	Auto-Dispatching	1,468
Optimized - Kept within budgetary constraints	TIS	Call/Voice Analytics 2023	7
Optimized - Kept within budgetary constraints	TIS	Construction Program	(697)
Optimized - Kept within budgetary constraints	TIS	Contract Market Harmonization	(3,546)
Optimized - Kept within budgetary constraints	TIS	Corrosion Protection and Leak Survey Enhancement	4,198
Optimized - Kept within budgetary constraints	TIS	Cost & Schedule Management (Ecosys)	2,378
Optimized - Kept within budgetary constraints	TIS	Crossbore & Locate Technology Advancements	(103)
Optimized - Kept within budgetary constraints	TIS	Customer Account creation Automation	317

Optimized - Kept within budgetary constraints	TIS	Customer Inquiry Tool Automation	37
Optimized - Kept within budgetary constraints	TIS	Customer Residential Pre-payment System	1,972
Optimized - Kept within budgetary constraints	TIS	Damage Reduction Technology Support	215,083
Optimized - Kept within budgetary constraints	TIS	EG - Building Management Systems Solution (2025)	79
Optimized - Kept within budgetary constraints	TIS	EG - Customer Data Analytics Solutions (2023)	4
Optimized - Kept within budgetary constraints	TIS	EG - Customer Data Analytics Solutions (2024)	15
Optimized - Kept within budgetary constraints	TIS	EG - Customer Data Analytics Solutions (2025)	54
Optimized - Kept within budgetary constraints	TIS	EG - DataStage Analytics (2025)	63
Optimized - Kept within budgetary constraints	TIS	Emergency Dispatch Capability Advancement	4,902
Optimized - Kept within budgetary constraints	TIS	Enhanced Intelligent Contact Centre, Customer Self Service & Communicat	532
Optimized - Kept within budgetary constraints	TIS	Expansion Surcharge Capability Advancement	117
Optimized - Kept within budgetary constraints	TIS	Fleet Alignment Solution	224
Optimized - Kept within budgetary constraints	TIS	Fleet Asset Management Program	(252)
Optimized - Kept within budgetary constraints	TIS	Forecaster & eWeather Upgrades 2026	168
Optimized - Kept within budgetary constraints	TIS	Forecasting & Planning Automation	1,307
Optimized - Kept within budgetary constraints	TIS	FRA Rollout to LUG	1,396
Optimized - Kept within budgetary constraints	TIS	General Service Rebasing Changes	(8,840)
Optimized - Kept within budgetary constraints	TIS	HVAC Portal & Get Connected Integration	239
Optimized - Kept within budgetary constraints	TIS	Inventory Management	4,117
Optimized - Kept within budgetary constraints	TIS	Material Barcoding Expansion	2,678
Optimized - Kept within budgetary constraints	TIS	Material Traceability	(19)
Optimized - Kept within budgetary constraints	TIS	Online Customer Appointment Booking	2,325
Optimized - Kept within budgetary constraints	TIS	OWP Replacement	878
Optimized - Kept within budgetary constraints	TIS	Push to Talk Radios - 2023	(682)
Optimized - Kept within budgetary constraints	TIS	Push to Talk Radios - 2029	(913)
Optimized - Kept within budgetary constraints	TIS	QR Code for Infractions	1,201
Optimized - Kept within budgetary constraints	TIS	Records Management Upgrade (2024-2027)	(4,060)
Optimized - Kept within budgetary constraints	TIS	Reporting & Analytics	3,334
Optimized - Kept within budgetary constraints	TIS	Scheduling and Dispatching Automation	800
Optimized - Kept within budgetary constraints	TIS	Third Party Locate Management	119
Optimized - Kept within budgetary constraints	TIS	UG - Customer Data Analytics Solutions (2025)	(142)
Optimized - Kept within budgetary constraints	TIS	Work Management Ops Support Program	161
Optimized - not within budgetary constraints	Distribution Pipe	000046, NRP - HNS Grove A1, 2025 - 2027 - 1612	-
Optimized - not within budgetary constraints	Distribution Pipe	000088, NRP - HNS Grove A2, 2028 - 2030 - 1611	-
Optimized - not within budgetary constraints	Distribution Pipe	000725, NRP - HNS Grove B2, 2028 - 2030 - 1608	-
Optimized - not within budgetary constraints	Distribution Pipe	8th St-Nipigon-1553	-
Optimized - not within budgetary constraints	Distribution Pipe	Ann St (MORATORIUM UNTIL 2028) - Southwest - London - 1402	-
Optimized - not within budgetary constraints	Distribution Pipe	Anne St S - Area 50 - 1204	-
Optimized - not within budgetary constraints	Distribution Pipe	Arthur St (MORATORIUM UNTIL 2026) - Eastern - Area 60 - 1724	-
Optimized - not within budgetary constraints	Distribution Pipe	Arthur St N - Southeast - Waterloo - 1800	-
Optimized - not within budgetary constraints	Distribution Pipe	Avondale Blvd 1 - GTA West - Area 20 - 1663	-
Optimized - not within budgetary constraints	Distribution Pipe	Avondale Blvd 2 - GTA West - Area 20 - 1664	-
Optimized - not within budgetary constraints	Distribution Pipe	Bank St (MORATORIUM UNTIL 2026) - Eastern - Area 60 - 1051	-
Optimized - not within budgetary constraints	Distribution Pipe	Bartholomew St - Eastern - Area 60 - 1116	-
Optimized - not within budgetary constraints	Distribution Pipe	Baseline Rd E-Whitby-1182	-
Optimized - not within budgetary constraints	Distribution Pipe	Belle River Rd 2 - Southwest - Windsor - 1368	-
Optimized - not within budgetary constraints	Distribution Pipe	Birch St N (MORATORIUM UNTIL 2028) -Timmins-1550	-
Optimized - not within budgetary constraints	Distribution Pipe	Blake St - Area 50 - 1209	-
Optimized - not within budgetary constraints	Distribution Pipe	Byng Ave-Kapuskasing-1539	-
Optimized - not within budgetary constraints	Distribution Pipe	Carden St - Southeast - Waterloo - 1801	-

Optimized - not within budgetary constraints	Distribution Pipe	Centre St - Southwest - London - 1479	-
Optimized - not within budgetary constraints	Distribution Pipe	Christena Cres 2 - Ajax - Area 40 - 1704	-
Optimized - not within budgetary constraints	Distribution Pipe	Circle St-Kapuskasing-1548	-
Optimized - not within budgetary constraints	Distribution Pipe	Clarkson Rd 2 (EXECUTE 2025 - ROAD REHABILITATION WORK PLANNED FC	-
Optimized - not within budgetary constraints	Distribution Pipe	Colborne Ave - GTA East - Area 30 - 1705	-
Optimized - not within budgetary constraints	Distribution Pipe	Cumberland St - Area 50 - 1200	-
Optimized - not within budgetary constraints	Distribution Pipe	Daniel St S - Eastern - Area 60 - 1213	-
Optimized - not within budgetary constraints	Distribution Pipe	Dauw Ave - Southwest - Windsor - 1384	-
Optimized - not within budgetary constraints	Distribution Pipe	Deamess Dr - Southwest - London - 1396	-
Optimized - not within budgetary constraints	Distribution Pipe	Devonshire Ave-Kapuskasing-1536	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Brant - High St - Southeast - Waterloo - 1294	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Brant - Park Rd N - Southeast - Waterloo - 1315	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - Bell Lane - Southeast - Waterloo - 1284	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - Catherine Ave - Southeast - Waterloo - 1321	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - Charing Cross St (MORATORIUM UNTIL 2026) - Southe	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - Colborne St - Southeast - Waterloo - 1817	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - Grand St (MORATORIUM UNTIL 2026) - Southeast - W.	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - N Park St (MORATORIUM UNTIL 2026) - Southeast - W	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - Ontario St - Southeast - Waterloo - 1298	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - Spalding Dr - Southeast - Waterloo - 1387	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - St Paul Ave (MORATORIUM UNTIL 2025) - Southeast -	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - Terrace Hill St - Southeast - Waterloo - 1290	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Brantford - Wilkes St (MORATORIUM UNTIL 2027) - Southeast - W	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Delhi - James St (MORATORIUM UNTIL 2026) - Southeast - Waterl	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Langton - Wycombe - 12th Concession Rd - Southeast - Waterloo	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Norfolk County - Atherton - Lynedoch Rd - Southeast - Waterloo	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Norfolk County - Halfway House Corner - Vittoria Rd - Southeast -	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Norfolk County - Marston - 10th Concession Rd 2 - Southeast - Wa	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Norfolk County - Silver Hill - 10th Concession Rd - Southeast - Wat	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Norfolk County - Simcoe - Blue Line Rd - Southeast - Waterloo - 13	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Tillsonburg - Hyman St - Southeast - Waterloo - 1374	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 06 - Tillsonburg - Tillson Ave - Southeast - Waterloo - 1392	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 07 - Meaford - Louisa St - Southeast - Waterloo - 1278	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 07 - Waterloo - Union St E - Southeast - Waterloo - 1390	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 16 - Haldimand - Jarvis - Talbot St E - Hamilton - 1732	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 16 - Haldimand - Selkirk - Erie St S - Hamilton - 1420	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 16 - Hamilton - Barton St E (MORATORIUM UNTIL 2027) - Hamilton - 1	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 16 - Hamilton - Kenilworth Ave N - Hamilton - 1733	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 16 - Hamilton - Market St - Hamilton - 1456	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 16 - Hamilton - Wentworth St S 1 - Hamilton - 1742	-
Optimized - not within budgetary constraints	Distribution Pipe	Div. 17 - Halton - Oakville - Kerr St (MORATORIUM UNTIL 2028) - Hamilton	-
Optimized - not within budgetary constraints	Distribution Pipe	Downie St 2 - Southwest - London - 1807	-
Optimized - not within budgetary constraints	Distribution Pipe	Dubois Ave - Southwest - Windsor - 1385	-
Optimized - not within budgetary constraints	Distribution Pipe	Dundas St (MORATORIUM UNTIL 2030) - Southwest - London - 1411	-
Optimized - not within budgetary constraints	Distribution Pipe	Dundas St 2 (MORATORIUM UNTIL 2030) - Southwest - London - 1518	-
Optimized - not within budgetary constraints	Distribution Pipe	Dundas St 3 (MORATORIUM UNTIL 2029) - Southwest - London - 1521	-
Optimized - not within budgetary constraints	Distribution Pipe	Edmund St 1 - Northeast - 1684	-
Optimized - not within budgetary constraints	Distribution Pipe	Edmund St 2 - Northeast - 1685	-
Optimized - not within budgetary constraints	Distribution Pipe	Elm St PTC - Area 80 - 1157	-
Optimized - not within budgetary constraints	Distribution Pipe	Eyre St - Northeast - 1286	-

Optimized - not within budgetary constraints	Distribution Pipe	Fanshawe Park Rd E - Southwest - London - 1478	-
Optimized - not within budgetary constraints	Distribution Pipe	Frederick_GTA West_Area 20_1481	-
Optimized - not within budgetary constraints	Distribution Pipe	Front St W - Southwest - London - 1544	-
Optimized - not within budgetary constraints	Distribution Pipe	Front St W 2 - Southwest - London - 1547	-
Optimized - not within budgetary constraints	Distribution Pipe	Garden Alley 1-Ganonoque-1460	-
Optimized - not within budgetary constraints	Distribution Pipe	Georgina Ave 1 - Northeast - 1693	-
Optimized - not within budgetary constraints	Distribution Pipe	Glendon Dr - Southwest - London - 1465	-
Optimized - not within budgetary constraints	Distribution Pipe	Gordon Ave - Southwest - London - 1482	-
Optimized - not within budgetary constraints	Distribution Pipe	Gore St W - Eastern - Area 60 - 1097	-
Optimized - not within budgetary constraints	Distribution Pipe	Grand Marais Rd W - Southwest - Windsor - 1328	-
Optimized - not within budgetary constraints	Distribution Pipe	Grand River St S - Southeast - Waterloo - 1805	-
Optimized - not within budgetary constraints	Distribution Pipe	Grove St-Belleville-1591	-
Optimized - not within budgetary constraints	Distribution Pipe	HAMI - Rainham Road - Walpole	-
Optimized - not within budgetary constraints	Distribution Pipe	HAMI - Woodburn	-
Optimized - not within budgetary constraints	Distribution Pipe	HAMI: Lloyminn/Crestview Av, Ancaster, BU Replacement	-
Optimized - not within budgetary constraints	Distribution Pipe	Hamilton St - Eastern - Area 60 - 1056	-
Optimized - not within budgetary constraints	Distribution Pipe	Harriett St (MORATORIUM UNTIL 2028)-Belleville-1600	-
Optimized - not within budgetary constraints	Distribution Pipe	Hill St - Southwest - London - 1567	-
Optimized - not within budgetary constraints	Distribution Pipe	Homedale Blvd - Southwest - Windsor - 1287	-
Optimized - not within budgetary constraints	Distribution Pipe	Homewood Ave PTC - Area 80 - 1149	-
Optimized - not within budgetary constraints	Distribution Pipe	Hughes St - Southwest - London - 1394	-
Optimized - not within budgetary constraints	Distribution Pipe	Huron St - Southwest - London - 1525	-
Optimized - not within budgetary constraints	Distribution Pipe	Iroquois Ave (MORATORIUM UNTIL 2026) - Southwest - London - 1519	-
Optimized - not within budgetary constraints	Distribution Pipe	Jacqueline St - Southwest - London - 1426	-
Optimized - not within budgetary constraints	Distribution Pipe	Kains St (MORATORIUM UNTIL 2028) - Southwest - London - 1476	-
Optimized - not within budgetary constraints	Distribution Pipe	Karl Pl - Southwest - Windsor - 1360	-
Optimized - not within budgetary constraints	Distribution Pipe	King - Augusta Lateral 30%SMYS Valve Replacement (Maitland)	-
Optimized - not within budgetary constraints	Distribution Pipe	King George St - Eastern - Area 60 - 1143	-
Optimized - not within budgetary constraints	Distribution Pipe	King St 1 (MORATORIUM UNTIL 2026) - Northeast - 1717	-
Optimized - not within budgetary constraints	Distribution Pipe	King St 2 - Northeast - 1718	-
Optimized - not within budgetary constraints	Distribution Pipe	King St W (MORATORIUM UNTIL 2030) - Ganonoque - Eastern - 1748	-
Optimized - not within budgetary constraints	Distribution Pipe	King Street-40-Peterborough-1064	-
Optimized - not within budgetary constraints	Distribution Pipe	King: Fifth & McConnell Concrete Encased Main Replacement (Cornwall)	-
Optimized - not within budgetary constraints	Distribution Pipe	La Salle Dr STC- Area 80 - 1186	-
Optimized - not within budgetary constraints	Distribution Pipe	Lambeth - Southwest - London - 1776	-
Optimized - not within budgetary constraints	Distribution Pipe	Lauzon Rd - Southwest - Windsor - 1274	-
Optimized - not within budgetary constraints	Distribution Pipe	Lebel Ave-Kirkland-1545	-
Optimized - not within budgetary constraints	Distribution Pipe	Leblanc Ave-Timmins-1557	-
Optimized - not within budgetary constraints	Distribution Pipe	Lewisham Dr_GTA West_Area 20_1146	-
Optimized - not within budgetary constraints	Distribution Pipe	Lilydale Ave N - Southwest - Windsor - 1365	-
Optimized - not within budgetary constraints	Distribution Pipe	LOND - Spare BU - London	402
Optimized - not within budgetary constraints	Distribution Pipe	Lorne Ave (MORATORIUM UNTIL 2027) - Southwest - London - 1526	-
Optimized - not within budgetary constraints	Distribution Pipe	Malden Rd 1 - Southwest - Windsor - 1659	-
Optimized - not within budgetary constraints	Distribution Pipe	Malden Rd 3 - Southwest - Windsor - 1661	-
Optimized - not within budgetary constraints	Distribution Pipe	Mary St 2 - Northeast - 1709	-
Optimized - not within budgetary constraints	Distribution Pipe	Mckenzie St-Thunder Bay-1556	-
Optimized - not within budgetary constraints	Distribution Pipe	Milford Crescent 1 - Northeast - 1711	-
Optimized - not within budgetary constraints	Distribution Pipe	Milford Crescent 2 - Northeast - 1712	-
Optimized - not within budgetary constraints	Distribution Pipe	Moore Line - Southwest - London - 1516	-
Optimized - not within budgetary constraints	Distribution Pipe	Moore Line 2 - Southwest - London - 1564	-

Optimized - not within budgetary constraints	Distribution Pipe	Morand St 1 - Southwest - Windsor - 1656	-
Optimized - not within budgetary constraints	Distribution Pipe	Morin St - Eastern - Area 60 - 1123	-
Optimized - not within budgetary constraints	Distribution Pipe	N Murray St-Trenton-1595	-
Optimized - not within budgetary constraints	Distribution Pipe	Niagara Wine Route NOTL - Area 80 - 1167	-
Optimized - not within budgetary constraints	Distribution Pipe	Norah St S-Thunder Bay-1495	-
Optimized - not within budgetary constraints	Distribution Pipe	Oak St 2 - Area 50 - 1655	-
Optimized - not within budgetary constraints	Distribution Pipe	Oakwood St PTC - Area 80 - 1811	-
Optimized - not within budgetary constraints	Distribution Pipe	OBrien Ave-Kapuskasing-1541	-
Optimized - not within budgetary constraints	Distribution Pipe	Ogden Ave - Eastern - Area 60 - 1076	-
Optimized - not within budgetary constraints	Distribution Pipe	Ormond St - Eastern - Area 60 - 1108	-
Optimized - not within budgetary constraints	Distribution Pipe	Oxford Ave FE - Area 80 - 1185	-
Optimized - not within budgetary constraints	Distribution Pipe	Park Ave - Eastern - Area 60 - 1224	-
Optimized - not within budgetary constraints	Distribution Pipe	Parkway WELL - Area 80 - 1155	-
Optimized - not within budgetary constraints	Distribution Pipe	Partington Ave - Southwest - Windsor - 1293	-
Optimized - not within budgetary constraints	Distribution Pipe	Percival St-Port Hope-1593	-
Optimized - not within budgetary constraints	Distribution Pipe	Pine St E (MORATORIUM UNTIL 2025)-Ganonoque-1265	-
Optimized - not within budgetary constraints	Distribution Pipe	Pinewood Dr - Southwest - London - 1523	-
Optimized - not within budgetary constraints	Distribution Pipe	Pr#60, NRP - 2024 - High Street - Collingwood - 1615	-
Optimized - not within budgetary constraints	Distribution Pipe	Pr#61, NRP - 2028 - Third Street - Collingwood - 1618	-
Optimized - not within budgetary constraints	Distribution Pipe	Pr#65, NRP - 2026 - Peel Street - Collingwood - 1617	-
Optimized - not within budgetary constraints	Distribution Pipe	Princess St W 2 (MORATORIUM UNTIL 2026) - Northeast - 1722	-
Optimized - not within budgetary constraints	Distribution Pipe	Regina St - Eastern - Area 60 - 1144	-
Optimized - not within budgetary constraints	Distribution Pipe	Riddell Ave S (MORATORIUM UNTIL 2026) - Eastern - Area 60 - 1225	-
Optimized - not within budgetary constraints	Distribution Pipe	Ridout St N (MORATORIUM UNTIL 2028) - Southwest - London - 1533	-
Optimized - not within budgetary constraints	Distribution Pipe	Riordon Ave - Eastern - Area 60 - 1102	-
Optimized - not within budgetary constraints	Distribution Pipe	Riverside Dr WELL- Area 80 - 1810	-
Optimized - not within budgetary constraints	Distribution Pipe	Riverview Blvd STC - Area 80 - 1162	-
Optimized - not within budgetary constraints	Distribution Pipe	Russel St W-Kawartha Lakes-1105	-
Optimized - not within budgetary constraints	Distribution Pipe	Sarnia Rd (MORATORIUM UNTIL 2029) - Southwest - London - 1464	-
Optimized - not within budgetary constraints	Distribution Pipe	Service Relay Program - All Areas	-
Optimized - not within budgetary constraints	Distribution Pipe	Sherbrooke St E - Eastern - Area 60 - 1081	-
Optimized - not within budgetary constraints	Distribution Pipe	Spruce Ave - GTA East - Area 30 - 1491	-
Optimized - not within budgetary constraints	Distribution Pipe	Spruce St-Timmins-1549	-
Optimized - not within budgetary constraints	Distribution Pipe	St Felix St (MORATORIUM UNTIL 2028) - Cornwall - Eastern - 1735	-
Optimized - not within budgetary constraints	Distribution Pipe	Stratford - St. David to Cambria-1769	-
Optimized - not within budgetary constraints	Distribution Pipe	Stratford-Avon St - Avondale to McLagan-1772	-
Optimized - not within budgetary constraints	Distribution Pipe	Stratford-Avondale Ave from Huron to Cemetary-1759	-
Optimized - not within budgetary constraints	Distribution Pipe	Stratford-Birmingham - Cambria to Daly-1764	-
Optimized - not within budgetary constraints	Distribution Pipe	Stratford-Brunswick St - King to Romeo-1765	-
Optimized - not within budgetary constraints	Distribution Pipe	Stratford-Cobourg St - Parkview to Queen-1773	-
Optimized - not within budgetary constraints	Distribution Pipe	Stratford-Douglas St-Huntington to John-1768	-
Optimized - not within budgetary constraints	Distribution Pipe	Stratford-Grange St - Waterloo to Front-1774	-
Optimized - not within budgetary constraints	Distribution Pipe	Stratford-Laurier St - East Gore to Norfolk-1775	-
Optimized - not within budgetary constraints	Distribution Pipe	Stratford-McDonald St - Willow to Devon-1766	-
Optimized - not within budgetary constraints	Distribution Pipe	Stratford-Perth St - Downie to Taylor-1761	-
Optimized - not within budgetary constraints	Distribution Pipe	Stratford-Perth St - Taylor to Borden-1767	-
Optimized - not within budgetary constraints	Distribution Pipe	Stratford-Queen St - Brunswick to Douro-1770	-
Optimized - not within budgetary constraints	Distribution Pipe	Stratford-W Gore St - St. Vincent to John-1762	-
Optimized - not within budgetary constraints	Distribution Pipe	Stratford-Water St - Queen to Parkview-1763	-
Optimized - not within budgetary constraints	Distribution Pipe	Stratford-Woods St - Birmingham to St. Vincent-1771	-

Optimized - not within budgetary constraints	Distribution Pipe	Sunnidale St - Area 50 - 1219	-
Optimized - not within budgetary constraints	Distribution Pipe	Sunset Dr (MORATORIUM UNTIL 2025) - Southwest - London - 1445	-
Optimized - not within budgetary constraints	Distribution Pipe	Talbot St (MORATORIUM UNTIL 2028) - Southwest - London - 1433	-
Optimized - not within budgetary constraints	Distribution Pipe	Taylor St Shallow Main - Huron St to Cheapside St - Southwest - London - 1	-
Optimized - not within budgetary constraints	Distribution Pipe	Tecumseh Rd E - Southwest - Windsor - 1355	-
Optimized - not within budgetary constraints	Distribution Pipe	Tecumseh Rd W - Southwest - Windsor - 1322	-
Optimized - not within budgetary constraints	Distribution Pipe	The Parkway - Southwest - London - 1432	-
Optimized - not within budgetary constraints	Distribution Pipe	Tiffen St - Area 50 - 1212	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Avonwick Gate and Beveridge Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Broadlands Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Cassandra Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Castlegrove Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Compton and Guild Hall Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Cornerbrook and Redwillow Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Danube and Wayne Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Deanvar and Glasworthy Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Elinor Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Goldsmith and Townley Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Gooderham Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Lawrence and Warden East Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Lawrence at Wayne Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Lawrence Ave E at Pharmacy Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Pharmacy North Lawrence Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Railside and Lawrence Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Roanoke Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Tower and Timgren Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Underhill Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Warden South Lawrence Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	TOR10YR - Warden West Replacement - Network # 455	-
Optimized - not within budgetary constraints	Distribution Pipe	Tweedsmuir Ave E - Southwest - Windsor - 1379	-
Optimized - not within budgetary constraints	Distribution Pipe	VSM - Queen and Airport Rd	-
Optimized - not within budgetary constraints	Distribution Pipe	VSM - SUMMERLEA	-
Optimized - not within budgetary constraints	Distribution Pipe	VSM - Yonge and Davis Dr West - Phase2	9
Optimized - not within budgetary constraints	Distribution Pipe	VSM on College from Huron to Elizabeth	21
Optimized - not within budgetary constraints	Distribution Pipe	Wall St-Trent-1271	-
Optimized - not within budgetary constraints	Distribution Pipe	Walton St (MORATORIUM UNTIL 2028) - Cornwall - Eastern - 1740	-
Optimized - not within budgetary constraints	Distribution Pipe	Wharncliffe Rd S - Southwest - London - 1451	-
Optimized - not within budgetary constraints	Distribution Pipe	Whitton Crescent - Eastern - Area 60 - 1140	-
Optimized - not within budgetary constraints	Distribution Pipe	William St (MORATORIUM UNTIL 2027)_GTA West_Area 20_1190	-
Optimized - not within budgetary constraints	Distribution Pipe	William St N - Kawartha Lakes - Area 40 - 1816	-
Optimized - not within budgetary constraints	Distribution Pipe	Woods St - Southwest - Windsor - 1337	-
Optimized - not within budgetary constraints	Distribution Stations	2022 Capacity Related Rebuilds	-
Optimized - not within budgetary constraints	Distribution Stations	33010A YONGE & GLEN CAMERON DISTRICT	-
Optimized - not within budgetary constraints	Distribution Stations	Brockville Gate Station - Integrity Retrofit < 30%	-
Optimized - not within budgetary constraints	Distribution Stations	CAVERLY & MARTINGROVE DISTRICT	-
Optimized - not within budgetary constraints	Distribution Stations	HAMI - Hagersville Sandusk Heating Upgrade	-
Optimized - not within budgetary constraints	Distribution Stations	HAMI: CALEDONIA GATE STN, Rebuild	-
Optimized - not within budgetary constraints	Distribution Stations	Harmer District Station - Integrity Retrofit < 30% SMYS	-
Optimized - not within budgetary constraints	Distribution Stations	King - under rated valves Woodbine TBS 28401002	-
Optimized - not within budgetary constraints	Distribution Stations	Maidenstone District Stn Raise	-

Optimized - not within budgetary constraints	Distribution Stations	MARTINGROVE & WATERBURY	-
Optimized - not within budgetary constraints	Distribution Stations	Perimeter Security - Station A	-
Optimized - not within budgetary constraints	Distribution Stations	Rideau Heights District Station - Integrity Retrofit	-
Optimized - not within budgetary constraints	Distribution Stations	RNG-London W12	-
Optimized - not within budgetary constraints	Distribution Stations	SARN: Novacor St Clair Heater Replacemnt	-
Optimized - not within budgetary constraints	Distribution Stations	St. Laurent Control District Station	-
Optimized - not within budgetary constraints	Distribution Stations	TBAY: Colonization Ave. S. DRS	-
Optimized - not within budgetary constraints	Distribution Stations	WATE: 17U-201R Salsbury Ave LP	-
Optimized - not within budgetary constraints	Distribution Stations	WATE: Fergus First Stage, Fergus, Station, Heater	-
Optimized - not within budgetary constraints	Distribution Stations	WATE: Southampton Trans Stn 30N-501, Southampton, Heating	-
Optimized - not within budgetary constraints	Growth	BRAN: Oxford Phase 2, Delhi, Reinforcement (2.8km of NPS 8)	-
Optimized - not within budgetary constraints	Growth	Cambridge Reinforcement	-
Optimized - not within budgetary constraints	Growth	HALT-Harrop	-
Optimized - not within budgetary constraints	Growth	Port Dover - Loop existing 2" with 4" ST along Haldimand Rd 3.	-
Optimized - not within budgetary constraints	Growth	TIMM: Glencore Concentrator, Station Upgrade	-
Optimized - not within budgetary constraints	Growth	WATE: 18T-101 Kitchener Gate , Kitchener, Station Rebuild (Load Growth),	-
Optimized - not within budgetary constraints	LNG	Hagar Desication Skid	(335)
Optimized - not within budgetary constraints	Real Estate & Workplace Services	Burlington Operations Centre	(879)
Optimized - not within budgetary constraints	Real Estate & Workplace Services	Cambridge Operations Centre	(99)
Optimized - not within budgetary constraints	Real Estate & Workplace Services	Disposition of Micro Site No. 1	(82)
Optimized - not within budgetary constraints	Real Estate & Workplace Services	Disposition of Micro Site No. 2	(82)
Optimized - not within budgetary constraints	Real Estate & Workplace Services	Elliot Lake Micro Operations Centre	(274)
Optimized - not within budgetary constraints	Real Estate & Workplace Services	Operations Centre Retirement No. 1	(115)
Optimized - not within budgetary constraints	Real Estate & Workplace Services	Operations Centre Retirement No. 2	(82)
Optimized - not within budgetary constraints	Real Estate & Workplace Services	Operations Centre Retirements No. 3	(76)
Optimized - not within budgetary constraints	Real Estate & Workplace Services	Sault Ste. Marie Operations Centre	(137)
Optimized - not within budgetary constraints	Real Estate & Workplace Services	TOC MEC Expansion	1,709
Optimized - not within budgetary constraints	TIS	Harmonize Feasibility Tools	-
Optimized - not within budgetary constraints	TIS	Increase Efficiency with Innovation	-
Optimized - not within budgetary constraints	TIS	Records Management Upgrade 2023	1,376
Optimized - not within budgetary constraints	TIS	UG - Customer Data Analytics Solutions (2024)	215

ENBRIDGE GAS INC.

Answer to Interrogatory from
Canadian Manufacturers & Exporters (CME)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, Appendix A. pp. 33-45 of 59

Question(s):

a) Please provide a description of the consequence of not completing the following projects:

- i. Kelfield Operations Centre – Land Purchase;
- ii. Kelfield Operations Centre – New Building;
- iii. Kennedy Road Expansion;
- iv. SMOC/Coventry Facility Consolidation;
- v. Station B New Building;
- vi. Thorold Regional Office – Building & Site;
- vii. VPC Core and Shell;
- viii. Dawn Administrative Centre;
- ix. New London Site; and
- x. Sudbury Regional Operations Centre.

Response:

a) Enbridge Gas follows standards to guide its approach to facilities upgrades and projects. The consequences of not completing projects are derived from facility condition analysis. Please see response at Exhibit I.2.6-SEC-137 for more information related to facility analysis.

The specific consequences of not completing the projects are listed below:

- i. Kelfield Operations Centre, land purchase: The new facility could not be accommodated at the current site.
- ii. Kelfield Operations Centre, new building: There would be increased maintenance and operational costs to continue to support facility operations, we would see increased inefficiencies and costs within field operations as the site is too small for employees and equipment, and gender equality and barrier free accessibility

would continue to be hindered.

- iii. Kennedy Rd expansion: There would be increased maintenance and operational costs to continue to support facility operations, we would see increased inefficiencies and costs within field operations as the site is too small for employees and equipment, and gender equality and barrier free accessibility would continue to be hindered.
- iv. SMOC/Coventry Facility Consolidation: This would constrain our opportunity to consolidate our operational sites in the Ottawa area and reduce our ability to realize operational savings. The building is currently under construction and there would be a risk of not having an operational facility for employees as well as lost/increased costs to halt construction.
- v. Station B New Building: The building is currently under construction and there would be a risk of not having an operational facility for employees as well as sunk/increased costs to halt construction. Enbridge Gas requires a downtown site to support safe and reliable operation of the system in Toronto.
- vi. Thorold regional office, building and site: The project is currently in development and not completing the facility will leave the operation and administration at risk of not having an operational facility for employees. This site was underutilized and was sold in 2022 to support the consolidation of our facilities through integration. Enbridge currently leases back a portion of the facility to accommodate operations until the new facility is completed in 2027. Higher operating costs will continue if the project is deferred.
- vii. VPC Core and Shell: The current, envelope and main building systems are at end of life and have the potential to impact building availability for over 1,200 employees including those who provide emergency call handling services. The 55-year-old building envelope is deemed safe but can no longer maintain a reliable wind and rain screen. Deferring this work can impact operational costs and ability to execute core work.
- viii. Dawn Administrative Centre: There would be increased maintenance and operational costs to continue to support facility operations, we would see increased inefficiencies and costs within field operations as the site is too small for employees and equipment, and gender equality and barrier free accessibility would continue to be hindered.
- ix. New London Facility: This would constrain our opportunity to consolidate our operational sites in the London area and reduce our ability to realize operational savings. There would be increased maintenance and operational costs to continue to support facility operations, we would see increased inefficiencies and

costs within field operations as the site is too small for employees and equipment, and gender equality and barrier free accessibility would continue to be hindered.

- x. Sudbury Regional Operations Centre: The existing facility is in fair condition and all functional and physical requirements are deemed correctable at the current site and facility. If these corrections are not made there would be increased maintenance and operational costs to continue to support facility operations, we would see increased inefficiencies and costs within field operations as the site is too small for employees and equipment, and gender equality and barrier free accessibility would continue to be hindered.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 1, p. 6

Question(s):

- a) Per page 6: "Enbridge Gas owns and operates approximately 153,000 km of main and service pipelines for the transportation and distribution of gas." Please provide table listing the kms of Enbridge transmission pipelines by pipe size. Please also provide a table listing the kms of Enbridge distribution pipelines by pipe size.
- b) Please provide a map of Enbridge pipelines in Ontario, colour coded to differentiate between transmission and distribution pipelines.

Response:

- a) The kilometers of Enbridge Gas's transmission and distribution pipelines by size is provided in Table 1 for 2021.

Table 1

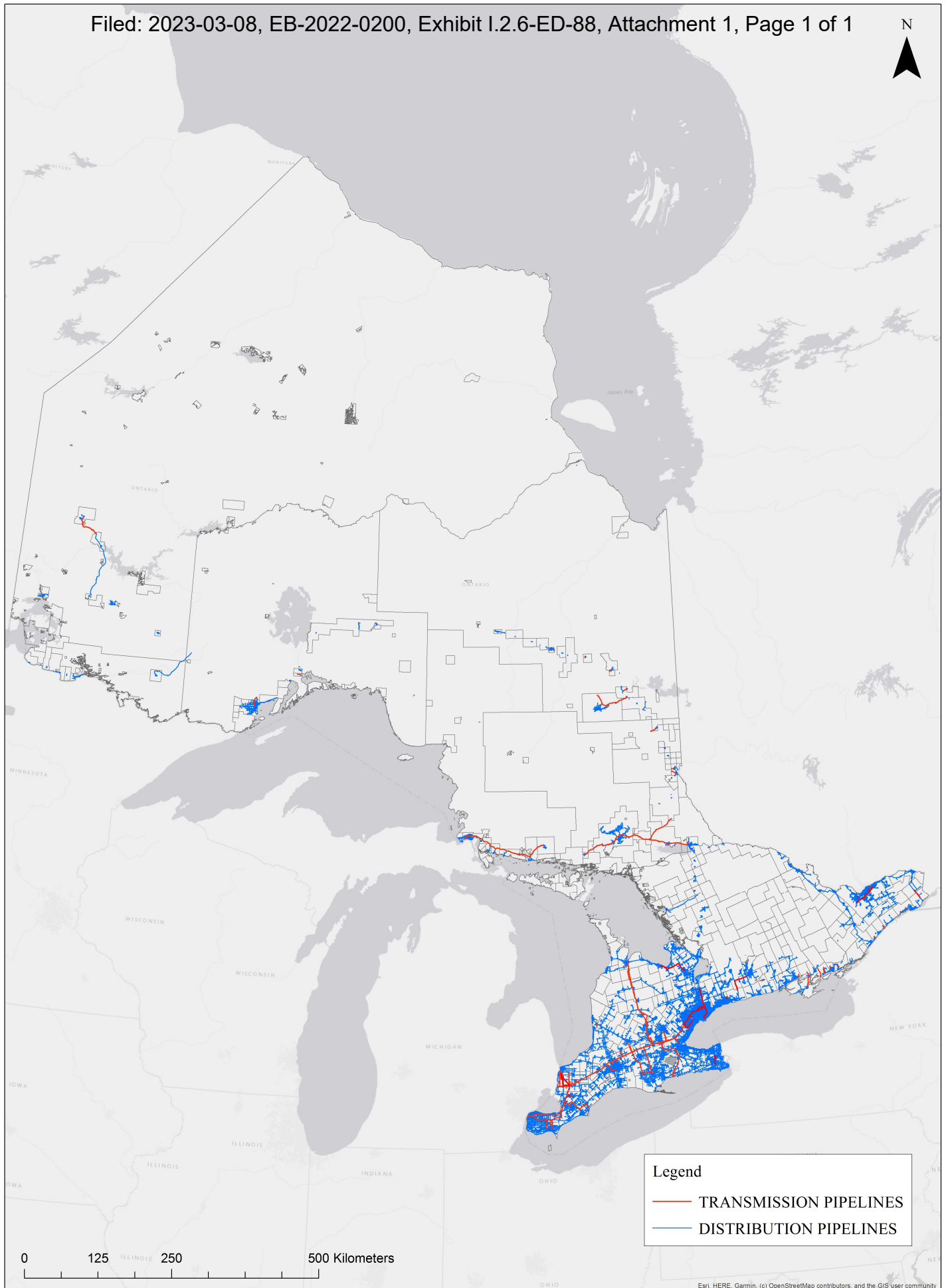
<u>Line No</u>	<u>Particulars (thousands of kilometers)</u>	
1	Distribution Pipelines	
2	< 4 inches	125.5
3	4 to 12 inches	21.8
4	> 12 inches	0.3
5	Transmission Pipelines	
6	<12 inches	2.9
7	12 to 24 inches	1.4
8	>24 inches	1.1
9		<u>153.0</u>

- b) Please see Attachment 1.

ENBRIDGE GAS INC.

Filed: 2023-03-08, EB-2022-0200, Exhibit I.2.6-ED-88, Attachment 1, Page 1 of 1

N



Legend

- TRANSMISSION PIPELINES
- DISTRIBUTION PIPELINES

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 1, p. 15

Question(s):

- a) Please provide a table of figures underlying Figure 1 on page 15. Please add rows to express the prices in \$CAD/m³. Please also add rows for the more recent ICF forecasts.
- b) Please provide a table showing the ICF forecasts from (i) 2010 and (ii) 2015 compared to the actual prices from 2010 to today.

Response:

a-b) Please see Attachment 1.

(US\$/mmbtu)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Henry Hub Historical	4.38	3.99	2.75	3.72	4.34	2.61	2.48	2.96	3.12	2.52	1.99	3.84	6.64																							
ICF Q4 2022 Projection													6.36	5.20	4.61	4.37	4.30	3.56	3.08	3.54	4.18	4.33	4.51	4.59	4.43	4.43	4.58	4.86	5.22	5.58	5.75	5.61	5.43	5.58	6.12	6.57
ICF Q2 2022 Projection													5.75	4.70	3.54	3.00	3.05	3.03	3.10	3.50	3.61	3.48	3.58	3.77	3.97	4.16	4.28	4.33	4.46	4.66	4.79	4.76	4.60	4.54	4.92	5.41
ICF Q2 2021 Projection													2.87	2.90	2.87	3.00	3.02	2.87	3.07	3.35	3.50	3.70	3.83	3.92	4.15	4.31	4.17	4.23	4.62	4.85	4.87	4.81	4.74	4.66	4.70	4.88
ICF Q2 2020 Projection													3.01	2.48	3.02	3.36	3.10	3.13	3.37	3.53	3.73	3.94	4.02	4.13	4.33	4.34	4.25	4.49	4.75	4.78	4.80	4.65	4.41	4.51	4.77	4.86
ICF Q2 2015 Projection						3.40	3.48	4.10	4.29	4.88	5.42	5.85	6.05	6.12	6.22	6.38	6.74	7.11	7.51	7.84	8.32	8.71	9.19	9.38	10.02	10.23										
ICF Q2 2010 Projection	4.79	5.06	4.92	6.11	6.13	6.52	7.11	6.85	7.22	7.91	8.32	8.74	9.34	9.49	9.91	10.23	10.62	10.74	11.32	11.48	11.82															
Heat Value	37.73	37.75	37.82	38.07	38.29	38.55	38.81	38.95	38.89	38.98	39.28	39.32	39.12	39.17	39.17	39.17	39.17	39.17	39.17	39.17	39.17	39.17	39.17	39.17	39.17	39.17	39.17	39.17	39.17	39.17	39.17	39.17	39.17	39.17	39.17	
Foreign Exchange Rate	1.03	0.99	1.00	1.03	1.10	1.28	1.33	1.30	1.30	1.33	1.34	1.25	1.30	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	
CAD\$/m ³	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Henry Hub Historical	0.16	0.14	0.10	0.14	0.17	0.12	0.12	0.14	0.15	0.12	0.10	0.18	0.32																							
ICF Q4 2022 Projection													0.31	0.26	0.23	0.22	0.21	0.18	0.15	0.18	0.21	0.22	0.22	0.23	0.22	0.22	0.23	0.24	0.26	0.28	0.29	0.28	0.27	0.28	0.30	0.33
ICF Q2 2022 Projection													0.28	0.23	0.18	0.15	0.15	0.15	0.17	0.18	0.17	0.18	0.19	0.20	0.21	0.21	0.22	0.22	0.23	0.24	0.24	0.24	0.23	0.23	0.24	0.27
ICF Q2 2021 Projection													0.14	0.14	0.14	0.15	0.15	0.14	0.15	0.17	0.17	0.18	0.19	0.20	0.21	0.21	0.21	0.23	0.24	0.24	0.24	0.24	0.23	0.23	0.24	
ICF Q2 2020 Projection													0.14	0.12	0.15	0.17	0.15	0.16	0.17	0.18	0.19	0.20	0.20	0.21	0.22	0.22	0.21	0.22	0.24	0.24	0.24	0.23	0.22	0.22	0.24	
ICF Q2 2015 Projection						0.16	0.17	0.20	0.21	0.24	0.27	0.27	0.29	0.30	0.31	0.32	0.34	0.35	0.37	0.39	0.41	0.43	0.46	0.47	0.50	0.51										
ICF Q2 2010 Projection	0.18	0.18	0.18	0.23	0.25	0.30	0.35	0.33	0.34	0.39	0.42	0.41	0.45	0.47	0.49	0.51	0.53	0.53	0.56	0.57	0.59															

CAD\$/m³ = US\$/mmbtu * FX / 1.055056 * Heat Value / 1000

Notes

- 1) Shaded data is included in Exhibit 2, Tab 6, Schedule 1, Figure 1.
- 2) Henry Hub Historical data is the annual average of monthly NYMEX futures contract settlements. Source: CME Group
- 3) Heat value is the Union South annual average heat value
- 4) Foreign Exchange Rate is the annual average USD/CAD exchange rate. Source: Bank of Canada
- 5) ICF Projection information is sourced from ICF International and is filed with permission

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 1

Question(s):

- a) Page 17 states: "Each year, Enbridge Gas completes a budget and multi-year LRP process. This process produces Enbridge Gas's forecast of annual volumes, revenues, operating costs, and capital investments." Please file the internal documentation referred to above for the latest year.
- b) Please reproduce figure 6 on page 36 with additional rows indicating the additional investments required for the "diversified" scenario described in the Guidehouse report regarding decarbonization pathways.
- c) Page 39 states: "Table 4 shows investments with total in-service capital that exceeds \$50 million that meet the ICM-eligible criteria for materiality, need and prudence. Based on the 2023 to 2032 capital expenditure forecast (please see Figure 7), Enbridge Gas does not anticipate seeking ICM recovery for these projects." What would need to change for Enbridge to decide to seek ICM recovery for these projects.
- d) How does Enbridge anticipate covering the costs of the projects listed in Table 4? If, say, 50% of the spending listed in Table 4 is not approved by the OEB in future leave to construct applications, how would those savings find their way back to ratepayers?
- e) Page 44 makes reference to the leave to construct application in the regulations being "presently \$2 million." Does Enbridge anticipate this changing? Please describe any communications Enbridge has had with the Ministry of Energy regarding this.

Response:

a) Enbridge Gas's internal documentation relating to the latest Budget and LRP process was used to develop this Application and the 2023 and 2024 forecasts of various components have already been filed in the evidence of this Application.

- For the forecast of annual volumes, please see:
 - Exhibit 3, Tab 2, Schedule 7 for General Service Volume Forecast
 - Exhibit 3, Tab 2, Schedule 8 for Distribution Contract Market Volume Forecast
- For the forecast of operating revenues, please see Exhibit 3, Tab 1, Schedule 1, updated March 8, 2023.
- For the forecast of operating costs, please see Exhibit 4, Tab 1, Schedule 1, updated March 8, 2023.
- For the forecast of capital investments, please see Exhibit 2, Tab 5, Schedule 1 and Exhibit 2, Tab 5, Schedule 2, updated March 8, 2023.

Please also see the latest consolidated budget and LRP presentation in response at Exhibit I.1.2-SEC-76, Attachment 1 (dated October 2022 and does not reflect March 8, 2023 updates).

b) Enbridge Gas respectfully declines to reproduce the figure for the following reasons:

The gas system costs presented for the Diversified scenario in the P2NZ Report relate to developing energy supply, connecting and integrating that supply with the system and costs to repurpose gas transmission infrastructure to hydrogen. Costs for expanding and upgrading the distribution system were out of scope. The descriptions of costs in the P2NZ Report are provided at Exhibit 1, Tab 10, Schedule 5, Attachment 2, page 47. The P2NZ Study did not determine the portion of the required investments related to the gas system costs that would be made by Enbridge Gas versus other parties, such as low-carbon fuel suppliers. Enbridge Gas also notes that the Diversified scenario in the P2NZ Report is just one version of what a Diversified scenario could look like in Ontario and it is not yet clear what additional investments may be required by Enbridge Gas.

The safe bet actions described in Enbridge Gas's Energy Transition Plan, as provided at Exhibit 1, Tab 10, Schedule 6, will support energy transition, regardless of the pathway to net-zero taken in the province. Capital costs related to Enbridge

Gas's safe bet actions are already included in the investments provided at Exhibit 2, Tab 6, Schedule 1, Figure 6.

- c) Please see response at Exhibit I.2.6-STAFF-71.
- d) Enbridge Gas's current expectation is that rates in 2025 to 2028, determined by applying the proposed price cap mechanism to the forecast 2024 base costs/rates, will provide the necessary funding for the potential ICM projects listed in Table 4, as well as the current forecast of all other capital spending over the Price Cap Term. In the event that a portion (e.g. 50%) of the capital spending identified in Table 4 is not approved by the OEB through future leave to construct applications, and it results in lower than forecast actual capital spending, it could contribute to higher earnings which could be shared with ratepayers if the proposed (or eventual approved) earnings sharing mechanism is triggered. In the event that the reduced capital spending were to cause utility earnings to be greater than 300 basis points above the OEB-approved ROE in any given year, the proposed off-ramp mechanism could also be triggered, which could cause the rate setting mechanism to be adjusted prospectively.
- e) Enbridge Gas notes that the results of the consultation(s) conducted by the Government of Ontario regarding proposed revisions to the OEB's leave to construct cost threshold for hydrocarbon pipelines, including the Company's comments, is posted publicly at:

<https://ero.ontario.ca/notice/019-3041>

At this time, Enbridge Gas has no reason to expect with any certainty that the threshold will be increased (nor can it say with any certainty what the magnitude of such a change would be) either before or during the rebasing term proposed in the current Application.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 1

Question(s):

- a) Please reproduce table 5 on page 44 adding (i) a column to indicate the total cost of the project and (ii) a row at the bottom with totals.
- b) Please reproduce table 5 on page 44 (i) adding a column to indicate the total cost of the project, (ii) only including the projects that would not require an LTC under the new LTC thresholds under consideration by the Ministry, and (iii) a row at the bottom with totals.
- c) Please reproduce table 6 on page 46 adding (i) a column to indicate the total cost of the project, (ii) a column to indicate the criteria that exempts it from the LTC requirement [e.g. as listed in para. 92], and (iii) a row at the bottom with totals.

Response:

The following response has been updated to reflect the Capital Update provided at /u Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

- a) Please see response at Exhibit I.2.6-SEC-117.
- b) Please see response at Exhibit I.2.6-ED-90 part e).
- c) Table 1 details the investments provided at Exhibit 2, Tab 6, Schedule 1, Table 6, and provides a description of project-specific characteristics that result in the non-application of the requirements set out in Section 90 of the Ontario Energy Board Act, 1998, S.O. 1998, c. 15, Sched. B (the "OEB Act") relating to Leave to Construct Hydrocarbon Pipelines. Note: the Total Investment Cost column includes 2020 actual costs excluding overheads, 2021 to 2022 actual costs including overheads, and 2023 to 2032 forecast costs including overheads.

Table 1

Asset Class	Investment Code	Investment Name	2024 Forecast	2023-2032 Forecast	Total Investment Cost	Project Description	
Distribution Pipe	4160	Vintage Steel: NPS 12 SC HP on Parliament St, Carlton St to Front St	2,826,373	2,826,373	3,121,019	The project involves relocation or reconstruction of an existing pipeline(s) with pipelines of identical size and without the need for authority to use or acquisition of additional lands, which qualifies for Exception under Section 90(2) of the OEB Act.	/u
Distribution Pipe	48831	SARN-Point Edward LP Leakage - Sarnia BU	2,032,570	2,072,201	2,176,245	The project involves relocation or reconstruction of an existing pipeline(s) with pipelines of identical size and without the need for authority to use or acquisition of additional lands, which qualifies for Exception under Section 90(2) of the OEB Act.	/u
Distribution Pipe	48846	SARN - Errol Rd E Leakage - Sarnia BU	2,167,797	2,167,797	2,167,797	The project involves relocation or reconstruction of an existing pipeline(s) with pipelines of identical size and without the need for authority to use or acquisition of additional lands, which qualifies for Exception under Section 90(2) of the OEB Act.	/u
Distribution Pipe	49816	WIND: Mersea Rd 2 - Ph 2, Leamington, Replacement	2,210,241	2,210,241	2,210,241	The project involves relocation or reconstruction of an existing pipeline(s) with pipelines of identical size and without the need for authority to use or acquisition of additional lands, which qualifies for Exception under Section 90(2) of the OEB Act.	/u
Distribution Stations	7777	WINSTON CHURCHILL AND STEELES FEEDER	7,043,068	9,659,604	9,659,604	Station-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u

Asset Class	Investment Code	Investment Name	2024 Forecast	2023-2032 Forecast	Total Investment Cost	Project Description	
Distribution Stations	100920	TIMM: Hearst TBS, Rebuild	3,784,550	3,955,332	3,955,332	Station-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Distribution Stations	101359	WIND 05A-201 Turkey Creek	2,604,524	2,849,458	2,854,093	Station-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Distribution Stations	502429	WIND-03D-301 Leamington North Gate Station	5,011,302	8,646,696	13,750,472	Station-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Distribution Stations	734689	LOND: 14R-104 Beachville Domtar Trans Stn	5,051,981	5,696,544	5,696,544	Station-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Distribution Stations	735335	GTAW Parkway Gate Station Rebuild Phase 2	9,365,335	11,312,293	14,885,996	Station-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Distribution Stations	734689	LOND: 14R-104 Beachville Domtar Trans Stn	5,051,981	5,696,544	5,696,544	Station-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Growth	30556	SRP_Southwest_London_13O-402STN_Westmount Station Rebuild	4,294,183	4,606,685	4,606,685	Station-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Growth	49805	SRP_Southwest_Hensall Trans_14N-302STN_Rebuild	5,910,707	8,488,963	8,854,089	Station-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Growth	500705	NW 5301 Barrie - Collingwood Pressure Increase SRP	2,440,993	3,738,965	6,744,828	Station-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Growth	734672	SRP_Southwest_Kerwood_12K-301STN_Rebuild	6,504,425	6,738,801	6,738,801	Station-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Growth	736975	Enbridge Gas Distribution System Hydrogen Feasibility Study	5,762,510	15,315,942	15,315,942	Not a facility-related project.	/u

Asset Class	Investment Code	Investment Name	2024 Forecast	2023-2032 Forecast	Total Investment Cost	Project Description	
Growth	739267	HAMI: Caledonia Transmission Station Rebuild (15X-401)	9,219,864	9,993,340	10,421,456	Station-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Compression Stations	48732	Waubuno Compression Lifecycle	2,355,233	29,218,620	29,218,620	Station-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Compression Stations	740281	Hagar 412FKR357 Major Overhaul and Foundation Work	7,577,971	7,577,971	7,577,971	Station-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Transmission Pipe & Underground Storage	1787	Panhandle NPS 16 - South of S Service Rd Class Location Replacement	2,551,111	2,680,024	3,969,998	The project involves relocation or reconstruction of an existing pipeline(s) with pipelines of identical size and without the need for authority to use or acquisition of additional lands, which qualifies for Exception under Section 90(2) of the OEB Act.	/u
Transmission Pipe & Underground Storage	6377	PCRW:Wells-Upgrade	7,747,375	11,443,473	12,387,675	Storage-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Transmission Pipe & Underground Storage	738426	LSEC: Meter Station Filter	2,248,654	2,461,521	2,478,161	Storage-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Transmission Pipe & Underground Storage	100086	Panhandle Line Replacement	1,414,428	37,899,145	37,947,743	The project falls under federal jurisdiction and requires approval from the Canada Energy Regulator.	/u
Real Estate & Workplace Services	3640	Station B New Building	25,611,157	38,590,879	53,699,623	Real Estate-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Real Estate & Workplace Services	3640	Station B New Building	25,611,157	38,590,879	53,699,623	Real Estate-related project that does not meet the leave to construct criteria	/u

Asset Class	Investment Code	Investment Name	2024 Forecast	2023-2032 Forecast	Total Investment Cost	Project Description	
						prescribed in Section 90(1) of the OEB Act.	
Real Estate & Workplace Services	100492	Dryden Operations Centre	3,157,488	8,958,563	16,293,777	Real Estate-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Real Estate & Workplace Services	501930	Dawn EOC MCR - COVID Impacts	4,388,908	5,033,472	5,769,919	Real Estate-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Real Estate & Workplace Services	737374	Ottawa - New Building	13,317,801	46,337,933	57,304,578	Real Estate-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Real Estate & Workplace Services	737786	Brockville Operations Centre - New Build	4,481,952	10,712,219	17,421,054	Real Estate-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
TIS	102291	Contract Market Harmonization	6,402,789	19,195,783	19,195,783	IT System-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
TIS	102304	Enterprise Contact Center	2,392,105	2,983,095	2,983,095	IT System-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
TIS	736081	General Service Rebasing Changes	15,366,694	17,914,329	17,914,329	IT System-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u

Asset Class	Investment Code	Investment Name	2024 Forecast	2023-2032 Forecast	Total Investment Cost	Project Description	
TIS	736942	Contract Market Systems - Technology Obsolescence	22,832,346	69,786,961	69,786,961	IT System-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
TIS	737248	AWS Ph3 2024	2,112,920	2,112,920	2,112,920	IT System-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
TIS	739859	5-week Planning Tool	5,122,231	6,396,468	6,396,468	IT System-related project that does not meet the leave to construct criteria prescribed in Section 90(1) of the OEB Act.	/u
Total			205,311,589	419,582,610	475,617,819		/u

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 1, p. 46-47

Preamble:

Table 6: 2024 Investments Not Subject to LTC

Asset Class	Investment Code	Investment Name	2024 Forecast	2023 to 2032 Forecast
Distribution Pipe	7660	VPM - Erin Township	\$3,032,186	\$11,695,807
Distribution Pipe	100339	A10: Wilson Avenue, Toronto, VSM Replacement	\$36,134,725	\$91,158,784

Question(s):

- Please explain why the Wilson Avenue, Toronto VSM Replacement does not require leave to construct application.
- Please provide the full project description, maps, and costing documentation for this project.
- Is Enbridge seeking any relief in relation to this project? If yes, please explain.
- Does the OEB have the jurisdiction to rule in this proceeding on the appropriateness of Enbridge's classification of this project as one that does not require a leave to construct application?

Response:

- The Wilson Avenue, Toronto VSM Replacement Project does not require a leave to construct application based on the exception set out in Section 90(2) of the Ontario Energy Board Act, 1998, S.O. 1998, c. 15, Sched. B which states:

Exception

(2) Subsection (1) does not apply to the relocation or reconstruction of a hydrocarbon line unless the size of the line is changed or unless the acquisition of additional land or authority to use additional land is necessary.

Because the project scope includes reconstruction of the existing pipeline(s) with new pipeline(s) of the same diameter and no acquisition of or authority to use additional land is required, the project meets the criteria for exception from the requirement for an order of the OEB granting leave to construct.

- b) The Wilson Avenue, Toronto, VSM Replacement Project is intended to replace 8.5km of NPS 12 high-pressure vintage steel main originally installed between 1955 and 1964 on Wilson Avenue. The replacement will begin on Walsh Avenue, continue along Wilson Avenue, and terminate at Richelieu Blvd in Toronto. Please see response at Exhibit I.2.6-ED-101 part a) for the map of Wilson Avenue pipeline. For cost information on the Wilson Avenue VSM Replacement Project, please see the response at Exhibit I.2.6-ED-100 part a) and b). Enbridge Gas will be conducting an Enhanced Integrity Assessment on the pipeline proposed for replacement, which will refine the scope further.
- c) The project is included in the capital forecast that forms part of the current Application. Therefore, Enbridge Gas is requesting to recover project costs through its proposed 2024 Rate Base.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 1, p. 46-47

Question(s):

- a) Please provide the full project description, maps, and costing documentation for Dawn C Compression Lifecycle project. Is Enbridge seeking any relief in relation to this project? If yes, please explain.

Response:

- a) Please see Dawn C Compression Lifecycle, Exhibit 2, Tab 6, Schedule 2 - Appendix A, page 4 for the project description and forecasted cost. Dawn C is located at the Dawn Compressor Station. Please see Exhibit 2, Tab 6, Schedule 2, page 181, Figure 5.3.3 Compressor Stations in the Dawn to Parkway Transmission System map. The project is expected to go into service in 2026 and will be included in the rate base at the next rebasing application for Enbridge Gas. The project is included in the table of potential ICM projects from 2025 to 2028 provided at Exhibit 2, Tab 6, Schedule 1, page 40, Table 4, however Enbridge Gas does not expect to request ICM recovery at this time. Also, please see response at Exhibit I.2.6-STAFF-71.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, s. 5.1.4 (Customer Connections)

Question(s):

- a) Please complete the following table regarding customer connections, with three years of actuals (2020-2022) followed by the AMP forecast:

Customer Attachment Totals by #, m3, m3/d, and m3/h				
	2020	2021	...	2032
Customer connections (#)				
Estimated increase in annual demand (m3) from new customers				
Estimated increase in design day demand (m3/d) from new customers				
Estimated increase in design day/hour demand (m3/hr) from new customers				

- b) Please complete the following table in three versions – one with customer numbers, one with annual demand (m3), and one with design day demand (m3/day).

Customer Attachments by Sector, Before and After Energy Transition Adjustments				
	2020	2021	...	2032
Before Energy Transition Adjustments				
Residential				
Commercial				
Industrial				
Total				
After Energy Transition Adjustments				
Residential				
Commercial				
Industrial				

Total				
Difference				
Residential				
Commercial				
Industrial				
Total				

c) Please complete the following table:

Residential Customer Attachments by Type				
	2020	2021	...	2032
Number of connections (#)				
Community expansion				
Fuel switching (excl. community expansion)				
Homes in residential housing development (subdivisions)				
New single-family dwellings				
Other				
Annual demand (m3)				
Community expansion				
Fuel switching (excl. community expansion)				
Homes in residential housing development (subdivisions)				
New single-family dwellings				
Other				
Design Day Demand (m3/day)				
Community expansion				
Fuel switching (excl. community expansion)				
Homes in residential housing development (subdivisions)				
New single-family dwellings				
Other				

Response:

The responses to parts (b) and (c) below are updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

- a) Enbridge Gas's annual volume forecast is not available for the categories listed. Please see response at Exhibit I.1.10-STAFF-31, Table 1 for Enbridge Gas's annual volume (demand) forecast. Table 1 shows Enbridge Gas's estimated year-over-year increase in design day and design hour demand.

Table 1
Estimated Year-over-Year Increase in Design Day and Design Hour Demand

	Customer Connections (#)	Estimated increase in design day demand (m ³ /d) from new customers	Estimated increase in design hour demand (m ³ /hr) from new customers
2020	Please see response to Exhibit I.1.10-STAFF-31, Table 16	Information not available in a comparable format.	83,115
2021			77,809
2022			149,226
2023		2,565,794	66,697
2024		2,520,043	63,193
2025		3,278,441	62,211
2026		4,782,402	58,377
2027		1,745,495	54,303
2028		1,673,065	50,347
2029		1,615,341	46,770
2030		1,571,344	42,480
2031		1,498,614	38,868
2032		1,466,220	34,793

- b) Table 2 includes the customer additions forecast before and after energy transition assumptions. Table 3 shows Enbridge Gas's before and after energy transition assumptions design day demand.

/u

Table 2
Customer Attachments (Before and After Energy Transition)* /u

	Before Energy Transition Assumptions				After Energy Transition Assumptions			
	Residential	Commercial	Industrial	Total	Residential	Commercial	Industrial	Total
2024	38,055	2,546	26	40,627	37,745	2,534	26	40,305
2025	38,173	2,406	26	40,605	37,510	2,382	26	39,918
2026	38,335	2,313	25	40,673	37,308	2,278	24	39,610
2027	38,563	2,208	24	40,795	36,841	2,154	23	39,018
2028	38,069	2,097	23	40,189	35,750	2,029	22	37,801
2029	36,749	2,007	23	38,779	33,948	1,927	21	35,896
2030	35,483	1,876	21	37,380	31,934	1,732	19	33,685
2031	33,940	1,793	21	35,754	30,224	1,649	19	31,892
2032	32,589	1,721	21	34,331	28,398	1,569	18	29,985
2033	31,350	1,652	21	33,023	27,315	1,507	18	28,840

*excludes CE

Table 3
Design Day Information for Customer Attachments and Growth

m3/d	Before Energy Transition Assumptions			After Energy Transition Assumptions			Difference		
	General Service	Contract Rate	Total	General Service	Contract Rate	Total	General Service	Contract Rate	Total
2020	Information not available in a comparable format.			Information not available. Previous forecasts did not include energy transition assumptions					
2021									
2022									
2023	1,526,510	1,262,624	2,789,134	1,303,170	1,262,624	2,565,794	223,340	0	-223,340
2024	1,485,190	1,249,311	2,734,502	1,270,732	1,249,311	2,520,043	214,458	0	-214,458
2025	1,397,050	2,079,000	3,476,050	1,199,441	2,079,000	3,278,441	197,609	0	-197,609
2026	1,369,411	3,603,880	4,973,291	1,178,522	3,603,880	4,782,402	190,889	0	-190,889
2027	1,314,596	612,000	1,926,596	1,133,495	612,000	1,745,495	181,102	0	-181,102
2028	1,240,080	612,000	1,852,080	1,061,065	612,000	1,673,065	179,015	0	-179,015
2029	1,174,275	612,000	1,786,275	1,003,341	612,000	1,615,341	170,934	0	-170,934
2030	1,113,433	621,760	1,735,193	949,584	621,760	1,571,344	163,849	0	-163,849
2031	1,060,566	607,235	1,667,801	891,379	607,235	1,498,614	169,187	0	-169,187
2032	999,965	626,525	1,626,490	839,696	626,525	1,466,220	160,270	0	-160,270

c) Customer attachments by type are provided in Table 4. Annual demand and design day demand information is not available for the categories listed in the question.

/u

Table 4
Customer Attachments by Type Before Energy Transition Impact

	Community Expansion (CE)	Fuel Switching Other than CE	Homes in residential developments (subdivisions)	Single family dwellings (Apartment Ensuite)	Other
2020	567	5,535	30,106	5,305	2,423
2021	428	4,953	33,268	1,741	2,420
2022	314	4,128	37,583	1,973	2,133
2023	575	3,904	33,285	1,718	2,670
2024	566	3,582	32,761	1,712	2,572
2025	1,115	3,255	33,232	1,686	2,432
2026	1,461	2,904	33,763	1,668	2,338
2027	1,657	2,681	34,238	1,644	2,232
2028	1,574	2,386	34,091	1,592	2,120
2029	1,076	2,168	33,030	1,551	2,030
2030	739	1,918	32,060	1,505	1,897
2031	679	1,674	30,812	1,454	1,814
2032	390	1,519	29,652	1,418	1,742

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, s. 5.1.4 (Customer Connections)

Question(s):

- a) Is Enbridge's customer attachment forecast net of Enbridge account closures (e.g. due to fuel switching or bankruptcy)?
- b) Please provide a table showing customer account closures (e.g. due to fuel switching or bankruptcy), with three years of actuals (2020-2022) followed by a forecast for 2023 to 2032.
- c) How many applicants have applied for an incentive payment through the Greener Homes Grant and/or the Enbridge program for (i) an air-source heat pump, (ii) a ground-source heat pump, or (iii) a heat pump water heater. Of those applicants, how many applied for a payment for an air-source heat pump and an air handler for central ducting?
- d) What is Enbridge's forecast of the number of participants in its DSM program obtaining an incentive for an air-source heat pump for each year from 2023 to 2028? If possible, please provide an estimate for how many of those will be fully electric versus hybrid systems.

Response:

- a) Enbridge Gas's customer attachment forecast represents new customers receiving a natural gas service and is not net of closed accounts.
- b) Table 1 shows the contract rate customer account closures from 2020 to 2022.

Table 1

Contract Rate Account Closures	
Year	Total
2022	2
2021	3
2020	16

Table 2 shows the number of non-contract accounts closed due to bankruptcy. This information is not forecasted.

Table 2

Non-Contract Bankruptcy Accounts	
Year	Total
2022	918
2021	582
2020	986

- c) Enbridge Gas is the program administrator for the Canada Greener Homes Grant (CGHG) in Ontario as of January 1, 2023. The funding from CGHG has been combined with the Company's DSM Program funding to establish the Home Energy Rebate Plus (HER+) program offering. Since HER+ has only been on the market for several weeks, the Company is not able to provide details of incentive payments or participants. Participation or incentives made on behalf of NRCan or for any information not agreed to be made public by NRCan cannot be provided. Before January 1, 2023, Enbridge Gas did not offer incentive payments for the requested items.
- d) Enbridge Gas has been the program administrator for the HER+ joint program offering for 2 months and has little data on which to base a forecast for specific measures that may be undertaken by participants applying to the joint program. The Company also notes that the current DSM Program term runs from 2023 to 2025 and the OEB has not approved any DSM funding beyond this period and any program details for future periods are yet to be determined.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, Appendix A

Question(s):

- a) How many kms of pipe are forecast to be built or replaced under the AMP from 2024 to 2028 (inclusive)?
- i. What percent of these pipes could certainly be used for 100% hydrogen from a technical perspective if a 100% hydrogen system were to be sought in the future? If the answer is greater than 0%, please (A) describe the pipes that are 100% hydrogen compatible, and (B) provide references to studies to conclusively establish that they can be used for 100% hydrogen.
- ii. What percent of these pipes could certainly be used for 20% hydrogen (by volume) if a 20% hydrogen system were to be sought in the future?

Response:

The response given below assumes the question is referring to all pipeline replacements covered in Exhibit 2, Tab 6, Schedule 2 not limited to Appendix A as noted in the reference.

a) Forecasted pipe installations 2024 to 2028:

Asset Class	Program	2024 (km)	2025 (km)	2026 (km)	2027 (km)	2028 (km)	Total (km)
Distribution Pipe	Proactive Vintage Steel Main Replacement	8.5	6.3	13.1	37.8	59.3	125
	Relocations ¹	-	-	-	-	-	-

¹ Relocations are reactive work based on municipality infrastructure renewal plans. As such this cannot be predicted with accuracy at this time.

	General mains ²	-	-	-	-	-	-
	Bare Unprotected	139	-	-	-	-	139
	Depth of Cover ³	0	0	0.3	0.3	0.3	<1
	St. Laurent Phase 3 ⁴	14	-	-	-	-	14
	St. Laurent Phase 4 ⁵	-	6.3	-	-	-	6.3
	Port Stanley Line	15	-	-	-	-	15
	NPS 12 Martin Grove Rd	-	-	6.4	-	-	6.4
	NPS 12 Wilson Ave	1.8	6.7	-	-	-	8.5
	Moulton Replacement Bare & Unprotected	-	5.6	-	-	-	5.6
	Erin Township	3.4	3.4	3.4	-	-	10.3
	NPS 10 Glenridge Avenue	4.4	4.4	-	-	-	8.8
Customer Connections	New main and customer reinforcements ⁶	-	-	-	-	-	-
Growth	System Reinforcement	25.8	40.8	6.2	10.1	11.6	94.5
Transmission Pipe & Underground Storage	All	Refer to Response to Exhibit I.2.6-SEC-136 b) for all asset subclasses					

i-ii) An engineering assessment specific to the pipeline system that is proposed for conversion will determine whether partial or full conversion may be required for the existing natural gas pipeline to accept blended or pure hydrogen.

² Future work for the 2024-2028 timeframe is not determined at the project level, the forecast is based on historical actuals. Projects may also include replacements of non-pipe assets including valves, fittings, etc.

³ Length is based on one project with scoping yet to be determined and driven by municipal work. Overall length is an estimate.

⁴ St. Laurent Phase 3 & 4 lengths noted are as described in Exhibit 2, Tab 6, Schedule 2, Appendix A, Pages 14-15.

⁵ St. Laurent Phase 3 & 4 lengths noted are as described in Exhibit 2, Tab 6, Schedule 2, Appendix A, Pages 14-15.

⁶ Pipe lengths associated with Customer Connections cannot be forecasted with accuracy, as this varies depending on customer location and composition year over year. All pipe installed to support new customer connections will be subject to the same response with respect to parts i) and ii).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2,

Question(s):

- a) To help us understand the relative risks to Enbridge shareholders and customers relating to the decarbonization of the economy, for each of the following scenarios, please describe whether Enbridge shareholders would not likely, likely, or certainly be made whole for their investments in gas infrastructure:
- i. Enbridge receives OEB approval to construct a transmission reinforcement to the Dawn Parkway system. However, the need only persists for five years, after which the demand falls below the incremental capacity. As a result, most of the forecast savings and revenue do not materialize. Are Enbridge shareholders (i) not likely, (ii) likely, or (iii) certain to be made whole for their investments? Please provide an answer, and discuss the relevant considerations.
 - ii. Enbridge receives OEB approval to construct a distribution reinforcement. However, the need only persists for five years, after which the demand falls below the incremental capacity. As a result, most of the forecast revenue does not materialize. Are Enbridge shareholders (i) not likely, (ii) likely, or (iii) certain to be made whole for their investments? Please provide an answer, and discuss the relevant considerations.
 - iii. A “death spiral” occurs from 2035 to 2040, leaving \$5 billion in rate base uncollectable from the remaining customers. Are Enbridge shareholders (i) not likely, (ii) likely, or (iii) certain to be made whole for their investments? Please provide an answer, and discuss the relevant considerations.

Response:

Please see response at Exhibit I.1.10-STAFF-34 and Exhibit I.1.10-SEC-28.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, Appendix A (AMP, Investments >\$10M)

Question(s):

- a) Please provide a table of all items in Appendix A with columns for: name, planning portfolio, full cost, expected in-service date, whether it is a “must do”, whether LTC is required.

Response:

The following response has been updated to reflect the Capital Update provided at /u Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

- a) Table 1 provides the requested data. Please note that the “Must Do” descriptions under the Investment Overview section of each Investment Summary Report do not map directly to the Investment Categories summarized in column (c) below. This column aligns with the categories in Exhibit 2, Tab 6, Schedule 2, Table 6.1-1. Exhibit I.2.6-CME-21 part b) provides a description of how Enbridge Gas reprioritizes its portfolio to work within the capital constraint. For a listing of value amounts for each investment identified as “Value Driven - Value Framework”, please refer to JT5.13. For a list of LTC projects, please refer to Exhibit I.2.6-SEC-117.

/u

Table 1
AMP Investments >\$10 Million

Investment Code	Appendix A Investment Name	AMP Planning Group	2023-2032 Forecast Including Overheads	2023-2032 Overhead Allocation	In Service Date
(a)	(b)	(c)	(d)	(e)	(f)
Asset Class (EGI) - Compression Stations					
48715	Dawn C Compression Lifecycle	Significant Investments (>\$10M) - Fixed Timing	\$166,338,152	\$41,178,152	2027
48732	Waubuno Compression Lifecycle	Value Driven - Fixed Timing	\$29,218,620	\$6,141,720	2025
100901	Dawn to Corunna	Value Driven - Fixed Timing	\$200,337,430	\$45,845,900	2023
734634	Dawn to Corunna (Dawn Tie-in)	Value Driven - Fixed Timing	\$105,753,129	\$23,718,491	2023
Asset Class (EGI) - Distribution Pipe					
10088	NPS 20 Lake Shore Replacement (Cherry to Bathurst)	Value Driven - Fixed Timing	\$20,896,371	\$4,797,127	2022
10290	St. Laurent Phase 3 - Coventry/Cummings/St. Laurent (Plastic)	Value Driven - Fixed Timing	\$25,033,190	\$5,478,112	2024
10293	St. Laurent Phase 3 - North/South (NPS12/16 Steel)	Value Driven - Fixed Timing	\$121,804,143	\$26,503,360	2025
10294	St. Laurent Phase 4 - East/West (NPS12 Steel)	Value Driven - Fixed Timing	\$53,906,876	\$11,800,108	2024
11443	NPS 12 Martin Grove Rd Main Replacement: Lavington to St. Albans Rd.	Value Driven - Value Framework	\$30,613,585	\$7,603,920	2026, subject to EDIMP assessment
100295	Div_04: NPS 8 Port Stanley, London, Replacement	Value Driven - Fixed Timing	\$18,916,863	\$4,025,457	2025, subject to EDIMP assessment
100339	A10: Wilson Avenue, Toronto, VSM Replacement	Executing - Re-Optimize	\$106,992,932	\$25,192,932	2026/2031, refer to Exhibit I.2.6- ED-100
503350	Moulton Replacement BU	Executing - Re-Optimize	\$18,165,905	\$3,813,905	2025
740604	NPS20 KOL - Parliament St.	Mandatory - Fixed Timing	\$13,131,787	\$3,014,631	2023
Asset Class (EGI) - Distribution Stations					

Investment Code	Appendix A Investment Name	AMP Planning Group	2023-2032 Forecast Including Overheads	2023-2032 Overhead Allocation	In Service Date
13034	SCRW:Station-Renewal In-Place	Mandatory - Fixed Timing	\$28,244,162	\$6,171,173	2025
503369	Lisgar Station	Executing - Re-Optimize	\$20,124,611	\$4,242,407	2025
734676	SARN: 13F-220R Vidal St	Value Driven - Value Framework	\$17,192,992	\$4,712,992	2031
735022	Sarnia Industrial Station 2029 Rebuild	Value Driven - Fixed Timing	\$14,849,863	\$3,849,863	2029
Asset Class (EGI) - Growth					
1024	NW 6581 Ottawa Reinforcement Phase 2 SRP	Mandatory - Fixed Timing	\$70,698,549	\$17,209,549	2029
30542	SRP_Southeast_Owen Sound_County Rd 40_Reinforcement_NPS 12_11800m_4670kPa	Mandatory - Fixed Timing	\$33,636,531	\$7,236,531	2025
30579	SRP_Southwest_Wonderland_New STN & MOP Upgrade	Mandatory - Fixed Timing	\$20,506,933	\$4,306,933	2025
100703	SRP_LUG East_Kingston_Creekford Rd_Reinforcement_NPS 8_6200m_6895kPa	Mandatory - Fixed Timing	\$45,292,234	\$11,283,270	2027
736259	Hamilton Reinforcement Project	Mandatory - Fixed Timing	\$125,821,854	\$26,713,062	2025
736975	Enbridge Gas Distribution System Hydrogen Feasibility Study	Value Driven - Fixed Timing	\$15,315,942	\$3,398,275	2022
Asset Class (EGI) - LNG					
48709	Hagar KVGR and Cycle Mix Cooler	Value Driven - Value Framework	\$24,740,190	\$5,648,190	2032
48714	Hagar Cold Box	Value Driven - Value Framework	\$14,401,282	\$3,401,282	2032
49955	Hagar JVG Compressor Upgrade	Value Driven - Value Framework	\$20,873,854	\$4,781,854	2032
Asset Class (EGI) - Real Estate & Workplace Services					
3640	Station B New Building	Value Driven - Fixed Timing	\$38,590,879	\$8,590,879	2025
8782	VPC Core and Shell	Value Driven - Value Framework	\$35,420,035	\$9,420,035	2031
100621	Dawn Administrative Centre	Value Driven - Value Framework	\$16,349,278	\$4,349,278	2028

Investment Code	Appendix A Investment Name	AMP Planning Group	2023-2032 Forecast Including Overheads	2023-2032 Overhead Allocation	In Service Date
101136	New London Site	Executing - Re-Optimize	\$49,500,658	\$11,959,058	2026
737272	Kennedy Road New Build	Value Driven - Value Framework	\$49,647,957	\$11,803,457	2026
737374	Ottawa - New Building	Value Driven - Value Framework	\$46,337,933	\$10,498,150	2026
737754	Thorold Operations Centre - New Building	Value Driven - Value Framework	\$21,533,430	\$5,033,430	2026
739714	GTA East - New Build - Peterborough	Value Driven - Value Framework	\$14,722,478	\$3,722,478	2024
739715	GTA West - New Build - Halton Hills	Value Driven - Value Framework	\$42,675,572	\$9,790,356	2026
Asset Class (EGI) - TIS					
102291	Contract Market Harmonization	Value Driven - Value Framework	\$19,195,783	\$4,335,783	2026
102364	Records Management Technology Obsolescence (2024-2026)	Value Driven - Value Framework	\$23,566,261	\$5,516,261	2026
736081	General Service Rebasement Changes	Value Driven - Value Framework	\$17,914,329	\$3,914,329	2025
736942	Contract Market Systems - Technology Obsolescence	Mandatory - Fixed Timing	\$69,786,961	\$15,776,961	2026
Asset Class (EGI) Transmission Pipe & Underground Storage					
48654	Dawn Parkway Expansion Project (Kirkwall-Hamilton NPS 48)	Mandatory - Fixed Timing	\$251,357,572	\$63,082,988	2027
49758	Panhandle Regional Expansion Project	Mandatory - Fixed Timing	\$224,328,497	\$47,088,489	2024
100086	Panhandle Line Replacement	Value Driven - Fixed Timing	\$37,899,145	\$8,128,866	2025
100699	Dawn Parkway Expansion Project (Dawn-Enniskillen NPS 48)	Mandatory - Fixed Timing	\$332,803,728	\$86,169,476	2029
735972	PREP: NPS 36 looping to Comber Transmission	Mandatory - Fixed Timing	\$95,496,455	\$25,496,455	2030
736923	Panhandle Regional Expansion Project - Leamington Interconnect	Mandatory - Fixed Timing	\$118,751,452	\$28,443,901	2026

Investment Code	Appendix A Investment Name	AMP Planning Group	2023-2032 Forecast Including Overheads	2023-2032 Overhead Allocation	In Service Date
740055	Panhandle Regional Expansion Project - Dawn Facilities	Mandatory - Fixed Timing	\$92,044,573	\$19,910,796	2025
Note: Table Include Total Project Forecast for PREP					

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, Appendix A (AMP, Investments >\$10M)

Preamble:

These questions relate to the Dawn C Compression Lifecycle project described at page 4.

Question(s):

- a) How long could this project be deferred for before becoming an intolerable risk?
- b) When was the concern that is driving this replacement first identified?
- c) Please provide all documentation detailing the risk.
- d) When was IRP first considered? Please provide details.
- e) Please provide all documentation detailing the efforts to consider IRP.

Response:

- a), c) Enbridge Gas is undertaking an Asset Health Review as described at Exhibit 2, Tab 6, Schedule 2, page 183 of 288, paragraph 4, which will support a third-party Reliability, Availability and Maintainability Study to quantify risks associated with asset failures. These activities will support detailed alternatives analysis and final scoping which will inform the project cost estimate, timing, and business case. Until this study is completed, the Company cannot estimate with great certainty the potential for and duration of project deferral.
- b) The concern driving this replacement was first identified in 2016.
- d), e) IRP was first considered as a potential alternative to the project in November 2022, as part of the Company's broader assessment of identified system needs, and

facility-related projects included in its Asset Management Plan (AMP). At that time, Enbridge Gas sought to assess the feasibility of IRPA implementation on eliminating, reducing, or deferring the project scope. Upon review of the natural gas storage pool and well related projects under the Asset Class of 'Transmission Pipe & Underground Storage Investments', which passed the binary screening, it was determined that storage compression-related projects like Dawn C fail the Technical Evaluation and will, therefore, not have any further IRPA evaluation completed. The Company's reasoning for drawing this conclusion is set out below:

Storage deliverability not only supports the natural gas demands on design day, but it also enables natural gas storage injections and withdrawals to respond to unexpected gas supply disruptions such as unscheduled pipeline maintenance and extreme weather conditions experienced throughout the year. The daily injection and withdrawal capacity is still required to fill and empty the storage space if the design day demand is reduced. The deliverability of the storage peaking pools in combination with the storage baseload pools provide the capability to maintain deliverability over the seasons. The injection and withdrawal capability allows Enbridge Gas to avoid costly winter gas purchases and the sell-off of summer gas purchases if gas cannot be injected.

The Dawn C compressor serves two primary purposes: first, for design day withdrawals to meet the firm demands on the system; and second, for February/March baseload withdrawals to ensure Enbridge Gas can meet its late winter season inventory targets. If the Company did not replace Dawn C, Enbridge Gas would not be able to meet a peak day demand event, nor would it be able to manage the inventory levels of its storage pools. Taking into account the design day needs and the storage pool inventory level impacts, Enbridge Gas would lose approximately 764 TJ/d of deliverability capacity if Dawn C were not replaced. 764 TJ/d is a significant quantity of gas that cannot be replaced by a market-based supply side IRP alternative as explained below.

The alternative to maintaining existing deliverability at the Dawn Hub provided by the storage pools, would be other Market Based Storage options, including un-utilized upstream capacity or capacity from another pipeline to compensate for the loss in capacity at the Dawn Hub. In this scenario, the natural gas demands would be met through un-utilized upstream or pipeline (delivered supply) instead of the Dawn Hub and this would result in price increases as storage is no longer able to meet the volatility of Ontario's natural gas demands. As discussed in Enbridge Gas's Dawn to Corunna Replacement Project¹, "reliance upon supply-side alternatives for these purposes going forward may expose customers to greater volatility and risk of system shortfall/outage"². The Dawn to Corunna Project is replacing 670 TJ/d which is

¹ EB-2022-0086.

² EB-2022-0086, Exhibit C, Tab 1, Schedule 1, p.10, para.11.

smaller than the 764 TJ/d that would need to be replaced if Enbridge Gas were to eliminate the Dawn C Project.

As noted by ICF in EB-2022-0086:³

1. The storage capacity and deliverability that would be lost with the retirement of the Corunna compressors represents a significant share of the infrastructure needed to meet Enbridge Gas in-franchise customer demands.
2. The retirement of the Enbridge Gas storage compression facilities will have important impacts on gas markets at Dawn and throughout Ontario if the physical storage capacity and deliverability is not replaced. These impacts include an average increase in annual natural gas prices at Dawn of C\$0.013 per GJ, and an average increase in the seasonal natural gas price basis (Winter minus Summer prices) at Dawn of \$0.072/GJ between April 2024 and March 2045.
3. ICF evaluated a range of available options to replace the loss in cost-of-service based storage capacity. Based on ICF's analysis, the Dawn to Corunna Project provides the least cost option to replace the storage capacity and deliverability lost due to the retirement of the Corunna compressors.
 - The Dawn to Corunna Project is expected to cost C\$206.4 million in direct investment costs (excluding indirect overhead allocated to the project). When spread over the 40-year asset life of the investment, the overall cost of service associated with this investment, including return, depreciation, taxes, and O&M costs would have a NPV of about \$276 million.
 - The access to storage capacity provided by the Dawn to Corunna Project will reduce the NPV of commodity purchase costs over the 40-year life of the asset by \$794 million, leading to a total reduction in the NPV of the cost-of-service to in-franchise customers of about \$589 million relative to the Non-Replacement option.
 - The annual reduction in commodity costs enabled by the Dawn to Corunna Project more than offset the annual cost of service of the new infrastructure, resulting in a reduction in the overall cost of service to Enbridge Gas in-franchise customers, relative to the cost of service in the "no-replacement" option.
 - The alternative supply side approaches to replacing the storage capabilities lost due to the retirement of the Corunna compressors are projected to lead to

³ EB-2022-0086, Exhibit C, Tab 1, Schedule 1, p.9, para. 10.

a higher cost-of-service to Enbridge Gas in-franchise customers relative to the Dawn to Corunna Project. Over the 40-year lifetime of the Dawn to Corunna Project, reliance on the least cost alternative to the Dawn to Corunna Project would lead to an increase in the cost-of-service of about C\$519 million relative to the Dawn to Corunna Project.

1. While the initial costs of the Dawn to Corunna Project option are higher than the initial costs of the other alternatives considered, the annual cost savings associated with the Dawn to Corunna Project are significantly higher than the other options.
 - On a NPV basis, the Dawn to Corunna project option becomes the lowest cost option after year 2038.
 - On an annual cost-of-service basis, Dawn to Corunna is the lowest cost option to replacing the storage capacity and deliverability lost due to the Corunna compressor retirements during every year of the analysis.
2. The Dawn to Corunna Project provides significant reliability and resiliency benefits to the regional natural gas system that would not be provided by other supply side alternatives.

ICF's review and evaluation of the Dawn to Corunna Project are applicable to the Dawn C Project. Without maintaining our facilities and storage capacities, Enbridge Gas would be exposing natural gas ratepayers to natural gas commodity price spikes and supply disruptions that would result in firm gas supply curtailments to customers in Ontario and/or system outages.

Additionally, due to the lack of or limited information (in Ontario, or any other jurisdiction) on the measured impacts of IRPAs on overall system wide natural gas demands, it is premature to suppose that such investments can reliably and cost-effectively reduce natural gas storage deliverability at this time. For these reasons, it is neither appropriate nor reasonable to conduct further IRP assessments on the Dawn C Project.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, Appendix A (AMP, Investments >\$10M)

Preamble:

These questions relate to the Wilson Avenue, Toronto, VSM Replacement

Question(s):

- a) Page 11 of Appendix A lists the Capex as \$72,015,518 whereas Exhibit 2, Tab 6, Schedule 1, Page 46 lists the forecast cost as \$91,158,784. Please provide a table reconciling both figures.
- b) Please provide a table indicating the total and a breakdown down of the full project cost, including capitalized overhead and pipeline abandonment.
- c) Has Enbridge confirmed that it will be able to abandon the pipeline in place without removing it, including concurrence from Toronto and ensuring that there are no conflicts with other future infrastructure plans.
- d) The investments summary report lists: "Moratorium - At Walsh Ave. W. past Matthews Gate, approximately 700 m expires December 31, 2024." What is this?
- e) When was the concern that is driving this replacement first identified?
- f) Please provide all documentation detailing the risk.
- g) Does Enbridge anticipate replacing the pipe sections east and/or west of the project area in the future? If yes, when and why. If no, please explain why Enbridge believes they are safe whereas the subject pipe is not.
- h) If demand served by this pipe could be reduced, could any risks associated with the vintage pipe be mitigated by lowering the pressure? Please discuss.

- i) Please assess the possibility of relocating all or portions of the pipeline to the greenspace directly adjacent to highway 401, just south of Wilson Ave.
- j) Please provide all available documentation regarding this project, including in relation to the cost, risk, justification, DCF figures, route alternatives, and IRP consideration.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023. /u

- a) Capital costs in Exhibit 2, Tab 6, Schedule 2 – Appendix A, page 11 include pre-spend in 2021 and 2022 but do not include overheads, whereas costs in Exhibit 2, Tab 6, Schedule 1, page 46 includes overheads and no pre-spend. An all-inclusive breakdown of costs can be found in the response to part b). /u
- b) Table 1 shows the all-inclusive cost and projected forecast of the Wilson Avenue Pipeline Replacement Project including the direct capital cost, overhead allocation, and dismantlement. The additional pre-spend cost from 2021 and 2022 was previously not reflected in the table, and has been added to the total cost. The pre-spend relates to an associated investment to reconnect several of the high-pressure services connecting the Wilson Avenue main to the adjacent intermediate pressure network, thereby reducing risks associated with corrosion and leak migration around those services. This pre-spend cost has been added to the amounts expressed previously to arrive at the total estimated cost, \$110.6 million, associated with the replacement of the high-pressure pipeline system along this section of Wilson Avenue. The change in capital costs for the Wilson Ave project are driven by delaying the project due to the planned Enhanced Distribution Integrity Management Program (EDIMP) assessment of this pipeline. In addition, the new forecast reflects the approach to complete construction in two phases given the road moratorium starting at the end of 2025. /u

Table 1
Wilson Avenue All-in Full Cost Breakdown in \$ Millions¹

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Total Cost	
Direct capital cost	0.2	1.5	0.6	0	54.8	3.0	0	0.5	2.0	20.5	1.0	84.1	/u
Overhead Allocation	0	0.4	0.2	0	15.0	1.0	0	0.2	0.6	7.9	0.4	25.7	/u
Dismantlement (Abandonment)	0	0.7	0	0	0	0	0	0	0	0	0	0.7	/u
Total	0.2	2.6	0.8	0	69.8	4	0	0.7	2.6	28.4	1.4	110.6	/u

- c) The current plan is to abandon in place with sections no longer than 1000m in accordance with Enbridge Gas standards. Regarding the abandonment scope specifically, confirmation with the City of Toronto and other future infrastructure plans will be determined during detailed design. If the abandoned pipe becomes an issue in future infrastructure plans, it would be assessed at that time.
- d) This is an existing 5-year road moratorium that is in place by the City of Toronto which expires at the end of 2024.
- e) Operations first raised concerns about corrosion in January 2020.
- f) Please see Attachment 1 for the Copperleaf risk assessment.

Please see Attachment 2 for documented risk factors provided by Enbridge Gas's Operations team. Enbridge Gas is requesting confidential treatment of this attachment for the reasons set out in the Company's accompanying request for confidential treatment of certain information filed in this proceeding.

Please see Attachment 3 for the Excel extract from the DIMP Risk Model described in Exhibit 2, Tab 6, Schedule 2, page 95 and 96 of 288, Section 5.2.3.4.1.3.1. As described on Page 96, the values expressed in the extract provide a basis for

¹ Project estimates for future years are preliminary and have not been refined to differentiate direct and dismantlement costs. This level of detail will be available during the estimate revision closer to the date of execution. Revised OH and dismantlement allocation from undertaking JT5.16, originally stated incorrect forecast values in error.

determining the predicted relative risk of steel mains in 40 years for the Enbridge Gas Distribution Network, and therefore do not represent the absolute present risk. Following the OEB Decision for St. Laurent (please see Decision and order EB-2020-0293), Enbridge Gas is in the process of introducing the Enhanced Distribution Integrity Program (EDIMP) to better understand the condition of distribution pipelines within the scope of the program, including Wilson Avenue. Following that assessment, Enbridge Gas will have a more complete view of the pipeline's current condition at which point further refinement of scope and cost for the project and determination of a long-term maintenance strategy will be undertaken, if required. Please see response at Exhibit I.1.13-STAFF-41 for more information on the Enhanced Distribution Integrity Program.

- g) The pipeline west of the scope has a different residential density as compared to the pipeline within the scope and was installed in 1976 versus the average 1962 install year of the current scope. For these reasons, the pipeline to the west is not in consideration for replacement.

The pipeline to the east (HWY 401 crossing to Yonge St) is in a separate corrosion area (with a different history of cathodic protection) and has not been raised as an area of concern by Enbridge field operations. Consequently, the pipeline to the east is currently not in consideration for replacement.

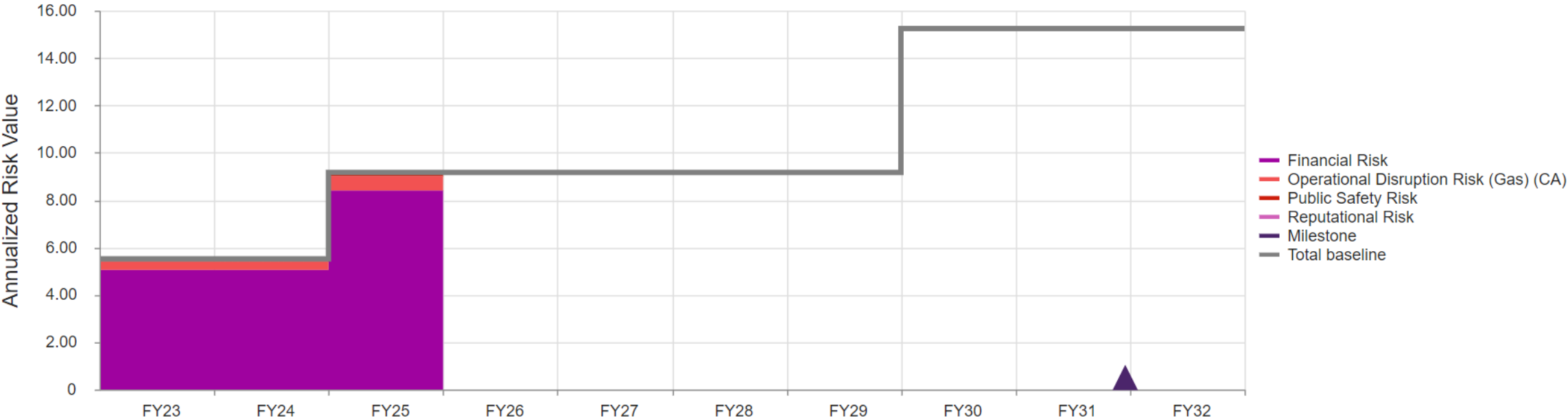
- h) Lowering the pressure of a pipeline could reduce the consequence of a potential event associated with the operating pressure of the pipeline, and therefore may reduce the risk associated to that event. While pressure is one variable that will impact the rate of leakage for a given leak, there are location-specific factors such as soil and surface conditions, and time dependent factors such as wind direction and velocity which will affect the rate of leakage and gas dispersion once leaking gas reaches the surface. So, while the gas flow rate for a given leak would be reduced through a reduction of pressure, the combination of these other factors may still result in build-up of flammable concentrations of gas that can pose a risk to public health and safety following the pressure reduction.

Furthermore, for corrosion related leaks, the likelihood of occurrence for a leak will not be reduced by lowering the operating pressure. So it cannot be concluded with certainty that a moderate reduction in pressure will lead to an overall reduction in risk associated with a specific leak. In addition, due to the vital feed of this pipeline to an extensive network of customers as quantified in response at Exhibit I.2.6-ED-102 part c), a pressure reduction is currently not possible to meet the required demand. This will be re-evaluated at the time of IRP assessment as proposed in response at Exhibit I.2.6-ED-102 part a).

- i) Alternative pipeline routes are limited for the Wilson Avenue replacement project firstly because of multiple constraints including 300+ existing services off this main which consequently restrict route options given that the existing pipeline footprint must be maintained when re-attaching a significant number of these services. Secondly, most of the green space to the South of Wilson Avenue is private property which falls outside of the municipal right-of-way and would therefore require land negotiations which may be costly and, ultimately, may not be successful.
- j)
 - i. Cost information can be found in the response provided in parts a) and b).
 - ii. Please see part f) for information on Risk and Justification.
 - iii. Since this is a replacement project which does not support any new incremental demand, DCF analysis would only be undertaken to compare project alternatives. As indicated in part f), the Enhanced Distribution Integrity Management Program will provide insights into the current condition of the pipeline and may inform alternative options, including potential partial replacements and long-term inspection and maintenance strategies. Once these alternatives are identified and costed, they can be compared against one another using a DCF analysis, giving due consideration for the relative risk reduction and other societal considerations such as future road closures required to facilitate inspections.
 - iv. Please see part l) for information on alternative routes for Wilson Avenue.
 - v. Please see response at Exhibit I.2.6-ED-102 parts a) and b) for information on IRP consideration.

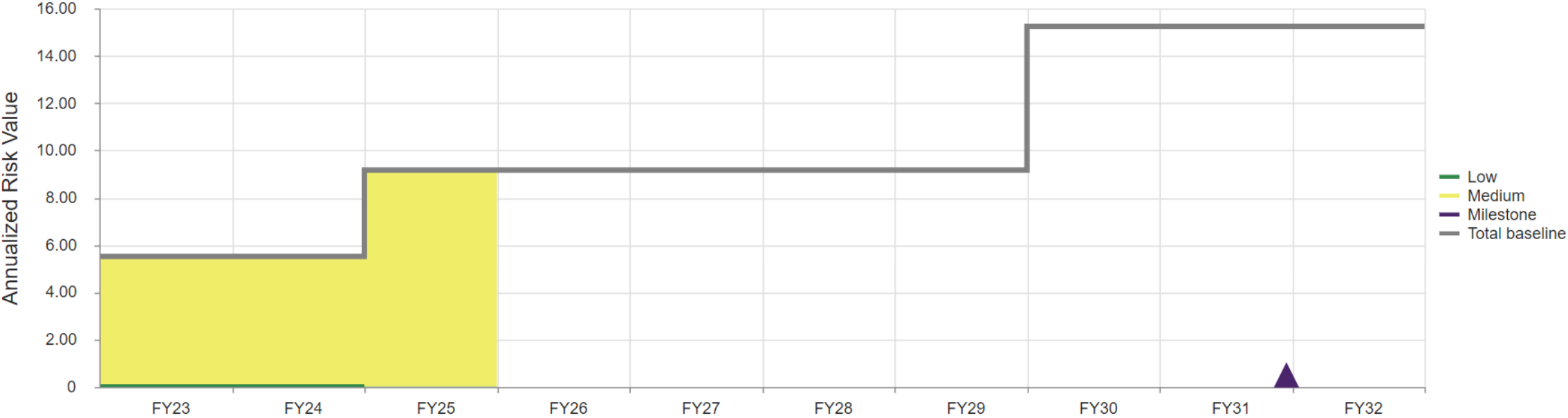
Annualized Outcome Risks by Risk Type

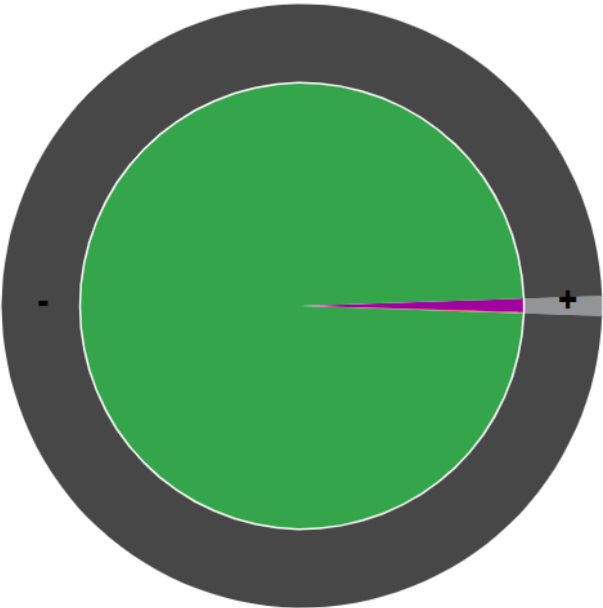
A10: Wilson Avenue, Toronto, VSM Replacement



Annualized Outcome Risks by Risk Level










A10: Wilson Avenue, Toronto, VSM Replacement





Draft Investment Value

A10: Wilson Avenue, Toronto, VSM Replacement

Value Measure	Value	
 Financial Risk	529.83	
 Operational Disru...	38.84	
 Public Safety Risk	3.64	
 Reputational Risk	0.44	
 Avoided GHG Emi...	0	
 Budget Savings CA...	0	
 Budget Savings OP...	0	
 Cost Avoidance C...	0	
 Cost Avoidance O...	0	
Total	(53,054.17)	

OPERATIONS REVIEW FOR FACTORS – NPS 12 WILSON AVE - WALSH TO BATHURST



General comments and issues:

- Approximately 8.3km of 12" SC HP Vintage Steel Gas Main from Walsh Ave to Bathurst Ave
- Operating pressure = ?? psi
- Mostly installed 1960-1964, but some main legs installed as early as 1955/56
- Some main legs look to have been replaced based on newer installation dates (i.e. 2001)
- Approximately 387 customers affected
- Main is currently protected by Rectifier
 - CP History shows average protection levels at 89%
 - 2 Mains (140079 & 140087) show historical protection levels at 76%
 - Corrosion on main has been an issue on Wilson due to stray current from TTC which continues to be an ongoing concern
 - The subway line runs above ground (elevated) where it crosses Wilson
 - 2 corrosion spots found around 2017 on newer replaced pipe at Billy Bishop / Wilson
 - Brad review with Corrosion (Bard J. / Steve M.) – confirmed – see 2009 Report
 - When was CP introduced? – Check with Corrosion (Brad J) – believed to be present from installation
- Compression Couplings:
 - Numerous Pumpkins that have been installed on it. Starting from Wendell Ave and going east towards Bathurst St
 - Records show 3 known unrestrained and 4 known pumpkined CCs
 - Other possible CCs / suspect valves that may have been tied in with CCs?
 - None identified by Ops
- The Service connections have Field Applied Coatings which leaves a concern for future corrosion issues on this main
 - Records show approximately over 250 service connections for the current scope of mains
 - Unprotected (non-coated) service connections
 - Double cut regulation to take HP to IP
- The Main in the road on Wilson Ave. CVT repairs are problematic due to the location of the main
 - Some history of damages due to CVT in road due to road work / car travel, etc.
 - Main crosses from south to north and back in several locations
- Environmental conditions (i.e. soil)
 - Wet soil towards Billy Bishop / TTC station due to drainage
 - Water issues from drainage ditch at Jane & Wilson
 - Clay to sand and rocky conditions mixed over length of mains
- Repair History
 - Operations recall 5-6 repairs (corrosion leaks) repaired with pumpkins (at \$15,000/ea)
 - Records show 1 leak between 2007-2017

OPERATIONS REVIEW FOR FACTORS – NPS 12 WILSON AVE - WALSH TO BATHURST



- Billy Bishop repair (corrosion leak) required stops and cut-out due to multiple locations of leaking pipe
- Year – 2017/18
- Repair Cost – approximately > \$100,000, took 1 week



- Two section of main under elevated roads (Hwy 400 / Allen Rd – includes subway station), 2 elevated railways near Walsh Ave and near Murray Rd.
- 3rd Party Damage concerns
 - No
- Depth of Cover
 - Mostly good DoC
- Criticality?
 - How many downstream customers?
 - Back feed?
 - Critical customers (i.e. Hospitals, schools, etc.)?

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

- Isolation and Valve condition / function
 - CVT in road, get seized, difficult to access due to location
 - Some occurrences / repairs for valve leaking

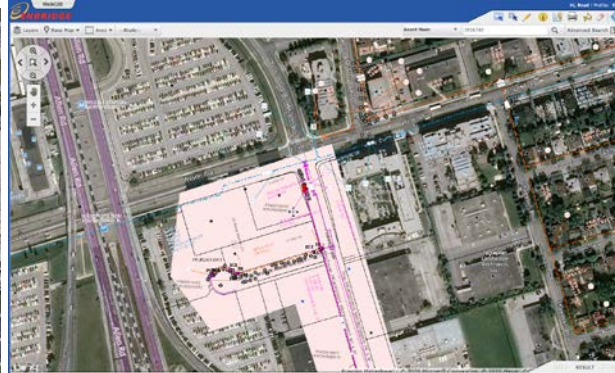
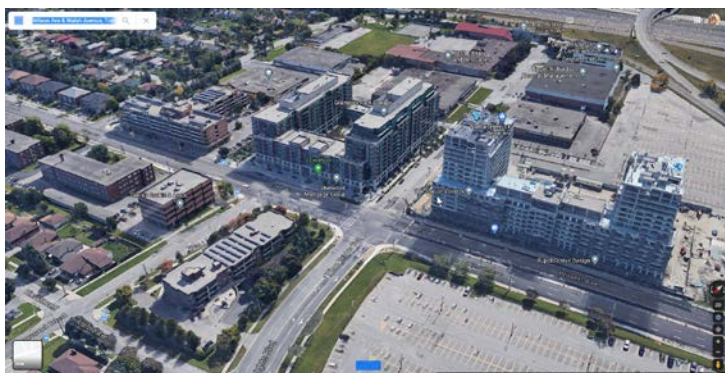
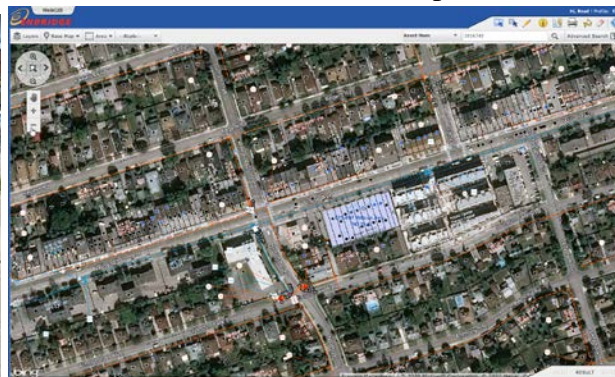
OPERATIONS REVIEW FOR FACTORS – NPS 12 WILSON AVE - WALSH TO BATHURST



- Casings
 - Casing at bridged water crossing (just at bridge abutments – pipe bare in middle) – Jane & Wilson – historic issues with casing in this location – shorting / contact with hangers, coating issues



- Stations
 - Condition?
 - Planned work?
 - Below Grade?
- Municipal planned work upcoming / moratoriums
 - Operations not aware of any, but road was resurfaced 2-3 years ago
- Wall to Wall
 - Many areas along Wilson have significant wall-to-wall concerns – see below examples



- Major intersections of Wilson / Keele, Wilson / Jane, Wilson / Dufferin St., Wilson / Bathurst
- Other Factors that degrade the condition of the pipe or create Risk?
 - Suspected that this was Medium Pressure and then was elevated to HP – look into MOP study
 - If yes, there may be more CCs unknown

**OPERATIONS REVIEW FOR FACTORS – NPS 12 WILSON AVE -
WALSH TO BATHURST**



- Latent damages experienced – coating damages not reported
- Road salt impacts
- Next Leak Survey Cycle
 - Mostly on a 4 year survey cycle – next survey in 2022 for most assets in scope

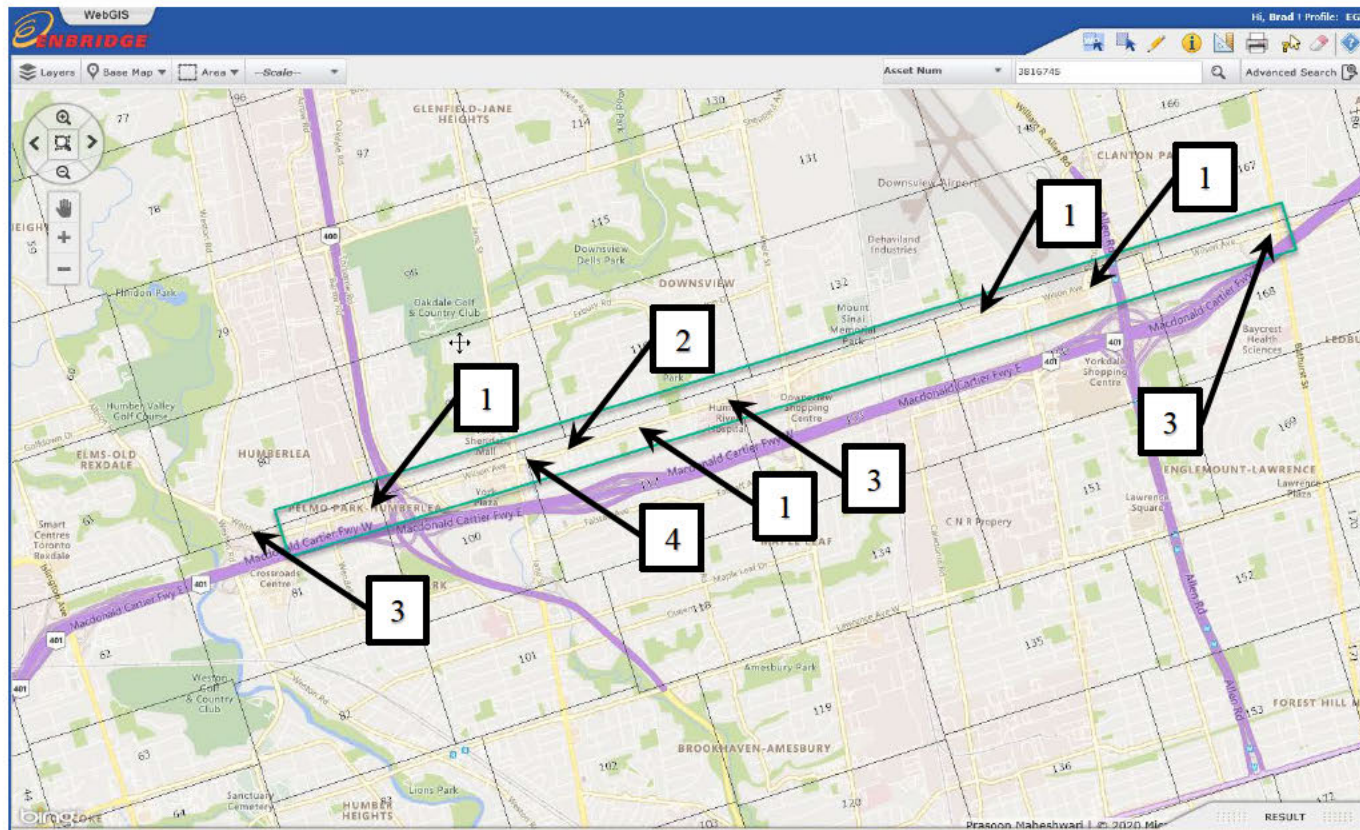
OPERATIONS REVIEW FOR FACTORS – NPS 12 WILSON AVE - WALSH TO BATHURST



Location specific issues:

1. Corrosion Issues
2. Unprotected CVT (no coatings)
3. Line Stop Fitting / Main Line Valve leak
4. Bridge Crossing issues

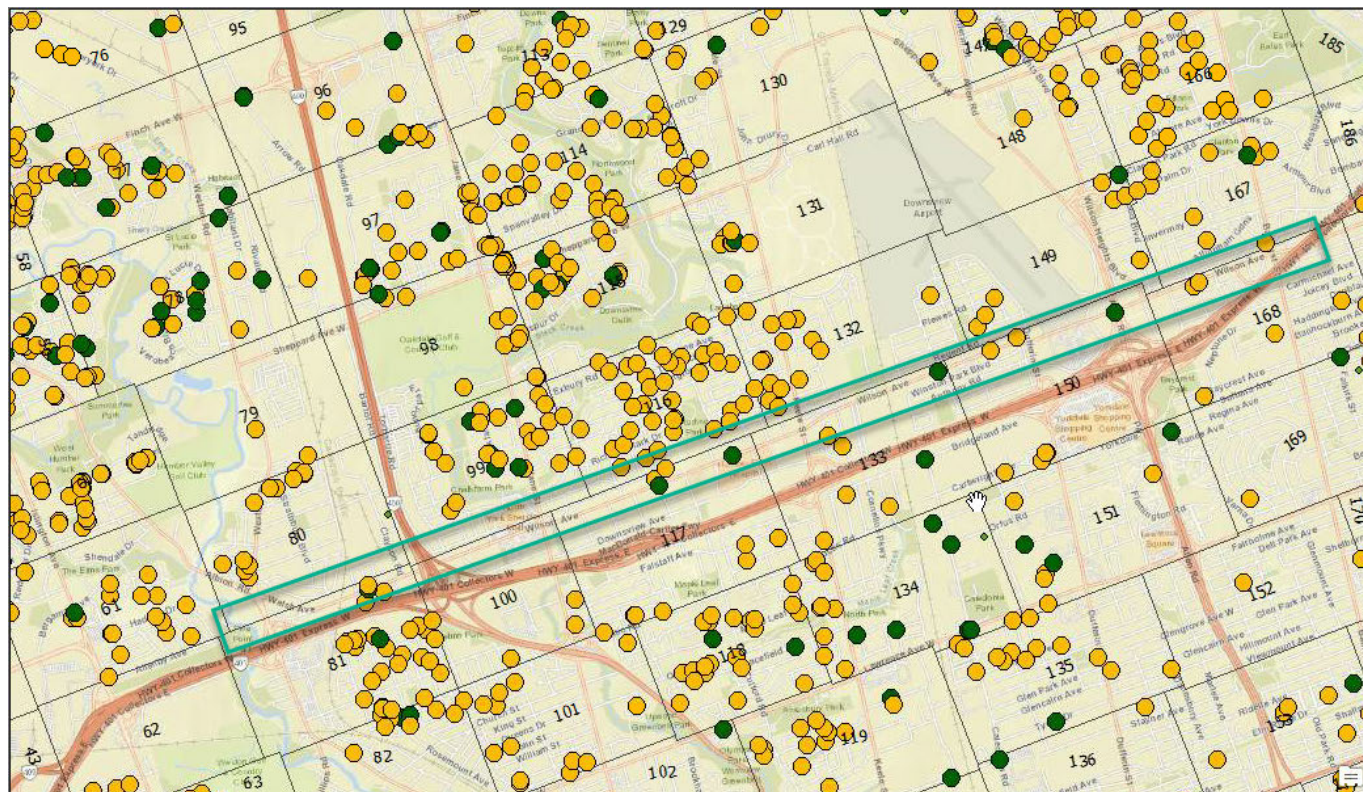
Mains Vintage Map



OPERATIONS REVIEW FOR FACTORS – NPS 12 WILSON AVE - WALSH TO BATHURST



Leak History (2007-2017 FCP Data)



- Layers**
- ☒ ALL Processed_FCP2018_LOC selection
 - ◆ <all other values>
 - ASSET_CATEGORY
 - Mains
 - Services

Project Information



PRIM_id	Project_Creator	C55_Investment_ID	Project_Name	Run_Name	Projection	Asset ID	System	NPS	Asset Subclass	Asset Type	Services - Count
			NPS 12 Wilson Ave	2020 Mains Risk V1.1 [P40] - 2020 Services							
1458	EGD\patzerb		Toronto	Risk V1.0 [P40]	40 Year	109851	LEGD		12 STEEL MAINS	MAIN	3
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		109853	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		109854	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		109857	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		109858	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		109859	LEGD		12 STEEL MAINS	MAIN	1
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		116400	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		116408	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		116417	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		126593	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		126596	LEGD		12 STEEL MAINS	MAIN	1
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		126598	LEGD		12 STEEL MAINS	MAIN	2
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		126600	LEGD		12 STEEL MAINS	MAIN	3
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		126604	LEGD		12 STEEL MAINS	MAIN	2
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		126606	LEGD		12 STEEL MAINS	MAIN	1
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		126615	LEGD		12 STEEL MAINS	MAIN	1
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		126621	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		140079	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		140087	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		2897420	LEGD		12 STEEL MAINS	MAIN	1
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		3475270	LEGD		12 STEEL MAINS	MAIN	5
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		3578916	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		3771269	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		3782738	LEGD		12 STEEL MAINS	MAIN	2
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		3791824	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		3812007	LEGD		12 STEEL MAINS	MAIN	3
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		3813279	LEGD		12 STEEL MAINS	MAIN	13
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		3816737	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		3816738	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		3816745	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		3816747	LEGD		12 STEEL MAINS	MAIN	3
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		3973134	LEGD		12 STEEL MAINS	MAIN	36
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		3973135	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		63110	LEGD		12 STEEL MAINS	MAIN	1
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1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		89793	LEGD		12 STEEL MAINS	MAIN	2
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		89795	LEGD		12 STEEL MAINS	MAIN	1
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		89796	LEGD		12 STEEL MAINS	MAIN	0
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		89803	LEGD		12 STEEL MAINS	MAIN	3
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		89804	LEGD		12 STEEL MAINS	MAIN	0
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1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P4 40 Year		89807	LEGD		12 STEEL MAINS	MAIN	1

Asset Information	Total Asset Risk
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Services - Average Age	AMP Fitting Count	Age	WT	Grade	MOP	EGI Operating Region	Asset Length (m)	Polyline Length (m)	Total Risk (\$/yr)	Risk/m (\$/m.yr)
	59	0	98	6.4	207	175 TORONTO	192.8548018	192.8548018	4496.366754	23.31477729
	0	0	59	6.4	207	175 TORONTO	5.990322681	5.990322681	65.45690868	10.92710897
	0	0	59	6.4	207	175 TORONTO	32.9700355	32.9700355	57.53914112	1.745195
	0	0	59	6.4	207	175 TORONTO	8.216470133	8.216470133	62.5436393	7.611984013
	0	0	59	6.4	207	175 TORONTO	8.548042977	8.548042977	63.55710394	7.435281281
	54	0	94	6.4	207	175 TORONTO	137.2552884	137.2552884	3032.187907	22.09159255
	0	0	98	6.4	207	175 TORONTO	47.62605996	47.62605996	3542.840423	74.38869446
	0	0	98	6.4	207	175 TORONTO	31.91521245	31.91521245	3652.671083	114.4492172
	0	0	98	6.4	207	175 TORONTO	24.83473575	24.83473575	3830.923541	154.2566661
	0	0	96	6.4	207	175 TORONTO	3.20576044	3.20576044	2587.916378	807.27067
	9	0	96	6.4	207	175 TORONTO	361.1305707	361.1305707	3340.47485	9.250047271
	47	0	98	6.4	207	175 TORONTO	85.295162	85.295162	3934.933962	46.13314366
	37	0	98	6.4	207	175 TORONTO	73.44250261	73.44250261	3958.844506	53.90399789
	36	0	98	6.4	207	175 TORONTO	119.4590878	119.4590878	4020.952069	33.65965823
	25	0	98	6.4	207	175 TORONTO	66.28386814	66.28386814	3535.310831	53.33591611
	25	0	104	6.4	207	175 TORONTO	42.28126442	42.28126442	6507.82694	153.91751
	0	0	96	6.4	207	175 TORONTO	29.64471718	29.64471718	2615.886625	88.24124073
	0	0	59	6.4	207	175 TORONTO	16.49499021	16.49499021	71.19171263	4.315959677
	0	0	59	6.4	207	175 TORONTO	12.24733398	12.24733398	68.7100843	5.610207447
	42	0	93	6.4	207	175 TORONTO	101.331733	101.331733	2533.535954	25.00239441
	36	0	98	6.4	207	175 TORONTO	263.2125468	263.2125468	7286.965691	27.68472012
	0	0	98	6.4	207	175 TORONTO	61.56164478	61.56164478	4694.209817	76.25218322
	0	0	98	6.4	207	175 TORONTO	3.683444028	3.683444028	3890.490572	1056.210042
	27	0	105	6.4	207	175 TORONTO	192.6932064	192.6932064	9713.344817	50.4083408
	0	0	93	6.4	207	175 TORONTO	32.00002642	32.00002642	2550.717787	79.70986501
	32	0	98	6.4	207	175 TORONTO	198.8813687	198.8813687	5067.062289	25.47781285
	34	0	98	6.4	207	175 TORONTO	98.06159185	98.06159185	6840.795106	69.76018823
	0	0	98	6.4	207	175 TORONTO	16.46486964	16.46486964	3902.39544	237.0134429
	0	0	98	6.4	207	175 TORONTO	2.399849128	2.399849128	3856.708503	1607.062901
	0	0	98	6.4	207	175 TORONTO	0.971522899	0.971522899	3856.708503	3969.755635
	3	0	98	6.4	207	175 TORONTO	435.7434982	435.7434982	5780.656072	13.26619008
	28	0	98	6.4	207	175 TORONTO	522.7491738	522.7491738	10590.62928	20.25948545
	0	0	98	6.4	207	175 TORONTO	4.435592704	4.435592704	3454.139109	778.7322551
	25	0	94	6.4	207	175 TORONTO	51.79807995	51.79807995	2399.598614	46.32601471
	37	0	98	6.4	207	175 TORONTO	137.254248	137.254248	7216.804503	52.5798262
	39	0	98	6.4	207	175 TORONTO	56.79095058	56.79095058	4453.905697	78.42632763
	0	0	59	6.4	207	175 TORONTO	61.88222864	61.88222864	80.05269561	1.293629809
	50	0	98	6.4	207	175 TORONTO	73.38840715	73.38840715	4656.720426	63.4530794
	41	0	98	6.4	207	175 TORONTO	88.77936607	88.77936607	4878.968704	54.95611109
	0	0	103	6.4	207	175 TORONTO	26.6772071	26.6772071	7724.835753	289.5668847
	43	0	98	6.4	207	175 TORONTO	175.9964558	175.9964558	5436.769979	30.89136059
	0	0	59	6.4	207	175 TORONTO	10.84621823	10.84621823	64.24319472	5.923096267
	50	0	98	6.4	207	175 TORONTO	64.71812977	64.71812977	4485.487205	69.3080474
	51	0	98	6.4	207	175 TORONTO	167.544483	167.544483	5128.889789	30.61210789

Total Asset FOF	Risk per Consequence Category					Cost / Benefit Categories
	Health & Safety	Financial	Environmental	Operational	Reputational	

Total FoF (Events/yr)	FoF/m (Events/m.yr)	Risk (\$/yr) - Public H&S	Risk (\$/yr) - Public Property	Risk (\$/yr) - Service Disruption	Risk (\$/yr) - Company Property	Risk (\$/yr) - Environmental	Risk (\$/yr) - Operational Disruption	Risk (\$/yr) - Technical Regulator	Risk (\$/yr) - Reputational Damage	Cost (\$/yr) - GHG Emissions	Cost (\$/yr) - Commodity Loss
0.030319	0.000157212	23.00062243	6.166886041	237.2741186	3956.975751	0	270.3401229	1.321631438	1.287621455	0	0
0.000379	6.32687E-05	0.264269383	0.067841	3.781363126	56.8290034	0	4.489318725	0.012720188	0.012392855	0	0
0.000373	1.13133E-05	0.260085699	0.066767	0.956222413	55.9293358	0	0.302014737	0.012518813	0.012196662	0	0
0.000368	4.47881E-05	0.256599296	0.065872	3.286819117	55.1796128	0	3.730351919	0.012351	0.012033168	0	0
0.000368	4.30508E-05	0.256599296	0.065872	3.671613801	55.1796128	0	4.359021875	0.012351	0.012033168	0	0
0.016825	0.000122582	11.00692523	3.489675	426.0763801	2349.140658	0	241.1824777	0.654314063	0.637476381	0	0
0.021729	0.000456242	12.11471197	3.628908716	133.9787768	3258.146213	0	133.5320198	0.729279563	0.710512768	0	0
0.021217	0.000664793	19.80695446	3.797843	148.2615726	3181.374578	0	298.0242677	0.712095563	0.69377097	0	0
0.022138	0.000891413	12.34274442	3.697214835	314.3010078	3319.473555	0	179.6421258	0.743006625	0.723886588	0	0
0.016723	0.005216547	7.098384047	2.911543116	53.31704381	2507.523546	0	15.95777327	0.561265688	0.54682245	0	0
0.021947	6.0773E-05	9.724071931	3.396703617	59.25682147	3251.447918	0	15.15497083	0.756921188	0.737443082	0	0
0.025919	0.000303874	12.44972353	4.062401755	229.7590287	3591.816799	0	94.82844356	1.021931438	0.995633735	0	0
0.026922	0.000366572	13.63951468	5.594517681	175.0536297	3697.88357	0	64.54408718	1.078469625	1.050717007	0	0
0.025948	0.000217212	11.15056938	4.519750071	234.4824144	3672.176234	0	96.68105499	0.98367975	0.958366391	0	0
0.023341	0.000352137	10.39980394	4.265686017	72.79848833	3424.427213	0	21.79618519	0.822307313	0.801146604	0	0
0.041199	0.000974403	17.97995955	7.374837304	276.9436397	6102.13788	0	100.583875	1.421666438	1.385082221	0	0
0.016951	0.000571805	7.195162829	2.951238854	49.37048487	2541.710915	0	13.53562815	0.568917938	0.554277783	0	0
0.000459	2.78266E-05	0.320051839	0.082161	1.56799541	68.8245714	0	0.366519031	0.015405188	0.015008761	0	0
0.000443	3.61711E-05	0.308895348	0.079297	1.513337618	66.4254578	0	0.353742769	0.014868188	0.014485579	0	0
0.015537	0.000153328	12.39615159	3.132723	144.4091097	2201.938379	0	170.4999356	0.587385563	0.572270174	0	0
0.038881	0.000147717	33.13980068	5.985623644	903.1420443	5286.582445	0	1054.985837	1.585368563	1.544571745	0	0
0.022508	0.000365617	18.00986111	3.625141903	594.3583708	3374.953057	0	701.7719764	0.75542475	0.735985153	0	0
0.021137	0.00573838	0	0	500.4812247	3169.37901	0	219.2297716	0.709410563	0.691155064	0	0
0.057465	0.00029822	42.68101718	10.786235	558.7465337	8434.895689	0	662.2425474	2.022419063	1.970375479	0	0
0.012793	0.000399781	7.222814564	2.289947	399.5093716	1918.241268	0	222.6067046	0.429365063	0.418316068	0	0
0.032992	0.000165888	23.43539333	4.198395627	194.6443686	4647.142837	0	195.1497324	1.262019	1.229543044	0	0
0.044506	0.000453858	32.21146854	4.545761376	715.1744856	5315.990524	0	768.5408662	2.194232625	2.137767705	0	0
0.021354	0.001296943	0	0	488.0010925	3201.916988	0	211.0624147	0.716693625	0.698250709	0	0
0.021104	0.008793886	0	0	482.2878644	3164.430838	0	208.5914208	0.708303	0.690076003	0	0
0.021104	0.021722597	0	0	482.2878644	3164.430838	0	208.5914208	0.708303	0.690076003	0	0
0.033037	7.58175E-05	30.76772106	5.899492235	488.1577274	4866.51779	0	387.0354234	1.153804313	1.124113082	0	0
0.086198	0.000164894	81.06820556	18.45498132	401.2249418	9679.242252	0	401.6108342	4.572870375	4.455195177	0	0
0.02115	0.004768247	13.18168801	2.361468421	132.7820223	3171.32829	0	133.0842133	0.709846875	0.691580149	0	0
0.015073	0.000290995	8.939799739	1.336473795	143.6360156	2184.68526	0	59.92545901	0.544812563	0.530792719	0	0
0.047523	0.000346241	38.84187271	5.806745849	743.5814447	5629.576929	0	794.3241935	2.367115688	2.30620191	0	0
0.024077	0.000423958	14.25419369	2.130960076	462.9464509	3492.784161	0	480.0749163	0.868684313	0.84633017	0	0
0.000404	6.52853E-06	0.281701401	0.072316	8.829519536	60.5776184	0	10.2647707	0.01355925	0.013210325	0	0
0.026395	0.000359662	17.23771537	2.576987801	481.7230718	3638.77388	0	514.3347895	1.050507188	1.023474136	0	0
0.024496	0.00027592	18.41282253	4.726784	602.9269998	3548.780129	0	702.3722316	0.886272	0.863465267	0	0
0.036988	0.001386502	18.53046597	2.962636644	986.0975325	5546.150865	0	1168.643379	1.24140975	1.209464139	0	0
0.028981	0.000164668	19.38345575	3.555434439	674.4949239	3949.211544	0	787.8005144	1.177199813	1.146906537	0	0
0.000378	3.48509E-05	0.263572103	0.067662	3.376134854	56.6790588	0	3.831720178	0.012686625	0.012360156	0	0
0.024436	0.000377576	14.79156923	2.21129614	464.428968	3506.501371	0	495.7743311	0.90143325	0.878236368	0	0
0.025955	0.000154914	19.82904637	5.090345	633.6225214	3730.34313	0	738.1204275	0.954439688	0.929878773	0	0

Total Risk Per Threat										
AHR		Uplifts		Third Party Damage	Cross Bore		Health & Safety	Financial		
Main - Corrosion / Degradation (\$/yr)	Services - Corrosion / Degradation (\$/yr)	Main - Non-Corrosion (\$/yr)	Main - Fittings & Connections (\$/yr)	Services - AMP Fitting (\$/yr)	Third Party Damage - All Equipment Types (\$/yr)	Crossbore (\$/yr)	Weighted Average Consequence (\$) - Public H&S	Weighted Average Consequence (\$) - Public Property	Weighted Average Consequence (\$) - Service Disruption	Weighted Average Consequence (\$) - Company Property
4466.536863	0	0	29.82989087	0	0	0	758.6207471	203.4000475	7825.921654	130511.4203
65.45690868	0	0	0	0	0	0	697.2806951	179	9977.211415	149944.6
57.53914112	0	0	0	0	0	0	697.2806951	179	2563.598962	149944.6
62.5436393	0	0	0	0	0	0	697.2806951	179	8931.573687	149944.6
63.55710394	0	0	0	0	0	0	697.2806951	179	9977.211415	149944.6
3023.383066	0	0	8.804840052	0	0	0	654.2006081	207.410104	25324.00476	139622.0302
3542.840423	0	0	0	0	0	0	557.5365626	167.0076265	6165.89704	149944.6
3652.671083	0	0	0	0	0	0	933.5417101	179	6987.866928	149944.6
3830.923541	0	0	0	0	0	0	557.5365626	167.0076265	14197.35332	149944.6
2587.916378	0	0	0	0	0	0	424.4683399	174.1041151	3188.246356	149944.6
3338.680014	0	0	1.794835521	0	0	0	443.0706671	154.7684703	2699.996422	148149.994
3921.350865	0	0	13.58309727	0	0	0	480.3319392	156.7345096	8864.502052	138578.5254
3942.834341	0	0	16.01016467	0	0	0	506.6308103	207.8046832	6502.252049	137355.4554
4010.937873	0	0	10.01419627	0	0	0	429.7275082	174.184911	9036.627656	141520.5887
3531.748346	0	0	3.562485036	0	0	0	445.5594851	182.7550669	3118.910429	146712.9606
6504.264455	0	0	3.562485036	0	0	0	436.417378	179.0052502	6722.09616	148113.7377
2615.886625	0	0	0	0	0	0	424.4683399	174.1041151	2912.54114	149944.6
71.19171263	0	0	0	0	0	0	697.2806951	179	3416.112005	149944.6
68.7100843	0	0	0	0	0	0	697.2806951	179	3416.112005	149944.6
2526.650821	0	0	6.88513359	0	0	0	797.8471773	201.6298513	9294.529812	141722.2359
7259.161701	0	0	27.80399028	0	0	0	852.3392064	153.9472659	23228.36461	135968.2736
4694.209817	0	0	0	0	0	0	800.1537723	161.0601521	26406.5386	149944.6
3890.490572	0	0	0	0	0	0	0	0	23677.96871	149944.6
9703.553671	0	0	9.791145606	0	0	0	742.7306566	187.7009484	9723.24952	146783.1844
2550.717787	0	0	0	0	0	0	564.5911486	179	31228.74787	149944.6
5051.960217	0	0	15.10207268	0	0	0	710.3356369	127.2549596	5899.74444	140856.6573
6777.731645	0	0	63.06346059	0	0	0	723.7556405	102.1381696	16069.17012	119444.3563
3902.39544	0	0	0	0	0	0	0	0	22852.91245	149944.6
3856.708503	0	0	0	0	0	0	0	0	22852.91245	149944.6
3856.708503	0	0	0	0	0	0	0	0	22852.91245	149944.6
5775.542793	0	0	5.113278709	0	0	0	931.3109864	178.5722746	14776.09127	147305.0758
10417.19658	0	0	173.4326977	0	0	0	940.4882429	214.0998784	4654.689688	112290.7985
3454.139109	0	0	0	0	0	0	623.2476601	111.6533533	6278.109804	149944.6
2395.978237	0	0	3.620376955	0	0	0	593.1002282	88.66674152	9529.358166	144940.3079
7144.963064	0	0	71.84143939	0	0	0	817.3278773	122.1881163	15646.76987	118460.0494
4448.255185	0	0	5.650511746	0	0	0	592.0253225	88.50604628	19227.74644	145067.2493
80.05269561	0	0	0	0	0	0	697.2806951	179	21855.24638	149944.6
4641.370335	0	0	15.3500907	0	0	0	653.0674509	97.63166513	18250.5426	137858.4535
4872.333491	0	0	6.635213259	0	0	0	751.6664979	192.9614631	24613.28379	144871.8211
7724.835753	0	0	0	0	0	0	500.9858864	80.09723812	26659.93113	149944.6
5418.592528	0	0	18.17745101	0	0	0	668.8332268	122.6815651	23273.69393	136268.9881
64.24319472	0	0	0	0	0	0	697.2806951	179	8931.573687	149944.6
4477.906568	0	0	7.580637046	0	0	0	605.3187602	90.49337617	19005.93256	143497.3552
5120.267892	0	0	8.621896995	0	0	0	763.977899	196.1219418	24412.34912	143723.488

Weighted Average Consequence											
						Corrosion					
Environmental	Operational	Reputational				Health & Safety	Financial		Environmental	Operational	
Weighted Average Consequence (\$) - Environmental	Weighted Average Consequence (\$) - Operational Disruption	Weighted Average Consequence (\$) - Technical Regulator	Weighted Average Consequence (\$) - Reputational Damage	Weighted Average Cost/Benefit (\$) - GHG Emissions	Weighted Average Cost/Benefit (\$) - Commodity Loss	Main - Corrosion / Degradation (\$/yr) - Public H&S	Main - Corrosion / Degradation (\$/yr) - Public Property	Main - Corrosion / Degradation (\$/yr) - Service Disruption	Main - Corrosion / Degradation (\$/yr) - Company Property	Main - Corrosion / Degradation (\$/yr) - Environmental	Main - Corrosion / Degradation (\$/yr) - Operational Disruption
0	8916.525047	43.59086505	42.46912679	0	0	15.32531873	4.131569709	236.9903386	3938.294919	0	270.0543632
0	11845.16814	33.5625	32.698825	0	0	0.264269383	0.067841	3.781363126	56.8290034	0	4.489318725
0	809.6909837	33.5625	32.698825	0	0	0.260085699	0.066767	0.956222413	55.9293358	0	0.302014737
0	10136.82587	33.5625	32.698825	0	0	0.256599296	0.065872	3.286819117	55.1796128	0	3.730351919
0	11845.16814	33.5625	32.698825	0	0	0.256599296	0.065872	3.671613801	55.1796128	0	4.359021875
0	14334.76837	38.8893945	37.88864075	0	0	8.824559652	2.79777	425.9927301	2343.634098	0	241.0982442
0	6145.336639	33.5625	32.698825	0	0	12.114711197	3.628908716	133.9787768	3258.146213	0	133.5320198
0	14046.48479	33.5625	32.698825	0	0	19.80695446	3.797843	148.2615726	3181.374578	0	298.0242677
0	8114.650187	33.5625	32.698825	0	0	12.34274442	3.697214835	314.3010078	3319.473555	0	179.6421258
0	954.2410616	33.5625	32.698825	0	0	7.098384047	2.911543116	53.31704381	2507.523546	0	15.95777327
0	690.5258499	34.48859468	33.60108818	0	0	9.325888784	3.335530701	59.23785147	3250.19915	0	15.14531316
0	3658.645918	39.42788833	38.41327733	0	0	9.63385079	3.286396712	229.6171387	3582.476383	0	94.75397967
0	2397.447707	40.05904558	39.0281928	0	0	10.43767648	4.281220189	174.8903897	3687.137714	0	64.45797484
0	3725.954023	37.90965585	36.93411404	0	0	9.299720396	3.769530549	234.3771344	3665.245802	0	96.62599354
0	933.8153975	35.23016634	34.32357672	0	0	9.687216452	3.973404114	72.76215833	3422.035661	0	21.77768951
0	2441.415447	34.50730449	33.61931652	0	0	17.26737207	7.082555401	276.9073097	6099.746328	0	100.5653793
0	798.515023	33.5625	32.698825	0	0	7.195162829	2.951238854	49.37048487	2541.710915	0	13.53562815
0	798.5164076	33.5625	32.698825	0	0	0.320051839	0.082161	1.56799541	68.8245714	0	0.366519031
0	798.5164076	33.5625	32.698825	0	0	0.308895348	0.079297	1.513337618	66.4254578	0	0.353742769
0	10973.80032	37.80559712	36.83273309	0	0	10.38227747	2.623782	144.3475797	2197.887947	0	170.4379763
0	27133.7115	40.77489166	39.72561778	0	0	25.14335113	4.596522158	902.8803143	5269.353133	0	1054.859824
0	31178.77983	33.5625	32.698825	0	0	18.00986111	3.625141903	594.3583708	3374.953057	0	701.7719764
0	10371.84897	33.5625	32.698825	0	0	0	0	500.4812247	3169.37901	0	219.2297716
0	11524.27647	35.19392783	34.28827075	0	0	39.81714613	10.062485	558.6590337	8429.135689	0	662.154437
0	17400.66479	33.5625	32.698825	0	0	7.222814564	2.289947	399.5093716	1918.241268	0	222.6067046
0	5915.062208	38.25227328	37.26791478	0	0	19.27642688	3.453326563	194.4999586	4637.636533	0	195.0445747
0	17268.25296	49.30195086	48.03324733	0	0	17.32627215	2.445125984	714.5206856	5272.951804	0	768.1576119
0	9883.975587	33.5625	32.698825	0	0	0	0	488.0010925	3201.916988	0	211.0624147
0	9883.975587	33.5625	32.698825	0	0	0	0	482.2878644	3164.430838	0	208.5914208
0	9883.975587	33.5625	32.698825	0	0	0	0	482.2878644	3164.430838	0	208.5914208
0	11715.21093	34.92460915	34.02588254	0	0	28.95592	5.552092235	488.1157274	4863.75299	0	387.0167445
0	4659.166503	53.05077119	51.68559801	0	0	37.67464047	8.882863082	399.6570818	9566.46548	0	400.2890449
0	6292.397791	33.5625	32.698825	0	0	13.18168801	2.361468421	132.7820223	3171.32829	0	133.0842133
0	3975.68228	36.14493216	35.21480258	0	0	8.01525513	1.198257092	143.5996856	2182.293708	0	59.90696332
0	16714.52125	49.809896	48.52812134	0	0	20.5023992	3.065048442	742.8607947	5582.137569	0	793.930476
0	19939.15007	36.07942487	35.150981	0	0	12.81482559	1.915778774	462.8898909	3489.060897	0	480.0319577
0	25407.84827	33.5625	32.698825	0	0	0.281701401	0.072316	8.829519536	60.5776184	0	10.2647707
0	19486.06893	39.7994767	38.7753035	0	0	13.32755079	1.992429685	481.5694218	3628.65932	0	514.2180887
0	28672.93565	36.18027433	35.24923527	0	0	16.48441291	4.231739	602.8671498	3544.840289	0	702.3434163
0	31595.20328	33.5625	32.698825	0	0	18.53046597	2.962636644	986.0975325	5546.150865	0	1168.643379
0	27183.34476	40.6197099	39.57442936	0	0	15.17557424	3.019158283	674.3040339	3936.645528	0	787.7086086
0	10136.82587	33.5625	32.698825	0	0	0.263572103	0.067662	3.376134854	56.6790588	0	3.831720178
0	20288.686	36.88955844	35.94026713	0	0	12.86053578	1.922612314	464.353088	3501.506299	0	495.7166985
0	28438.46764	36.77286409	35.82657572	0	0	17.32324159	4.447076	633.5447514	3725.223642	0	738.0829844

Risk Category Per Threat						
	Uplifts					
	Fittings & Connections					
	Health & Safety	Financial	Environmental	Operational	Reputational	

[illegible]

Third Party Damage							
Third Party Damage - All tool types							
Health & Safety	Financial	Environmental	Operational	Reputational		Health & Safety	

[illegible]

Cross Bore						
Cross Bore						
Financial	Environmental	Operational	Reputational		AHR	Upl

Crossbore (\$/yr) - Service Disruption	Crossbore (\$/yr) - Company Property	Crossbore (\$/yr) - Environmental	Crossbore (\$/yr) - Operational Disruption	Crossbore (\$/yr) - Technical Regulator	Crossbore (\$/yr) - Reputational Damage	Crossbore (\$/yr) - GHG Emissions	Crossbore (\$/yr) - Commodity Loss	Main - Corrosion / Degradation (failures/yr)	Main - Non-Corrosion (failures/yr)	Main - Fittings & Connections (failures/yr)	Services - Corrosion / Degradation (failures/yr)	
0	0	0	0	0	0	0	0	0	0.026265	0	0	0
0	0	0	0	0	0	0	0	0	0.000379	0	0	0
0	0	0	0	0	0	0	0	0	0.000373	0	0	0
0	0	0	0	0	0	0	0	0	0.000368	0	0	0
0	0	0	0	0	0	0	0	0	0.000368	0	0	0
0	0	0	0	0	0	0	0	0	0.01563	0	0	0
0	0	0	0	0	0	0	0	0	0.021729	0	0	0
0	0	0	0	0	0	0	0	0	0.021217	0	0	0
0	0	0	0	0	0	0	0	0	0.022138	0	0	0
0	0	0	0	0	0	0	0	0	0.016723	0	0	0
0	0	0	0	0	0	0	0	0	0.021676	0	0	0
0	0	0	0	0	0	0	0	0	0.023892	0	0	0
0	0	0	0	0	0	0	0	0	0.02459	0	0	0
0	0	0	0	0	0	0	0	0	0.024444	0	0	0
0	0	0	0	0	0	0	0	0	0.022822	0	0	0
0	0	0	0	0	0	0	0	0	0.04068	0	0	0
0	0	0	0	0	0	0	0	0	0.016951	0	0	0
0	0	0	0	0	0	0	0	0	0.000459	0	0	0
0	0	0	0	0	0	0	0	0	0.000443	0	0	0
0	0	0	0	0	0	0	0	0	0.014658	0	0	0
0	0	0	0	0	0	0	0	0	0.035142	0	0	0
0	0	0	0	0	0	0	0	0	0.022508	0	0	0
0	0	0	0	0	0	0	0	0	0.021137	0	0	0
0	0	0	0	0	0	0	0	0	0.056215	0	0	0
0	0	0	0	0	0	0	0	0	0.012793	0	0	0
0	0	0	0	0	0	0	0	0	0.030929	0	0	0
0	0	0	0	0	0	0	0	0	0.035166	0	0	0
0	0	0	0	0	0	0	0	0	0.021354	0	0	0
0	0	0	0	0	0	0	0	0	0.021104	0	0	0
0	0	0	0	0	0	0	0	0	0.021104	0	0	0
0	0	0	0	0	0	0	0	0	0.032437	0	0	0
0	0	0	0	0	0	0	0	0	0.0638	0	0	0
0	0	0	0	0	0	0	0	0	0.02115	0	0	0
0	0	0	0	0	0	0	0	0	0.014554	0	0	0
0	0	0	0	0	0	0	0	0	0.037228	0	0	0
0	0	0	0	0	0	0	0	0	0.023269	0	0	0
0	0	0	0	0	0	0	0	0	0.000404	0	0	0
0	0	0	0	0	0	0	0	0	0.0242	0	0	0
0	0	0	0	0	0	0	0	0	0.023641	0	0	0
0	0	0	0	0	0	0	0	0	0.036988	0	0	0
0	0	0	0	0	0	0	0	0	0.026254	0	0	0
0	0	0	0	0	0	0	0	0	0.000378	0	0	0
0	0	0	0	0	0	0	0	0	0.023352	0	0	0
0	0	0	0	0	0	0	0	0	0.024844	0	0	0

Frequency of Failure per Threat												
ifts	Third Party Damage						Cross Bore	Health & Safety	Financial			
Services - AMP Fitting (failures/yr)	Third Party Damage - Auger / Vertical Drilling (failures/yr)	Third Party Damage - Excavator / Backhoe (failures/yr)	Third Party Damage - Boring / Directional Drilling (failures/yr)	Third Party Damage - Hand Tools (failures/yr)	Third Party Damage - Other (failures/yr)	Third Party Damage - All Equipment Types (failures/yr)	Crossbore (Explosions/yr)	Services - Corrosion / Degradation - Public H&S	Services - Corrosion / Degradation - Public Property	Services - Corrosion / Degradation - Service Disruption	Services - Corrosion / Degradation - Company Property	
0	0	0	0	0	0	0	0.004054	0	7.675303704	2.035316332	0.28378	18.680832
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0.001195	0	2.182365579	0.691905	0.08365	5.50656
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0.000271	0	0.398183147	0.061172915	0.01897	1.248768
0	0	0	0	0	0	0	0.002027	0	2.815872743	0.776005043	0.14189	9.340416
0	0	0	0	0	0	0	0.002332	0	3.201838199	1.313297492	0.16324	10.745856
0	0	0	0	0	0	0	0.001504	0	1.850848986	0.750219522	0.10528	6.930432
0	0	0	0	0	0	0	0.000519	0	0.712587489	0.292281903	0.03633	2.391552
0	0	0	0	0	0	0	0.000519	0	0.712587489	0.292281903	0.03633	2.391552
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0.000879	0	2.013874124	0.508941	0.06153	4.050432
0	0	0	0	0	0	0	0.003739	0	7.996449549	1.389101485	0.26173	17.229312
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0.00125	0	2.863871053	0.72375	0.0875	5.76
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0.002063	0	4.158966454	0.745069064	0.14441	9.506304
0	0	0	0	0	0	0	0.00934	0	14.88519639	2.100635391	0.6538	43.03872
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0.0006	0	1.811801062	0.3474	0.042	2.7648
0	0	0	0	0	0	0	0.022398	0	43.39356509	9.572118237	1.56786	112.776772
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0.000519	0	0.924544609	0.138216703	0.03633	2.391552
0	0	0	0	0	0	0	0.010295	0	18.33947351	2.741697407	0.72065	47.43936
0	0	0	0	0	0	0	0.000808	0	1.439368101	0.215181302	0.05656	3.723264
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0.002195	0	3.910164581	0.584558116	0.15365	10.11456
0	0	0	0	0	0	0	0.000855	0	1.928409619	0.495045	0.05985	3.93984
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0.002727	0	4.207881506	0.536276156	0.19089	12.566016
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0.001084	0	1.931033442	0.288683826	0.07588	4.995072
0	0	0	0	0	0	0	0.001111	0	2.505804779	0.643269	0.07777	5.119488

RISK CATEGORY PER THREAT - SERVICES											
AHR						UPLIFT					
Corrosion						Fittings & Connections					
Environmental	Operational	Reputational				Health & Safety	Financial		Environmental	Operational	
Services - Corrosion / Degradation - Environmental	Services - Corrosion / Degradation - Operational Disruption	Services - Corrosion / Degradation - Technical Regulator	Services - Corrosion / Degradation - Reputational Damage	Services - Corrosion / Degradation - GHG Emissions	Services - Corrosion / Degradation - Commodity Loss	Services - Fittings & Connections - AMP Fittings (\$/yr) - Public H&S	Services - Fittings & Connections - AMP Fittings (\$/yr) - Public Property	Services - Fittings & Connections - AMP Fittings (\$/yr) - Service Disruption	Services - Fittings & Connections - AMP Fittings (\$/yr) - Company Property	Services - Fittings & Connections - AMP Fittings (\$/yr) - Environmental	Services - Fittings & Connections - AMP Fittings (\$/yr) - Operational Disruption
0	0.28575964	0.440112375	0.428786817	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0.08423354	0.129732188	0.126393746	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0.00965767	0.029420438	0.028663352	0	0	0	0	0	0	0	0
0	0.074463888	0.220056188	0.214393408	0	0	0	0	0	0	0	0
0	0.086112334	0.25316775	0.2466529	0	0	0	0	0	0	0	0
0	0.055061453	0.163278	0.159076313	0	0	0	0	0	0	0	0
0	0.018495686	0.056343938	0.05489402	0	0	0	0	0	0	0	0
0	0.018495686	0.056343938	0.05489402	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0.061959231	0.095426438	0.092970797	0	0	0	0	0	0	0	0
0	0.126012423	0.405915188	0.395469637	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0.088110397	0.135703125	0.132211031	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0.105157634	0.223964438	0.218201086	0	0	0	0	0	0	0	0
0	0.383254235	1.01397375	0.987880826	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0.018678852	0.0651375	0.063461295	0	0	0	0	0	0	0	0
0	1.321789351	2.431582875	2.369010142	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0.018495686	0.056343938	0.05489402	0	0	0	0	0	0	0	0
0	0.393717482	1.117650938	1.088890053	0	0	0	0	0	0	0	0
0	0.042958633	0.0877185	0.085461211	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0.116700742	0.238294688	0.232162571	0	0	0	0	0	0	0	0
0	0.028815358	0.092820938	0.090432345	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0.091905825	0.296049938	0.288431586	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0.057632621	0.11768175	0.114653406	0	0	0	0	0	0	0	0
0	0.037443114	0.120612938	0.117509165	0	0	0	0	0	0	0	0

Reputational	

Services - Fittings & Connections - AMP	Services - Fittings & Connections - AMP	Services - Fittings & Connections - AMP	Services - Fittings & Connections - AMP
Fittings (\$/yr) - Technical Regulator	Fittings (\$/yr) - Reputational Damage	Fittings (\$/yr) - GHG Emissions	Fittings (\$/yr) - Commodity Loss

[illegible]

Project Information

Asset Information

PRIM_id	Project_Creator	C55_Investment_ID	Project_Name	Run_Name	Projection	Total Asset Length (m)	Total Polyline Length (m)	Number of Main Assets	Number of Services	Number of AMP Fittings
1458	EGD\patzerb		NPS 12 Wilson Ave Toron	2020 Mains Risk V1.1 [P40] - 2020 Services	40 Year	4149.56207	4149.56207	44	100	0

Total Asset Risk	Total Asset FOF	Risk per Consequence Category					
		Health & Safety	Financial	Environmental	Operational	Reputational	

Total Risk (\$/yr)	Total Risk/m (\$/m.yr)	Total FoF (Events/yr)	Total FoF/m (Events/m.yr)	Risk (\$/yr) - Public H&S	Risk (\$/yr) - Public Property	Risk (\$/yr) - Service Disruption	Risk (\$/yr) - Company Property	Risk (\$/yr) - Environmental	Risk (\$/yr) - Operational Disruption	Risk (\$/yr) - Technical Regulator	Risk (\$/yr) - Reputational Damage
\$ 169,991	\$ 41	1.01804	0.000245337	\$ 634	\$ 148	\$ 14,117	\$ 142,154	\$ -	\$ 12,860	\$ 40	\$ 39

Cost / Benefit Categories	Total Risk Per Threat			
	AHR	Uplifts	Third Party Damage	Cross Bore

Cost (\$/yr) - GHG Emissions	Cost (\$/yr) - Commodity Loss	Main - Corrosion / Degradation (\$/yr)	Main - Non-Corrosion (\$/yr)	Main - Fittings & Connections (\$/yr)	Services - Corrosion / Degradation (\$/yr)	Services - AMP Fitting (\$/yr)	Third Party Damage - All Equipment Types (\$/yr)	Crossbore (\$/yr)
\$ -	\$ -	\$ 169,465	\$ -	\$ -	\$ 526	\$ -	\$ -	\$ -

Weighted Average Consequence									
Health & Safety	Financial		Environmental	Operational	Reputational			Health & Safety	

Weighted Average Consequence (\$) - Public H&S	Weighted Average Consequence (\$) - Public Property	Weighted Average Consequence (\$) - Service Disruption	Weighted Average Consequence (\$) - Company Property	Weighted Average Consequence (\$) - Environmental	Weighted Average Consequence (\$) - Operational Disruption	Weighted Average Consequence (\$) - Technical Regulator	Weighted Average Consequence (\$) - Reputational Damage	Weighted Average Cost/Benefit (\$) - GHG Emissions	Weighted Average Cost/Benefit (\$) - Commodity Loss	Main - Corrosion / Degradation (\$/yr) - Public H&S	Main - Corrosion / Degradation (\$/yr) - Public Property
\$ 623	\$ 145	\$ 13,866	\$ 139,635	\$ -	\$ 12,632	\$ 39	\$ 38	\$ -	\$ -	\$ 503	\$ 121

AHR											
Corrosion											
Financial	Environmental	Operational	Reputational			Health & Safety			Financial		

Main - Corrosion / Degradation (\$/yr) - Service Disruption	Main - Corrosion / Degradation (\$/yr) - Company Property	Main - Corrosion / Degradation (\$/yr) - Environmental	Main - Corrosion / Degradation (\$/yr) - Operational Disruption	Main - Corrosion / Degradation (\$/yr) - Technical Regulator	Main - Corrosion / Degradation (\$/yr) - Reputational Damage	Main - Corrosion / Degradation (\$/yr) - GHG Emissions	Main - Corrosion / Degradation (\$/yr) - Commodity Loss	Main - Non-Corrosion (\$/yr) - Public H&S	Main - Non-Corrosion (\$/yr) - Public Property	Main - Non-Corrosion (\$/yr) - Service Disruption	Main - Non-Corrosion (\$/yr) - Company Property
\$ 14,111	\$ 141,811	\$ -	\$ 12,856	\$ 32	\$ 31	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Risk Category Per Threat - Major							
				Uplifts			
Non-Corrosion				Fittings & Connections			
Environmental	Operational	Reputational		Health & Safety	Financial	Environmental	Operational

[illegible]

				Third Party Damage							
				Third Party Damage - All tool types							
Reputational		Health & Safety	Financial	Environmental	Operational	Reputational					

Main - Fittings & Connections (\$/yr) - Technical Regulator	Main - Fittings & Connections (\$/yr) - Reputational Damage	Main - Fittings & Connections (\$/yr) - GHG Emissions	Main - Fittings & Connections (\$/yr) - Commodity Loss	Third Party Damage - All Equipment Types (\$/yr) - Public H&S	Third Party Damage - All Equipment Types (\$/yr) - Public Property	Third Party Damage - All Equipment Types (\$/yr) - Service Disruption	Third Party Damage - All Equipment Types (\$/yr) - Company Property	Third Party Damage - All Equipment Types (\$/yr) - Environmental	Third Party Damage - All Equipment Types (\$/yr) - Operational Disruption	Third Party Damage - All Equipment Types (\$/yr) - Technical Regulator	Third Party Damage - All Equipment Types (\$/yr) - Reputational Damage
\$ -	\$ -	\$ -	\$ -	\$ -	\$ 132	\$ 27	\$ 5	\$ 343	\$ -	\$ 4	\$ 8

	Cross Bore						
	Cross Bore						
	Health & Safety	Financial		Environmental	Operational	Reputational	

Third Party Damage - All		Third Party Damage - All																			
Equipment Types (\$/yr) -		Equipment Types (\$/yr) -		Crossbore (\$/yr) - Public		Crossbore (\$/yr) - Public		Crossbore (\$/yr) -		Crossbore (\$/yr) -		Crossbore (\$/yr) -		Crossbore (\$/yr) -		Crossbore (\$/yr) -		Crossbore (\$/yr) - GHG		Crossbore (\$/yr) -	
GHG Emissions		Commodity Loss		H&S		Property		Service Disruption		Company Property		Environmental		Operational Disruption		Technical Regulator		Reputational Damage		Emissions	
\$		8		\$		-		\$		-		\$		-		\$		-		\$	

[illegible]

RISK CATEGORY PER THREAT - SERVICES												
AHR												
Corrosion												
Health & Safety	Financial			Environmental	Operational	Reputational				Health & Safety		
Services - Corrosion / Degradation - Public H&S	Services - Corrosion / Degradation - Public Property	Services - Corrosion / Degradation - Service Disruption	Services - Corrosion / Degradation - Company Property	Services - Corrosion / Degradation - Environmental	Services - Corrosion / Degradation - Operational Disruption	Services - Corrosion / Degradation - Technical Regulator	Services - Corrosion / Degradation - Reputational Damage	Services - Corrosion / Degradation - Emissions	Services - Corrosion / Degradation - GHG Commodity Loss	Services - Fittings & Connections - AMP Fittings (\$/yr) - Public H&S	Services - Fittings & Connections - AMP Fittings (\$/yr) - Public Property	
	0	0	0	0	0	0	0	0	0.945756	0	0	0.072284

UPLIFT							
Fittings & Connections							
Financial		Environmental	Operational	Reputational			
Services - Fittings & Connections - AMP	Services - Fittings & Connections - AMP	Services - Fittings & Connections - AMP	Services - Fittings & Connections - AMP	Services - Fittings & Connections - AMP	Services - Fittings & Connections - AMP	Services - Fittings & Connections - AMP	Services - Fittings & Connections - AMP
Fittings (\$/yr) - Service Disruption	Fittings (\$/yr) - Company Property	Fittings (\$/yr) - Environmental	Fittings (\$/yr) - Operational Disruption	Fittings (\$/yr) - Technical Regulator	Fittings (\$/yr) - Reputational Damage	Fittings (\$/yr) - GHG Emissions	Fittings (\$/yr) - Commodity Loss
0		0	0	0	0	0	0

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, Appendix A (AMP, Investments >\$10M)

Preamble:

These questions relate to the Wilson Avenue, Toronto, VSM Replacement

Question(s):

- a) Please provide a map showing the pipe to be replaced and all the pipes it serves.
- b) Please provide a map showing all customers served by the pipe.
- c) Please provide a map showing other nearby pipes that could serve some or all of the customers in question.
- d) Please provide a satellite image showing the customers served by the pipe.
- e) Please confer with the City of Toronto to determine when the stretch of Wilson Avenue in question is slated to be (i) resurfaced and (ii) reconstructed.
- f) Please estimate the cost savings, if any, of timing the project to coincide with scheduled (i) resurfacing or (ii) reconstruction.
- g) Will portions of lanes of Wilson Avenue ever need to be shut down for the project? If yes, approximately how many lanes at a time (maximum) and for how long?

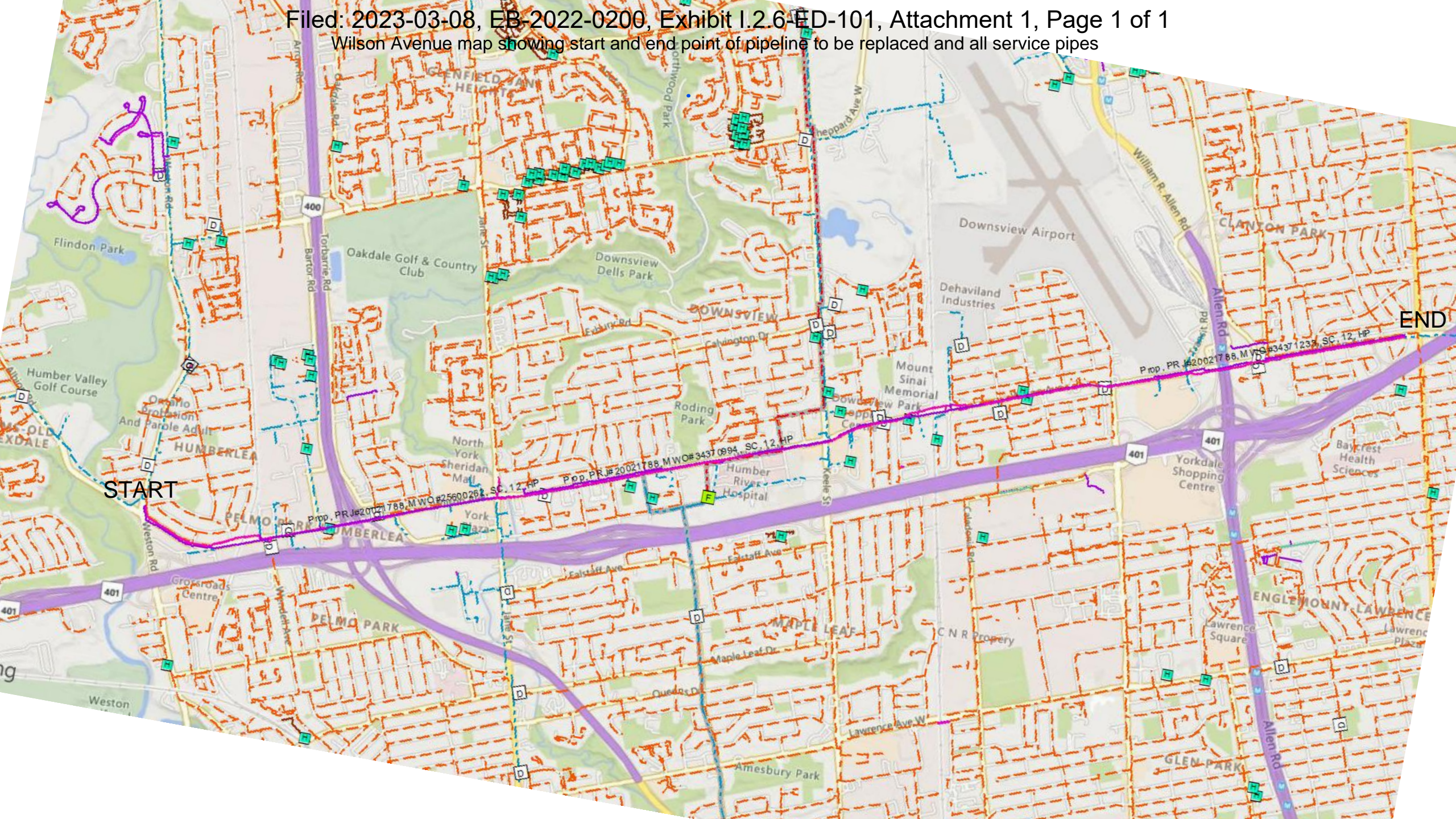
Response:

- a) Please see Attachment 1.
- b,d) Please see Attachment 2.
- c) This pipeline is a feeder to approximately a third of the customers in Downtown Toronto both directly and indirectly through an interconnected pipeline network.

There is no other existing pipeline that may serve these customers as an alternative to the pipeline for Wilson Avenue VSM Replacement.

- e) Resurfacing is to happen in 2025 with a Moratorium to be in place until the end of 2030. A planned bridge construction is also happening at the Jane St. intersection area in 2025.
- f) Enbridge Gas has been working with the City of Toronto through preliminary discussions to confirm the optimal timing for the execution of the Wilson Ave project as it pertains to the municipal planned reconstruction works. Typically, where municipal road work (reconstruction and resurfacing) is a factor for pipeline replacement, Enbridge Gas, as well as other infrastructure owners would adhere to an agreed upon schedule with the City to ensure relocation and replacement work is timed appropriately in the best interest of all parties involved to maximize financial efficiencies including final restoration costs. This has been the approach also for Wilson Ave project. It is estimated that financial efficiencies of up to approximately \$1.0 million could be achieved between the utility and the City of Toronto by coordinating the road resurfacing works immediately following pipeline installation to avoid or minimize project-specific permanent restoration costs.
- g) Yes, portions of lanes along Wilson Avenue will need to be shut down to execute this project, but detailed traffic management plans have not been created at this stage. At a minimum, one lane will always remain open in each direction. Enbridge Gas and its contractors will work with the City of Toronto to reduce overall traffic disruption in the area, which may involve incorporating strategies such as limiting work between the hours of 9:00 am to 4:00 pm to avoid rush hour traffic or extending working days/hours Monday through Saturday between 7:00 am to 11:00 pm to reduce overall construction duration.

Wilson Avenue map showing start and end point of pipeline to be replaced and all service pipes





ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, Appendix A (AMP, Investments >\$10M)

Preamble:

These questions relate to the Wilson Avenue, Toronto, VSM Replacement

Question(s):

- a) When was IRP first considered? Please provide details.
- b) Please provide all documentation detailing the efforts to consider IRP.
- c) Please complete the following table with as much detail as possible:

Load Served – Wilson Avenue, Toronto, VSM Replacement				
	2020	2021	...	End of depreciation period
# of customers				
Residential				
Commercial				
Industrial				
Total				
Annual demand (m3)				
Residential				
Commercial				
Industrial				
Total				
Design day demand (m3/day)				
Residential				
Commercial				
Industrial				
Total				
Design hour demand (m3/hour)				

Residential				
Commercial				
Industrial				
Total				
Capacity – NPS 12 pipe				
Capacity – next size smaller				

Response:

- a-b) The IRP technical assessment of the “Wilson Avenue, Toronto, VSM Replacement” has been prioritized but was not completed at the time of filing the Application. IRP was first considered in December 2022 for Wilson Avenue as part of the technical evaluation. However, due to the OEB Decision for the St. Laurent Project¹, Enbridge Gas is currently in the process of developing the Enhanced Distribution Integrity Management Program to better understand the condition of distribution pipelines within the scope of the program, as provided at Exhibit 1, Tab 13, Schedule 3. Thus, the technical evaluation for this project has been put “on hold” until the results from the integrity assessment and the potential impacts to the project scope are determined.
- c) Due to the complexity of the system the current customers that are forecasted to be served by the existing NPS 12 pipeline on a design day are shown below including an approximate design hour demand. As noted above, the project scope and technical evaluation are “on hold”. The scope and customers served will be re-evaluated in the future.

¹ EB-2020-0293, St. Laurent Ottawa North Replacement Project Decision and Order, May 3, 2022.

Load Served – Wilson Avenue, Toronto, VSM Replacement	
	Current (2023)
<u># of customers</u>	
Residential	49,317
Commercial	4,212
Industrial	347
Total	53,876
<u>Design hour demand (m³/hour)</u>	
Residential	36,705
Commercial	61,669
Industrial	6,632
Total	105,006
Capacity – NPS 12 pipe	Not available due to complexity of analysis. See response at Exhibit I.1.10-ED-65 for additional explanation.
Capacity – next size smaller	Not available due to complexity of analysis. See response at Exhibit I.1.10-ED-65 for additional explanation.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, Appendix A (AMP, Investments >\$10M)

Preamble:

These questions relate to the Wilson Avenue, Toronto, VSM Replacement

Question(s):

- a) When will the cost of this pipe be fully depreciated under the depreciation policies proposed by Enbridge in this application?
- b) When will the proposed pipe be at the end of its estimated useful life.
- c) How much of the project cost will be undepreciated by (i) 2040 and (ii) 2050.
- d) Please provide the NPV of the project, accounting for the forecast revenue from the customers served by the pipe. Please provide the DCF table.
- e) Please provide the NPV of the project, accounting for the forecast revenue from the customers served by the pipe ending in 2050. Please provide the DCF table.
- f) If they are not included, please calculate the NPV from (d) and (e) including all the O&M costs associated with serving the customers in question and provide the DCF table.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

- a) Under the depreciation policies proposed by Enbridge Gas in this Application and assuming the assets are fully intact without any damages and replacements, the cost of this pipe will be fully depreciated in 2061.

/u

b) The estimated useful life of the pipe will be influenced by various market conditions over time. Enbridge Gas expects the pipe to be useful for at least the average service life of the asset which is proposed to be 55 years.

c) Under the depreciation policies proposed by Enbridge Gas in this Application and assuming the assets are fully intact without any damages and replacements, the undepreciated value by 2040 is \$78,608,254 and by 2050 is \$42,182,874.

/u

d-f) Please see response at Exhibit I.2.6-ED-100 part j), response part iii.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, Appendix A (AMP, Investments >\$10M)

Preamble:

These questions relate to St. Laurent Phase 3 and Phase 4

Question(s):

- a) Please confirm whether Enbridge is necessarily proceeding with St. Laurent Phases 3 and 4 in light of the decision in EB-2020-0293.
- b) Please provide a table comparing the state of the pipes at issue in St. Laurent Phases 3 and 4 with those at issue in EB-2020-0293.
- c) Please provide the NPV of the replace and repair options in St. Laurent Phases 3 and 4.
- d) Please recalculate the response to (c) with the economic life of the pipes ending in 2050.

Response:

a-d) Please see response at Exhibit I.2.6-SEC-71.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, Appendix A (AMP, Investments >\$10M)

Preamble:

These questions relate to the Hamilton Industrial Reinforcement (p. 24)

Question(s):

- a) Please provide a breakdown of the total cost, including any abandonment costs and capitalized overhead.
- b) Please provide the NPV calculations and DCF tables underlying the calculation of the contribution in aid of construction.
- c) Please recalculate the NPV, DCF tables, and CIAC on the assumption that the pipeline is only used until (i) 2030, (ii) 2040, and (iii) 2050. Enbridge need not agree that the assumptions are possible outcomes.
- d) Please provide the NPV of the project, accounting for the forecast revenue from the customers served by the pipe ending in 2050. Please provide the DCF table.
- e) What would it cost to build an electrolyser with sufficient on-site storage to serve the load.
- f) When will the cost of this pipe be fully depreciated under the depreciation policies proposed by Enbridge in this application?
- g) When will the proposed pipe be at the end of its estimated useful life.
- h) How much of the project cost will be undepreciated by (i) 2040 and (ii) 2050?
- i) For how long will the customer in question be contractually obligated to buy gas from Enbridge (and thus generate revenue)? Will the customer be obligated to pay a penalty worth the lost revenue if it were to decide to stop using the pipeline?

- j) Please complete the following table comparing the available and required capacity for the pipeline serving the customer in question:

Hamilton Industrial Reinforcement – Capacity Surplus/Deficit Position Over Time				
	2020	2021	...	2032
Pipeline capacity (m3/hour)				
Target customer peak demand (m3/hour)				
Other customer design day demand (m3/hour)				
Surplus (deficit)				

- k) Please complete the following table showing a breakdown of the number of customers by type and demand by type for the relevant pipeline system. If possible, please complete this to the end of the period covered by the DCF tables underlying the CIAC, not only to 2032.

Hamilton Industrial Reinforcement – Demand & Customer Counts				
	2020	2021	...	2032
# of customers				
Residential				
Commercial				
Industrial (excl. power generation)				
Power generation				
Total				
Annual demand (m3)				
Residential				
Commercial				
Industrial (excl. power generation)				
Power generation				
Total				
Design day demand (m3/day)				
Residential				
Commercial				
Industrial (excl. power generation)				
Power generation				
Total				
Design hour demand (m3/hour)				
Residential				
Commercial				
Industrial (excl. power generation)				
Power generation				
Total				

Response:

- a-f, h, j-k) It is anticipated that Enbridge Gas will file a Leave to Construct (LTC) application for the Hamilton Reinforcement project towards the end of 2023 once project details have been finalized. Enbridge Gas is currently working to advance the streams of work required for the application. Therefore, answers to ED's questions regarding project costs and economics, alternatives and demand forecast are not available at this time.
- g) The estimated useful life of the pipe will be influenced by various market conditions over time. Enbridge Gas expects the pipe to be useful for at least the average service life of the asset which is proposed to be 55 years.
- i) As the Hamilton Industrial Project is in the early planning stages, no contracts have been executed at this time. In general, customer(s) underpinning a capital project are obligated to use the natural gas distribution service, as detailed in their Distribution Contract, for the full duration of the contract term, as agreed to by both Enbridge Gas and the customer.

The contract term may vary based on contract demand, estimated volumes and final project cost. The exact length of term is dependent upon the time it takes for a customer's revenue to cover the upfront capital investment and on-going O&M, following a discounted cash flow analysis. If a customer decides to consume less gas, the customer remains obligated to the terms of their contract including payment of demand charges and any other commitments to the end of the contract term.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, Appendix A (AMP, Investments >\$10M)

Preamble:

These questions relate to the East Kingston Creekford Road Reinforcement (p. 25)

Question(s):

- a) Why is this a “must do” investment?
- b) Would this project proceed but for the forecasted growth?
- c) Please provide the complete EBO 188 analysis justifying the economics of this project, including the NPV calculations and DCF tables.
- d) Please recalculate the NPV and DCF tables on the assumption that the pipeline is only used until (i) 2030, (ii) 2035, and (iii) 2040. Enbridge need not agree that the assumptions are possible outcomes.
- e) Please complete the following table showing a breakdown of the number of customers by type and demand by type for the relevant pipeline system. If possible, please complete this to the end of the period covered by the DCF tables underlying the EBO 188 analysis, not only to 2032.

East Kingston, Creekford Road Reinforcement – Demand & Customer Counts				
	2020	2021	...	2032
# of customers				
Residential				
Commercial				
Industrial (excl. power generation)				
Power generation				
Total				
Annual demand (m3)				
Residential				
Commercial				
Industrial (excl. power generation)				

Power generation				
Total				
Design day demand (m3/day)				
Residential				
Commercial				
Industrial (excl. power generation)				
Power generation				
Total				
Design hour demand (m3/hour)				
Residential				
Commercial				
Industrial (excl. power generation)				
Power generation				
Total				

Response:

- a) The East Kingston Reinforcement Project is categorized as a “must do investment” due to its nature as a growth/reinforcement project that satisfies the economic feasibility test (E.B.O 188) and given the Company’s obligation to safely and reliably meet the firm natural gas needs of customers within the communities that it serves. Please see Exhibit 2, Tab 6, Schedule 2, page 46, Table 4.1-2
- b) Growth is the driver for this project and it would not proceed without the increased demand that was observed at the time of filing the Asset Management Plan (AMP). Since filing the AMP, Enbridge Gas reviewed this project for IRP alternatives that could defer or reduce the scope of the project. Enbridge Gas’s IRP assessment was successful as the project has been delayed by implementing two IRP alternatives. First, Enbridge Gas worked with a contract customer in the project area to reduce their firm contracted demand allowing the capacity constraint to be remedied. Second, Enbridge Gas installed a CNG injection point to ensure shortages are not experienced during peak periods.
- c-e) Enbridge Gas has deferred the project and will need to revisit the expected demand and preferred alternative, in the coming years. At that time if the project is expected to move forward, economics will be prepared and filed with the OEB through a LTC application.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, Appendix A (AMP, Investments >\$10M)

Preamble:

These questions relate to the Wheatley-1B - Panhandle Distribution Reinforcement - Wheatley Lateral Replacement and Reinforcement

Question(s):

- a) Why is this a “must do” investment?
- b) Would this project proceed but for the forecasted growth?
- c) Please provide the complete EBO 188 analysis justifying the economics of this project, including the NPV calculations and DCF tables.
- d) Please recalculate the NPV and DCF tables on the assumption that the pipeline is only used until (i) 2030, (ii) 2035, and (iii) 2040. Enbridge need not agree that the assumptions are possible outcomes.
- e) Please provide a list of the CIAC for this project.
- f) In light of Enbridge putting its project on hold in EB-2022-0157, please provide an update on the need and timing of Wheatley-1B.

Response:

- a) Please see Exhibit 2, Tab 6, Schedule 2, page 46 for justification and description of the mandatory investments category.
- b) No, the driver for this reinforcement was due to forecasted greenhouse growth in the area.

c-e) Due to changes in demand that materialized after filing the current Application, the project is no longer required as originally proposed in the AMP. As a result, at this time there are no formal plans to proceed with this investment/project.

Should Enbridge Gas determine in the future that sufficient demand exists to support either this or any other project, the Company will update the AMP accordingly and seek leave to construct from the OEB as applicable.

f) Wheatley-1B was not directly part of Panhandle Regional Expansion Project¹, and was determined to not proceed at this time due to change in demand.

¹ EB-2022-0157.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, Appendix A (AMP, Investments >\$10M)

Preamble:

These questions relate to the Dawn Parkway Expansion Project (Kirkwall-Hamilton NPS 48) at page 55.

Question(s):

- a) Please provide a breakdown of the total cost, including any abandonment costs and capitalized overhead.
- b) Why is this listed as a “must do” investment?
- c) Please provide the EBO 134 analysis justifying the project, including the NPV calculations and DCF tables for stages 1, 2, and 3.
- d) Please recalculate the NPV figures and DCF tables on the assumption that the incremental pipeline capacity is only needed until (i) 2035, (ii) 2040, and (iii) 2050. Enbridge need not agree that the assumptions are possible outcomes.
- e) When will the cost of this pipe be fully depreciated under the depreciation policies proposed by Enbridge in this application?
- f) When will the proposed pipe be at the end of its estimated useful life.
- g) How much of the project cost will be undepreciated by (i) 2040 and (ii) 2050?
- h) Please complete the following table comparing the available and required capacity for the pipeline in question, not including the proposed reinforcement.

Kirkwall Hamilton – Forecast Capacity Surplus/Deficit Position Over Time				
	2020	2021	...	End of EBO 134 DCF analysis period
<u>Design day</u>				
Pipeline capacity (m3/day)				
Design day demand (m3/day)				
Surplus (deficit)				
<u>Design day - hourly</u>				
Pipeline capacity (m3/hour)				
Design day demand - hourly (m3/hour)				
Surplus (deficit)				

- i) Please complete the following table showing a breakdown of the number of customers by type and demand by type served by the relevant pipelines.

Kirkwall-Hamilton – Forecast Demand & Customer Counts				
	2020	2021	...	End of EBO 134 DCF analysis period
<u># of customers</u>				
Residential				
Commercial				
Industrial (excl. power generation)				
Power generation				
Total				
<u>Annual demand (m3)</u>				
Residential				
Commercial				
Industrial (excl. power generation)				
Power generation				
Total				
<u>Design day demand (m3/day)</u>				
Residential				
Commercial				
Industrial (excl. power generation)				
Power generation				
Total				
<u>Design hour demand (m3/hour)</u>				
Residential				
Commercial				
Industrial (excl. power generation)				
Power generation				
Total				

- j) Provide the customer attachments underlying the EBO 134 stage 2 analysis and the purported savings per customer type. Please describe the source of the purported

savings (e.g. use of gas versus other fuels or saved cost versus other gas transmission pathways, such as the mainline).

Kirkwall-Hamilton – Stage 2 Customer Attachments and Savings				
	Year 1	...	Year n	Total
<u>Number of Customer Attachments</u>				
Residential				
Commercial				
Industrial (excl. power generation)				
Power generation				
Total				
<u>Stage 2 Savings by Sector</u>				
Residential				
Commercial				
Industrial (excl. power generation)				
Power generation				
Total				

Response:

- a) Please see Table 1 with breakdown of total cost at time of filing. Please note that cost information is subject to change.

Table 1

	Total
CONTRACTOR	\$ 94,353,945
MATERIALS	\$ 11,276,268
OUTSIDE SERVICES	\$ 14,500,829
MISC	\$ 49,778,578
SALARIES & EXPENSES	\$ 1,376,304
CONTINGENCY	\$ 21,957,408
OVERHEAD	\$ 58,602,032
GRAND TOTAL	\$ 251,845,364

- b, j) Please see Schedule 2, Tab 6, Schedule 2, Page 16, Section 1.4 and Page 46, Table 4.1-2 for a justification and description of the mandatory investments category.

Projects that meet the economic feasibility tests in E.B.O 188 and E.B.O 134 must be addressed within their required time frame. The need for this project will have to be established through an open season process to secure the demand before the test is applied.

- c) Enbridge Gas will assess market demand and evaluate IRPA's prior to filing a LTC application for the Dawn Parkway Expansion Project (Kirkwall-Hamilton NPS 48) project. Enbridge Gas is currently working to begin assessing market demand, therefore answers to the questions asked are not available at this time. If there are still outstanding questions should Enbridge Gas reach a point of filing an LTC application, interrogatories can be submitted through that application, at which time Enbridge Gas should be in a position to provide the details requested.
- d) Please see response to part c).
- e) Under the depreciation policies proposed by Enbridge Gas in this Application and assuming the assets are fully intact without any damages and replacements, the cost of this pipe will be fully depreciated in 2083.
- f) The estimated useful life of the pipe will be influenced by various market conditions over time. Enbridge Gas expects the pipe to be useful for at least the average service life of the asset which is proposed to be 60 years.
- g) Under the depreciation policies proposed by Enbridge Gas in this Application and assuming the assets are fully intact without any damages and replacements, the undepreciated value by 2040 is \$193,968,540 and by 2050 is \$149,447,905.
- h) Please see Table 1 provided at Exhibit 2, Tab 7, Schedule 1. The Kirkwall Hamilton section is an integral part of the Dawn Parkway Transmission System and the information provided in this response is for the entire system. Enbridge Gas has a 10-year forecast available. The Dawn Parkway Transmission System is designed for daily demand and thus design hourly demand is not applicable.

Dawn Parkway Transmission System – Forecast Capacity Surplus/Deficit Position Over Time						
m3/day	<u>Design day</u>			<u>Design day - hourly</u>		
	Pipeline capacity	Design day demand	Surplus (deficit)	Pipeline capacity	Design day demand - hourly	Surplus (deficit)
2020	202115702	202796702	-681000	Design hour is not applicable to this system.		
2021	201507775	201402196	105579			
2022	202600690	204422707	-1822016			
2023	204702823	203169435	1533388			

Dawn Parkway Transmission System – Forecast Capacity Surplus/Deficit Position Over Time				
m3/day	<u>Design day</u>			<u>Design day - hourly</u>
2024	204207785	201941556	2266229	
2025	201450505	198731024	2719481	
2026	204112269	204494701	-382432	
2027	204098349	205018997	-920649	
2028	204062504	205606359	-1543856	
2029	203949605	206286659	-2337054	
2030	203930983	206976227	-3045246	
2031	203911823	207651084	-3739261	
2032	203917919	208337050	-4419131	

- i) Further to the response in part h) Enbridge Gas does not forecast customers or annual demands specific to the Dawn Parkway System. As such, customer numbers, annual demand and average demand cannot be provided.

The Dawn Parkway System serves both in-franchise and ex-franchise customers and contractual volume to delivery areas based on the Gas Supply Plan. Enbridge Gas cannot disaggregate design day demand information into the categories requested.

Design hour is not applicable to the Dawn Parkway System.

Growth forecasts for the Dawn Parkway System are subject to bids in an open season capacity process before they become realized and certainly before any facilities are constructed.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, Appendix A (AMP, Investments >\$10M)

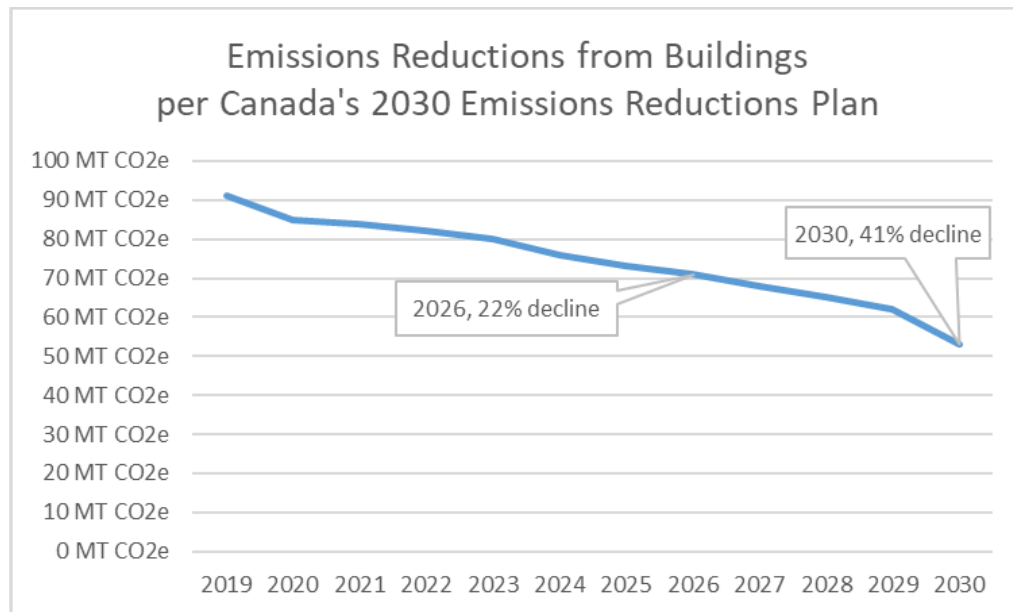
Preamble:

These questions relate to the Dawn Parkway Expansion Project (Kirkwall-Hamilton NPS 48) at page 55.

Question(s):

- a) What is the approximate probability that the incremental pipeline capacity is only needed until (i) 2035, (ii) 2040, and (iii) 2050?
- b) Canada's 2030 Emissions Reduction Plan includes targets for carbon emissions from buildings to decline by 22% by 2026 and by 41% by 2030 (illustrated below).¹ This is based on a reduction from 91 CO₂e in 2019 to 71 CO₂e in 2026 and 53 CO₂e in 2030. How might this impact the demand for the incremental capacity from this project before the end of its economic lifetime? Please provide a quantitative answer on a best-efforts basis, stating any necessary caveats and assumptions, and providing a range of possible impacts if appropriate.

¹ Exhibit I.ED.3(a), (f), & (g); see also: *2030 Emissions Reduction Plan – Canada's Next Steps for Clean Air and a Strong Economy* ([link](https://publications.gc.ca/collections/collection_2022/eccc/En4-460-2022-eng.pdf)); for the full plan see https://publications.gc.ca/collections/collection_2022/eccc/En4-460-2022-eng.pdf.



- c) Canada has committed to net-zero emissions from electricity generation by 2035, and re-affirmed its commitment in its 2030 Emissions Reduction Plan.² How might this impact the demand for the incremental capacity from this project before the end of its economic lifetime? Please provide a quantitative answer on a best-efforts basis, stating any necessary caveats and assumptions, and providing a range of possible impacts if appropriate.

Response:

- a) Enbridge Gas is unable to approximate the probability that the incremental pipeline capacity is only needed until (i) 2035, (ii) 2040, and (iii) 2050. Please see response at Exhibit I.2.6-STAFF-70 part b) for further discussion on this topic.
- b) Enbridge Gas is unable to forecast the impact of Canada's 2030 Emissions Reduction Plan on the demand for incremental capacity from this project before the end of its economic lifetime. Please see response at Exhibit I.2.6-STAFF-70 part b) for further discussion on this topic.
- c) Please see response at Exhibit I.1.10-STAFF-30 part d).

² Exhibit I.ED.3(a), (f), & (g); see also: *2030 Emissions Reduction Plan – Canada's Next Steps for Clean Air and a Strong Economy* ([link](#)); for the full plan see https://publications.gc.ca/collections/collection_2022/eccc/En4-460-2022-eng.pdf.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2

Question(s):

- a) Please provide a table listing the total AMP investments driven by forecast growth in design day or design hour demand for each year from 2023 to 2032. Please also include a breakdown between transmission and distribution projects.
- b) What is the probability that a material portion of those investments will be underutilized before the end of their economic life in that the revenue or other benefits underlying the EBO 134 or EBO 188 analysis falls short of the forecasted amount?
- c) What is the probability that a significant portion of those investments will be stranded before the end of their economic life in that the incremental capacity is no longer needed because demand declined before that time.
- d) Please confirm the net benefits and revenue horizon user in EBO 134 and EBO 188.
- e) Please comment on the pros and cons of decreasing the net benefits and revenue horizon underlying the economic analysis set out in EBO 134 and EBO 188 to account for the possibility that the relevant capacity may not required for the full time period.
- f) Is this proceeding the appropriate proceeding to consider adjustments to EBO 134 or EBO 188 such as the one described in (e)? Is it within the OEB's jurisdiction to do so? If Enbridge believes this is not the appropriate proceeding to consider these issues, what proceeding should they be considered in?

Response:

The following response has been updated to reflect the Capital Update provided at /u Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

- a) Please see updated Attachment 1. /u
- b) Enbridge Gas is unable to approximate the probability that any proportion of these investments will be underutilized before the end of their economic life. Please see response at Exhibit I.2.6-STAFF-70 part b) for further discussion on this topic.
- c) Enbridge Gas is unable to approximate the probability that any proportion of these investments will be stranded before the end of their economic life. Please see response at Exhibit I.2.6-STAFF-70 part b) for further discussion on this topic.
- d) The customer revenue horizon used in E.B.O 188 evaluations is 40 years except for large volume customers where the maximum is 20 years. E.B.O 134 evaluations are performed over a 40-year horizon.
- e) Please see response to part f).
- f) Enbridge Gas does not believe it is appropriate to consider adjustments to E.B.O 134 or E.B.O 188 within this Application.

/u

Investment Code	Investment Name	Asset Class (EGI)	ISD Results - Final
1024	NW 6581 Ottawa Reinforcement Phase 2 SRP	Growth	2029
1942	NW 6581 Greely Reinforcement SRP	Growth	2023
7727	Welland IP NW8925 Reinforcement	Growth	2027
7743	NW 6587 L'Original Reinforcement SRP	Growth	2025
16748	Erin IP System Reinforcement	Growth	2028
17243	NW 2225 Terra Cotta IP Reinforcement SRP	Growth	2028
23189	Almonte Reinforcement - Phase 2	Growth	2028
30500	NW 2103 Dundalk XHP Reinforcement SRP	Growth	2024
30501	NW 2103 Erin XHP Reinforcement SRP	Growth	2031
30502	NW 2201 Proton Station IP Reinforcement SRP	Growth	2023
30503	NW 5346 Midhurst Reinforcement SRP	Growth	2024
30504	NW 5446 Hwy 26 and Keith Reinforcement SRP	Growth	2024
30505	NW 5422 Robins Point Rd. Reinforcement SRP	Growth	2025
30508	SRP_LUG East_Barriefield_28403028STN_Rebuild	Growth	2028
30509	SRP_LUG East_Barriefield_28403029STN_Rebuild	Growth	2025
30510	SRP_LUG East_Settlers Ridge DRS 27802132 Rebuild	Growth	2032
30512	SRP_LUG East_Colborne_27401005STN_Rebuild	Growth	2026
30513	SRP_LUG East_Main St North & CPR Tracks PRS 29401011_Rebuild (Chesterville DRS)	Growth	2024
30514	SRP_LUG East_Cty Rd 9 (Union Street) PRS 29401037_Rebuild (Berwick)	Growth	2024
30515	SRP_LUG East_Deseronto_28103002STN_Rebuild	Growth	2023
30517	SRP_LUG East_Grafton_27405001STN_Rebuild	Growth	2027
30518	SRP_LUG East_Picton TBS 28103006STN_Rebuild	Growth	2025
30519	SRP_LUG East_Tweed_27805090STN_Rebuild	Growth	2026
30520	SRP_LUG East_Winchester_29301001STN_Rebuild	Growth	2030
30521	SRP_LUG East_Center & Queen St PRS_29301008STN_Rebuild (Winchester)	Growth	2024
30522	SRP_LUG East_Winchester_Main St_Reinforcement_NPS4_550m_1724kPa	Growth	2028
30523	SRP_North_Parry Sound_Seguín Trail_Reinforcement_NPS6_8500m_4960kPa	Growth	2027
30524	SRP_North_Sault Ste Marie_45103001STN_Rebuild	Growth	2025
30525	SRP_North_Timmins_Hwy 655_Reinforcement_NPS6_850m_6895kPa	Growth	2024
30527	SRP_Southeast_Baden_18S-501STN_Rebuild	Growth	2029
30528	SRP_Southeast_Baden_Peel St_Reinforcement_NPS6_400m_420kPa	Growth	2028
30529	SRP_Southeast_Brantford_Maple Grove Rd_Reinforcement_NPS6_830m_420kPa	Growth	2027
30530	SRP_Southeast_Breslau_19T-601RSTN_Rebuild	Growth	2028
30532	SRP_Southeast_Breslau_Sawmill Rd_Reinforcement_NPS4_500m_3450kPa	Growth	2027
30533	SRP_Southeast_Breslau_Sawmill Rd_Reinforcement_NPS4_900m_3450kPa	Growth	2032
30536	SRP_Southeast_Cambridge_Guelph Ave_Reinforcement_NPS6_1000m_420kPa	Growth	2026
30538	SRP_Southeast_Jarvis_12W-102STN_Rebuild	Growth	2026
30539	HAMI: 12W-201 Hagersville Sandusk Station, Jarvis, Station Rebuild, Growth	Growth	2025
30540	SRP_Southeast_Kitchener_Bleams_Reinforcement_NPS12_10m_6160kPa	Growth	2024
30541	WATE - SRP_Southeast_Listowel_21Q-103RSTN_Rebuild	Growth	2024
30542	SRP_Southeast_Owen Sound_County Rd 40_Reinforcement_NPS12_11800m_4670kPa	Growth	2025
30543	BRAN- St. Johns Rd E, Nanticoke, Port Dover East System Reinforcement	Growth	2023
30544	SRP_Southeast_Port Dover_HWY 6_Reinforcement_NPS4/NPS6_3000m_1900kPa	Growth	2029
30545	WATE: 29N-101 Port Elgin Station, Heater Replacement Only, Obsolete CWT Heater and growth	Growth	2023
30547	SRP_Southeast_Southampton_30N-501STN_Rebuild	Growth	2030

30548 SRP_Southeast_Southampton_South St_Reinforcement_NPS6_600m_550kPa	Growth	2028
30549 SRP_Southwest_Amherstburg_County Rd 20_Reinforcement_NPS4_1500m_420kPa	Growth	2032
30550 SRP_Southwest_Blenheim_Industrial Ave_Reinforcement_NPS6_600m_420kPa	Growth	2032
30551 SRP_Southwest_Embro_15Q-301STN_Rebuild	Growth	2023
30552 SRP_Southwest_Essex_05B-401RSTN_Rebuild(smith industrial park)	Growth	2024
30553 SRP_Southwest_Forest_Townsend Line_Reinforcement_NPS6_4500m_3450kPa	Growth	2031
30554 SRP_Southwest_Innerkip_16S-503STN_Rebuild	Growth	2029
30555 SRP_Southwest_Kettle Point_Ravenswood Line_Reinforcement_NPS4_2000m_3450kPa	Growth	2027
30556 SRP_Southwest_London_13O-402STN_Westmount Station Rebuild	Growth	2024
30557 SRP_Southwest_London_Bradley Ave_Reinforcement_NPS6_500m_420kPa	Growth	2031
30558 SRP_Southwest_London_Byron Baseline_Reinforcement_NPS8_700m_420kPa	Growth	2023
30559 SRP_Southwest_Mt. Brydges_12M-303RSTN_Rebuild	Growth	2025
30561 SRP_Southwest_Amherstburg_New STN & Reinforcement_NPS4_2200m_3450kPa	Growth	2032
30562 SRP_Southwest_Blenheim_New STN & Reinforcement_NPS4_700m_1900kPa	Growth	2023
30563 SRP_Southwest_Bluewater_New STN & Reinforcement_NPS4_7200m_3450kPa	Growth	2025
30564 SRP_Southwest_Oil Springs LP_Reinforcement	Growth	2025
30565 SRP_Southwest_Port Stanley_George Street_Reinforcement_NPS4_300m_420kPa	Growth	2028
30566 SRP_Southwest_Woodstock_Reinforcement & Reinforcement_NPS6_8200m_1900kPa	Growth	2028
30569 SRP_Southwest_St. Marys_Church Street_Reinforcement_NPS6_100m_420kPa	Growth	2032
30570 SRP_Southwest_St. Marys_Glass Street_Reinforcement_NPS4_650m_420kPa	Growth	2030
30571 SRP_Southwest_Stratford_18Q-501RSTN_Rebuild	Growth	2030
30572 SRP_Southwest_Talbotville_11O-173STN_Rebuild	Growth	2023
30573 SRP_Southwest_Talbotville_Talbotville Gore Rd_Reinforcement_NPS4_500m_420kPa	Growth	2030
30575 SRP_Southwest_Thamesford_Thorndale Road_Reinforcement_NPS4_570m_420kPa	Growth	2031
30576 SRP_Southwest_Windsor_05B-205RSTN_Rebuild	Growth	2026
30577 SRP_Southwest_Windsor_County Rd 42_Reinforcement_NPS6_3800m_420kPa	Growth	2032
30578 SRP_Southwest_Windsor_Howard_Reinforcement_NPS6_1800m_420kPa	Growth	2026
30579 SRP_Southwest_Wonderland_New STN & MOP Upgrade	Growth	2025
30580 SRP_Southwest_Woodstock_Oxford Road 17_Reinforcement_NPS6_1100m_420kPa	Growth	2023
48497 King - 22-20-709 McConnell Ave & Tollgate Rd PRS	Growth	2025
48654 Dawn Parkway Expansion Project (Kirkwall-Hamilton NPS 48)	Transmission Pipe & Underground Storage	2027
48757 HAMI: Dunnville Line Reinforcement	Growth	2023
49083 SRP_Southeast_Guelph_19V-401STN_Painting and Insulation	Growth	2023
49097 KING: Upgrade Dundas & CR2 PRS (28801009)	Growth	2024
49104 WATE: Starlight Dist Stn, Meaford, Growth	Growth	2025
49105 WATE: Baden Dist Stn, Baden, Growth	Growth	2025
49145 KING: Upgrade West St DRS (27601014)	Growth	2024
49164 NBAY: Upgrade Maplewood PRS (43801127)	Growth	2023
49179 BRAN- Lakeshore Rd System Reinforcement, Port Rowan	Growth	2024
49333 NBay: Old Barrie Rd & University Ave Station (Orillia)	Growth	2023
49758 Panhandle Regional Expansion Project	Transmission Pipe & Underground Storage	2024
49768 KING: Main St, Wellington Reinforcement	Growth	2029
49769 KING: Loyalist Pkwy Reinforcement, Wellington	Growth	2029
49794 WATE: Listowel System Reinforcement, Proj# 07-21-705	Growth	2024
49805 SRP_Southwest_Hensall Trans_14N-302STN_Rebuild	Growth	2024
100699 Dawn Parkway Expansion Project (Dawn-Enniskillen NPS 48)	Transmission Pipe & Underground Storage	2029
100703 SRP_LUG East_Kingston_Creekford Rd_Reinforcement_NPS8_6200m_6895kPa	Growth	2027

100778 King - Chesterville, Crysler, Finch Reinforcement	Growth	2026
100831 WATE: 21U-101 Fergus Second Stage, Fergus, Station Rebuild (Load Growth), Proj#	Growth	2025
100936 TIMM: West Timmins System Reinforcement (McBride North and Shirley/Riverside Stations)	Growth	2025
101233 WATE: 22S-401 Drayton Distribution Station, Drayton, Paint Insulation and Telemetry, Proj# 07-22-703	Growth	2024
101565 NBAY: Upgrade Callander TBS (43005001)	Growth	2023
102119 Brockville Gate Extension	Growth	2025
500705 NW 5301 Barrie - Collingwood Pressure Increase SRP	Growth	2024
501677 WATE - Speedvale Ave W Elmira Rd Northwest Guelph System Reinforcement	Growth	2025
501824 Huntmar Drive Reinforcement	Growth	2026
502443 KING: 22-21-713 Greenfield Global Ethanol (18700008) Rebuild	Growth	2023
502816 45-25-500 TIMM - St Jean @ Shirley NPS4 Reinforcement - Timmins	Growth	2025
502817 TIMM 45-22-502 Shirley St @ Riverside Rd 2 PE Reinforcement - Timmins	Growth	2027
503058 SRP_GTA West_Oakville_18Y-109RSTN_Rebuild_Khalsa Gate	Growth	2024
503140 SRP_LUG East_Tweed_River St_Reinforcement_NPS4_300m_420kPa 22-22-505	Growth	2023
503148 King: 22-23-480 Princess @ Augusta - Road X-ing Upgrade	Growth	2024
503234 TBAY :33-25-503 Riverdale Rd to Hwy 61 via 20th	Growth	2026
503342 SUDB: Station 43203020 New Sudbury Mall Reinforcement	Growth	2023
733977 King: 22-23-513 Kingsley Street Reinforcement (FBP - Brighton))	Growth	2029
734081 King: 22-25-503 Second Street East - Tie NPS4 1210kPa Main Together	Growth	2025
734531 THUN: Rosslyn Rd at Sideroad 20 Reinforcement Project	Growth	2026
734672 SRP_Southwest_Kerwood_12K-301STN_Rebuild	Growth	2024
734705 King: Madoc Lateral MOP Upgrade (Belleville North)	Growth	2029
734744 King: Brighton Reinforcement	Growth	2028
734929 HAMI: Hamilton Airport Regional Expansion Project - Natural Gas Expansion Program (NGEP)	Growth	2023
734979 Grimsby-Lincoln Expansion Project - Natural Gas Expansion Program (NGEP)	Growth	2025
735034 SRP_GTA West_Lowville_18X-101STN_Rebuild	Growth	2024
735962 HAMI: Dickenson Rd Airport Expansion Project, Mount Hope, Growth	Growth	2023
735963 HAMI: Nebo Rd Airport Expansion Project, Hannon, Growth	Growth	2023
735972 PREP: NPS 36 looping to Comber Transmission	Transmission Pipe & Underground Storage	2030
736070 WIND: LEAM-3 Panhandle Distribution Reinforcement - Essex Road 37 Reinforcement	Growth	2026
736071 WIND: LEAM-4 Panhandle Distribution Reinforcement - Mersea Road 12 Reinforcement	Growth	2031
736074 WIND: Staples 1A Panhandle Distribution Reinforcement - Ontario Hwy 77 and Mersea Rd 7 Reinforcement	Growth	2025
736150 WATE_Markdale Hospital Toronto St S Markdale System Reinforcement	Growth	2023
736259 Hamilton Reinforcement Project	Growth	2025
736268 BRAN- Hartley Ave, Paris, Reinforcement	Growth	2023
736389 A30: Interchange Way Reinf	Growth	2024
736524 NW 4793 Carnwith Dr. Brooklin Reinforcement SRP	Growth	2024
736532 NW 3723 Jane St. Reinforcement SRP	Growth	2025
736582 NW 6421 Richmond Reinforcement SRP	Growth	2023
736583 NW 6511 Beaverbrook Reinforcement SRP	Growth	2023
736617 SRP_LUG East_Strathcona_28102005STN_Rebuild	Growth	2023
736619 King: 22-22-720 Rosedale Estates PRS Rebuild SRP_LUG East_Sydenham_28408042STN_Rebuild	Growth	2023
736664 NW 3750 & 3832 Concession Rd 2 Reinforcement SRP	Growth	2027
736665 Station Rebuild 42183A Brock and 3rd Conc SRP	Growth	2023
736667 NW 4521 Avondale Drive Reinforcement SRP	Growth	2028
736669 New Station Bayly and Mackenzie Ave SRP	Growth	2023
736677 King: 22-22-714 Purdy Mills PRS Rebuild 28403230	Growth	2023

736679 NW 6544 Sherwood Drive Crossing SRP	Growth	2024
736680 NW 6429 Rockland IP Reinforcement SRP	Growth	2024
736685 A80: NW 8521_8520 Brawn Rd - Wainfleet - Reinforcement SRP	Growth	2024
736688 A80: NW 8521 Feeder Rd E Station Reinforcement SRP	Growth	2023
736690 Station Rebuild 14164A Lakeshore & Stadium SRP	Growth	2023
736758 NW 6466 Carp Pressure Increase SRP	Growth	2024
736759 NW 6462 Russell Pressure Increase and Reinforcement SRP	Growth	2030
736762 NW 6463 Embrun Reinforcement SRP	Growth	2023
736858 King: 22-22-715 Elgin and Ontario DRS Upgrade - SRP	Growth	2023
736923 Panhandle Regional Expansion Project - Leamington Interconnect	Transmission Pipe & Underground Storage	2026
737885 22-22-502 Kingston Reinforcement CNG Backfeed	Growth	2023
738258 LOND - Strathroy Industrial Park Reinforcement - Strathroy	Growth	2026
738328 57-22-311 NextStar Energy (Stellantis) EV Battery Manufacturing Plant	Growth	2023
738492 WATE- Kennedy Road, Breslau, Reinforcement	Growth	2023
738842 22-22-719 KING: Colborne TBS Line heater (27401001) replacement	Growth	2023
738860 NW3834 Glenbourne Park Dr Reinforcement	Growth	2023
738887 MONO REINFORCEMENT	Growth	2023
738981 WATE- Pinebush Road System Reinforcement- Cambridge	Growth	2025
738983 WATE_7321 Line 86 Woolwich Twp Reinforcement	Growth	2023
739075 Canada Wonderland Reinforcement	Growth	2023
739185 HAMI: Caledonia North Reinforcement, Haldimand	Growth	2024
739257 HAMI: New Hannon Airport Expansion Project, Hannon, Growth	Growth	2023
739262 HAMI: Ancaster Gate Modifications	Growth	2023
739267 HAMI: Caledonia Transmission Station Rebuild (15X-401)	Growth	2024
739351 LOND - Beards Lane Re-inforcement - Woodstock	Growth	2024
739483 BRAN- Shellard Lane, Brantford, Reinforcement	Growth	2023
739488 Finch Kennedy Birchmount Reinforcement	Growth	2023
739611 GreenFirst Forest Products Hearst New Kiln	Growth	2023
739652 WATE_375 Sligo Rd Mount Forest Reinforcement	Growth	2023
739844 HAMI: 15X-106R Upper James & White Church Station, Mount Hope, Reinforcement	Growth	2024
739857 28106010 York ST and Pitt St PRS Rebuild- Picton	Growth	2023
740055 Panhandle Regional Expansion Project - Dawn Facilities	Transmission Pipe & Underground Storage	2025
740081 BRAN- 8th Concession Road, Burford, Reinforcement	Growth	2024
740082 BRAN- Old Highway 24, Waterford, System Reinforcement	Growth	2024
740443 WATE - SRP Southampton System Reinforcement	Growth	2024
740444 WATE - SRP New Hamburg Peel St Hwy 7 System Reinforcement	Growth	2024
740445 WATE - SRP Wellesley Twp Herrgott Rd System Reinforcement	Growth	2024

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, Appendix B (IRP)

Question(s):

- a) Please provide a live excel copy of the IRP spreadsheet in Appendix B. It is very difficult to review without being able to use the sort function that would be available in excel. Whenever future AMPs are shared, we would very much appreciate receiving excel versions of this appendix.
- b) How does Enbridge propose to prioritize which projects are technically evaluated for IRP sooner rather than later? For instance, would Enbridge start with growth projects, with the ones with the closest in-service date being analyzed first?
- c) Per page 71, please provide all IRP analysis completed to date on the Kirkwall-Hamilton project. The IRPA's to be considered are listed as follows: "Market side supply options to be assed prior to LTC application." Why are demand-side options not also being assessed?
- d) Per page 70, the Hamilton Industrial Reinforcement IRP technical assessment is listed as "planned." Why has this not been prioritized and undertaken already in light of the relatively short timeframe until the in-service date? When will this technical assessment start and finish?
- e) Per page 109, the "Wilson Avenue, Toronto, VSM Replacement" IRP technical assessment is listed as "planned." Why has this not been prioritized and undertaken already in light of the relatively short timeframe until the in-service date? When will this technical assessment start and finish?

Response:

- a) Please see response at Exhibit I.2.6-STAFF-82.
- b) Enbridge Gas is prioritizing projects for technical evaluation based on the in-service dates of 2028 and prior, growth related projects and project costs.

- c) The IRP technical assessment is in progress for the “Dawn to Parkway Expansion Project (Kirkwall-Hamilton NPS 48)”. Enbridge Gas will be considering demand-side and market-side supply options as part of the IRP assessment.
- d) The IRP technical assessment of the “Hamilton Industrial Reinforcement” has been prioritized and IRPAs are currently being evaluated. The IRP assessment details will be filed as part of the project application.
- e) Please see response at Exhibit I.2.6-ED-102.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 1, Pages 44 and 45, Table 5 *2024 Investments Subject to LTC*

Question(s):

- a) Please confirm that EGI will not be applying for ICM funding for any of the projects listed in Table 5. Please explain your answer.
- b) What is the total amount of 2024 indirect overhead allocations of all of the projects listed in Table 5?
- c) If any of the projects listed in Table 5, does not proceed in 2024 will its indirect overhead allocation be expensed, or will it be allocated to other projects? Please explain your answer.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023. /u

- a) Please see response at Exhibit I.2.6-STAFF-71.
- b) The total amount of 2024 indirect overhead allocations for the projects provided at Table 5 in Exhibit 2, Tab 6, Schedule 1, updated July 6, 2023, is \$70,646,583. /u
- c) Indirect overheads are allocated to projects based on the percentage of total indirect overheads over total direct capital in the year of expense. If a project does not proceed, the indirect overheads will be allocated to other projects in the portfolio for that year. Also, see response at Exhibit I.2.6-EP-20.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 1, Pages 46 to 48, Table 6 *2024 Investments Not Subject to LTC*

Question(s):

Every project listed in Table 6 is estimated to cost more than \$2 million, which is one of the conditions for LTC approval requirement. For each project in the table please provide the reason why EGI believes that LTC approval will not be required.

- a) Please confirm that EGI will not be applying for ICM funding for any of the projects listed in Table 6. Please explain your answer.
- b) What is the total amount of 2024 indirect overhead allocations of all of the projects listed in table 6?
- c) If any of the projects listed in Table 6, does not proceed in 2024 will its indirect overhead allocation be expensed, or will it be allocated to other projects? Please explain your answer.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023. /u

Please see response at Exhibit I.2.6-ED-91 part c) for LTC exemption rationale.

- a) Please see response at Exhibit I.2.6-STAFF-71.
- b) The total amount of 2024 indirect overhead allocations for the projects listed in Table 6 in Exhibit 2, Tab 6, Schedule 1, updated July 6, 2023, is \$45,777,785. /u
- c) Please see response at Exhibit I.2.6-EP-31 part a).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, *EGI Asset Management Plan*, page 17

Preamble:

Through the process of moving the optimization constraint line downwards from \$1.4B to \$1.1B, EGI examined:

- Implications to asset class strategies
- Implications to in-service capital (as a proxy for impact to ratepayers)
- Implications for the management of identified risk,
- Ability to complete mandatory work,
- Ability to complete work that supports the energy transition,
- Ability to complete work that is in keeping with customers' stated preferences,
- Organizational capacity to complete work"

Question(s):

- a) Is the constraint "*Implications to in-service capital (as a proxy for impact to ratepayers)*" the only constraint that considered rate impact?
- b) How was this constraint applied? Were some projects rejected or redesigned to keep the impact to ratepayers below a threshold? Please discuss.
- c) Were cumulative impacts on ratepayers of ICM projects considered? Please discuss.

Response:

- a) The overall premise of the 2023 to 2032 AMP development exercise was to consider and mitigate rate impacts by optimizing and constraining the capital expenditure requirement as much as reasonable while accounting for and balancing a range of relevant factors. One specific factor was the consideration of the in-service capital associated with the overall capital constraint. Moreover, ratepayer impacts are also considered through the review of specific projects, where O&M expenditure avoidance impacts are one factor considered indirectly through the Copperleaf Value

Framework (as provided at Exhibit 2, Tab 6, Schedule 2, page 47) and through optimization and review of the investment portfolio. However, a constraint was not applied to the resultant projected O&M expenditures associated with the investment portfolio.

- b) To determine and apply the constraint, Enbridge Gas assessed scenarios between the 2022 Rates Application in-service capital, the 2023 Materiality Threshold of ~\$1.4 billion and the historical average spend of ~\$1.17 billion. When lowering the constraint level, Enbridge Gas focused on maintaining a 10-year portfolio that allowed for safe and reliable operations through meeting asset needs while balancing the impact to ratepayers.

For each of the constraint scenarios below, Enbridge Gas worked iteratively with internal stakeholders to evaluate impacts to asset class strategies, risk work, mandatory/compliance work, energy transition work, customer driven work, resourcing and ratepayers.

- i. \$1.1 billion + 2% escalation for inflation – This is approximately representative of the average spend between 2019 and 2021, not including projects eligible for ICM or CPT treatment. This constraint caused the optimization to fail as it could not accommodate all investments with fixed timing (which includes compliance work, relocations and reinforcements)
- ii. \$1.5 billion + 2% escalation for inflation - Allowed for safe and reliable outcomes through execution of asset class strategies and accommodated value-driven work
- iii. \$1.4 billion + 2% escalation for inflation - Allowed for safe and reliable outcomes through execution of asset class strategies and accommodated some value-driven work
- iv. \$1.4 billion in 2023, \$1.1 billion + 2% escalation for inflation in 2024-2032 - Caused the optimization to fail as it could not accommodate all investments with fixed timing (which includes compliance work, relocations and reinforcements)
- v. \$1.5 billion in 2023, \$1.2 billion + 2% escalation for inflation in 2023-2032 – Minimum constraint that allowed for safe and reliable outcomes through execution of asset class strategies and accommodated some value-driven work

As provided at Exhibit 2, Tab 6, Schedule 2, page 256, Enbridge Gas eliminated ~\$100 million/year and 320 investments from the 10-year plan through applying the final constraint to the portfolio. This was achieved through application of the constraint and consultation with asset managers and business stakeholders to better align the plan to life-cycle strategies, opportunities to pursue integrated resource

planning, resource balancing requirements, and other external project dependencies (moratoriums).

- c) Cumulative impacts of previous ICM projects were not considered in setting the capital constraint for the AMP. Projects that have been approved for ICM or cost pass-through treatment by the OEB during the deferred rebasing term and the previous IRM term for Union are reflected in the 2024 Test Year rate base in this Application. As stated in Exhibit 2, Tab 6, Schedule 1, page 41, paragraph 84, Enbridge Gas is not applying for ICM funding as part of 2023 Rates and is not anticipating applying for ICM treatment in the 2024 to 2028 forecast years.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, *EGI Asset Management Plan*, page 17 and Exhibit 2, Tab 6, Schedule 1, Page 44, Table 5

Preamble:

“The LTC decision for St. Laurent is not expected to impact the Vintage Steel Replacement Program as this program and the associated selection of pipe replacements are based off of predictive analytics (condition and risk from the DIMP Risk Model as described in Section 5.2.3.6.3.2).”

Question(s):

- a) When is EGI planning to re-apply for OEB approval of the St. Laurent replacement?
- b) The statement quoted in the preamble suggests that EGI is certain that the St. Laurent replacement will be approved by the OEB. Please explain why?

Response:

- a) Please see response at Exhibit I.2.6-SEC-71.
- b) The quoted statement was made in reference to the OEB's St. Laurent Ottawa North Replacement Project Decision¹, based on Enbridge Gas's understanding at the time. It was not made in reference to any future regulatory submissions.

It is worth noting that the Enhanced Distribution Integrity Management Program will incorporate findings from the St. Laurent Program and other applicable distribution pipeline programs in Enbridge Gas's system.

¹ EB-2020-0293, Decision and Order, May 3, 2022.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, *EGI Asset Management Plan*, page 134

Preamble:

“In addition to the risks discussed in Section 5.2.4.3.3, Distribution System Stations feeding low-pressure networks have additional safety consequences, as these networks are designed without individual regulators at customer meter sets, normally considered a second line of defence against potential piping overpressure inside the customer’s premises.”

Question(s):

- a) How many customers have meter sets without individual pressure regulators?
- b) Is EGI planning to install pressure regulators for these customers?

Response:

- a) There are two situations where an individual pressure regulator does not exist at the customer stations:
 - i. Low pressure (LP) networks- approximately 27,452 customers stations do not have a pressure regulator at the meter set. Enbridge Gas will continue with the various remediation activities involving pressure elevations, station alterations, and station replacements to reduce the risk associated with the low-pressure network, and
 - ii. Customer stations that are contracted at pipeline operating pressure. Data is unavailable at this time. These customer stations are engineered on a case-by-case basis to ensure appropriate safety controls are in place for each application.
- b) There are no plans to install pressure regulators at the customer stations that are contracted at line pressure. For the low-pressure networks, Enbridge Gas intends to mitigate the potential for an overpressure event and this is being applied through

situational requirements. For instance, additional layers of over pressure protection at the system station feeding the network, pressure elevation to the network which would include the installation of pressure regulators at these customer sites, or other designs to reduce the risk associated with the non-existence of the regulator at the customers' premise.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, *EGI Asset Management Plan*, page 156

Preamble:

“Vent shields are legacy components that were in place to protect vents. Debris or ice can build up on the vent shield, causing blockage and compromising pressure control.”

Question(s):

- a) When did EGD and Union Gas became aware of the problems with vent shields?
- b) How many customers have meter regulator sets with vent shields?
- c) Is EGI planning to remove all vent shields?

Response:

- a) The problem with vent shields was initially identified by Union Gas in 2001, and EGD in 2002.
- b-c) Union began a program to remove the vent shields in 2001 and the EGD program began in 2002. These programs have since been concluded therefore any vent shields remaining in the field in 2023 would be negligible. If any vent shields are found to still be in use they are removed as discovered.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, *EGI Asset Management Plan*, page 215

Preamble:

The facility assessment results for all EGI properties and the summary strategy for each property are shown in Table 5.4.5-1. Based on EGI's standards, FCI scores between 0% and 5% are considered good, 5% to 10% are fair, 10% to 30% are poor and greater than 30% are critical.

Question(s):

- a) What are EGI standards and why should the OEB believe that they are appropriate?
- b) Is there a document that explains EGI standards? If the answer is yes, please file it. If the answer is no, please explain why not.

Response:

- a) Enbridge Gas's standards are based on industry standard practices and calculations. Please see response at Exhibit I.2.6-SEC-137. Enbridge Gas has guidelines and standards that demonstrate how Enbridge Gas designs and constructs buildings, a sample operations design guide is attached.
- b) Please see Attachment 1 for Operations Centre: Design Guide.

OPERATIONS CENTRE: DESIGN GUIDE

ENBRIDGE INC.

REV 1.2 – March 3, 2022



WALTERFEDY





ENBRIDGE OPERATIONS CENTRE: MASTER DESIGN GUIDE

Project No.: 2018-0739-10

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INTRODUCTION

1.0 INTRODUCTION

1.1 Introduction to the Design Guide

This document is a Master Design Guide for Enbridge's future development of their operation centres. WalterFedy was retained by Enbridge to research design strategies and best practices of their existing operation centres and consolidate the lessons learned into a single document. The design guide is intended as a handbook for designers to better understand the site, as well as the architectural, and functional components of these facilities. The guide has been broken down into component elements and have been annotated with photographs and illustrations to demonstrate design intents.



Enbridge Parkway Operations Centre

The scope of this design guide includes Architectural Programming components only, and does not include Engineering Systems. The guide breaks down the operations centre into three general sections:

- **Site areas**, which include the parking areas, yard, and site security elements.
- **Office areas**, which include the open office areas, amenity areas, and change/shower areas.
- **Functional areas**, which include the warehouse spaces, weldshop spaces, and their service spaces.

We have identified standard equipment for each component.

1.2 Goals of an Operations Centre

A good Operations Centre must be able to safely and efficiently serve field staff in the maintenance of Enbridge infrastructure. The Operations Centre should be an all-in-one facility, which can provide all the parts, fabrication services, and office infrastructure to meet the typical requirements of the assigned geographic area. This facility (both building and yard) must be protected against a variety of security threats.

Enbridge's key business revolves around the safe and efficient operation of its gas distribution infrastructure. As such, Enbridge requires a large vehicle fleet to perform the many investigative and maintenance tasks needed to keep the operation running smoothly. The yard component of the operations centre must be able to safely accommodate a large vehicle fleet and the associated bulk materials. A good operations centre must have a sizable yard component, neatly organized with good traffic flow-throughs.

The building portion of the operations centre must support Enbridge office staff, provide warehousing and weldshop services, as well as provide a home base for field employees to be briefed, do paperwork, and resupply. A good operations centre should provide spaces to support all employees, but also provide acoustic and air separation controls between the office and industrial uses.

1.3 Types of Operations Centres

We have classified the Operations Centres into three categories. They are generally sorted by size and operational needs. These categories are the Micro Operations Centres, the Standard Operations Centres, and the Regional Operations Centres.

- **Small Operations Centres** support a small business area, and are typically 500 – 5,000 square feet in size. These facilities generally have a small office staff of 1 – 10 employees.
- **Operations Centres** support a larger business area, and are typically 5,000 – 10,000 square feet in size. These facilities generally have a medium size office staff of 10 – 80 employees.
- **Regional Operations Centres** are much larger facilities that support multiple operation centres, and are typically 10,000+ square feet in size. These facilities generally have a large sized office staff of 50+ employees. These centres are built for special use requirements of the business.

We have included additional program information for each of the three types of Operations Centres. This data is available in the appendix of this report, as a series of charts. These program charts indicate typical staffing levels, area required per person, and component area calculations. These program charts also include standard sized items such as truck wash bays.

We have omitted the facilities used for Administration and Gas Control from this report. These functions are separate from the key functions of an Operations Centre, and fall under the scope of a separate report. These functions include components such as the compressor station control rooms.

1.4 Format of the Report

The report is broken down into two sections. The first section provides a general introduction to facility design and principles. This section breaks down the Operation Centre into several blocks: an office block, a warehouse/weldshop block, a yard block, and a hazardous materials storage block. Each block has several overlapping requirements and adjacency preferences. The blocks are described at a high level, with tips for the designer of how best to lay them out. These blocks are then elaborated with a space program summary. This summary includes typical component space requirements and required adjacencies.

The second section is a detailed listing of individual program components. These components are listed by block, and then by function. Components are given a general description, a list of requirements, a list of common hazards, health and safety requirements. Components are shown with photographs as examples, and information from specific reference projects. A plan drawing of typical items and supporting equipment are provided with suggested / typical dimensions. Where appropriate, a typical outline specification summary has also been provided.

1.5 List of Reference Projects

- 2006: Kingston Operations Centre
- 2006: Burlington Operations Centre
- 2011: Hamilton Operations Centre
- 2012: Tecumseh Operations Centre
- 2013: Parkway Operations Centre (*compressor station*)
- 2014: Bright Operations Centre (*compressor station*)
- 2014: Lobo Operations Centre (*compressor station*)
- 2015: Sarnia Operations Centre





PROGRAM SUMMARY

2.0 PROGRAM SUMMARY

2.1 Site Relationships

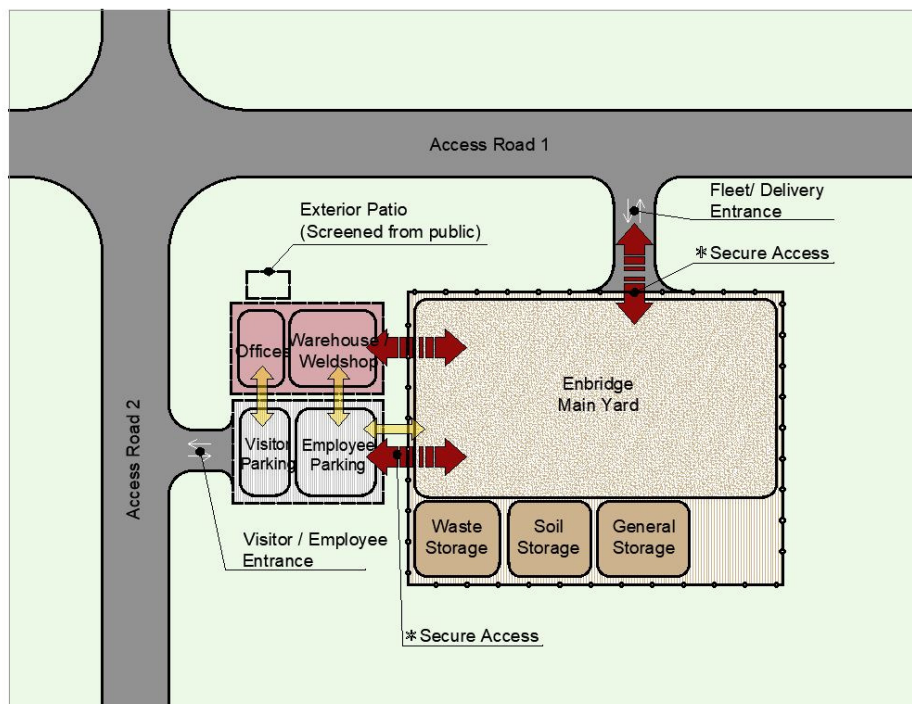
Enbridge Operations Centres are all-in-one facilities which provide maintenance, service, meter reading, and other services to a specific geographic area. The facility is largely used by Enbridge employees who spend much of their job at various off-site locations. The facility is designed as a home base where these employees can return to do paperwork, pick up/drop off equipment, perform maintenance and/or equipment repair, and maintain their work vehicles.

A typical Operations Centre has three functional clusters. These are:

- **An office cluster**, used as a touchdown area for the primarily off-site employees to touchdown to write reports and perform other paperwork.
- **An industrial cluster**, used to support the off-site employees by providing parts, storage, and maintenance services, and
- **A yard cluster**, used to store materials, aggregate, vehicles, equipment, spoils, and large sections of pipe.

The current best practice for site selection is a corner plot. A corner site allows small vehicle and truck access to the yard from one entrance, with trucks exiting the site from the other entrance. It is critical that large vehicles do not back up on site, even when the site is full of vehicles. The corner lot allows flexibility / redundant site access if one street is blocked for outside reasons. The yard must be secured with a high fence with barbed wire. Access is provided via a key-card reader near the employee parking lot. Vehicles exit via a proximity-sensing gate at the exit road. This vehicle routing path is optimal from a safety point of view.

Pedestrian access is also simplified in this scheme. There are two main pedestrian entrances from the employee parking lot. Visitors enter through the main vestibule, and must be checked by security before entering the site. Employees have a separate entrance to the office component, and must use a key-card to access the building. Pedestrian access to the building should be kept as simple as possible.

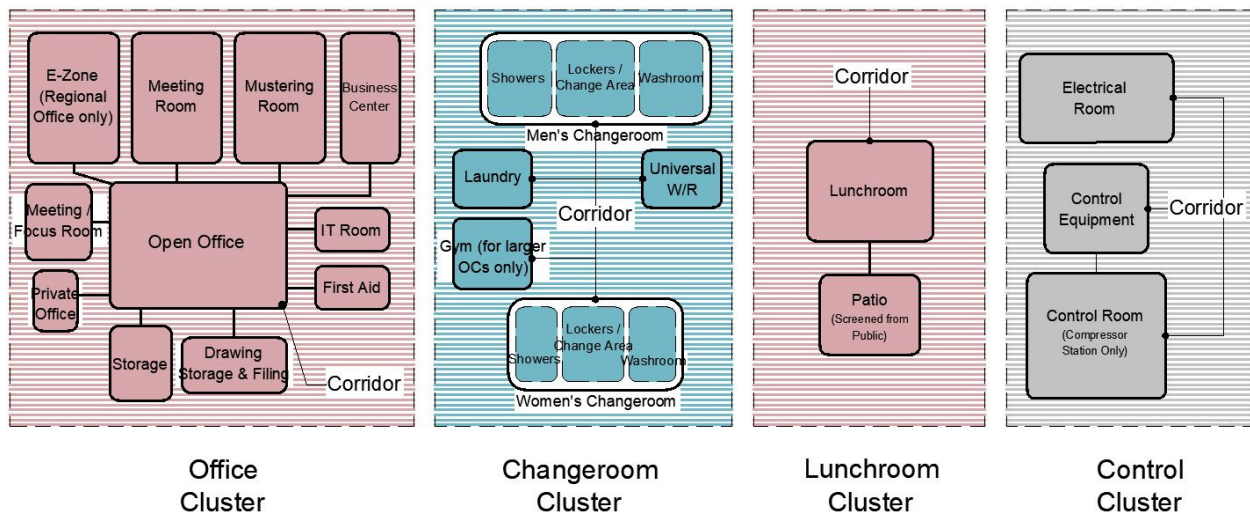


2.2 Office Cluster

The office component is primarily used as a touchdown space for the mostly off-site employees to perform administrative activities. These employees still have requirements when they are on site, such as touchdown desks, changing areas, and lunchroom areas. We have broken down the office component into four groups to explain their adjacency requirements.

These four groups are:

- **An office group**, the grouping of core office components supporting deskwork, computer, and other paperwork,
- **A changeroom group**, components designed to support employees with changing, personal items storage, clothes-washing, and personal fitness needs,
- **A lunchroom group**, a multi-purpose space with patio and universal washroom,
- **A control room group**, a set of components designed to support compressor stations only.

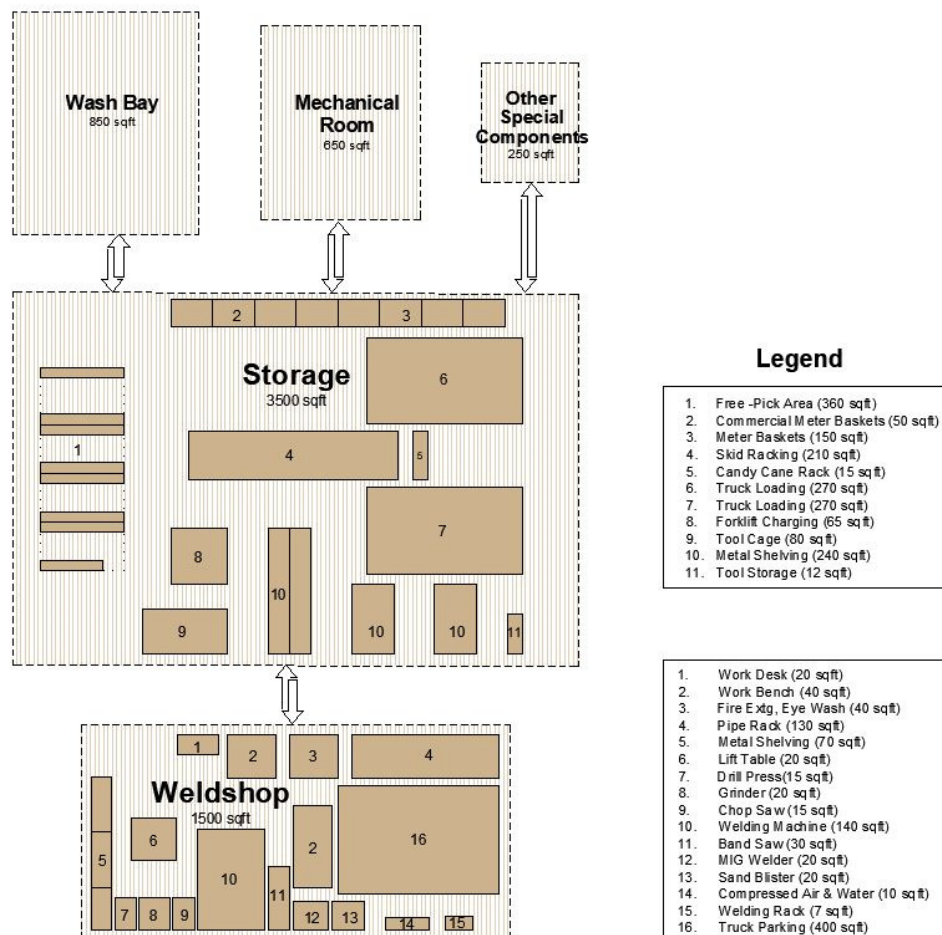


2.3 Industrial Cluster

The industrial cluster is designed to support the mainly off-site needs of Enbridge employees. There is a need for storage of parts of various sizes, as well as welding and other maintenance / finishing processes. As some of the parts are large and cumbersome to move, vehicle access is a necessity for each of these components.

The groups which make up the industrial cluster are:

- **A storage component**, used to store a variety of meters, small parts, large parts, tools, and pallet-loaded items,
- **A welding and fabrication component**, used for the assembly, maintenance, and retrofitting of various pipes, parts and assemblies,
- **A wash bay component**, used for the on-site all-season washing of fleet vehicles,
- **A mechanical and electrical room component**, which services the operations centre and may include backup generators, and
- **Other Special Uses.** These may include a gas measure component, a meter reading component, a service measurement and corrosion measurement component, and any other components as required.



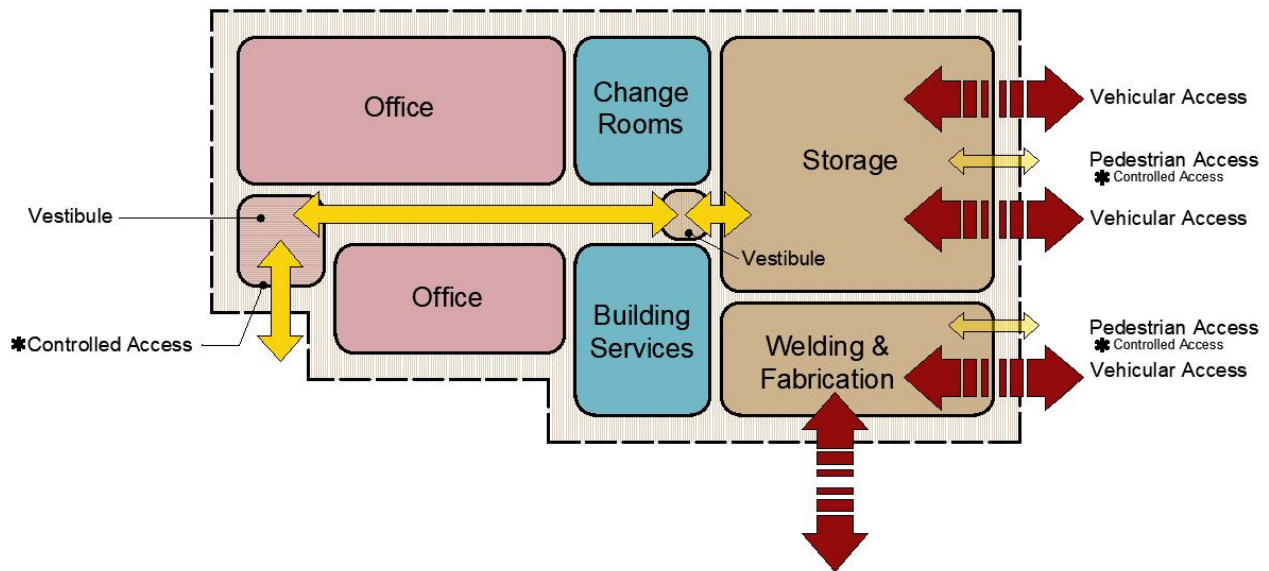
3.0 GENERAL FACILITY DESIGN

3.1 Program Adjacencies

The operations centre can be broken down into an **office cluster** and a **functional cluster**.

The office cluster is located to the front of the property, giving its office occupants good views towards the street. Behind the offices lie the changerooms and building services components. These components do not require windows, and are more appropriately sited away from the street.

The industrial cluster – the warehouse and weldshop components – require direct adjacencies to the yard. These components require vehicle and pedestrian access to the secure portion of the Enbridge yard. It is also good practice to place a negative-pressure vestibule between the office and functional clusters, to prevent smells and particulate matter from passing from the functional cluster to the office cluster.



3.1.1 Enbridge Office

The office cluster has several general requirements – lots of natural light, high ceilings, good mechanical systems, and high-quality furniture/finishes. The open office should support be a flexible space supported by modern desking systems for employees with more desk based work, and drop-in stations for those employees working more in the field.

An office cluster should also have high-quality amenities such as a large lunch room and patio. These amenities are necessary for an employer to remain competitive in attracting talent – these amenities are critical for maintaining employee morale and staff retention. These on-site amenities are especially important in remote operations centres where it may be difficult to find amenities nearby.



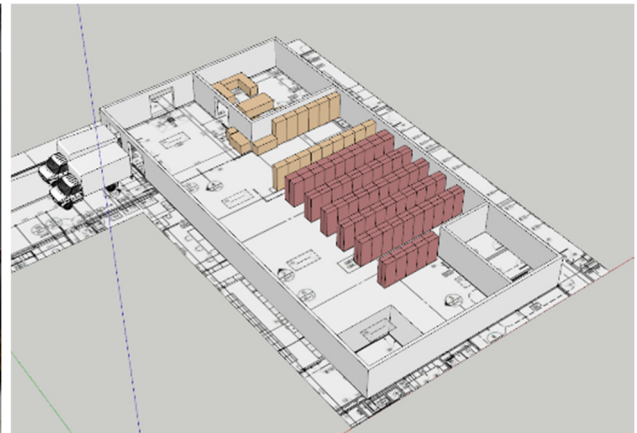
Natural Light: *Wherever possible, office components and amenities should be treated to ample natural light to improve employee's quality of life.*

3.1.2 Enbridge Warehouse & Weldshop

The industrial cluster of the Operations Centre supports a large grouping of storage, maintenance, and calibration components. These work areas should all be designed with as much natural light as practical, with ample working space, and following general ergonomic principles. These components also require various levels of security, with sensitive spaces such as the calibration rooms and IT storage requiring strictly controlled access.

The industrial cluster requires careful attention to component adjacencies and traffic flows.

- The warehouse requires adjacency to outdoors for truck load / unload,
- The weldshop requires adjacency to outdoors for unloading heavy equipment, ventilation
- The truck wash bay requires adjacency to the yard – two doors for pull-through access. Note that the truck wash bay component is only specified where required; ie in remote locations.



Open / Organized Spaces: *The Warehouse and Weldshop spaces are laid out to maximize organization and efficiency. Loading / unloading procedures are streamlined and placement of items within the warehouse is key. Accommodating the movement and/or transfer of items around the Warehouse and Weldshop are paramount.*

3.1.3 Enbridge Yard

The yard of the Operations Centre supports a grouping of storage, maintenance, and infrastructure components. The yard should have large setbacks from the street with low landscaping to keep clear lines of sight. The yard must be secured against unauthorized access via a 2.5m high chain-link fence (with barbed wire above) that encloses the yard. Vehicular access is provided through a cantilevered (or sliding) access gate which is opened through key-card access. There should be at least one pedestrian emergency exit from the yard with secure panic hardware.

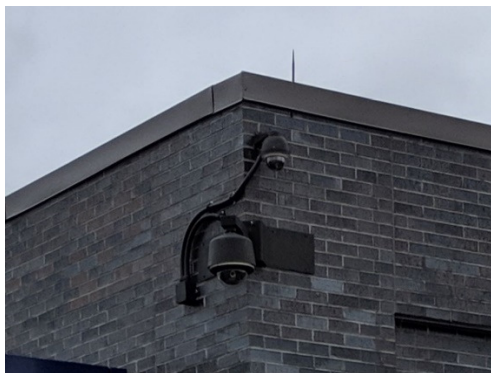
Traffic control is essential to a safe and efficient yard layout. Vehicle areas, storage areas, and waste areas should be clearly marked and separated. The yard should be designed with clear lines of sight and split lanes of traffic to minimize accidents. Vehicles should never have to make excessive travelling or turns on site to reach their intended destinations. Asphalt is recommended over gravel as the preferred finish material.



Traffic Control: Vehicle paths of travel should be laid out with clear lane markings and high visibility signage. Pull-through parking should be accommodated whenever possible. Cars should always park facing out towards drive aisles.



Hazardous Material Storage: Chemical, flammable, and explosive materials should be locked and marked with the appropriate hazard signage.



Site Security: Site security includes surveillance systems, physical barriers, and controlled access systems.





SITE COMPONENTS

4.1.1 SITE RELATION TO STREET

PROGRAM DESCRIPTION:

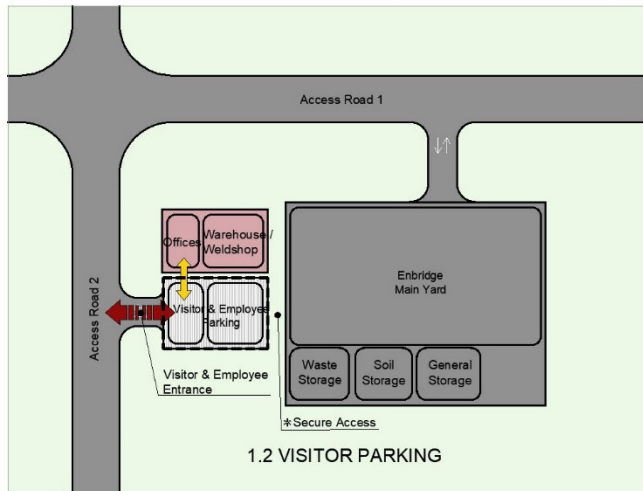
The operations centres are often the only building Enbridge clients see. Thus, the building should appear tidy and presentable for customers, visitors and the media. An operations centre must be an attractive building, while remaining a safe and secure facility. These general guidelines will help in laying out the building on the site.

- The operations centre should have office areas rather than industrial areas facing the street. The presence of entrances, windows, and shading devices presents an approachable human-scale façade.
- Architectural materials and finishes should be of high quality, and generally matching the language of other operation centres.
- The layout should respect the urban design context. In urban sites, the building shall be street facing with parking behind. In suburban sites, the parking may be in front of or beside the building.

SPECIFIC DESIGN PRINCIPLES:

Safety is top priority for a successful operations centre. Traffic onto the site is split into two. One access road is reserved for visitor and employee personal vehicle parking. The second access road is reserved for Enbridge fleet vehicles. Other safety principles include:

- Front-out (back-in) parking when parking against a wall, or another row of parking, Pull-through parking when the parking aisle is bounded by two drive aisles,
- Large sidewalks should be provided near visitor parking. Sidewalk widths shall accommodate the projection of truck bumpers over the sidewalk.
- Landscape buffers between parking area and the building,
- Suitable site lighting, wall mounted lighting, and clear lines of sight around the facility,
- Entrances to the building should be marked with clear signage and an architectural



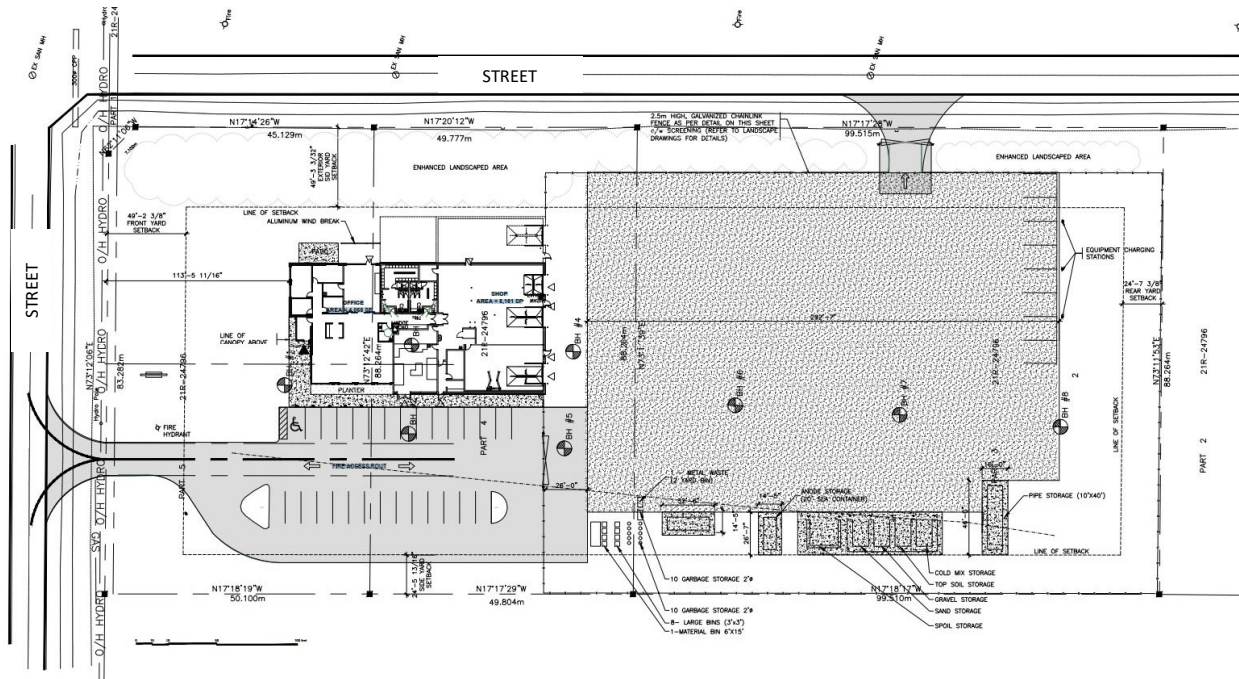
Program Adjacencies:

- 1.2 Visitor Parking
- 1.3 Employee Parking
- 1.6 Site Security



Landscape Buffers: The public-facing site areas of the Operations Centres should have well-maintained landscaping. The vegetation choices should be low, in order to maintain clear lines of sight throughout the facility and to and from street access roads.

4.1.1 SITE RELATION TO STREET



Typical Site: Street Relationship: Site Access is split into two in this preliminary site plan of the Belleville Operations Centre. The west entrance is intended for light vehicle use. Visitors park in this lot, close to the main entrance of the Operations Centre. Heavy vehicles such as Enbridge trucks take the north entrance directly into the yard. The reduction of cross-traffic allows for a safer site, while also allowing for more landscaping area in front of the Operation Centres. The turning path of a tractor trailer should be overlaid onto the yard, ensuring a clear path of travel from yard entrances to storage / weldshop areas.

SITE LIGHTING:

Where possible, avoid light standards in the centre of the yard. Light standards shall be located at the perimeter of the yard, or building mounted. Yard lights shall be motion activated by occupancy sensor.

EQUIPMENT:

All functional components to the site (access gates, parking parameters, signage, lane markings, etc.) will be discussed throughout future sections.

TRUCK TURNING RADIUS:

The Operations Centre yard should be laid out so that the largest truck which would use the site can back up into the storage / weldshop bays with a trailer. This can be checked via AutoTurn CAD software.

FINISHES:

Paving:

- Heavy Duty asphalt for employee entrances, fleet parking, and drive lanes where fleet vehicles drive through
- Regular duty asphalt for visitor parking

Site Fixtures:

- Wall mounted light packs and pole-mounted fixtures as appropriate for a well-lit site
- Key card readers in front of gated yard areas
- Barbed wire fence around yard areas (refer to 1.5 Site Security).

Site Finishes:

- Wide, textured sidewalks around visitor parking areas.

Concrete Apron:

Concrete Pads:

Stormwater Management:

- Consider permeable pavers where site does not permit.

4.1.2 EMPLOYEE PARKING

PROGRAM DESCRIPTION:

Employee Parking is located in the non-secure portion of the site. For smaller operations centres, employee parking may be located beside the visitor parking lot. All employees must use their key-cards to access the secure portion of the Operations Centre.

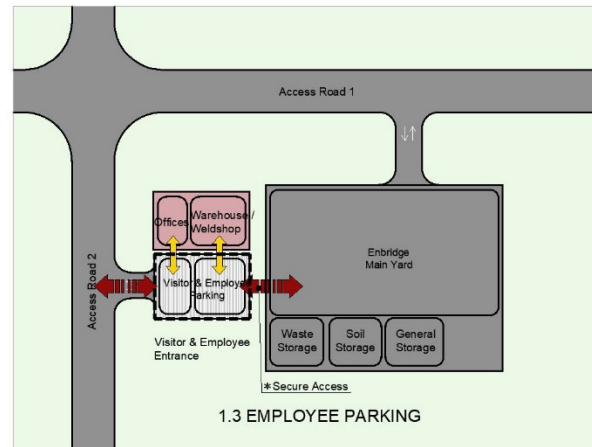
For smaller Operations Centres (Micro), visitor parking spaces may be located beside employee parking spaces.

Though visitor traffic is not a major concern at these locations, code requirements and zoning restrictions can sometimes dictate the orientation, layout, and quantity of available parking spaces.

SPECIFIC DESIGN PRINCIPLES:

Vehicular traffic should be kept as simple as possible. Where possible, drive-through parking stalls should be provided for larger vehicles. This would minimize safety hazards due to large vehicles backing up.

Large sidewalks should be provided near visitor parking, with landscape buffers and suitable site lighting. Entrances to the building should be marked with clear signage and an architectural canopy. The visitor parking areas should be easily monitored from the Operations Centre office spaces.



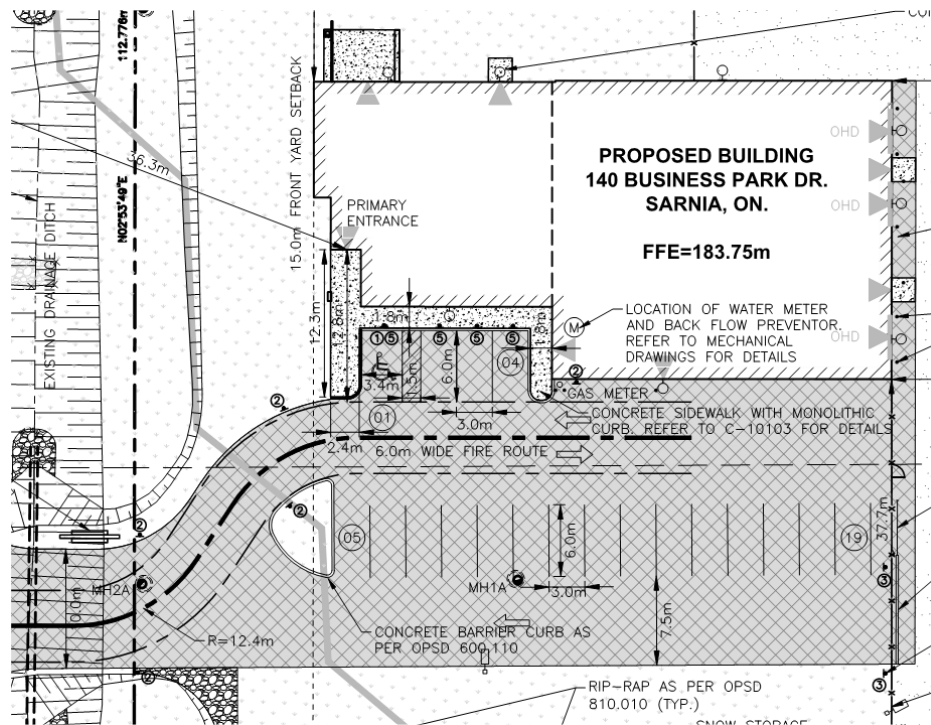
Program Adjacencies:

- 1.1 Street
- 1.4 Fleet Parking and Vehicle Maintenance
- 1.6 Yard Storage



Parking and Traffic Flow: Employee Parking and Visitor Parking may be combined in a small site. Parking for large employee vehicles such as trucks and vans should be on pull-through parking spots. The main entrance should have a canopy for shelter and to denote the main door.

4.1.2 EMPLOYEE PARKING



Typical Employee Parking: Employee parking is located close to the main entrance, with wide sidewalks linking the parking areas to the front door. The office component of the Operations Facility looks out on the parking lots.

SITE LIGHTING:

Where possible, avoid light standards in the centre of the yard. Light standards shall be located at the perimeter of the yard, or building mounted. Yard lights shall be motion activated by occupancy sensor.

EQUIPMENT:

Parking Stall Sizing:

- Typical visitor parking stall sizes are 6.0m deep by 3.0m wide
- The sizing is dependent on the type of vehicle traffic expected in the Visitor Parking
- When located on smaller Operation Centres where employee and visitor parking are shared, stall widths are to be governed by the Employee Parking standards.

Fire Route Access:

- Entrance lanes must provide a clear 6.0m wide Fire Route for code purposes

FINISHES:

There should be minimal use of curbs in parking area for ease of snow removal.

Paving:

- Heavy Duty asphalt for employee entrances, and fleet parking
- Regular duty asphalt for visitor parking

Site Fixtures:

- Wall mounted light packs and pole-mounted fixtures as appropriate for a well-lit site
- Key card readers in front of gated yard areas
- Barbed wire fence around yard areas (refer to 1.5 Site Security).

Site Finishes:

- Wide, textured sidewalks around visitor parking areas.

4.1.3 FLEET PARKING & VEHICLE MAINTENANCE

PROGRAM DESCRIPTION:

The Enbridge Vehicle fleet is parked and maintained inside the secure yard. The fleet consist of a variety of trucks, vans, trailers, and heavy trucks. Some vehicles may require to be ready to start and drive in any weather condition, requiring additional site equipment to keep them ready. This area may also require fueling stations, fuel storage areas, and/or compression stations.

Vehicles entering the yard must pass through a sliding gate, after using a key card to enter. There is also a telephone connection to allow special delivery trucks to call the office and ask for access to the yard. The vehicle yard must have adjacencies to building program such as the weldshop, warehouse, and truck-wash bay.

SPECIFIC DESIGN PRINCIPLES:

The fleet parking & vehicle maintenance area should be finished with heavy-duty asphalt. Other materials such as gravel are less than ideal.

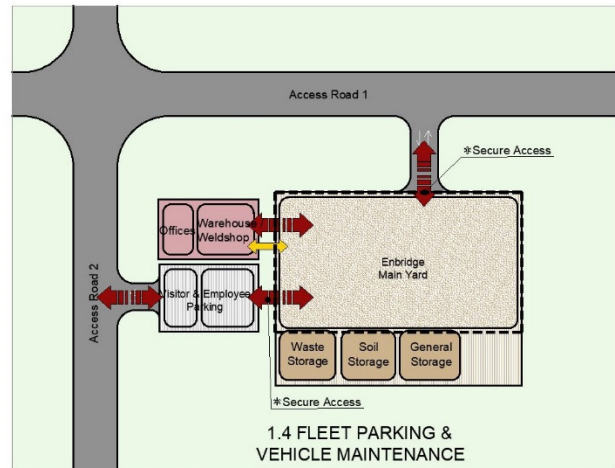
Vehicles should be stored in the appropriate parking lot stall type. Vans and smaller trucks should be parked in the smaller stalls, always facing outwards. Larger trucks and trailers should be parked in the larger stalls. These stalls are preferred to be drive-through stalls, removing the requirement for these vehicles to back up.

TYPICAL FLEET VEHICLE BAYS:

Utility Crew Truck Bay: 60' x 14'
 (Reserved for dump truck + trailer combinations)

Dump Truck / Equipment Trailer: 40' x 14'
 (Reserved for dump trucks, equipment trailers, pipe trailers, drill trailers, backhoes, and bulldozers.)

Light Duty – ½ & ¼ Ton Trucks: 30' x 10'
 (Reserved for light duty trucks, box vans, welding vans, and small box trucks.)



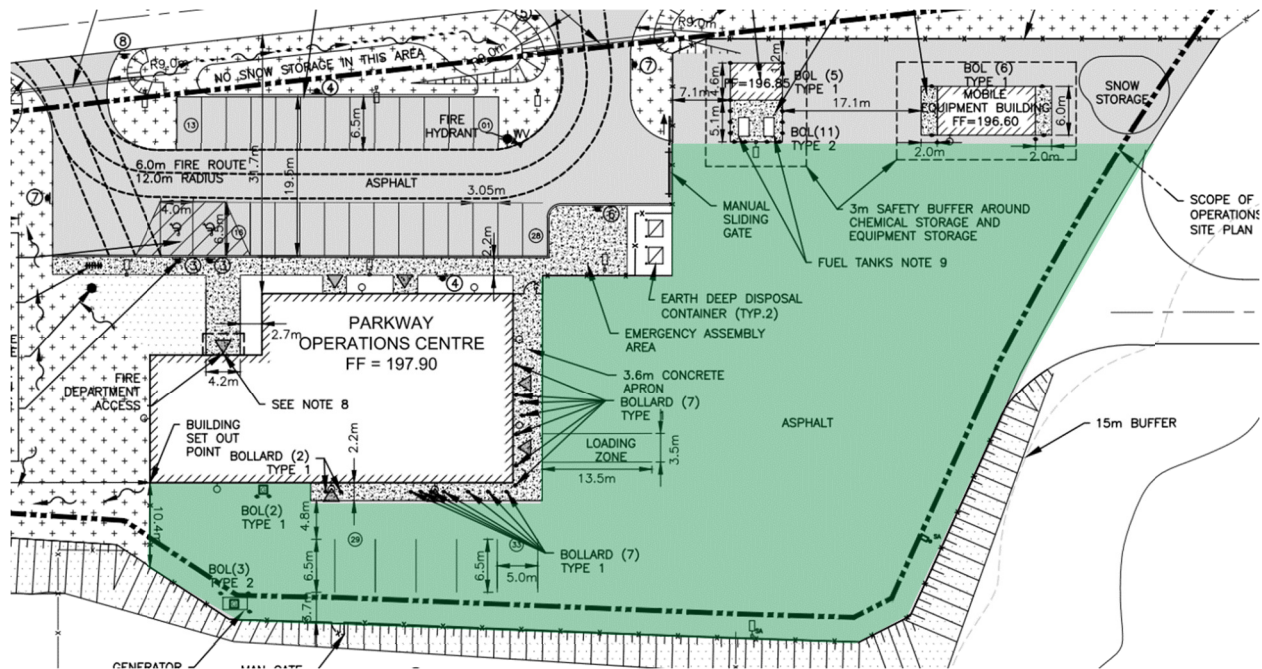
Program Adjacencies:

- | | |
|------------------------|-----------------|
| 4.1.2 Employee Parking | 4.3.1 Warehouse |
| 4.1.4 Site Storage | 4.3.4 Weldshop |
| 4.1.5 Site Security | 4.3.7 Wash Bay |



Fleet Parking (top): Fleet parking at the Toronto Victoria Park Operations Centre. Heavy vehicles are parked in a way where time backing up on site is minimized. **(bottom):** Fleet parking at the Samia Operations Centre. Vehicles are given wide berths, deep drive aisles and pull-through parking.

4.1.3 FLEET PARKING & VEHICLE MAINTENANCE



Fleet Parking & Vehicle Maintenance Areas: Fleet vehicles enter the site through the north entrance, avoiding the north-west visitor entrance. Enbridge Employees use their key-card to access the manual sliding gate on site. From here, they travel south to the fleet parking spaces. Fleet parking spaces have drive aisles on both sides. This allows trucks to not have to back up to get out of their parking spaces.

EQUIPMENT:

NGV Fueling Stations

- Fast Fill station and lane. Fast fill station sits on dedicated island with concrete curb and bollards to protect it. Confirm if needed – based on business requirement.
- Slow Fill and charger posts. Dual-use posts located every second parking space. Protected by concrete base. Confirm if needed – based on business requirement.
- Public Access NGV fill stations based on specific conditions.

Exterior Bollards

- To be located where vehicles can approach site furnishing, building, or swing of doors.
- 6" diam. Standard pipe bollard (fill with 25 MPa concrete)
- Bollard shield (yellow)

Car Plug Post

- 8" galvanized I-Beam post For charging service and other vehicles.
- All outlet & junction boxes to be weatherproof and suitable for outdoor use.

Entrance Gate Card Access

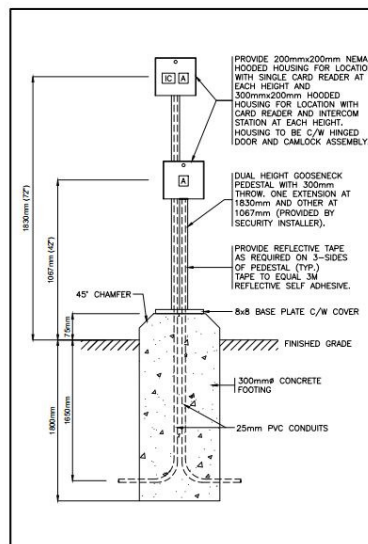
- Dual Mounted Pedestal Detail

FINISHES:

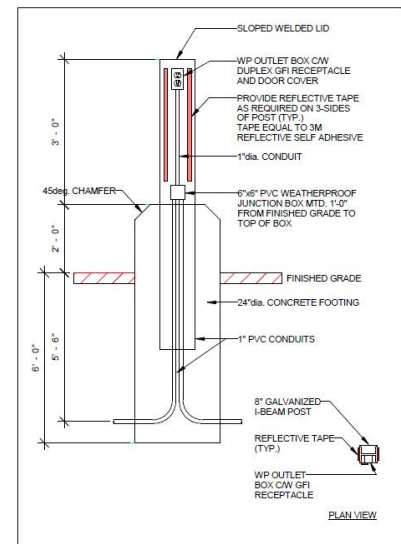
There should be minimal use of curbs in parking area for ease of snow removal.

Site:

- Heavy Duty Asphalt
- Concrete apron / sidewalks
- Frost slabs at exterior entrances where required



4
E1-1 DUAL MOUNT PEDESTAL DETAIL
N.T.S.



03 CAR PLUG POST DETAIL
SCALE: N.T.S.

4.1.4 YARD STORAGE

PROGRAM DESCRIPTION:

The Enbridge Yard storage area is used for the storage of bulk materials, pipes, waste, and other items. The Enbridge Yard storage area is located in the secure part of the Enbridge site. The yard storage is accessed by the service entrance, and requires key-card access.

The storage facilities should have a reasonable adjacency to the warehouse and weldshop spaces in the Operations Centre.

SPECIFIC DESIGN PRINCIPLES:

A variety of storage typologies are used to handle various item types. These typologies include:

- a material storage building
- waste storage bins / containers,
- spoils storage,
- sand / gravel / topsoil / cold-mix storage,
- pipe storage racks
- hazardous materials storage.

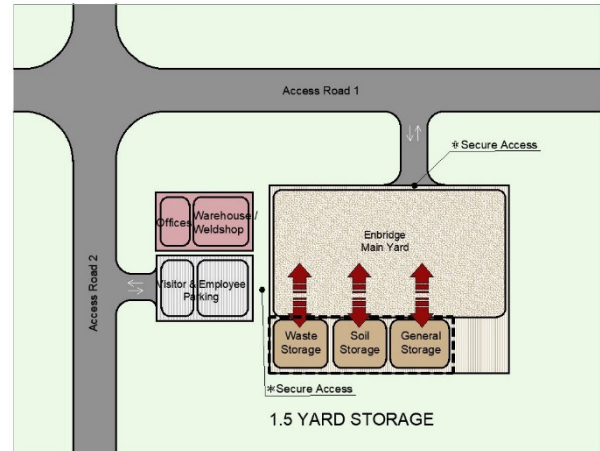
The storage solutions are dependant on each Operation Centre's requirements and supported business groups.

These facilities should have large open areas for heavy vehicles to operate with clear lines of sight. Vehicles should be able to load, unload, and back up safely.

FINISHES:

Exterior:

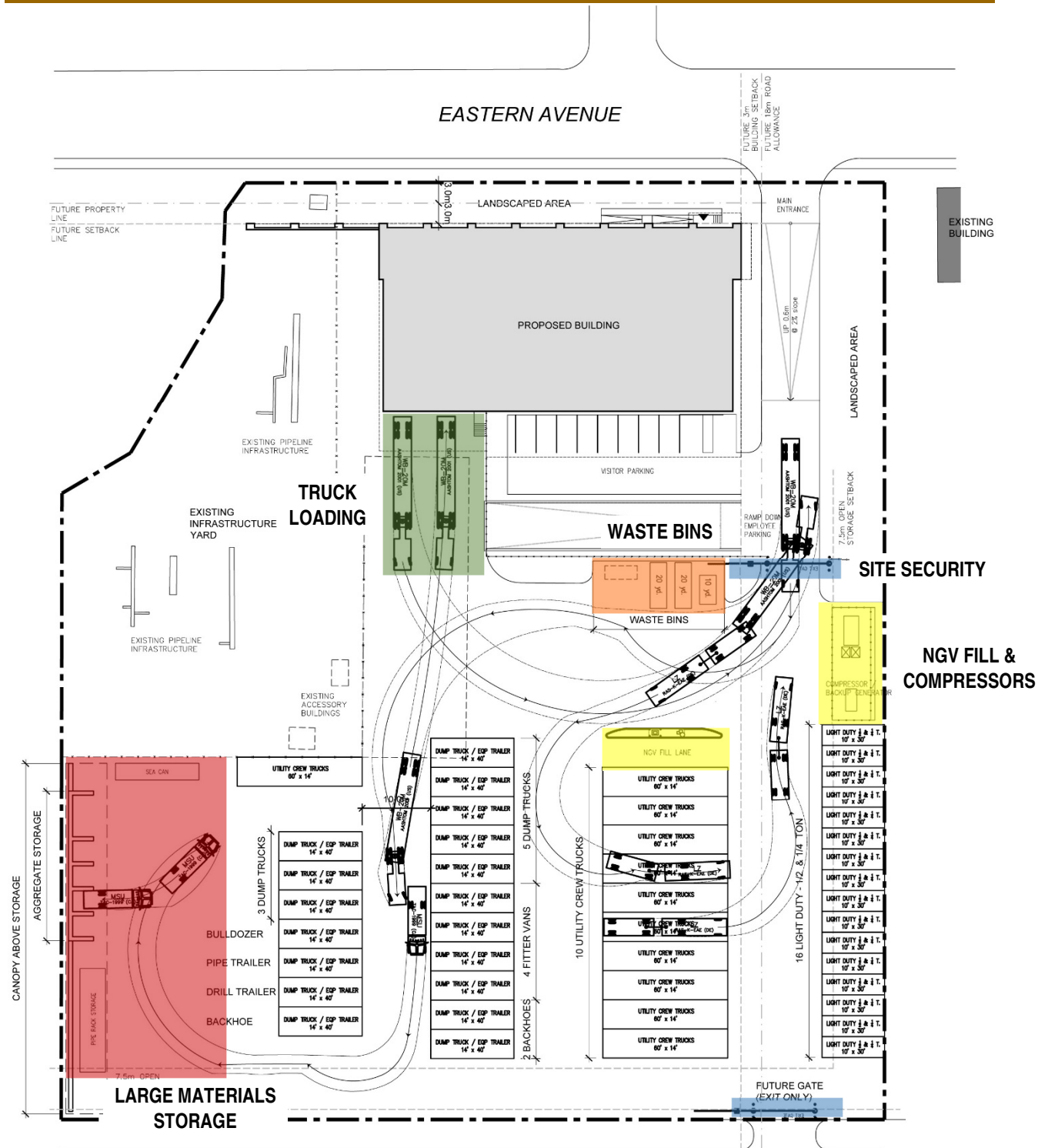
- Asphalt base
- Reinforced concrete pads



Program Adjacencies:

- 4.1.2 *Employee Parking*
- 4.3.1 *Warehouse Spaces*
- 4.3.4 *Weldshop Spaces*

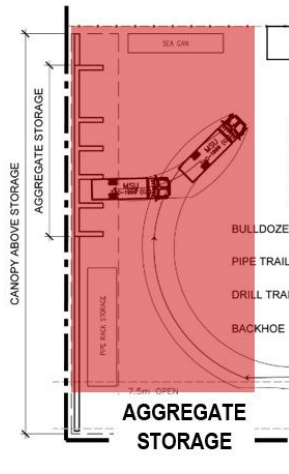
4.1.4 YARD STORAGE



Typical Yard Storage Area: A standard yard should be at least 2 acres in size. Ideally, an Operations Centre yard should be able to accommodate tractor trailer deliveries to the site. The yard should also be able to accommodate the safe one-way movement of trucks with trailers moving in and out of their parking spaces.

Yard storage is accommodated by a variety of bins, covered open-air sheds, and piping racks. Small parts and other materials are stored inside a building which can be locked. Waste (garbage, metal waste, etc.) is stored in a series of bins. Spoils / sand / gravel / topsoil / cold-mix are stored in an open-air shed structure. Long and/or large sections of pipe are stored outside on pipe storage racks.

4.1.4 YARD STORAGE (continued)



LARGE MATERIAL STORAGE:

Aggregate Bunkers

- Concrete bunkers to be minimum 4' high, with front clearance for backhoe access. Enclosure can be made of either poured concrete or retaining concrete blocks.
- Spoils storage (20' x 10')
- Sand storage (10' x 10')
- Stone storage (10' x 10')
- Cold patch storage (10' x 10')
- Gravel storage (10' x 10')

Loose Materials Storage – Miscellaneous

- Pipe Storage Rack (10'x40')

Anode Storage (where required)

- 20' Sea Container on concrete pad



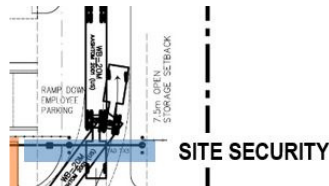
WASTE STORAGE:

Small Bins

- Garbage Storage (2' diam)
- Large Bins (3' x 3')
- Material Bin (6' x 15')

Large Bins

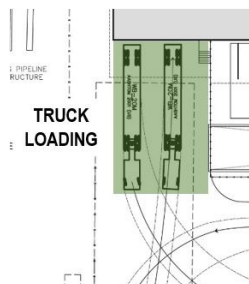
- 20 yard waste bin (26' x 8')
- 20 yard metal waste bin (26' x 8')
- 10 yard misc. waste bin (14' x 7.5')



SECURITY AND ACCESS:

Security and Access

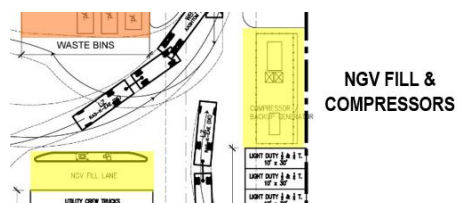
- See 4.1.5 Site Security



TRUCK LOADING:

Truck Loading

- Infrequent deliveries on tractor trailers should be accommodated
- Majority of use is Enbridge crew trucks and smaller delivery vans/trucks.



NGV FILL & COMPRESSORS

Compressors:

- See 4.1.6 NGV Fill

4.1.4 YARD STORAGE (continued)



Aggregate Storage – Loose Materials: Covered yard storage is used in urban areas with residential or corporate neighbours.



Uncovered Yard Storage: The Sarnia Operations Centre Yard consists of waste storage (top), pipe racking, and sand / gravel / top-soil / cold-mix storage. The uncovered typology is used in industrial areas.



Waste Bins: Standard waste and miscellaneous waste bins should be in easily accessible areas. Ensure appropriate space is given for truck access.



Access Control: Vehicular and pedestrian access to hazardous areas and/or secure areas must be controlled via key-card access points.



Truck Loading: Truck loading areas should be clear of obstructions and have bollards indicating exposed corners and doors. Areas should have adequate lighting.



NGV Fill Stations: Operations Centres may be designated to have on-site natural gas fueling stations to support their fleet. The station consists of a compressor and a pump station with card access. Basic NGV layout principles are covered in 4.1.6 NGV Fill.

4.1.5 SITE SECURITY

PROGRAM DESCRIPTION:

The Enbridge Facility must be secured against unauthorized entry through a series of building security and site security measures. The general goals of site security are to:

- Prevent unauthorized pedestrian and vehicle traffic,
- Deter unauthorized visits through appropriate site lighting and security cameras, and
- Ensure all dangerous, hazardous, and infrastructure assets are protected as much as possible

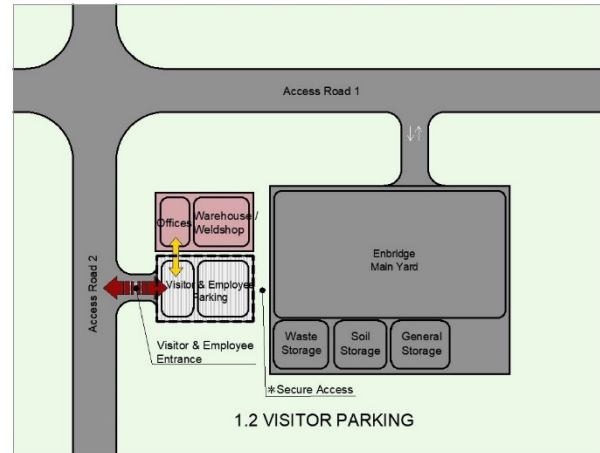
The Enbridge site must be accessed from several adjacent components. The site must be accessible via vehicle through the fleet/delivery entrance as well as the employee parking lot entrance. The site must be accessible by pedestrians and vehicles through the warehouse and weldshop components of the building.

SPECIFIC DESIGN PRINCIPLES:

Site Security consists of several systems

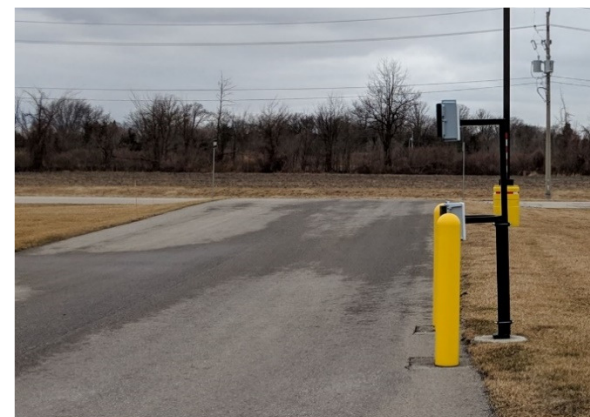
- Site Fencing.
- Site Vehicle Access Gates.
- Site Pedestrian Emergency Exits.
- Building Key-Card Access.
- Yard lights.
- Security Cameras.

The yard must balance security requirements with exiting requirements. Pedestrian doors to the site will require key card access to enter, but must have secured panic hardware for egress.



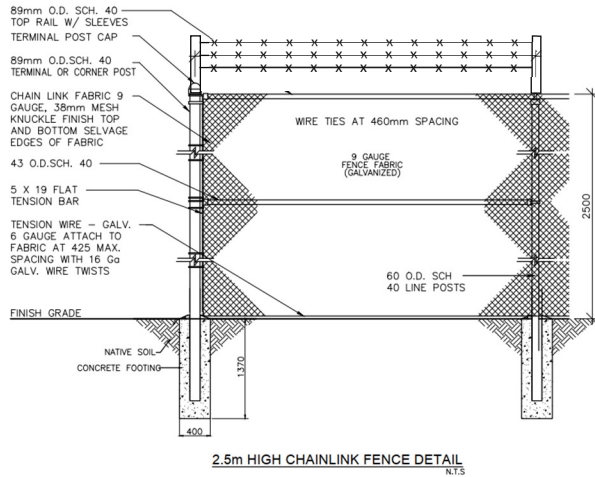
Program Adjacencies:

- 4.1.2 Visitor & Employee Parking
- 4.1.4 Yard Storage
- 4.3.1 Warehouse Spaces
- 4.3.4 Workshop Spaces



Site Security: A chain link fence encloses the yard. Vehicle access is provided through a set of cantilevered sliding gates. In order to activate the gates, a driver must activate the key-card terminal. Pedestrian access to the yard is through the Operations Centre.

4.1.5 SITE SECURITY



Secured Access Gates: Entrance / exit for the secured portion of the Enbridge site is maintained through the use of automatic sliding gates that are triggered by card access terminals / proximity sensors (when exiting). Fencing remains consistent throughout the whole site.

EQUIPMENT:

Chainlink Fence

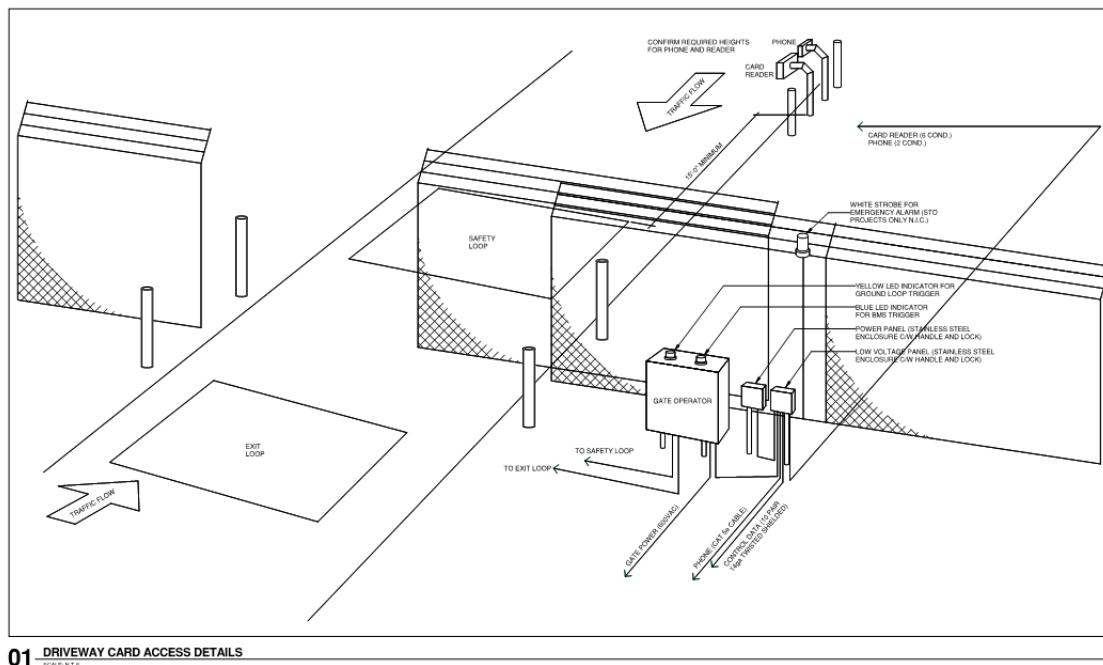
- 8' high galvanized chainlink fence with 9 gauge fence fabric
- 3 strands of barbed wire above
- Fence Screen 600 Professional Series commercial block, tight knit woven polypropylene, colour black

RFID remote / Proximity Card Reader

A dual-height post is to be located at the entry gate to the yard. The post will have two terminals, one at car height and one at truck height, and be equipped with RFID remote / Proximity Card Readers. A loop detector is to be located at the exit gate to the yard.

Gate Operator

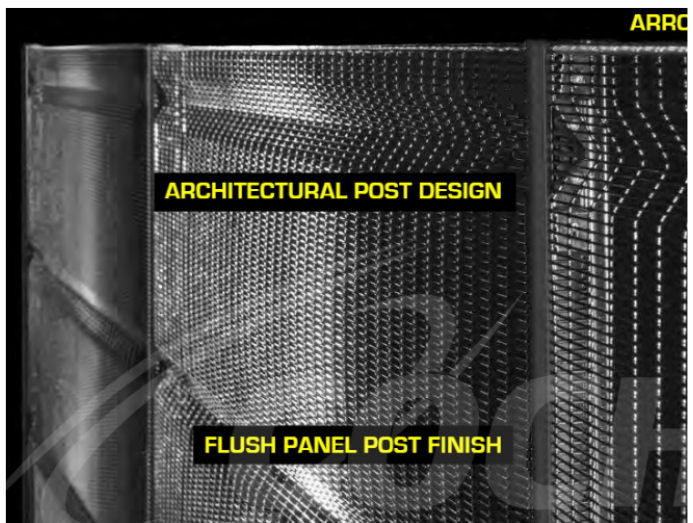
Heavy Duty Cantilever Sliding gate to have minimum clear opening of 30'. High-Traffic Commercial Slide Gate Operator to be LiftMaster SL3000 or similar. Safety and warning light to be connected to gate operator and activated upon gate energization.



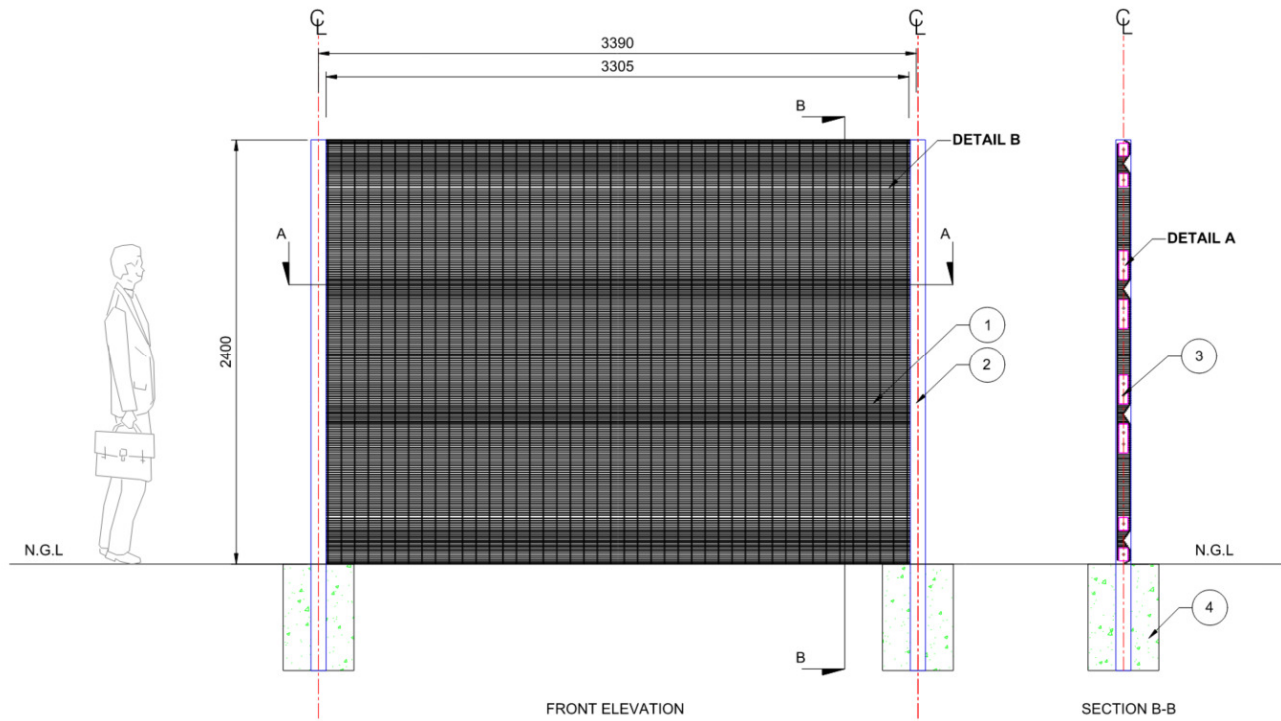
4.1.5 SITE SECURITY

PROGRAM DESCRIPTION:

Certain municipalities may also not allow chain link fence and barbed wire, especially close to residential areas. For areas like these (usually in urban areas) requiring a higher design standard, the ClearVu fencing product is proposed as an alternative.



4.1.5 SITE SECURITY



SPECIFICATION

CLEARVU INVISIBLE WALL PANEL

- 1 PANEL CLEARVU MESH PANELS 3305mm WIDE x 2400mm HIGH GALVANIZED .
 PANEL FORMATION: PANEL REINFORCED WITH 4X DEEP 'V' FORMATION HORIZONTAL RECESSED BANDS (RIGIDITY), 2 x 70° FLANGES ALONG SIDES (INTERNAL FIXTURES - ANTI VANDAL, ALLOWING FOR FLUSH POST AND PANEL FINISH, LINE WIRE SECURE CONNECTION, LOCKING RECESS MECHANISM) AND 2 x 30° FLANGES ALONG TOP AND TOE.
 (ARROW - STRAIGHT EDGES, INTEGRATED ANGLE).
 COATING: MESH GALVANIZED, THEN MARINE FUSION BOND COATED.

 (PATENTS AND DESIGN REGISTRATIONS APPLY)
- 2 POST COCHRANE TAPER LOCKING POST, SEALED WITH STEEL CAP.
 COATING: GALVANIZED, THEN STRUCTURAL MARINE GRADE COATED.
- 3 CLAMPS SINGLE BOLT COMB CLAMPS.
 DOUBLE BOLT COMB CLAMPS.
 COATING: GALVANIZED, THEN MARINE FUSION BOND COATED.
- 4 FOUNDATION TO BE SPECIFIED BY CIVIL ENGINEER ON SITE.

4.1.6 NGV FILL

PROGRAM DESCRIPTION:

Natural Gas Vehicle filling stations are split into two categories – fast fill and slow fill.

Fast fill stations require a dedicated fueling station attached to a nearby compressor. Fast fill stations are mounted on a concrete island, next to a dedicated NGV fast fill lane.

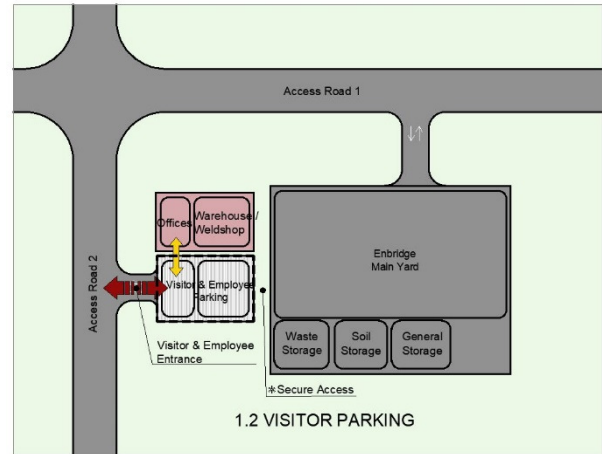
Slow fill ports are located on the charging posts next to the parking spaces. These ports fuel vehicles over several hours, or overnight. These ports are used to reduce the high demand on the compressor system versus fast fill.

SPECIFIC DESIGN PRINCIPLES:

NGV fill stations should be designed with

- Yellow bollards at every corner,
- Curbs for fast fill stations,
- Posts for slow fill ports,
- Employee fuel card readers
- No smoking / No idling signs

The NGV fast fill lane should be wide enough to accommodate fueling the largest anticipated fleet vehicle. The fill lane must be a drive-through lane, rather than a spot requiring back out of.



Program Adjacencies:

- 4.1.2 Visitor & Employee Parking
- 4.1.4 Yard Storage
- 4.3.1 Warehouse Spaces
- 4.3.4 Workshop Spaces



NGV fast fill (top) and NGV slow fill (bottom): A dedicated fast-fill lane and station support vehicles which need immediate refueling. Vehicles which are refueling overnight at the end of the day, or will not be in use for several hours, can use the slow fill stations. These ports are located on the car charging posts.

4.1.6 NGV FILL

Reserved for future illustrations.

4.1.7 CHEMICAL & HAZARDOUS MATERIAL STORAGE

PROGRAM DESCRIPTION:

Chemical & hazardous materials storage should be minimized on site. These materials (stored outside, in the yard), should only be ones used directly by business groups operating in this facility. Extra yard space should not be used as a long-term storage area for chemical & hazardous materials.

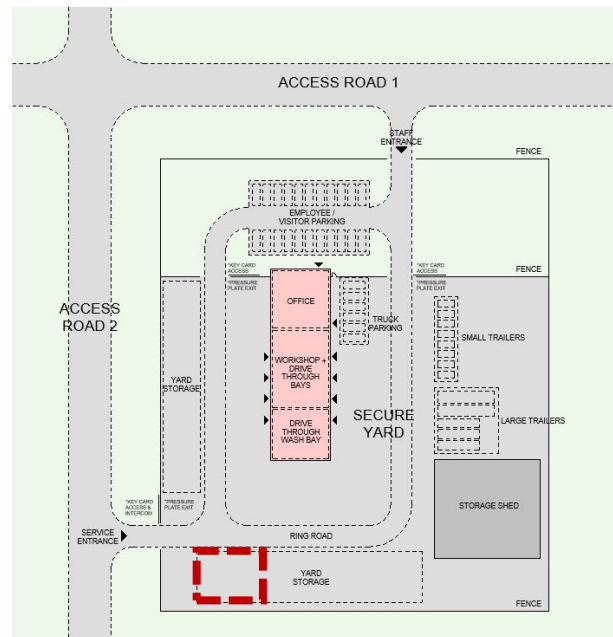
Refer to the following two pages for additional requirements for Excess Soils, as well as Hazardous Waste Requirements (from LEG and LUG procedures).

Preventative design principles aim to reduce risk associated with unauthorized access and spill prevention. These include:

- Keeping C&H materials located inside the locked yard,
- Keeping C&H materials in a secure shed or fenced compound, with controlled access
- Keeping this shed/compound out of main paths of vehicle traffic, and
- Locating bollards around this shed/compound to prevent accidental vehicle damage.

Secondary design principles aim to mitigate and react to spills. These principles are covered by the Enbridge Spill Management Standards. For site planning purposes, these include but are not limited to:

- Storing C&H liquids in closed containers
- Utilizing secondary containment methods, with a minimum containment volume of 150% the volume of the largest storage vessel,
- Keeping spill kits (as required by Enbridge standards) on site and readily available.



Chemical & Hazardous Waste Storage Sheds should be located away from high traffic areas whenever possible.

4.1.7 CHEMICAL & HAZARDOUS MATERIAL STORAGE



C&H Liquid Storage with Secondary Spill

Chemical and Hazardous materials should be stored in sealed containers, and protected from the elements. A secondary containment system should be used in case of any leaks in the containers.



Spill Kits

Spill kits should be kept on site and readily available. Spill kits should be in clearly marked locations. Spill kits should be protected from the elements.



Clear Signage

Chemicals & Hazardous Materials sheds should have clear signage displaying what is stored inside, what type of hazards they are, and any preventative actions (ie no smoking).



4.1.7 CHEMICAL & HAZARDOUS MATERIAL STORAGE

Excess Soils Requirements:

- O. Reg 406 requires that soils are to be managed and stored in a way that will not cause adverse effects (see Excess Soil Management [Standard](#) and [Procedures](#)).
- Below is a summary of requirements and suggested controls to help mitigate potential adverse effects.
 - Stockpiles **must** be stored...
 - At a facility that has controlled access (gates, fencing, attendants, or other)
 - In a location that is readily accessible for inspection, containment of spills, and spill clean-up,
 - In a quantity that does not exceed 100 cubic meters, (Note: If soils are to be stored greater than 500 cubic meters then they cannot be stored within 10m of the property line unless there is a physical barrier (concrete wall) or if it is stored for less than a week).
 - At a minimum of 30 m from a waterbody,
 - Soil of known quality must be separated from soil of unknown quality.
 - Yard stockpiles should have signage identifying the stockpile and appropriate contents.
 - Soil **must** also be managed in such a way as to prevent any adverse effects associated with the receiving, processing, storage and movement of soil including management of noise, dust, mud tracking, leaching, run-off and erosion, and potential odours.
 - The regulation and EGI Standards do not mandate specific control measures since they can vary from site to site. Many controls such as mud tracking, noise and odours should already be addressed as part of our routine operations of these facilities. Dust leaching, runoff and erosion may need to be addressed specifically and will be site specific. Some controls may include:
 - Placing soils on a impermeable pad,
 - Placing soils in covered three-sided containment or securely tarping to prevent contact with precipitation and leaching.
 - Treating stockpiles with water, minimizing freshly exposed surfaces, maintaining stockpile heights <3m or tarping to control dust.
 - Using a strategic storage location, silt fence, straw bale dams, berms, etc. to prevent sediment discharge into waterways and catch basins.



4.1.7 CHEMICAL & HAZARDOUS MATERIAL STORAGE

Hazardous Waste Requirements (from LEG and LUG procedure) :

- Any facility that stores hazardous waste must identify and label a designated storage location.
- The designated hazardous waste storage area must:
 - Be located on an impermeable pad;
 - Be segregated from incompatible materials;
 - Be an appropriate size for the amount of waste being stored (including covered secondary containment);
 - *Note: PCBs and NORM must be stored separately from other hazardous waste in a designated area*
 - Be easily accessible for the collection of waste and for disposal vehicles / waste haulers / carriers of the waste;
 - Have equipment/vehicle traffic protection measures, if necessary;
 - Have a fire extinguisher and appropriate spill kits readily available;
 - Have appropriate secondary containment, if required;
 - Be kept free of clutter, debris and other material;
 - Be within a completely fenced and locked area, if stored outdoors, and;
 - Be readily accessible for inspection, containment of spills, and spill clean-up
- The designated hazardous waste storage area must **not** be located:
 - Near designated smoking areas, open flames, or other sources of ignition
 - Next to an emergency exit door
 - Next to environmental sensitive areas (i.e., wetlands)
 - In areas accessible to the public
 - In areas where they could potentially
 - enter the environment (i.e., storm sewers, drainage systems, catch basin, watercourses, etc.)
 - contaminate surface or groundwater supplies
 - contribute to air contamination or odour issues

Note: For Quebec, hazardous waste must be stored in an area with 3 walls, a roof and an impermeable floor. The floor must rise to form a basin able to hold the greater of the following volumes: 25% of the total capacity of the receptacles stored or 125% of the capacity of the largest receptacle (if applicable).

4.1.8 ELECTRIC VEHICLE SUPPLY EQUIPMENT

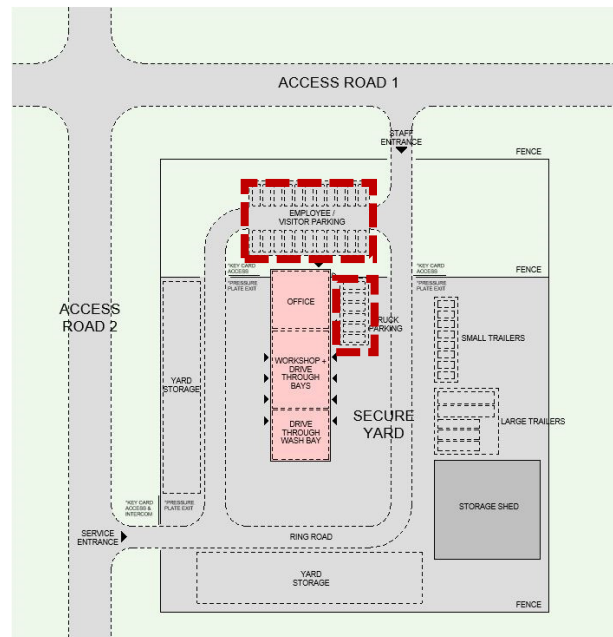
PROGRAM DESCRIPTION:

Electric Vehicle Supply Equipment is used to safely charge Electric Vehicles. Currently, there are two main types of chargers – Level 2, and DCFC. Level 2 chargers are more commonplace and can charge an EV to full charge over a day, or overnight. DCFC chargers are much larger and more expensive, but can charge an EV to full charge in just over an hour.

As electric vehicles become more commonplace, it will become standard practice to provide EVSE for employee and even fleet vehicle use.

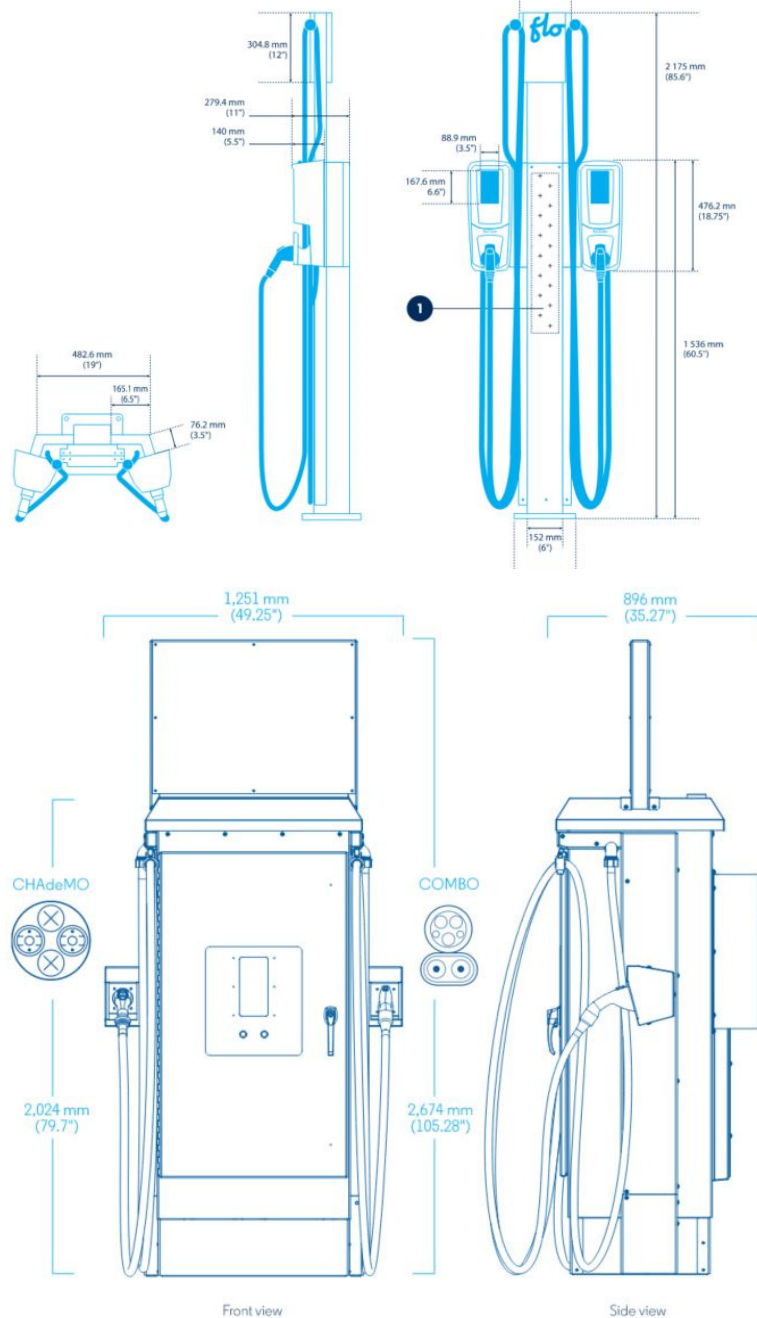
Site Considerations:

- The recommended charging stations are rated for outdoor use. There is no need to build covering enclosures. This equipment is rated for standard operating conditions (-40 °C to 50 °C, up to 95% humidity).
- The charging stations can be wall mounted or pedestal mounted. The pedestals can dual-mount chargers to supply two parking spaces. It is recommended to use the optional cable management system.
- All charging stations should be protected from water by a raised concrete pad (with positive drainage away from the equipment base).
- Charging stations should be protected from vehicle impact with highly visible traffic bollards.



EVSE are typically located at parking stalls.

4.1.8 ELECTRIC VEHICLE SUPPLY EQUIPMENT



Standard EVSE:

- FLO CoRe+ (top). This is a Level 2 charger. It can take up to 8h for a full charge. They operate at 208-240V, and are the most prevalent type of charger currently used.
- FLO SmartDC (bottom). This is a DCFC charger. Direct Current Fast Chargers are the fastest chargers currently available. They can charge an EV battery to 80% in 20-40 minutes, and to 100% in 60-90 minutes. DCFC stations are more expensive than Level 2 stations, but their quick charging times make them attractive for fleet usage.

Types of EV Charging ports

- SAE J1772 Charging Connector. This is the new North American EV charging connector standard. Supported vehicles models include but are not limited to: Chevy Volt, Nissan Leaf, Tesla Model S, and newer Toyota Prius.
- CHAdeMO. This is a fast-charging standard for electric vehicles. This protocol allows for communication between the charger and the vehicle to allow for safer charging.





OFFICE COMPONENTS

4.2.1 VESTIBULE

PROGRAM DESCRIPTION:

The vestibule is a secure entrance into the Enbridge Office. Visitors are allowed into the vestibule without key-card access during regular business hours. The vestibule has a telephone to allow conversation with staff in the open office. Visitors can then be buzzed into the secure office portion of the Operations Centre.

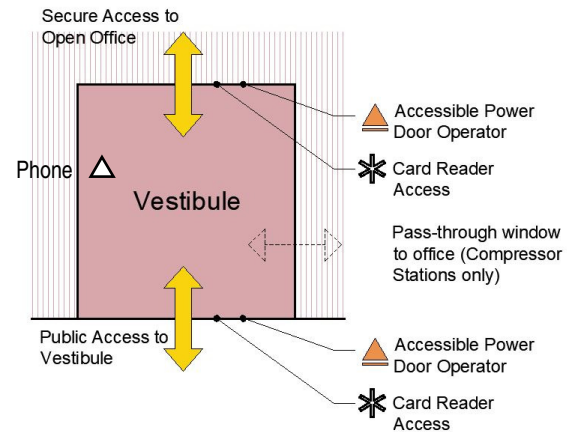
SPECIFIC DESIGN PRINCIPLES:

For security reasons, there are two sets of card-readers. During regular business hours, the outdoor card reader is left unlocked, allowing visitors to enter the vestibule.

From the vestibule, they can speak with an employee working at the office. If they are permitted access, the employee can buzz them through the second set of secure doors. After standard business hours, the outdoor card reader is locked.

Visitors must sign in at a visitor's sign-in log at a table after the vestibule. This log may be located at a reception or security desk where present.

Operations Centres with a compressor station attached will generally have higher security requirements. These operations centres may have a pass-through window to a security guard.



Program Adjacencies:

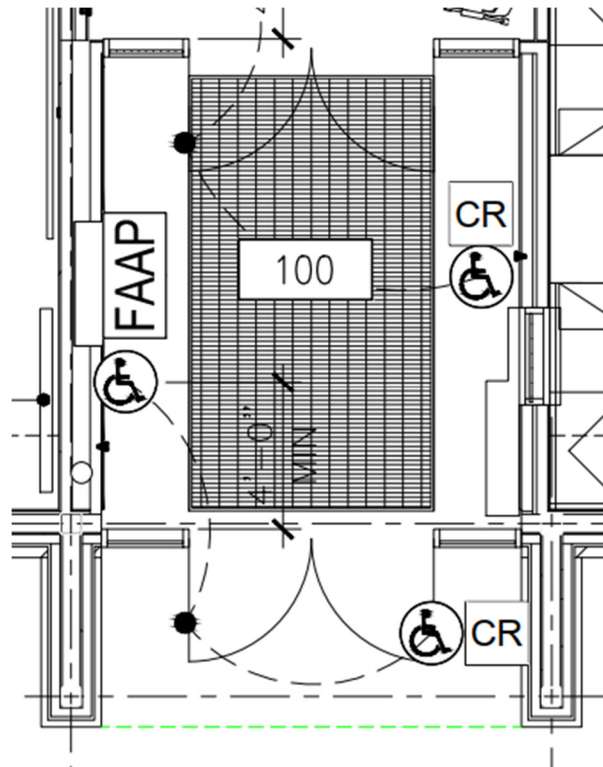
4.1.2 Visitor Parking

4.2.2 Open Office



Vestibule: The vestibule is open to public access during regular business hours. For access to the building, a visitor must phone the office on a wall mounted phone.

4.2.1 VESTIBULE



Vestibule: Two sets of electric strike equipped doors, connected to card-readers, secure the vestibule. The first set of doors is left unlocked during regular business hours, so visitors can walk in and speak to office staff. The visitors then can get buzzed in.

EQUIPMENT:

Fire Alarm Equipment Mounting

- Fire Alarm Annunciator Panel, Fire Alarm Graphic, and First Aid Kit are all mounted to one wall of the Vestibule.

Fail Secure / Fail Safe Electric Strikes

- In the event of a power failure or other emergency, the Operation Centre doors equipped with electric strikes will fail safe / fail secure to direct traffic out of the facility.

Floor Footgrille

- Recessed pre-finished aluminum footgrille. Sizing dependent on vestibule square footage (typically 13' x 6'-8")

FINISHES:

Flooring:

- Porcelain Tile

Base:

- Porcelain Tile

Walls:

- Exposed Brick

Ceiling:

- Painted
- Gypsum Board or other wind proof ceiling
- Painted Gypsum Bulkhead

4.2.2 OPEN OFFICE

PROGRAM DESCRIPTION:

The open office is a large workspace with semi-partitioned individual workstations. The office should have large windows for natural light and good views to the outside. The open office has a large amount of program adjacencies, including other office program, office support spaces, and a pull-through connection to the vestibule.

Area: Accommodate +/- 50% of staff

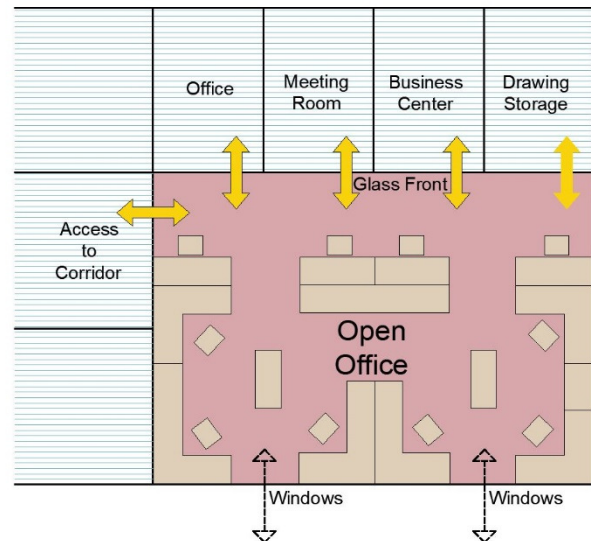
Workstation Size: 6' x 8'

SPECIFIC DESIGN PRINCIPLES:

The open office is split into two general desking types. The first type consists of large permanent desking for employees primarily involved in office work. The second type consists of drop-in desks for employees primarily involved in field work to perform paperwork and other office duties.

The office should have good support for mobile technology, such as good WiFi coverage and cellphone signal extenders.

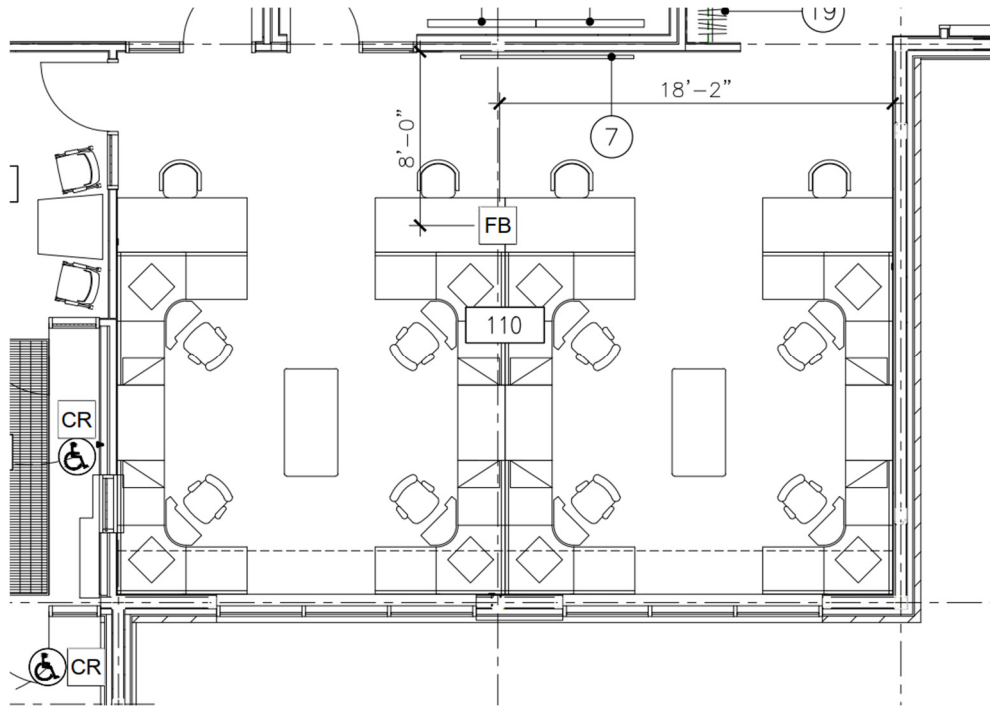
Specific office furniture selections and finishes should follow the latest version of the Enbridge Office Standards.



Program Adjacencies:

- | | | | |
|-------|-----------------------|-------|------------------------|
| 4.2.1 | <i>Vestibule</i> | 4.2.5 | <i>Business Centre</i> |
| 4.2.3 | <i>Private Office</i> | 4.2.6 | <i>First Aid Room</i> |
| 4.2.4 | <i>Meeting Spaces</i> | | |

4.2.2 OPEN OFFICE



Typical Open Office (top): An office layout with open desking layout. Employees work in a large room and share natural light and views outside. Private offices, meeting rooms and other support spaces are tucked further into the building. **(bottom right)** Enbridge Standard Open Plan Workstations and Drop In Workstations.

EQUIPMENT:

Office Desking

- Knoll Workstations

FINISHES:

Flooring:

- Carpet Tile

Base:

- Carpet Base

Walls:

- Paint

Ceiling:

- Acoustic Ceiling Tile
- Paint

4.2.3 PRIVATE OFFICE

PROGRAM DESCRIPTION:

The private office is an acoustically enclosed component which must sit directly adjacent to the open office. The Enbridge standard is to provide a 10' x 10' office with a desk and two chairs for employees.

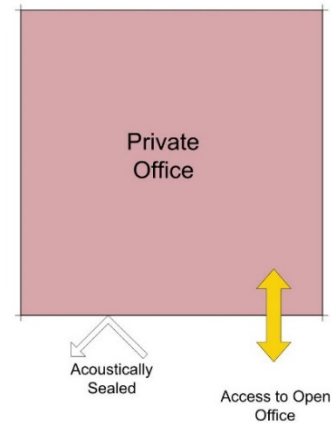
The private office should not face a window outside. This is to help equalize the difference between those sitting in private offices, and those sitting in the open office. Employees who sit in private offices have a larger, private space, but have no direct views outside. Employees in the open office have good views outside and ample daylight.

Area: 10' x 10'

Quantity: Varies. Maximum 20% staff. For small facilities – 1 office for dynamic / hotel use.

SPECIFIC DESIGN PRINCIPLES:

Specific office furniture selections and finishes should follow the latest version of the Enbridge Office Standards.



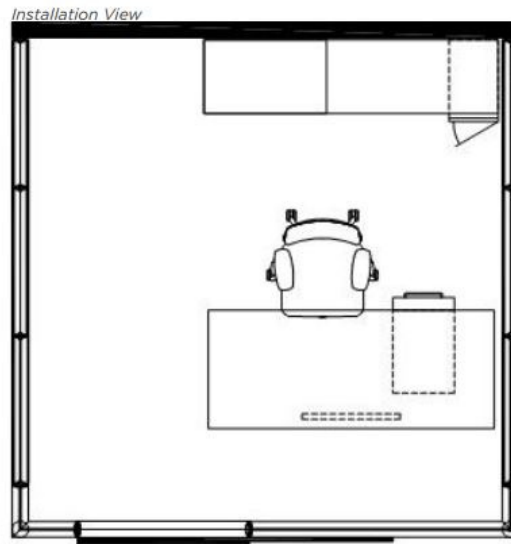
Program Adjacencies:

4.2.2 [Open Office](#)



Private Office: The Enbridge Office standard is floor-to-ceiling glazing, with frosted glazing as required for privacy. This system gives a clean, sophisticated look while still keeping acoustic separation, daylighting, and visual connections.

4.2.3 PRIVATE OFFICE



Typical Private Office (top): A private office must be acoustically sealed for confidential discussions. It requires adjacency to the open office and other office components. The Enbridge Standard is to use DIRT provided partitions, a floor to ceiling glazing system which offers daylighting, views, but also an eye-level frosted pattern for privacy. **(bottom right):** Typical partitioned office system and typical Knoll office desking system.

EQUIPMENT:

Office Desking

- Knoll Workstations

FINISHES:

Flooring:

- Carpet Tile

Base:

- Rubber Base

Walls:

- Paint
- Wall-to-Ceiling Glass Magnetic Whiteboard Material or panels

Ceiling:

- Acoustic Ceiling Tile



4.2.4 MEETING SPACES

PROGRAM DESCRIPTION:

There are three types of meeting spaces relevant to an Operations Centre. They are the:

- **Small Meeting Room** (10' x 10')
 For small facilities, 1 small meeting room present. For large facilities, 1 small meeting room per 15 staff.
- **Focus Room** (10' x 10')
 For small facilities, 1 small meeting room present. For large facilities, 1 small meeting room per 50 staff.
- **Large Meeting Room** (as necessary)
 For small facilities, 1 large meeting room present. The large meeting room should be able to accommodate all office staff. For large facilities, 1 large meeting room per 50 staff.

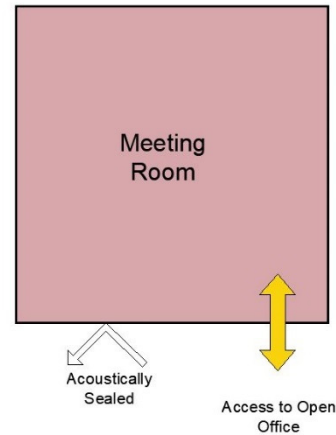
The meeting rooms should share adjacencies to the open office cluster.

SPECIFIC DESIGN PRINCIPLES:

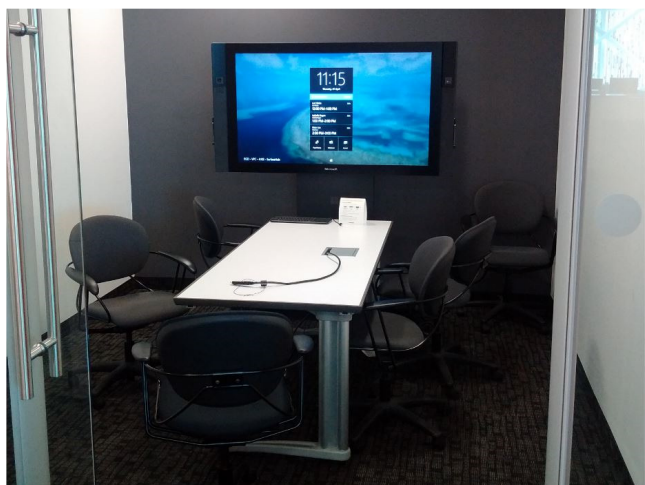
Other requirements include:

- Acoustical separation from main space
- Good wifi and lighting
- Accommodation for AV telepresence equipment
- Whiteboards
- Support for mobile technology, such as cellphone signal extenders.

Specific office furniture selections and finishes should follow the latest version of the Enbridge Office Standards.

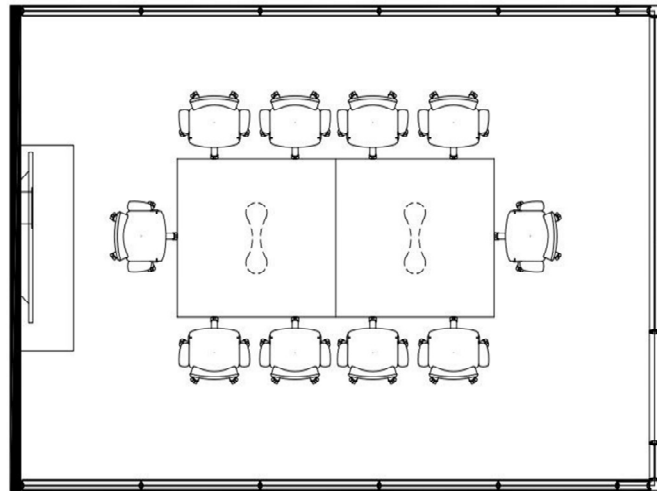
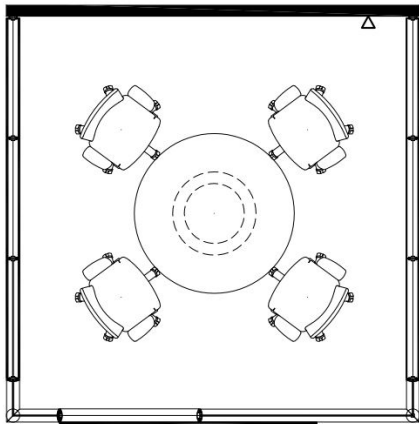


Program Adjacencies: 2.2 Open Office



Meeting Rooms: The Enbridge Office standard is floor-to-ceiling glazing, with frosted glazing as required for privacy. The meeting room should be acoustically sealed. Telepresence, A/V equipment, and whiteboards should be standard equipment in meeting rooms.

4.2.4 MEETING SPACES



Typical Focus Room and 10 Person Meeting Room: A meeting space must be acoustically sealed for confidential discussions. It requires adjacency to the open office and other office components. A meeting room also requires whiteboards, tackboards, and technology access. Best practice is to leave no less than 5'-0" of space between edge of table to wall.

EQUIPMENT:

Room Scheduling System (Enbridge Standard)

Wall/Glass mounted digital room scheduling system to be provided. Enbridge standard is the Steelcase Room Wizard II. System to be powered via data cabling.

Glass Magnetic White Board

Glass Magnetic WBs to be Egan Aero Hover Magneti, sized 4'-0" height x length of wall or as specifically noted. Boards to be supplied with 10 magnets and one 1'-0" long Egan Aero marker tray per room.

Tack Board

Tack Boards to be Architectural School Products-Forbo Bulletin Board. Size at 4'-0" x 4'-0".

FINISHES:

Flooring:

- Carpet Tile

Base:

- Carpet Base

Walls:

- Paint

Ceiling:

- Acoustic Ceiling Tile

4.2.5 MUSTERING ROOM

PROGRAM DESCRIPTION:

The Enbridge mustering room is a space where field staff are assembled to receive their daily work rotations, receive updates, and to be debriefed at the end of the work rotation. The mustering room has two major parts – a large meeting table for all staff to sit at, and individual workstations for staff to perform paperwork and other office tasks.

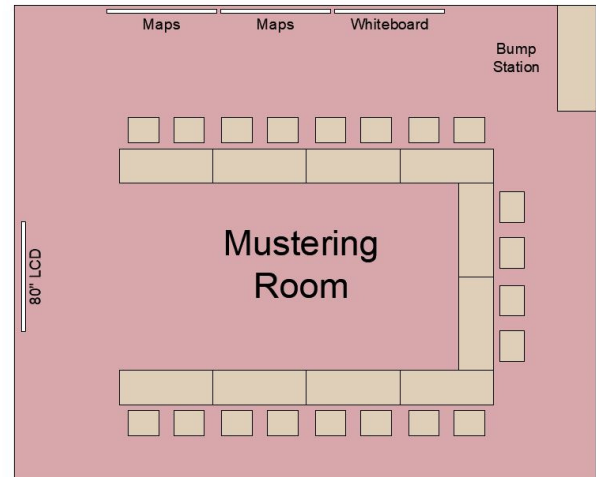
Additional mustering room equipment includes whiteboards, bulletin boards, and map rails / areas to post district maps. The meeting table should have A/V equipment, power for laptops, good wifi support and ample space for deskwork.

Area: 1 Chair / Field Staff @ 15 sf each, plus
 1 Dynamic Workstation

Small Facility: 2,300 sf

SPECIFIC DESIGN PRINCIPLES:

Specific office furniture selections and finishes should follow the latest version of the Enbridge Office Standards.



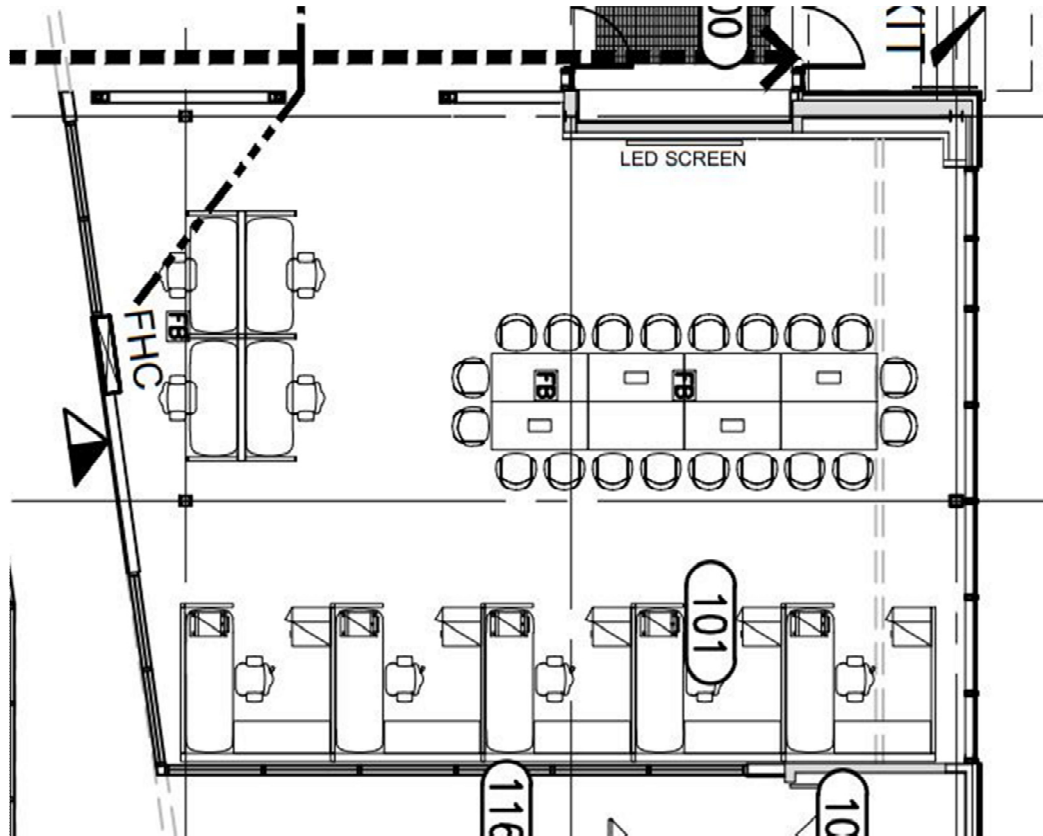
Program Adjacencies:

- 4.1.4 Fleet Parking
- 4.2.2 Open Office



Mustering Room: The Enbridge VPC Annex Mustering Room boasts a large floor-to-ceiling window wall. The space has high ceilings, pleasant views, and is reasonably protected from harsh daylight. The space is very inviting.

4.2.5 MUSTERING ROOM



Mustering Layout: Semi-private in layout, the Mustering room provides a gathering point adjacent to the open office area. As seen above, there is adequate circulation on all sides of the large meeting table which allows for ease in the flow of traffic as the debriefings occur.

EQUIPMENT:

Drop-in Workstations

Supplied by Knoll, refer to Open Office standard

Meeting Tables

Supplied by Knoll, refer to Open Office standard

Glass Magnetic White Board

Glass Magnetic WBs to be Egan Aero Hover Magneti, sized 4'-0" height x length of wall or as specifically noted. Boards to be supplied with 10 magnets and one 1'-0" long Egan Aero marker tray per room.

Tack Board

Tack Boards to be Architectural School Products-Forbo Bulletin Board. Size at 4'-0" x 4'-0".

FINISHES:

Flooring:

- Vinyl Tile

Base:

- Rubber Base

Walls:

- Painted Concrete Block

Ceiling:

- Acoustic Ceiling Tile

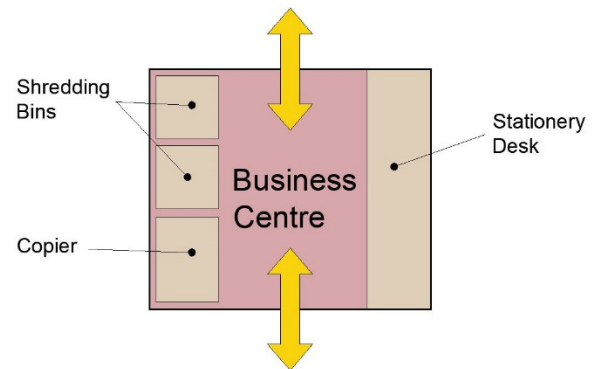
4.2.6 BUSINESS CENTRE

PROGRAM DESCRIPTION:

The business centre is an office support space. The space should be semi-enclosed for acoustic separation to the open office desking areas. The business centre should share adjacencies to the other open office components.

Common equipment includes:

- Printer/Copier machine
- Shredder machine or locked bin
- Mail supplies
- Assorted stationery
- Bulletin board and posting board



Program Adjacencies:
 2.2 Open Office

SPECIFIC DESIGN PRINCIPLES:

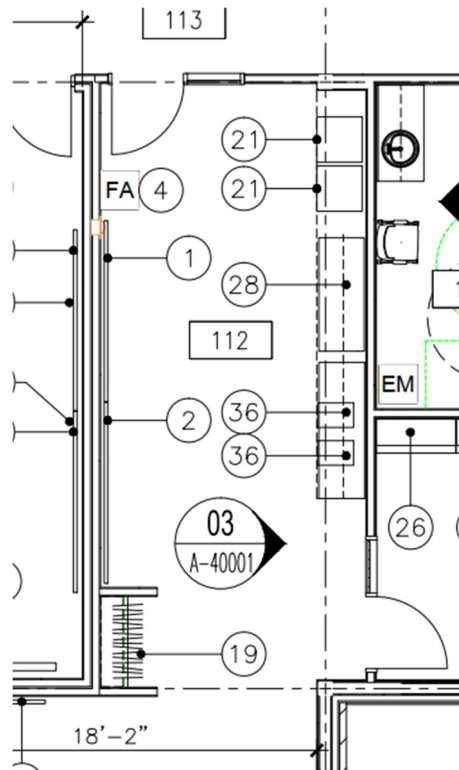
Furniture should be compact and efficient, with all necessary stationery close at hand.

Specific office furniture selections and finishes should follow the latest version of the Enbridge Office Standards.



Business Centre: The business centre holds a printer/copier, shredder, water cooler, mail supply area, stationery, and a posting board. At the Sarnia Operations centre, the Business Centre acts as a buffer space and acoustic separation between the main corridor and the open office.

4.2.6 BUSINESS CENTRE



Typical Business Centre: A business centre typically has two printer/coper machines, counterspace, storage, and other document finishing equipment. The business centre should have adjacencies to the open office and other office spaces such as meeting rooms and private offices.

EQUIPMENT:

Business centre equipment is dependent on the size of the Operation Centre and the staff capacity at the location. At a minimum, the following items should have space allocated:

- Printer / Copier Machine (1x or 2x)
- Shredder Machine / Locked Bin
- Water Cooler
- Mail Supplies
- Assorted Stationery
- Bulletin Board / Posting Board / Union Board

Millwork to include upper cabinetry and lower shelves with a countertop surface suitable for storage as well as general printing activities (compiling, collating, binding, etc.)

FINISHES:

Flooring:

- Vinyl Flooring+

Base:

- Rubber Base

Walls:

- Paint

Ceiling:

- Acoustic Ceiling Tile

4.2.7 FIRST AID ROOM

PROGRAM DESCRIPTION:

The first aid room is a room for employees who feel sick to rest and/or seek medical attention. The room is also used to store basic health and safety supplies and first aid kits. It should be noted that since the majority of hazards are faced on work sites, that injured staff would drive or be driven straight to the hospital.

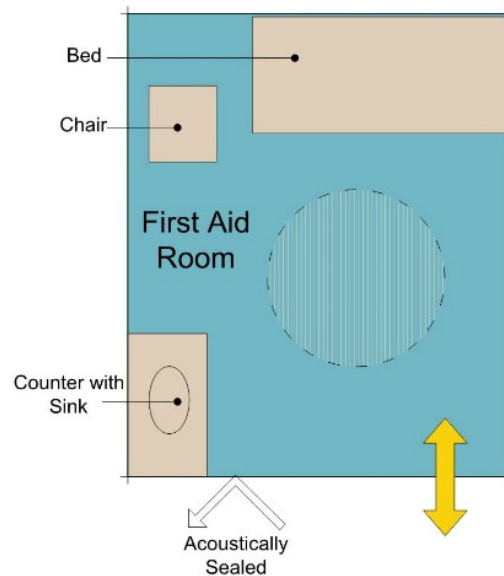
Application: All facilities, mandated where > 200 employees per shift.

SPECIFIC DESIGN PRINCIPLES:

Standard equipment should include:

- Sink
- Phone
- Health and Safety Policy & Manuals

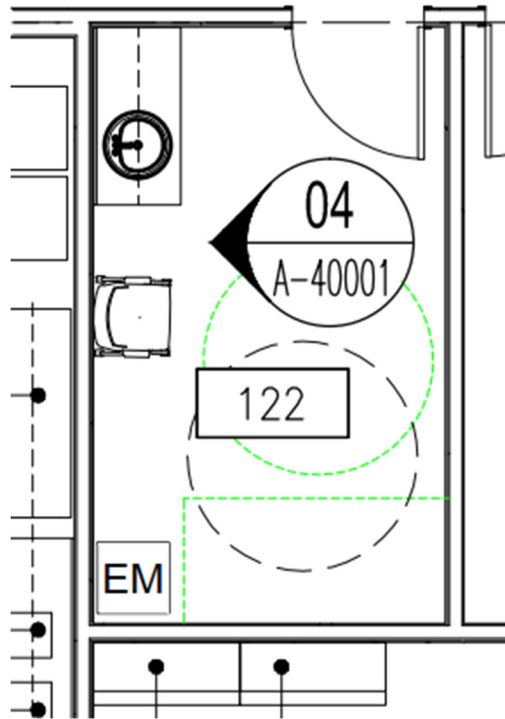
Previous First Aid Rooms have been labeled as “Universal Washrooms” and/or “Health Rooms”. The program of each Operation Centre dictates the requirement for each type of First Aid area. Universal Washrooms include a toilet while the Health Rooms can include an adult change table or even a shower.



Program Adjacencies:

4.2.2 Open Office

4.2.7 FIRST AID ROOM



Typical First Aid Room: The first aid room is an acoustically sealed room for an unwell employee to rest, or receive medical treatment. Furniture includes a cot bed, chair, and sink with a counter. The first aid room should have adjacencies to the open office as well as the building entrance to the yard.

EQUIPMENT:

The inventory of supplies in the First Aid Room should be monitored and maintained to ensure staff are able to use the space whenever necessary.

FINISHES:

Flooring:

- Porcelain Tile

Base:

- Tile Base

Walls:

- Paint

Ceiling:

- Acoustic Ceiling Tile

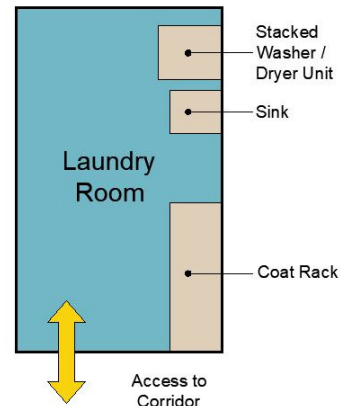
4.2.8 LAUNDRY ROOM

PROGRAM DESCRIPTION:

The Laundry Room is a room for Enbridge employees to clean off dirty work apparel before returning into the office. Outerwear may be contaminated with harsh chemicals and other hazardous substances. On-site laundry is also an amenity for staff, who would have to take dirty clothes home otherwise.

The laundry room should be located close to the building entrance facing the yard. This adjacency will mean less tracked mud and dirt around the Operations Centre.

Area: 350 sf



Program Adjacencies:

4.1.2 Employee Parking

4.1.3 Fleet Parking and Maintenance

SPECIFIC DESIGN PRINCIPLES:

The laundry room should be equipped to wash dirty clothes, boots, and other articles of clothing. The room should have:

- a washing machine
- a drying machine
- a sink and counter
- drying racks over the boot wash
- mats on the floor for grip

EQUIPMENT:

Stacked Washer / Dryer

- Maytag MLG20PDB – Energy Star Rated Stackable Washer / Dryer. Large Capacity 3.1 cu.ft washer, 6.7 cu.ft dryer.

Sink and counter

- Bradley Sentry Semi-circular, SN2023 – Wall-mounted

FINISHES:

Flooring:

- Trowelled Epoxy Flooring

Base:

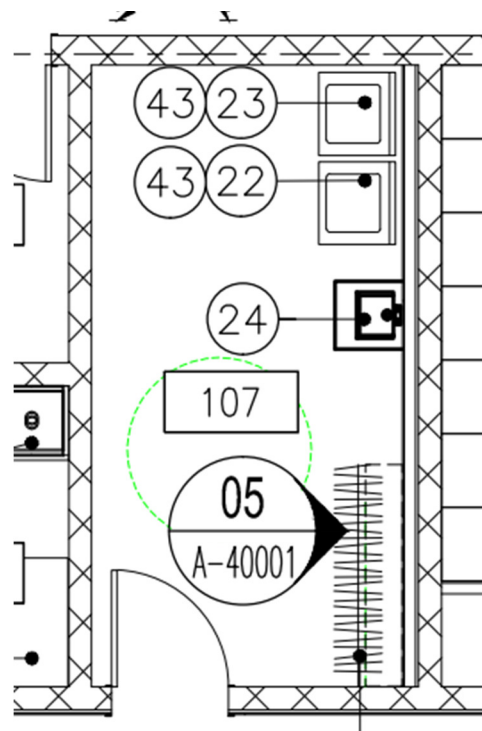
- Rubber Base

Walls:

- Epoxy Paint
- Ceramic Tile

Ceiling:

- Exposed Painted Structure



Typical Laundry Room: The laundry room is located close to the fleet parking entrance, in order to reduce the amount of mud tracked into the building. The laundry room is equipped with a washing machine, drying machine, sink and counter, boot wash station, and a clothes rack.

4.2.8 BOOT WASH

PROGRAM DESCRIPTION:

The Boot Wash is designed for employees to quickly wash mud and chemicals off of work boots before entering office spaces. The boot wash must be quick, intuitive, and easy to use.

The current best practice is to use a floor-mounted water-assisted brush product. With this product, the user steps into a slightly sloped cove with a trench drain. The user places his or her boot in between the brushes. The user turns on the water supply, which runs water from the sides. This makes it easier to wash off dried mud and chemicals off of the work boots.

Where possible, ledges should be avoided in designing a boot wash. This presents an unnecessary hazard. A sloped floor will be sufficient to keep runoff in.

EQUIPMENT:

Boot Wash

- Floor: Epoxy grout, resistant to urine, acids, alkalis, petroleum distillates, oils, etc.
- Walls surrounding boot wash area to have ceramic wall tile

FINISHES:

Flooring:

- Trowelled Epoxy Flooring

Base:

- Rubber Base

Walls:

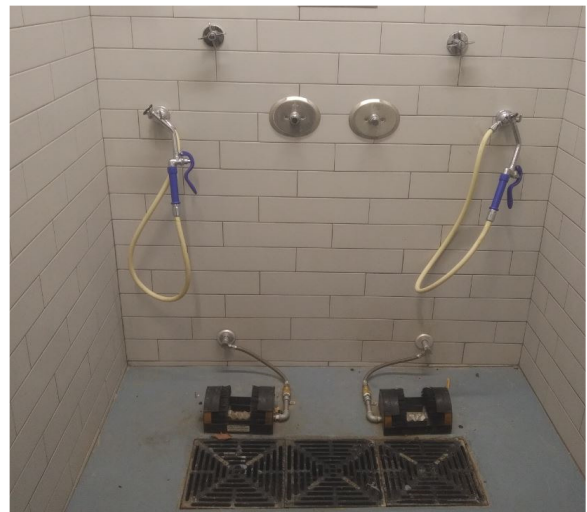
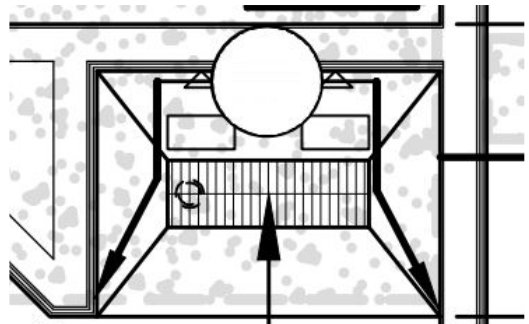
- Epoxy Paint
- Ceramic Tile

Ceiling:

- Exposed Painted Structure

Program Adjacencies:

- 4.1.2 *Employee Parking*
- 4.1.3 *Fleet Parking and Maintenance*



Typical Boot Wash: A boot wash located in a cove. The trench drain is open, with no ledge. Two floor-mounted water assisted boot washers help wash caked off mud.

4.2.9 LUNCH ROOM

PROGRAM DESCRIPTION:

The lunch room is an office amenity with ample seating area, basic food preparation, and patio seating. The lunch room is designed to be an attractive space which encourages employees to stay on the premises during the lunch hour.

The lunch room should be designed with ample daylight, good views to outside, good interior lighting and high-quality furniture and interior finishes. The lunch room is a very important office amenity space, and should be carefully designed.

Size for staff:

Large Facilities
 7 sf / per person

Small Facilities
 For facilities with less than 50 people,
 design maximum capacity at 50% of
 office staff. Absolute minimum to be four
 seats at a table.

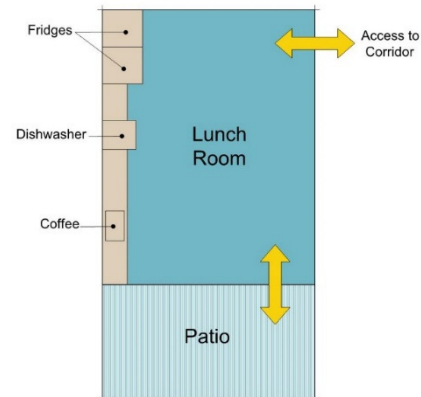
SPECIFIC DESIGN PRINCIPLES:

The lunch room also doubles as a coffee lounge and an impromptu meeting area when all other meeting spaces are taken. The lunch room should have support for technology (WiFi, power outlets) to allow for people to work on laptops in the space outside lunch hours. Televisions should also be provided for staff use.

Standard equipment should include:

- Refrigerators
- Dishwasher
- Sink
- Coffee Machine
- Tables and chairs
- Television
- Notice Board and/or White board

In some instances the Lunch Room can be converted to a training room where videoconferencing requirements are included in the layout of the space. Under table floor boxes (embedded into the concrete slab) allow for conferencing abilities at each table, while the large TV screen can be converted for use as a



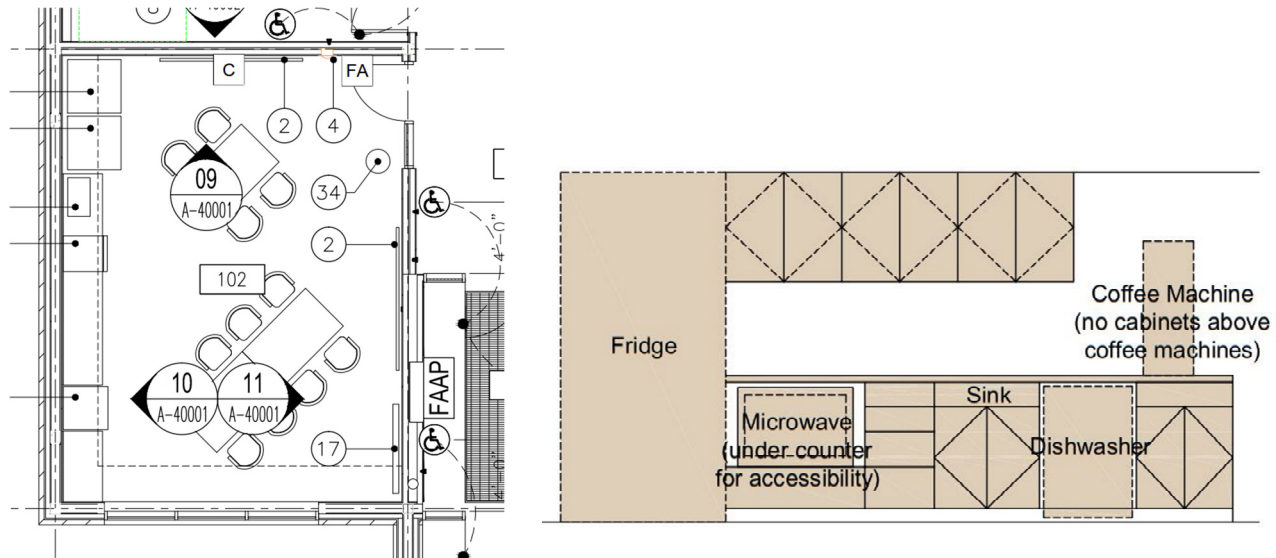
Program Adjacencies:

2.2 Open Office



Lunch Room: The lunch room is an important employee amenity. This lunch room has an associated patio as well as large windows allowing for generous daylighting. Playful furniture and high-quality millwork complement the space.

4.2.9 LUNCH ROOM



Typical Lunch Room: There is ample seating provided relative to the size of the operations centre. There are also several refrigerators, reducing the chance of overcrowding. The lunch room counter has several microwaves, a dishwasher, and in certain cases a stovetop. The lunch room should have adjacencies to the open office, as well as a direct connection to the patio.

EQUIPMENT:

Refrigerators

- 33" wide consumer grade, stainless steel finish.

Dishwasher

- Consumer grade, stainless steel finish.

Microwave

- Consumer Grade

Coffee Machine

- Keurig, Model K150 series

Water Cooler

- Water Logic, Model WL2000

Television

- 80" diagonal size, wall mounted, c/w wall mount hardware

FINISHES:

Flooring:

- Resilient Flooring

Base:

- Rubber Base

Walls:

- Paint

Ceiling:

- Acoustic Ceiling Tile
- Paint

4.2.10 CHANGEROOMS

PROGRAM DESCRIPTION:

A changeroom is provided to Enbridge Employees to change into work clothes, shower, use the gym, and store personal belongings. Changerooms should have adjacencies to the Fleet Parking yard, and gym (if present). In an Operations Centre, the changerooms also act as the main washrooms for staff.

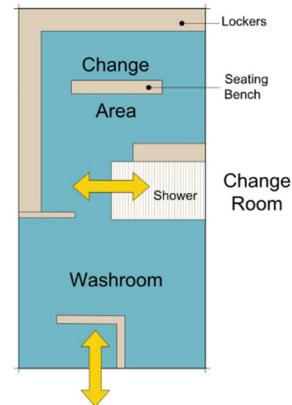
SPECIFIC DESIGN PRINCIPLES:

The changeroom should have large, well ventilated lockers. They should be made of metal and finished with a powder coat. There should be enough lockers provided for all staff which require one.

Ample seating should be provided in the change area.

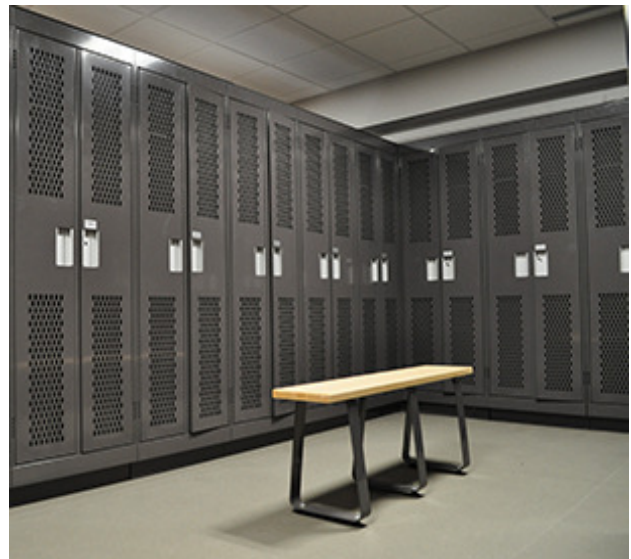
Wall mounted coat racks should be provided in the change area for the hanging of outerwear.

Private showers should be provided at a count appropriate to staffing levels. Showers should have towel racks as well as small shelves for soaps and shampoos.



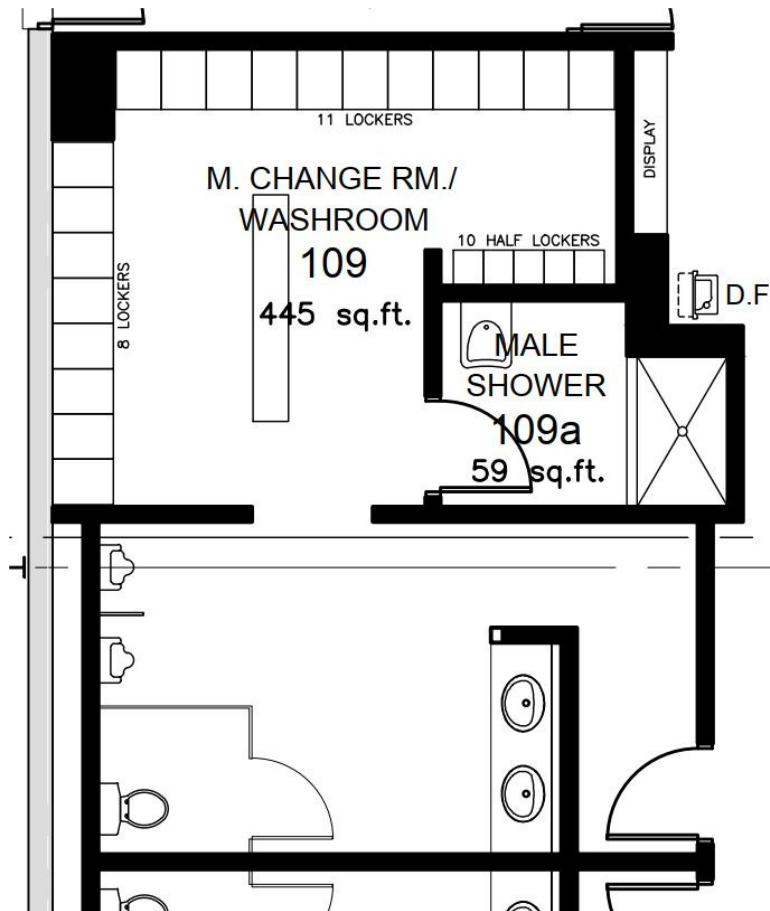
Program Adjacencies:

- 2.9 Changeroom Showers
- 2.9 Changeroom Washroom



Changerooms: Large lockers ensure enough space for employees to keep summer and winter outerwear as well as footwear inside their lockers. Ample storage space reduces the need of employees to keep extra belongings outside their designated lockers.

4.2.10 CHANGEROOMS



Typical Changeroom: A typical changeroom has three main components – a change area with lockers / seating, a shower, and a washroom. This room functions as the operation centre’s main washroom, change area, and personal items storage for staff.

EQUIPMENT:

Lockers

Lockers to be 2’ wide Gladiator vented lockers for field team.

Quantity: Provide 1 per field staff.

Locker Room Bench

Bench to be “A” frame steel pedestal with wooden seat. Pedestal 25mm x 25mm 16 gauge cold rolled steel, with powder coat finish. Colour 220 Slate. Size 280mm wide base x 385mm high frame. Frame spaced max 1m o.c. Black PVC glide at each leg. Seat to be Eastern Maple butch block 32mm thick x 255mm wide, 2000mm length.

FINISHES:

Flooring:

-Tile

Base:

-Tile

Walls:

-Epoxy Paint
 -Tile wet walls

Ceiling:

-Gypsum Wall Board

4.2.11 GYM (FOR REGIONAL OPERATIONS CENTRES)

PROGRAM DESCRIPTION:

The gym is a staff amenity provided for employee use only. While there is a cost to providing the space and equipment, the benefit is helping staff stay healthy, happy, and on-site instead of spending time travelling to a private gym. The gym should have adjacencies to the changerooms.

Application: Provide gym where staff count is > 100.

Program Adjacencies:

4.2.10 [Changeroom](#)

SPECIFIC DESIGN PRINCIPLES:

A typical gym should carry a selection of standard equipment such as:

- Cardio equipment,
- Strength equipment
- free weights,
- core conditioning equipment

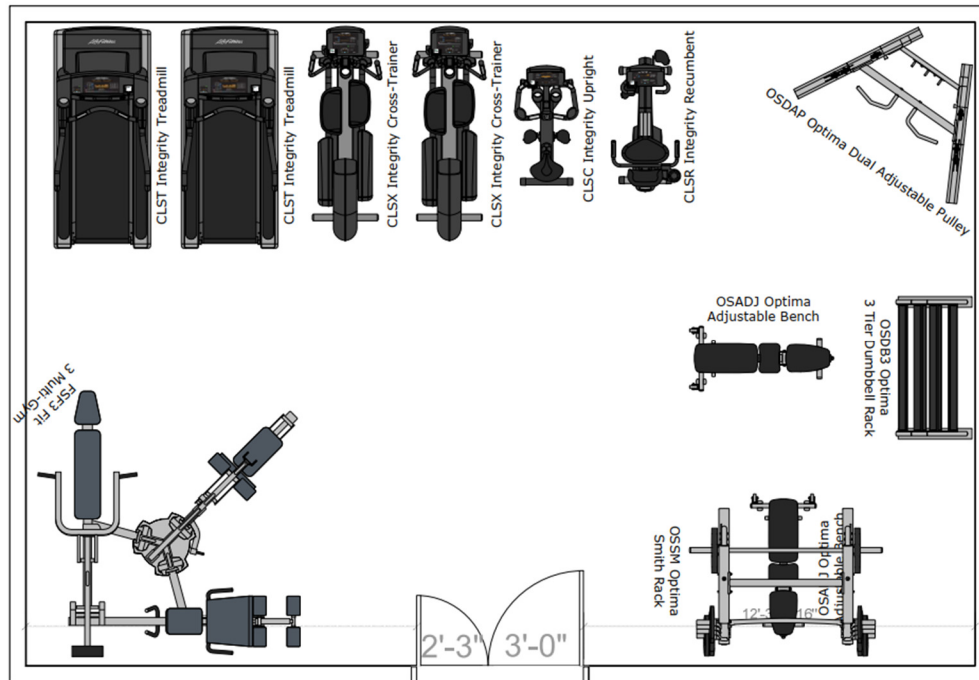
Please refer to the gym equipment supplier for appropriate sizing of gym area and equipment specifications.

Other equipment such as yoga mats/blocks, yoga balls, and stretching equipment provided would be an additional amenity.



Typical Small Gym: Gym size and equipment fit-outs should be appropriately sized for the staffing levels of the operations centre. For smaller operations centres, multi-use gym equipment is an ideal choice.

4.2.11 GYM (FOR REGIONAL OPERATIONS CENTRES)



Typical Gym: A small room located close to changerooms, or with direct connection to changerooms. A small gym should have a variety of cardio, weights, and strength training weights. Multi-use gym equipment would be a good use of limited space.

EQUIPMENT:

Treadmill

-Refer to equipment supplier for specifications.

Cross-Trainer Elliptical

-Refer to equipment supplier for specifications.

Upright Bicycle

-Refer to equipment supplier for specifications.

Recumbent Bicycle

-Refer to equipment supplier for specifications.

Weights and bench

-Refer to equipment supplier for specifications.

3-in-1 Multi-Gym

-Refer to equipment supplier for specifications.

SUPERVISION:

-Security Camera

FINISHES:

Flooring:

-Rubberized Athletic Flooring

Base:

-Rubber Base

Walls:

-Epoxy Paint
 -Pre-finished Metal Liner Panels

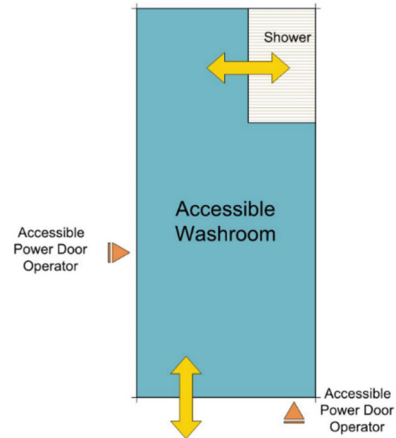
Ceiling:

Exposed Metal Liner Panel / Painted Structure

4.2.12 UNIVERSAL WASHROOM / SHOWER / LOCKER

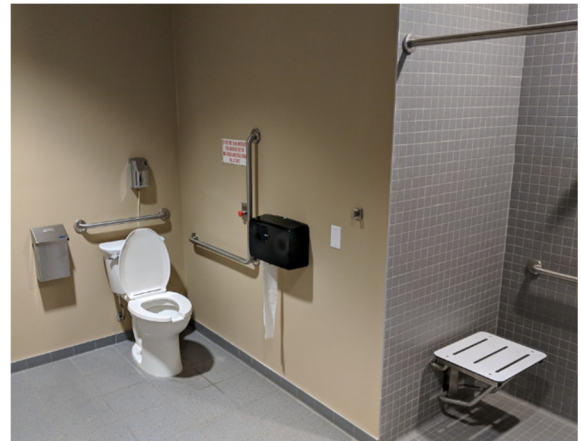
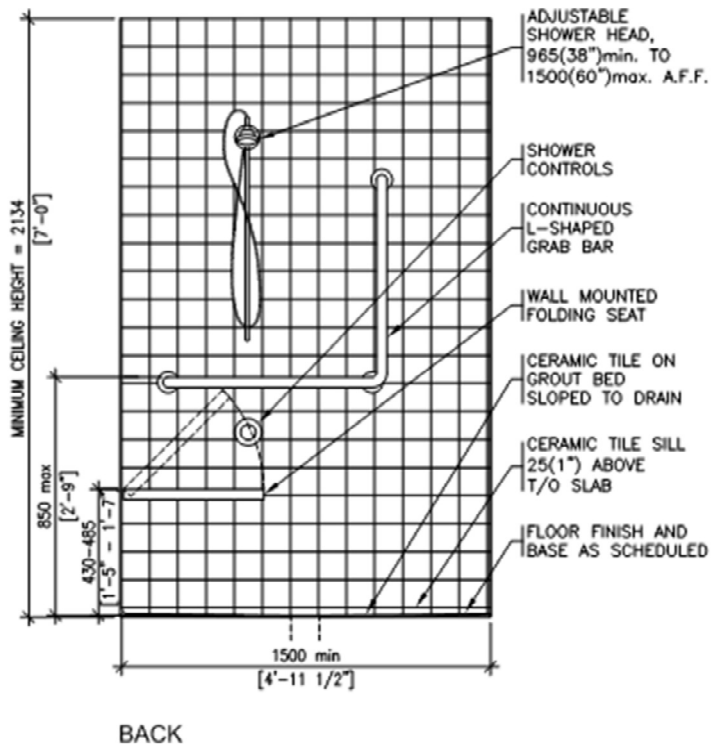
PROGRAM DESCRIPTION:

Universal washroom is located in the secure area of the building. Universal washroom to have standard universal shower.



Program Adjacencies:

4.2.2 Open Office



Universal Washroom: A universal washroom and shower must be provided as per OBC requirements.

The floor plan shows a rectangular bathroom stall. At the top center is a toilet. To the left of the toilet is a ventilation grille and a door handle. To the right of the toilet is a mirror labeled 'EM'. Below the mirror is a rectangular box labeled '103'. In the center of the stall is a circular sign with '04' and 'A-40002'. To the left of this sign is a circular sign with the number '8'. To the right of the sign is a circular sign with the number '20'. A dashed green line outlines a rectangular area on the left side of the stall. A dimension line indicates a width of '4'-0" MIN' for the area to the right of the dashed line. At the bottom center is a door handle labeled 'C'. At the bottom right is a door handle labeled 'FA'. A wheelchair symbol is located outside the stall on the right side. A dashed line labeled 'CTR' is at the top right corner.

[illegible]

- Gypsum Wall Board

SCALE: $1/4" = 1'-0"$

4.2.13 STORAGE ROOM, CUSTODIAL ROOM, AND ROOF ACCESS LADDER

PROGRAM DESCRIPTION:

The storage/custodial room is used for the keeping of building maintenance items. The room has cleaning supplies, a janitorial cart, shelving, as well as a mop sink.

The roof access ladder is located in a room closer to the centre of the building. This makes the access point further from the edge of the roof, reducing the fall hazard.

Area: 150sf

Program Adjacencies:

4.2.2 Open Office

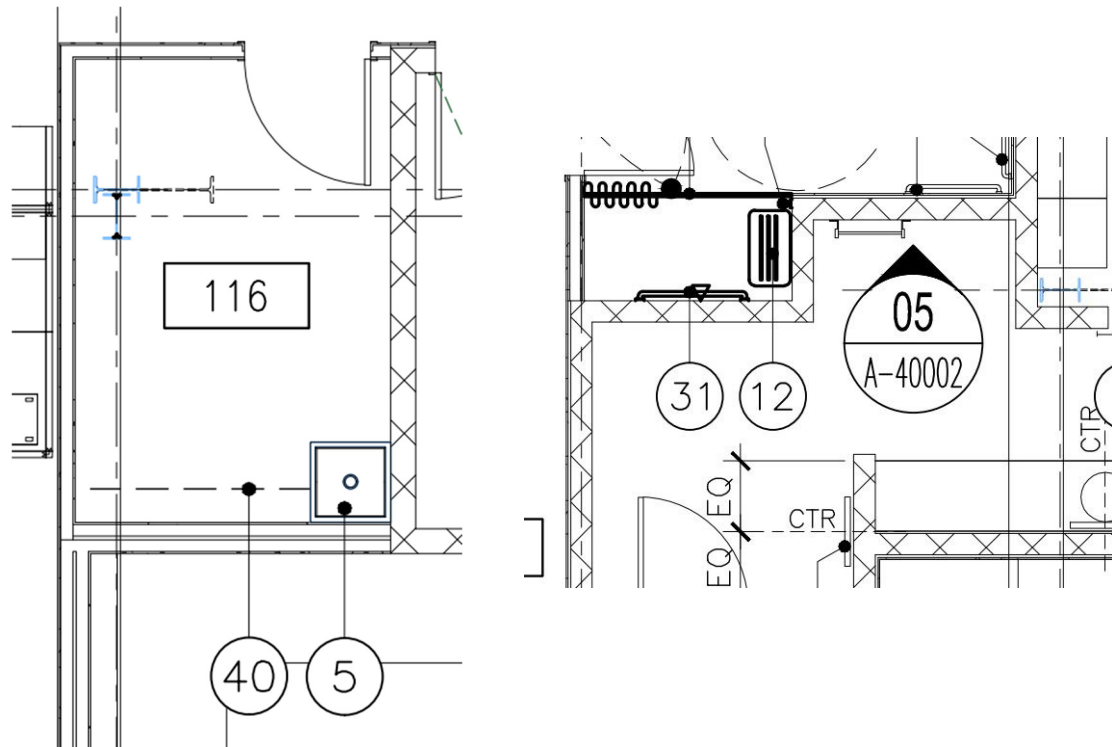
SPECIFIC DESIGN PRINCIPLES:

Chemicals should be clearly and safely stored. There should be ample shelving to reduce clutter and tripping hazards. The ladder can be placed in a room with a separate function, but should be designed with space around it as to not pose a hazard.

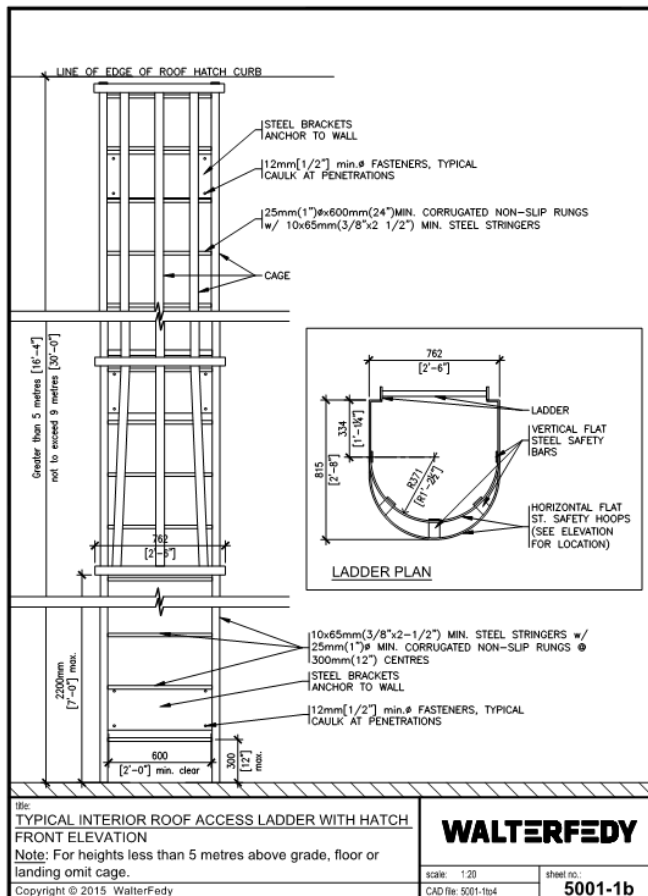


Roof Ladder & Custodial Room: This roof access ladder is located in the men's washroom, close to the centre of the operations centre. Having the ladder far away from the edge of the building reduces fall hazard for maintenance staff. This custodial room is reasonably sized for the operation centre.

4.2.13 STORAGE ROOM, CUSTODIAL ROOM, AND ROOF ACCESS LADDER



Typical Storage/Custodial Room (left): This custodial room is generous in size, and allows for easy access to shelving even when the mop cart is present. The custodial room should have a mop sink. **Roof Access Ladder (top):** The roof access ladder should be located close to the core of the building, away from the parapet.



FINISHES:

Flooring:

- Sealed Concrete

Base:

- Rubber Base

Walls:

- Paint

Ceiling:

- Painted Exposed Structure

4.2.14 LAN / SCADA / IT ROOM

PROGRAM DESCRIPTION:

To be added.

SPECIFIC DESIGN PRINCIPLES:

To be added.

4.2.14 LAN / SCADA / IT ROOM

Reserved for future illustrations.

4.2.14 MECHANICAL ROOM AND ELECTRICAL ROOM

PROGRAM DESCRIPTION:

The mechanical room and electrical room are controlled access spaces which house a variety of building services equipment. These rooms house equipment and large aisles to service and access the equipment.

The electrical room is ideally situated close to the middle of the building, with controlled access from inside. The mechanical room is also ideally situated close to the middle of the building, with controlled access from inside and outside.

ELECTRICAL ROOM REQUIREMENTS:

The electrical room is ideally located close to the centre of the building, to reduce the lengths of wiring required. The electrical room should also be sized to accommodate +/- 25% growth in capacity.

MECHANICAL ROOM REQUIREMENTS:

The mechanical room is ideally located close to the centre of the building, to reduce the lengths of ductwork required.

Rooftop equipment for HVAC to be avoided to reduce maintenance access requirements on the roof.

The electrical room should also be sized to accommodate +/- 25% growth in capacity.

Program Adjacencies:

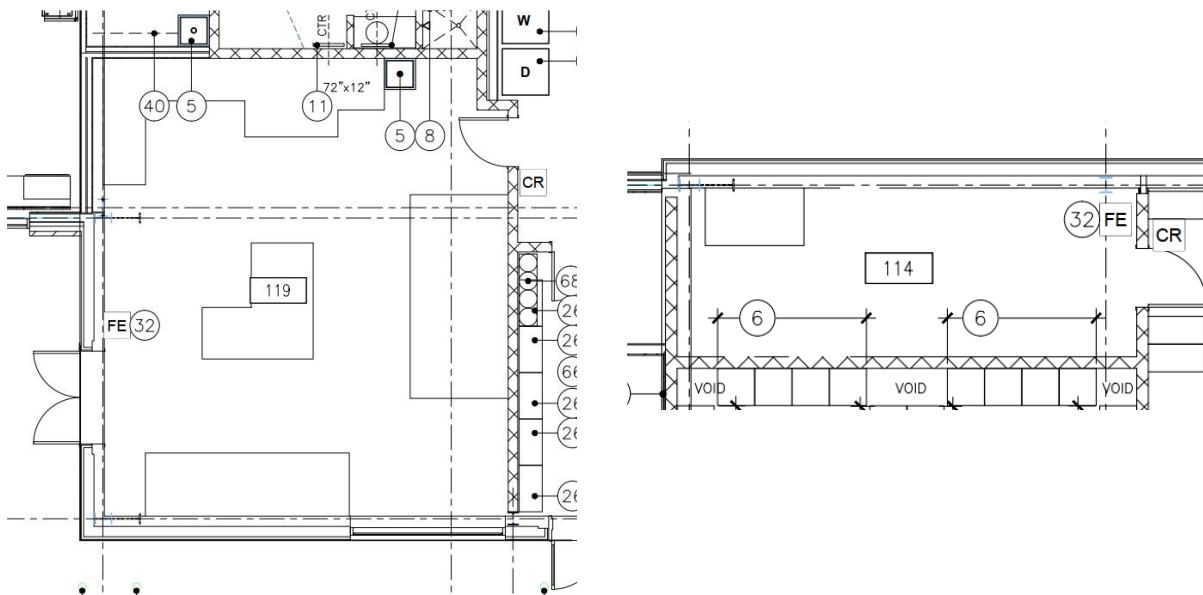
5.3.2 Open Office / Corridor

5.3.3 Yard / Front Yard

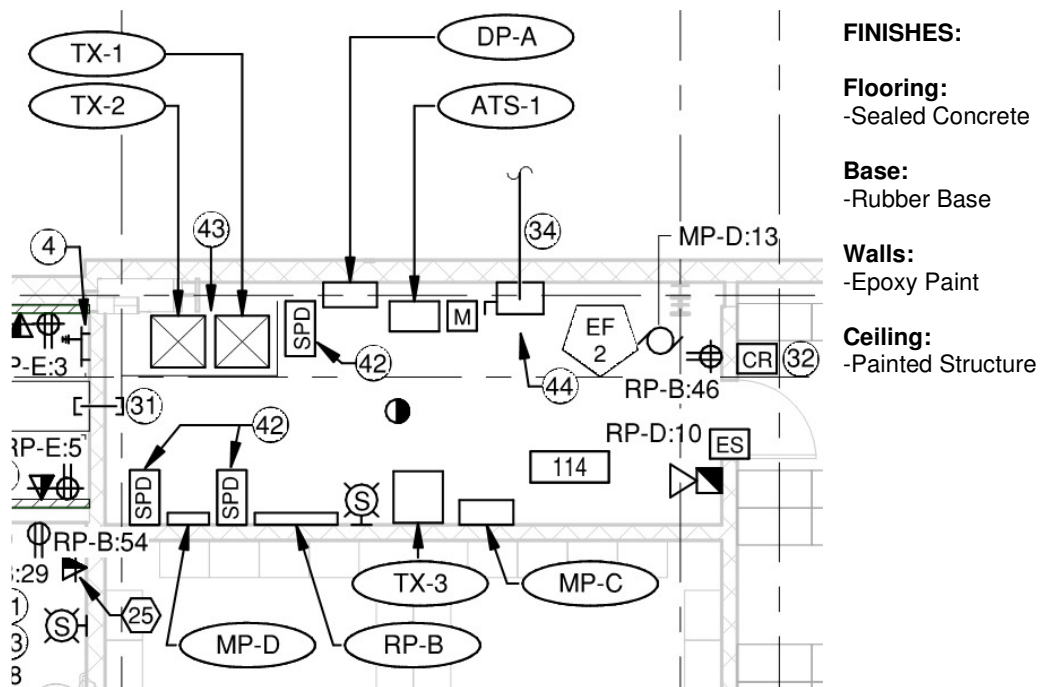


Mechanical Room and Electrical Room: Spacious and organized, the Mechanical Room at the Sarnia Operations Centre was well laid-out and each item was placed with a purpose. The various equipment pads are placed under equipment as necessary.

4.2.14 MECHANICAL ROOM AND ELECTRICAL ROOM



Typical Mechanical Room (left): It is best practice to locate all mechanical equipment on the ground floor of the operation centre, inside the mechanical room. Locating units on the roof should be avoided. A good practice is to locate equipment in the mechanical room on elevated concrete pads to avoid damage during floods. **Typical Electrical Room (right):** A good electrical room should have close proximity to an externally located generator.



Layout of Electrical Equipment: The key takeaway here is that the rooms fill up capacity quite quickly with all the equipment being located in this space. Planning and coordination is required from an early design date to ensure all will fit within the confines of the room.





INDUSTRIAL COMPONENTS

4.3.1 STORAGE SPACES

PROGRAM DESCRIPTION:

The Operations Centre Warehouse is used for the storage of various parts, materials, and small pieces of equipment that used in the daily operations of a transmission plant site. The warehouse requires high ceilings, good lighting, daylighting if possible, and heavy-duty finishes.

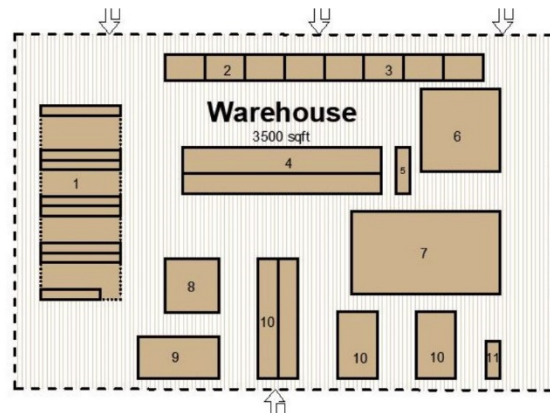
The warehouse services all of Enbridge's major operations divisions. Thus, the warehouse needs are varied and disparate.

Area:
 Regional Operations Centre Storage: 6,000 sf
 Operations Centre Storage: 3,350 sf
 Free Pick Area: 150 sf

TYPICAL COMPONENTS:

There are several general storage functions of the warehouse. As there are forklifts operating in the warehouse space, bollards will need to be installed to protect the racking units.

- **Meter Basket storage:** Natural Gas meters for residential and commercial clients are stored in wire baskets mounted on wheels.
- **Free Pick storage:** Smaller items are kept in open cubbies, shelves, and other storage containers.
- **Metal Racking – Forklift:** Larger items are stored on heavy-duty metal shelves. Access aisles are provided for forklifts to access
- **Tool Cage / IT Storage Cage:** High-value items are stored in a section of the warehouse protected by a metal cage. Access to the cage is through unlocking a padlock from the warehouse, or by special key-card access from a door from the IT room.
- **Overhead Doors:** 12'-0" w x 12'-0" h



Program Adjacencies:

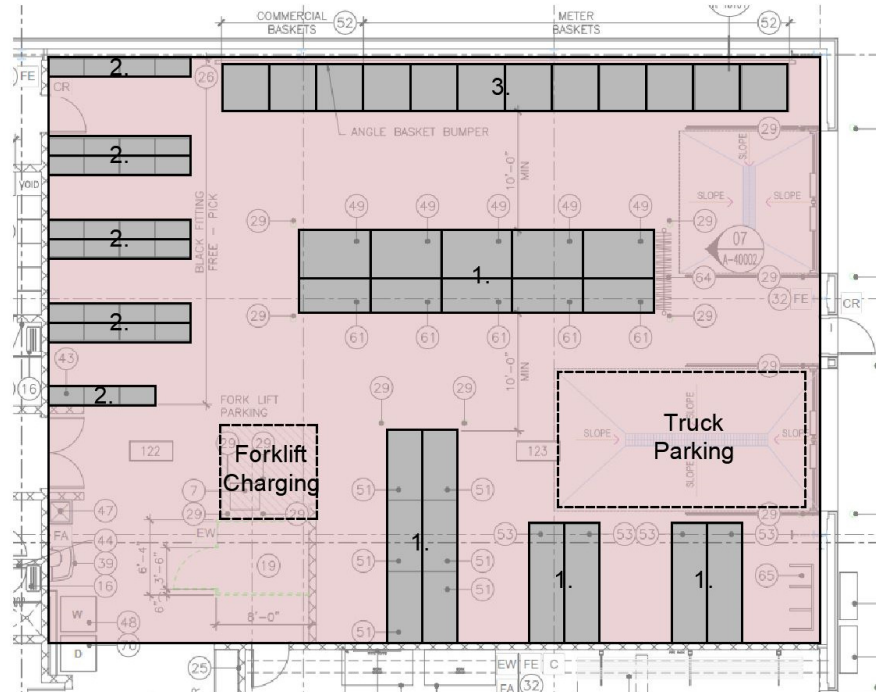
- 4.3.2 Warehouse Receiving Office
- 4.3.3 Loading Dock
- 4.3.4 Weldshop



Warehouse Spaces (top): Storage racking units have wide berths for forklift operation. Trucks can park in the access aisles for short-term unloading of items. **(bottom):** Shelving for tools and site equipment.

4.3.1 STORAGE SPACES

1. Shelving
2. Free Pick
3. Meter Basket Storage



Typical Storage Spaces: Two overhead doors allow for ease of egress when loading/unloading materials. The storage space is not intended for vehicle storage. However, given it is difficult to control the space, it shall be designed for vehicle storage overnight. This means the addition of oil interceptors, and ventilation sensors.

The racking / shelving are mainly placed along exterior walls with “aisles” being allocated for the lower, easier to reach materials. The southwest corner of this warehouse also shows the forklift charging station with the locked tool cage.

EQUIPMENT:

Forklift Charging

- Information varies from location to location
- Extreme Power, Model XPT24-600B IE-1
- 24-Cell LA Batteries
- Exhaust System
- Eyewash

Tool Cage

- Provide Padlock and hasp at gate
- Complete with cage lid 10'-0" AFF
- Typical sizing: 8'-0" x 6'-10"

Metal Shelving

- 36" W x 18" D x 96" H (w/ 6 Shelves. Type C)
- 72" W x 24" D x 96" H (w/ 6 Shelves. Type C)
- 72" W x 36" D x 96" H (w/ 6 Shelves. Type C)
- 120" W x 36" D x 96" H (w/ 6 Shelves. Type C)

Meter Baskets

- 48" W x 48" D x 96" H
- Baskets can stack 2 high

Interior Bollard

- Refer to detail shown here:

FINISHES:

Flooring:

- Concrete

Base:

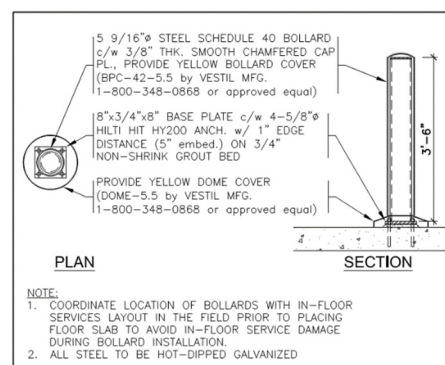
- Rubber Base

Walls:

- Epoxy Paint

Ceiling:

- Painted Structure



25 TYPICAL INTERIOR BOLLARD DETAIL
 SCALE: 1/2" = 1'-0"

4.3.2 WAREHOUSE RECEIVING OFFICE & TRUCKER'S WASHROOM

PROGRAM DESCRIPTION:

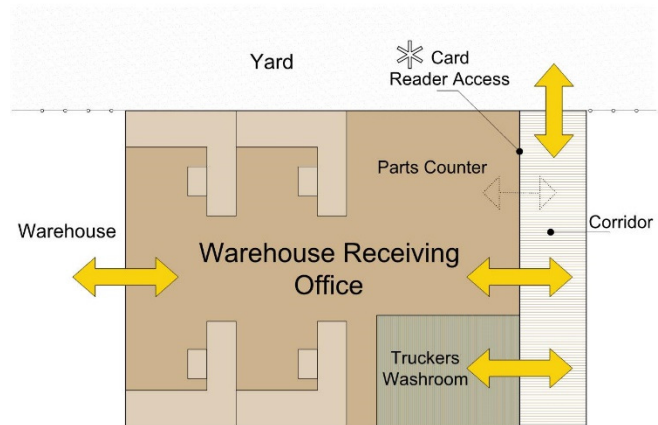
The warehouse receiving office processes the paperwork between Enbridge field operations, third party deliveries, and many other functions between the Operations Centre back of house. The receiving offices are located adjacent to the warehouse and loading docks.

Application: Regional Operations Centre.

TYPICAL COMPONENTS:

The components of a typical warehouse receiving office include:

- **Enclosed desk workstations:** Staff working in the receiving office perform focused tasks with computer requirements and paper management. The desks should have some visual and acoustical privacy separation.
- **Pass-thru parts counter:** The pass-thru counter should face onto a non-secure vestibule area, accessible during regular business hours. This allows truckers and other third-party service personnel to conduct business with warehouse receiving staff without being checked in.
- **Forklift charging station:** The forklift charging station, although part of the warehouse, should be located close to the warehouse receiving office. The forklift charging station should be located next to a sink and emergency shower. Additional safety equipment such as the eye-wash station are located in the warehouse receiving office.
- **Truckers washroom:** The trucker's washroom is located by the vestibule in a non-secure area. This allows visitors to use a washroom without having to be checked in by Enbridge staff.



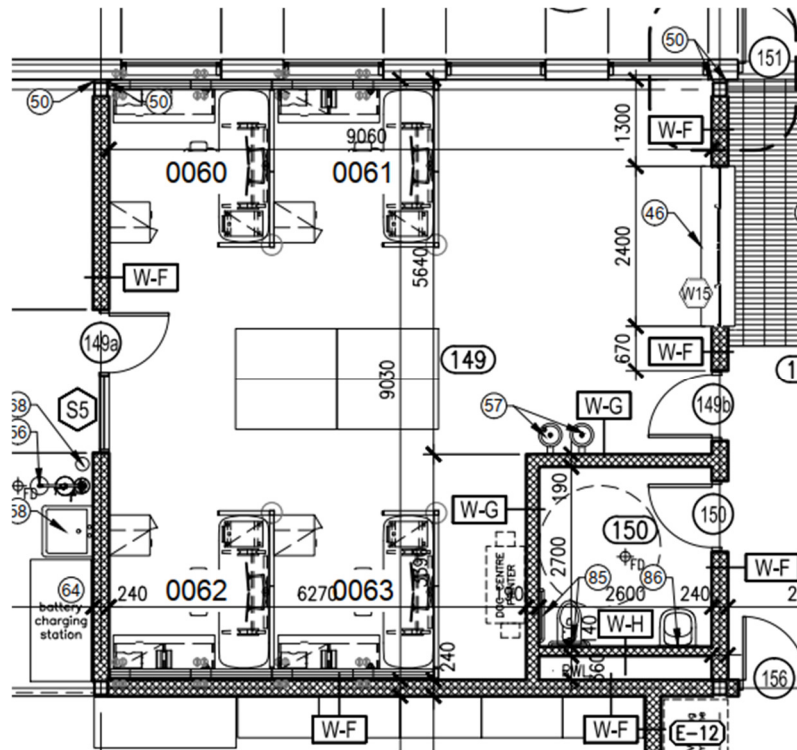
Program Adjacencies:

- 4.3.1 *Warehouse Spaces*
- 4.3.3 *Loading Dock*
- 4.3.4 *Weldshop*



Warehouse Receiving Offices: The Receiving Offices should have a clear line of sight towards the loading areas as well as the main warehouse space.

4.3.2 WAREHOUSE RECEIVING OFFICE & TRUCKERS WASHROOM



Receiving Area: Larger Enbridge facilities require separate handling areas for their warehouse equipment and supplies. Direct access to the warehouse is required and all desking / workstations are to meet Enbridge's standard for offices.

EQUIPMENT:

Stainless Steel Counter (Pass-thru for Parts)

- Four glazing panels, two fixed, two sliding with overhead and jamb track
- Model: Diane Model Pass Thru by CR Laurence

Forklift Charging

- Information varies from location to location
- Extreme Power, Model XPT24-600B IE-1
- 24-Cell LA Batteries

FINISHES:

Flooring:

- Sealed Concrete

Base:

- Rubber Base

Walls:

- Epoxy Paint
- Pre-finished Metal Liner Panels

Ceiling:

- Exposed Metal Liner Panel / Painted Structure

4.3.3 LOADING DOCK

PROGRAM DESCRIPTION:

Large material items / delivery items flow in and out of the loading dock landing in various locations throughout the Operations Centre.

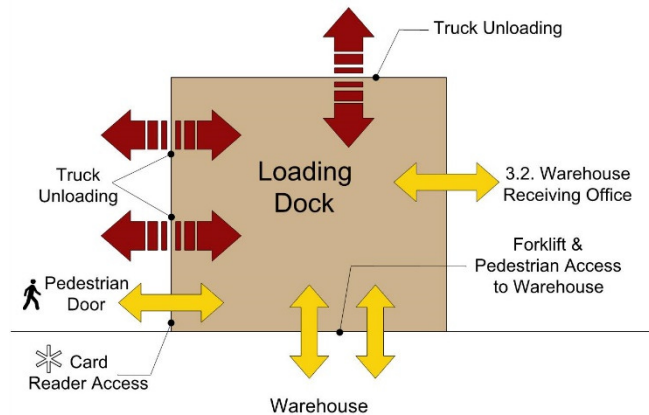
Application: Regional Operations Centre.

TYPICAL COMPONENTS:

- Oil / Water Separator
- CO² Detector & HVAC controls
- Bollards
- Roll-up door with power operator
- Roll-up door control box mounted on rail to protect from forklift collision.
- Suitable interior lighting
- 4' Recessed pit with low slope
- Drainage basin in recessed pit
- Safety handrails around recessed pit
- Loading dock hydraulic dock leveler
- Loading dock bumpers
- Loading dock foam seal

EXTRA COMPONENTS FOR SAFETY:

- Loading dock rain canopy
- Outdoor recessed pit heating coils
- Security camera feed inside office
- Extra space between loading bays
- Truck trailer locks



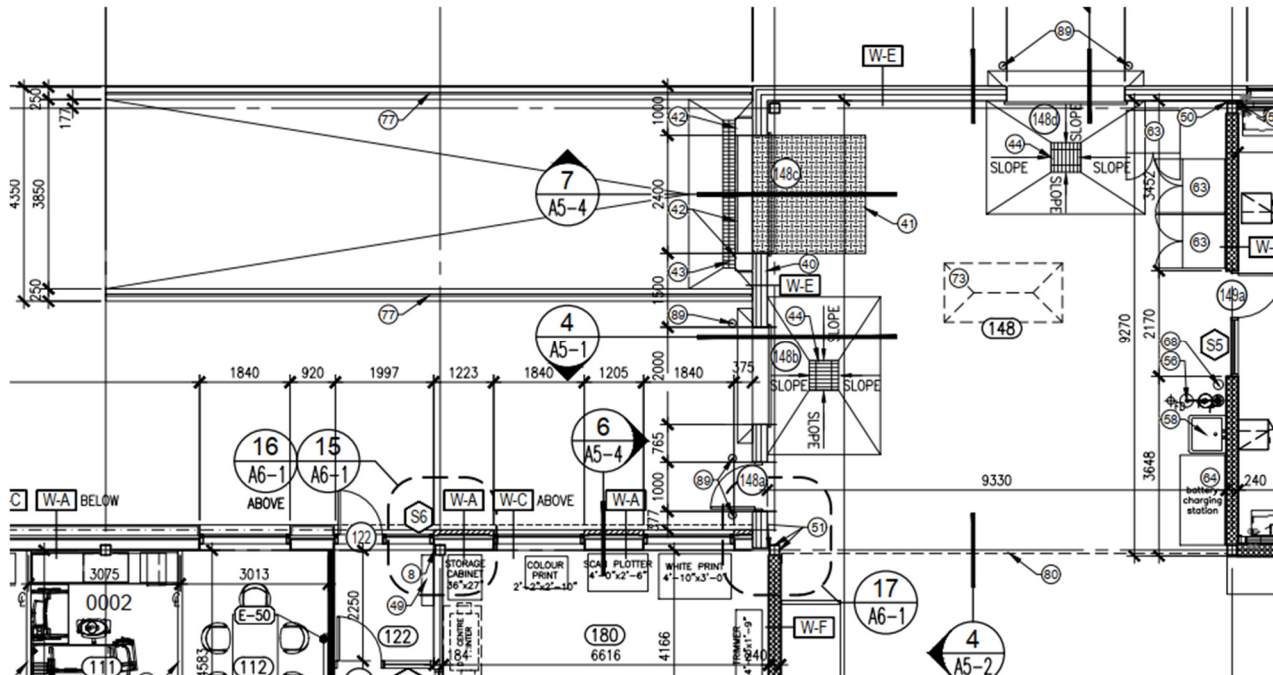
Program Adjacencies:

- 4.3.1 Warehouse Spaces
- 4.3.4 Weldshop



Loading Dock (top): A typical loading dock with bumpers, dock levelers, shroud, and red/green traffic light. **(bottom)** Two drive-on loading docks, with insulated metal panels and a single vision panel.

4.3.3 LOADING DOCK



Typical Loading Dock: This loading dock has three bays – two drive-in bays and one recessed bay. The unloading area is immediately adjacent to the Warehouse Receiving Office. Bollards are placed judiciously inside and outside around door openings, commercial door openings, shelving, racking, equipment, and any other hazard.

EQUIPMENT:

Hydraulic Dock Leveler

Hydraulic Dock Leveler to be Blue Giant Series "HA" 1980 mm wide x 2400 mm long with 15,875 kg roll over capacity. Unit should be supplied with two 457 mm x 254 mm x 10 mm moulded rubber dock bumpers.

Truck Restraints

Truck Restraints to be Blue Giant-Model SVR-303 with dock lights, warning lights, and restraint and Blue Genius-Gold Series III combination panel controller.

Dock Bumper

Width 355 mm x Height 510 mm x Projection 115 mm.

Dock Shelter and Seal

Dock Shelter to be Blue Giant-Model BG 400TS with 610 mm projection. Fabric to be 22 Oz vinyl, Colour Black.

Insulated Overhead Door

Sectional door to include thermal units, as well as double-glazed windows units at eye level. Door to have sensing bottom edge for auto-retraction if blocked. Opening dimensions to be minimum 12' x 12'.

Commercial Door Operators

Door Operators to be wall-mounted with chain hoist for manual operation in emergency or power outage. Door Operator to be Liftmaster Model H or similar.

Red/Green Traffic Light

Exterior wall-mounted traffic light to be located besides loading dock openings. Lights indicate when a commercial door has reached the open position.

FINISHES:

Flooring:

-Sealed Concrete

Walls:

-Epoxy Paint

Ceiling:

-Painted Structure

4.3.4 WELDSHOP

PROGRAM DESCRIPTION:

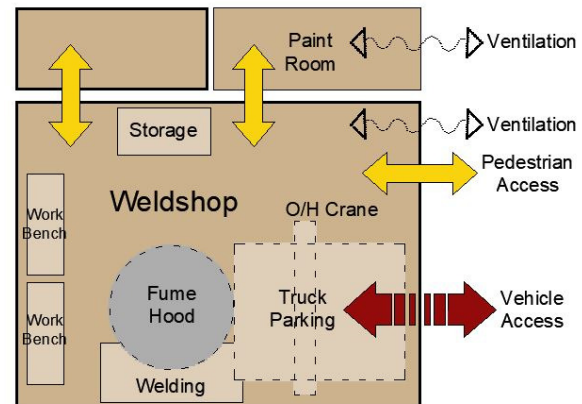
The hub for all repair / small fabrication services, the weldshop can incorporate multiple workstations to allow simultaneous work to be completed. Welding arms, overhead cranes and various pipe cutters / benders fill out the floor area. Sizing is to be determined by the number of welders on staff, but typical Operations Centres allow for 2-3 welders occupying the space simultaneously.

Area: 1,890 sf0

SPECIFIC DESIGN PRINCIPLES:

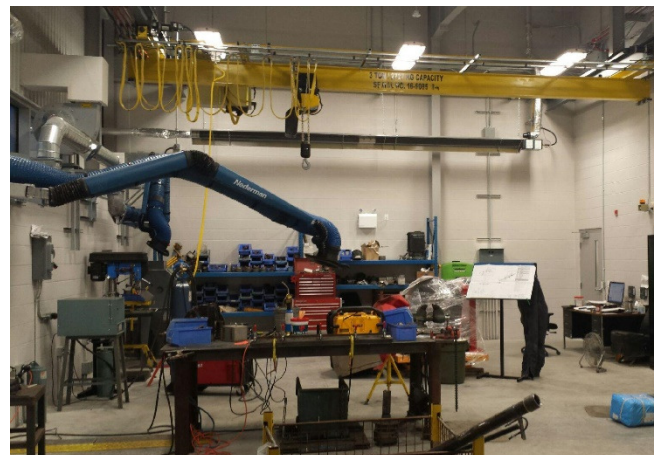
Access to the yard is essential for the program to succeed. Vehicles must have the ability to back into the space (through overhead rolling doors) and provide services within the weldshop. A high-bay structure is recommended as the crane has height restrictions and requirements to allow its smooth operation. Exhaust and ventilation strategies require at least one exterior facing wall within the space.

There are some activities that must be completed in isolation, and rooms can be made available adjacent to the weld / work shop to accommodate. Lighting infrastructure must be also be carefully considered as the overhead crane must be able to operate efficiently. The lighting levels at workstations must also be adequate for the welders / service staff.



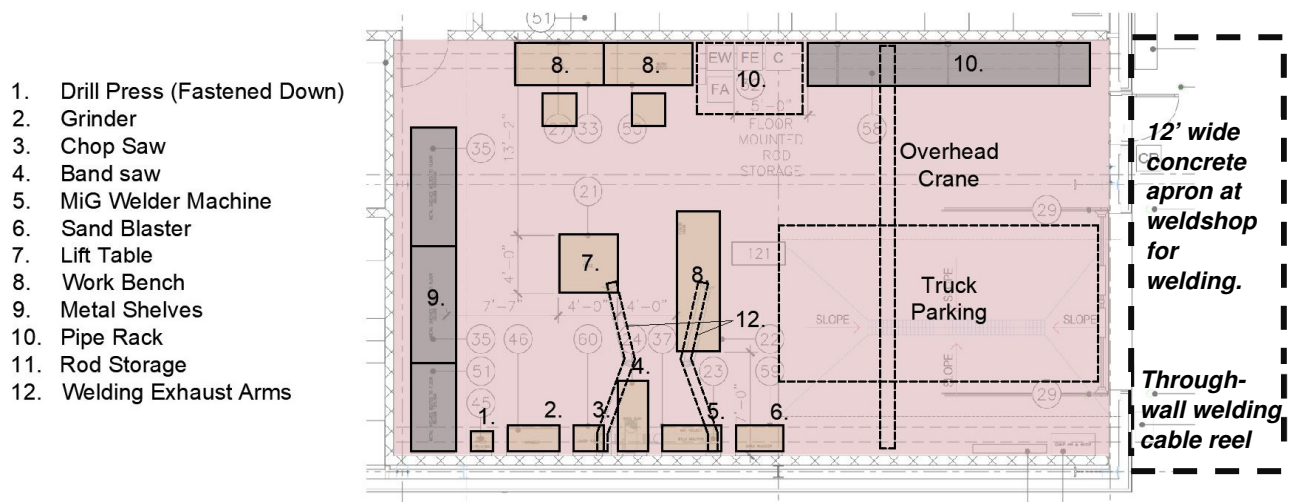
Program Adjacencies:

- 1.6 Yard Storage
- 1.7 Yard Vehicles
- 3.1 Warehouse



Weldshop: The Sarnia Operations Centre weldshop. The multi-program aspect to this room allows it to be versatile, especially with the overhead door exiting to the rear yard.

4.3.4 WELDSHOP



Weldshop Layouts: The location of the Overhead Bridge Crane dictates the orientation and layout of the overall weldshop. Typically the space is one large open area with very little interference from interior demising walls. The lighting levels are bright and fixtures are placed high so as not to interfere with the crane or other equipment.

EQUIPMENT:

Note that certain tools/equipment for the weldshop is typically specified by each individual Operations Centre. Some tools are brought from existing facilities, while others are purchased at the time of construction for the project. Their inclusion in the weldshop layout is important to determine how the space will feel with every inch of space allocated.

Grinder

- Black & Decker #D2322427 Direct Connect

Chop Saw

- Dewalt Model DW872

Work benches

- 92"(L)x36"(W)x24"(H) All metal construction

Interior Pipe Racking

- 180" W x 36" D x 48" H

Stationary Lift Table

- Econolift Serial # S14705-2

Cylinder Storage

- Wall anchored strap for 4 cylinders
- Prefinished vented metal cabinet, rain caps on vent stacks (48"Wx18"Dx60"H)

Mig Welder

- Model Lincoln K3068-2 Power MIG 256

Underhung Single Girder Bridge Crane

Bridge cranes to be pendant operated, single-girder, 3-TON capacity underhung bridge cranes complete with variable frequency electric motor-driven trolleys. Bridge-cranes shall be equipped with warning horn and flashing light.

Chain Hoist

Chain hoists to be pendant operated, 3-TON capacity lug-mounted, variable frequency electric hoist with 13-foot lift. Provide hook with spring-loaded safety latch and chain container (chain, hook and associated components to be galvanized).

FINISHES:

Flooring:

-Sealed Concrete

Walls:

-Epoxy Paint

Ceiling:

-Painted Structure

4.3.5 EQUIPMENT CALIBRATION ROOM

PROGRAM DESCRIPTION:

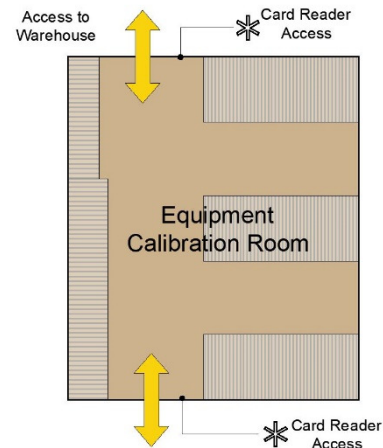
The equipment calibration room is used by Calibration / Service Maintenance and Corrosion group technicians to test and maintain electrical equipment. The room is equipped with the following:

- Two large work benches with calibration equipment.
- Filing cabinets behind each work bench.
- Metal shelving for parts and equipment.
- Storage for four cylinders.

Area: 240 sf

SPECIFIC DESIGN PRINCIPLES:

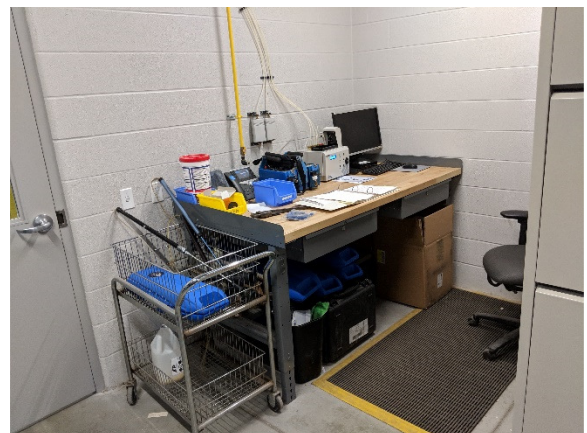
Secured card access is a strict requirement for this space and must be located in the "back of house" area of the operations centre. There must be a clear adjacency or relationship with the weldshop and meter reading room.



Program Adjacencies:

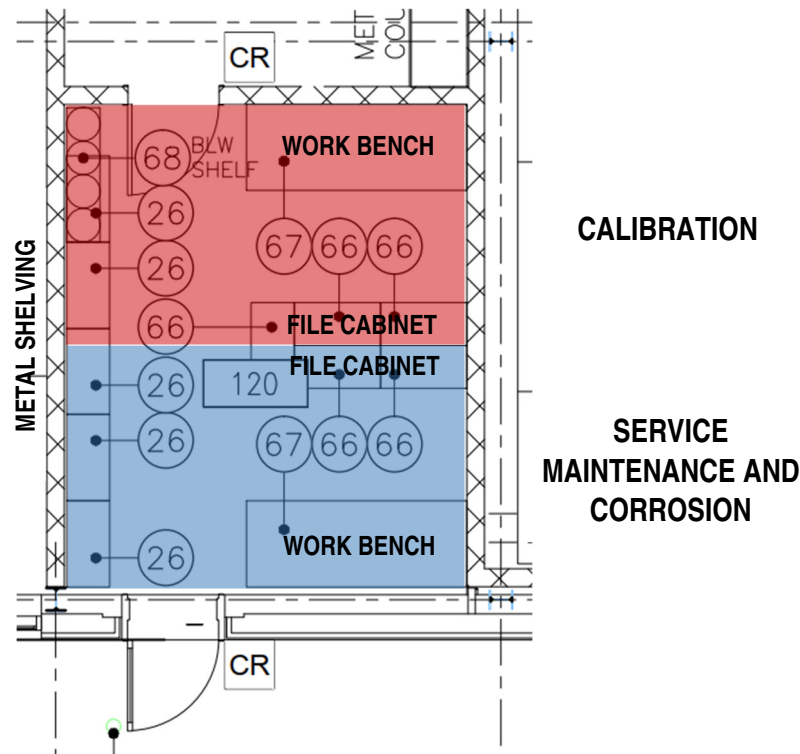
4.3.4 *Weldshop*

4.3.7 *Meter Reading Room*



Gas Measurement / Calibration Room: A small room located off the warehouse for the maintenance of gas measuring equipment. The room should have several workstations, filing storage, as well as parts / gas storage.

4.3.5 EQUIPMENT CALIBRATION ROOM



Typical Layout of Measurement Room: As previously mentioned, the exterior access and card-reader entry is mandatory for both interior and exterior exits. Direct adjacency and access to the warehouse spaces assist with the flow of calibration items in and out of the room.

EQUIPMENT:

Gas Monitor Calibration

- Specialized calibration equipment is brought in to each facility and space must be allocated in the measurement room.
- Measurement Testing Equipment and Regulation Testing Equipment are laid out in this space

Storage

- Metal Shelving – 36”(W)x18”(D)x96”(H)
- File Cabinet – 36”(L)x18”(W)

Workstation

- Work Bench 92”(L)x36”(W)x24”(H)

Cylinder Storage

- Wall anchored strap for 4 cylinders
- Prefinished vented metal cabinet, rain caps on vent stacks (48”Wx18”Dx60”H)

FINISHES:

Flooring:

- Sealed Concrete

Base:

- Rubber Base

Walls:

- Epoxy Paint
- Pre-finished Metal Liner Panels

Ceiling:

- Exposed Metal Liner Panel / Painted Structure

4.3.6 PERSONAL GAS MONITOR CALIBRATION ROOM

PROGRAM DESCRIPTION:

Personal Gas Monitors are brought into this area daily for maintenance and inspection of data shown. In some instances, these can be incorporated onto countertops that are placed near the Mustering Area.

Area: 60 sf

SPECIFIC DESIGN PRINCIPLES:

The personal gas monitor calibration room must include work surfaces for the employees to sit and review each component of the monitor and disassemble as necessary to troubleshoot a problem, or to record data. Each station to come equipped with data / power connection via receptacles.

EQUIPMENT:

Meter Reading Counter

- Length of counter determined by size of room or space and number of “stations” required
- Typical height for counter is 30” A.F.F.
- Receptacles and data ports to be placed at counter as well for staff to plug in Meter Reading Equipment
- A Phone to also be placed along the meter reader counter.

FINISHES:

Flooring:

- Sealed Concrete

Base:

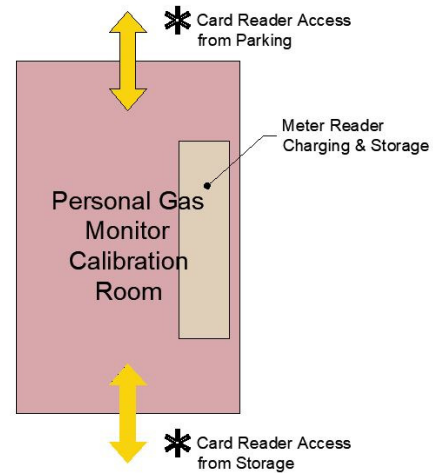
- Rubber Base

Walls:

- Epoxy Paint
- Pre-finished Metal Liner Panels

Ceiling:

- Exposed Metal Liner Panel / Painted Structure



Program Adjacencies:

4.3.1 Warehouse Spaces

4.3.5 Calibration / Measurement Room



Meter Reader Room: Some Operations Centres utilize make-shift work benches while others install specific millwork with required spacing below for staff to use as workstations.

4.3.7 METER READING ROOM

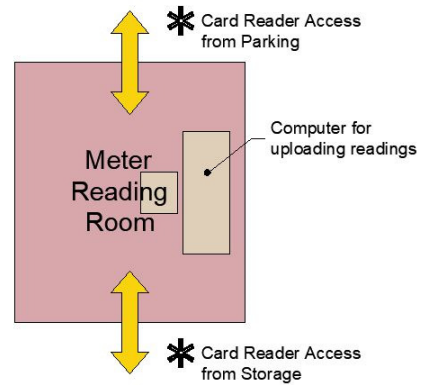
PROGRAM DESCRIPTION:

Exterior Access room for third party companies to upload data. Requires bench and chair and computer.

Size: 10' x 10' / 100 sf

SPECIFIC DESIGN PRINCIPLES:

The meter reading room requires card access for third party staff to access the facility. However, additional card readers should prevent access into the main operations centre.



4.3.8 WASH BAY & WATER HEATER TANK ROOM

PROGRAM DESCRIPTION:

Larger Operations Centres with large fleets may integrate an enclosed wash bay. The bay must have an adjacency to the secure yard.

The best case of a wash bay is to have a drive-through configuration. This removes the hazard created by large trucks backing up. Furthermore, CO² detection equipment must be installed as a motor vehicle will be operating in an enclosed area.

Area: 1,250 sf
 (Drive in wash bay)

Door Size: 12'-0" w x 12'-0" h
 (Overhead Doors)

SPECIFIC DESIGN PRINCIPLES:

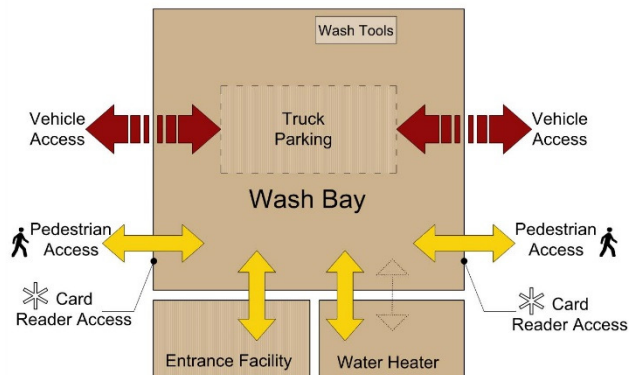
Wash Bays to have dual entrances / exits to allow for the vehicles to drive-through without obstruction. The entrances are fully within the service yard. Access to the Wash Bay can be separate from the rest of the Operations Centre.

Adjacent equipment room is required to house the various pressure washing equipment. The equipment room serves as a safe location for all tools (hand or powered) to assist staff to clean and sanitize their fleet vehicles.

The height requirements for access are determined by the type of service / fleet vehicles on-site, or the potential size of trucks that will enter the facility on a regular basis. Given that these Wash Bays are typically located on Transmission Sites, it is recommended to review all types of vehicles prior to the completion of design.

TYPICAL COMPONENTS:

- Heated water tank (perhaps grey-water)
- Water heater tank room
- Swivel wands
- Two sets of powered overhead doors
- Oil / Water separation
- Cleaning chemicals
- O/H bay heaters (keeping bay warm in winter months)
- Windshield washer fluid storage tank
- Shelves for storage of other consumables



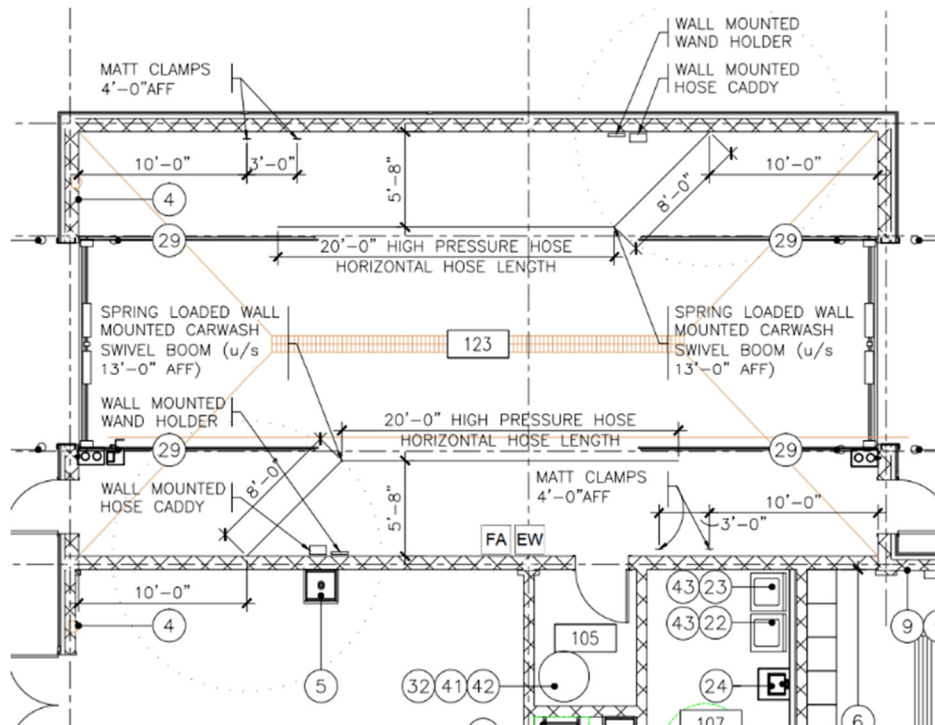
Program Adjacencies:

3.8 Water Heater Tank Room / Wash Bay Equipment Room



Wash Bay Access: Vehicular access via drive-through roll-up doors on either side. Man door to access space as a separate entrance from main Operations Centre.

4.3.8 WASH BAY & WATER HEATER TANK ROOM



Wash Bay Configurations: A drive-through wash bay.

EQUIPMENT:

Wall Mounted Carwash Swivel Boom

- Magikist Ceiling & Wall Overhead 360 Boom (Model: OB0)
- Overhead boom must be fastened to a secure mounting surface that can support the boom securely and withstand the downward force that can be applied to the end of the boom.

Floor Trench (Drainage)

- PowerDrain Trench Drain c/w Sump and ADA Grate rated to load class "E" by Acosystems

High Pressure Hoses & Hose Caddy

- Hoses to be at least 20'-0" in length and must be able to handle pressures from water heater
- Caddy and hoses will come in complete package with swivel boom

Pressure Washer / Water Heater

- Magikist High Pressure Hot Water Heater (Model: HWG40), 305,000 BTU input, 575V 60hz

Equipment Stand

- Heater must be mounted to a solid, non-combustible base. Mounting holes are provided on the inside bottom of the heater. The HWG40 has four 1/2" holes.

FINISHES:

Flooring:

- Painted Epoxy

Base:

- Epoxy Cove Base

Walls:

- Epoxy Paint

Ceiling:

- Epoxy Paint

Mechanical:

- Ductwork Protection

WELDING RACK DETAIL NOTES

1. GENERAL:

1. FABRICATION AND INSTALLATION MAY VARY DEPENDING ON CIRCUMSTANCES AND OR SITE REQUIREMENTS. ALL DIMENSIONS ARE TO BE FIELD VERIFIED PRIOR TO FABRICATION.
2. ALL STEEL TO BE G90 GALVANIZED AND PAINTED.

2. RACK & BOX INSTALLATION:

1. INSTALLATION OF WELDING RACK AND BOX TO EXTERIOR WALL WILL DEPEND ON BUILDING CONSTRUCTION.
EXAMPLE 1; HEX HEAD SLEEVE ANCHORS IF BOLTING INTO CONCRETE OR BLOCK.
EXAMPLE 2; HEX HEAD CARRIAGE BOLTS IF BOLTING INTO WOOD OR METAL.

3. ELECTRICAL NOTES:

1. PROVIDE 1/0, 600V HIGH FLEX WELDING CABLES (1-POS., 1-NEG., LENGTH ADEQUATE TO REACH WELDING LOCATIONS WITHIN THE BUILDING UP TO MANUFACTURING LIMIT) COILED ON INSIDE RACK. LEAVE 10FT. IN OUTSIDE BOX c/w CONNECTORS TO CONNECT TO TRUCK MOUNTED WELDING MACHINE.
2. PROVIDE 5c#14, 600V, 90', WATER RESISTANT TYPE SOW CABLE (LENGTH INSIDE ADEQUATE TO SUIT LOCATION, MAX. 100FT.). LEAVE 10FT. IN OUTSIDE BOX c/v 20A, 250V, 4-PRONG, 5 WIRE PLUG CAP AND REMOTE CONTROL END FOR FINE TUNE INCLUDING 15A, 125V DUPLEX RECEPTACLE.
3. PROVIDE 15A, 125V DUPLEX RECEPTACLE MOUNTED ADJACENT TO RACK, WIRED TO 15A BREAKER AT LOCAL PANEL AS PER O.E.S.C. AND 3c#14 SOW EXTENSION CORD c/v MALE PLUG CAP END & DOUBLE GANG DUPLEX RECEPTACLE. COIL EXTENSION CORD ON RACK (LENGTH TO SUIT)
4. EQUIPMENT, DEVICES & CONNECTORS TO BE CHOSEN TO SUIT SPECIFIC WELDING MACHINE.

4. WELDING MACHINE NOTES:

1. PROVIDE PARALLEL CONNECTIONS FOR POS. & NEG. CABLES WITH 18" LENGTHS & CONNECTORS FOR CONNECTION TO WELDING RACK OUTSIDE TERMINATIONS.
2. PROVIDE ADDITIONAL FINE TUNING REMOTE CONTROLLER FOR RIG USE ONLY.

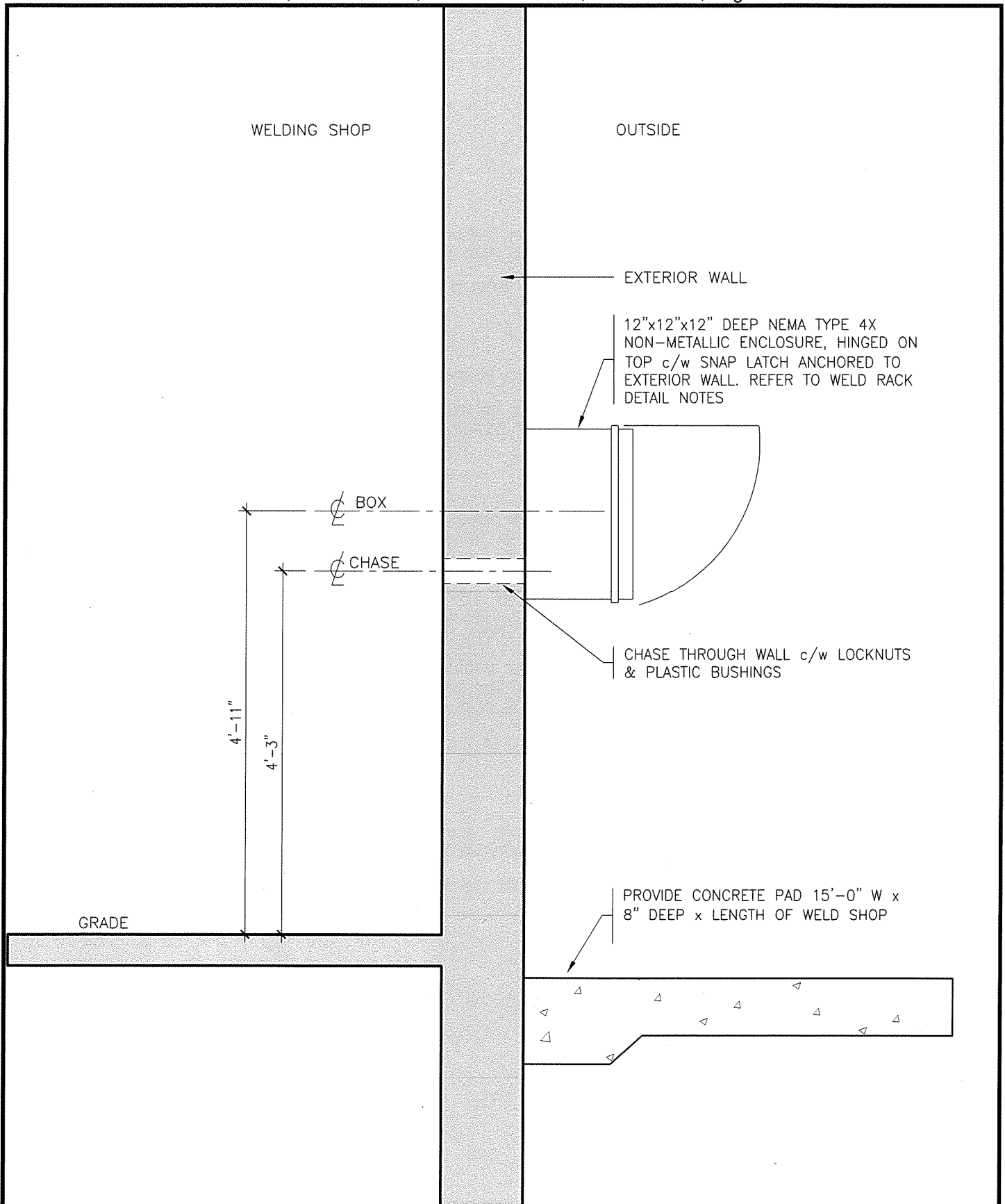
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WELD SHOP : WELDING RACK NOTES

WALTERFEDY

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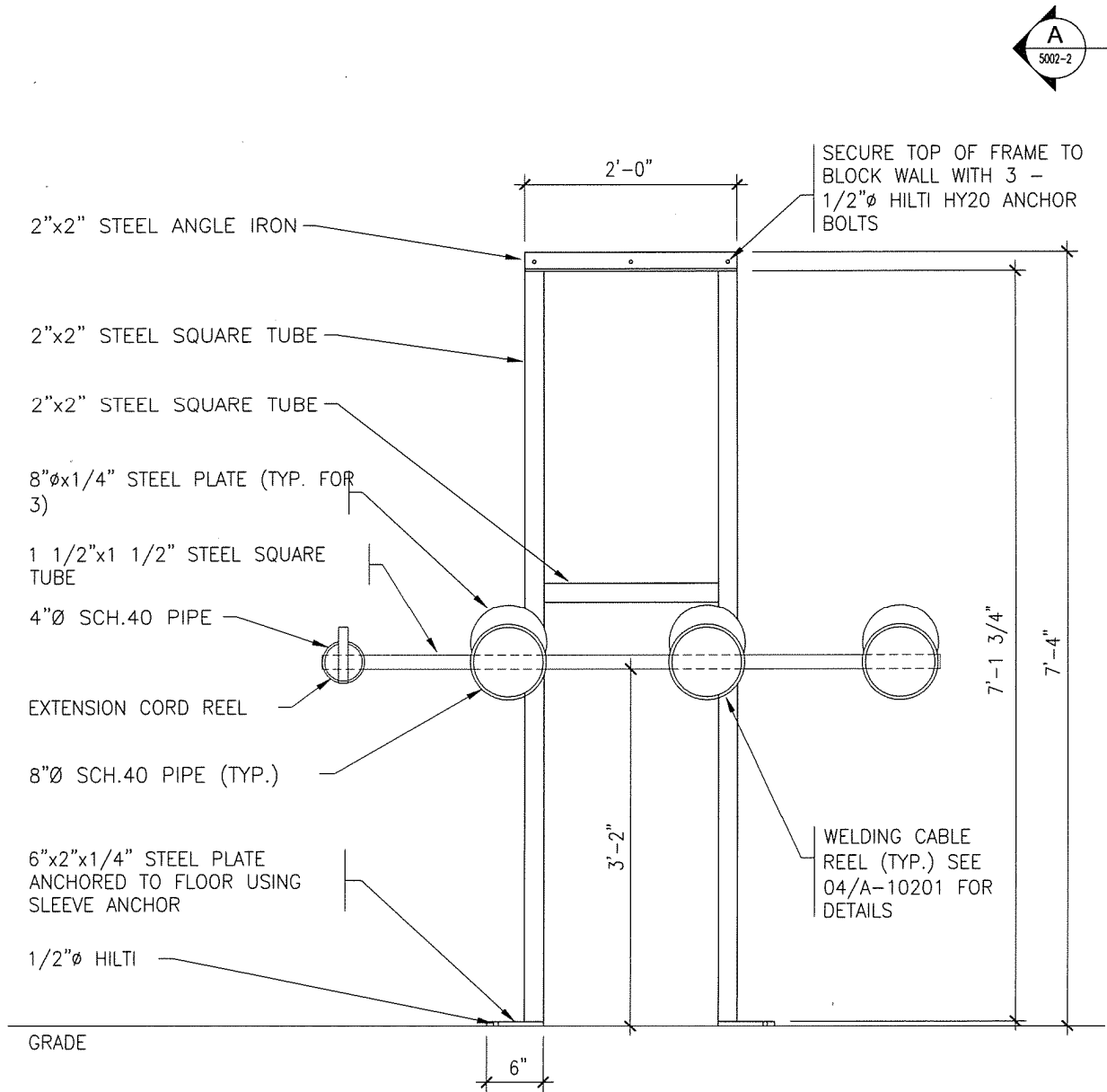
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WELD SHOP : WELDING RACK SECTION A-A

WALTER FEDY

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sheet no.:



WELDING RACK ELEVATION

NOTE: USE 1/4" FILLET WELDS ALL AROUND @ EACH CONNECTION

title:
WELD SHOP : WELDING RACK ELEVATION

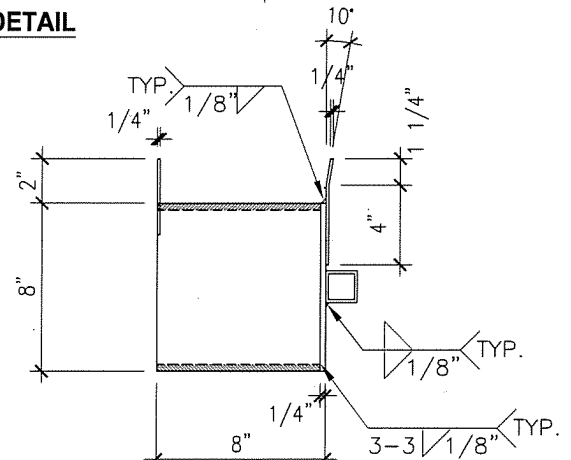
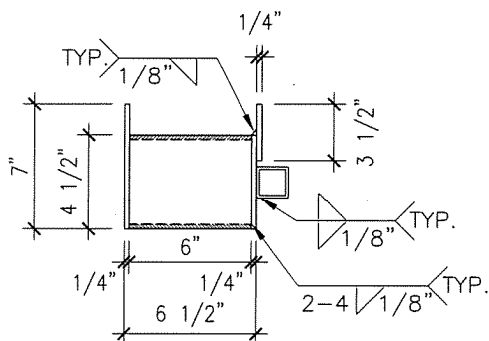
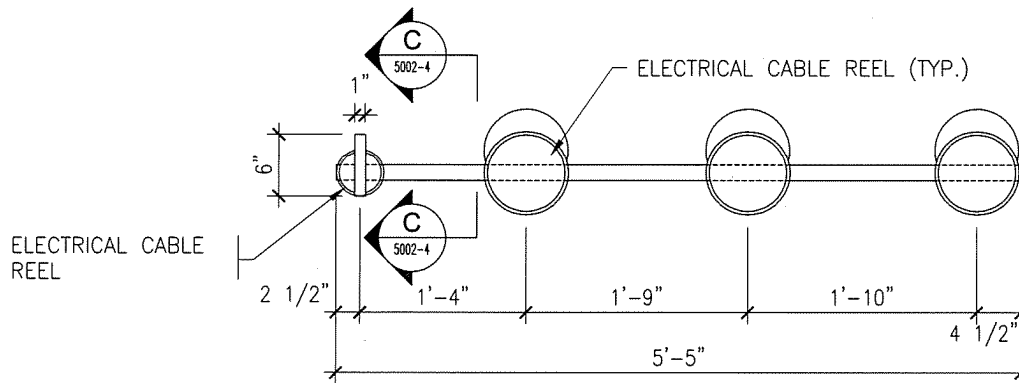
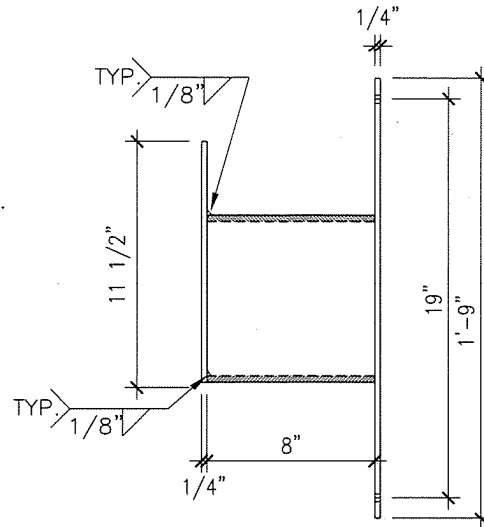
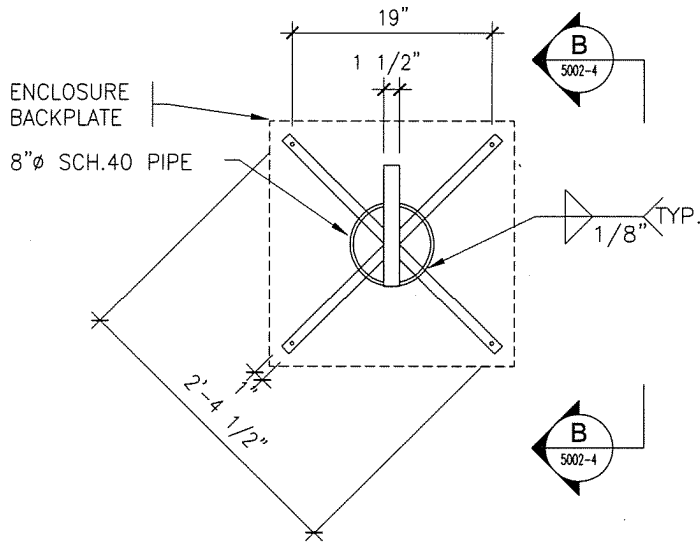
WALTER FEDY

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sheet no.:

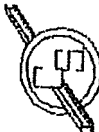
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5002-3



title:
WELD SHOP : WELDING RACK DETAILS

WALTER FEDY

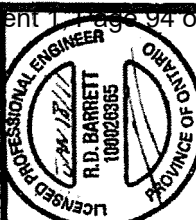


- Notes:
1. All values 2 times unless noted
 2. Structural Steel: CSA G40.21 - 300W (44W)
 3. W 840mm: CSA G40.21 - 300W (44W)
 4. HSS: CSA G40.21 - 300W (44W)
 5. Anchor Bolt: ASTM A307
 6. Primer: 1st CPMA 3-75
 7. Surface Prep: SSPC-SP3 Power Tool
 8. All welding shall conform to CSA W59

CHRISTMAS
STEEL

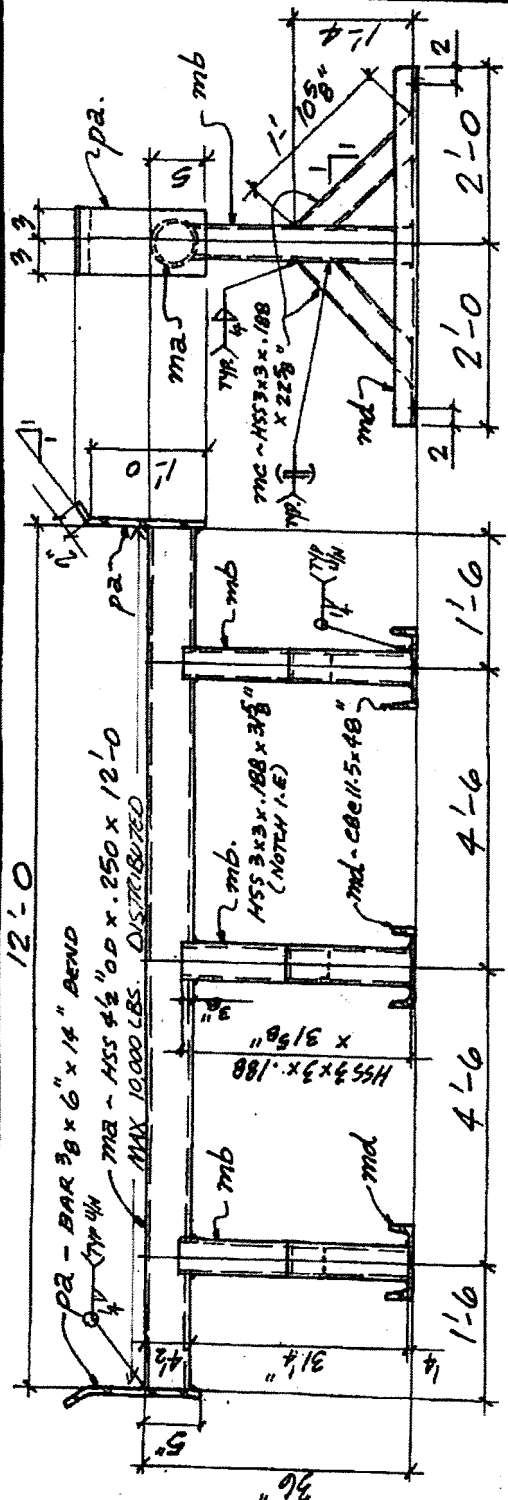
2023-03-08 FEB 2022-02-00

QTY	Mark	Material List	Length	Notes
4	PIPE RACKS			
4	mb	HSS 4 1/2" OD x .250	12'-0"	
12	mb	HSS 3 x 3 x .188	2'-7 1/2"	
24	mc	HSS 3 x 3 x .188	1'-10 3/4"	
12	md	CB 11.5	4'-0"	
8	pb	BAR 3/8 x 6	1'-2"	
	ONE-PIPE-RACK			
3	pb	R 4 x 2 1/2"	0'-2 1/2"	
6	pc	R 4 x 3"	1'-0"	
2	mf	HSS 3 x 3 x .188	16'-0"	
2	mg	HSS 3 x 3 x .188	6'-0"	
3	mh	HSS 3 x 3 x .188	3'-6"	
3	mk	HSS 3 x 3 x .188	2'-7 1/2"	
3	mm	HSS 3 x 3 x .188	3'-9"	
ONE	mp	HSS 3 x 3 x .188	5'-6"	
3	mt	HSS 2 1/2 x 2 1/2 x .188	1'-1"	
3	mv		0'-8 1/2"	
3	mw		2'-5"	
3	my	HSS 2 1/2 x 2 1/2 x .188	1'-6"	

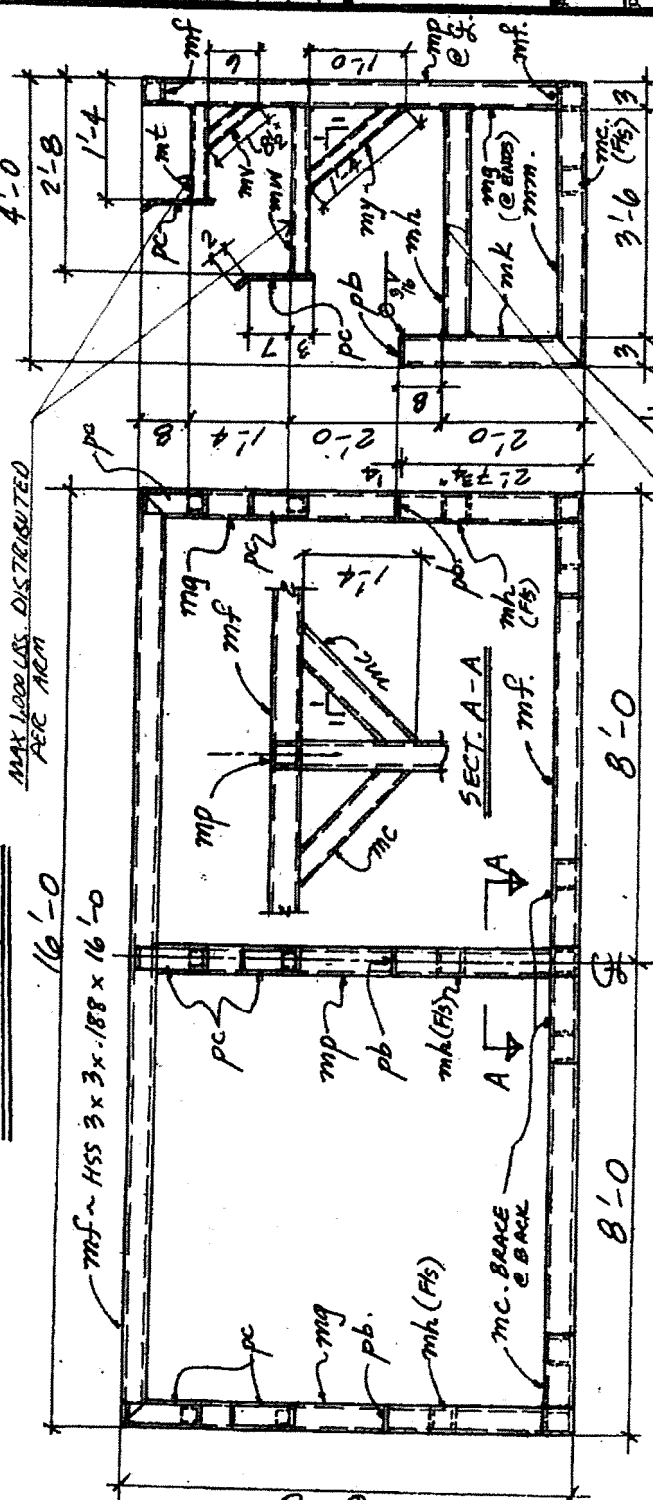


S. G. Christmas (1983) Limited
Custom Fabricators & Erectors
704-Fortune Cres.
Kingston, Ontario K7P 2T3
Tel (613) 389-5564 Fax (613) 388-3252
christmas@bellnet.ca

PROJECT: UNION GAS KINGSTON, ONT.
CLIENT: AEGON BLDG.
DESIGN: Aug.
CREATED BY: Ron.
WORK ORDER NO.: 1825-4
DRAWING NO.: SKI.



4 - REQ'D



ONE-REQ'D



ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, *EGI Asset Management Plan*, page 236, Table 5.6.3-1:
TIS Asset Class Inventory

Question(s):

Please provide ratios of laptops/desktops and mobile phones per employee in 2023 and 2024.

Response:

The ratios per employee are as follows:

1. Laptops/desktops - 1:1
2. Mobile phones - 0.69:1

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 1, pg. 11

Preamble:

EGI evidence states: *The objectives of Enbridge Gas's ETP are to 1) support an orderly energy transition in Ontario by identifying and proposing safe bet actions, defined as actions that will be needed in the future regardless of the pathway to net-zero that is taken...*

We would like to understand in the context of an orderly transition how EGI/EGD has allocated the capital that were funding EGD's Site Restoration Costs.

Question(s):

Please provide a reference to the evidence in this proceeding that speaks to how the merged utility will ensure proper funding if and when assets need to be retired more quickly than they are being added to.

- a) Has EGI considered segregated funding similar to the model the TCPL/TCE has developed?

Response:

Enbridge Gas discusses the topics of depreciation expense and risk mitigation related to Energy Transition in the following sections of evidence:

- i. Exhibit 1, Tab 10, Schedule 4, pages 16 to 18. This section discusses depreciation and the impacts of implementing an Economic Planning Horizon (EPH).
- ii. Exhibit 4, Tab 5, Schedule 1, pages 17 to 21. This section discusses depreciation and Energy Transition considerations as well as Site Restoration Costs (SRC) and the topic of a segregated fund for SRC

- iii. Exhibit 4, Tab 5, Schedule 1, Attachment 1, pages 17 to 19. In this section, Concentric provides their recommendations regarding an EPH
- a) Enbridge Gas understands this question to be in reference to the CER LMCI proceeding and the requirement for CER pipelines to establish segregated funds for pipeline abandonment. Enbridge Gas did consider a segregated fund for SRC costs but has not recommended implementing a fund at this time. Please see Exhibit 4, Tab 5, Schedule 1, pages 18 to 21 and response at Exhibit I.4.5-SEC-193.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 1, pg. 14-15

Question(s):

Please file the ICF Forecast: Natural Gas – Strategic, Q2 2022 Outlook referenced in this section.

Response:

Please see response at Exhibit I.2.6-ED-89, Attachment 1 for a table including the figures underlying Figure 1 at Exhibit 2, Tab 6, Schedule 1, page 15.

The ICF Base Case is a proprietary and commercially sensitive product with significant economic value. Consistent with past practice in OEB proceedings where parties requested copies of similar proprietary forecasts from ICF, according to ICF, ICF is prepared to license the ICF Gas Market Outlook to any party that is willing to accept its commercial terms.

For these reasons, Enbridge Gas declines to provide the ICF Base Case as requested by FRPO.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 1, pg. 14-15

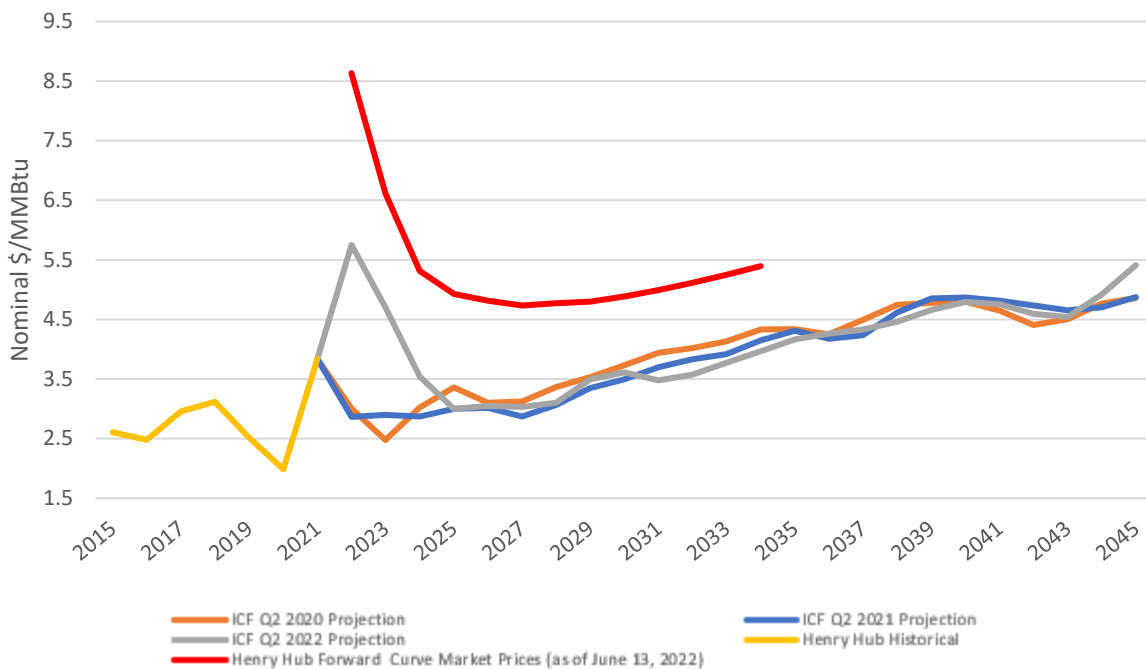
Question(s):

In figure 1 on page 15, please reproduce the Figure while adding the Henry Hub forward market prices to the graph from the same data as the Q2 2022 Outlook.

Response:

Please see Figure 1, which includes NYMEX Henry Hub futures prices at the time that ICF issued the Q2 2022 Outlook.

Figure 1: Long-Term Henry Price Forecast



ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 1, pg. 42-43

Preamble:

EGL evidence states: *Examples of opportunities anticipated over the 2024 to 2028 IR term include organizational alignment within Enbridge Gas's regional construction teams, productivity gains in alliance partner agreements and real estate optimization.*

Question(s):

What productivity has been seen in alliance partner agreements through 10 years of rebasing?

- a) Please file documentation of productivity gains over the 10 year period.
- b) What incentives are in place for pipeline contractors to minimize costs?

Response:

- a) Enbridge Gas does not track productivity specifically by driver however within the contract there is a financial metric associated with achieving 1% overall productivity target. Productivity gains have been achieved in several areas including technology, equipment, system integration, process improvements, alignment of facilities and performance measurement. For example, the alliance partners have implemented work and asset management systems which are integrated with Enbridge Gas's systems. This has resulted in more efficient workflow, management of resources, administrative tasks and billing.
- b) Enbridge Gas has included productivity in the master agreements with the 2 Alliance Partners for the execution of distribution construction work. Specifically, a productivity goal of 1% of total revenue has been included to incent pipeline contractors to deliver yearly productivity savings. This must be balanced with the importance of completing work with high regard for safety and quality.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 1, pg. 51-52

Question(s):

In the Process for Connecting Residential Infill Customers, the evidence states that there is no minimum load.

- a) For an average 20m service, would a pool heater generate sufficient margin to achieve a PI of 1.0? Please explain.

Response:

- a) The consumption of a single appliance like a pool heater may not generate enough revenue over 40 years to achieve a PI of 1.0 however it is rare for customers to request gas service for only a single appliance, and especially for seasonal or lifestyle appliances (e.g., pool heaters, cooktops, BBQs, dryers) considering the fixed monthly charge. The no minimum load requirement assumes that customers will eventually add more than one appliance to realize the economic benefits of natural gas.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 32

Preamble:

The integrity management section speaks strongly to identify risks to determine *fitness for continued service*. We would like to understand more about what EGI has done to examine the opportunity to enhance aging assets to create fitness to, not only continue service, but also, to extend service life.

Question(s):

Please provide a list of projects that EGI has undertaken to consider investments in the betterment of assets to extend service life.

a) Please provide the amount that EGI has invested in these projects.

Response:

Enbridge Gas actively undertakes studies and third-party assessments in pursuit of understanding asset health condition and extension of asset useful life. Some examples include

- Storage Well Cathodic Protection Study (2021)
- Compressor Assets Reliability, Availability, and Maintainability (RAM) Studies
- Asset Health Reviews
- Facility Condition Assessments

In addition, maintenance and renewal strategies are built around optimizing the life of assets across all asset classes and more information on these is provided at Exhibit 2, Tab 6, Schedule 6:

Page 82, Table 5.2.3-2: Pipe Condition and Strategy Overview

Page 125, Table 5.2.4-2 Distribution Stations Condition and Strategy Overview

Page 150, Table 5.2.5-3: Utilization Condition and Strategy Overview

Page 180, Table 5.3.4-1: STO Operations Condition and Strategy Overview

a) Examples of the project descriptions and costs of the studies can be found in the table below:

Investment Example	Description	Outcome and Examples	Investment amount (per investment)
Storage Well Cathodic Protection Study	Evaluation of the current corrosion Control approach used by EGD and UG at various storage pools, perform a review of existing downhole corrosion logs, analyze and compare varying past approaches, and provide post-assessment recommendations to an aligned standard	Outcome for CP recommendations was leveraged for all Tecumseh/EGD storage pools	\$40,000
RAM studies	The RAM Studies evaluate the design, redundancy, specific unit reliability, and repair times for various types of failures. They rely on key inputs from the AHR to inform asset reliability, availability, and maintainability. Quantify performance impact of obsolescence and deterioration factors over remaining operational life and identify areas of operational risk, i.e. key systems and equipment that result in losses, and rank by system and equipment contributions (criticality analysis)	Some completed examples include: Corunna, Dawn Dehydrator, Hagar Ongoing studies include: -Waubuno Lifecycle (Exhibit 2, Tab 6, Schedule 2-Appendix A, Page 8 -Dawn C Lifecycle Exhibit 2, Tab 6, Schedule 2-Appendix A, Page 4	\$ 49,000 (average)
Asset Health Review (AHR)	Refer to Exhibit 2, Tab 6, Schedule 2, Pages 184-185, Sections 5.3.5.2 and 5.3.5.3.	iBalance, Foundation Block replacements	Approximately \$2,000,000
Facility Condition Assessments	Facility condition assessments (FCAs) are comprehensive evaluations of the physical state of a building or infrastructure system. The basis of an FCA typically involves a detailed examination of various elements of the facility, including its mechanical, electrical, plumbing, and structural systems, as well as its overall layout and	See Exhibit 2, Tab 6, Schedule 2, Page 215 of 288, Table 5.4.5-1 for the resultant summary strategies for Enbridge Gas's Real Estate assets.	Approx. \$5-10,000 per Site. See Exhibit 2, Tab 6, Schedule 2, Page 215 of 288, Table 5.4.5-1 for a list of sites assessed.

	<p>organization. Third party reports are based upon the document from the National Research Council of Canada (NRC) "Protocols for Building Condition Assessment" published by The Institute for Research in Construction (IRC) and ASTM E 2018-01 Standard Guide for Property Condition Assessments: Baseline Property Condition Assessment Process. This process is one used by many municipalities in establishing the conditions of assets when determining capital planning needs.</p> <p>A component of the assessment is the AI (Adequacy Index) which is determined based on a set of programmatic criteria that Enbridge established against the use and the number of staff that operate out of the facility to ensure functional operations. These items include barrier free accessibility, programmatic needs to ensure safe operating conditions for staff (i.e., dedicated welding spaces if welding is taking place) and functional needs to support the work force located at the facility.</p> <p>See response at Exhibit I.2.6-SEC-137 for more detail.</p>		
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ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 32

Preamble:

EGL evidence states: *Create alignment in the organization by establishing an asset management policy, strategies and objectives that link to company strategic priorities.*

We would like to understand better the strategic priorities which figure prominently in this section.

Question(s):

Are there any EGL strategic priorities linked to return on investment, explicitly or implicitly?

- a) Are there any Enbridge Inc. strategic priorities linked to return on investment, explicitly or implicitly?

Response:

- a) Please see response at Exhibit I.2.6-FRPO-43.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 32

Preamble:

EGL evidence states: *Create alignment in the organization by establishing an asset management policy, strategies and objectives that link to company strategic priorities.*

We would like to understand better the strategic priorities which figure prominently in this section.

Question(s):

Are there any management incentives tied to an increase of capital installation completion?

a) Are there any management incentives tied to reducing actual capital invested?

Response:

There is no unique incentive specifically for management that is tied to capital installation completed or reduction in capital invested. All non-union employees of Enbridge's Gas Distribution and Storage business unit receive a short term incentive based on a scorecard that includes a metric tied to EBITDA from growth capital. For the purpose of calculating the metric, growth capital is defined as regulated or unregulated organic growth or M&A capital that requires approval from the enterprise CEO or EI Board of Directors, of which Enbridge Gas invested capital is a subset.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 45-47 & Appendix A

and <https://www.copperleaf.com/blog/innovation-copperleaf-how-the-value-model-library-helps-organizations-make-better-decisions/>

and EB-2020-0181 EGI_APPL_ PHASE 2_20201015 Section 7 Appendix: EGI Asset Management Plan 2021-2025 Appendix

Preamble:

Pg. 45-46 of the EGI evidence states: *EGI aims to have a clear framework for asset investment decision-making that balances risk, cost and performance throughout the asset life cycle. The strategies to achieve this are:*

- *Optimize portfolio based on asset management principles.*
- *Improve decision-making through transparency, clear accountabilities, stakeholder engagement and use of a common tool.*
- *Extend asset management decision-making to further include operations and maintenance activities to ensure that optimal asset value is attained over each asset's life.*
- *Improve decision-making through an understanding of the asset context and timing considerations for outages.*

The evidence goes on to describe the role of the Copperleaf C55 in this process. From the Copperleaf reference, the company's description is: *Once we've identified all the value measures, we then construct a series of "value models" that enable the organization to quantify the value of every proposed investment. These value models can come "off the shelf" from the library or can be based on models that already exist but tweaked to accommodate a particular client's needs. We can also develop models from scratch for clients with extremely unique requirements.*

At the end of this process, the Copperleaf Value Framework provides an enterprise-wide view of all the value measures that support the organization's goals—as well as the models used to calculate how individual investments or projects contribute to those

measures. The result is that everyone can understand the rationale behind each decision, driving consensus and linking day-to-day decisions with business strategy. This helps create a culture of transparency, accountability, and trust.”

Table 4.1-3 on page 47 presents EGI’s descriptions of the Value Measures.

Appendix A presents the Investment Summary reports but not the Value Function Measures.

Question(s):

For the completed ICM projects for which EGI is seeking inclusion in rate base in 2024, please provide the entire “Investment Summary Report” including Value Function Measures.

Response:

Please see Table 1 which identifies all projects for which ICM recovery was granted, and includes comments about information contained within the investment summary reports that are included in Attachment 1. Please note the following while reviewing Attachment 1:


- a) As identified in Enbridge Gas’s 2021 ICM Application¹ under “Implementation of a new asset investment planning tool” EGI states that C55 was implemented in January 2020. Therefore, ICM projects whose Leave to Construct application pre-dates Copperleaf (C55) implementation will not have had Copperleaf value framework applied, as projects were justified using other analyses outside of Copperleaf.
- b) As stated at Table 4.1-2², Mandatory projects include projects that meet the economic feasibility tests in EBO 188 and EBO 134. Mandatory projects are typically not subject to Value Framework assessments, and therefore may not reflect any benefits in the Alternative value section of the Investment Summary Report, as these are evaluated separately and are identified in the original project evidence.
- c) Capital summary reports reflect forecasted costs only, not actuals. Therefore, only forecasted costs for 2023 to 2032 are included under the Alternative Spend Profile – Recommended tables

¹ EB-2020-0181, Exhibit C, Part 2, Schedule 3, Page 19

² Ibid, Exhibit B, Tab 2, Schedule 2, Page 46 of 288

Table 1: ICM Project Value Framework Summary

OEB Case #	Project Name	Investment Summary Report Comments
EB-2018-0013	Kingsville Transmission Reinforcement Project	EBO-134 – Mandatory Investment. Value Framework not Applied.
EB-2018-0108	KOL – Don River 30” Replacement Project	Application for this project was submitted September 14th, 2018, with Decision and Order issued November 29th, 2018. Value Framework not applied.
EB-2018-0306	Stratford Reinforcement Project	EBO-134 – Mandatory Investment. Value Framework not Applied.
EB-2019-0172	Windsor Line Replacement Project	Application for this project was submitted August 09, 2019 with Decision and Order issued April 1 st , 2020.
EB-2020-0136	NPS 20 – Cherry to Bathurst Project	Project was supported by direct condition assessment via in-line-inspection and qualitative Repair vs Replace analysis as presented in EB-2020-0136, Exhibit B, Tab 1, Schedule 1, Page 26 of 30 Table 10. Value assessment not completed in Copperleaf as qualitative decision analysis had been completed and Copperleaf was still relatively new.
EB-2020-0192	London Lines Replacement Project	See Attachment A for the Investment Summary report. Please note that Investment Summary reports are forward looking and only account for remainder to spend in the forecast.

 Investment Summary Report	Investment Code	Report Start Year	Number of Years
	7179	2023	10
	Investment Name		
	NPS 20 Lake Shore KOL Replacement (Cherry to Bathurst)		

Investment Description

Main replacement project identified by Asset Management - Pipelines as high-priority. The line is NPS 20 HP and is this phase is 4850 m of NPS 20 and 500 m of NPS 16 on Mill St, it runs on Lake Shore Blvd from Cherry St to Bathurst. This is for core capital 2017/2018 only. Remaining project costs are in BC 10088. The majority of the costs for 2018 is for the ILI to provide more information in determining the timing of this project.

Recommended Alternative Description

Related BC 10088 2019 and beyond Scope of Work: This is phase 1 of 5 phase replacement of the NPS 20 HP from Stn B to Lisgar Stn. This phase is 4850 m of NPS 20 and 500 m of NPS 16 on Mill St, it runs on Lake Shore Blvd from Cherry St to Bathurst Resources: 2020 - OTC and would be bid on by external contractors Solution Impact: Main replacement project identified by Asset Management - Pipelines as high-priority. Replacement is required due to age, pipeline condition and risk assessment results Project Timing & Execution Risks: moratoriums, 3rd party development, Gardiner realignment and easements ILI completed in 2018. Stopple costs not accrued therefore need to request dollars for 2019.

Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - DP - Main Replacement - General Mains Replacement
Investment Stage	Executing		

Investment Overview


1. Project Information	State/Province	Ontario
	Operating Area (EGI)	10 - Toronto
	Asset Program (EGI)	DP - Main Replacement
	Asset Class (EGI)	Distribution Pipe
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	
	Third Party Relocation (EGI)	
	Program work with sufficient history and risk to warrant continuation (EGI)	

Alternative Spend Profile - Recommended

Name										Net Base Capex O (CA)
NPS 20 Lake Shore KOL Replacement (Cherry to Bathurst)										\$ -
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended

Report Generation Date:										2/21/2023
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 Investment Summary Report	Investment Code 10088	Report Start Year 2023	Number of Years 10
	Investment Name		
	NPS 20 Lake Shore Replacement (Cherry to Bathurst)		

Investment Description

The NPS 20 assessment identifies risk results that exceeds EGI's risk threshold and supports the recommendation that this section of the pipeline (Cherry to Bathurst) requires replacement. The vintage steel replacement of the NPS 20 main on Lakeshore KOL from Cherry St to Bathurst will help address known pipe integrity and operational field concerns by proactively replacing the steel main approaching intolerable risk due to failing pipes or pipes in poor condition. This project will replace approximately 4.5 km of NPS 20 HP steel main and will abandon approximately 4.5 km of the existing NPS 20 HP main on Lakeshore Blvd in Toronto.

Recommended Alternative Description

Scope of Work: This project is a size-for-size replacement of the existing NPS 20 HP steel main on Lake Shore Blvd from Cherry St. to Bathurst St.. This work includes approximately 4850 m of NPS 20 and 500 m of NPS 20 on Mill St, it runs on Lake Shore Blvd from Parliament St to Bathurst.

Resources: 2021 - OTC and would be bid on by external contractors

Solution Impact: Main replacement project identified by Asset Management - Pipelines as high-priority. Replacement is required due to age, pipeline condition and risk assessment results. Further investigation was completed in 2018 to collect additional pipe condition data to assist in the planning, engineering and risk components. This confirmed the timing for execution of this replacement project for 2021.

Project Timing & Execution Risks: Moratoriums, third-party developments, Gardiner realignment and required easements.

Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - DP - Main Replacement - Vintage Steel Mains Replacement Program
Investment Stage	Executing		


Investment Overview


1. Project Information	State/Province	Ontario
	Operating Area (EGI)	10 - Toronto
	Asset Program (EGI)	DP - Main Replacement
	Asset Class (EGI)	Distribution Pipe
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Alternative Spend Profile - Recommended

Name									Net Base Capex O (CA)	
NPS 20 Lake Shore Replacement (Cherry to Bathurst)									\$	26,216,609
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 26,216,609	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ 500,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended

	Value Function Measure	Value	Value in Percentage
	Total Investment Cost (CA)	(25,314)	100%
	Total	(25,314)	100%
Report Generation Date: 2/21/2023			

 Investment Summary Report	Investment Code 48670	Report Start Year 2023	Number of Years 10
	Investment Name		
	Windsor Line Replacement		

Investment Description

<p>Issue/Concern:</p> <p>A significant portion of the Windsor Line was installed in the 1930s, 1940s, and 1950s. Although this pipeline one of the oldest operating assets within the Union rate zones, it is not age alone that is driving the need for replacement. There are many other factors related to its condition that are more relevant than its age in considering the need for replacement:</p> <ul style="list-style-type: none">- History of leakage with significant costs to repair- All joints prior to 2000s were made with unrestrained mechanical couplings; portions of the older vintage pipe are not weldable.- Some sections of the line cannot be isolated because of inoperable mainline valves.- The line has sections that have poor depth of cover with less than 0.6 meters.- Sections of this pipeline are not located in easement. <p>Based on these concerns and the significant effort and resources spent already repairing leaks, the Windsor Line has been deemed an operational risk. To manage this risk, the line has been identified for replacement of those sections with the highest risk as identified above.</p> <p>Assets:</p> <p>Replacement of approximately 64 kilometers of the existing Windsor Line natural gas pipeline, (primarily a 10-inch diameter pipeline with some short sections of 8-inch pipeline), with a new 6-inch diameter pipeline.</p> <p>Related Programs: N/A</p>
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Recommended Alternative Description

<p>Scope of Work: The proposed project will replace 61.4 kilometers of the existing Windsor 10” pipeline, and construct a new ~65-kilometer, 6” distribution line operating at a higher operating pressure, between Windsor and Port Alma, which is expected to be placed into service on November 1, 2020.</p> <p>Resources:</p> <p>OTC 2020 with external contractors</p> <p>Solution Impact:</p> <p>Main replacement project identified by Operations - Pipelines as high-priority. Replacement is required due to age, pipeline condition and risk assessment results.</p> <p>Timing & Execution Risks:</p> <p>This confirmed the timing for execution of this replacement project for 2020.</p> <p>Risks: Moratoriums, 3rd party developments, COVID-19 impacts, permitting and required easements.</p>	Project (EGI)	Planning Portfolio	UG - Core - DP - Main Replacement - General Mains Replacement
Investment Type	Investment Stage		


Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_01 - Windsor
	Asset Program (EGI)	DP - Main Replacement
	Asset Class (EGI)	Distribution Pipe
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No


Alternative Spend Profile - Recommended

Name										Net Base Capex O (CA)
Windsor Line Replacement										\$ 33,089
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 33,089	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended

	Value Function Measure	Value	Value in Percentage
	Total Investment Cost (CA)	(32)	100%
	Total	(32)	100%

Report Generation Date: 2/21/2023

 Investment Summary Report	Investment Code	Report Start Year	Number of Years
	501708	2023	10
	Investment Name		
	Windsor Line Replacement - West Portion		

Investment Description

Issue/Concern:
A significant portion of the Windsor Line was installed in the 1930s, 1940s, and 1950s. Although this pipeline one of the oldest operating assets within the Union rate zones, it is not age alone that is driving the need for replacement. There are many other factors related to its condition that are more relevant than its age in considering the need for replacement:
- History of leakage with significant costs to repair
- All joints prior to 2000s were made with unrestrained mechanical couplings; portions of the older vintage pipe are not weldable.
- Some sections of the line cannot be isolated because of inoperable mainline valves.
- The line has sections that have poor depth of cover with less than 0.6 meters.
- Sections of this pipeline are not located in easement.

Based on these concerns and the significant effort and resources spent already repairing leaks, the Windsor Line has been deemed an operational risk. To manage this risk, the line has been identified for replacement of those sections with the highest risk as identified above.

Assets:
Replacement of approximately 64 kilometers of the existing Windsor Line natural gas pipeline, (primarily a 10-inch diameter pipeline with some short sections of 8-inch pipeline), with a new 6-inch diameter pipeline.

Recommended Alternative Description

Scope of Work: The proposed project will replace 61.4 kilometers of the existing Windsor 10” pipeline, and construct a new ~65-kilometer, 6” distribution line operating at a higher operating pressure, between Windsor and Port Alma, which is expected to be placed into service on November 1, 2020.

Resources:
OTC 2020 with external contractors

Solution Impact:
Main replacement project identified by Operations - Pipelines as high-priority. Replacement is required due to age, pipeline condition and risk assessment results.

Timing & Execution Risks:This confirmed the timing for execution of this replacement project for 2020.

Risks: Moratoriums, 3rd party developments, COVID-19 impacts, permitting and required easements.

Investment Type	Project (EGI)	Planning Portfolio			UG - Core - DP - Main Replacement - General Mains Replacement			
Investment Stage	Executing							


Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_01 - Windsor
	Asset Program (EGI)	DP - Main Replacement
	Asset Class (EGI)	Distribution Pipe
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No


Alternative Spend Profile - Recommended

Name									Net Base Capex O (CA)	
Windsor Line Replacement - West Portion									\$	319,011
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 319,011	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ (42,252)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended

	Value Function Measure	Value	Value in Percentage
	Total Investment Cost (CA)	(306)	100%
	Total	(306)	100%

Report Generation Date: 2/21/2023

 Investment Summary Report	Investment Code	Report Start Year	Number of Years
	6423	2023	10
	Investment Name		
	NPS 30 Don River Replacement		

Investment Description

Issue/Concern: Main replacement project identified by Asset Management - Pipelines as high-priority. This is an LTC project and the OEB filing number is EB-2018-0108. Studies have identified structural issues with the Bridge that can become further impaired during flood events which could cause the Bridge to fail resulting in catastrophic failure of the pipeline. The pipeline is a critical feed to the densely populated urban Toronto area. Damage to this crossing at peak design temperature would result the loss of ~ 92,500 customers, and may take days or weeks to restore service, once the pipeline issue has been addressed. Assets: NPS 30 XHP Main. Related Programs/BCs: NPS 20 HP, XHP and Station Replacement project (BC 10087) NPS 20 Lake Shore KOL (Cherry to Bathurst) (BC 10088)

Recommended Alternative Description

Scope: This project is for the replacement of approximately 0.35 km of NPS 30 XHP on the Don River Crossing. The current estimate assumes microtunneling under the Don river. Resources: Third party contractor - NPL and Ward & Burke
 Solution Impact: Replacement required due to the risk assessment results on the bridge over the Don River. See section 5.2.5 in the asset plan
 Solution timing and execution risk: 2019 Construction (Q1 start)
 Risks: TRCA, Metrolinx, 3rd party development, City of Toronto

Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - DP - Main Replacement - General Mains Replacement
Investment Stage	Executing		

Investment Overview


1. Project Information	State/Province	Ontario
	Operating Area (EGI)	10 - Toronto
	Asset Program (EGI)	DP - Main Replacement
	Asset Class (EGI)	Distribution Pipe
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Alternative Spend Profile - Recommended

Name										Net Base Capex O (CA)	
NPS 30 Don River Replacement										\$	-
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Base CAPEX O	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended

Report Generation Date: 2/21/2023

 Investment Summary Report	Investment Code 48655	Report Start Year 2023	Number of Years 10	
	Investment Name			
	Kingsville Transmission Reinf P			

Investment Description

System Reinforcement This is an ICM project.			
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Recommended Alternative Description

System Reinforcement			
Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Growth - System Reinforcement
Investment Stage	Completed		

Investment Overview


1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_01 - Windsor
	Asset Program (EGI)	GTH - System Reinforcement
	Asset Class (EGI)	Growth
2. Compliance	Compliance Investment	
	Compliance Justification & Code	
3. Must Do	Must Do Investment	Yes
	Intolerable Risk (EGI)	
	Third Party Relocation (EGI)	
	Program work with sufficient history and risk to warrant continuation (EGI)	

Alternative Spend Profile - Recommended

Name									Net Base Capex O (CA)	
Kingsville Transmission Reinf P									\$	-
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended

Report Generation Date: 2/21/2023

<div>  </div> <div>Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	100203	2023	10
	Investment Name		
	Stratford Reinforcement		

Investment Description

<p>Issue/Concern/Opportunity:</p> <p>In order to support a significant load addition on the Forest, Hensall, & Goderich Transmission System, a reinforcement is required from the end of the 2019 Stratford Reinforcement project to the inlet of Stratford Gate Station (17P-301).</p> <p>This project allows EGI to continue to provide regular rate customers with gas while also serving a new glass plant with a known demand of 18,000 m3/h.</p> <p>Justification: Reinforcement is required to add customer (a Glass plant) to the system.</p> <p>Assets: This project will consist of two components:</p> <ol style="list-style-type: none"> 1. Approximately 9.4 km of NPS 12 high pressure transmission (6160 kPa MOP) steel natural gas main extending from the end of the Stratford Reinforcement Phase 1 project at Perth-Oxford Rd and into Stratford Gate Station (along Crane Ave). 2. Approximately 1 km of NPS 6 (3450 kPa MOP) and approximately 700 m of NPS 4 (3450 kPa MOP) heading south along Erie St (Hwy 7) to the customer site at Erie & 29 Line. <p>Related Programs: N/A</p>
--

Recommended Alternative Description

Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Growth - System Reinforcement
Investment Stage	Completed		

Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_04 - London
	Asset Program (EGI)	GTH - System Reinforcement
	Asset Class (EGI)	Growth
2. Compliance	Compliance Investment	
	Compliance Justification & Code	
3. Must Do	Must Do Investment	Yes
	Intolerable Risk (EGI)	
	Third Party Relocation (EGI)	
	Program work with sufficient history and risk to warrant continuation (EGI)	

Alternative Spend Profile - Recommended

Name										Net Base Capex O (CA)
										\$ -
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -


Alternative Value - Recommended

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Alternative Spend Profile - Candidate

Name										Net Base Capex O (CA)
Stratford Reinforcement										\$ -
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Report Generation Date: 2/21/2023

 Investment Summary Report	Investment Code 49607	Report Start Year 2023	Number of Years 10
	Investment Name		
	LOND-London Lines Replacement		

Investment Description

Issue/Concern:

"Investment Code 49607 (Part 1 of 4) covers the 2021 In-Service work consisting of:

- A single replacement steel pipeline (3450 kPa) from Dawn to Komoka (consisting of approximately 15.1 km of NPS 6 from Dawn to Oakdale Header, 51.5 km of NPS 4 from Oakdale Header to Mt. Brydges, and 15.5 km of NPS 6 from Mt. Brydges to Komoka Trans.).
- A new NPS 6 steel pipeline feed from Dawn-Parkway Transmission to Mt. Brydges.
- 2021 In-Service station works includes: Oakdale Header Station, Komoka Transmission Station and nine 144H size stations along the route."

"Related Investment Codes include: 735670 = LOND-LLRP 2022-ISD:Stns-SRoyGate&Class7 / 735671 = LOND-LLRP 2022-ISD:Distrib.Srvcs&Mains / 735672 = LOND-LLRP 2022-ISD:Abandonment"

The London Lines is a pair of high pressure distribution pipeline that connects Dawn to the City of London, and the multiple municipalities in between and spans approximately 80.9 km. The London Lines consists of 2 high pressure (HP) pipelines running in parallel and is considered a major feed supplying gas to the small communities between Dawn and London. The line located further north is known as the London South Line and is comprised mainly of NPS 10 steel pipeline coated in Barrett Enamel and installed in 1935. The line located further south is known as the London Dominion Line and is comprised mainly of NPS 8 steel pipeline coated in Durnite and installed in 1936, which was subsequently replaced in 1952. The materials used were reclaimed and refurbished steel pipe from the Windsor district with an average vintage of 1920 - 1930.

There are a number of business benefits to replacing the London Lines pipelines as soon as possible. They include:

Integrity– associated risks from numerous outstanding leaks and future leak potential eliminated through replacement:

- Pipeline is constructed with unrestrained Dresser coupling fittings.
- Aerial crossings at ditches which in some instances are bare and/or have unrestrained Dresser couplings.
- Inoperable valves including valves installed at grade/in the ground
- Current system operates below MOP to reduce number of leaks.
- Both pipelines installed in the 1950s - one line constructed using reclaimed pipe from Windsor of 1920s vintage.
- Depth of cover issues in multiple sections.
- Non-standard supports at deep ditches to allow access for leak survey
- Increased difficulty of repairs including finding pipe suitable for welding

O&M resources - a reduction in the amount of O&M resources needed to address, monitor, and fix new and outstanding leaks is substantial. Estimated cost of a new repair is \$15-60k.

System flexibility – the connection of Strathroy to the Dawn to Parkway system in two locations will provide resiliency to the network.

Assets: London Lines consists of 2 HP pipelines running in parallel (London South Line and London Dominion Line).

Related Programs: N/A

Recommended Alternative Description

Scope of Work:

This project will install 83.5 km of NPS 6 & NPS 4 steel pipe with a MOP of 3450 kpa (500 psi) from Dawn Compressor Station to Komoka Transmission Station, replacing the two pipelines known collectively as the London Lines. There will also be secondary new pipeline installed to connect the new NPS 6/4 pipeline to the town of Strathroy. The pipeline provides service, directly and indirectly, to approximately 8,500 customers.

Resources: 2021 - OTC and would be bid on by external contractors

Solution Impact:

Main replacement project identified by Operations - Pipelines as high-priority. Replacement is required due to age, pipeline condition and risk assessment results. This confirmed the timing for execution of this replacement project for 2021.

Timing & Execution Risks:

Risks: Moratoriums, 3rd party developments, COVID-19 impacts, permitting and required easements.

Investment Type	Project (EGI)	Planning Portfolio	UG - Core - DP - Main Replacement - General Mains Replacement
Investment Stage	Executing		

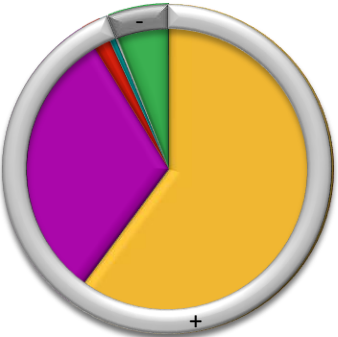
Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_03 - Sarnia
	Asset Program (EGI)	DP - Main Replacement
	Asset Class (EGI)	Distribution Pipe
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant	No

Alternative Spend Profile - Recommended

Name									Net Base Capex O (CA)	
LOND-London Lines Replacement									\$	558,963
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 558,963	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended

	Value Function Measure	Value	Value in Percentage
	Operational Risk	5,476	60%
	Financial Risk	2,834	31%
	Public Safety Risk	172	2%
	Employee And Contractor Safety Risk	59	1%
	Reputational Risk	21	0%
	Avoided GHG Emissions (CA)	0	0%
	Budget Savings OPEX (CA)	0	0%
	Cost Avoidance CAPEX (CA)	0	0%
	Cost Avoidance OPEX (CA)	0	0%
	Environmental Risk And Remediation	0	0%
	Total Investment Cost (CA)	(540)	6%
	Total	8,022	100%

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 45-47 & Appendix A

and <https://www.copperleaf.com/blog/innovation-copperleaf-how-the-value-model-library-helps-organizations-make-better-decisions/>

and EB-2020-0181 EGI_APPL_ PHASE 2_20201015 Section 7 Appendix: EGI Asset Management Plan 2021-2025 Appendix

Preamble:

Pg. 45-46 of the EGI evidence states: *EGI aims to have a clear framework for asset investment decision-making that balances risk, cost and performance throughout the asset life cycle. The strategies to achieve this are:*

- *Optimize portfolio based on asset management principles.*
- *Improve decision-making through transparency, clear accountabilities, stakeholder engagement and use of a common tool.*
- *Extend asset management decision-making to further include operations and maintenance activities to ensure that optimal asset value is attained over each asset's life.*
- *Improve decision-making through an understanding of the asset context and timing considerations for outages.*

The evidence goes on to describe the role of the Copperleaf C55 in this process. From the Copperleaf reference, the company's description is: *Once we've identified all the value measures, we then construct a series of "value models" that enable the organization to quantify the value of every proposed investment. These value models can come "off the shelf" from the library or can be based on models that already exist but tweaked to accommodate a particular client's needs. We can also develop models from scratch for clients with extremely unique requirements.*

At the end of this process, the Copperleaf Value Framework provides an enterprise-wide view of all the value measures that support the organization's goals—as well as the models used to calculate how individual investments or projects contribute to those measures. The result is that everyone can understand the rationale behind each

decision, driving consensus and linking day-to-day decisions with business strategy. This helps create a culture of transparency, accountability, and trust.”

Table 4.1-3 on page 47 presents EGI's descriptions of the Value Measures.

Appendix A presents the Investment Summary reports but not the Value Function Measures.

Question(s):

Please provide the entire “Investment Summary Report” including the Value Function Measures for the Projects identified in Appendix A.

Response:

Please see Attachment 1 for updated Investment Summary Reports. Please note that not all investments require value framework assessments as they are mandatory or compliance driven as described at Exhibit 2, Tab 6, Schedule 2, Page 46, and therefore may not have or require a value framework assessment. Additionally, there are some investments for which the value function will be supported and potentially updated through other planned condition and health assessments before project scopes are finalized. Please see the comments column in Table 1 for details regarding the application of value framework for such investments.

Table 1


Investment Code	Investment Name	Value Function Measures Included	Value Framework Application Details
100901	Dawn to Corunna	Yes	Project justified through classification as intolerable risk. Mandatory investment per Exhibit 2, Tab 6, Schedule 2, Page 46 of 288, Table 4.1-2.
48715	Dawn C Compression Lifecycle	Yes	Further assessment of risk underway through AHR per response to Exhibit I.2.6-SEC-134.
734634	Dawn to Corunna (Dawn Tie-in)	Yes	Project justified through classification as intolerable risk. Mandatory investment per Exhibit 2, Tab 6, Schedule 2, Page 46 of 288, Table 4.1-2.
48732	Waubuno Compression Lifecycle	Yes	Further assessment of risk underway through AHR per response to Exhibit I.2.6-SEC-134.
7660	VPM - Erin Township	Yes	
100339	A10: Wilson Avenue, Toronto, VSM Replacement	Yes	Pipeline to be further assessed under Enhanced DIMP Program per Exhibit 1, Tab 13, Schedule 3.

Investment Code	Investment Name	Value Function Measures Included	Value Framework Application Details
1938	NPS 10 Glenridge Avenue, St. Catharines	Yes	
11443	NPS 12 Martin Grove Rd Main Replacement: Lavington to St. Albans Rd.	Yes	Pipeline to be further assessed under Enhanced DIMP Program per Exhibit 1, Tab 13, Schedule 3.
10293	St. Laurent Phase 3 - North/South (NPS12/16 Steel)	No	Value Framework not applied. Project originally justified based on exceedance of Company's Risk tolerance per EB-2017-0306/0307, Exhibit C.STAFF.54, Attachment 1, Page 18 of 498. Pipeline has been subject to further assessment per response to Exhibit I.2.6.SEC 71
10294	St. Laurent Phase 4 - East/West (NPS12 Steel)	No	Value Framework not applied. Project originally justified based on exceedance of Company's Risk tolerance per EB-2017-0306/0307, Exhibit C.STAFF.54, Attachment 1, Page 18 of 498. Pipeline has been subject to further assessment per response to Exhibit I.2.6.SEC 71
503350	Moulton Replacement BU	Yes	
100295	NPS 8 Port Stanley Replacement	Yes	Pipeline to be further assessed under Enhanced DIMP Program per Exhibit 1, Tab 13, Schedule 3.
736530	Sudbury Lateral Integrity Digs 2023	No	Compliance Driven per Exhibit 2, Tab 6, Schedule 2, Page 46, Table 4.1-2
3610	CROWLAND STORAGE TRANSFER	Yes	
735335	GTAW Parkway Gate Station Rebuild Phase 2	Yes	
503369	Lisgar Station	Yes	
1024	NW 6581 Ottawa Reinforcement Phase 2 SRP	No	Mandatory - EBO 134/188 per Exhibit 2, Tab 6, Schedule 2, Page 46, Table 4.1-2.
736259	Hamilton Industrial Reinforcement	No	Mandatory - EBO 134/188 per Exhibit 2, Tab 6, Schedule 2, Page 46, Table 4.1-2.
100703	SRP_LUG East_Kingston_Creek ford Rd_Reinforcement_N PS8_6200m_6895kPa	No	Mandatory - EBO 134/188 per Exhibit 2, Tab 6, Schedule 2, Page 46, Table 4.1-2.

Investment Code	Investment Name	Value Function Measures Included	Value Framework Application Details
30523	SRP_North_Parry Sound_Seguin Trail_Reinforcement_NPS6_8500m_4960kPa	No	Mandatory - EBO 134/188 per Exhibit 2, Tab 6, Schedule 2, Page 46, Table 4.1-2.
30542	SRP_Southeast_Owen Sound_County Rd 40_Reinforcement_NPS12_11800m_4670kPa	No	Mandatory - EBO 134/188 per Exhibit 2, Tab 6, Schedule 2, Page 46, Table 4.1-2.
736075	WIND: Wheatley-1B - Panhandle Distribution Reinforcement - Wheatley Lateral Replacement and Reinforcement	No	Mandatory - EBO 134/188 per Exhibit 2, Tab 6, Schedule 2, Page 46, Table 4.1-2.
736975	Enbridge Gas Distribution System Hydrogen Feasibility Study	No	Mandatory – Time constrained to qualify and meet the agreement of the federal government requirement for government funding and to have the project completed by 2026 as referenced in Exhibit 4, Tab 2, Schedule 6, Page 18 Paragraph 49.
48714	Hagar Cold Box	Yes	
49955	Hagar JVG Compressor Upgrade	Yes	
48709	Hagar KVGR and Cycle Mix Cooler	Yes	
8701	Kelfield Operations Centre - Land Purchase	Yes	
737226	Kelfield Operations Centre - New Building	Yes	
501813	Kennedy Road Expansion	Yes	
3642 – Formally called “SMOC/Cover entry Facility Consolidation”	Ottawa – Land Purchase	No	Mandatory- Tied to Investment 737374 – Ottawa - New Building
737374 – Formerly Part of 3642	Ottawa – New Building	Yes	

Investment Code	Investment Name	Value Function Measures Included	Value Framework Application Details
3640	Station B New Building	Yes	
102059 – Formerly Part of 8681	Thorold Regional Operations Centre - Land	No	Mandatory- Tied to Investment 737754 – Thorold Operations Centre - New Building
737754 – Formerly Part of 8681	Thorold Operations Centre – New Building	Yes	
8782	VPC Core and Shell	Yes	
100621	Dawn Administrative Centre	Yes	
101136	New London Site	Yes	
100709	Sudbury Regional Operations Centre	Yes	
102291	Contract Market Harmonization	Yes	
736081	General Service Rebasing Changes	Yes	
736942	Contract Market Systems - Technology Obsolescence	No	Mandatory – Tied to timing of Contract Market Harmonization (102291) and General Service Rebasing Changes (736081)
102364	Records Management Technology Obsolescence (2024-2026)	Yes	
6377	PCRW:Wells-Upgrade	No	Compliance per Exhibit 2, Tab 6, Schedule 2, Page 46, Table 4.1-2
100699	Dawn Parkway Expansion Project (Dawn-Enniskillen NPS 48)	No	Mandatory - EBO 134/188 per Exhibit 2, Tab 6, Schedule 2, Page 46, Table 4.1-2.
48654	Dawn Parkway Expansion Project (Kirkwall-Hamilton NPS 48)	No	Mandatory - EBO 134/188 per Exhibit 2, Tab 6, Schedule 2, Page 46, Table 4.1-2.
49758	Panhandle Regional Expansion Project	No	Mandatory - EBO 134/188 per Exhibit 2, Tab 6, Schedule 2, Page 46, Table 4.1-2.
736923	Panhandle Regional Expansion Project - Leamington Interconnect	No	Mandatory - EBO 134/188 per Exhibit 2, Tab 6, Schedule 2, Page 46, Table 4.1-2.
100086	Panhandle Line Replacement	Yes	

Investment Code	Investment Name	Value Function Measures Included	Value Framework Application Details
735972	PREP: NPS 36 looping to Comber Transmission	No	Mandatory - EBO 134/188 per Exhibit 2, Tab 6, Schedule 2, Page 46, Table 4.1-2.

 Investment Summary Report	Investment Code 100901	Report Start Year 2023	Number of Years 10
	Investment Name		
	Dawn to Corunna		

Investment Description

Issue/Concern/Opportunity:
The Company recognizes its obligation to meet the firm demands of its customers; and as a result, assets are continually evaluated to identify hazards and to assess risks in order to ensure that they remain reliable, suitable, and fit for continued service. To this end, an Asset Health Review (AHR) was performed in 2018 and updated in 2021 as part of the Company’s comprehensive Reliability, Availability and Maintainability (RAM) Study for the Corunna Compressor Station (CCS), which was completed by a consultant. The results of this study indicate that the health and maintainability of certain compressor units at the CCS are in decline. Reasons for this decline include, but are not limited to performance, functional issues with custom components (i.e., spare parts), and wear. As a result of these assessments, the Company has identified serious and increasing obsolescence and reliability risks associated with certain CCS compressor units and is experiencing a need for increased maintenance and repair work to keep the units operational going forward.
Further, as a result of the compressor units’ obsolescence and reliability issues, the Company has experienced continued and increasing compressor unit downtime and long lead repair time. This has created a need for increased maintenance and repair work performed by EGI personnel at the CCS. EGI has also undertaken comprehensive studies, including a site-wide quantitative risk assessment (QRA) to determine the severity of the increasing safety risks, and has determined that the current configuration of compressor units (which includes multiple compressor units in close proximity within a single building), results in an excessive level of process safety risk.

Assets: Compressors K701, K702, K703, K705, K706, K707 and K708

Related Investments: 734634 - Dawn to Corunna (Dawn Tie-in)

Recommended Alternative Description

Scope of Work:
The scope of the project includes the retirement and abandonment of 7 of the 11 existing reciprocating compressor units at the Corunna Compressor Station (CCS) and the construction of approximately 20 km of NPS 36 pipeline from the Dawn Operations Centre in the Township of Dawn Euphemia to the Corunna Compressor Station in St. Clair Township. The project will also include station work at the Dawn Operations Centre and the Corunna Compressor Station required to tie in the new pipeline.

Resources:
-Consultant resources for design
-Contractor resources for abandonment, construction and commissioning

Solution Impact:
This alternative provides a one-to-one replacement in design day storage system withdrawal capacity compared to the existing compressor units at the CCS facility that are proposed to be retired and abandoned. The NPS 36 pipeline will also provide equivalent storage injection capacity via existing compression units located within Dawn. Further, the proposed pipeline simplifies EGI storage operations by reducing the amount of rotating assets and running equipment. This opportunity to replace compression with a pipeline alternative also reduces emissions through utilization of existing hp compression at Dawn which have a lower burn rate (at higher efficiency).

Project Timing & Execution Risks:
-2021: File environmental assessment (EA) with Ontario Pipeline Coordination Committee (OPCC).
-2022: File Leave to Construct (LTC) with Ontario Energy Board (OEB).
This project will need two years of design procurement and construction and requires EA and regulatory approval. In-service date is slated for 2023.


Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - Compression Stations - Replacements
Investment Stage	Executing		

Investment Overview

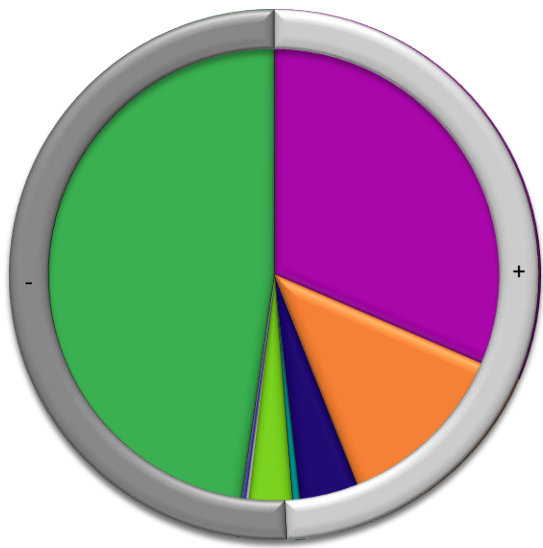
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	70 - Storage
	Asset Program (EGI)	CS - Replacements
	Asset Class (EGI)	Compression Stations
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name									Net Base Capex O (CA)	
Dawn to Corunna									\$	147,778,280
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 127,260,523	\$ 5,009,329	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ 5,069,400	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -


<div> Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	100901	2023	10
	Investment Name		
	Dawn to Corunna		

Alternative Value - Recommended



Value Function Measure	Value
Financial Risk	87,493
Cost Avoidance OPEX (CA)	34,988
Cost Avoidance CAPEX (CA)	11,573
Employee And Contractor Safety Risk	1,527
Budget Savings OPEX (CA)	(8,437)
Energy Efficiency (CA)	498
Avoided GHG Emissions (CA)	774
Environmental Risk And Remediation	0
Public Safety Risk	0
Reputational Risk	0
Budget Savings CAPEX (CA)	(135)
Revenue Impact (CA)	0
Total Investment Cost (CA)	(132,494)
Total	(4,213)

Report Generation Date: 5/30/2022

 Investment Summary Report	Investment Code 48715	Report Start Year 2023	Number of Years 10
	Investment Name		
	Dawn C Compression Lifecycle		

Investment Description

Issue/Concern:
Dawn C Plant is one of the nine centrifugal compressors located at the Dawn Compressor Station. It is primarily used to lift from lower storage pressure levels, experienced later in the operations season, to intermediate pressure levels. The intermediate pressure level is typically elevated further in pressure by another compressor to reach the desired Dawn outlet pressure. Dawn Plant C and Plant D have a suction pressure rating of 195 psig, the lowest rating of the compressor fleet at Dawn. Considering the other compressors at Dawn have a 225 psig minimum inlet rating, Dawn Plants C and D become very critical when pool storage levels fall below 225 psig, as they typically do late in the operational season. Overall, compression can pose a very large consequence of failure as compressors are integral assets required to achieve the Dawn to Parkway Transmission System deliverability requirements throughout the year. The consequence of compressor failure is dominated by gas cost impacts to customers. Transmission System consequences associated with failure of a single compressor are heavily influenced by the time of year, weather severity and time to mitigate the failure. Siemens, the original equipment manufacturer (OEM) of the Dawn C compressor, has indicated that 40 years is the typical timeframe for supporting the supply of engine parts required to recover from a critical engine failure or to complete recommended overhauls. Dawn Plant C was installed in 1984, which indicates that the RB211- 24A engine in Plant C is reaching end of life.

Justification:
By continuing to comply with OEM-recommended Preventive Maintenance (PM) schedules and overhauls, compressor reliability risk is controlled to moderate levels but risk increases gradually over the 25,000-hour recommended interval between overhauls. Availability of parts is essential to repair internal engine failures and complete overhauls. Notably, the RB211-24A in Plant C has non-standard dimensions and cannot be retrofitted with more modern editions of the RB211 without significant plant retrofits. Similar to the 40-year old Dawn Plant B, which was replaced and retired in 2017 due to the risks associated with discontinued OEM support of critical engine parts, it is expected that Dawn Plant C will be exposed to a similar level of risk at the age of 40.

Assets: Dawn Plant C

Related Programs: N/A

Recommended Alternative Description

Scope of Work:
Removal and abandonment of the plant, associated piping and electrical, and remediation of land back to level grade. A new compression facility and its associated infrastructure will be developed and installed at the Dawn Compressor Station.

Work includes full project gating cycle due to scale and complexity including: stakeholder consultations, planning, detailed design, permit applications, environmental assessment. procurement, retaining a construction contractor, isolate system, demolition of structures/equipment to be replaced, erect buildings if required, prefabricating piping, hydrotesting, install new piping and auxiliary systems, NDE as required, coating, inspection, train staff, energize system, remediating site, and records updates.

Resources:
Consultant resources for design
Contractor resources for abandonment, construction and commissioning
Regulatory approval

Solution Impact:
This project will ensure the safe removal of infrastructure and the replacement of 32,000 hp of obsolete compression to support the storage to transmission requirements at Dawn.

Project Timing & Execution Risk:
Regulatory approval and planning - 2 years, abandonment and remediation 18 months.


Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Compression Stations - Replacements
Investment Stage	Executing		

Investment Overview

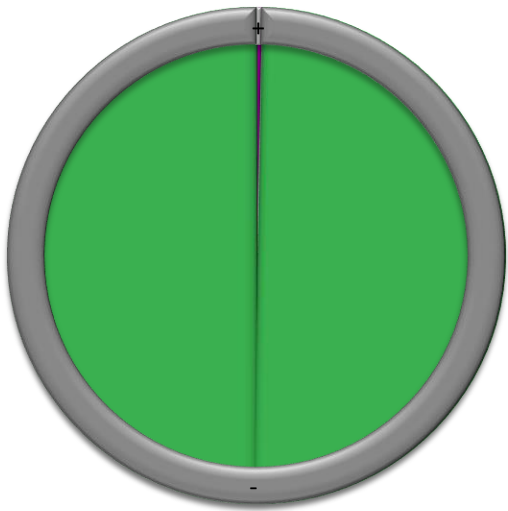
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_53 - Union South Storage
	Asset Program (EGI)	CS - Replacements
	Asset Class (EGI)	Compression Stations
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No













Spend Profile

Name									Net Base Capex O (CA)	
Dawn C Compression Lifecycle									\$	125,000,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 200,000	\$ 12,480,000	\$ 24,960,000	\$ 74,880,000	\$ 12,480,000	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -


 Investment Summary Report	Investment Code 48715	Report Start Year 2023	Number of Years 10
	Investment Name		
	Dawn C Compression Lifecycle		

Alternative Value - Recommended



Value Function Measure		Value
	Financial Risk	287
	Operational Risk	3
	Avoided GHG Emissions (CA)	0
	Budget Savings OPEX (CA)	0
	Cost Avoidance CAPEX (CA)	0
	Cost Avoidance OPEX (CA)	0
	Employee And Contractor Safety Risk	0
	Environmental Risk And Remediation	0
	Public Safety Risk	0
	Reputational Risk	0
	Gas Storage Reliability (CA)	0
	Total Investment Cost (CA)	(90,988)
Total		(90,698)

Report Generation Date: 5/30/2022

 Investment Summary Report	Investment Code 734634	Report Start Year 2023	Number of Years 10
	Investment Name		
	Dawn to Corunna (Dawn Tie-in)		

Investment Description

Issue/Concern/Opportunity:
The Company recognizes its obligation to meet the firm demands of its customers; and as a result, assets are continually evaluated to identify hazards and to assess risks in order to ensure that they remain reliable, suitable, and fit for continued service. To this end, an Asset Health Review (AHR) was performed in 2018 and updated in 2021 as part of the Company’s comprehensive Reliability, Availability and Maintainability (RAM) Study for the Corunna Compressor Station (CCS), which was completed by a consultant. The results of this study indicate that the health and maintainability of certain compressor units at the CCS are in decline. Reasons for this decline include, but are not limited to performance, functional issues with custom components (i.e., spare parts), and wear. As a result of these assessments, the Company has identified serious and increasing obsolescence and reliability risks associated with certain CCS compressor units and is experiencing a need for increased maintenance and repair work to keep the units operational going forward.
Further, as a result of the compressor units’ obsolescence and reliability issues, the Company has experienced continued and increasing compressor unit downtime and long lead repair time. This has created a need for increased maintenance and repair work performed by EGI personnel at the CCS. EGI has also undertaken comprehensive studies, including a site-wide quantitative risk assessment (QRA) to determine the severity of the increasing safety risks, and has determined that the current configuration of compressor units (which includes multiple compressor units in close proximity within a single building), results in an excessive level of process safety risk.

Assets: Compressors K701, K702, K703, K705, K706, K707 and K708

Related Investments: 100901 - Dawn to Corunna

Recommended Alternative Description

Scope of Work:
This portion of the project is specific to the Union rate zone and the dismantlement of Tecumseh Measurement and tie-in to Dawn yard for the NPS 36 pipeline.

Overall Project Scope
The scope of the project includes the retirement and abandonment of 7 of the 11 existing reciprocating compressor units at the Corunna Compressor Station (CCS) and the construction of approximately 20 km of NPS 36 pipeline from the Dawn Operations Centre in the Township of Dawn Euphemia to the CCS in St. Clair Township. The project will also include station work at the Dawn Operations Centre and the CCS required to tie-in the new pipeline.

Resources:
•Consultant resources for design
•Contractor resources for abandonment, construction and commissioning

Solution Impact:
This alternative provides a one-to-one replacement in design day storage system withdrawal capacity compared to the existing compressor units at the CCS facility that are proposed to be retired and abandoned. The NPS 36 pipeline will also provide equivalent storage injection capacity via existing compression units located within Dawn. Further, the proposed pipeline simplifies EGI storage operations by reducing the amount of rotating assets and running equipment. This opportunity to replace compression with a pipeline alternative also reduces emissions through utilization of existing hp compression at Dawn which have a lower burn rate (at higher efficiency).

Project Timing & Execution Risks:
•2021: File environmental assessment (EA) with Ontario Pipeline Coordination Committee (OPCC).
•2022: File LTC with Ontario Energy Board (OEB).
This project requires two years of design procurement and construction and requires EA and regulatory approval. In-service date is slated for 2023.


Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Compression Stations - Replacements
Investment Stage	Executing		

Investment Overview

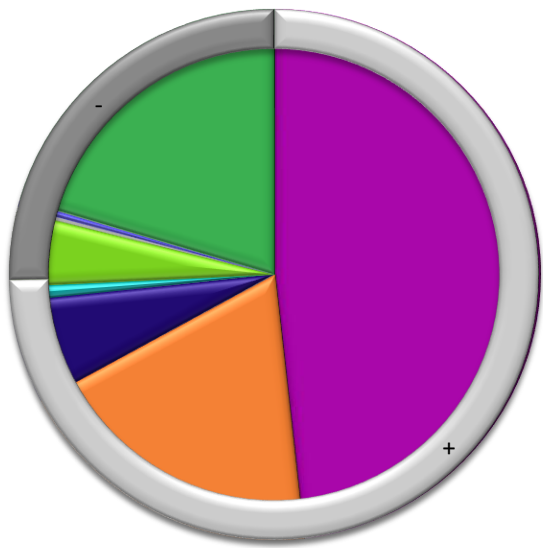
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_53 - Union South Storage
	Asset Program (EGI)	CS - Replacements
	Asset Class (EGI)	Compression Stations
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name									Net Base Capex O (CA)	
Dawn to Corunna (Dawn Tie-in)									\$	42,032,164
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 38,446,515	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ 9,414,600	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -


<div> Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	734634	2023	10
	Investment Name		
Dawn to Corunna (Dawn Tie-in)			

Alternative Value - Recommended



Value Function Measure	Value
Financial Risk	89,358
Cost Avoidance OPEX (CA)	34,988
Cost Avoidance CAPEX (CA)	11,573
Employee And Contractor Safety Risk	1,649
Budget Savings OPEX (CA)	(8,437)
Energy Efficiency (CA)	498
Avoided GHG Emissions (CA)	774
Environmental Risk And Remediation	0
Public Safety Risk	0
Reputational Risk	0
Budget Savings CAPEX (CA)	(135)
Revenue Impact (CA)	0
Total Investment Cost (CA)	(37,835)
Total	92,434

Report Generation Date: 5/30/2022

 Investment Summary Report	Investment Code 48732	Report Start Year 2023	Number of Years 10
	Investment Name		
	Waubuno Compression Lifecycle		

Investment Description

Issue/Concern/Opportunity:
The Waubuno compressor elevates available pipeline pressure to the Waubuno Pool Maximum Operating Pressure (MOP). Compression increases the working inventory value of the pool by approximately 3.5 PJ on top of what the pipeline alone can achieve. The compressor is operated approximately 45 days per year in late summer to early fall to top off the pool. The consequence of compressor failure is dominated by customer impact. Risk associated with failure of the Waubuno compressor is heavily influenced by the level of the pool at which the failure occurs and time to mitigate the failure.
The Joy Compressor (manufactured in 1985) was a used compressor package and installed at Waubuno in 1988. The Joy Compressor Company changed ownership approximately 20 years ago, at that time original equipment manufacturer (OEM) support for the compressor was discontinued. Although normal wear components are still available in the marketplace, replacement major compressor items such as cylinders, crankshafts, and rods, etc., required to support a critical failure are no longer available. In the event of a critical failure, sourcing used parts (which are rare) or aftermarket custom machining services would be the only options for repair. This was the case in 2007 when a discharge valve seat failed, resulting in catastrophic damage to cylinder 611. An extensive search across the used parts dealers was required to secure a viable used cylinder head. Other internal damage was repaired through custom machining services.

Justification: In the event of a future failure, if usable parts or custom machining are not available, the two options would be custom-designed aftermarket castings (if possible) or replacement of the entire compressor. However, both options would render the compressor out of service for at least one operational season.

Assets: Waubuno Compressor

Related Programs: N/A

Recommended Alternative Description

Scope of Work:
In order to meet lifecycle needs for the Waubuno storage facility, EGI is proposing to construct a new NPS 20 pipeline from Waubuno to TR-7 (~1.6 km). This will eliminate the requirement for a remote compressor at Waubuno; and therefore, this project will also involve the abandonment of the Waubuno Remote Compressor Unit and related equipment.
Waubuno Station Modifications (common in all scenario alternatives)
-New Control and Measurement Building
-Upgrade meters, control valve, and filter/separator
-Launcher and associated piping
Pipeline Construction
-NPS 20 Pipeline from Waubuno to TR-7/TR-2/TR-1
-~1.5 km NPS 20 Line (1,440 psi MOP)
-Connection to TR-7 (for injection); to TR-2 (200# Storage Suction); to TR-1 (Flexibility/Optionality)
-Valving to connect new pipeline with TR-1, TR-2, and TR-7 with overpressure protection
-Receiver and associated piping at new TR-7 valve site
-New Control Building
-Waubuno Compressor Abandonment (common in all alternative scenarios)
-Removal of the compressor and any associated equipment in compressor building.
-Removal of all the NPS 8 compressor suction and discharge piping back to their take-off at the bypass control valve.
-Removal of the aftercooler, filter and silencer.
-Removal of all electrical wiring, control wiring and SCADA communication wiring and panels associated with the compressor.
-Removal of the compressor building and foundation. As the site has been in existence since the 1980s, there is a strong possibility of ground contamination that will need remediation.

Resources:
-Consultant resources for design
-Contractor resources for abandonment, construction and commissioning


Solution Impact:
Replace approximately 3.5 PJ of inventory provided by the current compressor that is obsolete and poses the risk of significant downtime in the event of a failure.

Project Timing & Execution Risks:
-Requires Ontario Energy Board Leave to Construct approval
-Pool out of service
-Pipeline route not finalized
-Landowners may want abandoned pipeline removed
-Dependent on TR-7 pipeline

Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Compression Stations - Replacements
Investment Stage	Executing		

Investment Overview

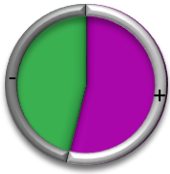
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_53 - Union South Storage
	Asset Program (EGI)	CS - Replacements
	Asset Class (EGI)	Compression Stations
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No



 Investment Summary Report	Investment Code 48732	Report Start Year 2023	Number of Years 10
	Investment Name		
	Waubuno Compression Lifecycle		


Spend Profile

Name										Net Base Capex O (CA)
Waubuno Compression Lifecycle										\$ 15,592,500
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 252,000	\$ 1,260,000	\$ 14,017,500	\$ 63,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ 630,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended



Value Function Measure		Value
	Financial Risk	14,106
	Total Investment Cost (CA)	(12,058)
Total		2,049

 Investment Summary Report	Investment Code 7660	Report Start Year 2023	Number of Years 10
	Investment Name		
	VPM - Erin Township		

Investment Description

Issue/Concern:
It has been reported through a leak event that the vintage plastic pipe in Erin Township has experience cracking due to the stony soil in this area. The Gas Technology Institute (GTI) study on Aldyl A pipe has stated stress intensifier such as rock impingement could result in SCG in this type of plastic pipe.

Assets: Vintage plastic pipe in Erin Township

Related Programs: Pipe replacement vintage plastic

Recommended Alternative Description

Scope of Work:
Replace 2,700 metres of 4-inch PE main, 10,000 m of 2-inch PE main and 300 services.

Resources: Extended Alliance contractors

Solution Impact:
Mains Replacement Program will address leaks and condition issues as identified. The approach depends on the extent of the poor condition. Localized poor condition is managed through pipeline repairs whereas broader condition issues are managed through more extensive replacement.

Project Timing & Execution Risks: Cost estimates continue to be refined as project design progresses and approaches construction. The work might require temporary land rights acquisition and permitting ahead of execution, which could have an impact to the project schedule.


Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - DP - Main Replacement - General Mains Replacement
Investment Stage	Executing		

Investment Overview

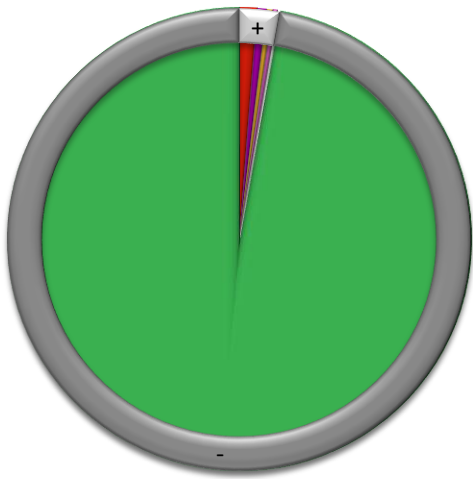
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	20 - Mississauga
	Asset Program (EGI)	DP - Main Replacement
	Asset Class (EGI)	Distribution Pipe
2. Compliance	Compliance Investment	Yes
	Compliance Justification & Code	Risk Assessment for Aldyl A attached
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No












Spend Profile

Name										Net Base Capex O (CA)	
VPM - Erin Township										\$	11,113,408
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Base CAPEX O	\$ 2,366,350	\$ 2,366,350	\$ 2,197,800	\$ 2,197,800	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Dismantlement	\$ 709,905	\$ 709,905	\$ 709,905	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	


 Investment Summary Report	Investment Code	Report Start Year	Number of Years
	7660	2023	10
	Investment Name		
VPM - Erin Township			

Alternative Value - Recommended



Value Function Measure		Value
	Public Safety Risk	106
	Financial Risk	56
	Operational Risk	36
	Reputational Risk	31
	Avoided GHG Emissions (CA)	20
	Budget Savings OPEX (CA)	5
	Cost Avoidance OPEX (CA)	0
	Environmental Risk And Remediation	0
	Employee And Contractor Safety Risk	0
	Cost Avoidance CAPEX (CA)	0
	Total Investment Cost (CA)	(8,805)
Total		(8,550)

Report Generation Date: 5/30/2022

 Investment Summary Report	Investment Code 100339	Report Start Year 2023	Number of Years 10
	Investment Name		
	A10: Wilson Avenue, Toronto, VSM Replacement		

Investment Description

<p>Issue/Concern/Opportunity:</p> <p>Phased replacement of 12 gas main from Bathurst Ave. to Walsh Ave. Main is currently protected by Rectifier.</p> <p>-The main on Wilson Ave. has numerous Pumpkins that have been installed on it. Starting from Wendell Ave. and going east towards Bathurst St.</p> <p>-Corrosion on main has been an issue on Wilson Ave. due to stray current from Toronto Transit Commission (TTC) which continues to be an ongoing concern.</p> <p>-The service connections have field-applied coatings which leaves a concern for future corrosion issues on this main.</p> <p>-Regarding the main in the middle of the road on Wilson Ave., Curbside Valve Tee (CVT) repairs are problematic due to the location of the main.</p> <p>Assets: There is 8.5 km of NPS 12 HP Vintage Steel Main (VSM) installed between 1955 and 1964 on Wilson Ave. between Walsh Ave. and Bathurst St., Toronto.</p> <p>Related Program: Not applicable.</p> <p>Phased replacement of 12 Gas Main from Bathurst Ave. to Walsh Ave. Main is currently protected by Rectifier.</p> <p>-The main on Wilson Ave. has numerous Pumpkins that have been installed on it. Starting from Wendell Ave. and going east towards Bathurst St.</p> <p>-Corrosion on main has been an issue on Wilson Ave. due to stray current from Toronto Transit Commission (TTC) which continues to be an ongoing concern.</p> <p>-The service connections have field-applied coatings which leaves a concern for future corrosion issues on this main.</p> <p>-Regarding the main in the middle of the road on Wilson Ave. , Curbside Valve Tee (CVT) repairs are problematic due to the location of the main.</p> <p>Assets: There is 8.5 km of NPS 12 HP Vintage Steel Main (VSM) installed between 1955 and 1964 on Wilson Ave. between Walsh Ave. and Bathurst St., Toronto.</p> <p>Related Program: N/A</p>
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Recommended Alternative Description

<p>Scope: Replace approximately 8.5 km of 12-inch SC HP Vintage Steel Gas Main, like for like. There are approximately 384 services and 746 customers. In addition, install 2,000 m of NPS 2 PE IP and 400 m of NPS 4 PE IP, eliminating 136 HP services of the 384 existing HP services.</p> <p>Resources: NPL to execute.</p> <p>Solution Impact: Eliminate vintage steel main, reduce the number of HP services attached and reduce corrosion and coding deficiencies.</p> <p>Project Timing & Execution Risks: 2024 to 2026</p> <p>-Toronto and Region Conservation Authority (TRCA) permit is required.</p> <p>-Moratorium - At Walsh Ave. W. past Matthews Gate, approximately 700 m expires December 31, 2024.</p> <p>-Easement is required for the Humber River Crossing.</p> <p>-Major Crossings - CP Rail, 400 Hwy, Humber River, Metrolinx – Barrie Line, the Allen, and 401 off ramp.</p>


Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - DP - Main Replacement - Vintage Steel Mains Replacement Program
Investment Stage	Executing		

Investment Overview

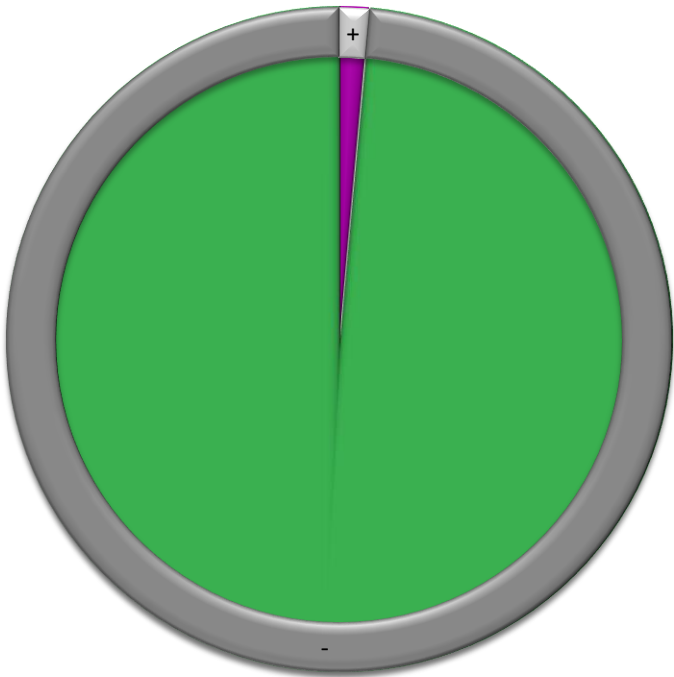
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	10 - Toronto
	Asset Program (EGI)	DP - Main Replacement
	Asset Class (EGI)	Distribution Pipe
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No


















Spend Profile

Name									Net Base Capex O (CA)	
A10: Wilson Avenue, Toronto, VSM Replacement									\$	72,015,518
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ 28,199,920	\$ 41,647,950	\$ 937,500	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ 1,447,500	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -


<div> Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	100339	2023	10
	Investment Name		
A10: Wilson Avenue, Toronto, VSM Replacement			

Alternative Value - Recommended



Value Function Measure	Value
 Financial Risk	489
 Operational Disruption Risk (Gas) (CA)	36
 Public Safety Risk	3
 Reputational Risk	0
 Avoided GHG Emissions (CA)	0
 Budget Savings CAPEX (CA)	0
 Budget Savings OPEX (CA)	0
 Cost Avoidance CAPEX (CA)	0
 Cost Avoidance OPEX (CA)	0
 Employee And Contractor Safety Risk	0
 Energy Efficiency (CA)	0
 Environmental Risk And Remediation	0
 Gas Storage Reliability (CA)	0
 Operational Risk	0
 Revenue Impact (CA)	0
 Operational Disruption Risk (Liquids) (CA)	0
 Total Investment Cost (CA)	(35,718)
Total	(35,189)

Report Generation Date: 5/30/2022

 Investment Summary Report	Investment Code 1938	Report Start Year 2023	Number of Years 10
	Investment Name		
	NPS 10 Glenridge Avenue, St. Catharines		

Investment Description

Issue/Concern:
GENERAL CONCERNS: Vintage steel exhibit increased failures as they age as steel mains are susceptible to external corrosion when barriers of pipe coatings and cathodic protection are compromised. The current pipe replacement rate (mains and services) is inadequate to prevent the average age of the population from increasing and hence reaching the end of their useful life. EGI has determined that a long-term proactive replacement program targeting higher-risk steel pipes installed on or before 1970 (Vintage Steel) is required to manage the increasing number of expected leaks that create increasing risk for the organization.

SITE SPECIFIC CONCERNS:
This project looks to replace approximately 8.7 km of mostly 1954 to 1960s vintage NPS 10 intermediate pressure (IP) pipe with sections of NPS 12 and NPS 8 spliced in over the years as repairs.

A 2019 DOC survey found that 366 (33%) survey locations had less than 90 cm of cover, and 90 survey locations (8%) had DOC<60cm, with one location found having exposed pipe due to creek erosion. Poor depth of cover leads to increased third-party damages (as has been seen with blow-off valves). Other risk factors include black coal tar pipe coatings used on 1959/1960 vintage NPS 10 pipe which show evidence of degradation, yielding to corrosion.

There are many unusual fittings (Stop-and-Go) and unusual construction practices (such as using unrestrained compression couplings to tie in service connections) that can lead to difficult emergency responses. For example, a recent leak repair took 24 days to complete at a cost of almost \$500K due to complications from DOC, components, and construction practices. Unrestrained compression couplings have been the source of leaks due to ground settlement and increase the risk of pull-out. The river crossing at Twelve Mile Creek is very difficult to access due to steep creek banks and heavy vegetation, making it difficult to perform cathodic protection and leak surveys. It will pose as a significant concern for any required emergency response. The numerous transitions from NPS 8 to NPS 10 to NPS 12 also creates concern and difficulties for operational work to be completed.

There are two main line valves that are suspected to be tied in with unrestrained compression couplings (CC) as per an Integrity Assessment for suspect CC locations. Cathodic protection for some of the NPS 10 segments has been historically poor, showing as much as 25% of historical readings over the last 20 years below minimum required levels.

Assets:
8.7 kilometers of mostly 1954 to 1960s vintage NPS 10 IP pipe with sections of NPS 12 and NPS 8 spliced in over the years as repairs that run along Glenridge Avenue from Russel Avenue south to Lockhart Drive, then along Lockhart Drive west to First Street Louth.

Related Programs: N/A

Recommended Alternative Description

Scope of Work: Asset Renewal and Improvement Main Replacement - Replace approximately 7,500 m of vintage main NPS 10-inch ST IP and approximately 110 service connections with NPS 8 PE.

Resources: External Alliance contractors.

Solution Impact:
Main replacement project identified by Operations as high priority. Replacement is required due to age, pipeline condition and risk assessment results.

Project Timing & Execution Risks:
The timing for execution of this replacement project is planned for 2025/26.
Execution Risks: Moratoriums, third-party developments, COVID-19 impacts, permitting and required easements.


Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - DP - Main Replacement - Vintage Steel Mains Replacement Program
Investment Stage	Short Term Planning		

Investment Overview

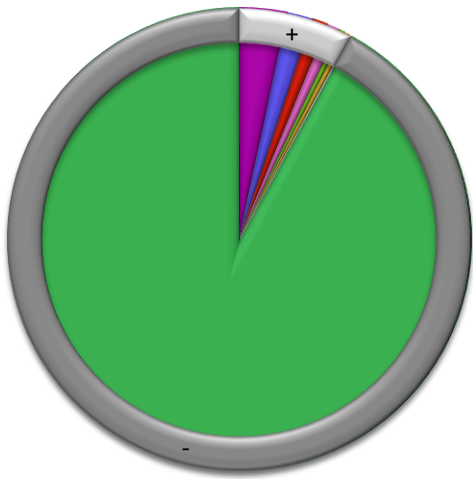
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	80 - Niagara
	Asset Program (EGI)	DP - Main Replacement
	Asset Class (EGI)	Distribution Pipe
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No












Spend Profile

Name									Net Base Capex O (CA)	
NPS 10 Glenridge Avenue, St. Catharines									\$	11,804,455
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ 300,000	\$ 6,047,929	\$ 5,456,526	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ 3,565,604	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -


<div> Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	1938	2023	10
	Investment Name		
	NPS 10 Glenridge Avenue, St. Catharines		

Alternative Value - Recommended



Value Function Measure		Value
	Financial Risk	310
	Avoided GHG Emissions (CA)	170
	Public Safety Risk	106
	Reputational Risk	85
	Budget Savings OPEX (CA)	40
	Operational Risk	36
	Employee And Contractor Safety Risk	11
	Cost Avoidance CAPEX (CA)	0
	Cost Avoidance OPEX (CA)	0
	Environmental Risk And Remediation	0
	Total Investment Cost (CA)	(8,757)
Total		(7,998)

Report Generation Date: 5/30/2022

 Investment Summary Report	Investment Code 11443	Report Start Year 2023	Number of Years 10
	Investment Name		
	NPS 12 Martin Grove Rd Main Replacement: Lavington to St. Albans Rd.		

Investment Description

Issue/Concern/Opportunity:

General Concerns:

Vintage steel exhibit increased failures as they age as steel mains are susceptible to external corrosion when barriers of pipe coatings and cathodic protection are compromised. The current pipe replacement rate (mains and services) is inadequate to prevent the average age of the population from increasing and hence reaching the end of their useful life. EGI has determined that a long-term proactive replacement program targeting higher-risk steel pipes installed on or before 1970 (Vintage Steel) is required to manage the increasing number of expected leaks that create increasing risk for the organization.

Site-Specific Concerns:

Martin Grove to St. Albans Road: Address NPS 12 pipe from Lavington Drive South to Burnhamthorpe Road, then west to Ashbourne Drive, then following Auckland Road south to St. Albans Road.

There are over 360 service connections that will be removed from the HP steel main and an intermediate pressure (IP) polyethylene (PE) subsystem installed to reconnect these customers. Depth of cover (DOC) has been identified as a significant concern for these main segments as identified by 2018 and 2019 DOC surveys that found over 52% of the survey locations had DOC less than 90 cm, with 77 survey locations measuring less than 60 cm of cover. Poor DOC can lead to increased third-party damages. Additional risk factors include two unrestrained compression couplings (CCs), nine restrained CCs, and three suspect valves where, due to their installation dates, may have been tied in using unrestrained CCs (as discovered by an Integrity Assessment showing significant correlation between valves of this vintage with unrestrained CC tie-ins).

Cathodic protection history for the past 20 years shows that over 15% of the readings taken each year were below the minimum requirements. Poor cathodic protection levels can lead to corrosion.

Assets: NPS 12 pipe from Lavington Drive south to Burnhamthorpe Road, then west to Ashbourne Drive, then following Auckland Rd South to St. Albans Road.

Related Programs: 10086.

Recommended Alternative Description

Scope of Work: Replacement of approximately 6.4 km of NPS 12 steel main from Martin Grove Road and Lavington Drive South to Burnhmthorpe Rd, then west to Ashbourne Drive, then south to Auckland Road and St. Albans Road. Approximately 360 services are to be reconnected to a new IP PE sub-system.

Resources: 2026 Out to Construction Phase 2 and resources are to be determined.

Solution Impact: Main replacement project identified as high priority. Replacement is required due to age, pipeline condition and risk assessment results.

Project Timing & Execution Risks: Moratoriums and easements.


Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - DP - Main Replacement - Vintage Steel Mains Replacement Program
Investment Stage	Short Term Planning		

Investment Overview

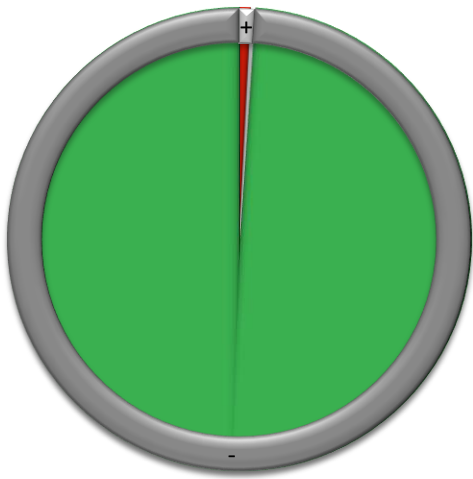
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	10 - Toronto
	Asset Program (EGI)	DP - Main Replacement
	Asset Class (EGI)	Distribution Pipe
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No












Spend Profile

Name									Net Base Capex O (CA)	
NPS 12 Martin Grove Rd Main Replacement: Lavington to St. Albans Rd.									\$	18,292,755
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ -	\$ 400,000	\$ 17,292,755	\$ 600,000	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -


 Investment Summary Report	Investment Code 11443	Report Start Year 2023	Number of Years 10
	Investment Name		
	NPS 12 Martin Grove Rd Main Replacement: Lavington to St. Albans Rd.		

Alternative Value - Recommended



Value Function Measure		Value
	Public Safety Risk	98
	Financial Risk	29
	Employee And Contractor Safety Risk	10
	Reputational Risk	3
	Environmental Risk And Remediation	1
	Operational Risk	0
	Avoided GHG Emissions (CA)	0
	Budget Savings OPEX (CA)	0
	Cost Avoidance CAPEX (CA)	0
	Cost Avoidance OPEX (CA)	0
	Total Investment Cost (CA)	(12,974)
Total		(12,833)

Report Generation Date: 5/30/2022

 Investment Summary Report	Investment Code 10293	Report Start Year 2023	Number of Years 10
	Investment Name		
	St. Laurent Phase 3 - North/South (NPS12/16 Steel)		

Investment Description

Issue/Concern/Opportunity:

General Concerns: Vintage steel exhibit increased failures as they age as steel mains are susceptible to external corrosion when barriers of pipe coatings and cathodic protection are compromised. The current pipe replacement rate (mains and services) is inadequate to prevent the average age of the population from increasing and hence reaching the end of their useful life. EGI has determined that a long-term proactive replacement program targeting higher-risk steel pipes installed on or before 1970 (Vintage Steel) is required to manage the increasing number of expected leaks that create increasing risk for the organization.

Site-specific Concerns:

Unable to determine leaks due to the close proximity of the NPS 12 470 psi system. Cathodic protection was not installed until the early 1970s. Approximately 429 services are off this network.

This project is to install 8,543 m of NPS 16/12 on Aviation Pkwy tying into the Network 6580 (Ottawa Gate) and running to Rockcliffe Station and abandon 12 km of NPS 12. Scheduled to be replaced 2024.

Full replacement of main comprising Network 6584 - The NPS 12 St. Laurent Ottawa North line is 13.3 km and operates at 275 psi as Network 6584. It runs from south of St. Laurent Control Station (6584:653:1969) to Rockcliffe Control Station (Station #6B558A). It does not include the main south from St. Laurent Control Station to Industrial Ave. as well as the NPS 12 lateral main to Trans Alta (6584:1234:1235) but does include the NPS 12 lateral main along Tremblay Rd. (but does not include the crossing at the Rideau River to Station #61171A).

Assets: Approximately 2.4 km of NPS 16 ST and 6.9 km of NPS 12 ST to be installed and rebuild 3 stations (Rockcliffe, Birch and St. Laurent Control)

Related Programs: 10089, 10288, 10290, 10291, 10292, 10289, 10294.

Recommended Alternative Description

Scope of Work: Install 6.5 km NPS 12 Steel Gas Main; Install 2.4 km NPS 16 Steel Gas Main; Install 5.1 km Plastic Gas Main and relay all XHP services to the new plastic gas main.

In 2024, for the Plastic Gas Main scope, approximately 3 km will be installed on St Laurent Blvd and Sandridge Road and 2.1 km on Coventry Rd. / Ogilvie Rd. and St. Laurent Blvd. Also, for the Steel Gas Main, approximately 6.5 km of NPS 12 will be installed on Cummings Ave., Brittany Drive., St. Laurent Blvd and Sandridge Road, and 2.4 km of NPS 16 on Michael Street.

Resources: TBD

Solution Impact: Replacing the main will ensure the continued operation of EGI's gas distribution system, and will mitigate safety risks to employees, contractors, and general public.

Timing & Execution Risks: Phase 3 is to executed in 2024, but the NPS 16/12 cannot be abandoned until this main is installed and all the services have been transferred onto the new plastic gas main.

Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - DP - Main Replacement - Vintage Steel Mains Replacement Program
Investment Stage	Executing		


Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	60 - Ottawa
	Asset Program (EGI)	DP - Main Replacement
	Asset Class (EGI)	Distribution Pipe
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name									Net Base Capex O (CA)	
St. Laurent Phase 3 - North/South (NPS12/16 Steel)									\$	54,437,118
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 1,000,000	\$ 43,799,598	\$ 1,550,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ 5,000,000	\$ 1,000,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Report Generation Date: 5/30/2022

 Investment Summary Report	Investment Code 10294	Report Start Year 2023	Number of Years 10
	Investment Name		
	St. Laurent Phase 4 - East/West (NPS12 Steel)		

Investment Description

Issue/Concern/Opportunity:

General Concerns:
Vintage steel exhibit increased failures as they age as steel mains are susceptible to external corrosion when barriers of pipe coatings and cathodic protection are compromised. The current pipe replacement rate (mains and services) is inadequate to prevent the average age of the population from increasing and hence reaching the end of their useful life. EGI has determined that a long-term proactive replacement program targeting higher-risk steel pipes installed on or before 1970 (Vintage Steel) is required to manage the increasing number of expected leaks that create increasing risk for the organization

Site-Specific Concerns:
Unable to determine leaks due to the close proximity of the NPS 12 470 psi system. Cathodic protection was not installed until the early 1970s. Approximately 429 services are off this network.

Full replacement of main comprising Network 6584 - The NPS 12 St. Laurent Ottawa North line is 13.3 km and operates at 275 psi as Network 6584. It runs from south of St. Laurent Control Station (6584:653:1969) to Rockcliffe Control Station (Station #6B558A). It does not include the main south from St. Laurent Control Station to Industrial Ave., as well as the NPS 12 lateral main to Trans Alta (6584:1234:1235) but does include the NPS 12 lateral main along Tremblay Rd. (but does not include the crossing at the Rideau River to Station #61171A).

In 2018, pressure increased to Avenue O.

In 2019, approximately 3.1 km of plastic will be installed on Tremblay and the Avenues, and the services transferred over to intermediate pressure (IP). Also, due to a road moratorium, 2 km of 6-inch PE IP main on St. Laurent between Donald St., and Montreal needs to be brought forward from 2021 to 2019 and approximately 80 services.

Assets: Phase 4 - This project is to install 3,685 m of NPS 12 in 2022 and relay 1 service.

Related Programs: 10089, 10288, 10290, 10291, 10292, 10293, and 10289.

Recommended Alternative Description

Scope of Work: Install 3.1 km NPS 12 Steel Gas Main; Install 3.2 km Plastic Gas Main and relay all XHP services to the new plastic gas main.

In 2025, approximately 3.2 km of plastic will be installed on Industrial Ave., St. Laurent Blvd and Lancaster Road and all the XHP services will be transferred over to intermediate pressure (IP). Also, approximately 3.1 km of steel will be installed on Ogilvie Road & Coventry Road and all existing vintage steel pipeline will be abandoned once the new pipeline is energized.

Resources: To be determined

Solution Impact: Replacing the main will ensure the continued operation of EGI's gas distribution system, and will mitigate safety risks to employees, contractors, and general public.

Timing & Execution Risks: Phase 4 is to be executed in 2025 but the NPS 16/12 vintage steel pipeline cannot be abandoned until this main is installed and all the services have been transferred onto the new intermediate pressure system.

Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - DP - Main Replacement - Vintage Steel Mains Replacement Program
Investment Stage	Executing		


Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	60 - Ottawa
	Asset Program (EGI)	DP - Main Replacement
	Asset Class (EGI)	Distribution Pipe
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name									Net Base Capex O (CA)	
St. Laurent Phase 4 - East/West (NPS12 Steel)									\$	19,141,532
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ -	\$ 18,224,123	\$ 530,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ 638,911	\$ 879,637	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Report Generation Date: 5/30/2022

<div> Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	503350	2023	10
	Investment Name		
	Moulton Replacement BU		

Investment Description

Issue/Concern/Opportunity:
There is 5.6 km of NPS 8 Intermediate Pressure (IP) bare steel main to be replaced with NPS 8 IP YJ steel main between #1472 Hwy 3 to #2199 Hwy 3. The in-service date is 2025.
Justification: Replacement of NPS 8 IP bare steel with size-on-size NPS 8 IP YJ steel main for the 5.6 km segment.

Assets: NPS 8 IP gas main between #1472 Hwy 3 to #2199 Hwy 3.

Related Program: N/A

Recommended Alternative Description

Scope of Work: Due to the existing NPS 8 IP steel gas main being bare pipe, the project scope includes replacement of this line with NPS 8 YJ steel gas main.

Resources: Extended Alliance Partners.

Solution Impact: Replacement with NPS 8 YJ steel gas main will remove the unprotected NPS 8 bare steel pipe for 5.6 km.

Project Timing & Execution Risk: Construction planned for 2025.

Investment Type	Project (EGI)	Planning Portfolio	UG - Core - DP - Main Replacement - Bare & Unprotected Steel Replacement Program
Investment Stage	Executing		

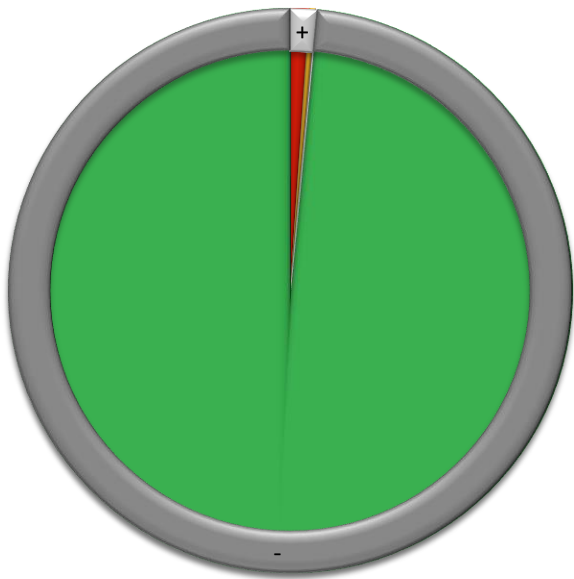
Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_16 - Hamilton
	Asset Program (EGI)	DP - Main Replacement
	Asset Class (EGI)	Distribution Pipe
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No


Spend Profile

Name									Net Base Capex O (CA)	
Moulton Replacement BU									\$	14,452,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ 600,000	\$ 13,752,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended



Value Function Measure		Value
	Public Safety Risk	114
	Operational Risk	39
	Employee And Contractor Safety Risk	11
	Financial Risk	3
	Reputational Risk	3
	Environmental Risk And Remediation	1
	Avoided GHG Emissions (CA)	0
	Budget Savings OPEX (CA)	0
	Cost Avoidance CAPEX (CA)	0
	Cost Avoidance OPEX (CA)	0
	Budget Savings CAPEX (CA)	0
	Revenue Impact (CA)	0
	Operational Disruption Risk (Gas) (CA)	0
	Total Investment Cost (CA)	(11,134)
Total		(10,963)

 Investment Summary Report	Investment Code 100295	Report Start Year 2023	Number of Years 10
	Investment Name		
	Div_04: NPS 8 Port Stanley, London, Replacement		

Investment Description

Issue/Concern/Opportunity:
The NPS 8 Port Stanley line is approximately 20 km of NPS 8 built in 1959, with unknown grade and wall thickness, bare and protected, and Dresser construction (some gas welded – such welds are usually susceptible to lack of fusion imperfections). There has been a history of a significant number of leaks due to corrosion on this single-feed system that provides natural gas to Port Stanley and St. Thomas, with about 13,000 customers including the St. Thomas hospital, a psychiatric hospital in St. Thomas and a retirement home in Port Stanley.

External corrosion has created difficulties with repairs due to the inability to weld. In one repair case, it took Operations three weeks to locate a suitable weld location for a repair. Repairs often require the use of split sleeves (\$8K/ea). Depth of cover is a significant risk factor, with two exposed pipe sections being reported over creek crossings in December 2019. There are significant accessibility issues with locations of the pipe, making it difficult for emergency response and condition surveys. Some sections of pipe are heavily over-grown while other locations can be over 500 m from the nearest road. There are three below-grade stations that are considered confined spaces and which often flood, and must be evacuated before inspections and maintenance can occur. Gas supply from Lake Erie (New Dundee Comp) was known to have high moisture content and may contribute to internal corrosion.

No isolation is built into the single feed system, so if supply needs to be shut down, all downstream customers would be affected. In 2000, 6.8 km of main were replaced due to corrosion and exposed pipe. In 2003, 230 m were replaced due to a Class B leak under a river crossing. Three casings on the system are known to be shorted. An attempted pressure increase in 1970 resulted in numerous leaks from compression couplings and pipe; therefore, the pipe cannot be pressure-elevated.

Assets: Port Stanley line is approximately 20 km of NPS 8 built in 1959.

Related Programs: N/A

Recommended Alternative Description

Scope of Work: Starting at the south end at the Port Stanley Gate Station (100501) headed north approximately 2.2 km, this section can be replaced with NPS 6 ST as per System Analysis decreased from current NPS 8. A large section of NPS 8 ST (approximately 6.8 km) was replaced in 2000 and does not require replacement. Also, 3 km of NPS 8 requires replacement to NPS 6. Furthermore, 10.2 km of NPS 8 is size-for-size replacement from Middlemarch headed East to the St. Thomas South Station (110501) and from Middlemarch North to the Existing NPS 10 at Talbot Line where it connects.

Resources: TBD

Projects Timing and Risks: 2024 Execution


Investment Type	Project (EGI)	Planning Portfolio	UG - Core - DP - Main Replacement - Vintage Steel Mains Replacement Program
Investment Stage	Executing		

Investment Overview

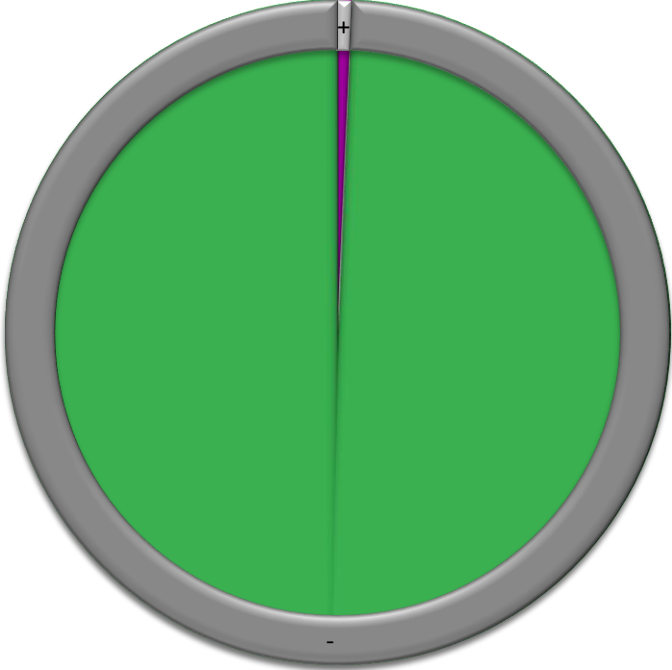
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_04 - London
	Asset Program (EGI)	DP - Main Replacement
	Asset Class (EGI)	Distribution Pipe
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name									Net Base Capex O (CA)	
Div_04: NPS 8 Port Stanley, London, Replacement									\$	15,221,497
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 489,630	\$ 14,401,776	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -


<div> Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	100295	2023	10
	Investment Name		
Div_04: NPS 8 Port Stanley, London, Replacement			

Alternative Value - Recommended



Value Function Measure	Value
Financial Risk	83
Public Safety Risk	2
Reputational Risk	0
Avoided GHG Emissions (CA)	0
Budget Savings OPEX (CA)	0
Cost Avoidance CAPEX (CA)	0
Cost Avoidance OPEX (CA)	0
Employee And Contractor Safety Risk	0
Environmental Risk And Remediation	0
Budget Savings CAPEX (CA)	0
Revenue Impact (CA)	0
Operational Disruption Risk (Gas) (CA)	0
Operational Risk	0
Energy Efficiency (CA)	0
Gas Storage Reliability (CA)	0
Operational Disruption Risk (Liquids) (CA)	0
Total Investment Cost (CA)	(12,457)
Total	(12,371)

Report Generation Date: 5/30/2022

<div>  </div> <div>Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	736530	2023	10
	Investment Name		
	Sudbury Lateral Integrity Digs 2023		

Investment Description

Issue/Concern/Opportunity:

General: The Integrity Digs portion of the Integrity Management Program is to specifically capture integrity dig work to respond to inspections. The Integrity Management Program is a mandated regulatory requirement which has been designed to comply with all applicable codes and standards. The program consists of the regular assessment and maintenance of the integrity of the pipeline systems to ensure their continued safety and reliability. Most of the expenditure included in this category is for pipelines that operate above 30% SMYS. It includes installation costs for permanent inline inspection (ILI) tool launcher and receiver facilities, retrofits to existing lines to remove restrictive fittings or pipe configurations so they can be inspected with ILI tools, and replacement of pipeline segments with integrity issues that are identified through the inspections.

Project-Specific: The pipeline section was in-line-inspected in 2021 with several Phase 2 features (corrosion with metal loss, and dents, etc.) reported. In compliance with the TIMP condition monitoring standard, all Phase 2 features are required to be investigated and repaired within 12 months of discovery. Consequently, 67 digs have been planned for the 2023 integrity dig works to effect repair or replacement of affected sections.

Assets: NPS 10 x 121 km Sudbury Lateral Section 1 > 50% SMYS.

Related Programs: 48268, 734703, 48244, and 736531.

Recommended Alternative Description

Scope of Work: Phase 1 (immediate response) anomalies detected from the 2021 in-line inspection (ILI) report will be mitigated through integrity verification digs and subsequent repair or replacement of affected sections.

Project-Specific: 67 digs to be executed on the NPS10 Sudbury Lateral Section 1.

Resources: TBD

Solution Impact: By mitigating all (immediate response) anomalies, the Integrity Management Program reduces the probability of pipeline failures, consequently reducing the overall risk to the public and ensuring reliable gas supply.

Project Timing & Execution Risks: 67 Integrity digs are to be executed in 2023. Dig permit constraints may limit the total number of digs executable in 2023.

Investment Type	Project (EGI)	Planning Portfolio	UG - Core - DP - Integrity - Integrity Digs
Investment Stage	Long Term Planning		


Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_43 - Sudbury & S.S. Marie
	Asset Program (EGI)	DP - Integrity
	Asset Class (EGI)	Distribution Pipe
2. Compliance	Compliance Investment	Yes
	Compliance Justification & Code	The Integrity Digs portion of the Integrity Management Program is to specifically capture integrity dig work to respond to inspections. The Integrity Management Program is a mandated regulatory requirement which has been designed to comply with all applicable codes and standards.
3. Must Do	Must Do Investment	Yes
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name									Net Base Capex O (CA)	
Sudbury Lateral Integrity Digs 2023									\$	10,000,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 10,000,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Report Generation Date: 5/30/2022

<div>  </div> <div>Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	3610	2023	10
	Investment Name		
	CROWLAND STORAGE TRANSFER		

Investment Description

Issue/Concern/Opportunity:

Crowland Storage Transfer Station is located on Enbridge owned property of approx 7300 m2 fenced compound in the Port Colborne, Ontario, approximately 7km southeast from Welland Ontario, within a rural area, in close proximity to a railway corridor. This station accepts natural gas from Enbridge Crowland Gas Storage facilities and provides supply to and from XHP networks, through components within the Measurement system, Pressure Control system , Heating system, Odourant system, and Telemetry system. This station delivers and withdraws natural gas from Storage Operations Wells in the Niagara Region. Major work is scheduled to take place to upgrade the Enbridge Storage facilities at Crowland, this project would be linked and completed in conjunction with that the Storage upgrade. The following issues have been identified at this station: ODOURIZATION: the odourant system was installed in 2000. The current configuration of the odourant system does not ensure adequate containment of the odourant product in the event of a leak and does not meet the current engineering standards and approvals. TELEMETRY & ELECTRICAL: the existing electrical system does not meet current EGD electrical installation standards. This poses a potential electrical hazard and faulty wiring may result in lost communications. COMPLIANCE: The Canadian Electrical Code Section 22.1 indicates that all electrical and instrumentation equipment located in a hazardous area must be rated for that area classification. The RTU building has been identified as being located in an area classification and its equipment is not rated to operate in this environment. This is a risk of ignition and fire in the event of a gas leak.

Phase Cost Estimate Includes:

(1) Install annubars on inlet and outlet.

-Install actuator on each operator regulator and on valves 8, 9 and 10.

-Required electrical work:

- Relocate RTU building out of classified area (including new building and foundation).
- Install generator and automatic transfer switch.
- Upgrade tower to improve signal quality.
- Upgrade lighting.

(2) Install filter separator and receiver on inlet.

-Install moisture analyzer and gas chromatograph.

-Install new YZ odourant system (including new building and foundation).

-Include station bypass equipment and setup (assume that we need to bypass the whole station to complete the work).

-Includes retrofits to station piping for temporary station connection.

-All planning/design costs, including drafting, surveys and permits, and geotechnical study.

Assets: Crowland Station

Related Program: Major work is scheduled to take place to upgrade the EGI Storage facilities at Crowland. This project would be linked and completed in conjunction with that Storage upgrade #6377

Recommended Alternative Description

Scope Work:

Filtration: Add filter/separator on station inlet

Pipes & Valves: Replace station inlet and outlet valves and associated piping. Existing bypass valve will be upgraded to a 2 valve configuration (plug and ball).

Heating System: Design team will determine if required.

Pressure Control: Sizing will be confirmed during design.

Odourant System: Will be upgraded with secondary containment for the odourant injection pumps to meet current design standards.

Telemetry & Electrical: Upgrade electrical and add pressure transmitters as required. Add remote actuation to valves to allow for efficient use of the STO/Distribution Stations facilities. Add gas chromatograph and moister analyzer.

Measurement: Ultrasonic meter on outlet of the Port Colborne line

Compliance & Others: The existing RTU building will be relocated to an area outside of any hazardous areas.

Solution Impact: TBD

Resources: Company Crews, Contractor Labour and 3rd Party vendor suppliers

Project Timing & Execution Risk: Planning in Year 1, Execution in Year 2 / Execution Risk - Weather impacts, Resource availability, Procurement, etc.


Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - Distribution Stations - Gate, Feeder & A Stations
Investment Stage	Executing		

Investment Overview

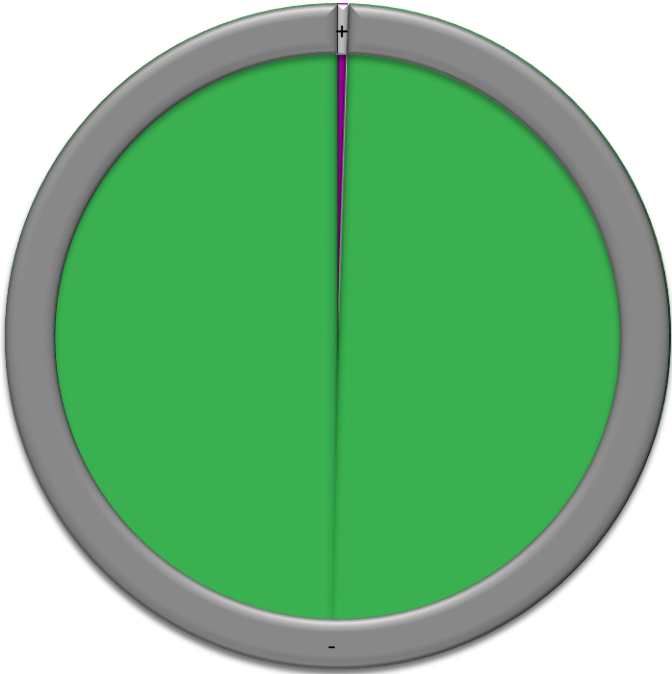
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	80 - Niagara
	Asset Program (EGI)	DS - Gate, Feeder & A Stations
	Asset Class (EGI)	Distribution Stations
2. Compliance	Compliance Investment	Yes
	Compliance Justification & Code	RTU building location contravenes Canadian Electrical Code Section 22.1 for unrated equipment operating in a hazardous area classification.
3. Must Do	Must Do Investment	Yes
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No


Spend Profile

Name									Net Base Capex O (CA)	
CROWLAND STORAGE TRANSFER									\$	19,335,824
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 18,905,824	\$ 430,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

<div> Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	3610	2023	10
	Investment Name		
	CROWLAND STORAGE TRANSFER		

Alternative Value - Recommended

	Value Function Measure	Value
	Financial Risk	75
	Cost Avoidance OPEX (CA)	16
	Reputational Risk	0
	Public Safety Risk	0
	Avoided GHG Emissions (CA)	0
	Budget Savings CAPEX (CA)	0
	Budget Savings OPEX (CA)	0
	Cost Avoidance CAPEX (CA)	0
	Employee And Contractor Safety Risk	0
	Energy Efficiency (CA)	0
	Environmental Risk And Remediation	0
	Gas Storage Reliability (CA)	0
	Operational Risk	0
	Revenue Impact (CA)	0
	Operational Disruption Risk (Gas) (CA)	0
	Operational Disruption Risk (Liquids) (CA)	0
	Total Investment Cost (CA)	(17,259)
	Total	(17,166)
Report Generation Date: 5/30/2022		

 Investment Summary Report	Investment Code 735335	Report Start Year 2023	Number of Years 10
	Investment Name		
	GTAW Parkway Gate Station Rebuild Phase 2		

Investment Description

Project: Parkway East Phase 2. Phase 1 commenced in 2021.

Issue/Concern/Opportunity: The following sub-assets will be rebuilt due to the issues described below:

Regulators: Two existing Becker control valves, i.e., NPS-8 and NPS-6 downstream operators – PRV-0502 and PRV-0504, Runs 9 and 10 on TC Energy feed (quantity is two) are defective and will not lock up; therefore, replacement is required. Currently, the inlet valve from the TC Energy feed is used to completely shut off the TC Energy feed; otherwise, the control valves will bleed by and affect nominations in the summer, automated TC Energy inlet valve for emergency shutoff from TC Energy, as well as to ensure inlet valve is closed to avoid bleed by of Becker control valves in summer conditions (CLOSE ONLY VALVE). Flow control valves on the TC Energy feed are Fairchild’s (will replace with DNGPs – RUNS 9/10) not a computer-controlled regulator and do not sense downstream pressure. Isolation valves for each run are operational. DNGP should also replace Fairchild for 12-inch Union East – CV replacement (12-inch closest to Boiler building - RUN 1); 4th Fairchild is on the MSL – not required – disconnect and replace with VRP pilot (pressure control only due to downstream system operation). The station can be down to facilitate work as system can be fed from Parkway West. An additional five Jordan motors that are obsolete are to be replaced with Rotork motors (quantity is five). Due to capacity constraints and designing for future flow provided by Distribution Optimization Engineering (DOE) / TSP, Run 1 T4 Becker is to be replaced with T1 Becker (NPS 12). Run 3 has undersized isolation valves (currently NPS 8) and will need upsizing to NPS 16.

Civil: There is no urethane layer between the pipe support cradle and the bottom of the pipe. A single new Odourant building is required. The wall between the Pressure Transmitter and Remote Terminal Unit (RTU) room is to be opened up for entire building to be RTU room. Demolition of existing Generator building is required. The Storage building is to be removed due to end of life.

Piping & Valves: An increase in pipe size near heaters to NPS 30 along with inlet/outlet HX valves to ensure flow requirements can be achieved. Upsizing downstream header and inlet pipe to regulators to NPS 30 is required to ensure it can handle capacity requirements.

Odourant: The Odourant system is a metallic odourant building without adequate containment with a rusted containment pan. The fill connection is outdoors. Supports are not fire-rated and no Fire Suppression system is installed. Grating within the building is not safe for accessing valves and equipment. A new Odourant building is required. Two 5,000 GAL odourant tanks complete with electric pumps are to be installed. Low-flow and high-flow pumps with full redundancy on winter pumps on each outlet are required. Switchover between pumps should be automated.

Telemetry & Electrical: Existing obsolete Bristol 3330 is to be replaced with Control Wave Micro. Additional electrical wiring and cabling (including power distribution) and programming are to be included in scope.

Assets: Station components are to be replaced as described above in Phase 2.

Related Program: Not applicable.

Recommended Alternative Description

Scope of Work:
Phase 2 of the station rebuild to address the issues described below related to pressure control issues, odourant compliance issues, Remote Terminal Unit (RTU) / Telemetry upgrades from obsolete equipment.

Resources:
This work will be performed by internal and contractor construction crews.

Solution Impact:
Rebuilding the station components will mitigate the safety risks to employees, contractors, and the general public.

Project Timing & Execution Risks:
This is Phase 2 that will commence in 2022 and will continue through 2023 with some assets being planned to be in service in 2022 and the balance in 2023.

Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - Distribution Stations - Gate, Feeder & A Stations
Investment Stage	Executing		

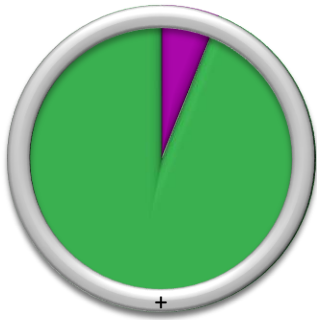
Investment Overview








1. Project Information	State/Province	Ontario
	Operating Area (EGI)	20 - Mississauga
	Asset Program (EGI)	DS - Gate, Feeder & A Stations
	Asset Class (EGI)	Distribution Stations
2. Compliance	Compliance Investment	Yes
	Compliance Justification & Code	New odorant system including odorant tanks required to meet code.
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	Yes


Spend Profile

Name									Net Base Capex O (CA)	
GTAW Parkway Gate Station Rebuild Phase 2									\$	12,300,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 8,500,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ 400,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended



Value Function Measure		Value
	Financial Risk	712
	Employee And Contractor Safety Risk	0
	Environmental Risk And Remediation	0
	Public Safety Risk	0
	Reputational Risk	0
	Operational Risk	0
	Total Investment Cost (CA)	(11,124)
Total		(10,412)

<div> Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	503369	2023	10
	Investment Name		
	Lisgar Station		

Investment Description

Issue/Concern/Opportunity:
The Lisgar Gate Station is located at a highly populated area in the City of Mississauga. The station is situated in an urban setting and is surrounded by residential buildings, a commercial plaza, and a church. The station has multiple feeds (two transmission lines and one XHP CER line) and various outlets to the local distribution networks. In the event of a major incident, the consequence would be significant given the close proximity of the houses and buildings.

Justification: The following issues and deficiencies have been identified:

- Pipes & Valves have been deemed unreliable at this site and requires removal and installation of new pipes, fittings, and valves.
- Heating system has been deemed unreliable as it has reached its end-of-life cycle usage. The placement of the heat exchangers in the basement of the boiler building has caused maintenance roadblocks along with flooding concerns.
- Pressure regulation: 20002A regulation has been deemed unreliable, regulation will be rebuilt because of inconsistent flows through them. 20002D has suffered from frost heaving issues as well and requires a rebuild.
- Odorant system current configuration does not ensure adequate containment of the odorant product in the event of a leak and does not meet the current engineering standards and approvals. The pumps need automation along with redundancy for better operational efficiency.
- Regulator building that houses 20002B & 20002C needs a noise evaluation study to determine a better noise attenuation solution.
- Existing Measurement is not reliable and accurate. A more robust and accurate measurement needs to be installed for custody transfer purposes

Assets: Distribution Station Assets at the Lisgar Gate Station

Related Program: AFF - 219 - NPS 24 Lisgar to Pine Valley - permanent launcher support (23192)

Recommended Alternative Description

Scope of Work: Rebuild the station with the following scope:

- Pipes & Valves: Replace station isolation valves with new ball valves. All station piping and valves will be examined to ensure that material specifications and their current condition are acceptable for continued use. Projected future station capacity requirements will also be considered.
- Heating System: Replace the boilers and heat exchanger. Boiler piping will also have to be replaced to match up with the new boilers and heat exchanger. Heat exchangers will need to be replaced and installed outside of the building.
- Pressure Control: There are three different stations at Lisgar. Each will be evaluated for current flow requirements through the design stage.
- Odorant System: The new odorant building will be installed that will include sufficient secondary containment which is not part of the current design. A new odorant tank will also be required, along with a second backup pump injection system to serve as redundancy.
- Telemetry & Electrical: The existing RTU cabinet and panel will be replaced with a new Control Wave unit. The telemetry and electrical systems will be brought up to current standards and will include methane and CO sensors and monitoring, station wiring upgrades, electrical service upgrades, station grounding, telemetry tower upgrades, UPS installation, generator upgrades, modem and firewall upgrades, station lighting upgrades, weather station installation/replacement.
- Measurement: Four new measurement ultrasonic flowmeters will be installed on the inlet NPS 30 from the new Union Gas takeoff. Another measurement will be installed at the outlet on the NPS 24 CER line. Piping will be designed to ensure gas measurement when operationally flowing from the NPS 24CER line to the NPS 20 and reverse. The flow meters will be programmed to have automatic run switching depending on the demand. The NPS 30,20 and 16 outlets will also be equipped with annubar flow meters to capture individual flowrates leaving the station.
- Compliance & Others: Sump pumps will be replaced/relocated to remove them from the confined space.

Resources: Capital Development and Delivery

Solution Impact: Risk reduction to the existing Lisgar Station site by replacing obsolete equipment.

Project Timing & Execution Risks: 2023/2024 Execution

Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - Distribution Stations - Gate, Feeder & A Stations
Investment Stage	Executing		

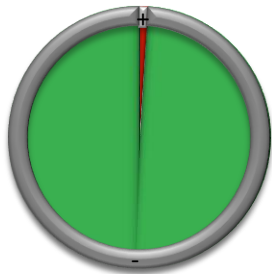
Investment Overview






1. Project Information	State/Province	Ontario
	Operating Area (EGI)	20 - Mississauga
	Asset Program (EGI)	DS - Gate, Feeder & A Stations
	Asset Class (EGI)	Distribution Stations
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No


Spend Profile

Name									Net Base Capex O (CA)	
Lisgar Station									\$	18,414,114
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 15,390,204	\$ 1,823,940	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ 1,273,400	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended



Value Function Measure		Value
	Public Safety Risk	153
	Operational Risk	4
	Financial Risk	0
	Reputational Risk	0
	Total Investment Cost (CA)	(15,270)
Total		(15,111)

 Investment Summary Report	Investment Code 1024	Report Start Year 2023	Number of Years 10
	Investment Name		
	NW 6581 Ottawa Reinforcement Phase 2 SRP		

Investment Description

Issue/Concern/Opportunity: Reinforcement projects broadly involve the installation of new or modification of existing gas distribution assets to maintain minimum required system pressure, maintain capacity, and meet customer demand. These projects are primarily driven by customer growth and system reliability considerations. Failure to implement reinforcement projects in a timely manner could lead to a potential inability to support increasing demands of existing customers and the addition of future customers.

This network in Ottawa is predominantly made up of residential and commercial customers. In the current configuration, a high pressure network is exclusively fed by both the Ottawa and Richmond Gate Stations. Network Analysis has identified an upstream flow constraint at the Ottawa Gate Station, along with a bottleneck constraint for gas fed from Richmond Gate Station. The South outlet of Ottawa Gate can be set to as low as 400 psig (normally 470 psig) while Richmond Gate is kept at 470 psig, thus flowing more gas from the west to the east.

The current configuration, an existing NPS 12 high pressure pipeline along Fallowfield Road is a bottleneck for gas flowing from the west to Richmond Gate Station, and to eastern areas. The previously constructed Ottawa Reinforcement Plan (ORP) Phase 1 as well as the Strandherd River crossing has helped move gas from Richmond Gate eastward to areas of concentrated and growing gas demand.

This reinforcement will assist in moving additional gas from Richmond Gate toward the areas that would be serviced by Ottawa Gate, and remove the bottleneck constraint. There were approximately 193,553 customers on the associated networks as of 2016.

Assets: Existing NPS 12 HP Pipe

Related Program: Not applicable

Recommended Alternative Description

Scope of Work: The proposed scope includes the installation of 7 km of NPS 12 high pressure main from Greenbank Rd. and W Hunt Club Rd. to Princess of Wales Dr. and W Hunt Club Rd. along W Hunt Club Rd.

Resources: Company crews, contractor labour and third-party vendor suppliers.

Solution Impact: This reinforcement project will ensure the system has adequate flow capacity in anticipation of projected customer growth.

Project Timing & Execution Risks: The Project is proposed to start in 2030 and be completed by 2032.

Risks: Weather impacts, resource availability, and procurement issues, etc.


Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - Growth - System Reinforcement
Investment Stage	Long Term Planning		

Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	60 - Ottawa
	Asset Program (EGI)	GTH - System Reinforcement
	Asset Class (EGI)	Growth
2. Compliance	Compliance Investment	
	Compliance Justification & Code	
3. Must Do	Must Do Investment	Yes
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name										Net Base Capex O (CA)	
NW 6581 Ottawa Reinforcement Phase 2 SRP										\$	52,686,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Base CAPEX O	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 268,000	\$ 5,348,000	\$ 47,070,000	
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Report Generation Date:										5/30/2022	

<div> Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	736259	2023	10
	Investment Name		
Hamilton Industrial Reinforcement			

Investment Description

Issue/Concern/Opportunity:
Reinforcement required to support changes to industrial demand in the area.

Assets: Distribution Reinforcement

Related Program: N/A

Recommended Alternative Description

Scope of Work: Route options are currently being assessed for constructability. Routes range from NPS 10 to NPS 30. Copperleaf will be updated accordingly once constructible alternatives have been determined.

Resources: Capital Development, Business Development, Engineering Construction

Solution Impact: In May 2021, the customer initiated a significant growth project with Enbridge for an increased demand of 96,000 m3/hr.

Project Timing & Execution Risk: November 2025 as required by the customer.

Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Growth - System Reinforcement
Investment Stage	Long Term Planning		


Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_16 - Hamilton
	Asset Program (EGI)	GTH - System Reinforcement
	Asset Class (EGI)	Growth
2. Compliance	Compliance Investment	
	Compliance Justification & Code	
3. Must Do	Must Do Investment	Yes
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name										Net Base Capex O (CA)	
Hamilton Industrial Reinforcement										\$	103,000,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Base CAPEX O	\$ 2,000,000	\$ 8,000,000	\$ 88,000,000	\$ 5,000,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	

Report Generation Date: 5/30/2022

<div> Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	100703	2023	10
	Investment Name		
SRP_LUG East_Kingston_Creekford Rd_Reinforcement_NPS8_6200m_6895kPa			

Investment Description

Issue/Concern/Opportunity: Kingston lateral replacement to be completed from Westbrook CMS to Woodbine TBS to account for forecasted growth, and to address Class Location and depth of cover issues which exist on the current Kingston lateral.

Assets: Kingston Lateral Replacement

Related Program: N/A

Recommended Alternative Description

Scope of Work: The project will replace the existing NPS 6 ST 6895 kPa distribution pipeline from the Westbrook TCPL takeoff to the Woodbine Town Border Station with an NPS 8 ST 6895 kPa pipeline. This project supports all pressures downstream to Kingston. The project is required to support growth and address additional other depth of cover, station and class location issues.

Resources: Company crews, 3rd party contractor crews and 3rd party vendors.

Solution Impact: Organic growth on the Kingston system wide. This reinforcement supports the entire system and downstream networks.

Project Timing & Execution Risks: System reinforcement is required in 2024 as per current plan and significant growth on systems. Risks include weather, resource availability, procurement of materials, etc.

Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Growth - System Reinforcement
Investment Stage	Executing		


Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_22 - Kingston
	Asset Program (EGI)	GTH - System Reinforcement
	Asset Class (EGI)	Growth
2. Compliance	Compliance Investment	
	Compliance Justification & Code	
3. Must Do	Must Do Investment	Yes
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name										Net Base Capex O (CA)	
SRP_LUG East_Kingston_Creekford Rd_Reinforcement_NPS8_6200m_6895kPa										\$	24,321,527
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Base CAPEX O	\$ 3,700,000	\$ 18,800,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	

Report Generation Date: 5/30/2022



Investment Summary Report

Investment Code	Report Start Year	Number of Years
30523	2023	10
Investment Name		
SRP_North_Parry Sound_Seguin Trail_Reinforcement_NPS6_8500m_4960kPa		

Investment Description

Risk/Concern/Opportunity: This project was generated as part of Distribution Optimization Engineering's 2021 System Reinforcement Plan (SRP). 8.5 km of NPS 6 steel looping is required on the existing Parry Sound Lateral (4960 kPa) to maintain the minimum inlet into the Parry Sound TBS station (44801002) and support the forecasted growth in Parry Sound. Without this project, the forecasted growth on the system would increase the likelihood that inlet pressures at Parry Sound TBS would drop below minimum operating limits.

Assets: The existing NPS 4 (4960 kPa) Parry Sound Lateral will be impacted by this investment.

Related Program: N/A

Recommended Alternative Description

Scope of Work: Loop the existing NPS 4 (4960kPa MOP) pipe with NPS 6 for 8.5 km.

Resources: This work will be performed by internal and contractor operations crews.

Solution Impact: The 8.5 km of NPS 6 steel main will ensure forecasted demands (based on the econometric forecast) for the Parry Sound distribution system are met (out to 2042).

Project Timing & Execution Risks: The expected in-service date for the proposed looping is 2032.

Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Growth - System Reinforcement
Investment Stage	Short Term Planning		


Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_43 - Sudbury & S.S. Marie
	Asset Program (EGI)	GTH - System Reinforcement
	Asset Class (EGI)	Growth
2. Compliance	Compliance Investment	
	Compliance Justification & Code	
3. Must Do	Must Do Investment	Yes
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name										Net Base Capex O (CA)	
SRP_North_Parry Sound_Seguin Trail_Reinforcement_NPS6_8500m_4960kPa										\$	17,500,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Base CAPEX O	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 17,500,000	
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	

Report Generation Date: 5/30/2022

 Investment Summary Report	Investment Code 30542	Report Start Year 2023	Number of Years 10
	Investment Name		
	SRP_Southeast_Owen Sound_County Rd 40_Reinforcement_NPS12_11800m_4670kPa		

Investment Description

Risk/Concern/Opportunity: The Owen Sound system north of St. Jacob’s historically adds about 1300 customers per year and growth has been strong along the lakeshore (Port Elgin, Southampton, Owen Sound & towards Collingwood).

Assets: Distribution Reinforcement

Related Programs: N/A

Recommended Alternative Description

Scope of Work: The project will loop the existing NPS10 ST 4,670 kPa main from existing PH4 reinforcement to Squire, Ontario with NPS12 ST main, as well as install a valve site and 12-inch receiver facilities. Alternative running lines and pipe sizes can be determined closer to the project design stages in 2023 and 2024. This project supports all pressures downstream to Owen Sound, Port Elgin, Southampton, Wiarton, Sauble Beach and east of Owen Sound. Actual growth rates and loads will need to be confirmed closer to the project planning stages.

Resources: Company crews, third-party contractor crews and third-party vendors.

Solution Impact: Organic growth on the Owen Sound system wide north of St. Jacobs Transmission Station. This reinforcement supports the entire system and downstream networks.

Project Timing & Execution Risks: System reinforcement is required in 2025 as per current plan and significant growth on systems. Risks include weather, resource availability, and procurement of materials, etc.

Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Growth - System Reinforcement
Investment Stage	Short Term Planning		


Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_07 - Waterloo
	Asset Program (EGI)	GTH - System Reinforcement
	Asset Class (EGI)	Growth
2. Compliance	Compliance Investment	
	Compliance Justification & Code	
3. Must Do	Must Do Investment	Yes
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name									Net Base Capex O (CA)	
SRP_Southeast_Owen Sound_County Rd 40_Reinforcement_NPS12_11800m_4670kPa									\$	26,400,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ -	\$ 26,400,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Report Generation Date: 5/30/2022



Investment Summary Report

Investment Code	Report Start Year	Number of Years
736075	2023	10
Investment Name		
WIND: Wheatley-1B - Panhandle Distribution Reinforcement - Wheatley Lateral Replacement and Reinforcement		

Investment Description

Risk/Concern/Opportunity:

Greenhouse growth in the Windsor area continues. The Panhandle distribution network needs to be reinforced to allow for the continued industrial customer expansion. A Panhandle transmission reinforcement is also required to meet the demand of the region.

Assets: Distribution Reinforcement

Related Programs: N/A

Recommended Alternative Description

Scope of Work: Wheatley-1B is a distribution system looping project which requires a new station at Wheatley Rd. and Goodreau Line: 5,300 m of NPS 8 and 10,800 m of NPS 8.

Resources: This work will be performed by internal and contractor construction crews.

Solution Impact: New facilities in this area will provide the reinforcement required to support the greenhouse industry growth.

Project Timing & Execution Risks: Project timing will have to align with the ability to justify natural gas expansion (commercial certainty of the new customers). Depending on the geographical spread of industrial customer expansion, the scope of the project will need to be adjusted to support the forecasted need.


Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Growth - System Reinforcement
Investment Stage	Executing		

Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_01 - Windsor
	Asset Program (EGI)	GTH - System Reinforcement
	Asset Class (EGI)	Growth
2. Compliance	Compliance Investment	
	Compliance Justification & Code	
3. Must Do	Must Do Investment	Yes
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name									Net Base Capex O (CA)	
WIND: Wheatley-1B - Panhandle Distribution Reinforcement - Wheatley Lateral Replacement and Reinforcement									\$	16,500,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 935,000	\$ 15,560,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
									Report Generation Date:	5/30/2022

 Investment Summary Report	Investment Code 736975	Report Start Year 2023	Number of Years 10
	Investment Name		
	Enbridge Gas Distribution System Hydrogen Feasibility Study		

Investment Description

Risk/Concern/Opportunity:
Comprehensive techno-economic feasibility study of blending hydrogen into Enbridge Gas Inc.'s (EGI) existing natural gas distribution and transmission network across Ontario.

Assets: Hydrogen Study

Related Programs: N/A

Recommended Alternative Description

Scope of Work:
Evaluate the technical feasibility and maximum limits of blended hydrogen gas in existing networks, identify necessary retrofits or upgrades for varying concentrations of hydrogen, and develop a staged roadmap for transitioning Ontario's gas network to a low-carbon future in line with technical and economic barriers and opportunities. The assessment comprises the entirety of EGI's gas pipeline network in Ontario:

- 78 214 km of gas distribution main lines
- 66 787 km of gas distribution service lines
- 5 471 km of gas transmission lines

Resources: 3rd party contractor

Solution Impact: By blending hydrogen at strategic locations across EGI's existing gas network, EGI aims to reduce the carbon intensity of its 3.8 million residential, commercial, institutional and industrial customers across over 500 communities in Ontario.

Project Timing & Execution Risks:
Study to be completed in 2026


Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - Growth - Hydrogen Blending
Investment Stage	Initial		

Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	30 - Richmond Hill
	Asset Program (EGI)	GTH - Hydrogen Blending
	Asset Class (EGI)	Growth
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name									Net Base Capex O (CA)	
Enbridge Gas Distribution System Hydrogen Feasibility Study									\$	12,000,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ 4,000,000	\$ 4,000,000	\$ 4,000,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Report Generation Date: 5/30/2022										

 Investment Summary Report	Investment Code 48714	Report Start Year 2023	Number of Years 10
	Investment Name		
	Hagar Cold Box		

Investment Description

Issue/Concern/Opportunity: The Cold Box is several heat exchangers in series used to cool the natural gas feedstock to -160 degrees Celsius at which point the natural gas turns into a liquid. The Cold Box is the core of the Liquefied Natural Gas (LNG) station and is necessary to produce LNG. The consequence of a Cold Box failure is dominated by customer impact. Risk of associated failure is heavily influenced by thermal cycling and operational hours. Over its 50 years of operation, the Cold Box has amassed 140,000 operational hours. Significant failure modes include leakage of natural gas or refrigerants out of the piping into the interior of the Cold Box shell reaching potentially explosive levels or heat exchanger cross leaks that reduce the effectiveness of the refrigeration process. Both of these failure modes impair LNG production to the extent the plant cannot meet its annual production requirements. As the Cold Box internals are encased in very densely packed insulation and clad in an outer steel jacket, troubleshooting and repair of either of these failure modes is extremely difficult and time consuming.

Assets: Cold Box

Related Programs: N/A

Recommended Alternative Description

Scope of Work: This project involves replacement of the Cold Box.

Solution Impact: Considering the complex nature of internal repair or replacement of the Cold Box, a reactive response to internal leakage would render the liquefaction process out of production and unable to meet its regulated requirements for at least an operational season. Due to the age of the plant, the replacement of an individual component such as the Boil Off Gas (BOG) Compressor introduces a risk of the compatibility of new equipment with the existing balance of the plant. This could result in a change in project scope or an approach that favours broader plant renewal.

Resources: Projects will work with a third-party engineering firm to complete the design and a contractor to complete the field work. Operations will support Major Projects as required.

Project Timing & Execution Risks: The proposed timing to complete the on-site work is during the second and third quarters of the year. Design and ordering of long-lead items will need to occur a year in advance.

Investment Type	Project (EGI)	Planning Portfolio	UG - Core - LNG - Integrity
Investment Stage	Long Term Planning		

Investment Overview

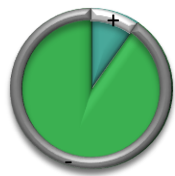
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_53 - Union South Storage
	Asset Program (EGI)	LNG - Integrity
	Asset Class (EGI)	LNG
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No



Spend Profile

Name										Net Base Capex O (CA)	
Hagar Cold Box										\$	11,000,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Base CAPEX O	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 2,500,000	\$ 8,500,000	
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	


Alternative Value - Recommended

Risk work has been planned



Value Function Measure		Value
	Avoided Reactive Replacement	538
	Total Investment Cost (CA)	(5,009)
Total		(4,471)

Report Generation Date: 5/30/2022

<div> Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	49955	2023	10
	Investment Name		
	Hagar JVG Compressor Upgrade		

Investment Description

Issue/Concern/Opportunity: The Boil Off Gas (BOG) Compressor is one of the two compressors used to power the refrigerant process which cools the natural gas feedstock to -160 degrees Celsius at which point the natural gas turns into a liquid. The BOG Compressor was also used to recover BOG (i.e., natural gas vapours) from the Liquefied Natural Gas (LNG) storage tank which occurs on a continuous basis due to the ambient warming of the tank exterior. In 2012, a separate compressor was installed to manage the LNG storage tank boil off gas.

The BOG Compressor is necessary to produce LNG. The consequence of compressor failure is dominated by customer impact. Risk associated with failure of the BOG compressor is heavily influenced by the time of year, weather severity and time to mitigate the failure. Over its 50 years of operation, the 240 horsepower Ingersoll Rand BOG Compressor has amassed 325,000 operational hours. The compressor is obsolete; and, although normal wear components are still available in the marketplace, core compressor replacement parts such as cylinders, crankshafts, and pistons, etc., required to support a critical failure are no longer manufactured by the original equipment manufacturer (OEM). In the event of a critical failure, securing used parts (which are rare) or aftermarket custom machining services are the only options for a timely repair. This was the case in 2017 when an aftermarket service was solicited to develop a weld and machine repair of a compressor cylinder which had failed. The aftermarket service was able to design a custom repair which took three months to complete. In the event that the cylinder is not repairable, a custom-designed aftermarket casting or a complete replacement of the compressor may be options. These options would take the plant out of service for at least one operational season, rendering the plant unable to perform its regulated requirements.

Assets: BOG Compressor

Related Programs: N/A

Recommended Alternative Description

Scope of Work: Replacement of the 240 horsepower Boil Off Gas (BOG) Compressor (JVG)

Solution Impact: Mitigate the risk of a critical part failure that is non-repairable due to obsolescence.

Resources: Projects will work with a third-party engineering firm to complete the design and a contractor to complete the field work. Operations will support Major Projects as required.

Project Timing & Execution Risks: The proposed timing is to complete the on-site work during the second and third quarters. Design and ordering of long-lead items will need to occur a year in advance. Due to the age of the plant, the replacement of an individual component such as the BOG compressor introduces a risk of the compatibility of new equipment with the existing balance of the plant. This could result in a change in project scope or an approach that favours broader plant renewal.

Investment Type	Project (EGI)	Planning Portfolio	UG - Core - LNG - Replacements
Investment Stage	Long Term Planning		

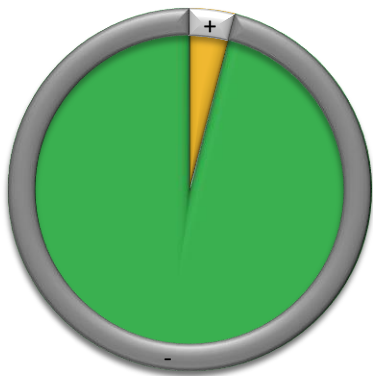
Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_92 - Union North Storage
	Asset Program (EGI)	LNG - Replacements
	Asset Class (EGI)	LNG
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No


Spend Profile

Name									Net Base Capex O (CA)	
Hagar JVG Compressor Upgrade									\$	26,820,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 1,500,000	\$ 14,592,000
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended



Value Function Measure		Value
	Operational Risk	488
	Financial Risk	2
	Reputational Risk	0
	Employee And Contractor Safety Risk	0
	Environmental Risk And Remediation	0
	Public Safety Risk	0
	Avoided Reactive Replacement	0
	Total Investment Cost (CA)	(11,693)
Total		(11,204)

 Investment Summary Report	Investment Code 48709	Report Start Year 2023	Number of Years 10
	Investment Name		
	Hagar KVGR and Cycle Mix Cooler		

Investment Description

Issue/Concern: The Hagar Liquefied Natural Gas (LNG) Plant was installed in 1968 to provide security of supply to the Sudbury industrial and distribution markets. The KVGR Compressor is one of the two compressors used to power the refrigerant process which cools the natural gas feedstock to -160 degrees Celsius at which point the natural gas turns into a liquid. The KVGR Compressor is necessary to produce LNG. The consequence of compressor failure is dominated by customer impact. Risk associated with failure of the KVGR Compressor is heavily influenced by the time of year, weather severity and time to mitigate the failure. Over its 50 years of operation, the 1,500 horsepower Ingersoll Rand KVGR Compressor has amassed 140,000 operational hours. The compressor is obsolete; and, although normal wear components are still available in the marketplace, core compressor replacement items such as cylinders, crankshafts, and pistons, etc., required to support a critical failure are no longer manufactured by the original equipment manufacturer (OEM). In the event of a critical failure, aftermarket, custom machining services are the only option for repair. In the event custom machining services are not able to make a repair, a custom designed aftermarket casting option or complete replacement of the compressor would be required rendering the LNG plant out of service for at least one operational season and rendering the plant unable to perform its regulated requirements.

Assets: Compressor and Cycle Mix Cooler

Related Programs: N/A

Recommended Alternative Description

Scope of Work: Replacement of the 1,500 horsepower KVGR Compressor

Solution Impact: Mitigate the risk of a critical part failure that is non-repairable due to obsolescence.

Resources: Projects will work with a third-party engineering firm to complete the design and a contractor to complete the field work. Operations will support Major Projects as required.

Project Timing & Execution Risks: The proposed timing to complete the on-site work is during the second and third quarters of the year. Design and ordering of long-lead items will need to occur a year in advance. Due to the age of the plant, the replacement of an individual component such as the compressor introduces a risk of the compatibility of new equipment with the existing balance of the plant. This could result in a change in project scope or an approach that favours broader plant renewal.

Investment Type	Project (EGI)	Planning Portfolio	UG - Core - LNG - Replacements
Investment Stage	Long Term Planning		

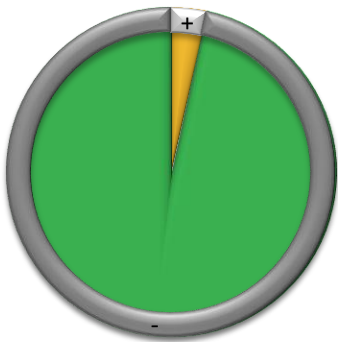
Investment Overview








1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_92 - Union North Storage
	Asset Program (EGI)	LNG - Replacements
	Asset Class (EGI)	LNG
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No


Spend Profile

Name										Net Base Capex O (CA)	
Hagar KVGR and Cycle Mix Cooler										\$	31,820,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Base CAPEX O	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 1,500,000	\$ 17,592,000	
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	

Alternative Value - Recommended



Value Function Measure		Value
	Operational Risk	488
	Financial Risk	2
	Reputational Risk	0
	Employee And Contractor Safety Risk	0
	Environmental Risk And Remediation	0
	Public Safety Risk	0
	Total Investment Cost (CA)	(13,863)
Total		(13,374)

 Investment Summary Report	Investment Code 8701	Report Start Year 2023	Number of Years 10
	Investment Name		
	Kelfield Operations Centre - Land Purchase		

Investment Description

Issue/Concern: The Kelfield office, owned by Enbridge Gas Inc. (EGI), is in poor physical condition and is considered obsolete in its functionality and utilization. It is an old facility with an approximate age of 56 years.

Physical Obsolescence: The acceptable EGI standard for the physical condition is a Facility Condition Index (FCI) of 0 to 5%. The current FCI of the facility based on this study is 10.47%. Therefore, the physical condition of the facility does not meet EGI acceptable standards.

Functional Obsolescence – Building: The acceptable EGI standard for the functional condition is 0. A functional condition between 0 and 49% is considered correctable at the current location. The current facility Adequacy Index (AI) is 71%. Based on the FCI/AI graph, the current recommendation for the existing facility is to increase the site area by purchasing the abutting property, demolish existing building, and rebuild the facility on the combined sites to accommodate current EGI standards.

Functional Obsolescence – Site: The site does not meet operational requirements for size and vehicular circulation. The yard has only one point of access. The yard size is smaller than EGI standard yard size requirements. The current yard size is 0.3 acres. EGI standard yard size is 2.5 acres. The existing building requires expansion by approximately 7,200 square feet to meet the need for current staff and EGI functional requirements. Building addition on the property entails further reduction in the yard and parking areas. Both the building and site area are too small to meet current EGI standards. The current building is approximately 7,724 square feet and the ideal building size, based on EGI design standards, is estimated to be 14,924 square feet, with a site area of approximately five acres. There is no opportunity for building expansion at the current location. It is understood that the location of the facility works well for EGI operations.

Assets: 40 Kelfield St., Etobicoke, ON.

Related Program: N/A

Recommended Alternative Description

Scope of Work:
The assets in scope are located at 40 Kelfield St., Etobicoke, ON. The nature of work is to purchase adjacent property.

Solution Impact:
Purchasing the extra land will ensure adequate yard area for current activities.

Timing & Execution Risks:
The project duration is 3 months (i.e., 0 – 3 months for site acquisition).

Expenditures:
The total cost for the project is \$25M net capital. The project costs are based on a Class 5 estimate.

Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - Real Estate & Workplace Services - Furniture/Structures & Improvements
Investment Stage	Short Term Planning		

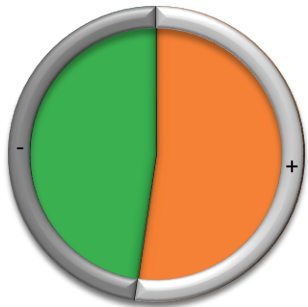
Investment Overview







1. Project Information	State/Province	Ontario
	Operating Area (EGI)	10 - Toronto
	Asset Program (EGI)	REWS - Furniture/Structures & Improvements
	Asset Class (EGI)	Real Estate & Workplace Services
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No


Spend Profile

Name									Net Base Capex O (CA)	
Kelfield Operations Centre - Land Purchase									\$	25,000,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ -	\$ 25,000,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended



Value Function Measure		Value
	Cost Avoidance OPEX (CA)	22,704
	Cost Avoidance CAPEX (CA)	0
	Budget Savings CAPEX (CA)	0
	Budget Savings OPEX (CA)	0
	Revenue Impact (CA)	0
	Total Investment Cost (CA)	(20,696)
Total		2,008

 Investment Summary Report	Investment Code 737226	Report Start Year 2023	Number of Years 10
	Investment Name		
	Kelfield Operations Centre - New Building		

Investment Description

Issue/Concern: The Kelfield office, owned by EGI, is in poor physical condition and is considered obsolete in its functionality and utilization. It is an old facility with an approximate age of 56 years.

Physical Obsolescence: The acceptable EGI standard for the physical condition is a Facility Condition Index (FCI) of 0 to 5%. The current FCI of the facility based on this study is 10.47%. Therefore, the physical condition of the facility does not meet EGI acceptable standards.

Functional Obsolescence – Building: The acceptable EGI standard for the functional condition is 0. A functional condition between 0 and 49% is considered correctable at the current location. The current facility Adequacy Index (AI) is 71%. Based on the FCI/AI graph, the current recommendation for the existing facility is to increase the site area by purchasing the abutting property, demolish existing building, and re-build the facility on the combined sites to accommodate current EGI standards.

Functional Obsolescence – Site: The site does not meet operational requirements for size and vehicular circulation. The yard has only one point of access. The yard size is smaller than EGI standard yard size requirements. The current yard size is 0.3 acres. EGI standard yard size is 2.5 acres. The existing building requires expansion by approximately 7,200 square feet to meet the need for current staff and EGI functional requirements. Building addition on the property entails further reduction in the yard and parking areas. Both the building and site area are too small to meet current EGI standards. The current building is approximately 7,724 square feet and the ideal building size, based on EGI design standards, is estimated to be 14,924 square feet, with a site area of approximately five acres. There is no opportunity for building expansion at the current location. It is understood that the location of the facility works well for EGI operations.

Asset: 40 Kelfield St, Etobicoke, ON.

Related Program: N/A

Recommended Alternative Description

Scope of Work:
The assets in scope are located at 40 Kelfield St, Etobicoke, ON. The nature of work is sell the existing property, development of adjacent property, construction and fit-up of a new building of approximately 15,000 sq.ft.

Solution Impact: Purchasing the extra land will ensure adequate yard area for current activities and a new building will correct the identified operational deficiencies, using less energy and emitting less greenhouse gases. Once the new facility is occupied the old facility will be demolished. The service life of the new facility will be 25-40 years.

Timing & Execution Risks:
The Project duration is 33 months as described below:
0 – 3 months: Programming, design development
3 – 9 months: Site plan agreement, permit & tender documents, permit and tender process
9 – 11 months: Contract award and winter contingency as required
11 – 25 months: Construction
25 – 27 months: Fit-up and occupancy
27 – 33 months: Disposition of the old property and remaining site activity

Risks include contractor delays and material delivery delays or defects.

Expenditures :
The total cost for the project is \$22M net capital which includes a working construction cost contingency of 15%. Construction costs are determined based on historical EGI project costs and land values are determined using marketplace comparisons. The project also leverages national pricing agreements with furniture, walls, and flooring manufacturers. The project costs are based on a Class 5 estimate.

Resources:
Professional resources for design and engineering will be contracted from the marketplace. EGI has historically retained architectural and engineering consulting services for the execution of similar projects.


Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - Real Estate & Workplace Services - Furniture/Structures & Improvements
Investment Stage	Initial		

Investment Overview

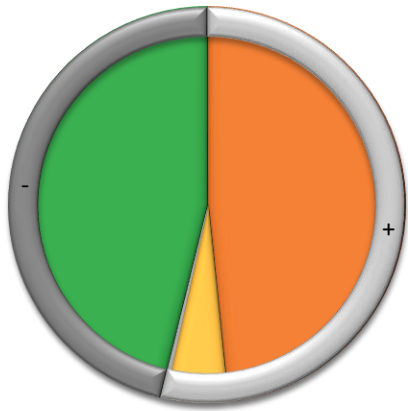
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	10 - Toronto
	Asset Program (EGI)	REWS - Furniture/Structures & Improvements
	Asset Class (EGI)	Real Estate & Workplace Services
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No










Spend Profile

Name									Net Base Capex O (CA)	
Kelfield Operations Centre - New Building									\$	22,000,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ -	\$ -	\$ -	\$ 13,666,667	\$ 8,333,333	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -


<div> Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	737226	2023	10
	Investment Name		
	Kelfield Operations Centre - New Building		

Alternative Value - Recommended



Value Function Measure		Value
	Cost Avoidance OPEX (CA)	15,958
	Employee Productivity (CA)	1,685
	Energy Efficiency (CA)	56
	Avoided GHG Emissions (CA)	50
	Cost Avoidance CAPEX (CA)	0
	Budget Savings CAPEX (CA)	0
	Budget Savings OPEX (CA)	0
	Revenue Impact (CA)	0
	Total Investment Cost (CA)	(15,227)
Total		2,522

Report Generation Date: 2/27/2023

 Investment Summary Report	Investment Code 501813	Report Start Year 2023	Number of Years 10
	Investment Name Kennedy Road Expansion		

Investment Description

Issue/Concern:
Overall, the existing building at the Kennedy Road facility is too small to meet current Enbridge Gas Inc. (EGI) standards. The separation of offices and warehouse into two separate buildings is not convenient for staff and causes operational and workplace difficulties and inefficiencies. The configuration of site functions and circulation is inefficient. The yard area is too small to meet current EGI standards. Building expansion on the same property will further reduce the size of the yard area and will cause additional pressure on parking and circulation. Based on the site deficiencies and space limitations, relocation to another property is recommended. This option may no longer be possible so further analysis is required depending on the ability to procure adjacent property or appropriately-sized property nearby. The analysis will look at the possible vertical industrial solution to meet the needs of the business.

Physical Obsolescence: The acceptable EGI standard for the physical condition is a Facility Condition Index (FCI) of 0 to 5%. The current FCI of the facility based on this study is 6.51%. Therefore, the physical condition of the facility does not meet EGI acceptable standards.

Functional Obsolescence – Building: The acceptable EGI standard for the functional condition is 0. A functional condition between 0 and 49% is considered correctable at the current location. The current facility Adequacy Index (AI) is 95%. Based on the FCI/AI graph, the current recommendation for the existing facility is to increase the site area by purchasing the adjacent property, demolish existing building, and rebuild the facility on the combined sites to accommodate current EGI standards.

Functional Obsolescence – Site: The site does not meet operational requirements for size and vehicular circulation. Access and exit from Kennedy is difficult and poses operational inefficiencies. The yard size is smaller than EGI standard yard size requirements. The current yard size is 1.3 acres. EGI standard yard size is 2.5 acres. The existing building requires expansion by approximately 11,000 square feet to meet the need for current staff and EGI functional requirements. Building additions on the property entail further reduction in the yard and parking areas.

Assets: 3157 Kennedy Road, Scarborough, ON.

Related Program: N/A

Recommended Alternative Description

Scope of Work: Sell the existing property, purchase a property suitable in size to accommodate the required program. Required size of new property is approximately 5 acres.

The project will correct operational and workplace inefficiencies, using less energy and emit less greenhouse gases on the combined site. This strategy will leverage current site improvements and keep land acquisition costs to a minimum by joining the currently vacant neighbouring property.

The assets in scope are located at 3157 Kennedy Road, Scarborough, ON. The nature of work includes development of the adjacent property and construction and fit-up of a new building.

Resources:
External professional resources for design and engineering along with a construction company will be contracted for the project. Historically, EGI has retained architectural and engineering consulting services and general construction contractors for the execution of similar projects.

Solution Impact: The service life of the new facility will be 25 – 40 years.

Timing and Execution Risks:
The project duration is 36 months:
0 – 3 months: Programming, design development
3 – 6 months: Site acquisition
6 – 12 months: Site plan agreement, permit and tender documents, permit and tender process
12 – 14 months: Contract award and winter contingency as required
14 – 28 months: Construction
28 – 30 months: Fit-up and occupancy
30 – 36 months: Disposition of old property


Risks include contractor delays and material delivery delays or defects.

Expenditures:
The total cost for the project is \$26.8M net capital which includes a working construction cost contingency of 15%. Construction costs are determined based on historical EGI project costs and estimated land values are based on marketplace comparisons. The project also leverages national pricing agreements with furniture, walls, and flooring manufacturers. The project costs are based on a Class 5 estimate.

Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - Real Estate & Workplace Services - Furniture/Structures & Improvements
Investment Stage	Executing		

Investment Overview

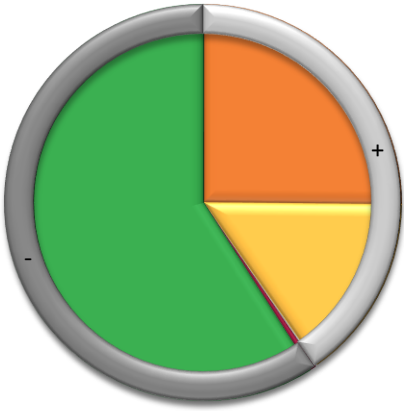
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	10 - Toronto
	Asset Program (EGI)	REWS - Furniture/Structures & Improvements
	Asset Class (EGI)	Real Estate & Workplace Services
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No










<div> Investment Summary Report</div>	Investment Code 501813	Report Start Year 2023	Number of Years 10
	Investment Name Kennedy Road Expansion		


Alternative Spend Profile - Recommended

Name										Net Base Capex O (CA)	
Kennedy Road Expansion										\$	46,595,427
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Base CAPEX O	\$ 250,000	\$ 19,750,000	\$ 18,000,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	-

Alternative Value - Recommended



Value Function Measure		Value
	Cost Avoidance OPEX (CA)	13,983
	Employee Productivity (CA)	8,407
	Avoided GHG Emissions (CA)	93
	Cost Avoidance CAPEX (CA)	0
	Budget Savings CAPEX (CA)	0
	Budget Savings OPEX (CA)	0
	Revenue Impact (CA)	0
	Energy Efficiency (CA)	(293)
	Total Investment Cost (CA)	(32,800)
Total		(10,609)

 Investment Summary Report	Investment Code 3642	Report Start Year 2023	Number of Years 10
	Investment Name		
	Ottawa - Land Purchase		

Investment Description

Issue/Concern:
Coventry Road
The office building in Ottawa is an owned facility that is in physically fair condition. The facility’s functionality is sound but there is excess space. In addition, the furniture and finishings do not meet functional standards. The office is in a good location to serve the respective area but there is duplication in coverage between the SMOC and Coventry Road facilities.

Functional Obsolescence – Building: The acceptable Enbridge Gas Inc. (EGI) standard for the functional condition is 0, anything between 0 and 49% is considered correctable at the current location. The current facility Adequacy Index is 43%, considered marginally correctable at current location without consideration of other factors including adequacy of land size and the Functional Condition Index.

Functional Obsolescence – Site: The site does not meet operational requirements for size and vehicular circulation within the site. The yard size is smaller than EGI standard yard size requirements. The current yard size is 1.42 acres. EGI standard yard size is 2.5 acres. Building is in average condition and functionally sound (building has excess area). The site does not meet non-functional standards (furniture standards, and finishes, etc.). The site is in a good location but is no longer optimized for best use. There is potential for consolidation with the SMOC facility on 90 Bill Leatham Drive, Nepean, ON.

SMOC
SMOC is an owned facility in physically fair condition. The facility’s functionality is sound; however, there is unused/excess space. In addition, the furniture and finishings do not meet non-functional standards (furniture standards, and finishes, etc.). The office is in a good location to serve its respective area but there is duplication in coverage between this office and the office at Coventry Road.

Functional Obsolescence – Building: The acceptable EGI standard for the functional condition is 0. Anything between 0 and 49% is considered correctable at the current location. The current facility Adequacy Index is 24% which is considered correctable at the current location, without consideration of other factors including adequacy of land size and the Functional Condition Index.

Functional Obsolescence – Site: The configuration of site functions and circulation is inefficient and poses a safety hazard. The yard area is too small to meet current EGI standards. The building is in average condition and is functionally sound (building has excess area). The building does not meet non-functional standards (furniture standards, and finishes, etc.). It is in a good location but there is potential for consolidation with the Coventry Road facility.

Assets: 400 Coventry Road, Ottawa, ON, and 90 Bill Leatham Drive, Nepean, ON (SMOC)

Related Program: N/A

Recommended Alternative Description

Scope of Work: Eastern Region Consolidated Facility Project
This project requires selling both the SMOC and Coventry Road properties, purchasing a property suitable in size (approximately 7 acres) and building a new 70,000 square-foot building that will consist of administration, warehouse, welding, and fabrication facilities. The assets in scope are located at 400 Coventry Road, Ottawa, ON, and 90 Bill Leatham Drive, Nepean, ON (SMOC). The nature of work is development of a new property and the construction and fit-up of a new building.

Resources: External professional resources for design and engineering along with a construction company will be contracted for the project. Historically, Enbridge Gas Inc. (EGI) has retained architectural and engineering consulting services and general construction contractors for the execution of similar projects.

Solution Impact: This option corrects operational and workplace inefficiencies by consolidating SMOC and Coventry redundancies. The new facility will use less energy and emit less greenhouse gases. The service life for the new facility will be 25 – 40 years.

Project Timing & Execution Risks:
The total project duration is 30 months:
0 – 3 months: Programming, design development, location analysis
3 – 6 months: Site acquisition
6 – 12 months: Site plan agreement, permit and tender documents, permit and tender process
12 – 14 months: Contract award and winter contingency as required
14 – 28 months: Construction
28 – 30 months: Fit-up and occupancy
Post-occupancy disposition of property

Risks include contractor delays and material delivery delays or defects.

Expenditures: The total cost for the project is \$23.8M net capital which includes a working construction cost contingency of 15%. Construction costs are determined based on historical EGI project costs and land values using marketplace comparisons. The project also leverages national pricing agreements with furniture, walls, and flooring manufacturers. The project costs are based on a Class 5 estimate.


Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - Real Estate & Workplace Services - Furniture/Structures & Improvements
Investment Stage	Executing		

Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	60 - Ottawa
	Asset Program (EGI)	REWS - Furniture/Structures & Improvements
	Asset Class (EGI)	Real Estate & Workplace Services
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Alternative Spend Profile - Recommended

Name									Net Base Capex O (CA)	
Ottawa - Land Purchase									\$	-
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

 Investment Summary Report	Investment Code 737374	Report Start Year 2023	Number of Years 10
	Investment Name		
	Ottawa - New Building		

Investment Description

Issue/Concern:

Coventry Road

The office building in Ottawa is an owned facility that is in physically fair condition. The facility’s functionality is sound but there is excess space. In addition, the furniture and finishings do not meet functional standards. The office is in a good location to serve the respective area, but there is duplication in coverage between the SMOC and Coventry Road facilities.

Functional Obsolescence – Building: The acceptable EGI standard for the functional condition is 0, anything between 0 and 49% is considered correctable at the current location. The current facility Adequacy Index is 43%, considered marginally correctable at current location without consideration of other factors including adequacy of land size and the Functional Condition Index.

Functional Obsolescence – Site: The site does not meet operational requirements for size and vehicular circulation within the site. The yard size is smaller than EGI standard yard size requirements. The current yard size is 1.42 acres. EGI standard yard size is 2.5 acres. Building is in average condition and functionally sound (building has excess area). The site does not meet non-functional standards (furniture standards, finishes etc.) The site is in a good location but is no longer optimized for best use. There is potential for consolidation with the SMOC facility on 90 Bill Leatham Drive, Nepean, ON.

SMOC

SMOC is an owned facility in physically fair condition. The facility’s functionality is sound, however, there is unused/excess space. In addition, the furniture and finishings do not meet non-functional standards (furniture standards, finishes etc.). The office is in a good location to serve its respective area, but there is duplication in coverage between this office and the office at Coventry Road.

Functional Obsolescence – Building: The acceptable EGI standard for the functional condition is 0. Anything between 0 and 49% is considered correctable at the current location. The current facility Adequacy Index is 24% which is considered correctable at the current location, without consideration of other factors including adequacy of land size and the Functional Condition Index.

Functional Obsolescence – Site: The configuration of site functions and circulation is inefficient and poses a safety hazard. The yard area is too small to meet current EGI standards. The building is in average condition and is functionally sound (building has excess area). The building does not meet non-functional standards (furniture standards, finishes etc.) It is in a good location but there is potential for consolidation with the Coventry Road facility.

Assets: 400 Coventry Road, Ottawa, ON, and 90 Bill Leatham Drive, Nepean, ON (SMOC)

Related Program: N/A

Recommended Alternative Description

Eastern Region Consolidated Facility Project

Scope of Work:

This project requires selling both the SMOC and Coventry Road properties, purchasing a property suitable in size (approx. 7 acres) and building a new 70,000 sq. ft. building that will consist of administration, warehouse, welding, and fabrication facilities. The assets in scope are located at 400 Coventry Road, Ottawa, ON, and 90 Bill Leatham Drive, Nepean, ON (SMOC). The nature of work is development of a new property and the construction and fit-up of a new building.

Solution Impact: This option corrects operational and workplace inefficiencies by consolidating SMOC and Coventry redundancies. The new facility will use less energy and emit less greenhouse gases. The service life for the new facility will be 25-40 years.

Timing: The total Project duration is 30 months:

0 – 3 months: Programming, design development, location analysis

3 – 6 months: Site acquisition

6 – 12 months: Site plan agreement, permit and tender documents, permit and tender process

12 – 14 months: Contract award and winter contingency as required

14 – 28 months: Construction

28 – 30 months: Fit-up and occupancy

Post-occupancy disposition of property

Risks include contractor delays and material delivery delays or defects.


Expenditures: The total cost for the project is \$23.8M net capital which includes a working construction cost contingency of 15%. Construction costs are determined based on historical EGI project costs and land values using marketplace comparisons. The project also leverages national pricing agreements with furniture, walls, and flooring manufacturers. The project costs are based on a Class 5 estimate.

Resources: External professional resources for design and engineering along with a construction company will be contracted for the project. Historically, EGI has retained architectural and engineering consulting services and general construction contractors for the execution of similar projects.

Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - Real Estate & Workplace Services - Furniture/Structures & Improvements
Investment Stage	Executing		

Investment Overview

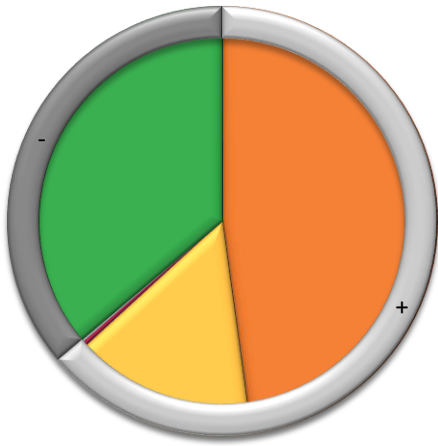
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	60 - Ottawa
	Asset Program (EGI)	REWS - Furniture/Structures & Improvements
	Asset Class (EGI)	Real Estate & Workplace Services
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No











 Investment Summary Report	Investment Code 737374	Report Start Year 2023	Number of Years 10
	Investment Name		
	Ottawa - New Building		


Spend Profile

Name										Net Base Capex O (CA)
Ottawa - New Building										\$ 34,750,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 17,000,000	\$ 17,750,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ 350,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended



Value Function Measure		Value
	Cost Avoidance OPEX (CA)	42,745
	Employee Productivity (CA)	13,755
	Energy Efficiency (CA)	351
	Avoided GHG Emissions (CA)	225
	Employee And Contractor Safety Risk	0
	Cost Avoidance CAPEX (CA)	0
	Budget Savings CAPEX (CA)	0
	Budget Savings OPEX (CA)	0
	Revenue Impact (CA)	0
	Total Investment Cost (CA)	(32,284)
Total		24,792

 Investment Summary Report	Investment Code 3640	Report Start Year 2023	Number of Years 10
	Investment Name		
	Station B New Building		

Investment Description

Issue/Concern:
The Station B office on Eastern Avenue is an owned property in a good location but does not meet current building standards or operational requirements. The physical condition is considered good but the utilization and functionality is challenged. The office space no longer meets the needs of the staff currently working out of the facility. The new building will be able to provide the needed functionality and safety for the staff to carry out their tasks.

Physical Obsolescence: The acceptable EGI standard for the physical condition is a Facility Condition Index (FCI) of 0 to 5%. The current FCI of the facility based on this study is 12.28%. Therefore, the physical condition of the facility does not meet EGI acceptable standards.

Functional Obsolescence – Building: The acceptable EGI standard for the functional condition is 0. A functional condition between 0 and 49% is considered correctable at the current location. The current facility Adequacy Index (AI) is 49%.

Functional Obsolescence – Site: The property is divided into two separate parts. The first part consists of approximately 0.7 acres completely fenced off including a secure gate station located adjacent to the site on the northwest corner. The reminder of the site consists of 3.2 acres and is used as an operations depot. The site does not meet operational requirements for size and vehicular circulation. One point of access is provided to the site which poses circulation difficulties and poses operational inefficiencies. The yard size is marginally smaller than EGI standard yard size requirements. The current yard size is 2.25 acres. The EGI standard yard size is 2.5 acres. It was noted by EGI staff that the existing yard size is adequate for current operations. The existing building requires expansion by approximately 8,000 square feet to meet the need for current staff and EGI functional requirements.

Assets: 405 Eastern Avenue, Toronto, ON.

Related Program: N/A

Recommended Alternative Description

Scope of Work:
The project entails demolishing the existing facility and building a new single-storey building with underground parking to ensure much needed yard requirements for core operational needs such as fleet and equipment parking, aggregate bunkers, and yard. Underground parking will ensure the site is maximized for operations yard needs as land in Toronto’s downtown is limited and requires efficient use of property. This will expand the usable existing yard. The new building footprint of approximately 20,000 square feet will ensure adequate interior storage/warehouse and fabrication space for operations, an operations muster/meeting space, washroom/locker facilities appropriately sized for the operation, and a larger office environment for site staff. The program will include currently missing elements such as a lunch room and meeting rooms. This new facility will correct operational and workplace inefficiencies, using less energy and emitting less greenhouse gases.

The assets in scope are located at 405 Eastern Avenue, Toronto, ON. The nature of work is site improvements and construction and fit-up of a new building.

Resources:
Professional resources for design and engineering along with a contractor will be retained from the marketplace. Historically, EGI has engaged architectural and engineering consulting services and general construction contractors for the execution of similar projects.

Solution Impact: The service life of the new facility would be 25 – 40 years, with the old building being demolished.

Project Timing:
The project duration is 36 months.
0 – 3 months: Programming and design development
3 – 9 months: Site plan agreement, permit and tender documents
9 – 12 months: Permit and tender process
12 – 14 months: Contract award and winter contingency as required
14 – 28 months: Construction
28 – 30 months: Fit-up and occupancy
30 – 36 months: Old building demolition and remaining site improvements


Risks include contractor delays and material delivery delays or defects.

Expenditures:
The total cost for the project is \$6.5 M net capital which includes a working construction cost contingency of 15%. Construction costs are determined based on historical EGI projects. The project also leverages national pricing agreements with furniture, walls, and flooring manufacturers. Project costs are based on a Class 5 estimate.

Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - Real Estate & Workplace Services - Furniture/Structures & Improvements
Investment Stage	Executing		

Investment Overview

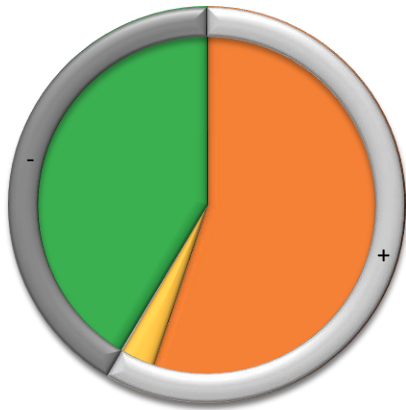
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	10 - Toronto
	Asset Program (EGI)	REWS - Furniture/Structures & Improvements
	Asset Class (EGI)	Real Estate & Workplace Services
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No










<div> Investment Summary Report</div>	Investment Code 3640	Report Start Year 2023	Number of Years 10
	Investment Name		
	Station B New Building		


Spend Profile

Name										Net Base Capex O (CA)
Station B New Building										\$ 40,000,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 10,000,000	\$ 20,000,000	\$ 10,000,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended



Value Function Measure		Value
	Cost Avoidance OPEX (CA)	47,678
	Employee Productivity (CA)	2,776
	Avoided GHG Emissions (CA)	29
	Cost Avoidance CAPEX (CA)	0
	Budget Savings CAPEX (CA)	0
	Budget Savings OPEX (CA)	0
	Revenue Impact (CA)	0
	Energy Efficiency (CA)	(121)
	Total Investment Cost (CA)	(35,815)
Total		14,546

<div></div> <div>Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	8681	2023	10
	Investment Name		
	Thorold Regional Office - Building & Site		

Investment Description

Issue/Concern/Opportunity: The administrative office in Thorold is an owned property that is in physically good condition, but operating at full occupancy offering minimal room for growth. This office was last renovated 18 years ago and the environment is in need of a refresh. Since this renovation, EGI office standards have evolved and include a focus on natural light and views to the outdoors. The facility does not meet current EGI office standards. In addition, the parking lot at the Thorold administrative facility does not meet current standards or growth demands. The parking lot currently accommodates 127 vehicles and does not accommodate the growth requirements for both operations and administrative staff parking. During peak periods, such as training sessions, department meetings, and special events, staff is required to park off site due to the limited space. In the winter after heavy snow, up to 10 parking spaces are lost until the snow is hauled away off-site.

Physical Obsolescence: The acceptable Enbridge standard for the physical condition is an FCI of 0 to 5%. The current FCI of the facility based on this study is 3.09%; therefore, the physical condition of the facility meets Enbridge acceptable standards.

Functional Obsolescence:

-Building: The acceptable EGI standard for the functional condition is 0. A functional condition between 0 and 49% is considered correctable at the current location. The current facility Adequacy Index (AI) is 59% which is marginally considered correctable at the current location, without consideration of other factors, including adequacy of land size and the FCI.

-Site: The site does not meet operational requirements for vehicular circulation. The yard size is smaller than EGI standard yard size requirements. The current usable yard size is 1.7 acres. EGI standard yard size is 2.5 acres, however there is at least one acre of landscaped area that could be reconfigured to accommodate site deficiencies.

Asset: 3401 Schmon Parkway, Thorold, Ontario.

Related Program: N/A

Recommended Alternative Description

Scope of Work:

The assets in scope are located at 3401 Schmon Parkway, Thorold, Ontario. The nature of work is interior renovation and furnishings and expanding the employee parking lot. This project will correct physical and functional deficiencies by renovating the current office space and expanding the parking lot. Physical and functional standards can be met more cost-effectively by renovating the current office space and site. The renovated facility will use less energy and emit less greenhouse gases.

Expenditures: Total capital expenditure for this Project is estimated to be \$16.5M which includes a working construction cost contingency of 15%. Construction costs are determined based on historical EGI project costs. The project also leverages national pricing agreements with furniture, walls, and flooring manufacturers. The project costs are based on a Class 5 estimate.

Resources: Professional resources for design and engineering will be contracted from the marketplace. Historically, EGI has retained architectural and engineering consulting services for the execution of similar projects.

Solution Impact: The renovation will extend the asset useful life by 15 years.

Project Timing & Execution Risks: The project duration is 12 months as described below:

0 to 2 months: Programming and design development

2 to 5 months: Permit and tender documents

5 to 7 months: Award, tender and permit process

7 to 11 months: Construction

11 to 12 months: Fit-up and occupancy

Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - Real Estate & Workplace Services - Furniture/Structures & Improvements
Investment Stage	Short Term Planning		

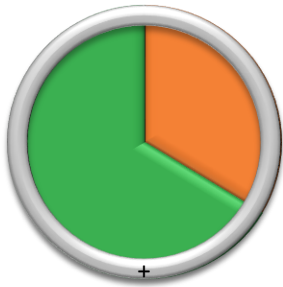
Investment Overview







1. Project Information	State/Province	Ontario
	Operating Area (EGI)	80 - Niagara
	Asset Program (EGI)	REWS - Furniture/Structures & Improvements
	Asset Class (EGI)	Real Estate & Workplace Services
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	
	Third Party Relocation (EGI)	
	Program work with sufficient history and risk to warrant continuation (EGI)	


Spend Profile

Name									Net Base Capex O (CA)	
Thorold Regional Office - Building & Site									\$	16,500,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 250,000	\$ 250,000	\$ 5,000,000	\$ 8,000,000	\$ 3,000,000	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ 600,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended



Value Function Measure		Value
	Cost Avoidance OPEX (CA)	6,035
	Cost Avoidance CAPEX (CA)	0
	Budget Savings CAPEX (CA)	0
	Budget Savings OPEX (CA)	0
	Revenue Impact (CA)	0
	Total Investment Cost (CA)	(11,912)
Total		(5,877)

 Investment Summary Report	Investment Code 102059	Report Start Year 2023	Number of Years 10
	Investment Name		
	Thorold Operations Centre - Land Purchase		

Investment Description

Issue/Concern/Opportunity: Land purchase for a new Thorold Ops centre. Approx 10,000 SF. 5 acre site.
Justification:
Assets:
Related Investments:
Issue/Concern:

Recommended Alternative Description

Scope of Work: Purchase a new 5 acre site
Resources:
Solution Impact:
Project Timing & Execution Risk:

Scope:
This Project requires purchasing a property suitable in size (approx. 5 acres). The nature of work is locating a purchasing a new property off-site. The total Project duration is 4 months as described below:

0 – 1 months: Location analysis
1 – 4 months: Site acquisition

Expenditures
The total cost for the Project is \$3.5M net capital (as shown in Table 5-134).

Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - Real Estate & Workplace Services - Furniture/Structures & Improvements
Investment Stage	Executing		


Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	80 - Niagara
	Asset Program (EGI)	REWS - Furniture/Structures & Improvements
	Asset Class (EGI)	Real Estate & Workplace Services
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name									Net Base Capex O (CA)	
Thorold Operations Centre - Land Purchase									\$	-
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Report Generation Date: 2/24/2023

 Investment Summary Report	Investment Code 737754	Report Start Year 2023	Number of Years 10
	Investment Name		
	Thorold Operations Centre - New Building		

Investment Description

Issue/Concern/Opportunity: Build a new Thorold Ops centre. Approx 10,000
Justification:
Assets:
Related Investments:
Issue/Concern:

Recommended Alternative Description

Scope of Work: Build a new 10,000 sf facility.
Resources:
Solution Impact:
Project Timing & Execution Risk:

Scope:
This Project requires purchasing a property suitable in size (approx. 5 acres) and building a new 10,000 sq. ft. building that will consist of administration, warehouse, welding and fabrication facilities. The new facility will use less energy and emit less greenhouse gases. The service life for the new facility will be 25-40 years. The nature of work is development of a new property and the construction and fit-up of a new building. The total Project duration is 25 months as described below:

0 – 3 months: Programming, design development
3 – 9 months: Site plan agreement, permit and tender documents, permit and tender process
9 – 11 months: Contract award and winter contingency as required
11 – 25 months: Construction
28 – 30 months: Fit-up and occupancy

Expenditures
The total cost for the Project is \$16.5M net capital (as shown in Table 5-134) which includes a working construction cost contingency of 15%. Construction costs are determined based on historical EGD project costs and land values using marketplace comparisons. The Project also leverages national pricing agreements with furniture, walls, and flooring manufacturers. The Project costs are based on a Class 5 estimate.

Resources
External professional resources for design and engineering along with a construction company will be contracted for the Project. Historically EGD has retained architectural and engineering consulting services and general construction contractors for the execution of similar projects


Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - Real Estate & Workplace Services - Furniture/Structures & Improvements
Investment Stage	Executing		

Investment Overview

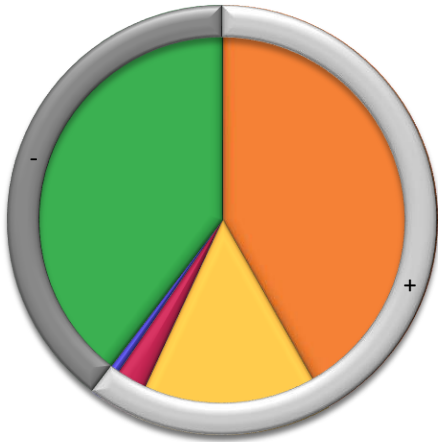
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	80 - Niagara
	Asset Program (EGI)	REWS - Furniture/Structures & Improvements
	Asset Class (EGI)	Real Estate & Workplace Services
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No











Spend Profile

Name									Net Base Capex O (CA)	
Thorold Operations Centre - New Building									\$	20,700,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 50,000	\$ 650,000	\$ 8,000,000	\$ 12,000,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -


<div> Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	737754	2023	10
	Investment Name		
	Thorold Operations Centre - New Building		

Alternative Value - Recommended



Value Function Measure		Value
	Cost Avoidance OPEX (CA)	17,371
	Employee Productivity (CA)	6,258
	Energy Efficiency (CA)	1,101
	Avoided GHG Emissions (CA)	331
	Employee And Contractor Safety Risk	0
	Cost Avoidance CAPEX (CA)	0
	Budget Savings CAPEX (CA)	0
	Budget Savings OPEX (CA)	0
	Revenue Impact (CA)	0
	Total Investment Cost (CA)	(16,450)
Total		8,611

Report Generation Date: 2/27/2023

 Investment Summary Report	Investment Code 8782	Report Start Year 2023	Number of Years 10
	Investment Name		
	VPC Core and Shell		

Investment Description

Issue/Concern: The building shell and core for the VPC facility is over 50 years old. The tower building was constructed in or around 1968 as a two-storey building with an addition in 1978 that included floors 3 to 5. The VPC facility houses over 1,200 employees. It is an owned facility that is currently undergoing renovations.

Physical Condition: Currently safe, ongoing periodic structural review required.

Functional Condition: Failed performance as an insulator and barrier to the outdoors, water and vapour intrusion, and comfort and energy efficiency is compromised.

Proposed Activity: Envelope replacement - high performance curtain wall, new shell with very high levels of glazing allowing increased daylight and views; change from 30% today to 60 – 80% penetration of light.

Assets: 500 Consumers Rd., North York, ON

Related Program: N/A

Recommended Alternative Description

Scope of Work: The assets in scope are located at 500 Consumers Rd., North York, ON. The nature of work is the removal and replacement of the 50-year-old exterior envelope on the tower and the replacement of core mechanical and electrical systems. This project calls for correcting physical and functional deficiencies by renovating and renewing the existing facility. This is the preferred strategy since the Facility Condition Index (FCI) and Adequacy Index (AI) show the building and site deficiencies are correctable by the following activities:

- Renewing the building’s main mechanical system
- Adding two elevators
- Renovating the three main staircases
- Replacing the building envelope

Resources: External professional resources for design and engineering as well as a construction company will be contracted for the project. Historically, Enbridge Gas Inc. (EGI) has retained architectural and engineering consulting services and general construction contractors for the execution of similar projects.

Solution Impact: The renovation will correct operational and workplace inefficiencies by using less energy and emitting less greenhouse gases on the existing property. The service life of the renewed facility would be 40 years.

Timing: The project duration is 24 months:
0 – 3 months: Programming and design development
3 – 9 months: Permit and tender documents
9 – 12 months: Permit and tender process
12 – 14 months: Contract award and winter contingency as required
14 – 24 months: Construction

Risks include contractor delays and material delivery delays or defects.

Expenditures: The total cost for the project is \$20M net capital. Construction costs are determined from facility assessment reports and architectural consultant budget forecasts and using marketplace comparisons. Project costs are based on a Class 5 estimate.


Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - Real Estate & Workplace Services - Furniture/Structures & Improvements
Investment Stage	Short Term Planning		

Investment Overview

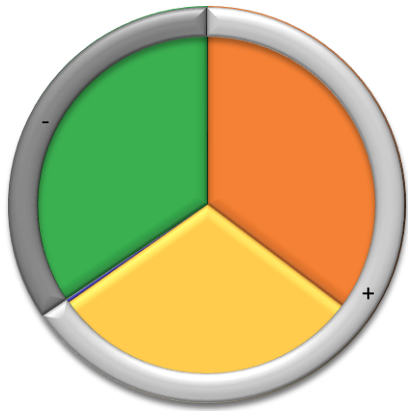
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	00 - Head Office
	Asset Program (EGI)	REWS - Furniture/Structures & Improvements
	Asset Class (EGI)	Real Estate & Workplace Services
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No










Spend Profile

Name									Net Base Capex O (CA)	
VPC Core and Shell									\$	26,000,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ 10,000,000	\$ 10,000,000	\$ 6,000,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ 1,000,000	\$ 1,000,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -


 Investment Summary Report	Investment Code 8782	Report Start Year 2023	Number of Years 10
	Investment Name		
	VPC Core and Shell		

Alternative Value - Recommended



Value Function Measure		Value
	Cost Avoidance OPEX (CA)	22,367
	Employee Productivity (CA)	18,988
	Avoided GHG Emissions (CA)	179
	Energy Efficiency (CA)	24
	Cost Avoidance CAPEX (CA)	0
	Budget Savings CAPEX (CA)	0
	Budget Savings OPEX (CA)	0
	Revenue Impact (CA)	0
	Total Investment Cost (CA)	(21,818)
Total		19,741

Report Generation Date: 2/27/2023

 Investment Summary Report	Investment Code 100621	Report Start Year 2023	Number of Years 10
	Investment Name		
	Dawn Administrative Centre		

Investment Description

Issue/Concern: The Dawn admin centre on Bentpath Line is an owned property in a good location but does not meet current building standards or operational requirements. The physical condition is considered poor and the utilization and functionality is challenged. The office space no longer sufficiently accommodates current and future staffing needs of the facility.

Physical Obsolescence: The acceptable Enbridge Gas Inc. (EGI) standard for the physical condition is a Facility Condition Index (FCI) of 0 to 5%. The current FCI of the facility based on this study is 16.95%. Therefore, the physical condition of the facility does not meet EGI acceptable standards.

Functional Obsolescence – Building: The acceptable EGI standard for the functional condition is 0. A functional condition between 0 and 49% is considered correctable at the current location. The current facility Adequacy Index (AI) is 28%.

Functional Obsolescence – Site: The area occupied by the building is separated from the adjacent functions with metal fence complete with barb wire. The building occupies approximately 7.5% of 233,541 SF fenced site area. The two driveways to the south and east of the building act as main entry and exit only servicing visitors and employees. There are four access points from the south and east driveway that lead to the front parking lot. The parking area consists of 68 parking spaces and is considered adequate to accommodate staff and visitors.

There is no yard associated with the building due to its unique function as an office building with no industrial components. The building is located in the underground gas storage zone. It was reported by staff the proximity of the building to the underground gas storage is of concern to staff and relocation to an area outside the storage zone is desirable.

Assets: 3332 Bentpath Line, Tupperville, ON.

Related Program: N/A

Recommended Alternative Description

Scope of Work: Build new facility elsewhere on the Dawn campus. The current Asset Management Plan has allocated funds in 2021 and 2022 to fulfill the strategy. This presents the safest, most cost-effective solution for maintaining a Category 1 facility.

Solution Impact: The service life of the new facility will be 25-40 years.

Timing and Execution Risks:
The Project duration is 36 months:
0 – 3 months: Programming and design development
3 – 9 months: Site plan agreement, permit and tender documents
9 – 12 months: Permit and tender process
12 – 14 months: Contract award and winter contingency as required
14 – 28 months: Construction
28 – 30 months: Fit-up and occupancy
30 – 36 months: Old building demolition and remaining site improvements

Risks include contractor delays and material delivery delays or defects.


Expenditures:
The total cost for the project is \$13M net capital which includes a working construction cost contingency of 15%. Construction costs are determined based on historical EGI project costs and estimated land values are based on marketplace comparisons. The project also leverages national pricing agreements with furniture, walls, and flooring manufacturers. The project costs are based on a Class 5 estimate.

Resources:
External professional resources for design and engineering along with a construction company will be contracted for the project. Historically, EGI has retained architectural and engineering consulting services and general construction contractors for the execution of similar projects.

Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Real Estate & Workplace Services - Furniture/Structures & Improvements
Investment Stage	Short Term Planning		

Investment Overview

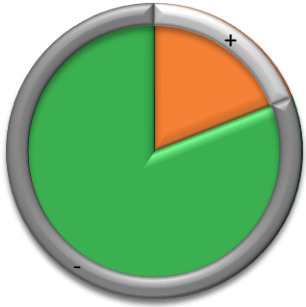
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_02 - Chatham
	Asset Program (EGI)	REWS - Furniture/Structures & Improvements
	Asset Class (EGI)	Real Estate & Workplace Services
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No







 Investment Summary Report	Investment Code 100621	Report Start Year 2023	Number of Years 10
	Investment Name		
	Dawn Administrative Centre		

Spend Profile


Name										Net Base Capex O (CA)
Dawn Administrative Centre										\$ 13,000,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ -	\$ -	\$ -	\$ 1,000,000	\$ 12,000,000	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended



Value Function Measure		Value
	Cost Avoidance OPEX (CA)	2,020
	Cost Avoidance CAPEX (CA)	0
	Budget Savings CAPEX (CA)	0
	Budget Savings OPEX (CA)	0
	Revenue Impact (CA)	0
	Total Investment Cost (CA)	(8,596)
Total		(6,576)

Report Generation Date: 2/27/2023

<div>  </div> <div>Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	101136	2023	10
	Investment Name		
	New London Site		

Investment Description

Issue/Concern/Opportunity: This project will allow for potential consolidation currently under review of four operational sites in the Union rate zones into a single facility. Boundary analysis still ongoing and investment details will continually be updated as strategy progresses.

Functional Obsolescence – Building: N/A

Functional Obsolescence – Site: N/A

Assets: N/A

Related Program: N/A

Recommended Alternative Description

Scope of Work:

This project requires selling existing assets, purchasing a property suitable in size (approximately 7 to 10 acres) and building a new 44,000 sq. ft. building that will consist of administration, warehouse, welding and fabrication facilities. The preferred strategy is to correct physical and functional deficiencies by purchasing a new site and build a new facility on the new site.

Resources: External professional resources for design and engineering along with a construction company will be contracted for the project. Historically, Enbridge Gas Inc. (EGI), has retained architectural and engineering consulting services and general construction contractors for the execution of similar projects.

Solution Impact: This option corrects operational and workplace inefficiencies by consolidating existing facilities. The new facility will use less energy and emit less greenhouse gases. The service life for the new facility will be 25 to 40 years.

Project Timing & Execution Risks

Timing: The total project duration is 30 months:

0 – 3 months: Programming, design development, and location analysis

3 – 6 months: Site acquisition

6 – 12 months: Site plan agreement, permit and tender documents, permit and tender process

12 – 14 months: Contract award and winter contingency as required

14 – 28 months: Construction

28 – 30 months: Fit-up and occupancy

Post-occupancy disposition of property

Risks include contractor delays and material delivery delays or defects.

Expenditures:

The total cost for the project is \$28.8M net capital which includes a working construction cost contingency of 15%. Construction costs are determined based on historical EGI project costs and land values using marketplace comparisons. The project also leverages national pricing agreements with furniture, walls, and flooring manufacturers. The project costs are based on a Class 5 estimate.


Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Real Estate & Workplace Services - Furniture/Structures & Improvements
Investment Stage	Executing		

Investment Overview

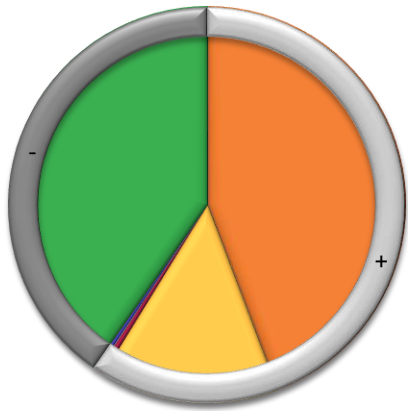
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_04 - London
	Asset Program (EGI)	REWS - Furniture/Structures & Improvements
	Asset Class (EGI)	Real Estate & Workplace Services
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No










Spend Profile

Name									Net Base Capex O (CA)	
New London Site									\$	38,810,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ -	\$ 18,810,000	\$ 20,000,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -


 Investment Summary Report	Investment Code 101136	Report Start Year 2023	Number of Years 10
	Investment Name		
	New London Site		

Alternative Value - Recommended



Value Function Measure		Value
	Cost Avoidance OPEX (CA)	33,927
	Employee Productivity (CA)	11,182
	Energy Efficiency (CA)	392
	Avoided GHG Emissions (CA)	273
	Cost Avoidance CAPEX (CA)	0
	Budget Savings CAPEX (CA)	0
	Budget Savings OPEX (CA)	0
	Revenue Impact (CA)	0
	Total Investment Cost (CA)	(30,902)
Total		14,872

Report Generation Date: 2/27/2023

 Investment Summary Report	Investment Code 100709	Report Start Year 2023	Number of Years 10
	Investment Name		
	Sudbury Regional Operations Centre		

Investment Description

Issue/Concern: The Sudbury depot on Falconbridge Road is an owned property in a good location, but does not meet current building standards or operational requirements. The physical condition is considered poor and the utilization and functionality is challenged. The office space no longer sufficiently accommodates current and future staffing needs of the facility.

Physical Obsolescence: The acceptable EGI standard for the physical condition is a Facility Condition Index (FCI) of 0 to 5%. The current FCI of the facility based on this study is 8.49%. Therefore, the physical condition of the facility does not meet EGI acceptable standards.

Functional Obsolescence – Building: The acceptable EGI standard for the functional condition is 0. A functional condition between 0 and 49% is considered correctable at the current location. The current facility Adequacy Index (AI) is 13%.

Functional Obsolescence – Site: The site is 1.9 acres and is serviced by two driveways off of Westbourne Street. The northern driveway is a two way driveway that provides access to the front parking lot for both employees and staff. The southern driveway is equipped with card access into the yard servicing only employees. The site consists of a main office and warehouse building. The parking and yard are arranged such that the main employee and staff parking is located to the north east of the building with additional staff parking and yard to the south of the building.

Asset: 828 Falconbridge Road, Sudbury, ON.

Related Program: N/A

Recommended Alternative Description

Scope of Work: Correct physical and functional deficiencies by renovating the existing facility. This Project will correct physical and functional deficiencies by renovating the current office space. Physical and functional standards can be met more cost-effectively by renovating the current office space and site. The renovated facility will use less energy and emit less greenhouse gases.

Solution Impact: The renovation will extend the asset useful life by 15 years.

Timing: The Project duration is 12 months as described below:

0 – 2 months: Programming and design development

2 – 5 months: Permit and tender documents

5 – 7 months: Award, tender and permit process

7 – 11 months: Construction

11 – 12 months: Fit-up and occupancy

Expenditures:Total capital expenditure for this Project is estimated to be \$6.57M which includes a working construction cost contingency of 15%. Construction costs are determined based on historical EGI project costs. The Project also leverages national pricing agreements with furniture, walls, and flooring manufacturers. The Project costs are based on a Class 5 estimate.

Resources: Professional resources for design and engineering will be contracted from the marketplace. Historically, EGI has retained architectural and engineering consulting services for the execution of similar projects.


Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Real Estate & Workplace Services - Furniture/Structures & Improvements
Investment Stage	Short Term Planning		

Investment Overview

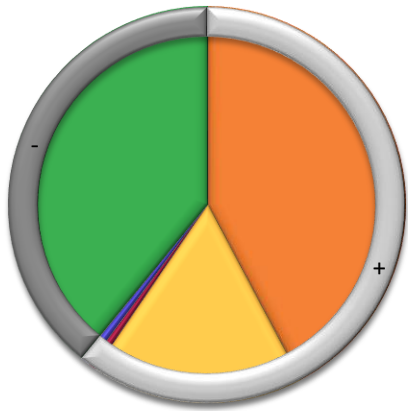
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_43 - Sudbury & S.S. Marie
	Asset Program (EGI)	REWS - Furniture/Structures & Improvements
	Asset Class (EGI)	Real Estate & Workplace Services
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	
	Third Party Relocation (EGI)	
	Program work with sufficient history and risk to warrant continuation (EGI)	










Spend Profile

Name										Net Base Capex O (CA)	
Sudbury Regional Operations Centre										\$	8,500,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Base CAPEX O	\$ -	\$ 1,600,000	\$ 6,900,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -


<div> Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	100709	2023	10
	Investment Name		
	Sudbury Regional Operations Centre		

Alternative Value - Recommended



Value Function Measure		Value
	Cost Avoidance OPEX (CA)	7,719
	Employee Productivity (CA)	3,164
	Energy Efficiency (CA)	114
	Avoided GHG Emissions (CA)	132
	Cost Avoidance CAPEX (CA)	0
	Budget Savings CAPEX (CA)	0
	Budget Savings OPEX (CA)	0
	Revenue Impact (CA)	0
	Total Investment Cost (CA)	(7,142)
Total		3,988

Report Generation Date: 2/27/2023

 Investment Summary Report	Investment Code 102291	Report Start Year 2023	Number of Years 10
	Investment Name		
	Contract Market Harmonization		

Investment Description

Issue/Concern/Opportunity: The OEB MAADs decision specified that EGI shall file a proposal for rate harmonization in its next rebasing application. In order to harmonize contract market rates, services must also be harmonized. Enbridge believes that harmonizing and aligning services for the contract market will improve the customer experience for contract customers by reducing the number of systems they must transact in, aligning policies across rate zones, and simplifying processes. If the proposal filed as part of 2024 Rebasing is approved, this project will be required to implement the approved rates and services in the systems listed below. By implementing this project coincident with the Contract Market Systems – Technology Obsolescence project, the investment of capital is optimized.

Assets: TIS Business Solutions. EnTRAC, URICA, Enerline, CARE, ConTrax, GDAR, SAP- CIS, SAP-ERP, Oracle Financials, Data Marts are examples of the systems impacted

Related Program: Contract Market Systems - Technology Obsolescence #736942, Rates and Service Harmonization Project #76081

Recommended Alternative Description

Scope of Work: Currently, Enbridge Gas Inc (EGI) has 3 different rate zones (EGD, Union North, Union South), 11 separate service designs and 43 rate classes. This results in complex business and accounting processes. This project will implement changes to several EGI business applications to implement harmonized services, rate zones, and rate classes.

This project, in conjunction with the Contract Market - Technology Obsolescence Project, is required to provide consistent services with common design elements for customers in all areas of the franchise. The simplified, consistent services will enhance the customer experience, provide more flexibility for customers, and reduce the complex variations in the existing services and rates. Contract market harmonization will facilitate harmonized business processes, reduced system complexity, and will reduce the level of effort associated with ongoing business and TIS support. Detailed information regarding the service and rate harmonization and the associated benefits will be filed with EGI’s 2024 rebasing application.

Several business applications are impacted based upon the changes proposed:

-ConTrax/CARE/GDAR/Enerline - The Union rate zone business applications that perform contracting, billing and gas management/nominations functions, including customer facing portals.

-EnTRAC/Urica/GDAR – The EGD rate zone business applications that perform contracting and gas management/nominations functions, including customer facing portals.

This functionality will be enabled in conjunction with the Contract Market Systems - Technology Obsolescence project, which will coincidentally integrate the above legacy company applications and replace aging technologies. These business applications must be integrated to allow for the harmonization of rate zones, rate classes and services as well as a single customer portal. If the applications are not integrated, EGI will need to make changes to multiple applications to align them with the harmonized services and business processes. A single customer portal would remain a requirement regardless of the underlying business applications. In addition, some of the proposals for service harmonization may not be able to be implemented. For example, the scenario where customers or contracts cross between the existing rate zones. In addition to the primary business applications, there will also be changes required to downstream processes and applications such as gas accounting, QRAM, and financial reporting to align with the harmonized rates and services.

This project will follow TIS project methodologies as developed and governed by the Project Management Office.

Resources: Project Manager, Business Analysts, Business Systems Support Team, Customer Care SMEs, Regulatory SMEs, Finance SMEs, TIS SMEs, Energy Services SMEs, Enterprise Architecture, Solutions Architecture, Data & Analytics, Report Developers, AMS provider, Solutions Integrator, Audit, Testing, Organizational Change Management (OCM)

Solution Impact: EGI currently has 3 Rate Zones, 11 Separate Service Designs and 43 Rate Classes. This project will implement the required changes to enable service and rate harmonization.

Project Timing & Execution Risks:

-Project expected to start late 2023, and will continue into 2024 pending the approval of Rate and Service Design by the OEB as part of the 2024 Rebasing Application. A key dependency is the Contract Market - Technology Obsolescence Project. In order to harmonize services, EGI must consolidate and modernize the contract rate billing, contracting, GDAR and gas management/nominations applications. Target implementation date is Q2 2026. Project milestones for design, build, test and delivery to be developed once project approved, team established, and project initiated.

-Risks include resource constraints, competing priorities, OEB approval of service and rate harmonization as submitted by EGI.


Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - TIS - TIS Business Solutions
Investment Stage	Long Term Planning		

Investment Overview

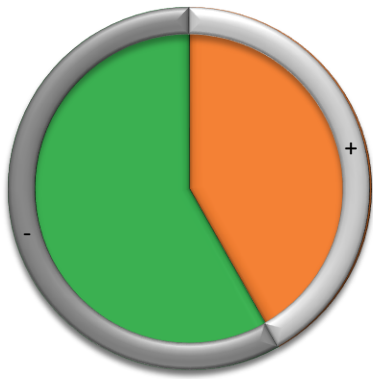
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	00 - Head Office
	Asset Program (EGI)	TIS Business Solutions
	Asset Class (EGI)	TIS
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No









Spend Profile

Name									Net Base Capex O (CA)	
Contract Market Harmonization									\$	14,760,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 2,000,000	\$ 5,000,000	\$ 5,000,000	\$ 2,760,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -


 Investment Summary Report	Investment Code 102291	Report Start Year 2023	Number of Years 10
	Investment Name		
	Contract Market Harmonization		

Alternative Value - Recommended



Value Function Measure		Value
	Cost Avoidance OPEX (CA)	8,435
	Cost Avoidance CAPEX (CA)	0
	Budget Savings CAPEX (CA)	0
	Budget Savings OPEX (CA)	0
	Revenue Impact (CA)	0
	Public Safety Risk	0
	Employee Productivity (CA)	0
	Total Investment Cost (CA)	(11,719)
Total		(3,284)

Report Generation Date: 6/2/2022

 Investment Summary Report	Investment Code 736942	Report Start Year 2023	Number of Years 10
	Investment Name		
	Contract Market Systems - Technology Obsolescence		

Investment Description

Issue/Concern/Opportunity:
This project will consolidate the contracting, gas management/nominations and billing applications at EGI. The Contract to Cash processes are currently using aging and disparate systems for groups such as Large Volume Contracting, Gas Supply and Storage and Transmission Sales. This new platform and integrated systems will then enable Rate and Service Harmonization (if approved) and further enhance the customer experience, and reduce total cost of ownership.

Justification: Many of these systems are 20-30 years old and are built using technology that is or will become unsupported in the near future and requires upgrading. Failure to refresh aging systems and applications puts our business at risk with an increased chance of service outages, degraded performance, business and customer interruptions, increased costs, difficulty in acquiring support and ability to address cybersecurity risks.

Assets: Legacy (EGD&Union) Contract Management and Billing (EnTrac, URICA, ConTrax) and associated Legacy (LEGD&LUG) Gas Management systems (CARE, Enerline) will be replaced and/or modified by SAP modules and decommissioned (EGI may still retain this system name/brand for the customer facing portal, even if the underlying technology is replaced). New system integrations with CIS/SAP/Oracle/Cost of Gas, reporting, and data warehouse are examples of additional changes and systems impacted.

Related Investments: Contract Market Harmonization Project #102291

Recommended Alternative Description

Scope of Work:
Legacy (LEGD&LUG) Contract Management and Billing (EnTrac, URICA, ConTrax) and associated Legacy (LEGD&LUG) Gas Management systems (CARE, Enerline) will be replaced and/or modified by SAP modules and decommissioned. New system integrations with CIS/SAP/Oracle, reporting, and data warehouse are examples of additional changes and systems impacted.

TIS benefits:
-Improved support and sustainment and cyber security.
- Decommissioning of servers and legacy applications.
- Reduced complexity and total cost of ownership for Contract and Gas Management systems and support

Business Benefits:
- Alignment, simplification and automation of business processes
- Easier to train staff, one set of unified processes and procedures
- Reduction in testing efforts, eliminating multiple systems and applications
- Improved customer experience and ease of use when transacting with Enbridge systems
- Reduced chance of service outages and degraded system performance

Resources: Customer Care Large Volume SME's, Energy Services Gas Management SME's, Finance, TIS SME's, Enterprise Architect, Data and Analytics Arch, Network and Security, Change Management, Project Manager, System Integrator, (Legal, Finance, Regulatory SME's as required)

Solution Impact: This project is required to align disparate and aging systems which must be replaced in order to ensure that contract market customers can continue to transact. Without this project, transactions such as contracting, gas management, and billing are at risk of service outage, degraded performance, cyber security risk, and increased cost of sustainment. This project also delivers a modernized technology platform that will enable the Contract Market Harmonization project which implements the proposed harmonized rates and services for the contract market. The implementation of this project and the Contract Market Harmonization project will deliver improved customer experience, simplified processes and aligned services on a modernized and reliable technology platform.

Project Timing & Execution Risks:
Timing- Project activities are expected to start in 2023, with the teams proving out the technology, and process mining tools, and reviewing business processes for standardization. An Request For Proposal (RFP) will be developed and selection the System Integrator (SI) for a project implementation date in 2026.

Risks- Competing priorities and resource constraints, continuity of resources on the project team to help mitigate schedule impacts for knowledge gaps (current state/future state, design/testing) and any potential rework as a result.


Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - TIS - TIS Business Solutions
Investment Stage	Initial		

Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	00 - Head Office
	Asset Program (EGI)	TIS Business Solutions
	Asset Class (EGI)	TIS
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	Yes
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name									Net Base Capex O (CA)	
Contract Market Systems - Technology Obsolescence									\$	53,240,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 7,450,000	\$ 17,830,000	\$ 17,830,000	\$ 10,130,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

 Investment Summary Report	Investment Code 736081	Report Start Year 2023	Number of Years 10
	Investment Name		
	General Service Rebasing Changes		

Investment Description

Issue/Concern/Opportunity: The OEB MAADs decision specified that EGI shall file a proposal for rate harmonization in its next rebasing application. EGI believes that harmonizing rates will improve the customer experience for general service customers by simplifying rates, processes, and improved cost transparency. If the proposal filed as part of 2024 Rebasing is approved, this project will be required to implement the proposal in the EGI systems listed below.

Assets: TIS Business Solutions. CIS-SAP, Kubra, SAP-ERP, Oracle Financials, EnTRAC, ConTrax, GDAR, MyAccount, Data Marts (BBDM, CTDS, BW, EDW, etc), Guardian, Load Gathering, Synergee, Get Connected are examples of the systems impacted.

Related Program: N/A

Recommended Alternative Description

Scope of Work: Currently, Enbridge Gas Inc. (EGI) has three different rate zones (EGD, Union South and Union North) and six general service customer classes across eight rate categories. This results in complex business and accounting processes. This project will implement changes to several EGI systems to implement a harmonized model with a single rate zone for EGI, two customer classes (rate categories – Small Demand and General Demand) and harmonized rates. This will simplify rates for customers and related business and accounting processes such as QRAM. This project will follow TIS project methodologies as developed and governed by the Project Management Office.

Benefits include improved customer experience due to simplification of rates and improved cost transparency, business process simplification resulting from one set of terms and conditions of service across entire EGI franchise area, simplification of accounting processes including QRAM, forecasting, financial reporting, and easier to administer regulatory application and OEB review processes.

Resources: Project Manager, Business Analysts, Business Systems Support Team, Customer Care SMEs, Regulatory SMEs, Finance SMEs, TIS SMEs, Energy Services SMEs, Finance SMEs Enterprise Architecture, Solutions Architecture, Data & Analytics, Report Developers, AMS provider, Solutions Integrator, Audit, Testing, Organizational Change Management (OCM)

Solution Impact: This project will implement the required changes to enable a single rate zone for EGI with two customer classes (Rate Categories – Small Demand and General Demand) and the harmonization of general service rates.

Project Timing & Execution Risks:
-Project to start no later than January 2024, with approval from the OEB of General Service Rate Harmonization. Target implementation date Q2 2025. Project milestones for design, build, test and delivery to be developed once project approved, team established, and project initiated.
-Risks include resource constraints, competing priorities, OEB approval of harmonization as submitted by EGI.


Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - TIS - TIS Business Solutions
Investment Stage	Long Term Planning		

Investment Overview

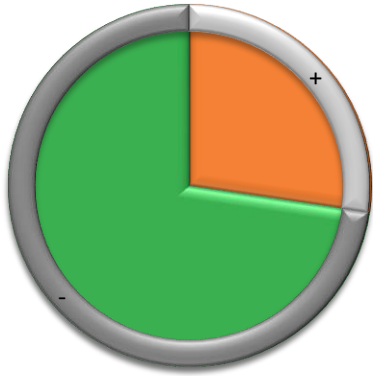
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	00 - Head Office
	Asset Program (EGI)	TIS Business Solutions
	Asset Class (EGI)	TIS
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No









Spend Profile

Name									Net Base Capex O (CA)	
General Service Rebasing Changes									\$	16,000,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ 14,000,000	\$ 2,000,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -


 Investment Summary Report	Investment Code 736081	Report Start Year 2023	Number of Years 10
	Investment Name		
	General Service Rebasing Changes		

Alternative Value - Recommended



Value Function Measure		Value
	Cost Avoidance OPEX (CA)	4,938
	Cost Avoidance CAPEX (CA)	0
	Budget Savings CAPEX (CA)	0
	Budget Savings OPEX (CA)	0
	Revenue Impact (CA)	0
	Public Safety Risk	0
	Employee Productivity (CA)	0
	Total Investment Cost (CA)	(13,123)
Total		(8,185)

Report Generation Date: 6/2/2022

 Investment Summary Report	Investment Code 102364	Report Start Year 2023	Number of Years 10
	Investment Name		
	Records Management Technology Obsolescence (2024-2026)		

Investment Description

Issue/Concern/Opportunity:
The Records Management technologies host information about EGI gas carrying asset which are critical to drive integrity and operation of these assets. In addition, the information is used by the Integrity group to determine asset condition which will inform the asset life cycle strategies used to develop the 10 year Asset Plan with focus on safe and reliable operations of EGI assets. The Records Management technologies is made up of multiple systems which will become vendor unsupported between 2024 to 2026 and requires upgrades to reduce technology complexity, cyber risk, and to enable process optimization. Failure to maintain software warranty will increase the likelihood of system failures, increase outages, degraded performance and increase vulnerability to cybersecurity attacks.

The objective of the Records Management (Asset Records) Technology Obsolescence project is to align the key systems and high level process for gas carrying asset records which are used to support Operations in performing maintenance, and construction work as well as Engineering to conduct analysis and produce asset plans. This will be enabled through the selection of an integrated suite of applications that satisfy all technical and business requirements.

Assets:
TIS Business Solutions, examples of the core systems impacted:
-ESRI ArcServer GIS (Packaged Software) 10.8 (2026 retirement)
-Hexagon GIS (Packaged Software) G/Technology (2024 retirement)
-iViewer (Custom)
-ProjectWise Connect (Packaged Software) (2024 retirement)

Related Program: N/A

Recommended Alternative Description

Scope of Work :
The scope and objective of the Records Management (Asset Records) Technology Obsolescence project is to address the technology obsolescence and align the key systems for gas carrying asset records. This will be enabled through the selection of an integrated suite of applications that satisfy all technical and business requirements. The work will consist of upgrading software to the latest supported versions as well as incorporate the opportunities to optimize business processes by leveraging new capabilities offered by the software.

The initiative will follow TIS project methodologies as developed and governed by the Project Management Office, including, signed charter and a project plan covering the activities of design, build, test and implementation.

Benefits:
EGI will be able to leverage advancements in technology which could provide further benefits in optimizing business processes. As such the following benefits are estimated: Technology savings of \$975k annual savings related to a reduction in technology, licenses, and infrastructure. Business savings are comprised of \$1,000,000 related to drafting efficiencies in Distribution Operations; \$400,000 related to Records Management team savings in Engineering & STO; \$50,000 related to efficiencies in Engineering Construction/Drafting and Capital Development; all savings have been derived using an ~8% rate reduction

Resources:
Project Managers, Enterprise Architecture, System Integrators, Operations SMEs, Asset Records SMEs, TIS SMEs, Vendor Professional Services, External Contractors

Solution Impact:
This will impact Operations and Engineering employees as well as third-party alliance partners who require asset records to perform their work. This will also impact teams within the organization that produce and manage asset records throughout the asset lifecycle, such as the Records Management team and Asset Integrity. The solution will implement the latest version of software where software bugs have been resolved and the technology would be compatible to the latest hardware thereby ensuring a more secure, reliable, and sustainable platform. With the upgrades there are advancements in software technology introducing new capabilities that will optimize business processes.


Project Timing & Execution Risks:
This project is expected to start in 2024. With design efforts starting January 2024 and in service target date of completion Dec 2026.

Risk: Competing priorities, resource constraints, and business cost pressures.

Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - TIS - TIS EGI Business Solutions
Investment Stage	Long Term Planning		

Investment Overview

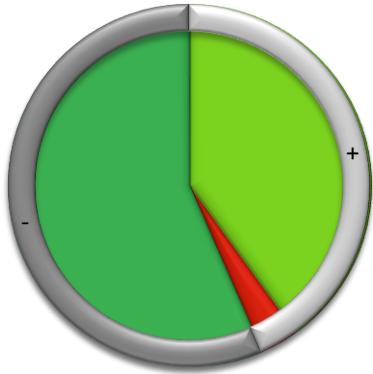
1. Project Information	State/Province	Ontario
	Operating Area (EGI)	00 - Head Office
	Asset Program (EGI)	TIS Business Solutions
	Asset Class (EGI)	TIS
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	Yes
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No









 Investment Summary Report	Investment Code 102364	Report Start Year 2023	Number of Years 10
	Investment Name		
	Records Management Technology Obsolescence (2024-2026)		


Spend Profile

Name										Net Base Capex O (CA)
Records Management Technology Obsolescence (2024-2026)										\$ 21,550,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ 4,250,000	\$ 8,650,000	\$ 8,650,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended



Value Function Measure		Value
	Budget Savings OPEX (CA)	11,549
	Public Safety Risk	979
	Cost Avoidance CAPEX (CA)	0
	Cost Avoidance OPEX (CA)	0
	Budget Savings CAPEX (CA)	0
	Revenue Impact (CA)	0
	Employee Productivity (CA)	0
	Total Investment Cost (CA)	(16,288)
Total		(3,760)

 Investment Summary Report	Investment Code 6377	Report Start Year 2023	Number of Years 10
	Investment Name		
	PCRW:Wells-Upgrade		

Investment Description

Issue/Concern:
Wells at Crowland are much older than other wells at EGI. Due to age, the wells were constructed to a production standard which would normally be retired after 10 years. Instead, the wells were converted to Storage service in the early 1970s and have continued to operate ever since. Many wells have been relined, increasing the risk of leaks. Most wells possess only two casings; the current standard requires a minimum of three casings. The two-casing design at Crowland is comprised of an inner casing that runs from the surface to the reservoir (about 225 m) plus a surface casing that runs from the surface to a depth of about 20 m. Most wells do not have an intermediate casing with cement between the inner and intermediate casings; however, there is cement between the inner casing and the surrounding rock. Should the inner casing fail, this provides a poor barrier to gas flow. In addition, none of the wells at Crowland employ wellheads and master valves. Instead, the inner casing is simply connected to a flanged 1/4 turn valve without wing valves or wellhead vents. The surface casing is separated from the surface using cement. There are no casing vents and part of the inner casing (typically a length of 2 to 16 in.) is exposed at the surface. The lack of casing vents eliminates normal approaches to controlling a failed well. Vertilogs have been performed in the last 5 years, and indicated that the inner casing integrity is adequate, although 2 of the 26 wells needed to be abandoned. Currently, there are 24 wells remaining. Bond logs have not been performed yet to determine the condition of cement at sulphur layers.

The primary concerns are:
(1) Code compliance of the wells and wellheads. Technically, these wells were constructed before CSA Z341 came into force and are grandfathered. However, a well failure would likely be viewed negatively by technical regulators.
(2) Risk to employees and the public. In the event of a loss of containment, there are insufficient barriers to gas flow. Public risk also extends to possible sulphur contamination of well water at surface levels. In addition to the wells, much of the gathering system is as old as the wells. The gathering system is operating at <30% SMYS, which means that they have not be considered for integrity inspections until recently and that the gathering system pipe condition is unknown after 50 to 100 years of operation.

Assets: Crowland wells and gathering system.

Related Programs: This investment is under consideration in conjunction with the Distribution Station #3610 Crowland Investment. Issues related to the wells and gathering system should be considered together with the additional distribution station and compressor station issues/concerns.

Recommended Alternative Description

Scope of Work:
The scope of works includes: Drilling applications and well locations studies, design, materials, core sampling, drilling of 2 new wells and wellheads / master valves to 12 existing wells, stimulating 2 new wells and 12 existing wells, and upgrading wellheads for 12 existing wells

Resources:The majority of design and installation work will be performed by third parties.

Solution Impact: Results of the core integrity testing will verify that the confining geological formations are suitable for storage, provide inputs needed to simulate the wells, abandon up to eight existing wells thereby reducing risk.

Risks Reduced:
-Loss of containment from exposed inner casing above the surface level of the well.
-Effects of well casing corrosion, where exposed to corrosive sulphur, can be mitigated more readily with modern wellheads and master valves. This limits pressurized gas leaking through the well casing and contaminating well water at surface with sulphur.
-Effects of deteriorated cement between the casing and rock can be mitigated more readily with modern wellheads and master valves. Existing cement is not resistant to the effects of sulphur and has reduced life expectancy. Compromised cement may allow well casing leaks to migrate to the surface.

Project Timing & Execution Risks:
Year 1 - permits, applications, order long lead items, testing and planning
Year 2- Construction
Year 3 - Abdonment

Risks/Assumptions:
-Project schedule is influenced by reservoir pressures, regulatory approvals, and environmental factors.
-Environmental findings may impact execution costs.
-Crowland is located in a marshy area which may impact execution and, subsequently, costs.


Investment Type	Project (EGI)	Planning Portfolio	EGD - Core - Transmission Pipe & Underground Storage - Replacements
Investment Stage	Executing		

Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	70 - Storage
	Asset Program (EGI)	TPS - Replacements
	Asset Class (EGI)	Transmission Pipe & Underground Storage
2. Compliance	Compliance Investment	Yes
	Compliance Justification & Code	CSA Z341.1-14 Section 5.8.7
3. Must Do	Must Do Investment	Yes
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name									Net Base Capex O (CA)	
PCRW:Wells-Upgrade									\$	12,780,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 8,500,000	\$ 1,750,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ 3,000,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

 Investment Summary Report	Investment Code 100699	Report Start Year 2023	Number of Years 10
	Investment Name		
	Dawn Parkway Expansion Project (Dawn-Enniskillen NPS 48)		

Investment Description

Issue/Concern: In response to increased natural gas demand growth along the Dawn Parkway System, the Kirkwall to Hamilton Expansion has a forecast in-service date of 2029 to 2030 and will provide reliable, secure, economic natural gas capacity to meet the growing design day demand of the Dawn Parkway Transmission system which serves both in- and ex-franchise markets.

Assets: Install approximately 17.2 km of NPS 48 internally-coated pipeline from Dawn Compressor Station (10G-301) to Enniskillen Valve Site (11H-301V) on the Dawn Parkway System.

Related Programs: These facilities are incremental to the Kirkwall to Hamilton Expansion (#48654) and timing is dependent on the Dawn Parkway System demands.

Recommended Alternative Description

Scope of Work: Install approximately 17.2 km of NPS 48 internally-coated pipeline from Dawn Compressor Station (10G-301) to Enniskillen Valve Site (11H-301V) on the Dawn Parkway System.

Resources: Projects group to provide project management support from design and planning phase to project execution.

Solution Impact: Capacity is available on the Dawn Parkway System to meet in-franchise growth and customer demand.

Project Timing & Execution Risks:

- Schedule delays due to right-of-way access for survey, ladn aquisition, environmental studies, permitting, and/or issuance of OEB Leave to Construct may put at risk the planned in-service date.
- Further analysis for potential IRPAs.
- This project will follow Kirkwall to Hamilton (48654). It will be based upon studies done by the Transmission System Planning identifying a need for expansion based upon the demands from the study.
- Estimate/ Forecast does not include MOP Upgrade or Dawn Station Work.


Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Transmission Pipe & Underground Storage - Growth
Investment Stage	Long Term Planning		

Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_04 - London
	Asset Program (EGI)	TPS - Growth
	Asset Class (EGI)	Transmission Pipe & Underground Storage
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	Yes
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name										Net Base Capex O (CA)	
Dawn Parkway Expansion Project (Dawn-Enniskillen NPS 48)										\$	246,634,252
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Base CAPEX O	\$ -	\$ -	\$ -	\$ -	\$ 24,612,151	\$ 49,222,260	\$ 148,187,690	\$ 24,612,151	\$ -	\$ -	
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
										Report Generation Date: 5/30/2022	

<div></div> <div>Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	48654	2023	10
	Investment Name		
	Dawn Parkway Expansion Project (Kirkwall-Hamilton NPS 48)		

Investment Description

Issue/Concern: In response to increased natural gas demand growth along the Dawn Parkway System, the Kirkwall to Hamilton Expansion has a forecast in-service date of November 1, 2026 and will provide reliable, secure, economic natural gas capacity to meet the growing design day demand of the Dawn Parkway Transmission system which serves both in- and ex-franchise markets.

Assets: The Kirkwall-Hamilton Expansion Project consists of 10.2 km of NPS 48 pipeline from the Kirkwall Valve Site to the Hamilton Valve Site.

Related Programs: N/A

Recommended Alternative Description

Scope of Work: System installation of approximately 10.2 km of NPS 48 internally-coated pipeline from Kirkwall Valve Site (17V-302) to Hamilton Valve Site (18W-601V) on the Dawn Parkway System.

Resources: Projects group to provide project management support from design and planning phase to project execution.

Solution Impact: Capacity is available on the Dawn Parkway System to meet in-franchise growth and customer demand.

Project Timing & Execution Risks: In March 2021, this project was pushed out to 2025 and is forecast for November 1, 2026 in-service date. This project was filed with the Ontario Energy Board (OEB); but due to the global pandemic, there was demand uncertainty and the project ultimately was paused. Further analysis for potential IRPAs. Schedule delays due to right-of-way access for survey, environmental studies, land acquisition. permitting, and/or issuance of OEB Leave to Construct may put at risk the planned in-service date.

Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Transmission Pipe & Underground Storage - Growth
Investment Stage	Executing		


Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_16 - Hamilton
	Asset Program (EGI)	TPS - Growth
	Asset Class (EGI)	Transmission Pipe & Underground Storage
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	Yes
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name									Net Base Capex O (CA)	
Dawn Parkway Expansion Project (Kirkwall-Hamilton NPS 48)									\$	192,008,405
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ -	\$ 19,000,000	\$ 38,247,415	\$ 115,027,169	\$ 16,000,000	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Report Generation Date: 5/30/2022

 Investment Summary Report	Investment Code 49758	Report Start Year 2023	Number of Years 10
	Investment Name		
	Panhandle Regional Expansion Project		

Investment Description

Issue/Concern:
To provide reliable, secure, and affordable natural gas supply to meet the growth in Design Day demand of the Panhandle System:

- Assets:
- i. Dawn Yard: 700 m of 8960 kPa MOP NPS42 station header is required to maintain the maximum sustainable pressure on design day. This header will also provide operational flexibility and security of supply to the Panhandle system.
 - ii. Panhandle Take-off Station: The existing station will be modified to meet the new system capacity demand requiring measurement, odourization and regulation assets.
 - iii. Dover Transmission Station: This existing regulating station will be modified to connect the new NPS 36 pipeline to the upstream system. Flow measurement equipment will also be added to the station.
 - iv. Panhandle Loop : 19 km of NPS 36 6040 kPag MOP pipeline will parallel the NPS 20 from Dover Transmission station to a new valve site at Richardson Sideroad.
 - v. Richardson Sideroad Valve Site: A new valve site is required at the end of the NPS 36 Panhandle loop to connect to the existing NPS20 mainline. Isolation valves and launcher/receiver facilities will be installed at this location.

Related Programs: Other PREP Investments: #735972 & 736923

Recommended Alternative Description

1. Scope: To provide reliable, secure, and affordable natural gas supply to meet the growth in Design Day demand of the Panhandle System:
- i. Dawn Yard: 700 m ofNPS 42 8960 kPa MOP station header is required to maintain the maximum sustainable pressure on design day. This header will also provide operational flexibility and security of supply to the Panhandle system.
- ii. Panhandle Take-off Station: The existing station will be modified to meet the new system capacity demand requiring measurement, odourization and regulation assets.
- iii. Dover Transmission Station: This existing regulating station will be modified to connect the new NPS 36 pipeline to the upstream system. Flow measurement equipment will also be added to the station.
- iv. Panhandle Loop : 19 km of 6040 kPag MOP NPS36 pipeline will parallel the NPS 20 from Dover Transmission station to a new valve site at Richardson Sideroad.
- v. Richardson Sideroad Valve Site: A new valve site is required at the end of the NPS 36 Panhandle loop to connect to the existing NPS20 mainline. Isolation valves and launcher/receiver facilities will be installed at this location.
2. Resources:
This project will be internally managed by EGI staff. Construction work, such as well drilling and new pool piping installation, will be performed by contractors.
3. Solution Impact:
Expansion of the Panhandle system provides customers with increased access to diversity, reliability and security of supply of the Dawn Hub.
4. Project Timing & Execution Risks:
This project starts 2021 with its feasibility endorsed in Q2 2022. Construction will commence in 2023 . The expected in-service date is Fall 2023.


Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Transmission Pipe & Underground Storage - Growth
Investment Stage	Executing		

Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_02 - Chatham
	Asset Program (EGI)	TPS - Growth
	Asset Class (EGI)	Transmission Pipe & Underground Storage
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	Yes
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name										Net Base Capex O (CA)
Panhandle Regional Expansion Project										\$ 197,451,236
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 167,263,803	\$ 8,592,570	\$ 67,613	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Report Generation Date:										5/30/2022

 Investment Summary Report	Investment Code 736923	Report Start Year 2023	Number of Years 10
	Investment Name		
	Panhandle Regional Expansion Project - Leamington Interconnect		

Investment Description

Issue/Concern/Opportunity:
To provide reliable, secure, and affordable natural gas supply to meet the growth in Design Day demand of the Panhandle System,

Assets:

i) Leamington Interconnect : 12 km of 6040 kPag MOP NPS16 pipeline connecting the Leamington North Line, Leamington North Loop, Mersea Line and Kingsville East Line.

ii. Leamington Interconnect Valve Sites: Three new valve sites with isolation valves are required to connect to each of the existing laterals (1. Leamington North Line and Leamington North Loop, 2. Mersea Line and 3. Kingsville East Line). Launcher/receiver facilities will be installed at location 1 and 3.

Related Program: Not Applicable

Recommended Alternative Description

1. Scope Install approximately 11 km of NPS 16 connecting Kingsville East Line, Mersea Line and the Leamington North Lines.

Reinforcement projects broadly involve the installation of new or modification of existing gas distribution assets to maintain minimum required system pressure, maintain capacity, and meet customer demand. These projects are primarily driven by customer growth and system reliability considerations. Failure to implement reinforcement projects in a timely manner could lead to a potential inability to support increasing demands of existing customers and the addition of future customers.

2. Resources:
This project will be internally managed by EGI staff. Construction work, such as well drilling and new pool piping installation, will be performed by contractors.

3. Solution Impact:
Expansion of the Panhandle system provides customers in the Leamington and Kingsville area with increased access to diversity, reliability and security of supply of the Dawn Hub.

4. Project Timing & Execution Risks:
This project starts 2021 with its feasibility endorsed in Q2 2022. Construction will commence in 2024 . The expected in-service date is Fall 2024.

Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Transmission Pipe & Underground Storage - Growth
Investment Stage	Executing		


Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_01 - Windsor
	Asset Program (EGI)	TPS - Growth
	Asset Class (EGI)	Transmission Pipe & Underground Storage
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	Yes
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name									Net Base Capex O (CA)	
Panhandle Regional Expansion Project - Leamington Interconnect									\$	55,278,330
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 12,242,784	\$ 39,598,802	\$ 3,047,378	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Report Generation Date: 6/2/2022

<div> Investment Summary Report</div>	Investment Code	Report Start Year	Number of Years
	100086	2023	10
	Investment Name		
	Panhandle Line Replacement		

Investment Description

Issue/Concern:
Enbridge Gas Inc.'s (EGI's) Integrity Management team initiated work in 2019 to better understand the risk associated with the two NPS12 crossings that connect the Panhandle Eastern System owned and operated by Energy Transfer in Michigan with the EGI system in Ontario. These two crossings, installed in 1947, have never been internally inspected to check for the presence of the primary threat of internal corrosion; such inspection cannot be achieved given the configuration of the asset. A risk assessment was recently completed for the river crossings. The risk owner and risk approver reviewed the risk results and have decided the risk requires treatment with a permanent solution.

Assets: Transmission Pipeline (Canada Energy Regulator-regulated crossing)

Related Programs: N/A

Recommended Alternative Description

Scope of Work: Replacement of the twin NPS 12 Crossings with a single pipeline of equivalent capacity.

Resources: Projects group to provide project management support from design and planning phase to project execution.

Solution Impact: The principal risk is the lack of In-line Inspection (ILI) data needed to inform effective decision-making to mitigate a potential loss of pipeline containment (i.e., leak). Replacement with a new single pipeline, designed, manufactured and constructed to current standards that is ILI-capable can address this risk.

Project Timing & Execution Risks: Original in-service date is estimated to be Q3 2024. Overall project schedule is highly dependent on regulatory process and discussion with joint partner (Energy Transfer).

Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Transmission Pipe & Underground Storage - Replacements
Investment Stage	Executing		

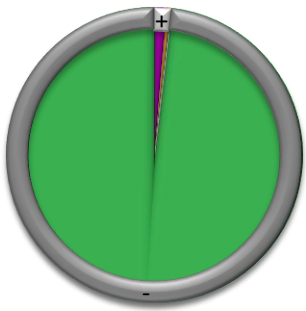
Investment Overview







1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_01 - Windsor
	Asset Program (EGI)	TPS - Replacements
	Asset Class (EGI)	Transmission Pipe & Underground Storage
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	No
	Intolerable Risk (EGI)	Yes
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No


Spend Profile

Name									Net Base Capex O (CA)	
Panhandle Line Replacement									\$	29,809,389
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Base CAPEX O	\$ 1,619,900	\$ 24,257,660	\$ 3,392,719	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Alternative Value - Recommended



Value Function Measure		Value
	Financial Risk	305
	Environmental Risk And Remediation	105
	Reputational Risk	46
	Operational Risk	6
	Public Safety Risk	0
	Total Investment Cost (CA)	(24,613)
Total		(24,152)

 Investment Summary Report	Investment Code 735972	Report Start Year 2023	Number of Years 10
	Investment Name		
	PREP: NPS 36 looping to Comber Transmission		

Investment Description

Issue/Concern:
Panhandle System expansion is driven by in-franchise growth in Chatham-Kent, Windsor-Essex and surrounding areas, including the fast-growing greenhouse market in the Leamington/Kingsville area. Based on the current forecast for in-franchise general service and contract growth in the Panhandle Transmission System market, EGI has determined that the next Panhandle facilities for expansion will need to be in place as early as the 2028 to 2029 winter season (construction beginning in 2028). These facilities are incremental to the Panhandle Regional Expansion Project and timing is dependent on the Panhandle System demands.

Assets:
Install approximately 12 km of NPS 36 pipeline from Richardson sideroad, looping the existing Panhandle NPS 20 pipeline to Comber Transmission Station (05E-403).

Recommended Alternative Description

Scope
To provide reliable, secure, and affordable natural gas supply to meet the growth in Design Day demand of the Panhandle System by installing approximately 12 km of NPS 36 pipeline from Richardson Sideroad, looping the existing Panhandle NPS 20 pipeline to Comber Transmission Station (05E-403).

Resources
This project will be internally managed by EGI staff. Construction work, such as well drilling and new pool piping installation, will be performed by contractors.

Solution Impact
Expansion of the Panhandle system will provide customers with increased access to diversity, reliability and security of supply of the Dawn Hub.

Project Timing & Execution Risks
This project starts in 2026 with its feasibility endorsed in Q2 2027. Construction will commence in 2028. The expected in-service date is Fall 2028.

Investment Type	Project (EGI)	Planning Portfolio	UG - Core - Transmission Pipe & Underground Storage - Growth
Investment Stage	Long Term Planning		

Investment Overview

1. Project Information	State/Province	Ontario
	Operating Area (EGI)	Div_02 - Chatham
	Asset Program (EGI)	TPS - Growth
	Asset Class (EGI)	Transmission Pipe & Underground Storage
2. Compliance	Compliance Investment	No
	Compliance Justification & Code	
3. Must Do	Must Do Investment	Yes
	Intolerable Risk (EGI)	No
	Third Party Relocation (EGI)	No
	Program work with sufficient history and risk to warrant continuation (EGI)	No

Spend Profile

Name										Net Base Capex O (CA)	
PREP: NPS 36 looping to Comber Transmission										\$	70,000,000
Account Type	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Base CAPEX O	\$ -	\$ -	\$ -	\$ 7,000,000	\$ 14,000,000	\$ 42,000,000	\$ 7,000,000	\$ -	\$ -	\$ -	
Contributions	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Dismantlement	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Report Generation Date: 5/30/2022											

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 66

Preamble:

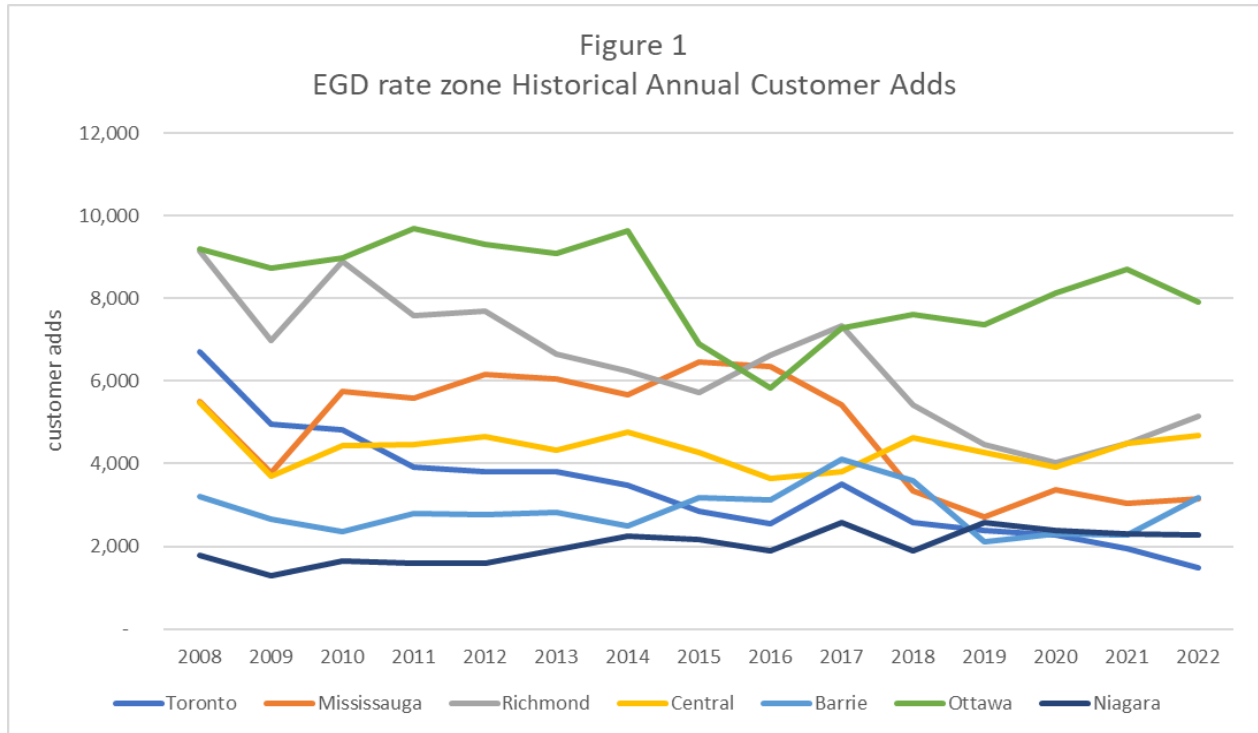
Figure 5.1-2 graphically presents the Customer Growth Forecast. We would like to understand the scale of the Ottawa growth relative to other regional areas.

Question(s):

Please provide EGI's perspective on why the Ottawa region is more than twice other regions.

Response:

The customer additions forecast for the Ottawa region relative to other regions in EGD rate zone is consistent with the historical trend as shown in Figure 1. The Ottawa region continues to experience higher growth relative to the other regions in the EGD rate zone. In recent years, the scale of growth for the Ottawa region sits at about double or more relative to the other regions.



ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 68

Preamble:

Figures 5.1-4 and 5.1-5 graphically represent the growth forecast by customer type for the respective rate zones. We would like to understand the substantial difference in the forecast of multi-family growth between the EGD zone at 4% and the Union zone at 29%.

Question(s):

Please provide EGI's perspective on the drivers behind the difference in growth of the multi-family growth forecasts.

Response:

Historically in the Union rate zones, the residential sector has had higher customer growth in multi-family apartments compared to single family homes. This trend is the opposite in the EGD rate zone which exhibits higher growth in single family homes compared to multi-family units. The total annual customer growth in the Union rate zones is approximately 15,000, which is much lower compared to 27,000 customers in the EGD rate zone. The pie charts in Figures 5.1-4 and 5.1-5 show the percentage of multi-family to total forecasted customer growth. Since the Union rate zones have an overall smaller customer base they yield a higher percentage of customer growth in that segment (23.5%) compared to EGD rate zone that has a larger customer base which results in lower growth by proportion (4%).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 85

Preamble:

EGI evidence states: *The risks associated with these pipelines are mitigated through the TIMP by identifying and remediating (as required) pipeline defects prior to failure. These inspections allow EGI to determine whether a pipeline is fit for service and provide quantitative data that can be used to forecast maintenance activities, inform models and the expected life of the asset. Understanding pipeline condition allows EGI to make informed decisions on service life **extensions**.* (emphasis added)

Question(s):

Please provide a summary of some significant initiatives being undertaken and the number and cost of resources being invested in developing approaches to generate service life extensions.

Response:

In order to maintain safe and reliable operations, the TIMP aims to proactively remediate pipeline defects to prevent a potential failure. Pipeline defects can generally be detected and sized through such inspections. Enbridge Gas continues to retrofit some pipelines initially assessed through direct assessment methods, among others, to accommodate ILI tools and improve integrity assessment completeness and accuracy. In-line inspections provide the most comprehensive data for certain types of integrity conditions and are considered best-in-class for integrity management in the pipeline industry. By investing in in-line inspection projects, remediation of targeted sections of assets can be undertaken in a timely manner, when needed, thereby extending the useful life of the assets while maintaining their safety and operational reliability. Personnel supporting pipeline retrofit efforts and integrity excavations work under various functions across Enbridge Gas since they perform many duties in addition to the TIMP (e.g., Engineering, System Improvement, Integrity, Operations, Finance). For this reason, determining the number of resources dedicated to a specific task, which varies in complexity and scope from year to year, will not result in an accurate estimate.

Please see Exhibit 2, Tab 6, Schedule 2, pages 119 and 202 for the costs associated with pipeline retrofits and integrity digs.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 97-98

Preamble:

Figure 5.2-28 and 5.2-29 graphically present the Historical Steel Main Corrosion Leaks (Post-1970) for EGD and Union respectively. We would like to understand how initiatives throughout the deferred rebasing period have contributed to improvements.

Question(s):

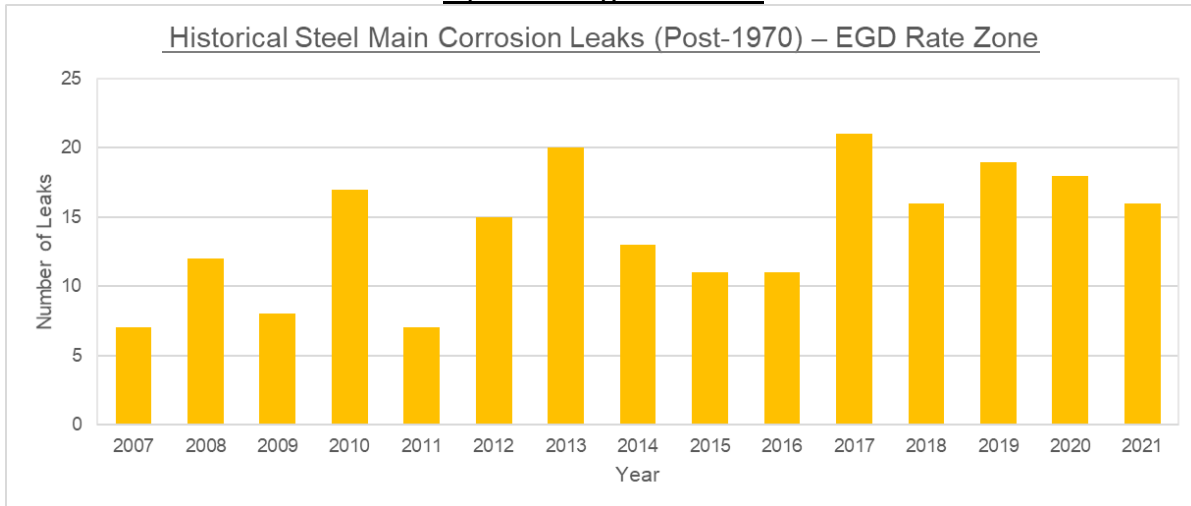
Please update and re-present the figures to include data from 2020, 2021 and 2022.

- a) Please provide a list of initiatives and incremental investment in the remediation of these systems to reduce the number of leaks.

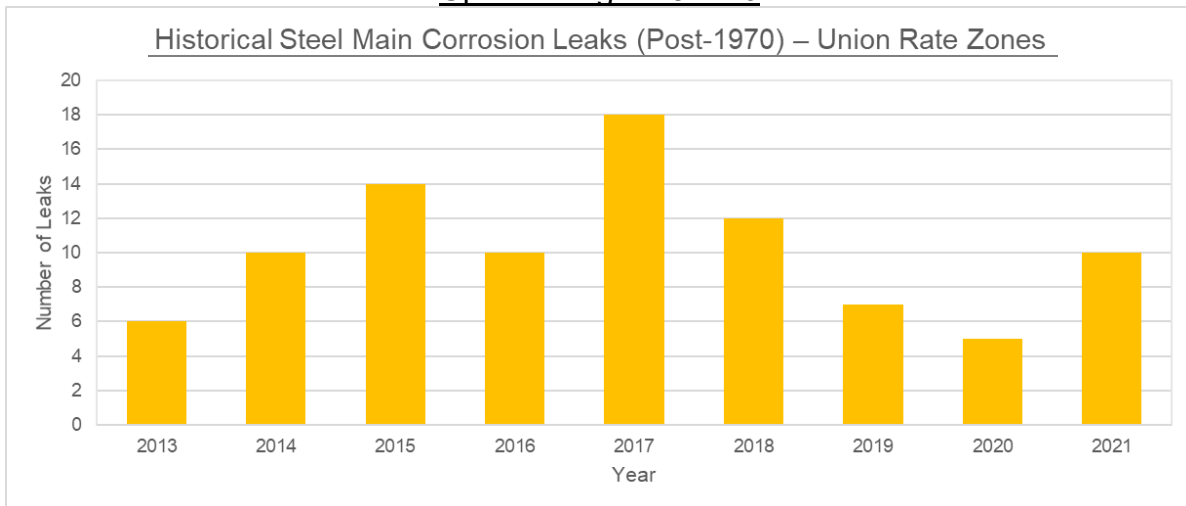
Response:

Please see below for the requested updates to Figure 5.2-28 and Figure 5.2-29. Both figures have been updated to include data for 2020 and 2021. However, 2022 is not included in these updated figures as the requested data has not yet been compiled. With data from 2022 coming available in Q2 of this year, Enbridge Gas will be returning to the annual cycle for model updating, reviewing and validation to incorporate 2022 and updating projections appropriately at that time. This is intended to be completed by end of Q3 2023.

Updated Figure 5.2-28



Updated Figure 5.2-29



a) As provided at Exhibit 2, Tab 6, Schedule 2, page 116 of 288, Section 5.2.3.6.4

The preferred life cycle approach to corrosion leaks on post-1970 distribution steel pipe is to repair them as they are discovered and perform replacements for a few select mains where condition, risk and other factors cause a repair to not be viable through the Emergency Replacement Program. The number of failures for this asset subclass in the short term is considered manageable through existing approaches.

Exhibit 2, Tab 6, Schedule 2, page 82, Table 5.2.3-2 identifies Enbridge Gas's maintenance strategies to reduce leaks.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 97-98

Preamble:

Figure 5.2-30 graphically present the Post-1970 Steel Mains Corrosion Leak Projections (2020 to 2040) for EGD and Union respectively. We would like to understand how initiatives throughout the deferred rebasing period have contributed to improvements.

Question(s):

Please update and re-present the figures including data from 2020, 2021 and 2022 including any adjustments to future years as a result of recent data.

- a) If there are no adjustments to future years, please explain why not.
- b) What investments are planned to be made to reduce the number of leaks in the 2024-2029 period?

Response:

- a) There have been no adjustments made to future years based on 2020-2022 data because this data has not yet been incorporated into the Reliability Models. The Reliability Models that generate Exhibit 2, Tab 6, Schedule 2, Figures 5.2-30 & 5.2-31, page 98, have not yet been updated to include failure data from 2020 and forward. Typically, the review process to update and validate leak models is on an annual cycle. The integration impacted 2020 to 2022 data updates as there have been significant efforts to reconcile data completeness and quality from EGD and Union to update the model effectively. In addition, through the data cleanup efforts learnings have been incorporated to provide data in a consistent way going forward. With data from 2022 coming available in Q2 of this year, Enbridge Gas will be returning to the annual cycle for model updating, reviewing and validation to incorporate 2020 to 2022 and updating projections appropriately at that time. This is intended to be completed by the end of Q3 2023.

- b) As stated in Section 5.2.3.6.4 “The preferred life cycle approach to corrosion leaks on post-1970 distribution steel pipe is to repair them as they are discovered and perform replacements under the Emergency Replacement Program for a few select mains where condition, risk and other factors cause a repair to not be viable. The number of failures for this asset subclass in the short term is considered manageable through existing approaches”. No incremental proactive investments are planned for this population subset, but ongoing work shown under Maintenance Strategy provided at Exhibit 2, Tab 6, Schedule 2, Table 5.2.3-2, page 82, will continue.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 114

Preamble:

EGI evidence on the Martin Grove Rd project states: *Depth of cover (DOC) has been identified as a significant concern for these main segments as identified by 2018 and 2019 DOC surveys that found over 52% of the survey locations had DOC less than 90 cm, with 77 survey locations measuring less than 60 cm of cover.*

We would like to understand EGI's approach to consideration of risk management for these types of projects.

Question(s):

Using both total number and percentages, please disaggregate the results of the survey into categories that define the surface condition (e.g., asphalt, cement, median cover (including grass), sidewalk, grass on the boundaries of the road allowance, etc.).

- a) How does EGI distinguish the risks associated with the respective surface conditions? Please explain fully.

Response:

The DOC survey does not distinguish survey readings based on surface condition. The requested information cannot be provided.

- a) Enbridge Gas recognizes two classifications of cover type for the purpose of risk assessment. These classifications are as follows:
- i. Wall-to-Wall – This is a hardcover from building to building which does not allow for any natural gas inventory from a loss of containment incident to vent to the atmosphere.

- ii. Not wall-to-wall – This allows any natural gas inventory from a loss of containment incident to vent to the atmosphere.

Loss of containment from a wall-to-wall hardcover has a higher probability of gas migration (below ground) to a further distance than the non-wall-to-wall cover. For Martin Grove, the cover type is 100% not wall-to-wall.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 115-117 & Appendix A, pg. 9

Preamble:

EGL evidence on p. 115 states: *Erin Township investment is replacing Aldyl-A PE pipe that is prone to slow crack growth (SCG) due to its known material and manufacturing flaws (large inner bore spherulitic structures and surface oxidation of the inner surface). The presence of stress intensification factors (for example, rock, service connections, and bend radius) can accelerate SCG and lead to loss of containment. Erin Township has seen several loss of containment Aldyl-A crack failures (see Figure 5.2-59), due to rocky soil where rocks create a stressor on the pipe that accelerates the cracking failures. This is a multi-year investment that will replace about 13.2 km of Aldyl-A mains and service pipe. See Appendix A, Pg. 9 for additional detail on this investment.*

We are trying to reconcile this above evidence with that found in Section 5.2.3.6.5.1 while striving to seek the additional information in the Appendix A reference.

Question(s):

Please provide additional information on the number of loss of containment failures by providing the number and year of these failures.

- a) Please provide a map that shows the location of these failures along the subject pipeline.
- b) Using Section 5.2.3.6.5.1, please provide some form of threshold or metrics that triggers EGL to shift from responding to loss of containment periodically to initiate the process of replacement.
- c) Please correct the reference or provide the evidence that was intended in the Appendix A reference as page 9 refers to the Wabuno Compressor.

Response:

Table 1 sets out the number and year of the referenced failures.

Table 1

Year	PUNCH TEE	PUNCH TEE CAP	Service Pipe	Main Pipe	Grand Total
2007				1	1
2012				1	1
2014				1	1
2016				1	1
2017			4		4
2018	2			1	3
2019				1	1
2020	1		2	1	4
2021			1		1
Grand Total	3		7	4	17

a) Please see the map.



- b) There is not a specific metric or trigger Enbridge Gas uses to determine that a reactive repair program is more appropriate than a pipeline replacement to address the risks associated with an asset. Enbridge Gas may employ one or more of the Risk Analysis tools provided at Exhibit 2, Tab 6, Schedule 2, page 50 of 288, Section 4.2.2 to analyze untreated Risk. Once a risk is analyzed treatment options are compared using the Value Framework in Copperleaf and other qualitative factors to evaluate replacement projects against reactive repair programs.
- c) The AMP is a stand alone document with its own page numbering. Page number 9 is the correct number with respect to page numbering used in the base document for Appendix A as shown in the bottom right-hand corner of each page. Exhibit 2, Tab 6, Schedule 2, Appendix A, page 10 is the correct reference in this Application. The page numbers assigned to Appendix A as evidence, are 1 + the page number assigned to the base document.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 115-117 & Appendix A, pg. 9

Preamble:

Figure 5.2-61: Copper (AMP-Fittings) Riser Leak Projection – Reactive vs. Proactive Strategy shows the projections going forward from 2020 to 2060.

Question(s):

Please add the last 10 years of actual data on leaks and proactive replacements.

Response:

Please see Table 1. Data for 2022 has not yet been validated and will be available later in 2023:

Table 1

Year	Replaced Leaking Copper Risers	Proactive Replacements	Grand Total
2011	456	338	794
2012	903	1304	2207
2013	1172	1684	2856
2014	490	1806	2296
2015	782	3976	4758
2016	996	5997	6993
2017	1135	7266	8401
2018	1344	3715	5059
2019	1226	6017	7243
2020	1383	2022	3405
2021	989	4583	5572
Grand Total	10876	38708	49584

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 128

Preamble:

EGI evidence states: *Under-pressure Event: Under-pressure at a station can lead to loss of service for customers. This is of particular concern for industrial customers, who expect a reliable natural gas supply for processes, and other customers for heating needs during colder periods. Stations approaching design capacity could experience under-pressure situations, loss of service to customers and station equipment performing beyond recommended operating limits.*

Question(s):

Please confirm that a gate station that is approaching its design capacity or performing beyond recommended operating limits can create a risk of loss of service.

- a) In the last 10 years, please list the gate stations that contained a large, dry gas filter that have been rebuilt and their respective age at time of replacement.
- b) Please provide a list of the ten oldest remaining gate stations whose large dry gas filter has not been replaced.

Response:

Please see Exhibit 2, Tab 6, Schedule 2, page 128, Section 5.2.4.3.3. If a station is approaching its design capacity there is a risk of loss of service due to the likelihood of experiencing an "Under-pressure Event".

- a) The EGD rate zone did not install large dry gas filters at gate stations as part of typical design practice. There was a large dry gas filter installed at the Oro-Medonte Gate station that was 19 years old when decommissioned.

The requested information is not available for the Union rate zones. In the asset information system, there is no install date but rather a 'Valid From' date, which may

not be the installed date. This field is populated when the asset is installed but would be overwritten anytime data is modified on the data record.

- b) The ten oldest remaining gate stations (subject to the data limitations identified in the response to part a)) that have large dry gas filters include:
- i. Puslinch Transmission Station
 - ii. Sandwich Transmission Station
 - iii. Owen Sound Gate Station
 - iv. Rothsay Transmission Station
 - v. Strausburg Transmission Station
 - vi. Elmira Gate Station
 - vii. PT Rowan Gate Station
 - viii. Chatham North Gate Station
 - ix. Ridgetown North Transmission Station
 - x. Dutton Gate Station

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 133

Preamble:

EGL evidence states: *The system station replacement programs are informed by condition surveys to reduce the risk of any issues observed. For example, boot-style regulators, which use a combination of a flexible boot element and gas pressure to regulate downstream flow and pressure, may be more susceptible to higher failure rates due to their design. This type of regulator station design has demonstrated susceptibility to failures caused by debris, particulates, hydrates and sulfur deposits. Adopting a new design philosophy to use alternative regulator models or including filtration minimizes the potential for downstream overpressure events.*

Question(s):

How many over-pressure events have occurred at distribution stations in each of the last 5 years?

- a) How many of those incidents have been attributed to the flexible boot (i.e., not other components such the pilot being plugged).

Response:

There are two recorded entries:

- i. Woodstock Event 23357 where there was a station overpressure that was related to a failure in the relief valve.
- ii. London Event 26692 where there was a tear in the regulator boot and the overpressure protection device fully opened to normalize the pressure with no negative impact to the downstream network.

There is a distinction between experiencing an over-pressure of the pressure control device setpoint and exceeding the downstream network Maximum Operating Pressure.

Please see Exhibit 2, Tab 6, Schedule 2, Section 5.2.4.3.3 in the “Loss of Pressure Control” section on page 128 that states: “Typically, the pressure control design includes redundancy with a method of overpressure protection to reduce the likelihood of a pressure control failure”.

a) One, as noted in ii.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 140-141

Preamble:

EGL evidence states: *A subset of the Customer Stations population are called Pressure Factor Metering (PFM) stations. Many PFMs in the Union rate zones do not have built-in bypasses or provisions for a bypass which does not allow for standard operation inspections to be performed. These installations are operationally inspected every five years and during this period the total population will be assessed. Those that require a rebuild will be identified within the next five-year window. The mitigation of this configuration will be completed before the next inspection within the following five-year window.*

Question(s):

Please explain why portable bypass equipment could not be used to allow for an inspection every 5 years versus rebuilding the station to incorporate a bypass.

Response:

Please see Exhibit 2, Tab 6, Schedule 2, Section 5.2.4.6.3.3 which states:

“Many PFMs in the Union rate zones do not have built-in bypasses or provisions for a bypass which does not allow for standard operation inspections to be performed”

Temporary bypasses cannot be installed until provision for bypass is installed. The program is intended to ensure provision for a portable bypass or a permanent bypass is installed to eliminate the need to interrupt customers during future inspections or meter changes.

The decision to install a permanent bypass over provision for temporary bypass will take into consideration the required piping configuration, benefits such as increased productivity and safety during inspections, and reduction to greenhouse gas emissions due to venting gas from temporary bypass lines.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 141

Preamble:

EGL evidence states: *The new CNG Station Strategy involves the acquisition of new large and mobile Natural Gas Transportation (NGT) and small Vehicle Refueling Appliances (VRA) station customers and the installation of the necessary fueling equipment. The timing and scope for new NGT assets are based on the likelihood of contract confirmation and historical station installations of similar size and scope. The renewal and upgrade of existing stations to ensure the continued safe, efficient, and reliable operations of all NGT stations.*

This approach includes the following activities:

- *Small NGT Stations (VRAs)*
- *Proactively replacing/rebuilding VRA compressors (~35 units per year)*
- *Proactively replacing/rebuilding remote panels (~33 units per year)*
- *Reactively replacing gas detectors as needed (~5 units per year)*

Question(s):

How were the original station installations funded?

- a) How much has been spent in each of the last 10 years on CNG stations?
- b) How much is EGL expecting to spend each year to follow this approach?
- c) Is EGL expecting to recover these costs from ratepayers?
- d) What has changed that necessitates increasing expenditures?

Response:

The original installations were included in the core portfolio.

- a) Please see Table 1 for the Enbridge Gas capital spend per year on CNG Stations from 2013 to 2022.

Table 1
CNG Stations – Capital Expenditure 2013 to 2022

\$ million	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
CNG	n/a	0.73	0.96	5.7	2.1	7.3	0.51	1.55	1.47	0.47

- b) Please see Table 2 for the Enbridge Gas forecast capital spend per year on CNG Stations from 2023 to 2032, which is also provided at Exhibit 2, Tab 6, Schedule 2, page 143, Section 5.2.4.7 in Table 5.2.4-8.

Table 2
CNG Stations – Capital Expenditures 2023 to 2032

\$ million	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
CNG	4.7	2.9	4.2	1.0	1.1	1.1	1.1	1.1	1.2	1.1

- c) Yes, Enbridge Gas has included these CNG stations as part of the core portfolio in the 10 Year AMP and in the 2024 Test Year Forecast. Please see Exhibit 2, Tab 6, Schedule 2, page 143, Section 5.2.4.7 in Table 5.2.4-8.
- d) The first three years are forecasted to have higher costs due to the installation of CNG stations at new Enbridge Gas buildings to support our Fleet requirements.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 153

Preamble:

Table 5.2.5-4 presents Meter Replacements (Historical) while Figures 5.2-78 and 5.2-79 provide Typical Causes of Non-Program Meter Exchanges. We would like to understand more about the rate zone differences seen in the data.

Question(s):

Please provide the factors which result in the variability in EGD Rate Zone Program Meter Exchanges over the years and why that variability is not seen in the Union Rate Zone.

- a) Did EGD and Union purchase the same type of meters in the period of reporting?
- b) Please explain the difference in the respective percentages for the criteria of "damaged"?

Response:

Prior to the integration of EGD and Union, the meter populations were managed differently based on the unique strategies of the two companies. Both EGD and Union met the requirements of Measurement Canada but had different goals for meter population management. Union's strategy was to level the workload year over year. EGD's strategy was to maximize the life of the meters, and adjust workload volumes as necessary, which caused the variability.

- a) EGD and Union purchased similar meters for the period of reporting, with slight variations. As an example; EGD purchased 400 series meters that measured in metric units and Union purchased 400 series meters that measured in imperial units. Another example would be that EGD would purchase pre-sealed meters from vendors, whereas Union would buy unsealed meters that would then be sealed in-house. In 2021, the purchase specifications were harmonized, and the process has

been streamlined so that meter purchases conform to the harmonized strategy.

- b) For the period captured in the referenced charts, the EGD and Union were using two different information systems, with different reason codes for the cause of the meter exchange. At EGD there were fewer reason codes, and many of the removals were attributed as “damaged”. Since 2021, reporting on meters is done within the same system, which will lead to a unified approach for reporting on unplanned meter exchanges.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 6, Schedule 2, pg. 153

Preamble:

EGI evidence states: *Customer-owned systems, as described in Section 5.2.5.1, may consist of:*

- *Customer-owned piping refers to the gas piping or tubing downstream of the meter outlet tailpiece and extending from the meter outlet to customer appliances.*
- *Service jumpers refer to a specific type of customer-owned pipe installed from an outside meter to inside the building, entering the building below ground.*

Question(s):

Under what circumstances does the CSA B149 Code allow for pipe to enter a building below ground?

- a) How does EGI ensure that Service Jumpers are sealed properly?

Response:

According to B149, piping may pass through the exterior wall of a structure either above grade or below grade. If entering below grade, a portion of the piping upstream to the entry of the underground wall must rise above grade. Additionally, a watertight seal must be provided where it passes through the exterior wall below grade. As a point of reference, piping is not allowed to pass underneath a foundation wall or a building and therefore, any below grade passage through an exterior building element would only be able to be done through a wall, and not through a floor.

- a) It is unclear if the question is referring to customer-owned or Enbridge Gas owned 'service jumpers'. Both situations are answered below.

Installation requirements for Enbridge Gas's service jumpers would be governed by CSA Z662 and not CSA B149.1, which applies only to piping that is owned by the customer, and none of the utility-owned piping.

- i. For customer-owned piping that passes below-grade, Enbridge Gas's role as the distributor is to inspect that the CSA B149.1 requirements are met. In this case to visually confirm the seal upon entry into the building interior. If not conforming to CSA B149.1, then Enbridge Gas would issue an infraction as per its duties under O. Reg. 212/01, and depending on the potential severity of the infraction, gas would either be shut off to the line, or allowed to remain on for 42 days, and if not remedied, shut off at that time.
- ii. For Enbridge Gas-owned piping that passes through a wall underground, Enbridge Gas has procedures for coring and sealing the wall. Conformance would be checked using different aspects of Enbridge Gas's management system – inspections before accepting the work and random quality management audits.

ENBRIDGE GAS INC.

Answer to Interrogatory from
London Property Management Association (LPMA)

Interrogatory

Reference:

Exhibit 2, Tab 6, Sch. 1, page 41

Question(s):

At paragraph 84 EGI states that it is not anticipating applying for ICM treatment in the 2024 to 2028 forecast years. Does EGI believe it is eligible for ICM treatment in the 2024 rebasing year?

Response:

Enbridge Gas does not believe it is eligible for ICM treatment in the 2024 rebasing year. Enbridge Gas notes that reference to forecast years for ICM treatment was incorrect. The corrected statement is that Enbridge Gas is not anticipating applying for ICM treatment in the 2025 to 2028 forecast years. Also, please see response at Exhibit I.2.6-STAFF-71.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Pollution Probe (PP)

Interrogatory

Question(s):

The OEB expects that two IRP pilot projects will be selected and deployed by the end of 2022 as proposed by Enbridge Gas [EB-2020-0091 Decision, page 9]. Please provide an update on the status of the pilot and the current schedule related to planning, approval, deployment and reporting.

Response:

Consistent with the letter filed with the OEB¹ indicating the status of the IRP Pilots, Enbridge Gas is developing a single application and supporting evidence requesting approval to invest in and implement two IRP Pilot Projects in 2023, in order to influence natural gas consumption as soon as the winter of 2023/2024. The Company expects that its IRP Pilots Application will be filed in Q2 2023. While Enbridge Gas has already initiated IRP Pilot project development, including installation or enablement of necessary measurement devices, and engagement with the affected local municipalities, local distribution companies (LDCs) and the IESO, the Company will not fully implement the Pilot Projects or request cost recovery unless and until the OEB has approved its IRP Pilots Application.

¹ EB-2022-0335, December 22, 2022.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Pollution Probe (PP)

Interrogatory

Reference:

Exhibit 4, Tab 2, Schedule 6, pages 3-4

Question(s):

Please provide a description, blending percentage and current status of the hydrogen blending examples provided by Enbridge including: Atco Gas and Pipelines Ltd (Atco Gas) in Alberta, Gazifère Inc.(Gazifère) in Québec, FortisBC Energy Inc. (FEI) in British Columbia, Southern California Gas Company and NW Natural in the U.S, Minneapolis CenterPoint Energy , New Jersey Resources, Dominion Energy Inc. in Utah, CenterPoint Energy Inc. in Minneapolis, NW Natural in Oregon and Chesapeake Utilities Corp in Florida.

Response:

Please see Attachment 1 which is based on publicly available information. Links are provided for reference. Enbridge cannot guarantee that the information provided is current beyond the date provided with each company's online information.

Blending and Contemplated Blending Projects and Status Cited

#	Company Name	Project Description	Blend Percentage	Canada	United States	Current Status	HotLink
1	Atco Gas and Pipelines Ltd.	Delivers blend of natural gas containing five per cent hydrogen by volume into a subsection of the Fort Saskatchewan natural gas distribution system]	5%	Alberta		Blending has commenced	https://gas.atco.com/en-ca/community/projects/fort-saskatchewan-hydrogen-blending-project.html#:~:text=In%20a%20first%20Dof%2Dits,distribut ion%20system%20in%20October%202022
2	Gazifère Inc.(Gazifère)	Green hydrogen produced via electrolysis will be injected into Gazifère's natural gas distribution network via a new 15-kilometre pipeline connecting the plant to the Gazifère grid.	TBD	Québec		At the planning and engineering stage	(https://www.enbridge.com/stories/2021/february/gazifere-evolugen-green-hydrogen-injection-project-gatineau-quebec) / (https://gazifere.com/en/green-hydrogen-in-gatineau-a-local-project-of-national-interest/)
3	FortisBC Energy Inc. (FEI)	Since hydrogen gas doesn't emit carbon dioxide when used for energy, adding hydrogen to FortisBC's gas system would help us further decarbonize by replacing conventional natural gas and helping us to reduce our customers' greenhouse gas emissions by 30 percent by 2030	TBD	British Columbia		At the planning and evaluation stage	https://www.fortisbc.com/news-events/stories/sustainable-energy-solutions-for-a-better-bc (https://www.fortisbc.com/news-events/stories/sustainable-energy-solutions-for-a-better-bc)
4	Chesapeake Utilities Corp (blended gas delivered to CHP)	The Eight Flags CHP hydrogen test program was intended to refine the operational practices and requirements for safe transportation and injection of hydrogen into a distribution system.	4%		Florida	Completed	Chesapeake Utilities branches into hydrogen on heels of renewable gas push S&P Global Market Intelligence (spglobal.com)
5	Southern California Gas Company	The project would initially blend 5 percent hydrogen, with a goal of gradually increasing the hydrogen blend up to 20 percent, resulting in potentially significant CO2 emissions reductions.	5%		California	Filed with regulator	https://newsroom.socalgas.com/press-release/socalgas-and-the-university-of-california-irvine-announce-hydrogen-blending-project?_ga=2.102324228.463703529.1676394666-51226548.1676394666
6	North West Natural	A 5% blend at NW Natural's state-of-the-art training facility in Sherwood, Oregon, and confirmed that it will work in our system.	5%		Oregon	Application Withdrawn	https://www.nwnatural.com/about-us/environment/clean-hydrogen
7	CenterPoint Energy	The green hydrogen produced by the system is added in low concentrations, up to five percent, to the natural gas in a low-pressure section of CenterPoint Energy's local distribution pipeline system. As a substitute for natural gas that would otherwise be used, the green hydrogen is expected to avoid approximately 1,200 tons of CO2 emissions per year.	5%		Minneapolis	In Service	CenterPoint Energy launches green hydrogen project in Minnesota CenterPoint Energy, Inc.,
8	New Jersey Resources	NJNG's Hydrogen project was completed and began producing green hydrogen in October 2021	<1%		Howell, N.J	Initial Pilot Completed	New Jersey Resources starts up 1st East Coast green hydrogen blending project S&P Global Market Intelligence (spglobal.com)
9	Dominion Energy Inc.	The company is developing multiple pilot projects to blend hydrogen into its gas distribution system, which will reduce emissions and deliver clean energy to customers. The first pilot project is underway at the company's Training Academy in Utah. The company is blending 5 percent hydrogen in a test system to learn how hydrogen works in gas lines and appliances before blending it into the larger system that serves more than 1 million gas utility customers in Utah. The company recently proposed a similar pilot in North Carolina.	5%		Utah	First phase of 3 pilots completed. Remaining 2 commenced in summer 2022. Next phase is to blend in 2023	Hydrogen: The Next Frontier of Clean Energy Dominion Energy

ENBRIDGE GAS INC.

Answer to Interrogatory from
Pollution Probe (PP)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 2, Appendix A, Page 29 – Proposed Hydrogen Study

Question(s):

- a) Please provide the scope of work for the proposed Hydrogen Study.
- b) Please explain why a hydrogen study is capital rather than O&M.

Response:

- a) Please see Exhibit 4, Tab 2, Schedule 6, pages 16 to 18 for a description of the scope of work.
- b) The capital project was initially set up to capture costs for the Hydrogen Study as the purpose of the study is to determine what changes will need to be made to Enbridge Gas's pipeline system to support the addition of hydrogen in the system. If at the end of the study, the recommendations are only a change to the operation of the gas network, the costs of this study will become O&M.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Pollution Probe (PP)

Interrogatory

Reference:

EB-2022-0200, Exhibit 2, Tab 6, Schedule 2, Page 139 (Section 5.2.4.6.1.7)

Question(s):

Please provide a copy of the RNG Strategy.

Response:

Exhibit 2, Tab 6, Schedule 2, Section 5.2.4.6.1.7 describes the Renewable Natural Gas Station Strategy. This strategy supports customer stations that allow RNG producers to inject their lower-carbon fuel into the distribution system. As provided at Exhibit 2, Tab 6, Schedule 2, page 126 of 288, Section 5.2.4.3, RNG Stations are included under Stations with Auxilliary Equipment. The strategy for these stations is provided at Exhibit 2, Tab 6, Schedule 2, page 137-138 of 288, Section 5.2.4.6.1.1.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.256

Question(s):

Please confirm that the Applicant did not consider any non-pipe alternatives prior to or during the optimization of the 10-year plan, and only implemented IRP screening and analysis after the plan had been developed. Please provide all reports, memoranda, presentations or other documents in the possession of Enbridge relating to its decision to optimize the plan without IRP.

Response:

Confirmed. Enbridge Gas did not include any non-pipe alternatives prior to or during the optimization of the 10-year Asset Management Plan (AMP). This was not possible, as the 2023 to 2032 AMP was not completed until May 2022 and this left an insufficient amount of time to do so.

There are no reports, memoranda, presentations or other documents relating to this decision except for the presentation provided to the IRP Technical Working Group ("TWG") on May 24, 2022 (IRP TWG Meeting #5, see slide 8 of Attachment 1). As noted in the meeting, Enbridge Gas completed the 2023 to 2032 AMP in May 2022, which identified the required facility projects for the next 10 years. In the noted meeting, Enbridge Gas explained the process it would use to conduct IRP assessments on the projects in the AMP. This process included three phases, and the Company noted that Phase I of the assessments would be included as Appendix B of the AMP filed in the Rebasing proceeding (subsequently provided at Exhibit 2, Tab 2, Schedule 2 in this application). Further, Enbridge Gas stated it "will continue to assess projects and update Appendix B of the AMP to include projects that have had a Phase II and III evaluation - updates to be provided via Rebasing interrogatories in 2023".

Enbridge Gas intends to file a 2025 to 2034 AMP with the OEB in October 2024. At that time, any technically and economically feasible non-pipe alternatives will be considered

prior to or as part of the AMP's optimization and resultant impacts to the capital forecast will be identified. Additionally, IRP evaluations will continue to be performed as part of the alternatives assessment for any projects requiring a leave to construct application.

IRP Technical Working Group Meeting #5

May 24, 2022

IRP Annual Report

IRP Annual Report



-
- Draft #2 of the Annual Report was issued May 9 for TWG comments
 - Enbridge Gas received comments from several TWG participants up to May 19
 - Enbridge Gas responded to the comments and edited the Annual Report where applicable
 - Discussion:
 - Outstanding concerns or comments?
 - TWG Report – approach and timing
 - Enbridge Gas will issue the Final IRP Annual Report May 26, 2022
 - Enbridge will file the IRP Annual Report on May 31, 2022

Enhanced Targeted Energy Efficiency (ETEE)

ETEE Measures of Focus for Peak Hour



Residential	Commercial	Multi-Residential	Industrial
Heating System Advancement	Heating System Advancement	Heating System Advancement	Heating System Advancement
Air Sealing	Ventilation	Ventilation	Ventilation
Whole Home Building Envelope (Wall / Attic / Basement Insulation)	Building Envelope	Building Envelope	Building Envelope

ETEE Pilot Input Assumptions



- Focus on general service customers
- Contract customers will be considered on a case-by-case basis
- Gross impact measured for IRP
- In-situ baselines
- Derating factors or IRPA oversubscription
- Testing customer rebate and participant measure uptake

IRP Pilot Discussion

IRP – Asset Management Plan Review - Update



- Enbridge Gas completed the 2023-2032 Asset Management Plan (AMP), identifying the system needs and required facility projects for the next 10 years.
- Enbridge Gas completed the IRP binary screening using the OEB approved screening criteria
- IRP will assess the AMP projects in three phases in order to meet the Rebasing evidence timelines
 - Phase I – High level assessment of whether an IRP alternative is possible for all projects
 - Phase II – Assessment of which alternatives are technically feasible for the projects
 - Phase III – Detailed assessment and development of IRPA plans where technically and economically feasible
- The results of the Phase I IRP assessments will be included in Appendix B of the AMP
- IRP will continue to assess projects and update Appendix B of the AMP to include projects that have had a Phase II and III evaluation - updates to be provided via Rebasing interrogatories in 2023

IRP – Pilot Strategy - Discussion



- In addition to screening the Asset Management Plan (AMP) project-by-project, Enbridge Gas is evaluating how projects in the AMP could be grouped and addressed through an IRPA plan that includes one or more IRP alternatives.
- Enbridge is analyzing the following project portfolios/groupings:
 - Geographical areas
 - Asset class, i.e. storage, distribution, stations, etc.
 - Need - i.e. vintage steel replacement, integrity, growth
 - Risk profile, i.e, projects with a risk profile that could allow for enhanced inspection
- Enbridge proposes that one IRP Pilot consider a “Geographical IRPA Plan” that would address multiple needs over the next 10 years within a specific area using a suite of IRP alternatives
 - Enbridge is reviewing several geographical areas and will bring potential areas/projects to the June IRP TWG meeting for review and input
 - Suite of IRP Alternatives will include supply side, demand side as well as consider enhanced inspection/integrity management
- Enbridge will continue to develop a second pilot per previous TWG discussions

For Discussion: DRAFT TWG Schedule / Next Steps



- ***June TWG Meeting:***

- *Meeting #1:* Enbridge to bring potential pilot projects, TWG to discuss and provide feedback

- ***July TWG Meetings***

- *Meeting #1:*
 - Using TWG feedback, bring revised list of potential Pilots - choose/confirm Pilot Projects
 - Enhanced Targeted Energy Efficiency (ETEE) discussion continued – applicable measures (if not yet finalized) and discussion of methodology for estimating peak hour reduction per alternative
- *Meeting #2:* Enbridge to provide/review DCF+ Study, TWG to provide feedback

- ***August TWG Meeting:***

- *Meeting #1:*
 - DCF+ Study discussion continued (if required)
 - Enbridge to provide update on Pilot Projects, TWG to provide input
- *Meeting #2:* Enbridge to provide update on Pilot Projects, TWG to provide input

For Discussion: DRAFT TWG Schedule / Next Steps



- **September TWG Meeting:**
 - *Meeting #1:* Enbridge to provide update on Pilot Projects, TWG to provide input
- ***September - December:*** Enbridge develop IRP Pilot evidence/application(s) depending on scope and timing of agreed upon pilots
- ***January 2023 - April 2023:*** Complete OEB proceedings
- **Deploy pilot projects (prior to winter 2023)**

For Discussion: Frequency of meetings for September and into 2023, should we book bi-weekly for now and determine agenda during the summer and adjust as needed?

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.256; Appendix B

Question(s):

Please confirm that Phases 3 and 4 of the St. Laurent project, for which leave to construct was denied by the OEB in EB-2020-0293, has now been rescheduled at a cost of \$118 million for 2024 and 2025. Please provide evidence that the conditions established by the OEB in its Decision with Reasons dated May 3, 2022 have been met by Enbridge.

Response:

In June 2022, Enbridge Gas initiated a Targeted Integrity Program (Program) for the St. Laurent Pipeline system to gather additional information regarding its physical condition. This was in accordance with the OEB Decision and Order, dated May 3, 2022:

...the OEB urges Enbridge Gas to thoroughly examine other alternatives such as the development and implementation of an in-line inspection and maintenance program using available modern technology, and propose appropriate action based on its findings as part of its next rebasing application...¹

The Program encompassed several integrity and operations-related activities, including leak surveys, odourant surveys, corrosion surveys, excavations, non-destructive examination, and in-line robotic inspections. This field work was executed over the third and fourth quarters of 2022.

Based on data from the in-line robotic inspection completed, Enbridge Gas identified an integrity feature that represented a material safety concern. The feature was located on the NPS 12 East/West pipeline where that pipeline passes beneath the King's Highway 417 (a busy public highway) on-ramp from St. Laurent Boulevard, adjacent to Tremblay Road. The in-line robotic inspection tool identified a series of four safety features located in close proximity to each other.

¹ EB-2020-0293 Decision and Order (May 3, 2022), pp. 3 and 23.

Immediately following the identification of the corrosion feature, Enbridge Gas activated an Emergency Operations Center (“EOC”), which is typically used to respond to emergency incidents. Given the physical condition of the existing pipeline segment, the critical location of the corrosion feature identified, and absent any remediation, had a leak occurred Enbridge Gas would have had to isolate the affected NPS 12 East/West pipeline along Tremblay Road, which directly distributes natural gas to the Department of Public Works Canada and RCMP headquarters and is also a major source of supply for thousands of customers in downtown Ottawa. If such an outage occurred during peak winter conditions, more than 10,000 customers could have been without natural gas service while the Company completed pipeline repairs, re-energized the system, and made safe/re-lit customers’ appliances.

Therefore, considering the potential extent of the metal loss identified and consequences of a system failure/outage, the EOC members developed an Emergency Response Plan and replaced (like-for-like) a new 270-meter NPS 12 segment of pipeline along Tremblay Road within City of Ottawa road allowance and abandoned the existing damaged and degraded pipeline. Furthermore, remediation work was executed in two other targeted dig locations. The output of this and other field work became an input for the ensuing Integrity Assessment, which is still being finalized by various subject matter experts at Enbridge Gas.

Throughout this period, and in accordance with the OEB’s guidance, Enbridge Gas has maintained ongoing communication with the City of Ottawa and Hydro Ottawa to pursue Integrated Resource Planning alternatives and explore different scenarios for the St. Laurent Pipeline. These conversations are currently ongoing.

Enbridge Gas is finalizing its analyses, reviews, and consultations that will determine how it intends to resolve underlying constraints and needs on the St. Laurent Pipeline. The baseline facility project included within the referenced exhibit is a placeholder. Any additional details remain undetermined at this time.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.281, 282, 288, Appendix B

Question(s):

SEC is seeking to better understand how Enbridge is applying the OEB's decision in EB-2020-0091.

- a) Please confirm that, of the 3087 projects in the optimized AMP:
- i. 809 (26.2%) were deemed not subject to any IRP process because they related to non-gas carrying investments;
 - ii. 1392 (45.1%) were screened out using binary screening
 - iii. 262 (8.5%) had as of the time of filing undergone a completed technical evaluation, and none had passed the evaluation;
 - iv. 624 (20.2%) remained to undergo technical evaluation or had the evaluation currently in progress at that time;
 - v. None have proceeded to the stage where an economic evaluation was required.
- b) Please update the above figures if further work has been done, and provide an updated Appendix B.

Response:

- a)
- i. Confirmed.
 - ii. Confirmed.
 - iii. 261 investments had a technical evaluation fully completed and none of these had passed.

iv. 625 investments remained to undergo technical evaluation or had the technical evaluation currently in progress at that time.

v. Confirmed.

b) Please see response at Exhibit I.2.6-STAFF-82 for an updated AMP Appendix B.

i. 809 (26.2%) were deemed not subject to any IRP process because they related to non-gas carrying investments.

ii. 1392 (45.1%) were screened out using binary screening.

iii. 552 (17.9%) as of this interrogatory response, have undergone a completed technical evaluation and 25 have passed the evaluation.

iv. 334 (10.8%) remain to undergo technical evaluation or have the evaluation currently in progress as of this interrogatory response. 9 of the 334 have an "On Hold" status for the technical evaluation, including 8 projects awaiting further assessment under the Enhanced Distribution Integrity Management Program (EDIMP) to confirm project scope and timing and one project with a leave-to-construct application that is currently in abeyance (the Panhandle Regional Expansion Project).

v. Projects that have passed the technical evaluation will proceed to the economic evaluation stage. No economic evaluations have been completed as of this interrogatory response.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.286

Question(s):

The AMP states that: “EGI is cognizant that there may be impacts to customer growth forecasts based on climate/carbon policies”. Please confirm that those impacts have not been taken into account in the development and optimization of the 10-year plan.

Response:

Not confirmed. The impacts of climate/carbon policies have been included in development and optimization of the 10-year plan. Exhibit 2, Tab 6, Schedule 2, page 67 states:

“Over the 10-year forecast, the number of customer connections decline when factoring in energy transition.”

Exhibit 2, Tab 6, Schedule 2, page 69 states:

“For long-range system planning, EGI uses operational input, economic factors, and energy transition assumptions (Exhibit 1, Tab 10, Schedule 4).”

Exhibit 1, Tab 10, Schedule 4, paragraph 6 outlines the sources of data and insights used to develop its energy transition assumptions. Part b) of that paragraph indicates that Enbridge Gas’s energy transition assumptions were based on:

“b) A review of current climate policies, provided at Exhibit 1, Tab 10, Schedule 3, Section 2,”

The only exception to these statements occurs within the capital forecast for customer connections provided at Exhibit 1, Tab 6, Schedule 2, page 75. The capital forecast for customer connections in the AMP is based on a forecast from 2022 that did not include

energy transition assumptions. This forecast was used as a basis for the required capital due to time constraints in preparing the optimized Asset Management Plan, and the expectation that the relative impact on required capital in the 2024 Test Year would be negligible. The impact of including energy transition assumptions on the forecast customer connections used to develop the AMP is a 0.03% reduction to the 2024 Test Year Forecast of capital expenditures for Customer Connections.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6

Question(s):

Please provide a copy of all third-party review, assessment, report, study, analysis, or similar document undertaken on behalf, and for Enbridge, since 2018, regarding a review or assessment of any material aspect of Enbridge's capital work and planning processes. This includes capital planning, project execution, project development, asset condition, needs assessment, an reliability modelling.

Response:

For the key documents in the requested categories, please see Attachment 1 for a report on Enbridge Gas's most recent Asset Maturity Assessment which addresses maturity of our capital work and planning and needs assessment processes. The report also includes assessment and findings related to other Enbridge business units (i.e., other than the regulated utility), and such information has been redacted in the report since it is not relevant to this proceeding.

Please see Attachment 2 which includes third-party assessment reports covering asset condition and reliability modelling.

Please see Attachment 3 which is a third-party review of leading practices across utilities in the area of construction capability and maturity.



Asset Management Maturity Review

Final Report (Revised)

FES0826201216CGY | 1.1

September 8, 2020

Enbridge Inc.



Final Report

Asset Management Maturity Review

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Author: Catherine Simpson, RPP, MCIP

Jacobs Consultancy Canada Inc.

245 Consumers Road, Suite 400
Toronto, Ontario M2J 1R3
Canada
T +1.416.499.9000

www.jacobs.com

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Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
0	08-31-2020	Report for staff review	C. Simpson	A. Whittaker	C. Simpson	A. Whittaker
1	09-03-2020	Final report	C. Simpson			
1.1	09-08-2020	Final report (revised)	C. Simpson			

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Appendixes

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Acronyms and Abbreviations

AIPM	Asset Investment Planning and Management
AM	asset management
AM Objective	Asset Management Objective
AM Policy	Asset Management Policy
AM Strategy	Asset Management Strategy
AMP	Asset Management Plan
BU	Business Unit
CAPEX	capital expenditure
EAM	Enterprise Asset Management
ECM	Equipment Class Manager / Management
EGD	Enbridge Gas Distribution
Enbridge	Enbridge Inc.
FP&A	Financial Planning and Analysis
GDS	Gas Distribution and Storage
GFMAM	Global Forum on Maintenance and Asset Management
GTM	Gas Transmission
IAM	Institute for Asset Management
ICS	Integrity Control Service
ILI	in-line inspection
IMS	Integrated Management System
ISO	International Standards Organization
km	kilometre(s)
LoS	Level(s) of Service
LP	Liquid Pipelines
LP MRP	Liquid Pipelines Maintenance and Reliability Program
MEC	Materials Evaluation Centre
MoC	Management of Change
O&M	Operations and Maintenance
OD	Operations & Data
OPEX	operating expenditure
PI	Pipeline Integrity
RM	Reliability Management
SAMP	Strategic Asset Management Plan
SCADA	Supervisory Control and Data Acquisition

Final Report

SME	Subject Matter Expert
SOP	Standard Operating Procedure
SP	Strategy and Planning
STO	Storage and Transmission Operations
TOM	Target Operating Model
TOTEX	Total Expenditure
UG	Union Gas

1. Introduction

Enbridge Inc. (Enbridge) retained Jacobs Consultancy Canada Inc. (Jacobs) to facilitate a series of Asset Management (AM) Target Operating Model (TOM) Reviews with the liquid pipelines (LP), gas transmission (GTM), and gas distribution and storage (GDS) Business Units (BUs). This report identifies the outcomes of these reviews, which were based upon an assessment of existing practices against globally-recognized good practice as set out in the 39 Subjects of the Global Forum on Maintenance & Asset Management (GFMAM) AM Landscape. The assessment also compares the results to the priority improvements in 18 of the 39 Subjects over Enbridge's 3-year Roadmap period.

1.1 Background

Enbridge is an energy delivery company operating across North America. With Canadian headquarters in Calgary, Alberta, Enbridge is a publicly traded company with a workforce of approximately 13,000. There are three core business areas: LP, natural gas pipelines, and utilities and power.

The LP business area operates the world's longest and most complex crude oil and liquids transportation system with approximately 27,564 kilometres (km) of active crude pipeline across North America.

The natural gas pipelines (GTM) business area connects North America's natural gas supply basins to major demand centres, in addition to liquefied natural gas and Mexico export markets. GTM and midstream pipelines cover approximately 38,375 km.

The utilities and power (GDS) business area operates North America's largest natural gas utility by volume, with 78,214 km of gas distribution mainlines, 66,787 km of gas distribution service lines, and 5,471 km of gas transmission lines. In addition, the renewable energy portfolio includes wind, solar, and geothermal projects in North America and Europe.

1.2 Target Operating Model

In early 2018, Enbridge executive leadership approved a business case to drive improvement in Enterprise Asset Management (EAM) practices and capabilities. A TOM was developed which defines a vision for EAM to confidently state "Our assets are safe, reliable, and profitable. We know it and we can prove it."

The approved business case required a step change in certain aspects of EAM over a 3-year program with continual improvement activities beyond that. Improvement plans (Roadmaps) were developed at the Enterprise and BU levels for this 3-year period based on an assessment of existing practices against global good practice, as set out in the 39 Subject Elements of the GFMAM AM Landscape. Enbridge leaders prioritized improvements in 18 of the 39 Subject Elements.

Enbridge is now in the second year of the EAM Program implementation. Executive leaders have asked for a check-in on progress to enable the LP, GTM, and GDS BUs to subsequently identify any opportunities to refocus plans and resources where applicable. This report outlines the results from the 2020 Asset Management TOM Progression Reviews.

1.3 Foundational Elements of Asset Management

Over the past few decades, the management of infrastructure assets has advanced significantly. By the early 2000s, several guidance documents had been published in Australia, New Zealand, and the United Kingdom, describing key principles for better managing infrastructure assets and providing methods for gaining the most value from those assets.

In 2014, the International Organization for Standardization (ISO) released the first international standard for AM, ISO 55000. As with other ISO standards, ISO 55000 is a “management system.” A management system is “the way in which an organization manages the inter-related parts of its business in order to achieve its objectives”¹. ISO 55000 is composed of three documents:

- 1) ISO 55000 provides an overview of the standards, AM principles, and terminology;
- 2) ISO 55001 stipulates the AM System requirements; and
- 3) ISO 55002 offers guidelines for the application of the requirements included in ISO 55001.

While organizations can eventually achieve ISO 55000 certification, most organizations are demonstrating alignment to the standard and using it to incorporate the best-in-class principles and practices to improve service and optimize investments.

In ISO 55000, AM is defined as the “coordinated activity of an organization to realize value from assets” and “involves the balancing of costs, opportunities and risks against the desired performance of assets, to achieve the organizational objectives”². As such, coordinated activities, realizing value from assets, and using risk management to balance the objective of delivering established levels of service while minimizing life cycle costs can be considered the cornerstone principles of AM.

Within a private Enterprise context, the ability to produce and sell a commodity at a profit relies upon the performance of infrastructure assets and on the application of “good practice” decision-making to utilize resources efficiently and effectively. Consequently, understanding how to define AM, how well is it being practiced, and what is “good practice” is important.

¹ International Organization for Standardization (ISO). 2019. Management system standards. Accessed July 2019. <https://www.iso.org/management-system-standards.html>.

² ISO 55000:2014 Asset management -- Overview, principles and terminology

2. The Maturity Assessment Process

Assets fundamentally exist to provide value to customers and other stakeholders, as well as the environment, and as such, AM is very much focused on understanding the connection between the assets and the service they provide, with ultimately all investment linked to either maintaining or enhancing service. In addition, people “do” AM and, therefore, the quality of AM is reliant on people, their knowledge, competence, motivation, and teamwork.

To be truly effective, AM needs to be multi-disciplinary, involving many parts of the organization including, but not limited to, leadership and management, finance, planning, engineering, and Operations and Maintenance (O&M).

Many organizations carry out maturity assessments to obtain a better understanding of their capabilities and competencies with regard to AM. There are various approaches to AM assessments. For this project, the Institute for Asset Management’s (IAM’s) SAM+ tool will be used.

2.1 SAM+ Tool

Although initially designed for PAS 55 and ISO 55000 assessments, the SAM+ tool has been updated to contain additional functionality for assessment of the 39 GFMAM Subject Elements, organized within the six Subject Areas of the AM Landscape (Figure 2-1).

These Subject Areas are aligned to the content of the following seven key requirements of ISO 55001:

- 1) Clause 4 – Context of the organization;
- 2) Clause 5 – Leadership;
- 3) Clause 6 – Planning;
- 4) Clause 7 – Support;
- 5) Clause 8 – Operation;
- 6) Clause 9 – Performance evaluation; and
- 7) Clause 10 – Improvement.

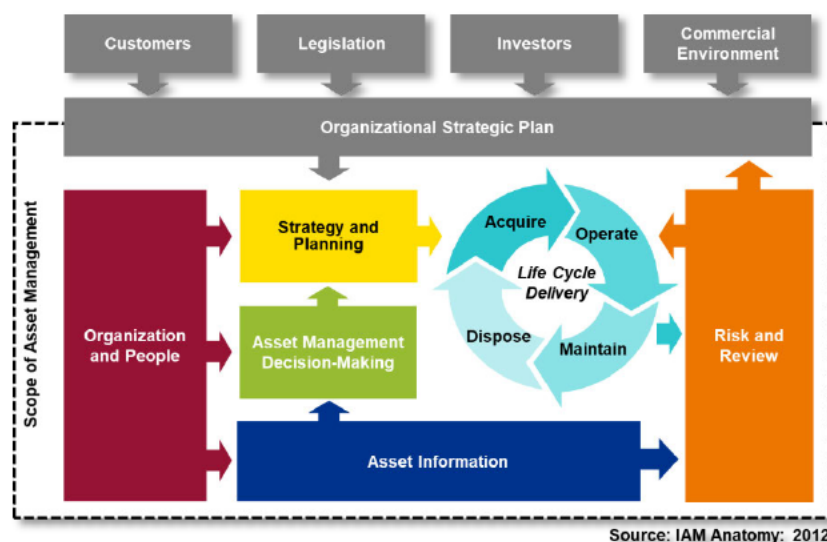


Figure 2-1. GFMAM Subject Areas

The SAM+ tool therefore aims to meet the intent of ISO 55001, however is not intended to be a formal assessment against the standard. IAM Maturity Assessment focuses on AM practices, not assets. It provides a baseline for an action plan to address key gaps, as well as identifying strengths.

2.2 Maturity Scale

Maturity is ranked on a five-point Maturity Assessment Scale (Levels 0 to 3 and beyond) as shown in Figure 2-2, where Level 3 is deemed as competent. This scale enables benchmarking and demonstrating progress, diagnosing and prioritizing the development of new capabilities, and communicating competency or excellence to stakeholders. It also serves to establish processes and habits of continual improvement with an objective basis of evidence across the many dimensions of AM.



Figure 2-2. ISO 5501 Maturity Assessment Scale

2.3 2020 Review Process

Jacobs, an IAM-endorsed assessor, was engaged to conduct the 2020 TOM Progression Reviews as follows:

- 1) **Discovery Phase** – Two documents were provided during discovery, the 2018 maturity assessment across all three BUs and the EGD maturity assessment 2017.
- 2) **Maturity Assessment** – Conducting an IAM Maturity Assessment separately for the GDS (Toronto), LP (Calgary), and GTM (Houston) BUs through a series of workshops. The objective of each assessment was to capture a single maturity level score by consensus of workshop participants for each of the 39 Subject Elements. At the workshop, the IAM SAM+ Tool was used to record and evaluate the input from the participants. For the 18 GFAM elements identified in the business case (Figure 2-3), the assessment included a progress review against the original baseline. These elements were prioritized for in-depth discussion and review. For the remaining GFAM elements, the assessment was discovery based and less intensive, as the intent was to create an initial baseline for those elements. Follow-up sessions will be held to explore additional detail, engaging additional staff where warranted.

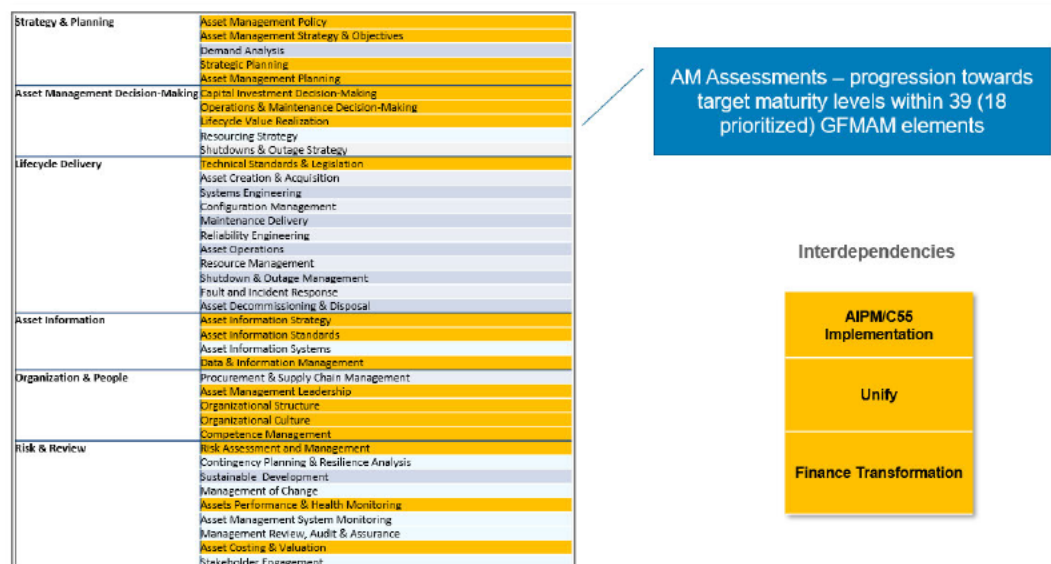


Figure 2-3. GFAM Subjects and Elements with 18 Enbridge Priorities

Final Report

- 3) **Report** – A preliminary report was prepared for each BU summarizing the workshop results. This final report was prepared to incorporate all BU results from this 2020 Review in comparison to the 2018 Review.

2.4 Workshop Schedule and Attendees

The assessment was conducted through remote delivery rather than in-person meetings due to COVID-19 protocols. A series of six preliminary workshops were held with two workshops per BU in order to divide the assessment into manageable timeslots for remote delivery. The first workshop with each BU was focused on 20 Subjects that were mostly related to Strategy and Planning (SP) while the second workshop focused on 19 Subjects that were mostly related to Operations and Data (OD). Follow-up sessions occurred to complete question sets and confirm details. The workshop schedule and attendees for each BU are presented in Table 2-1. Results from the workshop are described in Section 3.

Table 2-1. Workshop Schedule and Attendees

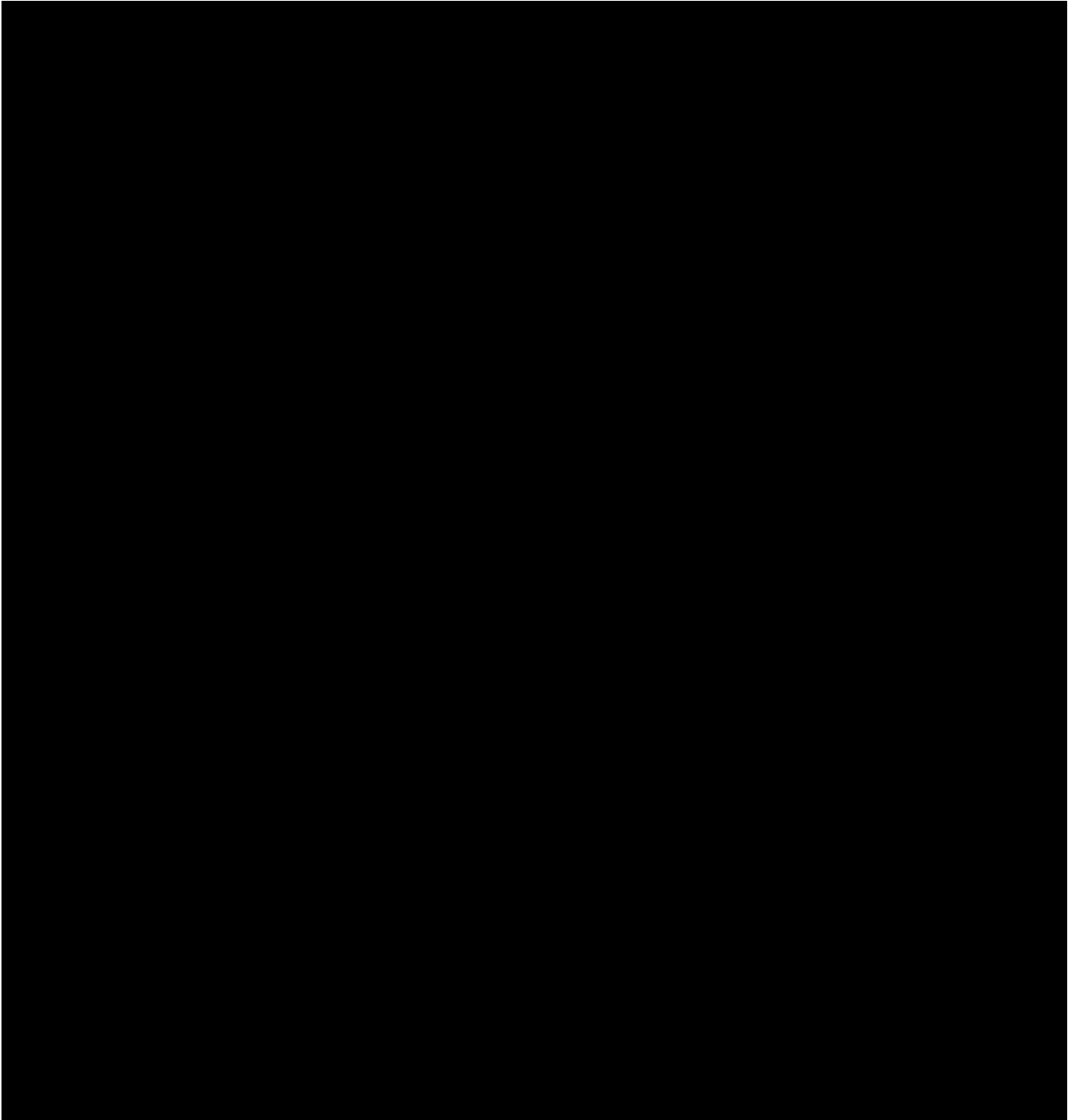
GDS			
Strategy and Planning		July 27	
Catherine McCowan, Manager Risk, SP	Michael Vettese, Specialist II AM Stations	Steve Dinopoulos, Specialist Project Plan Design	Observer: Rebecca Mayhew, EAM Governance
Danielle Turney, Specialist II AM Integration	Danielle Dreveny, Supervisor Capital FP&A	Kevin Bando, Manager Operations	
Erik Naczynski, Manager Asset Classes Distribution	Mike Hildebrand, Mgr Asset Classes Storage & Transmission	Angela Scott, Manager Integrity Management	
Operations and Data		July 28	
Catherine McCowan, Manager Risk, SP	Pamela Callow, Supervisor Process Attachment & Construction	Todd Piercey, Manager Pipeline Engineering	Observer: Rebecca Mayhew, EAM Governance
Andrew Welburn, Manager Asset Data & Information	Jim Harradine, Mgr O&M Engineering	Ahmed Nossair, Manager Stations & Utilizations Engineering	Observer: Caryn Campbell, Manager, EAM Project Management
Taylor Jones, Specialist II AM Distribution Pipe	Hugh MacMillan, Manager Fin/Law/Aff/Data/Support	Johanna Sanchez Gomez, Manager Construction	
Operations and Data Follow-up		August 17	
Catherine McCowan, Manager Risk, SP	Angela Scott, Manager Integrity Management	Andrew Welburn, Manager Asset Data & Information	Observer: Rebecca Mayhew, EAM Governance
Erik Naczynski, Manager Asset Classes Distribution	Mike Hildebrand, Manager Asset Classes Storage & Transmission		Observer: Caryn Campbell, Manager, EAM Project Management
Competence Management		August 10	
Catherine McCowan, Manager Risk, SP	Bridget Sneddon, Manager of Technical Training		Observer: Rebecca Mayhew, EAM Governance

Note:

FP&A = Financial Planning and Analysis

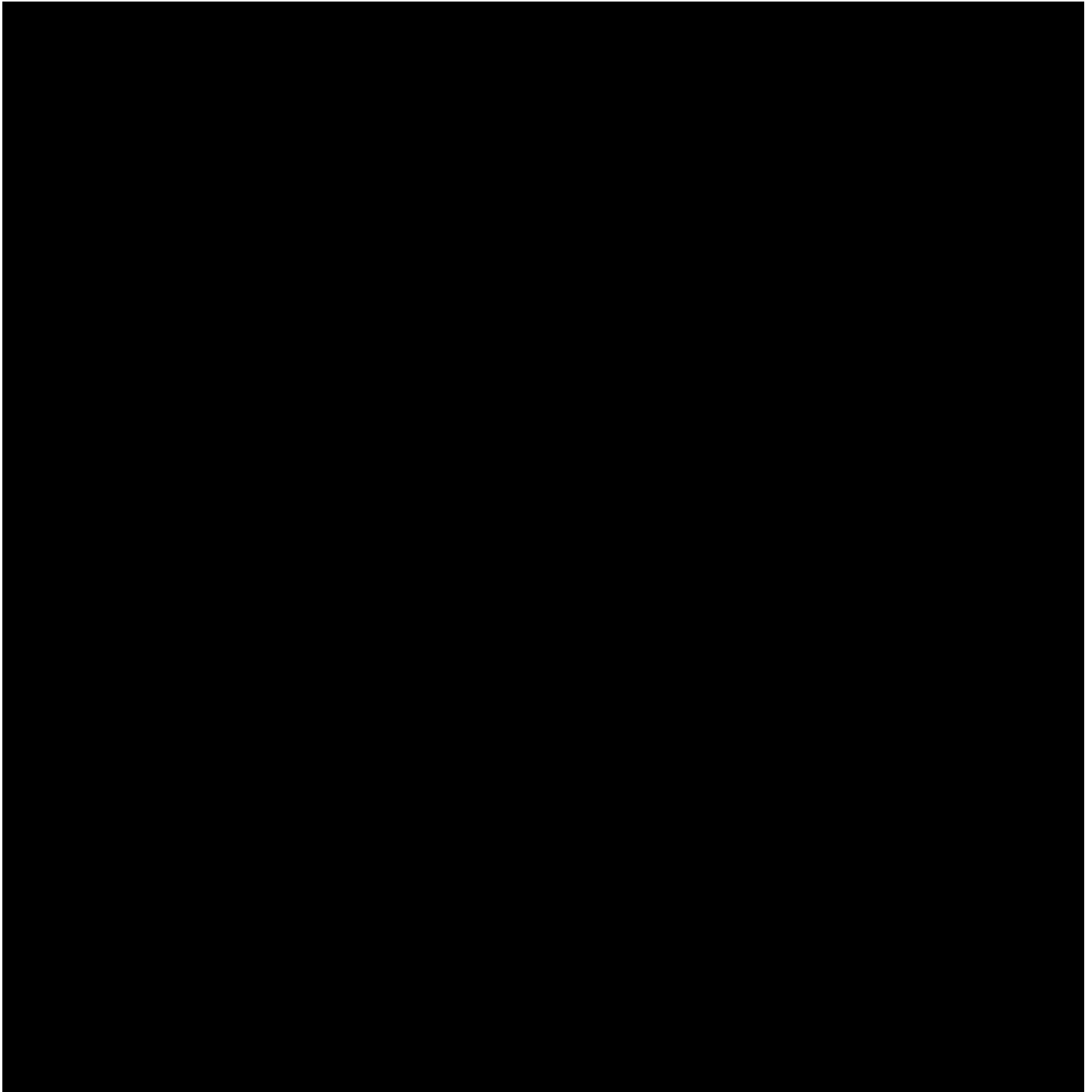
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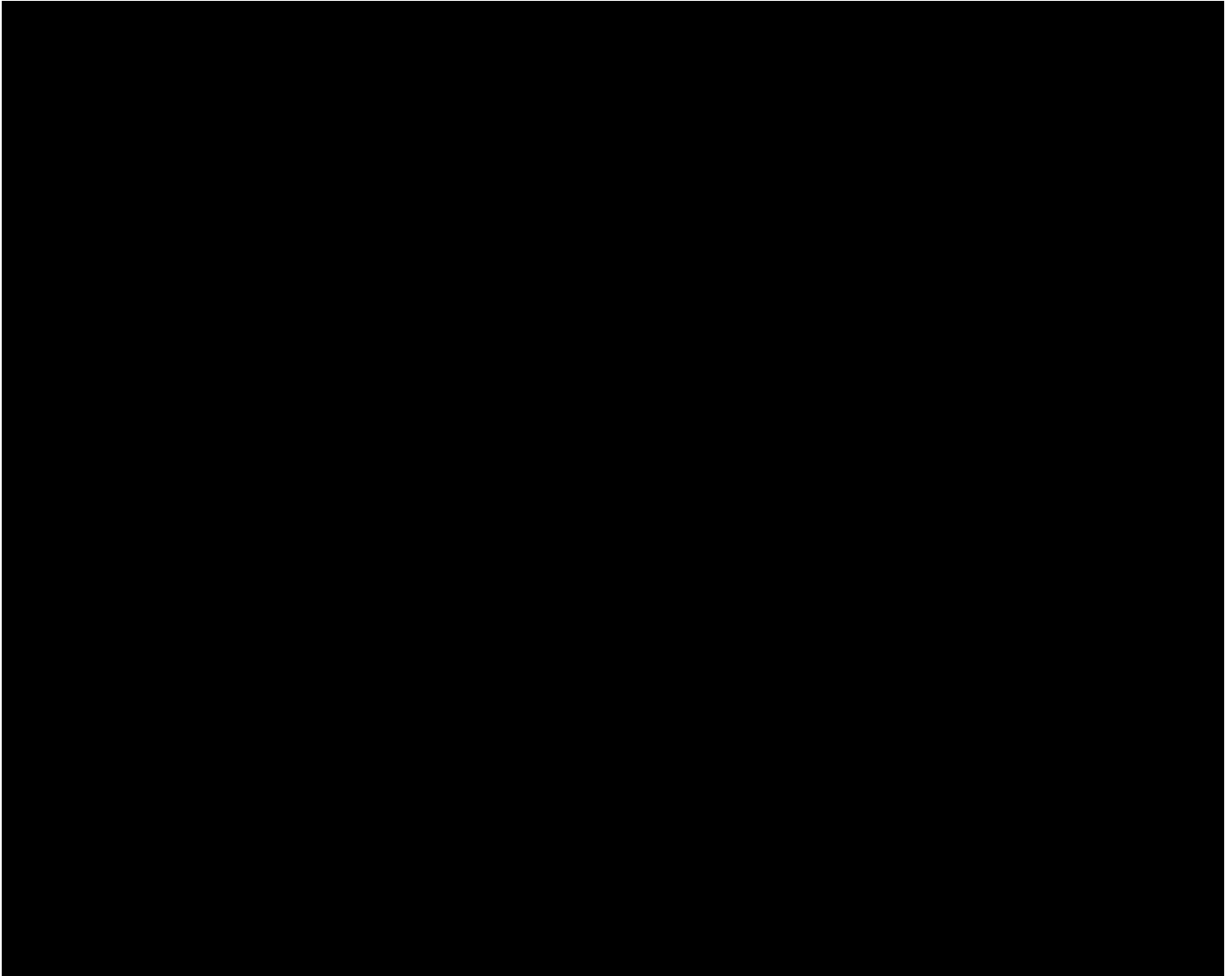
Final Report

Jacobs



Final Report

Jacobs



3. Maturity Assessment Results

Results from the 39 Subjects assessed for each BU are described as follows. Detailed workshop questions are included in Appendix A and workshop notes are included in Appendix B.

3.1 Gas Distribution and Storage Assessment Details

A total of 17 GDS staff were engaged during this process in addition to two observers from EAM. The GDS SP Workshop was held on July 27 and two OD Workshops were held on July 28 and August 17. A follow-up meeting to gather further information regarding the SP area of Competence Management was held August 10.

The 2020 results for GDS are summarized in Figure 3-1 alongside the 2018 results for the 18 Subjects previously assessed prior to integration. The 2018 results are for Enbridge Gas Distribution (EGD) and Union Gas (UG) respectively.

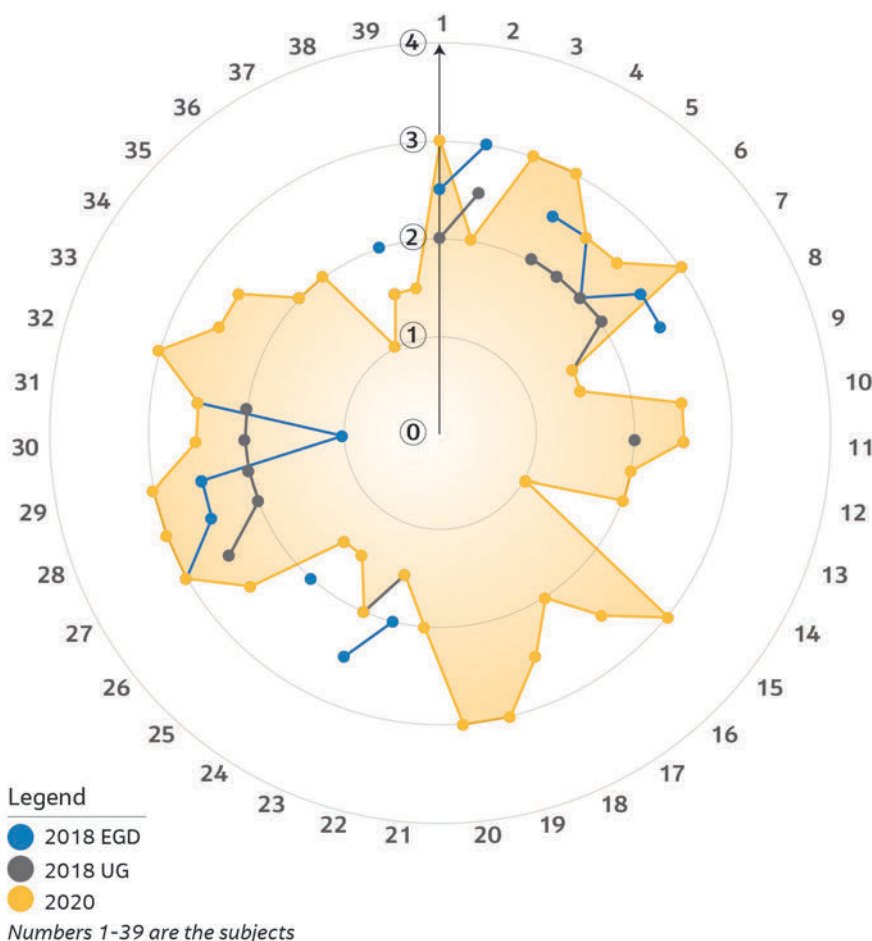


Figure 3-1. GDS Maturity in 2018 and 2020

The current maturity level has been presented for each of the 39 Subjects assessed along with a description of progress to date, rationale, and evidence.

Subject 1: Asset Management Policy (AM Policy) – The principles and mandated requirements derived from and consistent with the organizational strategic plan, providing a framework for the development and implementation of the Asset Management Strategy (AM Strategy) and the setting of the Asset Management Objectives (AM Objectives).

Maturity Level				
0	1	2	3	Beyond
			●	

An AM Policy is in place and endorsed by top management. It is updated annually to reflect organizational priorities and published for ease of access by staff across the organization as well as the public. The AM Policy is linked to the Strategic Asset Management Plan (SAMP).

While awareness of the AM Policy exists across the organization, there are opportunities for further communication and training.

Subject 2: Asset Management Strategy and Objectives – The strategic plan for the management of assets of an organization that will be used to achieve the organizational/corporate objectives.

Maturity Level				
0	1	2	3	Beyond
		●		

There is a SAMP in place, along with a Roadmap for the TOM which is a separate document. Top level objectives and performance measures are in place, however are not linked to the asset base. The extent of performance measures varies across asset classes. For example, performance measures are strong for non-gas assets and distribution assets, however other areas (such as, tying in compression reliability with criticality of specific assets) could be improved considering the criticality of the assets.

The rating for the SAMP is higher, at approximately a 2.5 while the AM Objectives are rated at 2.

There is an opportunity to promote further integration across asset classes by aligning performance measures. In addition, some required financial information is available but further work is necessary as part of the integration process in order to gain consensus on demonstrating the effectiveness of the organization as a whole. Measurability of some objectives is a challenge. There is an opportunity for stronger documentation, such as adding metrics to the TOM prior to finalizing and corporate roll-out.

Subject 3: Demand Analysis – The processes an organization uses to both assess and influence the demand for, and Level of Service (LoS) from, an organization's assets.

Maturity Level				
0	1	2	3	Beyond
			●	

There are annual processes for both planning and network analysis that re-evaluate the need for products. This includes consideration of expansion and growth projects.

Working beyond a level 3 maturity; this is an area of strength and part of the core business.

Subject 4: Strategic Planning – The processes an organization uses to conduct strategic AM planning.

Maturity Level				
0	1	2	3	Beyond
			●	

Strategic planning is being conducted in alignment with business needs and overall financial forecasts. Inputs from demand forecasts are being linked to AM. Asset plans exist for each asset class which includes a set of asset strategies (Section 5 of each plan), including documents and approaches outlining the balance being maintained between risk and safety, capital and O&M, and so forth.

And in some instances beyond this rating.

Furthermore, there are various levels of risk-based analysis being conducted on parts of the asset base. Strategic planning processes are in place for demand forecasts and to address the existing asset base. Growth is documented in addition to the need for expansion based on specific regulations (such as, the Canada Energy Regulator).

Subject 5: Asset Management Planning – The activities to develop the Asset Management Plans (AMPs) that specify the detailed activities and resources, responsibilities, and timescales and risks for the achievement of the AM Objectives.

Maturity Level				
0	1	2	3	Beyond

Strong.

An AMP exists and the latest edition will be published in August 2020. AMPs are a regulatory requirement. Asset managers review the AMP with executing groups to verify their ability to implement it. There is a review with stakeholders after the initial version of the AMP and feedback is incorporated.

The resources required to achieve the AMP/end state are not understood or well documented. For example, processes for understanding additional O&M requirements associated with new projects could be applied with additional rigour. Furthermore, there are opportunities for improvement in linking planned capital expenditure (CAPEX) with actual engineering resources required for delivery of the CAPEX.

Subject 6: Capital Investment Decision-Making – The processes and decisions to evaluate and analyze scenarios for decisions related to capital investments of an organization. These processes and decisions may relate to new assets for the organization (such as, greenfield projects) and replacements of assets at end-of-life (CAPEX sustaining programs).

Maturity Level				
0	1	2	3	Beyond

Moving towards a 3; some fluctuations by asset class.

Overall fairly strong. There are systematic capital investment decision-making processes and methods in place, supported by documentation. Business case processes exist in the form of flow charts. Risk assessments are conducted as part of the process. There is alignment across groups. Although C55 is being used, there is more rigour placed on capital and the O&M component of the decision is often missing.

There are good processes and practices in place; however, it is not yet a well-oiled machine and some fine-tuning is needed.

Subject 7: Operations & Maintenance Decision-Making – The management activities and processes involved in determining the O&M requirements in support of the AM Objectives and goals.

Maturity Level				
0	1	2	3	Beyond

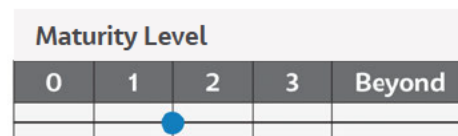
Maturity depends on the area, with some being more advanced.

O&M decision-making is based on a suite of requirements and methods including business requirements, manufacturer's recommendations, reliability-centered maintenance, and a significant amount of Canadian code and legislative requirements. Standards are updated every 5 years.

Documents and practices are reviewed, and this is triggered when a standard is changed. Both legacy companies rate high so, even though work is still underway to bring them together, performance has been maintained and the result will further enhance business and risk management. From an integration perspective, there is movement towards having one set of documents to show frequency of O&M for assets, inspection frequency, and

established procedures for how to complete maintenance. Harmonization is in progress, with maintenance schedules working and effective. A company-wide approach to preventative and predictive maintenance is being taken – both defined by history of failure and manufacturer's recommendations. Most risk is associated with damage and third-party intervention.

Subject 8: Life Cycle Value Realization – The activities conducted by an organization to balance the costs and benefits of different renewal, maintenance, overhaul, and disposal interventions.

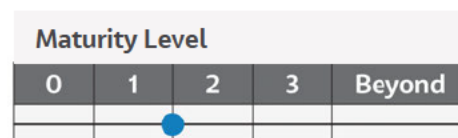


Moving towards a 2, with more strength in non-gas carrying assets.

The ability to manage life cycle costs has been explored, and there is some understanding of what activities need to be done. Activities are conducted in key areas and those with risk drivers. Fleet is also being done well. Storage & Transmission is more reactive. There is uncertainty regarding areas that are not tied directly to capital project spending.

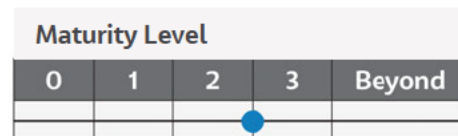
There are opportunities for improvement, including working towards the systematic and consistent achievement of O&M as part of an asset's life cycle.

Subject 9: Resourcing Strategy – Determining and documenting the activities and processes to be conducted by an organization to procure and utilize people, plant, tools, and materials to deliver the AM Objectives and AMP(s).



Resourcing is strong when looking out 1 year, however it is weaker longer-term. The approach is more reactive than proactive, with limited consistency across the organization. From an execution perspective, staff work to ensure a balance of available resources across regions. A clear view of upcoming resourcing needs is not often available; however, this is more effective for larger projects. Typically, staff are made aware of projects as they come in for approval. It is more difficult to look at smaller jobs and tie that to specific requirements within AMPs. Resources exist to execute work in the AMPs, and there are robust tools in place to manage these, however there is a heavy reliance upon third-party contractors. Also, current hiring practices are focusing on future leadership potential making it difficult to hire future SMEs.

Subject 10: Shutdowns & Outage Strategy – The activities taken by an organization to develop a strategy for shutdown and outages.



There is extensive planning around the annual shutdown strategy however there are no documented processes and it is reliant on the people. The strategy does not extend beyond the current year. There is 100 percent redundancy in summer, where construction necessitates some shutdowns. There have been some very complex outages over last few years and they have been addressed well. For storage and transmission, the process is well-defined and led by the operations group – prepared at the beginning of construction season for current year starting with the maintenance schedule and construction outages sit on top of that. Weekly meetings are held regarding planned outages. There are no major outages for distribution.

There is an opportunity to further document processes and extend the planning window.

Subject 11: Technical Standards & Legislation – The processes used by an organization to verify its AM activities are compliant with the relevant technical standards and legislation.

Processes are in place to verify AM activities are compliant with technical standards and legislation for commodity carrying assets. There is a regulatory Management of Change (MoC) group that updates standards. These updates are sent through Maximo for determination of possible effects on AM. Currently, there are two sets of standards; processes and procedures – one for each legacy company. A 3- to 4- year process is underway to update documentation and complete integration. In the interim, change processes are in place along with a clear approach to use until transition is complete. For buildings as an example, there are standardized documents to allow for consistent and repeatable design and execution of real estate. There has been a mismatch in technical standards between head office, engineering office, versus major/core projects. There is not yet a harmonized set of design standards, however some mismatch has been cleaned-up recently by a dedicated project team.

There is an opportunity to further address gaps and provide further clarity regarding integration when considering technical standards and legislation.

Maturity Level				
0	1	2	3	Beyond

Evidence is pointing towards a 3, and there is a higher-level of maturity on the gas carrying side as well as for engineering. Maturity as one integrated organization is lower than individual legacy organizations.

Subject 12: Asset Creation & Acquisition – An organization's processes for the acquisition, installation, and commissioning of assets.

Front-end asset design processes by the projects organization follow a project life cycle gating process which is robust. However, asset handover has been less rigorously managed. Typically, a good job is done with commissioning activities, training plans, and maintenance strategies for new projects. However, a robust suite of documented processes and standards for commissioning and back-end handover is not readily available.

With the above in mind, GDS recently implemented an initiative to develop a standard and associated process for asset turnover between the projects organization and operations. One area where asset creation is managed particularly well is service installations where thousands of instances are dealt with every year and the process is well laid out and understood.

Maturity Level				
0	1	2	3	Beyond

Subject 13: Systems Engineering – An interdisciplinary, collaborative approach to derive, evolve, and verify a life cycle balanced system solution which satisfies customer expectations and meets public acceptability.

There are well-established practices in place including resources, system analysis tools, and functionality that are applied on a consistent basis. From a distribution analysis perspective, there is a centralized team of network modelers within Engineering that are using Synergy and have developed cascading models with multiple pressure classes.

Assumptions are documented in the model, however the rationale for those assumptions may not be documented. Network analysis is well documented and tracked in Maximo; it is transaction based. For large projects, a Leave to Construct Application provides justification, alternatives, and analysis to the Ontario Energy

Maturity Level				
0	1	2	3	Beyond

Solid, leading into a 3 once existing practices are tied together. Network analysis is closer to a 3.

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Board. A number of different planning groups (such as, network analysis, transmission engineering, and optimization, storage planning) meet monthly and look at the entire system to make decisions collaboratively regarding the most balanced solutions. The right people are getting together, however there are not any process maps documented.

There is an opportunity to document processes for the planning groups and tie existing practices together.

Subject 14: Configuration Management – A management process for establishing and maintaining consistency of a product's physical and functional attributes with its design and operational information throughout its life.

Maturity Level				
0	1	2	3	Beyond
	●			

There is strength for most assets (many km of mains and services, as well as stations which are closer to a 2.5).

Changing expectations over time, as well as expectations that exceed capabilities, are resulting in performance issues (for example, with older storage, compression and LNG facilities such as the Dawn Dehydration Plant). Reliability-centered maintenance analysis has been attempted in the past, however expectations have not been formalized, and configuration management relies on people. However, for thousands of distribution stations there are documented processes, as well as records for MOP-in and MOP-out, capacity, and performance.

There is an opportunity to improve documentation, which would enable changes to be flagged (such as, degrading performance) and when it is not functionally possible to achieve expectations.

Subject 15: Maintenance Delivery – The management of maintenance activities including both preventive and corrective maintenance management methodologies.

Maturity Level				
0	1	2	3	Beyond
			●	

There is a blend of proactive, predictive, and reactive maintenance being conducted. Work plans are in place (in SAP and Maximo) to manage annual maintenance and GDS overall achieves 100 percent compliance with the maintenance schedule. A score card is available regarding system equipment reliability. Plans are reviewed as OEMs (original equipment manufacturer) change, which demonstrates that system equipment reliability is being achieved for the business. Overall work is delivered safely, on-time, and on-budget, with adjustments made as required. For legacy UG, there was a robust non-conformance process with heavy mitigations plans in place if the full maintenance workload was not delivered.

Subject 16: Reliability Engineering – The processes for ensuring that an item shall operate to a defined standard for a defined period of time in a defined environment.

Maturity Level				
0	1	2	3	Beyond
		●		

There are some robust reliability practices, however not all of the asset base is covered. This has been focused primarily on distribution. Legacy EGD had more robust procedures around equipment failures (such as, regulator valves). Now there are triggers on failures for Materials Evaluation Centre (MEC) with full-blown analysis resulting in a report to determine if it is a systemic issue. However, this can only be scaled for certain sized assets. For compressors, the root cause analysis is managed and follows a similar process. Maintenance practices have changed based on failure analysis in some instances in the past.

There is an opportunity to take a step back and re-evaluate the level of detail and rigour for some assets.

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Subject 17: Asset Operation – The processes used by an organization to operate its assets to achieve the business objectives.

Maturity Level				
0	1	2	3	Beyond
		●		

Moving towards a 2.5.

This is a successfully operating system, with effective asset operation in place. It is currently going through integration and is adapting as required, recognizing that there is currently a heavy reliance on subject matter expertise. Documented procedures are in place and being updated alongside a more robust training program that is under development. For Storage and Transmission Operations (STO), there are processes for operators, mechanics, plant operators, gas controllers, and technicians that direct how equipment is operated. There is an Operations Manager Committee, and resource challenges are often raised particularly during the summer months as competing priorities arise.

The system is starting to experience the impacts of the recent Voluntary Workforce Options on asset operations, as a lot of field experience was lost. There has been an increasing strain on operations and reliance on knowledge.

Subject 18: Resource Management – Implementing the Resourcing Strategy to manage the use of funds, people, plant, tools, and materials in delivering AM activities.

Maturity Level				
0	1	2	3	Beyond
		●		

There is a good track record of execution and delivering on the capital plan regardless of whether internal or outsourced resources are utilized. Resources are well-managed, and additional support is brought in from across the organization or externally as required. This is demonstrated even in emergency situations. There are few projects that are deferred due to resourcing, typically delays are due to permitting.

There is an opportunity to improve predictions for future resource needs, and to address skillset boundaries for support functions (such as, engineering and drafting resources).

Subject 19: Shutdown & Outage Management – An organization's processes for identification, planning, scheduling, execution, and control of work related to shutdowns or outages.

Maturity Level				
0	1	2	3	Beyond
			●	

There are existing operational and execution processes within Gas Control, STO, Distribution Operations and System Improvement to manage planned and unplanned outages. Shutdown and outage management is most prevalent in the STO division, however examples for Distribution Operations would include planned in-line inspections (ILIs) and unplanned outages (such as, the Red Lake fires which resulted in the loss of 1,500 customers in 2020). Robust plans are in place and built into annual maintenance plans (such as, turbines taken offline during off season, and ILI). This is coordinated with operations and tentative dates and allowances for each plant are reviewed in meetings. The Work Planning Group prepares a package of permitting while the Execution Group conducts the work.

For compression stations, shutdown and outage management is part of the maintenance program and built into procedures. Staff feel they are being as effective as possible with the equipment available. There are procedures in place for safe shutdowns of pipelines, how to properly blow down a pipeline, blowdown times, and so forth with extensive supporting documentation.

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The gap relates to the time horizon for the planning of outages and the execution efficiencies that could come from planning outages in the 2- to 3-year timeline. There is also a strong reliance on individuals and their knowledge, and an opportunity to further document the full range of processes in place.

Subject 20: Fault & Incident Response – Responding to failures and incidents in a systematic manner, including incident detection, and identification, fault analysis, use of standard responses, temporary, and permanent repairs as well as the taking over and handing back of sites.

Maturity Level				
0	1	2	3	Beyond
			●	

There is a strong safety culture and a solid corporate memory regarding major incidents. The STO division primarily leads fault incident and response at the STO facilities. This is achieved through individual expertise as a function within the organization as opposed to a department.

There is a very robust and integrated emergency response plan (filed with the Canada Energy Regulator) through the Incident Command Structure, with more than 300 people trained. It involves procedures regarding how to establish local groups and escalate up as required. There are also emergency response metrics in place, and these are reported to the Ontario Energy Board.

There is also a detailed process for incident investigation and response in Distribution Operations. Failures are analyzed through the MEC to understand systematic issues, with feedback provided to determine if a program is needed to be more proactive. Where appropriate these are communicated upwards through the GDS Integrated Management System Top Management Review. This has proven to be an excellent method for reporting and capturing learning even when failures do not become incidents.

The main gaps are in the fault analysis and documentation of the more routine faults. Although failed components are routinely sent to the MEC for analysis and there are regular stakeholder meetings, the capture of information on routine work orders for regulator replacement, main repair, and station rebuilds is not consistent and accurate. Further, there are opportunities to ensure that risk, integrity, and data are always considered in the incident investigation.

Subject 21: Asset Decommissioning & Disposal – The processes used by an organization to decommission and dispose of assets due to ageing or changes in performance and capacity requirements.

Maturity Level				
0	1	2	3	Beyond
		●		

Strong.

There is a standard process in place for pipe decommissioning and disposal with a defined funding program. Decommissioning planning for rotating assets is less effective and can result in a costly inventory of spares left behind in stores. Decommissioning planning often begins at the end of asset life and there have been challenges with agreeing the responsibility for funding disposal costs.

While future abandonment costs are assigned for pipe assets there is an opportunity to further consider end-of-life strategies when building new assets and take a more proactive approach to decommissioning.

Subject 22: Asset Information Strategy – The strategic approach to the definition, collection, management, reporting, and overall governance of asset information necessary to support the implementation of an organization’s AM Strategy and AM Objectives.

Extensive efforts have been conducted over the last few years as the AM Program has been initiated. The recent focus has been at the Enterprise-level; however, this is shifting back to BUs with a push that occurred initially before integration.

An appropriate governance framework is being put in place at the Enterprise-level. There are solid components of an Asset Information Strategy, however the focus is narrow with an outlook to 2023, and some components (such as, a detailed Roadmap) are missing. Various documents record elements of the system (such as, a high-level Roadmap with timelines), however, there is not a single document consolidating the approach.

Each legacy company has its own work management system. Eventually, this will be replaced by the new Maximo work management system, and a Roadmap is being prepared to migrate assets into the new system.

There are challenges with information that is not always readily available, and in beginning to roll-out a system in advance of the processes and procedures in place at the Enterprise-level. There is an opportunity to develop a Roadmap with a wider breadth, and look at a longer-term approach, as part of updating the Asset Information Strategy. Communication across the organization is also needed.

Maturity Level				
0	1	2	3	Beyond

Moving towards a 2 by updating to a corporate approach with a wider range of information types and systems.

Subject 23: Asset Information Standards – The specification of a consistent structure and format for collecting and storing asset information and for reporting on the quality and accuracy of asset information.

Maturity Level				
0	1	2	3	Beyond

There is a clear picture of where the organization is going with respect to asset information standards, and work is underway to integrate legacy businesses. Many standards are defined in existing systems, however, in the past they were not consistently adhered to. The approach to keeping records is well-defined, with corporate guidelines, policies, and procedures in place. Standards are being implemented for GDS. From a data perspective, attributes are defined, and systems are in place, however this is not necessarily enforced.

There is variation in how records are stored (such as, SharePoint and personal storage) that will be addressed through standardization over approximately the next year. Furthermore, there is an opportunity to improve data quality as part of the process for amalgamating information collection from the legacy businesses.

Subject 24: Asset Information Systems – The asset information systems an organization has in place to support the AM activities and decision-making processes in accordance with the Asset Information Strategy.

Maturity Level				
0	1	2	3	Beyond

With a solid 2 in some situations.

Asset information systems are well-managed, with a change process in place for upgrades. Testing is also conducted. There are maps of systems and interfaces with a variety of levels of detail. System Roadmaps are in place, with a focused 1- to 2-year horizon and a less focused 2- to 3-year horizon. These Roadmaps are integrated into processes, utilities, Unify, and AM. However, the landscape is changing rapidly (month to month) and this evolution is making a longer-term Roadmap more difficult to establish.

An implementation plan is also in place, although it is a fluid and it does not cover all systems. In general, staff know where data are and the system of record for particular data, however getting access to the data can be

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difficult where experts have moved on to different roles. The Asset and Work System is being well planned, implemented, resourced, and tested.

There is an acknowledged need for consistency and work is being conducted to address related gaps. This is challenging as data and integration reviews across legacy systems is complex. There are opportunities to prepare a longer-term Roadmap for asset information systems, and to improve the consistency of information within systems. Furthermore, there are other systems that are posing challenges that will need to be addressed.

Subject 25: Data & Information – The data and information held within an organization's asset information systems and the processes for the management and governance of that data and information.

Maturity Level				
0	1	2	3	Beyond

Approaching 2, for failure data the pipeline assets are in good shape but station assets further behind.

It is very clear what data has been created and where it is stored, and the systems in place are doing their jobs well. Within individual ecosystems, information needs are identified and consistent. However, there are inconsistencies across legacy companies and, as a result, it is currently difficult to meet the needs of the business. A Fit for Purpose Study was conducted before integration and it showed that most attribute data were in reasonably good shape for operating and maintaining pipelines. Some problems were identified with integrity management (such as, pipe location data were good quality and easily accessible, however, material grade data were not easily accessible and needed to be taken from as-built drawings). Most data issues are related to historical data, so the organization is in better shape for moving forward. Data stewards have been identified, the level of awareness about data integrity and stewardship has increased significantly over last couple of years, and the structure and process exist for moving forward.

There is an opportunity through integration to improve overall consistency and address past challenges while moving into the future. There is an acknowledged need for a standard level of rigour to be applied.

Subject 26: Procurement and supply chain management – The processes used by an organization to ensure that all outsourced AM activities are aligned with the AM Objectives of the organization and to monitor the outcomes of these activities against these objectives.

Maturity Level				
0	1	2	3	Beyond

There is a strong focus on procurement and supply chain management, with structured processes in place. This is centralized through the Enterprise. The standard to which service providers are being held has increased, and controls have continued to improve over time. Contracts cannot be secured independently; the process ensures the right people and right prices are obtained. Service level agreements and metrics are being tracked. Consequences are being enforced for contractors unable to meet expectations.

Procurement and Supply Chain Management has come a long way, however there are still opportunities for improvement. For example, in some cases the data that is captured by third-parties have limited controls on the quality.

Subject 27: Asset Management Leadership – The leadership of an organization required to promote a whole life AM approach to deliver the organizational and AM Objectives of the organization.

Maturity Level				
0	1	2	3	Beyond

Strong and pushing beyond.

AM leadership is engaged from the top down. Senior levels of the organization are demonstrating strong leadership and commitment (for example, asset investment planning process, risk, and decision-making). There is a commitment to a whole

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life approach for assets. Resources are in place, including an entire AM function for the organization. The recent webcast, monthly steering committee, and specific AM roles (such as, a Vice President of Engineering and Asset Management, the President of GDS is supporting organizational AM as well as acting as the head of EAM work) demonstrate this commitment.

The next step is to execute on the whole life approach for assets. Additional awareness is need for average employees regarding AM, and in particular communicating their connection and building support.

Subject 28: Organizational Structure – The structure of an organization in terms of its ability to deliver the organizational and AM Objectives.

The AM Organizational Structure is solid, and the core AM process is generally well understood. The AMP is part of regulatory requirements and this helps to drive the organizational set up.

The integration of the legacy businesses is still ongoing and there are a couple of areas that require more clarity, (such as, risk assessments) but they are of lesser impact.

Maturity Level				
0	1	2	3	Beyond
			●	

For AM structure; business structure has a lower score.

Subject 29: Organizational Culture – The culture of an organization in terms of its ability to deliver the organizational and AM Objectives.

There is a good culture and support, starting from the Director level and flowing into operations as demonstrated by the asset investment planning process and capital portfolio. Overall, everyone is able to drive organizational and AM Objectives. Results indicate consistency.

The regional groups have less visibility of each other's activities than in the past; therefore, this is an area that may improve collaboration.

Maturity Level				
0	1	2	3	Beyond
			●	

Subject 30: Competence Management – The processes used by an organization to systematically develop and maintain an adequate supply of competent and motivated people to fulfil its AM Objectives including arrangements for managing competence in the boardroom and the workplace.

Well-developed, very robust training programs are in place for critical roles within GDS (that is, technical training to field and office technical systems), with a clearly laid out learning journey. This program was established 3 years ago in-house and has made significant progress. There are 17 technical competency learning maps in place that illustrate the journey from end to end (beginner to specialized through technical and health and safety and system courses). There is a learning chapter/module for each competency, along with assessments (levels 1 to 4 and n/a), evaluations, and module tests.

On-the-job training and mentorship are also in place. Placemats are used to illustrate the journey, and to show annual progress against competencies (such as, needs formal training, needs informal training, does not need competency, masters, and so forth). A video has recently been created for new leaders coming into a supervisor role for annual assessment of performance. The program is reviewed annually to verify the competencies are still appropriate and aligned with the business, with an annual Directors meeting to provide statistics and enable discussion regarding future focus areas.

Maturity Level				
0	1	2	3	Beyond
		●		

Strong program in place but scope has been mostly focused on field staff and the roll-out to office-based staff is underway.

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A report is also prepared each year for Directors to demonstrate progress and recognize the transition of staff. A separate program for Integrity Engineers is being prepared based on the same program model with consistent and aligned processes. Training programs for other roles (such as, professional realm of employees, and in particular risk and capital project managers) are out of scope.

A high turnover rate has posed challenges in the past, as investments are made in training and staff and they move to other regions. There are opportunities to fully integrate the program with GDS over the next year and a half. Furthermore, professional employees (lawyers, financial/budgeting experts) have not yet been included, however the model for Competence Management lends itself to being adapted for these roles. Additionally, there is an opportunity for more broad communication regarding the EAM framework and how it relates to GDS Competence Management.

Subject 31: Risk Assessment and Management – The policies and processes for identifying, quantifying, and mitigating risk and exploiting opportunities.

Maturity Level				
0	1	2	3	Beyond
			●	

The Risk Management process includes a centralized 7x7 risk matrix to assist in identifying, quantifying and mitigating risk. There are processes in place for risk assessments that are working, with a consistent approach being applied to drive asset replacements. Both legacy organizations have had risk processes in place for years.

Opportunities are identified through the investment management process (C55) which includes the Value Framework and is also based on the 7x7 matrices but brings in additionally the stream of financial benefits and costs that are more relevant on opportunity type investments.

A shared mindset is beginning to emerge but there can be inconsistencies in the way that risk is applied across GDS. There is a tendency to be somewhat reactive rather than proactive in understanding risk, as long-term perspectives and planning for emerging risks are still a challenge.

Subject 32: Contingency Planning & Resilience Analysis – The processes and systems put in place by an organization to ensure it is able to continue to either operate its assets to deliver the required LoS in the event of an adverse impact or maintain the safety and integrity of the assets (whether or not they operate).

Maturity Level				
0	1	2	3	Beyond
			●	

Quite mature with emergency response planning and business continuity planning.

Doing well in this area, with solid documentation, structured and forward-looking processes, adequate staffing, and tests occurring regularly. Time and effort are spent on mock emergencies, looking at the range of possibilities with the distribution, storage, and transmission systems. A process and associated accountabilities are set up. There are also resources outside the organization that are in place to provide mutual support in an emergency.

Subject 33: Sustainable Development – The interdisciplinary, collaborative processes used by an organization to ensure an enduring, balanced approach to economic activity, environmental responsibility, and social progress to verify activities are sustainable in perpetuity.

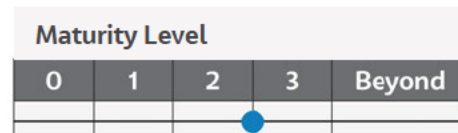
Maturity Level				
0	1	2	3	Beyond
			●	

Customer surveys are conducted, and the results are used to drive spending allocations. Some sustainable development processes are incorporated into the SAMP and AMPs, however more work is needed. Sustainability

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goals have been translated into C55 decision criteria and projects are prioritized to deliver on environmental goals, such as working to reduce greenhouse gas emissions, leakage rates, and recovering more gas from planned releases.

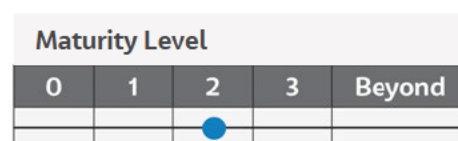
Subject 34: Management of Change – An organization’s processes for the identification, assessment, implementation and communication of changes to people, processes, and assets.



MoC processes exist and are documented; however, they are not necessarily in place for all levels and all areas. These processes are supported by the organization. Existing processes are more effective for assets than for people.

There are opportunities for further clarity regarding documentation to support people changes (for example, as a result of turnover), and for more broad communication to the average employee.

Subject 35: Assets Performance & Health Monitoring – The processes and measures used by an organization to assess the performance and health of its assets using performance indicators.

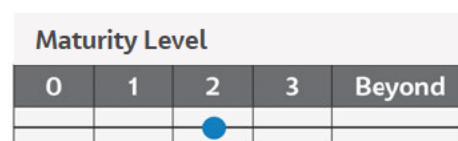


A recent third-party assurance exercise indicates that GDS is industry leading in this area for integrity. For distribution assets, there is clear definition about what needs to be collected, condition monitoring is conducted, and asset performance and health information is being collected, historical performance data is used to forecast, and there is a review process in place. Facilities are moving towards this level. For transmission pipelines, inspection data is available to determine the life of assets. For stations assets, condition and performance information is gathered but there is not a good understanding of how to utilize this data to inform decisions. For storage and transmission facilities, inspection routines are good, however there is uncertainty about the best measures of condition and performance and how to use that information to forecast.

Closer to a 3 for transmission pipelines; a 2 for stations and facilities

There are opportunities for further improvement with station assets, as well as storage and transmission facilities.

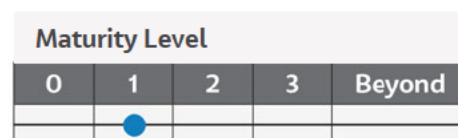
Subject 36: Asset Management System Monitoring – The processes and measures used by an organization to assess the performance and health of its AM System.



There is reporting up to top management on the AM System, and a series of measures are being well-monitored. This is part of an integrated management system, with regular meetings as part of the program. There are concerns about whether the current monitoring measures are the most appropriate and effective and this is an area for improvement. Although the program is functioning in an integrated manner, the documentation for program and processes is not complete.

Pushing towards a 2.5

Subject 37: Management Review, Audit, and Assurance – An organization’s processes for reviewing and auditing the effectiveness of its AM processes and AM System.



An internal audit team exists; however, the team has been instructed not to proceed with a review of AM as part of internal audit because AM it is not a regulatory requirement. Instead, an external reviewer will be engaged.

Moving towards a 1.5

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Subject 38: Asset Costing and Valuation – An organization’s processes for defining and capturing ‘as-built’, maintenance and renewal unit costs and the methods used by an organization for the valuation and depreciation of its assets.

Maturity Level				
0	1	2	3	Beyond

Moving towards a 2.

There is variation in the process for Asset Costing and Valuation depending on the asset class. Where effort is defined and captured through work orders in SAP, there has been good costing and other information recorded since the system was put in place in 2016 (for example, related to compression assets, station assets, and commercial meter sets). With respect to construction costs, legacy Union had information tracked on the cost per metre of installed pipe.

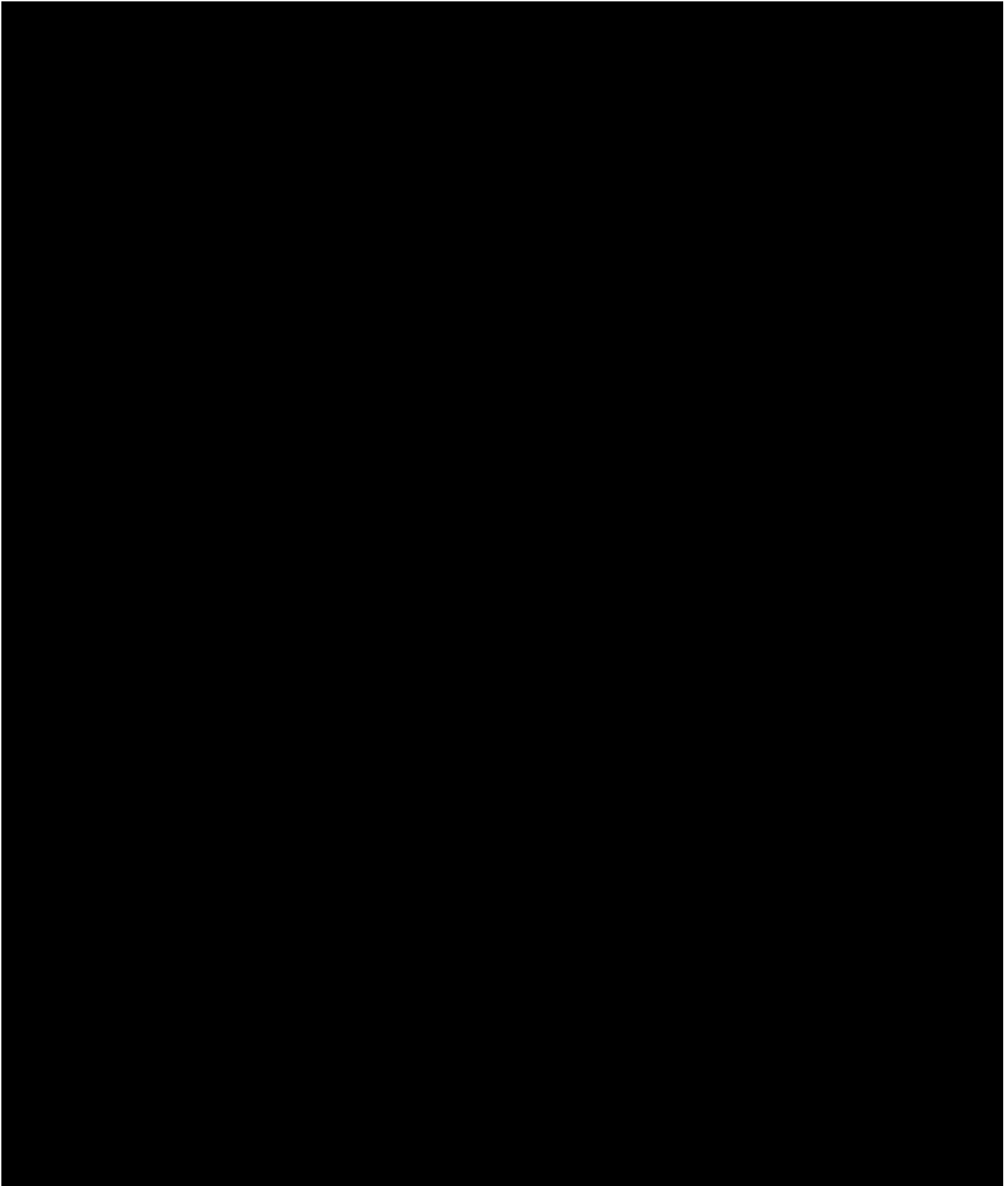
There are some gaps in information and processes when time or materials are not booked through work orders, for smaller assets such as residential meter sets, and for non-gas carrying assets (for example, electronics on a station). There are also opportunities to gather and utilize information collected through work orders to inform future decision-making.

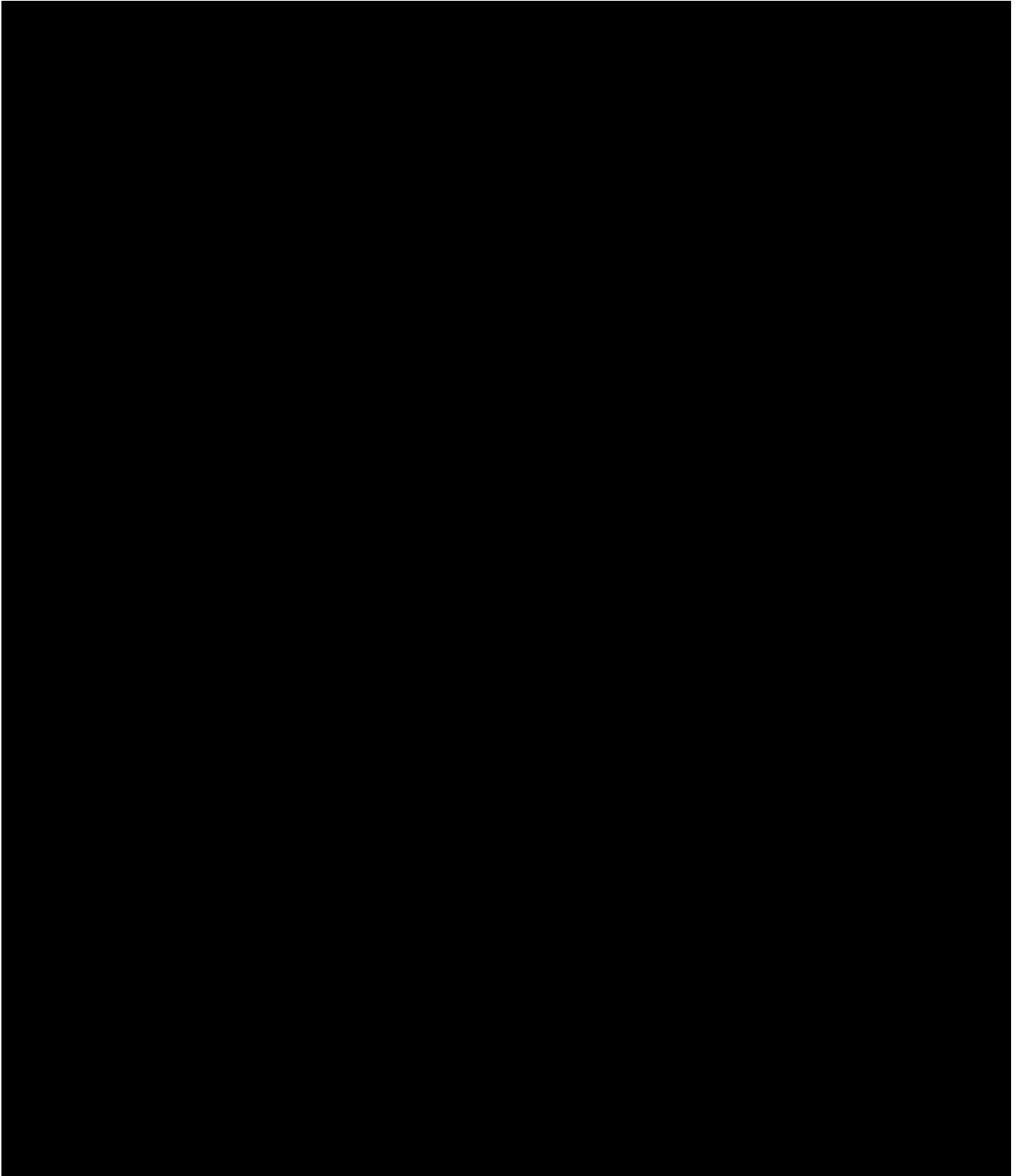
Subject 39: Stakeholder Engagement – The methods an organization uses to engage with stakeholders.

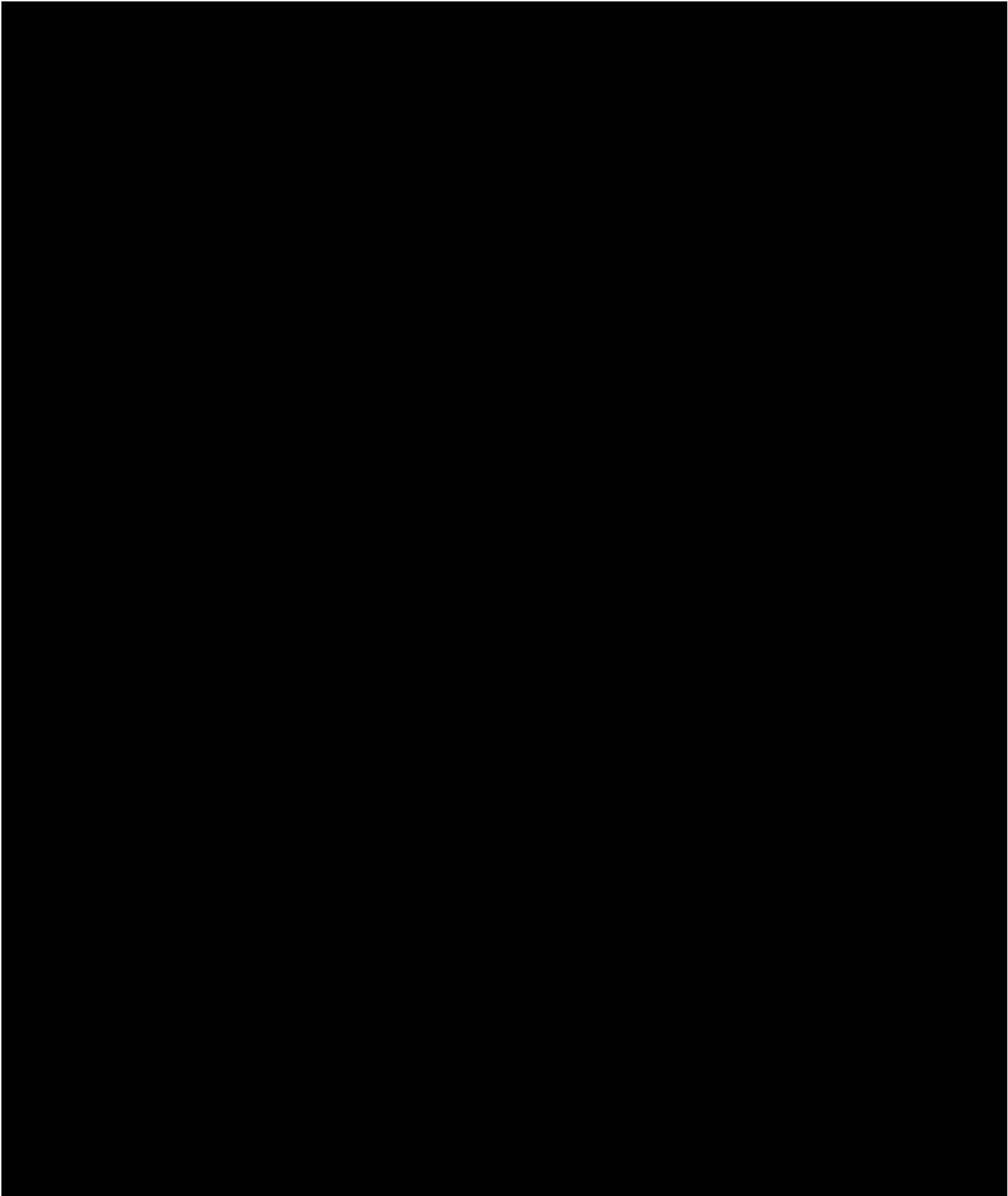
Maturity Level				
0	1	2	3	Beyond

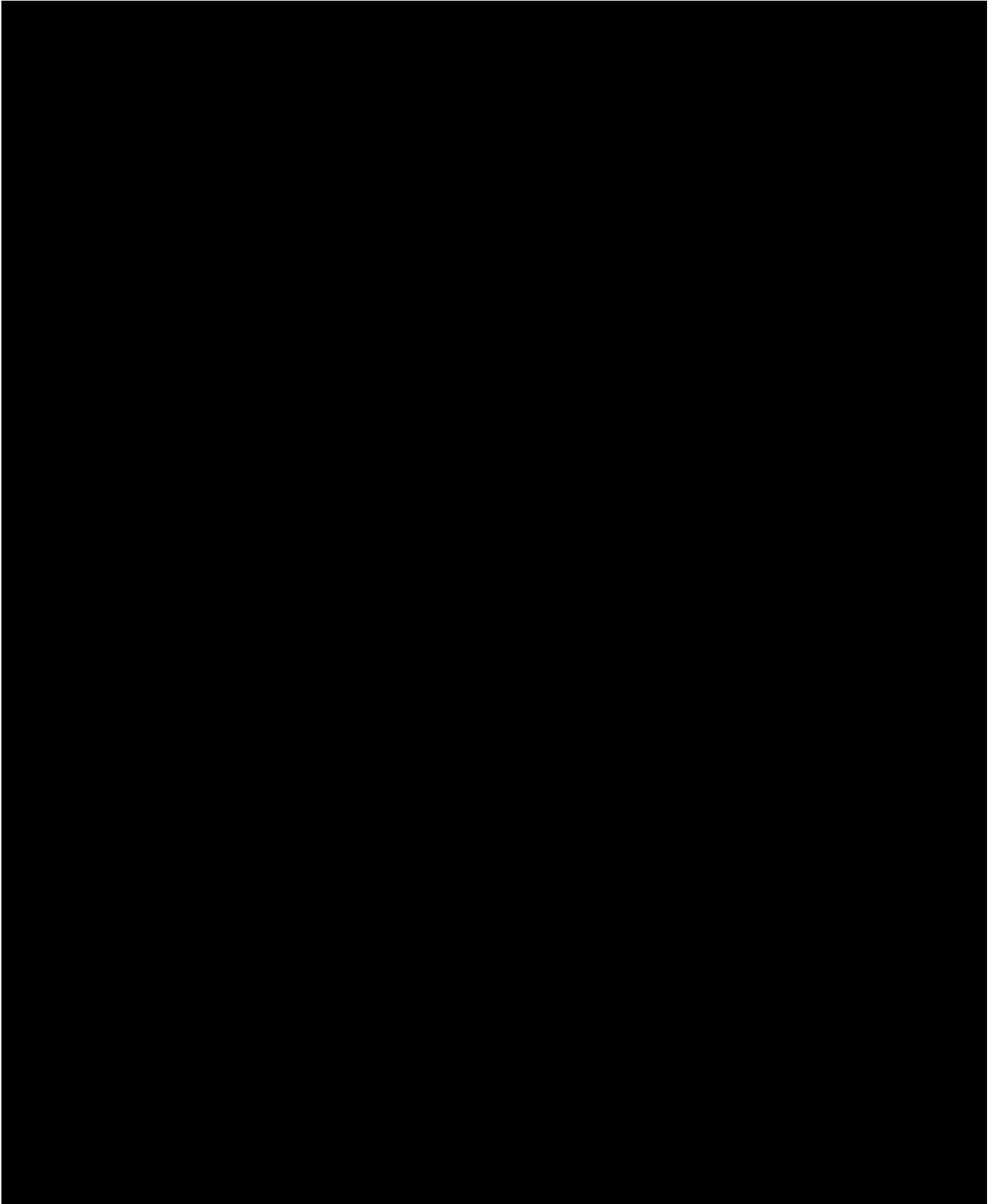
Internal stakeholder engagement is done well. Currently, there is not much formalized external AM stakeholder engagement, however customers surveys have been conducted in the past. There is likely value in doing more stakeholder engagement with certain external stakeholders, for example the Ontario Energy Board.

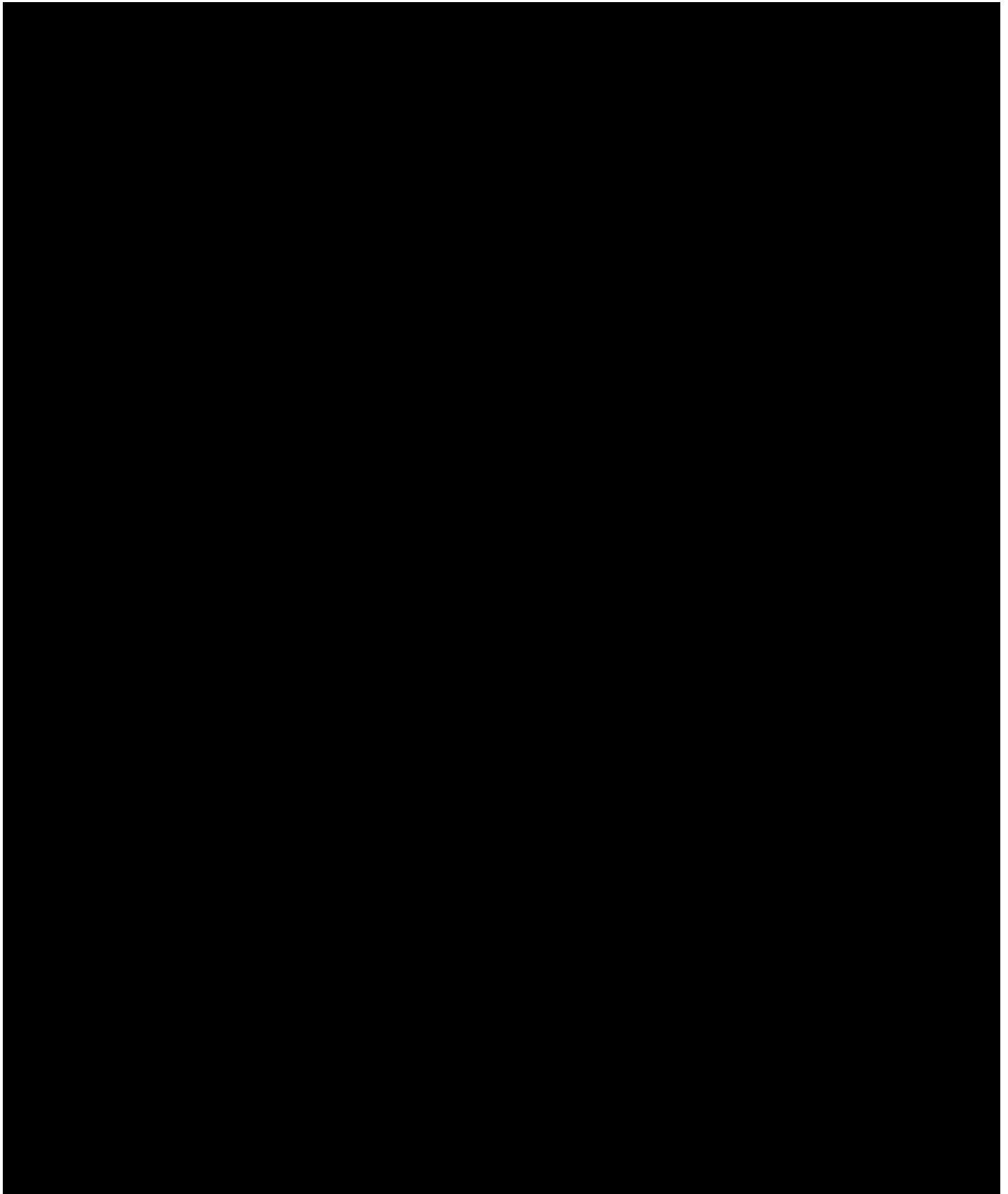
There is an opportunity to conduct additional external stakeholder engagement (for example, sharing proposed plans as a follow-up to initial customer engagement) and it is likely that this will be done in the future.

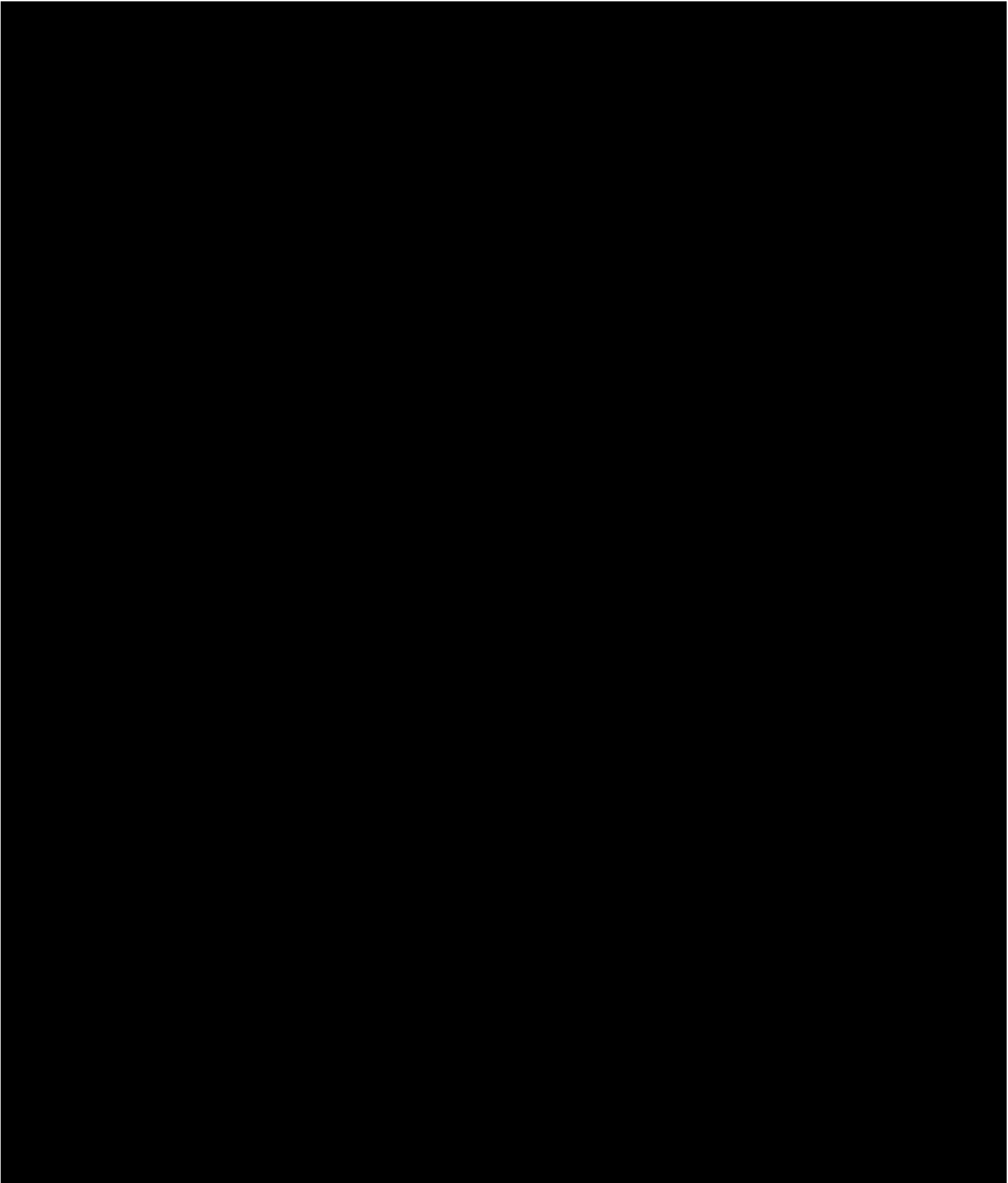


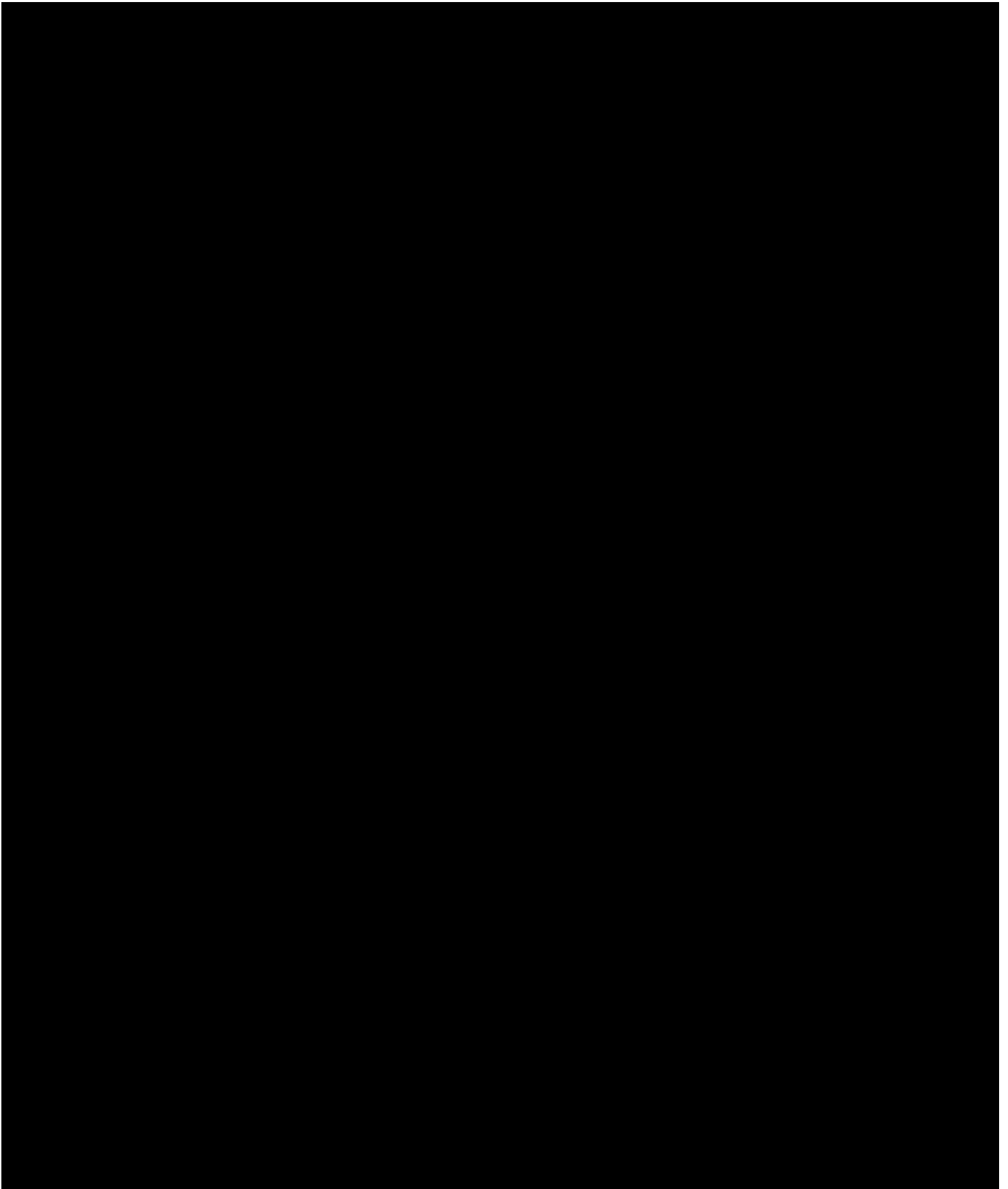


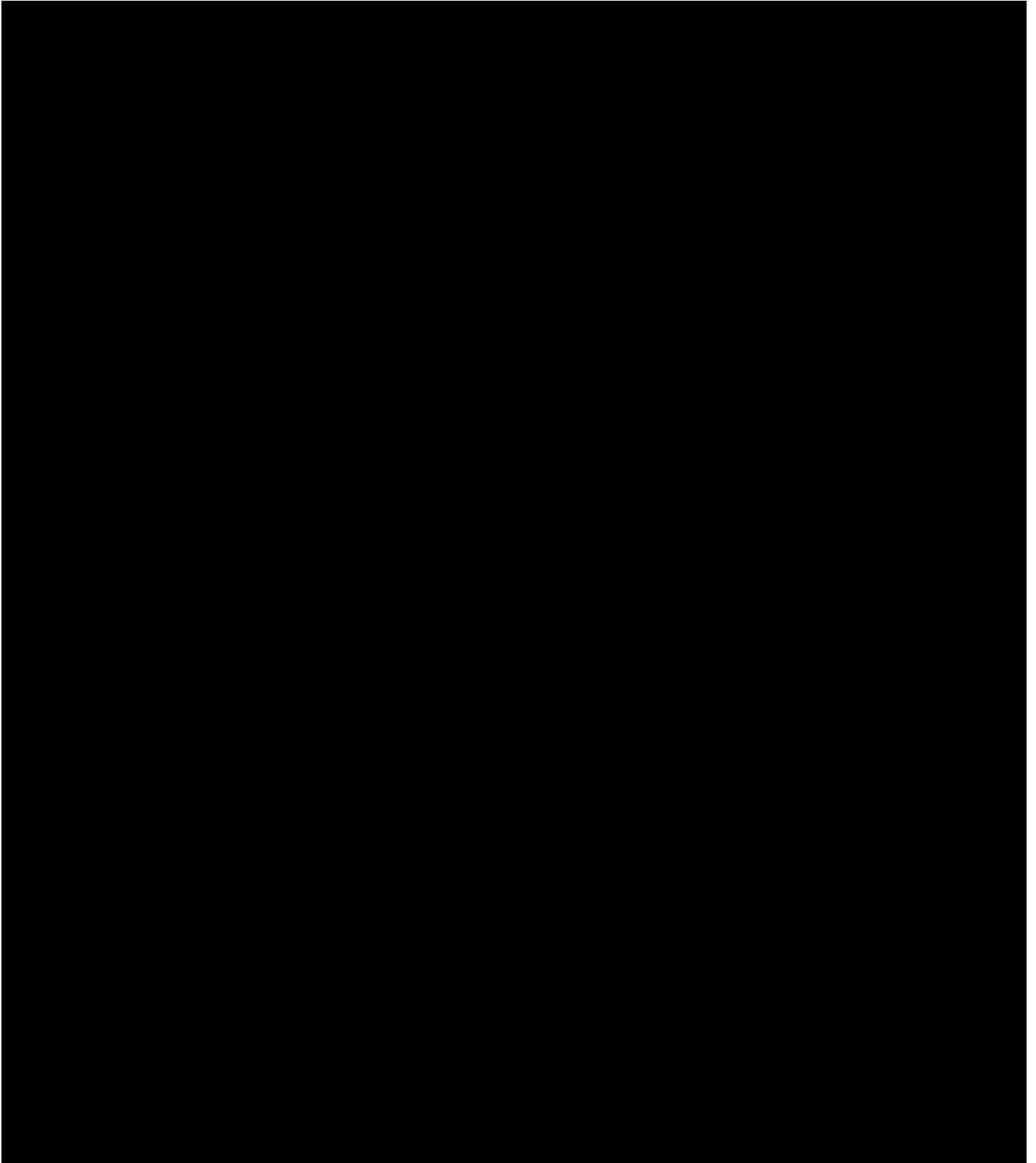


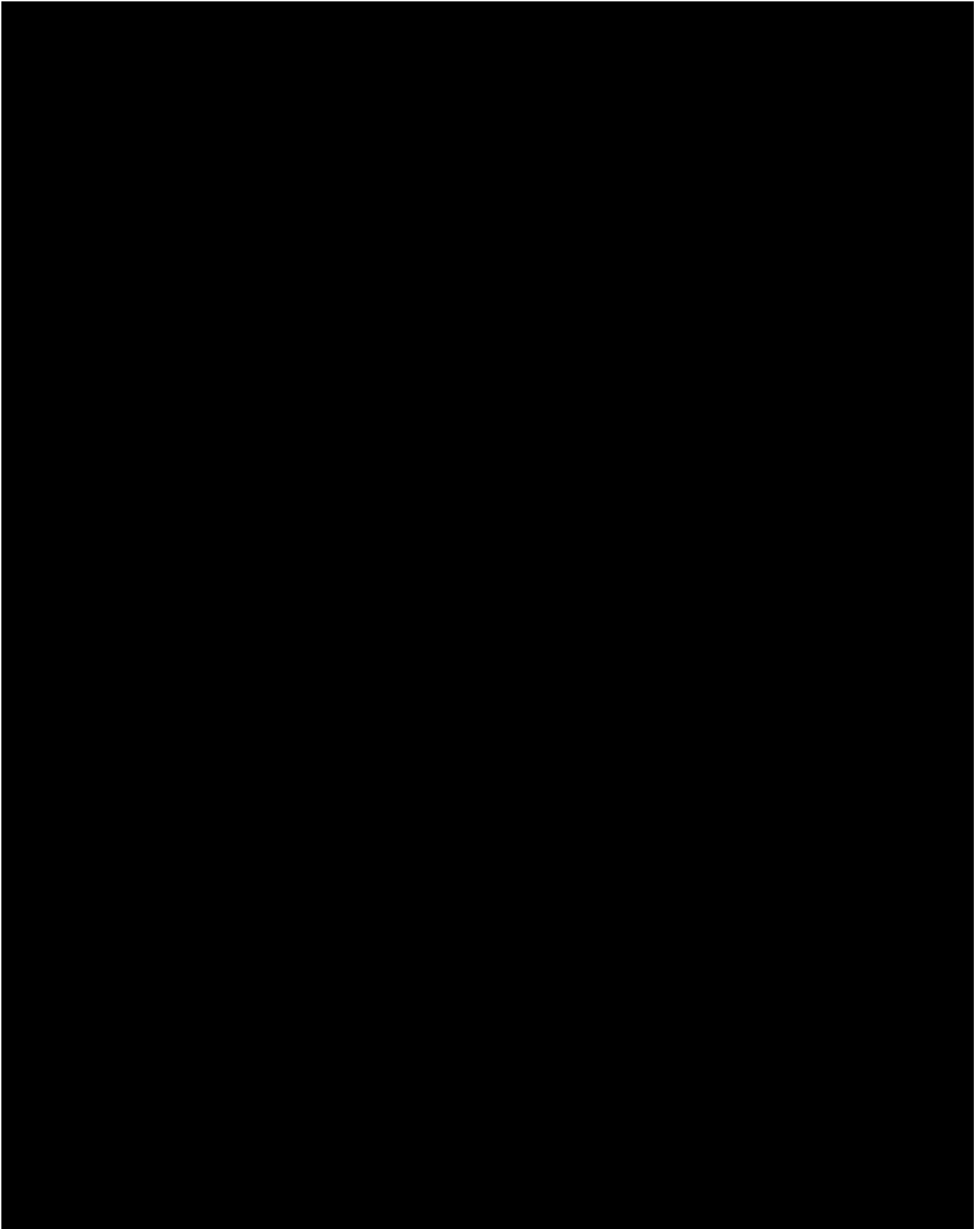


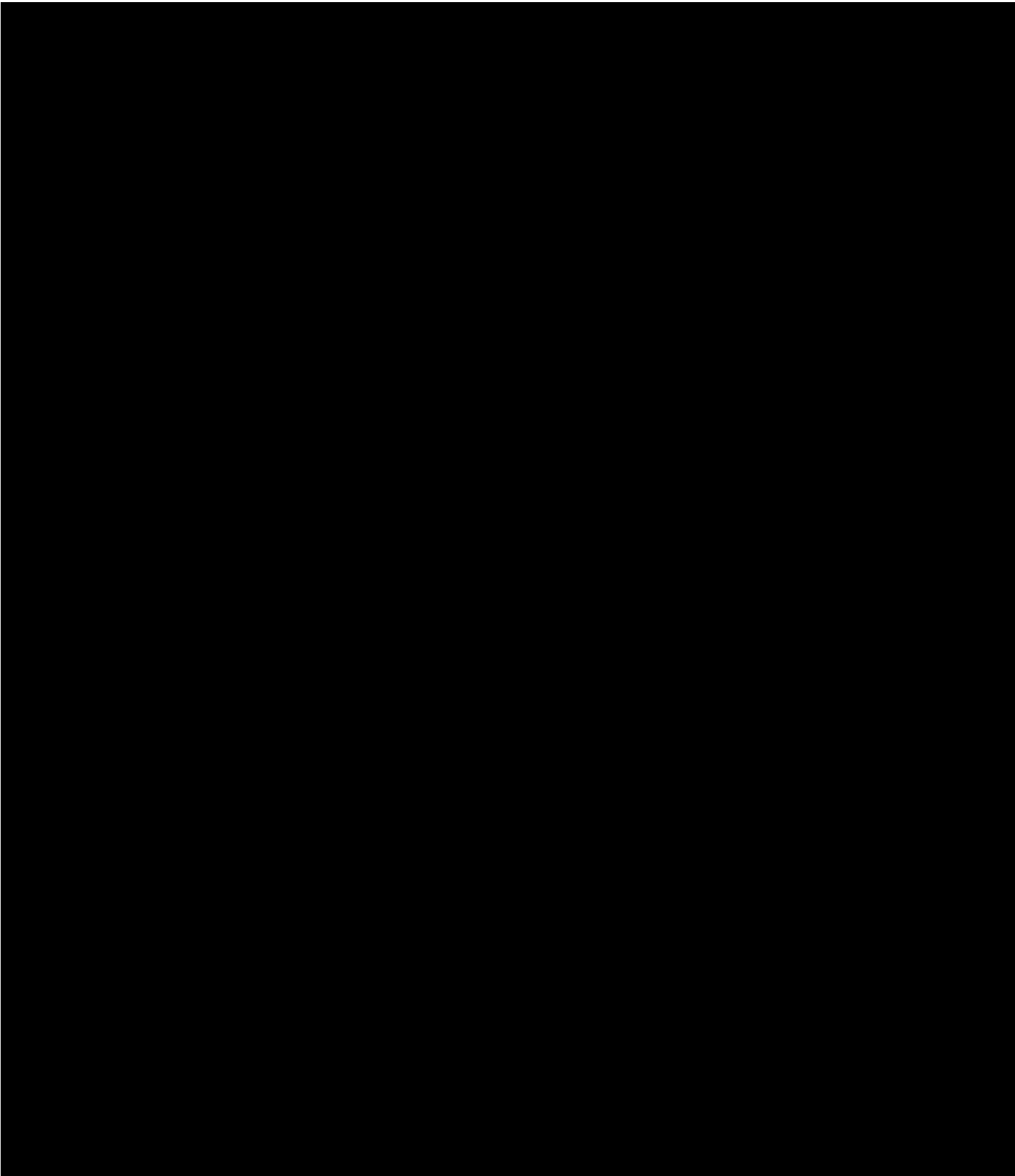


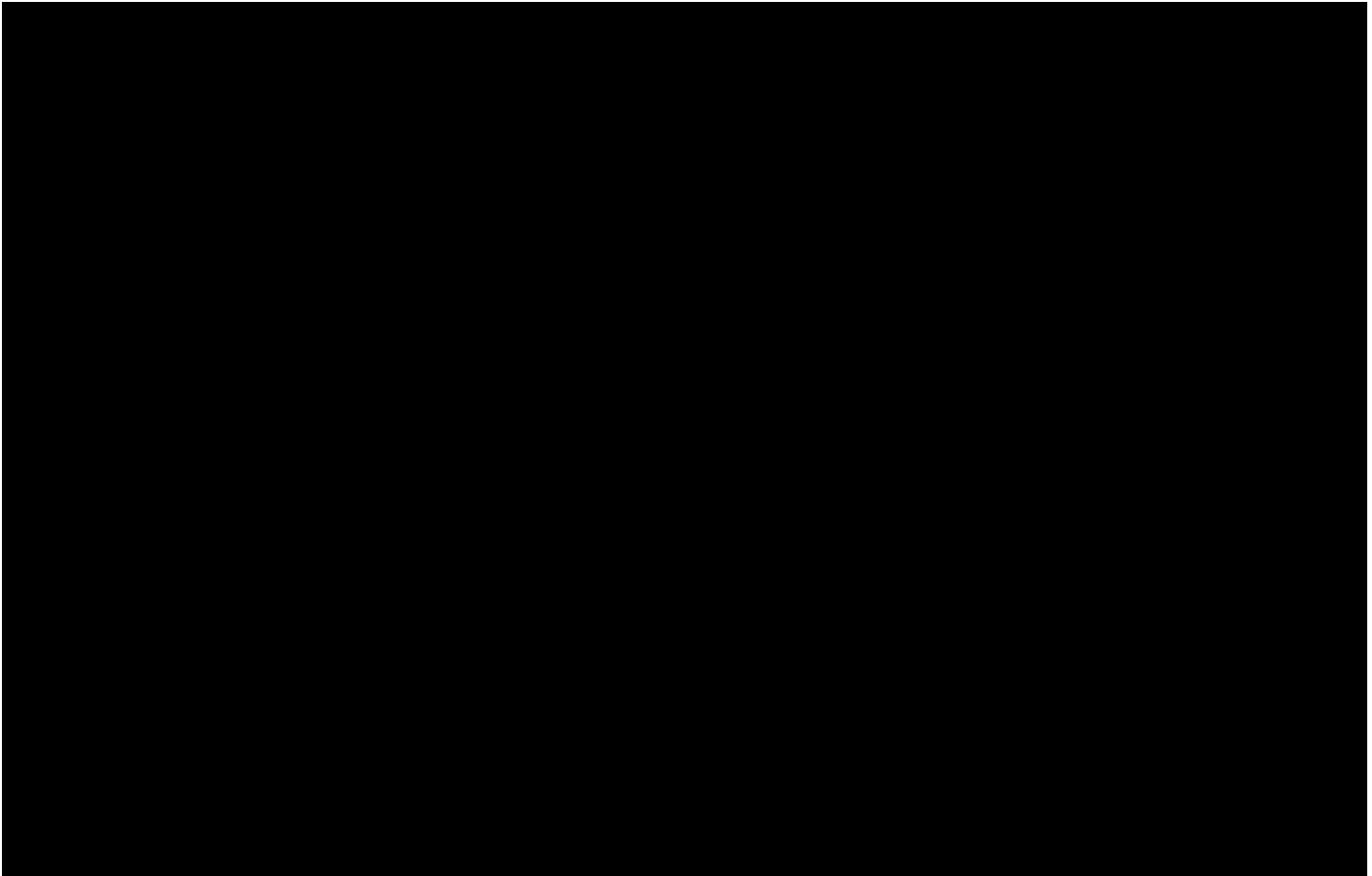


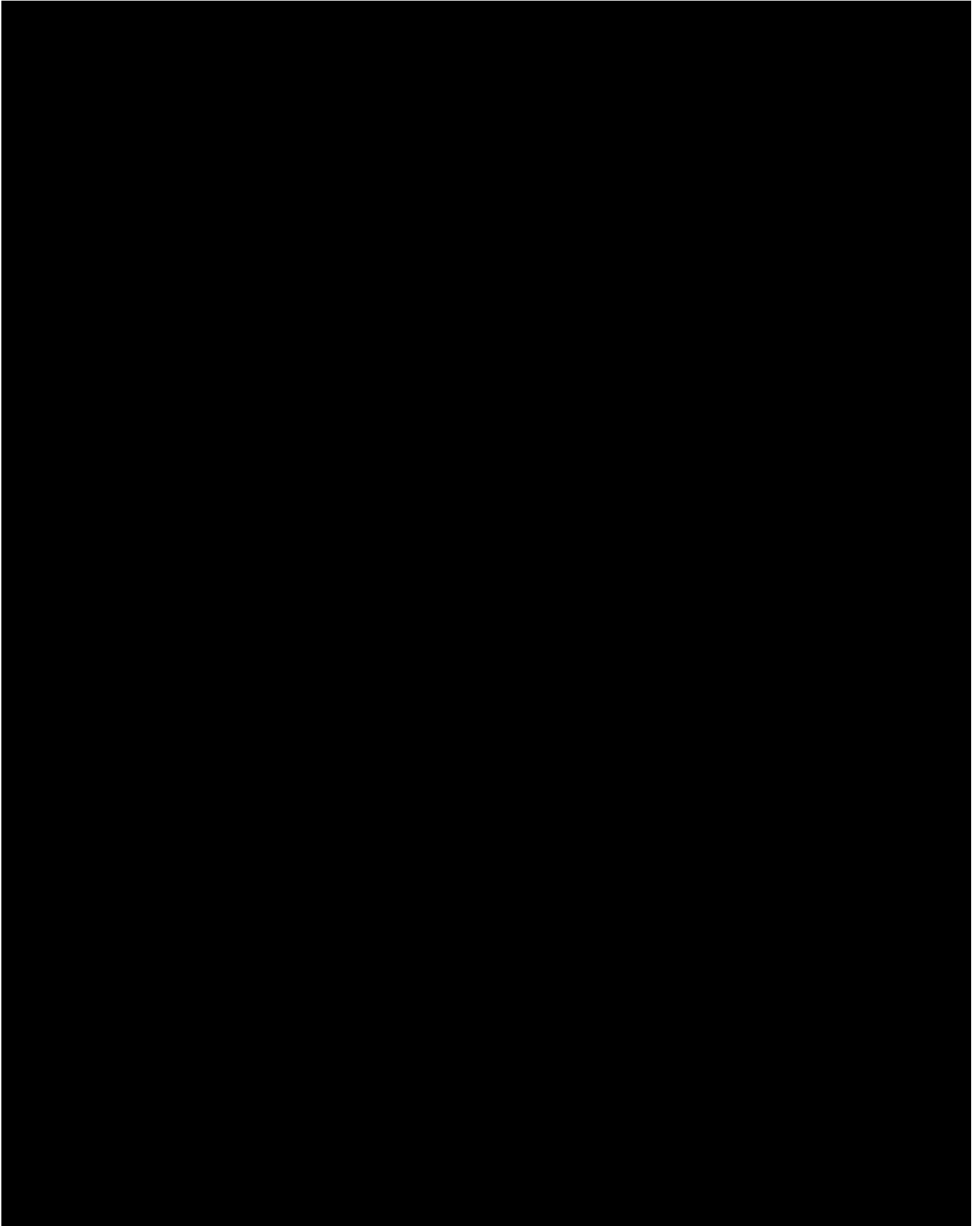


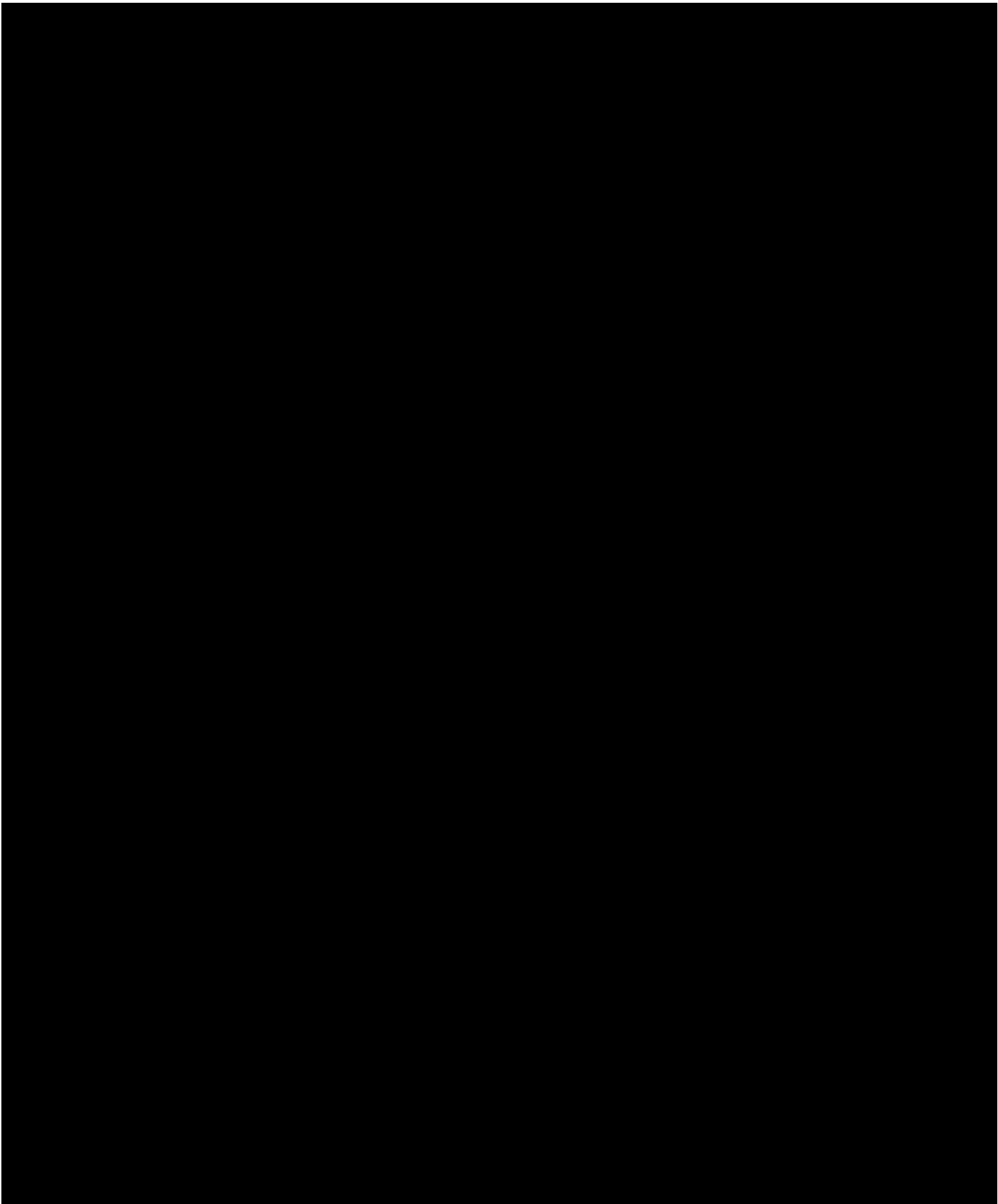


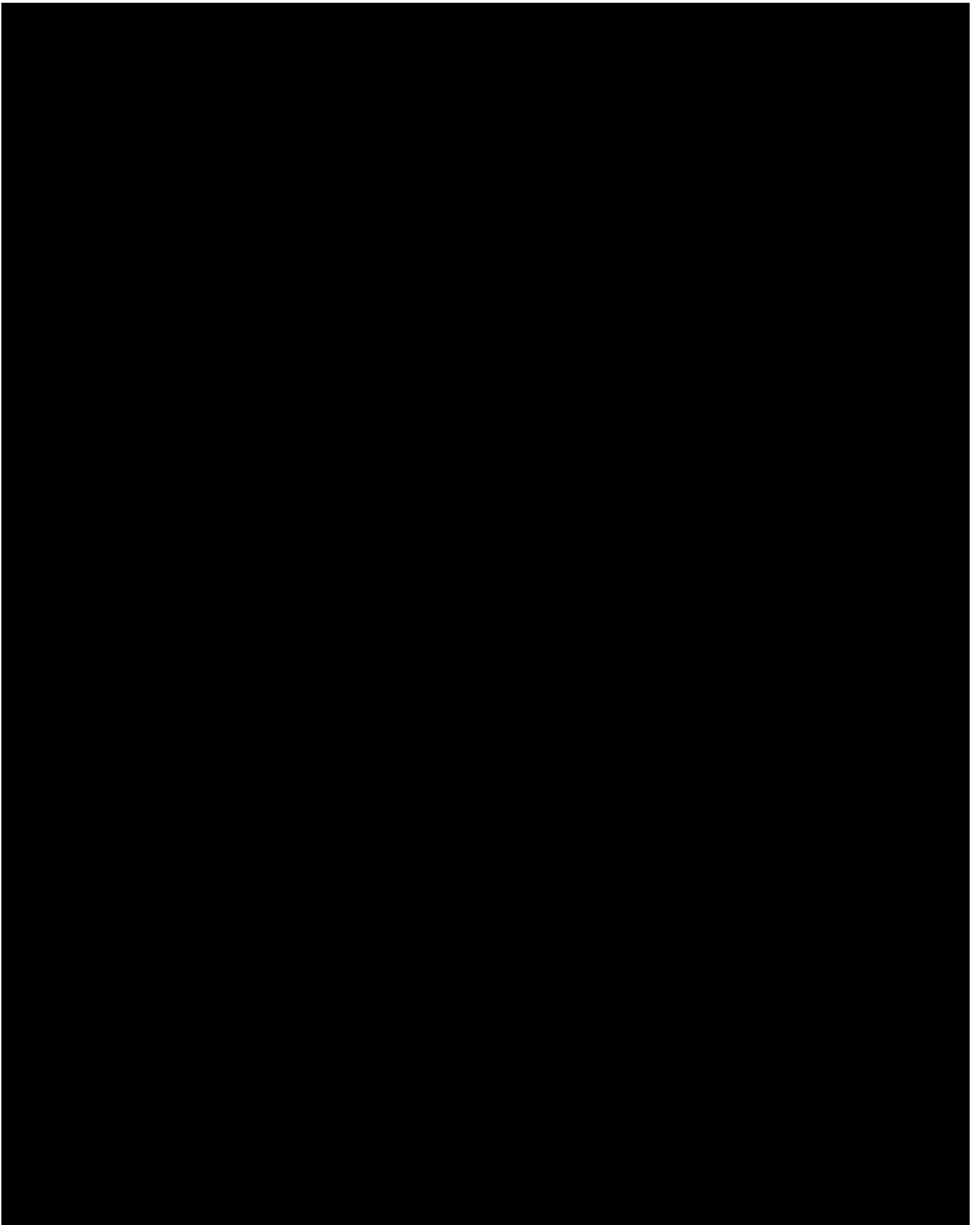


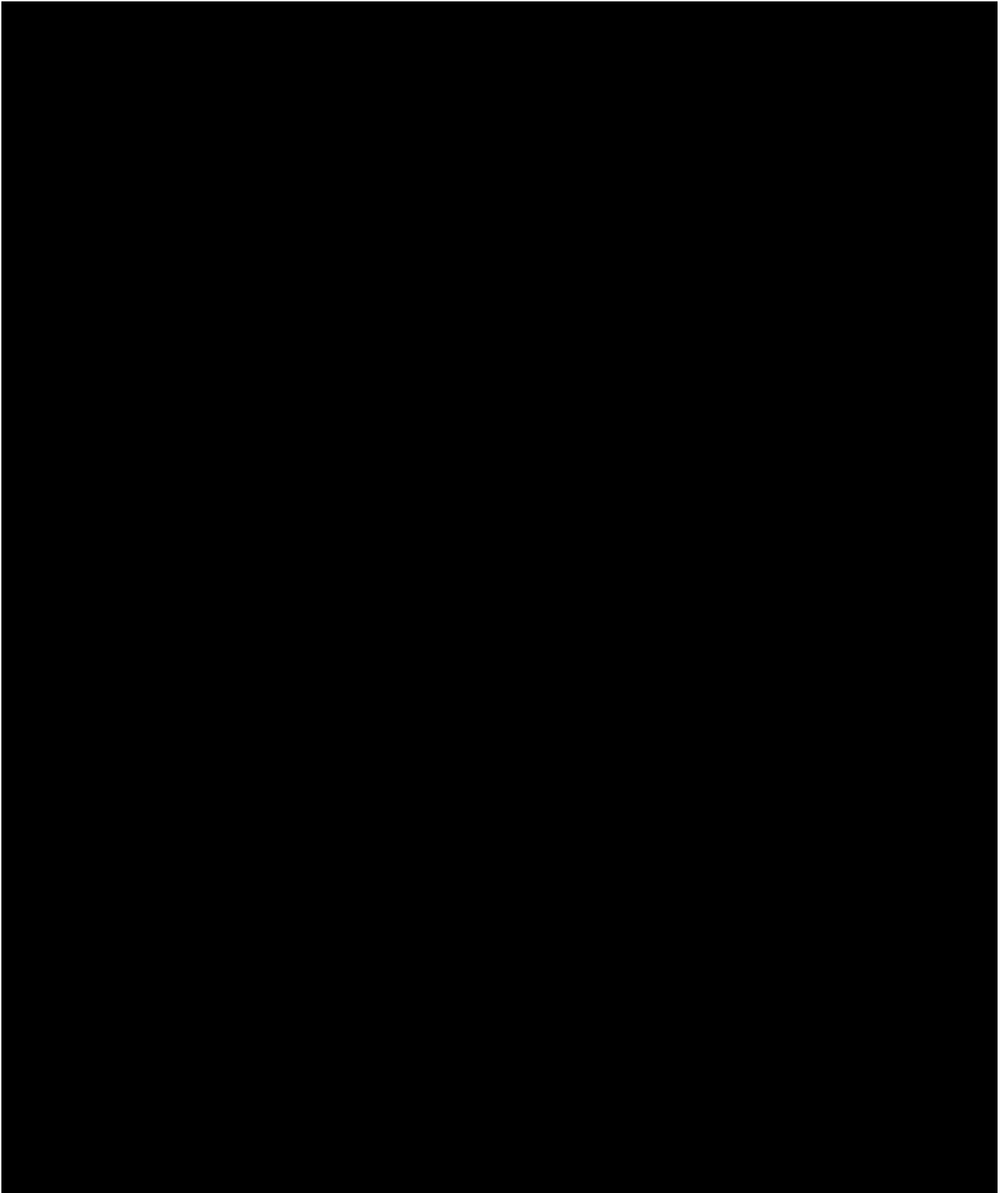


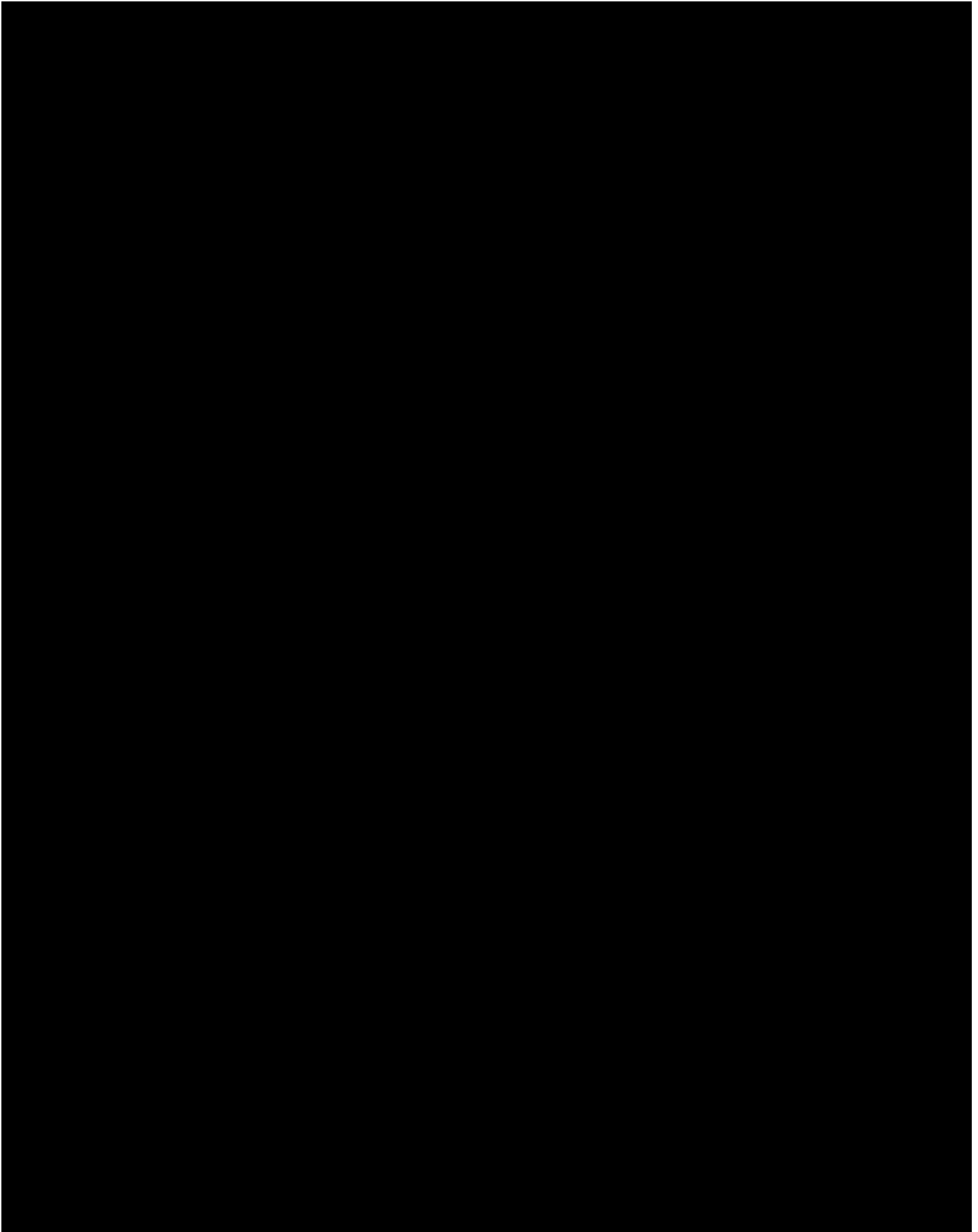


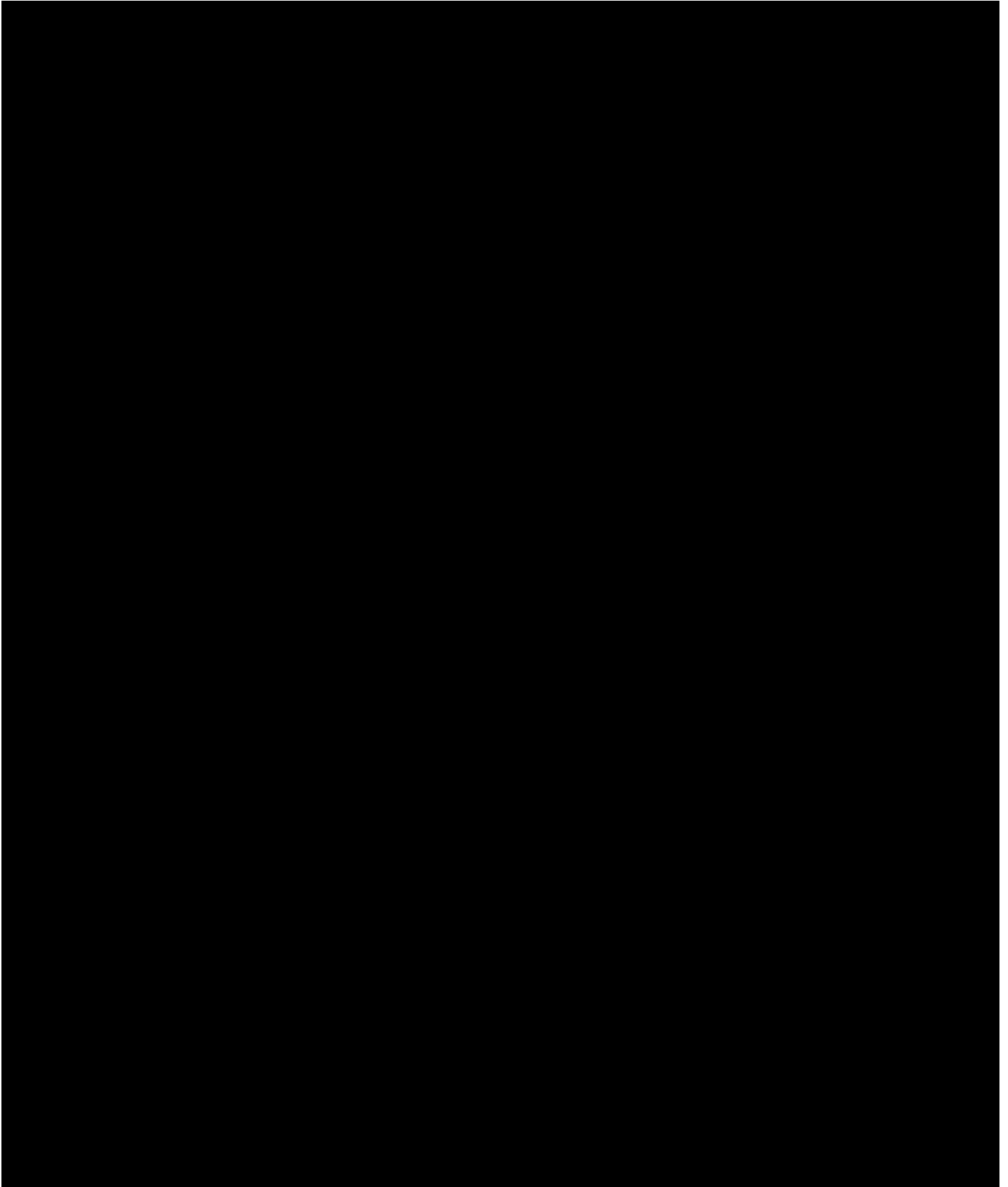


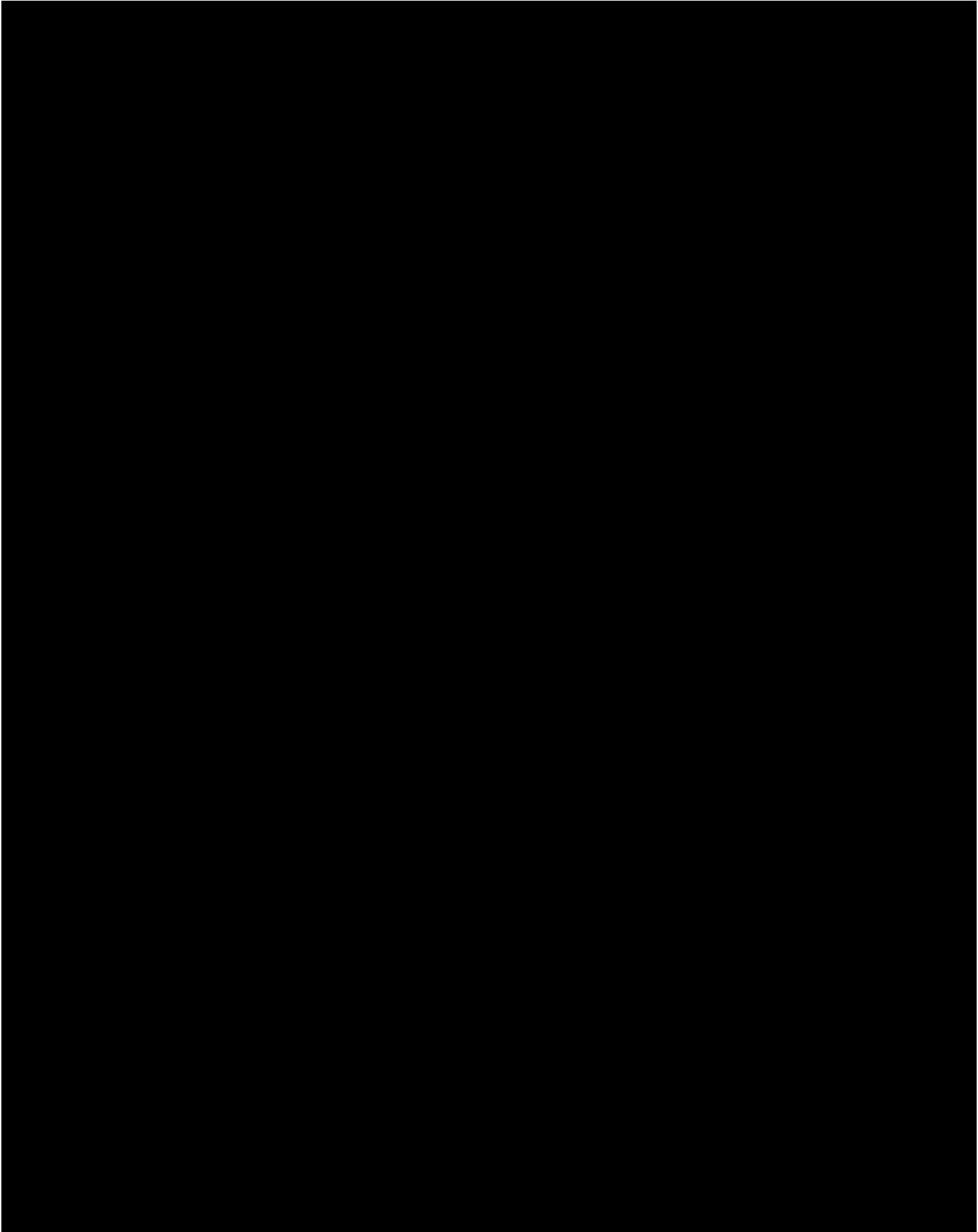


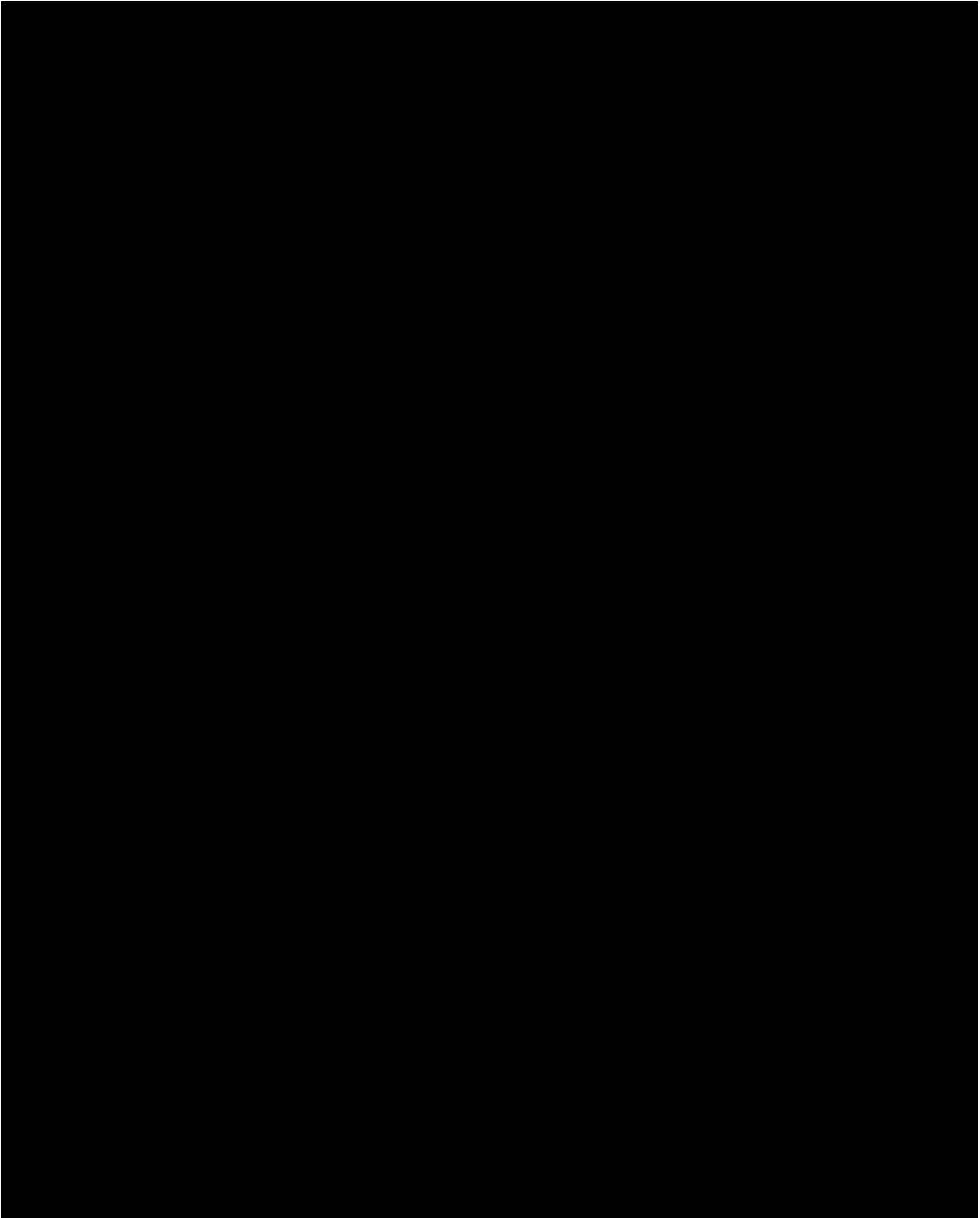


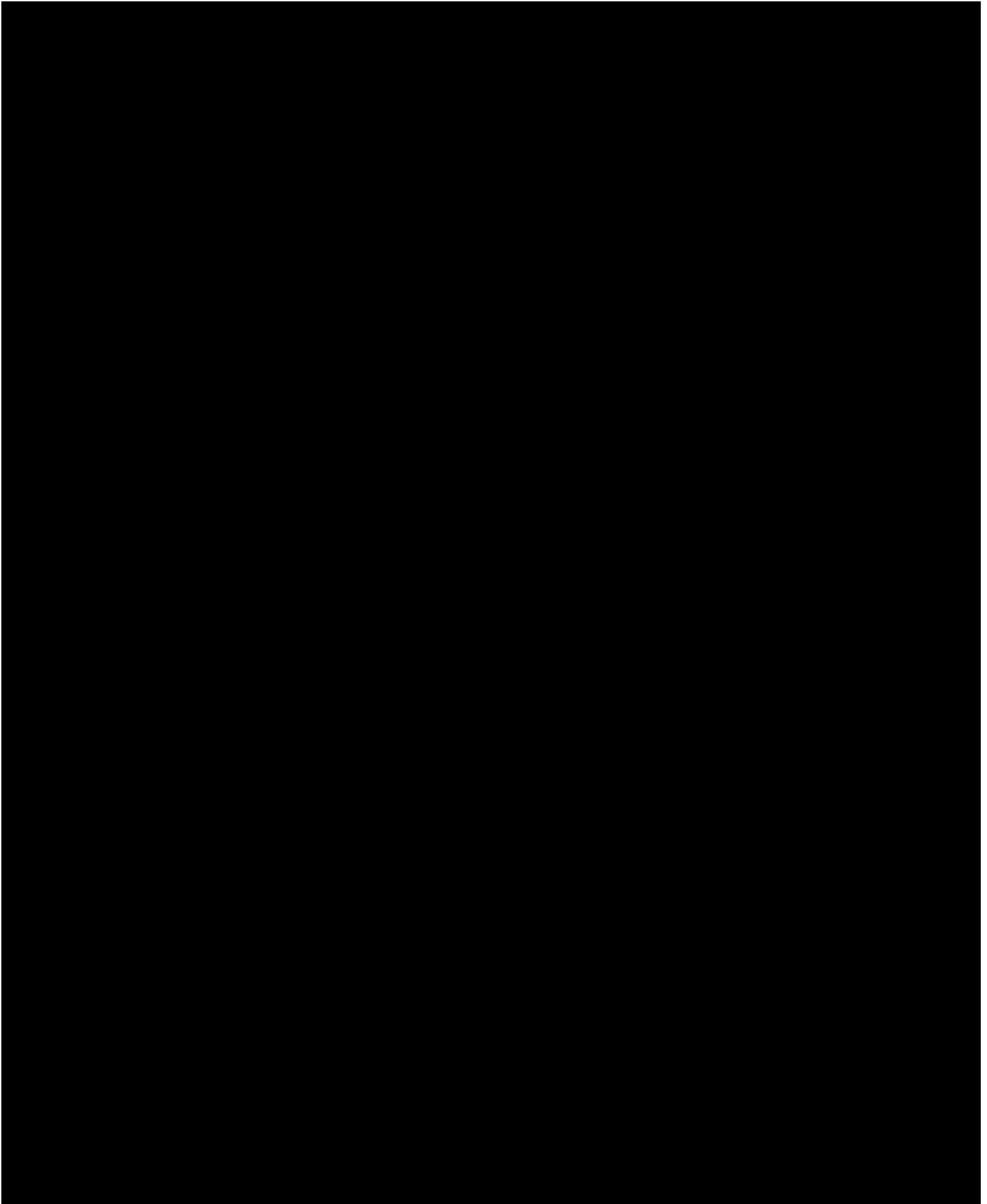


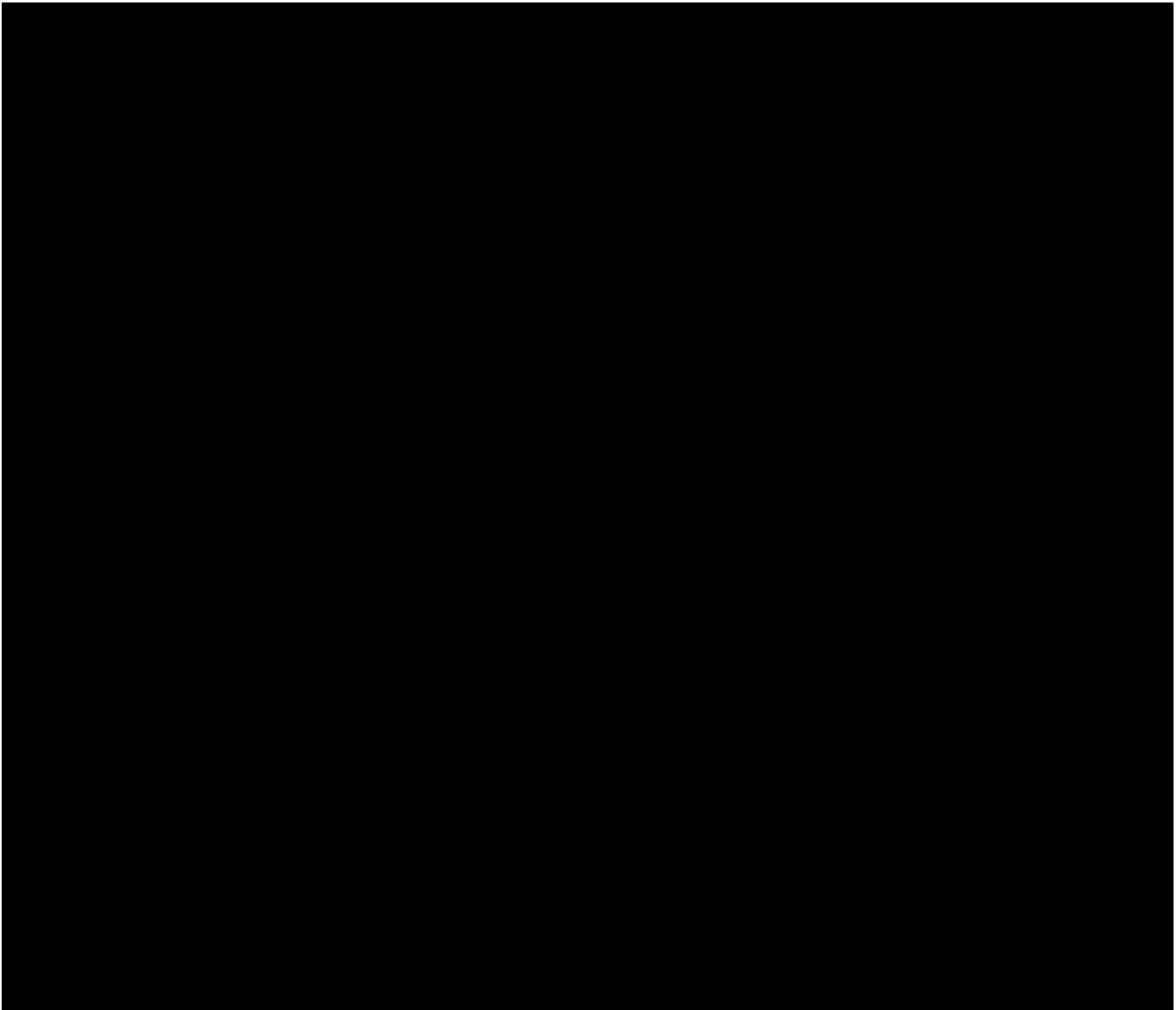












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3.4 Summary

A comparison of the maturity scores for each BU for 2018 and 2020 is shown in Figure 3-4 for the 18 priority Subjects.

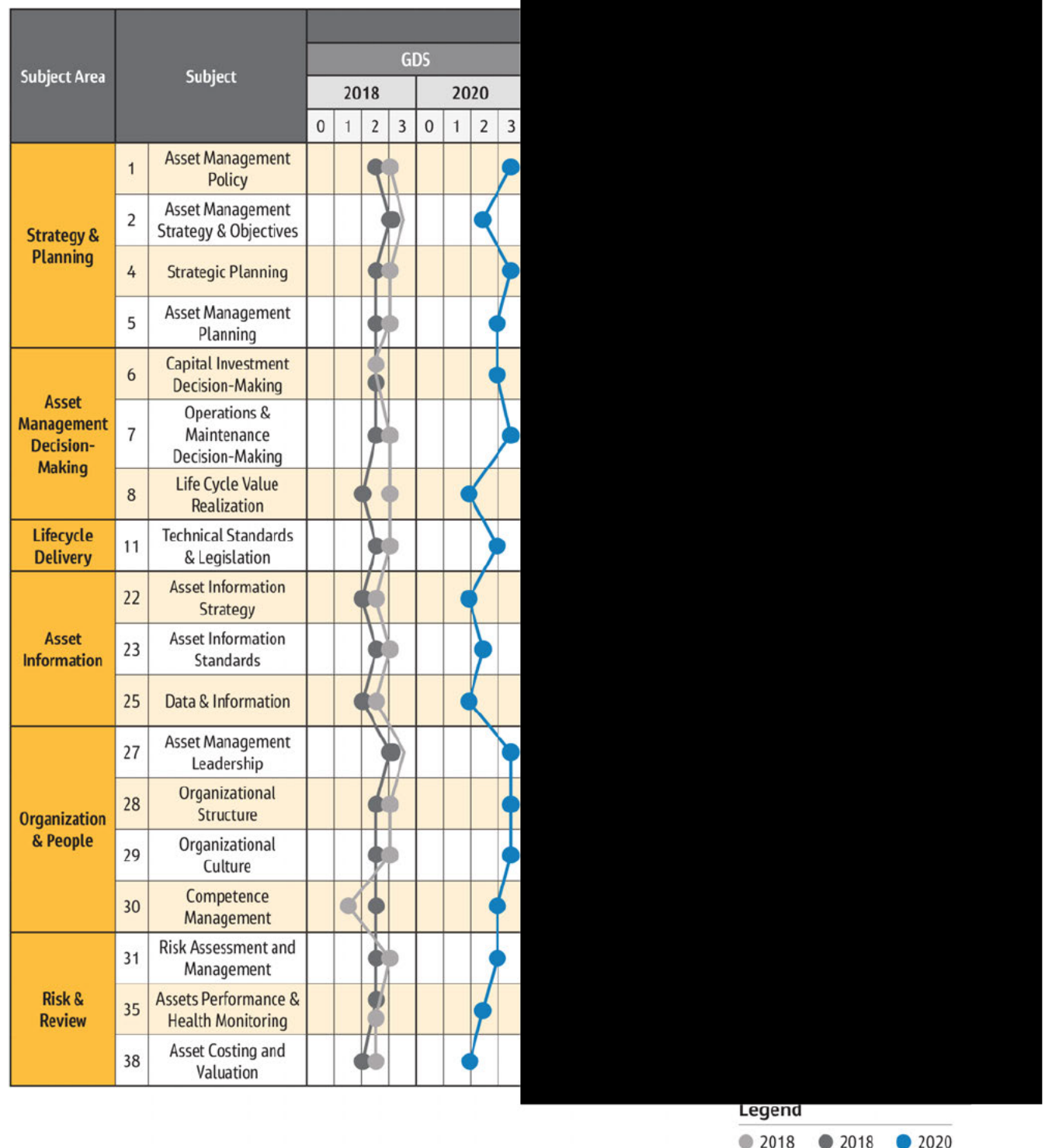


Figure 3-4. Maturity Scores by Business Unit for 2018 and 2020

4. Key Observations and Recommendations

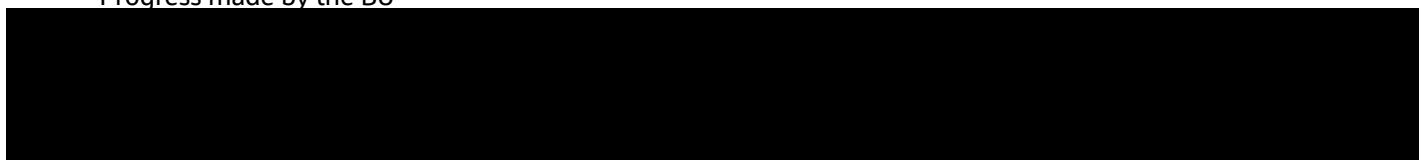
4.1 General Observations

Enbridge is a mature and successful business and all of the BUs have demonstrated a good degree of maturity in processes and practices for several of the 39 subjects. A score of 3 has been assigned when the BU has already achieved the threshold requirements, or where the BU is close to achieving these requirements in recognition of ongoing improvement activities.

The final scores are considered to be a reasonable overall representation of BU maturity. The two initial workshops covered many subjects and captured maturity scores and rationale. The follow-up sessions focused on subjects where it was important to consult additional staff to get an understanding of current practices. The final review made a few small adjustments (plus/minus half-point) and provided additional rationale as evidence for the scores.

The differences between 2018 maturity scores and 2020 maturity scores are due to two main factors:

- Progress made by the BU



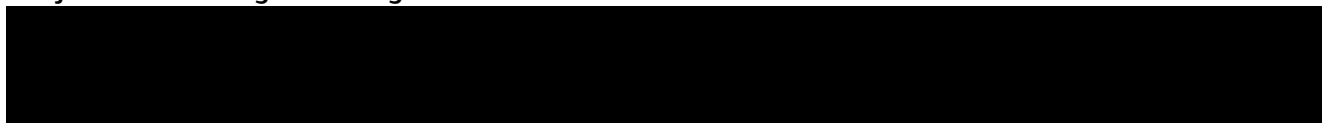
4.2 Recommendations

There are some broad recommendations relating to the lower scores on the 18 priority Subjects. For the other subjects with higher maturity scores Enbridge has ongoing initiatives in place, and it is important to continue the momentum and continue to progress.

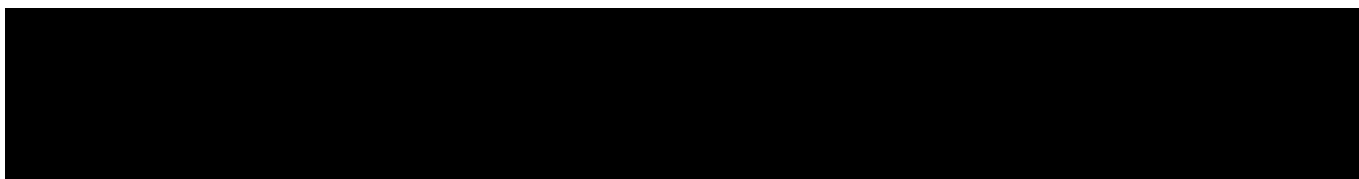
Subject 2 Asset Management Strategy and Objectives

Enbridge could derive significant value from implementing SAMPs. More sophisticated businesses tend to get more value from SAMPs as elements of existing good practice can be further aligned and strengthened during the SAMP development process. There appear to be different approaches across the three BUs and a fragmentation of what would be considered to be the contents of a SAMP document into separate parts. While it is not a requirement of ISO 55000 to have a single document, it is very helpful in the early stages of SAMP development. Defining a clear, common structure for all BUs by, for example, expanding the IMS Asset Management Program document requirements to become a SAMP, is a possible way forward. This would achieve two purposes of both developing a SAMP and implementing IMS documentation should Enbridge decide to include AM as a mandatory program in IMS.

Subject 4 Strategic Planning



Subject 5 Asset Management Planning



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Subject 7 Operations & Maintenance Decision-Making

All BUs already have well-developed practices and processes. This subject is a crucial capability for all BUs and Enbridge should consider setting a higher maturity target that drives continued focus on integration of existing practices in the short term and moves the BUs towards optimization in the medium to long-term.

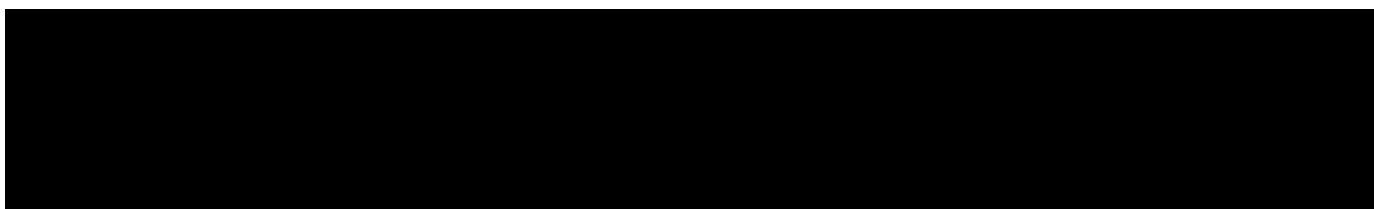
Subject 8 Life Cycle Value Realization

Enbridge would benefit from more coordination and drive for this subject. It might be useful to establish an Enterprise wide project, with representation from each BU, to establish a common framework, conduct BU pilots in coordination, and share learnings.

Subjects 22, 23, 25 Asset Information Strategy, Asset Information Standards, Data, and Information

There are several Enterprise and BU projects and initiatives in place already to progress these subjects. Enbridge should continue to drive these activities in coordination with other ongoing Enterprise-wide systems and data initiatives.

Subjects 27, 28, 29 Asset Management Leadership, Organizational Structure, Organizational Culture



Subject 35 Assets Performance and Health Monitoring

Similar to Subjects 2 and 8 it seems likely that Enbridge would benefit from more coordination and drive for this Subject. It might be useful to establish an Enterprise wide project, with representation from each BU, to establish a common framework and conduct BU pilots in coordination and share learnings.

Additional Recommendations

Subject 33 Sustainable Development: Enbridge has a corporate sustainability team that have recently established sustainability goals and strategy. The development of the SAMP would be an excellent opportunity to clarify sustainability goals and objectives and incorporate these into AM decision-making frameworks (such as, C55).

Appendix A

Workshop Questions

Asset Management Anatomy Question Set						
No.	Subsection	Question	Maturity Level 0	Maturity Level 1	Maturity Level 2	Maturity Level 3
1	Asset Management Policy	The principles and mandated requirements derived from and consistent with the organizational strategic plan, providing a framework for the development and implementation of the asset management strategy and the setting of the asset management objectives.	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>1.1 The AM Policy has been authorized by the top management</p> <p>1.2 AM Policy is appropriate to the purpose, scale and nature of the organization</p> <p>1.3 AM Policy provides a set of principles, intentions, organization’s mandated requirements and commitments.</p> <p>1.4 AM Policy provides a framework for development and implementation of the Strategic Asset Management Plan.</p> <p>1.5 AM Policy is consistent with Organisational Plan, organizational objectives, stakeholder requirements, constraints and other relevant policies within the organization</p> <p>1.6 The policy sets out the organization’s commitment to satisfy applicable (e.g. legal, regulatory, etc) requirements and to continual improvement</p> <p>1.7 The policy is effectively communicated to employees and stakeholders as appropriate</p> <p>1.8 The AM Policy is regularly reviewed and updated to support continual improvement.</p>
2	Asset Management Strategy & Objectives	The strategic plan for the management of assets of an organisation that will be used to achieve the organizational / corporate objectives.	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>2.1 AM objectives have been established at relevant levels and functions of the organisation</p> <p>2.2 AM objectives consider stakeholder and other relevant requirements</p> <p>2.3 The AM objectives are Specific. Measurable, Achievable, Realistic and Time bound.</p> <p>2.4 The AM objectives are documented and included within the Strategic Asset Management Plan (SAMP).</p> <p>2.5 The SAMP sets out the organization’s strategic approach to the management of its assets and the achievement of AM objectives.</p> <p>2.6 The AM objectives and SAMP are aligned with the organisation’s objectives, the AM Policy and relevant requirements</p> <p>2.7 The SAMP is consistent with the risk tolerability criteria and the organisation’s decision making criteria.</p> <p>2.8 The SAMP is consistent with the methodology for determining asset criticality</p> <p>2.9 The SAMP outlines the role of the asset management system in achieving the AM objectives and plans for developing asset management capability.</p> <p>2.10 The SAMP and AM objectives take into account existing and future needs in relation to assets and AM capabilities.</p> <p>2.11 The SAMP & AM objectives have been communicated to relevant internal and external parties.</p> <p>2.12 The SAMP and AM objectives are reviewed and updated.</p>
3	Demand Analysis	The processes an organization uses to both assess and influence the demand for, and level of service from, an organization's assets.	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>3.1 The organization identifies internal and external factors that may pose risks or opportunities to achieving its AM objectives</p> <p>3.2 The organisation forecasts how these factors can influence the demand for its products and services in the future and the requirements this will place on the assets.</p> <p>3.3 Quantitative analysis tools and techniques are used for forecasting demand and required levels of service as appropriate to the requirements of the organization.</p> <p>3.4 Demand analysis is used to develop alternative planning scenarios and to address uncertainties in data and models.</p> <p>3.5 The results of demand analysis are taken into account in setting organizational objectives and asset management objectives; and in developing the SAMP and the asset management plans.</p> <p>3.6 Demand analyses are reviewed and updated to reflect changes.</p>
4	Strategic Planning	The processes an organization uses to undertake strategic asset management planning.	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>4.1 The strategic planning process to achieve asset management objectives integrates with other organizational planning activities, including financial, human resources and other support functions.</p> <p>4.2 The strategic planning process is aligned with and supports the organization’s overall business planning</p> <p>4.3 The strategic planning process incorporates the results of supply and demand forecasting</p> <p>4.4 The strategic planning process provides a structured approach and framework for developing Asset Management Plans for asset systems and asset types.</p> <p>4.5 The strategic planning process and the asset management planning processes are undertaken in an iterative way combining top-down direction with bottom-up asset needs.</p>

Asset Management Anatomy Question Set						
5	Asset Management Planning	The activities to develop the Asset Management plans that specify the detailed activities and resources, responsibilities and timescales and risks for the achievement of the asset management objectives.	<ul style="list-style-type: none"> The organisation has not recognised this subject and/or there is no evidence of commitment to develop it. 	<ul style="list-style-type: none"> The organisation has identified the need to address this subject, and there is evidence of intent to develop it. Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place. 	<ul style="list-style-type: none"> The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans. Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation. 	<p>5.1 Documented Asset Management (AM) plans exist for asset systems and critical assets in alignment with the SAMP for the achievement of the asset management objectives.</p> <p>5.2 The AM Plans take account of the risks and opportunities, including how these can change with time.</p> <p>5.3 The AM plans take account of requirements from outside the AM system and consider the financial and non-financial implications of the plans.</p> <p>5.4 The AM plans take account of the results of demand analysis</p> <p>5.5 the AM plans seek to address continual improvement opportunities</p> <p>5.6 AM Planning activity is integrated with other planning activities such as IT, human resources and financial planning</p> <p>5.7 The AM plans detail the processes and methods for managing the assets over their life cycles.</p> <p>5.8 AM plans include activities and their timescales, the resources to be utilized, the roles and responsibilities, risks/opportunities and the expected outputs/outcomes from the delivery of the plans.</p> <p>5.9 Activities within the AM plan are prioritised based on the organisation’s agreed method and decision criteria documented in the SAMP.</p> <p>5.10 The AM plans are reviewed and updated regularly, in accordance with specified review periods, to account for the dynamic nature of risks and opportunities.</p>
6	Capital Investment Decision-Making	The processes and decisions to evaluate and analyse scenarios for decisions related to capital investments of an organization. These processes and decisions may relate to new assets for the organization (e.g. Greenfield projects) and/or replacements of assets at end of life (CAPEX sustaining programs).	<ul style="list-style-type: none"> The organisation has not recognised this subject and/or there is no evidence of commitment to develop it. 	<ul style="list-style-type: none"> The organisation has identified the need to address this subject, and there is evidence of intent to develop it. Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place. 	<ul style="list-style-type: none"> The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans. Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation. 	<p>6.1 Capital investment decision-making follows the organization’s criteria for asset management decision-making agreed with its stakeholders</p> <p>6.2 The processes and methods for capital investment decision-making are documented, where necessary, and are aligned with the asset management policy, asset management objectives and SAMP.</p> <p>6.3 Credible alternatives are considered, including non-capital interventions, at an individual asset, groupings of assets and asset systems level.</p> <p>6.4 Options are evaluated considering the agreed decision criteria, constraints and mandatory compliance requirements, and consider the impact of decisions over all life cycle stages and the organisation’s long term need for the asset.</p> <p>6.5 Records are maintained of the decision.</p> <p>6.6 Risk is included in the evaluation, including consideration of how risk changes with time.</p> <p>6.7 The processes and methods are consistently applied across all capital investments, including new build, replacement and refurbishment (where this extends asset life). Records are available to demonstrate compliance. Processes consider the nature and criticality of the assets, and are commensurate to the risk and opportunity.</p> <p>6.8 The methods and processes are reviewed for their effectiveness in achieving asset management objectives and are updated as required.</p>
7	Operations & Maintenance Decision-Making	The management activities and processes involved in determining the Operations and Maintenance requirements in support of the Asset Management objectives and goals.	<ul style="list-style-type: none"> The organisation has not recognised this subject and/or there is no evidence of commitment to develop it. 	<ul style="list-style-type: none"> The organisation has identified the need to address this subject, and there is evidence of intent to develop it. Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place. 	<ul style="list-style-type: none"> The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans. Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation. 	<p>7.1 Operations & Maintenance (O&M) strategies are determined using the organization’s criteria for asset management decision-making.</p> <p>7.2 The methods and processes for determining O&M strategies are documented, where necessary, and are aligned with the asset management policy, asset management objectives and SAMP.</p> <p>7.3 The processes and methods are consistently applied across all assets and operations and consider asset criticality, remaining life of assets, required service levels, planned capital interventions and the balance between preventive and corrective maintenance. Records are available to demonstrate conformance.</p> <p>7.4 Risk is included in the evaluation of O&M strategies, including consideration of how risk changes with time.</p> <p>7.5 Asset performance, condition, costs and maintenance history is analysed regularly to verify the effectiveness of O&M strategies and identify the need for any changes.</p> <p>7.6 Review processes ensure that, where appropriate, capital interventions will be initiated at the appropriate time and considered through the capital investment decision making process.</p>
8	Life Cycle Value Realisation	The activities undertaken by an organization to balance the costs and benefits of different renewal, maintenance, overhaul and disposal interventions.	<ul style="list-style-type: none"> The organisation has not recognised this subject and/or there is no evidence of commitment to develop it. 	<ul style="list-style-type: none"> The organisation has identified the need to address this subject, and there is evidence of intent to develop it. Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place. 	<ul style="list-style-type: none"> The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans. Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation. 	<p>8.1 Criteria for ‘life cycle value’ are determined and documented using the organization’s criteria for asset management decision-making agreed with its stakeholders.</p> <p>8.2 The methods and processes for life cycle value realisation are documented, where necessary, and are aligned with the asset management policy, asset management objectives, Strategic Asset Management Plan, and methods and criteria used for capital investment decision-making and operations and maintenance decision-making.</p> <p>8.3 The processes and methods for life cycle value realisation are consistently applied across all assets and operations in determining the best combination of asset acquisition/creation, utilization, maintenance, improvement, renewal and disposal activities over the life cycle of assets (i.e. life cycle strategies). Records are available to demonstrate conformance.</p> <p>8.4 Risk is included in determining the life cycle strategies, including consideration of how risk changes with time.</p> <p>8.5 The organisation continually improves its approach to quantifying, modelling, forecasting, measuring and improving life cycle value.</p>

Asset Management Anatomy Question Set						
9	Resourcing Strategy	Determining and documenting the activities and processes to be undertaken by an organization in order to procure and use people, plant, tools and materials to deliver the Asset Management objectives and Asset Management Plan(s).	<ul style="list-style-type: none"> The organisation has not recognised this subject and/or there is no evidence of commitment to develop it. 	<ul style="list-style-type: none"> The organisation has identified the need to address this subject, and there is evidence of intent to develop it. Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place. 	<ul style="list-style-type: none"> The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans. Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation. 	<p>9.1 The organization determines the required asset management roles and the type and level of human resources required to establish, implement, maintain and improve its Asset Management System.</p> <p>9.2 The resourcing strategy is be consistent with all relevant mandatory and organizational policies and strategies.</p> <p>9.3 The organization determines the people, plant, equipment, tools and materials required for meeting the asset management objectives and for implementing the activities specified in the Asset Management Plan(s), including those activities required to support and enable those plans.</p> <p>9.4 The organization develops its resourcing strategy to source the required resources, including through recruitment, partnering, outsourcing or procuring the resources as appropriate.</p> <p>9.5 The resourcing strategy is aligned with the Strategic Asset Management Plan and takes into account the organization’s long term strategy, customer demand for its products/services, availability of skills in the market and the level of competition amongst the supply chain.</p> <p>9.6 The resourcing strategy considers costs and risks, including risks associated with the long term sustainability of the strategy.</p> <p>9.7 The resourcing strategy is communicated to all relevant functions within the organization, including HR, Procurement, etc. and is used in developing resourcing plans.</p> <p>9.8 The resourcing strategy is reviewed periodically in light of market conditions and updated to ensure it remains effective.</p>
10	Shutdowns & Outage Strategy	The activities taken by an organisation to develop a strategy for shutdown and outages.	<ul style="list-style-type: none"> The organisation has not recognised this subject and/or there is no evidence of commitment to develop it. 	<ul style="list-style-type: none"> The organisation has identified the need to address this subject, and there is evidence of intent to develop it. Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place. 	<ul style="list-style-type: none"> The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans. Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation. 	<p>10.1 Criteria for developing the shutdown and outage strategy are in line with the organization’s criteria for asset management decision-making agreed with its stakeholders.</p> <p>10.2 The shutdown and outage strategy is aligned with the asset management policy, asset management objectives and the Strategic Asset Management Plan.</p> <p>10.3 The shutdown and outage strategy considers the requirements of all internal stakeholders and the impact of planned shutdowns and outages on external stakeholders, including customers.</p> <p>10.4 The shutdown and outage strategy considers the trade-off between fewer and longer shutdown and outages against frequent and shorter shutdown and outages.</p> <p>10.5 The shutdown and outage strategy is consistently applied in the development and implementation of Asset Management Plan(s).</p> <p>10.6 The organization ensures that the AM Plan(s) take into account relevant requirements coming from outside the AM system.</p>
11	Technical Standards & Legislation	The processes used by an organisation to ensure its asset management activities are compliant with the relevant technical standards and legislation.	<ul style="list-style-type: none"> The organisation has not recognised this subject and/or there is no evidence of commitment to develop it. 	<ul style="list-style-type: none"> The organisation has identified the need to address this subject, and there is evidence of intent to develop it. Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place. 	<ul style="list-style-type: none"> The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans. Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation. 	<p>11.1 The organisation determines the full extent of financial, non-financial and technical information required to enable it to meet its obligations.</p> <p>11.2 The organisation has all relevant documented information required by applicable standards and legal and regulatory requirements to support the Asset Management System.</p> <p>11.3 The organisation has a process to ensure that any documents required by the Asset Management System and any standards and applicable legal and regulatory requirements are available and suitable for use when required and are adequately protected.</p> <p>11.4 The organisation has a process to create and regularly review and update the documented information.</p> <p>11.5 The organisation has a process to control the documented information, including the distribution and access, storage and preservation, version control and retention and/or disposal.</p> <p>11.6 The organisation has a process to identify and control documented information from sources outside the organisation that is required by the Asset Management System.</p> <p>11.7 Technical documents are aligned to and support the Asset Management System.</p> <p>11.8 The organisation is able to demonstrate how any changes to technical and legislative documentation are appropriately communicated.</p> <p>11.9 The organisation has a process in place to ensure that there is consistency and traceability between organisational data in compliance with any legal and regulatory requirements.</p>

Asset Management Anatomy Question Set						
12	Asset Creation & Acquisition	An organisation’s processes for the acquisition, installation and commissioning of assets.	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>12.1 The organisation determines and documents the processes and methods related to the acquisition and creation of assets.</p> <p>12.2 The organisation’s processes and methods related to the acquisition and creation of assets are integral to the life cycles of the assets.</p> <p>12.3 The organisation’s processes and methods related to the acquisition and creation of assets identify and manage the technical and non-technical risks associated with the acquisition and creation of assets for the organisation..</p> <p>12.4 The documented processes ensure that the acquisition and creation of assets is consistent with organisational standards and with Asset Management criteria.</p> <p>12.5 The acquisition process complies with legal and statutory requirements, including all relevant organisational policies and the Asset Management Policy.</p> <p>12.6 The organisation considers appropriate life cycle costing in the acquisition and creation of assets.</p> <p>12.7 The acquisition process utilises project management controls to ensure the timely and cost efficient delivery of the asset management plan(s) and consideration of relevant time horizons.</p>
13	Systems Engineering	An interdisciplinary, collaborative approach to derive, evolve and verify a life-cycle balanced system solution which satisfies customer expectations and meets public acceptability.	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>13.1 The organisation determines and documents the processes and methods to manage its assets throughout their lives</p> <p>13.2 The organisation considers the interaction and interdependency of assets operating as a system (or systems).</p> <p>13.3 The organisation has processes to ensure that overall system solutions are optimised for cost, risk and performance.</p> <p>13.4 The organisation has processes and methods that consider asset risks that will change over time and any residual liabilities beyond the period of operation or use of the asset(s).</p> <p>13.5 The Asset Management System is of an appropriate scale according to the nature and complexity of the organisation.</p> <p>13.6 The organisation has a process in place to ensure that the relevant systems engineering standards are followed.</p> <p>13.7 Ensure risk is considered and managed at a system level consistent with asset and other risk management processes.</p>
14	Configuration Management	A management process for establishing and maintaining consistency of a product's physical and functional attributes with its design and operational information throughout its life.	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>14.1 The organisation determines and documents the processes and methods to manage its assets throughout their lives</p> <p>14.2 The organisation determines its information requirements to support its assets throughout their lives and also to support its asset management system.</p> <p>14.3 The organisation has process(es) for assessing the impacts of planned changes and for managing risks that arise.</p> <p>14.4 The organisation has process(es) for internal and external dissemination of information that is relevant to its assets throughout their lives.</p> <p>14.5 The organisation has processes for evaluating and reporting asset and asset system performance</p> <p>14.6 The organisation has processes for identifying non-conformities or incidents related to its assets and asset systems and for taking appropriate action to deal with them.</p> <p>14.7 The organisation determines the requirements of how to identify and document asset information to enable the configuration of asset systems ensuring the physical and functional attributes are consistent with the design and operational requirements throughout its life.</p> <p>14.8 The organisation has clear processes defined for the collection and quality control of information and the addition of the information onto appropriate information systems.</p> <p>14.9 The organisation is compliant with relevant configuration management standards.</p>

Asset Management Anatomy Question Set						
15	Maintenance Delivery	The management of maintenance activities including both preventive and corrective maintenance management methodologies.	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>15.1 The organisation determines and documents the processes and methods to manage its assets throughout their lives</p> <p>15.2 The organisation determines the extent, resourcing, responsibilities and target achievement of actions required to manage its assets.</p> <p>15.3 The organisation plans, implements and controls the processes needed to implement the asset management plans</p> <p>15.4 The organisation determines its information requirements to support its assets throughout their lives and also to support its asset management.</p> <p>15.5 The organisation reviews the performance of its assets and asset systems and takes appropriate action to manage asset performance.</p> <p>15.6 The organisation has processes for identifying non-conformities or incidents related to its assets and asset systems and for taking appropriate corrective or preventive action to deal with them.</p> <p>15.7 The organisation has identified maintenance actions as part of process(es) and methods to manage its assets.</p> <p>15.8 The organisation reviews the effectiveness of its maintenance strategy to ensure optimal delivery.</p> <p>15.9 The organisation adapts maintenance as operating contexts, objectives and constraints change over time</p>
16	Reliability Engineering	The processes for ensuring that an item shall operate to a defined standard for a defined period of time in a defined environment.	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>16.1 The organisation determines and documents the processes and methods to manage its assets throughout their lives</p> <p>16.2 The organisation determines its information requirements to support its assets throughout their lives and also to support its asset management system.</p> <p>16.3 The organisation has process(es) for assessing the impacts of planned changes and for managing risks that arise.</p> <p>16.4 The organisation has processes for evaluating and reporting asset and asset system performance</p> <p>16.5 The organisation reviews the performance of its assets and asset systems and takes appropriate action.</p> <p>16.6 The organisation has processes for identifying non-conformities or incidents related to its assets and asset systems and for taking appropriate corrective or preventive action to deal with them.</p> <p>16.7 The organisation uses a root cause analysis process that is aligned with the reliability plan goals, and has developed preventative actions that consider cost, risks and performance.</p> <p>16.8 The organisation tracks mitigation actions resulting from root cause analysis, and carries out periodic reviews and revisions of the reliability plan to reflect root cause findings.</p> <p>16.9 The organisation is implementing and following a reliability plan which includes definitions of reliability goals and requirements.</p> <p>16.10 The organisation carries out systematic periodic reviews and revisions of reliability plans using appropriate tools and techniques.</p>
17	Asset Operation	The processes used by an organisation to operate its assets to achieve the business objectives.	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>17.1 The organisation is systematically managing the interaction between operations and other asset management activities over the lifecycle of the assets.</p> <p>17.2 The organisation is using operational processes to address identified risks and opportunities and corrective and preventive actions</p> <p>17.3 The organisation has in place processes to ensure that all operating requirements are aligned with the Asset Management System.</p> <p>17.4 The organisation clearly documents the processes, activities, responsibilities and risks related to outsourcing, and ensures the integration of outsourcing activities into the Asset Management System.</p> <p>17.5 The organisation has controls in place to ensure operational activities are carried out in accordance with the requirements specified.</p> <p>17.6 The organisation clearly documents in appropriate standards and specifications the operating requirements for all assets.</p> <p>17.7 The organisation retains documented information as assurance that operational activities have been undertaken in accordance with requirements.</p> <p>17.8 The organisation has implemented mechanisms to ensure appropriate interactions between operations and other functions over the lifecycle of the assets.</p> <p>17.9 The organisation has a change management process that controls, reviews and mitigates the consequences of planned changes.</p> <p>17.10 The organisation collects and assesses feedback and results from all operating activities and implements improvement to operating regimes as required.</p>

Asset Management Anatomy Question Set						
18	Resource Management	Implementing the Resourcing Strategy to manage the use of funds, people, plant, tools and materials in delivering asset management activities.	<ul style="list-style-type: none"> The organisation has not recognised this subject and/or there is no evidence of commitment to develop it. 	<ul style="list-style-type: none"> The organisation has identified the need to address this subject, and there is evidence of intent to develop it. Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place. 	<ul style="list-style-type: none"> The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans. Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation. 	<p>18.1 The organisation provides adequate resources for the management of the Asset Management System, in accordance with the resourcing strategy</p> <p>18.2 The organisation implements and controls the requirements of the resource strategy; which address the needs of the Asset Management Plan(s) and Asset Management System.</p> <p>18.3 The organization delivers activities through an aligned and integrated resource management process.</p> <p>18.4 The organisation allocates people resources to work in a systematic way which ensures and justifies the effectiveness and efficiency of resources.</p> <p>18.5 The organisation considers and justifies work priorities, risks and flexibility to changes in work plans, while allocating people and plant resources.</p> <p>18.6 The organisation's inventory and stock is delivered according to specific requirements within agreed timescales.</p> <p>18.7 The organisation maintains and calibrates all equipment and tools at appropriate frequencies that are consistent with the delivery of activities and objectives.</p> <p>18.8 The organisation applies consistent processes to ensure that outsourced resources meet internal and external specifications and requirements.</p>
19	Shutdown & Outage Management	An organisation's processes for identification, planning, scheduling, execution and control of work related to shutdowns or outages	<ul style="list-style-type: none"> The organisation has not recognised this subject and/or there is no evidence of commitment to develop it. 	<ul style="list-style-type: none"> The organisation has identified the need to address this subject, and there is evidence of intent to develop it. Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place. 	<ul style="list-style-type: none"> The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans. Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation. 	<p>19.1 Shutdown constraints have been considered when developing the Strategic Asset Management Plan and the Asset Management Plan.</p> <p>19.2 Planning of delivery activities associated with shutdowns and outages is consistent with shutdown strategy</p> <p>19.3 Processes are in place for managing and controlling shutdown activities to ensure the impact on service and stakeholders is minimised and measures are in place to ensure unplanned shutdowns are minimised and risk managed.</p> <p>19.4 Mechanisms are in place to maximise opportunities arising from unplanned or extended shutdowns.</p> <p>19.5 Effective communication is in place across lifecycle activities to ensure that shutdown plans are aligned in order to minimise downtime.</p> <p>19.6 Lessons learnt from shutdowns and outages are used to improve shutdown management</p>
20	Fault & Incident Response	Responding to failures and incidents in a systematic manner, including incident detection and identification, fault analysis, use of standard responses, temporary and permanent repairs as well as the taking over and handing back of sites.	<ul style="list-style-type: none"> The organisation has not recognised this subject and/or there is no evidence of commitment to develop it. 	<ul style="list-style-type: none"> The organisation has identified the need to address this subject, and there is evidence of intent to develop it. Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place. 	<ul style="list-style-type: none"> The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans. Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation. 	<p>20.1 The organisation has documented and systematic processes and/or plans in place for managing unplanned events - including nonconformities with Asset Management processes.</p> <p>20.2 Response plans include provision for adequate resources</p> <p>20.3 Response plans are integrated across the organisation</p> <p>20.4 The organisation has identified the scope, method and timing for analysis and evaluation activities for failures, incidents and non-conformities in order to determine the root cause(s)</p> <p>20.5 Evidence is retained of analysis of failures, incidents and non-conformities</p> <p>20.6 Procedures for investigation of incidents and reporting align with mandatory and other requirements.</p> <p>20.7 Processes are in place for planning and controlling the implementation of (permanent and/or temporary) treatment actions, including taking ownership of and handing back assets, where relevant treatment actions are proportionate to the nature and scale of the issue.</p> <p>20.8 Actions include, where applicable, elimination of the cause of nonconformity and any changes to the Asset Management System to prevent future occurrences.</p> <p>20.9 Records are kept of faults, incidents and non-conformities, actions taken and outcome of actions taken.</p>
21	Asset Decommissioning & Disposal	The processes used by an organisation to decommission and dispose of assets due to ageing or changes in performance and capacity requirements.	<ul style="list-style-type: none"> The organisation has not recognised this subject and/or there is no evidence of commitment to develop it. 	<ul style="list-style-type: none"> The organisation has identified the need to address this subject, and there is evidence of intent to develop it. Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place. 	<ul style="list-style-type: none"> The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans. Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation. 	<p>21.1 Decommissioning and disposal is considered as part of lifecycle cost and benefit analysis at all relevant stages of lifecycle management.</p> <p>21.2 Decommissioning and disposal activities are effectively planned, including the integration with other planning activities (such as human resource planning)</p> <p>21.3 Decommissioning and disposal processes are defined, documented and consistently applied.</p> <p>21.4 The organisation ensures records are made available to demonstrate the processes are being followed.</p> <p>21.5 Decommissioning processes ensure that asset information is updated and that all interfaces to assets that remain in service are managed.</p> <p>21.6 Documented asset information is kept for an agreed period beyond disposal of asset, in line with requirements and as defined in the organisation's records retention policy.</p>

Asset Management Anatomy Question Set						
22	Asset Information Strategy	The strategic approach to the definition, collection, management, reporting and overall governance of asset information necessary to support the implementation of an organisation's asset management strategy and objectives.	<ul style="list-style-type: none"> The organisation has not recognised this subject and/or there is no evidence of commitment to develop it. 	<ul style="list-style-type: none"> The organisation has identified the need to address this subject, and there is evidence of intent to develop it. Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place. 	<ul style="list-style-type: none"> The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans. Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation. 	<p>22.1 The organisation determines what asset management information is required to support its assets, management of assets, the AM System and organizational objectives.</p> <p>22.2 The organization has a documented Asset Information Strategy that is consistent and aligned with the SAMP.</p> <p>22.3 • Development of the strategy considers:</p> <ul style="list-style-type: none"> o the significance of identified risks on information requirements. o information required to support key decisions required within asset management processes, procedures and activities. o the exchange of information with stakeholders, including service providers. o how and when information is to be collected, analysed and evaluated. o impact of quality, availability and management of information on its' organizational decision-making. <p>22.4 The strategy defines the quality required of asset information.</p> <p>22.5 The strategy is designed to ensure there is appropriate traceability and consistency between financial and non-financial information relevant to asset management to the extent required to meet its legal, regulatory and stakeholder requirements and organisational objectives.</p> <p>22.6 The strategy contains objectives relating to proposed improvements in asset information that are SMART including the identification of gaps between the currently available information (including its quality and accuracy) and that which is required.</p> <p>22.7 The strategy identifies the processes that are required to manage asset information and assure its quality, along with their governance, including responsibilities and accountabilities, and any programmes to improve these processes.</p> <p>22.8 The strategy contains information system business requirements necessary to support the organization's business processes and information needs.</p> <p>22.9 The strategy includes processes to ensure asset information retains alignment to needs as the organization's requirements evolve including migration of data and users from existing systems to new systems.</p> <p>22.10 The requirements are determined for aligning terminology (financial and non-financial) relevant to asset management across the organization.</p>
23	Asset Information Standards	The specification of a consistent structure and format for collecting and storing asset information and for reporting on the quality and accuracy of asset information.	<ul style="list-style-type: none"> The organisation has not recognised this subject and/or there is no evidence of commitment to develop it. 	<ul style="list-style-type: none"> The organisation has identified the need to address this subject, and there is evidence of intent to develop it. Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place. 	<ul style="list-style-type: none"> The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans. Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation. 	<p>23.1 The organization has developed standards and guidelines to ensure a consistent approach to the recording of asset information to meet the asset information needs defined in the Asset Information Strategy.</p> <p>23.2 The information structure has a hierarchy for assets, and enables the recording of their physical location.</p> <p>23.3 There are definitions for the attributes required for asset information, including acceptable values and quality criteria.</p> <p>23.4 The information structure enables collection of data on asset utilisation, condition and performance, incidents and non-conformities and describes how these should be recorded in order to support strategic Asset Management planning, improve service and reliability, support long and short term planning activities and help determine overall asset lives and intervals between intervention activities.</p> <p>23.5 The organization has defined the quality and accuracy that is required for all asset information.</p> <p>23.6 The organization has defined how the quality and accuracy of all asset information is to be assessed.</p>
24	Asset Information Systems	The asset information systems an organization has in place to support the asset management activities and decision-making processes in accordance with the Asset Information Strategy.	<ul style="list-style-type: none"> The organisation has not recognised this subject and/or there is no evidence of commitment to develop it. 	<ul style="list-style-type: none"> The organisation has identified the need to address this subject, and there is evidence of intent to develop it. Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place. 	<ul style="list-style-type: none"> The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans. Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation. 	<p>24.1 The organization has identified the necessary asset information systems and architecture required in order to collect, store, process and analyse the asset information to manage its assets over their life cycle and deliver the Asset Information Strategy.</p> <p>24.2 The organization has an Asset Information Systems implementation plan and migration plans (when required), which include governance arrangements.</p> <p>24.3 The organization has implemented, in accordance with the organisation's IT strategy, the systems required in order to deliver the Asset Information Strategy.</p> <p>24.4 There is consideration of the optimum mix of software applications, taking account of the size and complexity of the organization and the regulatory environment it operates in. This includes an analysis of the costs and benefits of implementing new or updated asset information systems; evaluation of how systems can be used to automate business processes; an assessment of compatibility between existing business processes and IT solutions.</p> <p>24.5 The organization has clearly defined system ownership responsibilities.</p> <p>24.6 The asset information system contains a robust reporting system.</p>

Asset Management Anatomy Question Set						
25	Data & Information	The data and information held within an organization's asset information systems and the processes for the management and governance of that data and information.	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>25.1 There are governance processes to provide assurance that information is consistent with the quality and accuracy requirements defined in the Asset Information Strategy and asset information standards.</p> <p>25.2 There are data collection and maintenance plans to address any information gaps identified in the Asset Information Strategy.</p> <p>25.3 There are processes to ensure provision of asset information resulting from asset interventions.</p> <p>25.4 Suitable controls are incorporated into the business decision making process to ensure data of the required data quality is used to inform the decision.</p> <p>25.5 Processes and governance for managing asset management information are specified, implemented and maintained.</p> <p>25.6 There are processes and systems in place for the storage and preservation, distribution, access, retrieval and use of data and information to ensure that required information is available and suitable for use, where and when it is needed.</p> <p>25.7 Information is adequately protected, including from loss of confidentiality, improper use or loss of integrity.</p> <p>25.8 There are processes in place for the control of changes to data and information</p> <p>25.9 Information is adequately protected, including from loss of confidentiality, improper use or loss of integrity.</p> <p>25.10 There are processes in place for the control of changes to data and information</p> <p>25.11 There are processes and systems in place for the retention and disposition of data and information.</p> <p>25.12 Documented information originating from outside the organization and determined to be necessary for asset management activities is identified and controlled.</p>
26	Procurement and supply chain management	The processes used by an organisation to ensure that all outsourced asset management activities are aligned with the asset management objectives of the organisation and to monitor the outcomes of these activities against these objectives	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>26.1 The organization identifies Asset Management activities that are appropriate for outsourcing and those which should remain in-house.</p> <p>26.2 The organization provides the resources required for meeting the Asset Management Objectives and for implementing the activities specified in the Asset Management Plans, including outsourced activities.</p> <p>26.3 Where the organization develops processes and sets objectives for outsourced Asset Management activities these are fully aligned with the Strategic Asset Management Plan and Asset Management Objectives, the Asset Management System and other internal processes.</p> <p>26.4 The organization establishes risk and opportunity management processes that ensure outsourced processes and activities are controlled consistent with achieving Asset Management Objectives and which are integrated with the Asset Management System.</p> <p>26.5 Responsibilities and authorities for the management of outsourced activities are clearly defined and documented.</p> <p>26.6 The organizational resourcing strategy includes the selection of appropriate service providers and the development of clear criteria and service levels.</p> <p>26.7 The organization specifies and clearly documents the requirements, scope, and the means for information and knowledge sharing for outsourced activities.</p> <p>26.8 The organization ensures that outsourced activities meet requirements of competency, awareness and documentation consistent with Asset Management System requirements.</p> <p>26.9 The organization establishes and implements contracts with appropriate incentive schemes, and actively builds sustainable, long-term relationships with suppliers.</p> <p>26.10 The organization ensures that the performance of outsourced activity is adequately monitored through the establishment of appropriate performance indicators consistent with Asset Management System requirements.</p> <p>26.11 The organization monitors commercial circumstances and ownership structures of service providers and suppliers to ensure relationship viability and longevity.</p> <p>26.12 The organization establishes processes for minimizing risk when transitioning from one supplier to another.</p>

Asset Management Anatomy Question Set						
27	Asset Management Leadership	The leadership of an organisation required to promote a whole life asset management approach to deliver the organisational and asset management objectives of the organisation	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>27.1 Top management demonstrate leadership and commitment to Asset Management by ensuring Asset Management Policy, Strategic Asset Management Plan and Asset Management Objectives are established and are aligned to the organisational objectives.</p> <p>27.2 Top management ensures the Asset Management System requirements are integrated into business processes and that the Asset Management System achieves intended outcomes.</p> <p>27.3 Top management ensures resources for the Asset Management System are available and actively directs and supports people to contribute to effective Asset Management.</p> <p>27.4 Leaders support and influence staff to deliver the Asset Management Strategy and objectives of the organization.</p> <p>27.5 Leaders communicate the importance of asset management and Asset Management System requirements in a clear and concise manner.</p> <p>27.6 Top Management actively promotes cross-functional working and supports leadership in Asset Management.</p> <p>27.7 Leaders demonstrate, by their behaviour, commitment to values and principles of Asset Management set out in the Asset Management Policy, Objectives and Strategic Asset Management Plan.</p> <p>27.8 Top management ensures alignment and integration of asset risk into the organisational risk management system.</p> <p>27.9 Leaders promote continual improvement.</p> <p>27.10 Leaders are responsible for ensuring that Asset Management decisions are taken by the relevant role.</p> <p>27.11 Top management provides stakeholder confidence of the direction being taken and benefits that will be achieved.</p> <p>27.12 Top management and leaders endorse all key Asset Management System documentation.</p> <p>27.13 Top Management and leaders identify the interfaces between Asset Management activities and other organizational activities.</p>
28	Organisational Structure	The structure of an organisation in terms of its ability to deliver the organizational and asset management objectives.	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>28.1 The organization clearly understands its purpose and gives consideration to multiple factors (e.g. sector, product, service, location, scale, customers and stakeholders) and whether assets and Asset Management are central to its purpose or enablers.</p> <p>28.2 The organization considers both external and internal factors when designing an appropriate structure (e.g. social, cultural, political, legal, regulatory, financial, technological, economic, environmental, internal governance, capability, policies, strategies, objectives etc.)</p> <p>28.3 The organization designs and implements an appropriate organizational structure that clearly and unambiguously identifies roles, authorities and responsibilities.</p> <p>28.4 Roles and responsibilities are sufficiently understood by everybody, communicated, maintained and updated as required.</p> <p>28.5 Top management assigns responsibility and authority for ensuring the adequacy, ongoing suitability and effectiveness of the Asset Management System and ensuring that the Asset Management System supports delivery of the Strategic Asset Management Plan.</p> <p>28.6 Top management assigns responsibility and authority for the establishment and update of the Strategic Asset Management Plan, Asset Management Objectives and Asset Management Plans</p> <p>28.7 Decision-making processes are clearly defined across the cross-functional organizational structure and management is best placed to be a leader in taking key performance and reliability decisions.</p> <p>28.8 The organizational structure is resourced consistent with its roles, responsibilities and workload to enable effective performance of the organization and delivery of Asset Management Objectives, statutory and stakeholder requirements.</p> <p>28.9 Competency requirements and training are aligned and consistent with the organizational structure.</p> <p>28.10 Individuals challenge the way of working to continuously improve the Asset Management System.</p> <p>28.11 Top management assigns the responsibility and authority for reporting the performance of the Asset Management System back up to top management.</p>

Asset Management Anatomy Question Set						
29	Organizational Culture	The culture of an organization in terms of its ability to deliver the organizational and asset management objectives	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>29.1 The organization identifies internal and external issues relevant to its purpose and considers these in designing its Asset Management System.</p> <p>29.2 Every individual in the organisation perceives Asset Management as a good investment with positive long term benefits.</p> <p>29.3 There is consistent self-discipline at all levels in the organisation as an observable habit.</p> <p>29.4 Top management proactively shapes organisational culture to ensure observed behaviours align with organizational values, the Asset Management Policy, and achievement of Asset Management Objectives.</p> <p>29.5 The organization ensures roles and responsibilities are assigned and conducive to collaborative and cross-functional Asset Management thinking.</p> <p>29.6 The organization has an embedded culture of risk management and all persons working under the organization's control are trained and made aware of the activities they are responsible for, the associated risks and required controls, and opportunities are systematically captured and where appropriate progressed.</p> <p>29.7 The organization considers and plans for the long term and values processes as well as outputs.</p> <p>29.8 Top management promotes collaborative and participative consultation to understand and address the cultural challenges that the organisation faces.</p> <p>29.9 A clear chain of command and communication processes exist in the organization and everybody understands how to escalate issues.</p> <p>29.10 The organization identifies and determines the aspects of culture that need to change and the pathway between current and desired culture.</p> <p>29.11 The organisation actively identifies barriers and constraints for culture change and proactively plans to remove or mitigate. The organization establishes effective processes for culture change and identifies the mechanisms of change that are most effective.</p> <p>29.12 The organization is a 'learning organization' with consistency in understanding, behaviour and good practice.</p>
30	Competence Management	The processes used by an organisation to systematically develop and maintain an adequate supply of competent and motivated people to fulfil its asset management objectives including arrangements for managing competence in the boardroom and the workplace.	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>30.1 The organisation establishes a Competence Management System which aligns all required asset management competences to the roles and responsibilities identified within the organisation's Asset Management System.</p> <p>30.2 The Competence Management System incorporates processes for identifying competency requirements for asset management activities and assessing competence of resources both internal and external.</p> <p>30.3 The organization takes necessary actions to acquire competent persons and evaluates the effectiveness of such actions.</p> <p>30.4 The Competence Management System is utilised to support the recruitment, development and training of all staff within the Asset Management System.</p> <p>30.5 The organization ensures persons are competent on the basis of education, training and/or experience.</p> <p>30.6 The organization identifies appropriate activities to address any gaps in competence.</p> <p>30.7 The organisation retains appropriate documented information as evidence of competence, for both internal and outsourced resources.</p> <p>30.8 The organization periodically reviews current and future competency requirements.</p> <p>30.9 The organization proactively forecasts competence requirements to support the development of the Asset Management System and the delivery of the Strategic Asset Management Plan.</p>

Asset Management Anatomy Question Set						
31	Risk Assessment and Management	The policies and processes for identifying, quantifying and mitigating risk and exploiting opportunities.	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>31.1 Top management ensures that the management of asset management risks is aligned the organization's risk management approach.</p> <p>31.2 The organization's approach to risk and opportunity assessment and management ensures compliance with legal, statutory requirements and is consistent with stakeholder requirements and expectations.</p> <p>31.3 The organization assesses the risks and opportunities associated with outsourcing any activities that can have an impact on the achievement of its asset management objectives</p> <p>31.4 The organization determines the risks and opportunities to be addressed to: a) enable the asset management system to achieve its required outcomes b) prevent or reduce undesired effects on the asset management system c) continually improve the asset management system</p> <p>31.5 The organization assesses how these risks and opportunities can change over time.</p> <p>31.6 The organization creates and carries out action plans to address the risks and opportunities and integrates the actions into its asset management processes.</p> <p>31.7 The organization evaluates the effectiveness of its actions to address risks and opportunities.</p> <p>31.8 The organization has documented risk management processes for assets and asset management activities to: a) Identify and assess risks and opportunities; b) Identify the criticality of assets with respect to achievement of asset management objectives; c) Select and implement appropriate treatments for risks and opportunities; d) Monitor these treatments and their effectiveness;</p> <p>31.9 The organization ensures that staff carrying out risk and opportunity assessment are competent to perform the activity.</p> <p>31.10 The organization documents its risks in a way that supports the identification, recording, evaluation, ranking/ prioritizing, reporting, review, , updating and archiving and closure of business risk records.</p> <p>31.11 The organization manages risks and opportunity arising from the management of change, and assesses risks which can impact on achievement of objectives before the change is implemented.</p> <p>31.12 The organization includes the treatment and monitoring of risks and opportunities in its processes for operational planning and control.</p> <p>31.13 The organization evaluates and reports on the effectiveness of its processes for managing risks and opportunities.</p>
32	Contingency Planning & Resilience Analysis	The processes and systems put in place by an organization to ensure it is able to continue to either operate its assets to deliver the required level of service in the event of an adverse impact or maintain the safety and integrity of the assets (whether or not they operate).	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>32.1 Top management ensures that the management of asset management risks is aligned with the organization's risk management approach including contingency planning</p> <p>32.2 The organization has considered and evaluated asset and other risks (internal and external) that impact on the capability of assets to deliver the required continuity of business functions under adverse conditions.</p> <p>32.3 The organization has established processes to proactively identify potential failures in asset performance and evaluate the need for preventive action addressed through contingency plans.</p> <p>32.4 The organization's operational planning and control processes include documented contingency management processes for the risks that have been identified that this is appropriate.</p> <p>32.5 Contingency plans and/or procedures include information on: a) establishing levels of command and person in charge for each event type b) responsibility matrix and escalation criteria c) the provision of resources, and the maintenance of any equipment, facilities or services that could be required during disruptions, incidents or emergency situations; d) identifying required support organisations, with their specified responsibilities, needed for each type of event (or phase of an event), including contact details; e) contacts and arrangements for internal and external communication; f) how critical asset management activities will be maintained or restored in the event of disruption; g) recording of essential information whilst responding to, and managing, incidents and emergencies; h) the process for returning to normal operations.</p> <p>32.6 The organization tests its contingency plans on a regular basis, as far as is reasonably practicable, and implements the appropriate lessons learned.</p> <p>32.7 The organization seeks continual improvement of its contingency planning</p>

Asset Management Anatomy Question Set						
33	Sustainable Development	The interdisciplinary, collaborative processes used by an organisation to ensure an enduring, balanced approach to economic activity, environmental responsibility and social progress to ensure all activities are sustainable in perpetuity.	<ul style="list-style-type: none"> The organisation has not recognised this subject and/or there is no evidence of commitment to develop it. 	<ul style="list-style-type: none"> The organisation has identified the need to address this subject, and there is evidence of intent to develop it. Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place. 	<ul style="list-style-type: none"> The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans. Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation. 	<p>33.1 The organisation determines the external issues that are relevant to its purpose, including its environmental, social and financial impacts,</p> <p>33.2 The organisation determines the requirements and expectations of stakeholders with respect to the environmental, social and financial impacts of its asset management activities.</p> <p>33.3 The organization demonstrates that it takes account of the external issues and stakeholder requirements related to environmental, social and financial impacts in the development of its AM policy, AM objectives, SAMP and AM plans.</p>
34	Management of Change	An organization's processes for the identification, assessment, implementation and communication of changes to people, processes and assets.	<ul style="list-style-type: none"> The organisation has not recognised this subject and/or there is no evidence of commitment to develop it. 	<ul style="list-style-type: none"> The organisation has identified the need to address this subject, and there is evidence of intent to develop it. Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place. 	<ul style="list-style-type: none"> The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans. Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation. 	<p>34.1 The organisation has documented policies & processes for dealing with changes to physical assets, asset management processes and the supporting resources</p> <p>34.2 The organization carries out risk and opportunity assessment on any planned change that can affect the delivery of asset management objectives prior to the implementation of the changes.</p> <p>34.3 The management of risks associated with changing assets or asset management activities is consistent with the organisation's documented risk management processes .</p> <p>34.4 The organization controls planned changes and reviews the unintended consequences of the changes as required. The organization mitigates adverse effects as required.</p> <p>34.5 Records are available to demonstrate that change management processes and plans are followed.</p>
35	Assets Performance & Health Monitoring	The processes and measures used by an organization to assess the performance and health of its assets using performance indicators.	<ul style="list-style-type: none"> The organisation has not recognised this subject and/or there is no evidence of commitment to develop it. 	<ul style="list-style-type: none"> The organisation has identified the need to address this subject, and there is evidence of intent to develop it. Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place. 	<ul style="list-style-type: none"> The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans. Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation. 	<p>35.1 The organization determines its requirements to monitor and measure the performance and health of its assets, including:</p> <p>a) What is to be monitored and measured</p> <p>b) Methods of monitoring, measurement, analysis and evaluation to ensure results are valid</p> <p>c) Establishing criteria to understand when there is deviation from the required level of performance, and if appropriate identify as a non-conformance</p> <p>d) The frequency of monitoring, measurement, analysis and evaluation</p> <p>35.2 The organization reports on asset performance, including asset health, in accordance with stakeholder requirements</p> <p>35.3 The organization develops a hierarchy of asset performance and asset health reporting through the organization appropriate to the needs and decisions that are being managed</p> <p>35.4 The organization develops a range of leading and lagging performance measures for its assets</p> <p>35.5 The organisation establishes monitoring and reporting that allows for the prediction of future asset performance & health</p> <p>35.6 The organization regularly reviews asset performance and asset health monitoring, measurement, analysis and evaluation to ensure that it supports the achievement of asset management objectives and to identify opportunities for improvement.</p> <p>35.7 The organization maintains records of asset performance and asset health monitoring, analysis and evaluation</p>

Asset Management Anatomy Question Set						
36	Asset Management System Monitoring	The processes and measures used by an organization to assess the performance and health of its Asset Management System.	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>36.1 The organization determines its requirements to monitor and measure the effectiveness of the asset management system, including:</p> <p>a) What is to be monitored and measured for financial and non-financial performance (including the extent to which the organisation follows the elements of the AM system)</p> <p>b) methods of monitoring, measurement, analysis and evaluation to ensure results are valid</p> <p>c) Establishing criteria to understand when there is deviation from the required level of performance, and if appropriate identify as a non-conformance</p> <p>d) The frequency of monitoring, measurement, analysis and evaluation</p> <p>36.2 The organization reports on the effectiveness of its asset management system, in accordance with stakeholder requirements.</p> <p>36.3 The organization has in place a hierarchy of asset management performance reporting through the organization appropriate to the needs and decisions that are being managed</p> <p>36.4 The organization has in place a range of leading and lagging performance measures for its asset management processes</p> <p>36.5 The organization evaluates its processes for managing risks and opportunities in the asset management system and reports on their effectiveness</p> <p>36.6 The organization regularly reviews its asset management system monitoring, measurement, analysis and evaluation of the asset management system and implements these where they are found to be beneficial and cost effective.</p> <p>36.7 The organization maintains records of asset management system monitoring, analysis and evaluation.</p>
37	Management Review, Audit and Assurance	An organization’s processes for reviewing and auditing the effectiveness of its asset management processes and asset management system.	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>37.1 The organisation has documented audit policies and processes.</p> <p>37.2 The organization carries out internal audits in accordance with its programme, to confirm that the asset management system meets:</p> <p>a) its own requirements</p> <p>b) the requirements of ISO55001.</p> <p>37.3 The organization determines the frequency and content of internal audit of its asset management system</p> <p>37.4 The organization periodically reviews and continually develops the audit programme to reflect the relative importance of the organization’s processes and the results of previous audits</p> <p>37.5 The organization demonstrates that the audits are objective and impartial by:</p> <p>a) Using competent auditors, independent of those having direct responsibility for the activity being examined.</p> <p>b) Conducting audits in accordance with agreed definitions for scope and audit criteria</p> <p>c) Retaining records of the audit results</p> <p>37.6 The organization reports the audit findings to the appropriate level of management</p> <p>37.7 The organization’s top management reviews the asset management system, to ensure its suitability, adequacy and effectiveness, by:</p> <p>a) Conducting the review in accordance with a planned schedule</p> <p>b) Considering the status of actions from previous management reviews</p> <p>c) Assessing changes in issues that are relevant to the asset management system</p> <p>d) Assessing trend analysis of non-conformities and corrective actions, results derived from monitoring and measurement, and audit reports</p> <p>e) Receiving reports on asset management activity</p> <p>f) Considering improvement opportunities</p> <p>g) Considering changes in risk and opportunity profiles</p> <p>h) deciding on continual improvement actions and changes needed to the asset management system</p> <p>37.8 The organization produces and keeps records of the top management review.</p>

Asset Management Anatomy Question Set						
38	Asset Costing and Valuation	An organization’s processes for defining and capturing ‘as built’, maintenance and renewal unit costs and the methods used by an organization for the valuation and depreciation of its assets.	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>38.1 The organization determines the financial and technical data and information that is necessary to enable the management of its assets.</p> <p>38.2 The organization ensures that data and information are aligned to the achievement of the organization’s objectives.</p> <p>38.3 The organization determines that these data and information enable the organization to fulfil its:</p> <p>a)legal and regulatory obligations</p> <p>b)stakeholder requirements</p> <p>c)needs to make informed decisions on asset management issues</p> <p>38.4 The organisation has an Asset valuation register and a documented valuation methodology</p> <p>38.5 The organisation has documented processes for capturing ‘as-built’ capital costs.</p> <p>38.6 The organization reviews the financial and technical data and information periodically in the light of developments in quantitative and qualitative analytical measures and also the importance and complexity of the decisions being made</p> <p>38.7 The organization implements changes to the measurement, collection and analysis of financial and technical data and information that support asset costing and valuation where it is beneficial</p>
39	Stakeholder Engagement	The methods an organization uses to engage with stakeholders.	<ul style="list-style-type: none">• The organisation has not recognised this subject and/or there is no evidence of commitment to develop it.	<ul style="list-style-type: none">• The organisation has identified the need to address this subject, and there is evidence of intent to develop it.• Processes are poorly controlled and reactive. Performance is unpredictable. Proposals may be under development and some basic requirements may be in place.	<ul style="list-style-type: none">• The organisation has identified the means of systematically and consistently achieving competency in this subject, and can demonstrate that these are being progressed with credible and resourced plans.• Processes may be planned, documented, applied and controlled at a local level or within functional departments, often in a reactive mode but able to achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.	<p>39.1 The organization identifies the people and organizations that:</p> <p>a)can have an impact on the asset management system,</p> <p>b)can experience the consequences of actions and decisions arising from the asset management system,</p> <p>c)perceive that they could be affected by actions and decisions arising from the asset management system.</p> <p>39.2 The organization has developed and implemented a strategy to engage with stakeholders. This includes determination of:</p> <p>a)the needs and expectations of stakeholders with respect to asset management,</p> <p>b)the criteria which are to be considered when making decisions in asset management,</p> <p>c)the range of asset management information that is necessary to support stakeholder relationships,</p> <p>d)the necessary arrangements to report the information to internal and external stakeholders</p> <p>39.3 The stakeholder identification process and engagement strategy are aligned with the Asset Management System and takes into account the organization's external and internal contexts.</p> <p>39.4 The stakeholder identification process and engagement strategy is are reviewed periodically in light of changes to external and internal conditions and updated to ensure it they remains effective</p> <p>39.5 Consultation with, and reporting to, stakeholders is conducted at a frequency and in formats, language and level of detail suitable to the needs of each of the stakeholders</p>

Appendix B

Records of Workshop and Meeting Notes



Meeting Minutes

245 Consumers Road, Suite 400
Toronto, Ontario M2J 1R3
Canada
T +1.416.499.9000

www.jacobs.com

Subject	GDS - Strategy and Planning Meeting Notes		
Project	Enbridge Asset Management Maturity Review		
Project No.	CE777500	File	2020-07-27 GDS Strategy and Planning - Meeting Notes
Prepared by	Catherine Simpson, RPP, MCIP	Phone No.	604-346-9428
Location	Web-based	Date/Time	July 27, 2020
Participants	Catherine McCowan, Manager Risk, Strat & Planning Danielle Turney, Specialist II AM Integration Erik Naczynski, Manager Asset Classes Distribution Michael Vettese, Specialist II AM Stations Danielle Dreveny, Supervisor Capital FP&A Mike Hildebrand, Mgr Asset Classes Storage & Transmission Steve Dinopoulos, Specialist Proj Plan Design Kevin Bando, Manager Operations Angela Scott, Manager Integrity Management		
Observers	Rebecca Mayhew, EAM Governance		
Facilitators	Andy Whittaker, Jacobs Catherine Simpson, Jacobs		

Notes	Action
<p>0 Introductions (Gas Distribution)</p> <ul style="list-style-type: none"> ▪ Part of way through the second year of AM program ▪ Did an assessment a couple years ago ▪ Refocused plans and resources where needed ▪ Objective is to hit targeted step changes within certain areas of EAM ▪ Engaged Jacobs – endorsed IAM assessors ▪ First chance to baseline as an integrated utility ▪ Today: Run through IAM 39 elements (20 this morning focused on strategy and planning) <ul style="list-style-type: none"> – 18 priority subjects previously identified which we will concentrate on more – Working towards a consensus – Wil document rationale behind score, and evidence 	



Meeting Minutes

GDS - Strategy and Planning Meeting Notes
July 27, 2020

Notes	Action
<p>1 Asset Management Policy</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> – 3 ▪ Rationale <ul style="list-style-type: none"> – Policy in place and updated annually to reflect organizational priorities – Incorporated in strategic asset management plan – Published in public record – Communication and training to lowest levels of the organization may not be all the way there – Field staff (such as, a meter reader) probably can't recite the policy – There is awareness more than being able to recite the policy; can find quickly when a search is done – There is a gap on processes being sufficiently implemented – Everything identified under maturity level 3 is applicable ▪ Evidence <ul style="list-style-type: none"> – Policy 	
<p>2 Asset Management Strategy & Objectives</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> – 2.5 SAMP – 2 AM objectives – 2 overall ▪ Rationale <ul style="list-style-type: none"> – Have a SAMP – Roadmap for target operating model but that's separate from SAMP and is not measurable – Measurability of some objectives a challenge – Need to re-think; not final or rolled out to organization – Have financials but not solid; have measures and pieces but two sides of the organizations coming together and still need work; can't get consensus on demonstrability of effectiveness of organization; work in progress – Have top level performance measures but not linked to asset base – Performance varies across asset classes: non-gas assets pretty clear; to a greater extent with distribution assets; fall down in other areas like tying compression reliability with criticality of specific assets – Process not integrated 	



Meeting Minutes

GDS - Strategy and Planning Meeting Notes
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Notes	Action
<ul style="list-style-type: none"> - Process documentation could be stronger ▪ Evidence <ul style="list-style-type: none"> - SAMP - Target Operating Model – Roadmap - Top level performance measures <p>3 Demand Analysis</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 3 but will follow-up with some other individuals ▪ Rationale <ul style="list-style-type: none"> - Area of strength – planning and network analysis both have annual processes that re-evaluate need for product - Get expansion and growth projects into the plan for analysis - We are very good at this as a core business; things we could do better would take us to a 4 - This is an opportunity ▪ Evidence <ul style="list-style-type: none"> - ▪ Other People to Engage <ul style="list-style-type: none"> - Contract sales – Previously Ryan Oregon’s team - Business development – Hillary - System planning - Distribution planning - Storage planning - Connected to network analysis 	<p>Rebecca to identify specific people for follow-up; Jacobs to follow-up</p>
<p>4 Strategic Planning</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 3 at least ▪ Rationale <ul style="list-style-type: none"> - In good shape financially; taking inputs on demand forecasts and ensuring relationship to AM; from overall financial forecast ensuring alignment with strategic planning - Various levels of risk-based analysis on parts of asset - Asset plans for each asset class has a set of asset strategies: Section 5 of asset plan there is a set of documents and strategies that outline balancing risk and safety, capital and O&M, etc. - All in alignment of business - Have strategic planning processes in place for demand forecasts for growth and to address existing asset base 	



Meeting Minutes

GDS - Strategy and Planning Meeting Notes
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Notes	Action
<ul style="list-style-type: none"> - Documented growth and need to expand based on specific regulations (such as, energy board) ▪ Evidence <ul style="list-style-type: none"> - Asset Plans - Processes (such as, demand forecasts) <p>5 Asset Management Planning</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 2.5+ ▪ Rationale <ul style="list-style-type: none"> - Hitting most but missing resource requirements to get to plan (not understood or documented) / end state - Asset managers do review plan with executing groups to ensure ability to implement; and make changes if need - Connecting engineering resources to plan is cursory and room for improvements; don't have a direct line between \$s spent and number of engineering hours - Give and take; best is review with stakeholders after 1st iteration of optimization and adjust accordingly; facilitate conversations - Focus on execution hours as opposed to things required to get projects ready - What new O&M requirements not consistently understood (based on new projects, there isn't a lot of rigor to O&M associated – S&T time for example there isn't a lot of solid analysis) ▪ Evidence <ul style="list-style-type: none"> - AMP exists (latest edition to be published in Aug) 	
<p>6 Capital Investment Decision-Making</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 2.5 or 3 during discussion - 2.5 consensus ▪ Rationale <ul style="list-style-type: none"> - Pretty strong with capital investment decision-making - Risk assessments with rules on when higher level assessments are undertaken - Effort on capital investment decisions high; have strong documentation and planning to inform decision-making - Not a well-oiled machine; road feels bumpy; have alignment and systematic method in place but fine tuning is needed - Using C55 but O&M is missing in part; more rigorous on capital 	



Meeting Minutes

GDS - Strategy and Planning Meeting Notes
July 27, 2020

Notes	Action
<ul style="list-style-type: none"> - Depends on asset class - For some assets there is a need to improve clarity for process ▪ Evidence <ul style="list-style-type: none"> - Business case processes - flow charts <p>8 Life Cycle Value Realization</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 2 at best - 1.5 consensus ▪ Rationale <ul style="list-style-type: none"> - Not systematically and consistency achieving competency on O&M - Do in key areas and those with risk drivers - Unsure if this is done well in areas that aren't tied directly to capital spend projects - S&T side more reactive - Non-gas carrying assets are stronger - Know what we need to do in some cases - Explored ability to manage lifecycle costs; a lot of room for growth ▪ Evidence <ul style="list-style-type: none"> - Example: fleet being done well 	
<p>11 Technical Standards & Legislation</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 2.5 to 3 during discussion - 2.5 consensus - A lot of evidence to point to a 3 ▪ Rationale <ul style="list-style-type: none"> - Note: Associated primarily with design phase of assets to apply to a design or modification to ensure meeting of external requirements (regs.) but also good practice - Definitely have this for commodity carrying assets - Have for buildings also - have standardized documents to allow for consistent and repeatable design and execution of real estate - Higher level of maturity on gas carrying side and for engineering - Regulatory management of change with group that changes the standards and is sent through Maximo for determination about whether this affects asset management 	



Meeting Minutes

GDS - Strategy and Planning Meeting Notes
July 27, 2020

Notes	Action
<ul style="list-style-type: none"> - In middle of integration so have 2 sets of standards, processes and procedures (each legacy company had this); this is a 3-4 year process to update documentation to one company - Exist in legacy organizations – whole change processes in place along with approach to use until transition is complete - Our maturity as one integrated organization is lower - Have had a mismatch in technical standards between head office, engineering office v. major/core projects; may not have a harmonized set of design standards and has been a struggle in the past - Some mismatch has been cleaned up; core project team is to build standards in place at that location (local legacy standards); not a consistent standard but do have a consistent process - Gaps: slight lack of clarity and integration of two organizations - Confirm that it's clear to construction groups what standard they are building to ▪ Evidence <ul style="list-style-type: none"> - Standardized documents - A lot of evidence 	
<p>12 Asset Creation & Acquisition</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 1-2.25 during discussion - 2.25 consensus ▪ Rationale <ul style="list-style-type: none"> - Have a recent initiative to develop a standard and process for asset turnover between projects organization and operations - Great training plans, maintenance strategies, commissioning activities do a really great job - Do a good job but would have a hard time producing documentation on commissioning and back-end handover - Front end design processes with projects organization follows a project lifecycle gating controls process which is very robust - Need for more rigor with turnover - Do thousands every year and well laid out and understood (front end) for service installations - Changes and modifications are spotty ▪ Evidence <ul style="list-style-type: none"> - Training plans 	



Meeting Minutes

GDS - Strategy and Planning Meeting Notes
July 27, 2020

Notes	Action
<ul style="list-style-type: none"> - Maintenance strategies - Standards - Handbook for service installations <p>21 Asset Decommissioning & Disposal</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 2 strong ▪ Rationale <ul style="list-style-type: none"> - Don't do a good job of planning for rotating asset with a costly inventory of spares - Decommissioning is when people start the discussion but have had challenges with people not wanting to take responsibility for cost of disposal - Not thinking about end of life when building new assets – this is an afterthought - Reasonably well accommodated from a financial aspect - Yes, there is a future abandonment cost assigned - A bit reactive when it actually happens - Part of standard processes – well built in for most of asset base ▪ Evidence <ul style="list-style-type: none"> - Processes 	
<p>27 Asset Management Leadership</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 3 strong, pushing beyond ▪ Rationale <ul style="list-style-type: none"> - From the top down; senior levels of leadership are demonstrating leadership and commitment - Huge level of commitment to asset investment planning process, risk, decision-making - Have commitment for whole life approach for assets but we need to execute on this - Resources are there and support from top is there - We have an entire AM function for organization - Can't go to average employee about AM and their support and connection to it; but it is there at the top ▪ Evidence <ul style="list-style-type: none"> - Cynthia's webcast recently (presidential level down) - Monthly steering committee - VP of engineering and AM 	



Meeting Minutes

GDS - Strategy and Planning Meeting Notes
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Notes	Action
<p>– President is head of EAM work</p> <p>– President of GDS is supporting organizational AM</p> <p>28 Organizational Structure</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> – 3 or 2.5 during discussion – 3 consensus ▪ Rationale <ul style="list-style-type: none"> – AM structure is solid, but business has a different (lower) score – Path is generally well understood to organization – Asset plan is part of regulatory requirements and need to follow path to money – Key areas around risk assessments with lack of clarity has been identified and actively working to resolve – Integration and level of ambiguity still an issue; may be some areas that are ambiguous, but they are smaller – A couple areas around integration of legacy businesses are being sorted out, such as risk ▪ Evidence <ul style="list-style-type: none"> – 	
<p>29 Organizational Culture</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> – 2.5 or 3 during discussion – 3 consensus ▪ Rationale <ul style="list-style-type: none"> – For operations yes but there is room for improvement – Overall everyone follows process – Now that we're regional we don't meet with different groups the same way – hope what you're doing is aligned with what others are doing but seems pretty consistent from results that have been seen – Good culture and support from director level such as, asset investment planning process and capital portfolio – So deep into AM part of business but Kevin's opinion is a strong driver ▪ Evidence <ul style="list-style-type: none"> – 	
<p>30 Competence Management</p>	<p>Rebecca to confirm specific people such</p>



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Notes	Action
<ul style="list-style-type: none"> ▪ Competent at creating a framework for what's needed and then going through process to recruit or train to move towards set of competencies <ul style="list-style-type: none"> – looking broadly across core functions contributing to AM ▪ Current Rating <ul style="list-style-type: none"> – 1.5 or 2 during discussion – 2 consensus with need for follow-up ▪ Rationale <ul style="list-style-type: none"> – Well-developed training programs for critical roles, still working on others – Good practice in O&M where operator practices are well defined, but other parts of the organization are not as well defined due to high turnover rate – High turnover rate so don't stick around long enough to be competent; have defined job roles; prefer to leave Toronto to go to the regions – Is this a gap in marketplace (i.e. outside influence affecting this?) – Storage and transmission operations has a number of roles – don't hire someone into role, they must require a 4-year progression and hit benchmarks (don't have fully developed) – Yes, doing for other areas – we know what we want but it's finding the people – Integration complicates this – Very solid training program – Storage and transmission isn't to the same level – Quite a bit of variability across areas – Pretty good competency management system for operators (field workers) but integrity identified need for better competency within integrity team ▪ Evidence <ul style="list-style-type: none"> – ▪ People to follow-up with <ul style="list-style-type: none"> – Bridget Sneedon – training – HR – how resource plans are developed, and skillsets are identified 	as Bridget (training) and HR; Jacobs to follow-up
<p>31 Risk Assessment and Management</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> – 2-2.5 during discussion 	



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Notes	Action
<ul style="list-style-type: none"> - 2.5 consensus ▪ Rationale <ul style="list-style-type: none"> - Risk assessments are identified - Region by region we're still reactionary - Have processes in place that are working, and things are happening - Have a consistent approach to what's being replaced - Both legacy organizations have had risk processes in place for years - Opportunity because people are doing risk in different ways - Starting to see a similar mindset but opportunity for growth - Have a centralized 7x7 matrix that's intended to capture opportunities as well as bad risk ▪ Evidence <ul style="list-style-type: none"> - Centralized 7x7 matrix 	
<p>33 Sustainable Development</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 2.5 or 3 during discussion - 2.5 consensus ▪ Rationale <ul style="list-style-type: none"> - Take into account environmental concerns and public perception in risk matrix - Done customer surveys on drivers for spending more now or in the future - May not all be in SAMP and AMPs - Stuck on the term perpetuity – forever is an unobtainable - Really mean it when we set out environmental goals - C55 decision criteria we're genuinely putting projects in place to deliver on this - Trying to reduce GHGs and leakage rates ▪ Evidence <ul style="list-style-type: none"> - Customer surveys on drivers for when to spend - SAMP 	
<p>34 Management of Change</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 2.5 or 3 during discussion 	



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Notes	Action
<ul style="list-style-type: none"> - 2.5 consensus ▪ Rationale <ul style="list-style-type: none"> - Have process and may not be communicated to average employee - Have list of materials for replacement; need to follow process and it's pretty well understood - Can provide process and examples - Great for light changes - Better for material than for people - Documented for people but very unclear (such as, turnover) - MOC initiated recently for a new role - Are actively doing but maybe not for all levels and all areas ▪ Evidence <ul style="list-style-type: none"> - MOC process supported by organization 	
<p>36 Asset Management System Monitoring</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 2-2.5 during discussion - 2 consensus but pushing to 2.5 ▪ Rationale <ul style="list-style-type: none"> - Reporting up to top management - There are a series of measures being monitored - Struggle most with effectiveness - Overall well monitored - Part of integrated management system ▪ Evidence <ul style="list-style-type: none"> - Regular meetings – program within integrated management system - Today's assessment 	
<p>37 Management Review, Audit and Assurance</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 1 or 1.5 during discussion - 1 consensus ▪ Rationale <ul style="list-style-type: none"> - Have an internal audit team - Have not directed them to asset management - AM not a regulatory requirement so instructed not to proceed with as part of internal audit 	



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Notes	Action
<ul style="list-style-type: none"> - Instead will look towards an external reviewer ▪ Evidence <ul style="list-style-type: none"> - <p>38 Asset Costing and Valuation</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 1.5-2 during discussion - 1.5 strong consensus ▪ Rationale <ul style="list-style-type: none"> - Depends: some very good – average cost for plastic service installation and assigning work in the field; fall down where we don't need to book time to work orders, or materials aren't put in work orders - SAP good on compression and those assets - Legacy union had cost of meter of installed pipe so in terms of construction costs we are doing well - Station related assets: pretty good since 2016 for commercial meter sets since SAP was implemented - Not sure about smaller assets such as residential meter sets - Non-gas carrying assets would be harder (such as, electronics on a station) - Fleet would be better - Each one is a fixed asset; on estimates to build we're pretty good; pretty good overall - Spotty on pulling together and using information; not well developed ▪ Evidence <ul style="list-style-type: none"> - 	
<p>39 Stakeholder Engagement</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 1.5 ▪ Rationale <ul style="list-style-type: none"> - Don't currently do a lot of formalized AM stakeholder engagement - Have done customer surveys but haven't shared back plans to get feedback because of recent integration - Stakeholder engagement not to par with other organizations - Do well with internal stakeholder engagement - Missing 'play back' to ensure that we're getting this right 	



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Notes	Action
<ul style="list-style-type: none">- Will likely undertake more stakeholder engagement in the future▪ Evidence-	



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245 Consumers Road, Suite 400
Toronto, Ontario M2J 1R3
Canada
T +1.416.499.9000

www.jacobs.com

Subject	GDS - Operations, Management and Data Meeting Notes		
Project	Enbridge Asset Management Maturity Review		
Project No.	CE777500	File	2020-07-28 GDS Data and Operations - Meeting Notes CAS
Prepared by	Catherine Simpson, RPP, MCIP	Phone No.	604-346-9428
Location	Web-based	Date/Time	July 28, 2020
Participants	Catherine McCowan, Manager Risk, Strat & Planning Andrew Welburn, Manager Asset Data & Information Taylor Jones, Specialist II AM Distribution Pipe Pamela Callow, Supervisor Process Attachment & Construction Jim Harradine, Mgr Operations & Maintenance Engineering Hugh MacMillan, Mgr Fin/Law/Aff/Data/Support Todd Piercey, Manager Pipeline Engineering Ahmed Nossair, Mgr Stations & Utilizations Engineering Johanna Sanchez Gomez, Manager Construction		
Observers	Rebecca Mayhew, EAM Governance Caryn Campbell, Manager EAM Proj Mgmt		
Facilitators	Andy Whittaker, Jacobs Catherine Simpson, Jacobs		
Apologies	Andrew Calder, Manager Fleet Erik Naczynski, Manager Asset Classes Distribution		

Notes	Action
0 Introductions (Gas Distribution) <ul style="list-style-type: none"> Part of way through the second year of AM program Executive leaders asked for a check-in Did an assessment a couple years ago Refocused plans and resources where needed Part of a continuous improvement process Objective is to hit targeted step changes within certain areas of AM Engaged Jacobs – endorsed IAM assessors 	



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Notes	Action
<ul style="list-style-type: none"> ▪ First chance to do an assessment as an integrated utility ▪ Today: Run through IAM 39 elements (19 this morning focused on operations and data) <ul style="list-style-type: none"> – 18 priority subjects previously identified which we will concentrate on more – Working towards a consensus score on each subject – Will document rationale behind score, and evidence 	
<p>7 Operations & Maintenance Decision-Making</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> – 2 or 3 and beyond in some areas – 3 consensus ▪ Rationale <ul style="list-style-type: none"> – Reflective of IT asset class; O&M is based on business requirements; SAMP has documentation on lifecycle refresh on hardware but for software business requirements there is no documentation – Pipeline: key O&M is dictated by code (such as, leak management) – From an integration perspective moving towards having one set of documents to show how the company meets code requirements (frequency for assets; inspection frequency, established procedures for how to complete maintenance) – Different systems for record keeping but working towards one: legacy union uses SAP – Stations: most of maintenance and inspection frequencies are well defined in MSN procedure or CNN standard – Using two systems to manage work that will be integrated into one; will be in much better shape – Suite of things: regulatory requirements, manufacturers recommendations, RCM, etc. – Majority of assets has frequency for maintenance and inspection and working towards a common frequency as part of integration – not starting from scratch; are very well positioned – Taking a company-wide approach of preventative maintenance and protective maintenance through integrity program – both approaches defined by history of failure, manufacturers recommendations, etc. – World is changing and advancing but we are still using the same equipment – Distribution side – assets designed with a simple approach and high-level monitoring of how process is managed 	<p>Rebecca to identify specific people for follow-up with, if necessary; Jacobs to follow-up</p>



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Notes	Action
<ul style="list-style-type: none"> - Gas turbine is more complicated with monitoring to show degradation - Changes in frequency would be based on learning out of industry - Assets aren't undergoing significant technological changes - Drive a lot by Canadian code and legislative requirements; standards get updated every 5 years, but O&M hasn't changed significantly; documents and practices are reviewed, and this is triggered when a standard is changed - Clear suite of methods in place to drive maintenance, regulatory requirements, RCM processes, manufacturer's recommendations - Are monitoring what's going on with performance, and changes in standards as well as in industry - Storage: engineering group focuses on compression within stations but also appurtenances; different than traditional gas carrying assets but do support the gas carrying system; - Looking after rotating assets it's a blend of predictive and reactive maintenance but moving more towards predictive maintenance - Have piloted some stations for predictive and found that predictive isn't a good fit for the whole facility – looking at extremely high reliability at the best cost - Have a score card and requirement to meet reliability levels - Will use predictive outlooks where it makes sense and working to expand across all systems - Do run to end of life where possible - Front line staff do day-to-day work and flag anomalies back into work order system - Track anomalies and respond where necessary, engaging the OEM and engineering group where necessary - 6 engineers that provide support to the field - Have root cause failure when complex failures occur - Sit on a few committees – OEMs; G10 committee for turbine operators which meet once a year as a committee and a global meeting every other year; a member on CSA 276 LNG committee - Siemens was doing live monitoring on a turbine for a year but found cost didn't derive the anticipated value but did learn things from it - Have old equipment from 50s that's running reliably but coming up for replacement; have replaced some units from 70s and 80s because they have become obsolete 	



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Notes	Action
<ul style="list-style-type: none"> - Still harmonizing; maintenance schedules are working and effective but opportunity to be consistent across both legacy organizations - Most of risk is coming from damages and third-party intervention; based on results we are not lacking - Both legacy companies rate high so even though still bringing them together that will enhance business and risk management; it's been successful so far - Value package; a lot of maintenance and rotating equipment for larger assets; smaller asset maintenance addressed based on appropriate scale; geared appropriately for varying asset types ▪ Evidence <ul style="list-style-type: none"> - MSN procedure - CNN standard ▪ Other People to Engage <ul style="list-style-type: none"> - Steve Party – storage element (integrity program designed around that); Angela was on yesterday's call and touched on this 	
<p>9 Resourcing Strategy</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 1 to 2 during discussion - 1.5 consensus ▪ Rationale <ul style="list-style-type: none"> - From a pipeline standpoint it's hit and miss - Don't often have a clear view of resourcing – made aware of projects as they come in for approval and hard to look at smaller jobs and tie that to specific requirements within asset plan - Larger projects provide a better view - More reactive than proactive - From an executability perspective we work to ensure balance across Regions but from a supporting perspective there are gaps (engineering, drafting, planning, etc.) - Have plans in place and talk about this but reliance of third-party contractors is high - Hiring practices are interesting because focus is on future leaders but not hiring consistent people that will become subject matter experts - Resources to execute work in asset plan? Yes - Have a great tool to manage asset plan; lacks identification of resources from engineering to execution 	



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Notes	Action
<ul style="list-style-type: none"> - Made a lot of progress in looking towards risk and from a planning perspective, but recognize that growth is reactive - Limited consistency across organization - Strong for 1st year but weaker longer term ▪ Evidence <ul style="list-style-type: none"> - 	
<p>10 Shutdowns & Outage Strategy</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 2 to 3 during discussion - 2.5 consensus but will do some follow-up ▪ Rationale <ul style="list-style-type: none"> - Storage and transmission: well defined process led by operations group – done at the beginning of construction year for current year; annual maintenance schedule is recurring with related outages; construction outages sit on top of that; have had some very complex outages over last few years and have addressed well - Reliance on people but processes aren't as well documented - Applicable in some cases; no major outages for distribution - We design for minimal planned shutdowns, if any - Have redundancy at 100% in summer; construction requires some shutdowns - Extensive planning around overall shutdown strategy - Designs ensure minimal outages - Agree it's very reliant on people - Used to be a weekly meeting on planed outages ▪ Evidence <ul style="list-style-type: none"> - ▪ Other People to Engage <ul style="list-style-type: none"> - Follow-up re: redundancy, reliance of people and specifically details regarding operations meetings 	<p>Rebecca to identify specific people for follow-up regarding reliability and specifically operations meetings as evidence; Jacobs to follow-up</p>
<p>13 Systems Engineering</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - ▪ Rationale <ul style="list-style-type: none"> - ▪ Evidence 	<p>For follow-up</p>



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Notes	Action
<p>–</p> <p>14 Configuration Management</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> – ▪ Rationale <ul style="list-style-type: none"> – ▪ Evidence <ul style="list-style-type: none"> – <p>15 Maintenance Delivery</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> – 2 or 3 during discussion – 3 consensus ▪ Rationale <ul style="list-style-type: none"> – Have work plans in place (in SAP and Maximo) to manage annual maintenance – Blend of proactive, predictive and reactive maintenance – Review plans as OAMs change things - showing that we're achieving system equipment reliability for business – Do safety, on time and on budget, but adjust as required – Do a good job in 100% compliance of maintenance schedule – From a predictive and proactive approach there is more that we can do – All tracked through Maximo for legacy EDG – Get involved with non-conformance – On legacy union side there was a robust non-conformance process with heavy mitigations plans in place ▪ Evidence <ul style="list-style-type: none"> – Score card on system equipment reliability <p>16 Reliability Engineering</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> – 2.5 consensus ▪ Rationale <ul style="list-style-type: none"> – Primarily distribution: legacy EDG had more robust procedures around equipment failures (such as, regulator valves) – Now there are triggers on failures for MEC lab with full-blown analysis resulting in a report to determine if it's a systemic issue 	<p>For follow-up</p>



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Notes	Action
<ul style="list-style-type: none"> - Can only be scaled for certain sized assets – may distribution assets - On compressor side the root cause analysis is managed and follow a similar process - Have changed maintenance practices based on failure analysis in some instances in the past - We go too far for some assets - Don't cover all of the asset base - Some processes new ▪ Evidence <ul style="list-style-type: none"> - 	
<p>17 Asset Operation</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 2 or 2.5 during discussion - 2 consensus moving towards 2.5 ▪ Rationale <ul style="list-style-type: none"> - STO side yes, have operators, mechanics, plant operators and gas controllers and technicians that direct how we operate equipment - Have documented procedures - Working on a more robust training program - Successfully operating system and not seeing failures due to sloppy operations - Sit on operations manager committee; do often comment on resource challenges - Definitely competing priorities during summer months - Going through integration and adapting as we go - Are updating procedures and training; heavy reliance on subject matter expertise - Lost a lot of field experience with VWO - VWO: voluntary workforce options (approach to shedding 800 staff – most left June 27 or July 10 with a few more leaving); starting to see impact of that - Strains on operations and reliance on knowledge ▪ Evidence <ul style="list-style-type: none"> - 	
<p>18 Resource Management</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 2.5 consensus 	



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Notes	Action
<ul style="list-style-type: none"> ▪ Rationale <ul style="list-style-type: none"> – Good on execution (O&M) but on support functions we're lacking (engineering, etc.) – Pretty solid at getting it done (delivering on plan) whether internal or outsourced resources – Very good on executing capital plan for the most part – Legacy union was stronger – Both good at executing on capital plan – There are few projects outside this year that are deferred because of resourcing, usually permitting, etc. – Skillset boundaries, for example overcommitting engineering and drafting resources – Run into challenges there and will outsource when that happens – Done a good job looking for \$s across organization to address needs – Better at managing than predicting resource needs – Emergencies are prioritized and everyone comes together to mitigate – Good at managing and bring in resources when needed ▪ Evidence <ul style="list-style-type: none"> – 	
<p>19 Shutdown & Outage Management</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> – 2.5 to 3 during discussion – 2.5 moving towards 3 ▪ Rationale <ul style="list-style-type: none"> – More prevalent in STO division: robust plans in place built into annual maintenance plans (such as, turbines taken offline during off season); coordinated with operations and discussed in meetings; tentative dates and allowances for each plant; work planning group ensures package of permitting, etc.; execution group undertakes work – Planned release of gas – working to recover for a more environmental perspective – Within compression stations it's part of the maintenance program and built into procedures – Do best we can with equipment available – Have procedures in place for safe shutdowns of pipelines, how to properly blow down a pipeline, blowdown times, etc. 	



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Notes	Action
<ul style="list-style-type: none"> - Safe procedures have quite a bit of documentation - A lot still falls on individuals - Emissions control and environmental performance linked to sustainability question from yesterday ▪ Evidence <ul style="list-style-type: none"> - <p>20 Fault & Incident Response</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 2.5 to 3 during discussion - 2.5 approaching 3 consensus ▪ Rationale <ul style="list-style-type: none"> - Other companies would have a reliability division; we do this with individual expertise as a function within the organization as opposed to a department - SGO primarily leads this however safety and reliability group (incident management group) is adding additional discussion around review - Reliability group doesn't get into FMEA and RCA; they oversee review process - Individuals with a range of related backgrounds (such as, process safety and analysis) - Not a finely tuned machine; can be hit and miss because not all the right people are involved; things can sit for a bit - Very robust emergency response protocol; one of first things to be integrated – how to set up local groups and escalate up - Culture around safety is quite good - Corporate memory re: major incidents is good - Incident reviews – a lot of robust processes and procedures but opportunity to continue to improve (such as, getting right people at the table to ensure focus on the right things) - Great process of incident investigation - Area of opportunity to bring right people together - Don't have an RCA mechanism to address failures - We do look at failures to understand systematic issues and then feedback to determine if a program is needed to be more proactive; components in place - Missing a dedicated reliability function to drive significant improvement in design 	<p>Jim Harradine to follow-up re: reliability individuals; Jacobs to follow-up with further discussion</p>



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Notes	Action
<ul style="list-style-type: none"> - Great way to report and capture learning; certain failures that don't become incidents; don't have a reliability function which would drive significant improvements - Response is good, backed by strong safety culture. Do investigations – thorough - but maybe not everyone is involved and may not do to desired level of rigor - Majority of incidents have a thorough incident analysis: respond to emergencies within 30 min, and achieve 99% of time - All involved in reliability - More work needed on incident investigation side ▪ Evidence <ul style="list-style-type: none"> - ▪ Other People to Engage <ul style="list-style-type: none"> - Mike Scarland – incident management group - JH will look into who specifically is involved further 	
<p>22 Asset Information Strategy</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 1 to 2 during discussion - 1.5 moving towards 2 (updating with corporate approach and wider range of info types and systems) consensus ▪ Rationale <ul style="list-style-type: none"> - Strategic documents put together with asset information strategy - A lot of work over last few years as AM program initiated - Big focus recently on enterprise-level - Shifted back to business unit level, with a big push initially before integration - Now moving back to this strategy - Have been maturing - Information is used in a consistent manner: have standard queries; a lot of work to pull similar info from legacy companies - Still working on pulling info systematically and consistently - Have competency and well adept resources - Challenge is that information is not always readily available - Plan is in place, but timelines look out to 2023 - Putting in an appropriate governance framework - Strategy in place at higher level about what's going to happen with Unify 	



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Notes	Action
<ul style="list-style-type: none"> - Bringing in a new work management system - A financial system for Oracle has been brought in - Strategy for other systems is a work in progress – have had roadmaps developed but need to revisit based on new landscape with Unify roadmap - Eventually a lot of subsystems will be rolled into Maximo and are working on a roadmap to put those in place - Good pieces in place for the AIS, but there are gaps - Not aware of (for GDS) a specific asset information strategy document; each legacy company has own work management system and they have challenges - Some maintenance work is done on the fly as found, without a work order - Robust system in place with a lot of systems and records documents elements in place but not aware of 1 document in place that brings it together - For the asset information strategy there is the technology as well as the processes and procedures and data and information and records; look at broader umbrella - Need work on how it knits together - There are discrepancies between legacy organizations and how things are brought together consistently, particularly on the data side - Had a strategy document but not well communicated and maybe not current or detailed enough - Worse than 2018 or same? A lot of challenges using the system without processes and procedures this year; not clear on transition to vision - Not worse, advancements made on enterprise front from unify and EAM and AIS - Have high level roadmap with timelines, etc. but they haven't been maintained as well as they could be - Have an AIS in place: perhaps narrow focus but doesn't have roadmap with breadth and longer term; hasn't been broadly communicated; needs updates ▪ Evidence <ul style="list-style-type: none"> - 	
<p>23 Asset Information Standards</p> <ul style="list-style-type: none"> ▪ Current Rating 	



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Notes	Action
<ul style="list-style-type: none"> – 2 ▪ Rationale <ul style="list-style-type: none"> – Records side of things well defined – records from corporate level has guidelines, policies and procedures – Work to implement standards within gas distribution – Well off from a records perspective but gaps with things like system or record for storing records and will address over next year or so (some records on share point, personal storage, etc.); working to standardize – Data perspective: attributes collected consistently; systems in place but not necessarily enforced; mechanism there but not capturing some things – Data quality standards: work underway to put in place and address data quality; a lot of areas for improvement; in process of amalgamating information collection into one system – Quite a clear idea of where we're going – A lot of standards are defined in existing systems – Data standards aren't always adhered to with variability – Work in progress around integrating legacy businesses together ▪ Evidence <ul style="list-style-type: none"> – 	
<p>24 Asset Information Systems</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> – ▪ Rationale <ul style="list-style-type: none"> – ▪ Evidence <ul style="list-style-type: none"> – 	Remainder for follow-up
<p>25 Data & Information</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> – ▪ Rationale <ul style="list-style-type: none"> – ▪ Evidence <ul style="list-style-type: none"> – 	
<p>26 Procurement and supply chain management</p>	



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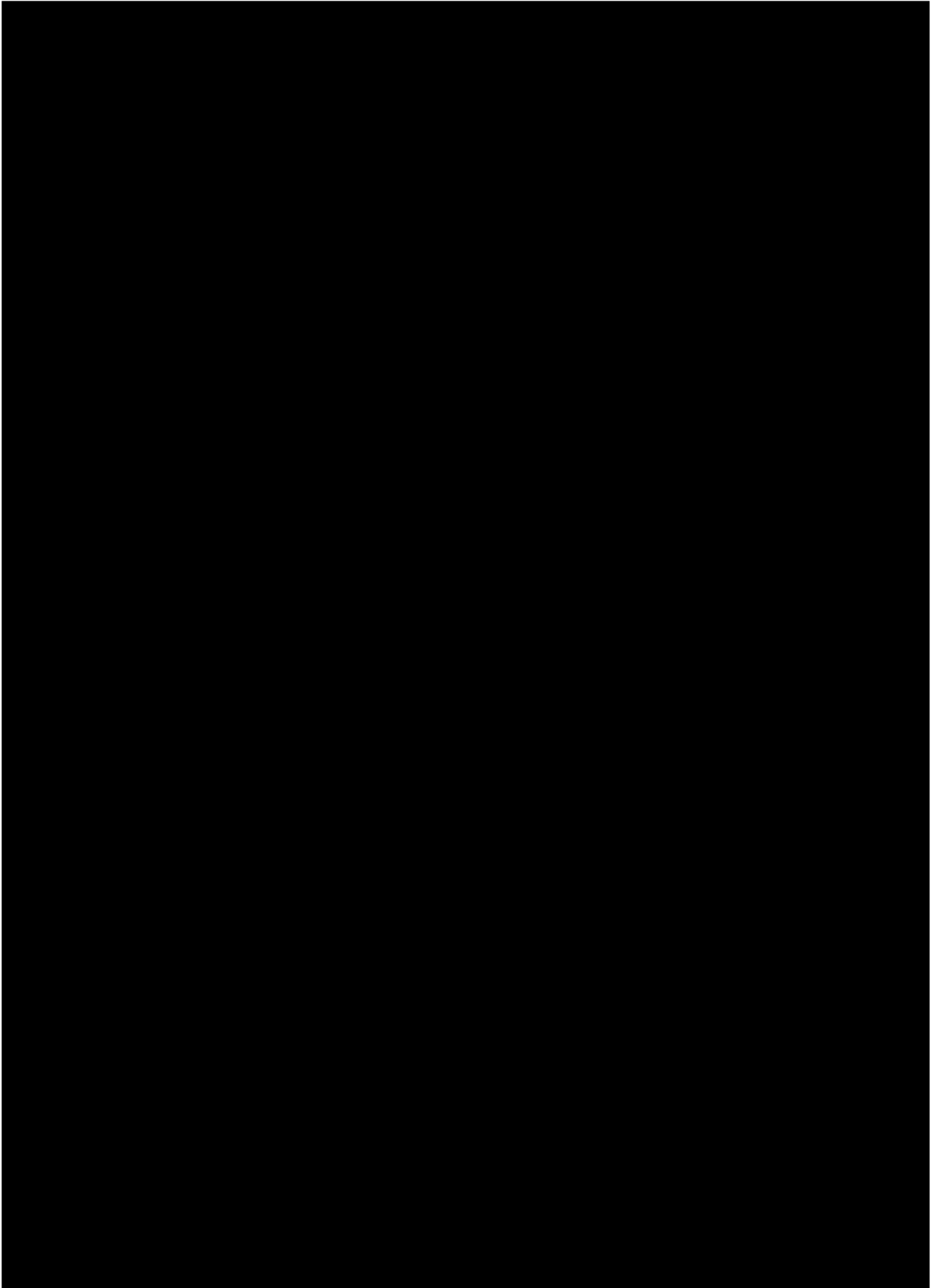
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Notes	Action
<ul style="list-style-type: none"> ▪ Current Rating – ▪ Rationale – ▪ Evidence – 	
<p>32 Contingency Planning & Resilience Analysis</p> <ul style="list-style-type: none"> ▪ Current Rating – ▪ Rationale – ▪ Evidence – 	
<p>34 Management of Change</p> <ul style="list-style-type: none"> ▪ Current Rating – ▪ Rationale – ▪ Evidence – 	
<p>35 Assets Performance & Health Monitoring</p> <ul style="list-style-type: none"> ▪ Current Rating – ▪ Rationale – ▪ Evidence – 	



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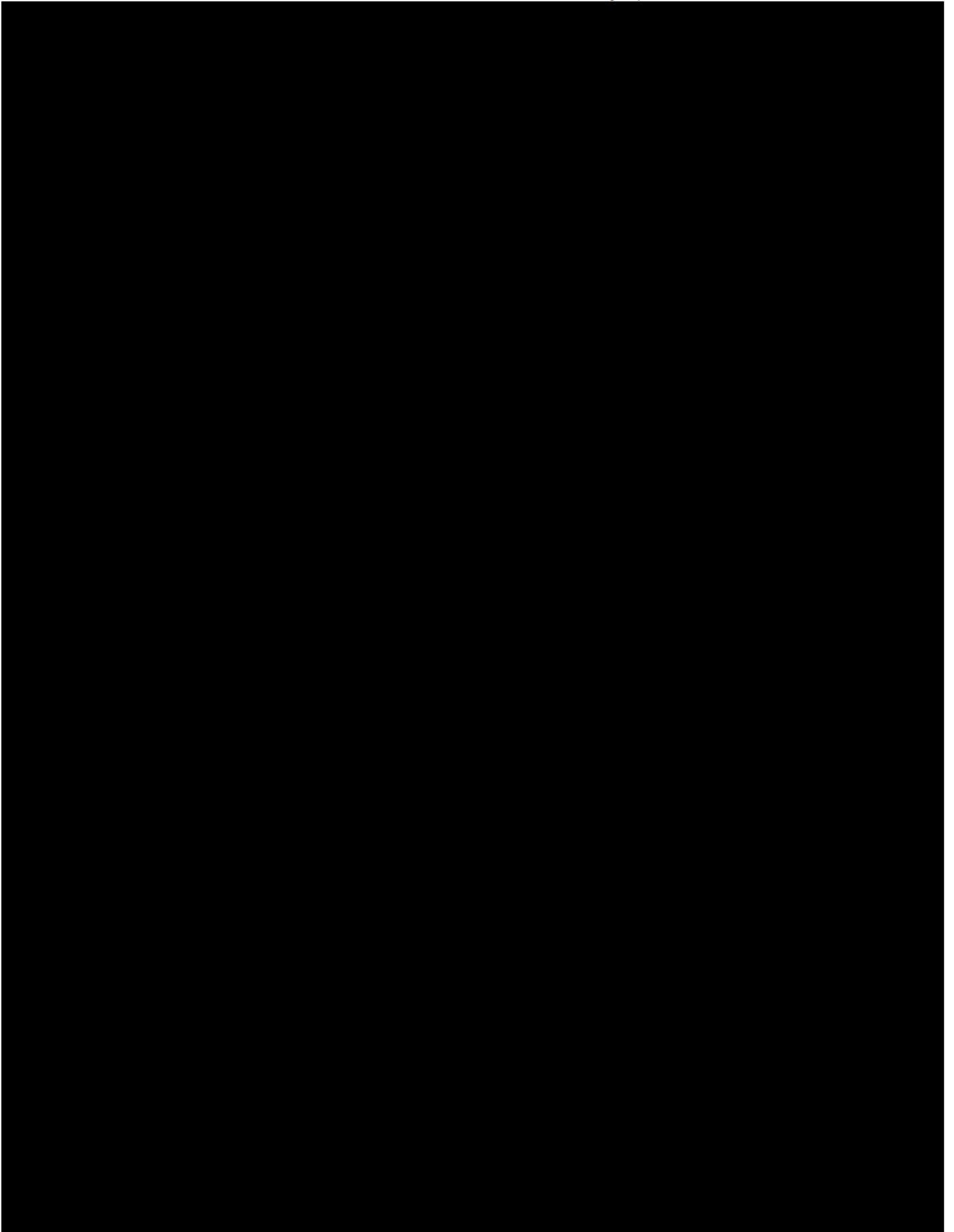
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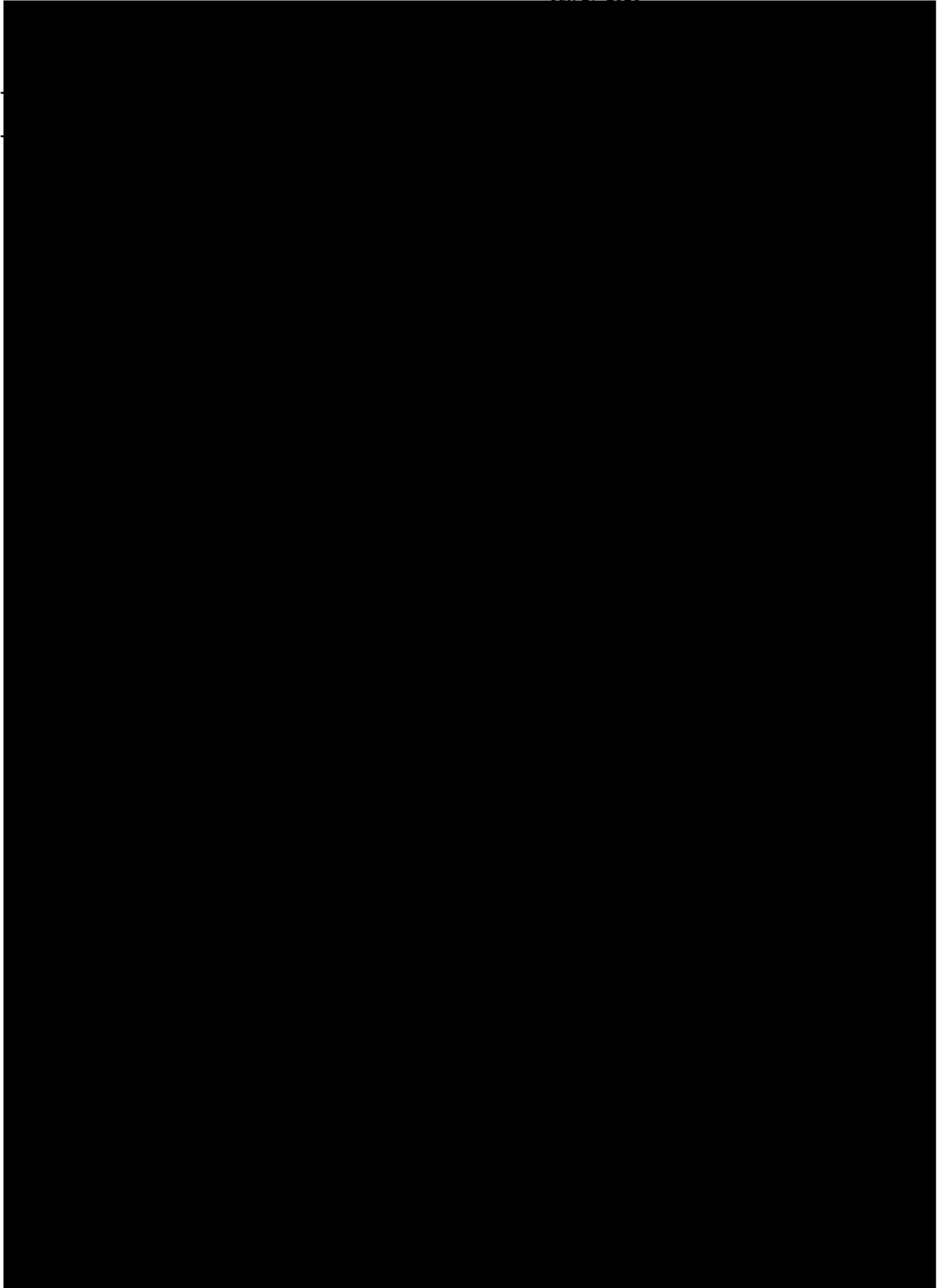




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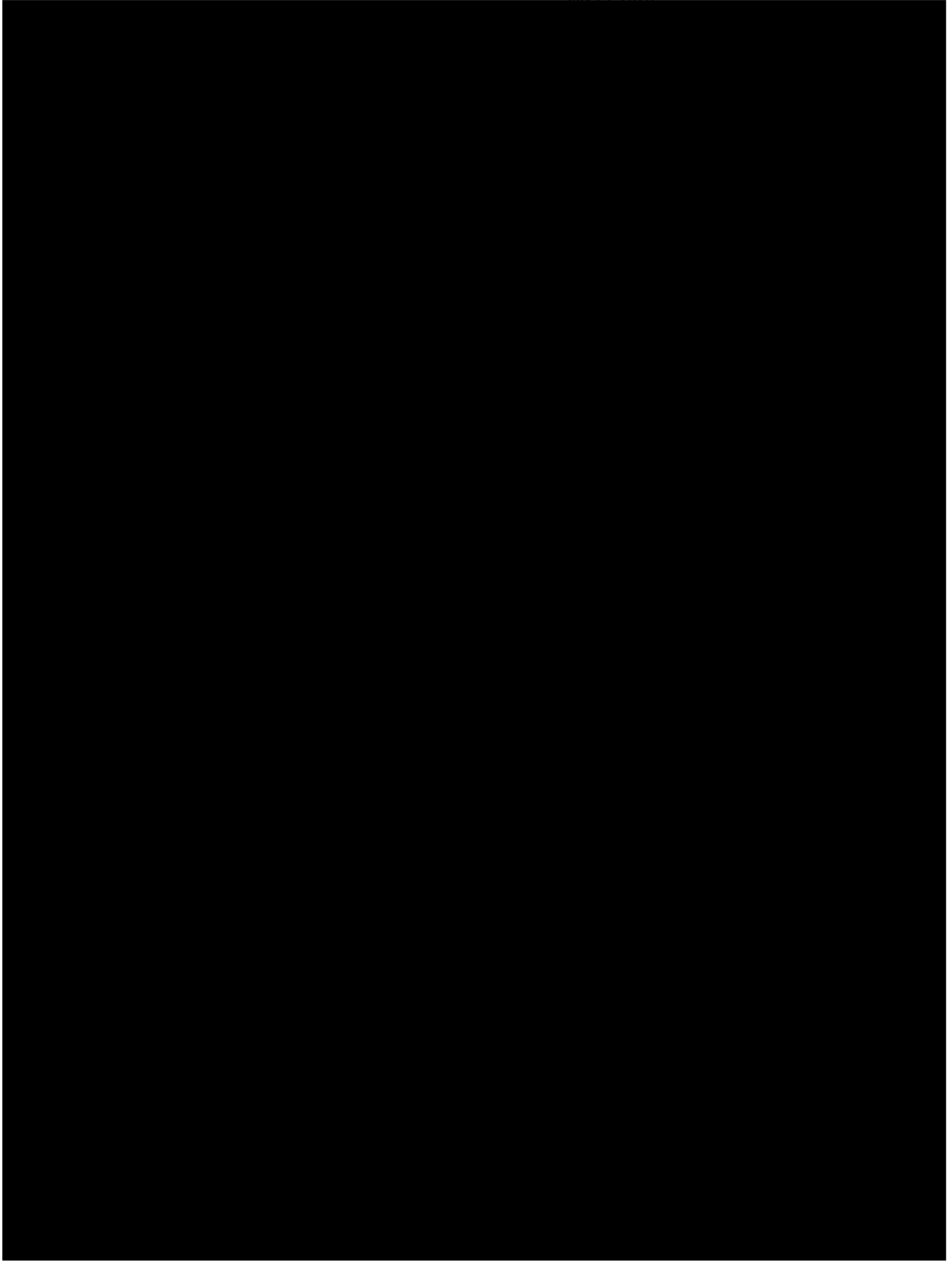
July 29, 2020





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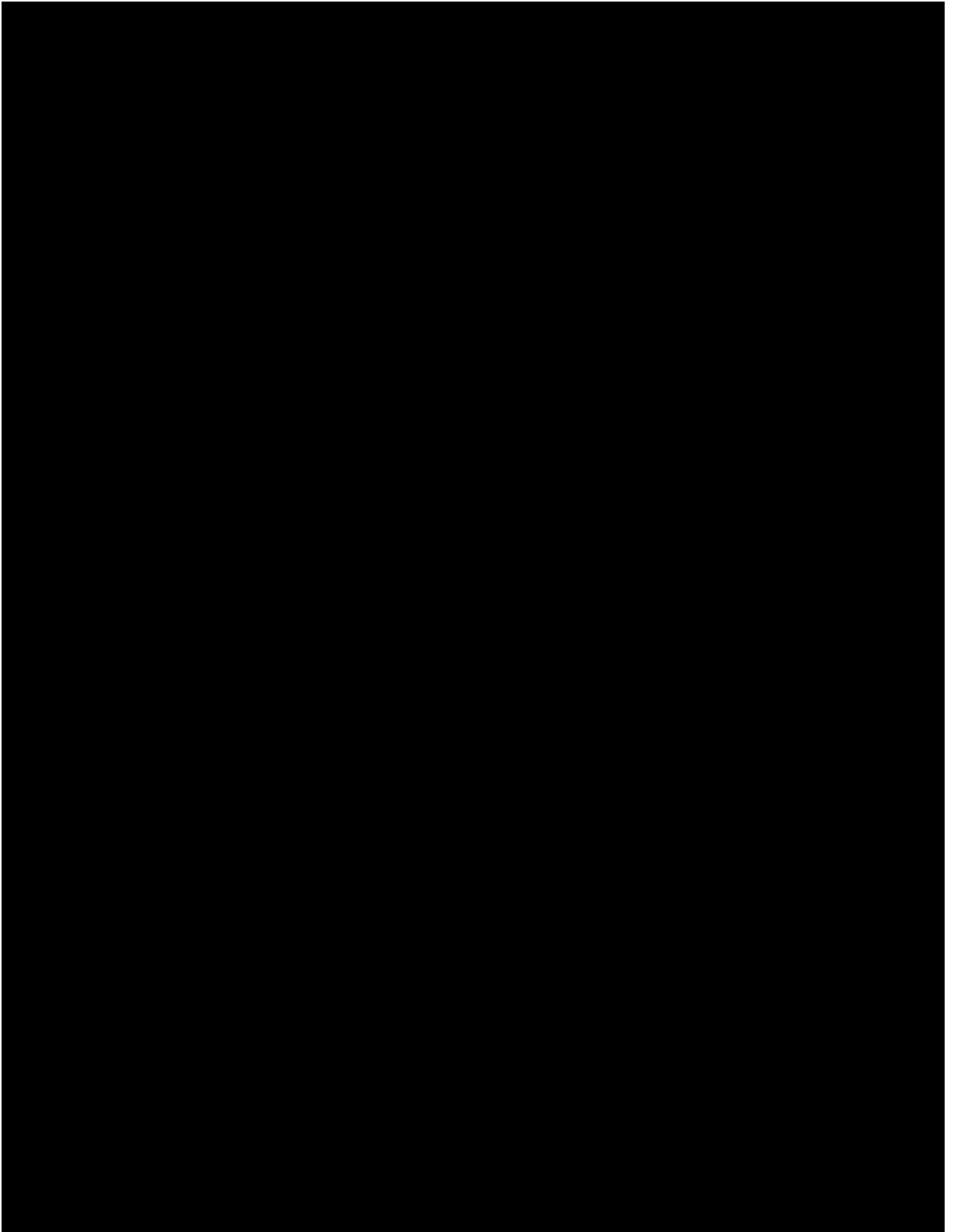
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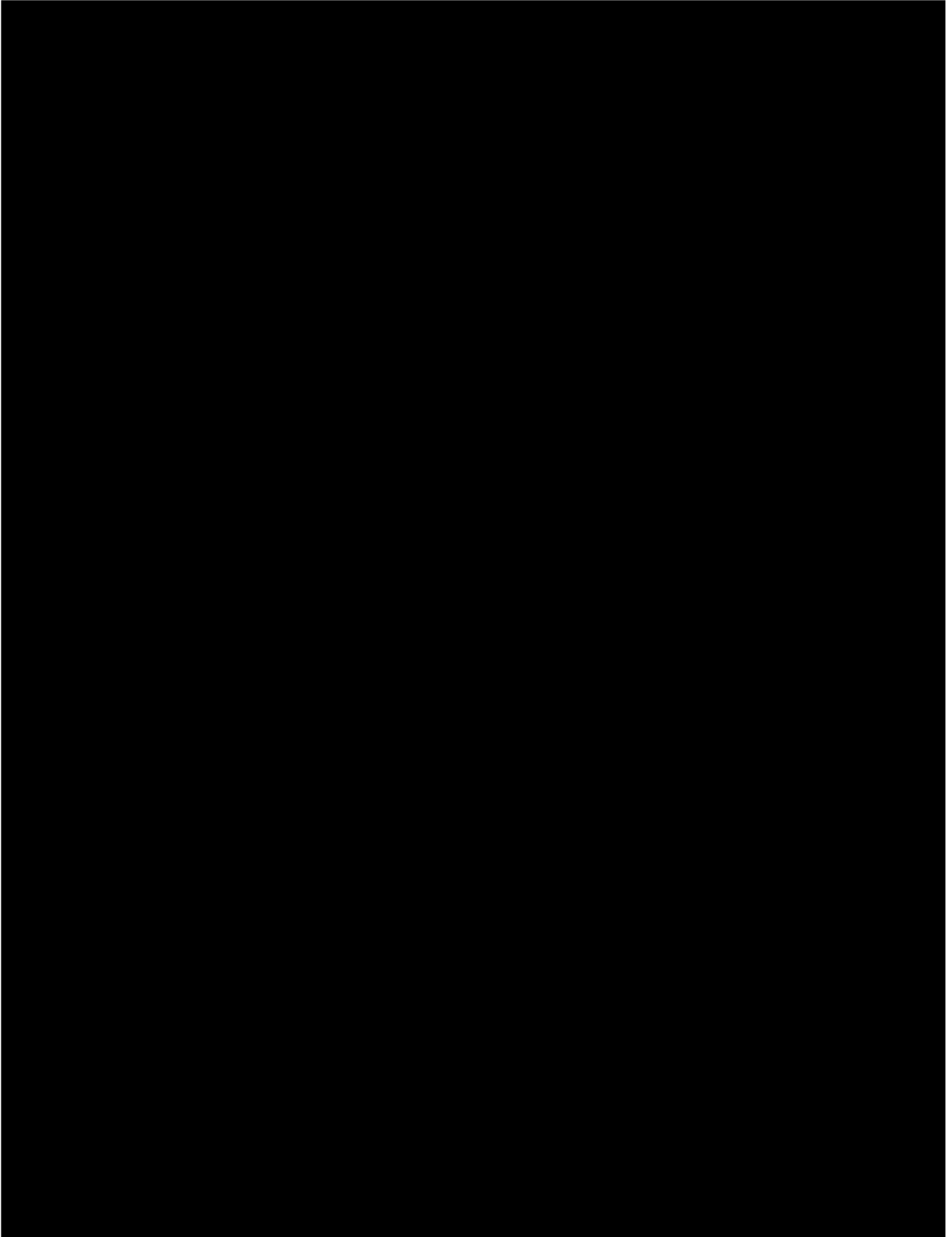
LP - Strategy and Planning Meeting Notes





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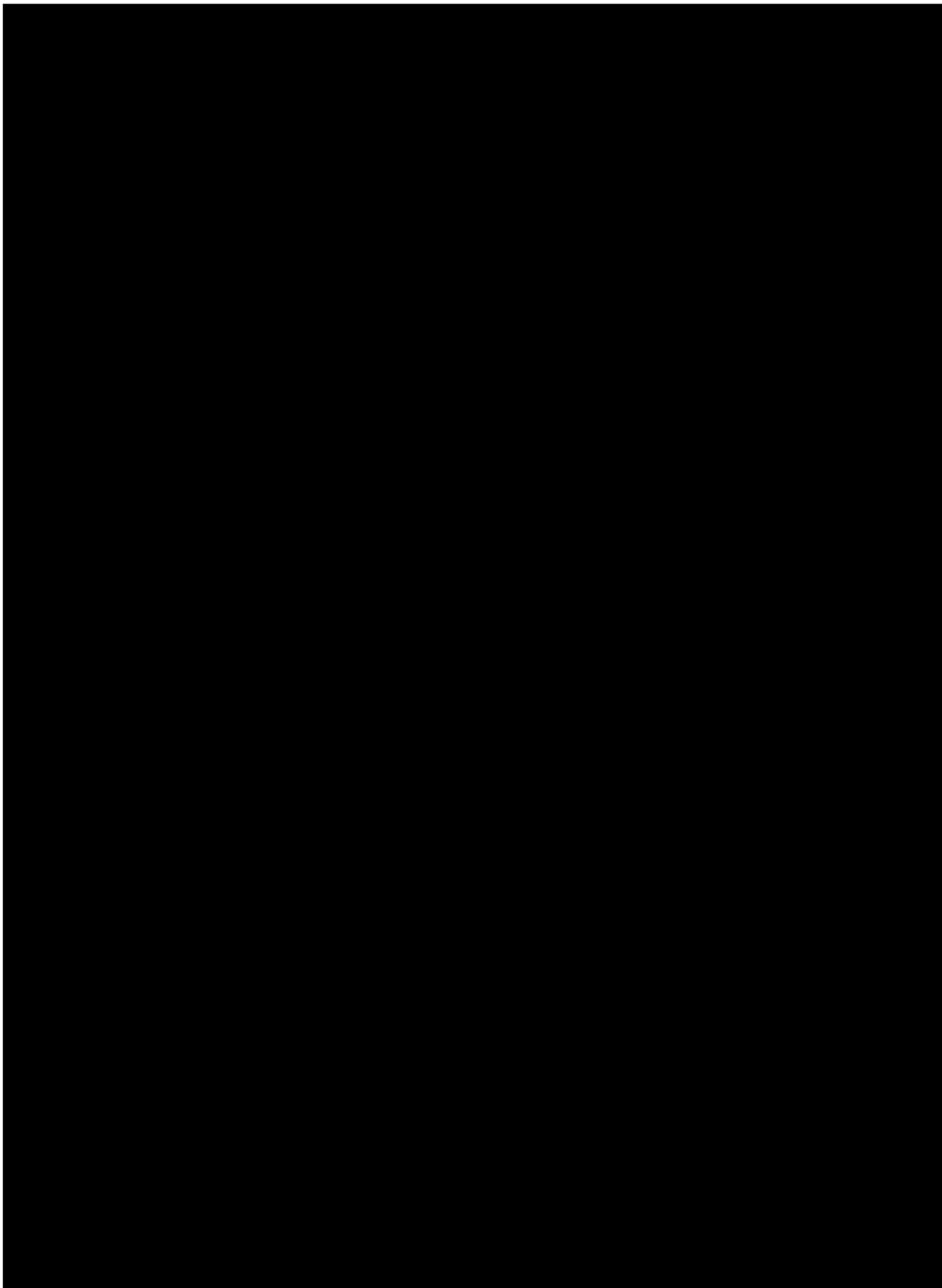
LP - Strategy and Planning Meeting Notes





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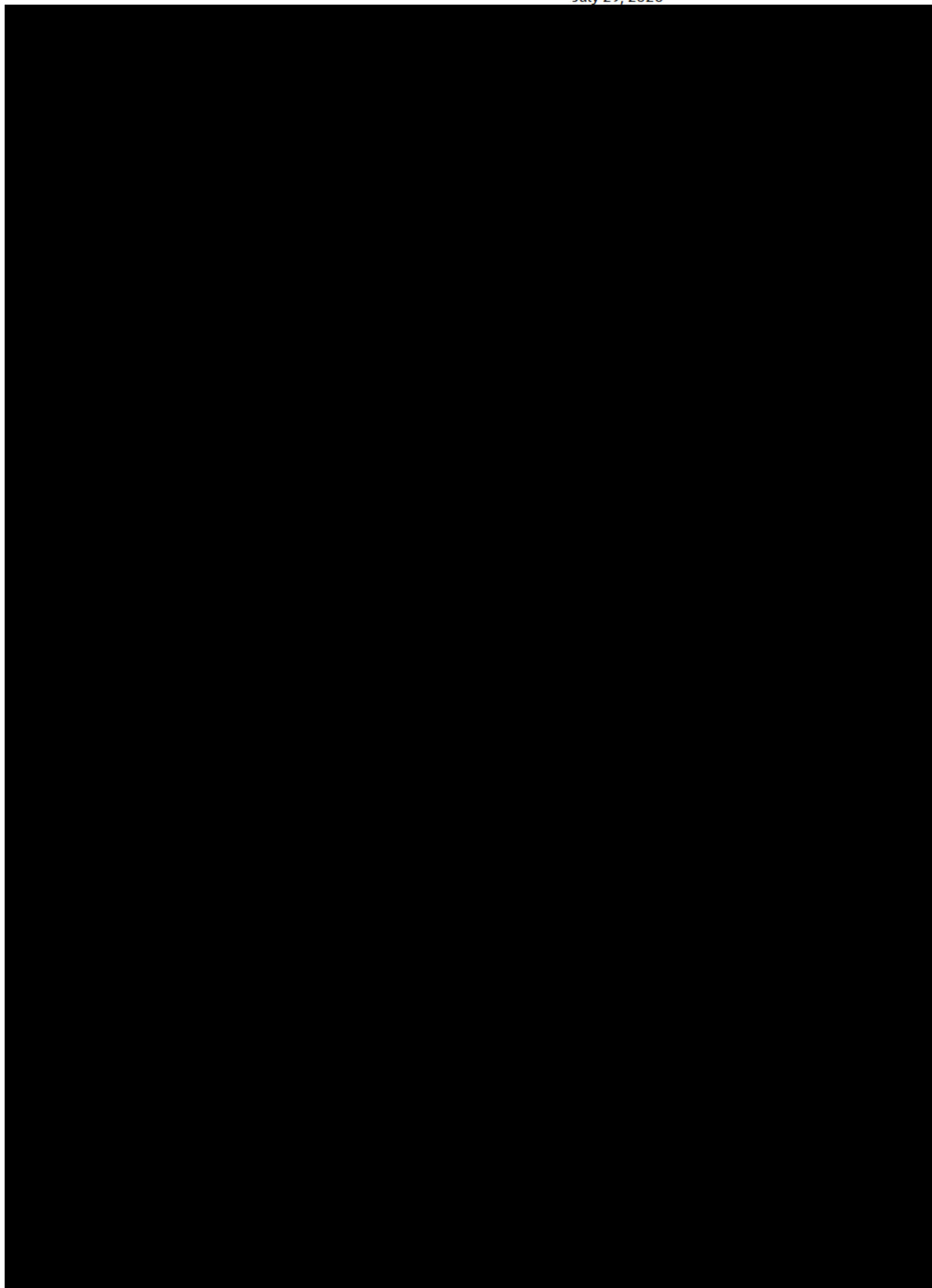
LP - Strategy and Planning Meeting Notes
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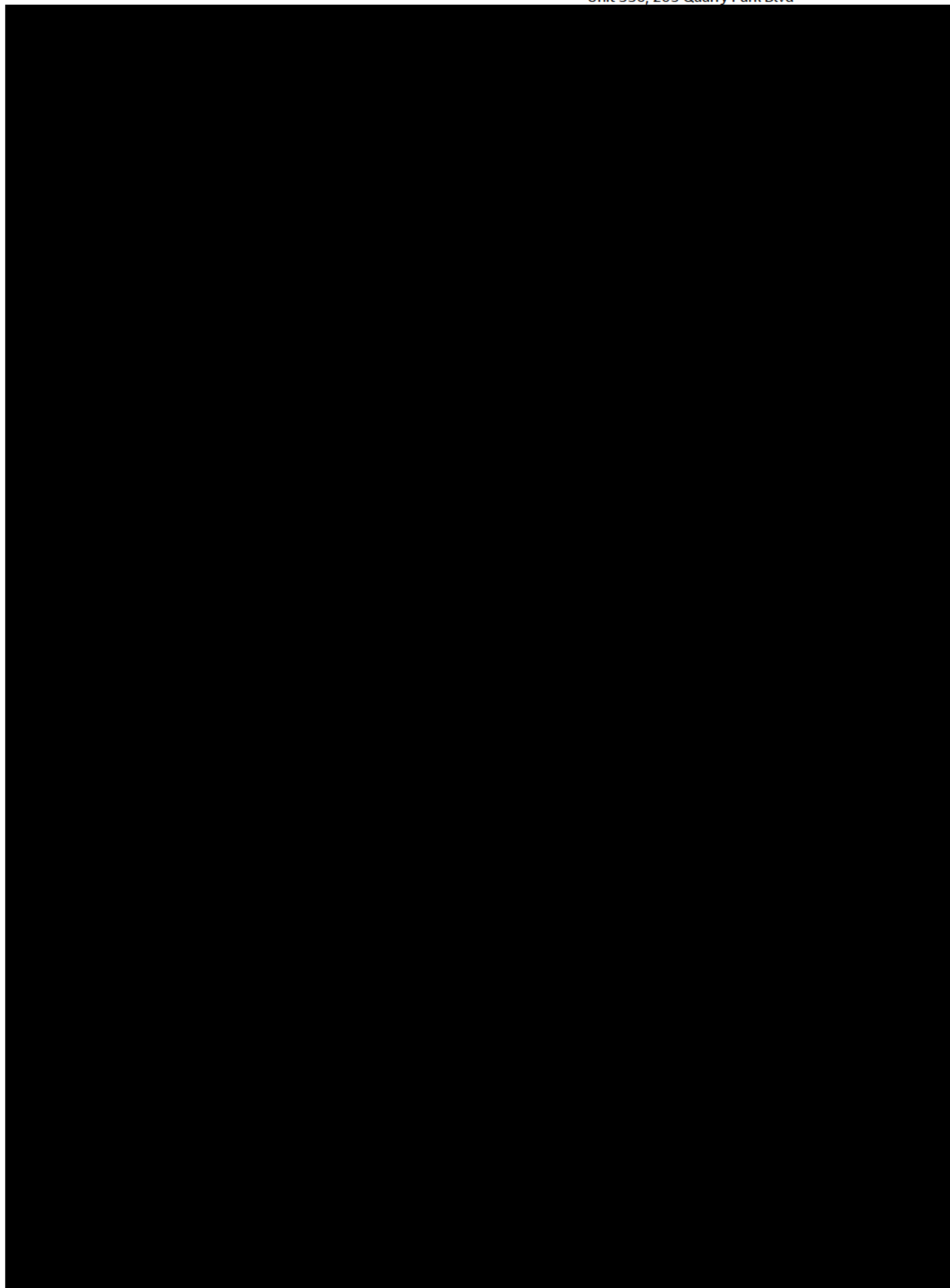
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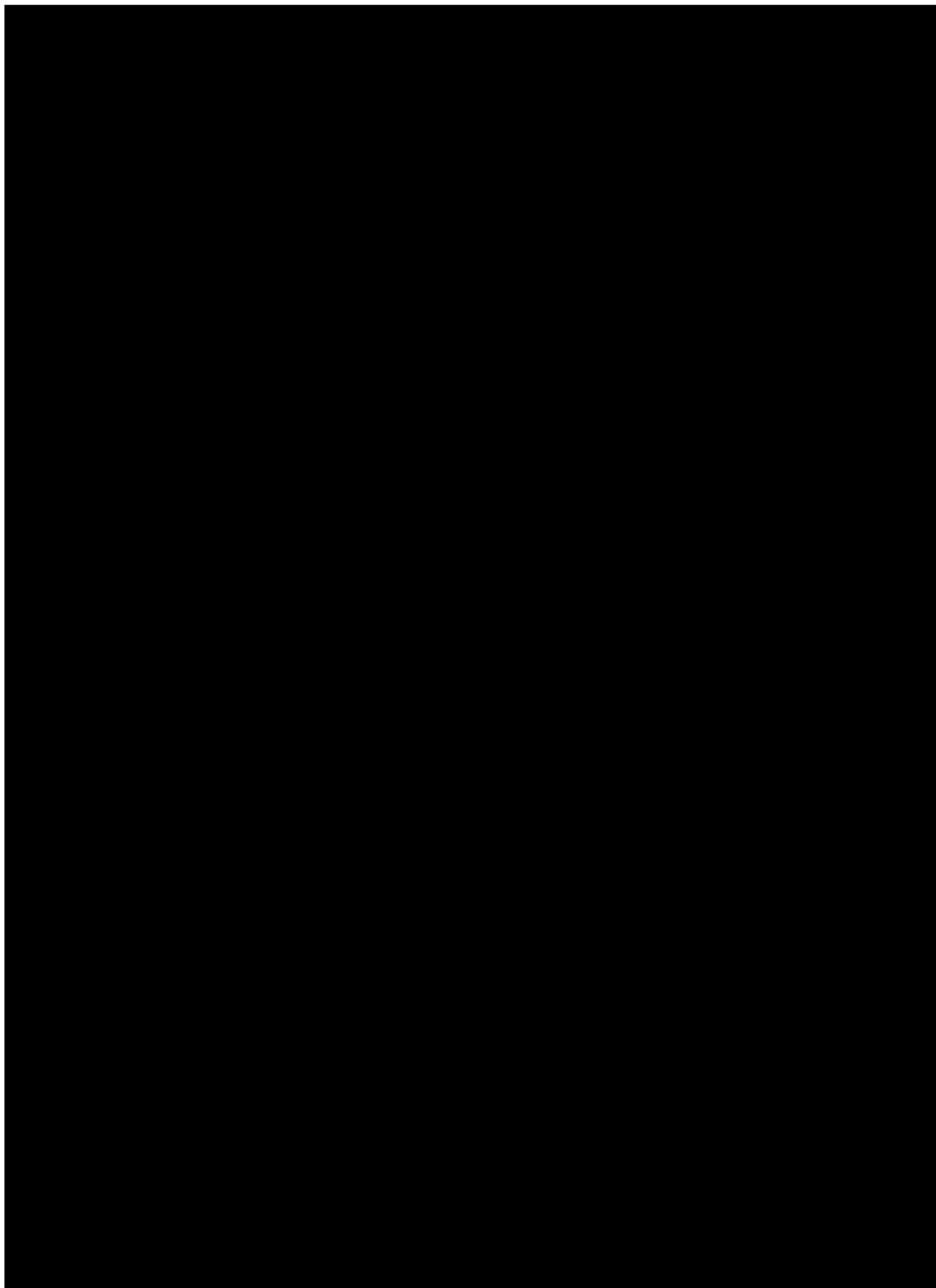
Unit 330, 205 Quarry Park Blvd





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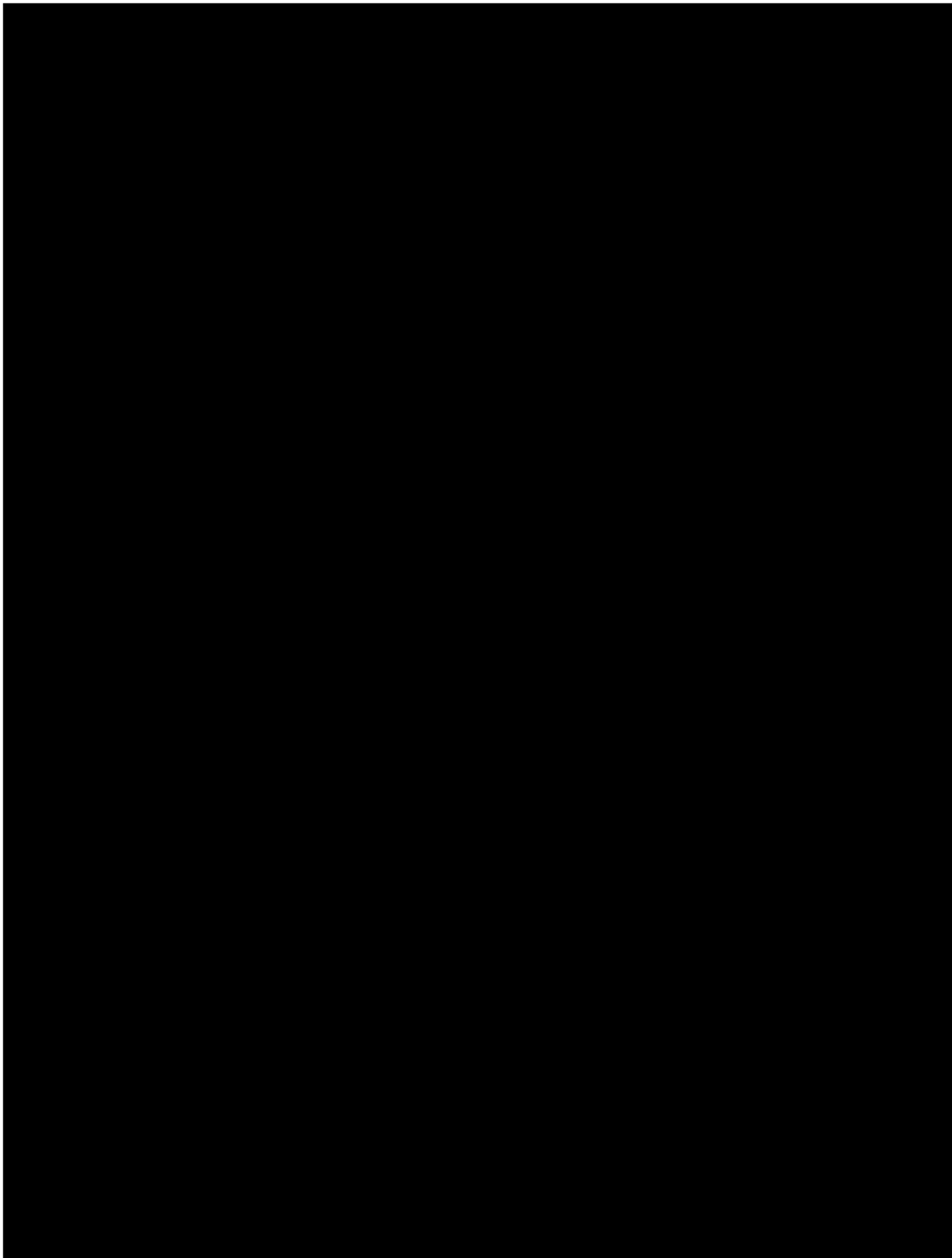
LP - Operations, Management and Data Meeting





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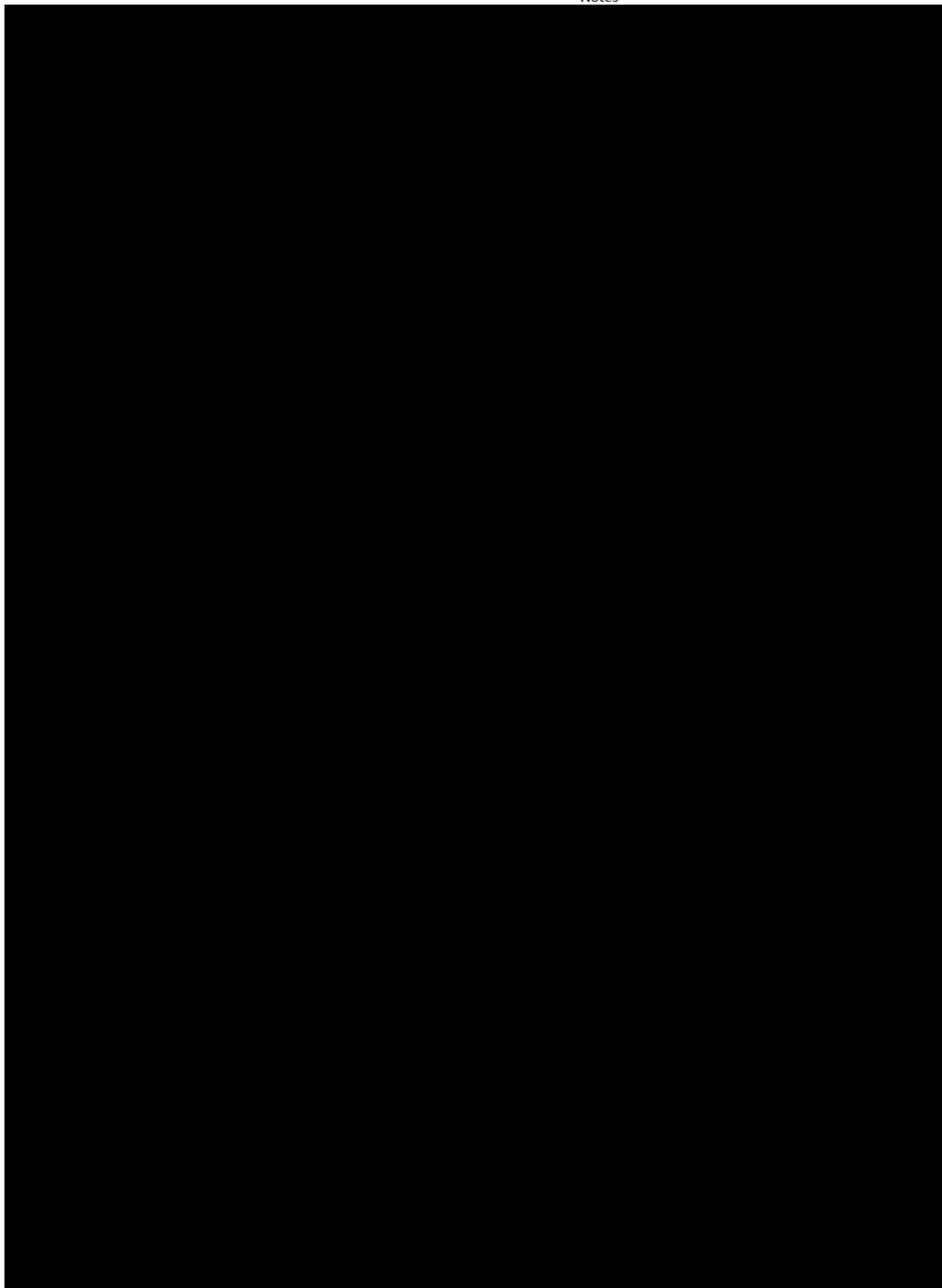
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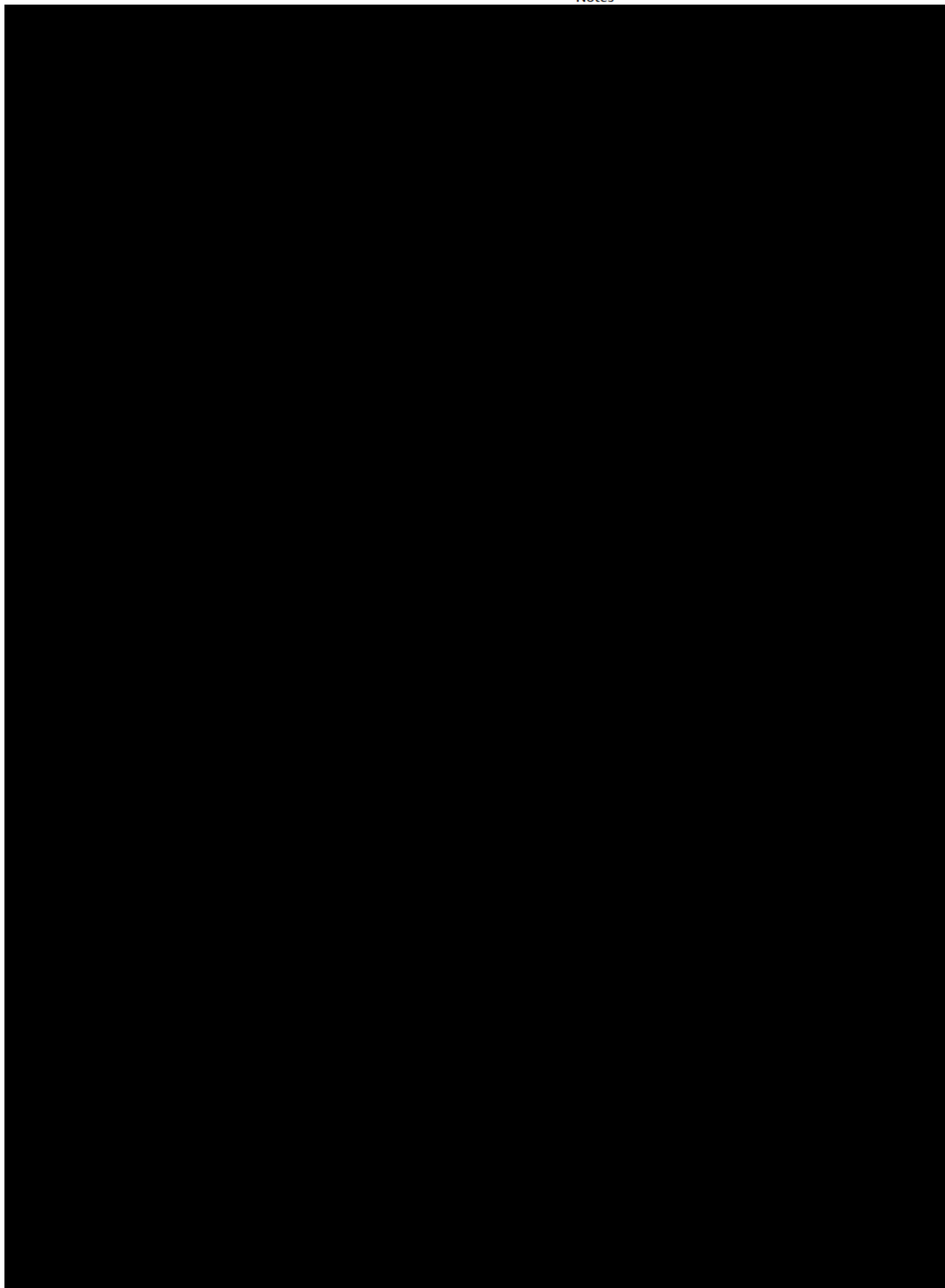
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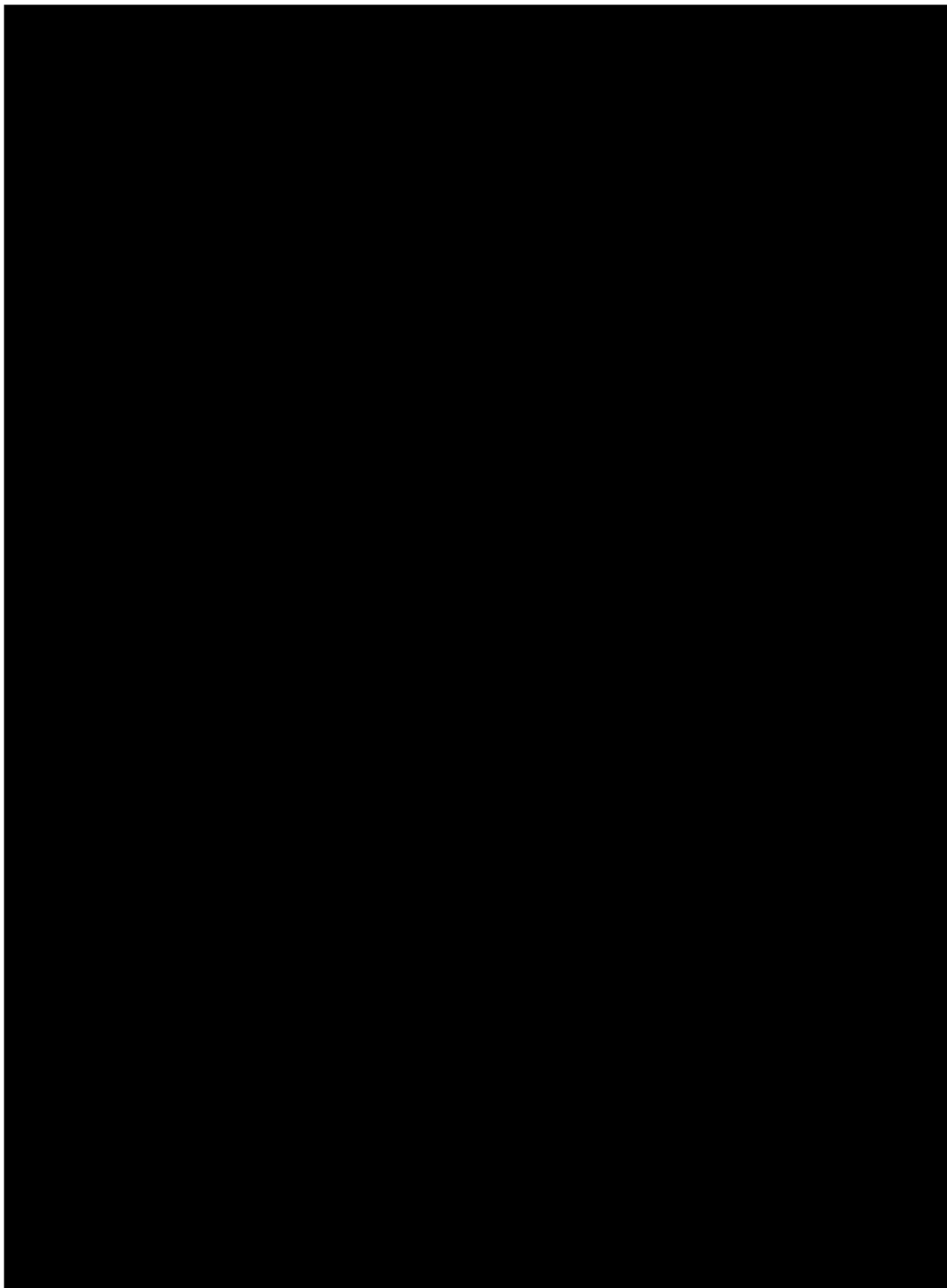
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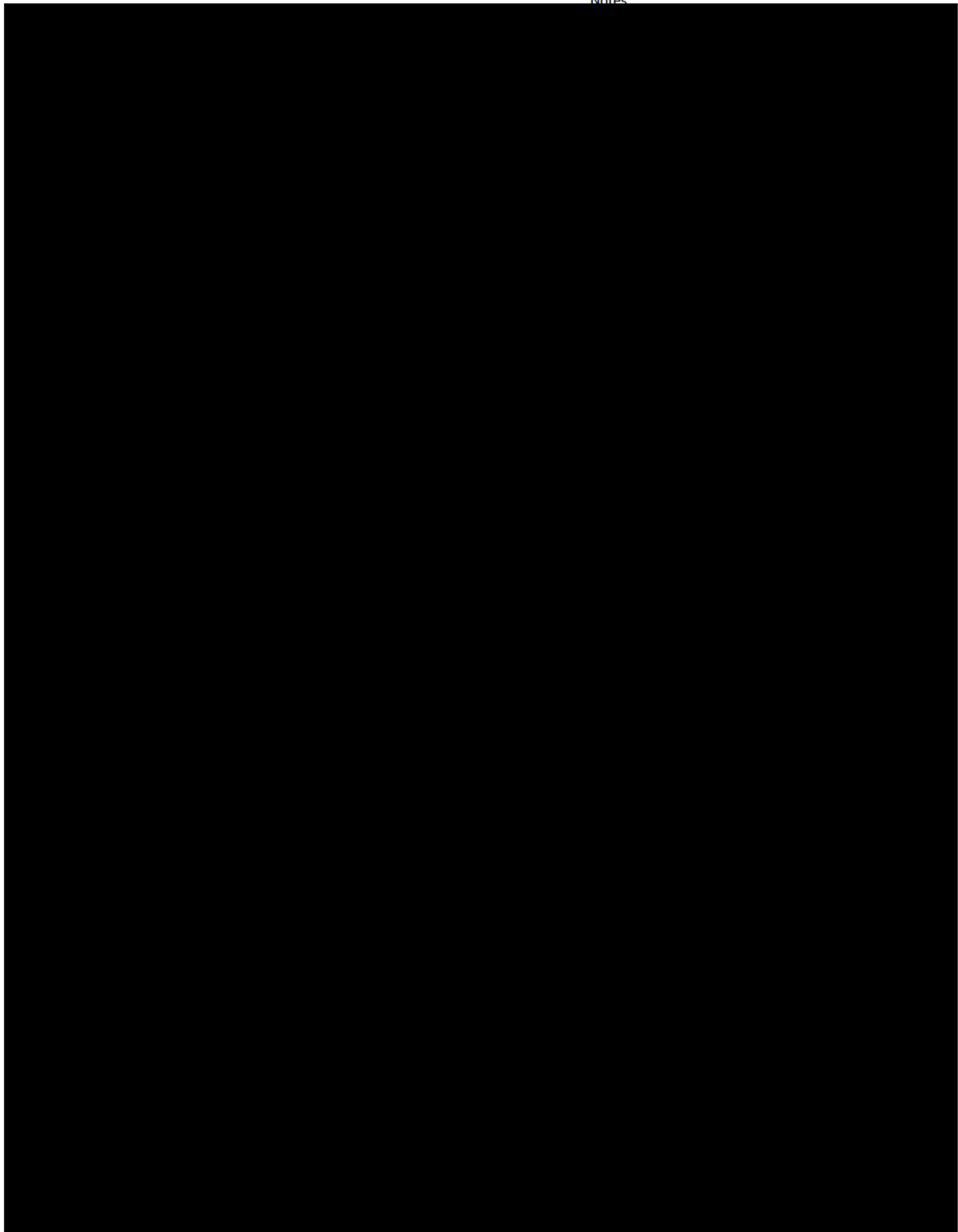
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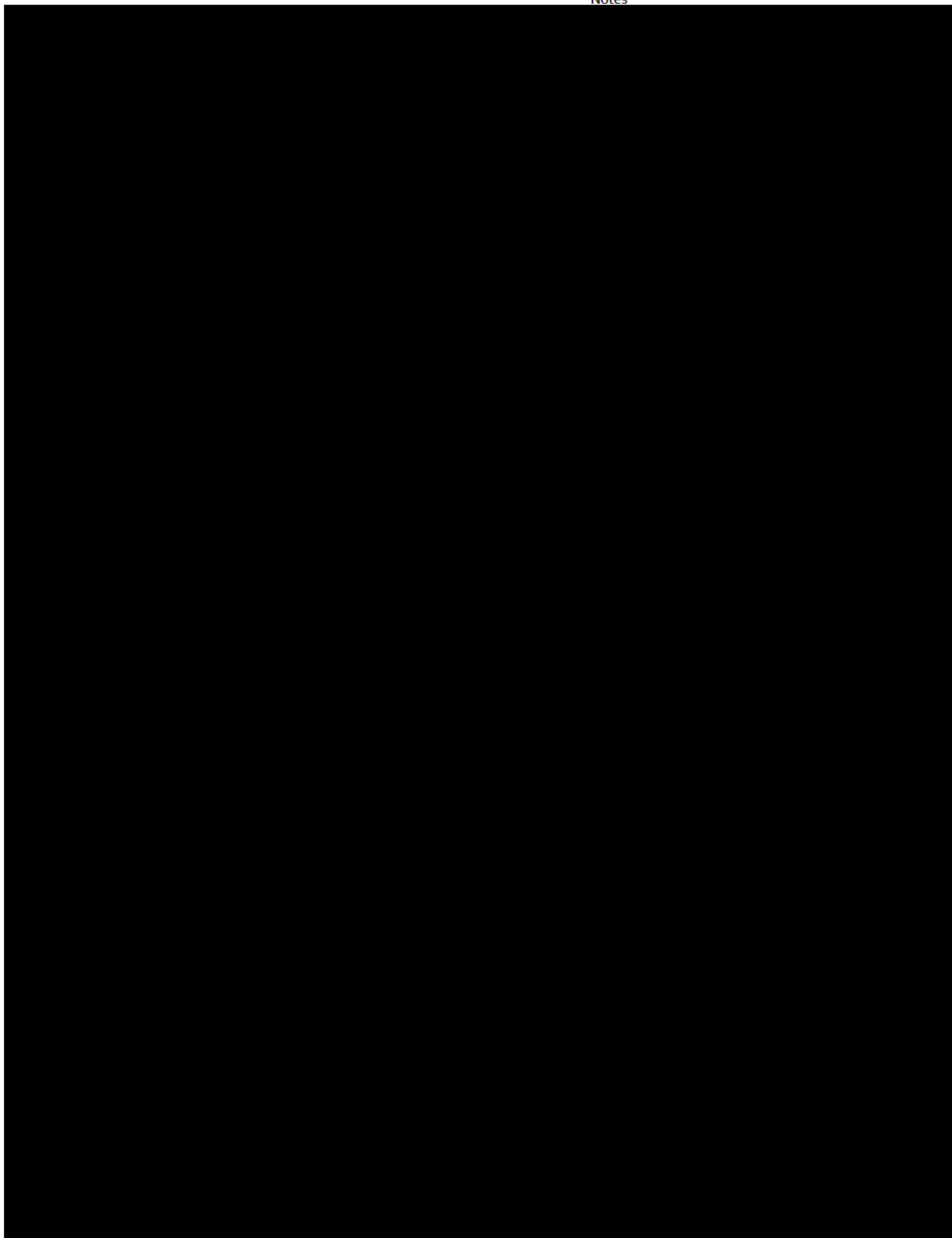
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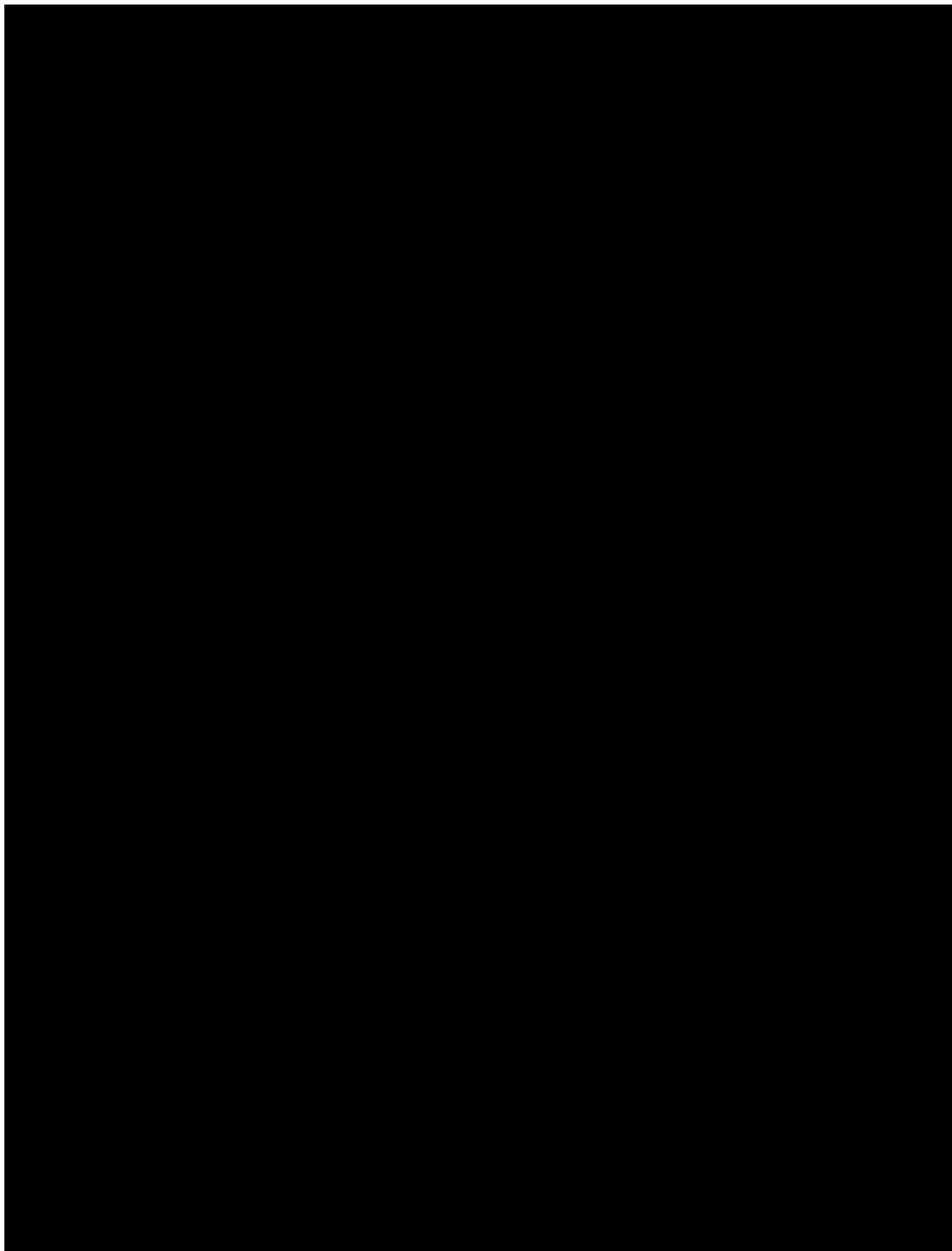
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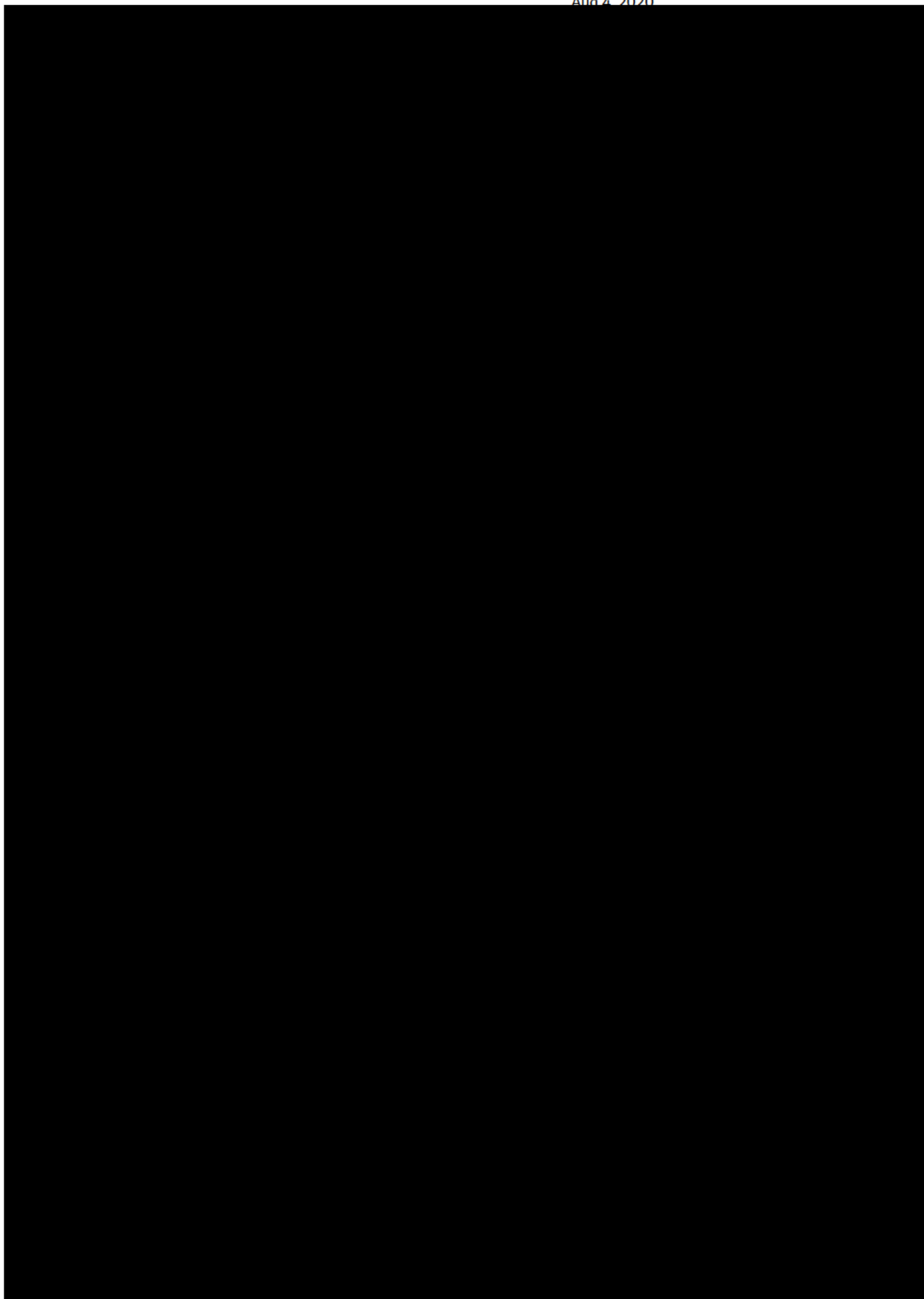
245 Consumers Road, Suite 400





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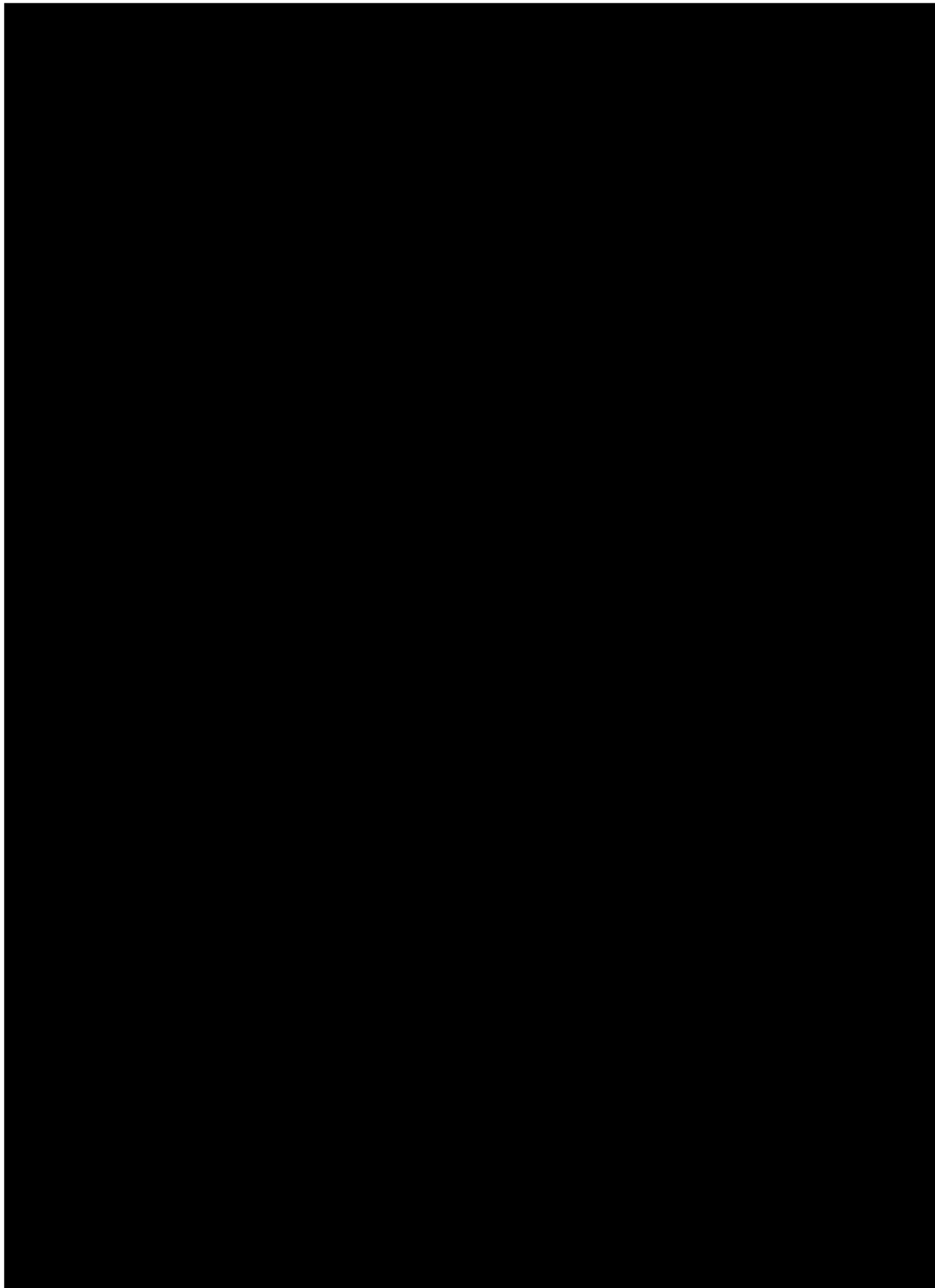
GTM - Strategy and Planning Meeting Notes
Aug 4, 2020





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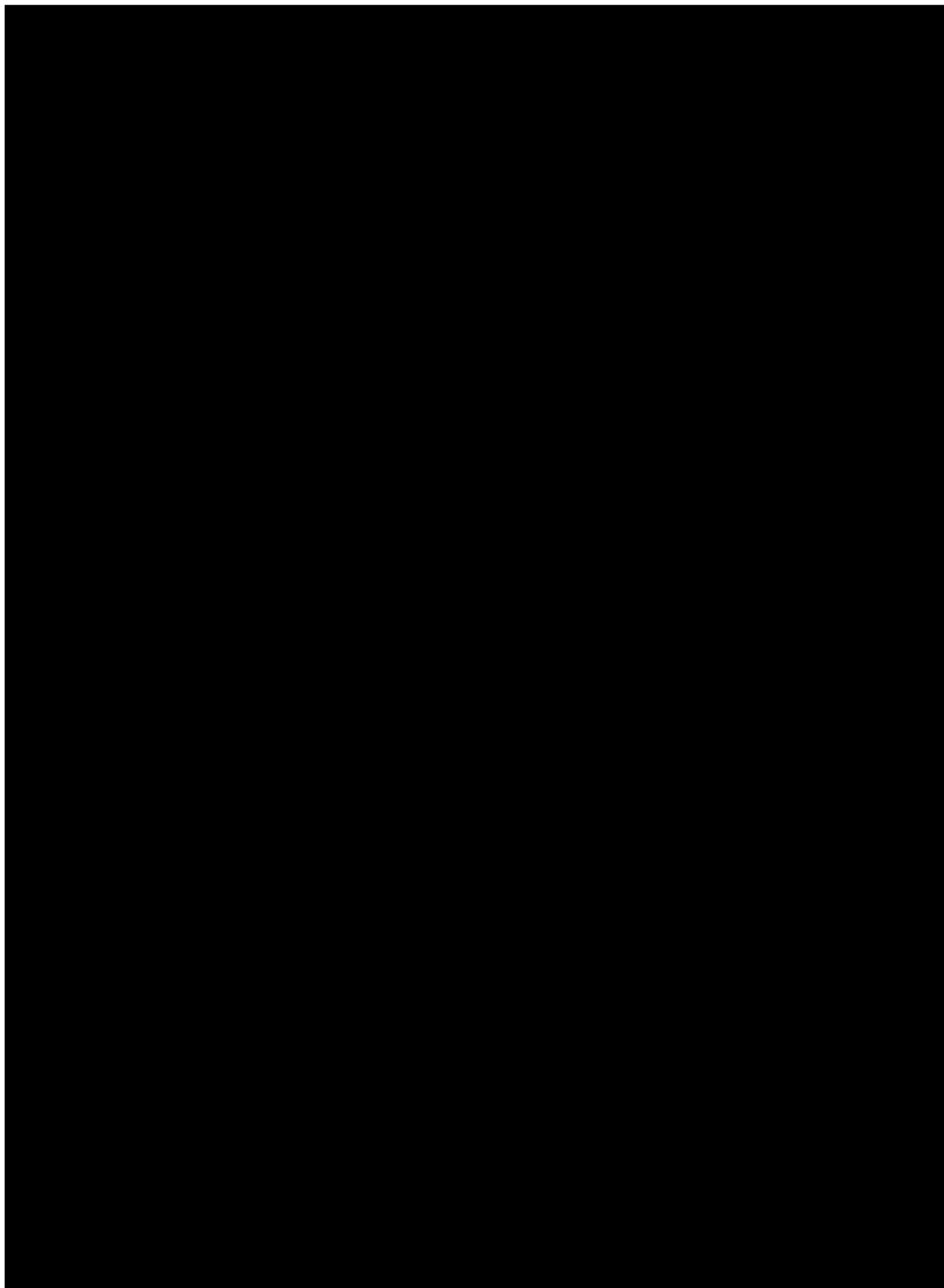
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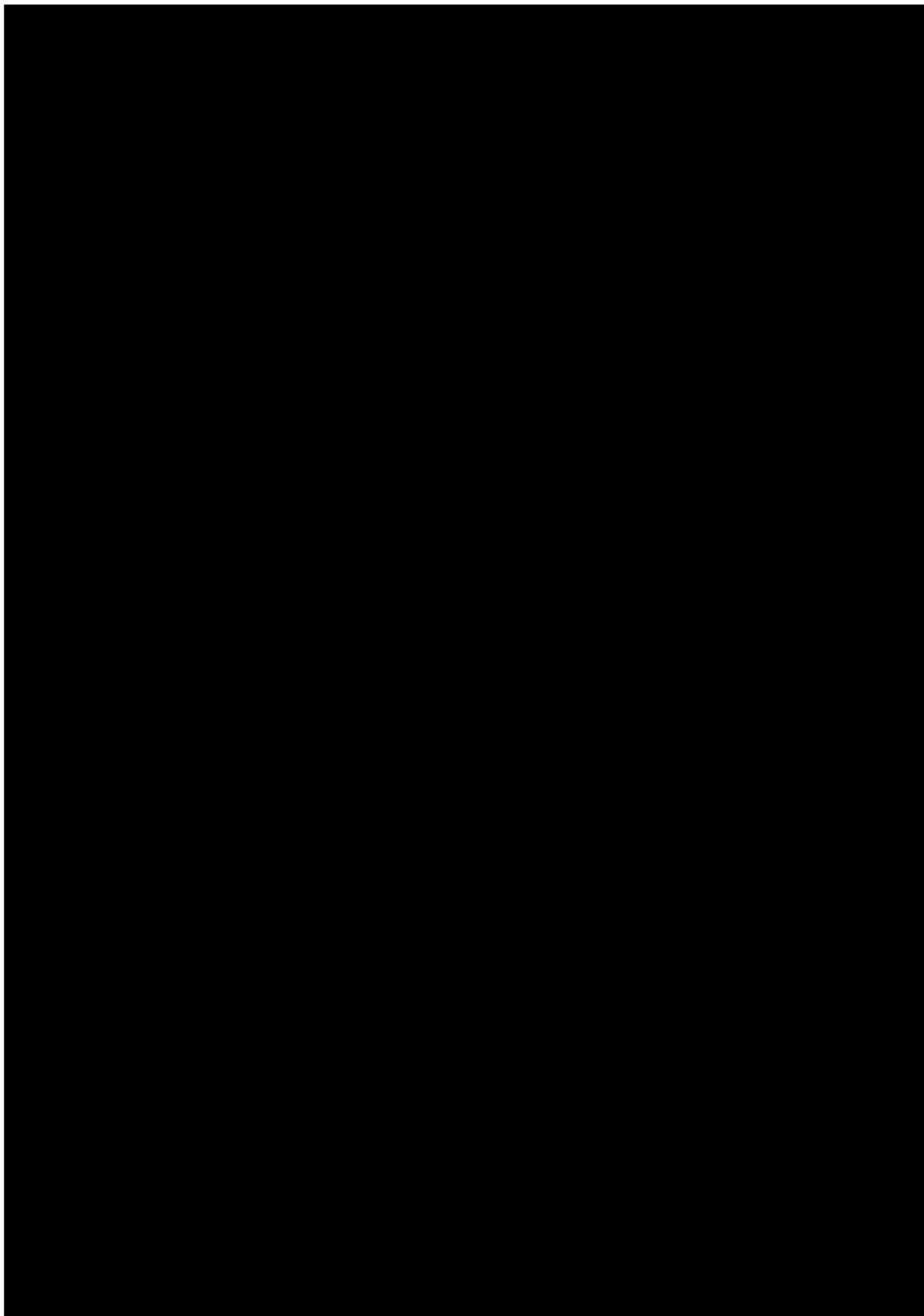
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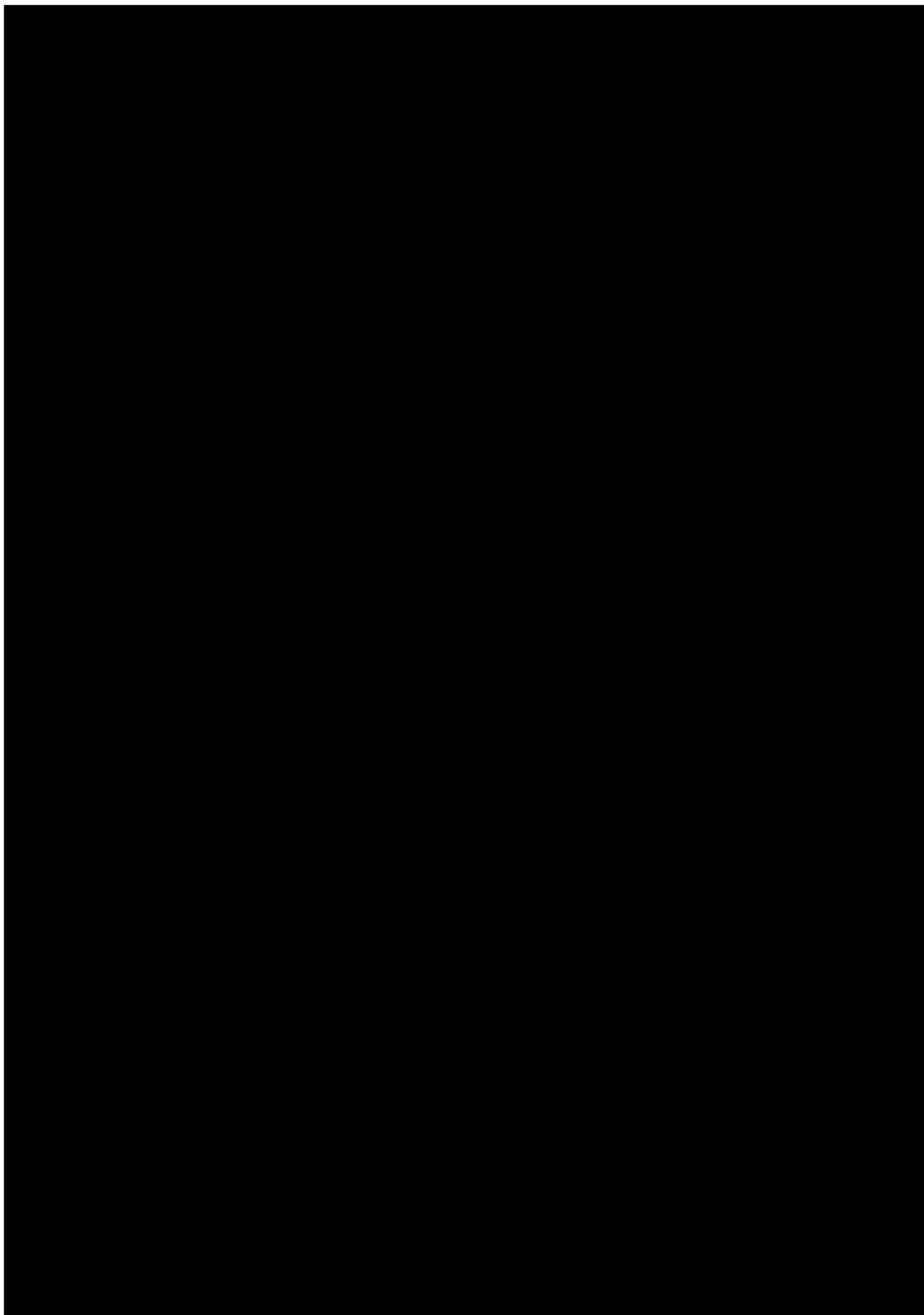
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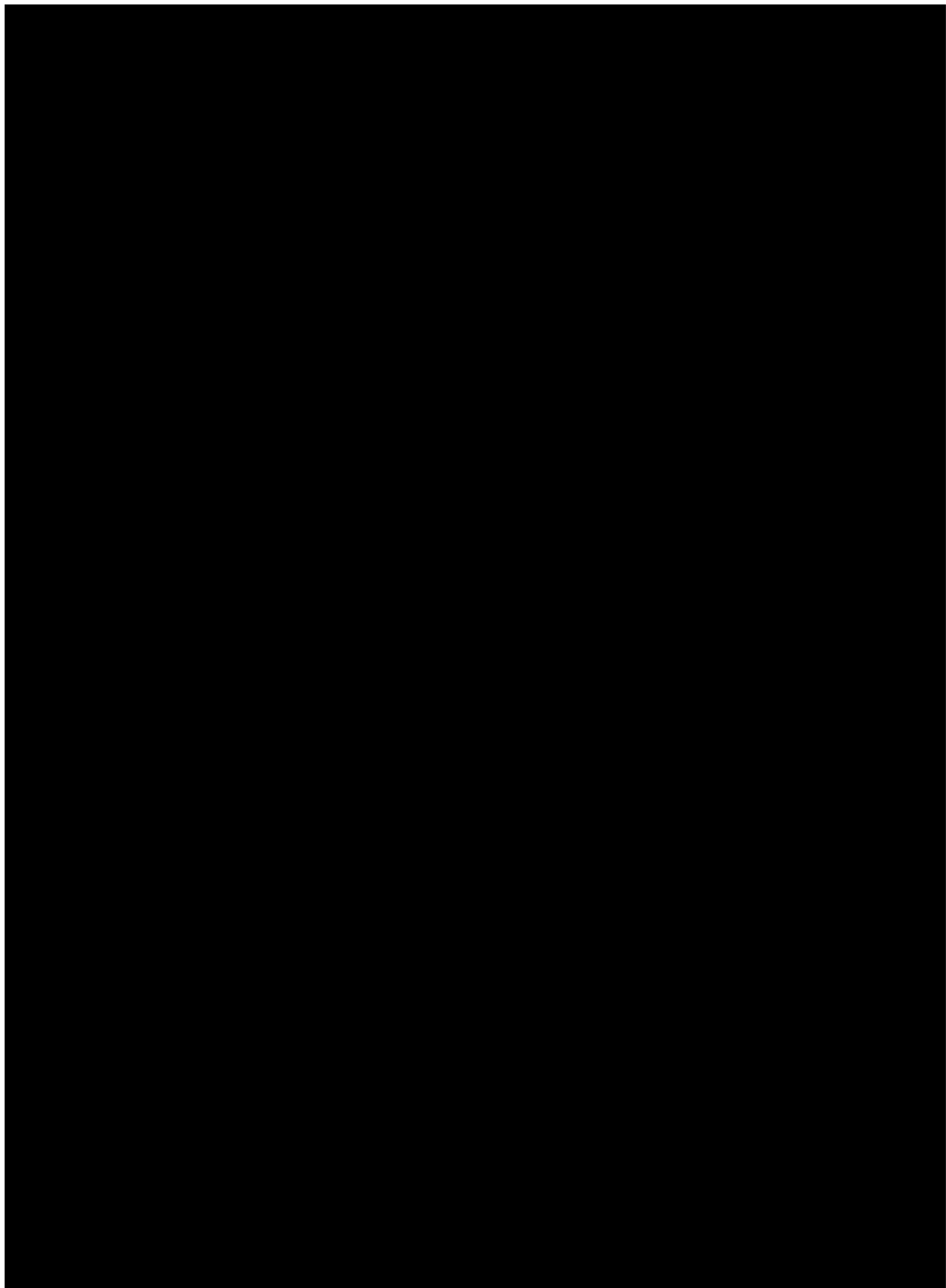
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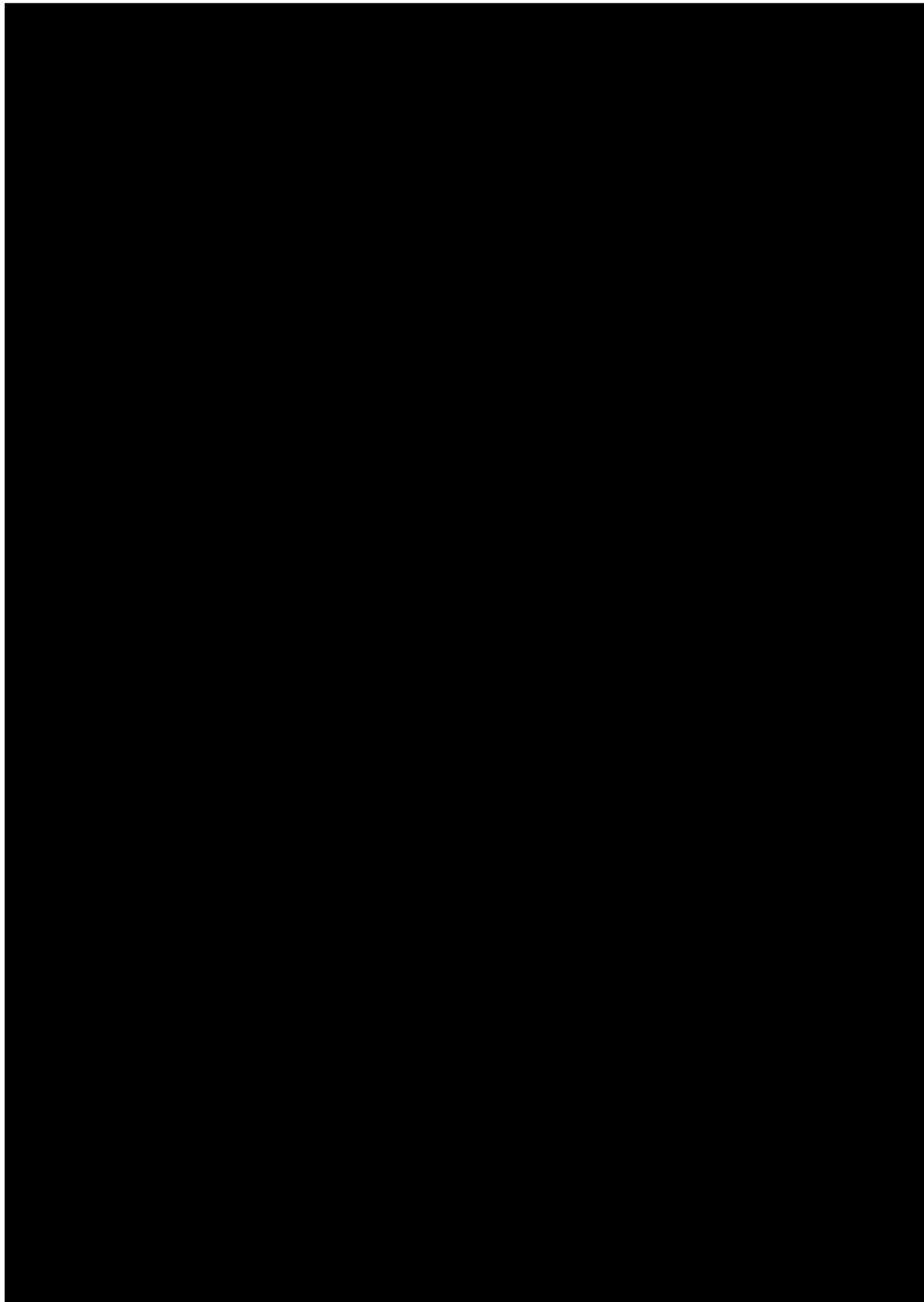
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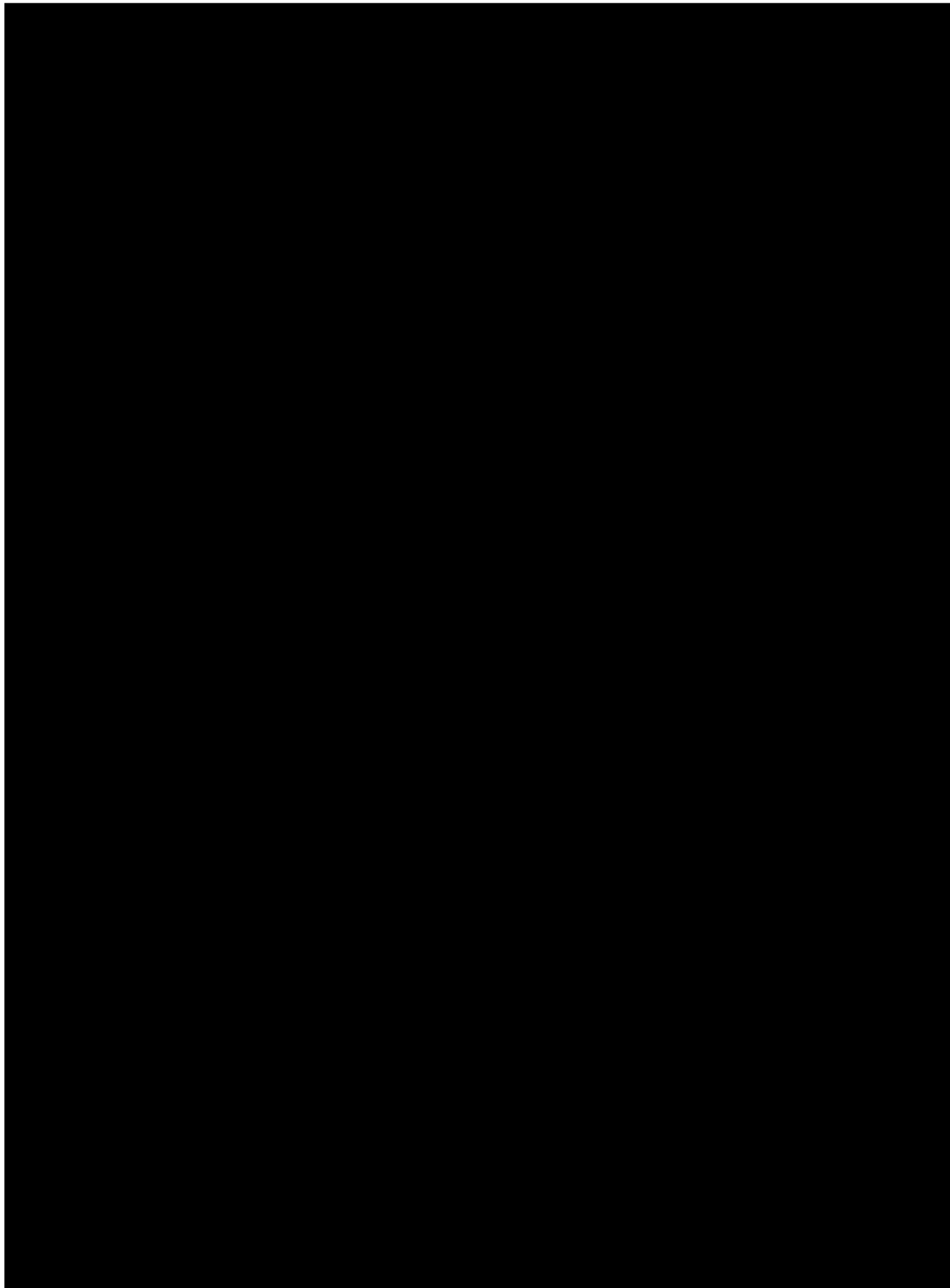
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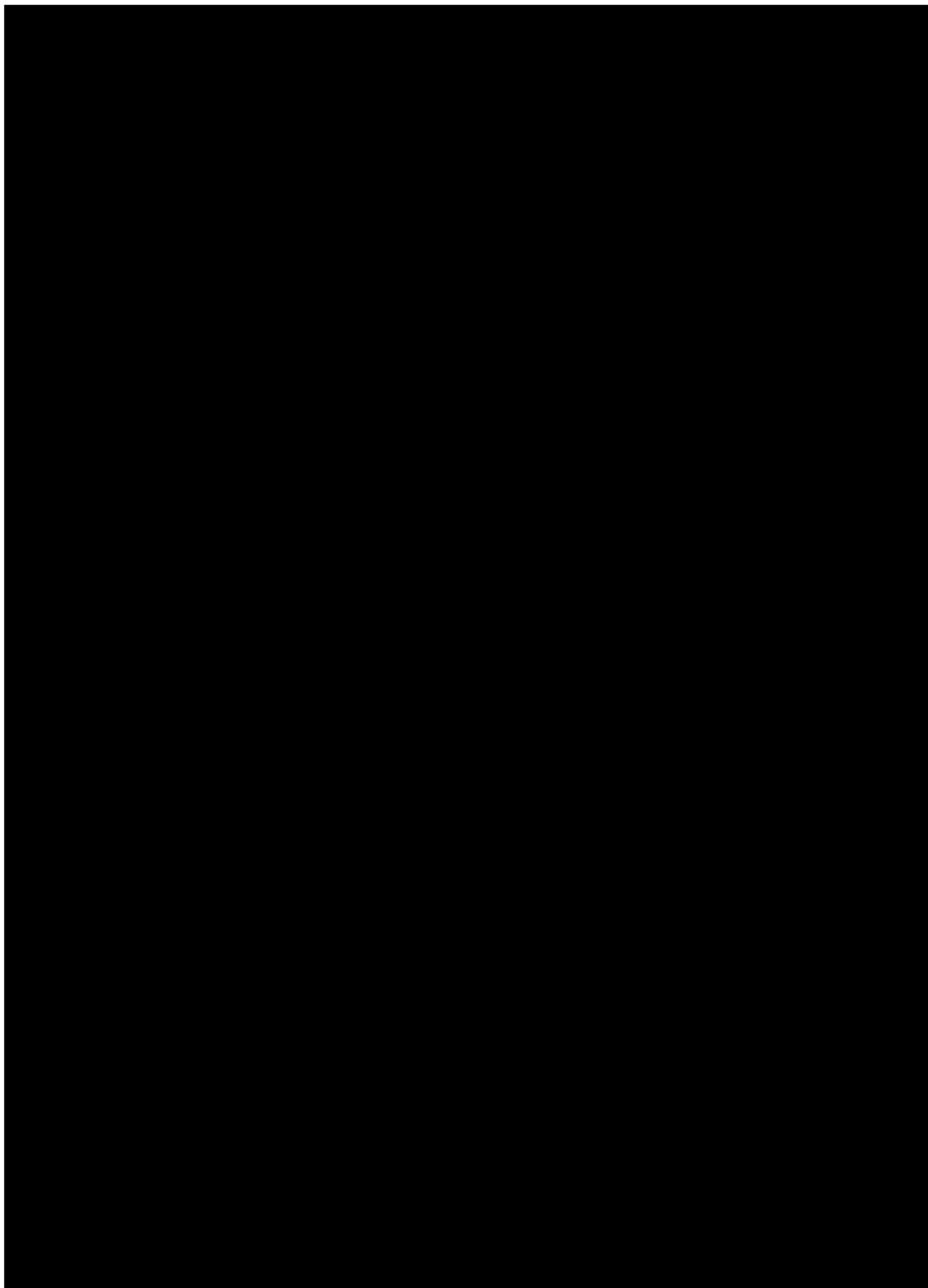
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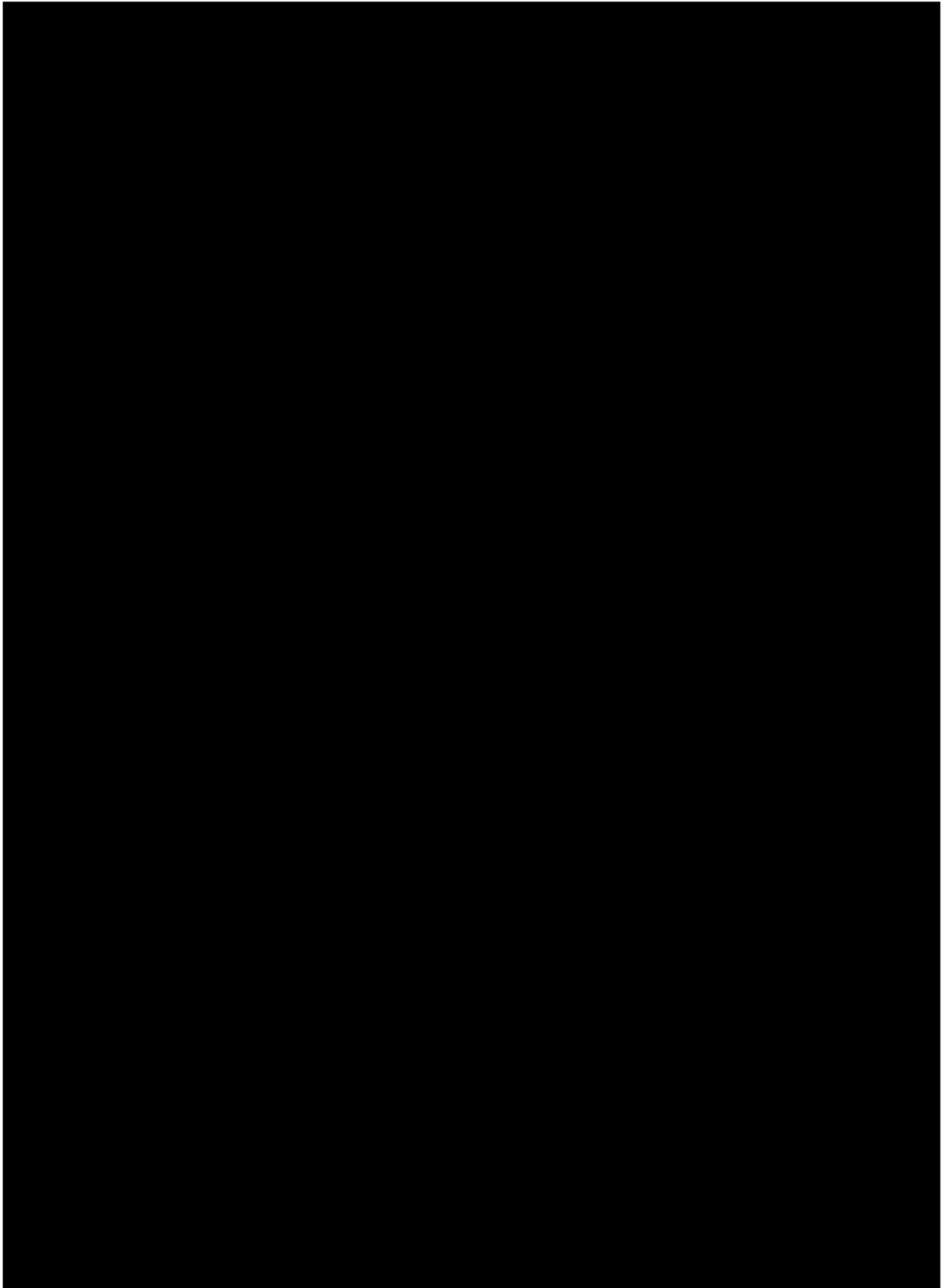
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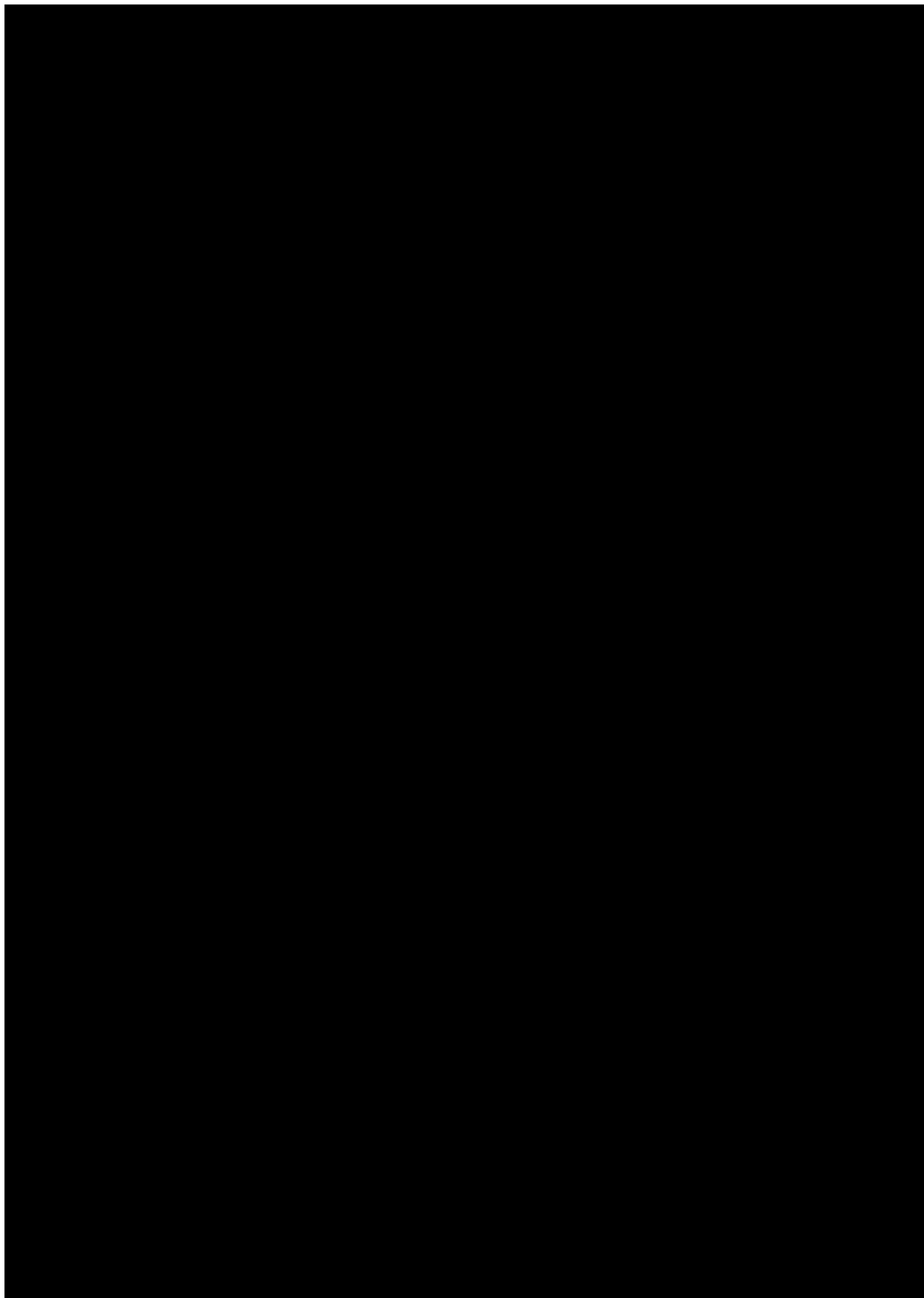
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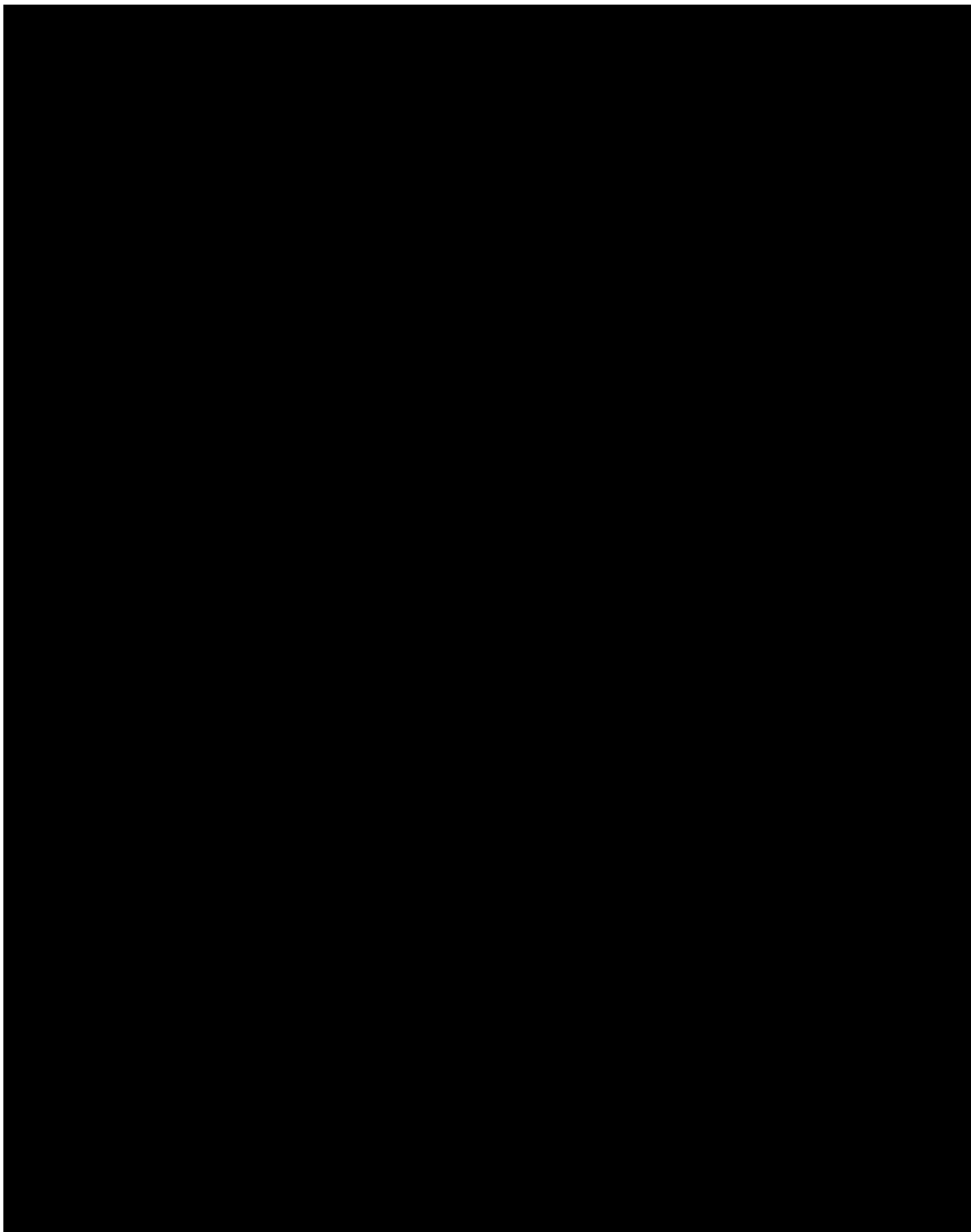
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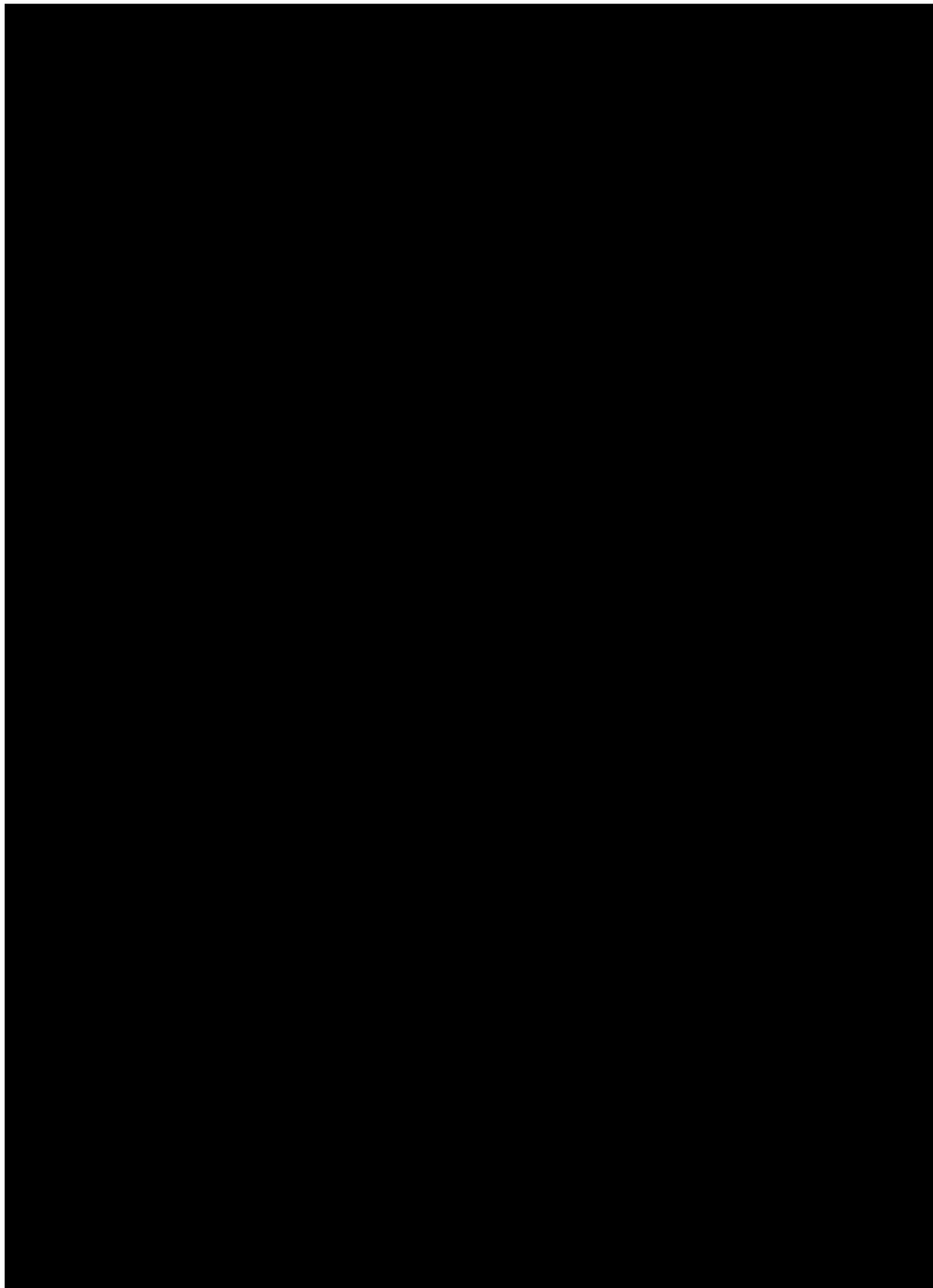
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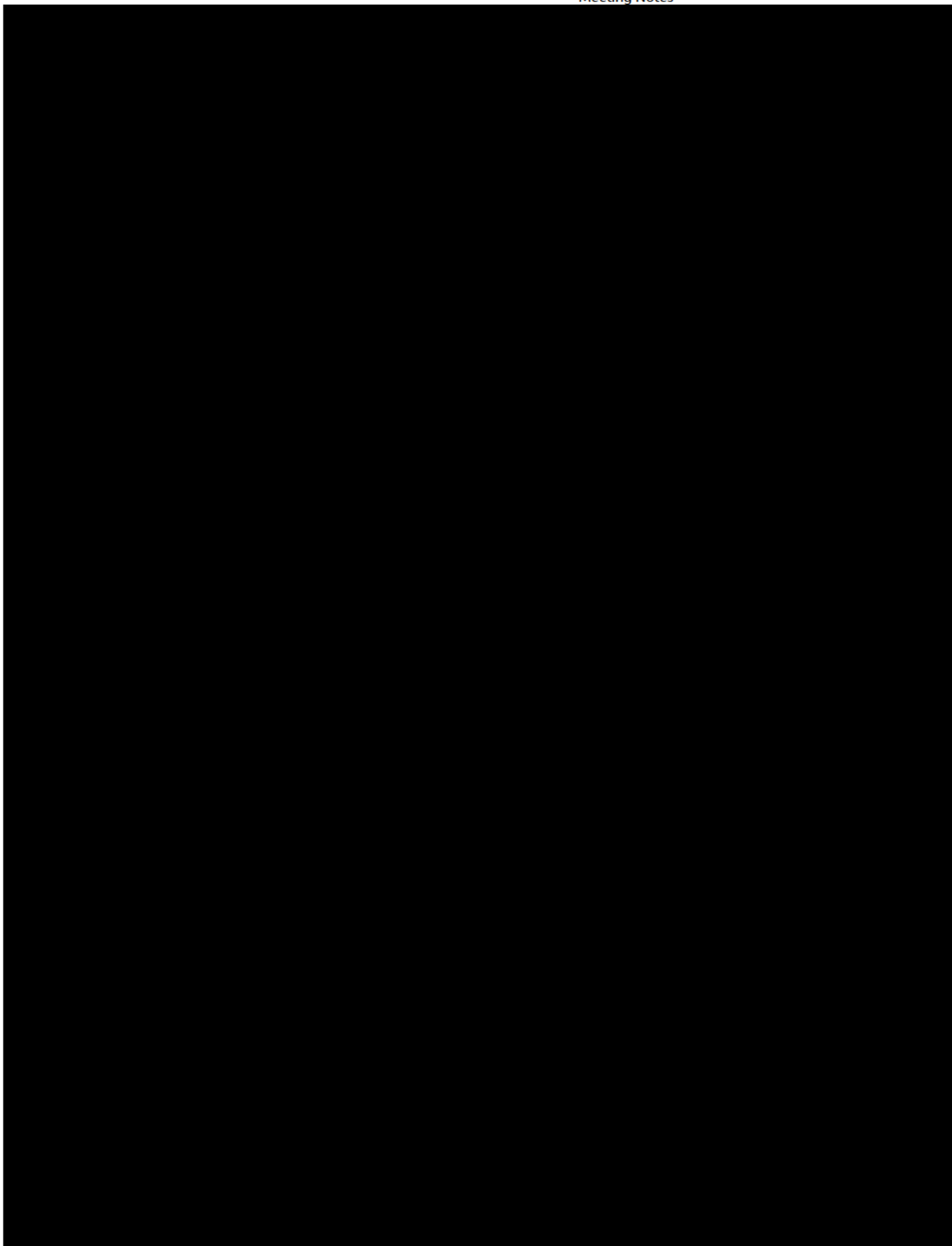
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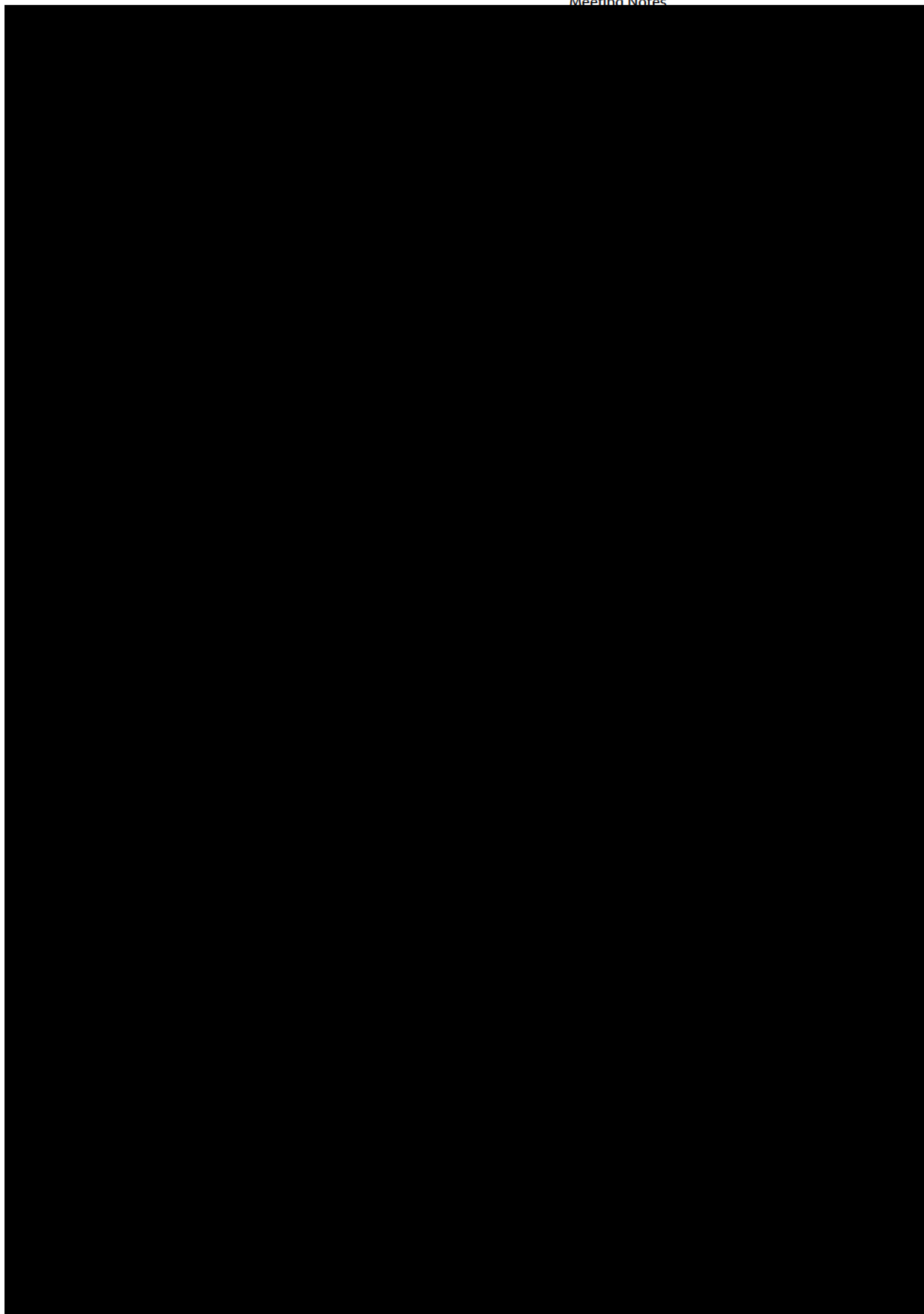
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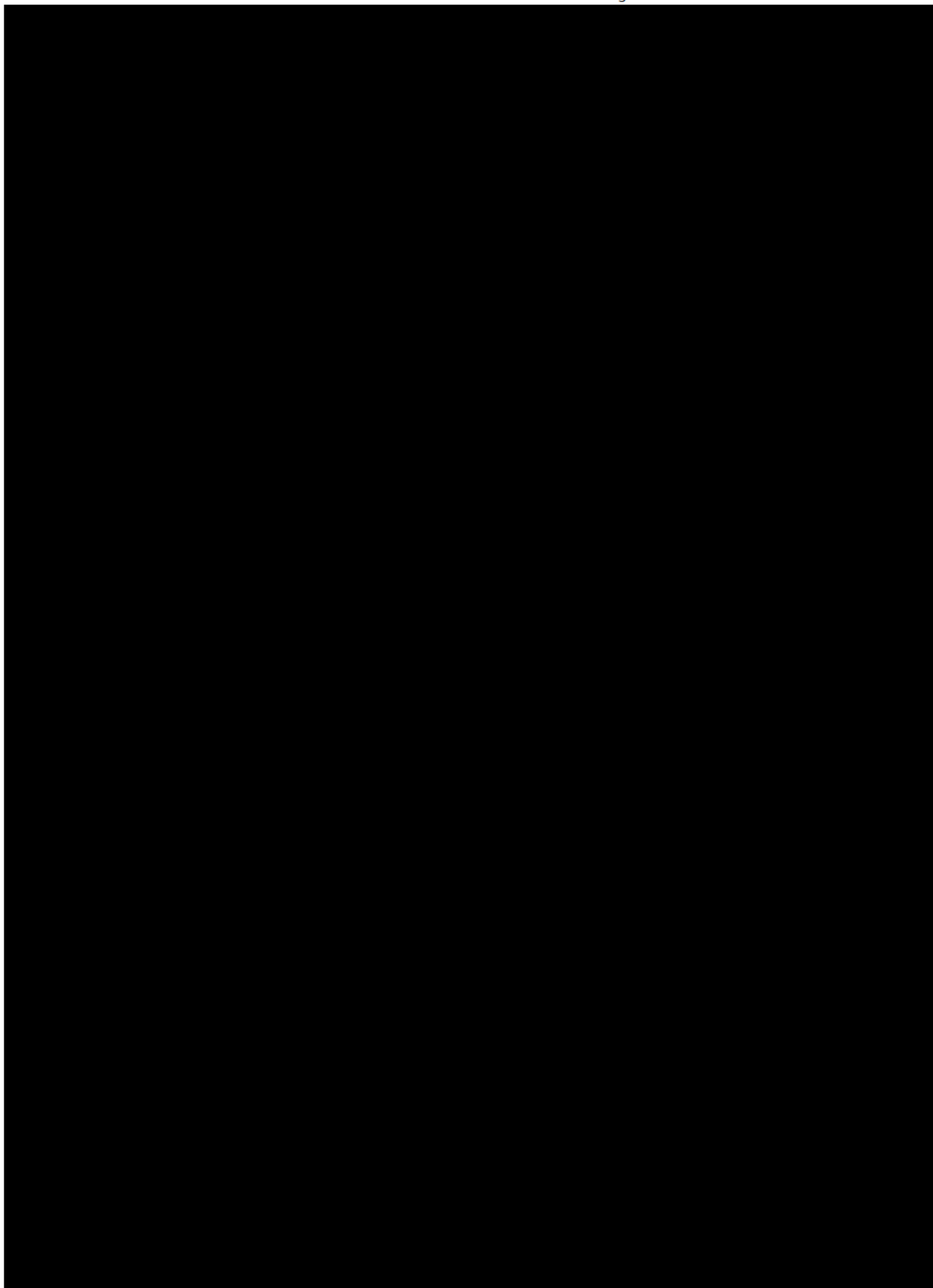
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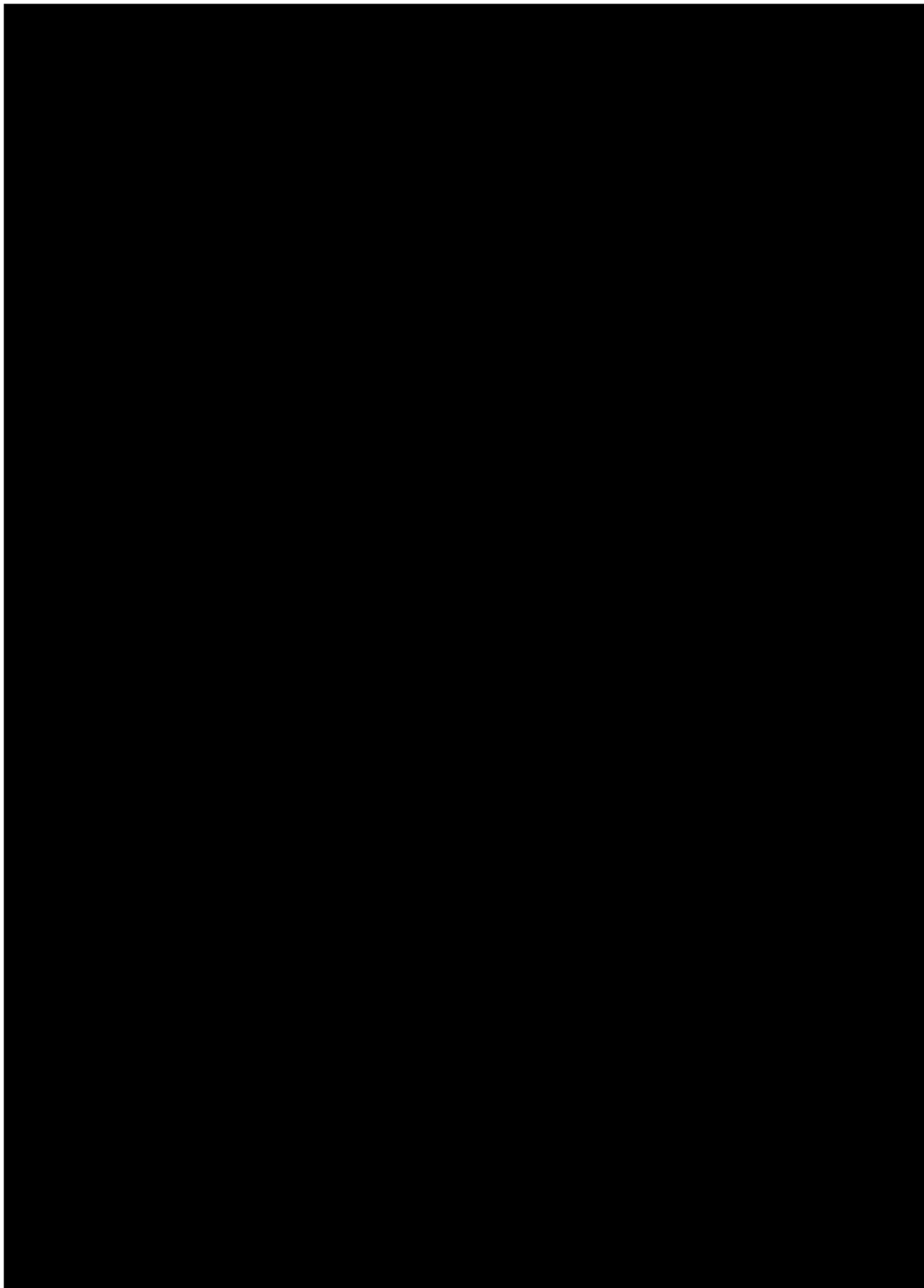
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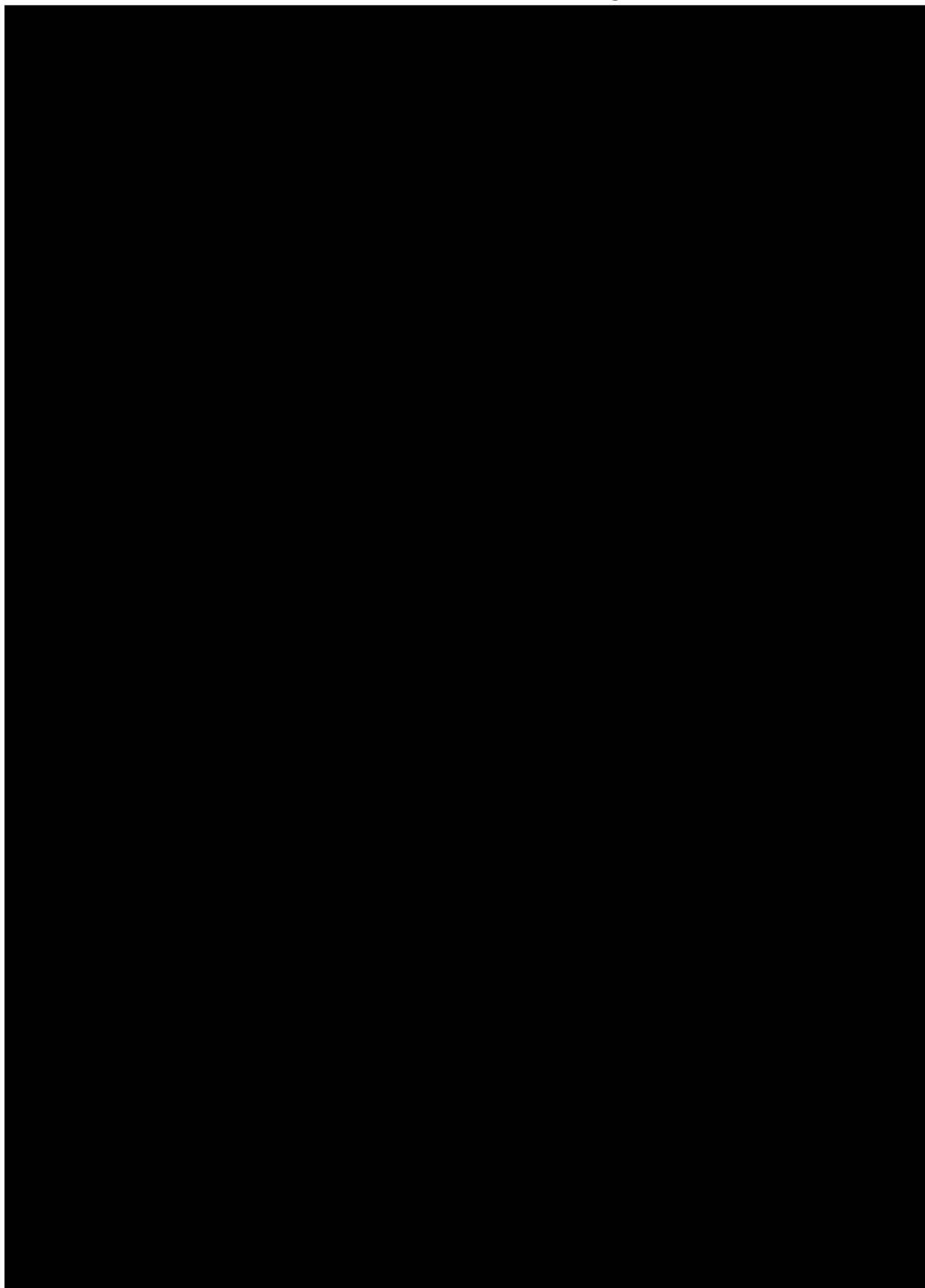
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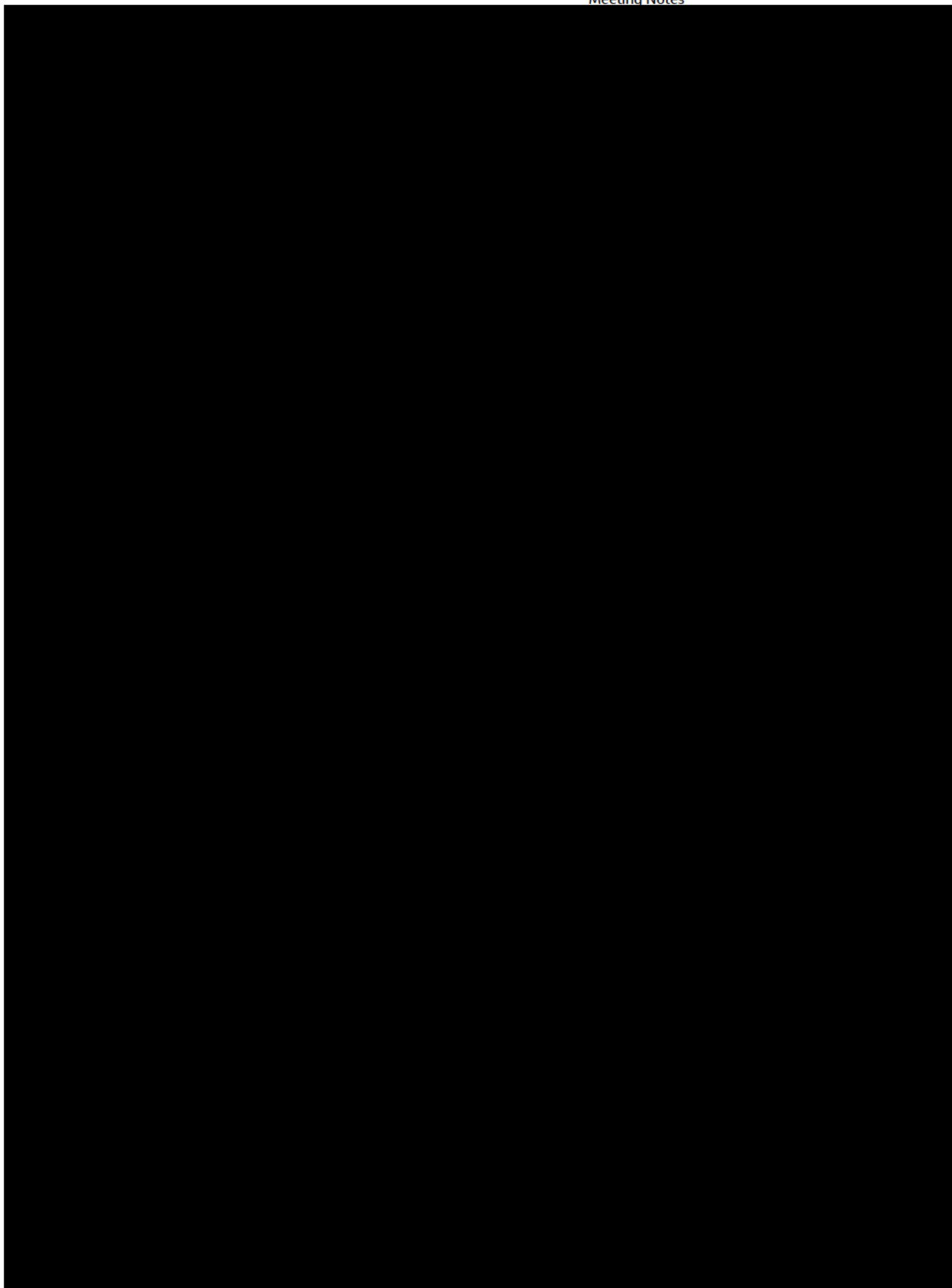
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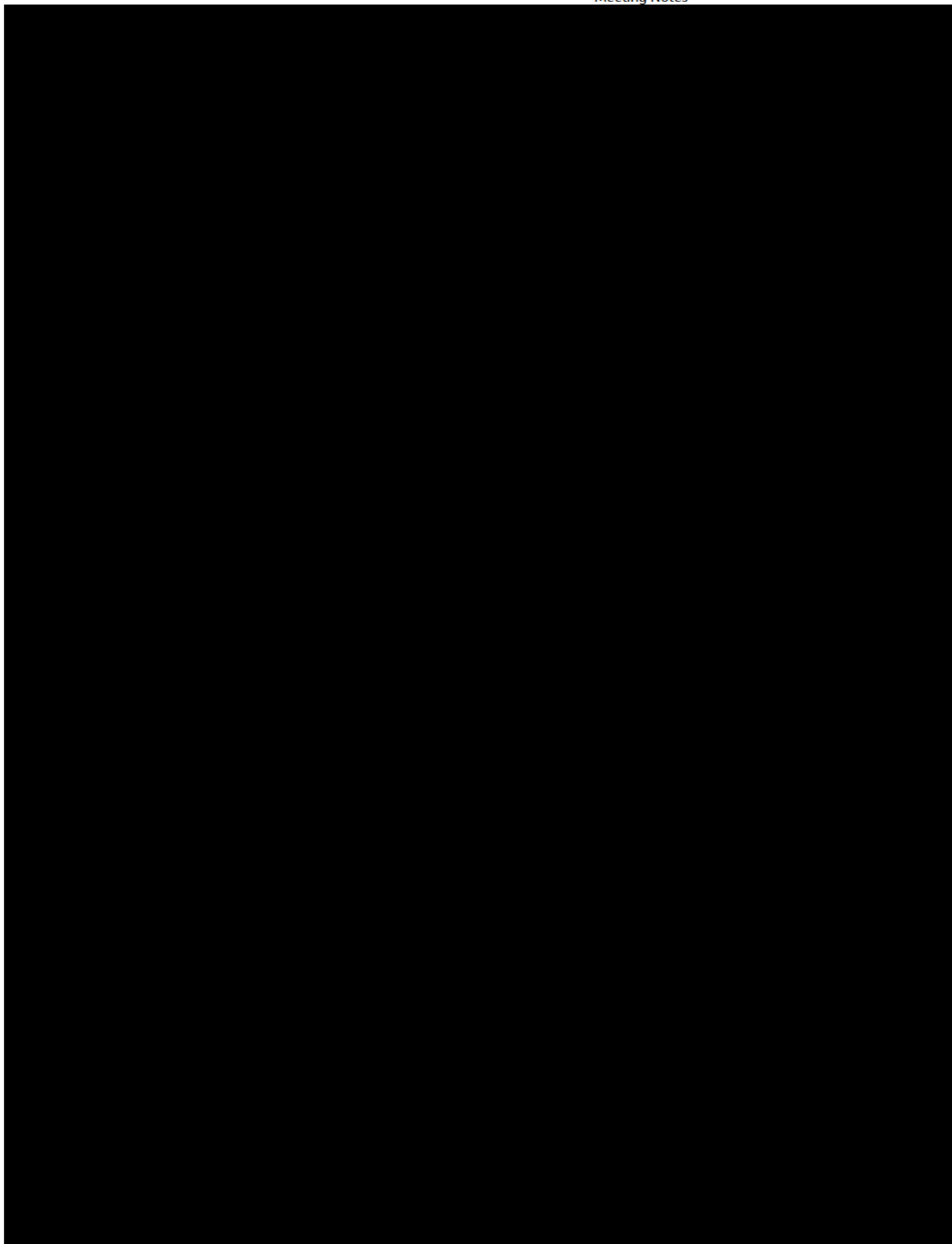
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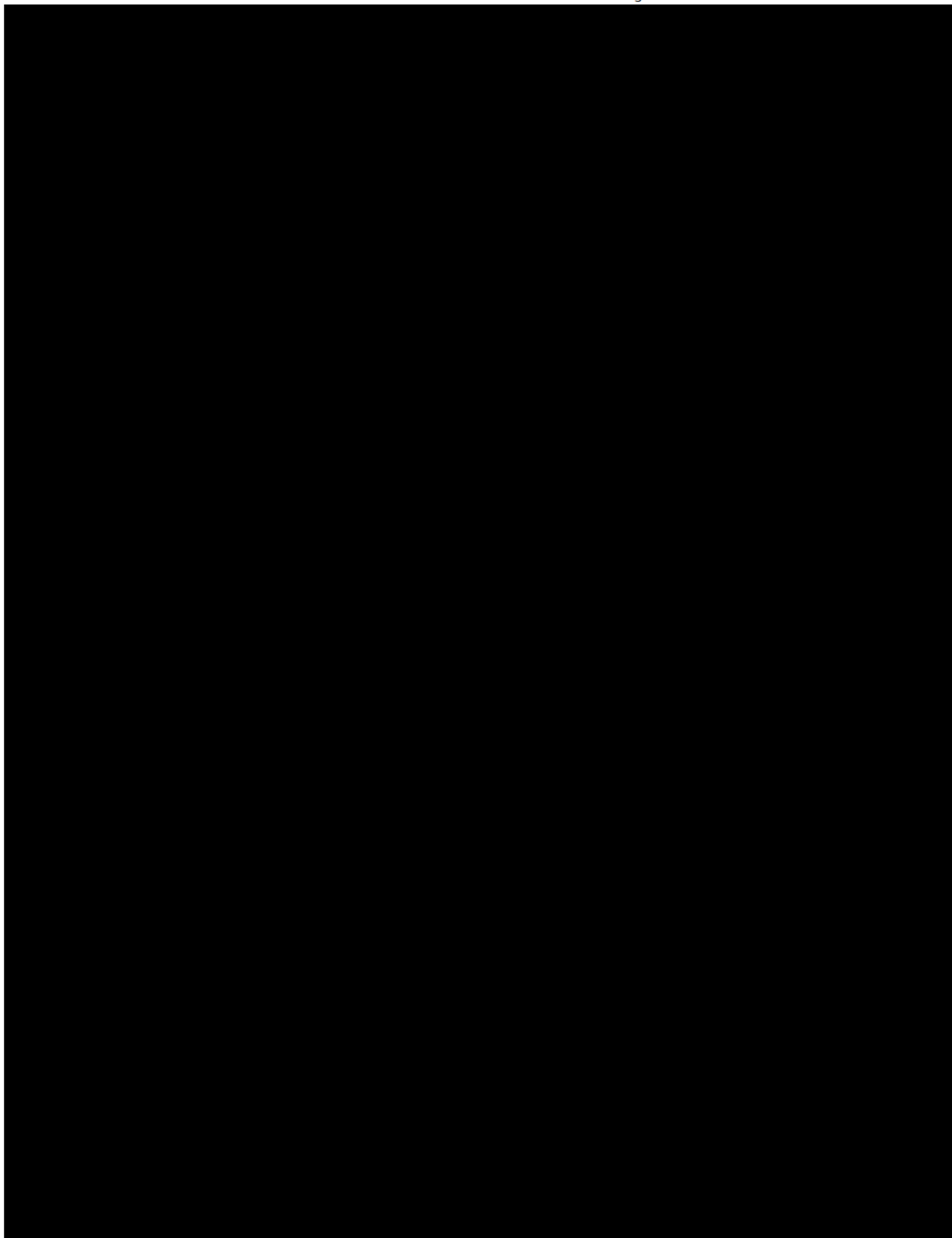
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Subject	GDS - Strategy and Planning Follow-up Meeting Notes		
Project	Enbridge Asset Management Maturity Review		
Project No.	CE777500	File	2020-08-10 GDS SP Q30 Competence Management - Meeting Notes
Prepared by	Catherine Simpson, RPP, MCIP	Phone No.	604-346-9428
Location	Web-based	Date/Time	August 10, 2020
Participants	Catherine McCowan, Manager Risk, Strat & Planning Bridget Sneddon, Manager of Technical Training		
Regrets	Rebecca Mayhew, EAM Governance		
Facilitators	Andy Whittaker, Jacobs Catherine Simpson, Jacobs		

Notes	Action
<p>0 Introductions (Gas Distribution)</p> <ul style="list-style-type: none"> Doing a maturity assessment 39 questions for evaluating One question about having the competence around the board to management AM – from front line field workers to analyzing data You handle the field and training work Assessment across 3 business units (GDS, GTM, LP) Level 3 is alignment with international good practices – plan, do, check Not a regulatory review – it's self-imposed Did a maturity assessment done about 3 years ago before integration Jacobs brought on to do a second assessment Looking to rebase ourselves 	
<p>30 Competence Management</p> <ul style="list-style-type: none"> Q: specific to AM, from field work to ensuring capabilities to set standards, etc. but defines everything we do from end to end of the lifecycle (operations, maintenance, capital, renewal, planning) Have functions, and look at the roles and what's required – experience and certification or equivalent 	<p>Bridget to share evidence with Rebecca</p> <p>Flag for follow-up with GTM: Kim</p>



Meeting Minutes

GDS - Strategy and Planning Follow-up Meeting
Notes
August 10, 2020

Notes	Action
<ul style="list-style-type: none"> ▪ Professional and front-line roles ▪ 1) Setting out a competence management system ▪ 2) Utilize the competence management system to identify areas to fill gaps through recruitment, development of staff, training needs ▪ 3) review competence management system and check that it's relevant and that strategic documents guide this including understanding forecasting of staff requirements ▪ Current Rating <ul style="list-style-type: none"> – 3 with scope caveat so maybe 2.5 – 2.5 because strong with program in place but scope focused on field staff ▪ Rationale <ul style="list-style-type: none"> – Scope does not include professional realm of employees – Includes process safety management – Very robust program for the front line – touching pipe or making decisions on – Kicked off technical competency management program 3 years ago and making more progress – 1) not fully integrated with EGI yet (another year and a half – integrating procedures and assets in distribution systems from legacy companies) – Goal is to have a learning path/journey with competencies – 2) on professional side, left out lawyers, financial/budgeting experts, etc. BUT did include engineering – Don't train integrity engineers but have taken program model and are preparing their own technical competency learning map – consistent and aligned process – Program – 17 technical competency learning maps – Shows learning journey from beginning to specialized – Lists all competencies and a learning chapter/module for each – Also in the job training and mentorship – Do assessments and evaluations with module tests – Can see learning journey end to end – technical and health and safety and system courses – A very laid out journey – think of a placemat – Part 2 and Part 3 of Questions Description: other side of 'placemat' is what drives the continual capability and competency management – names of everyone and rate annually against competency (needs 	<p>Jackson (rating too high)</p>



Meeting Minutes

GDS - Strategy and Planning Follow-up Meeting
Notes
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Notes	Action
<p>formal training, needs informal training, don't need competency, masters, etc.)</p> <ul style="list-style-type: none"> - An analysis of all training requirements - Part 4 – review competency managements system annually to ensure these are still the right competencies; continually done each year for the business - Have an annual training council meeting with directors (1h) to provide stats and an opportunity for directors to ask what is needed next and confirm that the right things are being focused on – Bridget gets direction from Council and it's important for planning the future - Summary: robust program in palace; being implemented in field and engineering; good coverage of front-line staff integrity going to pick up for their staff - Integrity and folks in AM aren't necessarily trained but they are adopting the technical competency learning path layout to build out their expectations, but they own the training component - Have a new video to orientate new leaders coming into a supervisor area so they can perform this annually - Assessment levels 1-4 or N/A - Do an annual report to directors to show progress, recognizing transition of staff - Anything in risk, project management? No, although project management is a requirement for planners in their role. Very focused on technical training to field and office technical systems. Model lends itself to be able to do risk assessments but don't currently train for that. - Not aware of EAM framework – Catherine is interface with Bridget – 	



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GDS - Strategy and Planning Follow-up Meeting
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Notes	Action
<ul style="list-style-type: none"> ▪ Summary: <ul style="list-style-type: none"> – Sensible and practical and homemade – Have got some gaps if it's directly based on AM but if it's relative to people making good decisions and being competent in their role – the bits and pieces that make a strong system are in place – Don't have a lot to do with AM as a department – Really robust program that in certain areas would rate a 3 but overall at 2 to 2.5 because it hasn't been rolled out everywhere yet (Bridget's scope has been completely rolled out but for GDS there are gaps including engineering and risk and capital project managers they need to do work – need more people for Bridget if they want to do more training OR could deliver on their own with different team) ▪ Evidence <ul style="list-style-type: none"> – Send a copy to Rebecca – something simple to summarize – Placemats by role – example was shared 	



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Subject	GDS - Operations, Management and Data Follow-up Meeting Notes		
Project	Enbridge Asset Management Maturity Review		
Project No.	CE777500	File	2020-08-17 GDS Data and Operations Follow-up - Meeting Notes
Prepared by	Catherine Simpson, RPP, MCIP	Phone No.	604-346-9428
Location	Web-based	Date/Time	August 17, 2020
Participants	Catherine McCowan, Manager Risk, Strat & Planning Erik Naczynski, Manager Asset Classes Distribution Angela Scott, Manager Integrity Management Mike Hildebrand, Mgr Asset Classes Storage & Transmission Andrew Welburn, Manager Asset Data & Information		
Observers	Rebecca Mayhew, EAM Governance Caryn Campbell, Manager EAM Proj Mgmt		
Facilitators	Andy Whittaker, Jacobs Catherine Simpson, Jacobs		

Notes	Action
0 Introductions (Gas Distribution) <ul style="list-style-type: none"> Within second year of EAM program Executive would like to see adjustments to ensure targets can be hit Set the stage for continual improvement Engaged Jacobs to facilitate sessions – IAM endorsed assessor Not a formal audit This is a follow-up to the previous conversation 8 questions to go through today 	
13 Systems Engineering <ul style="list-style-type: none"> Current Rating <ul style="list-style-type: none"> Network analysis is a 3 2 (solid, leading into a 3) Rationale <ul style="list-style-type: none"> Have the demand analysis that we've already spoken about 	



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GDS - Operations, Management and Data
Follow-up Meeting Notes
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Notes	Action
<ul style="list-style-type: none"> - From a distribution analysis perspective – there is a team of network modelers with regions they manage; using Synergy; using cascading models with multiple pressure classes; evidence - A number of different planning groups with monthly meetings (such as, network analysis, transmission engineering and optimization, storage planning) and looking at the entire system to make decisions on the right solutions - The right people are getting together but there aren't any process maps documented - Documented processes around how these planning groups is an opportunity to improve - Evidence to show consistency in how work is done - Maybe perceived assumptions that are documented in the model but the rationale for those assumptions may not be documented - Well-established practices in place including resources, system analysis tools and functionality; used on a consistent basis - Require more documentation around process - Network analysis is well documented – and tracked in Maximo – because it's transaction based (so the rating is higher in this area, a 3) - Interaction between 2 groups (there is an annual meeting but don't have a formal process for hand-off so not fully mature) - Next step: a process to tie existing practices together would get to a 3 ▪ Evidence <ul style="list-style-type: none"> - Leave to Construct Application – for large projects provides justification, alternatives and analysis to Ontario Energy Board - Facilities Business Plan - Network Analysis Documented Process 	
<p>14 Configuration Management</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 1 ▪ Rationale <ul style="list-style-type: none"> - With the Dawn De-hydration plant we have seen performance issues over the years which is traced back to changing expectations over the year and expectations exceeding capabilities - Have tried to do RCM analysis in the past and don't have expectations written down – relies on people's memories and perception - Could do better on documentation 	



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Notes	Action
<div> <ul style="list-style-type: none"> - It would allow us to flag when changes occur such as performance degrading or when it's not functionally possible to achieve expectations - For thousands of distribution stations, have records for mop in and mop out, capacity, performance; processes are documented ▪ Evidence <ul style="list-style-type: none"> - </div> <div> <p>24 Asset Information Systems</p> </div> <div> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 1 to 2 during discussion, with a solid 2 in some cases - 1.5 consensus ▪ Rationale <ul style="list-style-type: none"> - Have maps of systems and interfaces with a variety of levels of detail - Systems managed well - Change processes in place for upgrades - Testing done - Roadmaps are in place, but challenge is that landscape is changing rapidly (month to month) with critical timelines; have to constantly go back and revisit these - Roadmaps are integrated into processes, utility integrations, unify and asset management - Challenging to pull out a 10-year roadmap because of evolution of utilities - Are implementation plans sufficiently comprehensive , or more broadly focused on major initiatives? AWS is being well planned, implemented, resourced, and tested. - Challenge with other systems that we haven't turned our attention to yet. - Sort term planning is done well (such as, upgrading to Windows 10 and linking to application updates required) - Unify is underway - Do have a system map and implementation plan (a bit fluid and it doesn't necessarily cover everything) but have good evidence and systems there - Scope doesn't include all systems on the documented roadmap; some fluidity - Not talking about alignment with C55 alignment with Encompass and Oracle - Opportunities longer term </div>	



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GDS - Operations, Management and Data
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August 17, 2020

Notes	Action
<ul style="list-style-type: none"> - 1-2 year horizon is focused; 2-3 years less focused - Roadmaps for 5-year implementation exist but are high level (but more focused on LP or GTM) - Acknowledgement of need for consistency and work is being undertaken to address gaps - Challenging to look at data and integration across legacy systems because it's a complex landscape - Know where data is and the system of record for particular data but getting access to the data can be difficult where experts have moved on to different roles - Consistency of information in systems is sometimes challenging ▪ Evidence <ul style="list-style-type: none"> - 	
<p>25 Data & Information</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - More than a 1 - Close to a 2 - 1.5 consensus ▪ Rationale <ul style="list-style-type: none"> - Clear where data is stored - Systems in place are doing jobs well - May not be consistent across legacy companies - Causing us some growing pains - It is clear what data is created and where - Most data issues are related to historical data - In good shape for moving forward - Consistency on capturing information to meet the needs of the business is an ongoing challenge - Have data stewards identified - Level of awareness about data integrity and stewardship has increased significantly over last year or two - In many cases have two different processes, but identified and consistent within individual ecosystems - Structure and processes exist: well developed processes and procedures and acknowledgement of level of rigour to be applied 	



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Notes	Action
<ul style="list-style-type: none"> - Overall consistency can be a challenge sometimes even with new projects (such as, new pipeline built and significant missing attributes) so not meeting level of rigour in some places - Did a Fitness for Purpose Study before integration and it showed that most data was in reasonably good shape for operating and maintaining pipelines. Some problems with integrity management (such as, if you want to locate pipes, data is good; if you want to know the grade of material, etc. the data isn't easily accessible and needs to be taken from as-built drawings) - Station assets are a bit further behind at least on legacy Union side - Reporting of leaks are lacking day-to-day reporting - Overall: variability across asset and datasets; clear holes ▪ Evidence <ul style="list-style-type: none"> - Fitness for Purpose Study 	
<p>26 Procurement and Supply Chain Management</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 2.5 ▪ Rationale <ul style="list-style-type: none"> - Pretty strong - Developed really stringent processes - Standard to which service providers are being held to has increased - Controls in place that have continued to improve over time - Seen the results of contractors not meeting expectations (being removed from the preferred list) - Have come a long way, but still opportunities for improvement - Centralized through Enterprise - Controlled so that you can't get a contract for anything independently – now a very structured process to go through to ensure the right people and right prices - Track service level agreements and metrics ▪ Evidence <ul style="list-style-type: none"> - Process documentation 	
<p>32 Contingency Planning & Resilience Analysis</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 3 ▪ Rationale <ul style="list-style-type: none"> - We do quite well in this area 	



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GDS - Operations, Management and Data
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Notes	Action
<ul style="list-style-type: none"> - Spend a lot of time on mock emergencies - Set up an entire process and accountabilities in regard to emergency response - Have resources outside organization to share resources in an emergency - Look at all kinds of things that could happen within distribution, storage and transmission systems - Test on a regular basis - Very structured and staffed and forward-looking - Are quite mature here – emergency response planning and business continuity planning - Well documented, structured and good process - Get tested on this pretty regularly ▪ Evidence <ul style="list-style-type: none"> - 	
<p>35 Assets Performance & Health Monitoring</p> <ul style="list-style-type: none"> ▪ Current Rating <ul style="list-style-type: none"> - 3 (gas carrying assets - integrity) - 2 (stations and facilities) - 2 consensus ▪ Rationale <ul style="list-style-type: none"> - Integrity – all gas carrying assets in scope are at level 3 - Aware of all assets - Distribution asset health perspective: do condition monitoring; use historical failure data to forecast - On facilities side moving towards that - Have inspection data on transmission pipelines to determine the life of the assets - Went through a 3rd party assurance exercise indicating that we're industry leading in this area, and certain aspects of the transmission program is industry leading - For stations assets (recognize some variability), information is gathered (condition and performance) but don't have a good understanding of how to utilize this data to inform decisions - Opportunities for further improvement with storage and transmission facilities – good on inspection routines but not sure about best measures of condition and performance and how to become more predictive using that information 	



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GDS - Operations, Management and Data
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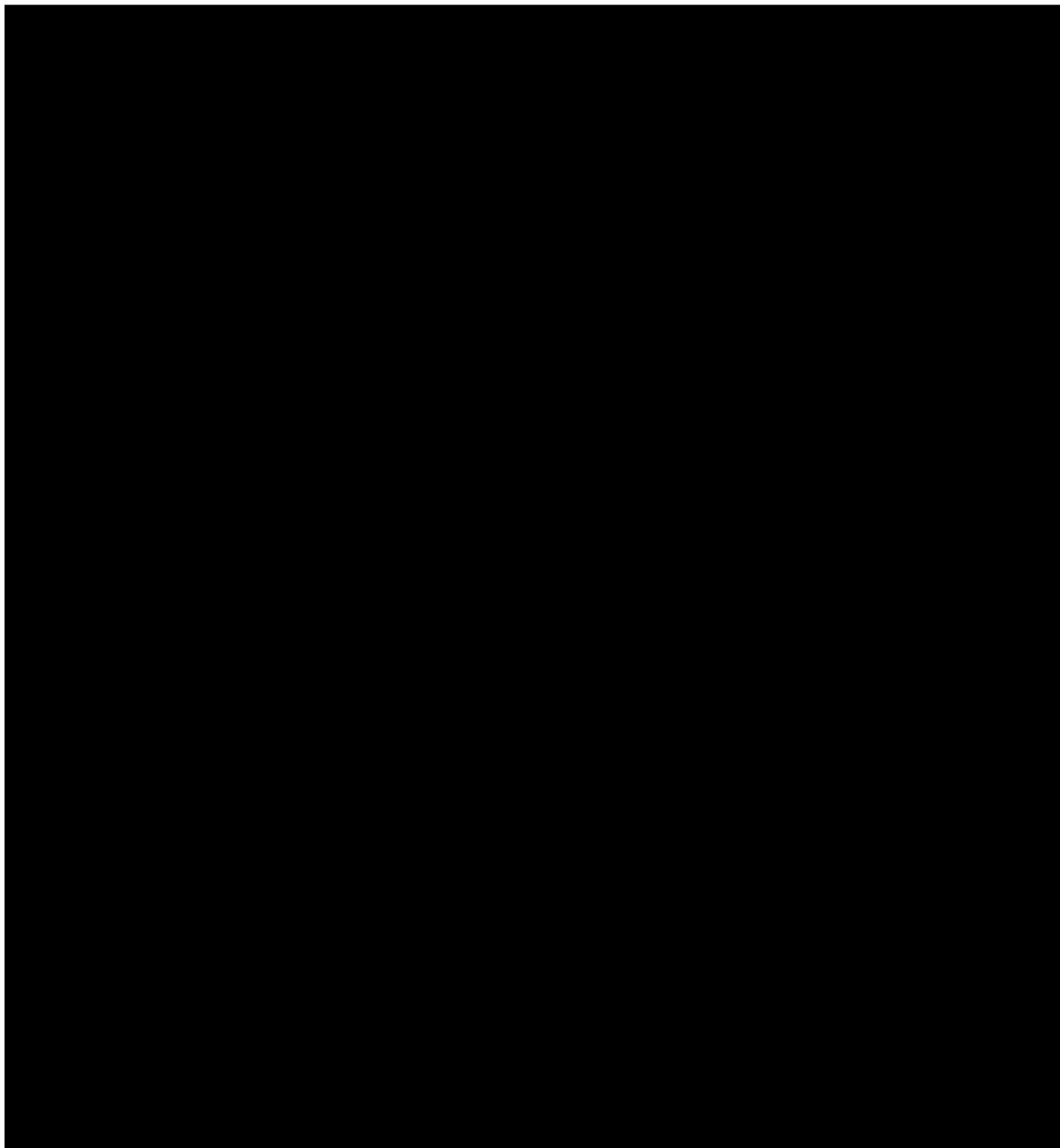
Notes	Action
<ul style="list-style-type: none"> - Summary: integrity: have defined what is needed to collect, collect it and have review processes; stations and other assets: have collected a lot of data but need to work on lining up with what's really needed ▪ Evidence <ul style="list-style-type: none"> - 3rd Party Assurance Exercise 	



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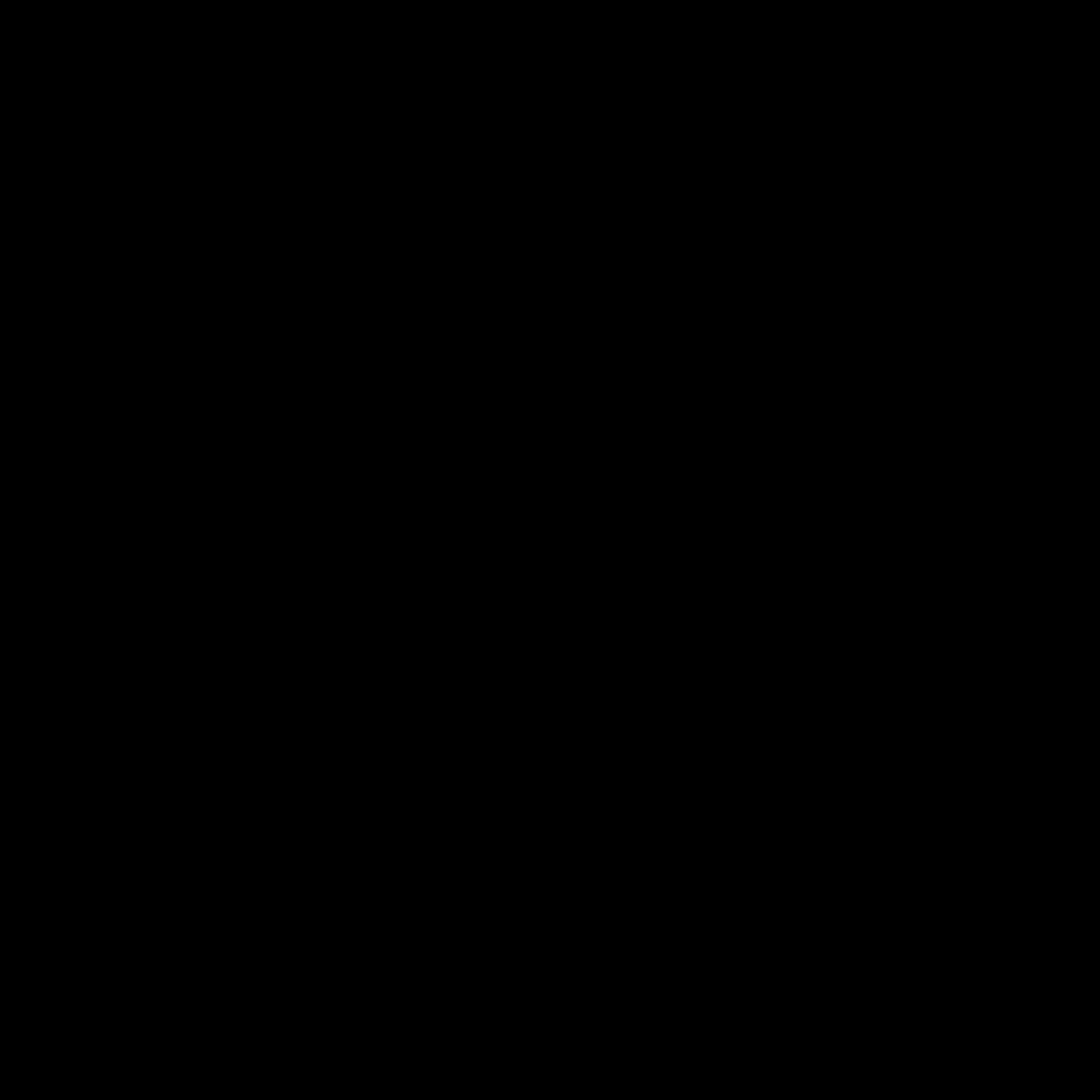
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Notes
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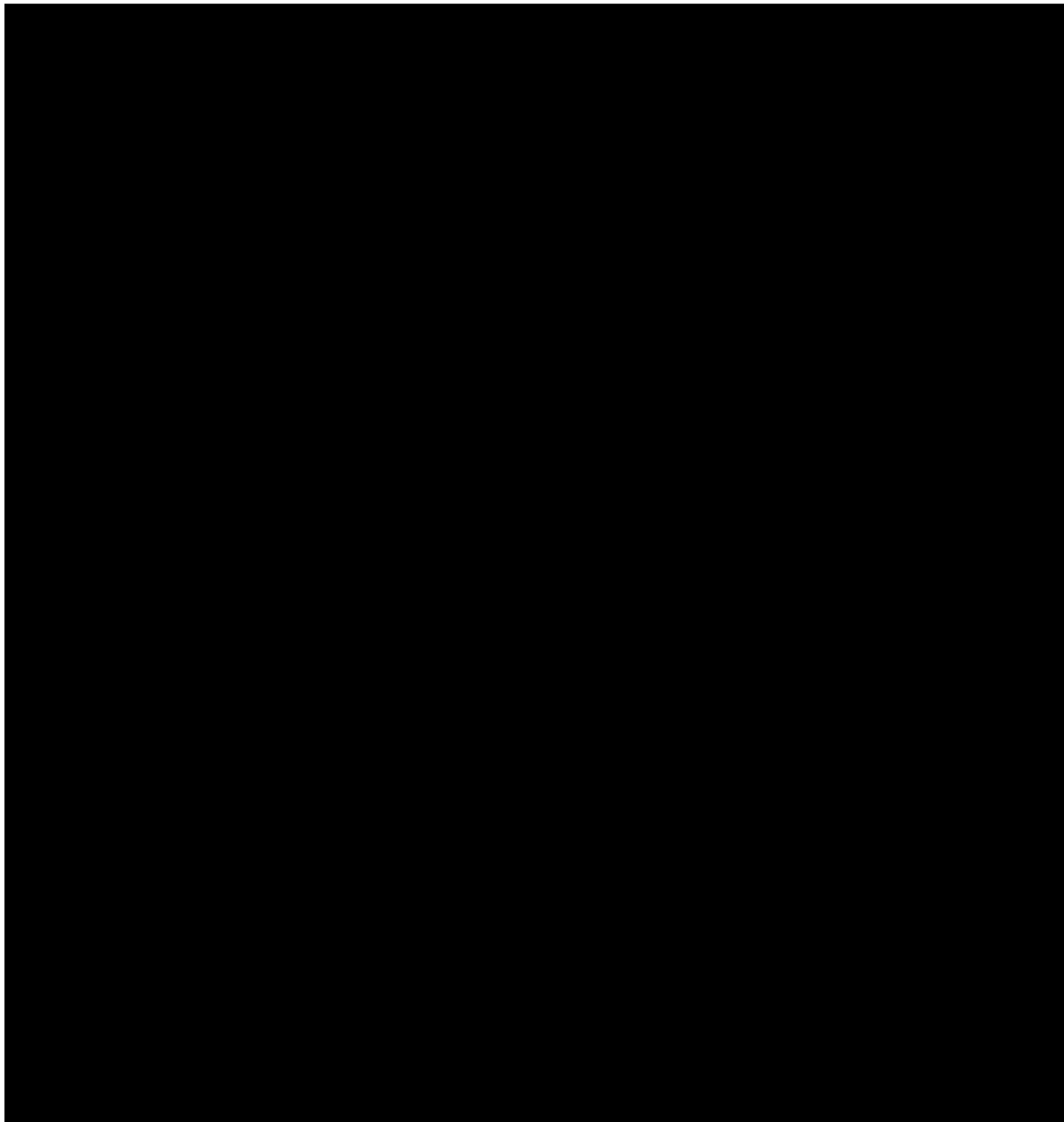
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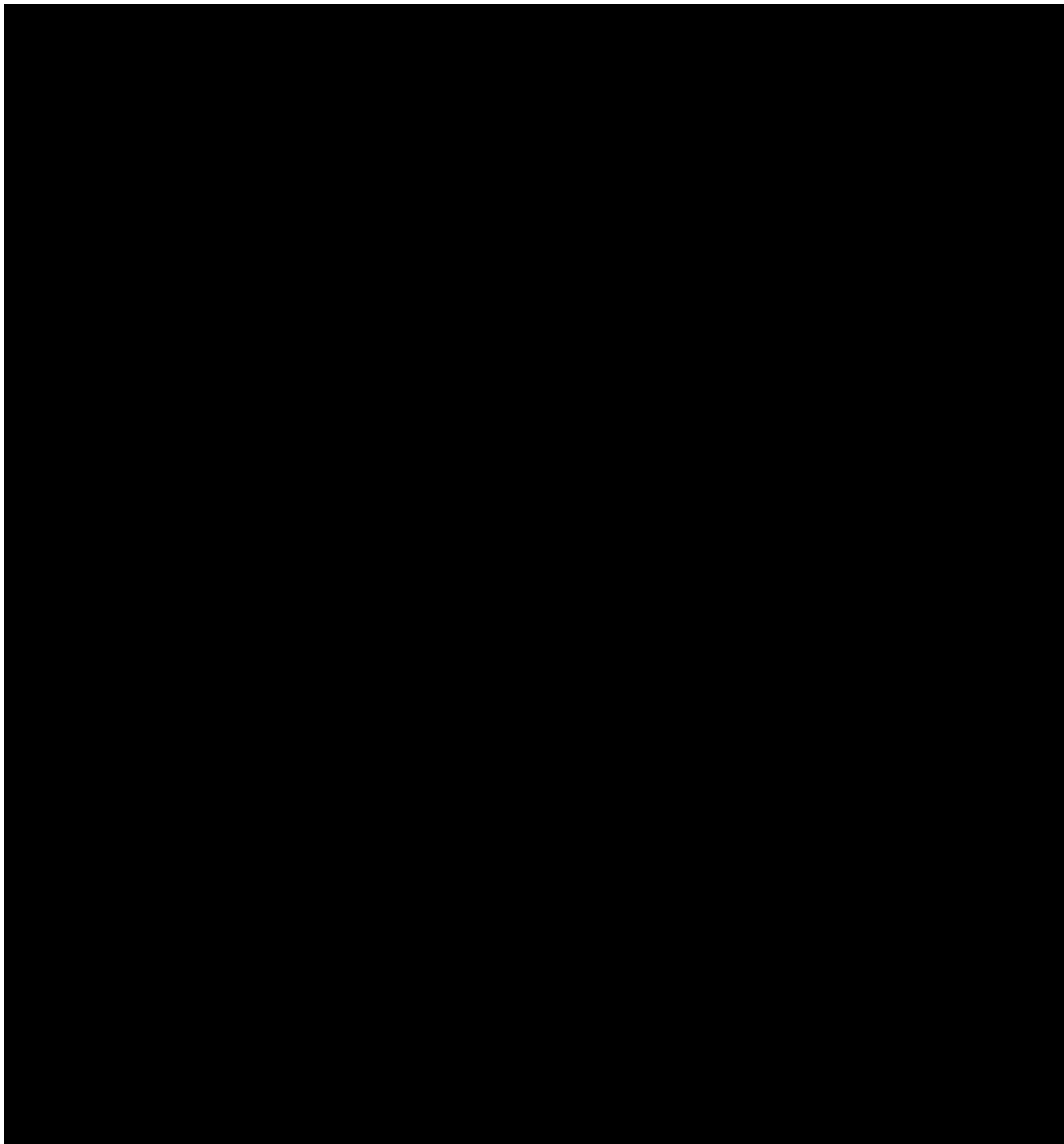
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LP - Strategy and Planning Meeting - Follow Up
Notes

August 18, 2020

Notes	Action
	

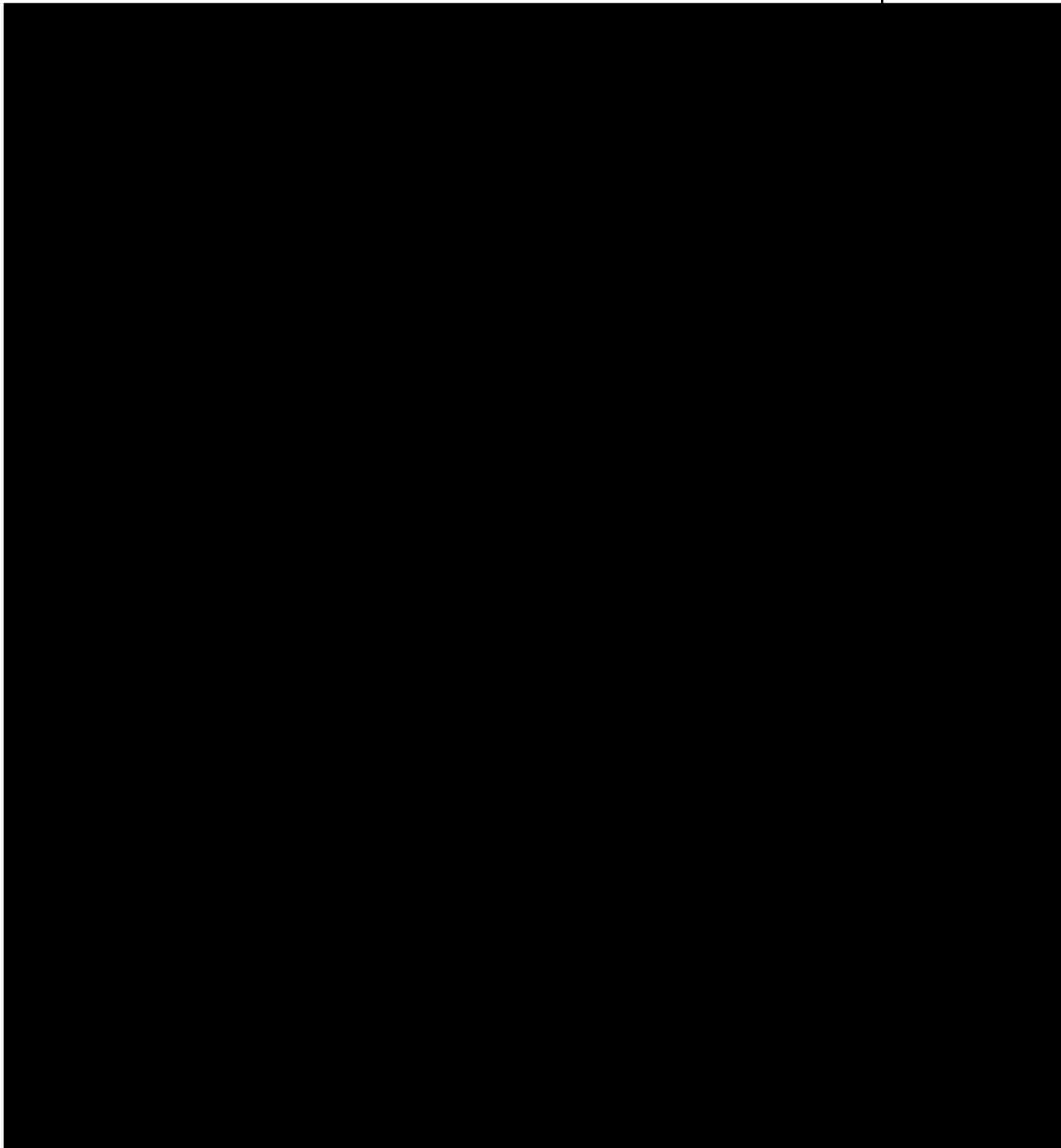


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LP - Strategy and Planning Meeting - Follow Up
Notes

August 18, 2020

Notes	Action
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Meeting Minutes

GTM - Strategy and Planning Follow-up Meeting
Notes
Aug 18, 2020 / 9 am

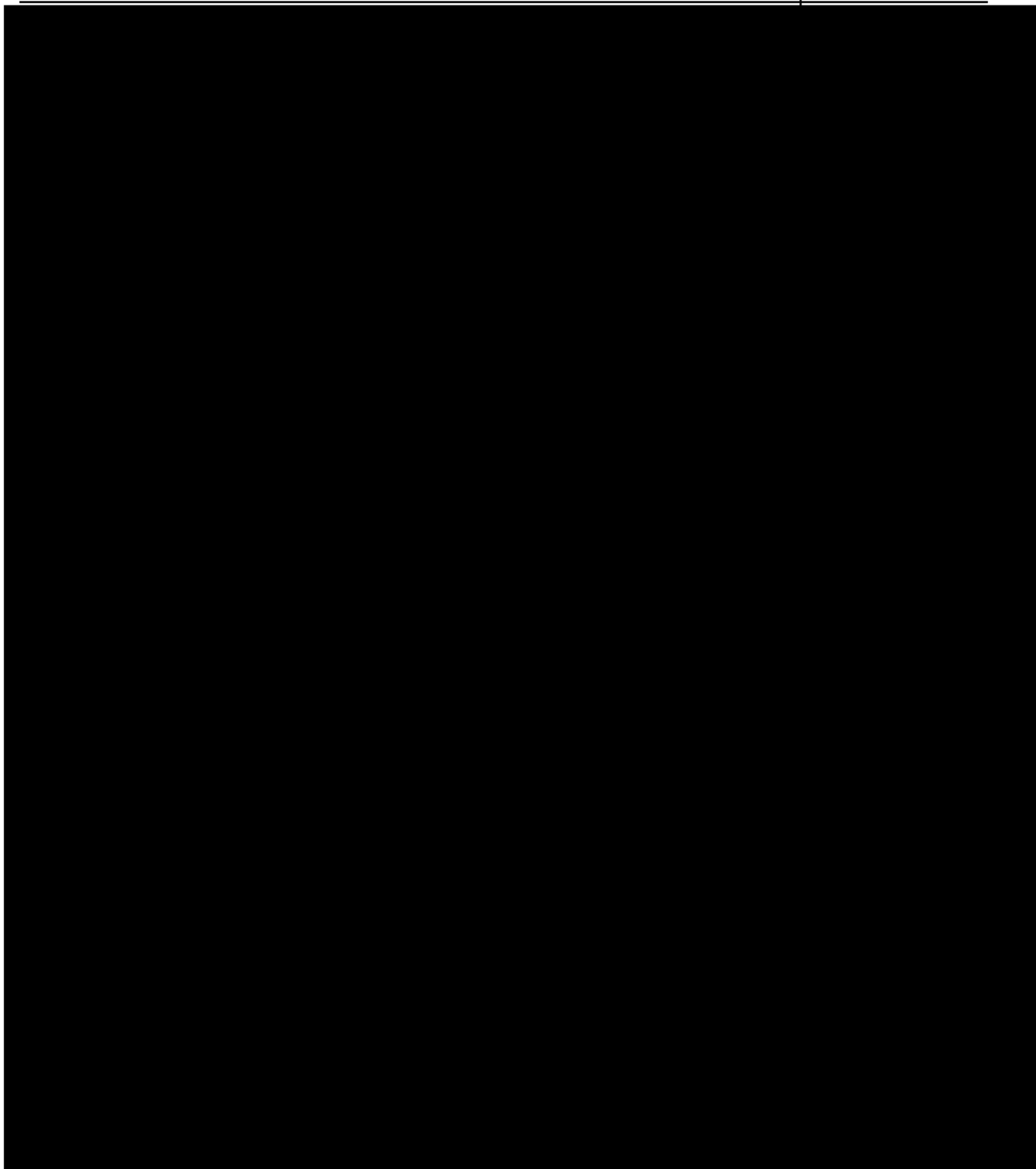
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Meeting Minutes

GTM - Strategy and Planning Follow-up Meeting
Notes
Aug 18, 2020 / 9 am

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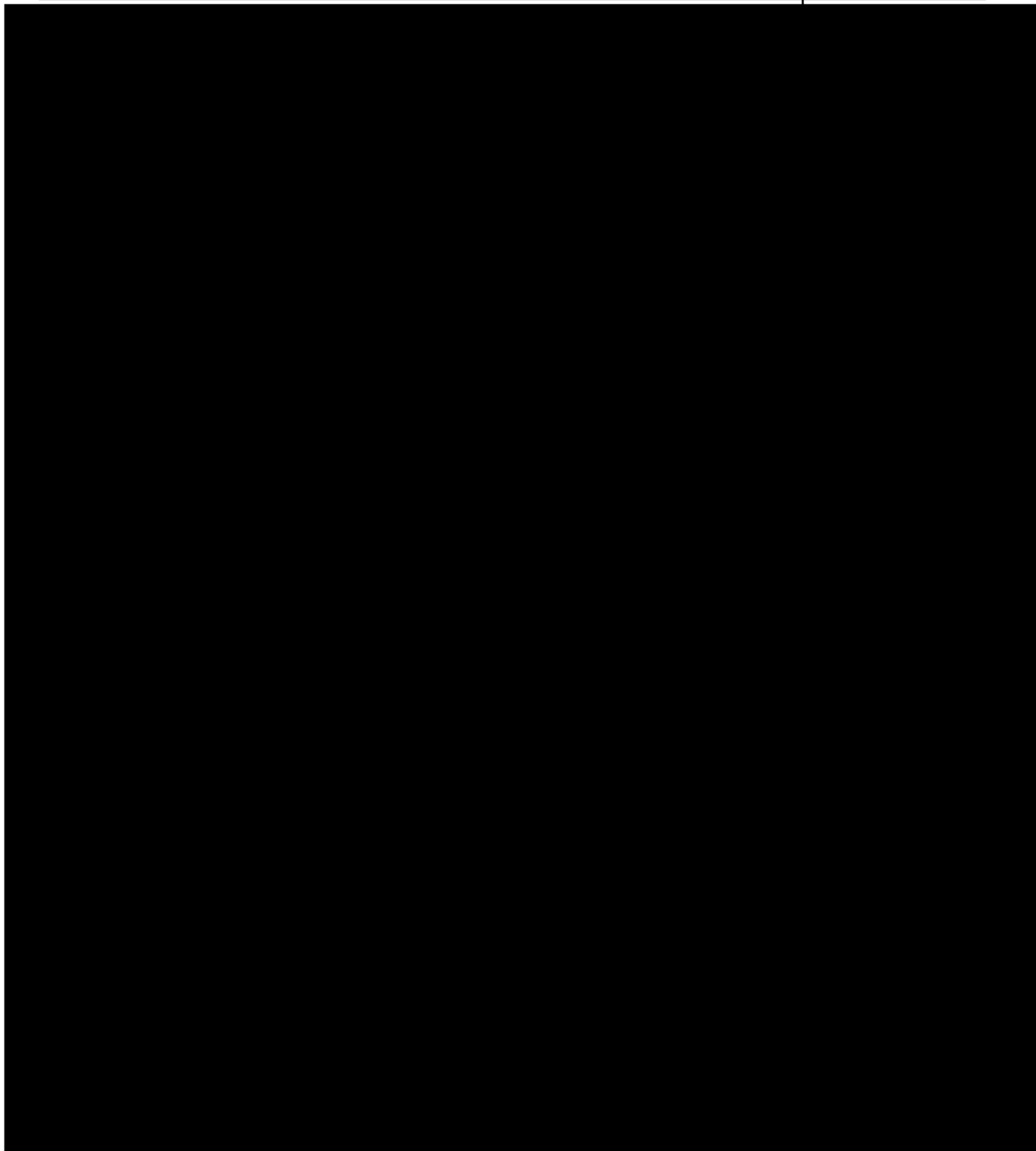




Meeting Minutes

GTM - Strategy and Planning Follow-up Meeting
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Aug 18, 2020 / 9 am

Notes	Action
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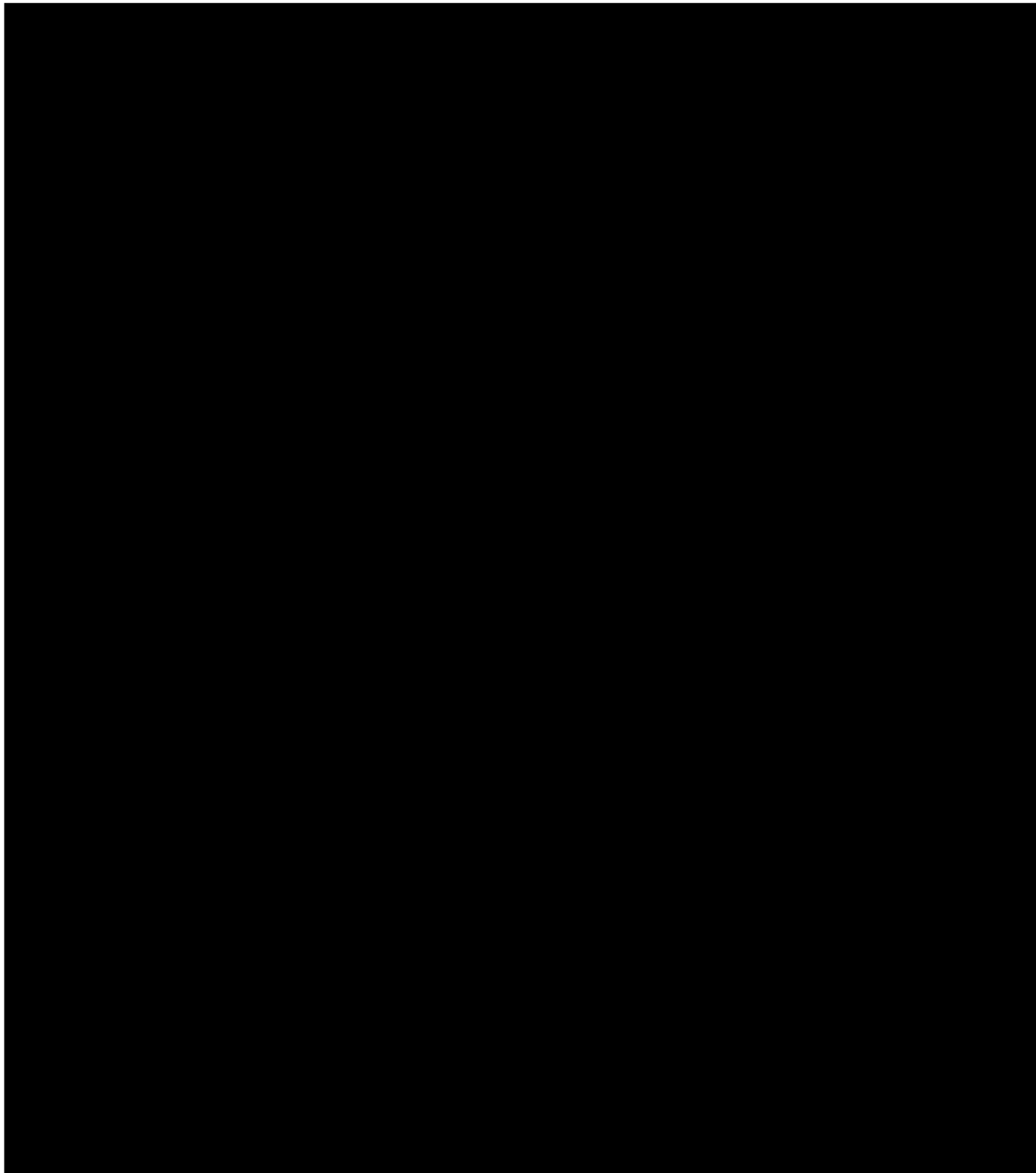




Meeting Minutes

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Calgary, AB

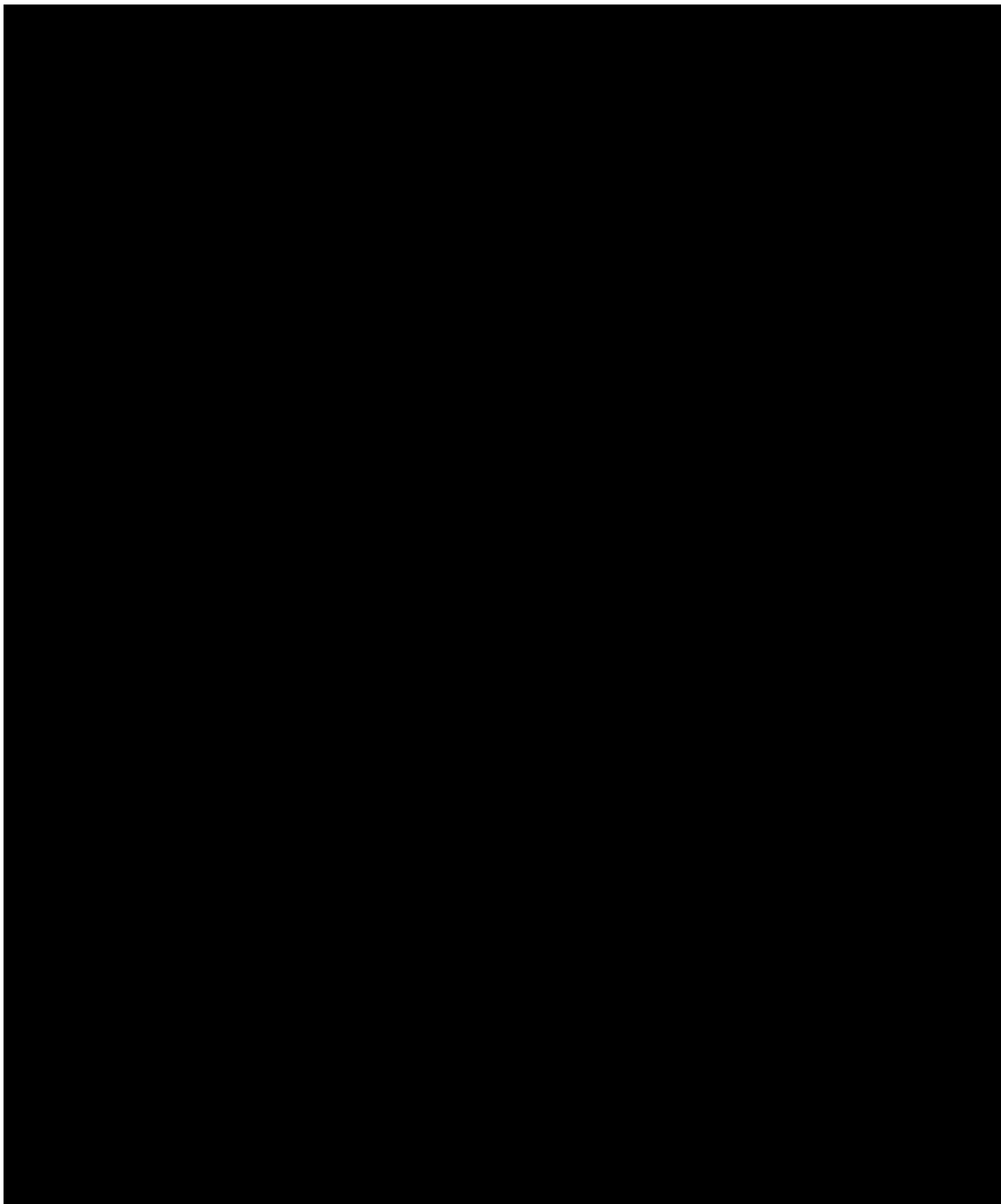
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Meeting Minutes

LP - Demand Analysis Meeting Follow Up Notes
August 19, 2020

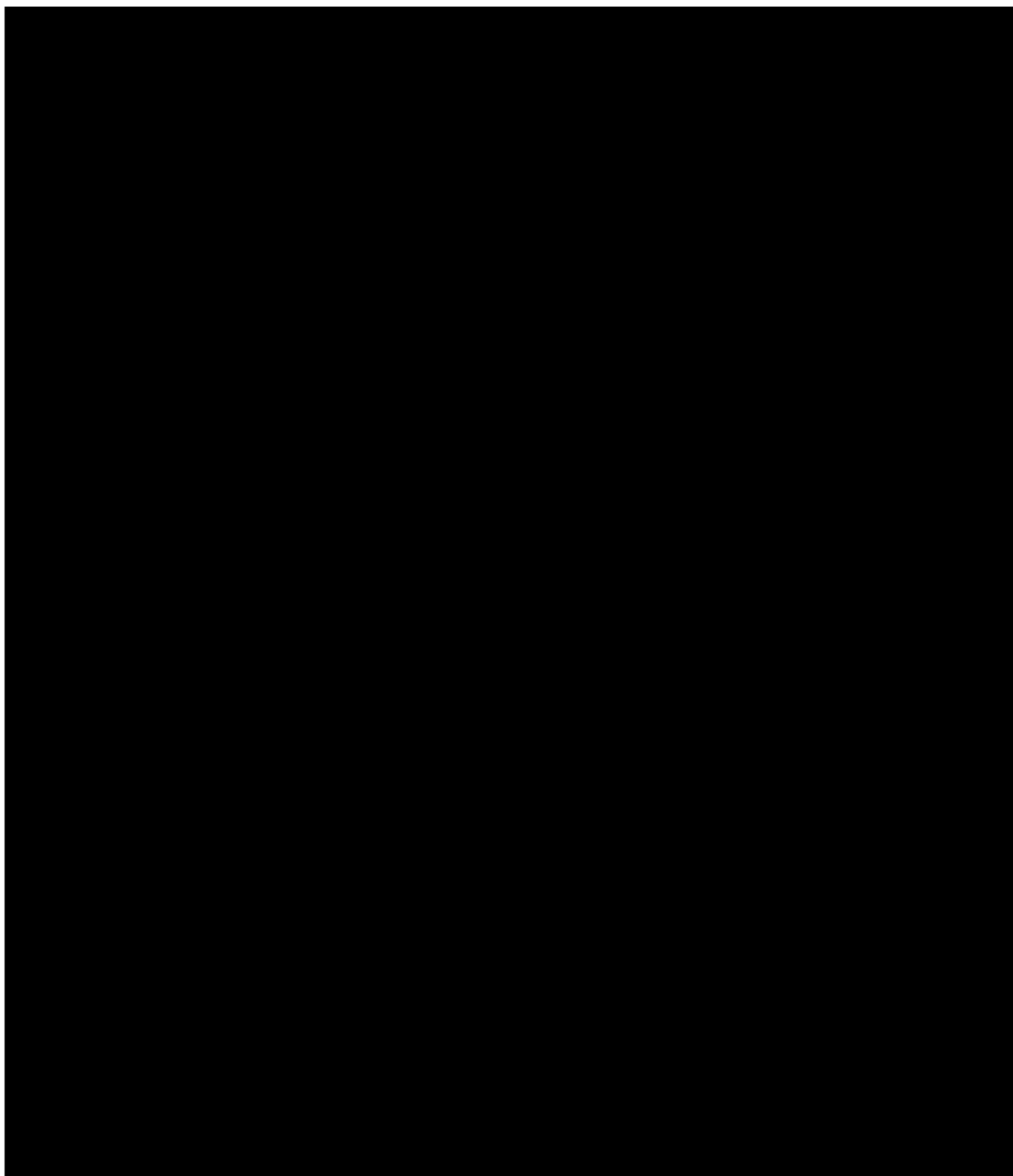




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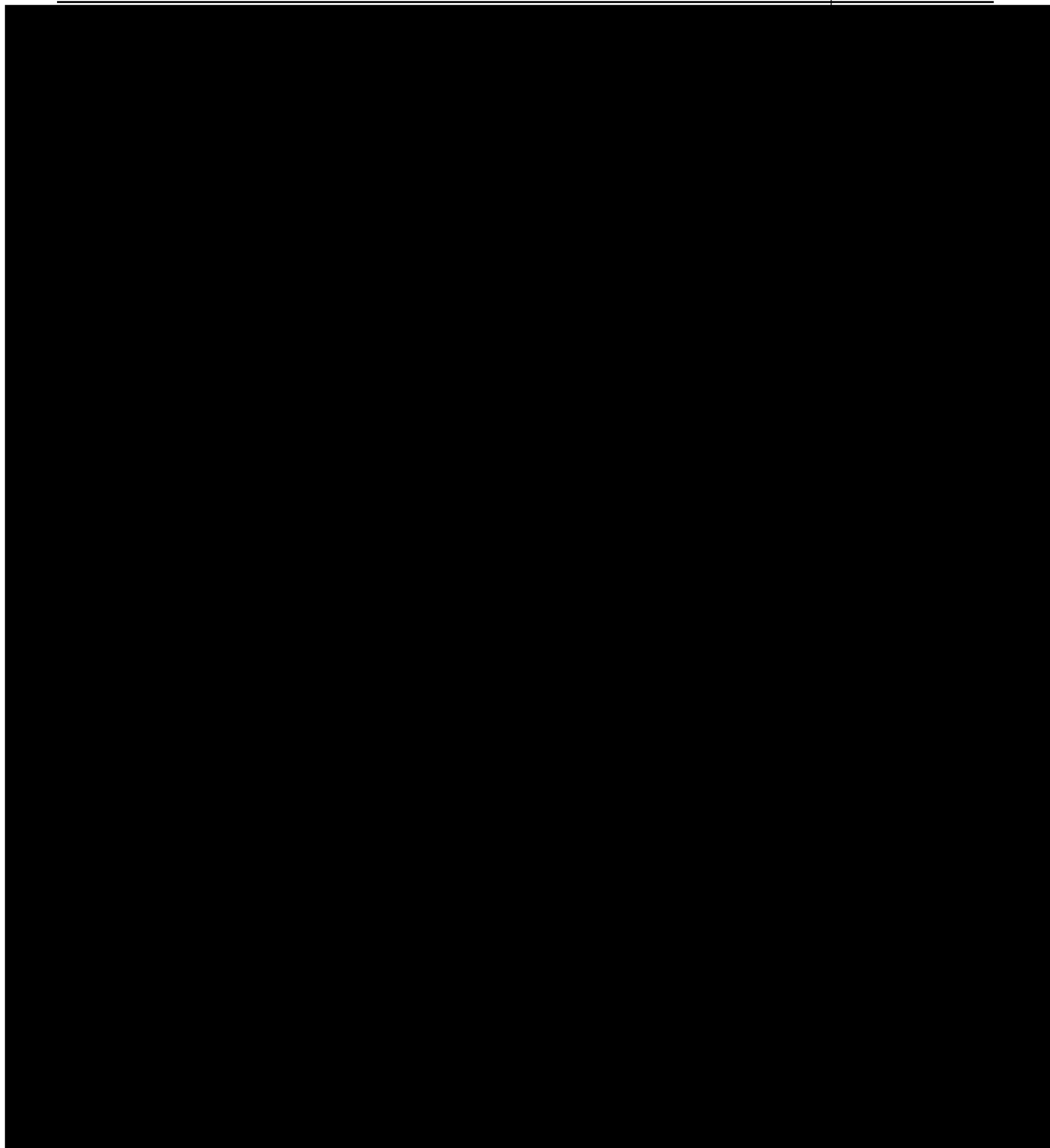




Meeting Minutes

GTM - Strategy and Planning Follow-up Meeting
Notes
Aug 19, 2020 / 8:30 am

Notes	Action
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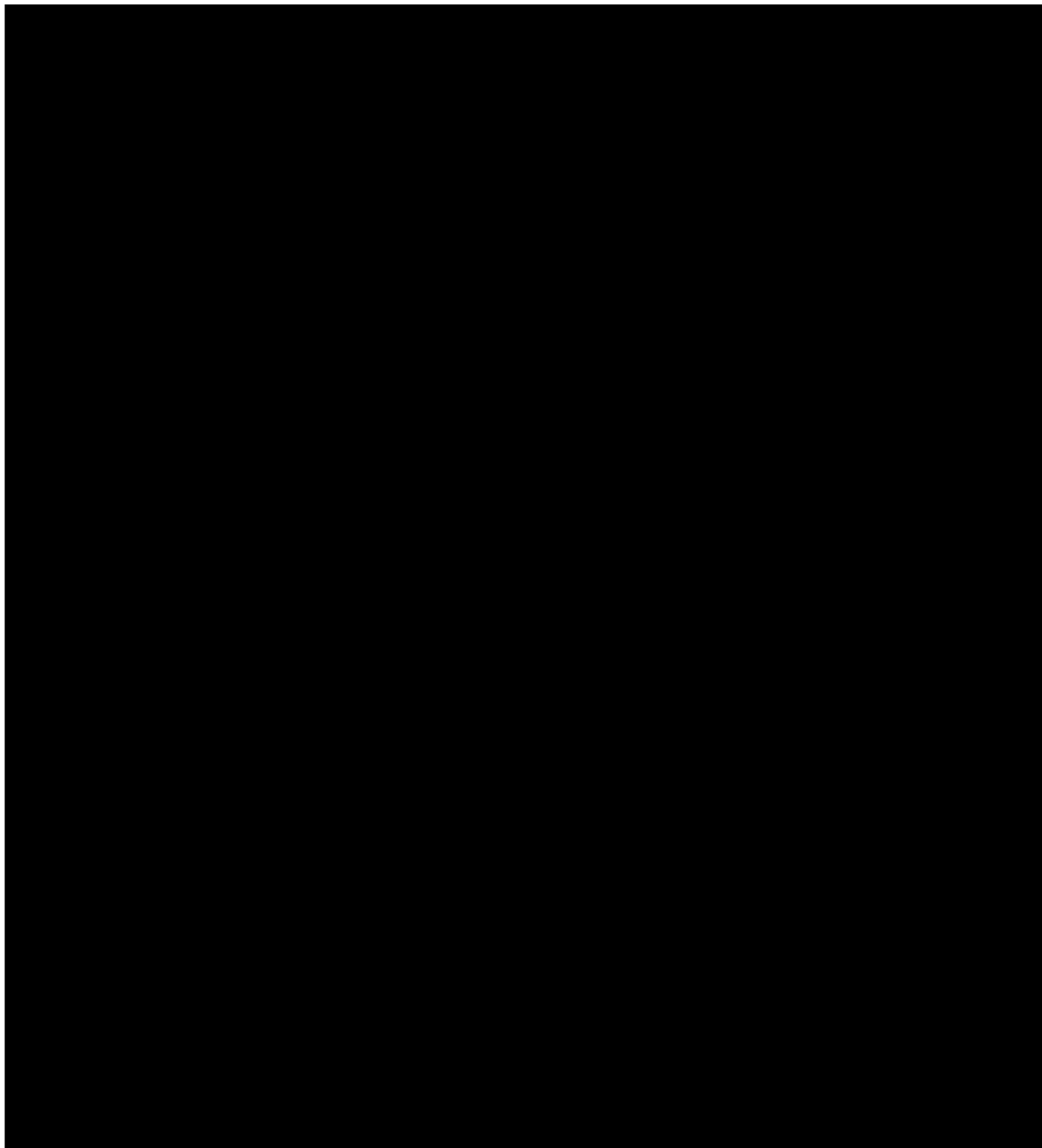




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LP - Procurement and Supply Chain Follow Up
Notes
August 20, 2020

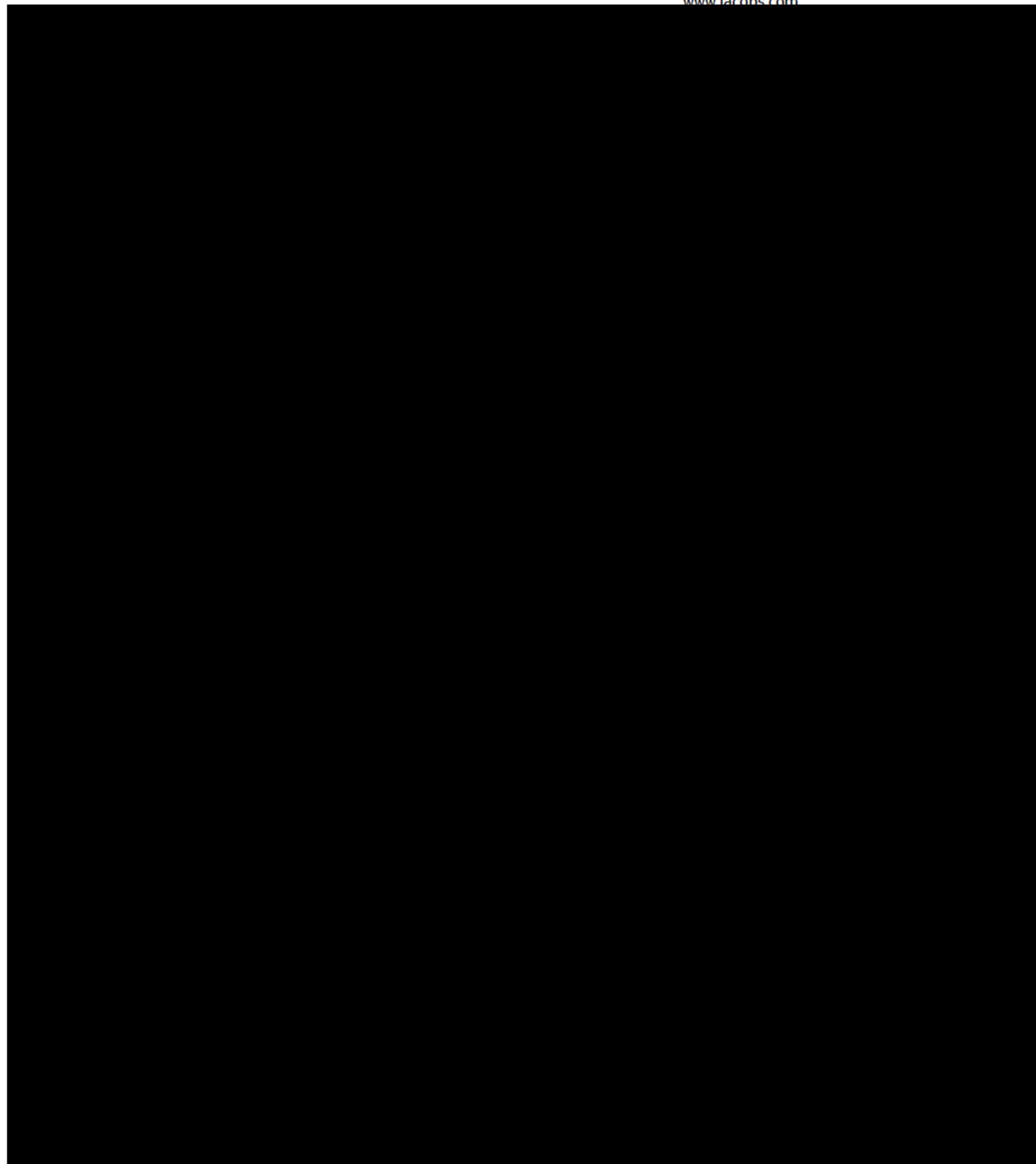
Notes	Action
	



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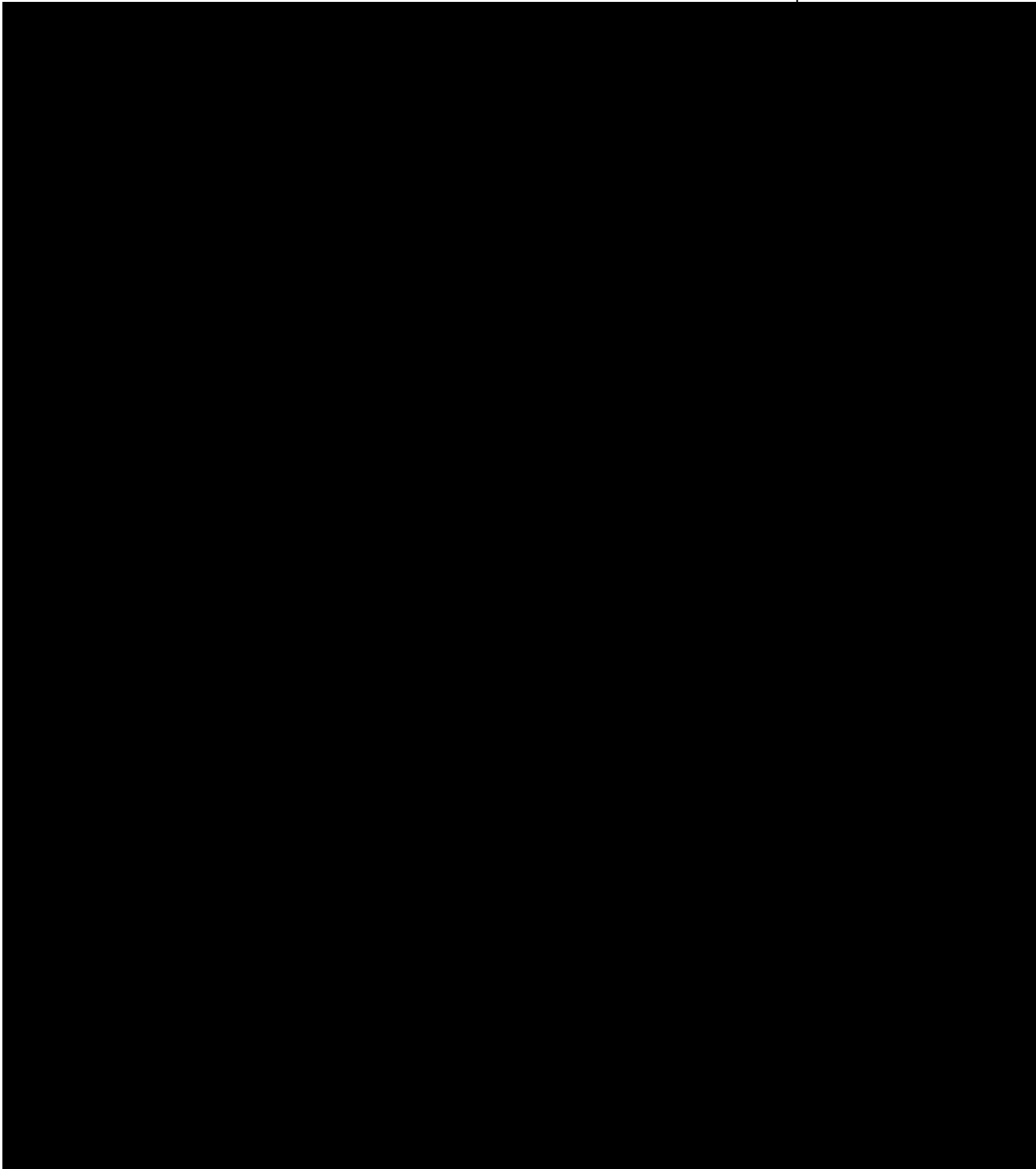
GTM - Strategy and Planning Follow-up Meeting
Notes
Aug 18, 2020 / 9 am

Notes	Action
	



Meeting Minutes

GTM - Strategy and Planning Follow-up Meeting
Notes
Aug 18, 2020 / 9 am

Notes	Action
	



Meeting Minutes

GTM - Strategy and Planning Follow-up Meeting
Notes
Aug 18, 2020 / 9 am

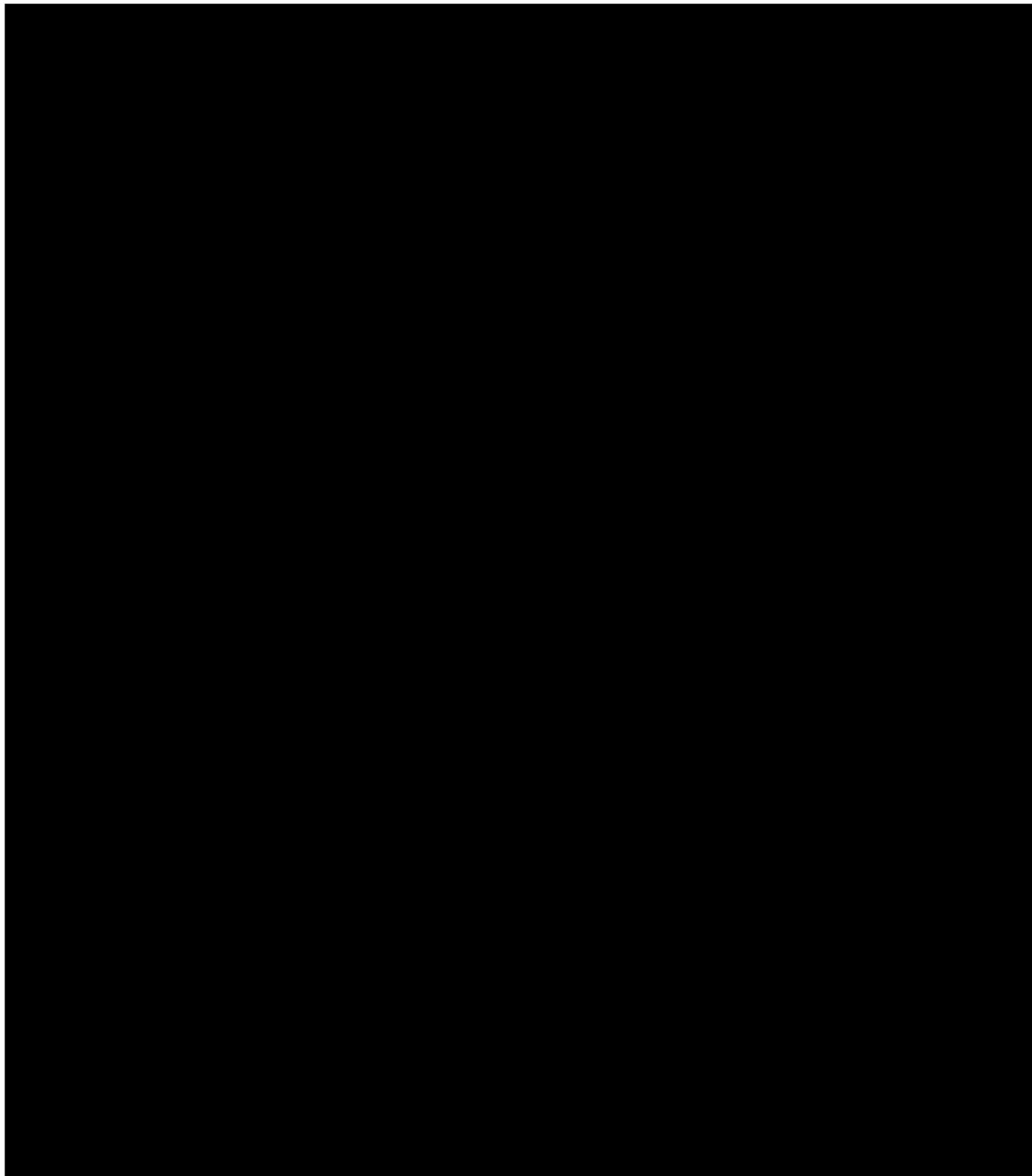
Notes	Action
	



Meeting Minutes

Unit 330, 205 Quarry Park Blvd,
Calgary, AB

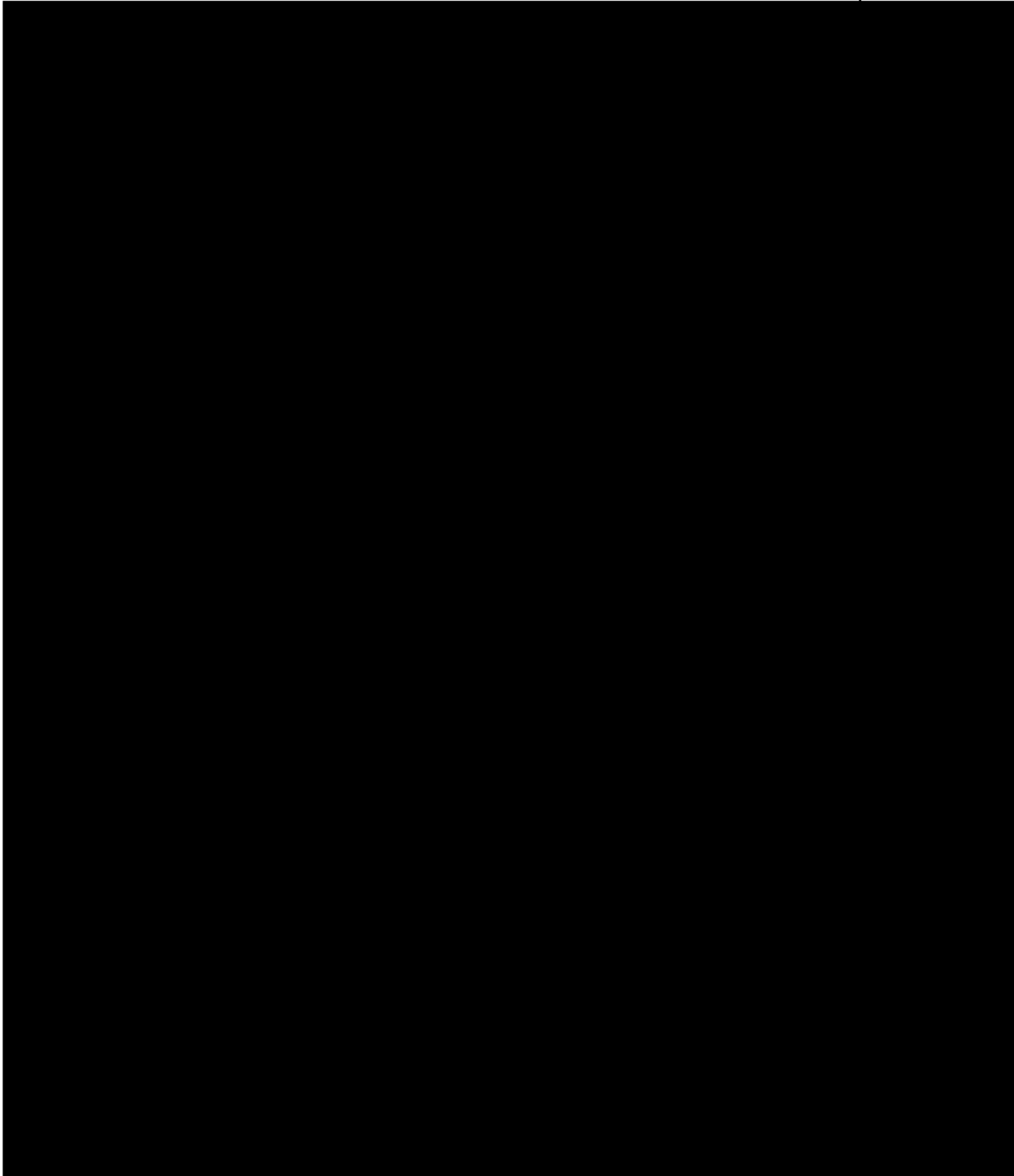
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Meeting Minutes

LP - Systems Engineering Follow Up Notes
August 25, 2020

Notes	Action
	



3.01 FACILITY ASSESSMENT

ENBRIDGE GAS DISTRIBUTION INC.

BRAMPTON REGIONAL OPERATIONS CENTRE

6 Colony Court, Brampton, ON

Project No.: 2016-0613-05

REV 1.1 – April 09, 2018

WALTERFEDY

ENBRIDGE GAS DISTRIBUTION INC.

FACILITY ASSESSMENT

Brampton Regional Operations Centre

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Appendix A – Capital Expenditures Forecast

Appendix B – Program

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1.0 SUMMARY

1.1 Introduction

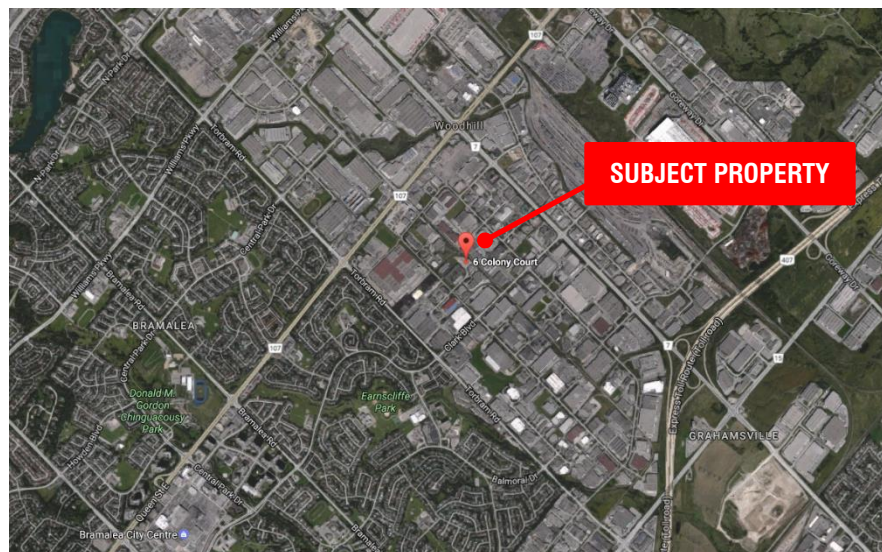
WalterFedy was retained by Enbridge to conduct a physical and functional assessment of the facility located at 6 Colony Court, Brampton, Ontario for the purpose of identifying functional adequacy and physical renewal requirements for budgeting and planning purposes. The scope of the report includes a general visual inspection of visible civil, architectural, structural, mechanical, and electrical components. It also includes a brief Ontario Building Code (OBC) review to address barrier-free accessibility issues.

Following the initial report, a list of recommendations with estimated costs is provided for corrective and preventive maintenance items required.

1.2 Facility Description

The facility is categorized by Enbridge as a Regional Operations Centre. The original building was constructed in 1998 on 3 acre industrial zoned land.

The facility is located on Colony Court off of Summerlea Road in Brampton. It has excellent access to major transportation routes. Highway 410 is within 6 km to the southwest of the property, highway 407 is 2.5 km to the east and highway 427 is 7 km northeast. Queen Street east (highway 7) is also less than 1 km to the northwest and Main Street (Highway 10) is 9 km to the southwest. The immediate surrounding area is predominantly industrial



1.2.1 Property Summary

1) General:

Owned / Leased:	Owned
FCI score:	11.02 %
AI score:	49 %
Current Occupancy:	113

2) Physical Building Properties:

Building Ground Floor :	12,200± SF
Mezzanine:	2,050± SF
<i>Total Gross Floor Area</i>	<i>14,250± SF</i>

Office Space:	4,700± SF
Common Areas:	3,000± SF
Industrial:	2,900± SF
Circulation:	3,650± SF

3) Site Characteristics:

Site Area (Entire Site):	130,000± Sqf (3 acres)
Building Coverage (current):	11% (14,250 SF / 3 acre)
Yard Area:	90,500± SF (2 acres)
Parking:	109,500± SF (2.5 acres)
Misc. (setback / landscape):	10,000± SF (0.23 acres)

4) Zoning:

Zone: M3A – Industrial

Parking required: Up to 5,000m²: 1 parking space per 60 square metres (645 SF) of gross floor area or portion thereof;
Parking required: 22 spaces

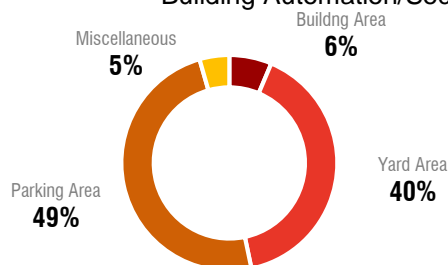
Parking provided: 57 cars/vans, 12 trucks, 10 equipment

Loading provided: 2 loading spaces

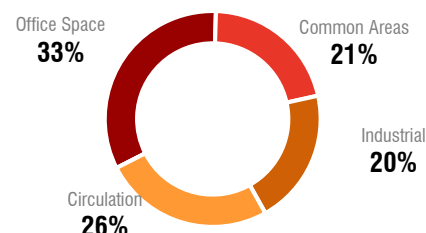
Front Yard Depth (minimum)	9.0 meters	Provided 22 meters
Side Yard Width (minimum)	6.0 meters	Provided 19 meters
Rear Yard Depth (minimum)	7.6 meters	0 meters at rail line

5) Building Systems:

HVAC:	Rooftop HVAC units, ceiling mounted radiant tube heaters.
Plumbing:	Municipal domestic water and septic tank sanitary
Electrical:	400 A/600 V three phase service
Building Automation/Security:	None



SITE AREA DISTRIBUTION



BUILDING AREA DISTRIBUTION

1.3 Scope of Work

The scope of work for this assessment was approved by Enbridge and was completed in accordance with WalterFedy's fee proposal dated September 08, 2016.

The scope of work for the Asset Management Report will include a Functional Assessment, a Physical Assessment, and a Market Condition Assessment. The report will provide recommendations for strategic decisions based on the metrics reviewed in the assessments.

1.4 Assessment Methodology

The building condition assessment is based on general visual examination performed on September 19, 2016 by WalterFedy's Architectural and Facility Management departments.

The observations in this report were made using non-destructive methods through existing access points. Existing drawings provided by Enbridge for the building were also used to supplement site observations.

The guiding principles of this study is based upon the document from the National Research Council of Canada (NRC) "Protocols for Building Condition Assessment" published by The Institute For Research in Construction (IRC).

1.5 Limitation of Study

This assessment is based on our general review and walkthrough of the facility and it is not intended to form a detailed life safety analysis or Ontario Building and Fire Code assessment. The facility was built in 1998. It is recommended that a further detailed life safety review and assessment is carried out to determine what building systems upgrades would be required to meet the requirements of Section 9.2 of Ontario Fire Code to the satisfaction of the Fire Department.

This report was completed in accordance with the approved scope of work as described in Section 1.3. This report is limited and is not intended to be comprehensive or exhaustive, or to suggest a risk-free facility. The report may not address all existing issues associated with the facility and may omit issues that are or may be of interest to the Owner. The findings and statements in this report are based on general site observations of the current conditions as they existed during the time period of the investigation.

The purpose of this report is for the sole use of the Owner for budgetary planning purposes. Issues identified in this report require further detailed assessments to determine repair and maintenance work required. This report should not be used by third parties involved in any work related to the facility; such third parties should undertake their own investigations and studies to determine how the existing condition of the facility will affect their plans and work. WalterFedy accepts no responsibility for liabilities incurred by or damages suffered by any third party as a result of decisions made or actions taken, based upon this report.

The passage of time might affect the views, conclusions and recommendations provided in this report.

The following report is a general guide only and is not intended to be used as a document for construction.

This study does not include hazardous materials review or inspection.

2.0 PHYSICAL AND FUNCTIONAL ASSESSMENT

2.1 Physical Assessment

2.1.2 Site and Landscaping

The site is located at a cul-de-sac at the end of Colony Court. The property is near rectangular-shaped at the front with curved yard at the back. The building occupies approximately 11% of the entire site area.

The remainder of the site is occupied by gravel areas and asphalt pavement parking areas, cast-in-place concrete paving, concrete curbs, a perimeter fence with powered access gates and areas of soft landscaping (i.e. grass, shrubs, and trees). Wall mounted lighting units provide illumination for the site. During the site visit the asphalt paved areas were noted to be in fair to poor condition overall with sections experiencing significant alligator and longitudinal cracking requiring repair. Site lighting is also in good condition; however, consideration should be given to replacing the wall pack units with LED fixtures for improved energy performance at the later portion of the analysis.

The property is secured by a six-foot chain link fence along the perimeter of the property. The fence has one operable gate at the front entrance and a side gate for access by Enbridge. Damage to one section of the fencing at the back of the property was noted and repair is recommended.

Since the inspection was limited to visible areas, no examination of the catch basins was performed and no review of the initial compliance with code was performed. The inspection of underground or concealed components is outside the scope of work.

2.1.3 Mechanical

Heating and cooling is primarily provided by roof mounted packaged rooftop air handling units. The list of current rooftop HVAC units with dates of installation and recommended units for replacement is provided below:

List:	MFG	M/N	S/N	Date of MFG	Recommend Replacement?
RTU-1	York	ZF090N15N5AAA5	N1E4706903	2014	No
RTU-2	York	ZF090N15N5AAA5	N1A2537825	2012	No
RTU-3	York	D2CG072N09958BDA	NEMM057003	2003	Yes
RTU-4	York	D2CG072N09958BDA	NBMM014239	2003	Yes
RTU-5	York	D2CG072N09958BDA	Unknown	2003	Yes

Supplementary heating for warehouse area is provided by two ceiling mounted radiant tube heaters and a forced air ceiling mounted Reznor unit. Based on age and observed condition, replacement of the radiant tube heaters should not be required within the evaluation period.

Domestic Hot Water ("DHW") within the site building is provided by a Bradford White Corp domestic hot water tank located in the mezzanine area.

There was reportedly no shortage of DHW within the site building. It is WalterFedy's experience that the anticipated service life of a DHW is typically 10-15 years. Therefore based on age, replacement will be required within the term of the analysis.

Corrosion and peeling paint was noted on the gas supply piping on the exterior of the building. It is recommended that the gas supply pipes are leak testing and refinished/painted.

2.1.4 Electrical

The electrical power for the site building is supplied from a pole-mounted transformer. The buildings electrical room has a main 400 Ampere, 347/600 Volt, 3 phase breaker panel and electric service. The breakers provide power through copper wire conduit to the various lighting and receptacle unit distribution panels throughout the site building.

Interior lighting is predominately provided by T8 fluorescent T8 tube lighting fixtures. An improvement consideration should be given for an LED retrofit near the end portion of this analysis.

Combination battery pack units provide emergency lighting and exit signage within egress pathways.

2.1.5 Structural

As outlined in the scope of work, a limited visual assessment of the condition of the structural elements was carried out on the elements which were visible at the time of the inspection. The site building is a slab on grade structure. The superstructure of the site building is comprised of concrete masonry block exterior walls, concrete columns, wood joists and concrete. No major visually identifiable structural deficiencies were noted at the time of the site inspection.

2.1.6 Building Envelope

The roof system atop the site building consists of an SBS modified bitumen (BUR), near-flat roof system. The roof system is installed atop a layer of rigid insulation, atop a corrugated metal roof decking. Neither the presence of a vapour barrier, nor the type or the thickness of the insulation could be verified, as the scope of the work did not include destructive testing. It is WalterFedy's experience that the anticipated service life of a DHW is typically 20-25 years. Based on age and observed condition, roof replacement should be considered.

Drainage of the roof system is provided by internal roof drains which presumably drain to the municipal sewer system.

Penetrations through the roof system include plumbing stacks, an exhaust vent stack, internal roof drains, mechanical curbs, and service penetrations.

The exterior walls of the building consist of a combination of block masonry and sheet metal cladding.

The window systems of the site building consist of fixed insulated glazed units ("IGU") set within aluminum frames in punched configurations. Exterior doors serving the site building are comprised of single glazed units set into metal frames. Metal doors within metal frames were observed serving the warehouse egresses and of the site building. Two sectional overhead doors were observed on the rear elevation. Based on age and observed condition, replacement of windows within the office and warehouse areas should not be required within the terms of the analysis.

2.1.7 Finishes

The floor finishes within the site building consist of unsealed concrete slab-on-grade, ceramic and resilient floor tiles and carpeting. The wall finishes within the site building consist of painted gypsum board and painted concrete masonry block. The ceiling finishes within the site building primarily consist of exposed structure, and painted suspended ceiling tile. Water stained tiles were noted throughout the building and the carpet runners within the office area was noted to be worn and showing signs of early deterioration. Repair/replacement of these interior finishes is recommended within the term of the analysis.

2.2 Functional Assessment

2.2.1 Site

The building is located on a 3 acre site. Enbridge is a tenant in the building and the landlord is responsible for landscaping and snow removal on the property.

The following functional deficiencies were observed during the walkthrough:

- The site area is generally considered sufficient for current Enbridge GDP requirements. Access to the yard is provided by way of an automatic sliding gate at the south side. Two access points/exits are recommended in compliance with Enbridge GDP standards.
- The rear section of the yard has compacted gravel finish. Asphalt finish is recommended as per Enbridge GDP standards. The area of yard with gravel finish is approximately 47,000 SF which represents about 60% of the yard area.
- The existing yard fence is not in compliance with Enbridge GDP standards for height. In some areas the fence is two feet lower than the required 5' high fence with 1' barb wire at the top. New fencing around the full perimeter is recommended.

2.2.2 Interior Space Planning

The building consists of office space, amenity areas and a warehouse. The following are functional deficiencies observed during the walkthrough:

- There is no coat closet area in the building.
- The office space in the mezzanine area has no access to daylight. The installation of new windows or skylights is recommended.
- Currently there are two male and two female washrooms in the existing building. Additional washrooms are required to accommodate current staff. In accordance with Ontario Building Code a minimum of 4 washrooms per sex is required for 133 staff members.
- The locker room is small and according to staff the room becomes very crowded during peak hours.
- The existing mustering room has recently been renovated and additional space was added. New skylights were installed that significantly increased the level of natural light in the space. The space is generally adequate for its current use.
- A barrier-free chair lift was recently installed at the corridor mezzanine stair. The chair lift caused major reduction to the exit stair width. The exit stair width is not in compliance with OBC. A clear stair width of 900mm shall be maintained.
- The existing warehouse is too small and is not sufficient for current operations. There is lack of staging and storage area. Additional space is required.
- The warehouse is not properly equipped for welding activities. There are no exhaust vents for removal of fumes at the welding areas.
- The washing machine is located in the warehouse area. A separate room for the washing machine is recommended.

- The counter used for personal gas monitor (PGM) is located in the warehouse area; a separate space for safety devices is recommended in accordance with Enbridge GDP standards.

2.2.3 Furniture

Existing furniture is legacy furniture throughout. All existing office furniture has reached the end of its life cycle and replacement is recommended to enhance the functional and environmental condition in the office area. The height of the existing cubicle partitions blocks natural light and access to existing windows from the core area.

It is recommended to meet Enbridge's office standards that the furniture be phased out and replaced with new.

2.2.4 Ontario Building Code – Life Safety

Section 3.2 - Building Fire Safety

The building falls under Part 3, Group F Division 2 and Group D major occupancies.

To meet current Ontario Building Code the building should satisfy the requirements of 3.2.2.72: Group F, Division 2, up to 2 Storeys:

- The building is sprinklered.
- Standpipe system is not required.
- The building is permitted to be of combustible construction or non-combustible construction used singly or in combination.
- Floor assemblies shall have a fire-resistance rating not less than 45 minutes if of combustible construction.
- Loadbearing walls, columns, and arches supporting an assembly required to have a fire-resistance rating shall have a fire resistance rating of 45 minutes or shall be of non-combustible construction.

Section 3.8 - Barrier-free Design

3.8.1.3. Barrier-free Path of Travel

3.8.1.3.(1) Every barrier path of travel shall provide an unobstructed width of at least 1100 mm for the passage of wheelchairs.

3.8.1.2. The facility has two entrances. Both entrances are not equipped with barrier-free door operator and none of them qualify as barrier-free entrance. In accordance with article 3.8.1.2, a minimum of one barrier-free entrance to the building is required.

3.8.2.3. Washrooms required being barrier-free.

On the main floor there is currently two barrier-free washroom stalls located in the male and female washroom areas.

3.8.3.12. Universal (barrier-free) toilet rooms: There is no universal barrier-free washroom in the facility. This is considered an existing non-conforming condition for compliance with Ontario Building Code. There is no mandate in the current code to upgrade the existing facility for compliance with the Universal Barrier Free washroom requirements. However in compliance with Part 11 of Ontario Building Code the addition of a universal washroom will be required in the event of extensive renovation in the building.

2.3 Functional and Physical Condition Analysis

WalterFedy utilized a risk management approach taking into consideration the impact of failure of the building component on the long term serviceability of the building as well as the functional requirements associated with the building. Both Facility Condition Indexing (FCI) and Adequacy Indexing (AI) was utilized in order to help make the best possible decision related to the future of the site building and to determine whether or not to invest, maintain, repurpose or dispose of the asset.

FCI:

FCI is a condition index tool used to illustrate the condition of an asset expressed in a percentage ratio of required maintenance/repair costs divided by the replacement value of the asset expressed as:

FCI = (Maintenance and Repair Costs)/(Cost to Replace the Building)

The replacement value of the building is based on industry standards for construction costs. Therefore, the lower a FCI is, the better the condition of the building. The resulting FCI at ten years is 1.61% which is classified as being in good condition.

$$\text{FCI (Brampton)} = (\$340,250) / (14,034 \times 220) = 11.02\%$$

AI:

AI is a condition index tool used to illustrate the functional condition of the asset expressed in a percentage ratio of required functional upgrade costs divided by the replacement value of the asset to meet the functional needs expressed as:

AI = Functional Upgrade Costs/Cost to Replace the Building with its Functional Equivalent

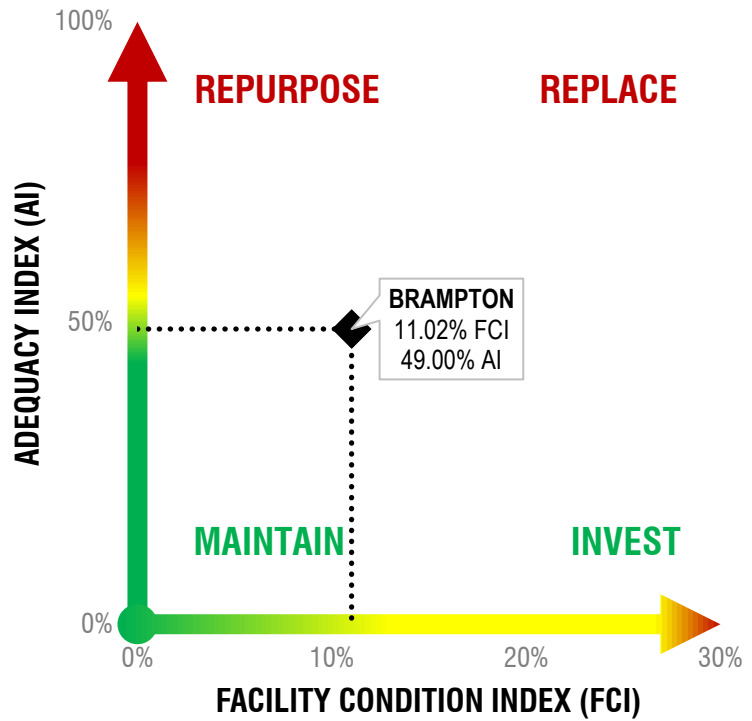
The Adequacy Index for 6 Colony Court is calculated by dividing the current functional and physical renewal costs by the cost to replace the building with its functional equivalent size.

The estimated cost to upgrade the facility to current Enbridge GDP standards is estimated at \$3,285,000. This includes the addition of 9,000 SF and interior improvements to 7,700 SF of interior office space. The estimated cost to build a new facility to Enbridge GDP current standards based on 23,000 SF, the area required to accommodate current program, is \$6,670,000 based on 60% office space at \$350/SF and 40% industrial space at \$200/SF.

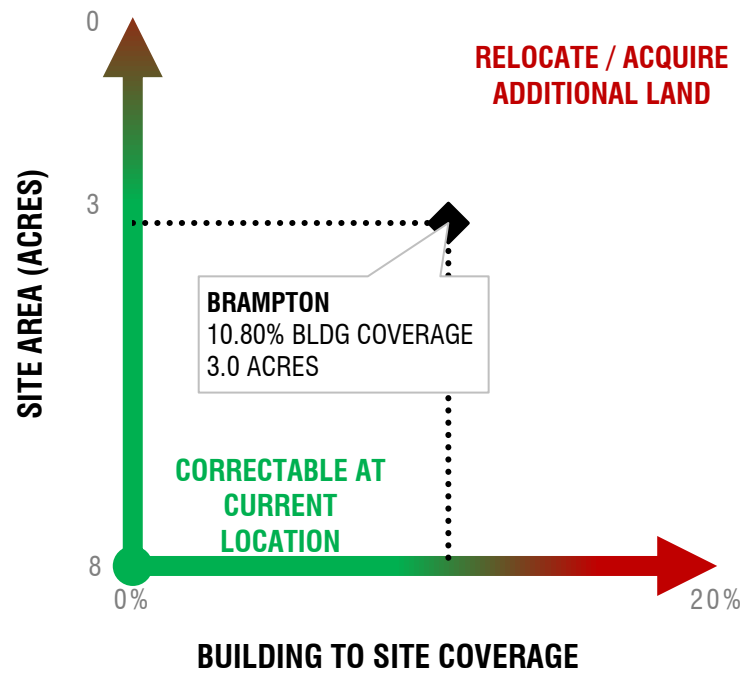
$$\text{AI (Colony Court)} = (\$3,285,000) / (\$6,670,000) = 49\%$$

With quantification of FCI and AI for your building, comes the ability to make comparisons between industry benchmarks, and drive decision making related to the future of the property. The chart below shows the relationship between FCI and AI and indicates visually where 6 Colony Court within the decision making criteria.

FACILITY CONDITION & ADEQUACY GRAPH



SITE CONSTRAINTS GRAPH



2.4 Key Findings

- PHYSICAL OBSOLESCENCE:

The acceptable Enbridge standard for the physical condition is an FCI of 0 to 5%. The current FCI of the facility based on this study is 11.02% therefore the physical condition of the facility does not meet Enbridge acceptable standards.

Meets Standards	Correctable at Current Location
Positive	<div>NEGATIVE</div> <div>POSITIVE</div>
	Negative

- FUNCTIONAL OBSOLESCENCE BUILDING :

The acceptable Enbridge GDP standard for the functional condition is 0, anything between 0 to 50% is considered correctable at current location. The current facility AI index is 49%. Based on the FCI/AI graph the current recommendation for the existing facility is to repurpose to accommodate current EGD standards.

Meets Standards	Correctable at Current Location
Positive	<div>NEGATIVE</div> <div>POSITIVE</div>
	Negative

- FUNCTIONAL OBSOLESCENCE SITE:

The site does not meet operational requirements for vehicular circulation. The yard has only one point of access.

The existing building requires expansion by approximately 9,000sqft to meet the need for current staff and Enbridge functional requirements. Building addition on the property will entail reduction in the yard and parking areas, however the yard size will still be considered adequate based on the current operations.

Meets Standards	Correctable at Current Location
Positive	<div>NEGATIVE</div> <div>POSITIVE</div>
	Negative

Overall the existing building is too small to meet current Enbridge GDP standards. The current building is approximately 14,250 SF. Additional 9,000 SF is required to accommodate office and industrial space. The estimated project cost to address the current functional needs is \$5,072,000.

The site area is considered in general conformance with Enbridge GDP requirement for size and layout.

2.5 Development Scenarios

The following is a comparison of the available options to address the deficiencies at 6 Colony Court:

SCENARIO	1	2
DESCRIPTION	Correct physical and functional deficiencies by expanding the existing facility on the existing site	Tear down the existing building and build new on the existing property
LAND ACQUISITION	\$-	\$-
LAND SALE PROCEEDS	\$-	\$-
NEW CONSTRUCTION COST	\$2,610,000**	\$6,670,000**
RENOVATION COST	\$385,000	\$-
NEW ASPHALT IN YARD AREA	\$250,000*	\$250,000
NEW FENCE	\$25,000	\$25,000
NEW AUTOMATIC GATE	\$15,000	\$15,000
SUB-TOTAL	\$3,285,000	\$6,960,000
SOFT COST	\$657,000	\$1,390,000
FURNITURE	\$1,130,000****	\$1,130,000****
TOTAL	\$5,072,000	\$9,480,000
MEETS ENBRIDGE GDP STANDARDS	YES	YES
PRIORITY	1	2

* Based on 7,700 SF improvement renovation scope based on \$50/SF renovation area includes the office space and amenity areas excluding the new mustering room and the industrial space.

** Total construction cost is based on \$350/SF for the office area and \$200/SF for the industrial space. Total required additional floor area is 9,000 SF. 40% industrial space and 60% office, amenity and circulation space is assumed.

*** Total construction cost is based on \$350/SF for the office area and \$200/SF for the industrial space. Total required additional floor area is 23,000 SF. 40% industrial space and 60% office, amenity and circulation space is assumed.

**** Based on \$10,000 per employee.

Enbridge Gas Distribution Inc.
Brampton Regional Operations Centre – Facility Assessment



APPENDIX A

Capital Expenditures Forecast



7.0 CAPITAL FORECAST

6 Colony Court, Brampton, Ontario

The following Capital Plan has been compiled from the following:

- 1 EGD Long Range Capital Plan (LRP)
- 2 EGD/FMG Property Inspection (FMG)
- 3 3rd Party Property Condition Assessment (PCA)
- 4 Non-Functional Standards Assessment - Section 5 (nFSA)
- 5 Electrical Safety Authority Inspection (ESA)
- 6 EGD Quarterly Health/Safety Inspection (HSI)

			1	2	3	4	5	6	7	8	9	10
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
SECTION	CATEGORY	DEFICIENCY	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD

Maintenance Deficiencies												
	Building Envelope	Replace roof membrane system								\$ 180,000		
	Building Envelope	Replace skylights						\$ 7,500				
	HVAC	Leak test and repaint natural gas supply system			\$ 2,000							
	HVAC	Packaged HVAC unit replacement				\$ 16,500			\$ 14,500			\$ 14,500
	Leasehold Improvements	Retrofit T8 lighting to LED					\$ 20,000					
	Life/Safety	Allowance to replace battery pack lighting units							\$ 2,000			
	PLMB	Replace domestic water heater			\$ 2,750							
	Site Work/Exterior Elements	Asphalt repairs	\$ 30,000			\$ 15,000			\$ 15,000			
	Site Work/Exterior Elements	Repair section of fencing				\$ 3,000						
	Site Work/Exterior Elements	Replace wall mounted and pole mounted site lighting (upgrade to LED)						\$ 5,500		\$ 12,000		
Total Maintenance Deficiencies			\$ 30,000	\$ -	\$ 4,750	\$ 34,500	\$ 20,000	\$ 13,000	\$ 31,500	\$ 192,000	\$ -	\$ 14,500
Cummulative FCI			0.97%	0.97%	1.13%	2.24%	2.89%	3.31%	4.33%	10.55%	10.55%	11.02%

Functional Deficiencies												
	New Construction Cost	9,000 sqf new addition	\$ 1,305,000	\$ 1,305,000								
	Renovation Cost		\$ 192,500	\$ 192,500								
	New Asphalt in Yard			\$ 250,000								
	New Fence			\$ 25,000								
	New Automatic Gate			\$ 15,000								
	Soft Cost		\$ 657,000									
	Furniture	Based on \$10,000 / employee		\$ 1,130,000								
Total Functional Deficiencies			\$ 2,154,500	\$ 2,917,500	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Total			\$ 2,184,500	\$ 2,917,500	\$ 4,750	\$ 34,500	\$ 20,000	\$ 13,000	\$ 31,500	\$ 192,000	\$ -	\$ 14,500
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Enbridge Gas Distribution Inc.
Brampton Regional Operations Centre – Facility Assessment



APPENDIX B

Program

Operations Depot: Brampton - Colony Court

Description	Standard # per person	Quantity	Size	Area Factor	Area sq.ft.	Area sq.ft. Current	Area sq.ft. Variance	Notes
General Building Infrastructure								
Main Vestibule	<	1	9	x 5	1.00	45	97	52
Waiting Area	<	1	9	x 5	1.00	45	130	85
Rear Entrance	<	1	7	x 5	1.00	35	65	30
Showers/Change/Washrooms	37	1	5	x 6	1.00	1,110	703	-407
Universal Washroom	1 / floor	1	8	x 10	1.00	80		-80
Janitor	1 / facility	1	6	x 10	1.00	60	17	-43
Mechanical/Electrical and IT Room	1 / facility	1	12	x 14	1.00	168	142	-26
Storage						100	92	-8
Sub Total						1,643	1,246	-397
Functional Building Area								
MPO Office	20% of office staff	23	10	x 10	1.00	2,300	1,001	-1299
Cubicles Workstations (45 capacity employees)	50% of office staff	57	8	x 6	1.50	4,104	3,386	-718
Meeting Room (8-10 people) 1/70 staff	1 per 70	2	16	x 11	1.50	528	711	183
Mustering Room(1chair/person) +1 HR workstation with connectivity and large TV screen for training	10	1	4	x 5	4.00	800	650	-150
Break out room (4 people) 1/50 staff	1 per 50	2	10	x 12	1.00	240	0	-240
Micro Kitchen/Ezone - 1/floor	1/200	1	15	x 20	1.00	300	90	-210
Hotel Station (2:1 ratio of dynamic staff)	30% of office staff	34	6	x 2.5	1.50	765	371	-394
Print Copy Rm/Mail Room	1/ 100	1				250	110	-140
Health room - required if there are 200 or more employees on any one shift.	<	0	11	x 10	1.00	0		0
Coat Storage	<	1	2	x 6	1.00	12	0	-12
Gas monitor calibration (1/10 people)		1	8	x 8	1.00	60	0	-60
Measurement & Regulation Test/ Storage		1	12	x 20	1.00	240	309	69
Warehouse (where required by business ops)		1	30	x 77	1.00	2,310	2,589	279
Free Pick storage	1/Building	1	15	x 10	1.00	150	0	-150
Locked Storage Room	<	1	10	x 15	1.00	150	0	-150
Wash Bay / Repair Garage(if fleet exists)	1/Building	1	25	x 50	1.00	1,250	0	-1250
Welding Bay / Fabrication	1/Building	1	35	x 54	1.00	1,890	0	-1890
Boot wash		1	6	x 10	1.00	60	0	-60
Washing Machine Area		1	6	x 10	1.00	60	0	-60
Sub Total						15,469	9,217	-6252
Total Building Area (not including circulation)						17,112	10,463	-6649
Circulation	35.75%					6,118	3,741	-2377
Total Building Area (not including out buildings)						23,230	14,204	-9026

Out - Buildings Site Specific								
Trailer						0	648	648 Mobile Trailer
Total Occupied Out-Building Areas						0	648	648

Site								
Total Site Area:						130,000		
Setbacks		per by-law requirments				15,489	146	-15,343 parking and storage within setback
Building Footprint		per site					12,817	0
Future Building Expansion		deficit of site program above				9,026	0	-9026
Landscaping		per site					9,140	0
M&R Station		unique to site location					0	0
Staff Parking	1 per employee	113	9	x 18	3.00	54,918	16,744	-38174 10 spaces
Visitor Parking	<	4	9	x 18	3.00	1,944	2,101	157 6 spaces
Sub Total						81,377	40,948	-47043
Available Yard Area:						108,900	89,052	-19848 Based on minimum 2.5 acres required
Site Deficit:							-66891	

Enbridge Gas Distribution Inc.
Brampton Regional Operations Centre – Facility Assessment



APPENDIX C

Photographs



6 Colony Court, Brampton, ON

Appendix B.1

1. Gate



2. Parking Lot



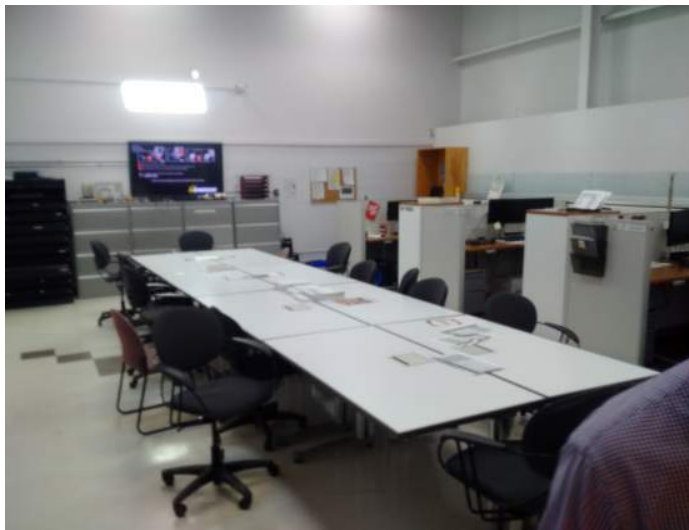
3. Yard



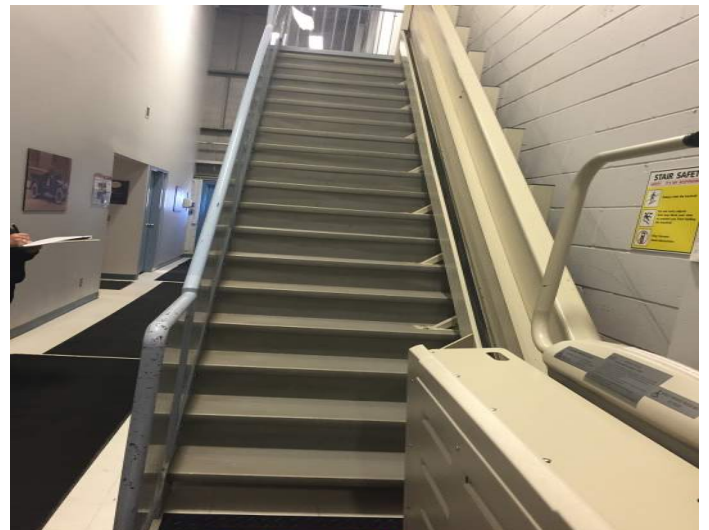
4. Warehouse



5. Office Area



6. Stairway





6 Colony Court, Brampton, ON

Appendix B.2

1. Asphalt Repairs



2. Asphalt Repairs



3. Interior Lighting



4. Exterior Lighting



5. Exterior Fence



6. Exterior Lighting and Roof Access



Enbridge Gas Distribution Inc.
Brampton Regional Operations Centre – Facility Assessment



APPENDIX D

Drawings



General Building Infrastructure

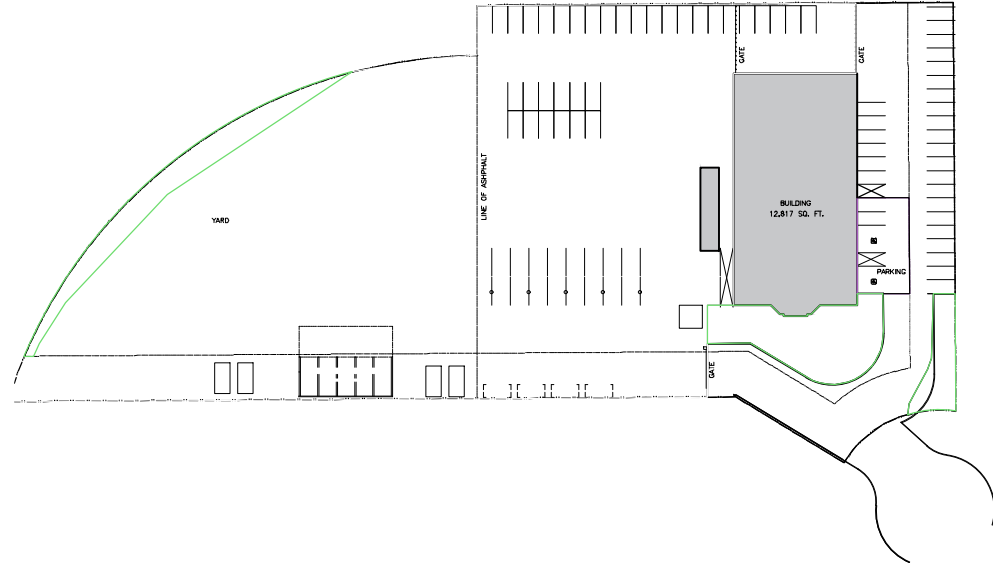
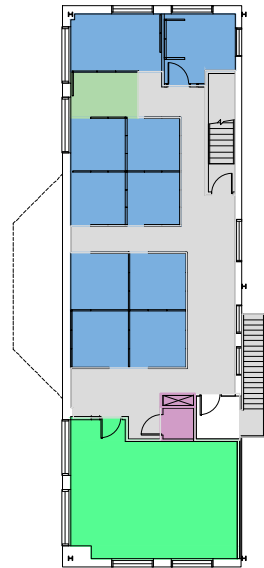
- Main Vestibule
- Waiting Area
- Alternate Entrance
- Showers-Change
- Janitor
- Mech-Elec
- Storage-File

Functional Building Area

- Office-MPO
- Workstations
- Meeting
- Hotel Station
- Micro Kitchen
- Print Mail
- Mustering
- M&R
- Warehouse

MISC.

- Circulation



Site Plan



Floor Plan

2016-0613-05

Enbridge Colony
6 Colony Court, Brampton, ON



3.02 FACILITY ASSESSMENT

ENBRIDGE GAS DISTRIBUTION INC.

KENNEDY REGIONAL OPERATIONS CENTRE

3157 Kennedy Road, Scarborough, ON

Project No.: 2016-0613-05

REV 1.0 - December 6, 2017

WALTERFEDY

ENBRIDGE GAS DISTRIBUTION INC.

FACILITY ASSESSMENT

Kennedy Regional Operations Centre

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Appendix A - Capital Expenditures Forecast

Appendix B - Photographs

Appendix C - Program

Appendix D - Drawings

1.0 SUMMARY

1.1 Introduction

WalterFedy was retained by Enbridge to conduct a physical and functional assessment of the facility located at 3157 Kennedy Road in Scarborough, Ontario for the purpose of identifying functional adequacy and physical renewal requirements for budgeting and planning purposes. The scope of the report includes a general visual inspection of visible civil, architectural, structural, mechanical, and electrical components. It also includes a brief Ontario Building Code (OBC) review to address barrier-free accessibility issues.

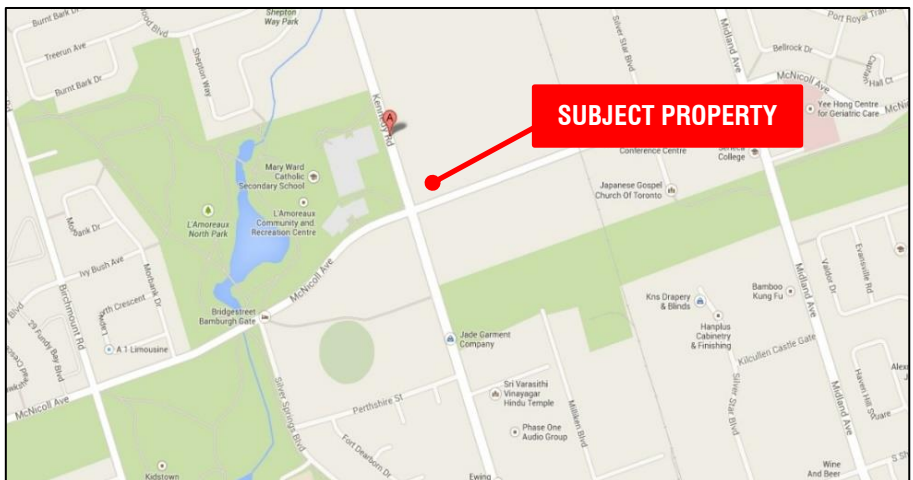
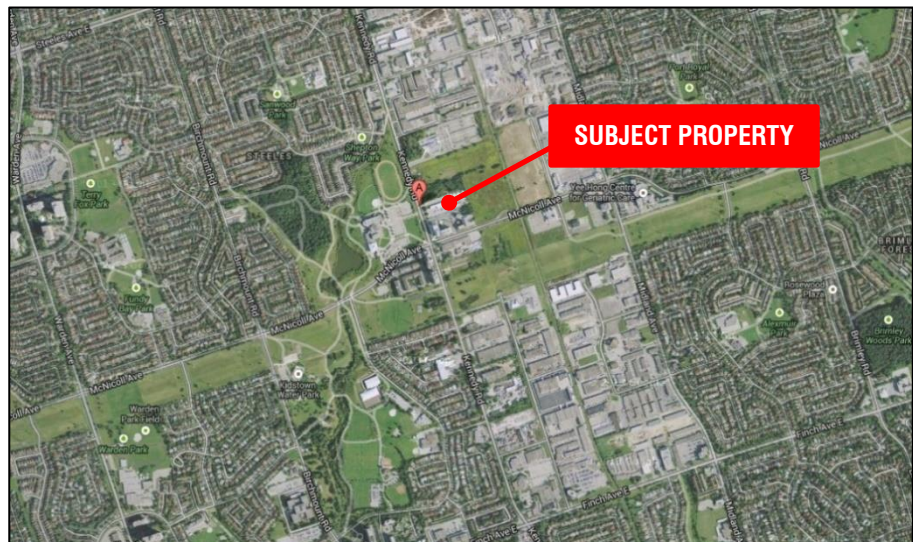
Following the initial report, a list of recommendations with estimated costs is provided for corrective and preventive maintenance items required.

1.2 Facility Description

The facility is categorized by Enbridge as Regional Operation Centre. The original building was constructed in 1960 with two major renovations and additions completed in 1979 and 1998.

There are three structures on the property; the main building, the welding shop and a portable unit used as an office space. The main building consists of a ground floor and a mezzanine with a total gross floor area of 11,000 SF. The welding shop is a separate warehouse building one storey structure with a total floor area of 1,900 SF. The third building is a portable trailer used as an office space with a total area of 650 SF.

The facility is located on Kennedy Road between Steeles and Finch Avenue. It is within proximity of major transportation routes including highway 401, 404, 407 and Markham Road. The surrounding use is primarily commercial and industrial.



1.2.1 Property Summary

(1) General:

Owned / Leased:	Owned
FCI score:	6.51 %
AI score:	95 %
Current Occupancy:	119

(2) Physical Building Properties:

Building Constructed:	1960
Completed Renovations:	1979; 1998

Gross Floor Area

Building A (Main Building)	11,061	SF
Building B (Metal Shop)	1,912	SF
Building C (Office Trailer)	948	SF

Building Area (Foot Print):

Building A:	9,768	SF
Building B:	1,912	SF
Building C:	948	SF

Mezzanine Area:	1,293	SF
Office Space:	4,070	SF
Common Areas:	2,900	SF
Industrial:	3,188	SF
Circulation:	2470	SF

(3) Site Characteristics:

Site Area: 150,500 SF (3.4 ac.)

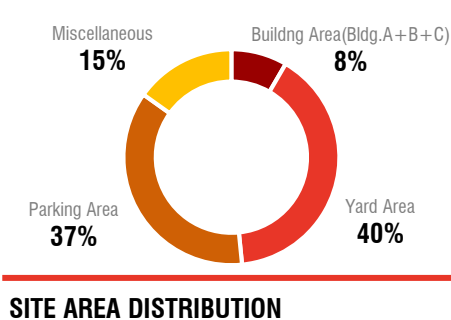
Existing Building Coverage: 8.4% (12,628 SF)
(bldg.A+B+C)

Future Building Coverage 14% (21,647 SF)
(after the proposed addition)

Yard Area: 60,250 SF (1.3 ac.)

Parking: 54,832 SF

Miscellaneous: 22,790 SF

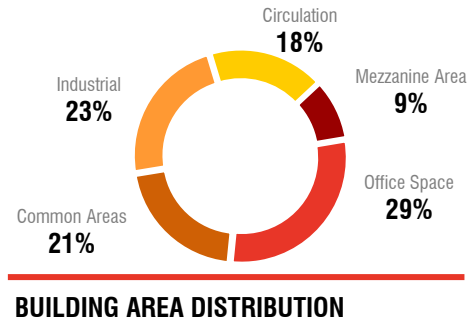


(4) Zoning:

Zone:	Employment Industrial Zone (E)
Parking Required:	1.5 per 100m ² (18 cars required)
Parking provided:	93 cars/vans, 41 trucks, 20 equipment
Loading Provided:	2 loading spaces
Front Yard Depth (min.)	3.0 meters Provided 28 meters
Side Yard Width (min.)	3.0 meters Provided 10.5 meters
Rear Yard Depth (min.)	7.5 meters Provided 45 meters
Building Height (max.)	Office - 20.0 meters
Parking Setback	0.5 meters

(5) Building Systems:

HVAC:	Office – Rooftop HVAC units Warehouse – Radiant tube and forced air unit heaters
Plumbing:	Municipal water supply, septic sanitary
Electrical:	400 A/600 V, 3 phase
Building Automation/Security:	None



1.3 Scope Of Work

The scope of work for this assessment was approved by Enbridge and was completed in accordance with WalterFedy's fee proposal dated September 08, 2016.

The scope of work for the Asset Management Report will include a Functional Assessment, a Physical Assessment, and a Market Condition Assessment. The report will provide recommendations for strategic decisions based on the metrics reviewed in the assessments.

1.4 Assessment Methodology

The building condition assessment is based on general visual examination performed on September 21, 2016 by WalterFedy's Architectural and Facility Management departments.

The observations in this report were made using non-destructive methods through existing access points. Existing drawings provided by Enbridge for the building were also used to supplement site observations.

The guiding principles of this study are based upon the document from the National Research Council of Canada (NRC) "Protocols for Building Condition Assessment" published by The Institute For Research in Construction (IRC).

1.5 Limitation of Study

This assessment is based on our general review and walkthrough of the facility and it is not intended to form a detailed life safety analysis or Ontario Building and Fire Code assessment. The facility was built in 1960 and is not in compliance with current Ontario Building and Fire Codes. It is recommended that a further detailed life safety review and assessment be carried out to determine what building systems upgrades would be required to meet the requirements of Section 9.2 of the Ontario Fire Code to the satisfaction of the Fire Department.

This report was completed in accordance with the approved scope of work as described in Section 1.3. This report is limited and is not intended to be comprehensive or exhaustive, or to suggest a risk-free facility. The report may not address all existing issues associated with the facility and may omit issues that are or may be of interest to the Owner. The findings and statements in this report are based on general site observations of the current conditions as they existed during the time period of the investigation.

The purpose of this report is for the sole use of the Owner for budgetary planning purposes. Issues identified in this report require further detailed assessments to determine repair and maintenance work required. This report should not be used by third parties involved in any work related to the facility; such third parties should undertake their own investigations and studies to determine how the existing condition of the facility will affect their plans and work. WalterFedy accepts no responsibility for liabilities incurred by or damages suffered by any third party as a result of decisions made or actions taken, based upon this report.

The passage of time might affect the views, conclusions and recommendations provided in this report.

The following report is a general guide only and is not intended to be used as a document for construction.

This study does not include hazardous materials review or inspection.

2.0 PHYSICAL AND FUNCTIONAL ASSESSMENT

2.1 Physical Assessment

2.1.1 Site and Landscaping

The site is a near rectangular-shaped property. The building occupies approximately 8.4% of the site.

The remainder of the site is occupied by asphalt pavement parking areas, cast-in-place concrete paving, concrete curbs, a perimeter fence with powered access gates and areas of soft landscaping (i.e., grass, shrubs, and trees) located on the perimeter of the site and a block and poured concrete retaining wall along the northeast perimeter of the site. Wall mounted lighting units and pole mounted light standards provide illumination for the site. During the site visit the asphalt paved areas and concrete site features were noted to be in satisfactory condition overall with regular maintenance being performed to ensure realization of service life. Site lighting is aged and consideration should be given to replacing the wall pack units and pole mounted lighting standards with LED fixtures for improved energy performance.

The property is secured by a four-foot high chain link fence along the west side of the property. The fence has three entrances each with an operable gate.

Since the inspection was limited to visible areas, no examination of the catch basins was performed and no review of the initial compliance with code was performed. The inspection of underground or concealed components is outside the scope of work.

2.1.2 Mechanical

Heating and cooling for the office area is provided by three rooftop mounted HVAC units. One of the older Lenox Units (AHU-1, west offices) has been replaced since the last study. The remaining two units (AHU-2, central offices and AHU-3, southeast offices) have aged past their projected useful life and consideration should be given for their replacement in the next 10 years. Additional supplementary heating is provided by a wall mounted electric unit heater and additional supplementary cooling is provided by four split DX cooling units located around the exterior of the building. Based on age, an allowance has been provided to replace the electric wall heater and two of the split DX cooling units within the next 10 years.

Heating in the warehouse area is provided by ceiling mounted natural gas fire radiant tube and forced air unit heaters. Based on age, an allowance for replacement has been provided.

The welding shop is heated by a pair of natural gas-fired, ceiling mounted unit heaters.

Domestic Hot Water ("DHW") within the site building is provided by a Bradford White Magnum series domestic hot water tank located in a utilities room off of the men's washroom/change room. Based on the name plate data on the equipment, the domestic hot water tank was manufactured in 2002.

There was reportedly no shortage of DHW within the site building. However, based on WalterFedy's experience the anticipated service life of a DHW is typically 10-15 years. Therefore based on age, replacement should be considered within the term of analysis.

2.1.3 Electrical

The electrical power for the site building is supplied from a pad-mounted transformer which is accessed from the west portion of the site and feeds the electrical room of the site building via underground cables.

Emergency power is provided by a natural gas fired ONAN Genset (M/N – GGHC 3370385, S/N – D990898893). At the time of the site visit the Genset was having issues with voltage ramp up as indicated by the service contractor that was onsite at the time of the site inspection. The housing unit was also noted to be rusted. Based on age and the issues reported with this Genset, replacement should be considered within the next 10 years.

Interior lighting is predominately provided by T8 fluorescent T8 tube lighting fixtures. As a leasehold improvement, consideration should be given for an LED retrofit.

Combination battery pack units provide emergency lighting and exit signage within egress pathways. Due to age, approximately three units will require replacement within the next 10 years.

WalterFedy also recommends the replacement of the Square D distribution panel in the office area due to age and deterioration.

2.1.4 Structural

As outlined in the scope of work, a limited visual assessment of the condition of the structural elements was carried out on the elements which were visible at the time of the inspection. The site building is a slab on grade structure. The superstructure of the site building is comprised of concrete masonry block exterior walls, concrete columns, wood joists and concrete. No major visually identifiable structural deficiencies were noted at the time of the site inspection.

2.1.5 Building Envelope

The roof system atop the site building consists of a single ply Polyvinyl Chloride Membrane (PVC), near-flat, mechanically fastened roof system. The roof system is installed atop a layer of rigid insulation, atop a corrugated metal roof decking. Neither the presence of a vapour barrier, nor the type or the thickness of the insulation could be verified, as the scope of the work did not include destructive testing.

Drainage of the roof system is provided by internal roof drains which presumably drain to the municipal sewer system.

Penetrations through the roof system include plumbing stacks, exhaust vents, internal roof drains, mechanical curbs, and service penetrations.

The weld shop is covered with a metal roof with aluminum gutters and downspouts that discharge rainwater to site grade.

The exterior walls of the site building consist of architectural concrete block masonry. Major spalling along the base of the concrete block columns along the north elevation was observed at the time of the site inspection. This deterioration is likely the result of overuse of de-icing salts during the winter. It is recommended that the spalling be addressed in the early term of this study and some protection be provided in this area to reduce future exposure to de-icing salts.

The window systems of the site building consist of fixed single glazed (“SG”) units set within metal frames in strip and punched configurations. The washroom windows are aluminum-framed, double glazed units. Operable windows are horizontal sliders and awning type units. Exterior doors serving the site building are comprised of IG units set into aluminum frames. Metal doors within metal frames were observed serving the warehouse egresses and of the site building. Sectional metal overhead doors were noted serving the warehouse areas. Replacement of windows within the office and warehouse areas is recommended based on age along with the overhead warehouse door.

The exterior walls of the weld shop consist of corrugated sheet metal cladding.

The window systems of the weld shop include fixed SG units set within metal frames in punched configurations. Exterior doors serving the weld shop are comprised of metal doors with fire rated vision panels within metal frames. A large sectional metal overhead door serves the weld shop areas.

2.1.6 Finishes

The floor finishes within the site building consist of unsealed concrete slab-on-grade, carpet, ceramic and resilient floor tiles. The wall finishes within the site building consist of painted gypsum board and painted concrete masonry block. The ceiling finishes within the site building primarily consist of exposed structure, and painted suspended ceiling tile. No major deficiencies associated with the building finishes were noted at the time of the site inspection.

2.2 Functional Assessment

2.2.1 Site

The site is serviced by three driveways, each with gate access off of Kennedy Road. The northernmost driveway of the site is a two way driveway with card access for employees only. The two driveways to the north of the building act as main entry and exit only servicing visitors, truck and fleet access; middle driveway (entry only), and the southernmost driveway (exit only). There are functional challenges with accessing and exiting the site from Kennedy Road due to the heavy traffic of that main thoroughfare. Signs are posted for staff and visitors to exit to the right hand lane only when departing the facility.

The site consists of a main office and warehouse building, along with some smaller subsidiary buildings that house some of the key functions of the facility; Weld shop/ fabrication building. The addition of an office trailer has been added to the site to facilitate the deficiency of office space in the main building.

The parking and yard are arranged such that the main employee parking is located to the north of the site with visitor, truck and fleet parking to the east and south of the building. Pipe racks, refuge, and material storage is located on the perimeter of the building.

The following site functional deficiencies were observed during the walkthrough:

- The site does not meet operational requirements for size and vehicular circulation. Access to and exit from Kennedy is difficult and poses operational inefficiencies. It was noted that a gate was added to the rear of the property to help alleviate this issue, onto the new extension of Milliken Boulevard. However it was noted that this exit/entrance is not fully operational and currently outfitted with a swing gate and not a motorized control access security gate.
- The yard size is smaller than Enbridge standard yard size requirements. The current yard size is 1.3 acres. Enbridge standard yard size is 2.5 acres. Building an addition on the property to address the building functional deficiencies will cause further reduction to the yard and parking/vehicular circulation space and will entail additional operational constraints.

2.2.2 Interior Space Planning

The interior layout is divided into two parts; industrial zone and office area. Based on a detailed review of the space plan of the building we found that the building was deficient and there is lack of space in several key areas; general infrastructure, including common areas and office amenities, office space, and industrial zones. The area deficiencies result in about 10,613 SF of building area. Refer to the Appendix B for a breakdown of the programmatic elements.

The following functional deficiencies were observed during the walkthrough:

- The welding shop is located in a separate building in the yard; there is also an office portable that takes up part of the site that was added to accommodate the spatial deficiencies of the office portion of the existing building. These two buildings pose both operational inefficiencies and special inefficiencies.
- The locker rooms and lockers do not meet Enbridge's current standards. The area of the lockers is not functional due to the limited space and limited access.
- There is no cafeteria/ lunchroom with an adequate kitchen in the facility. Currently there is a small coffee counter located in the main corridor.
- The janitor's room is tight and additional space is recommended.
- The main warehouse area is also used as a wash bay. A separate wash bay area is recommended.
- The ceiling height of the open office space on the mezzanine level is too low.
- The access and exit to the mezzanine from the central staircase is restricted by the photo copier, filing cabinet and mail slots. A spare photocopier and mailroom room is recommended.
- There is not a lift provided for accessibility to the mezzanine level.
- A separate boot wash and washing machine area is required. Currently there is not a boot wash in the facility and the washing machine is located in the warehouse.
- The plotter, photo copier, and filing cabinets in the construction office are located such that it restricts movement within the open office area, leaving little room for movement and layout space.
- On the ground floor the photocopier, filing cabinets and mail slots are all located in the main corridor next to the main entrance. The location is not suitable and it affects the flow and circulation in the corridor. A separate photocopier room is recommended.
- There are very few windows in the mustering room, construction office and mezzanine. Additional windows should be added to enhance the space to meet Enbridge's access to light standards.

2.2.3 Furniture

Existing furniture is legacy furniture throughout. All existing office furniture has reached the end of its life cycle and replacement is recommended to enhance the functional and environmental condition in the office area. The height of the existing cubicle partitions blocks natural light and access to existing windows from the core area.

To meet Enbridge's office standards it is recommended the furniture be phased out and replaced with new.

2.2.4 Ontario Building Code – Life Safety

Section 3.2 - Building Fire Safety

The building falls under Part 3, Group F Division 2 and Group D major occupancies.

To meet current Ontario Building Code the building should satisfy the requirements of 3.2.2.71:
Group F, Division 2, up to 2 Storeys:

- The building is not required to be sprinklered.
- Standpipe system is not required.

- The building is permitted to be of combustible construction or non-combustible construction used singly or in combination, and,
- Floor assemblies shall be fire separations and, if of combustible construction, shall have a fire-resistance rating not less than 45 minutes (Not applicable).
- Loadbearing walls, columns, and arches supporting an assembly required to have a fire-resistance rating shall have a fire resistance rating of 45 minutes or shall be of non-combustible construction.

Section 3.8 - Barrier-free Design

3.8.1.3. Barrier-free Path of Travel

3.8.1.3.(1) Every barrier path of travel shall provide an unobstructed width of at least 1100 mm for the passage of wheelchairs.

- The width of the corridor leading to the southwest exit door is reduced to less than 1100. Storage shelving is placed in the corridor section adjacent to the exit door. This is an indication that there is lack of storage space in the facility which have impact on life safety related to obstruction of exits and reduction of exit corridors.

3.8.1.2. The facility has two entrances to the ground level. Neither entrance is equipped with barrier-free door operator nor do they qualify as a barrier-free entrance. In accordance with article 3.8.1.2, a minimum of one barrier-free entrance to the building is required.

3.8.2.3. Washrooms required being barrier-free

On the main floor there are currently two barrier-free washroom stalls located in the male and female washroom areas.

3.8.3.12. Universal (barrier-free) toilet rooms:

There is not a universal barrier-free washroom in the facility. This is considered an existing non-conforming condition for compliance with Ontario Building Code. There is no mandate in the current code to upgrade the existing facility for compliance with the Universal Barrier Free washroom requirements. However in compliance with Part 11 of Ontario Building Code the addition of a universal washroom will be required in the event of extensive renovation in the building.

2.3 Functional and Physical Condition Analysis

WalterFedy utilized a risk management approach taking into consideration the impact of failure of the building component on the long term serviceability of the building as well as the functional requirements associated with the building. Both Facility Condition Indexing (FCI) and Adequacy Indexing (AI) was utilized in order to help make the best possible decision related to the future of the site building and to determine whether or not to invest, maintain, repurpose or dispose of the asset.

FCI:

FCI is a condition index tool used to illustrate the condition of an asset expressed in a percentage ratio of required maintenance/repair costs divided by the replacement value of the asset expressed as:

$$\text{FCI} = (\text{Maintenance and Repair Costs}) / (\text{Cost to Replace the Building})$$

The replacement value of the building is based on industry standards for construction costs. Therefore, the lower a FCI is, the better the condition of the building. The resulting FCI at ten years is 6.51% which is classified as being in fair condition.

$$\text{FCI (Kennedy)} = (\$171,750) / (10,553 \times 250) = 6.51\%$$

AI:

AI is a condition index tool used to illustrate the functional condition of the asset expressed in a percentage ratio of required functional upgrade costs divided by the replacement value of the asset to meet the functional needs expressed as:

$$\text{AI} = \text{Functional Upgrade Costs} / \text{Cost to Replace the Building with its Functional Equivalent}$$

The Adequacy Index for Kennedy operations depot is calculated by dividing the current functional and physical renewal costs by the cost to replace the building with its functional equivalent size.

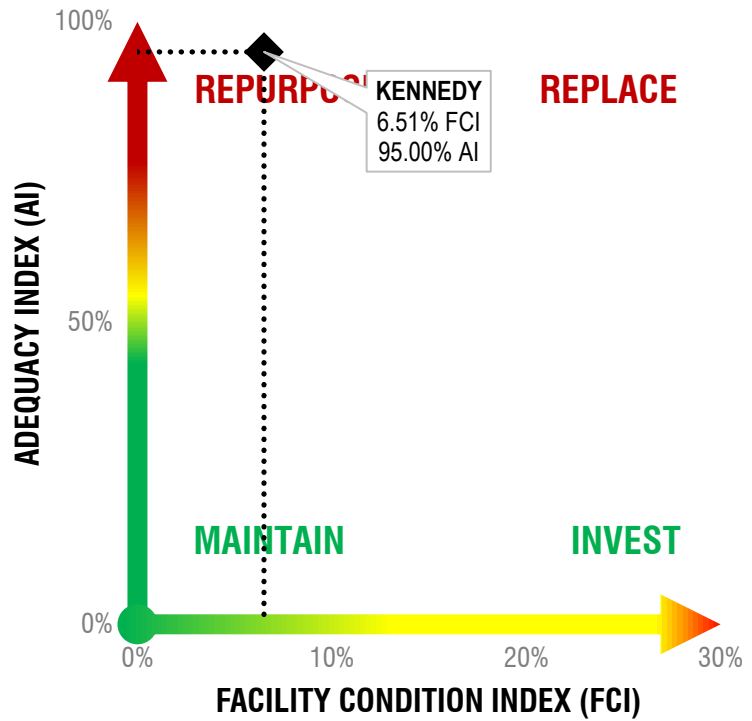
The cost to upgrade the facility to current Enbridge GDP standards is estimated at \$5,940,000. This is based on complete renovation of the existing building based on renovation estimated cost of \$250/sqf and the construction of a new addition of 11,000 sf based on 60% office space at \$350/sqf and 40% industrial space at \$200/sqf. Add \$3,000,000 for \$10,000 sf fleet garage at \$300/sf. Through discussion with Enbridge staff the new fleet garage at Kennedy Road will replace the existing garage structure at VPC.

The estimated cost to build a new facility to Enbridge GDP current standards based on \$22,000 sqf the area required to accommodate current program, 60% office space and 40% industrial space is \$6,380,000. Add \$3,000,000 for \$10,000 sf fleet garage at \$300/sf. Through discussion with Enbridge staff the new fleet garage at Kennedy Road will replace the existing garage structure at VPC.

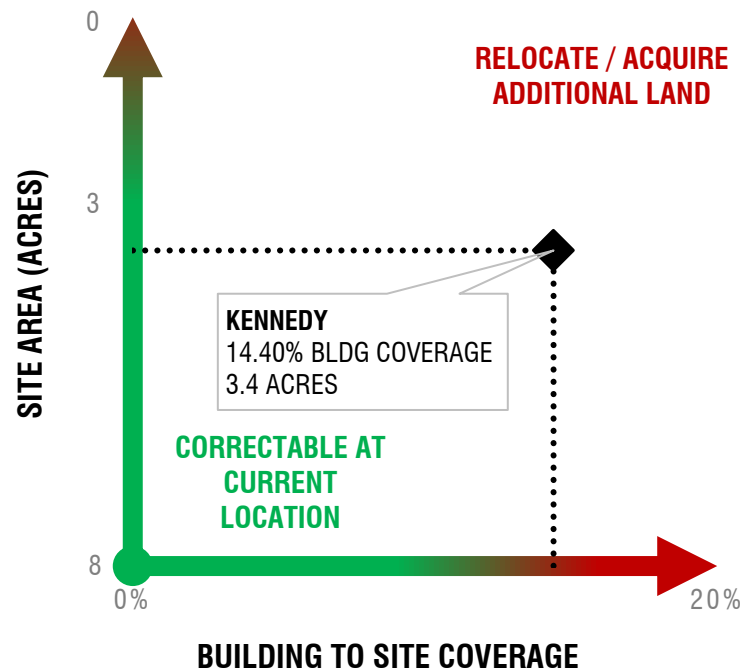
$$\text{AI (Kennedy Road)} = (\$8,940,000) / (\$9,380,000) = 95\%$$

With quantification of FCI and AI for your building, comes the ability to make comparisons between industry benchmarks and drive decision making related to the future of the property. The chart below shows the relationship between FCI and AI and indicates visually where Kennedy Road operations depot falls within the decision making criteria.

FACILITY CONDITION & ADEQUACY GRAPH



SITE CONSTRAINTS GRAPH



2.4 Key Findings

- PHYSICAL OBSOLESCENCE:

The acceptable Enbridge standard for the physical condition is an FCI of 0 to 5%. The current FCI of the facility based on this study is 6.51% therefore the physical condition of the facility does not meet Enbridge acceptable standards.

Meets Standards	Correctable at Current Location
Positive	Positive
NEGATIVE	NEGATIVE

- FUNCTIONAL OBSOLESCENCE BUILDING :

The acceptable Enbridge standard for the functional condition is 0, anything between 0 to 50% is considered correctable at the current location. The current facility AI index is 95%. Based on the FCI/AI graph the current recommendation for the existing facility is to repurpose to accommodate current ENBRIDGE GDP standards.

Meets Standards	Correctable at Current Location
Positive	Positive
NEGATIVE	NEGATIVE

- FUNCTIONAL OBSOLESCENCE SITE:

The site does not meet operational requirements for size and vehicular circulation. Access and exit from Kennedy is difficult and poses operational inefficiencies.

The yard size is smaller than Enbridge standard yard size requirements. The current yard size is 1.3 acres. Enbridge standard yard size is 2.5 acres.

The existing building requires expansion by approximately 11,000 SF to meet the need for current staff and Enbridge functional requirements. Building addition on the property will entail further reduction in the yard and parking areas.

Meets Standards	Correctable at Current Location
Positive	Positive
NEGATIVE	NEGATIVE

Overall the existing building is too small to meet current Enbridge Gas Distribution standards. The separation of offices and warehouse into two separate buildings is not convenient for staff and causes operational and work place difficulties and inefficiencies.

The configuration of site functions and circulation is inefficient. The yard area is too small to meet current Enbridge GDP standards. Building expansion on the same property will further reduce the size of yard area and will cause additional pressure on parking and circulation.

Based on the site deficiencies and space limitations, relocation to another property or land expansion by land acquisition is recommended. Although the FCI and AI graph indicates recommendation to maintain and repurpose the existing facility, the site deficiencies including space limitations and inefficiencies will prevent the option of expanding the existing building on the same property, without increasing the land area.

2.5 Property Evaluation

In 2008 Wagner, Andrews & Kovacs Ltd completed appraisal report on the property at 3157 Kennedy Road, The appraised amount based on the report in 2008 is \$4,220,000.

The following is a list of comparable industrial properties currently listed in the market.

		Cost	sq. ft.	Acres	\$/sq.ft.	\$/Acre
Scarborough						
2981 Kennedy RD, Scarborough, ON M1V1S9		\$ 3,850,000	6,752	2.84	\$ 570.20	\$ 1,355,634
100 Nugget Avenue, Scarborough, ON M1S3A7		\$ 2,495,000	22,540	1.03	\$ 110.69	\$ 2,422,330
4069 Gordon Baker Road, Scarborough, ON M1W2P3		\$ 6,250,000	35,830	2.51	\$ 174.43	\$ 2,490,040
787 Warden Avenue, Scarborough, ON M1L4C2		\$ 6,950,000	52,700	2.15	\$ 131.88	\$ 3,232,558
191 Ashtonbee Road, Scarborough, ON M1L2P1		\$ 9,250,000	53,174	4.83	\$ 173.96	\$ 1,915,114
1120 Bellamy Rd N, Scarborough, Ontario		\$ 2,500,000	23,600	1.30	\$ 105.93	\$ 1,923,077

Based on the above list we estimate the average value per acre for industrial properties in the area between \$2,000,000 to \$2,500,000.

Based on the above the estimated value of 3157 Kennedy Road is between \$6,800,000 and \$8,500,000.

2.6 Development Scenarios

The following is a comparison of the available options to address the deficiencies at 3157 Kennedy Road:

SCENARIO	1	2	3	4
DESCRIPTION	Correct physical and functional deficiencies by expanding the existing facility on the existing site	Purchase the abutting property (approximately 2 acres) and correct physical and functional deficiencies by expanding and renovating the existing facility	Buy the adjacent property (approximately 2 acres), demolish the existing buildings on site, build new facility on the same site	Sell the existing property, purchase a property suitable in size to accommodate the required program. Required size of new property is approximately 5 acres
CONSTRUCTION COST (OFFICES & WAREHOUSE)	\$5,940,000***	\$5,940,000***	\$6,380,000**	\$6,380,000**
CONSTRUCTION COST (NEW 10,000SF FLEET GARAGE including fit-up)	-	\$3,000,000****	\$3,000,000****	\$3,000,000****
SOFT COST	\$1,188,000	\$1,788,000	\$1,876,000	\$1,876,000
FURNITURE	\$1,190,000	\$1,190,000	\$1,190,000	\$1,190,000
SUB-TOTAL CONSTRUCTION	\$8,318,000	\$11,918,000	\$12,446,000	\$12,446,000
LAND ACQUISITION	\$-	\$7,000,000	\$7,000,000	\$11,250,000
LAND SALE PROCEEDS	\$-	\$-	\$-	-\$3,825,000*
TOTAL PROJECT COST	\$8,318,000	\$18,918,000	\$19,446,000	\$19,871,000
MEETS ENBRIDGE STANDARDS	NO	NO	YES	YES
PRIORITY			1	2

* Land sale proceeds is equal to 50% of the actual property evaluation/sale price. This is based on the "rate base split"/Enbridge portion of proceeds.

** Total construction cost is based on \$350/sq. ft. for the office area and \$200/SF for the industrial space. Total required gross floor area is 22,000 SF. 40% industrial space and 60% office, amenity and circulation space is assumed.

*** Based on complete renovation to the existing building at \$250/SF and 11,000 SF addition (40% industrial space at \$200/SF and 60% office space at \$350/SF).

**** 10,000 SF fleet garage space will replace the existing aging fleet garage at Victoria Park. Cost is based on \$300/SF including fit-up.



APPENDIX A

Capital Expenditures Forecast



7.0 CAPITAL FORECAST

3157 Kennedy Road, Toronto, ON
Regional Operating Centre

The following Capital Plan has been compiled from the following:

- 1 EGD Long Range Capital Plan (LRP)
- 2 EGD/FMG Property Inspection (FMG)
- 3 3rd Party Property Condition Assessment (PCA)
- 4 Non-Functional Standards Assessment - Section 5 (nFSA)
- 5 Electrical Safety Authority Inspection (ESA)
- 6 EGD Quarterly Health/Safety Inspection (HSI)

			1	2	3	4	5	6	7	8	9	10
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	CATEGORY	DEFICIENCY	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD
Maintenance Deficiencies												
	Doors & Windows	Overhead industrial door replacement								\$ 2,000		
	Doors & Windows	Replace warehouse windows					\$ 8,500					
	Doors & Windows	Replace office windows			\$ 18,500							
	ELEC	Replace aged distribution panel in office area									\$ 1,200	
	HVAC	Replace rooftop units		\$ 8,000		\$ 8,500						
	HVAC	Replace radiant and unit heaters in warehouse				\$ 8,500				\$ 6,500		
	HVAC	Replace electric wall mounted unit heaters in office area							\$ 2,000			
	HVAC	Replace air-cooled split systems						\$ 3,800				
	Leasehold Improvements	Retrofit T8 lighting to LED		\$ 20,000								
	Life/Safety	Allowance to replace battery pack lighting units						\$ 1,500				
	Life/Safety	Allowance to replace aged unit Genset		\$ 35,000								
	PLMB	Replace domestic water heater			\$ 2,500							
	Site Work/Exterior Elements	Spalling at base of block columns around North elevation	\$ 1,500							\$ 5,000		
	Site Work/Exterior Elements	Replace wall mounted and pole mounted site lighting (upgrade to LED)			\$ 33,000			\$ 5,000				
	Site Work/Exterior Elements	Repainting/resurfacing bolster around Genset (3 bolsters)			\$ 750							
Total Maintenance Deficiencies			\$ 1,500	\$ 63,000	\$ 54,750	\$ 17,000	\$ 8,500	\$ 10,300	\$ 2,000	\$ 13,500	\$ 1,200	\$ -
Cummulative FCI			0.06%	2.44%	4.52%	5.16%	5.49%	5.88%	5.95%	6.46%	6.51%	6.51%
Functional Deficiencies												
	Land Acquisition						\$ 7,000,000					
	Construction Cost	11,000 sqf addition to accommodate space deficiencies						\$ 3,190,000	\$ 3,190,000			
	Construction Cost	10000 sqf Fleet garage						\$ 1,500,000	\$ 1,500,000			
	Furniture	Based on \$10,000 per employee						\$ -	\$ 1,190,000			
	Soft Costs	20% of Construction Cost					\$ 938,000	\$ 938,000				
Total Functional Deficiencies			\$ -	\$ -	\$ -	\$ -	\$ 7,938,000	\$ 5,628,000	\$ 5,882,000	\$ -	\$ -	\$ -
Total			\$ 1,500	\$ 63,000	\$ 54,750	\$ 17,000	\$ 7,946,500	\$ 5,638,300	\$ 5,882,000	\$ 13,500	\$ 1,200	\$ -

Note: The preceding schedule does not include capital for remediation/correction of functional deficiencies



APPENDIX B

Photographs



3157 Kennedy Road, Toronto, ON

Appendix B.1

1. Bunkers



2. Building Exterior



3. Employee Parking Lot



4. Warehouse



5. Office



6. Yard

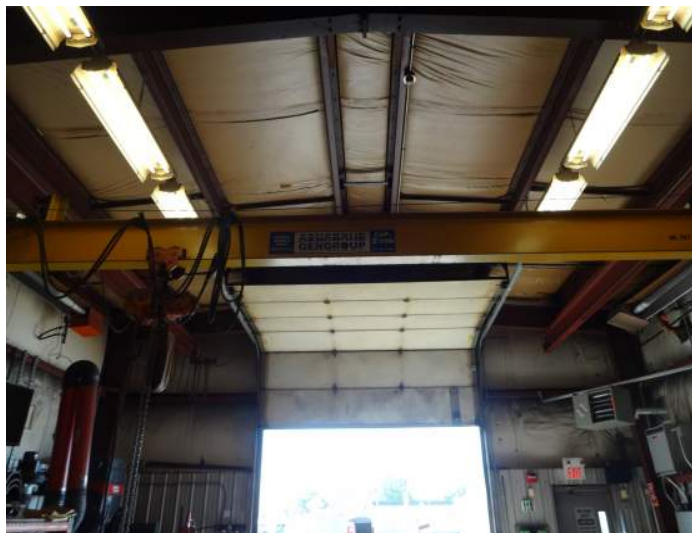




3157 Kennedy Road, Toronto, ON

Appendix B.2

1. Weld Shop - Overhead Door



2. Electric Unit Heater



3. Window



4. Generator Requiring Replacement



5. Brick



6. Exterior Lighting and Speaker





APPENDIX C

Program

Operations Depot: KENNEDY

Description	Standard # per person	Quantity	Size	Area Factor	Area sq.ft.	Area sq.ft. Current	Area sq.ft. Variance	Notes
General Building Infrastructure								
Main Vestibule	<	1	9 x 5	1.00	45	0	-45	
Waiting Area	<	1	9 x 5	1.00	45	0	-45	
Rear Entrance	<	1	7 x 5	1.00	35	0	-35	
Showers/Change/Washrooms	42	1	5 x 6	1.00	1,260	1,206	-54	
Universal Washroom	1 / floor	1	8 x 10	1.00	80	0	-80	
Janitor	1 / facility	1	6 x 10	1.00	60	30	-30	
Mechanical/Electrical and IT Room	1 / facility	1	12 x 14	1.00	168	194	26	
Storage					100	94	-6	
Sub Total					1,793	1,524	-269	
Functional Building Area								
MPO Office	20% of office staff	24	10 x 10	1.00	2,400	479	-1921	
Cubicles Workstations (45 capacity employees)	50% of office staff	60	8 x 6	1.50	4,320	1,912	-2408	
Meeting Room (8-10 people) 1/70 staff	1 per 70	1	16 x 11	1.50	264	0	-264	
Mustering Room(1chair/person) +1 HR workstation with connectivity and large TV screen for training	10	1	4 x 5	4.00	800	867	67	
Break out room (4 people) 1/50 staff	1 per 50	1	10 x 12	1.00	120	0	-120	
Micro Kitchen/Ezone - 1/floor	1/200	1	15 x 20	1.00	300	40	-260	
Hotel Station (2:1 of dynamic staff)	30% of office staff	36	6 x 2.5	1.50	803	117	-686	
Print Copy Rm/Mail Room	1/ 100				250	62	-188	
Health room - required if three are 200 or more employees on any one shift.	<	0	11 x 10	1.00	0	0	0	
Coat Storage	<	1	2 x 6	1.00	12	0	-12	
Gas monitor calibration (1/10 people)		1	8 x 8	1.00	60	15	-45	Located within mustering room
Measurement & Regulation Test/ Storage		1	12 x 20	1.00	240	0	-240	
Warehouse (where required by business ops)		1	30 x 77	1.00	2,310	1,610	-700	
Free Pick storage	1/Building	1	15 x 10	1.00	150	48	-102	
Locked Storage Room	<	1	10 x 15	1.00	150	228	78	
Wash Bay / Repair Garage(if fleet exists)	1/Building	1	25 x 50	1.00	10,000	1,674	-8326	The new fleet garage will replace the existing fleet garage at VPC
Welding Bay / Fabrication	1/Building	1	35 x 54	1.00	1,890	0	-1890	
Boot wash		1	6 x 10	1.00	60	0	-60	
Washing Machine Area		1	6 x 10	1.00	60	15	-45	Located within warehouse.
Sub Total					24,189	7,067	-17122	
Total Building Area (not including circulation)					25,982	8,591	-17391	
Circulation	28.75%				7,470	2,470	-5000	
Total Building Area (not including out buildings)					33,452	11,061	-22,391	

Out - Buildings Site Specific								
Office Trailer	1					648	648	not included in building sq.ft.
Weld Shop	1	1	35 x 54	1.00	1,890	1,912	22	not included in building sq.ft.
Measurement & Regulation Test/ Storage	1	1	12 x 20	1.00	240	97	-143	
Total Occupied Out-Building Areas					2,130	2,657	527	

Site								
Total Site Area:						150,715		
Setbacks			per by-law requirements	20,273	6,479	-13,794		Storage/Parking within setbacks on much of site-Available to yard
Building Footprint			per site		13,466			Inc. Out- Buildings
Future Building Expansion			deficit of site program above	4,793	0	-4793		
Site Feature, Landscaping, etc.			per site		4,460			
Staff Parking	1 per employee	119	9 x 17	2.00	36,414	24,669	-11745	68
Visitor Parking	<	9	9 x 17	2.00	2,754	4,258	1,504	9
Sub Total					43,961	53,332	-15034	
Available Yard Area:					108,900	97,383	-11517	Based on minimum 2.5 acres required
Site Deficit:							-26551	

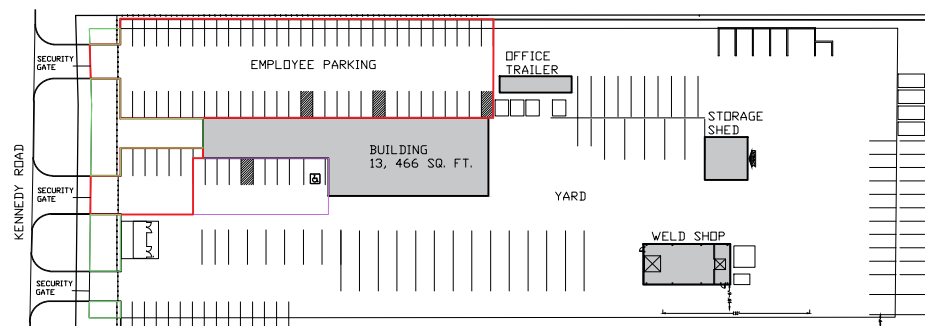


APPENDIX D

Drawings

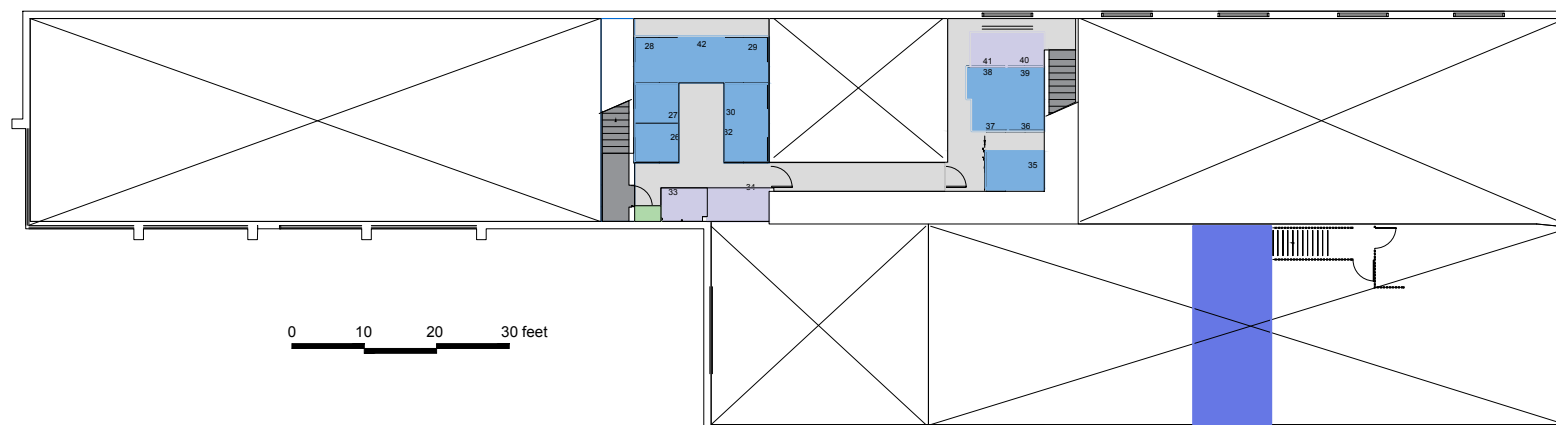


- General Building Infrastructure**
- Stairs
 - Showers-Change
 - Office Washrooms-Janitor-FirstAid
 - Mech-Elec
- Functional Building Area**
- Office-MPO
 - Workstations
 - Print-Mail
 - Training
 - Micro Kitchen
 - Gas Monitor Calibration
 - Warehouse
 - Storage-Free Pick
 - Wash-Repair Bay
 - Laundry
- Storage Facilities**
- Storage-Locked
 - Storage-File
- MISC.**
- Circulation

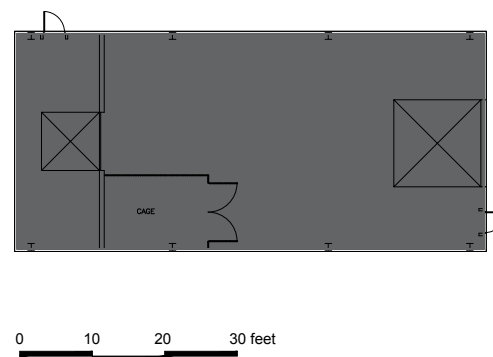


Enbridge Kennedy
3157 Kennedy Road, Toronto, ON

2016-0613-05



Mezzanine Floor Plan



Weld Shop Floor Plan

Enbridge Kennedy
3157 Kennedy Road, Toronto, ON

2016-0613-05



3.03 FACILITY ASSESSMENT

ENBRIDGE GAS DISTRIBUTION INC.

MARKHAM REGIONAL OPERATIONS CENTRE

101 Honda Boulevard, Markham, ON

Project No.: 2016-0613-05

REV 1.0 - December 6, 2017

WALTERFEDY

ENBRIDGE GAS DISTRIBUTION INC.

FACILITY ASSESSMENT

Markham Regional Operations Centre

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1.0 SUMMARY

1.1 Introduction

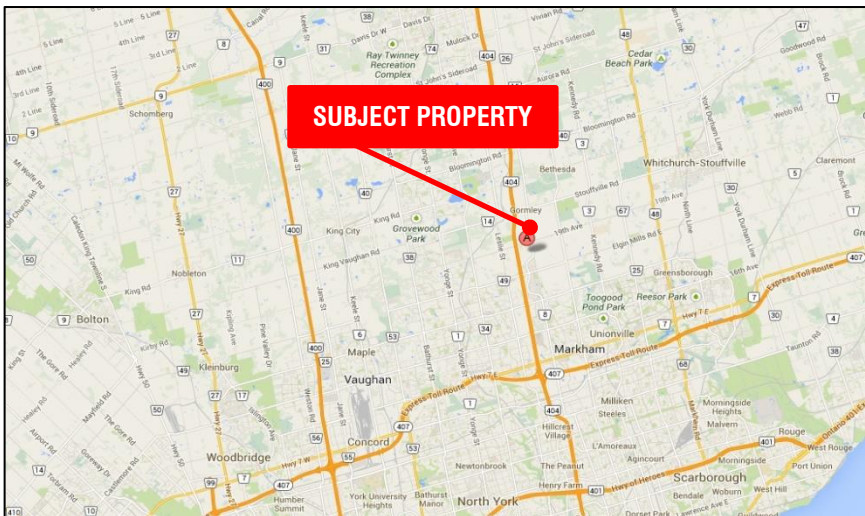
WalterFedy was retained by Enbridge to conduct a physical and functional building condition assessment of the facility located at 101 Honda Boulevard, Markham, Ontario for the purpose of identifying functional adequacy and physical renewal requirements for budgeting and planning purposes. The scope of the report includes a general visual inspection of visible civil, architectural, structural, mechanical, and electrical components. It also includes a brief Ontario Building Code (OBC) review to address barrier-free accessibility issues.

Following the initial report, a list of recommendations with estimated costs is provided for corrective and preventive maintenance items required.

1.2 Facility Description

The facility is categorized by Enbridge as Regional Operation Centre. The building was constructed in 2011.

The property is located at Elgin Mills Road and Highway 404 on Honda Blvd in an industrial park in Markham's northernmost area. The general area has been recently developed and surrounding uses include Honda Canada's new facility in Markham. The location has excellent access to the major 400 series highways via the 404.



1.2.1 Property Summary

- 1) General:

Owned / Leased:	Owned
FCI scope:	0.08%
AI scope:	4.8%
Current Occupancy:	293

- 2) Physical Building Properties:

Gross Floor Area:	99,700 ±SF
Office Space:	17,300 ±SF
Training:	12,900 ±SF
Industrial:	24,700 ±SF
Common Areas:	19,500 ±SF
Circulation:	25,300 ±SF

- 3) Site Characteristics:

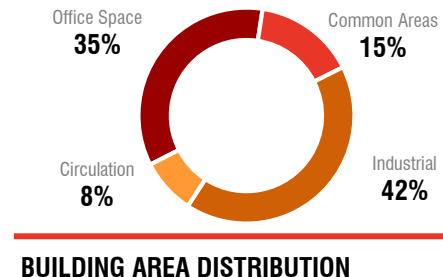
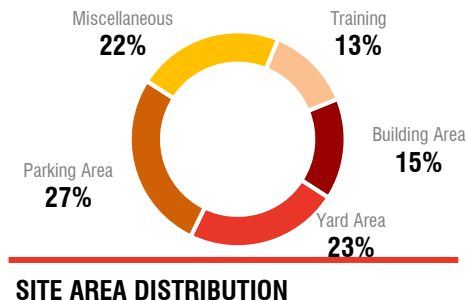
Site Area:	485,048± SF (11.1 acres)
Building Coverage:	14.3% (69,655± SF)
Main Bldg + Storage + Garage):	69,655(64424+1356+3875) ± SF
Yard Area:	105,646 ±SF (2.5 Acres)
Parking:	123,215 ±SF
Misc.:	101,057 ±SF
Training site	58,475 ±SF

- 4) Zoning:

Zone:	BP – Business Park
Parking Required:	1 per 30m ² (324 SF) : 308
Parking Provided:	350 cars/vans, 41 trucks, 10 equipment
Front Yard Depth (minimum)	6.0 meters Provided 25.5 meters
Side Yard Width (minimum)	3.0 meters Provided 33.0 meters
Rear Yard Depth (minimum)	3.0 meters Provided 3.0 meters
Maximum Floor Space Index	1.75
Building Height (maximum)	46.0 meters

- 5) Building Systems:

HVAC:	Central Boilers, Chillers, Radiant tube heaters and unit heaters
Plumbing:	Domestic well water and septic tank sanitary
Electrical:	1200 A/600 V three phase service
Building Automation/Security:	None



1.3 Scope of Work

The scope of work for this assessment was approved by Enbridge and was completed in accordance with WalterFedy's fee proposal dated September 08, 2016.

The scope of work for the Asset Management Report will include a Functional Assessment, a Physical Assessment, and a Market Condition Assessment. The report will provide recommendations for strategic decisions based on the metrics reviewed in the assessments.

1.4 Assessment Methodology

The building condition assessment is based on general visual examination performed on September 21, 2016 by WalterFedy's Architectural and Facility Management departments.

The observations in this report were made using non-destructive methods through existing access points. Existing drawings provided by Enbridge for the building were also used to supplement site observations.

The guiding principles of this study is based upon the document from the National Research Council of Canada (NRC) "Protocols for Building Condition Assessment" published by The Institute For Research in Construction (IRC).

1.5 Limitation of Study

This assessment is based on our general review and walkthrough of the facility and it is not intended to form a detailed life safety analysis or Ontario Building and Fire Code assessment. The facility was built in 1960 and is not in compliance with current Ontario Building and Fire Codes. It is recommended that a further detailed life safety review and assessment is carried out to determine what building systems upgrades would be required to meet the requirements of Section 9.2 of Ontario Fire Code to the satisfaction of the Fire Department.

This report was completed in accordance with the approved scope of work as described in Section 1.3. This report is limited and is not intended to be comprehensive or exhaustive, or to suggest a risk-free facility. The report may not address all existing issues associated with the facility and may omit issues that are or may be of interest to the Owner. The findings and statements in this report are based on general site observations of the current conditions as they existed during the time period of the investigation.

The purpose of this report is for the sole use of the Owner for budgetary planning purposes. Issues identified in this report require further detailed assessments to determine repair and maintenance work required. This report should not be used by third parties involved in any work related to the facility; such third parties should undertake their own investigations and studies to determine how the existing condition of the facility will affect their plans and work. WalterFedy accepts no responsibility for liabilities incurred by or damages suffered by any third party as a result of decisions made or actions taken, based upon this report.

The passage of time might affect the views, conclusions and recommendations provided in this report.

The following report is a general guide only and is not intended to be used as a document for construction.

This study does not include hazardous materials review or inspection.

2.0 PHYSICAL AND FUNCTIONAL ASSESSMENT

2.1 Physical Assessment

2.1.1 Site and Landscaping

The site is a near rectangular-shaped property. The site building occupies approximately 3.6% of the site.

The remainder of the site is occupied by asphalt pavement parking areas, cast-in-place concrete paving, concrete curbs, a perimeter fence with powered access gates and areas of soft landscaping (i.e., grass, shrubs, and trees). Wall mounted lighting units provide illumination for the site.

The property is secured by a seven-foot fence along the perimeter of the property. The fence has two operable gates at each of the entrances.

Since the inspection was limited to visible areas no examination of the catch basins was performed and no review of the initial compliance with code was performed. The inspection of underground or concealed components is outside the scope of work.

2.1.2 Mechanical

Heating and cooling for the building is provided by two 'Thermal Solutions' natural gas fired boilers (B1: M/N – TS1000; B2: M/N - TS1000) at 1,000 BTUH each and two 'York' water Chilled Chillers (C1: YCWL00848E58; C2: YCWL00848E58) rated at 75 Ton each. The water cooled chillers are connected to the rooftop mounted air cooled 'Waltco' Cooling Tower (M/N – WGX-0618-75) rated at 600 Gallons per minute. Two packaged rooftop units provide 120,000 and 140,000 BTUs of heating each. Name plate data on the equipment was not readily available but the systems are all original to the 2011 construction making them all around 5 years old. The expected projected useful life of packaged roof top units typically fall between 20 to 25 years and the projected useful life of chillers and boilers typically fall between 30 to 35 years with cooling towers seeing upwards of 40 years of projected service life provided that they are well maintained. Therefore, based on age, replacement is not anticipated within the term of this analysis.

Supplementary heating for warehouse area is provided by eight straight tube configuration natural gas fired forced infrared heaters and seven (U-tube) configuration forced air unit heaters located in the warehouse and training wing area. Based on age and observed condition, replacement of the radiant tube heaters and unit heaters should not be required within the evaluation period.

Domestic Hot Water ("DHW") within the site building is provided by a 'Rheed' Powervent domestic hot water tank and an instant on demand water heater each with a heating capacity of 199,000 BTU. Based on the name plate data on the equipment the units were installed in 2011 during original construction. There was reportedly no shortage of DHW within the site building. Based on WalterFedy's experience the anticipated service life of a hot water tank is typically 10-15 years, the anticipated service life of an on demand water heater is estimated at 15-20 years. Therefore based on age, replacement of the domestic hot water tank should be required within the term of analysis whereas the on demand water heater should remain serviceable throughout the term of the analysis.

2.1.3 Electrical

The electrical power for the site building is supplied from a pole-mounted transformer. The buildings electrical room has a main 800 Ampere, 347/600 Volt, 3 phase breaker panel and electric service. The breakers provide power through copper wire conduit to the various lighting and receptacle unit distribution panels throughout the site building.

Interior lighting is provided by LED first generation fixtures.

Combination battery pack units provide emergency lighting and exit signage within service areas. Emergency power is provided by a pad mounted 'Olympian' 200 kW diesel generator located on the south lot.

2.1.4 Structural

As outlined in the scope of work, a limited visual assessment of the condition of the structural elements was carried out on the elements which were visible at the time of the inspection. The site building is a slab on grade structure. The superstructure of the site building is comprised of concrete masonry block exterior walls, concrete columns, wood joists and concrete. No major visually identifiable structural deficiencies were noted at the time of the site inspection.

2.1.5 Building Envelope

The roof system atop the site building consists of a single ply Polyvinyl Chloride Membrane (PVC), near-flat, mechanically fastened roof system that was installed last year. The roof systems are installed atop a layer of rigid insulation, atop a corrugated metal roof decking. Neither the presence of a vapour barrier, nor the type or the thickness of the insulation could be verified, as the scope of the work did not include destructive testing. Drainage of the roof system is provided by internal roof drains which presumably drain to the municipal sewer system.

Penetrations through the roof system include plumbing stacks, an exhaust vent stack, internal roof drains, mechanical curbs, and service penetrations.

The window systems of the site building consist of fixed insulated glazed units ("IGU") set within aluminum frames in punched configurations and an insulated glazed curtain wall system at the front elevation. Exterior doors serving the site building are comprised of single glazed units set into metal frames. Metal doors within metal frames were observed serving the warehouse egresses and of the site building. Sectional metal overhead doors were noted serving the warehouse areas.

Based on age and observed condition no major capital expenditures associated with the building envelope are anticipated within the capital planning window.

2.1.6 Finishes

The floor finishes within the site building consist of unsealed concrete slab-on-grade, carpet, ceramic and resilient floor tiles. The wall finishes within the site building consist of painted gypsum board and unfinished plywood sheathing. The ceiling finishes within the site building primarily consist of exposed structure, and painted gypsum and suspended ceiling tile.

Based on age and observed condition no major capital expenditures associated with the interior finishes are anticipated within the capital planning window.

2.2 Functional Assessment

2.2.1 Site

The facility was built in 2011 and is in general compliance with Enbridge GDP standards

The property has two points of access along Honda Blvd, each entrance driveway has three lanes (two exit lanes and one entry lane).

The yard area has one vehicle entry point with automatic sliding gate. It is recommended that a second entry/exit gate to be provided to enhance vehicle circulation in the yard area and for added safety.

There is one man-door access point in the fence around the yard area. It is recommended that a second exit door to be installed to provide a second mean of egress from the site in case of emergency.

2.2.2 Interior Space Planning

The building consists of office space, amenity areas, regional distribution warehouse and training classrooms and labs. The following are functional deficiencies observed during the walkthrough:

- The current occupant capacity of the facility is 233 based on the layout provided by Enbridge. There is currently 293 staff assigned to the facility. It was noted by Enbridge staff that additional mustering space is required to increase the occupant capacity of the building in order to accommodate the current 293 staff member. Additional 800 to 1,000 sqf will be required for the required expansion to the mustering room.
- Enbridge staff noted that additional \$2,500 sqf of lab area is required for M&R (Measurement and Testing) expansion.
- The second and third floors are used as office space, currently the second floor occupancy is 103 staff members and the third floor is 100 staff members. This represents approximately 140 sqf per person for office space. This indicates that the second and third floors are slightly over capacity based on Enbridge GDP standard of 150 sqf per person for office space.

2.2.3 Furniture

The existing furniture in the facility is in accordance with Enbridge GDP standards and replacement or upgrade is not required.

2.2.4 Ontario Building Code – Life Safety

Section 3.2 - Building Fire Safety

The building was constructed in 2011 and it is assumed to be in general compliance with Ontario Building Code. The existing building is sprinklered and is equipped with a fire alarm system.

Safety Requirements within Floor Areas:

The building falls under Part 3, Group F Division 2 and Group D major occupancies.

To meet current Ontario Building Code the building should satisfy the requirements of 3.2.2.54 D Occupancy and 3.2.2.70 F2 Occupancy.

- The building shall be of combustible or non-combustible construction.

- Floor assemblies shall have a fire-resistance rating of not less than 45 min or be of non-combustible construction.
- Mezzanines shall have a fire-resistance rating not less than 45 min, or be of non-combustible construction.
- Loadbearing walls, columns, and arches supporting an assembly required to have a fire-resistance rating shall have a fire resistance rating of 45 min or shall be of non-combustible construction.
- Roof assembly shall have a fire-resistance rating of not less than 45 min, or be of non-combustible construction.

Section 3.8 - Barrier-free Design

3.8.3.12. Universal (barrier-free) toilet rooms: There are no universal washrooms in the facility. The building is considered an existing non-conforming condition for compliance with Ontario Building Code. There is no mandate in the current code to upgrade the existing facility for compliance with the Universal Barrier Free washroom requirements. However in compliance with Part 11 of Ontario Building Code the addition of a universal washroom will be required in the event of extensive renovation in the building. As part of the new addition it is recommended that a new universal washroom to be provided for compliance with Ontario Building Code.

2.3 Functional and Physical Condition Analysis

WalterFedy utilized a risk management approach taking into consideration the impact of failure of the building component on the long term serviceability of the building as well as the functional requirements associated with the building. Both Facility Condition Indexing (FCI) and Adequacy Indexing (AI) was utilized in order to help make the best possible decision related to the future of the site building and to determine whether or not to invest, maintain, repurpose or dispose of the asset.

FCI:

FCI is a condition index tool used to illustrate the condition of an asset expressed in a percentage ratio of required maintenance/repair costs divided by the replacement value of the asset expressed as:

$$\text{FCI} = (\text{Maintenance and Repair Costs}) / (\text{Cost to Replace the Building})$$

The replacement value of the building is based on industry standards for construction costs. Therefore, the lower a FCI is, the better the condition of the building. The resulting FCI at ten years is 0.16% which is classified as being in good condition.

$$\text{FCI (TOC)} = (\$28,250) / (10,0721 \times 360) = 0.08\%$$

AI:

AI is a condition index tool used to illustrate the functional condition of the asset expressed in a percentage ratio of required functional upgrade costs divided by the replacement value of the asset to meet the functional needs expressed as:

$$\text{AI} = \text{Functional Upgrade Costs} / \text{Cost to Replace the Building with its Functional Equivalent}$$

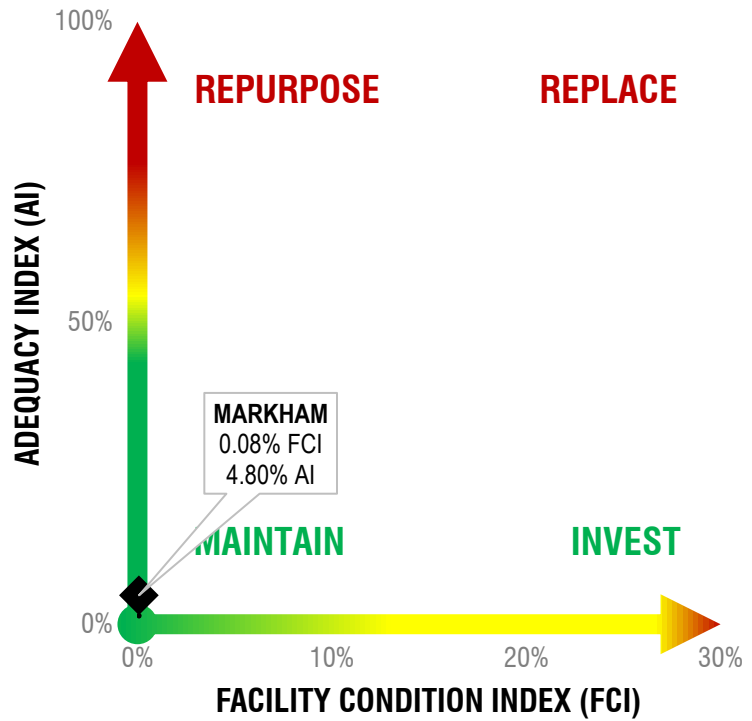
The Adequacy Index for 101 Honda Blvd is calculated by dividing the current functional and physical renewal costs by the cost to replace the building with its functional equivalent size.

The cost to upgrade the facility to current Enbridge GDP standards is estimated at \$1,600,000. The estimated cost to build a new facility to EDG current standards based on 106,500sqf, the area required to accommodate current program, is \$33,300,000. This is based on 75% of office space and lab space at \$350/SF and 25% industrial space at \$200/SF.

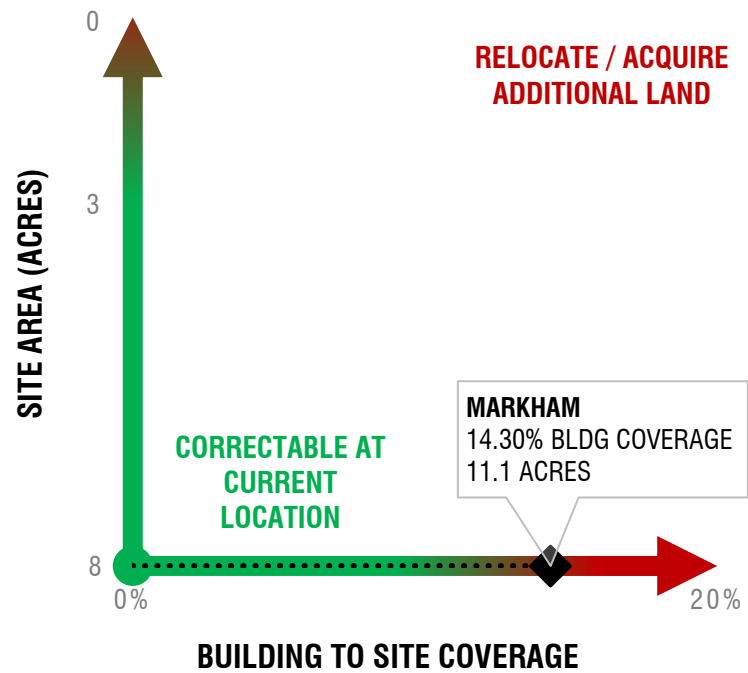
$$\text{AI (TOC)} = (\$1,600,000) / (33,300,000) = 4.8\%$$

With quantification of FCI and AI for your building, comes the ability to make comparisons between industry benchmarks, and drive decision making related to the future of the property. The chart below shows the relationship between FCI and AI and indicates visually where 101 Honda Blvd falls within the decision making criteria.

FACILITY CONDITION & ADEQUACY GRAPH



SITE CONSTRAINTS GRAPH



2.4 Key Findings

- PHYSICAL OBSOLESCENCE:

The acceptable Enbridge standard for the physical condition is an FCI of 0 to 5%. The current FCI of the facility based on this study is 0.08% therefore the physical condition of the facility does not meet Enbridge acceptable standards.

Meets Standards		Correctable at Current Location	
POSITIVE	Negative	POSITIVE	Negative

- FUNCTIONAL OBSOLESCENCE BUILDING :

The acceptable Enbridge standard for the functional condition is 0, anything between 0 to 50% is considered correctable at current location. The current facility AI index is 4.80%. Based on the FCI/AI graph the current recommendation for the existing facility is to repurpose to accommodate current EGD standards.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	POSITIVE	Negative

- FUNCTIONAL OBSOLESCENCE SITE:

No major site deficiencies were observed on site during the walkthrough. The facility is in general compliance with Enbridge GDP standards.

Meets Standards		Correctable at Current Location	
POSITIVE	Negative	POSITIVE	Negative

The FCI and AI graph indicates recommendation to maintain the existing facility.

2.5 Development Scenarios

The existing facility is in general compliance with Enbridge GDP standards. The existing functional deficiencies are correctable on the existing site. An addition of approximately 3,500 sqft is required to address the current functional deficiencies. This will include extension to the exiting mustering room and additional measurement and regulation lab:

SCENARIO	1
DESCRIPTION	Correct physical and functional deficiencies by expanding the existing facility on the existing site
LAND ACQUISITION	\$
LAND SALE	\$
CONSTRUCTION COST	\$1,600,000
SOFT COST	\$350,000
FURNITURE & EQUIPMENT	\$250,000
TOTAL	\$2,200,000
MEETS EDG STANDARDS	YES
PRIORITY	1



APPENDIX A

Capital Expenditures Forecast



7.0 CAPITAL FORECAST

101 Honda Boulevard, Markham, ON

Regional Operations Centre

The following Capital Plan has been compiled from the following:

- 1 EGD Long Range Capital Plan (LRP)
- 2 EGD/FMG Property Inspection (FMG)
- 3 3rd Party Property Condition Assessment (PCA)
- 4 Functional Standards Assessment - Section 4 (FSA)
- 5 Non-Functional Standards Assessment - Section 5 (nFSA)
- 6 Electrical Safety Authority Inspection (ESA)
- 7 EGD Quarterly Health/Safety Inspection (HSI)

SECTION	CATEGORY	DEFICIENCY	1	2	3	4	5	6	7	8	9	10
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
			BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD
Maintenance Deficiencies												
	HVAC	Replace exhaust units									\$ 1,500	\$ 1,500
	PLMB	Replace domestic water heater								\$ 2,750		
	Site Work/Exterior Elements	Repair deteriorated and impact damaged concrete curbs						\$ 2,500				
	Site Work/Exterior Elements	Allowance for localized asphalt repairs						\$ 10,000				\$ 10,000
Total Maintenance Deficiencies			\$ -	\$ -	\$ -	\$ -	\$ -	\$ 12,500	\$ -	\$ 2,750	\$ 1,500	\$ 11,500
Cummulative FCI			0.00%	0.00%	0.00%	0.00%	0.00%	0.03%	0.03%	0.04%	0.05%	0.08%
Functional Deficiencies												
	Building Construction	10,200 sqf new building to accommodate space deficiencies		\$ 480,000	\$ 1,120,000							
	Furniture	Based on \$10,000 per employee allowance			\$ 250,000							
	Soft Costs	20% of Construction Cost		\$ 350,000								
Total Functional Deficiencies			\$ -	\$ 830,000	\$ 1,370,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Total			\$ -	\$ 830,000	\$ 1,370,000	\$ -	\$ -	\$ 12,500	\$ -	\$ 2,750	\$ 1,500	\$ 11,500

\$ 28,250



APPENDIX B

Program

Regional Operations Centre: MARKHAM TOC

Description	Standard # per person	Quantity	Size	Area Factor	Area sq.ft.	Area sq.ft. Current	Area sq.ft. Variance	Notes
General Building Infrastructure								
Main Vestibule	<	1	10 x 14	1.00	140	140	0	
Waiting Area	<	1	13 x 14	1.00	182	182	0	
Alternate Entrance	<	5	10 x 7	1.00	325	325	0	
Security / Reception	<	1	13 x 13	1.00	169	169	0	
Shipping & Receiving	<	1	12 x 11	1.00	126	0	-126	
Showers/Change/Washrooms (1 locker / field services staff)	70	1	3 x 6	1.00	1,260	1,159	-101	
Office Washrooms	2 / floor	7	10 x 24	1.00	1,680	1,797	117	
Universal Washroom	1 / floor	3	8 x 10	1.00	240	0	-240	
Janitor	1 / facility	1	10 x 15	1.00	150	182	32	
Cafeteria	1 / facility	1	45 x 50	1.00	2,252	2,600	348	
Fitness Centre	1 / facility	1	25 x 48	1.00	1,200	1,201	1	
Mechanical/Electrical and IT Room	1 / facility		x	1.00	3,298	3,298	0	
General Storage			x	1.00	1,253	1,253	0	
Sub Total					12,275	12,306	31	
Functional Building Area								
MPO Office	20% of office staff	59	10 x 10	1.00	5,900	4,339	-1561	2+12+14=28 in total
Cubicles Workstations	50% of office staff	147	8 x 6	1.50	10,584	11,952	1,368	26+87+81=194 in total
Meeting Room (8-10 people) 1/70 staff	1 per 70	5	16 x 11	1.50	1,320	4,656	3,336	
Break out room (4 people) 1/50 staff	1 per 50	6	10 x 12	1.00	720	325	-395	1+2+1=4 in total
Focus Rooms (4 people) 1/50 staff	1 per 50	6	10 x 10	1.00	600	0	-600	
Hotel Station (2:1 of dynamic staff)	30% of office staff	88	6 x 3	1.50	2,012	473	-1539	9+8+0=17 in total
Training Rm PC Training (12-24)	<	18	24 x 30	1.0	720	903	183	
Micro Kitchen/Ezone - 1/floor	1/200	2	15 x 20	1.00	600	500	-100	
Print Copy Rm/Mail Room	1/ 100	3			250	410	160	
Health room - required if there are 200 or more employees on any one shift.	<	1	11 x 10	1.00	110	110	0	
IT Room	<	1	11 x 11	1	121	121	0	
Coat Storage	<	1	2 x 6	1.00	12	46	34	
Lab						176	176	
Mustering Room (1chair/person) +1 HR workstation with connectivity and large TV screen for training	21	1	3 x 5	4.00	1,260	464	-796	
Gas monitor calibration (1/10 people)		1	8 x 10	1.00	75	75	0	In Boot Wash Room
Measurement & Regulation Test/ Storage		1	12 x 20	1.00	240	260	20	
Warehouse (where required by business ops)		1	x		21,206	21,206	0	Unique to this location
Free Pick storage	1/Building	1	15 x 10	1.00	150	472	322	
Locked Storage Room	<	1	10 x 15	1.00	150	344	194	
Wash Bay / Repair Garage (if fleet exists)	1/Building	1	25 x 50	1.00	1,250	0	-1250	out building provided
Welding Bay / Fabrication	1/Building	1	35 x 54	1.00	1,890	2,083	193	
Boot wash		1	6 x 10	1.00	60	216	156	
Washing Machine Area		1	6 x 10	1.00	60	60	0	In Boot Wash Room
Sub Total					49,290	49,191	-99	
Training Facility								
Classroom	unique				7,759	7,759	0	
Lab	unique				6,600	4,100	-2500	
Storage	unique				1,046	1,046	0	
Sub Total					15,405	12,905	-2500	
Total Building Area (not including circulation)					76,970	74,402	-2568	
Circulation/Structure	34.00%				26,170	25,297	-873	
Total Building Area (not including out buildings)					103,140	99,699	-3441	
Out - Buildings Site Specific								
Garage						3,874	3,874	not included in building sq.ft.
Storage Shed						1,356	1,356	not included in building sq.ft.
Total Occupied Out Building Areas					0	5,230	5,230	



APPENDIX C

Photographs



101 Honda Boulevard, Markham, ON

Appendix B.1

1. Roof and Overhead Structure



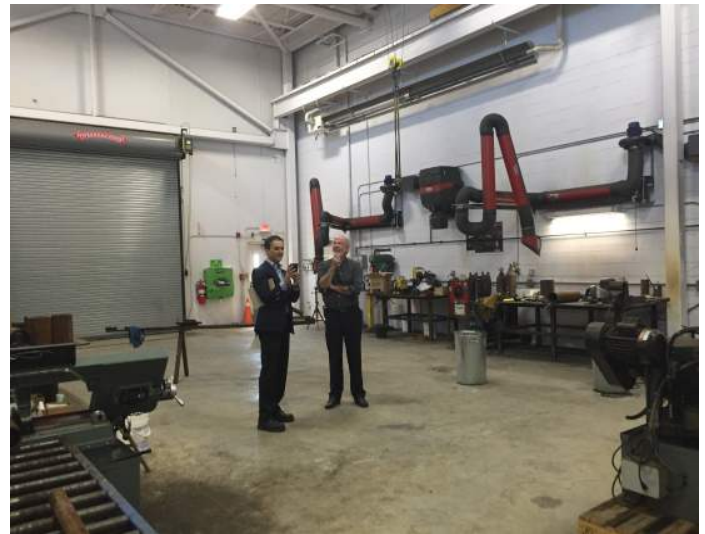
2. Company Parking Lot



3. Warehouse



4. Shop



5. Office Area



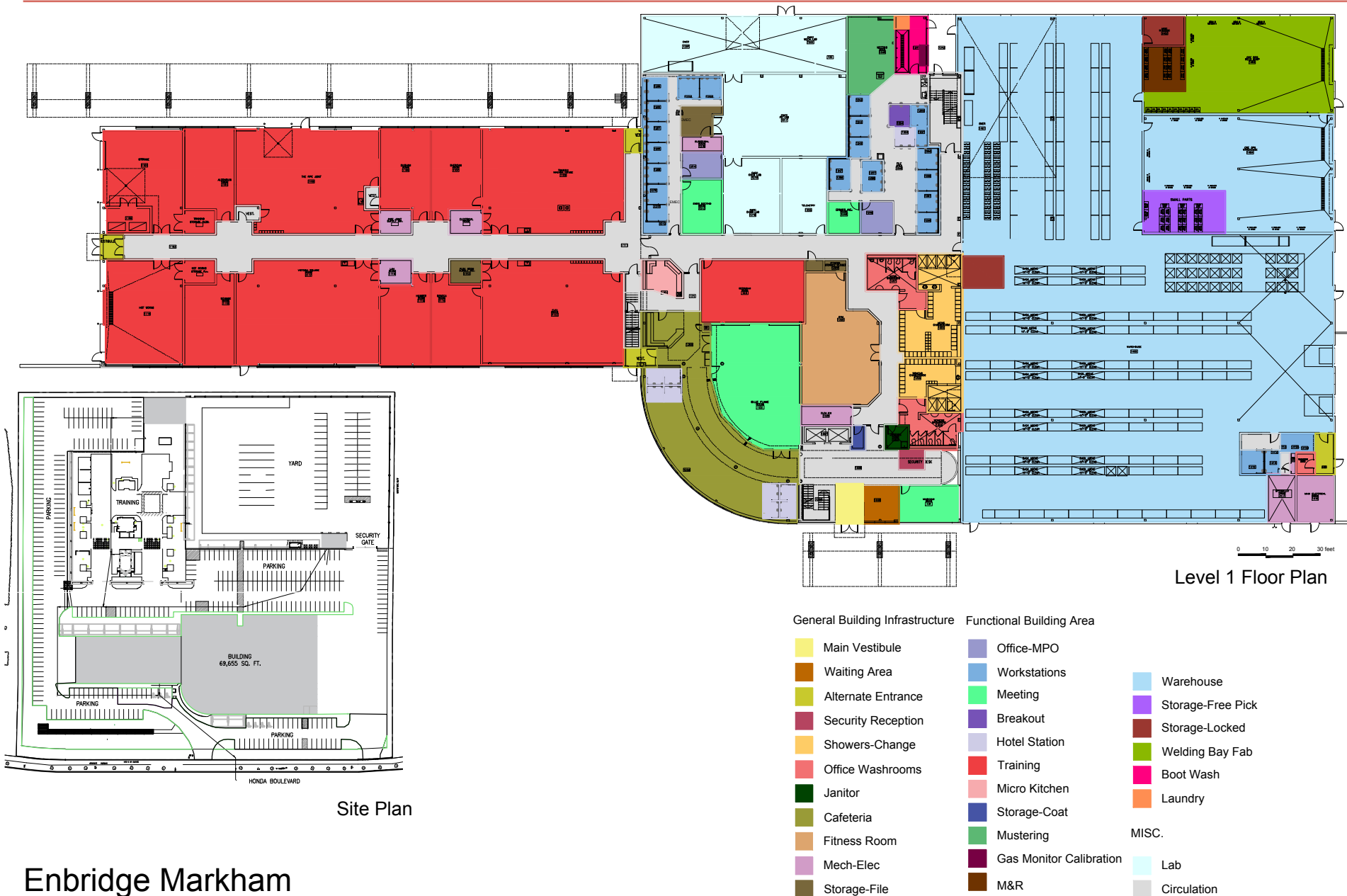
6. Open Area





APPENDIX D

Drawings



2016-0613-05



General Building Infrastructure

- | | |
|---|--|
| ■ Office Washrooms | ■ Breakout |
| ■ Janitor | ■ Hotel Station |
| ■ Cafeteria | ■ Micro Kitchen |
| ■ Mech-Elec | ■ Print Mail |
| ■ Storage-File | ■ Health |
|
Functional Building Area | |
| ■ Office-MPO | ■ MISC. |
| ■ Workstations | ■ Circulation |
| ■ Meeting | |

Enbridge Markham
101 Honda Boulevard, Markham, ON

2016-0613-05

WALTERFEDY



Level 3 Floor Plan

General Building Infrastructure

- Office Washrooms
- Janitor
- Mech-Elec
- Storage-File

Functional Building Area

- Office-MPO
- Workstations
- Meeting
- Breakout

■ Micro Kitchen

■ Print Mail

MISC.

■ Lab

■ Circulation

Enbridge Markham
101 Honda Boulevard, Markham, ON

2016-0613-05

WALTERFEDY



3.04 FACILITY ASSESSMENT

ENBRIDGE GAS DISTRIBUTION INC.

THOROLD REGIONAL OPERATIONS CENTRE

3401 Schmon Parkway, Thorold, ON

Project No.: 2016-0613-05

REV 1.0 - December 6, 2017

WALTERFEDY

ENBRIDGE GAS DISTRIBUTION INC.

FACILITY ASSESSMENT

Thorold Regional Operations Centre

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1.0 SUMMARY

1.1 Introduction

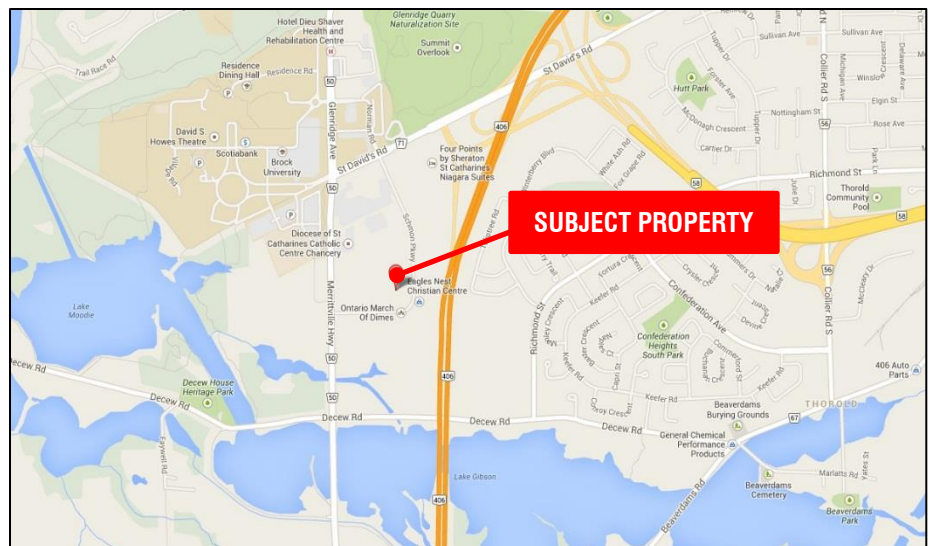
WalterFedy was retained by Enbridge to conduct a physical and functional building condition assessment of the facility located at 3401 Schmon Parkway, Thorold, Ontario for the purpose of identifying functional adequacy and physical renewal requirements for budgeting and planning purposes. The scope of the report includes a general visual inspection of visible civil, architectural, structural, mechanical, and electrical components. It also includes a brief Ontario Building Code (OBC) review to address barrier-free accessibility issues.

Following the initial report, a list of recommendations with estimated costs is provided for corrective and preventive maintenance items required.

1.2 Facility Description

The facility is categorized by Enbridge as a Regional Operations Centre. The original building was constructed in 1992 on 8 acres of Industrial zoned property.

The property is located on Schmon Parkway just east of Merrittville Highway. The property has easy access to major transportation routes; Highway 406 and 58 are less than 2 Km to the northeast of the property providing access to both Thorold and St. Catharines. Glenridge Avenue is also less than 2 Km away providing an alternative route to St. Catharines downtown core. North of the property is Brock University, with lake Gibson to the south. East of the property is predominantly residential with green space to the west.



1.2.1 Property Summary

1) General:

Owned / Leased:	Owned
FCI score:	3.09%
AI score:	59%
Current Occupancy:	122

2) Physical Building Properties:

Gross Floor Area:	±89,051 SF
Building Area(foot print):	±53,410 SF
Tenant Space	±41,444 SF
Office Space:	±12,870 SF
Common Areas:	±14,325 SF
Industrial:	±19,269 SF
Circulation:	±46,731 SF

3) Site Characteristics:

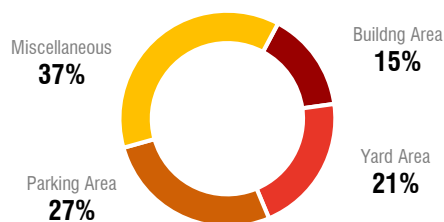
Site Area:	±355,341 SF (8.1 acres)
Building Coverage:	±15% (53,410 SF)(1.2 acres)
Yard	±74,236 SF(1.7 acres)
Parking	±95,809 SF(2.1 acres)
Miscellaneous (landscaping, etc.)	±131,886 SF (3 acres)

4) Zoning:

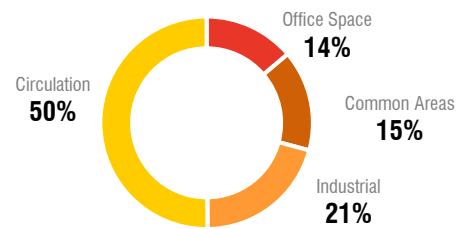
Zone :	PI-2 Prestige Industrial Zone	
Parking Required	1 per 18.5m ² (200 SF) of GFA = 445	
Parking Provided	356	
Front Yard Depth (minimum)	15 meters	provided 34.4 meters
Side Yard Width (minimum)	6.0 meters	provided 50.9 meters
Rear Yard Depth (minimum)	6.0 meters	provided 48.5 meters
Buildings Height (maximum)	10 meters	

5) Building Systems:

HVAC:	Roof top air handling units, split cooling and radiant heater units
Electrical:	800A, 600V three phase
Plumbing:	Municipal water/sewer
Building Automation/Security:	Enerstat – System 10



SITE AREA DISTRIBUTION



BUILDING AREA DISTRIBUTION

1.3 Scope of Work

The scope of work for this assessment was approved by Enbridge and was completed in accordance with WalterFedy's fee proposal dated September 08, 2016.

The scope of work for the Asset Management Report will include a Functional Assessment, a Physical Assessment, and a Market Condition Assessment. The report will provide recommendations for strategic decisions based on the metrics reviewed in the assessments.

1.4 Assessment Methodology

The building condition assessment is based on general visual examination performed on September 21, 2016 by WalterFedy's Architectural and Facility Management departments.

The observations in this report were made using non-destructive methods through existing access points. Existing drawings provided by Enbridge for the building were also used to supplement site observations.

The guiding principles of this study is based upon the document from the National Research Council of Canada (NRC) "Protocols for Building Condition Assessment" published by The Institute For Research in Construction (IRC).

1.5 Limitation of Study

This assessment is based on our general review and walkthrough of the facility and it is not intended to form a detailed life safety analysis or Ontario Building and Fire Code assessment. The facility was built in 1992 and may not be in compliance with current Ontario Building and Fire Codes. It is recommended that a further detailed life safety review and assessment is carried out to determine what building systems upgrades would be required to meet the requirements of Section 9.2 of Ontario Fire Code to the satisfaction of the Fire Department.

This report was completed in accordance with the approved scope of work as described in Section 1.3. This report is limited and is not intended to be comprehensive or exhaustive, or to suggest a risk-free facility. The report may not address all existing issues associated with the facility and may omit issues that are or may be of interest to the Owner. The findings and statements in this report are based on general site observations of the current conditions as they existed during the time period of the investigation.

The purpose of this report is for the sole use of the Owner for budgetary planning purposes. Issues identified in this report require further detailed assessments to determine repair and maintenance work required. This report should not be used by third parties involved in any work related to the facility; such third parties should undertake their own investigations and studies to determine how the existing condition of the facility will affect their plans and work. WalterFedy accepts no responsibility for liabilities incurred by or damages suffered by any third party as a result of decisions made or actions taken, based upon this report.

The passage of time might affect the views, conclusions and recommendations provided in this report.

The following report is a general guide only and is not intended to be used as a document for construction.

This study does not include hazardous materials review or inspection.

2.0 PHYSICAL AND FUNCTIONAL ASSESSMENT

2.1 Physical Assessment

2.1.1 Site and Landscaping

The site is a near rectangular-shaped property. The site building occupies approximately 25% of the site.

The remainder of the site is occupied by asphalt pavement parking areas, cast-in-place concrete paving, and concrete curbs and areas of soft landscaping (i.e. grass, shrubs, and trees) complete with an irrigation system. During the site visit the asphalt paved areas were noted to be in fair condition overall and was reportedly paved in 1999. Localized longitudinal and alligator cracking was present in several areas. Ongoing maintenance has been undertaken in the form of localized crack repairs. Continued localized repairs are recommended throughout the term of the analysis.

Wall mounted lighting units and pole mounted light standards provide illumination for the site. All of the lighting standards and the wall pack units were retrofitted with high efficiency LED fixtures last year.

The irrigation system was reported to be deteriorated and requiring approximately \$5,000 to \$7,000 in maintenance costs per year in order to keep the system functioning. Given that the system is at the end of its service life as is evident by the high annual maintenance costs, replacement of the irrigation system is recommended in the early portion of the analysis.

The trees located around the perimeter of the building and within the site boundaries are reportedly at the end of their service life. Sixty of the ash trees had been replaced in October, 2016. As such, an allowance to replace the remaining approximate fifty trees, has been provided within the terms of the analysis.

Fencing at the property consists of galvanized chain link fencing along the perimeter of the southwest side parking lot and loading area. There is also a section of precast retaining wall along the west side of the property.

Since the inspection was limited to visible areas no examination of the catch basins was performed and no review of the initial compliance with code was performed. The inspection of underground or concealed components is outside the scope of work.

2.1.2 Mechanical

Heating and cooling is primarily provided by roof mounted packaged rooftop air handling units, air conditioning units and condenser units. The rooftop HVAC units are fitted with economizers to utilize outside air cooling when available.

The list of current rooftop HVAC units, air condition units and condenser units with dates of installation and recommended units for replacement is provided below:

LIST	MFG	M/N	LOCATION	DATE OF MFG	RECOMMEND REPLACEMENT?
R/T #1	Lennox	LGH180H4BH	5616D08894	2016	No
R/T #2	Lennox	LGH180H4BH	5676D06930	2016	No
R/T #3	Carrier	48TFE012	3204G30600	2004	Yes
R/T #4	Lennox	LGH180H4BH	5615C00886	2016	No
R/T #5	Carrier	48TFE008	3004G30635	2004	Yes

R/T #6	Carrier	48TFE006	1405G30220	2004	Yes
R/T #7	Lennox	LGH180H4BH	5616E07872	2016	No
R/T #8	Carrier	48TFE0014	4004G40674	2004	Yes
R/T #9	Lennox	LGH180H4BH	5615C06456	2016	No
R/T #10	Carrier	48TFE007	2005G10340	2004	Yes
R/T #11	Lennox	LGH180H4BH	5615A07503	2016	No
R/T #12	Carrier	48TFE012	4504G20749	2004	Yes
R/T #13	Carrier	48TFE012	3204G30604	2004	Yes
R/T #14	Lennox	LGH150S4BH	5616D13093	2016	No
R/T #15	Carrier	48TFE014	3802G20639	2004	Yes
R/T #16	Carrier	48TFE008	2802G0485	2004	Yes
LIBRT#3	Leibert	VH199AUBAU19400	959400-001	2009	No
LIBRT#2	Leibert	UH199A-BAM	223603-001	2005	Yes
LIBRT#1	Leibert	UH199A-BAM	221950-001	1994	Yes
R/T LIBRT#1	Leibert	DCDF205LB	97090534	1994	Yes
R/T LIBRT#2	Leibert	DCDL205B	0508C75844	2005	Yes
R/T LIBRT#3	Leibert	DCDL205-BS1136	070C94786	2009	No
R/T	Leibert	DD0491B	0903C18657	2012	No
MecLanRm	Multistack	MS030XC1C1W2AA R410A	AB01-176	2012	No
R/T Data Centre	Leibert	PFH096-BL7	Y13JG11020	2013	No
Data Centre MecLanRm	Leibert	MMD96E7B00L0S98	Y13JB18491	2013	No
Accenture Lan Room airhandler	Carrier	FB4CNF060	1613A89130	2013	No
Accenture Lan Room Condensing unit	Carrier	24ABB360A320	2113E24382	2013	No
R/T	Motivair	MPC-FC6000	Z09S1075	2014	No

Air is distributed to the occupied spaces through a variable air volume (VAV) system comprised on zone bypass VAV boxes and a ceiling return air plenum.

Process and sanitary exhaust is provided by rooftop exhaust units. The list of current exhaust units with dates of installation and recommended units for replacement (based on a PUL of 10-15 years) is provided below:

LIST	MFG	M/N	LOCATION	SIZE	DATE OF MFG	RECOMMEND REPLACEMENT?
EXU-1	SnyderGen	JennFan	W/R Accenture near training room	250 CFM	1990	Yes
EXU-2	SnyderGen	JennFan	Washroom	250 CFM	1990	Yes
EXU-3	SnyderGen	JennFan	Washroom	250 CFM	1990	Yes
EXU-4	SnyderGen	JennFan	Washroom	250 CFM	1990	Yes
EXU-5	SnyderGen	JennFan	Washroom	250 CFM	1990	Yes
EXU-6	SnyderGen	JennFan NBCR 250A	Washroom	3,000 CFM	1990	Yes
EXU-7	SnyderGen	JennFan	Washroom	3,000 CFM	1990	Yes
EXU-8	SnyderGen	JennFan	Electrical Vault	1,000 CFM	1990	Yes

<i>EXU-9</i>	<i>SnyderGen</i>	<i>JennFan</i>	<i>Washbay – Fleet</i>	<i>1,000 CFM</i>	<i>1990</i>	<i>Yes</i>
<i>EXU-10</i>	<i>SnyderGen</i>	<i>JennFan</i>	<i>Fleet – Garage Bay</i>	<i>1,000 CFM</i>	<i>1990</i>	<i>Yes</i>
<i>EXU-11</i>	<i>SnyderGen</i>	<i>JennFan</i>	<i>Fleet – Garage Bay</i>	<i>1,000 CFM</i>	<i>1990</i>	<i>Yes</i>

It was reported at the time of the site assessment that inadequate exhaust rates are currently being provided within the washrooms. As such a study is recommended to verify adequate ventilation rates and recommend appropriate changes to the ventilation requirements in the washrooms. In addition, at the time of replacement of exhaust units as a life cycle renewal it is recommended that new units come equipped with variable frequency drives.

Supplementary heating in the warehouse areas are provided by ceiling mounted radiant tube and forced air unit heaters. The list of current radiant tube and unit heaters with dates of installation and recommended units for replacement is provided below:

LIST	MFG	M/N	S/N	DATE OF MFG	RECOMMEND REPLACEMENT?
<i>UH-1</i>	<i>Reznor</i>	<i>CRGB75-5-MV</i>	<i>EBEF66M8N03713MVI</i>	<i>2004</i>	<i>No</i>
<i>UH-2</i>	<i>Reznor</i>	<i>CRGB75-5-MV</i>	<i>EBEF66M8N03713MVI</i>	<i>2004</i>	<i>No</i>
<i>UH-3</i>	<i>Reznor</i>	<i>UDAS300</i>	<i>BEC79Y3N7761X</i>	<i>2005</i>	<i>No</i>
<i>UH-4</i>	<i>Reznor</i>	<i>UDAS300</i>	<i>BEC79Y3N7762X</i>	<i>2005</i>	<i>No</i>
<i>RH-1</i>	<i>Easy Radiant</i>	<i>1250</i>	<i>36905640</i>	<i>1990</i>	<i>Yes</i>
<i>RH-2</i>	<i>Easy Radiant</i>	<i>1250</i>	<i>36905648</i>	<i>1990</i>	<i>Yes</i>
<i>RH-3</i>	<i>Easy Radiant</i>	<i>1250</i>	<i>36905644</i>	<i>1990</i>	<i>Yes</i>
<i>RH-4</i>	<i>Easy Radiant</i>	<i>1250</i>	<i>36905641</i>	<i>1990</i>	<i>Yes</i>
<i>RH-5</i>	<i>Easy Radiant</i>	<i>1250</i>	<i>36905642</i>	<i>1990</i>	<i>Yes</i>
<i>RH-6</i>	<i>Easy Radiant</i>	<i>1250</i>	<i>36905646</i>	<i>1990</i>	<i>Yes</i>
<i>RH-7</i>	<i>Schwank</i>	<i>STW-J2-200-N-SS</i>	<i>JZWN200FC01SS</i>	<i>1990</i>	<i>Yes</i>
<i>RH-8</i>	<i>Easy Radiant</i>	<i>1250</i>	<i>36905649</i>	<i>1990</i>	<i>Yes</i>
<i>RH-9</i>	<i>Easy Radiant</i>	<i>1250</i>	<i>36905647</i>	<i>1990</i>	<i>Yes</i>
<i>RH-10</i>	<i>Superior</i>	<i>TX80</i>	<i>108033</i>	<i>2009</i>	<i>No</i>

Domestic Hot Water (“DHW”) within the site building is provided by a RHEEM domestic hot water heater and reserve tank (Heater: M/N – G65-360-1; S/N – 0411G00625, Tank: M/N – ST120; S/N – RR0203G02933). Based on the name plate data on the equipment the domestic hot water tank was manufactured in 2012 and has a heat input capacity of 360,000 BTUH.

There was reportedly no shortage of DHW within the site building. Based on WalterFedy’s experience the anticipated service life of a DHW is typically 10-15 years. Therefore based on age, replacement should not be required within the term of analysis.

There is one main water service to the building which also serves the buildings wet sprinkler system. All of the plumbing is distributed through to the building to the tenant spaces, washrooms, kitchens and janitor mop sinks through copper piping.

Plumbing fixtures within the majority of the washrooms are original to the 1989 construction. Based on age and observed condition as a leasehold improvement plumbing upgrades to six of the washrooms is recommended at the later portion of the analysis.

Sanitary drains from plumbing fixtures and miscellaneous service areas are collected by cast iron drains that empty to the municipal service.

2.1.3 Electrical

The electrical power for the site building is supplied from a pad-mounted transformer that feeds the main electrical room within the site building.

The building is equipped with an 800 Ampere, 600 Volt, three phase service. Distribution panels provide power via copper conduit to the various secondary distribution panels for lighting and receptacles that are located within each section of the building. Much of the electrical systems were upgraded/replaced in 2007 as part of a data system expansion. An Arc flash study along with thermal scanning of distribution panels to identify and correct hot spots was reportedly completed four years ago.

Emergency power is provided by a 600 KW, Caterpillar natural gas/diesel fired generator (M/N – C18, S/N – G6B18070) installed in 2011.

Interior lighting in the office and training areas is predominately provided by T8 tube lighting fixtures which was converted from T12 approximately four years ago. Lighting in the warehouse is provided by T5 tube lighting fixtures which was converted from T8 approximately four years ago. As a leasehold improvement consideration should be given to upgrade office lighting to high efficient LED lighting near the end portion of the analysis.

The central Simplex 4100 ES Fire control system was replaced two years ago.

Combination battery pack units provide emergency lighting and exit signage within egress pathways.

2.1.4 Structural

As outlined in the scope of work, a limited visual assessment of the condition of the structural elements was carried out on the elements which were visible at the time of the inspection. The building is comprised of poured concrete slab on grade construction supported by a steel frame structure and corrugated metal clad exterior walls. The steel roof deck is supported by open web steel joists and the joists are supported by steel beams and columns. No major visually identifiable structural deficiencies were noted at the time of the site inspection.

2.1.5 Building Envelope

The roof system atop the site building consists of a single ply Polyvinyl Chloride Membrane (PVC), near-flat, mechanically fastened roof system that was installed last year. The roof systems are installed atop a layer of rigid insulation, atop a corrugated metal roof decking. Neither the presence of a vapour barrier, nor the type or the thickness of the insulation could be verified, as the scope of the work did not include destructive testing.

Drainage of the roof system is provided by internal roof drains which presumably drain to the municipal sewer system.

Penetrations through the roof system include plumbing stacks, an exhaust vent stack, internal roof drains, mechanical curbs, and service penetrations.

The exterior walls of the site building consist of sheet metal cladding and a curtain wall system along the west (front) elevation. Impact damage was noted along the base of the sheet metal cladding along the west (front elevation). These sections should be repaired and cleaned to limit deterioration.

The window systems of the site building consist of fixed insulated single glazed (“SG”) units set within aluminum frames in punched configurations. Exterior doors serving the site building are comprised of single glazed units set into metal frames. Metal doors within metal frames were observed serving the warehouse egresses and of the site building. Nine sectional metal overhead doors, accessed from the south and west elevations, were noted serving the warehouse areas.

The three exterior doors located at the main front entrance were noted to be warped and not closing properly. Based on age and observed condition, replacement of these doors is recommended.

2.1.6 Finishes

The floor finishes within the site building consist of unsealed concrete slab-on-grade, ceramic, carpet and resilient floor tiles. The wall finishes within the site building consist of painted gypsum board and painted concrete masonry block. The ceiling finishes within the site building primarily consist of exposed structure, and painted suspended ceiling tile.

The overall condition of the interior components is fair. Maintenance has noticeably been performed and ongoing upgrades have been undertaken.

2.2 Functional Assessment

2.2.1 Site

The site is located off of Schmon Parkway. The site is organized with access points on the east and south of the site. There is a steep grade change from northeast to the southwest of the site. The access on the east of the site serves as a tenant parking lot and access along with visitor parking for Enbridge GDP, with direct access to the second floor tenant entrance and Enbridge visitor/security entrance. The access on the south of the site services Enbridge GDP service yard and employee parking, with direct access to the ground floor level.

The following functional deficiencies were observed during the walkthrough:

- There are two points of entry/exit to the site:
- The east entry/exit services visitors and tenant parking lot.
- The south entry/exit services the yard, and employee parking. Employee parking is located within the secure yard space, with the majority of the parking located on the southeast corner of the yard, and the remainder interspersed around the perimeter of the yard. This creates an unsafe environment within the yard. It is recommended that a second point of exit/entry be added to separate truck traffic from car traffic. This could be achieved by reworking of the yard layout to separate employee parking from the yard functions in accordance with Enbridge GDP design standards.
- The service yard does not meet Enbridge standard yard size requirements. The current usable yard size is 1.7 acres. Enbridge’s standard yard size is 2.5 acres.
- It was noted that there was not a location for snow removal within the yard and that snow needs to be removed from the site regularly, to ensure that it doesn’t pile up.
- Some of Enbridge employee parking is located in the upper tenant parking lot.

2.2.2 Interior Space Planning

The building is 2 storeys in height with a central outdoor courtyard space, on the ground level. The ground floor is occupied by Enbridge Gas Distribution office space, amenity areas, repair garage, and warehouse. The second floor is occupied by both Enbridge and a tenant space of 30,240 SF. Enbridge occupies 5,670 SF of area on the second floor and consists of visitors/reception area, storage, and training rooms.

The following are functional deficiencies observed during the walkthrough:

- There is a lack of natural light throughout the ground floor office area. It is recommended that office area be redesigned to take full advantage of the available exterior walls on the east, south and west of the building.
- There is a room on the second floor aloted for hoteling space that appears unused. The space appears forgotten and could be repurposed.

2.2.3 Furniture

Existing furniture is legacy furniture throughout. All existing office furniture has reached the end of its life cycle and replacement is recommended to enhance the functional and environmental condition in the office area. The height of the existing cubicle partitions blocks natural light and access to existing windows from the core area.

It is recommended to meet Enbridge's office standards that the furniture be phased out and replaced with new.

2.2.4 Ontario Building Code – Life Safety

Section 3.2 - Building Fire Safety

The building is sprinklered and is equipped with a fire alarm system.

Safety requirements within floor areas:

The building falls under Part 3, Group F Division 2 and Group D major occupancies.

To meet current Ontario Building Code the building should satisfy the requirements of 3.2.2.54 D Occupancy and 3.2.2.69 F2 Occupancy:

- The building is sprinklered.
- Standpipe system is not required.
- The building shall be of non-combustible construction.
- Floor assemblies shall have a fire-resistance rating of not less than 1 hour.
- Mezzanines shall have a fire-resistance rating not less than 1 hour.
- Loadbearing walls, columns, and arches supporting an assembly required to have a fire-resistance rating, shall have a fire resistance rating of 2 hours or shall be of non-combustible construction.

Section 3.8 - Barrier-free Design

3.8.1.3. Barrier-free Path of Travel

3.8.1.3. (1) Every barrier path of travel shall provide an unobstructed width of at least 1100 mm for the passage of wheelchairs.

- The building generally meets the requirements for barrier free path of travel.
- With the exception of the basement, the ladies locker room and fitness area are not accessible. Though per sentence 3.8.2.1.(2) (i) the provision of barrier-free path of travel does not apply to floor levels not serviced by a passenger elevator, a platform-equipped passenger-elevating device does not make for an exclusive use of space.

3.8.2.3. Washrooms required to be barrier-free.

- Currently there are accessible washrooms on each floor plate.

3.8.3.12. Universal (barrier-free) toilet rooms:

There is not a universal washroom on every floor of the existing building. This is considered to be existing non-conforming condition. There is no mandate in the current code to upgrade the existing facility for compliance with the universal barrier-free washroom requirements. However in compliance with Part 11 of Ontario Building Code the addition of a universal washroom will be required in the event of extensive renovation in the building.

2.3 Functional and Physical Condition Analysis

WalterFedy utilized a risk management approach taking into consideration the impact of failure of the building component on the long term serviceability of the building as well as the functional requirements associated with the building. Both Facility Condition Indexing (FCI) and Adequacy Indexing (AI) was utilized in order to help make the best possible decision related to the future of the site building and to determine whether or not to invest, maintain, repurpose or dispose of the asset.

FCI:

FCI is a condition index tool used to illustrate the condition of an asset expressed in a percentage ratio of required maintenance/repair costs divided by the replacement value of the asset expressed as:

$$\text{FCI} = (\text{Maintenance and Repair Costs}) / (\text{Cost to Replace the Building})$$

The replacement value of the building is based on industry standards for construction costs. Therefore, the lower a FCI is, the better the condition of the building. The resulting FCI at ten years is 3.09% which is classified as being in good condition.

$$\text{FCI (Thorold)} = (\$744,000) / (83,382 \times 289) = 3.09\%$$

AI:

AI is a condition index tool used to illustrate the functional condition of the asset expressed in a percentage ratio of required functional upgrade costs divided by the replacement value of the asset to meet the functional needs expressed as:

$$\text{AI} = \text{Functional Upgrade Costs} / \text{Cost to Replace the Building with its Functional Equivalent}$$

The Adequacy Index for Thorold Operations Depot is calculated by dividing the current functional and physical renewal costs by the cost to replace the building with its functional equivalent size.

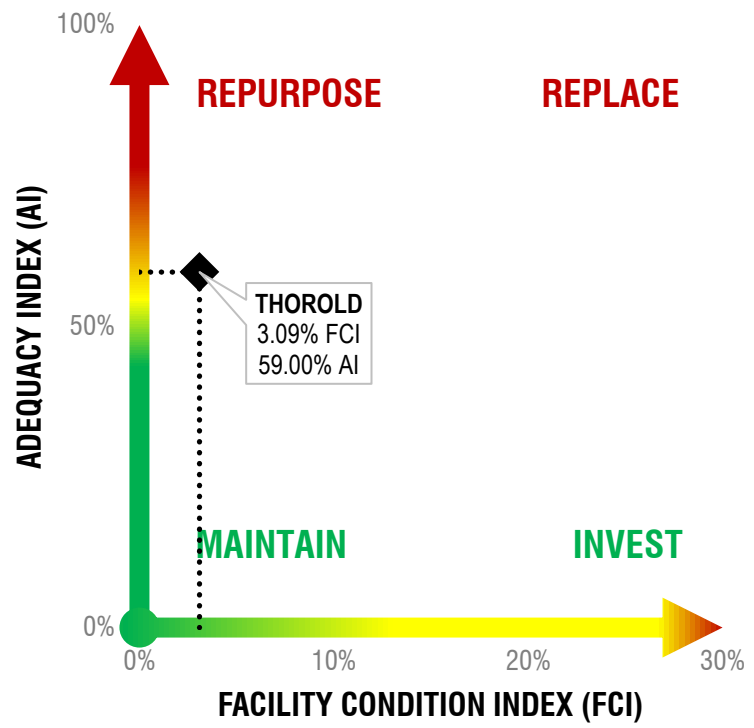
The cost to upgrade the facility to current Enbridge GDP standards is estimated at \$5,100,000. This is based on 20,000 sqf renovation of the existing building based on renovation estimated cost of \$250 and site improvements of approximately \$100,000.

The estimated cost to build a new facility to Enbridge GDP current standards based on 38,980 sqf the area required to accommodate current program, 60% office space at \$350/SF and 40% industrial space at \$200/SF is \$6,380,000

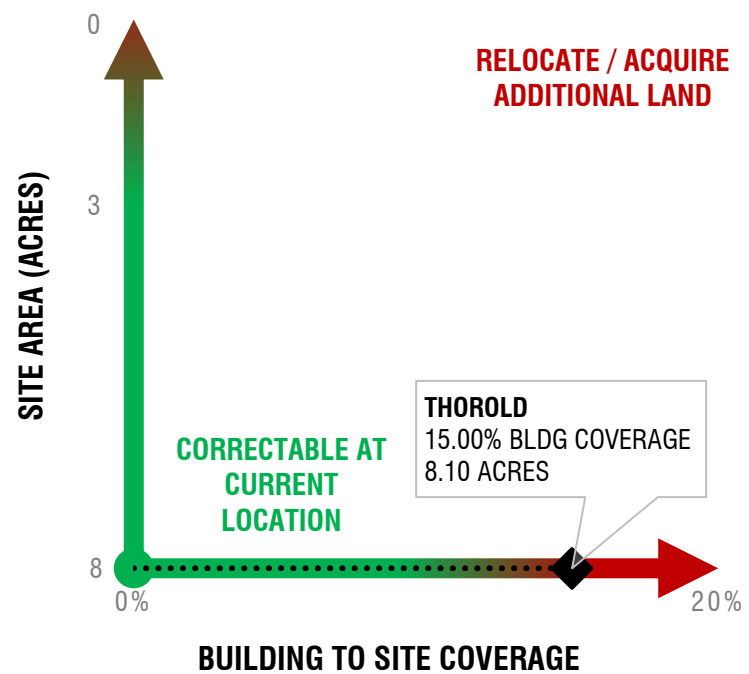
$$\text{AI (Thorold)} = (\$5,100,000) / (\$8,575,600) = 59\%$$

With quantification of FCI and AI for your building, comes the ability to make comparisons between industry benchmarks, and drive decision making related to the future of the property. The chart below shows the relationship between FCI and AI and indicates visually where Thorold Operations Depot falls within the decision making criteria.

FACILITY CONDITION & ADEQUACY GRAPH



SITE CONSTRAINTS GRAPH



2.4 Key Findings

- PHYSICAL OBSOLESCENCE:

The acceptable Enbridge standard for the physical condition is an FCI of 0 to 5%. The current FCI of the facility based on this study is 3.09% therefore the physical condition of the facility meets Enbridge acceptable standards.

Meets Standards		Correctable at Current Location	
POSITIVE	Negative	POSITIVE	Negative

- FUNCTIONAL OBSOLESCENCE BUILDING :

The acceptable Enbridge standard for the functional condition is 0, anything between 0 to 50% is considered correctable at current location. The current facility AI index is 59% which is marginally considered correctable at current location without consideration of other factors including adequacy of land size and the FCI index.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	Positive	NEGATIVE

- FUNCTIONAL OBSOLESCENCE SITE:

The site does not meet operational requirements for vehicular circulation. The yard size is smaller than Enbridge's standard yard size requirements. The current usable yard size is 1.7 acres. Enbridge standard yard size is 2.5 acres, however there is approximately 1 acre of landscaped area that could be reconfigured to accommodate some of the site deficiencies.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	POSITIVE	Negative

Overall the building is in excess of the standard Enbridge Gas distribution standard, given the lack of access to daylight in the office area, and the safety hazards posed by the inefficient site configuration, functions, and vehicle circulation within the Enbridge yard. It is recommended that a business study be performed to determine the best course of action.

Based on the site deficiencies and space limitations, reconfiguration of the existing office area and site layout is recommended. The FCI and AI graph indicates recommendation to maintain and repurpose the existing facility

2.5 Property Evaluation

In 2010 Penwarden Appraisals completed appraisal report on the property at 3401 Schmon Parkway, Thorold, Ontario, The appraised amount based on the report in 2010 is between \$7,500,000 and \$8,000,000.

Based on the above the estimated value of 3401 Schmon Parkway, Thorold, Ontario is between \$7,500,000 and \$8,000,000, we have estimated the dollars per acre to be \$1,000,000.

At the time of the study there were no available industrial properties with suitable location in the service area, therefore the option to relocate to a new site was not investigated. Based on discussions with Enbridge staff an estimated value of \$1,000,000 per acre is used in development scenarios 2 below. Further market analysis study is required to confirm.

2.6 Development Scenarios

The following is a comparison of the available options to address the deficiencies at 3401 Schmon Parkway:

SCENARIO	1	2
DESCRIPTION	Correct physical and functional deficiencies by completing an interior renovation and expanding the parking lot to elevate the site deficiencies. (Based on Tenant Remaining)	Sell the existing property, purchase a property suitable in size to accommodate the required program. Required size of new property is approximately 5 acres (based on tenant leaving current location)
LAND ACQUISITION	\$-	\$5,000,000
LAND SALE	\$-	\$-4,000,000*
CONSTRUCTION COST	\$5,100,000**	\$8,575,600***
SOFT COST	\$1,020,000	\$1,715,000
FURNITURE	\$1,220,000****	1,220,000****
TOTAL	\$7,340,000	\$11,511,000
MEETS EDG STANDARDS	YES	NO
PRIORITY	1 (reflected in the capital expenditure matrix Appendix A)	2

* Land sale proceeds is equal to 50% of the actual property evaluation/sale price. This is based on the “rate base split”/Enbridge portion of proceeds

** Based on 20,000 SF interior renovation scope and \$250/SF construction rate for the office and industrial building components.

*** Total construction cost is based on \$350/SF for the office area and \$200/SF for the industrial space. Total required gross floor area is 12,000 SF 40% industrial space and 60% office, amenity and circulation space is assumed.

**** Based on \$10,000 per employee.



APPENDIX A

Capital Expenditures Forecast



7.0 CAPITAL FORECAST

3401 Schmon Parkway, Thorold, ON
Regional Operations Centre

The following Capital Plan has been compiled from the following:

- 1 EGD Long Range Capital Plan (LRP)
- 2 EGD/FMG Property Inspection (FMG)
- 3 3rd Party Property Condition Assessment (PCA)
- 4 Non-Functional Standards Assessment - Section 5 (nFSA)
- 5 Electrical Safety Authority Inspection (ESA)
- 6 EGD Quarterly Health/Safety Inspection (HSI)

			1	2	3	4	5	6	7	8	9	10
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
SECTION	CATEGORY	DEFICIENCY	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD
Maintenance Deficiencies												
	Building Envelope	Repair impact damaged metal cladding	\$ 5,000									
	Building Envelope	Replace three front entrance doors	\$ 6,000									
	HVAC	Replace radiant tube heaters						\$ 13,000	\$ 13,000	\$ 13,000	\$ 13,000	\$ 6,500
	HVAC	Replace ten roof top HVAC units							\$ 24,500	\$ 24,500	\$ 24,500	\$ 24,500
	HVAC	Washroom ventilation study	\$ 5,000									
	HVAC	Replace 250 CFM process and sanitary exhaust units		\$ 2,000	\$ 4,000	\$ 4,000						
	HVAC	Replace 1,000 CFM process and sanitary exhaust units					\$ 7,000	\$ 7,000				
	HVAC	Replace 3,000 CFM process and sanitary exhaust units							\$ 5,000	5000		
	HVAC	Replace two LAN a/c units						\$ 15,000				
	HVAC	Replace two LAN condenser units						\$ 30,000				
	Leasehold Improvements	Washroom plumbing fixture upgrades (six washrooms)								\$ 50,000	\$ 50,000	\$ 50,000
	Leasehold Improvements	Office LED lighting retrofit										\$ 82,500
	Leasehold Improvements	Elevator Modernization		\$ 95,000								
	Site Work/Exterior Elements	Repair allowance for asphalt paved areas			\$ 20,000			\$ 20,000			\$ 20,000	
	Site Work/Exterior Elements	Replace irrigation system	\$ 55,000									
	Site Work/Exterior Elements	Replace trees around building perimeter and on site (50 trees)		\$ 50,000								
Total Maintenance Deficiencies			\$ 71,000	\$ 147,000	\$ 24,000	\$ 4,000	\$ 7,000	\$ 85,000	\$ 42,500	\$ 92,500	\$ 107,500	\$ 163,500
Cummulative FCI			0.29%	0.90%	1.00%	1.02%	1.05%	1.40%	1.58%	1.96%	2.41%	3.09%
Functional Deficiencies												
	Site Works/Exterior Elements	Site Improvements					\$ 30,000	\$ 70,000				
	Interior Renovation	Interior Renovations (\$250 PSF 20,000 sqf)					\$ 1,500,000	\$ 3,500,000				
	Soft Cost	20% of construction cost					\$ 306,000	\$ 714,000				
	Furniture	Based on \$10,000 / employee						\$ 1,220,000				
Total Functional Deficiencies			\$ -	\$ -	\$ -	\$ -	\$ 1,836,000	\$ 5,504,000	\$ -	\$ -	\$ -	\$ -
Total			\$ 71,000	\$ 147,000	\$ 24,000	\$ 4,000	\$ 1,843,000	\$ 5,589,000	\$ 42,500	\$ 92,500	\$ 107,500	\$ 163,500



APPENDIX B

Photographs



3401 Schmon Parkway, Thorold, ON

Appendix B.1

1. Building Exterior



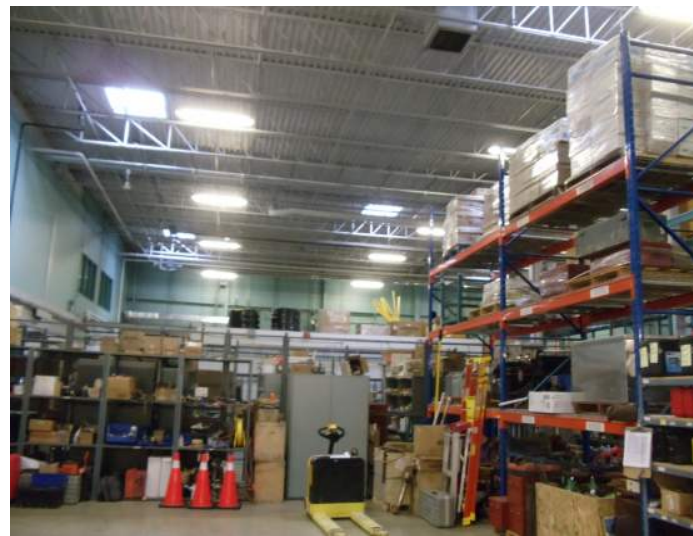
2. Parking Lot



3. Roof



4. Warehouse



5. Loading Area



6. Office Area





3401 Schmon Parkway, Thorold, ON

Appendix B.2

1. Cracked Asphalt



2. Roof Unit



3. Roof Unit



4. Roof Exhaust Fan



5. Roof Unit



6. Water Heater





APPENDIX C

Program

Regional Operations Centre: Thorold

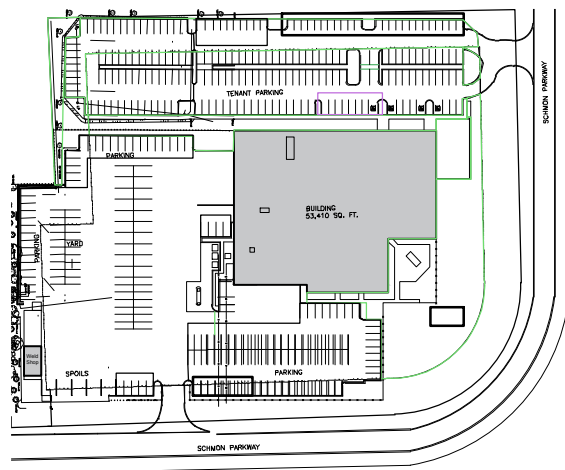
Description	Standard # per person	Quantity	Size	Area Factor	Area sq.ft.	Area sq.ft. Current	Area sq.ft. Variance	Notes
General Building Infrastructure								
Main Vestibule	<	1	10	x 23	1.00	230	-67	
Waiting Area	<	1	21	x 24	1.00	500	0	
Alternate Entrance	<	3	10	x 7	1.00	203	0	
Security / Reception	<	1	13	x 13	1.00	169	0	
Shipping & Receiving	<	1	12	x 11	1.00	126	1,606	
Showers/Change/Washrooms (1 locker / field services staff)	50	1	5	x 6	1.00	1,500	1,613	
Office Washrooms	2 / floor	6	10	x 24	1.00	1,440	370	
Universal Washroom	1 / floor	3	8	x 10	1.00	240	69	Two on First floor
Janitor	1 / facility	1	10	x 15	1.00	150	36	
Cafeteria	1 / facility	1	45	x 50	1.00	2,252	1,428	
Fitness Centre	1 / facility	1	25	x 48	1.00	1,200	748	
Mechanical/Electrical and IT Room	1 / facility			x	1.00	4,524	6,087	
General Storage				x	1.00	150	3,540	
Sub Total						12,684	15,660	2,976
Functional Building Area								
MPO Office	20% of office staff	24	10	x 10	1.00	2,400	1,862	-538
Cubicles Workstations	50% of office staff	61	8	x 6	1.50	4,392	5,535	1,143
Meeting Room (8-10 people) 1/70 staff	1 per 70	2	16	x 11	1.50	528	1,688	1,160
Break out room (4 people) 1/50 staff	1 per 50	3	10	x 12	1.00	360	668	308
Focus Rooms (4 people) 1/50 staff	1 per 50	3	10	x 10	1.00	300	0	-300
Hotel Station (2:1 of dynamic staff)	30% of office staff	7	6	x 3	1.50	160	77	-83
Training Rm PC Training (12-24)	<	7	24	x 30	1.0	720	3,040	2,320
Micro Kitchen/Ezone - 1/floor	1/200	1	15	x 20	1.00	300	90	-210
Print Copy Rm/Mail Room	1/ 100	2				250	177	-73
Health room - required if there are 200 or more employees on any one shift.	<	0	11	x 10	1.00	0	93	93
IT Room	<	1	11	x 11	1	121	0	-121
Coat Storage	<	1	2	x 6	1.00	12	0	-12
Mustering Room (1chair/person) +1 HR workstation with connectivity and large TV screen for training	10	1	3	x 5	4.00	600	1,397	797
Gas monitor calibration (1/10 people)		1	8	x 10	1.00	75	0	-75
Measurement & Regulation Test/ Storage		1	12	x 20	1.00	240	409	169
Warehouse (where required by business ops)		1	30	x 77	1.00	2,310	7,967	5,657
Free Pick storage	1/Building	1	15	x 10	1.00	150	0	-150
Locked Storage Room	<	1	10	x 15	1.00	150	2,568	2,418
Wash Bay / Repair Garage (if fleet exists)	1/Building	1	40	x 90	1.00	3,600	3,817	217
Welding Bay / Fabrication	1/Building	1	35	x 54	1.00	1,890	2,717	827
Boot wash		1	6	x 10	1.00	60	90	30
Washing Machine Area		1	6	x 10	1.00	60	304	244
Sub Total						18,678	32,499	13,821
Total Building Area (not including circulation)						31,362	48,159	16,797
Circulation/Structure	24.29%					7,618	11,698	4,080
Total Building Area (not including Tenant space)						38,980	59,857	20,877

Site								
Total Site Area:						355,341		
Setbacks				per by-law requirements	108,764	84,000	-24,764	Storage/Parking within setbacks on much of site-Available to yard
Building Footprint				per site		53,410		Site Footprint
Future Building Expansion				deficit of site program above		0	0	
Site Feature, Landscaping, etc.				per site		47,886		
Tenant Parking						63,265	63,265	not calculated in deficiency
Staff Parking	1 per employee	166	9	x 17	2.00	50,796	30,002	-20794
Visitor Parking	<	6	9	x 17	2.00	1,836	2,542	706
Sub Total						52,632	281,105	43,177
Available Yard Area:						108,900	74,236	-34664
Site Deficit:								8,513

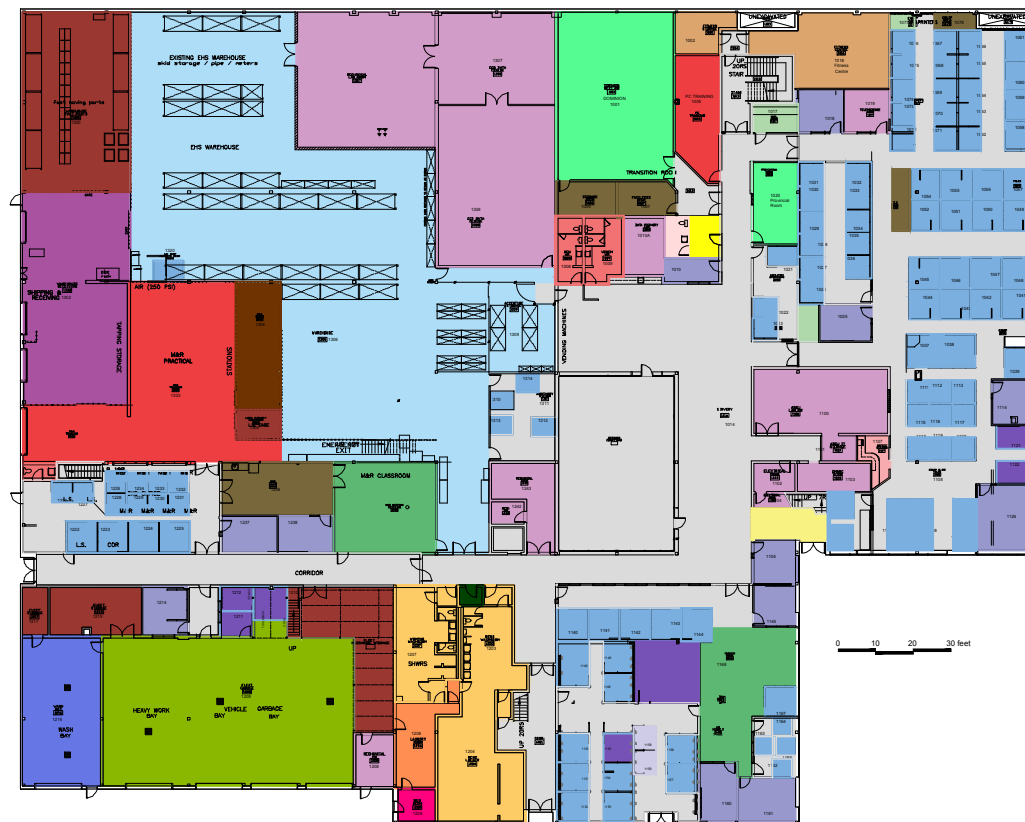


APPENDIX D

Drawings



Site Plan



Level 1 Floor Plan

General Building Infrastructure

- Main Vestibule
- Shipping-Receiving
- Showers-Change
- Office Washrooms
- Universal Washroom
- Janitor
- Fitness Room
- Mech-Elec
- Storage-File

Functional Building Area

- Office-MPO
- Workstations
- Meeting
- Breakout
- Hotel Station
- Training
- Micro Kitchen
- Print Mail
- Health
- Mustering
- M&R
- Warehouse
- Storage-Locked
- Wash-Repair Bay
- Welding Bay Fab
- Boot Wash
- Laundry

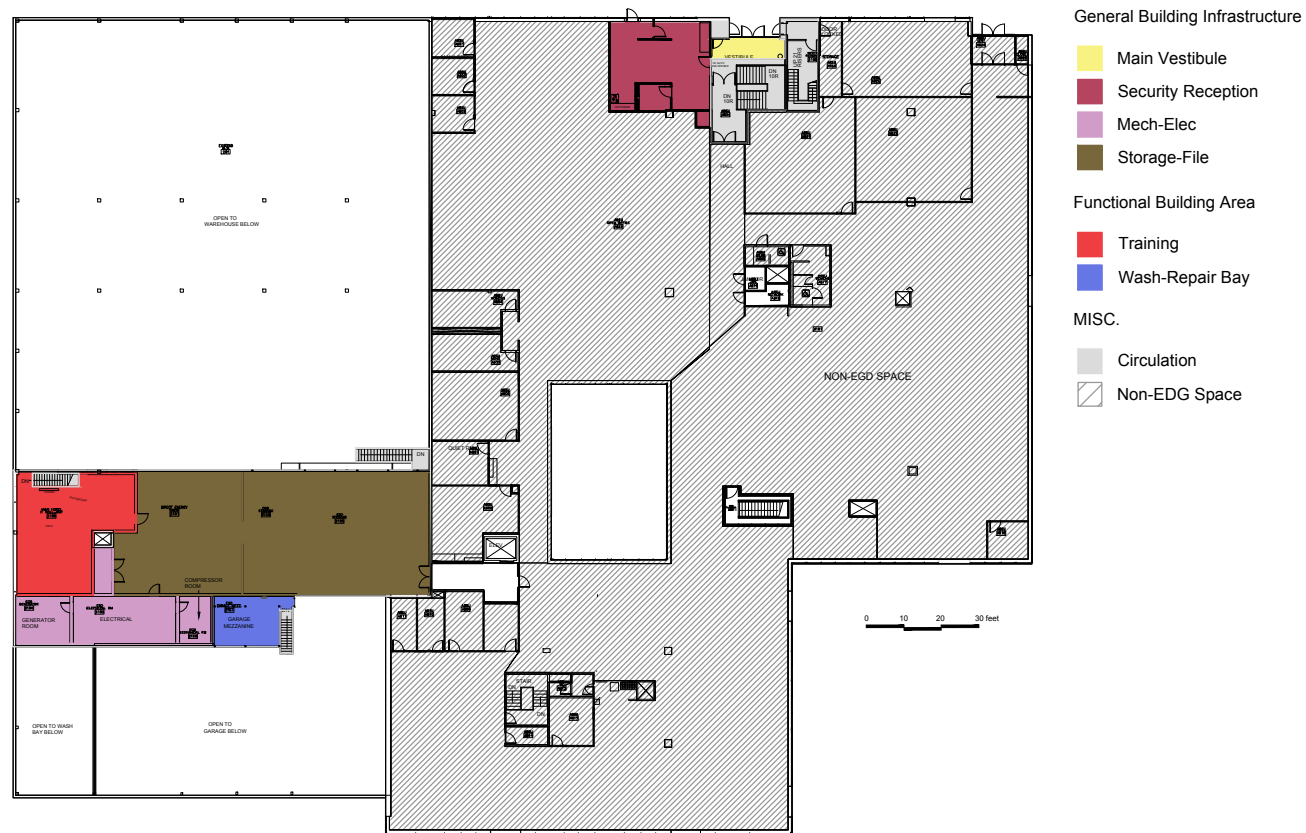
MISC.

- Circulation

Enbridge Thorold

3401 Schmon Parkway, Thorold, ON

2016-0613-05



Level 2 Floor Plan

Enbridge Thorold
3401 Schmon Parkway, Thorold, ON

2016-0613-05



3.05 FACILITY ASSESSMENT

ENBRIDGE GAS DISTRIBUTION INC.

COVENTRY ROAD OTTAWA REGIONAL OPERATIONS CENTRE

400 Coventry Rd, Ottawa, ON

Project No.: 2016-0613-05

REV 1.0 - December 6, 2017

WALTERFEDY

ENBRIDGE GAS DISTRIBUTION INC.

FACILITY ASSESSMENT

Coventry Road Ottawa Regional Operations Centre

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1.0 SUMMARY

1.1 Introduction

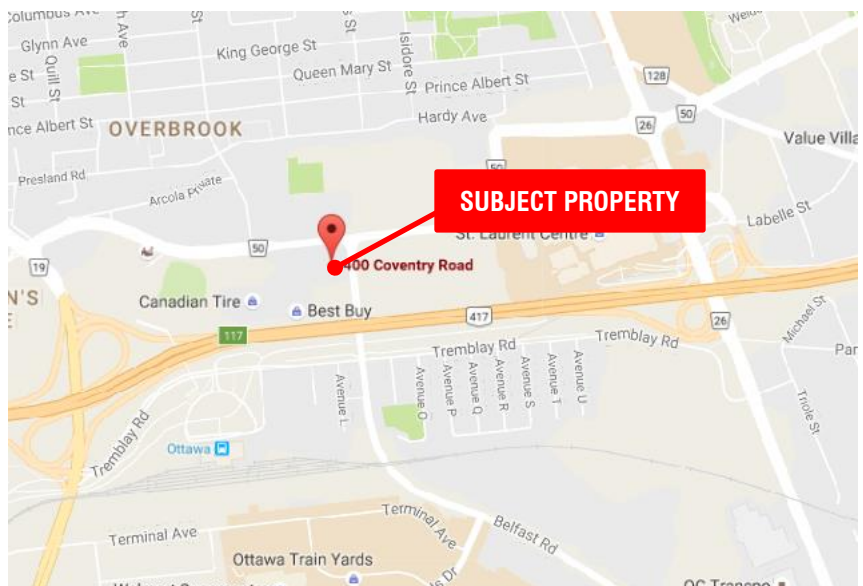
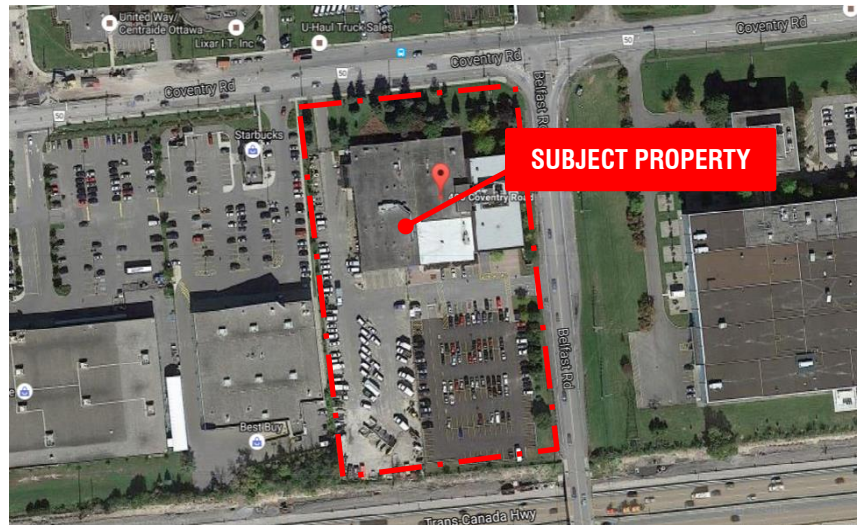
WalterFedy was retained by Enbridge to conduct a physical and functional assessment of the facility located at 400 Coventry Road, Ottawa, Ontario for the purpose of identifying functional adequacy and physical renewal requirements for budgeting and planning purposes. The scope of the report includes a general visual inspection of visible civil, architectural, structural, mechanical, and electrical components. It also includes a brief Ontario Building Code (OBC) review to address barrier-free accessibility issues.

Following the initial report, a list of recommendations with estimated costs is provided for corrective and preventative maintenance items required.

1.2 Facility Description

The facility is categorized by Enbridge as Regional Operation Centre. The building was originally constructed in 1965, with additions in 1981 and 1991.

The facility is located in Central Ottawa on the north side of Highway 417, just east of Vanier Parkway. The general area consists of predominantly older commercial development but major intensification is underway as a result of transportation infrastructure and official plan review. Major retailers such as Best Buy, are occupying the site to the west of the subject property.



1.2.1 Property Summary

(1) General

Owned / Leased:	Owned
FCI score:	4.65 %
AI score:	43 %
Current Occupancy:	166

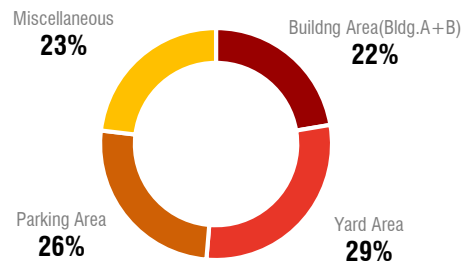
(2) Physical Building Properties:

Building Constructed:	1960
Completed Renovations:	1981; 1991
Gross Floor Area:	78,700 SF
1 st Floor Area:	48,000 SF
2 nd Floor Area:	13,200 SF
3 rd Floor Area:	12,000 SF
Underground Level Area:	5,500 SF

Building Area (footprint):	48,000 SF
Office Space:	30,613 SF
Common Areas:	30,851 SF
Industrial:	10,491 SF
Circulation:	6,745 SF
Number of Storeys:	3 Storeys + Basement

(3) Site Characteristics:

Site Area:	214,750 SF (4.93 ac.)
Building Coverage:	22% (1.11 ac.)
Yard:	62,240 SF (1.42 ac.)
Parking:	54,832 SF (1.26 ac.)
Miscellaneous:	49,678 SF (1.14 ac.)



SITE AREA DISTRIBUTION

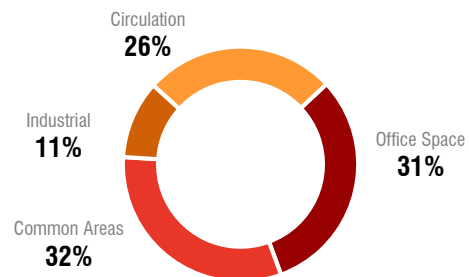
(4) Zoning:

Zone: General Mixed Use Zone 9
Height restriction of 34m on the front portion of the site and 90m at the rear section of the site

Parking Required:	1.8 per 100m ² : 131
Parking provided:	164 cars, 20 trucks, 18 equipment
Loading Provided:	1 loading space
Front Yard Depth (min.)	3.0 meters Provided 5.0 m
Side Yard Width (min.)	none Provided 24.5 m
Rear Yard Depth (min.)	none Provide 20.7 m
Building Height (max.)	18 m

(5) Building Systems:

HVAC:	2 gas-fired hot water boilers 2 RTUs 4 roof top air handling units Chilled water cooling
Plumbing:	Municipal water/sewer
Electrical:	1200 A/600 V, 3 phase
Building Automation/Security:	None



BUILDING AREA DISTRIBUTION

1.3 Scope Of Work

The scope of work for this assessment was approved by Enbridge and was completed in accordance with WalterFedy's fee proposal dated September 08, 2016.

The scope of work for the Asset Management Report will include a Functional Assessment, a Physical Assessment, and a Market Condition Assessment. The report will provide recommendations for strategic decisions based on the metrics reviewed in the assessments.

1.4 Assessment Methodology

The building condition assessment is based on general visual examination performed on September 21, 2016 by WalterFedy's Architectural and Facility Management departments.

The observations in this report were made using non-destructive methods through existing access points. Existing drawings provided by Enbridge for the building were also used to supplement site observations.

The guiding principles of this study is based upon the document from the National Research Council of Canada (NRC) "Protocols for Building Condition Assessment" published by The Institute For Research in Construction (IRC).

1.5 Limitation of Study

This assessment is based on our general review and walkthrough of the facility and it is not intended to form a detailed life safety analysis or Ontario Building Code and Fire Code assessment. The facility was built in 1960 and is not in general compliance with current Ontario Building Code and Fire Code. It is recommended that a further detailed life safety review and assessment is carried out to determine what building systems upgrades would be required to meet the requirements of Section 9.2 of Ontario Fire Code to the satisfaction of the Fire Department.

This report was completed in accordance with the approved scope of work as described in Section 1.3. This report is limited and is not intended to be comprehensive or exhaustive, or to suggest a risk-free facility. The report may not address all existing issues associated with the facility and may omit issues that are or may be of interest to the Owner. The findings and statements in this report are based on general site observations of the current conditions as they existed during the time period of the investigation.

The purpose of this report is for the sole use of the Owner for budgetary planning purposes. Issues identified in this report require further detailed assessments to determine repair and maintenance work required. This report should not be used by third parties involved in any work related to the facility; such third parties should undertake their own investigations and studies to determine how the existing condition of the facility will affect their plans and work. WalterFedy accepts no responsibility for liabilities incurred by or damages suffered by any third party as a result of decisions made or actions taken, based upon this report.

The passage of time might affect the views, conclusions and recommendations provided in this report.

The following report is a general guide only and is not intended to be used as a document for construction.

This study does not include hazardous materials review or inspection.

2.0 PHYSICAL AND FUNCTIONAL ASSESSMENT

2.1 Physical Assessment

2.1.1 Site and Landscaping

The site is a near rectangular-shaped property. The site building occupies approximately 22% of the site.

The remainder of the site is occupied by asphalt pavement parking areas, cast-in-place concrete paving, concrete curbs, a perimeter fence with powered access gates and areas of soft landscaping (i.e., grass, shrubs, and trees). The parking area was reportedly repaved four years ago and the soft landscaping features were redone two years ago. During the site visit the asphalt paved areas were noted to be in good condition overall; however localized longitudinal and alligator cracking present on the shipping and receiving lane way. In addition, impact damage along the concrete curb at the rear (south) elevation of the building was noted and should be addressed to prevent further deterioration of this site element.

Wall mounted lighting units and pole mounted light standards provide illumination for the site. The lighting standards have recently been retrofitted with high efficiency LED fixtures, whereas the wall mounted lighting units are generally original to the date of most recent major addition (1991). Wall pack units are aged and consideration should be given to replacing them with LED fixtures for improved energy performance.

The property is secured by a five-foot chain link fence along the west side of the property. The fence has two operable gates (one at each of the entrances). Deteriorated sections of fencing was noted along the west portion of the property. The front gate was also showing signs of deterioration and the site representative indicated that the electro-mechanical operator was beginning to fail. Therefore an allowance to repair the deteriorated section of fencing and replace the Coventry Road access gate has been provided within the evaluation period.

Several of the spoils bunkers located to the southwest of the property were noted to be impact damaged and deteriorating. Therefore an allowance to repair the deteriorated spoils bunkers has been provided in the capital expenditures table.

Since the inspection was limited to visible areas no examination of the catch basins was performed and no review of the initial compliance with code was performed. The inspection of underground or concealed components is outside the scope of work.

2.1.2 Mechanical

Heating for the site building is primarily supplied by two Thermal Solutions hydronic heating boilers (Boiler #1: M/N – EVA100BNI-UFCM; S/N – 65224742, and Boiler #2: M/N – EVA1000BNI-UFCM; S/N – 65224741) with a rated output of 880,000 BTUH each. These boilers were reportedly replaced in 2008. The heat is distributed throughout the building through wall mounted, forced air heating units along the office perimeters and common areas; through fan coil units in the garbage room, mechanical penthouse storage room, service room and basement boiler room; and through heating coils located with the six air handling units. These air handling units are located on the roof, in the M and R storage room, and in the basement boiler room.

Central air handling units are provided with humidification via three Nortec natural gas-fired humidification units (HF #2: M/N – NGMC 020; S/N – 1E3111690, HF #3: M/N – NGMC 075; S/N – 1E3111692, HF #4: M/N – GSTC-100 N-DV; S/N – 2020865)

The air distribution system uses variable air volume (VAV) terminal boxes connected to the central supply air plenum to distribute airflow to zones in the building. Each zone has a thermostat that controls the VAV box to modulate the air flow to the rooms within that zone. Based on information provided by the building operator there are approximately 71 VAV boxes located throughout the site building. The majority of these units are approximately 25 years old. Given a typical projected useful life of 20 to 30 years for these types of building components, an on-going replacement allowance has been included within the term of our analysis.

Supplementary heating and cooling is provided by roof mounted packaged rooftop air handling units and condenser units located on the lower roof section. The list of current rooftop HVAC and condenser units with dates of installation and recommended units for replacement is provided below:

List:	MFG	M/N	S/N	Area Served	Date of MFG	Recommend Replacement?
AHU-1	ENG Air	LM-26-C	M-2481	3 RD Floor	1991	Yes
AHU-2	ENG Air	FWE92/DJS40/0	M17042	Café	2015	No
AHU-3	York	XTD-042X057-BBHGO58A	CEVM XT0242	Admin	2009	No
AHU-4	York	XTD-042X057-FBKHO58A	CMRMXT0393	Warehouse	2007	No
AHU-5	York	DF078N15P5AAA3C	N0M6222520	Dispatch	2007	No
AHU-7	ENG Air	FWE93/HE40/0	M17042	Kitchen	2015	No
AHU-8	ENG Air	JM-1500	NU-37E-5	Basement	1991	Yes
AHU-9	ENG Air	JM-1500	NU-37E-5	C&M Room	1991	Yes
AHU-Facilities	Lennox	GC16-048-120-14	5697H-05539	Facilities	2004	No
AHU-LAN Room	Carrier	FV4BNF003000AAA	140A72621	LAN Room	2004	No
AHU-LAN Room	Liebert	MML024F	N/A	LAN Room	2004	No
AHU-LAN Room	Leibert	MMC026W-P00	61145	LAN Room	2004	No
AHU-2 nd Floor	Mitsubishi	PUY-A42H2	68U00477D	2 nd Floor LAN Room	2008	No

Process and sanitary exhaust is provided by rooftop exhaust units. The list of current exhaust units with dates of installation and recommended units for replacement (based on a PUL of 10-15 years) is provided below:

List:	MFG	M/N	S/N	Area Serviced	Date of MFG	Recommend Replacement?
EXU-1	Delhi	M-310		3 RD FLR S	1991	Yes
EXU-2	Delhi	M-310		3 RD FLR N	1991	Yes
EXU-3	Loren Cook	195VCR195V6B	405SG1578800/ 00007D1	Kitchen	2015	No
EXU-4	Delhi	M-309		1 st FLR WW	1991	Yes
EXU-5	Greenheck	GB-141-3-X	1411544315D	Garage	2015	No
EXU-6	Greenheck	SP-108		Jan Room	1991	Yes
EXU-7	Delhi	M-312		Ran Valt	1991	Yes
EXU-8	Greenheck	BCF-TH-107-4	91E02076	Bsm WR	1991	Yes
EXU-9	Greenheck	BCF-TH-106-4	91E02077	Bsm Gym	1991	Yes
EXU-10	Greenheck	CBE-18-3	28493	Warehouse	1991	Yes
EXU-11	LFI	AX14 1V		Garage	2002	Yes
EXU-12	Neederman	10451104	7510	Garage	2002	Yes
EXU-13	Carnes	VEBK18R1B1CA 20SPC1	549941.002	1 st FLR WR	2008	No
EXU-14	Leader			Hydro Vault	1991	Yes
EXU-15	Delhi	312		Hydro Vault	1991	Yes
EXU-16	Delhi	M-309		Dispatch WR	1991	Yes

A dedicated exhaust system has not been provided for the battery charging area in the warehouse to prevent the accumulation of flammable hydrogen gas. As per the Ontario Fire Code a dedicated exhaust system is required in this area. An allowance for installation of the dedicated exhaust system has been included in the Capital Expenditures table in the early term of the analysis.

Cooling for the site building is primarily supplied by a chilled water system. The York reciprocating chiller (M/N – YCW288CC0, S/N – 40KM-0W395) is located in the second floor mechanical room and was manufactured in 2001. The BAC Cooling towers (CT #1: M/N – VTL 103-137; S/N – 91800107, CT #2: M/N – VTL 103-137; S/N – 91800108) connect with the chiller water system is installed on the tower roof and were also manufactured in 2001. The total cooling capacity of the system is estimated at 88 tons. Based on age and observed condition, replacement of the central chiller and two cooling towers is recommended within the evaluation period.

There are eight heating and cooling pumps that circulate the heated and chilled water loops. The list of current rooftop HVAC pumps with dates of installation and recommended units for replacement is provided below:

List:	MFG	M/N	S/N	Area Serviced	Date of MFG	Recommend Replacement?
P-1	Leitch	4VBC-10/215JM090	CH/HC CIRC	2 ND Flr Mech	1991	Yes
P-2	Leitch	4VBC-10/215JM090	CH/HC CIRC	2 ND Flr Mech	1991	Yes
P-3	Leitch	6VBC-10/215JM092	180560-1	2 ND Flr Mech	1991	Yes
P-4	Leitch	6VBC-10/215JM092	180560-2	Warehouse	1991	Yes
P-5	Maxmotion	2VBC-5/JMP-22	178443-1	Basement	1991	Yes
P-6	Weg	184JM 1190	178443-2	Basement	2012	No

P-7	Armstrong	JQK56B17D11008AK	K10K090010	Basement	2011	No
P-8	Armstrong	JQK56B17D11008AK	K10K090167	Basement	2011	No

Domestic Hot Water ("DHW") within the site building is provided by two RHEED RUUD domestic hot water tanks (DWT #1: M/N – G82-156; S/N – URNG1111G01107, DWT #2: M/N – G82-156; S/N – URNG00412001053) located within the basement mechanical room. Based on the name plate data on the equipment the domestic hot water tank was manufactured in 2011 and each has a capacity of 78 gallons at 156,000 BTUH.

There was reportedly no shortage of DHW within the site building. However, based on WalterFedy's experience the anticipated service life of a DHW is typically 10-15 years. Therefore based on age, replacement should not be required within the term of analysis.

2.1.3 Electrical

The electrical power for the site building is supplied from a pad-mounted transformer which is accessed from the northeast portion of the site and feeds the electrical transformer vault within the site building.

The building is equipped with a 1,200 Ampere, 600 Volt, three phase service.

Emergency power is provided by a natural gas fired generator that was converted from diesel. Based on age and observed condition, replacement within the next 10 years is recommended.

Interior lighting is predominately provided by T8 fluorescent tube lighting fixtures which was recently converted from the lower efficiency T12 electronic ballasts and tubes.

Combination battery pack units provide emergency lighting and exit signage within egress pathways.

2.1.4 Structural

As outlined in the scope of work, a limited visual assessment of the condition of the structural elements was carried out on the elements which were visible at the time of the inspection. The building is comprised of the original structure built in 1966 and two building additions constructed in 1981 and 1991. The original structure includes a small basement at the north centre and a crawl space within the west side of the basement. The 1981 and 1991 additions are comprised of poured concrete foundations of concrete masonry block exterior walls, concrete columns, steel joists and a concrete roof deck. No major visually identifiable structural deficiencies were noted at the time of the site inspection.

2.1.5 Building Envelope

The roof system atop the original 1966 building, the 1991 addition front portion of the 1981 addition consists of a single ply Polyvinyl Chloride Membrane (PVC), near-flat, mechanically fastened roof system that was installed in sections over the last four years. The roof systems are installed atop a layer of rigid insulation, atop a corrugated metal roof decking. Neither the presence of a vapour barrier, nor the type or the thickness of the insulation could be verified, as the scope of the work did not include destructive testing.

The roof system atop of the back portion of the 1981 addition consists of a two ply conventionally built-up modified bitumen roof assembly, torched down roof system that is original to the 1981 construction. The roof system is installed atop a layer of rigid insulation, atop a corrugated metal roof decking. Neither the presence of a vapour barrier, nor the type or the thickness of the insulation could be verified, as the scope of the work did not include destructive testing.

Based on age and observed condition, replacement of the remaining modified bitumen roof assembly is recommended within the next 10 years.

Drainage of the roof system is provided by internal roof drains which presumably drain to the municipal sewer system.

Penetrations through the roof system include plumbing stacks, an exhaust vent stack, internal roof drains, mechanical curbs, and service penetrations.

An abandoned chimney stack that was previously associated with removed boiler equipment was noted on the roof of the building. It is recommended that this chimney stack be removed.

The exterior walls of the site building consist of architectural concrete block masonry, solid brick masonry and a curtain wall on the north, east and south elevations of the office tower.

The window systems of the site building consist of fixed single glazed insulated ("SG") units set within aluminum frames in punched configurations. Exterior doors serving the site building are comprised of single glazed units set into metal frames. Metal doors within metal frames were observed serving the warehouse egresses and of the site building. Seven sectional metal overhead doors, accessed from the south and west elevations, were noted serving the warehouse areas. Replacement of sealant/gaskets associated with office tower curtain wall and replacement of punched SG windows on the original 1966 building is recommended based on age and observed condition.

2.1.6 Finishes

The floor finishes within the site building consist of unsealed concrete slab-on-grade, ceramic, quarried and resilient floor tiles. The wall finishes within the site building consist of painted gypsum board and painted concrete masonry block. The ceiling finishes within the site building primarily consist of exposed structure, and painted suspended ceiling tile. A number of the suspended ceiling tiles were noted to be discoloured, stained and/or water damaged. Replacement of the effected ceiling tiles should be carried out under routine maintenance.

The overall condition of the interior components is fair. Maintenance has noticeably been performed and ongoing upgrades have been undertaken. Most of the interior finishes have been upgraded within the last ten years. Modernization of the office tower passenger elevator is recommended and have been included in the capital expenditures table.

2.2 Functional Assessment

2.2.1 Site

The site is located on the corner of Coventry Road and Belfast Road bound by highway 117 directly to the south of the property. The site is 4.93 acres, with visitor and employee parking occupying 1.26 acres. The operation yard occupies 1.42 acres and is separated by a chain-link fence and a mechanical security gate.

The following functional deficiencies were observed during the walkthrough:

- There are two points of entry to the site:
 - o The yard is serviced with a truck only entrance from the northwest corner of the site off of Coventry Road, with exiting bisecting the yard and sharing an exit with the main visitor and employee exit onto Belfast Road.
 - o Main entry and exit to the building is located off of Belfast Road servicing employee and visitor parking, and truck traffic exiting the site.
- With only one point of exit from the site onto Belfast Road that services all vehicular traffic, it is recommended that a second point of exit be provided for trucks exiting the site in accordance with Enbridge design standards.
- The service yard does not meet Enbridge's minimum standard yard size of 2.5 acres.
- The location of the material and spoils bunkers, as well as a storage shed is located within an island in the middle of the yard as opposed to being organized on the perimeter of the site per the recommended yard organization standards. These make for a challenging traffic flow within the yard. It is recommended that a review of the location of the material and spoils bunkers, and storage shed be considered for relocation.
- The shipping and receiving bay is located on the west side of the site adjacent to a one way truck entrance. This location makes it difficult for trucks entering the site when a delivery is taking place. The loading dock is an uninsulated vinyl walled space.
- It was noted that there was not a location for snow removal within the yard and that snow needs to be removed from the site regularly to ensure that it doesn't pile up.
- It was noted that if there is training occurring inside the building there is not enough parking on the site.

2.2.2 Interior Space Planning

The building was originally built in 1965, with additions in 1981, and 1991. It is comprised of a 3 storey office tower that consists of office space, training and amenity areas and a one storey area that houses the industrial functions of the fleet service garage, welding shop and warehouse.

The Industrial component of the building occupies the original 1966 building and houses the main industrial components of the building along with support spaces; mustering room, locker rooms, and training. There is a basement level that is associated with the original building houses; fitness centre, laundry facility, and women's locker room.

The office component of the building occupies the 1981 ground floor addition, and the 1991 office tower addition. The spaces include; open office space, meeting rooms, break out rooms, focus rooms, micro kitchen/Ezone and print copy room.

The following are functional deficiencies observed during the walkthrough:

- There is not a wash bay at this site. A wash bay is recommended due to the extent of fleet housed at this site.
- Training spaces are divided and distributed throughout the building. In order to increase efficiency and functionality of this programmatic element it is recommended that these spaces be consolidated into one location.
- The mezzanine level associated with the warehouse is being used for storage; however the height of the ceiling in this space is very low and hazardous.
- The boot wash is not unisex and it is at the entry of the men's locker room. It is not associated with the laundry facilities that are located in the basement. It is recommended that the laundry room be associated with the boot wash area to meet current standards.
- The laundry room supports gas fired appliances; however the existing doors and room are not fire rated.
- The ladies locker room is outdated and does not support the current EGD standard locker size. The men's locker room has been recently updated to meet current standards.
- There is not a lift to the lower basement level.
- There is not a micro kitchen/ Ezone on each floor.
- The existing cafeteria is out of date and requires upgrades to meet current EGD standards.
- The existing office areas and common space exceeds the current EGD standard for interior space planning, and it was noted that the staff is sparsely divided over the three floors of the office tower. It is recommended that the office and common areas be consolidated to aid in the efficiency of the facility.
- The existing cafeteria is outdated and does not meet current EGD standard interior design guidelines.
- There is little access to light in the original 1965, and 1981 addition of the building. It is recommended that additional windows be added.

2.2.3 Furniture

Existing furniture is legacy furniture throughout. All existing office furniture has reached the end of its life cycle and replacement is recommended to enhance the functional and environmental condition in the office area. The height of the existing cubicle partitions blocks natural light and access to existing windows from the core area.

It is recommended, to meet Enbridge's office standards, that the furniture be phased out and replaced with new.

2.2.4 Ontario Building Code – Life Safety

Section 3.2 - Building Fire Safety

The building was constructed in 1965 and is classified as what is known as “existing non-compliant” for the purpose of compliance with requirements of the current Ontario Building Code. The existing building is not sprinklered; to comply with current Ontario Building Code, a sprinkler system will be required.

Safety Requirements within Floor Areas:

- Travel distance in a non-sprinklered Group D occupancy must not exceed 25m, in a Group F, Division 2 not more than 10m. There are a few travel distances within the space that are considered an existing non-conforming condition for compliance with the Ontario Building Code. There is no mandate to update the existing facility for compliance with these requirements;

however in compliance with Part 11 of the Ontario Building Code travel distance will be required in the event of extensive renovation in the building.

The building falls under Part 3, Group F Division 2 and Group D major occupancies.

To meet current Ontario Building Code the building should satisfy the requirements of 3.2.2.54 D Occupancy and 3.2.2.70 F2 Occupancy.

- The building shall be of combustable or non-combustible construction.
- Floor assemblies shall have a fire-resistance rating of not less than 45 min or be of non-combustible construction.
- Mezzanines shall have a fire-resistance rating not less than 45 min, or be of non-combustible construction.
- Loadbearing walls, columns, and arches supporting an assembly required to have a fire-resistance rating shall have a fire resistance rating of 45 min or shall be of non-combustible construction.
- Roof assembly shall have a fire-redistance rating of not less than 45 min, or be of non-combustable construction.

Section 3.8 - Barrier-free Design

3.8.1.3. Barrier-free Path of Travel

3.8.1.3. (1) Every barrier-free path of travel shall provide an unobstructed width of at least 1100 mm for the passage of wheelchairs

- The basement; ladies locker room and fitness area are not accessible. Though per sentence 3.8.2.1.(2) (i) the provision of barrier free path of travel does not apply to floor levels not serviced by a passenger elevator, a platform-equipped passenger-elevating device; it does not promote an exclusive work environment.

3.8.2.3. Washrooms required being barrier-free

- There are accessible washrooms on each floor, however they do not meet current standards. At a minimum the following would need to be upgraded or added to meet current Ontario Building Code requirements under section 3.8.2.3: power door operators, and heights of vanities, sinks, and accessories.
- The third floor woman's washroom has been upgraded in the last year , with the addition of a barrier free operator, new sinks, vanity, and accessories to meet the current Ontario Building Code requirements under section 3.8.2.3.

3.8.3.12. Universal (barrier-free) toilet rooms:

- There is one universal barrier free washroom in the facility on the ground floor; however it does not meet current standards and is considered an existing non-conforming condition for compliance with Ontario Building Code. There is no mandate in the current code to upgrade the existing facility for compliance with the universal barrier free washroom requirements; however in compliance with Part 11 of Ontario Building Code, the addition of a universal washroom will be required in the event of extensive renovation in the building. It should also be noted that the barrier-free access to this washroom from the 1981 addition to the 1966 original building where the universal washroom is located is via a ramp that passes through the warehouse.
- There is not a universal washroom on every floor. This does not meet the requirements of section 3.8.3.12.

2.3 Adequacy and Facility Conditional Indexes

WalterFedy utilized a risk management approach taking into consideration the impact of failure of the building component on the long term serviceability of the building as well as the functional requirements associated with the building. Both Facility Condition Indexing (FCI) and Adequacy Indexing (AI) was utilized in order to help make the best possible decision related to the future of the site building and to determine whether or not to invest, maintain, repurpose or dispose of the asset.

FCI:

FCI is a condition index tool used to illustrate the condition of an asset expressed in a percentage ratio of required maintenance/repair costs divided by the replacement value of the asset expressed as:

FCI = (Maintenance and Repair Costs)/(Cost to Replace the Building)

The replacement value of the building is based on industry standards for construction costs. Therefore, the lower a FCI is, the better the condition of the building. The resulting FCI at ten years is 4.65% which is classified as being in good condition.

$$\text{FCI (Ottawa)} = (\$969,750) / (76,697 \times 272) = 4.65\%$$

AI:

AI is a condition index tool used to illustrate the functional condition of the asset expressed in a percentage ratio of required functional upgrade costs divided by the replacement value of the asset to meet the functional needs expressed as:

AI = Functional Upgrade Costs/Cost to Replace the Building with its Functional Equivalent

The Adequacy Index for Ottawa-Coventry is calculated by dividing the current functional and physical renewal costs by the cost to replace the building with its functional equivalent size.

The cost to upgrade the facility to current Enbridge GDP standards is estimated at \$ 7,500,000. The estimated cost to build a new facility to Enbridge GDP current standards based on 55,000 sqf the area required to accommodate current program is \$17,600,000, this is based on current program 80% of office space at \$350/sqf and 20% industrial space at \$200/sqf.

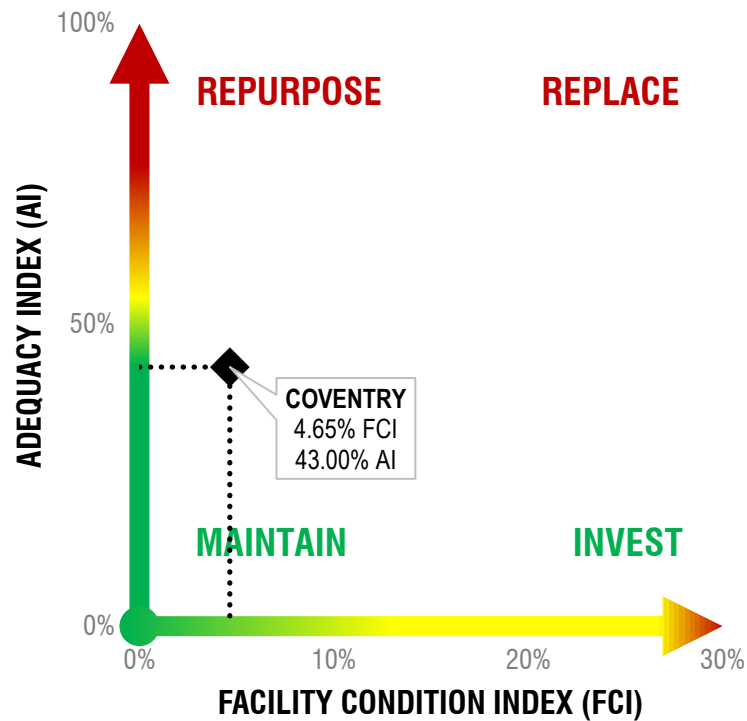
$$\text{AI (Ottawa)} = \$7,500,000 / \$17,600,000 = 43\%$$

With quantification of FCI and AI for your building, comes the ability to make comparisons between industry benchmarks, and drive decision making related to the future of the property. The chart below shows the relationship between FCI and AI and indicates visually where Ottawa falls within the decision making criteria based on the capital expenditures forecast found in Appendix A of this report.

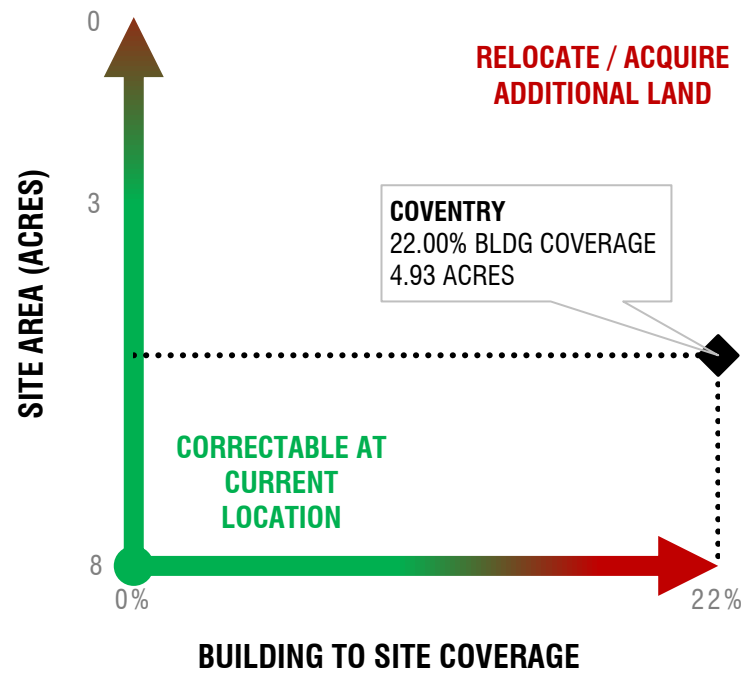
* The estimated cost to upgrade the existing facility to current Enbridge GDP standards includes the following cost items:

- Provide new perimeter windows	\$1,500,000
- Interior renovations to 40,000 SF of existing space (based on \$200/SF)	\$6,000,000

**FACILITY CONDITION &
ADEQUACY GRAPH**



**SITE CONSTRAINTS
GRAPH**



2.4 Key Findings

- PHYSICAL OBSOLESCENCE:

The acceptable Enbridge standard for the physical condition is an FCI of 0 to 5%. The current FCI of the facility based on this study is 4.65% therefore the physical condition of the facility does not meet Enbridge acceptable standards.

Meets Standards		Correctable at Current Location	
POSITIVE	Negative	POSITIVE	Negative

- FUNCTIONAL OBSOLESCENCE BUILDING:

The acceptable Enbridge standard for the functional condition is 0, anything between 0 to 50% is considered correctable at current location. The current facility AI index is 43% which marginally considered correctable at current location without consideration of other factors including adequacy of land size and the FCI index.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	Positive	NEGATIVE

- FUNCTIONAL OBSOLESCENCE SITE:

The site does not meet operational requirements for size and vehicular circulation within the site. The yard size is smaller than Enbridge standard yard size requirements. The current yard size is 1.42 acres. Enbridge standard yard size is 2.5 acres.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	Positive	NEGATIVE

Based on the site deficiencies and space limitations; relocation to another property is recommended. Although the FCI and AI graph indicates recommendation to maintain the existing facility, however the site deficiencies including space limitations and inefficiencies will prevent this option.

2.5 Property Evaluation

On June 13, 2016, UCS Real Estate Advisors completed an appraisal report on the property at 400 Coventry Road, Ottawa Ontario. The appraised amount based on the report is \$11,500,000.

The following is a list of comparable industrial properties currently listed in the market.

Address	Unit	Cost	Square Foot	Acres	\$/sq.ft.	\$/Acre		Listing	Location
distance from 400 Coventry Road, Ottawa, ON									
Ottawa									
890 Taylor Creek Drive		\$ 1,500,000	12,122	-	\$ 123.74	n/a	13min/17.3km	http://www.d	https://www
2191 THURSTON DR, OTTAWA, ON		\$ 3,800,000	27,594	2.10	\$ 137.71	\$ 1,809,524	12min/5.9km	https://space	https://www
LAND									
21 Jackson Lane, Ottawa, ON		\$ 3,786,750	-	13.77	n/a	\$ 275,000	20min/14.6km	http://looplin	https://www
Innes Road and Mer Bleue Road, Orleans, ON K4A0A2		\$ 9,075,000	-	33.00	n/a	\$ 275,000	20min/14.6km	http://looplink.ottawa.cbre	

Based on the above list we estimate the average value per acre for industrial properties in the area to be \$1,809,524.

Based on UCS Real Estate Advisors report above estimated value of 400 Coventry Road, Ottawa is approximately \$11,500,000.

2.6 Development Scenarios

The following is a comparison of the available options to address the deficiencies at:

SCENARIO	1	2	3
DESCRIPTION	Correct physical and functional deficiencies by expanding the existing facility on the existing site	Sell the existing property, purchase a property suitable in size to accommodate the required program. Required size of new property is approximately 6 acres	Sell the existing property, purchase a property suitable in size to accommodate the combined program of SMOC and Coventry Road programs. Required size of new property is approximately 7 acres
LAND ACQUISITION	\$ -	\$3,000,000	\$3,500,000
LAND SALE	\$ -	\$5,750,000*	\$7,274,000*
CONSTRUCTION COST	\$7,500,000	\$17,600,000**	\$21,650,000***
SOFT COST	\$1,500,000	\$3,520,000	\$4,330,000
NEW OFFICE FURNATURE	\$1,660,000****	\$1,660,000****	\$1,870,000****
TOTAL	\$10,660,000	\$20,030,000	\$24,076,000
MEETS ENBRIDGE GDP STANDARDS	NO	YES	YES
PRIORITY		2	1 (reflected in the capital expenditure matrix in Appendix A)

* Land sale proceeds is equal to 50% of the actual property evaluation/sale price. This is based on the "rate base split"/Enbridge portion of proceeds. In Option 3, land sale is equal to the combined value of sale of proceeds from the sale of both sites SMOC and Coventry.

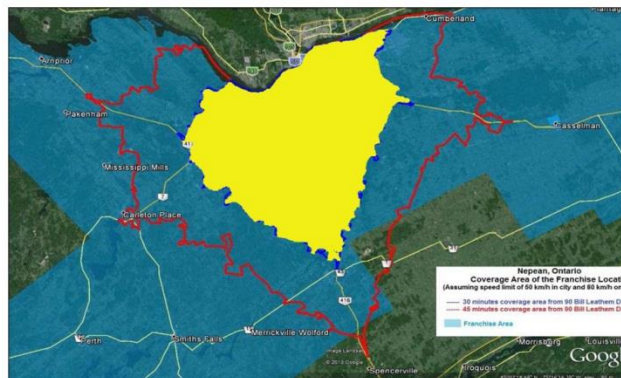
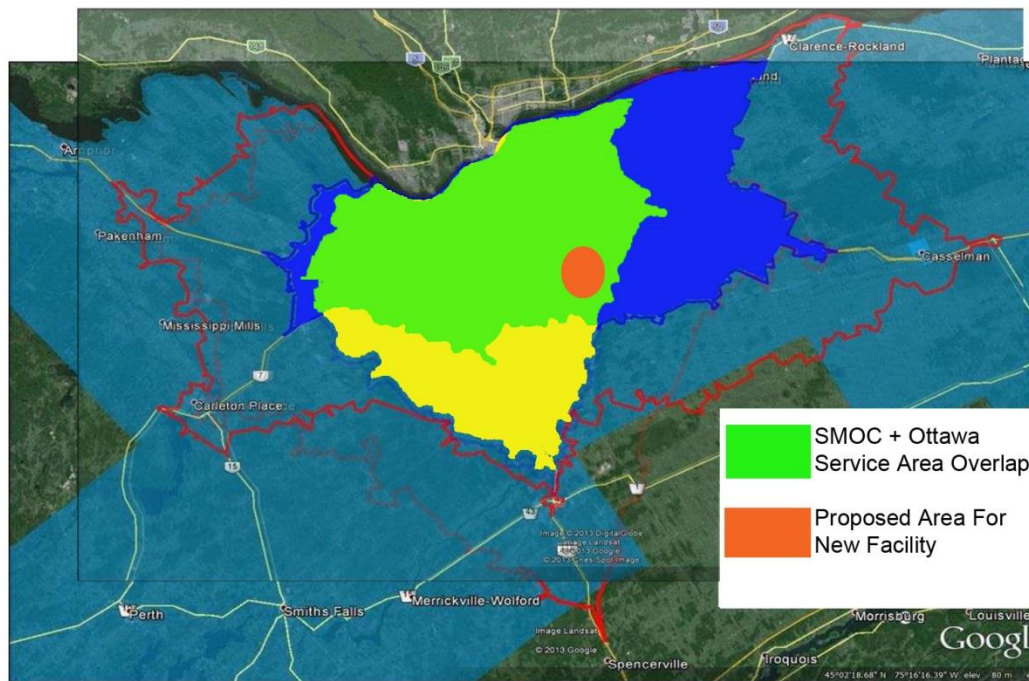
** Total construction cost is based on 55,000 sqf of space required for Coventry relocation, \$350/SF for the office space and \$200/SF for the industrial space with 20% of the space assigned for industrial based on current program.


*** Total required gross floor area to accommodate the combined programs of Coventry and SMOC is 67,000 sq. ft. Total construction cost is based on \$350/SF for office space, amenities and circulation and \$200/SF for industrial space (Based on appendix A 12,000 SF industrial space and 55,000 sqf office space).

**** Furniture cost is based on \$10,000 per employee.

The following is a study of the service areas for Coventry and SMOC; the yellow represents SMOC service area, the blue represents Coventry service area, and the green depicts where the two service areas overlap.

The study identifies that a site centrally located within the two areas would be best suited to cover the service areas of Coventry and SMOC. The orange identifies an ideal location for the new facility. Based on the comparable properties available at the time of this study, there were two possible sites on the market located within or close to the desired orange zone.



 South Merivale Operations Centre
"SMOC", Nepean
Regional Response Time GIS



 Ottawa (Coventry Road)
Regional Response Time GIS

compiled from Enbridge separately commissioned Response Time GIS Analysis

SCENARIO 3: SERVICE AREA ANALYSIS



APPENDIX A

Capital Expenditures Forecast



Capital Expenditures Forecast
400 Coventry Road, Ottawa, ON
Regional Operations Centre

The following Capital Plan has been compiled from the following:

- 1 EGD Long Range Capital Plan (LRP)
- 2 EGD/FMG Property Inspection (FMG)
- 3 3rd Party Property Condition Assessment (PCA)
- 4 Non-Functional Standards Assessment - Section 5 (nFSA)
- 5 Electrical Safety Authority Inspection (ESA)
- 6 EGD Quarterly Health/Safety Inspection (HSI)

SECTION	CATEGORY	DEFICIENCY	1	2	3	4	5	6	7	8	9	10	11	12
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
			BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD

Maintenance Deficiencies														
	Building Envelope	Replace remianing original BUR roof assembly							\$ 312,000					
	Building Envelope	Replace sealants/ gaskets at curtain wall						\$ 17,000						
	Building Envelope	Replace windows on 1996 portion of building				\$ 20,000								
	HVAC	Replace Pumps			\$ 13,000			\$ 19,500						
	HVAC	Replace tower rooftop AHU #1		\$ 85,000										
	HVAC	Replace two roof top HVAC units								\$ 10,500			\$ 10,500	
	HVAC	Replace process and sanitary exhaust units			\$ 3,000	\$ 3,000	\$ 3,000	\$ 3,000	\$ 4,500		3000			
	HVAC	Replace two cooling towers			\$ 80,000									
	HVAC	Replace central chiller			\$ 120,000									
	HVAC	Replace VAV boxes			\$ 9,000	\$ 9,000	\$ 9,000	\$ 9,000	\$ 3,750					
	HVAC	Remove abandoned chimney stacks		\$ 3,000										
	Leasehold Improvements	Elevator Modernization		\$ 95,000										
	Life/Safety	Install battery charging station exhaust in warehouse area	\$ 15,000											
	Life/Safety	Allowance to replace aged unit Genset				\$ 70,000								
	Site Work/Exterior Elements	Replace wall pack lighting units with LED			\$ 11,000									
	Site Work/Exterior Elements	Repair deteriorated and impact damaged concrete curbs		\$ 3,500										
	Site Work/Exterior Elements	Repair asphalt paving on shipping and receiving laneway			\$ 15,000									
	Site Work/Exterior Elements	Repair damaged fence sections		\$ 5,000										
	Site Work/Exterior Elements	Repair deteriorated spoil bunker			\$ 2,500									
	Site Work/Exterior Elements	Replace gate openers					\$ 3,000							
Total Maintenance Deficiencies			\$ 15,000	\$ 191,500	\$ 253,500	\$ 102,000	\$ 15,000	\$ 48,500	\$ 320,250	\$ 10,500	\$ 3,000	\$ -	\$ 10,500	\$ -
Cummulative FCI			0.07%	0.99%	2.21%	2.69%	2.77%	3.00%	4.53%	4.58%	4.60%	4.60%	4.65%	4.65%

Functional Deficiencies														
	Land Acquisition		\$ 3,500,000	\$ -	\$ -	\$ -								
	Construction			\$ 10,825,000	\$ 10,825,000									
	Furniture	Based on \$10,000 per employee		\$ 935,000	\$ 935,000									
	Soft Costs	25% of Construction Cost	\$ 2,165,000	\$ 2,165,000										
Total Functional Deficiencies			\$ 5,665,000	\$ 13,925,000	\$ 11,760,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Total			\$ 5,680,000	\$ 14,116,500	\$ 12,013,500	\$ 102,000	\$ 15,000	\$ 48,500	\$ 320,250	\$ 10,500	\$ 3,000	\$ -	\$ 10,500	\$ -
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APPENDIX B

Photographs



400 Coventry Road, Ottawa, ON

Appendix B.1

1. Building Exterior



2. Company Fleet Parking Lot



3. Bunkers



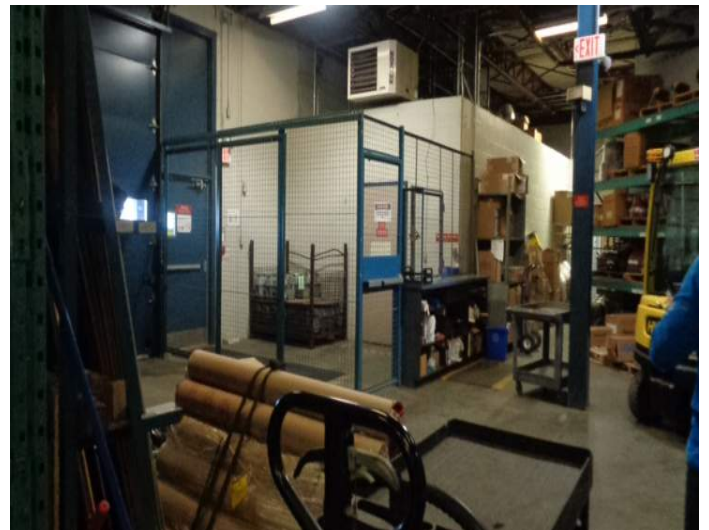
4. Office Hallway



5. Rooftop



6. Warehouse





400 Coventry Road, Ottawa, ON

Appendix B.2

1. Asphalt Paving



2. Cracking Pavement



3. Rooftop HVAC Unit



4. Rooftop Ventilation



5. Wall Pack Lighting Units



6. Central Chiller





APPENDIX C

Program

Regional Operations Centre: COVENTRY RD

Description	Standard # per person	Quantity	Size	Area Factor	Area sq.ft.	Area sq.ft. Current	Area sq.ft. Variance	Notes
General Building Infrastructure								
Main Vestibule	<	1	10 x 23	1.00	230	230	0	
Waiting Area	<	1	21 x 24	1.00	500	500	0	
Alternate Entrance	<	3	10 x 7	1.00	203	203	0	
Security / Reception	<	1	13 x 13	1.00	169	247	78	
Shipping & Receiving	<	1	12 x 11	1.00	126	126	0	
Showers/Change/Washrooms (1 locker / field services staff)	50	1	5 x 6	1.00	1,500	1,561	61	
Office Washrooms	2 / floor	6	10 x 24	1.00	1,440	1,635	195	
Universal Washroom	1 / floor	3	8 x 10	1.00	240	79	-161	Two on First floor
Janitor	1 / facility	1	10 x 15	1.00	150	150	0	
Cafeteria	1 / facility	1	45 x 50	1.00	2,252	2,252	0	
Fitness Centre	1 / facility	1	25 x 48	1.00	1,200	1,054	-146	
Mechanical/Electrical and IT Room	1 / facility		x	1.00	4,524	4,524	0	
General Storage			x	1.00	2,649	2,649	0	
Sub Total					15,183	15,210	27	
Functional Building Area								
MPO Office	20% of office staff	33	10 x 10	1.00	3,300	5,953	2,653	40 in total
Cubicles Workstations	50% of office staff	83	8 x 6	2.00	7,968	18,334	10,366	169 in total
Meeting Room (8-10 people) 1/70 staff	1 per 70	3	16 x 11	1.50	792	3,400	2,608	
Break out room (4 people) 1/50 staff	1 per 50	4	10 x 12	1.00	480	553	73	
Focus Rooms (4 people) 1/50 staff	1 per 50	4	10 x 10	1.00	400	0	-400	
Hotel Station (2:1 of dynamic staff)	30% of office staff	10	6 x 3	1.50	229	160	-69	
Training Rm PC Training (12-24)	<	1	24 x 30	1.0	720	2,035	1,315	
Micro Kitchen/Ezone - 1/floor	1/200	3	15 x 20	1.00	900	483	-417	
Print Copy Rm/Mail Room	1/ 100	2			250	585	335	
Health room - required if three are 200 or more employees on any one shift.	<	1	11 x 10	1.00	110	105	-5	
IT Room	<	1	11 x 11	1	121	662	541	
Coat Storage	<	1	2 x 6	1.00	12	133	121	
Mustering Room(1chair/person) +1 HR workstation with connectivity and large TV screen for training	10	1	3 x 5	4.00	600	560	-40	
Gas monitor calibration (1/10 people)		1	8 x 10	1.00	75	224	149	
Measurement & Regulation Test/ Storage		1	12 x 20	1.00	240	0	-240	
Warehouse (where required by business ops)		1	30 x 77	1.00	2,310	4,002	1,692	
Free Pick storage	1/Building	1	15 x 10	1.00	150	159	9	
Locked Storage Room	<	1	10 x 15	1.00	150	1,162	1,012	Industrial Storage?
Wash Bay / Repair Garage(if fleet exists)	1/Building	1	25 x 50	1.00	6,250	3,020	-3230	
Welding Bay / Fabrication	1/Building	1	35 x 54	1.00	1,890	0	-1890	
Boot wash		1	6 x 10	1.00	60	88	28	
Washing Machine Area		1	6 x 10	1.00	60	216	156	
Sub Total					27,067	41,834	14,767	
Total Building Area (not including circulation)					42,250	57,044	14,794	
Circulation/Structure	30.80%				13,015	17,572	4,557	
Total Building Area (not including out buildings)					55,264	74,616	19,352	

Site								
Total Site Area:						214,909		
Setbacks			per by-law requirements	26,027	22,224	-3,803		Storage/Parking within setbacks on much of site-Available to yard
Building Footprint			per site		48,405			Site Footprint
Future Building Expansion			deficit of site program above		0	0		
Site Feature, Landscaping, etc.			per site		29,198			
Staff Parking	1 per employee	166	9 x 17	2.00	50,796	46,140	-4656	137
Visitor Parking	<	19	9 x 17	2.00	5,814	8,692	2,878	19
Sub Total					56,610	154,659	-1778	
Available Yard Area:					108,900	60,250	-48650	Based on minimum 2.5 acres required
Site Deficit:						-50428		



APPENDIX D

Combined Building Program – Coventry & SMOC

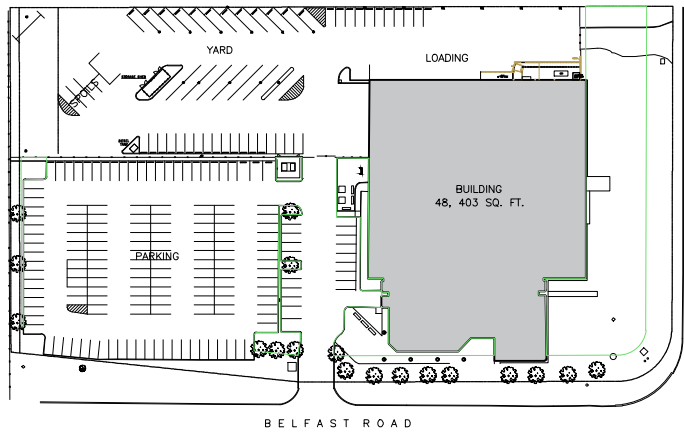
Regional Operations Centre: COVENTRY & SMOC Combined

Description	Standard # per person	Quantity	Size	Area Factor	Area sq.ft.	Area sq.ft. Current	Area sq.ft. Variance	Notes
General Building Infrastructure								
Main Vestibule	<	1	10 x 23	1.00	230	230	0	
Waiting Area	<	1	21 x 24	1.00	500	500	0	
Alternate Entrance	<	3	10 x 7	1.00	203	203	0	
Security / Reception	<	1	13 x 13	1.00	169	247	78	
Shipping & Receiving	<	1	12 x 11	1.00	126	126	0	
Showers/Change/Washrooms (1 locker / field services staff)	92	1	5 x 6	1.00	2,760	1,561	-1199	
Office Washrooms	2 / floor	9	10 x 24	1.00	2,160	1,635	-525	
Universal Washroom	1 / floor	3	8 x 10	1.00	240	79	-161	Two on First floor
Janitor	1 / facility	1	10 x 15	1.00	150	150	0	
Cafeteria	1 / facility	1	45 x 50	1.00	2,252	2,252	0	
Fitness Centre	1 / facility	1	25 x 48	1.00	1,200	1,054	-146	
Mechanical/Electrical and IT Room	1 / facility		x	1.00	4,524	4,524	0	
General Storage			x	1.00	2,649	2,649	0	
Sub Total					17,163	15,210	-1953	
Functional Building Area								
MPO Office	20% of office staff	37	10 x 10	1.00	3,700	5,953	2,253	40 in total
Cubicles Workstations	50% of office staff	94	8 x 6	2.00	9,024	18,334	9,310	169 in total
Meeting Room (8-10 people) 1/70 staff	1 per 70	4	16 x 11	1.50	1,056	3,400	2,344	
Break out room (4 people) 1/50 staff	1 per 50	5	10 x 12	1.00	600	553	-47	
Focus Rooms (4 people) 1/50 staff	1 per 50	5	10 x 10	1.00	500	0	-500	
Hotel Station (2:1 of dynamic staff)	30% of office staff	11	6 x 3	1.50	251	160	-91	
Training Rm PC Training (12-24)	<	1	24 x 30	1.0	720	2,035	1,315	
Micro Kitchen/Ezone - 1/floor	1/200	3	15 x 20	1.00	900	483	-417	
Print Copy Rm/Mail Room	1/ 100	2			250	585	335	
Health room - required if three are 200 or more employees on any one shift.	<	1	11 x 10	1.00	110	105	-5	
IT Room	<	1	11 x 11	1	121	662	541	
Coat Storage	<	1	2 x 6	1.00	12	133	121	
Mustering Room(1chair/person) +1 HR workstation with connectivity and large TV screen for training	92	1	3 x 5	4.00	5,520	560	-4960	
Gas monitor calibration (1/10 people)		1	8 x 10	1.00	75	224	149	
Measurement & Regulation Test/ Storage		1	12 x 20	1.00	240	0	-240	
Warehouse (where required by business ops)		1	30 x 77	1.00	2,310	4,002	1,692	
Free Pick storage	1/Building	1	15 x 10	1.00	150	159	9	
Locked Storage Room	<	1	10 x 15	1.00	150	1,162	1,012	Industrial Storage?
Wash Bay / Repair Garage(if fleet exists)	1/Building	1	25 x 50	1.00	6,250	3,020	-3230	
Welding Bay / Fabrication	1/Building	1	35 x 54	1.00	1,890	0	-1890	
Boot wash		1	6 x 10	1.00	60	88	28	
Washing Machine Area		1	6 x 10	1.00	60	216	156	
Sub Total					33,949	41,834	7,885	
Total Building Area (not including circulation)					51,112	57,044	5,932	
Circulation/Structure	30.80%				15,745	17,572	1,827	
Total Building Area (not including out buildings)					66,857	74,616	7,759	

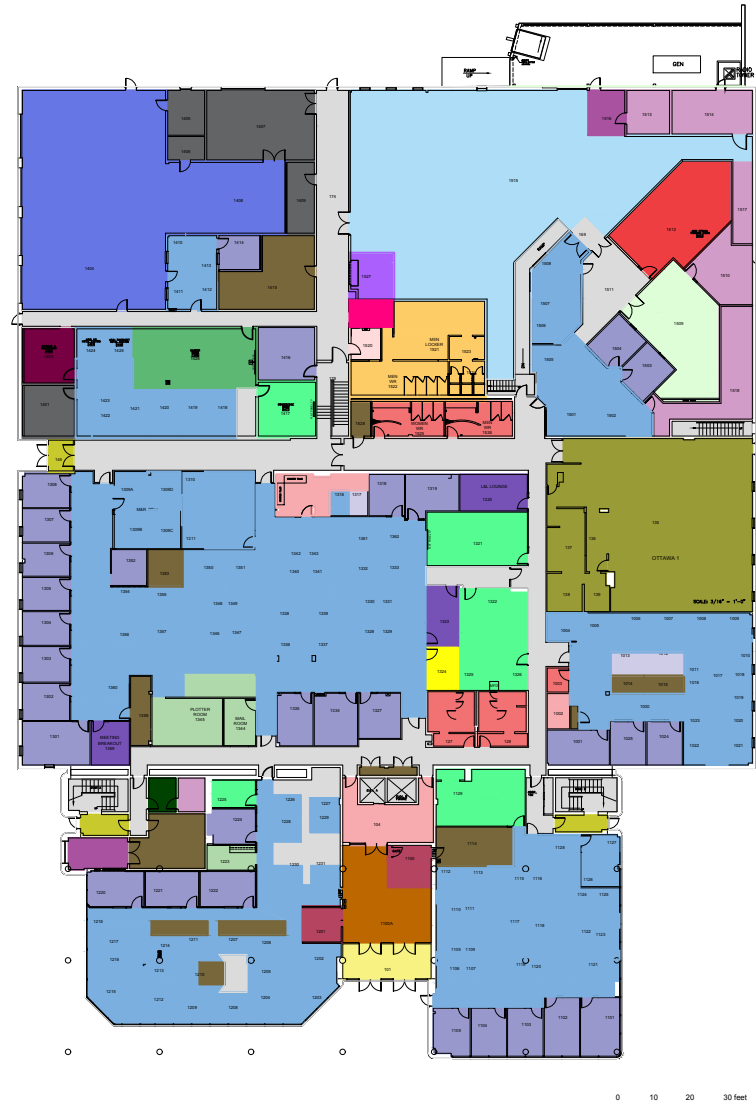


APPENDIX E

Drawings



Site Plan



Level 1 Floor Plan

General Building Infrastructure

- Main Vestibule
- Waiting Area
- Alternate Entrance
- Security Reception
- Shipping-Receiving
- Showers-Change
- Office Washrooms
- Universal Washroom
- Janitor
- Cafeteria
- Mech-Elec
- Storage-File

Functional Building Area

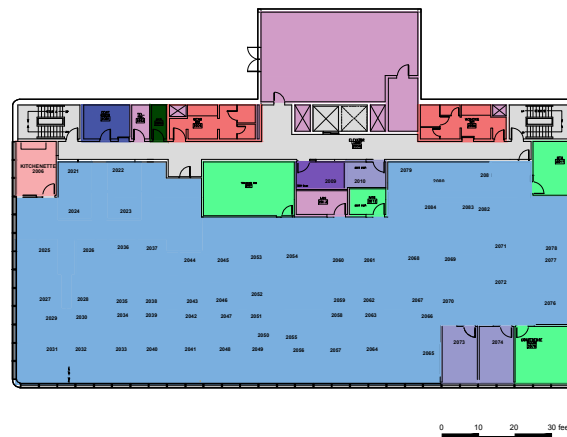
- Office-MPO
- Workstations
- Meeting
- Breakout
- Hotel Station
- Training
- Micro Kitchen
- Print Mail
- Health
- IT
- Mustering
- Gas Monitor Calibration
- Warehouse
- Storage-Free Pick
- Wash-Repair Bay
- Boot Wash

MISC.

- Industrial
- Circulation

Enbridge Ottawa
400 Coventry Road, Ottawa, ON

2016-0613-05



Level 2 Floor Plan

General Building Infrastructure

- Office Washrooms
- Janitor
- Mech-Elec

Functional Building Area

- Office-MPO
- Workstations
- Meeting
- Breakout
- Micro Kitchen
- Storage-Coat

MISC.

- Circulation

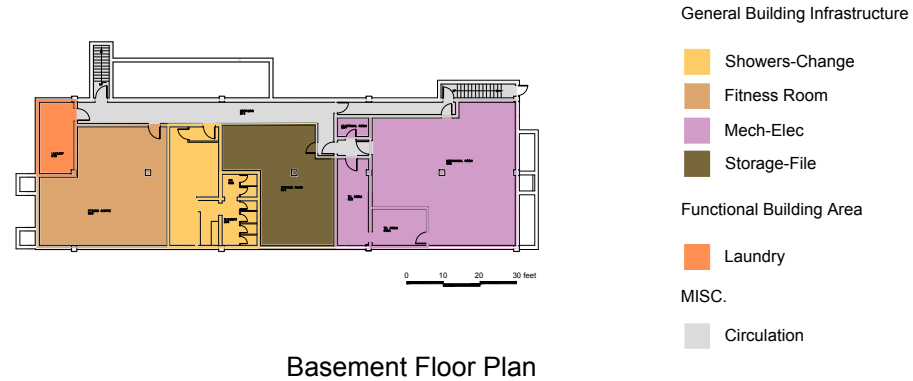
Enbridge Ottawa
400 Coventry Road, Ottawa, ON

2016-0613-05



Enbridge Ottawa
400 Coventry Road, Ottawa, ON

2016-0613-05



Enbridge Ottawa
400 Coventry Road, Ottawa, ON

2016-0613-05



3.06 FACILITY ASSESSMENT

ENBRIDGE GAS DISTRIBUTION INC.

OTTAWA SMOC REGIONAL OPERATIONS CENTRE

90 Bill Leatham Drive, Nepean, ON

Project No.: 2016-0613-05

REV 1.0 - December 6, 2017

WALTERFEDY

ENBRIDGE GAS DISTRIBUTION INC.

FACILITY ASSESSMENT

Ottawa SMOC Regional Operations Centre

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Enbridge Gas Distribution Inc.
Ottawa SMOC Regional Operations Centre – Facility Assessment

1

1.0 SUMMARY

1.1 Introduction

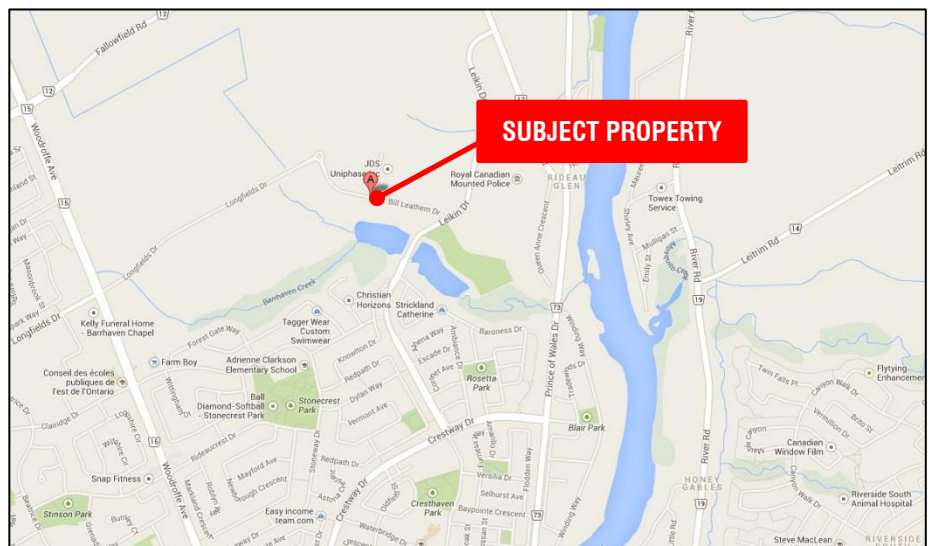
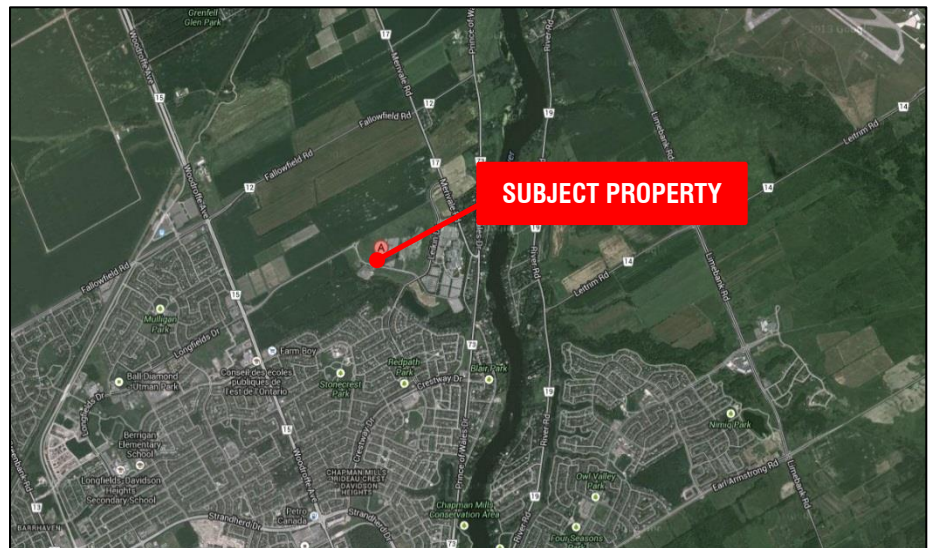
WalterFedy was retained by Enbridge to conduct a physical and functional assessment of the facility located at 90 Bill Leatham Drive, Nepean, Ontario for the purpose of identifying functional adequacy and physical renewal requirements for budgeting and planning purposes. The scope of the report includes a general visual inspection of visible civil, architectural, structural, mechanical, and electrical components. It also includes a brief Ontario Building Code (OBC) review to address barrier-free accessibility issues.

Following the initial report, a list of recommendations with estimated costs is provided for corrective and preventative maintenance items required.

1.2 Facility Description

The facility is categorized by Enbridge as Regional Operation Centre. The building was originally constructed in 1995.

The property is located at 90 Bill Leatham Drive; west of Prince of Wales Drive and east of Woodroffe Avenue. Highway 416 is 9 Km to the west and Highway 417 is 10 Km to the north. The Rideau River lies to the east of the property. The surrounding area is a mix of agricultural to the north, and several large office campuses and industrial buildings to the east. South and west of the property are primarily residential buildings.



1.2.1 Property Summary

- 1) General:

Owned / Leased:	Owned
FCI score	2.04%
AI score	24%
Current Occupancy	21 Office Staff
	42 Total Occupancy Including Field Staff

- 2) Physical Building Properties:

Gross Floor Area (not including Tenant)	17,250 ±SF
Building Area (Including non EGD Area):	27, 576 ±SF
Office Space:	766 ±SF
Common Areas:	3,604 ±SF
Industrial:	8,205 ±SF
Training:	3,331 ±SF
Circulation:	1,344 ±SF
Non EGD Area:	10,326 ±SF

- 3) Site Characteristics:

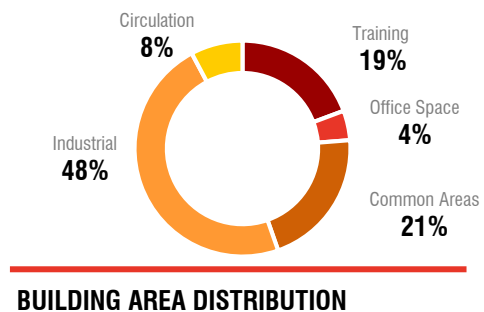
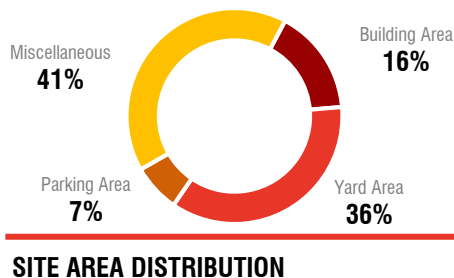
Site Area:	173,598±SF (3.9 Acres)
Building Area /Coverage (Includes Non EDG area):	27, 576 ±SF (16%)
Yard	62,306 ±SF (1.4 Acres)
Parking	12,527 ±SF
Misc. (landscaping, yard, etc.)	71,189 ±SF

- 4) Zoning:

Zone:	IL9 – Industrial Zone
Parking required	0.8 per 100m ² (1076 SF) of GFA : 20
Parking provided	45 cars/vans, 40 trucks, 10 equipment
Loading required / provided	1 / 2
Front Yard Depth (minimum)	6 meters Provided 21 meters
Side Yard Width (minimum)	6 meters Provided 7.5 meters
Rear Yard Depth (minimum)	6 meters Provided 33 metres
Lot Coverage (maximum)	60%. Provided 16%
Building Height (maximum)	22 m

- 5) Building Systems:

HVAC:	Roof top air handling units, split cooling and radiant heater units
Electrical:	200A, 600V three phase
Plumbing:	Municipal water/sewer
Building Automation/Security:	None



1.3 Scope of Work

The scope of work for this assessment was approved by Enbridge and was completed in accordance with WalterFedy's fee proposal dated September 08, 2016.

The scope of work for the Asset Management Report will include a Functional Assessment, a Physical Assessment, and a Market Condition Assessment. The report will provide recommendations for strategic decisions based on the metrics reviewed in the assessments.

1.4 Assessment Methodology

The building condition assessment is based on general visual examination performed on September 21, 2016 by WalterFedy's Architectural and Facility Management departments.

The observations in this report were made using non-destructive methods through existing access points. Existing drawings provided by Enbridge for the building were also used to supplement site observations.

The guiding principles of this study is based upon the document from the National Research Council of Canada (NRC) "Protocols for Building Condition Assessment" published by The Institute For Research in Construction (IRC).

1.5 Limitation of Study

This assessment is based on our general review and walkthrough of the facility and it is not intended to form a detailed life safety analysis or Ontario Building Code and Fire Code assessment. The facility was built in 1960 and is not in compliance with current Ontario Building Code and Fire Code. It is recommended that a further detailed life safety review and assessment is carried out to determine what building systems upgrades would be required to meet the requirements of Section 9.2 of Ontario Fire Code to the satisfaction of the Fire Department.

This report was completed in accordance with the approved scope of work as described in Section 1.3. This report is limited and is not intended to be comprehensive or exhaustive, or to suggest a risk-free facility. The report may not address all existing issues associated with the facility and may omit issues that are or may be of interest to the Owner. The findings and statements in this report are based on general site observations of the current conditions as they existed during the time period of the investigation.

The purpose of this report is for the sole use of the Owner for budgetary planning purposes. Issues identified in this report require further detailed assessments to determine repair and maintenance work required. This report should not be used by third parties involved in any work related to the facility; such third parties should undertake their own investigations and studies to determine how the existing condition of the facility will affect their plans and work. WalterFedy accepts no responsibility for liabilities incurred by or damages suffered by any third party as a result of decisions made or actions taken, based upon this report.

The passage of time might affect the views, conclusions and recommendations provided in this report.

The following report is a general guide only and is not intended to be used as a document for construction.

This study does not include hazardous materials review or inspection.

2.0 PHYSICAL AND FUNCTIONAL ASSESSMENT

2.1 Physical Assessment

2.1.1 Site and Landscaping

The site is a near rectangular-shaped property. The site building occupies approximately 16% of the site.

The remainder of the site is occupied by asphalt pavement parking areas, cast-in-place concrete paving, concrete curbs, a perimeter fence with powered access gates and areas of soft landscaping (i.e., grass, shrubs, and trees). During the site visit the asphalt paved areas were noted to be in fair condition overall; however localized longitudinal and alligator cracking was present in several areas. In addition, impact damage along the concrete curbs was noted and should be addressed to prevent further deterioration of this site element.

Wall mounted lighting units and pole mounted light standards provide illumination for the site. All of the lighting standards and the majority of the wall pack units have recently been retrofitted with high efficiency LED fixtures. Approximately four wall pack units remain to be converted. It is recommended that the wall pack conversion occur in the early term of the analysis.

The property is secured by a five-foot chain link fence along the north, east and south sides of the property. The fence has one operable gate (accessed by Bill Leathem Drive). A section of wood fencing with noticeable deterioration was noted along the west portion of the property. Therefore an allowance to the section of wood fencing with an approved chain link standard fence section has been provided within the evaluation period.

Since the inspection was limited to visible areas, no examination of the catch basins was performed and no review of the initial compliance with code was performed. The inspection of underground or concealed components is outside the scope of work.

2.1.2 Mechanical

Heating and cooling is primarily provided by roof mounted packaged rooftop air handling units and condenser units. The list of current rooftop HVAC and condenser units with dates of installation and recommended units for replacement is provided below:

LIST	MFG	M/N	LOCATION	DATE OF MFG	RECOMMEND REPLACEMENT?
Office A/C	York Dia	BTRC197-118	Hallway	2002	Yes
A/C	Mitsubishi		Lan Room	1996	Yes
A/C	Mitsubishi		Warehouse Office	2012	No
RTU-1	York	J03ZN08U2BZZ10003	New TT Storage	2012	No
RTU-2	York	J03ZN08U2BZZ10005	New TT Area	2012	No

Process and sanitary exhaust is provided by rooftop exhaust units. The list of current exhaust units with dates of installation and recommended units for replacement (based on a PUL of 10-15 years) is provided below:

LIST	MFG	M/N	LOCATION	DATE OF MFG	RECOMMEND REPLACEMENT?
EXU-1	Greenheck	GB-081	TT Practical Room	2012	No
EXU-2	Greenheck	CSP-B110	Compressor Room	2012	No
EXU-3	Greenheck	CSP-A900	TT Storage Room	2012	No
EXU-4			Northeast Wall	1996	Yes
EXU-5			Northwest Wall	1996	Yes
EXU-6	Delhi	9209-2	Weldshop	1996	Yes
EXU-7	Delhi	9209-2	Weldshop	1996	Yes
EXU-8	Delhi	9209-2	Weldshop	1996	Yes
EXU-9	Greenheck	CSP-B110	Weldshop	2012	No

Supplementary heating in the warehouse areas are provided by ceiling mounted radiant tube and forced air unit heaters. The list of current radiant tube and unit heaters with dates of installation and recommended units for replacement is provided below:

LIST	MFG	M/N	LOCATION	DATE OF MFG	RECOMMEND REPLACEMENT?
UH-1	Reznor	RPB-125	Office Roof	1996	Yes
UH-2	Reznor	SC150	Warehouse South Side	1996	Yes
UH-3	Reznor	SC150	Warehouse South Side	1996	Yes
UH-4	Lennox	KGA048S4DH2J	Office Roof	2014	No
UH-5	Lennox	KGA046S4BH2J	Office Roof	2013	No
RH-1	Verber Ray	Type 2 DX-75	Warehouse	1996	No
RH-2	Verber Ray	Type 2 DX-75	Warehouse	1996	No
RH-3	Verber Ray	Type 2 DX-75	Weldshop	1996	No
RH-4	Verber Ray	Type 1 DBU-20	Weldshop	1996	Yes
RH-5	Verber Ray	Type 2 DX-75	Utilities Bay	1996	No
RH-6	Verber Ray	Type 1 DBU-20	Utilities Bay	1996	Ye

Domestic Hot Water (“DHW”) within the site building is provided by an A.O. Smith domestic hot water tank (M/N – BTRC197-118) located within the janitor utilities room. Based on the name plate data on the equipment the domestic hot water tank was manufactured in 2015 and each has a capacity of 78 gallons at 197,000 BTUH.

There was reportedly no shortage of DHW within the site building. However, based on WalterFedy’s experience the anticipated service life of a DHW is typically 10-15 years. Therefore based on age, replacement should not be required within the term of analysis.

2.1.3 Electrical

The electrical power for the site building is supplied from a pad-mounted transformer that feeds the electrical transformer vault within the site building.

The building is equipped with a 200 Ampere, 600 Volt, three phase service.

Emergency power is provided by two natural gas fired generators. Based on age and observed condition a maintenance overhaul on the Cummins Genset located along the north elevation is recommended.

Interior lighting in the office and training areas is predominately provided by high efficient LED tube lighting fixtures which was converted approximately four years ago. Lighting in the warehouse is provided by LED tube lighting fixtures and high-intensity discharge types.

Combination battery pack units provide emergency lighting and exit signage within egress pathways.

2.1.4 Structural

As outlined in the scope of work, a limited visual assessment of the condition of the structural elements was carried out on the elements which were visible at the time of the inspection. The building is comprised of poured concrete slab on grade construction supported by a steel frame structure and corrugated metal clad exterior walls. The steel roof deck is supported by open web steel joists and the joists are supported by steel beams and columns. No major visually identifiable structural deficiencies were noted at the time of the site inspection.

2.1.5 Building Envelope

The roof system atop the site building consists of a single ply Polyvinyl Chloride Membrane (PVC), near-flat, mechanically fastened roof system that was installed last year. The roof systems are installed atop a layer of rigid insulation, atop a corrugated metal roof decking. Neither the presence of a vapour barrier, nor the type or the thickness of the insulation could be verified, as the scope of the work did not include destructive testing. Drainage of the roof system is provided by internal roof drains which presumably drain to the municipal sewer system.

Penetrations through the roof system include plumbing stacks, an exhaust vent stack, internal roof drains, mechanical curbs, and service penetrations.

The exterior walls of the site building consist of corrugated sheet metal cladding and a curtain wall system along the east (front) elevation. Corrosion and impact damage was noted along the base of the sheet metal cladding along the west (rear elevation). These sections should be repaired, cleaned and re-painted to limit further corrosion and deterioration.

The window systems of the site building consist of fixed single glazed insulated (“SG”) units set within aluminum frames in punched configurations. Exterior doors serving the site building are comprised of single glazed units set into metal frames. Metal doors within metal frames were observed serving the warehouse egresses and of the site building. Five sectional metal overhead doors, accessed from the south and south elevations, were noted serving the warehouse areas. Based on age and observed condition, an allowance to replace the two sectional doors serving the weldshop is recommended.

2.1.6 Finishes

The floor finishes within the site building consist of unsealed concrete slab-on-grade, ceramic, and resilient floor tiles. The wall finishes within the site building consist of painted gypsum board and painted concrete masonry block. The ceiling finishes within the site building primarily consist of exposed structure, and painted suspended ceiling tile.

The overall condition of the interior components is fair. Maintenance has noticeably been performed and ongoing upgrades have been undertaken.

2.2 Functional Assessment

2.2.1 Site

The site services both Enbridge Gas Distribution Operations Depot (EGD) and Training Centre and a tenant space occupied by Canada Post Distribution Centre (CPDC). There are two access points to the site. One main access that services both the main parking lot and the gated yard; shared by both EGD and Canada Post, the secondary entrance to the west of the property that services the Tenant Canada Post. Canada Post operations occupy approximately 0.4 acres of yard area, while Enbridge's operations occupy 1.4 acres. The two share approximately 0.14 acres of circulation space within the yard, and 0.17 acres of circulation space outside of the yard.

The following functional deficiencies were observed during the walkthrough:

- There are two points of entry to the site, however one is for tenant parking, and the other services both tenant truck traffic, Enbridge's truck traffic, and Enbridge's employee and visitors parking. Currently the pedestrians from EGD parking have to cross the path of main trucks for both the tenant and Enbridge truck traffic. It is recommended that this be rectified in order to meet with EGD standards.
- The service yard does not meet Enbridge's minimum standard yard size of 2.5 acres. The current yard is 1.4 acres.
- The garbage refuse is located within an island in the middle of the yard as opposed to being organized on the perimeter of the site per the recommended yard organization standards. This makes for a challenging traffic flow within the yard. It is recommended that the garbage refuse be relocated to the perimeter of the yard.
- It was noted that there was not a location for snow removal within the yard and that snow needs to be removed from the site regularly to ensure that it doesn't pile up; this is due to the inadequate yard size.
- Curb cuts are too high to meet barrier-free code requirements.
- The south west corner of the office portion of the building appears to be damaged due to truck traffic hitting the side of the building when accessing the welding shop. Bollards should be added at this location to protect the building.

2.2.2 Interior Space Planning

The building is a 1 story structure that houses 10,326 ±SF of non EGD tenant space, occupied by Canada Post, and 17,250 ±SF of Enbridge Gas Distribution Operations Depot. The operations depot consists of a Training Centre, industrial warehouse, welding shop, repair garage/washbay, and office area, complete with support spaces.

The following are functional deficiencies observed during the walkthrough:

- The existing office areas is approximately 766 ±SF. This is less than the standard requirements for the number of staff at this facility, there is however an excess of warehouse space. It is possible to gain this area by reconfiguring some of the existing interior spaces.
- Access to some of the training rooms is within the warehouse, and not off a main circulation spine.
- Existing washrooms are outdated and require renewal to meet current EGD standards.
- The mud room/laundry room supports gas fired appliances, however the existing doors are not fire rated. Service rooms with gas fired equipment require fire resistant rating in compliance with Ontario Building Code.

2.2.3 Furniture

Existing furniture is legacy furniture throughout. All existing office furniture has reached the end of its life cycle and replacement is recommended to enhance the functional and environmental condition in the office area. The height of the existing cubicle partitions blocks natural light and access to existing windows from the core area.

It is recommended to meet Enbridge's office standards that the furniture be phased out and replaced with new.

2.2.4 Ontario Building Code – Life Safety

3.3.1 Safety Requirements within Floor Areas:

- Travel distance in a non-sprinklered Group D occupancy must not exceed 25m, in a Group F, Division 2 not more than 10m. There are a few travel distances within the space that are considered an existing non-conforming condition for compliance with the Ontario Building Code. There is no mandate to update the existing facility for compliance with these requirements. However in compliance with Part 11 of the Ontario Building Code the facility shall meet the requirements of travel distance in the event of extensive renovation in the building.

Section 3.2 - Building Fire Safety

The building falls under Part 3, Group F Division 2 and Group D major occupancies.

To meet current Ontario Building Code the building should satisfy the requirements of 3.2.2.71: Group F, Division 2, up to 2 Storeys:

- The building is not required to be sprinklered.
- Standpipe system is not required.
- The building is permitted to be of combustible construction or non-combustible construction used singly or in combination.
- Floor assemblies shall be fire separations and, if of combustible construction, shall have a fire-resistance rating not less than 45 minutes (Not applicable).
- Loadbearing walls, columns, and arches supporting an assembly required to have a fire-resistance rating shall have a fire resistance rating of 45 minutes or shall be of non-combustible construction.

Section 3.8 - Barrier-free Design

3.8.1.3. Barrier-free Path of Travel

3.8.1.3.(1) Every barrier path of travel shall provide an unobstructed width of at least 1100 mm for the passage of wheelchairs.

3.8.1.2. The facility has two entrances to the ground level. Neither entrance is equipped with a barrier-free door operator nor do they qualify as barrier-free entrances. In accordance with article 3.8.1.2, a minimum of one barrier-free entrance to the building is required.

3.8.2.3. Washrooms required being barrier-free:

On the main floor there are currently two barrier free washroom stalls located in the male and female washroom areas.

3.8.3.12. Universal (barrier-free) toilet rooms:

There is not a universal washroom in the existing building. This is considered an existing non-conforming condition for compliance with Ontario Building Code. There is no mandate in the current code to upgrade the existing facility for compliance with the Universal Barrier Free washroom requirements. However in compliance with Part 11 of Ontario Building Code the addition of a universal washroom will be required in the event of extensive renovation in the building.

2.3 Functional and Physical Condition Analysis

WalterFedy utilized a risk management approach taking into consideration the impact of failure of the building component on the long term serviceability of the building as well as the functional requirements associated with the building. Both Facility Condition Indexing (FCI) and Adequacy Indexing (AI) was utilized in order to help make the best possible decision related to the future of the site building and to determine whether or not to invest, maintain, repurpose or dispose of the asset.

FCI:

FCI is a condition index tool used to illustrate the condition of an asset expressed in a percentage ratio of required maintenance/repair costs divided by the replacement value of the asset expressed as:

$$\text{FCI} = (\text{Maintenance and Repair Costs}) / (\text{Cost to Replace the Building})$$

The replacement value of the building is based on industry standards for construction costs. Therefore, the lower a FCI is, the better the condition of the building. The resulting FCI at ten years is 2.04% which is classified as being in good condition.

$$\text{FCI (SMOC)} = (\$104,000) / (26,531 \times 192) = 2.04\%$$

AI:

AI is a condition index tool used to illustrate the functional condition of the asset expressed in a percentage ratio of required functional upgrade costs divided by the replacement value of the asset to meet the functional needs expressed as:

$$\text{AI} = \text{Functional Upgrade Costs} / \text{Cost to Replace the Building with its Functional Equivalent}$$

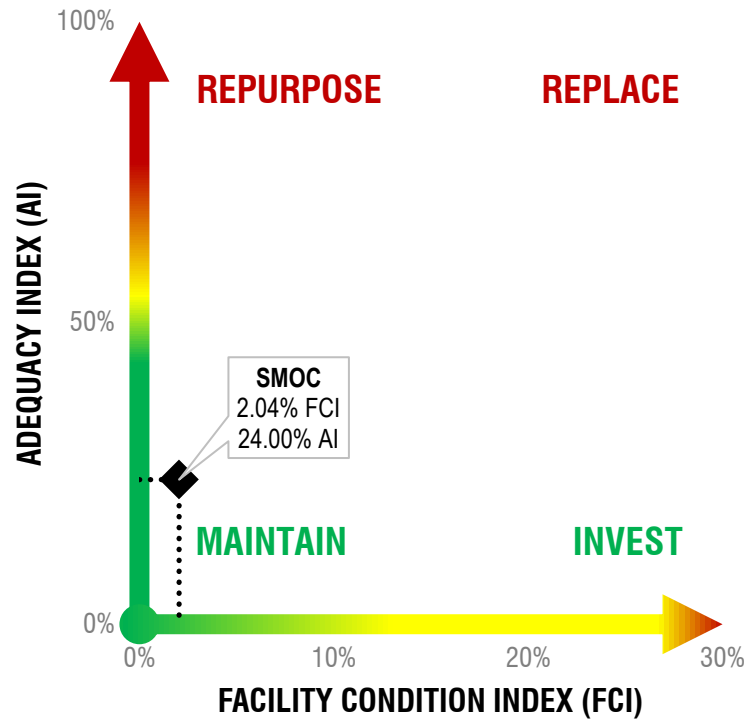
The Adequacy Index for SMOC Operations Depot is calculated by dividing the current functional and physical renewal costs by the cost to replace the building with its functional equivalent size.

The cost to upgrade the facility to current Enbridge GDP standards is estimated at \$1,100,000. The estimated cost to build a new facility to EDG current standards based on \$15,500 sqf the area required to accommodate current program is \$4,495,000, this is based on 60% of office space at \$350/sqf and 40% industrial space at \$200/sqf.

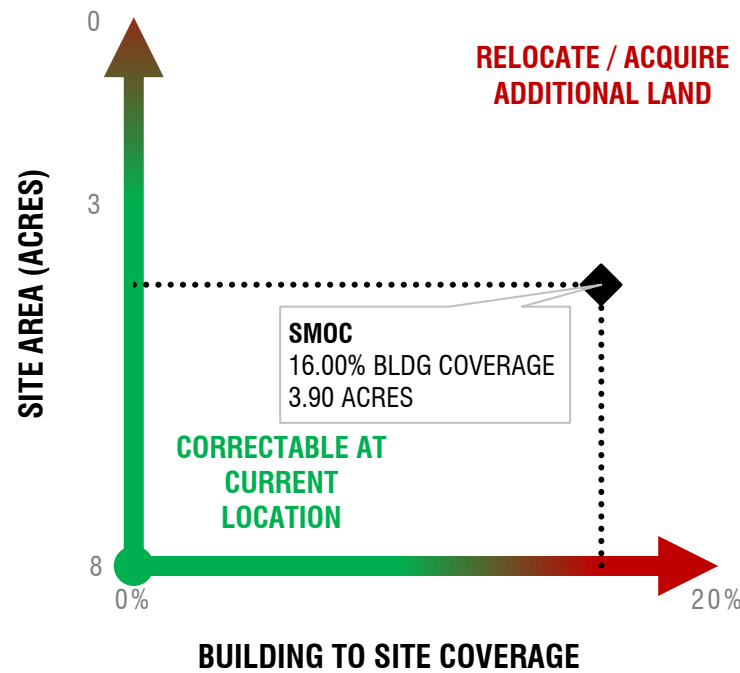
$$\text{AI (SMOC)} = 1,100,000 / \$4,495,000 = 24\%$$

With quantification of FCI and AI for your building, comes the ability to make comparisons between industry benchmarks, and drive decision making related to the future of the property. The chart below shows the relationship between FCI and AI and indicates visually where Ottawa SMOC Operations Depot falls within the decision making criteria.

**FACILITY CONDITION &
ADEQUACY GRAPH**



**SITE CONSTRAINTS
GRAPH**



2.4 Key Findings

- PHYSICAL OBSOLESCENCE:

The acceptable Enbridge standard for the physical condition is an FCI of 0 to 5%. The current FCI of the facility based on this study is 2.04% therefore the physical condition of the facility meets Enbridge acceptable standards.

Meets Standards		Correctable at Current Location	
POSITIVE	Negative	POSITIVE	Negative

- FUNCTIONAL OBSOLESCENCE BUILDING :

The acceptable Enbridge standard for the functional condition is 0, anything between 0 to 50% is considered correctable at current location. The current facility AI index is 24% which is considered correctable at current location without consideration of other factors including adequacy of land size and the FCI index.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	POSITIVE	Negative

- FUNCTIONAL OBSOLESCENCE SITE:

The yard size is smaller than Enbridge standard yard size requirements. The current yard size is 1.4 acres. Enbridge standard yard size is 2.5 acres.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	Positive	NEGATIVE

The configuration of site functions and circulation is inefficient and poses a safety hazard. The yard area is too small to meet current EGD standards.

Based on the site deficiencies and space limitations, relocation to another property is recommended. Although the FCI and AI graph indicates recommendation to maintain and repurpose the existing facility but the site deficiencies including space limitations and inefficiencies will prevent the option of expanding the existing building on the same property.

2.5 Property Evaluation

In June 2016 Juteau Johnson Comba Inc. completed appraisal report of the property at 90 Bill Leatham Drive in Nepean. The appraisal amount based on the report is \$3,049,230. For the purpose of completing the cost projection of the available development scenarios a value of \$750,000 per acre is used to establish the cost to increase the site area. The cost per acre is based on the 2016 appraisal.

For the relocation option (combined SMOC and Coventry program), the cost projection is based on a purchase price of \$200,000 to \$500,000 per acre for a new industrial property located in a central location between the two service zones. The price range is established through discussions with Enbridge staff.

2.6 Development Scenarios

The following is a comparison of the available options to address the deficiencies at 90 Bill Leathem Drive:

SCENARIO			
DESCRIPTION	Correct physical and functional deficiencies by renovating and renewing the existing facility on the existing site	Purchase additional 1 acre from the abutting property and correct physical and functional deficiencies by expanding and renovating the existing facility	Sell the existing property, purchase a property suitable in size to accommodate the combined program of SMOC and Coventry Road programs. Required size of new property is approximately 7 acres
LAND ACQUISITION	\$-	\$750,000	\$3,500,000
LAND SALE PROCEEDS	\$-	\$-	\$7,274,000**
CONSTRUCTION COST	\$1,100,000*	\$1,600,000*	\$21,650,000***
SOFT COST	\$220,000	\$320,000	\$4,330,000
NEW OFFICE FURNITURE	\$210,000****	\$210,000****	\$1,870,000****
TOTAL	\$1,530,000	\$2,880,000	\$24,076,000
MEETS EDG STANDARDS	NO	YES	YES
PRIORITY	This option becomes feasible if Canada Post the existing tenant move out and Enbridge yard area is increased by utilizing the parking area assigned for Canada Post.	2	1 (reflected in the capital expenditure matrix in Appendix A)

* Construction cost is based on interior renovation of 5,000 SF based on \$200/SF including allowance for site improvements. In the second option \$500,000 allowance is added for site development of the additional 1 acre acquired.

** Land sale proceeds is equal to 50% of the actual property evaluation/sale price. This is based on the “rate base split”/Enbridge portion of proceeds. In Option 3, land scale is equal to the combined value of sale proceeds of both sites SMOC and Coventry.

*** Total required gross floor area to accommodate the combined programs of Coventry and SMOC is 67,000 SF. Total construction cost is based on \$350/SF for office space, amenities and circulation and \$200/SF for industrial space (based on appendix A 12,000 SF industrial space and 55,000 SF office space).

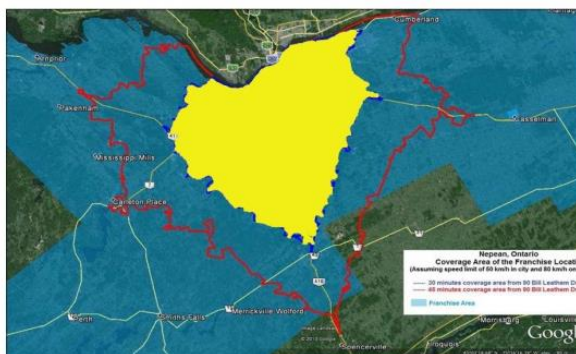
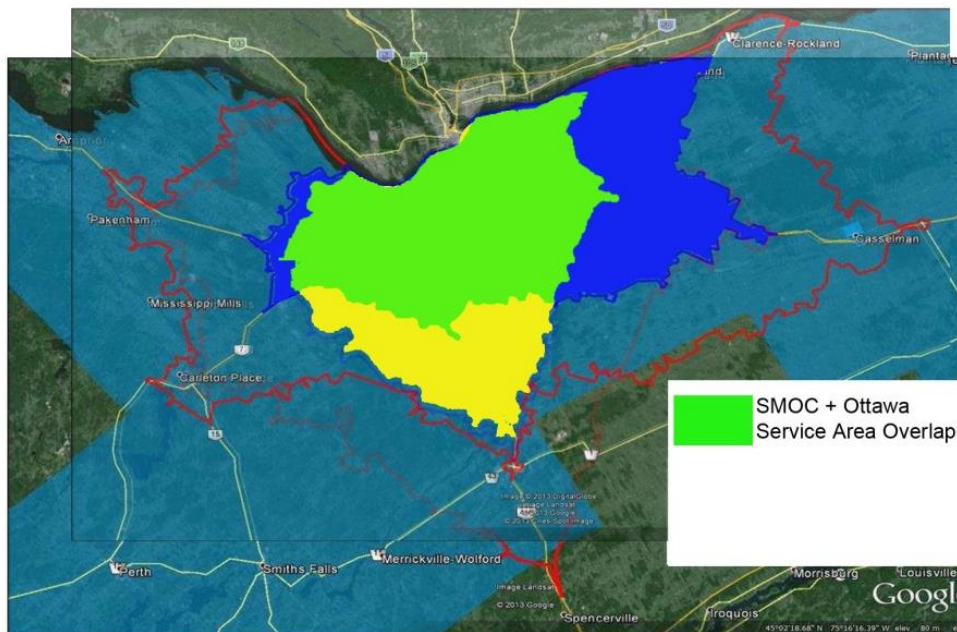
**** Furniture cost is based on \$10,000 per employee.

The following is an analysis of the service areas for Coventry and SMOC; the yellow zone represents SMOC service area, the blue zone represents Coventry service area, and the green zone depicts where the two

Enbridge Gas Distribution Inc.
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service areas overlap. The study identifies that a site centrally located within the three areas would be best suited to cover the service areas of Coventry and SMOC.



South Merivale Operations Centre
"SMOC", Nepean
Regional Response Time GIS



Ottawa (Coventry Road)
Regional Response Time GIS

compiled from Enbridge separately commissioned Response Time GIS Analysis

SCENARIO 3: SERVICE AREA ANALYSIS



APPENDIX A

Capital Expenditures Forecast



7.0 CAPITAL FORECAST

90 Bill Leatham Drive, Nepean, ON
Operations Depot

The following Capital Plan has been compiled from the following:

- 1 EGD Long Range Capital Plan (LRP)
- 2 EGD/FMG Property Inspection (FMG)
- 3 3rd Party Property Condition Assessment (PCA)
- 4 Non-Functional Standards Assessment - Section 5 (nFSA)
- 5 Electrical Safety Authority Inspection (ESA)
- 6 EGD Quarterly Health/Safety Inspection (HSI)

SECTION	CATEGORY	DEFICIENCY	1	2	3	4	5	6	7	8	9	10
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
			BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD
Maintenance Deficiencies												
	Building Envelope	Repair impact and corrosion deteriorated cladding at rear elevation	\$ 5,000									
	Building Envelope	Replace weldshop sectional doors				\$ 2,500			\$ 2,500			
	HVAC	AC Units			\$ 4,500		\$ 4,500					
	HVAC	Replace aged exhaust units				\$ 3,000		\$ 3,000				
	HVAC	Replace ceiling hung unit heaters						\$ 5,500	\$ 5,500	\$ 5,500		
	HVAC	Replace radiant tube heaters									\$ 6,500	\$ 6,500
	Life/Safety	Allowance to major overhaul of the north elevation Genset				\$ 15,000						
	Site Work/Exterior Elements	Replace wall pack lighting units with LED		\$ 2,000								
	Site Work/Exterior Elements	Repair deteriorated and impact damaged concrete curbs		\$ 2,500								
	Site Work/Exterior Elements	Allowance for localized asphalt repairs				\$ 25,000						
	Site Work/Exterior Elements	Replace deteriorated wood fence section		\$ 5,000								
Total Maintenance Deficiencies			\$ 5,000	\$ 9,500	\$ 4,500	\$ 45,500	\$ 4,500	\$ 8,500	\$ 8,000	\$ 5,500	\$ 6,500	\$ 6,500
Cummulative FCI			0.10%	0.28%	0.37%	1.27%	1.35%	1.52%	1.68%	1.79%	1.91%	2.04%
Functional Deficiencies (Based on relocation with combined program SMOC & Coventry)												
	Land Acquisition		\$ 3,500,000									
	Construction			\$ 10,825,000	\$ 10,825,000							
	Furniture	Based on \$10,000 per employee		\$ 935,000	\$ 935,000							
	Soft Costs	20% of Construction Cost	\$ 2,165,000	\$ 2,165,000								
Total Functional Deficiencies			\$ 5,665,000	\$ 13,925,000	\$ 11,760,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Total			\$ 5,670,000	\$ 13,934,500	\$ 11,764,500	\$ 45,500	\$ 4,500	\$ 8,500	\$ 8,000	\$ 5,500	\$ 6,500	\$ 6,500



APPENDIX B

Photographs



90 Bill Leathem Drive, Nepean, ON

Appendix B.1

1. Front Gate



2. Bunkers



3. Yard



4. Warehouse



5. Roof



6. Meeting Room





90 Bill Leathem Drive, Nepean, ON

Appendix B.2

1. Front Entrance Pavement



2. GenSet



3. Deteriorated Metal Cladding



4. Wood Fence and Curb Deterioration



5. Wall Pack Exterior Lighting



6. Roof Vent





APPENDIX C

Program

Operations Depot: SMOC

Description	Standard # per person	Quantity	Size	Area Factor	Area sq.ft.	Area sq.ft. Current	Area sq.ft. Variance	Notes	
General Building Infrastructure									
Main Vestibule	<	1	9	x 5	1.00	45	90	45	
Waiting Area	<	1	9	x 5	1.00	45	0	-45	
Rear Entrance	<	1	7	x 5	1.00	35	96	61	
Showers/Change/Washrooms	42	1	5	x 6	1.00	1,260	980	-280	
Universal Washroom	1 / floor	1	8	x 10	1.00	80	0	-80	
Janitor	1 / facility	1	6	x 10	1.00	60	56	-4	
Mechanical/Electrical and IT Room	1 / facility	1	12	x 14	1.00	168	220	52	
Storage						100	72	-28	
Sub Total						1,793	1,514	-279	
Functional Building Area									
MPO Office	20% of office staff	4	10	x 10	1.00	400	766	366	5 offices
Cubicles Workstations (45 capacity employees)	50% of office staff	11	8	x 6	1.50	792	0	-792	
Meeting Room (8-10 people) 1/70 staff	1 per 70	1	16	x 11	1.50	264	411	147	
Mustering Room (1chair/person) +1 HR workstation with connectivity and large TV screen for training	10	1	4	x 5	4.00	800	716	-84	
Break out room (4 people) 1/50 staff	1 per 50	1	10	x 12	1.00	120	0	-120	
Micro Kitchen/Ezone - 1/floor	1/200	1	15	x 20	1.00	300	488	188	
Hotel Station (2:1 ratio of dynamic staff)	30% of office staff	3	6	x 2.5	1.50	68	154	87	
Print Copy Rm/Mail Room	1/ 100					250	36	-214	
Health room - required if there are 200 or more employees on any one shift.	<	0	11	x 10	1.00	0		0	
Training						3,331	3,331	0	
Coat Storage	<	1	2	x 6	1.00	12	14	2	
Gas monitor calibration (1/10 people)		1	8	x 8	1.00	60	0	-60	
Measurement & Regulation Test/ Storage		1	12	x 20	1.00	240	0	-240	
Warehouse (where required by business ops)		1	30	x 77	1.00	2,310	4,972	2,662	
Free Pick storage	1/Building	1	15	x 10	1.00	150	722	572	TBV
Locked Storage Room	<	1	10	x 15	1.00	150	258	108	TBV
Wash Bay / Repair Garage (if fleet exists)	1/Building	1	25	x 50	1.00	1,250	849	-401	
Welding Bay / Fabrication	1/Building	1	35	x 54	1.00	1,890	1,170	-720	
Boot wash		1	6	x 10	1.00	60	122	62	
Washing Machine Area		1	6	x 10	1.00	60	112	52	
Sub Total						12,507	14,121	1,615	
Total Building Area (not including circulation)						14,300	15,635	1,336	
Circulation	8.60%					1,229	1,344	115	
Total Building Area (not including out buildings)						15,529	16,979	1,450	

Site										
Total Site Area:							173,598			
Setbacks		per by-law requirments				30,641	20,965	-9,676	Storage/Parking within setbacks on much of site-Available to yard	
Building Area		per site					27,576		Above + tenant	
Future Building Expansion		deficit of site program above					0	0		
Tenant/Ciculation Space							32,101			
Landscaping		per site					18,123			
Staff Parking	1 per employee	21	9	x 17	2.00	6,426	8,735	2,309	28	
Visitor Parking	<	12	9	x 17	2.00	3,672	3,792	120	Training	
Sub Total						10,098	111,292	2,429		
Available Yard Area:						108,900	62,306	-46594	Based on minimum 2.5 acres required	
Site Deficit:								-44165		



APPENDIX D

Drawings

Enbridge SMOC
90 Bill Leathem Drive, Nepean, ON

2016-0613-05



3.08 FACILITY ASSESSMENT

ENBRIDGE GAS DISTRIBUTION INC.

BARRIE REGIONAL OPERATIONS CENTRE

10 Churchill Drive, Barrie, ON

Project No.: 2016-0613-05

REV 1.0 - December 6, 2017

WALTERFEDY

ENBRIDGE GAS DISTRIBUTION INC.

FACILITY ASSESSMENT

Barrie Regional Operations Centre

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Appendix A – Capital Expenditures Forecast

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1.0 SUMMARY

1.1 Introduction

WalterFedy was retained by Enbridge to conduct a physical and functional assessment of the facility located at 10 Churchill Drive, Barrie, Ontario for the purpose of identifying functional adequacy and physical renewal requirements for budgeting and planning purposes. The scope of the report includes a general visual inspection of visible civil, architectural, structural, mechanical, and electrical components. It also includes a brief Ontario Building Code (OBC) review to address barrier-free accessibility issues.

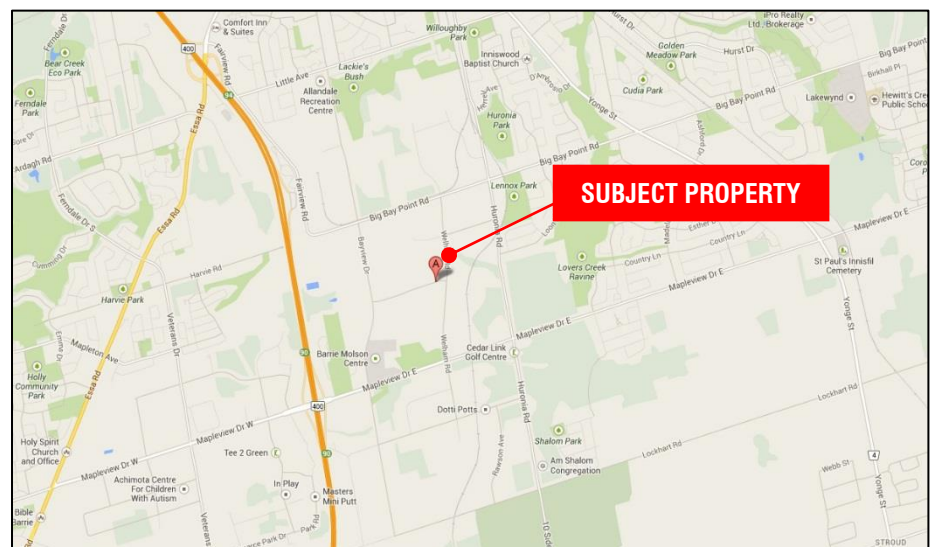
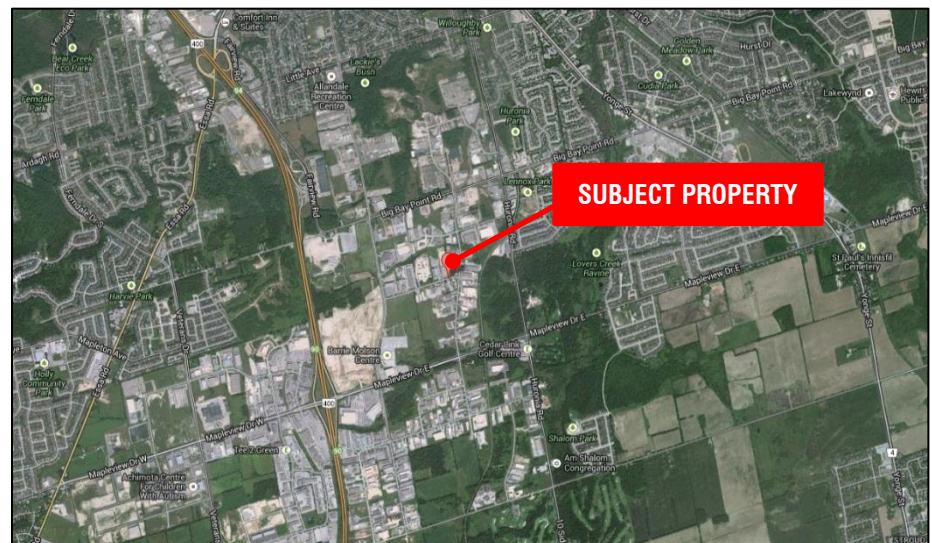
Following the initial report, a list of recommendations with estimated costs is provided for corrective and preventive maintenance items required.

1.2 Facility Description

The facility is categorized by Enbridge as a satellite Operations Depot. The original building was constructed in 2005 on 5.19 acre industrial zoned land.

Enbridge is a tenant in the property. The space is shared between Enbridge GDP and NPL Canada, a private gas distribution and utility construction company. NPL Canada occupies around 30% of the building and the west strip of the land which equates to approximately 1.8 acres.

The facility is located on Churchill Drive just off of Welham Road in Barrie. The property has good access to major transportation routes with highway 400 only 2 km to the west of the property. The property is located in an industrial park area with immediately surrounding uses ranging from retail to light and heavy industrial.



1.2.1 Property Summary

1) General:

Owned / Leased:	Leased
FCI score:	1.61 %
AI score:	58 %
Current Occupancy:	70
Office Staff:	39
Field Staff:	31

2) Physical Building Properties:

Building Gross Floor Area:	10,750± SF
(Including area occupied by NPL)	
<i>Area of Building Occupied by Enbridge:</i>	
Gross Floor Area:	7,350± SF
Ground Level	7,350± SF
Mezzanine Area:	N/A
Office Space:	3,350± SF
Common Areas:	1,300± SF
Industrial:	1,830± SF
Circulation:	870± SF

3) Site Characteristics:

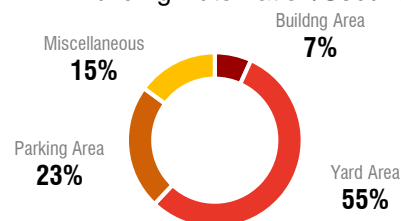
Site Area (Entire Site):	226,500± Sqf (5.19 Acres)
Site Area (Occupied by Enbridge GDP):	108,850± Sqf (2.5 Acres)
Building Coverage (current):	6.7% (7,350 SF / 2.5 Acre)
Yard Area:	60,000± SF (1.37 Acres)
Parking:	25,000± SF (0.57 Acres)
Misc. (setback / landscape):	16,200± SF (0.37 Acres)

4) Zoning:

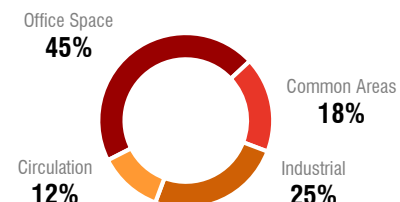
Zone:	EM4 – General Industrial		
Parking required:	1 space per 30m ² (325 SF) of gross floor area 23 parking spaces required		
Parking Provided:	44 cars/vans, 32 trucks, 44 equipment		
Loading Provided:	2 loading spaces		
Front Yard Depth (minimum)	7.0 meters	Provided	48 meters
Side Yard Width (minimum)	3.0 meters	Provided	15 meters
Rear Yard Depth (minimum)	7.0 meters	Provided	173 meters
Lot Coverage (maximum)	60%	Provided	6.7% (entire site)

5) Building Systems:

HVAC:	Rooftop HVAC units, ceiling mounted radiant tube heaters.
Plumbing:	Municipal domestic water and septic tank sanitary
Electrical:	400 A/600 V three phase service
Building Automation/Security:	None



SITE AREA DISTRIBUTION



BUILDING AREA DISTRIBUTION

1.3 Scope of Work

The Scope of Work for this assessment was approved by Enbridge and was completed in accordance with WalterFedy's fee proposal dated September 08, 2016.

The scope of work for the Asset Management Report will include a Functional Assessment, a Physical Assessment, and a Market Condition Assessment. The report will provide recommendations for strategic decisions based on the metrics reviewed in the assessments.

1.4 Assessment Methodology

The building condition assessment is based on general visual examination performed on October 7, 2016 by WalterFedy's Architectural and Facility Management departments.

The observations in this report were made using non-destructive methods through existing access points. Existing drawings provided by Enbridge for the building were also used to supplement site observations.

The guiding principles of this study is based upon the document from the National Research Council of Canada (NRC) "Protocols for Building Condition Assessment" published by The Institute For Research in Construction (IRC).

1.5 Limitation of Study

This assessment is based on our general review and walkthrough of the facility and it is not intended to form a detailed life safety analysis or Ontario Building and Fire Code assessment.

This report was completed in accordance with the approved scope of work as described in Section 1.3. This report is limited and is not intended to be comprehensive or exhaustive, or to suggest a risk-free facility. The report may not address all existing issues associated with the facility and may omit issues that are or may be of interest to the Owner. The findings and statements in this report are based on general site observations of the current conditions as they existed during the time period of the investigation.

The purpose of this report is for the sole use of the Owner for budgetary planning purposes. Issues identified in this report require further detailed assessments to determine repair and maintenance work required. This report should not be used by third parties involved in any work related to the facility; such third parties should undertake their own investigations and studies to determine how the existing condition of the facility will affect their plans and work. WalterFedy accepts no responsibility for liabilities incurred by or damages suffered by any third party as a result of decisions made or actions taken, based upon this report.

The passage of time might affect the views, conclusions and recommendations provided in this report.

The following report is a general guide only and is not intended to be used as a document for construction.

This study does not include hazardous materials review or inspection.

2.0 PHYSICAL AND FUNCTIONAL ASSESSMENT

2.1 Physical Assessment

2.1.2 Site and Landscaping

The site is a near rectangular-shaped property. The building occupies approximately 4.7% of the entire site area. Enbridge GDP section of the building occupies 6.7% of the site area allocated for Enbridge use.

The remainder of the site is occupied by asphalt pavement parking areas, cast-in-place concrete paving, concrete curbs, a perimeter fence with powered access gates and areas of soft landscaping (i.e. grass, shrubs, and trees). Wall mounted lighting units provide illumination for the site. During the site visit the asphalt paved areas were noted to be in fair condition overall with only minor sections for repair recommended. Site lighting is also in good condition; however, consideration should be given to replacing the wall pack units with LED fixtures for improved energy performance at the later portion of the analysis.

The property is secured by a six-foot chain link fence along the perimeter of the property. The fence has one operable gate at the front entrance and a side gate for manual access by Enbridge.

Since the inspection was limited to visible areas no examination of the catch basins was performed and no review of the initial compliance with code was performed. The inspection of underground or concealed components is outside the scope of work.

2.1.3 Mechanical

Heating and cooling is primarily provided by roof mounted packaged rooftop air handling units. The list of current rooftop HVAC units with dates of installation and recommended units for replacement is provided below:

List:	MFG	M/N	S/N	Date of MFG	Recommend Replacement?
RTU-1	Lennox	LGA048H2BH3J	5605L08280	2005	No
RTU-2	Lennox	LGA036H2BS2J	5605C01189	2005	No
RTU-3	Lennox	LGA060H2BH2J	5605D01489	2005	No
RTU-4	Lennox	GCS16-036-90-6J	5605L02989	2005	No

Supplementary heating for warehouse area is provided by ceiling mounted radiant tube heaters. Based on age and observed condition, replacement of the radiant tube heaters should not be required within the evaluation period.

Domestic Hot Water ("DHW") within the site building is provided by two Bradford White Corp domestic hot water tanks (DHWT-1: M/N - M2TW75T8BN, S/N - LK35128734; DHWT-2: M/N - MIITW75T6BN12, S/N - BG6457858) located in the warehouse area. Based on the name plate data on the equipment and discussion with the site representative, the domestic hot water tanks were manufactured in 2015.

There was reportedly no shortage of DHW within the site building. Based on WalterFedy's experience the anticipated service life of a DHW is typically 10-15 years. Therefore based on age, replacement should not be required within the term of analysis.

Poor exhaust ventilation was reported in the men's washroom. It is recommended that the existing exhaust unit is replaced and resized as appropriate.

Corrosion and peeling paint was noted on the gas supply piping on the exterior of the building. It is recommended that the gas supply pipes are leak tested and refinished/painted.

2.1.4 Electrical

The electrical power for the site building is supplied from a pole-mounted transformer. The buildings electrical room has a main 400 Ampere, 347/600 Volt, 3 phase breaker panel and electric service. The breakers provide power through copper wire conduit to the various lighting and receptacle unit distribution panels throughout the site building.

Interior lighting is predominately provided by T8 fluorescent T8 tube lighting fixtures. As a leasehold improvement, consideration should be given for an LED retrofit near the end portion of this analysis.

Combination battery pack units provide emergency lighting and exit signage within egress pathways.

2.1.5 Structural

As outlined in the scope of work, a limited visual assessment of the condition of the structural elements was carried out on the elements which were visible at the time of the inspection. The site building is a slab on grade structure. The superstructure of the site building is comprised of concrete masonry block exterior walls, concrete columns, wood joists and concrete. No major visually identifiable structural deficiencies were noted at the time of the site inspection.

2.1.6 Building Envelope

The roof system atop the site building consists of an SBS modified bitumen (BUR), near-flat roof system. The roof system is installed atop a layer of rigid insulation, atop a corrugated metal roof decking. Neither the presence of a vapour barrier, nor the type or the thickness of the insulation could be verified, as the scope of the work did not include destructive testing.

Drainage of the roof system is provided by internal roof drains which presumably drain to the municipal sewer system.

Penetrations through the roof system include plumbing stacks, an exhaust vent stack, internal roof drains, mechanical curbs, and service penetrations.

The exterior walls of the building consist of a combination of block masonry and sheet metal cladding.

The window systems of the site building consist of fixed insulated glazed units ("IGU") set within aluminum frames in punched configurations. Exterior doors serving the site building are comprised of single glazed units set into metal frames. Metal doors within metal frames were observed serving the warehouse egresses and of the site building. Two sectional overhead doors were observed on the rear elevation. Based on age and observed condition, replacement of windows within the office and warehouse areas should not be required within the terms of the analysis. However, caulking and resealing around windows is recommended as the current condition of the caulking was considered poor and the site representative indicated that drafts around windows were reported by the building occupants.

2.1.7 Finishes

The floor finishes within the site building consist of unsealed concrete slab-on-grade, ceramic and resilient floor tiles and carpeting. The wall finishes within the site building consist of painted gypsum board and painted concrete masonry block. The ceiling finishes within the site building primarily consist of exposed structure, and painted suspended ceiling tile. Water stained tiles were noted throughout the building and the carpet runners within the office area was noted to be worn and showing signs of early deterioration. Repair/replacement of these interior finishes is recommended within the term of the analysis.

2.2 Functional Assessment

2.2.1 Site

The building is located on a 5.19 acre site. The site is shared between Enbridge GDP and NPL Canada, a private gas distribution and utility construction company. NPL Canada occupies about 30% of the existing building and about 52% of the site area which equates to approximately 2.7 acres. Enbridge is a tenant in the building and the landlord is responsible for landscaping and snow removal on the property.

The following functional deficiencies were observed during the walkthrough:

- The site has two operational point of access shared between Enbridge and NPL. There are two exit/entry gates to and from the yard. Enbridge staff use the west gate and the east gate is used by NPL. Currently Enbridge has no access to the north exit gate. Two exit gates recommended in accordance with Enbridge GDP standards.
- The north strip of the site is utilized by NPL including the back side of the yard.
- The north section of the fence is maintained by NPL. The fence is too low relative to Enbridge EGP standard fence height, Extensive amount of overgrown vegetation were observed during the walkthrough. This poses security concerns for Enbridge.
- Circulation in the front parking area is satisfactory. Through discussion with staff it was indicated the number of parking provided at the front is adequate for the number of staff provided in the facility.
- Exit door (man gate) is not provided at the fence area. An exit door is required for egress.
- It was noted by staff that lighting levels in the yard area is not adequate.
- The existing bunkers on site belongs to EPL, Enbridge doesn't have storage bunkers on site.

2.2.2 Interior Space Planning

The building consists of office space, amenity areas and a warehouse. The following are functional deficiencies observed during the walkthrough:

- There is no coat closet area in the building.
- There is lack of storage space in the building, Part of the female washroom and the corridor space is used for storage, also part of the corridor adjacent to the IT room is used for storage. Corridors used for exiting should not be used for storage in compliance with Ontario Building Code.
- There is shortage of lockers in the male locker room. The room is small and according to staff the room becomes very crowded during peak hours.
- Lighting level is low in the male washrooms; lighting fixtures are not provided in the washroom stalls.
- According to staff, the existing male washroom count is not sufficient, especially during peak times. Additional washrooms are recommended.
- The existing meeting room appeared small based on the number of chairs provided in the room.
- A boot wash and a mop sink are provided in the mustering room next to the exterior exit door. The location of the boot wash is not adequate. A separate vestibule with a boot wash is recommended.
- The car wash bay is located in the welding shop area with no trench drain provided. A separate car wash with proper trench drain is recommended.
- It was noted by staff that odours and exhaust fumes from the warehouse leak into the office space. A vestibule between the office space and the warehouse is recommended.
- The washing machine is currently located in the welding shop, a separate area designated for the washing machine and the boot wash is recommended.
- The counter used for personal gas monitor (PGM) is located in the welding shop, a separate space for safety devices is recommended in accordance with Enbridge GDP standards.
- The main electrical distribution panels are located in the electrical room outside Enbridge GDP area in the adjacent tenant space.
- The water meter is shared between Enbridge GDP and EPL and is located in the adjacent tenant space. When EPL staff use the hose next to the meter water, pressure at Enbridge space is greatly reduced.
- The access hatch to the roof is located in the electrical room in the adjacent tenant space. The ladder leading to the hatch is missing a safety cage.

2.2.3 Furniture

Existing furniture is legacy furniture throughout. All existing office furniture has reached the end of its life cycle and replacement is recommended to enhance the functional and environmental condition in the office area. The height of the existing cubicle partitions block natural light and access to existing windows from the core area.

It is recommended to meet Enbridge's office standards that the furniture be phased out and replaced with new.

2.2.4 Ontario Building Code – Life Safety

Section 3.2 - Building Fire Safety

The building falls under Part 3, Group F Division 2 and Group D major occupancies.

To meet current Ontario Building Code the building should satisfy the requirements of 3.2.2.71: Group F, Division 2, up to 2 Storeys:

- The building is not required to be sprinklered.
- Standpipe system is not required.
- The building is permitted to be of combustible construction or non-combustible construction used singly or in combination.
- Floor assemblies shall be fire separations and, if of combustible construction, shall have a fire-resistance rating not less than 45 minutes (Not applicable).
- Loadbearing walls, columns, and arches supporting an assembly required to have a fire-resistance rating shall have a fire resistance rating of 45 minutes or shall be of non-combustible construction.

Section 3.8 - Barrier-free Design

3.8.1.3. Barrier-free Path of Travel

3.8.1.3.(1) Every barrier path of travel shall provide an unobstructed width of at least 1100 mm for the passage of wheelchairs.

3.8.1.2. The facility has two entrances. Both entrances are not equipped with barrier-free door operator and none of them qualify as barrier-free entrance. In accordance with article 3.8.1.2, a minimum of one barrier-free entrance to the building is required.

3.8.2.3. Washrooms required being barrier-free

On the main floor there is currently two barrier free washroom stalls located in the male and female washroom areas.

3.8.3.12. Universal (barrier-free) toilet rooms: There is no universal barrier free washroom in the facility. This is considered an existing non-conforming condition for compliance with Ontario Building Code. There is no mandate in the current code to upgrade the existing facility for compliance with the Universal Barrier Free washroom requirements. However in compliance with Part 11 of Ontario Building Code the addition of a universal washroom will be required in the event of extensive renovation in the building.

2.3 Functional and Physical Condition Analysis

WalterFedy utilized a risk management approach taking into consideration the impact of failure of the building component on the long term serviceability of the building as well as the functional requirements associated with the building. Both Facility Condition Indexing (FCI) and Adequacy Indexing (AI) was utilized in order to help make the best possible decision related to the future of the site building and to determine whether or not to invest, maintain, repurpose or dispose of the asset.

FCI:

FCI is a condition index tool used to illustrate the condition of an asset expressed in a percentage ratio of required maintenance/repair costs divided by the replacement value of the asset expressed as:

$$\text{FCI} = (\text{Maintenance and Repair Costs}) / (\text{Cost to Replace the Building})$$

The replacement value of the building is based on industry standards for construction costs. Therefore, the lower a FCI is, the better the condition of the building. The resulting FCI at ten years is 1.61% which is classified as being in good condition.

$$\text{FCI (Barrie)} = (\$44,000) / (10,454 \times 261) = 1.61\%$$

AI:

AI is a condition index tool used to illustrate the functional condition of the asset expressed in a percentage ratio of required functional upgrade costs divided by the replacement value of the asset to meet the functional needs expressed as:

$$\text{AI} = \text{Functional Upgrade Costs} / \text{Cost to Replace the Building with its Functional Equivalent}$$

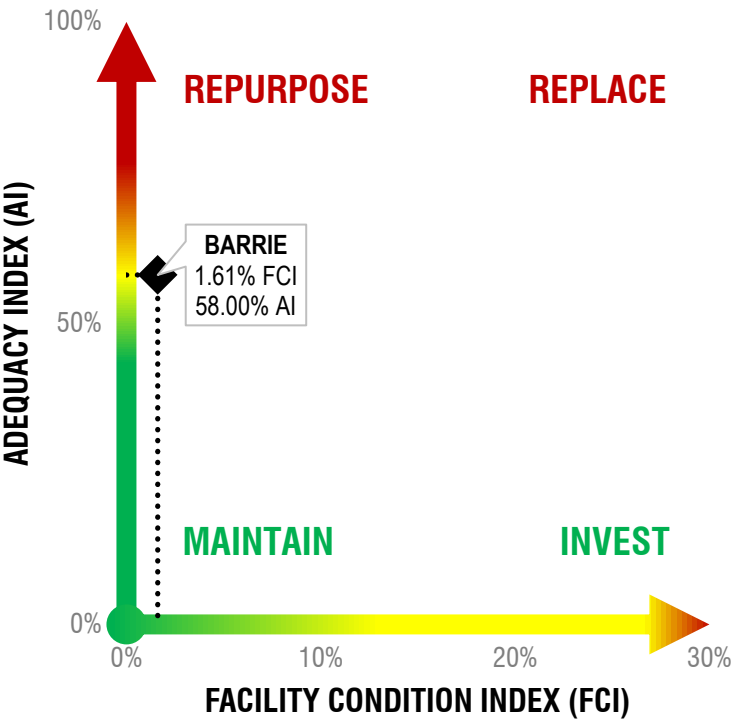
The Adequacy Index for 10 Churchill Drive is calculated by dividing the current functional and physical renewal costs by the cost to replace the building with its functional equivalent size.

The estimated cost to upgrade the facility to current Enbridge GDP standards is estimated at \$2,900,000. The estimated cost to build a new facility to EDG current standards based on \$17,000 SF the area required to accommodate current program is \$9,930,000. This is based on 60% office space at \$350/SF and 40% industrial space at \$200/SF.

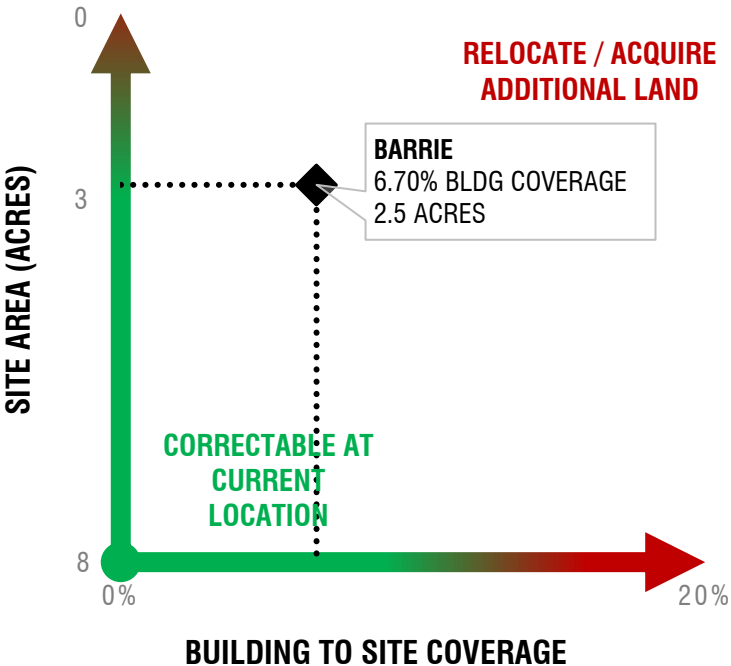
$$\text{AI (Barrie)} = (\$2,900,000) / (\$4,930,000) = 58\%$$

With quantification of FCI and AI for your building, comes the ability to make comparisons between industry benchmarks, and drive decision making related to the future of the property. The chart below shows the relationship between FCI and AI and indicates visually where 10 Churchill drive falls within the decision making criteria.

FACILITY CONDITION &
ADEQUACY GRAPH



SITE CONSTRAINTS
GRAPH



2.4 Key Findings

- PHYSICAL OBSOLESCENCE:

The acceptable Enbridge standard for the physical condition is an FCI of 0 to 5%. The current FCI of the facility based on this study is 1.61% therefore the physical condition of the facility meets Enbridge acceptable standards.

Meets Standards		Correctable at Current Location	
POSITIVE	Negative	POSITIVE	Negative

- FUNCTIONAL OBSOLESCENCE BUILDING :

The acceptable Enbridge GDP standard for the functional condition is 0, anything between 0 to 50% is considered correctable at current location. The current facility AI index is 58%. Based on the FCI/AI graph the current recommendation for the existing facility is to repurpose to accommodate current Enbridge GDP standards.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	Positive	NEGATIVE

- FUNCTIONAL OBSOLESCENCE SITE:

The site does not meet operational requirements for size and vehicular circulation. The yard has only one point of access.

The current yard size is 1.37 acres. Enbridge standard yard size is 2.5 acres. The facility is considered a satellite operations depot and according to staff 1.37 acres is a sufficient yard size for the type of operations in Barrie. It was noted by staff that Enbridge GDP is planning in the future to relocate some staff from Barrie to a satellite depot in Orangeville.

The existing building requires expansion by approximately 10,000 SF to meet current Enbridge GDP standards. Building addition on the property will entail further reduction in the yard and parking areas. Current space pressure can be addressed by relocating staff to a new satellite operations depot in Orangeville and by acquiring the adjacent space currently occupied by the property landlord.

Meets Standards		Correctable at Current Location	
POSITIVE	Negative	POSITIVE	Negative

Overall the existing building is too small to meet current Enbridge GDP standards. The site and building are shared with another tenant and the limited yard area allocated to Enbridge GDP causes operational and work place difficulties and inefficiencies.

The configuration of site functions and circulation is inefficient; only one point of vehicular access to Enbridge yard is provided. Building expansion on the same property will further reduce the size of yard area and will cause additional pressure on parking and circulation.

Based on the site deficiencies and space limitations, expansion into the adjacent space occupied by the landlord is recommended.

2.5 Property Evaluation

An appraisal for the property was not available at the time of the study. The existing property is currently leased by Enbridge GDP. To relocate to another site, Enbridge will vacate the existing site and purchase a site suitable in size to accommodate the program requirements.

The following is a list of comparable industrial properties listed in the market at the time of the study:

Barrie	Cost	Sq. Ft.	Acres	Cost / Sq. Ft.	Cost / Acre	Distance from 10 Churchill Dr, Barrie
720 Bayview Drive, Barrie	\$1,575,000	11,500	3.00	\$136.96	\$525,000	4 min/2.5km
354 Tiffin St, Barrie	\$2,100,000	13,300	1.80	\$157.89	\$1,166,667	10 min/ 7km
124 Brock St, Barrie	\$940,000	12,000	1.00	\$78.33	\$940,000	9 min/ 5.6km

Based on the above list the estimated average value per acre for industrial properties in the area is between \$500,000 to \$1,000,000.

For the purpose of the study an average value of \$700,000 per acre is used based on comparable properties listed in the market at the time of the study.

2.6 Development Scenarios

The following is a comparison of the available options to address the deficiencies at 10 Churchill Drive:

SCENARIO	1	2	3
DESCRIPTION	Correct physical and functional deficiencies by expanding the existing facility on the existing site	Purchase the existing property in its entirety and expand into the adjacent tenant space area.	Relocate from the existing property, purchase a property suitable in size to accommodate the required program. Required size of new property is approximately 5 acres
LAND ACQUISITION	\$-	\$3,500,000	\$3,500,000
LAND SALE PROCEEDS	\$-	\$-	\$-
CONSTRUCTION COST	\$2,900,000*	\$2,585,000**	\$4,930,000**
SOFT COST	\$580,000	\$517,000	\$986,000
FURNITURE	\$390,000	\$390,000	\$390,000
TOTAL	\$3,870,000	\$6,992,000	\$9,806,000
MEETS EDG STANDARDS	NO	YES	YES
PRIORITY		1	2

* Total construction cost is based on \$350/SF for the office area and \$200/SF for the industrial space. Total required gross floor area is 17,000 SF, approximately 10,000 SF addition will be required. 40% industrial space and 60% office, amenity and circulation space is assumed.

** Total construction cost is based on \$350/SF for the office area and \$200/SF for the industrial space. Total required gross floor area is 17,000 SF Existing tenant space available for expansion is 3,500 SF. A unit rate of \$200/SF for renovation cost is used for the available tenant space. The remainder of the required floor area is assumed to be achieved by way of a 6,500 SF addition (40% industrial space at \$200/SF and 60% office, amenity and circulation space at \$350/SF is assumed.)

The total area of the existing building is 10,750 SF of which only 7,350 SF is occupied by Enbridge GDP; the balance of the space is occupied by NPL Canada, the landlord of the facility. The ideal foot print of the building that meets Enbridge GDP standards is approximately 17,000 SF. The existing building area is less than the ideal standard building area. Based on the analysis above, the most cost effective development scenario is for Enbridge to acquire the existing site and expand into the adjacent tenant space area. The site area is sufficient to accommodate an addition on site to allow for additional space area without compromising the parking and yard space.

Enbridge Gas Distribution Inc.
Barrie Regional Operations Centre – Facility Assessment



APPENDIX A

Capital Expenditures Forecast



CAPITAL FORECAST

10 Churchill Drive, Barrie, ON

Operations Depot

The following Capital Plan has been compiled from the following:

- 1 EGD Long Range Capital Plan (LRP)
- 2 EGD/FMG Property Inspection (FMG)
- 3 3rd Party Property Condition Assessment (PCA)
- 4 Non-Functional Standards Assessment - Section 5 (nFSA)
- 5 Electrical Safety Authority Inspection (ESA)
- 6 EGD Quarterly Health/Safety Inspection (HSI)

6 EGD Quarterly Health/Safety Inspection (HSI)			1	2	3	4	5	6	7	8	9	10
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
SECTION	CATEGORY	DEFICIENCY	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD
Maintenance Deficiencies												
	Building Envelope	Recaulk windows and doors										
	HVAC	Allowance to address mens washroom exhaust										
	HVAC	Leak test and repaint natural gas supply system										
	Leasehold Improvements	Retrofit T8 lighting to LED								\$ 20,000		
	Finishes/interiors	Replace water stained ceiling tiles	\$ 1,000									
	Finishes/interiors	Replace office carpeting runners		\$ 3,500								
	Site Work/Exterior Elements	Allowance to repair exit cracked asphalt sections				\$ 5,000						
	Site Work/Exterior Elements	Replace wall mounted site lighting (upgrade to LED)										\$ 5,000
Total Maintenance Deficiencies			\$ 1,000	\$ 3,500	\$ -	\$ 5,000	\$ -	\$ -	\$ -	\$ 20,000	\$ -	\$ 5,000
Cumulative FCI			0.04%	0.16%	0.16%	0.35%	0.35%	0.35%	0.35%	1.08%	1.08%	1.26%
Functional Deficiencies												
	Property acquisition									\$ 3,500,000		
	Building Addition	9,900 sqf addition to accommodate space deficiencies (\$400/sqf)								\$ 775,500	\$ 1,809,500	
	Furniture	Based on \$10,000 per employee allowance									\$ 390,000	
	Soft Costs	20% of Construction Cost								\$ 517,000		
Total Functional Deficiencies			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 4,792,500	\$ 2,199,500	\$ -
Total			\$ 1,000	\$ 3,500	\$ -	\$ 5,000	\$ -	\$ -	\$ -	\$ 4,812,500	\$ 2,199,500	\$ 5,000

Enbridge Gas Distribution Inc.
Barrie Regional Operations Centre – Facility Assessment



APPENDIX B

Program

Operations Depot: BARRIE

Description	Standard # per person	Quantity	Size	Area Factor	Area sq.ft.	Area sq.ft. Current	Area sq.ft. Variance	Notes
General Building Infrastructure								
Main Vestibule	<	1	9 x 5	1.00	45	152	107	
Waiting Area	<	1	9 x 5	1.00	45	88	43	
Rear Entrance	<	1	7 x 5	1.00	35	0	-35	
Showers/Change/Washrooms	31	1	5 x 6	1.00	930	755	-175	
Universal Washroom	1 / floor	1	8 x 10	1.00	80	0	-80	
Janitor	1 / facility	1	6 x 10	1.00	60	24	-36	
Mechanical/Electrical and IT Room	1 / facility	1	12 x 14	1.00	168	71	-97	
Storage					150		-150	
Sub Total					1,513	1,090	-423	
Functional Building Area								
MPO Office	20% of office staff	8	10 x 10	1.00	800	117	-683	1 office
Cubicles Workstations (45 capacity employees)	50% of office staff	20	8 x 6	1.50	1,440	1,201	-239	20 workstations
Meeting Room (8-10 people) 1/70 staff	1 per 70	1	16 x 11	1.50	264	188	-76	
Mustering Room(1chair/person) +1 HR workstation with connectivity and large TV screen for training	31	1	4 x 5	4.00	2,480	315	-2165	
Break out room (4 people) 1/50 staff	1 per 50	1	10 x 12	1.00	120	0	-120	
Micro Kitchen/Ezone - 1/floor	1/200	1	15 x 20	1.00	300	268	-32	
Hotel Station (2:1 ratio of dynamic staff)	30% of office staff	12	6 x 2.5	1.50	270	606	336	13 Workstations
Print Copy Rm/Mail Room	1/ 100	1			250	33	-217	no dedicated room
Health room - required if there are 200 or more employees on any one shift.	<	0	11 x 10	1.00	0	0	0	
Coat Storage	<	1	2 x 6	1.00	12	12	0	
Gas monitor calibration (1/10 people)		1	8 x 8	1.00	60	12	-48	
Measurement & Regulation Test/ Storage		1	12 x 20	1.00	240	0	-240	
Warehouse (where required by business ops)		1	30 x 77	1.00	2,310	877	-1433	
Free Pick storage	1/Building	1	15 x 10	1.00	150	0	-150	
Locked Storage Room	<	1	10 x 15	1.00	150	0	-150	
Wash Bay / Repair Garage (if fleet exists)	1/Building	1	25 x 50	1.00	1,250	0	-1250	
Welding Bay / Fabrication	1/Building	1	35 x 54	1.00	1,890	957	-933	
Boot wash		1	6 x 10	1.00	60	13	-47	Located in Mustering Room
Washing Machine Area		1	6 x 10	1.00	60	8	-52	Located in Fabrication
Sub Total					12,106	4,607	-7499	
Total Building Area (not including circulation)					13,619	5,697	-7922	
Circulation	29.00%				3,950	1,652	-2297	
Total Building Area (not including out buildings)					17,569	7,349	-10219	

Site	Area sq.ft.	Area sq.ft. Current	Area sq.ft. Variance	
Total Site Area:		226,504		
Site Area Occupied by EGD	108,850	108,850		
Site Area Occupied by Non EDG	117,654	117,654		
Existing Building Coverage (EDG space)	-	7,350		
Future Additional Bldg Coverage	14850	-		
Setbacks and Landscaped Buffers	16200	16,500		
Parking	25000	25,000		
Yard	108,000	60,000	-48000	(1.1 Acre Deficit)
Sub Total	390,554	335,354	-55200	
Site Deficit:			-55200	(1.27 Acre Deficit)

Enbridge Gas Distribution Inc.
Barrie Regional Operations Centre – Facility Assessment



APPENDIX C

Photographs



10 Churchill Drive, Barrie, ON

Appendix B.1

1. Building Exterior



2. Parking Lot



3. Gate



4. Yard



5. Garage



6. Roof





10 Churchill Drive, Barrie, ON

Appendix B.2

1. Carpet



2. Lighting



3. Window Trim



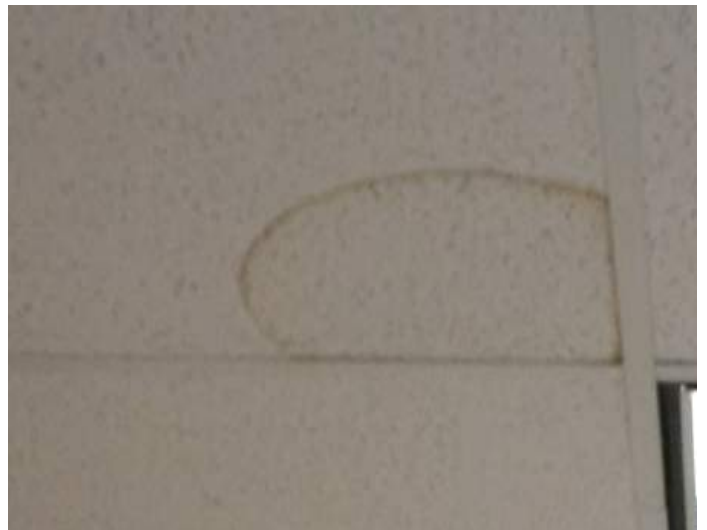
4. Cracked Asphalt



5. Rusting Exterior



6. Stained Ceiling Tile

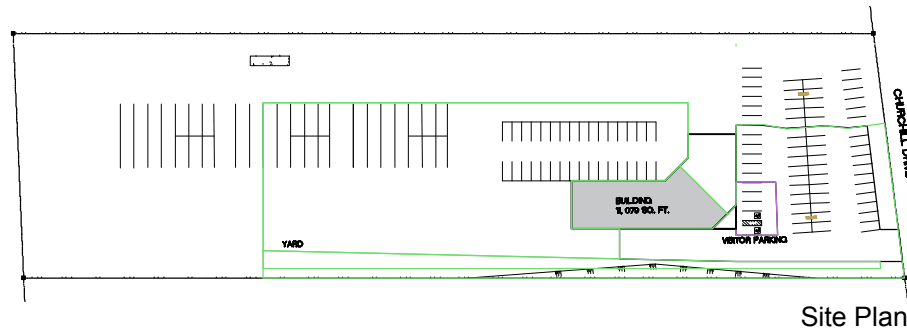


Enbridge Gas Distribution Inc.
Barrie Regional Operations Centre – Facility Assessment



APPENDIX D

Drawings



General Building Infrastructure

- Main Vestibule
- Waiting Area
- Showers-Change
- Janitor
- Mech-Elec

Functional Building Area

- Office-MPO
- Workstations
- Meeting
- Hotel Station
- Micro Kitchen
- Print Mail
- Storage-Coat
- Mustering
- Gas Monitor Calibration
- Warehouse
- Welding Bay Fab
- Boot Wash
- Laundry

MISC.

- Circulation
- Owner's Space

Enbridge Churchill
10 Churchill Drive, Barrie, ON

2016-0613-05



3.09 FACILITY ASSESSMENT

ENBRIDGE GAS DISTRIBUTION INC.

BROCKVILLE OPERATIONS DEPOT

900 Centennial Drive, Brockville, ON

Project No.: 2016-0613-05

REV 1.0 - December 6, 2017

WALTERFEDY

ENBRIDGE GAS DISTRIBUTION INC.

FACILITY ASSESSMENT

Brockville Operations Depot

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1.0 SUMMARY

1.1 Introduction

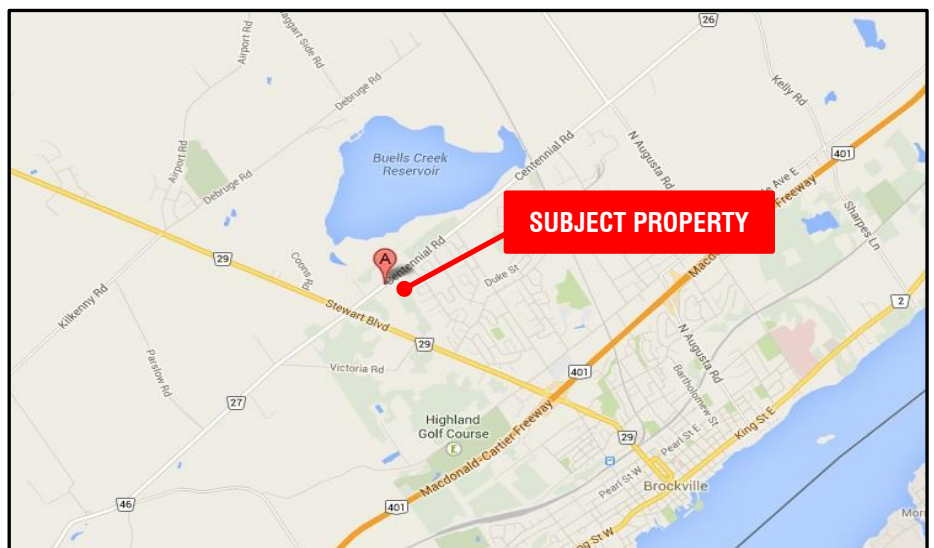
WalterFedy was retained by Enbridge to conduct a physical and functional assessment of the facility located at 900 Centennial Road in Brockville, Ontario for the purpose of identifying functional adequacy and physical renewal requirements for budgeting and planning purposes. The scope of the report includes a general visual inspection of visible civil, architectural, structural, mechanical, and electrical components. It also includes a brief Ontario Building Code (OBC) review to address barrier-free accessibility issues.

Following the initial report, a list of recommendations with estimated costs is provided for corrective and preventive maintenance items required.

1.2 Facility Description

The facility is categorized by Enbridge as Regional Operation Centre. The original building was constructed in 1970. An approximately 0.7 acres gate station is located adjacent to the site on the southwest corner of the site.

The facility is located on Centennial Road at the north boundary of the City of Brockville. The surrounding area is primarily agricultural with residential development to the east and west. The immediate lands to the south remain agricultural. The site is bordered by a Trans-Canada Pipeline easement and Conservation Authority lands to the north. There is a neighbouring property immediately to the east of the site that is currently used as a dog kennel.



1.2.1 Property Summary

1) General:

Owned / Leased:	Owned
FCI score:	7.53%
AI score:	84%
Current Occupancy	7

2) Physical Building Properties:

Gross Floor Area:	4,125± SF
Building	4,125± SF
Office Space:	538± SF
Common Areas:	289± SF
Industrial:	2513± SF
Circulation:	402± SF

3) Site Characteristics:

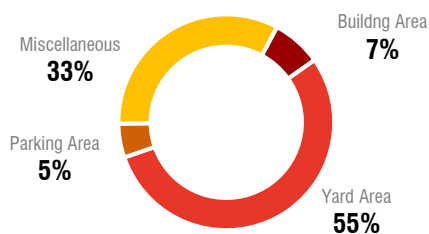
Site Area:	50,141± SF(1.15 Acres)
Building Coverage:	8.2% (4,125 SF)(0.1 Acres)
Yard Area:	30,157 SF (0.69 Acres)
Parking:	2,814 SF (0.06 Acres)
Misc.:	2,105 SF (0.05 Acres)
Gate Station:	10940 SF (0.06 Acres)

4) Zoning:

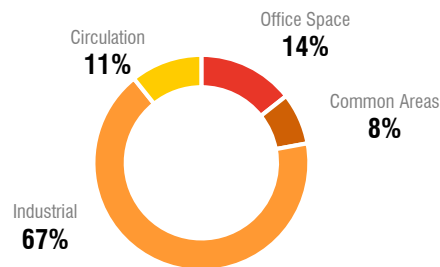
Zone :	I1 – Institutional		
Parking Required	3.5 per 100m ² (1076 SF) : 4		
Parking Provided	16 cars/vans. 8 trucks, 10 equipment		
Loading Provided	1 loading spaces		
Front Yard Depth (minimum)	6.0 meters	Provided	15.0 meters
Side Yard Width (minimum)	4.5 meters	Provided	34.5 meters
Rear Yard Depth (minimum)	7.5 meters	Provided	7.6 meters
Building Height (maximum)	20.0 meters		

5) Building Systems:

HVAC:	Natural gas fired furnace, ceiling mounted unit heaters.
Plumbing:	Domestic well water and septic tank sanitary
Electrical:	200 A/600 V three phase service
Building Automation/Security:	None



SITE AREA DISTRIBUTION



BUILDING AREA DISTRIBUTION

1.3 Scope of Work

The Scope of Work for this assessment was approved by Enbridge and was completed in accordance with WalterFedy's fee proposal dated September 08, 2016.

The scope of work for the Asset Management Report will include a Functional Assessment, a Physical Assessment, and a Market Condition Assessment. The report will provide recommendations for strategic decisions based on the metrics reviewed in the assessments.

1.4 Assessment Methodology

The building condition assessment is based on general visual examination performed on September 21, 2016 by WalterFedy's Architectural and Facility Management departments.

The observations in this report were made using non-destructive methods through existing access points. Existing drawings provided by Enbridge for the building were also used to supplement site observations.

The guiding principles of this study is based upon the document from the National Research Council of Canada (NRC) "Protocols for Building Condition Assessment" published by The Institute For Research in Construction (IRC).

1.5 Limitation of Study

This assessment is based on our general review and walkthrough of the facility and it is not intended to form a detailed life safety analysis or Ontario Building Code and Fire Code assessment. The facility was built in 1960 and is not in compliance with current Ontario Building Code and Fire Code. It is recommended that a further detailed life safety review and assessment is carried out to determine what building systems upgrades would be required to meet the requirements of Section 9.2 of Ontario Fire Code to the satisfaction of the Fire Department.

This report was completed in accordance with the approved scope of work as described in Section 1.3. This report is limited and is not intended to be comprehensive or exhaustive, or to suggest a risk-free facility. The report may not address all existing issues associated with the facility and may omit issues that are or may be of interest to the Owner. The findings and statements in this report are based on general site observations of the current conditions as they existed during the time period of the investigation.

The purpose of this report is for the sole use of the Owner for budgetary planning purposes. Issues identified in this report require further detailed assessments to determine repair and maintenance work required. This report should not be used by third parties involved in any work related to the facility; such third parties should undertake their own investigations and studies to determine how the existing condition of the facility will affect their plans and work. WalterFedy accepts no responsibility for liabilities incurred by or damages suffered by any third party as a result of decisions made or actions taken, based upon this report.

The passage of time might affect the views, conclusions and recommendations provided in this report.

The following report is a general guide only and is not intended to be used as a document for construction.

This study does not include hazardous materials review or inspection.

2.0 PHYSICAL AND FUNCTIONAL ASSESSMENT

2.1 Physical Assessment

2.1.1 Site and Landscaping

The site is a near rectangular-shaped property. The site building occupies approximately 8.2% of the site.

The remainder of the site is occupied by asphalt pavement parking areas, cast-in-place concrete paving, concrete curbs, a perimeter fence with powered access gates and areas of soft landscaping (i.e. grass, shrubs, and trees). Wall mounted lighting units provide illumination for the site. During the site visit the asphalt paved areas were noted to be in good condition overall with the exception of the interface where the property meets Centennial road. In that localized area there was severe deterioration and ponding. Site lighting was replaced last year with LED fixtures for improved energy performance. Repair of the deteriorated asphalt section at the front of the property is recommended in the early term of the analysis.

The property is secured by a five-foot chain link fence along the perimeter of the property. The fence has one operable gate accessed from Centennial Road.

Since the inspection was limited to visible areas no examination of the catch basins was performed and no review of the initial compliance with code was performed. The inspection of underground or concealed components is outside the scope of work.

2.1.2 Mechanical

Heating and cooling for the office area is provided by direct fired natural gas heated and electrically cooled Luxaire furnace. Cooling for the furnace is provided by an exterior pad mounted Lennox unit (M/N – BRC50361BDG, S/N – WA5420623) with an approximate cooling capacity of 3.5 Tons. Based on the name plate data on the condenser unit (nameplate data on the furnace was not accessible) the furnace and condenser unit are both at least ten years old. The expected projected useful life of furnaces and condenser units typically fall between 10 to 15 years. Therefore, based on age replacement is recommend within the term of this analysis.

Supplementary heating for warehouse area is provided by two Lennox natural gas fired forced air ceiling mounted unit heaters. The unit heater at the back portion of the warehouse was replaced last year whereas the unit heater located in the mid portion of the warehouse is at least 10 years old. Based on age and observed condition, replacement of the one unit heater, the furnace and the exterior condenser unit is recommended within the evaluation period.

Domestic Hot Water (“DHW”) within the site building is provided by a Giant domestic hot water tank (M/N – UG40-38LF-N1U, S/N – 7577488) located in the warehouse area. Based on the name plate data on the equipment, the unit was installed last year.

There was reportedly no shortage of DHW within the site building. Based on WalterFedy's experience the anticipated service life of a DHW is typically 10-15 years. Therefore based on age, replacement should not be required within the term of analysis.

2.1.3 Electrical

The electrical power for the site building is supplied from a pole-mounted transformer. The buildings electrical room has a main 200 Ampere, 347/600 Volt, 3 phase breaker panel and electric service. The breakers provide power through copper wire conduit to the various lighting and receptacle unit distribution panels throughout the site building.

Interior lighting is predominately provided by T8 fluorescent T8 tube lighting fixtures. As a leasehold improvement consideration should be given for an LED retrofit.

Combination battery pack units provide emergency lighting and exit signage within egress pathways. An allowance to replace three battery pack units has been included within the term of the analysis.

2.1.4 Structural

As outlined in the scope of work, a limited visual assessment of the condition of the structural elements was carried out on the elements which were visible at the time of the inspection. The site building a slab on grade structure. The superstructure of the site building is comprised of corrugated sheet metal exterior walls, wood columns, wood joists and a steel roof deck. No major visually identifiable structural deficiencies were noted at the time of the site inspection.

2.1.5 Building Envelope

The roof system atop the site building consists of corrugated sheet metal pitched roof system. Neither the presence of a vapour barrier, nor the type or the thickness of the insulation could be verified, as the scope of the work did not include destructive testing.

Drainage of the roof system is provided by perimeter eaves troughs which presumably drain to site.

Penetrations through the roof system include plumbing stacks, an exhaust vent stack, and service penetrations.

The exterior walls of the site building consist of corrugated sheet metal cladding.

The window systems of the site building consist of fixed insulated glazed units (“IGU”) set within aluminum frames in punched configurations. Exterior doors serving the site building are comprised of single glazed units set into metal frames. Metal doors within metal frames were observed serving the warehouse egresses and of the site building. Two sectional metal overhead doors, were noted serving the warehouse areas. Replacement of windows within the office and warehouse areas are recommended based on age and observed condition.

2.1.6 Finishes

The floor finishes within the site building consist of unsealed concrete slab-on-grade, ceramic and resilient floor tiles. The wall finishes within the site building consist of painted gypsum board and unfinished plywood sheathing. The ceiling finishes within the site building primarily consist of exposed structure, and painted suspended ceiling tile.

2.2 Functional Assessment

2.2.1 Site

The property is located at 900 Centennial Road, Brockville, ON divided into two separate parts. The first part consists of an approximately 0.2 acres completely fenced off and secure gate station and is located adjacent to the site on the southwest corner. The remainder of the site consists of 1.2 acres and is used as operations depo.

The following functional deficiencies were observed during the walkthrough:

- There is one operational access for trucks and yard traffic.
- The parking for visitors and employees can be characterised as on street parking directly off Centennial Road, this creates an unsafe condition for entering and accessing the site for visitors and employees. It is recommended that the parking be revised to provide a safe entry/exit to the site, in accordance with Enbridge design standards. It was noted that there was plans in the works to revise the parking to provide a safer visitor and employee parking lot in front of the gate station.
- There is water drainage and grading issues at the front of the facility along Centennial Road. It is recommended that this be addressed as soon as possible. This area creates an unsafe environment for employees and visitors. It was noted by Building Systems Facilities Services Supervisor that there was currently a plan in place to address these issues.
- It is recommended that a minimum of one exit door with panic hardware be added to the fence along Centennial Road.
- There is a small outdoor lunch area outside of the existing mustering room, situated over the location of the existing septic tank. There is a pipe to service the septic tank that poses a tripping hazard. It is recommended that the outdoor eating area be relocated to a more suitable location and that planting be proposed over the area of the septic tank.
- No camera security.
- Gate access is key pad and entrance doors are key locks rather than card access.

2.2.2 Interior Space Planning

The building consists of office space, amenity areas and a warehouse. The following are functional deficiencies observed during the walkthrough:

- The janitor room is tight and additional space is recommended.
- There is not a wash bay at this site; the wash area is located outside in the yard.
- A separate boot wash and washing machine area is required. There is no boot wash in the facility and the washing machine is currently located in the warehouse.
- A separate locker room is required. The locker room is currently located in the warehouse.
- The photocopier and filing cabinets/mail slots are all located in the main corridor. The location is not suitable and it affects the circulation in the corridor, and creates a safety issue. A separate photocopier room/area is recommended.
- The mustering room and kitchenette occupy the same space. The current mustering room does not meet Enbridge's current standards.
- There is no access to day light in the warehouse area.
- One private office does not have access to daylight.
- The plotter occupies the same space as the M.E.T Meter Readers. It is suggested that these functions be separated and the plotter be part of a single print/copy room/area.
- Overall the building is too small to meet Enbridge's current standards. Refer to appendix C for a complete programmatic breakdown.

2.2.3 Furniture

Existing furniture is legacy furniture throughout. All existing office furniture has reached the end of its life cycle and replacement is recommended to enhance the functional and environmental condition in the office area. It is recommended to meet Enbridge's office standards that the furniture be phased out and replaced with new.

2.2.4 Ontario Building Code – Life Safety

Section 3.2 - Building Fire Safety

The building falls under Part 3, Group F Division 2 and Group D major occupancies.

To meet current Ontario Building Code the building should satisfy the requirements of 3.2.2.71: Group F, Division 2, up to 2 Storeys:

- The building is not required to be sprinklered
- Standpipe system is not required.
- The building is permitted to be of combustible construction or non-combustible construction used singly or in combination, and,
- Floor assemblies shall be fire separations and, if of combustible construction, shall have a fire-resistance rating not less than 45 minutes (Not applicable).
- Loadbearing walls, columns, and arches supporting an assembly required to have a fire-resistance rating shall have a fire resistance rating of 45 minutes or shall be of non-combustible construction.

Section 3.8 - Barrier-free Design

3.8.1.2. The facility has two entrances, both entrances are not equipped with barrier free door operator nor do they qualify as barrier free entrance. In accordance with article 3.8.1.2, a minimum of one barrier-free entrance to the building is required.

3.8.2.3. Washrooms required to be barrier-free.

Of the two washrooms in the facility, only one can be classified as meeting the requirements of barrier-free design outlined in 3.8.2.3.

3.8.3.12. Universal (barrier-free) toilet rooms: There is currently not a universal washroom in the facility in general compliance with 3.8.3.12.

Section 3.6.2. Service Rooms

3.6.2.1. Fuel-fired appliances shall be installed in service rooms separated from the remainder of the building by fire separations having a fire-resistance rating not less than 1 h: The washing machine and dryer located in the warehouse are fuel fired appliances and should be enclosed within a room having a fire resistance rating as outlined here in 3.6.2.1.

The water heater that is suspended in the warehouse servicing the facility is also fuel fired and is required to be separated for the remainder of the building as outlined in this section.

2.3 Functional and Physical Condition Analysis

WalterFedy utilized a risk management approach taking into consideration the impact of failure of the building component on the long term serviceability of the building as well as the functional requirements associated with the building. Both Facility Condition Indexing (FCI) and Adequacy Indexing (AI) was utilized in order to help make the best possible decision related to the future of the site building and to determine whether or not to invest, maintain, repurpose or dispose of the asset.

FCI:

FCI is a condition index tool used to illustrate the condition of an asset expressed in a percentage ratio of required maintenance/repair costs divided by the replacement value of the asset expressed as:

$$\text{FCI} = (\text{Maintenance and Repair Costs}) / (\text{Cost to Replace the Building})$$

The replacement value of the building is based on industry standards for construction costs. Therefore, the lower a FCI is, the better the condition of the building. The resulting FCI at ten years is 7.53% which is classified as being in fair condition.

$$\text{FCI (Brockville)} = (\$56,000) / (3,952 \times 187) = 7.53\%$$

AI:

AI is a condition index tool used to illustrate the functional condition of the asset expressed in a percentage ratio of required functional upgrade costs divided by the replacement value of the asset to meet the functional needs expressed as:

$$\text{AI} = \text{Functional Upgrade Costs} / \text{Cost to Replace the Building with its Functional Equivalent}$$

The Adequacy Index for Brockville Operations Depot is calculated by dividing the current functional and physical renewal costs by the cost to replace the building with its functional equivalent size.

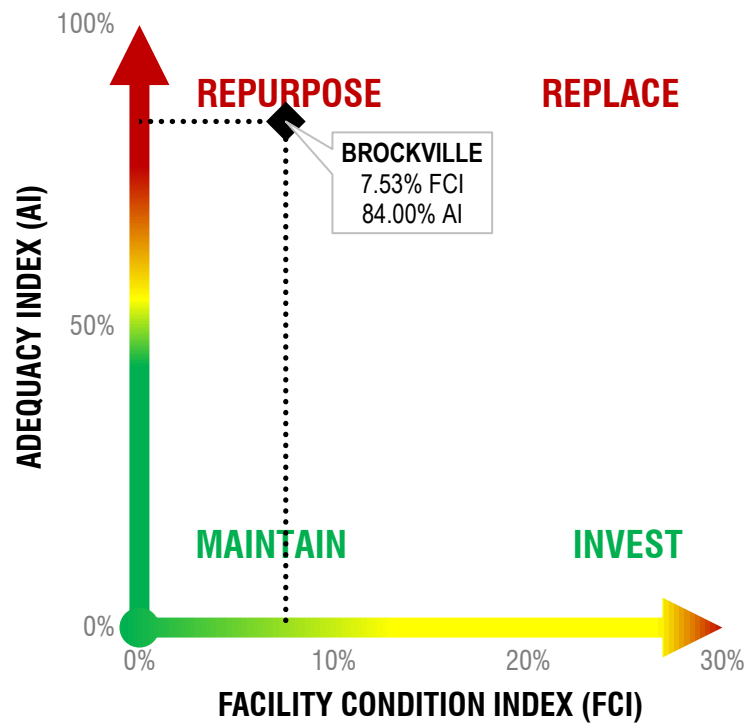
The cost to upgrade the facility to current Enbridge GDP standards is estimated at \$2,450,000. This is based on complete renovation of the existing building , approximately 4,000 SF with a renovation estimated cost of \$250/SF and the construction of a new addition of 5,000 SF based on 60% office space at \$350/SF and 40% industrial space at \$200/SF.

The estimated cost to build a new facility to Enbridge GDP current standards based on 10,000 sqf the area required to accommodate current program, 60% office space and 40% industrial space is \$2,900,000.

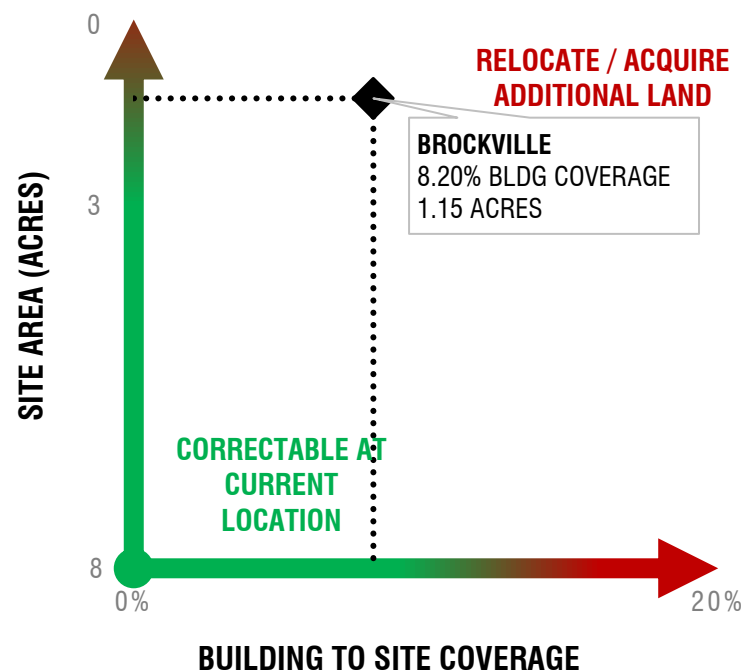
$$\text{AI (Brockville)} = (\$2,450,000) / (2,900,000) = 84\%$$

With quantification of FCI and AI for your building, comes the ability to make comparisons between industry benchmarks, and drive decision making related to the future of the property. The chart below shows the relationship between FCI and AI and indicates visually where Brockville Road operations depot falls within the decision making criteria.

FACILITY CONDITION &
ADEQUACY GRAPH



SITE CONSTRAINTS
GRAPH



2.4 Key Findings

- PHYSICAL OBSOLESCENCE:

The acceptable Enbridge standard for the physical condition is an FCI of 0 to 5%. The current FCI of the facility based on this study is 7.53% therefore the physical condition of the facility does not meet Enbridge acceptable standards.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	Positive	NEGATIVE

- FUNCTIONAL OBSOLESCENCE BUILDING :

The acceptable Enbridge standard for the functional condition is 0, anything between 0 to 50% is considered correctable at current location. The current facility AI index is 84% which is considered correctable at current location without consideration of other factors including adequacy of land size and the FCI index.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	Positive	NEGATIVE

- FUNCTIONAL OBSOLESCENCE SITE:

The site does not meet operational requirements for size and vehicular circulation.

The yard size is smaller than Enbridge standard yard size requirements. The current yard size is 0.69 acres. Enbridge standard yard size is 2.5 acres.

The existing building requires expansion by approximately 6,000 sqft to meet the need for current staff and Enbridge functional requirements. Building addition on the property will entail further reduction in the yard and parking areas.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	Positive	NEGATIVE

Overall the existing building is too small to meet current Enbridge Gas Distribution standards. The undersized spaces, lack of proper locker rooms, lunch room, and mustering room are not convenient for staff and causes operational and work place difficulties and inefficiencies.

The configuration of site functions and circulation is inefficient and poses a safety hazard. The yard area is too small to meet current EGD standards. Building expansion on the same property will further reduce the size of yard area making it unusable and will impose additional pressure on parking and circulation.

Based on the site deficiencies and space limitations, relocation to another property is recommended. Although the FCI and AI graph indicates recommendation to maintain and repurpose the existing facility, the site deficiencies including space limitations and inefficiencies will prevent the option of expanding the existing building on the same property and no opportunity to acquire additional lands. The site is bounded to the northwest by an Ontario Hydro transformer site, to the north by environmentally protected lands, and by roads to the southwest and southeast. Notwithstanding that there is a gate station on site. This facility is recommended for relocation.

2.5 Property Evaluation

In 2013 MPAC completed appraisal report on the property 900 Centennial Road, appraised the property between \$250,00 to \$300,000.

At the time of this study there was not any comparable industrial properties listed in the market for the Brockville area.

At the time of the study there were no available industrial properties with suitable location in the service area, therefore the option to relocate to a new site was not investigated. Based on discussions with Enbridge staff an estimated value of \$260, 000 per acre is used in development scenarios 2. Further market analysis study is required to confirm.

2.6 Development Scenarios

The following is a comparison of the available options to address the deficiencies at 900 Centennial Road:

SCENARIO	1	2
DESCRIPTION	Correct physical and functional deficiencies by expanding the existing facility on the existing site and completely renovating the interior.	Sell the existing property, purchase a property suitable in size to accommodate the required program. Required size of new property is approximately 5 acres
LAND ACQUISITION	\$ -	\$1,300,000
LAND SALE PROCEEDS	\$ -	\$150,000*
CONSTRUCTION COST	\$2,450,000***	\$2,900,000**
SOFT COST	\$490,000	\$580,000
FURNITURE	\$70,000	\$70,000
TOTAL	\$3,010,000	\$4,700,000
MEETS EDG STANDARDS	NO	YES
PRIORITY	2	1

* Land sale proceeds is equal to 50% of the actual property evaluation/sale price. This is based on the “rate base split”/Enbridge portion of proceeds.

** Total construction cost is based on \$350/SF for the office area and \$200/SF for the industrial space. Total required gross floor area is 10,000 SF; 40% industrial space and 60% office, amenity and circulation space is assumed.

*** Based on a 4,000 sqf interior renovation to the existing building at \$250/SF and 5,000 SF addition (40% industrial space at \$200/SF and 60% office space at \$350/SF).



APPENDIX A

Capital Expenditures Forecast



CAPITAL FORECAST

900 Centennial Road, Brockville, ON

Regional Operations Centre

The following Capital Plan has been compiled from the following:

- 1 EGD Long Range Capital Plan (LRP)
- 2 EGD/FMG Property Inspection (FMG)
- 3 3rd Party Property Condition Assessment (PCA)
- 4 Non-Functional Standards Assessment - Section 5 (nFSA)
- 5 Electrical Safety Authority Inspection (ESA)
- 6 EGD Quarterly Health/Safety Inspection (HSI)

			1	2	3	4	5	6	7	8	9	10
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
SECTION	CATEGORY	DEFICIENCY	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD
Maintenance Deficiencies												
	Building Envelope	Window replacement									\$ 10,000	\$ 10,000
	HVAC	Replace Unit Heater					\$ 4,500					
	HVAC	Replace furnace unit						\$ 6,500				
	HVAC	Replace condenser Unit						\$ 5,500				
	Leasehold Improvements	Retrofit T8 lighting to LED			\$ 12,500							
	Life/Safety	Allowace for exit signage/emergency light unit replacement (~3 units)							\$ 1,650			
	Site Work/Exterior Elements	Allowance for asphalt repair along entrance laneway				\$ 5,000						
Total Maintenance Deficiencies			\$ -	\$ -	\$ 12,500	\$ 5,000	\$ 4,500	\$ 12,000	\$ 1,650	\$ -	\$ 10,000	\$ 10,000
Cummulative FCI			0.00%	0.00%	1.69%	2.37%	2.98%	4.60%	4.82%	4.82%	6.18%	7.53%
Functional Deficiencies												
	Land Acquisition						\$ 1,300,000					
	New Building	10,000 sqf					\$ 870,000	\$ 2,030,000				
	Soft Costs	20% of Construction Cost					\$ 174,000	\$ 406,000				
	Furniture	Based on \$10,000 per employee					\$ -	\$ 70,000				
Total Functional Deficiencies			\$ -	\$ -	\$ -	\$ -	\$ 2,344,000	\$ 2,506,000	\$ -	\$ -	\$ -	\$ -
Total			\$ -	\$ -	\$ 12,500	\$ 5,000	\$ 2,348,500	\$ 2,518,000	\$ 1,650	\$ -	\$ 10,000	\$ 10,000



APPENDIX B

Photographs



900 Centennial Road, Brockville, ON

Appendix B.1

1. Building Exterior



2. Building Rear Exterior



3. Garage Working Area



4. Gate



5. Office



6. Yard





900 Centennial Road, Brockville, ON

Appendix B.2

1. Interior Lighting



2. Asphalt Next to Front Entrance



3. Side Exit Door



4. Unit



5. Condenser Unit



6. Window





APPENDIX C

Program

Operations Depot: Brockville

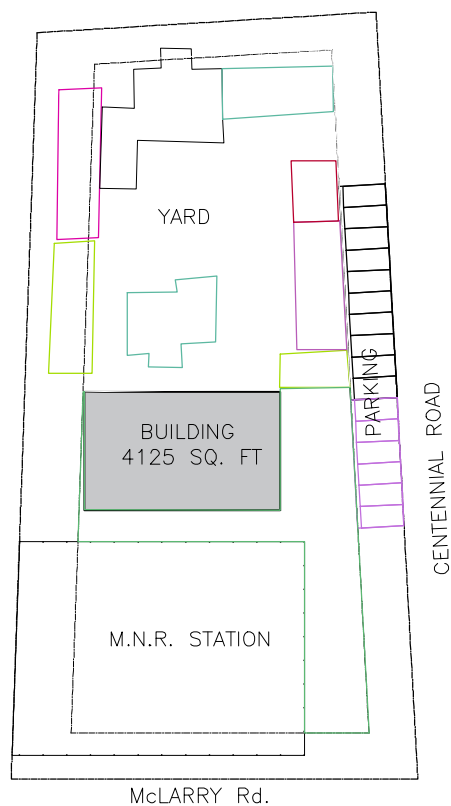
Description	Standard # per person	Quantity	Size	Area Factor	Area sq.ft.	Area sq.ft. Current	Area sq.ft. Variance	Notes
General Building Infrastructure								
Main Vestibule	<	1	9 x 5	1.00	45	53	8	
Waiting Area	<	1	9 x 5	1.00	45		-45	
Rear Entrance	<	1	7 x 5	1.00	35		-35	
Showers/Change/Washrooms	2	1	5 x 6	1.00	60		-60	
Universal Washroom	1 / floor	1	8 x 10	1.00	80	145	65	
Janitor	1 / facility	1	6 x 10	1.00	60	18	-42	
Mechanical/Electrical and IT Room	1 / facility	1	12 x 14	1.00	168	73	-95	
Storage					100		-100	
Sub Total					593	289	-304	
Functional Building Area								
MPO Office	20% of office staff	2	10 x 10	1.00	200	362	162	3 offices
Cubicles Workstations (4 capacity employees actual employees 7)	50% of office staff	4	8 x 6	1.50	288		-288	
Meeting Room (8-10 people) 1/70 staff	1 per 70	1	16 x 11	1.50	264		-264	
Mustering Room(1chair/person) +1 HR workstation with connectivity and large TV screen for training	10	1	4 x 5	4.00	800	259	-541	
Break out room (4 people) 1/50 staff	1 per 50	1	10 x 12	1.00	120		-120	
Micro Kitchen/Ezone - 1/floor	1/200	1	15 x 20	1.00	300	289	-11	
Hotel Station (2:1 ratio of dynamic staff)	30% of office staff	1	6 x 2.5	1.50	23		-23	
Print Copy Rm/Mail Room	1/ 100				250		-250	
Health room - required if three are 200 or more employees on any one shift.	<	0	11 x 10	1.00	0		0	
Coat Storage	<	1	2 x 6	1.00	12	11	-1	
Gas monitor calibration (1/10 people)		1	8 x 8	1.00	60	86	26	
Measurement & Regulation Test/ Storage		1	12 x 20	1.00	240		-240	
Warehouse (where required by business ops)		1	30 x 77	1.00	2,310	1,389	-921	
Free Pick storage	1/Building	1	15 x 10	1.00	150		-150	
Locked Storage Room	<	1	10 x 15	1.00	150		-150	
Wash Bay / Repair Garage(if fleet exists)	1/Building	1	25 x 50	1.00	1,250	1,017	-233	
Welding Bay / Fabrication	1/Building	1	35 x 54	1.00	1,890		-1890	
Boot wash		1	6 x 10	1.00	60		-60	
Washing Machine Area		1	6 x 10	1.00	60	21	-39	within warehouse
Sub Total					8,427	3,434	-4993	
Total Building Area (not including circulation)					9,020	3,723	-5297	
Circulation	10.80%				974	402	-572	
Total Building Area (not including out buildings)					9,994	4,125	-5869	

Site								
Total Site Area:						50,141		
Setbacks		per by-law requirments				13,008		Storage within setbacks on much of site-Available to yard
Building Area		per site				4,125		
Future Buildng Expansion		deficit of site program above				5,869	0	-5869
Landscaping		per site					5,243	
M&R Station		unique to site location					7,802	not including area included within setback
Staff Parking	1 per employee	7	9 x 18	1.00	1,134	1,759	625	10 spaces
Visitor Parking	<	6	9 x 18	1.00	972	1,055	83	6 spaces
Sub Total					7,975	19,984	-5161	
Available Yard Area:					108,900	30,157	-78743	Based on minimum 2.5 acres required
Site Deficit:							-83904	

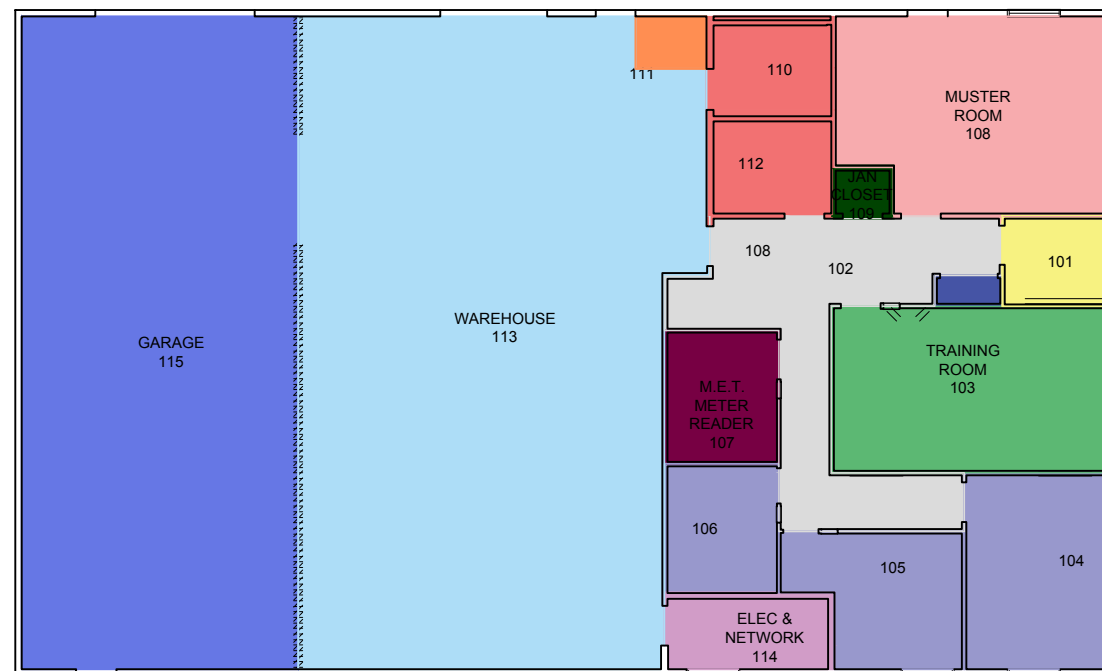


APPENDIX D

Drawings



Site Plan



General Building Infrastructure

- Main Vestibule
- Office Washrooms
- Janitor
- Mech-Elec

Functional Building Area

- Office-MPO
- Micro Kitchen
- Storage-Coat
- Mustering
- Gas Monitor Calibration
- Warehouse
- Wash-Repair Bay
- Laundry

MISC.

- Circulation

Floor Plan



Enbridge Brockville
900 Centennial Drive, Brockville, ON

2016-0613-05



3.07 FACILITY ASSESSMENT

ENBRIDGE GAS DISTRIBUTION INC.

ARNPRIOR OPERATIONS DEPOT

249 Baskin Drive, Arnprior, ON
Project No.: 2016-0613-05

REV 1.0 - December 6, 2017

WALTERFEDY

ENBRIDGE GAS DISTRIBUTION INC.

FACILITY ASSESSMENT

Arnprior Operations Depot

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1.0 SUMMARY

1.1 Introduction

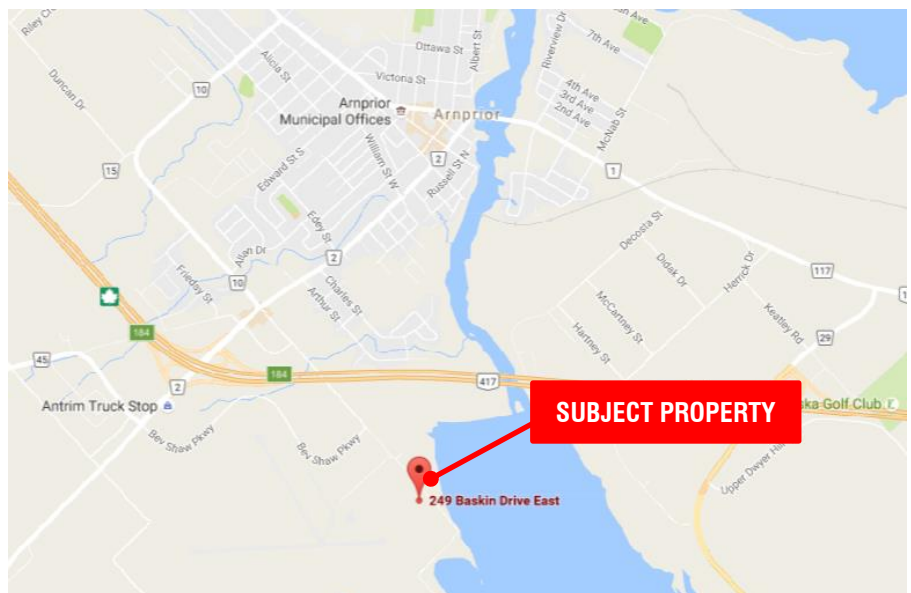
WalterFedy was retained by Enbridge GDP to conduct a physical and functional assessment of the facility located at 249 Baskin Drive in Arnprior, Ontario for the purpose of identifying functional adequacy and physical renewal requirements for budgeting and planning purposes. The scope of the report includes a general visual inspection of visible civil, architectural, structural, mechanical, and electrical components. It also includes a brief Ontario Building Code (OBC) review to address barrier-free accessibility issues.

Following the initial report, a list of recommendations with estimated costs is provided for corrective and preventive maintenance items required.

1.2 Facility Description

The facility is categorized by Enbridge as an Operations Depot. The original building was constructed in 1970.

The facility is located on Baskin Drive East, on the Southeast boundary of Arnprior. The surrounding area is primarily agriculture, with industrial and storage area in the immediate abutting area. Lake Madawaska lies to the southeast of the site, with Renfrew Municipal Airfield on the west. The Trans-Canada Highway (417) is approximately 1km north of the site.



Enbridge Gas Distribution Inc.
 Arnprior Operations Depot – Facility Assessment

2

1.2.1 Property Summary

1) General:

Owned / Leased:	Owned
FCI scope:	3.82%
AI scope:	58%
Current Occupancy:	7

2) Physical Building Properties:

Gross Floor Area:	4,711 ±SF
Building Area (main Building):	4,711 ±SF
Building Area (storage Building):	5,000 ±SF
Office Space:	1,939 ±SF
Common Areas:	844 ±SF
Industrial:	2,308 ±SF
Circulation:	464 ±SF

3) Site Characteristics:

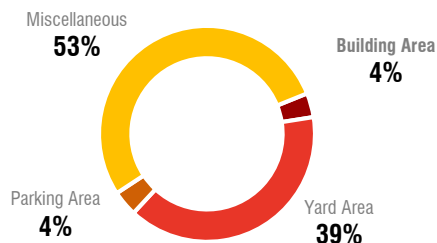
Site Area:	268,179 ±SF (6.15 Acres)
Building Coverage:	3.6% (9,711± SF 0.22 Acres)
Main Bldg + Storage Bldg:	(4,711+ 5000 ± SF)
Yard Area:	105,646 ±SF (2.5 Acres)
Parking:	10,260 ±SF
Misc.:	142,487 ±SF

4) Zoning:

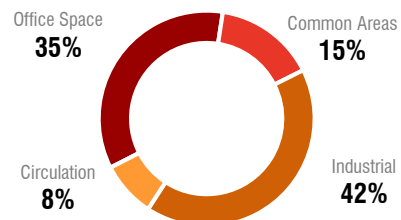
Zone :	Airport (A) Zone		
Parking Required	1 per 100m ² (4,711 ±SF)		
Parking Provided	14±		
Loading Required	1 loading space for 1500 m ²		
Loading Provided	1 loading spaces		
Front Yard Depth (minimum)	15.0 meters	Provided	28.0 meters
Side Yard Width (minimum)	10.0 meters	Provided	55.5 meters
Rear Yard Depth (minimum)	15.0 meters	Provided	71.3 meters
Lot Coverage (maximum)	30%	Provided	3.6%
Building Height (maximum)	20.0 meters		

5) Building Systems:

HVAC:	Furnaces, condenser units, ceiling mounted unit heaters
Plumbing:	Municipal water main owned by Enbridge. Part of the road in front of the building
Electrical:	200 A/600 V three phase service
Building Automation/Security:	None



SITE AREA DISTRIBUTION



BUILDING AREA DISTRIBUTION

1.3 Scope of Work

The Scope of Work for this assessment was approved by Enbridge and was completed in accordance with WalterFedy's fee proposal dated September 08, 2016.

The scope of work for the Asset Management Report will include a Functional Assessment, a Physical Assessment, and a Market Condition Assessment. The report will provide recommendations for strategic decisions based on the metrics reviewed in the assessments.

1.4 Assessment Methodology

The building condition assessment is based on general visual examination performed on September 21, 2016 by WalterFedy's Architectural and Facility Management departments.

The observations in this report were made using non-destructive methods through existing access points. Existing drawings provided by Enbridge for the building were also used to supplement site observations.

The guiding principles of this study is based upon the document from the National Research Council of Canada (NRC) "Protocols for Building Condition Assessment" published by The Institute For Research in Construction (IRC).

1.5 Limitation of Study

This assessment is based on our general review and walkthrough of the facility and it is not intended to form a detailed life safety analysis or Ontario Building and Fire Code assessment. The facility was built in 1970 and is not in compliance with current Ontario Building and Fire Codes. It is recommended that a further detailed life safety review and assessment is carried out to determine what building systems upgrades would be required to meet the requirements of Section 9.2 of Ontario Fire Code to the satisfaction of the Fire Department.

This report was completed in accordance with the approved scope of work as described in Section 1.3. This report is limited and is not intended to be comprehensive or exhaustive, or to suggest a risk-free facility. The report may not address all existing issues associated with the facility and may omit issues that are or may be of interest to the Owner. The findings and statements in this report are based on general site observations of the current conditions as they existed during the time period of the investigation.

The purpose of this report is for the sole use of the Owner for budgetary planning purposes. Issues identified in this report require further detailed assessments to determine repair and maintenance work required. This report should not be used by third parties involved in any work related to the facility; such third parties should undertake their own investigations and studies to determine how the existing condition of the facility will affect their plans and work. WalterFedy accepts no responsibility for liabilities incurred by or damages suffered by any third party as a result of decisions made or actions taken, based upon this report.

The passage of time might affect the views, conclusions and recommendations provided in this report.

The following report is a general guide only and is not intended to be used as a document for construction.

This study does not include hazardous materials review or inspection.

2.0 PHYSICAL AND FUNCTIONAL ASSESSMENT

2.1 Physical Assessment

2.1.1 Site and Landscaping

The site is a near rectangular-shaped property. The site building occupies approximately 3.6% of the site.

The remainder of the site is occupied by asphalt pavement parking areas, cast-in-place concrete paving, concrete curbs, a perimeter fence with powered access gates and areas of soft landscaping (i.e. grass, shrubs, and trees). Wall mounted lighting units provide illumination for the site. During the site visit the asphalt paved areas were noted to be in good condition at the back portion of the property and deteriorated at the front portion with alligator and longitudinal cracking along the lane way and visitor parking area. Site lighting is aged and consideration should be given to replacing the wall pack units and the remaining light standard (one of two light standards have been upgraded) at the back of the property with LED fixtures for improved energy performance.

The property is secured by a five-foot chain link fence along the perimeter of the property. The fence has two operable gates at each of the entrances.

Since the inspection was limited to visible areas no examination of the catch basins was performed and no review of the initial compliance with code was performed. The inspection of underground or concealed components is outside the scope of work.

2.1.2 Mechanical

Heating and cooling for the office area is provided by two direct fired natural gas heated and electrically cooled Lennox Elite Series furnaces. Cooling for the furnaces is provided by two exterior pad mounted Lennox units with an approximate cooling capacity of 3.5 Tons each. Name plate data on the furnaces and condenser units was not accessible but based on discussion with the site representative, the furnaces and condenser units are both at least ten years old. The expected projected useful life of furnaces and condenser units typically fall between 10 to 15 years. Therefore, based on age replacement is recommend within the term of this analysis.

Supplementary heating for warehouse area is provided by four Lennox natural gas fired forced air ceiling mounted unit heaters. Name plate data on the unit heaters was not accessible but based on discussion with the site representative the units have all been replaced within the last two years. Therefore based on age and observed condition, replacement of only the two furnaces and the two exterior condenser units is recommended within the evaluation period.

Domestic Hot Water ("DHW") within the site building is provided by a Giant domestic hot water tank (M/N – UG40-38LF-N1U, S/N – C00113851) located in the warehouse area. Based on the name plate data on the equipment the unit was installed last year.

There was reportedly no shortage of DHW within the site building. Based on WalterFedy's experience the anticipated service life of a DHW is typically 10-15 years. Therefore based on age, replacement should not be required within the term of analysis.

2.1.3 Electrical

The electrical power for the site building is supplied from a pole-mounted transformer. The buildings electrical room has a main 200 Ampere, 347/600 Volt, 3 phase breaker panel and electric service. The breakers provide power through copper wire conduit to the various lighting and receptacle unit distribution panels throughout the site building.

Electrical outlets for block heaters are provided in the parking lot along the north side of the property.

Interior lighting is predominately provided by T8 fluorescent T8 tube lighting fixtures. As a leasehold improvement consideration should be given for an LED retrofit.

Combination battery pack units provide emergency lighting and exit signage within egress pathways. All exit signage appears to have been replaced recently.

2.1.4 Structural

As outlined in the scope of work, a limited visual assessment of the condition of the structural elements was carried out on the elements which were visible at the time of the inspection. The site building is a slab on grade structure. The superstructure of the site building is comprised of concrete masonry block exterior walls, concrete columns, wood joists and concrete. No major visually identifiable structural deficiencies were noted at the time of the site inspection.

2.1.5 Building Envelope

The roof system atop the site building consists of corrugated sheet metal pitched roof system. Neither the presence of a vapour barrier, nor the type or the thickness of the insulation could be verified, as the scope of the work did not include destructive testing.

Drainage of the roof system is provided by perimeter eaves troughs which presumably drain to site.

Penetrations through the roof system include plumbing stacks, an exhaust vent stack, and service penetrations.

The exterior walls of the site building consist of corrugated sheet metal cladding.

The window systems of the site building consist of fixed insulated glazed units (“IGU”) set within aluminum frames in punched configurations. Exterior doors serving the site building are comprised of single glazed units set into metal frames. Metal doors within metal frames were observed serving the warehouse egresses and of the site building. Two sectional metal overhead doors were noted, serving the warehouse areas.

Refinishing of the roof system and the refinishing of the sectional overhead doors are recommended based on age and observed condition.

2.1.6 Finishes

The floor finishes within the site building consist of unsealed concrete slab-on-grade, ceramic and resilient floor tiles. The wall finishes within the site building consist of painted gypsum board and unfinished plywood sheathing. The ceiling finishes within the site building primarily consist of exposed structure, and painted suspended ceiling tile.

2.2 Functional Assessment

2.2.1 Site

There are two operational points of access to the facility; visitor and employee parking are separated from the truck traffic. The front of the site, along Baskin Drive, is occupied by visitors and employee parking along with a large landscape area. The yard and storage building occupy the rear of the property.

The following functional deficiencies were observed during the walkthrough:

- Though there is a man-door access point in the chain-link fence it is recommended that it be replaced by an exit door with panic hardware. It is recommended that a second exit door be installed to provide a second means of egress from the site in case of emergency.

2.2.2 Interior Space Planning

The building consists of office space, amenity areas and a warehouse. The following are functional deficiencies observed during the walkthrough:

- The ladies washroom area is tight. There is not a locker room function associated with the ladies washroom.
- The men's washroom and shower area is limited in space; lockers are located in the corridor outside the washroom.
- There is no cafeteria /lunch room with adequate kitchen in the facility. Currently there is a small coffee counter located in the mustering room. It was noted by staff that that there was a renovation scheduled to include changes to increase the size of the mustering room and relocate the kitchenette, to a separate function.
- The janitor room is tight and additional space is recommended.
- It was noted by staff that there is no welding shop in the facility. A welding shop is not required. Welding in this facility can occur in the yard.
- The industrial garage area is also used as a wash bay. A separate wash bay area is recommended.
- A separate boot wash and washing machine area is required. There is no boot wash in the facility and the washing machine is currently located in the warehouse.
- The photocopier and filing cabinets/mail slots are all located in the main corridor next to the main entrance. The location is not suitable and it affects the flow and circulation in the corridor. A separate photocopier room is recommended.
- There is little natural light in the mustering room, warehouse, and industrial garage; this does not meet Enbridge's standards for access to natural light. It is recommended that provisions be made to add additional windows.

2.2.3 Furniture

Existing furniture is legacy furniture throughout. All existing office furniture has reached the end of its life cycle and replacement is recommended to enhance the functional and environmental condition in the office area.

It is recommended to meet Enbridge's office standards that the furniture be phased out and replaced with new.

2.2.4 Ontario Building Code – Life Safety

Section 3.2 - Building Fire Safety

The building falls under Part 3, Group F Division 2 and Group D major occupancies.

To meet current Ontario Building Code the building should satisfy the requirements of 3.2.2.71: Group F, Division 2, up to 2 Storeys:

- The building is not required to be sprinklered
- Standpipe system is not required.
- The building is permitted to be of combustible construction or non-combustible construction used singly or in combination, and,
- Floor assemblies shall be fire separations and, if of combustible construction, shall have a fire-resistance rating not less than 45 minutes (Not applicable).
- Loadbearing walls, columns, and arches supporting an assembly required to have a fire-resistance rating shall have a fire resistance rating of 45 minutes or shall be of non-combustible construction.

Section 3.8 - Barrier-free Design

- 3.8.1.2. The facility has two entrances to the ground level. Both entrances are not equipped with barrier free door operator and none of them qualify as barrier-free entrance. In accordance with article 3.8.1.2, a minimum of one barrier-free entrance to the building is required.
- 3.8.2.3. Washrooms are required to be barrier-free: Currently there are no barrier-free washrooms in the facility.
- 3.8.3.12. Universal (barrier-free) toilet rooms: There is no universal barrier free washroom in the facility. This is considered an existing non-conforming condition for compliance with Ontario Building Code. There is no mandate in the current code to upgrade the existing facility for compliance with the Universal Barrier Free washroom requirements. However in compliance with Part 11 of Ontario Building Code the addition of a universal washroom will be required in the event of extensive renovation in the building.

2.3 Functional and Physical Condition Analysis

WalterFedy utilized a risk management approach taking into consideration the impact of failure of the building component on the long term serviceability of the building as well as the functional requirements associated with the building. Both Facility Condition Indexing (FCI) and Adequacy Indexing (AI) was utilized in order to help make the best possible decision related to the future of the site building and to determine whether or not to invest, maintain, repurpose or dispose of the asset.

FCI:

FCI is a condition index tool used to illustrate the condition of an asset expressed in a percentage ratio of required maintenance/repair costs divided by the replacement value of the asset expressed as:

$$\text{FCI} = (\text{Maintenance and Repair Costs}) / (\text{Cost to Replace the Building})$$

The replacement value of the building is based on industry standards for construction costs. Therefore, the lower a FCI is, the better the condition of the building. The resulting FCI at ten years is 3.82% which is classified as being in good condition.

$$\text{FCI (Arnprior)} = (\$56,000) / (4,334 \times 338) = 3.82\%$$

AI:

AI is a condition index tool used to illustrate the functional condition of the asset expressed in a percentage ratio of required functional upgrade costs divided by the replacement value of the asset to meet the functional needs expressed as:

$$\text{AI} = \text{Functional Upgrade Costs} / \text{Cost to Replace the Building with its Functional Equivalent}$$

The Adequacy Index for 249 Baskin Drive is calculated by dividing the current functional and physical renewal costs by the cost to replace the building with its functional equivalent size.

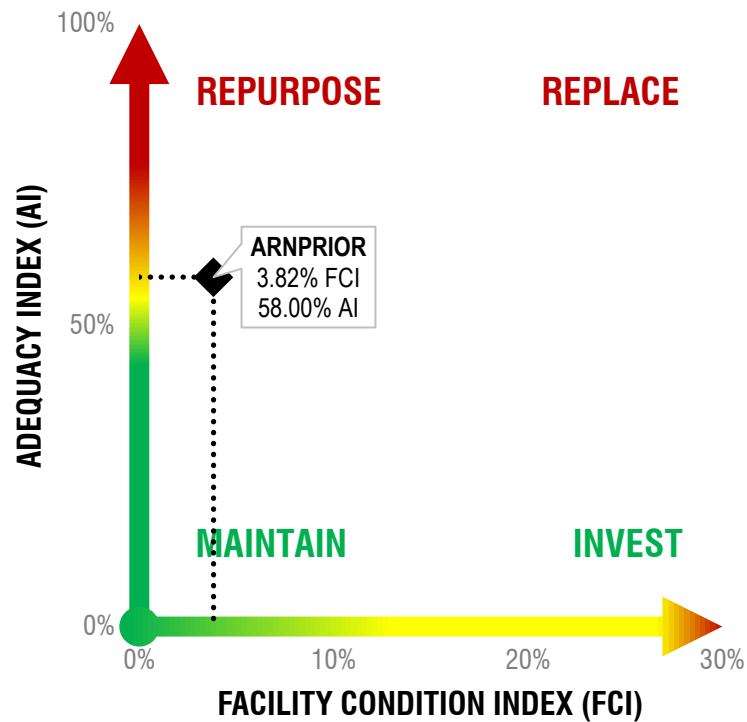
The cost to upgrade the facility to current Enbridge GDP standards is estimated at \$1,700,000. This is based on an 800sqf interior renovation of the existing building with a renovation estimated cost of \$250/sqf and the construction of a new addition of 5,000sqf with an average cost of \$300/sqf.

The estimated cost to build a new facility to Enbridge GDP current standards based on \$10,060 sqf, the area required to accommodate current program, is \$ 2,917,400. This is based on 60% of office space at \$350/sqf and 40% industrial space at \$200/sqf.

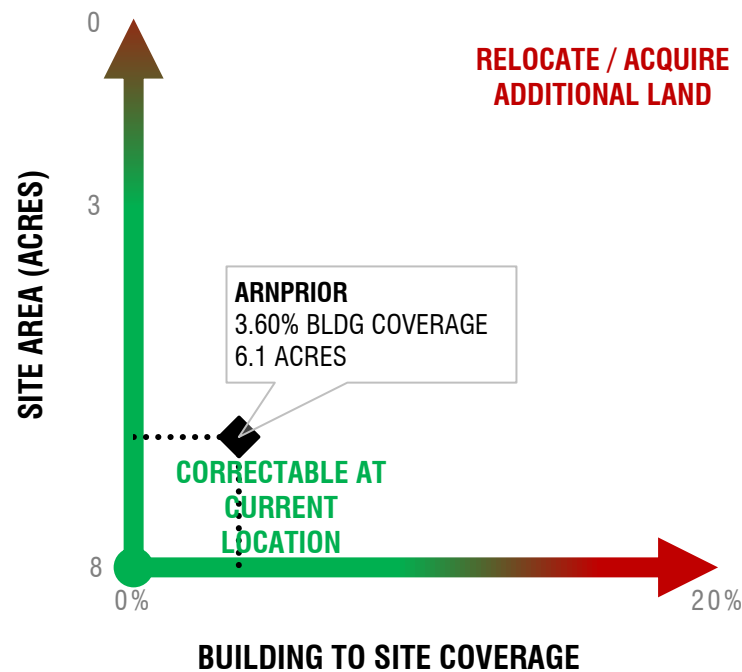
$$\text{AI (Arnprior)} = (\$1,700,000) / (\$2,917,400) = 58\%$$

With quantification of FCI and AI for your building, comes the ability to make comparisons between industry benchmarks, and drive decision making related to the future of the property. The chart below shows the relationship between FCI and AI and indicates visually where Arnprior Operations Depot falls within the decision making criteria.

**FACILITY CONDITION &
ADEQUACY GRAPH**



**SITE CONSTRAINTS
GRAPH**



2.4 Key Findings

- **PHYSICAL OBSOLESCENCE:**
The acceptable Enbridge standard for the physical condition is an FCI of 0 to 5%. The current FCI of the facility based on this study is 3.82% therefore the physical condition of the facility meets Enbridge Gas Distributions acceptable standards.

Meets Standards		Correctable at Current Location	
POSITIVE	Negative	POSITIVE	Negative

- **FUNCTIONAL OBSOLESCENCE BUILDING:**
The acceptable Enbridge standard for the functional condition is 0, anything between 0 to 50% is considered correctable at current location. The current facility AI index is 58% which is considered not to be correctable at current location without consideration of other factors including adequacy of land size and the FCI index.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	Positive	NEGATIVE

- **FUNCTIONAL OBSOLESCENCE SITE:**
The site does meet operational requirements for size and vehicular circulation.

The existing building requires expansion by approximately 5,183 sqft to meet the need for current staff and Enbridge functional requirements. The existing site is 6.1 acres which meets Enbridge Gas Distributions standards and is enough space on the property to support a building addition.

Meets Standards		Correctable at Current Location	
POSITIVE	Negative	POSITIVE	Negative

Overall the existing building is too small to meet the current Enbridge Gas Distribution standards. In order to meet Enbridge Gas Distribution standards an addition of approximately 5,000 sqf is required. The existing site is large enough to support an addition of this size.

The FCI and AI graph indicates recommendation to repurpose the existing facility.

2.5 Development Scenarios

The following is a comparison of the available options to address the deficiencies at 249 Baskin Drive:

SCENARIO	1
DESCRIPTION	Correct physical and functional deficiencies by expanding the existing facility on the existing site
LAND ACQUISITION	N/A
LAND SALE	N/A
CONSTRUCTION COST	\$1,700,000*
SOFT COST	\$ 340,000
FURNITURE	\$ 70,000****
TOTAL PROJECT COST	\$ 2,110,000
MEETS ENBRIDGE GDP STANDARDS	YES
PRIORITY	1

* Construction cost is based on interior renovation of 800sqf based on \$250/SF, and an addition of 5,000 SF based with an average cost of \$300/SF.

**** Furniture cost is based on \$10,000 per employee

Enbridge Gas Distribution Inc.
Arnprior Operations Depot – Facility Assessment



APPENDIX A

Capital Expenditures Forecast



CAPITAL FORECAST

249 Baskin Drive, Arnprior

Regional Operations Centre

The following Capital Plan has been compiled from the following:

- 1 EGD Long Range Capital Plan (LRP)
- 2 EGD/FMG Property Inspection (FMG)
- 3 3rd Party Property Condition Assessment (PCA)
- 4 Non-Functional Standards Assessment - Section 5 (nFSA)
- 5 Electrical Safety Authority Inspection (ESA)
- 6 EGD Quarterly Health/Safety Inspection (HSI)

SECTION	CATEGORY	DEFICIENCY	1	2	3	4	5	6	7	8	9	10
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
			BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD
Maintenance Deficiencies												
	Building Envelope	Metal roof maintenance and surface refinishing							\$ 10,000			
	Building Envelope	Repaint/refinish deteriorated finishes on surface of industrial doors		\$ 1,000								
	HVAC	Replace furnace unit						\$ 6,500			\$ 6,500	
	HVAC	Replace condenser Units						\$ 4,500			\$ 4,500	
	Leasehold Improvements	Retrofit T8 lighting to LED			\$ 15,000							
	Site Work/Exterior Elements	Replace wall pack lights and light standards with LED		\$ 3,000								
	Site Work/Exterior Elements	Asphalt repaving/repairs at front elevation				\$ 5,000						
Total Maintenance Deficiencies			\$ -	\$ 4,000	\$ 15,000	\$ 5,000	\$ -	\$ 11,000	\$ 10,000	\$ -	\$ 11,000	\$ -
Cummulative FCI			0.00%	0.27%	1.30%	1.64%	1.64%	2.39%	3.07%	3.07%	3.82%	3.82%
Functional Deficiencies												
	Building Addition	5,000 sqf addition to accommodate space deficiencies						\$ 450,000	\$ 1,050,000			
	Interior Renovation	800 sqf of interior renovation						\$ 60,000	\$ 140,000			
	Soft Costs	20% of Construction Cost						\$ 102,000	\$ 238,000			
	Furniture	Based on \$10,000 per employee							\$ 70,000			
Total Functional Deficiencies			\$ -	\$ -	\$ -	\$ -	\$ -	\$ 612,000	\$ 1,498,000	\$ -	\$ -	\$ -
Total			\$ -	\$ 4,000	\$ 15,000	\$ 5,000	\$ -	\$ 623,000	\$ 1,508,000	\$ -	\$ 11,000	\$ -

Enbridge Gas Distribution Inc.
Arnprior Operations Depot – Facility Assessment



APPENDIX B

Program

Operations Depot: ARNPRIOR

Description	Standard # per person	Quantity	Size	Area Factor	Area sq.ft.	Area sq.ft. Current	Area sq.ft. Variance	Notes
General Building Infrastructure								
Main Vestibule	<	1	9 x 5	1.00	45	83	38	
Waiting Area	<	1	9 x 5	1.00	45	0	-45	
Rear Entrance	<	1	7 x 5	1.00	35	0	-35	
Showers/Change/Washrooms	7	1	5 x 6	1.00	210	256	46	
Universal Washroom	1 / floor	1	8 x 10	1.00	80	47	-33	
Janitor	1 / facility	1	6 x 10	1.00	60	24	-36	
Mechanical/Electrical and IT Room	1 / facility	1	12 x 14	1.00	168	188	20	
Storage					100	246	146	
Sub Total					743	844	101	
Functional Building Area								
MPO Office	20% of office staff	1	10 x 10	1.00	100	367	267	
Cubicles Workstations (45 capacity employees)	50% of office staff	4	8 x 6	1.50	288	240	-48	
Meeting Room (8-10 people) 1/70 staff	1 per 70	1	16 x 11	1.50	264	0	-264	
Mustering Room (1chair/person) +1 HR workstation with connectivity and large TV screen for training	10	1	4 x 5	4.00	800	488	-312	
Break out room (4 people) 1/50 staff	1 per 50	1	10 x 12	1.00	120	0	-120	
Micro Kitchen/Ezone - 1/floor	1/200	1	15 x 20	1.00	300	0	-300	
Hotel Station (2:1 of dynamic staff)	30% of office staff	1	6 x 2.5	1.50	23	0	-23	
Print Copy Rm/Mail Room	1/ 100				250	0	-250	
Health room - required if there are 200 or more employees on any one shift.	<	0	11 x 10	1.00	0	0	0	
Coat Storage	<	1	2 x 6	1.00	12	0	-12	
Gas monitor calibration (1/10 people)		1	8 x 8	1.00	60	0	-60	
Measurement & Regulation Test/ Storage		1	12 x 20	1.00	240	0	-240	
Warehouse (where required by business ops)		1	30 x 77	1.00	2,310	1,291	-1019	
Free Pick storage	1/Building	1	15 x 10	1.00	150	0	-150	
Locked Storage Room	<	1	10 x 15	1.00	150	0	-150	
Wash Bay / Repair Garage (if fleet exists)	1/Building	1	25 x 50	1.00	1,250	1,000	-250	
Welding Bay / Fabrication	1/Building	1	35 x 54	1.00	1,890	0	-1890	
Boot wash		1	6 x 10	1.00	60	0	-60	
Washing Machine Area		1	6 x 10	1.00	60	17	-43	within warehouse
Sub Total					8,327	3,403	-4924	
Total Building Area (not including circulation)					9,070	4,247	-4823	
Circulation	10.93%				991	464	-527	
Total Building Area (not including out buildings)					10,060	4,711	-5349	

Site								
Total Site Area:						268,179		
Setbacks		per by-law requirements				74,204		
Building Area		per site				4,786		
Future Building Expansion		deficit of site program above				5,349	-5349	
Landscaping		per site				68,283		
M&R Station		unique to site location						not including area included within setback
Staff Parking	1 per employee	7	9 x 18	1.00	1,134	8,105	6,971	10 spaces
Visitor Parking	<	4	9 x 18	1.00	648	2,155	1,507	6 spaces
Sub Total						157,533	3,129	
Available Yard Area:					108,900	110,646	1,746	Based on minimum 2.5 acres required
Site Deficit:							4,875	

Enbridge Gas Distribution Inc.
Arnprior Operations Depot – Facility Assessment



APPENDIX C

Photographs



249 Baskin Drive, Arnprior, ON

Appendix B.1

1. Building Exterior



2. Parking Lot



3. Hangar Interior



4. Yard



5. Garage



6. Office Area





249 Baskin Drive, Arnprior, ON

Appendix B.2

1. Asphalt at Front Elevation



2. Condenser Unit



3. Exterior Lighting



4. Interior Lighting



5. Industrial Door



6. Roof and Exterior

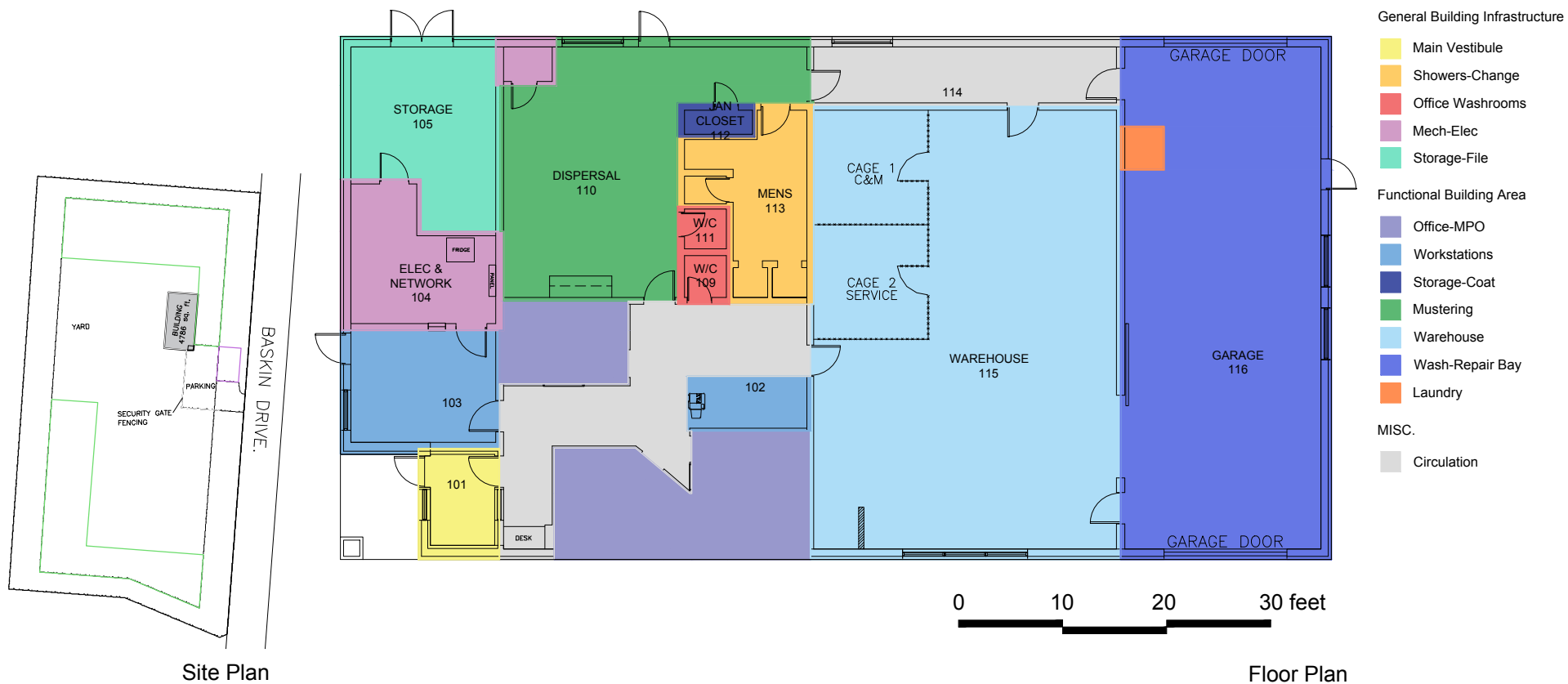


Enbridge Gas Distribution Inc.
Arnprior Operations Depot – Facility Assessment



APPENDIX D

Drawings



Enbridge Arnprior
249 Baskin Drive, Arnprior, ON

2016-0613-05



3.10 FACILITY ASSESSMENT

ENBRIDGE GAS DISTRIBUTION INC.

ETOBICOKE OPERATIONS DEPOT

40 Kelfield Street, Etobicoke, ON

Project No.: 2016-0613-05

REV 1.0 - December 6, 2017

WALTERFEDY

ENBRIDGE GAS DISTRIBUTION INC.

FACILITY ASSESSMENT

Etobicoke Operations Depot

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Appendix A – Capital Expenditures Forecast

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1.0 SUMMARY

1.1 Introduction

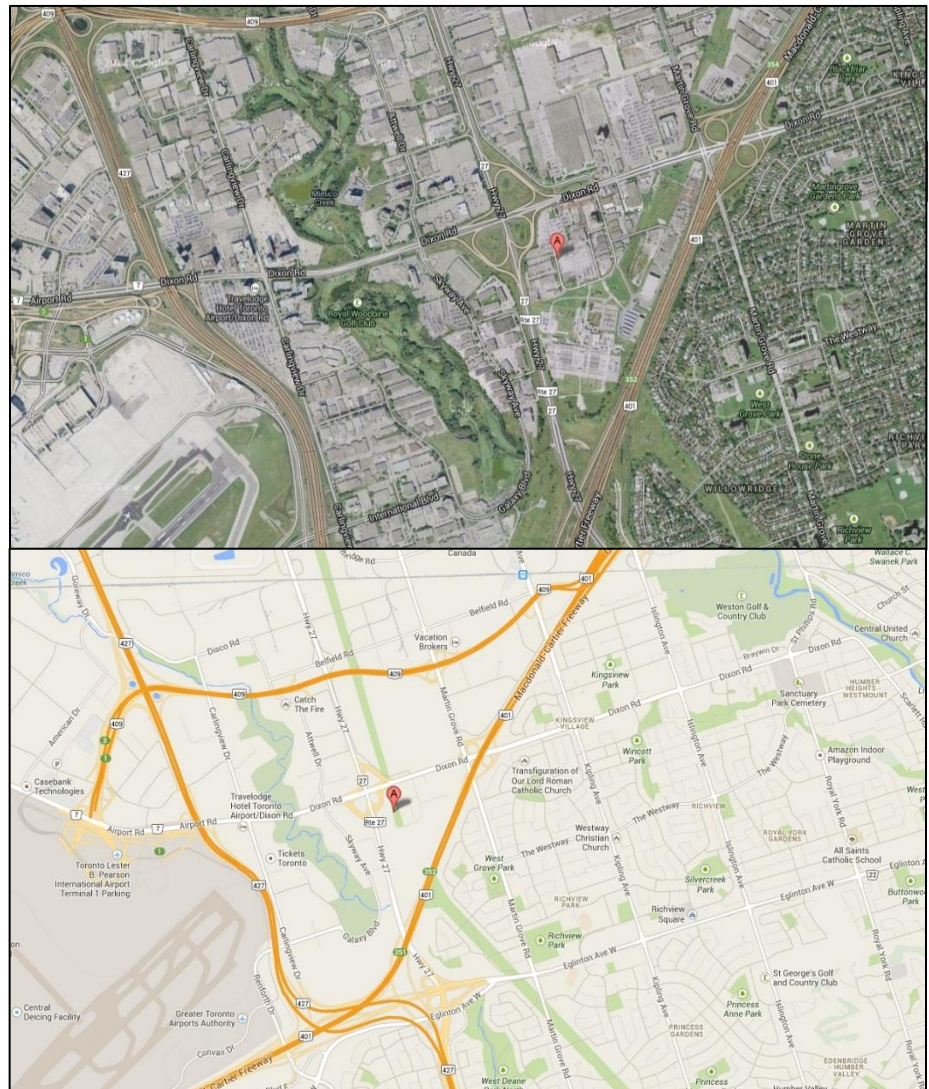
WalterFedy was retained by Enbridge to conduct a physical and functional assessment of the facility located at 40 Kelfield Street, Etobicoke, Ontario for the purpose of identifying functional adequacy and physical renewal requirements for budgeting and planning purposes. The scope of the report includes a general visual inspection of visible civil, architectural, structural, mechanical, and electrical components. It also includes a brief Ontario Building Code (OBC) review to address barrier-free accessibility issues.

Following the initial report, a list of recommendations with estimated costs is provided for corrective and preventive maintenance items required.

1.2 Facility Description

The facility is categorized by Enbridge as Operations Depot. The original building was constructed in 1960 on 1.47 acre industrial zoned land.

The property is located on Kelfield Street in Etobicoke. It has excellent access to major transportation routes in all directions including Highways 409, 401, 427, 27 and Dixon Road. The immediate surrounding area is predominantly aged industrial buildings, with residential housing lying slightly farther to the south and east. It is understood that the southeastern region of the city is serviced from this location and that points to the west are generally serviced by the Brampton location.



1.2.1 Property Summary

1) General:

Owned / Leased:	Owned
FCI score:	10.47 %
AI score:	71%
Current Occupancy:	38

2) Physical Building Properties:

Gross Floor Area:	7,724	SF
Building Area:	7,724	SF
Office Space:	2,513	SF
Common Areas:	1,370	SF
Industrial:	2,501	SF
Circulation:	1,343	SF

3) Site Characteristics:

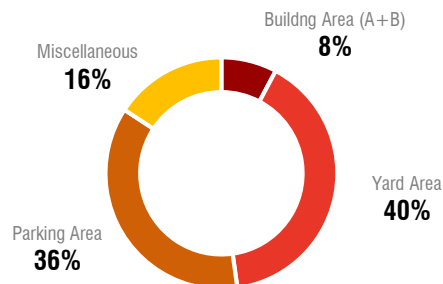
Site Area:	45,726 SF (1.04 Acres)
Building Coverage:	16.8% (7,724 SF) (0.177 Acres)
Yard Area:	15.103 SF (0.3 Acres)
Parking:	15,204 SF
Miscellaneous:	8,472 SF

4) Zoning:

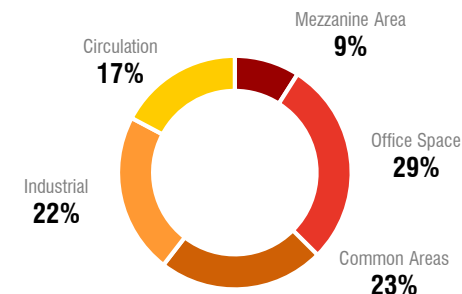
Zone :	E1 – Employment Industrial Zone		
Parking Required:	1.5 per 100 m ² (328 SF):	24	
Parking Provided:	48 cars/vans, 8 trucks, 4 equipment		
Front Yard Depth (minimum)	3.0 meters	Provided	8.5 meters
Side Yard Width (minimum)	3.0 meters	Provided	3.0 meters
Rear Yard Depth (minimum)	7.5 meters	Provided	14.5 meters
Parking Set Back	0.5 meters	Provided	0.5 meters
Building Height (maximum)	Office – 20 meters		
	Other – N/A		

5) Building Systems:

HVAC:	Rooftop HVAC units, ceiling mounted radiant tube heaters.
Plumbing:	Municipal domestic water and septic tank sanitary
Electrical:	400 A/600 V three phase service



SITE AREA DISTRIBUTION



BUILDING AREA DISTRIBUTION

1.3 Scope of Work

The Scope of Work for this assessment was approved by Enbridge and was completed in accordance with WalterFedy's fee proposal dated September 08, 2016.

The scope of work for the Asset Management Report will include a Functional Assessment, a Physical Assessment, and a Market Condition Assessment. The report will provide recommendations for strategic decisions based on the metrics reviewed in the assessments.

1.4 Assessment Methodology

The building condition assessment is based on general visual examination performed on September 21, 2016 by WalterFedy's Architectural and Facility Management departments.

The observations in this report were made using non-destructive methods through existing access points. Existing drawings provided by Enbridge for the building were also used to supplement site observations.

The guiding principles of this study is based upon the document from the National Research Council of Canada (NRC) "Protocols for Building Condition Assessment" published by The Institute For Research in Construction (IRC).

1.5 Limitation of Study

This assessment is based on our general review and walkthrough of the facility and it is not intended to form a detailed life safety analysis or Ontario Building and Fire Code assessment. The facility was built in 1960 and is not in compliance with current Ontario Building and Fire Codes. It is recommended that a further detailed life safety review and assessment is carried out to determine what building systems upgrades would be required to meet the requirements of Section 9.2 of Ontario Fire Code to the satisfaction of the Fire Department.

This report was completed in accordance with the approved scope of work as described in Section 1.3. This report is limited and is not intended to be comprehensive or exhaustive, or to suggest a risk-free facility. The report may not address all existing issues associated with the facility and may omit issues that are or may be of interest to the Owner. The findings and statements in this report are based on general site observations of the current conditions as they existed during the time period of the investigation.

The purpose of this report is for the sole use of the Owner for budgetary planning purposes. Issues identified in this report require further detailed assessments to determine repair and maintenance work required. This report should not be used by third parties involved in any work related to the facility; such third parties should undertake their own investigations and studies to determine how the existing condition of the facility will affect their plans and work. WalterFedy accepts no responsibility for liabilities incurred by or damages suffered by any third party as a result of decisions made or actions taken, based upon this report.

The passage of time might affect the views, conclusions and recommendations provided in this report.

The following report is a general guide only and is not intended to be used as a document for construction.

This study does not include hazardous materials review or inspection.

2.0 PHYSICAL AND FUNCTIONAL ASSESSMENT

2.1 Physical Assessment

2.1.2 Site and Landscaping

The site is a near rectangular-shaped property. The site building occupies approximately 10% of the site.

The remainder of the site is occupied by asphalt pavement parking areas, cast-in-place concrete paving, concrete curbs, a perimeter fence with powered access gates and areas of soft landscaping (i.e., grass, shrubs, and trees) located on the perimeter of the site. Wall mounted lighting units and pole mounted light standard provide illumination for the site. During the site visit the asphalt paved areas and concrete site features were noted to be in satisfactory condition overall with regular maintenance being performed to ensure realization of service life. The asphalt was reportedly redone four years ago. Site lighting is aged and consideration should be given to replacing the wall pack units and pole mounted lighting standards with LED fixtures for improved energy performance.

The property is secured by a four-foot chain link fence along the perimeter of property. The fence has one operable gate at the entrance from Kelfield. A pedestrian gate was recently installed next to the powered operable entrance gate. At the time of the site assessment there was a section of fencing along the west portion of the site that was noticeably bent out towards the adjacent property. Repair of this section of fencing is recommended in the early portion of this analysis.

Since the inspection was limited to visible areas no examination of the catch basins was performed and no review of the initial compliance with code was performed. The inspection of underground or concealed components is outside the scope of work.

2.1.3 Mechanical

Heating and cooling for the office area is provided by two rooftop mounted HVAC units (RTU-1: M/N - ZF060N10N2NNN4, RTU-2: M/N - ZF048N10N2NNN4) that were reportedly replaced last year. Additional supplementary heating is provided by wall mounted electric unit heaters.

Heating in the warehouse area is provided by three ceiling mounted natural gas fired radiant tube heaters.

Domestic Hot Water (“DHW”) within the site building is provided by an on-demand instant hot water heater located in a utilities room off of the men’s washroom/change room. Based on the name plate data on the equipment the domestic hot water tank was manufactured in 2012. There was reportedly no shortage of DHW within the site building. However, based on WalterFedy’s experience the anticipated service life of a DHW is typically 10-15 years. Therefore based on age, replacement should be considered within the term of analysis.

A dedicated exhaust system has not been provided for the battery charging area in the warehouse to prevent the accumulation of flammable hydrogen gas. As per the Ontario Fire Code a dedicated exhaust system is required in this area. An allowance for installation of the dedicated exhaust system has been included in the Capital Expenditures table in the early term of the analysis.

Corrosion and peeling paint was noted on the gas supply piping on the exterior of the building. It is recommended that the gas supply pipes are leak tested and refinished/painted.

2.1.4 Electrical

The electrical power for the site building is supplied from a pad-mounted transformer which is accessed from the east portion of the site and feeds the electrical room of the site building via underground cables.

The main distribution panel within the electrical room is original to the building construction and consideration should be given to the replacement of the unit.

Emergency power is provided by a 100 kW, natural gas fired Kohler Genset that was reportedly replaced last year.

Interior lighting is predominately provided by T8 fluorescent T8 tube lighting fixtures. As a leasehold improvement consideration should be given for an LED retrofit.

Combination battery pack units provide emergency lighting and exit signage within egress pathways. Due to age, approximately four units will require replacement within the next 10 years.

2.1.5 Structural

As outlined in the scope of work, a limited visual assessment of the condition of the structural elements was carried out on the elements which were visible at the time of the inspection. The site building is a slab on grade structure. The superstructure of the site building is comprised of concrete masonry block exterior walls, concrete columns, wood joists and concrete. No major visually identifiable structural deficiencies were noted at the time of the site inspection.

2.1.6 Building Envelope

The roof system atop the site building consists of a built-up modified bitumen assembly with gravel overlay. The roof system is installed atop a layer of rigid insulation, atop a corrugated metal roof decking. Neither the presence of a vapour barrier, nor the type or the thickness of the insulation could be verified, as the scope of the work did not include destructive testing.

Drainage of the roof system is provided by internal roof drains which presumably drain to the municipal sewer system.

Penetrations through the roof system include plumbing stacks, exhaust vents, internal roof drains, mechanical curbs, and service penetrations.

The roof system is original to the building construction. Considering a typical projected service life of 20 to 25 years, roof replacement is recommended within the term of the analysis.

The exterior walls of the site building consist of architectural concrete block masonry.

The window systems of the site building consist of fixed insulated glazing ("IG") units set within metal frames in strip and punched configurations. Based on the date stamps of the window frames the windows were manufactured in 1994. Exterior doors serving the site building are comprised of IG units set into aluminum frames. Metal doors within metal frames were observed serving the warehouse egresses and of the site building. Sectional metal overhead doors were noted, serving the warehouse areas. Replacement of windows within the office area is recommended based on age and observed condition.

2.1.7 Finishes

The floor finishes within the site building consist of unsealed concrete slab-on-grade, carpet, ceramic and resilient floor tiles. The wall finishes within the site building consist of painted gypsum board and painted concrete masonry block. The ceiling finishes within the site building primarily consist of exposed structure, and painted suspended ceiling tile. No major deficiencies associated with the building finishes were noted at the time of the site inspection.

2.2 Functional Assessment

2.2.1 Site

The property is 1.04 acres and is used as operations depot.

The following functional deficiencies were observed during the walkthrough:

- The site has one operational point of access only. It is recommended that two points of entry/exit be provided to and from the site in accordance with Enbridge design standards. Employee parking is located within the secure yard space. This creates an unsafe environment within the yard. Vehicle flow is not safe and not efficient especially at the exit area due to the absence of a second point of exit.
- The service yard does not meet Enbridge GDP standard size of 2.5 acres.
- It was noted that there was not a location for snow removal within the yard and that snow needs to be removed from the site regularly.
- There currently is not an exit door with panic hardware along the fence line from the yard. It is recommended that a second exit door to be installed to provide a second means of egress from the site in case of an emergency.

2.2.2 Interior Space Planning

The building consists of office space, amenity areas and a warehouse. The following are functional deficiencies observed during the walkthrough:

- Lockers in the men's and woman's locker rooms do not meet the current standard.
- There is no cafeteria /lunch room with adequate kitchen in the facility. Currently there is a small coffee area.
- A separate boot wash and washing machine area is required. There is no boot wash in the facility and the washing machine is currently located in the warehouse.
- The photocopier and filing cabinets/mail slots are all located in the main corridor next to the main entrance. The location is not suitable and it affects the flow and circulation in the corridor. A separate photocopier room is recommended.
- There is little natural light in throughout the office and warehouse area; this does not meet Enbridge's standards for access to natural light. It is recommended that provisions be made to add additional windows.
- The warehouse area is crowded.

2.2.3 Furniture

Existing furniture is legacy furniture throughout. All existing office furniture has reached the end of its life cycle and replacement is recommended to enhance the functional and environmental condition in the office area. The height of the existing cubicle partitions blocks natural light and access to existing windows from the core area.

It is recommended, to meet Enbridge's office standards, that the furniture be phased out and replaced with new.

2.2.4 Ontario Building Code – Life Safety

Section 3.2 - Building Fire Safety

The building falls under Part 3, Group F Division 2 and Group D major occupancies.

To meet current Ontario Building Code the building should satisfy the requirements of 3.2.2.71:
3.2.2.26 Group F, Division 2, up to 2 Storeys:

- The building is not required to be sprinklered
- Standpipe system is not required.
- The building is permitted to be of combustible construction or non-combustible construction used singly or in combination, and,
- Floor assemblies shall be fire separations and, if of combustible construction, shall have a fire-resistance rating not less than 45 minutes (Not applicable).
- Loadbearing walls, columns, and arches supporting an assembly required to have a fire-resistance rating shall have a fire resistance rating of 45 minutes or shall be of non-combustible construction.

Section 3.8 - Barrier-free Design

3.8.1.3. Barrier-free Path of Travel.

3.8.1.2. The facility has one entrance to the ground level. However, the entrance is not equipped with a barrier free door operator and does not qualify as a barrier free entrance. In accordance with article 3.8.1.2, a minimum of one barrier-free entrance to the building is required.

3.8.2.3. Washrooms are required to be Barrier-free.

On the main floor there are currently two barrier free washroom stalls located in the male and female washroom areas.

3.8.3.12. Universal (barrier-free) toilet rooms:

There is no universal barrier free washroom in the facility. This is considered an existing non-conforming condition for compliance with Ontario Building Code. There is no mandate in the current code to upgrade the existing facility for compliance with the Universal Barrier Free washroom requirements. However in compliance with Part 11 of Ontario Building Code the addition of a universal washroom will be required in the event of extensive renovation in the building.

2.3 Functional and Physical Condition Analysis

WalterFedy utilized a risk management approach taking into consideration the impact of failure of the building component on the long term serviceability of the building as well as the functional requirements associated with the building. Both Facility Condition Indexing (FCI) and Adequacy Indexing (AI) was utilized in order to help make the best possible decision related to the future of the site building and to determine whether or not to invest, maintain, repurpose or dispose of the asset.

FCI:

FCI is a condition index tool used to illustrate the condition of an asset expressed in a percentage ratio of required maintenance/repair costs divided by the replacement value of the asset expressed as:

$$\text{FCI} = (\text{Maintenance and Repair Costs}) / (\text{Cost to Replace the Building})$$

The replacement value of the building is based on industry standards for construction costs. Therefore, the lower a FCI is, the better the condition of the building. The resulting FCI at ten years is 10.47% which is classified as being in poor condition.

$$\text{FCI (Etobicoke)} = (\$165,200) / (7,340 \times 215) = 10.47\%$$

AI:

AI is a condition index tool used to illustrate the functional condition of the asset expressed in a percentage ratio of required functional upgrade costs divided by the replacement value of the asset to meet the functional needs expressed as:

$$\text{AI} = \text{Functional Upgrade \$} / \$ \text{ to Replace the Building with its Functional Equivalent}$$

The Adequacy Index for Kelfield operations depot is calculated by dividing the current functional and physical renewal costs by the cost to replace the building with its functional equivalent size.

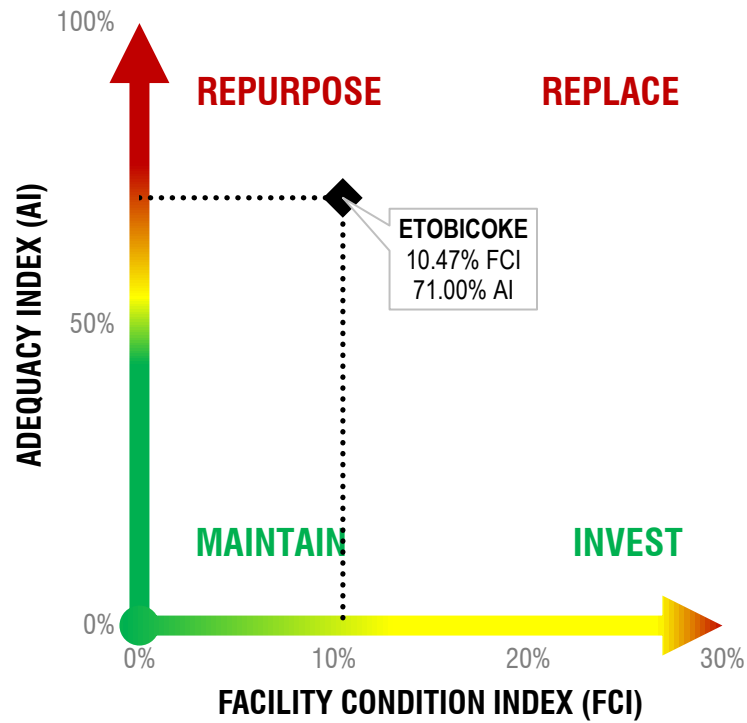
The cost to upgrade the facility to current Enbridge GDP standards is estimated at \$3,088,000. This is based on a 4,000 SF interior renovation of the existing building with a renovation estimated cost of \$250/SF and the construction of a new addition of 7,200 SF based on 60% office space at \$350/SF and 40% industrial space at \$200/SF.

The estimated cost to build a new facility to Enbridge GDP current standards based on 14,924 SF the area required to accommodate current program is \$4,327,960. This is based on 60% of office space at \$350/SF and 40% industrial space at \$200/SF.

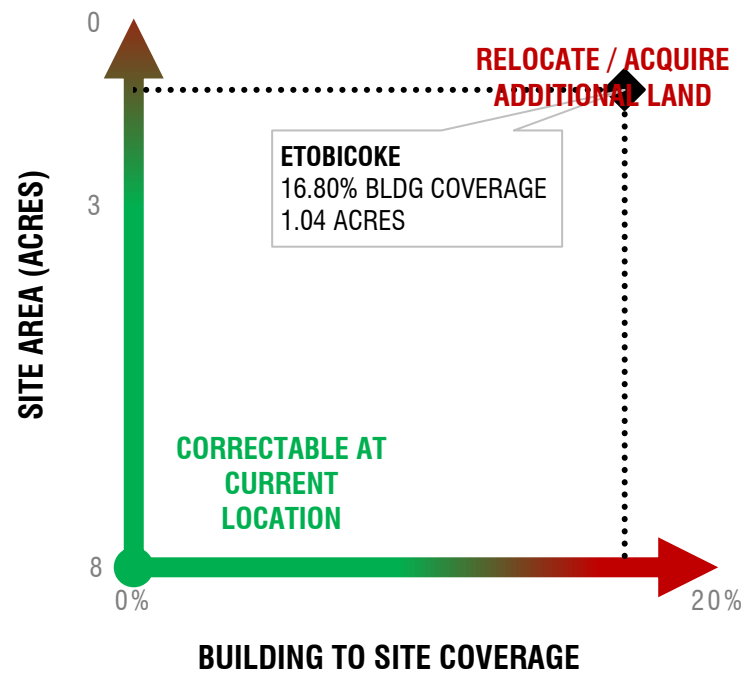
$$\text{AI (Kelfield)} = (\$3,088,000) / (\$4,327,960) = 71\%$$

With quantification of FCI and AI for your building, comes the ability to make comparisons between industry benchmarks, and drive decision making related to the future of the property. The chart below shows the relationship between FCI and AI and indicates visually where Kelfield Road operations depot falls within the decision making criteria.

**FACILITY CONDITION &
ADEQUACY GRAPH**



**SITE CONSTRAINTS
GRAPH**



2.4 Key Findings

- PHYSICAL OBSOLESCENCE:

The acceptable Enbridge standard for the physical condition is an FCI of 0 to 5%. The current FCI of the facility based on this study is 10.47% therefore the physical condition of the facility does not meet Enbridge acceptable standards.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	POSITIVE	Negative

- FUNCTIONAL OBSOLESCENCE BUILDING :

The acceptable Enbridge GDP standard for the functional condition is 0, anything between 0 to 50% is considered correctable at current location. The current facility AI index is 71%. Based on the FCI/AI graph the current recommendation for the existing facility is to repurpose to accommodate current EGD standards.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	Positive	NEGATIVE

- FUNCTIONAL OBSOLESCENCE SITE:

The site does not meet operational requirements for size and vehicular circulation. The yard has only one point of access.

The yard size is smaller than Enbridge standard yard size requirements. The current yard size is 0.3 acres. Enbridge standard yard size is 2.5 acres.

The existing building requires expansion by approximately 7,200SFt to meet the need for current staff and Enbridge functional requirements. Building addition on the property will entail further reduction in the yard and parking areas.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	Positive	NEGATIVE

Both the building and site area are too small to meet current Enbridge GDP standards. The current building is approximately 7,724 SF and the ideal building size, based on Enbridge GDP design standards is estimated to be 14,924 SF with a site area of approximately 5 acres. There is no opportunity for building expansion at the current location. It is understood that the location of the facility works well for Enbridge GDP operations. It is recommended that this facility be maintained if possible and further investigation be conducted to review a scenario where the adjacent property is purchased or the site be relocated to an alternative facility in the same area, if available.

2.5 Property Evaluation

In 2012 MPAC completed appraisal report on the property 40 Kelfield Street, Etobicoke, ON, appraised the property between \$1,653,429 to \$1,903,429.

At the time of this study there were no available industrial properties with suitable location in the service area, therefore the option to relocate to a new site is theoretical. Based on discussions with Enbridge staff an estimated average value of \$1,700,000 per acre is used in development scenarios 3 and 4. Further market analysis study is required to confirm.

2.6 Development Scenarios

The following is a comparison of the available options to address the deficiencies at 40 Kelfield Street:

SCENARIO	1	2	3	4
DESCRIPTION	Correct physical and functional deficiencies by expanding the existing facility on the existing site and an interior renovation of 4,000 SF	Demolish the existing facility and build a new two storey building with maintaining the area of the existing yard	Increase the site area by purchasing the abutting property (0.5 acres and building), demolish the existing buildings on site, and build new two storey facility, increasing existing yard size.	Sell the existing property; purchase a property suitable in size to accommodate the required program. Required size of new property is approximately 3.5 acres
LAND ACQUISITION	\$-		\$1,000,000	\$4,000,000
LAND SALE PROCEEDS	\$-		\$-	-\$952,000*
DEMOLITION		\$100,000	\$200,000	
CONSTRUCTION COST	\$3,088,000***	\$4,328,000**	\$4,328,000**	\$4,328,000**
SOFT COST	\$617,600	\$885,000	\$905,000	\$865,000
FURNITURE	\$360,000	\$360,000	\$360,000	\$360,000
TOTAL	\$4,065,600	\$5,673,000	\$6,793,000	\$8,601,000
MEETS EDG STANDARDS	NO	YES	YES	YES
PRIORITY	(Site area is too small to accommodate this option)	3	1 (reflected in the capital expenditure matrix in Appendix A)	2

* Land sale proceeds is equal to 50% of the actual property evaluation/sale price. This is based on the “rate base split”/Enbridge portion of proceeds.

** Total construction cost is based on \$350/SF for the office area and \$200/SF for the industrial space.

*** Based on complete renovation to the existing building at \$250/SF and 4,000 SF addition (40% industrial space at \$200/SF and 60% office space at \$350/SF).

Enbridge Gas Distribution Inc.
Etobicoke Operations Depot – Facility Assessment



APPENDIX A

Capital Expenditures Forecast



7.0 CAPITAL FORECAST

40 Kelfield St., Etobicoke, ON
Operations Depot

The following Capital Plan has been compiled from the following:

- EGD Long Range Capital Plan (LRP)
- EGD/FMG Property Inspection (FMG)
- 3rd Party Property Condition Assessment (PCA)
- Non-Functional Standards Assessment - Section 5 (nFSA)
- Electrical Safety Authority Inspection (ESA)
- EGD Quarterly Health/Safety Inspection (HSI)

			1	2	3	4	5	6	7	8	9	10
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
SECTION	CATEGORY	DEFICIENCY	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD
Maintenance Deficiencies												
	Building Envelope	Replace roof membrane system	\$ 90,000									
	Building Envelope	Replace office windows and framing							\$ 20,000			
	ELEC	Replace aged distribution panel in office area					\$ 1,200					
	HVAC	Install dedicated exhaust for battery charging station	\$ 15,000									
	HVAC	Leak test and repaint natural gas supply system			\$ 2,000							
	Leasehold Improvements	Retrofit T8 lighting to LED		\$ 25,000								
	Life/Safety	Allowance to replace battery pack lighting units						\$ 2,000				
	PLMB	Replace domestic water heater			\$ 2,750							
	Site Work/Exterior Elements	Repair section of fencing				\$ 3,000						
	Site Work/Exterior Elements	Replace wall mounted and pole mounted site lighting (upgrade to LED)			\$ 2,500			\$ 1,750				
Total Maintenance Deficiencies			\$ 105,000	\$ 25,000	\$ 7,250	\$ 3,000	\$ 1,200	\$ 3,750	\$ 20,000	\$ -	\$ -	\$ -
Cummulative FCI			6.65%	8.24%	8.70%	8.89%	8.96%	9.20%	10.47%	10.47%	10.47%	10.47%
Functional Deficiencies												
	Land Acquisition								\$ 1,000,000			
	Demolition									\$ 200,000		
	Construction	14,924 sq.ft.								\$ 1,298,388	\$ 3,029,572	
	Soft Costs	20% of Construction Cost								\$ 299,678	\$ 605,914	
	Furniture	Based on \$10,000 per employee									\$ 360,000	
Total Functional Deficiencies			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 1,000,000	\$ 1,798,066	\$ 3,995,486	\$ -
Total			\$ 105,000	\$ 25,000	\$ 7,250	\$ 3,000	\$ 1,200	\$ 3,750	\$ 1,020,000	\$ 1,798,066	\$ 3,995,486	\$ -

Enbridge Gas Distribution Inc.
Etobicoke Operations Depot – Facility Assessment

APPENDIX B

Program

Operations Depot: ETOBICOKE

Description	Standard # per person	Quantity	Size	Area Factor	Area sq.ft.	Area sq.ft. Current	Area sq.ft. Variance	Notes
General Building Infrastructure								
Main Vestibule	<	1	9 x 5	1.00	45	0	-45	
Waiting Area	<	1	9 x 5	1.00	45	0	-45	
Rear Entrance	<	1	7 x 5	1.00	35	0	-35	
Showers/Change/Washrooms	38	1	5 x 6	1.00	1,140	763	-377	
Universal Washroom	1 / floor	1	8 x 10	1.00	80	0	-80	
Janitor	1 / facility	1	6 x 10	1.00	60	16	-44	
Mechanical/Electrical and IT Room	1 / facility	1	12 x 14	1.00	168	205	37	
Storage					100	386	286	
Sub Total					1,673	1,370	-303	
Functional Building Area								
MPO Office	20% of office staff	8	10 x 10	1.00	800	448	-352	4 offices
Cubicles Workstations (45 capacity employees)	50% of office staff	19	8 x 6	1.50	1,368	1,081	-287	23 workstations
Meeting Room (8-10 people) 1/70 staff	1 per 70	1	16 x 11	1.50	264	283	19	
Mustering Room (1chair/person) +1 HR workstation with connectivity and large TV screen for training	10	1	4 x 5	4.00	800	0	-800	
Break out room (4 people) 1/50 staff	1 per 50	1	10 x 12	1.00	120	0	-120	
Micro Kitchen/Ezone - 1/floor	1/200	1	15 x 20	1.00	300	70	-230	
Hotel Station (2:1 ratio of dynamic staff)	30% of office staff	2	6 x 2.5	1.50	45	102	57	
Training Room					529	529	0	
Print Copy Rm/Mail Room	1/ 100	1			250	0	-250	
Health room - required if there are 200 or more employees on any one shift.	<	0	11 x 10	1.00	0	0	0	
Coat Storage	<	1	2 x 6	1.00	12	0	-12	
Gas monitor calibration (1/10 people)		1	8 x 8	1.00	60	0	-60	
Measurement & Regulation Test/ Storage		1	12 x 20	1.00	240	0	-240	
Warehouse (where required by business ops)		1	30 x 77	1.00	2,310	2,200	-110	
Free Pick storage	1/Building	1	15 x 10	1.00	150	0	-150	
Locked Storage Room	<	1	10 x 15	1.00	150	0	-150	
Wash Bay / Repair Garage (if fleet exists)	1/Building	1	25 x 50	1.00	1,250	0	-1250	
Welding Bay / Fabrication	1/Building	1	35 x 54	1.00	1,890	290	-1600	
Boot wash		1	6 x 10	1.00	60	0	-60	
Washing Machine Area		1	6 x 10	1.00	60	9	-51	Located in warehouse
Sub Total					10,658	5,012	-5646	
Total Building Area (not including circulation)					12,331	6,382	-5949	
Circulation	21.03%				2,593	1,342	-1251	
Total Building Area (not including out buildings)					14,924	7,724	-7200	

Site								
Total Site Area:						45,726		
Setbacks		per by-law requirments				5,580	5,580	
Building Area		per site				7,727		
Future Building Expansion		deficit of site program above				7,200	-7200	
Landscaping/miscellaneous		per site				2,892		
Staff Parking	1 per employee	38	9 x 18	2.00	12,312	12,312	0	
Visitor Parking	<	6	9 x 18	2.00	1,944	2,112	168	
Sub Total					21,456	30,623	-7032	
Available Yard Area:						108,900	15,103	-93797
								Based on minimum 2.5 acres required
Site Deficit:							-100829	

Enbridge Gas Distribution Inc.
Etobicoke Operations Depot – Facility Assessment



APPENDIX C

Photographs



40 Kelfield Street, Etobicoke, ON

Appendix B.1

1. Bunkers



2. Parking Lot



3. Office



4. Building Exterior



5. Warehouse Lighting



6. Warehouse





40 Kelfield Street, Etobicoke, ON

Appendix B.2

1. Exterior Windows



2. Pole Mounted Lighting



3. Exterior Fencing



4. Office Lighting



5. Discoloured Locks



6. Ventilation



Enbridge Gas Distribution Inc.
Etobicoke Operations Depot – Facility Assessment

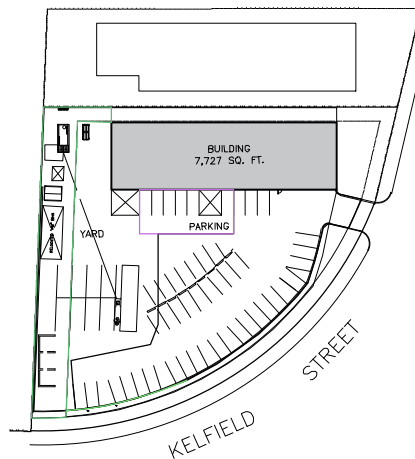


APPENDIX D

Drawings



Floor Plan



Site Plan

General Building Infrastructure

- Showers-Change
- Janitor
- Mech-Elec
- Storage-File

Functional Building Area

- Office-MPO
- Workstations
- Meeting
- Hotel Station
- Training
- Micro Kitchen
- Warehouse
- Welding Bay Fab
- Laundry

MISC.

- Circulation

Enbridge Kelfield

40 Kelfield Street, Etobicoke, ON

2016-0613-05



3.11 FACILITY ASSESSMENT

ENBRIDGE GAS DISTRIBUTION INC.

OSHAWA OPERATIONS DEPOT
1350 Thornton Road, Oshawa, ON
Project No.: 2016-0613-05

REV 1.0 - December 6, 2017

WALTERFEDY

ENBRIDGE GAS DISTRIBUTION INC.

FACILITY ASSESSMENT

Oshawa Operations Depot

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1.0 SUMMARY

1.1 Introduction

WalterFedy was retained by Enbridge to conduct a physical and functional assessment of the facility located at 1350 Thornton Road South, Oshawa, Ontario for the purpose of identifying functional adequacy and physical renewal requirements for budgeting and planning purposes. The scope of the report includes a general visual inspection of visible civil, architectural, structural, mechanical, and electrical components. It also includes a brief Ontario Building Code (OBC) review to address barrier-free accessibility issues.

Following the initial report, a list of recommendations with estimated costs is provided for corrective and preventive maintenance items required.

1.2 Facility Description

The facility is categorized by Enbridge as Regional Operation Centre. The original building was constructed in 1989.

The property is located at 1350 Thornton Road South, Oshawa, Ontario off of Wentworth Street West in Oshawa. It has access to major transportation routes to the north with highway 401 3 Km away, and Dundas Street East 5 Km away. To the south is Lake Ontario. The immediate surrounding area is predominantly industrial.



1.2.1 Property Summary

1) General:

Owned / Leased:	Owned
FCI score:	14.92%
AI score:	30%
Current Occupancy:	57

2) Physical Building Properties:

Gross Floor Area:	12,116 SF
Building Area:	12,116 SF
Office Space:	4,755 SF
Common Areas:	1,307 SF
Industrial:	3,642 SF
Circulation:	2,412 SF

3) Site Characteristics:

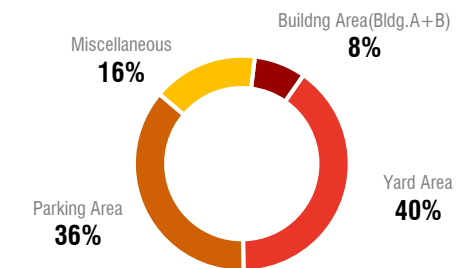
Site Area:	155, 772 SF (3.89 Acres)
Building Coverage:	7.7% (12,116 SF)
Yard Area:	69,564 SF (1.6 Acres)
Parking:	25,214 SF (0.57 Acres)
Miscellaneous:	46,274 SF (1.06 Acres)

4) Zoning:

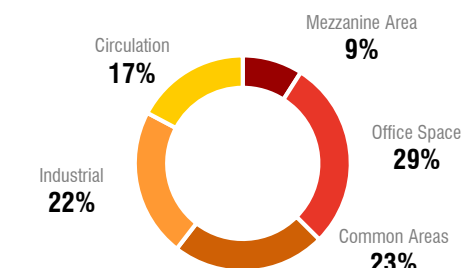
Zone :	SI-B Select Industrial Zones		
Parking Required	1 per 28m ² (300 SF): 41		
Parking Provided	70 cars/vans, 24 trucks, 10 equipment		
Front Yard Depth (minimum)	9.0 meters	Provided	25.0 meters
Side Yard Width (minimum)	3.0 meters	Provided	15.0 meters
Rear Yard Depth (minimum)	7.5 meters	Provided	26.0 meters
Lot Coverage (maximum)	50%		
Building Height (maximum)	20.0 meters		

5) Building Systems:

HVAC:	Office – Rooftop HVAC units Warehouse – Radiant tube and forced air unit heaters
Plumbing:	Municipal water supply, septic sanitary
Electrical:	400 A/600 V, 3 phase
Building Automation/Security:	None



SITE AREA DISTRIBUTION



BUILDING AREA DISTRIBUTION

1.3 Scope of Work

The scope of work for this assessment was approved by Enbridge and was completed in accordance with WalterFedy's fee proposal dated September 08, 2016.

The scope of work for the Asset Management Report will include a Functional Assessment, a Physical Assessment, and a Market Condition Assessment. The report will provide recommendations for strategic decisions based on the metrics reviewed in the assessments.

1.4 Assessment Methodology

The building condition assessment is based on general visual examination performed on September 21, 2016 by WalterFedy's Architectural and Facility Management departments.

The observations in this report were made using non-destructive methods through existing access points. Existing drawings provided by Enbridge for the building were also used to supplement site observations.

The guiding principles of this study is based upon the document from the National Research Council of Canada (NRC) "Protocols for Building Condition Assessment" published by The Institute For Research in Construction (IRC).

1.5 Limitation of Study

This assessment is based on our general review and walkthrough of the facility and it is not intended to form a detailed life safety analysis or Ontario Building and Fire Code assessment. The facility was built in 1960 and is not in compliance with current Ontario Building and Fire Codes. It is recommended that a further detailed life safety review and assessment is carried out to determine what building systems upgrades would be required to meet the requirements of Section 9.2 of Ontario Fire Code to the satisfaction of the Fire Department.

This report was completed in accordance with the approved scope of work as described in Section 1.3. This report is limited and is not intended to be comprehensive or exhaustive, or to suggest a risk-free facility. The report may not address all existing issues associated with the facility and may omit issues that are or may be of interest to the Owner. The findings and statements in this report are based on general site observations of the current conditions as they existed during the time period of the investigation.

The purpose of this report is for the sole use of the Owner for budgetary planning purposes. Issues identified in this report require further detailed assessments to determine repair and maintenance work required. This report should not be used by third parties involved in any work related to the facility; such third parties should undertake their own investigations and studies to determine how the existing condition of the facility will affect their plans and work. WalterFedy accepts no responsibility for liabilities incurred by or damages suffered by any third party as a result of decisions made or actions taken, based upon this report.

The passage of time might affect the views, conclusions and recommendations provided in this report.

The following report is a general guide only and is not intended to be used as a document for construction.

This study does not include hazardous materials review or inspection.

2.0 PHYSICAL AND FUNCTIONAL ASSESSMENT

2.1 Physical Assessment

2.1.1 Site and Landscaping

The site is a near rectangular-shaped property. The site building occupies approximately 7.5% of the site.

The remainder of the site is occupied by asphalt pavement parking areas, cast-in-place concrete paving, concrete curbs, a perimeter wood fence with powered access gates and areas of soft landscaping (i.e. grass, shrubs, and trees) located on the perimeter of the site. Wall mounted lighting units and pole mounted light standard provide illumination for the site. During the site visit the asphalt paved areas and concrete site features were noted to be in satisfactory condition overall with regular maintenance being performed to ensure realization of service life. Approximately half of the asphalt was repaved two weeks ago. The remaining half of the asphalt paved area should be completed within the term of the analysis. Site lighting is aged and consideration should be given to replacing the wall pack units and pole mounted lighting standards with LED fixtures for improved energy performance.

The property is secured by sections of four-foot chain link fence and four-foot wood fencing along the perimeter of property. The fence has one operable gate at the entrance from Thornton Road. A pedestrian gate was recently installed next to the powered operable entrance gate. At the time of the site assessment the wood sections of fencing was showing signs of deterioration. Replacement of the wood sections of fencing is recommended in the early portion of this analysis.

Since the inspection was limited to visible areas, no examination of the catch basins was performed and no review of the initial compliance with code was performed. The inspection of underground or concealed components is outside the scope of work.

2.1.2 Mechanical

Heating and cooling for the office area is provided by two direct fired natural gas heated and electrically cooled Lennox Elite Series furnaces. Cooling for the furnaces is provided by two exterior pad mounted Lennox units with an approximate cooling capacity of 3.5 Tons each. Name plate data on the furnaces and condenser units was not accessible but based on discussion with the site representative, the furnaces and condenser units are both at least ten years old. The expected projected useful life of furnaces and condenser units typically fall between 10 to 15 years. Therefore, based on age replacement is recommend within the term of this analysis.

Supplementary heating for warehouse area is provided by four Lennox natural gas fired forced air ceiling mounted unit heaters. Name plate data on the unit heaters was not accessible but based on discussion with the site representative, the units have all been replaced within the last two years. Therefore based on age and observed condition, replacement of only the two furnaces and the two exterior condenser units is recommended within the evaluation period.

Domestic Hot Water ("DHW") within the site building is provided by a Giant domestic hot water tank (M/N – UG40-38LF-N1U, S/N – C00113851) located in the warehouse area. Based on the name plate data on the equipment, the unit was installed last year.

There was reportedly no shortage of DHW within the site building. Based on WalterFedy's experience the anticipated service life of a DHW is typically 10-15 years. Therefore based on age, replacement should not be required within the term of analysis.

2.1.3 Electrical

The electrical power for the site building is supplied from a pad-mounted transformer which is accessed from the east portion of the site and feeds the electrical room of the site building via underground cables.

The main distribution panel within the electrical room has a 400 ampere, 347/600 V, 3 phase service. All splitters/breakers provide power via conduit to the various distribution panels for lighting and receptacles. Reportedly upgrades to the electrical systems were done in 2003.

Interior lighting is predominately provided by T8 fluorescent T8 tube lighting fixtures. As a leasehold improvement consideration should be given for an LED retrofit.

Combination battery pack units provide emergency lighting and exit signage within egress pathways.

2.1.4 Structural

As outlined in the scope of work, a limited visual assessment of the condition of the structural elements was carried out on the elements which were visible at the time of the inspection. The site building is a slab on grade structure. The superstructure of the site building is comprised of concrete masonry block exterior walls, concrete columns, wood joists and concrete. No major visually identifiable structural deficiencies were noted at the time of the site inspection.

2.1.5 Building Envelope

The roof system atop the site building consists of corrugated sheet metal pitched roof system. The roof system is installed atop a layer of rigid insulation, atop a corrugated metal roof decking. Neither the presence of a vapour barrier, nor the type or the thickness of the insulation could be verified, as the scope of the work did not include destructive testing.

Drainage of the roof system is provided by internal roof drains which presumably drain to the municipal sewer system.

Penetrations through the roof system include plumbing stacks, exhaust vents, internal roof drains, mechanical curbs, and service penetrations.

The roof system is original to the building construction. Considering a typical projected service life of 20 to 25 years, roof replacement is recommended within the term of the analysis.

The exterior walls of the site building consist of architectural concrete block masonry. Spalled blocks were noted in a number of locations on the building exterior, particularly at the northeast corner of the building.

The window systems of the site building consist of fixed insulated glazing ("IG") units set within metal frames in strip and punched configurations. Based on the date stamps of the window frames the windows were manufactured in 1989. Exterior doors serving the site building are comprised of IG units set into aluminum frames. Metal doors within metal frames were observed serving the warehouse egresses and of the site building. Sectional metal overhead doors were noted serving the warehouse areas. Replacement of windows within the office area is recommended based on age and observed condition.

2.1.6 Finishes

The floor finishes within the site building consist of unsealed concrete slab-on-grade, carpet, ceramic and resilient floor tiles. The wall finishes within the site building consist of painted gypsum board and painted concrete masonry block. The ceiling finishes within the site building primarily consist of exposed structure, and painted suspended ceiling tile. No major deficiencies associated with the building finishes were noted at the time of the site inspection.

2.2 Functional Assessment

2.2.1 Site

The site is located on the corner of Phillip Murray Ave and Thornton Road South. The site is 3.89 acres, with visitor and employee parking occupying 0.68 acres. The operation yard occupies 1.6 acres and is separated by a chain-link fence, wood fence and a mechanical security gate.

The following functional deficiencies were observed during the walkthrough:

- The site is serviced by one driveway accessed from Thornton Road acting as the point of exit and entry to the property for both truck and car traffic. Some of the employee parking shares the yard space. This poses a safety risk. With only one point of exit and entry to the site it is recommended that a second point of exit be provided for truck entry and exit to the yard, and employee parking be separated from the yard activity in accordance with Enbridge design standards.
- The fire department connection is located behind the security gate within the yard. This does not meet code requirements. The fence line should be reconfigured to allow access to the connection from outside of the fence.
- The yard area is smaller than the Enbridge's standard.
- The yard is enclosed with a combination of a wood fence, on the east and west side of the yard, and chain-link fence, on the west and north of the yard.
- There is only one man door exit from the yard. It is recommended that a second be added.

2.2.2 Interior Space Planning

The building was built in 1989, and consists of office space, amenity areas, warehouse and welding/fabrication shop. The following are functional deficiencies observed during the walkthrough:

- The men's and woman's washroom areas are tight. The area of the locker room is not functional due to the limited space and limited access. The lockers do not meet current standards.
- A separate boot wash and washing machine area is required. The boot wash and the washing machine are currently located in the warehouse.
- There is little access to daylight within the warehouse and welding bay areas. It is recommended that window or skylights be considered for these areas.
- There is no wash bay, it was noted that car washing occurs outside in the yard.

2.2.3 Furniture

Existing furniture is legacy furniture throughout. All existing office furniture has reached the end of its life cycle and replacement is recommended to enhance the functional and environmental condition in the office area. The height of the existing cubicle partitions blocks natural light and access to existing windows from the core area.

It is recommended to meet Enbridge's office standards that the furniture be phased out and replaced with new.

2.2.4 Ontario Building Code – Life Safety

Section 3.2 - Building Fire Safety

The building falls under Part 3, Group F Division 2 and Group D major occupancies.

To meet current Ontario Building Code the building should satisfy the requirements of 3.2.2.71: Group F, Division 2, up to 2 Storeys:

- The building is not required to be sprinklered.
- Standpipe system is not required.
- The building is permitted to be of combustible construction or non-combustible construction used singly or in combination.
- Floor assemblies shall be fire separations and, if of combustible construction, shall have a fire-resistance rating not less than 45 minutes (Not applicable).
- Loadbearing walls, columns, and arches supporting an assembly required to have a fire-resistance rating shall have a fire resistance rating of 45 minutes or shall be of non-combustible construction.

Section 3.8 - Barrier-free Design

3.8.1.3. Barrier-free Path of Travel.

3.8.1.3.(1) Every barrier path of travel shall provide an unobstructed width of at least 1100 mm for the passage of wheelchairs.

3.8.1.2. The facility has one entrance to the ground level. It is not equipped with barrier-free door operator and does not qualify as a barrier-free entrance. In accordance with article 3.8.1.2, a minimum of one barrier-free entrance to the building is required.

3.8.2.3. Washrooms required being barrier-free.

There are currently two barrier-free washroom stalls located in the male and female washroom areas.

3.8.3.12. There is not a universal barrier-free washroom in the facility. This is considered an existing non-conforming condition for compliance with Ontario Building Code. There is no mandate in the current code to upgrade the existing facility for compliance with the Universal Barrier Free washroom requirements. However in compliance with Part 11 of Ontario Building Code the addition of a universal washroom will be required in the event of extensive renovation in the building.

2.3 Functional and Physical Condition Analysis

WalterFedy utilized a risk management approach taking into consideration the impact of failure of the building component on the long term serviceability of the building as well as the functional requirements associated with the building. Both Facility Condition Indexing (FCI) and Adequacy Indexing (AI) was utilized in order to help make the best possible decision related to the future of the site building and to determine whether or not to invest, maintain, repurpose or dispose of the asset.

FCI:

FCI is a condition index tool used to illustrate the condition of an asset expressed in a percentage ratio of required maintenance/repair costs divided by the replacement value of the asset expressed as:

$$\text{FCI} = (\text{Maintenance and Repair Costs}) / (\text{Cost to Replace the Building})$$

The replacement value of the building is based on industry standards for construction costs. Therefore, the lower a FCI is, the better the condition of the building. The resulting FCI at ten years is 14.92% which is classified as being in poor condition.

$$\text{FCI (Oshawa)} = (\$420,200) / (11,638 \times 242) = 14.92\%$$

AI:

AI is a condition index tool used to illustrate the functional condition of the asset expressed in a percentage ratio of required functional upgrade costs divided by the replacement value of the asset to meet the functional needs expressed as:

$$\text{AI} = \text{Functional Upgrade Costs} / \text{Cost to Replace the Building with its Functional Equivalent}$$

The Adequacy Index for Oshawa Operations Depot is calculated by dividing the current functional and physical renewal costs by the cost to replace the building with its functional equivalent size.

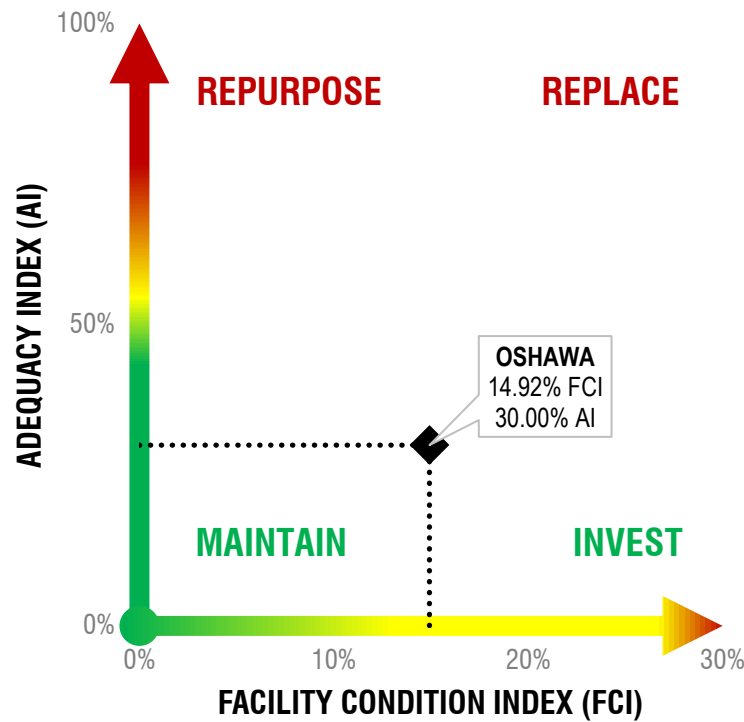
The cost to upgrade the facility to current Enbridge GDP standards is estimated at \$1,418,000. This is based on interior renovation of the existing building with renovation estimated cost of \$250/SF and the construction of a new addition of 4,200 SF based on 60% office space at \$350/SF and 40% industrial space at \$200/SF.

The estimated cost to build a new facility to Enbridge GDP current standards based on 16,337 SF the area required to accommodate current program is \$4,737,730, this is based on 60% of office space at \$350/SF and 40% industrial space at \$200/SF.

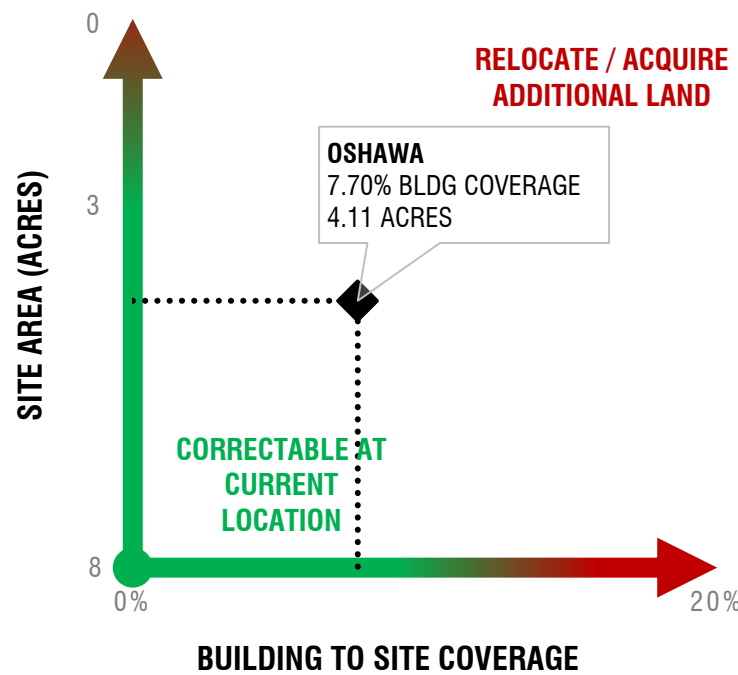
$$\text{AI (Oshawa)} = (\$1,418,000) / (\$4,737,730) = 30\%$$

With quantification of FCI and AI for your building, comes the ability to make comparisons between industry benchmarks, and drive decision making related to the future of the property. The chart below shows the relationship between FCI and AI and indicates visually where Oshawa Operations Depot falls within the decision making criteria.

**FACILITY CONDITION &
ADEQUACY GRAPH**



**SITE CONSTRAINTS
GRAPH**



2.4 Key Findings

- PHYSICAL OBSOLESCENCE:

The acceptable Enbridge standard for the physical condition is an FCI of 0 to 5%. The current FCI of the facility based on this study is 14.92% therefore the physical condition of the facility does not meet Enbridge acceptable standards.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	POSITIVE	Negative

- FUNCTIONAL OBSOLESCENCE BUILDING :

The acceptable Enbridge standard for the functional condition is 0, anything between 0 to 50% is considered correctable at current location. The current facility AI index is 30% which is considered correctable at current location without consideration of other factors including adequacy of land size and the FCI index.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	POSITIVE	Negative

- FUNCTIONAL OBSOLESCENCE SITE:

The yard size is smaller than Enbridge standard yard size requirements. The current yard size is 1.6 acres. Enbridge standard yard size is 2.5 acres. There is available space on the property to relocate existing parking located in within the yard area and increase the size of the yard to achieve a more functional space.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	POSITIVE	Negative

Overall the existing building is smaller than Enbridge Gas Distribution current standards. In order to meet current standards an addition of approximately 4,200 SF is required.

Though the current site is marginally smaller than Enbridge's standards it is proposed that Enbridge Gas Distribution expand the existing building at the current location.

The FCI and AI graph indicates recommendation to repurpose the existing facility.

2.5 Development Scenarios

The following is a comparison of the available options to address the deficiencies at 1350 Thornton Road South:

SCENARIO	1
DESCRIPTION	Correct physical and functional deficiencies by renovating and renewing the existing facility on the existing site
LAND ACQUISITION	N/A
LAND SALE PROCEEDS	N/A
CONSTRUCTION COST	\$1,418,000*
SOFT COST	\$283,000
FURNITURE	\$570,000****
Total Project Cost	\$ 2,271,000
MEETS EDG STANDARDS	YES
PRIORITY	1

* Construction cost is based on interior renovation of 1,000 SF based on \$200/SF, and an addition of 4,200 SF. based on \$350/SF for the office area and \$200/SF for the industrial space. Total required gross addition area is 4,200 SF 40% industrial space and 60% office, amenity and circulation space is assumed.

**** Furniture cost is based on \$10,000 per employee.



APPENDIX A

Capital Expenditures Forecast



CAPITAL FORECAST

1350 Thornton Road South, Oshawa, ON
Operations Depot

The following Capital Plan has been compiled from the following:

- 1 EGD Long Range Capital Plan (LRP)
- 2 EGD/FMG Property Inspection (FMG)
- 3 3rd Party Property Condition Assessment (PCA)
- 4 Non-Functional Standards Assessment - Section 5 (nFSA)
- 5 Electrical Safety Authority Inspection (ESA)
- 6 EGD Quarterly Health/Safety Inspection (HSI)

SECTION	CATEGORY	DEFICIENCY	1	2	3	4	5	6	7	8	9	10
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
			BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD
Maintenance Deficiencies												
	Building Envelope	Replace roof membrane system	\$ 140,000									
	Building Envelope	Replace office windows and framing							\$ 60,000	\$ 60,000		
	Building Envelope	Allowance for concrete block repairs	\$ 5,000									
	HVAC	Replace rooftop HVAC units		\$ 13,500				\$ 10,500	\$ 8,500			
	HVAC	Replace three rooftop exhaust units								\$ 1,500	1500	1500
	HVAC	Replace unit heaters								\$ 5,500	5500	5500
	HVAC	Leak test and repaint natural gas supply system			\$ 2,000							
	Leasehold Improvements	Retrofit T8 lighting to LED		\$ 30,000								
	PLMB	Replace domestic water heater			\$ 2,200							
	Site Work/Exterior Elements	Repave remaining section of parking area					\$ 50,000					
	Site Work/Exterior Elements	Replace sections of wood fencing				\$ 2,500						
	Site Work/Exterior Elements	Replace wall mounted and pole mounted site lighting (upgrade to LED)			\$ 10,000			\$ 5,000				
Total Maintenance Deficiencies			\$ 145,000	\$ 43,500	\$ 14,200	\$ 2,500	\$ 50,000	\$ 15,500	\$ 68,500	\$ 67,000	\$ 7,000	\$ 7,000
Cummulative FCI			5.15%	6.69%	7.20%	7.29%	9.06%	9.61%	12.04%	14.42%	14.67%	14.92%
Functional Deficiencies												
	Building Addition	4,000 sqf addition to accommodate space deficiencies						\$ 365,400	\$ 852,600			
	Interior Renovation	1,000 of interior renovation						\$ 60,000	\$ 140,000			
	Soft Costs	20% of Construction Cost						\$ 85,080	\$ 198,520			
	Furniture	Based on \$10,000 per employee						\$ -	\$ 570,000			
Total Functional Deficiencies			\$ -	\$ -	\$ -	\$ -	\$ -	\$ 510,480	\$ 1,761,120	\$ -	\$ -	\$ -
Total			\$ 145,000	\$ 43,500	\$ 14,200	\$ 2,500	\$ 50,000	\$ 525,980	\$ 1,829,620	\$ 67,000	\$ 7,000	\$ 7,000



APPENDIX B

Program

Operations Depot: OSHAWA

Description	Standard # per person	Quantity	Size	Area Factor	Area sq.ft.	Area sq.ft. Current	Area sq.ft. Variance	Notes
General Building Infrastructure								
Main Vestibule	<	1	9 x 5	1.00	45	57	12	
Waiting Area	<	1	9 x 5	1.00	45	0	-45	
Rear Entrance	<	1	7 x 5	1.00	35	32	-3	
Showers/Change/Washrooms	42	1	5 x 6	1.00	1,260	935	-325	
Universal Washroom	1 / floor	1	8 x 10	1.00	80	0	-80	
Janitor	1 / facility	1	6 x 10	1.00	60	46	-14	
Mechanical/Electrical and IT Room	1 / facility	1	12 x 14	1.00	168	237	69	
Storage					100	0	-100	
Sub Total					1,793	1,307	-486	
Functional Building Area								
MPO Office	20% of office staff	11	10 x 10	1.00	1,100	596	-504	4 offices
Cubicles Workstations (45 capacity employees)	50% of office staff	29	8 x 6	1.50	2,088	1,696	-392	27 Workstations
Meeting Room (8-10 people) 1/70 staff	1 per 70	1	16 x 11	1.50	264	909	645	
Mustering Room (1chair/person) +1 HR workstation with connectivity and large TV screen for training	10	1	4 x 5	4.00	800	673	-127	
Break out room (4 people) 1/50 staff	1 per 50	2	10 x 12	1.00	240	0	-240	
Micro Kitchen/Ezone - 1/floor	1/200	1	15 x 20	1.00	300	328	28	
Hotel Station (2:1 ratio of dynamic staff)	30% of office staff	3	6 x 2.5	1.50	68	447	380	10 Workstations
Print Copy Rm/Mail Room	1/ 100	1			250	106	-144	
Health room - required if there are 200 or more employees on any one shift.	<	0	11 x 10	1.00	0	0	0	
Coat Storage	<	1	2 x 6	1.00	12	0	-12	
Gas monitor calibration (1/10 people)		1	8 x 8	1.00	60	0	-60	
Measurement & Regulation Test/ Storage		1	12 x 20	1.00	240	264	24	
Warehouse (where required by business ops)		1	30 x 77	1.00	2,310	1,931	-379	
Free Pick storage	1/Building	1	15 x 10	1.00	150	0	-150	
Locked Storage Room	<	1	10 x 15	1.00	150	197	47	
Wash Bay / Repair Garage(if fleet exists)	1/Building	1	25 x 50	1.00	1,250	0	-1250	
Welding Bay / Fabrication	1/Building	1	35 x 54	1.00	1,890	1,215	-675	
Boot wash		1	6 x 10	1.00	60	20	-40	
Washing Machine Area		1	6 x 10	1.00	60	15	-45	
Sub Total					11,292	8,397	-2895	
Total Building Area (not including circulation)					13,085	9,704	-3381	
Circulation	24.86%				3,253	2,412	-840	
Total Building Area (not including out buildings)					16,337	12,116	-4221	

Site								
Total Site Area:						155,772		
Setbacks		per by-law requirements			36,648	27,547	-9,101	
Building Area		per site				12,116		
Future Building Expansion		deficit of site program above			4,221	0	-4221	
Landscaping		per site				18,727		
Staff Parking	1 per employee	57	9 x 18	2.00	18,468	15,210	-3258	53
Visitor Parking	<	16	9 x 18	2.00	5,184	10,004	4,820	
Sub Total					64,521	83,604	-2659	
Available Yard Area:					108,900	72,168	-36732	Based on minimum 2.5 acres required
Site Deficit:							-39391	



APPENDIX C

Photographs



1350 Thornton Road South, Oshawa, ON

Appendix B.1

1. Building Exterior



2. Parking Lot



3. Roof



4. Yard



5. Loading Area



6. Office Area





1350 Thornton Road South, Oshawa, ON

Appendix B.2

1. Cracked Pavement



2. Wall Mounted Lighting



3. Rooftop Unit



4. Rooftop



5. Window Framing



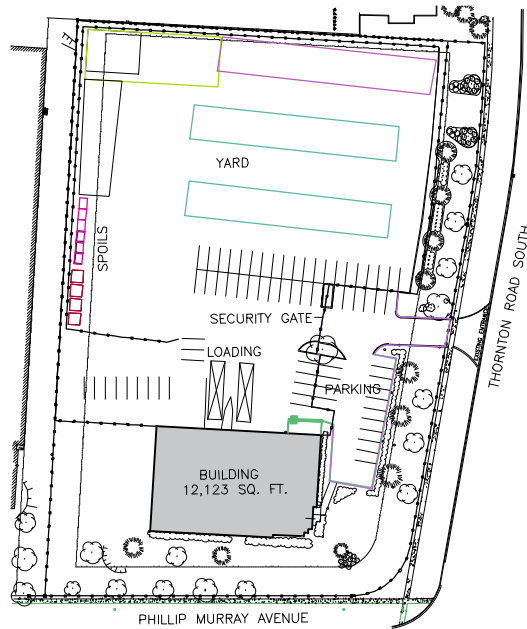
6. Water Heater





APPENDIX D

Drawings



Site Plan



0 10 20 30 feet

Floor Plan

General Building Infrastructure

- Main Vestibule
- Alternate Entrance
- Showers-Change
- Janitor
- Mech-Elec
- Office-MPO
- Workstations

Functional Building Area

- Meeting
- Hotel Station
- Micro Kitchen
- Print Mail
- Mustering
- M&R
- Warehouse
- Storage-Locked
- Welding Bay Fab

- Boot Wash
- Laundry
- MISC.
- Circulation

Enbridge Oshawa

1350 Thornton Road South, Oshawa, ON

2016-0613-05



3.12 FACILITY ASSESSMENT

ENBRIDGE GAS DISTRIBUTION INC.

PETERBOROUGH OPERATIONS DEPOT

572 Neal Drive, Peterborough, ON

Project No.: 2016-0613-05

REV 1.0 - December 6, 2017

WALTERFEDY

ENBRIDGE GAS DISTRIBUTION INC.

FACILITY ASSESSMENT

Peterborough Operations Depot

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Appendix A – Capital Expenditures Forecast

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1.0 SUMMARY

1.1 Introduction

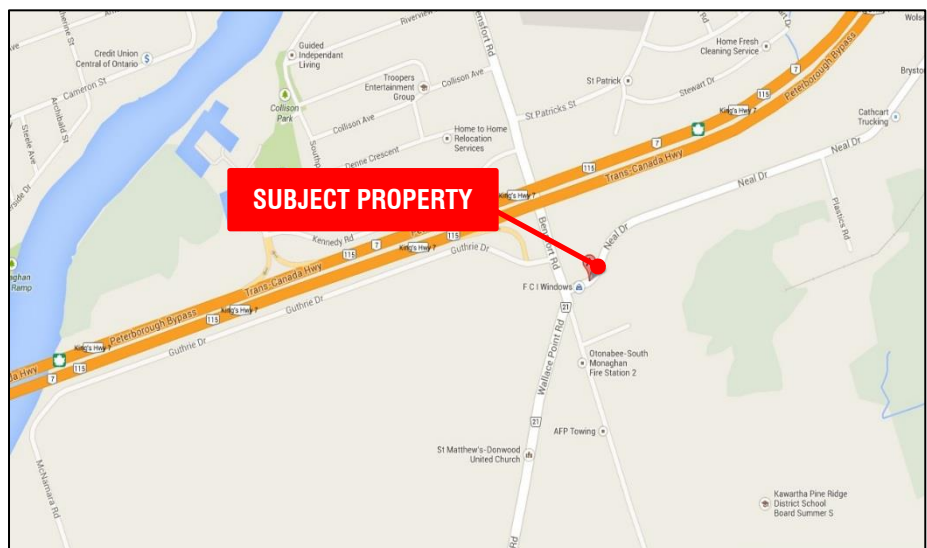
WalterFedy was retained by Enbridge to conduct a physical and functional assessment of the facility located at 572 Neal Drive in Peterborough, Ontario for the purpose of identifying functional adequacy and physical renewal requirements for budgeting and planning purposes. The scope of the report includes a general visual inspection of visible civil, architectural, structural, mechanical, and electrical components. It also includes a brief Ontario Building Code (OBC) review to address barrier-free accessibility issues.

Following the initial report, a list of recommendations with estimated costs is provided for corrective and preventive maintenance items required.

1.2 Facility Description

The facility is categorized by Enbridge as a satellite Operation Centre. The original building was constructed in 1981 on 1.1 acre industrial zoned land.

The facility is located on Neal Drive east of Bensford Road and south of highway 115. The facility has excellent access to major transportation routes to the north and south. The surrounding area is predominantly light industrial.



1.2.1 Property Summary

1) General:

Owned / Leased:	Owned
FCI score:	10.38 %
AI score:	32 %
Current Occupancy:	21

2) Physical Building Properties:

Gross Floor Area:	6,900± SF
Ground Level	6,100± SF
Mezzanine Area:	800± SF
Office Space:	1,134± SF
Common Areas:	1,847± SF
Industrial:	2,270± SF
Circulation:	849± SF

3) Site Characteristics:

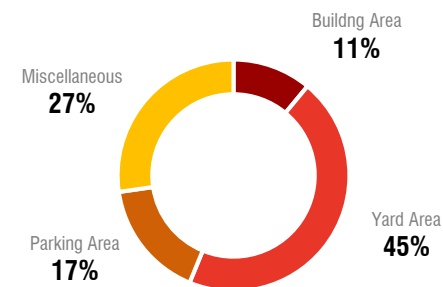
Site Area:	49,250± Sqf (1.1 acres)
Building Coverage:	12.37% (6,100 SF)
Yard Area:	25,000 SF (0.57 acres)
Parking:	9,150 SF (0.21 acres)
Misc.:	15,100 (0.34 acres)

4) Zoning:

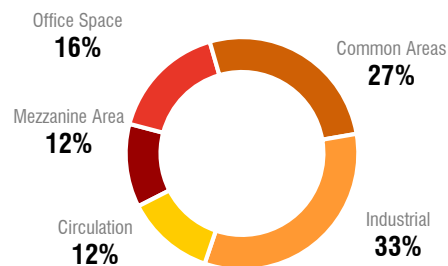
Zone :	M1.2 – General Industrial
Parking Required	1/28m ² (301 SF) of GFA: 23
Parking Provided	28 cars/vans, 9 trucks, 2 equipment
Front Yard Depth (minimum):	6.0 meters Provided 8.8 meters
Side Yard Width (minimum):	6.0 meters Provided 24 meters
Rear Yard Depth (minimum):	6.0 meters Provided 21 meters
Lot Coverage (maximum):	60%

5) Building Systems:

HVAC:	Rooftop HVAC units, ceiling mounted unit heaters.
Plumbing:	Municipal domestic water and septic tank sanitary
Electrical:	200 A/600 V three phase service
Building Automation/Security:	None



SITE AREA DISTRIBUTION



BUILDING AREA DISTRIBUTION

1.3 Scope of Work

The scope of work for this assessment was approved by Enbridge and was completed in accordance with WalterFedy's fee proposal dated September 08, 2016.

The scope of work for the Asset Management Report will include a Functional Assessment, a Physical Assessment, and a Market Condition Assessment. The report will provide recommendations for strategic decisions based on the metrics reviewed in the assessments.

1.4 Assessment Methodology

The building condition assessment is based on general visual examination performed on September 26, 2016, WalterFedy's Architectural and Facility Management departments.

The observations in this report were made using non-destructive methods through existing access points. Existing drawings provided by Enbridge for the building were also used to supplement site observations.

The guiding principles of this study is based upon the document from the National Research Council of Canada (NRC) "Protocols for Building Condition Assessment" published by The Institute For Research in Construction (IRC).

1.5 Limitation of Study

This assessment is based on our general review and walkthrough of the facility and it is not intended to form a detailed life safety analysis or Ontario Building and Fire Code assessment. The facility was built in 1960 and is not in compliance with current Ontario Building and Fire Codes. It is recommended that a further detailed life safety review and assessment is carried out to determine what building systems upgrades would be required to meet the requirements of Section 9.2 of Ontario Fire Code to the satisfaction of the Fire Department.

This report was completed in accordance with the approved scope of work as described in Section 1.3. This report is limited and is not intended to be comprehensive or exhaustive, or to suggest a risk-free facility. The report may not address all existing issues associated with the facility and may omit issues that are or may be of interest to the Owner. The findings and statements in this report are based on general site observations of the current conditions as they existed during the time period of the investigation.

The purpose of this report is for the sole use of the Owner for budgetary planning purposes. Issues identified in this report require further detailed assessments to determine repair and maintenance work required. This report should not be used by third parties involved in any work related to the facility; such third parties should undertake their own investigations and studies to determine how the existing condition of the facility will affect their plans and work. WalterFedy accepts no responsibility for liabilities incurred by or damages suffered by any third party as a result of decisions made or actions taken, based upon this report.

The passage of time might affect the views, conclusions and recommendations provided in this report.

The following report is a general guide only and is not intended to be used as a document for construction.

This study does not include hazardous materials review or inspection.

2.0 PHYSICAL AND FUNCTIONAL ASSESSMENT

2.1 Physical Assessment

2.1.2 Site and Landscaping

The site is a near rectangular-shaped property. The site building occupies approximately 5% of the site.

The remainder of the site is occupied by asphalt pavement parking areas, cast-in-place concrete paving, concrete curbs, a perimeter fence with powered access gates and areas of soft landscaping (i.e. grass, shrubs, and trees). Wall mounted lighting units provide illumination for the site. During the site visit the asphalt paved areas were noted to be in good condition overall. Site lighting is aged and consideration should be given to replacing the wall pack units with LED fixtures for improved energy performance. The paint finish on the bolsters providing protection to the emergency power generator was noted to be worn and repainting/refinishing in the near future should be considered.

The property is secured by a five-foot chain link fence along the perimeter of the property. The fence has two operable gates at each of the entrances.

Since the inspection was limited to visible areas no examination of the catch basins was performed and no review of the initial compliance with code was performed. The inspection of underground or concealed components is outside the scope of work.

2.1.3 Mechanical

Heating and cooling for the office area is provided by two Lennox natural gas heated and electrically cooled packaged rooftop HVAC unit (RTU-1 (upper roof): M/N – GCS16-60-120-4J, S/N – 5603G 09717, RTU-2 (lower roof): M/N – GCS16-60-120-4J, S/N – 5603H 09769). Based on the nameplate data on the equipment the package HVAC units were manufactured in 2003 and have a rated heating output of 96,000 BTUH and a cooling output of approximately 7.5 tonnes each. The typical projected useful life of a rooftop mounted HVAC unit is 20 to 25 years.

Supplementary heating for warehouse area is provided by three Reznor natural gas fired forced air ceiling mounted unit heaters.

Based on age and observed condition, replacement of the unit heaters and rooftop mounted HVAC units should not be required within the evaluation period.

Domestic Hot Water (“DHW”) within the site building is provided by a James Wood domestic hot water tank located in the mezzanine area. Based on the name plate data on the equipment and discussion with the site representative, the domestic hot water tank was manufactured/replaced last year.

There was reportedly no shortage of DHW within the site building. Based on WalterFedy's experience the anticipated service life of a DHW is typically 10-15 years. Therefore based on age, replacement should not be required within the term of analysis.

2.1.4 Electrical

The electrical power for the site building is supplied from a pole-mounted transformer. The buildings electrical room has a main 200 Ampere, 347/600 Volt, 3 phase breaker panel and electric service. The breakers provide power through copper wire conduit to the various lighting and receptacle unit distribution panels throughout the site building.

Electrical outlets for block heaters are provided in the parking lot along the north side of the property.

Interior lighting is predominately provided by T8 fluorescent T8 tube lighting fixtures. As a leasehold improvement consideration should be given for an LED retrofit.

Combination battery pack units provide emergency lighting and exit signage within egress pathways.

2.1.5 Structural

As outlined in the scope of work, a limited visual assessment of the condition of the structural elements was carried out on the elements which were visible at the time of the inspection. The site building a slab on grade structure. The superstructure of the site building is comprised of concrete masonry block exterior walls, concrete columns, wood joists and concrete. No major visually identifiable structural deficiencies were noted at the time of the site inspection.

2.1.6 Building Envelope

The roof system atop the site building consists of an upper and lower section of a conventional built-up modified bitumen (BUR), near-flat, gravel ballasted roof system. The roof system is installed atop a layer of rigid insulation, atop a corrugated metal roof decking. Neither the presence of a vapour barrier, nor the type or the thickness of the insulation could be verified, as the scope of the work did not include destructive testing.

Drainage of the roof system is provided by internal roof drains which presumably drain to the municipal sewer system.

Penetrations through the roof system include plumbing stacks, an exhaust vent stack, internal roof drains, mechanical curbs, and service penetrations.

The exterior walls of the building consist of a combination of block masonry and sheet metal cladding.

The window systems of the site building consist of fixed insulated glazed units ("IGU") set within aluminum frames in punched configurations with aluminum spandrel panels below each window sill. Exterior doors serving the site building are comprised of single glazed units set into metal frames. Metal doors within metal frames were observed serving the warehouse egresses and of the site building. Two sectional metal overhead doors were noted serving the warehouse areas. Replacement of windows within the office and warehouse areas are recommended based on age and observed condition along with repair/refinishing of the deteriorated exterior door on the east elevation and replacement of the door hardware (with ULC rated hardware) on the exterior door on the west elevation.

2.1.7 Finishes

The floor finishes within the site building consist of unsealed concrete slab-on-grade, ceramic and resilient floor tiles and carpeting. The wall finishes within the site building consist of painted gypsum board and painted concrete masonry block. The ceiling finishes within the site building primarily consist of exposed structure and painted suspended ceiling tile. Damaged ceramic tiles were noted at the front entrance and the carpet within the office area was noted to be worn and showing signs of early deterioration. Repair/replacement of these interior finishes is recommended within the term of the analysis.

At the time of the site assessment the enclosure for the electrical room was not adequately fire rated and did not have a continuous partition separation to the upper roof deck. Therefore upgrades to this room to achieve a 1 hour fire separation are required and has been included for in our capital expenditures table.

2.2 Functional Assessment

2.2.1 Site

There are two access points to the property off Neal Drive, at the southwest and southeast corners of the property. The west entrance/exit driveway provides access to two visitor's parking spaces and serves as an exit from the maintenance yard area through a security gate. The east entrance provides access to the employee parking area and serves as an entrance to the maintenance yard zone through a security gate. There are 6 employee parking spots located outside the fenced area near the east entrance driveway. In addition to the 6 employee and 2 visitors parking located outside the fenced area there are approximately 24 additional parking spots in the yard zone.

The following functional deficiencies were observed during the walkthrough:

- The yard is too small to accommodate the operational requirement of the facility. The existing yard is 0.57 acres. A minimum of 2.5 acres is required in accordance with Enbridge GDP standards.

2.2.2 Interior Space Planning

The building consists of office space, amenity areas and a warehouse with mezzanine. The mezzanine is used as a storage space. The following are functional deficiencies observed during the walkthrough:

- The entrance area is tight, additional space is required for the area to function properly as an entrance to the building.
- There is lack for storage space in the facility.
- The photocopier and printing supplies are located in the corridor and office space, separate room for the photocopier and printing supplies is recommended.
- Due to the furniture layout and height of cubicles there is lack of natural light in the office space
- The toilet fixtures in the women washrooms are residential style fixture. Replacement with commercial style with open lid seat is recommended
- The ceiling height in the mezzanine is low, the space is used only for storage.
- The Mustering Room is small based on the occupant load, additional space is recommended.
- The Electrical Room requires fire rating, currently the walls and door to the room are not fire rated.
- The Janitor Room is not rated, closer on the door and fire rating for walls and door is required.

2.2.3 Furniture

Existing furniture is legacy furniture throughout. All existing office furniture has reached the end of its life cycle and replacement is recommended to enhance the functional and environmental condition in the office area. The height of the existing cubicle partitions blocks natural light and access to existing windows from the core area.

It is recommended to meet Enbridge's office standards that the furniture be phased out and replaced with new.

2.2.4 Ontario Building Code – Life Safety

Section 3.2 - Building Fire Safety

The building falls under Part 3, Group F Division 2 and Group D major occupancies.

To meet current Ontario Building Code the building should satisfy the requirements of 3.2.2.71: Group F, Division 2, up to 2 Storeys:

- The building is not required to be sprinklered.
- Standpipe system is not required.
- The building is permitted to be of combustible construction or non-combustible construction used singly or in combination.
- Floor assemblies shall be fire separations and, if of combustible construction, shall have a fire-resistance rating not less than 45 minutes (Not applicable).
- Loadbearing walls, columns, and arches supporting an assembly required to have a fire-resistance rating shall have a fire resistance rating of 45 minutes or shall be of non-combustible construction.

Section 3.8 - Barrier-free Design

3.8.1.2. The facility has two entrances. Both entrances are not equipped with barrier-free door operator and none of them qualify as barrier-free entrance. In accordance with article 3.8.1.2, a minimum of one barrier-free entrance to the building is required.

3.8.2.3. Washrooms required being barrier-free.

There are no barrier-free washrooms in the building. As a minimum one barrier-free washroom for male and one barrier-free washroom for female are required.

3.8.3.12. Universal (barrier-free) toilet rooms:

Universal Washrooms do not exist in the building. This is considered an existing non-conforming condition for compliance with Ontario Building Code. There is no mandate in the current code to upgrade the existing facility for compliance with the Universal Barrier Free washroom requirements. However in compliance with Part 11 of Ontario Building Code the addition of a universal washroom will be required in the event of extensive renovation in the building.

2.3 Functional and Physical Condition Analysis

WalterFedy utilized a risk management approach taking into consideration the impact of failure of the building component on the long term serviceability of the building as well as the functional requirements associated with the building. Both Facility Condition Indexing (FCI) and Adequacy Indexing (AI) was utilized in order to help make the best possible decision related to the future of the site building and to determine whether or not to invest, maintain, repurpose or dispose of the asset.

FCI:

FCI is a condition index tool used to illustrate the condition of an asset expressed in a percentage ratio of required maintenance/repair costs divided by the replacement value of the asset expressed as:

$$\text{FCI} = (\text{Maintenance and Repair Costs}) / (\text{Cost to Replace the Building})$$

The replacement value of the building is based on industry standards for construction costs. Therefore, the lower a FCI is, the better the condition of the building. The resulting FCI at ten years is 1.61% which is classified as being in good condition.

$$\text{FCI (Peterborough)} = (\$125,250) / (5,636 \times 214) = 10.38\%$$

AI:

AI is a condition index tool used to illustrate the functional condition of the asset expressed in a percentage ratio of required functional upgrade costs divided by the replacement value of the asset to meet the functional needs expressed as:

$$\text{AI} = \text{Functional Upgrade Costs} / \text{Cost to Replace the Building with its Functional Equivalent}$$

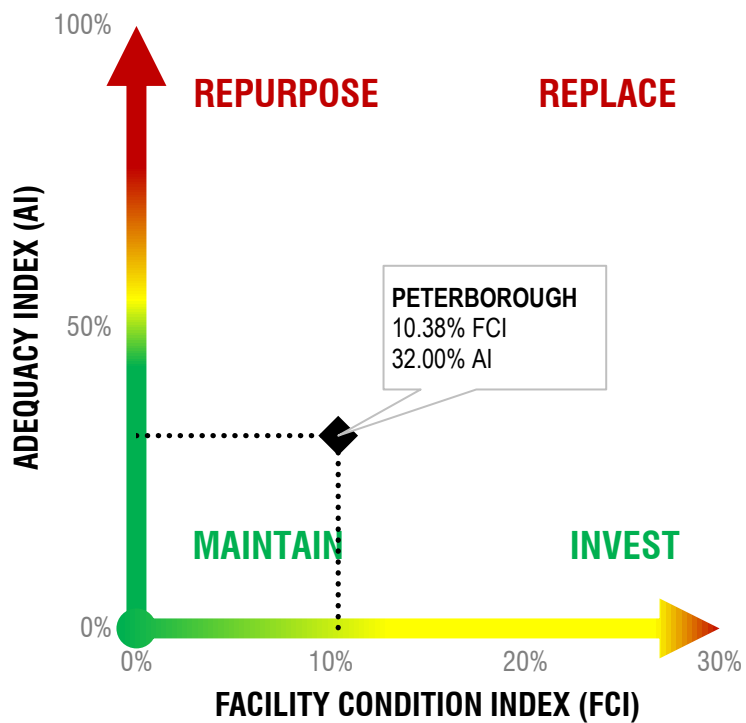
The Adequacy Index for Peterborough Operations Depot is calculated by dividing the current functional and physical renewal costs by the cost to replace the building with its functional equivalent size.

The cost to upgrade the facility to current ENBRDGE GDP standards is estimated at \$957,000. The estimated cost to build a new facility to ENBRDGE GDP current standards based on 10,200 sqf, the area required to accommodate current program, is \$2,958,000. This is based on current program 60% of office space at \$350/sqf and 40% industrial space at \$200/sqf.

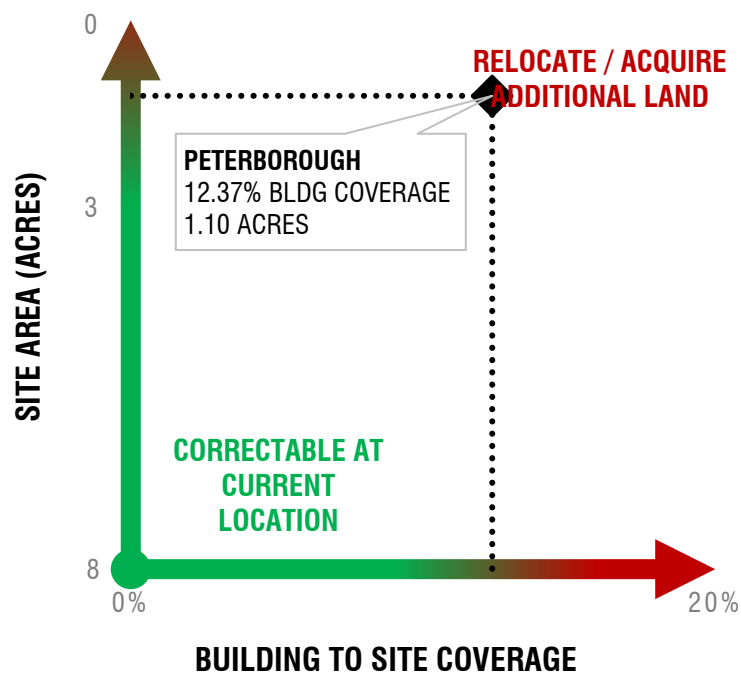
$$\text{AI (Peterborough)} = (\$957,000) / (\$2,958,000) = 32\%$$

With quantification of FCI and AI for your building, comes the ability to make comparisons between industry benchmarks, and drive decision making related to the future of the property. The chart below shows the relationship between FCI and AI and indicates visually where Peterborough Operations Depot falls within the decision making criteria.

FACILITY CONDITION & ADEQUACY GRAPH



SITE CONSTRAINTS GRAPH



2.4 Key Findings

- PHYSICAL OBSOLESCENCE:

The acceptable Enbridge standard for the physical condition is an FCI of 0 to 5%. The current FCI of the facility based on this study is 10.38% therefore the physical condition of the facility does not meet Enbridge acceptable standards.

Meets Standards	Correctable at Current Location
Positive	Positive
NEGATIVE	POSITIVE

- FUNCTIONAL OBSOLESCENCE BUILDING :

The acceptable Enbridge standard for the functional condition is 0, anything between 0 to 50% is considered correctable at the current location. The current facility AI index is 32%. Based on the FCI/AI graph the current recommendation for the existing facility is to repurpose to accommodate current ENBRDGE GDP standards.

Meets Standards	Correctable at Current Location
Positive	Negative
NEGATIVE	POSITIVE

- FUNCTIONAL OBSOLESCENCE SITE:

The yard size is smaller than Enbridge standard yard size requirements. The current yard size is 0.57 acres. Enbridge standard yard size is 2.5 acres.

The existing building requires expansion by approximately 3,300 sqft to meet the need for current staff and Enbridge functional requirements. Building addition on the property will entail further reduction in the yard and parking areas.

Meets Standards	Correctable at Current Location
Positive	Positive
NEGATIVE	NEGATIVE

Overall the existing building is too small to meet current Enbridge Gas Distribution standards.

The configuration of site functions and circulation is inefficient. The yard area is too small to meet current ENBRDGE GDP standards. Building expansion on the same property will further reduce the size of yard area and will cause additional pressure on parking and circulation.

Based on the site deficiencies and space limitations, relocation to another property is recommended. Although the FCI and AI graph indicates recommendation to maintain and repurpose the existing facility, the site deficiencies including space limitations and inefficiencies will prevent the option of expanding the existing building on the same property.

2.5 Property Evaluation

An appraisal for the property was not available at the time of the study. For the purpose of the study an assumed value of \$100,000 to \$200,000 per acre is used for a comparable vacant industrial land in Peterborough.

In Option 2 below an assumed value of \$500,000 is used for the existing land and building.

2.6 Development Scenarios

The following is a comparison of the available options to address the deficiencies at 572 Neal Drive, Peterborough:

SCENARIO	Option 1: Correct at Existing Location	Option 2: Relocate to New Site
DESCRIPTION	Correct physical and functional deficiencies by expanding the existing facility on the existing site	Purchase a vacant 5 acre industrial property and build a new facility
LAND ACQUISITION	\$-	\$700,000
LAND SALE PROCEEDS	\$-	\$(250,000)***
CONSTRUCTION COST	\$957,000**	\$2,958,000*
SOFT COST	\$191,400	\$591,000
FURINTURE	\$210,000	\$210,000
TOTAL	\$1,358,400	\$4,209,000
MEETS ENBRIDGE GDP STANDARDS	NO	YES
PRIORITY		1

* Total construction cost is based on \$350/SF for the office area and \$200/SF for the industrial space. Total required gross floor area is 10,200 SF. 40% industrial space and 60% office, amenity and circulation space is assumed.

** Total construction cost is based on \$350/SF for the office area and \$200/SF for the industrial space. Total required additional floor area is 3,300 SF. 40% industrial space and 60% office, amenity and circulation space is assumed.

*** Land sale proceeds is equal to 50% of the actual property evaluation/sale price. This is based on the “rate base split”/Enbridge portion of proceeds.



APPENDIX A

Capital Expenditures Forecast



7.0 CAPITAL FORECAST

572 Neal Drive, Peterborough, ON
Operations Depot

The following Capital Plan has been compiled from the following:

- 1 EGD Long Range Capital Plan (LRP)
- 2 EGD/FMG Property Inspection (FMG)
- 3 3rd Party Property Condition Assessment (PCA)
- 4 Non-Functional Standards Assessment - Section 5 (nFSA)
- 5 Electrical Safety Authority Inspection (ESA)
- 6 EGD Quarterly Health/Safety Inspection (HSI)

			1	2	3	4	5	6	7	8	9	10
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
SECTION	CATEGORY	DEFICIENCY	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD
Maintenance Deficiencies												
	Building Envelope	Replace aged roof assembly (2 phases)						\$ 60,000				15000
	Building Envelope	Replace door hardware on warehouse egress door (next to O/H)	\$ 500									
	Building Envelope	Repaint/refinish deteriorated finishes on surface of side exit door		\$ 250								
	Building Envelope	Replace windows				\$ 20,000						
	Finishes/interiors	Replace damaged ceramic tile at front entrance		\$ 1,000								
	Finishes/interiors	Replace front office carpeting					\$ 3,500					
	Leasehold Improvements	Retrofit T8 lighting to LED			\$ 15,000							
	Life/Safety	Install proper fire separation to metal roof deck for electrical room	\$ 5,000									
	Site Work/Exterior Elements	Replace wall mounted mounted site lighting (upgrade to LED)				\$ 5,000						
Total Maintenance Deficiencies			\$ 5,500	\$ 1,250	\$ 15,000	\$ 25,000	\$ 3,500	\$ 60,000	\$ -	\$ -	\$ -	\$ 15,000
Cummulative FCI			0.46%	0.56%	1.80%	3.88%	4.17%	9.14%	9.14%	9.14%	9.14%	10.38%
Functional Deficiencies												
	Property acquisition								\$ 700,000			
	Building Construction	10,200 sqf new building to accommodate space deficiencies								\$ 1,479,000	\$ 1,479,000	
	Furniture	Based on \$10,000 per employee allowance									\$ 210,000	
	Soft Costs	20% of Construction Cost								\$ 591,000		
Total Functional Deficiencies			\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 700,000	\$ 2,070,000	\$ 1,689,000	\$ -
Total			\$ 5,500	\$ 1,250	\$ 15,000	\$ 25,000	\$ 3,500	\$ 60,000	\$ 700,000	\$ 2,070,000	\$ 1,689,000	\$ 15,000



APPENDIX B

Program

Operations Depot: PETERBOROUGH

Description	Standard # per person	Quantity	Size	Area Factor	Area sq.ft.	Area sq.ft. Current	Area sq.ft. Variance	Notes
General Building Infrastructure								
Main Vestibule	<	1	9 x 5	1.00	45	55	10	
Waiting Area	<	1	9 x 5	1.00	45	0	-45	
Rear Entrance	<	1	7 x 5	1.00	35	71	36	
Showers/Change/Washrooms	17	1	5 x 6	1.00	510	430	-80	
Universal Washroom	1 / floor	1	8 x 10	1.00	80	0	-80	
Janitor	1 / facility	1	6 x 10	1.00	60	44	-16	
Mechanical/Electrical and IT Room	1 / facility	1	12 x 14	1.00	168	626	458	Most of Mezz. Space
Storage					100	271	171	Mezz. Space
Sub Total					1,043	1,497	454	
Functional Building Area								
MPO Office	20% of office staff	4	10 x 10	1.00	400	0	-400	
Cubicles Workstations (45 capacity employees)	50% of office staff	11	8 x 6	1.50	792	674	-118	
Meeting Room (8-10 people) 1/70 staff	1 per 70	1	16 x 11	1.50	264	239	-25	
Mustering Room (1chair/person) +1 HR workstation with connectivity and large TV screen for training	10	1	4 x 5	4.00	800	634	-166	
Break out room (4 people) 1/50 staff	1 per 50	1	10 x 12	1.00	120	0	-120	
Micro Kitchen/Ezone - 1/floor	1/200	1	15 x 20	1.00	300	285	-15	
Hotel Station (2:1 ratio of dynamic staff)	30% of office staff	6	6 x 2.5	1.50	135	0	-135	
Print Copy Rm/Mail Room	1/ 100	1			250	116	-134	not a dedicated room
Health room - required if there are 200 or more employees on any one shift.	<	0	11 x 10	1.00	0	0	0	
Coat Storage	<	1	2 x 6	1.00	12	0	-12	
Gas monitor calibration (1/10 people)		1	8 x 8	1.00	60	12	-48	Within mustering room
Measurement & Regulation Test/ Storage		1	12 x 20	1.00	240	0	-240	
Warehouse (where required by business ops)		1	30 x 77	1.00	2,310	2,465	155	
Free Pick storage	1/Building	1	15 x 10	1.00	150	0	-150	
Locked Storage Room	<	1	10 x 15	1.00	150	92	-58	
Wash Bay / Repair Garage (if fleet exists)	1/Building	1	25 x 50	1.00	0	0	0	Not Required at this location
Welding Bay / Fabrication	1/Building	1	35 x 54	1.00	1,890	0	-1890	
Boot wash		1	6 x 10	1.00	60	84	24	
Washing Machine Area		1	6 x 10	1.00	60	15	-45	In boot wash room
Sub Total					7,993	4,616	-3377	
Total Building Area (not including circulation)					9,036	6,113	-2923	
Circulation	12.86%				1,162	786	-376	
Total Building Area (not including out buildings)					10,198	6,899	-3299	

Site								
Total Site Area:						49,143		
Setbacks		per by-law requirments				8,450	6,749	-1,701 parking/storage space not included
Building Area		per site					6,050	
Future Building Expansion		deficit of site program above				3,299		-3299
Landscaping		per site					4,439	
M&R Station		unique to site location					0	0
Staff Parking	1 per employee	21	9 x 18	3.00	10,206	9,246	-960	15 spots
Visitor Parking	<	6	9 x 18	3.00	2,916	5,233	2,317	8 spots
Sub Total					24,871	31,717	-1942	
Available Yard Area:						108,900	17,426	-91474 Based on minimum 2.5 acres required
Site Deficit:							-93416	



APPENDIX C

Photographs



572 Neal Drive, Peterborough, ON

Appendix B.1

1. Parking Lot



2. Bunkers



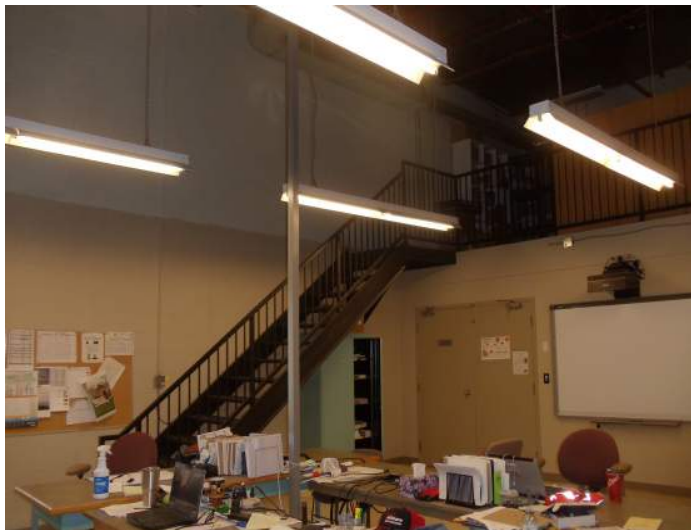
3. Gate



4. Loading Area



5. Open Working Area



6. Mezzanine Area





572 Neal Drive, Peterborough, ON

Appendix B.2

1. Damaged Tile



2. Office Carpet



3. Indoor Lighting



4. Side Exit Door



5. Portion of Rooftop



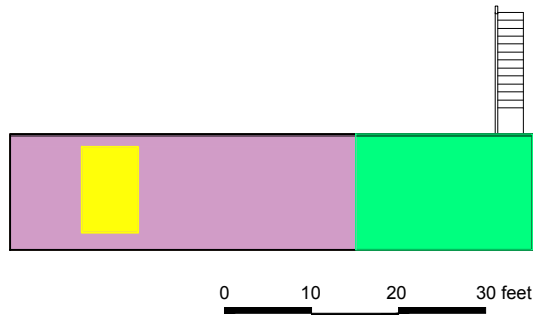
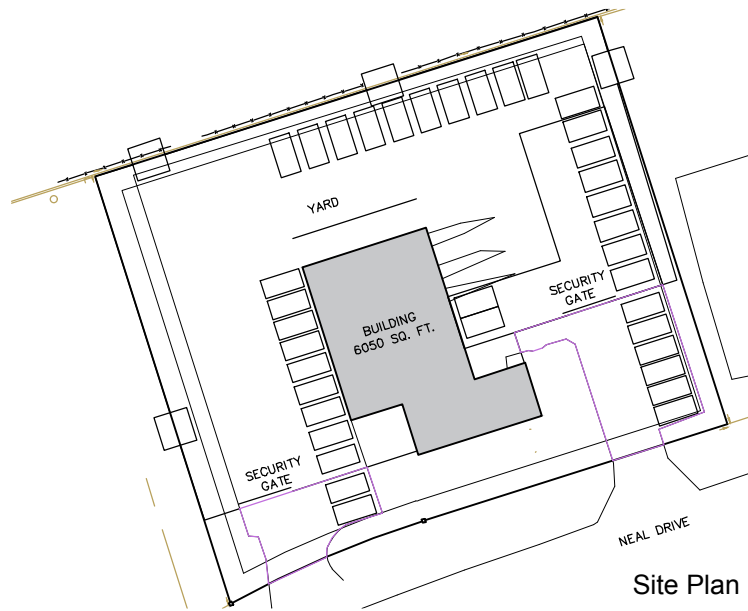
6. Wall Mounted Lighting





APPENDIX D

Drawings



Enbridge Peterborough
572 Neal Drive, Peterborough, ON

General Building Infrastructure

- Main Vestibule
- Alternative Entrance
- Showers-Change
- Janitor
- Mech-Elec

Functional Building Area

- Workstations
- Meeting
- Micro Kitchen

- Print-Mail
- Health
- Mustering
- Gas Monitor Calibration
- Warehouse
- Storage-Locked
- Boot Wash
- Laundry
- MISC.**
- Circulation



2016-0613-05



3.13 FACILITY ASSESSMENT

ENBRIDGE GAS DISTRIBUTION INC.

TECUMSEH OPERATIONS DEPOT
TECUMSEH GAS AND TECUMSEH ENGINEERING BUILDING
3595 Tecumseh Road, Mooretown, ON
Project No.: 2016-0613-05

REV 1.0 - December 6, 2017

WALTERFEDY

ENBRIDGE GAS DISTRIBUTION INC.

FACILITY ASSESSMENT

Tecumseh Engineering Operations Depot

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1.0 SUMMARY

1.1 Introduction

WalterFedy was retained by Enbridge to conduct a physical and functional assessment of the facility located at 3595 Tecumseh Road, Mooretown, Ontario for the purpose of identifying functional adequacy and physical renewal requirements for budgeting and planning purposes. The scope of the report includes a general visual inspection of visible civil, architectural, structural, mechanical, and electrical components. It also includes a brief Ontario Building Code (OBC) review to address barrier-free accessibility issues.

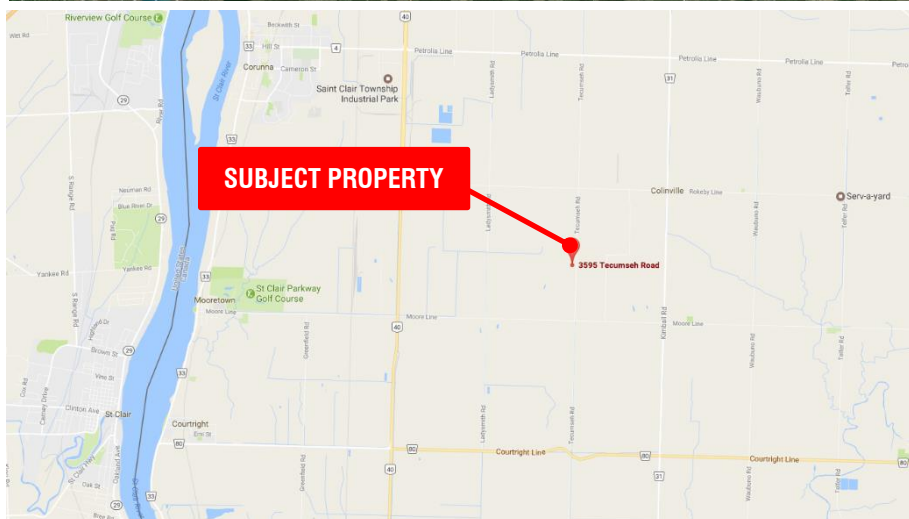
Following the initial report, a list of recommendations with estimated costs is provided for corrective and preventive maintenance items required.

1.2 Facility Description

The facility is comprised of two buildings one is categorized by Enbridge as an Operations Depot and the other is the Engineering building that houses special projects and additional warehouse space. The Engineering building was constructed in 2009, and occupies 4.8 acre of industrial zoned land. Tecumseh Operations Depot was completed in January 2016 and occupies 9.99 acres of industrial zone.



The property is located on Tecumseh Road east of highway 40 and south of highway 402. The facility has excellent access to major transportation routes in all directions. The surrounding area is predominantly agricultural land.



Enbridge Gas Operations depot is located south of the plant, with the Engineering building located north of the plant.

Enbridge Gas Distribution Inc.
Tecumseh Engineering Operations Depot – Facility Assessment

1.2.1 Property Summary

(1) General

Owned / Leased:	Owned
FCI score	
Building A (Gas):	0.81%
Building B (Engineering):	0.28%
AI score:	
Building A (Gas):	0%
Building B (Engineering):	0%
Current Occupancy:	
Building A (Gas):	71
Building B(Engineering):	0 (19 hoteling stations)

Total Parking:	29,613 SF
Miscellaneous:	269,959 SF

Building B(Engineering):

Site Area:	212,199 SF (4.8 ac.)
Existing Building Coverage:	5.1% (1,100 SF)
Total Yard Area:	53,877 SF (1.2 ac.)
Total Parking:	8,033 SF
Miscellaneous:	139,290 SF

(2) Physical Building Properties:

Building A (Gas):

Building Constructed:	2015/ 2016
Gross Floor Area:	±44,491 SF
Building Area (Foot Print):	± 42,862 SF
Mezzanine area	± 1,629 SF
Office Space:	±11,248 SF
Common Areas:	± 7,934 SF
Industrial:	±13,528 SF
Circulation:	±10,151 SF

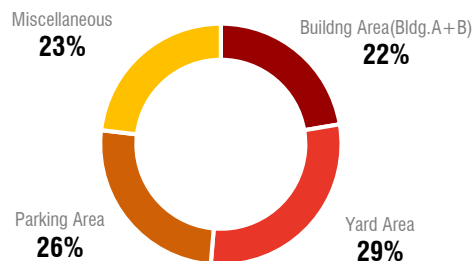
Building B(Engineering):

Building Constructed:	2009
Gross Floor Area:	±12,506 SF
Building Area (Foot Print):	± 11,000 SF
Mezzanine Area:	±1,506 SF
Office Space:	± 2,467 SF
Common Areas:	±1,075 SF
Industrial:	± 6,354 SF
Circulation:	±1,104 SF

(3) Site Characteristics:

Building A(Gas)

Site Area:	±435,367 SF (9.99 ac.)
Existing Building Coverage:	9.8% (42,862 SF)
Total Yard Area:	75,777 SF (1.7 ac.)



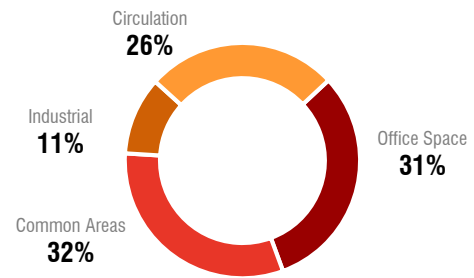
SITE AREA DISTRIBUTION

(4) Zoning:

Zone:	M5-1 INDUSTRIAL
Parking Required:	1/37 m2 99 required
Parking Provided:	113
Loading Provided:	1 loading space
Front Yard Depth (min.)	15 meters Provided 38 meters
Side Yard Width (min.)	15.0 meters Provided 19.8 meters
Rear Yard Depth (min.)	15 meters Provided 79.5 meters
Building Height (max.)	10 m

(5) Building Systems:

HVAC:	2 gas-fired hot water boilers 2 RTUs 2 Air handling units 3 Make up air handling units 2 Condensers 3 ERVs
Plumbing:	Municipal water/sewer
Electrical:	1200 A/600 V, 3 phase
Building Automation/Security:	Yes



BUILDING AREA DISTRIBUTION

Enbridge Gas Distribution Inc.
Tecumseh Engineering Operations Depot – Facility Assessment

1.3 Scope Of Work

The scope of work for this assessment was approved by Enbridge and was completed in accordance with WalterFedy's fee proposal dated September 08, 2016.

The scope of work for the Asset Management Report will include a Functional Assessment, a Physical Assessment, and a Market Condition Assessment. The report will provide recommendations for strategic decisions based on the metrics reviewed in the assessments.

1.4 Assessment Methodology

The building condition assessment is based on general visual examination performed on September 21, 2016 by WalterFedy's Architectural and Facility Management departments.

The observations in this report were made using non-destructive methods through existing access points. Existing drawings provided by Enbridge for the building were also used to supplement site observations.

The guiding principles of this study is based upon the document from the National Research Council of Canada (NRC) "Protocols for Building Condition Assessment" published by The Institute For Research in Construction (IRC).

1.5 Limitation of Study

This assessment is based on our general review and walkthrough of the facility and it is not intended to form a detailed life safety analysis or Ontario Building Code and Fire Code assessment. The Operations depot completed construction in January 2016, and is considered to be in general compliance with the current Ontario Building Code. The Engineering building was built in 2009 and is not in general compliance with current Ontario Building Code and Fire Code. It is recommended that a further detailed life safety review and assessment is carried out to determine what building systems upgrades would be required to meet the requirements of Section 9.2 of Ontario Fire Code to the satisfaction of the Fire Department.

This report was completed in accordance with the approved scope of work as described in Section 1.3. This report is limited and is not intended to be comprehensive or exhaustive, or to suggest a risk-free facility. The report may not address all existing issues associated with the facility and may omit issues that are or may be of interest to the Owner. The findings and statements in this report are based on general site observations of the current conditions as they existed during the time period of the investigation.

The purpose of this report is for the sole use of the Owner for budgetary planning purposes. Issues identified in this report require further detailed assessments to determine repair and maintenance work required. This report should not be used by third parties involved in any work related to the facility; such third parties should undertake their own investigations and studies to determine how the existing condition of the facility will affect their plans and work. WalterFedy accepts no responsibility for liabilities incurred by or damages suffered by any third party as a result of decisions made or actions taken, based upon this report.

The passage of time might affect the views, conclusions and recommendations provided in this report.

The following report is a general guide only and is not intended to be used as a document for construction.

This study does not include hazardous materials review or inspection.

Enbridge Gas Distribution Inc.
Tecumseh Engineering Operations Depot – Facility Assessment

2.0 PHYSICAL AND FUNCTIONAL ASSESSMENT

2.1 Physical Assessment

2.1.1 Site and Landscaping

The Engineering Operations Site is a near rectangular-shaped property. The Site Building occupies approximately 5% of the Site.

The remainder of the Engineering Site is occupied by asphalt pavement parking areas, cast-in-place concrete paving, concrete curbs, a perimeter fence with powered access gates and areas of soft landscaping (i.e., grass, shrubs, and trees). Wall mounted lighting units provide illumination for the site. During the Site visit the asphalt paved areas were noted to be in good condition overall. Site lighting is also in good condition, however, consideration should be given to replacing the wall pack units with LED fixtures for improved energy performance at the later portion of the analysis.

The Engineering property is secured by a six-foot chain link fence along the perimeter of the property. The fence has one operable gate at the front entrance. At the time of the site investigation the pedestrian exit gate was not closing properly requiring additional force to latch the gate closed. Therefore, maintenance repairs on this gate are recommended in the early portion of this analysis.

Since the inspection was limited to visible areas no examination of the catch basins was performed and no review of the initial compliance with code was performed. The inspection of underground or concealed components is outside the scope of work.

The Gas Operations Site is a near rectangular-shaped property. The Site Building occupies approximately 10% of the Site.

The remainder of the Gas Site is occupied by asphalt pavement parking areas, cast-in-place concrete paving, concrete curbs, and areas of soft landscaping (i.e., grass, shrubs, and trees). The paved areas and lighting are in good condition due to the recent construction of the Site. Capital allocation toward asphalt repairs should be considered in the term of analysis.

The Gas property is secured by fencing along the perimeter of the property. Multiple sliding and arm gates secure the company parking lot on the north, south, and west sides of the building. Due to the recent Site construction, maintenance repairs on the fencing and gates are recommended in the term of analysis.

2.1.2 Mechanical

In the Engineering building, heating and cooling for the office area is provided by a Carrier natural gas heated and electrically cooled packaged rooftop HVAC unit (M/N – 48TME009----121HQ, S/N – 4508G50539). Based on the nameplate data on the equipment the package HVAC units were manufactured in 2008 and have a rated heating output of 96,000 BTUH and a cooling output of approximately 7.5 tonnes. The typical projected useful life of a rooftop mounted HVAC unit is 20 to 25 years. Therefore replacement should not be required within the term of this analysis.

Supplementary cooling in the office area is provided by a Fujitsu pad mounted split DX unit (M/N – AOU1SCL, S/N – DCN0 1-9050). Based on the nameplate data on the equipment the split DX unit was manufactured in 2008 and have a rated cooling output of 18,000 BTUH. The typical projected useful life of a split DX unit is 15 to 20 years. Therefore replacement should not be required within the term of this analysis.

Enbridge Gas Distribution Inc.
Tecumseh Engineering Operations Depot – Facility Assessment

Supplementary heating for warehouse area is provided by ceiling mounted radiant tube heaters. Based on age and observed condition, replacement of the radiant tube heaters should not be required within the evaluation period.

Domestic Hot Water (“DHW”) within the Site Building is provided by a James Wood domestic hot water tank located in the warehouse area. Based on the name plate data on the equipment and discussion with the site representative the domestic hot water tank was manufactured in 2009.

There was reportedly no shortage of DHW within the Site Building. Based on WalterFedy’s experience the anticipated service life of a DHW is typically 10-15 years. Therefore based on age, replacement should be considered within the term of analysis.

In the Gas building, heating and cooling for the office area is provided by a natural gas heated and electrically cooled packaged rooftop HVAC unit. The typical projected useful life of a rooftop mounted HVAC unit is 20 to 25 years. Therefore replacement should not be required within the term of this analysis.

Domestic Hot Water (“DHW”) within the Site Building is provided from the warehouse area. Based on WalterFedy’s experience the anticipated service life of a DHW is typically 10-15 years. Due to the recent construction of the Gas Operations building, replacement should not need to be considered within the term of analysis.

2.1.3 Electrical

The electrical power for the Site Building is supplied from a pole-mounted transformer. The buildings electrical room has a main 200 Ampere, 347/600 Volt, 3 phase breaker panel and electric service. The breakers provide power through copper wire conduit to the various lighting and receptacle unit distribution panels throughout the site building.

Interior lighting is predominately provided by T8 fluorescent T8 tube lighting fixtures. As a leasehold improvement consideration should be given for an LED retrofit near the end portion of this analysis.

Combination battery pack units provide emergency lighting and exit signage within egress pathways.

EDIT THIS SECTION – HAVE AS GAS OPERATIONS

The electrical power for the Site Building is supplied from a pad-mounted transformer. The buildings electrical room has a main 800 Ampere, 347/600 Volt, 3 phase breaker panel and electric service. The breakers provide power through copper wire conduit to the various lighting and receptacle unit distribution panels throughout the site building.

Combination battery pack units provide emergency lighting and exit signage within egress pathways.

2.1.4 Structural

As outlined in the scope of work, a limited visual assessment of the condition of the structural elements was carried out on the elements which were visible at the time of the inspection. The Site Building a slab on grade structure. The superstructure of the Site Building is comprised of concrete masonry block exterior walls, concrete columns, wood joists and concrete. No major visually identifiable structural deficiencies were noted at the time of the site inspection.

EDIT THIS SECTION – HAVE AS GAS OPERATIONS

The Gas Operations Building is comprised of a slab on grade structure. The superstructure of the Site Building is comprised of concrete masonry block exterior walls, concrete columns, and steel joists. No major visually identifiable structural deficiencies were noted at the time of the site inspection.

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Tecumseh Engineering Operations Depot – Facility Assessment

2.1.5 Building Envelope

The Engineering building roof system atop the Site Building consists of an upper and lower section of a conventional built-up modified bitumen (BUR), steel roof system. The roof system is installed atop a layer of rigid insulation, atop a corrugated metal roof decking. Neither the presence of a vapour barrier, nor the type or the thickness of the insulation could be verified, as the scope of the work did not include destructive testing.

Drainage of the roof system is provided by internal roof drains which presumably drain to the municipal sewer system.

Penetrations through the roof system include plumbing stacks, an exhaust vent stack, internal roof drains, mechanical curbs, and service penetrations.

The exterior walls of the Site Building consist of a combination of brick masonry with concrete block walls.

The window systems of the Site Building consist of fixed Insulated Glazed units (“IGU”) set within aluminum frames in punched configurations. Exterior doors serving the Site Building are comprised of Single Glazed units set into metal frames. Metal doors within metal frames were observed serving the warehouse egresses and of the Site Building. Based on age and observed condition replacement of windows within the office and warehouse areas should not be required within the terms of the analysis.

The Gas building roof system atop the Site Building consists of a single ply Polyvinyl Chloride Membrane (PVC), near-flat, mechanically fastened roof system that was installed during construction of the facility. The roof system is installed atop a layer of rigid insulation, atop a corrugated metal roof decking. Neither the presence of a vapour barrier, nor the type or the thickness of the insulation could be verified, as the scope of the work did not include destructive testing.

Drainage of the roof system is provided by internal roof drains which presumably drain to the municipal sewer system.

Penetrations through the roof system include plumbing stacks, an exhaust vent stack, internal roof drains, mechanical curbs, and service penetrations.

Exterior doors serving the Site Building are comprised of Single Glazed units set into metal frames. Based on age, replacement of windows within the office and warehouse areas should not be required within the terms of the analysis.

2.1.6 Finishes

The floor finishes within the Site Building consist of unsealed concrete slab-on-grade, ceramic and resilient floor tiles and carpeting. The wall finishes within the Site Building consist of painted gypsum board and painted concrete masonry block. The ceiling finishes within the Site Building primarily consist of exposed structure, and painted suspended ceiling tile.

The floor finishes within the Site Building consist of unsealed concrete slab-on-grade, ceramic and resilient floor tiles and carpeting. The wall finishes within the Site Building consist of painted gypsum board and painted concrete masonry block. The ceiling finishes within the Site Building primarily consist of exposed structure, and painted suspended ceiling tile.

Enbridge Gas Distribution Inc.
Tecumseh Engineering Operations Depot – Facility Assessment

2.2 Functional Assessment

2.2.1 Site

The sites for the Tecumseh Engineering building and the Tecumseh Gas building are located on Tecumseh road and flank either side of Enbridge Gas Storage plant.

Tecumseh Gas building, acts as the main operations depot and is located to the south of the Enbridge Gas Storage Plant and occupies 9.8% of a 10 acre site, with a 1.7 acre service yard. There are two points of entry/exit that service the site, each are shared with both truck and car traffic. The employee and visitor parking is located at the front of the site and is accessible from both driveways, located on each side of the building. The parking area is separate from the yard activities and provides safe access for pedestrians to the building. The operations yard is smaller than Enbridge GP standards; however, Enbridge staff noted that the current yard size and circulation layout meets Enbridge's operational requirements for this site.

Tecumseh Engineering building, serves as a special projects hoteling/ satellite office space and additional warehouse space that supports the plant and operations depot. Located north of the Enbridge Gas Storage Plant and occupies 5.1% of a 4.8 acre site, with a 1.2 acre service yard located at the rear of the building. There is one point of access, to the site by way of one main driveway, shared by trucks and car traffic. The employee and visitor parking is located at the front of the site, and is access from the main driveway. The parking area is separate from the yard activities and provides safe movement for both vehicles and pedestrians. Enbridge staff has noted that the current site size and layout meets Enbridge's operational requirements for this site.

There are no major functional inefficiencies to note about the current site conditions at the Tecumseh Gas Operations depot building or the Tecumseh Engineering building.

2.2.2 Interior Space Planning

The Tecumseh Engineering building was built in 2009. It is a one-story building with approximately 4,686 SF of office space, amenity areas and 7,860 SF of industrial warehouse and storage mezzanine.

During a walkthrough of the building, the following functional deficiencies were noted:

- The individual offices break the office component into small spaces, creating the feeling of a compressed double loaded corridor bisecting the office component of the building. We recommend a detailed review of the current layout be undertaken to review the possibility of demolish some of the partition walls and in order to create a more open concept space to meet Enbridge's current standards. Enbridge staff noted that there would not be any plans to renovate the existing building at this time and that the space though it does not meet their current standards it is functional for their needs at this time.

The Tecumseh Gas building completed construction in January 2016. The building is one story and consists of an office space and, amenities, and Industrial function. The office and amenity area is approximately 14,500 SF., the space includes, but is not limited to, the following; office space, meeting rooms, break out rooms, focus rooms, micro kitchen/Ezone, control room and print copy room. The Industrial component of the building is approximately 18,362 SF., the space includes, but is not limited to, the following; warehouse, shipping and receiving, warehouse instrumentation shop, wash bay, fabrication shop, mustering room, boot wash and laundry room, and warehouse instrumentation shop.

There were no deficiencies noted for the Tecumseh Gas building during the walk through.

2.2.3 Furniture

Enbridge Gas Distribution Inc.
Tecumseh Engineering Operations Depot – Facility Assessment

The furniture in the Tecumseh Engineering building is legacy furniture throughout. Enbridge has noted that they would like to keep the furniture as is for now and plans for replacement to be considered at a later date. Currently the exiting furniture is functional for the 19 hoteling stations located in the facility.

The furniture in the Tecumseh Gas building is new and meets Enbridge GDP current standards.

2.2.4 Ontario Building Code – Life Safety

Section 3.2 - Building Fire Safety

The Tecumseh Engineering building was constructed in 2009 and is classified as what is known as “existing non-compliant” for the purpose of compliance with requirements of the current Ontario Building Code. The existing building is not sprinklered; to comply with current Ontario Building Code, a sprinkler system will be required.

The building falls under Part 3, Group F Division 2 and Group D major occupancies.

To meet current Ontario Building Code the building should satisfy the requirements of 3.2.2.54 D Occupancy and 3.2.2.70 F2 Occupancy.

- The building shall be of combustible or non-combustible construction
- Floor assemblies shall have a fire-resistance rating of not less than 45 min or be of non-combustible construction.
- Mezzanines shall have a fire-resistance rating not less than 45 min, or be of non-combustible construction
- Loadbearing walls, columns, and arches supporting an assembly required to have a fire-resistance rating shall have a fire resistance rating of 45 min or shall be of non-combustible construction.
- Roof assembly shall have a fire-resistance rating of not less than 45 min, or be of non-combustible construction

The Tecumseh Gas building completed construction in January 2016. The existing building is sprinklered; and complies with current Ontario Building Code.

The building falls under Part 3, Group F Division 2 and Group D major occupancies and meets current the Ontario Building Code the building requirements of 3.2.2.54 D Occupancy and 3.2.2.72 F2 Occupancy.

- The building shall be of combustible or non-combustible construction
- Floor assemblies if of combustible construction shall have a fire-resistance rating of not less than 45 min or be of non-combustible construction.
- Mezzanines shall have a fire-resistance rating not less than 45 min, or be of non-combustible construction
- Loadbearing walls, columns, and arches supporting an assembly required to have a fire-resistance rating shall have a fire resistance rating of 45 min or shall be of non-combustible construction.

Enbridge Gas Distribution Inc.
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Section 3.8 - Barrier-free Design

3.8.3.12. Universal (Barrier-free) Toilet Rooms:

- Tecumseh Engineering building has three washrooms: one male washroom (containing two water closets and two urinals, none of which are barrier-free), one female washroom (containing two water closets, neither of which are barrier free), one barrier free washroom. The one standalone barrier free is located on the ground floor does not meet current standards and is considered an existing non-conforming condition for compliance with Ontario Building Code. There is no mandate in the current code to upgrade the existing facility for compliance with the universal barrier free washroom requirements; however, in compliance with Part 11 of Ontario Building Code, the addition of a universal washroom will be required in the event of extensive renovation in the building.

Enbridge Gas Distribution Inc.
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2.3 Adequacy and Facility Conditional Indexes

WalterFedy utilized a risk management approach taking into consideration the impact of failure of the building component on the long term serviceability of the building as well as the functional requirements associated with the building. Both Facility Condition Indexing (FCI) and Adequacy Indexing (AI) was utilized in order to help make the best possible decision related to the future of the site building and to determine whether or not to invest, maintain, repurpose or dispose of the asset.

FCI:

FCI is a condition index tool used to illustrate the condition of an asset expressed in a percentage ratio of required maintenance/repair costs divided by the replacement value of the asset expressed as:

$$\text{FCI} = (\text{Maintenance and Repair Costs}) / (\text{Cost to Replace the Building})$$

The replacement value of the building is based on industry standards for construction costs. Therefore, the lower a FCI is, the better the condition of the building. The resulting FCI at ten years is 0.28% for the engineering building and 0.81% for the Gas for the which both buildings are classified as being in good condition.

$$\text{FCI (Tecumseh Engineering)} = (\$58,200) / (76,697 \times 272) = 0.28\%$$

$$\text{FCI (Tecumseh Gas)} = (\$18,200) / (10,695 \times 211) = 0.81\%$$

AI:

The Adequacy Index for Oshawa Operations Depot is calculated by dividing the current functional and physical renewal costs by the cost to replace the building with its functional equivalent size.

The existing buildings meet Enbridge GDP current standards, and it estimated that no additional upgrades are required at this time. There for the cost to upgrade the Engineering building is based on replacing of facility to current Enbridge GDP standards is estimated at \$0.

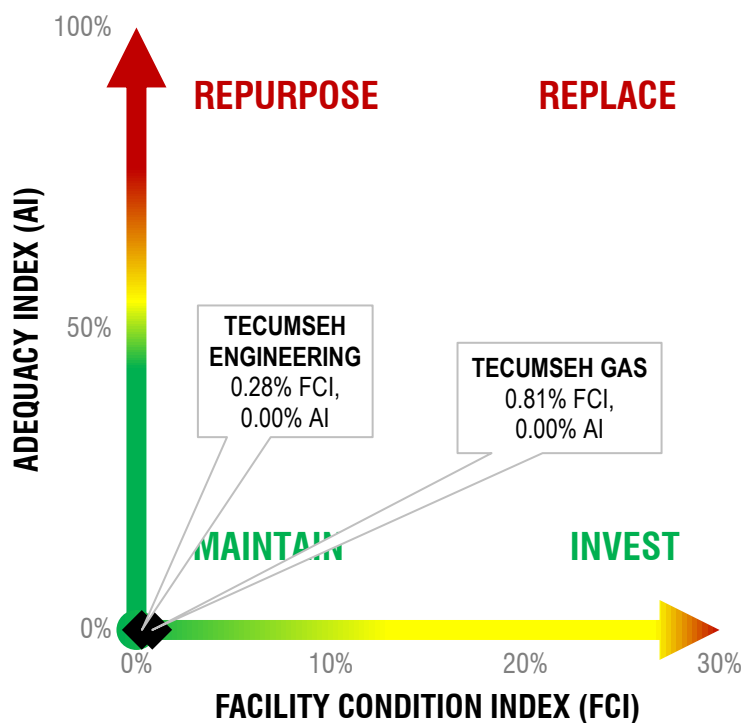
The estimated cost to build a new facility to Enbridge GDP current standards based on 44,492 SF (Tecumseh Gas Building) and 12,506 SF (Tecumseh Engineering Building) for the for the area required to accommodate current program at both building is \$12,902,680 (Tecumseh Gas Building) and is \$ 3,626,740 (Tecumseh Engineering Building), this is based on 60% of office space at \$350/SF and 40% industrial space at \$200/SF.

$$\text{AI (Tecumseh Engineering)} = \$0 / \$3,626,740 = 0\%$$

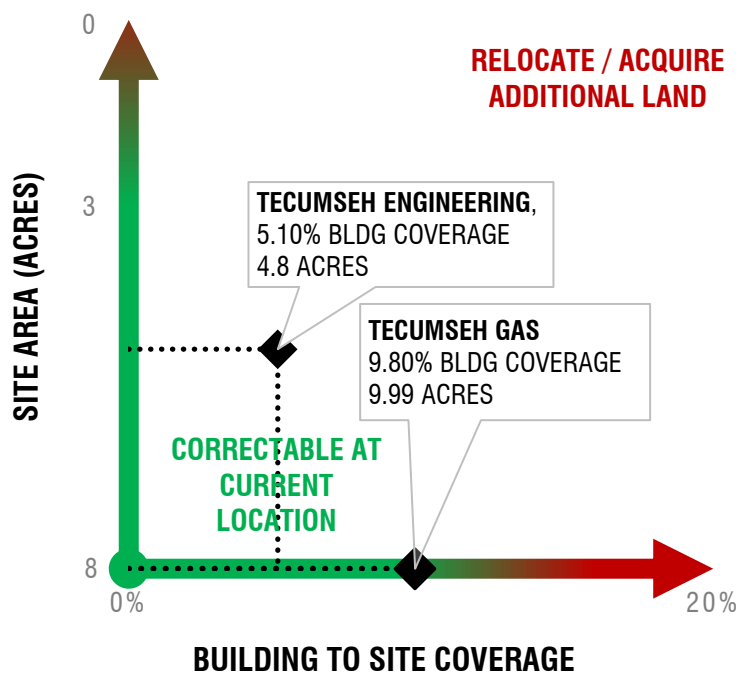
$$\text{AI (Tecumseh Gas)} = \$0 / \$12,902,680 = 0\%$$

With quantification of FCI and AI for your building, comes the ability to make comparisons between industry benchmarks, and drive decision making related to the future of the property. The chart below shows the relationship between FCI and AI and indicates visually where Tecumseh Engineering Building and Tecumseh Gas building falls within the decision making criteria.

FACILITY CONDITION & ADEQUACY GRAPH



SITE CONSTRAINTS GRAPH



2.4 Key Findings

- PHYSICAL OBSOLESCENCE:

The acceptable Enbridge standard for the physical condition is an FCI of 0 to 5%. The current FCI of the facility based on this study is 0.28% therefore the physical condition of the facility does meet Enbridge acceptable standards.

Meets Standards		Correctable at Current Location	
POSITIVE	Negative	POSITIVE	Negative

- FUNCTIONAL OBSOLESCENCE BUILDING:

The acceptable Enbridge standard for the functional condition is 0, anything between 0 to 50% is considered correctable at current location. The current facility AI index is 0% which is considered correctable at current location without consideration of other factors including adequacy of land size and the FCI index.

Meets Standards		Correctable at Current Location	
POSITIVE	Negative	POSITIVE	Negative

- FUNCTIONAL OBSOLESCENCE SITE:

Tecumseh Gas and Tecumseh Engineering sites meet the functional operational requirements for size and vehicular circulation within the sites. Both buildings Yard sizes are smaller than Enbridge standard Yard size requirements; however, Tecumseh Engineering Building and Tecumseh Gas operations depot are considered to have an acquit Yard sizes for each building to function for the operational requirements of each site. The current yard size of the Tecumseh Gas Operations depot is 1.7 acre, and Tecumseh Engineering is 1.2 acres. Enbridge standard yard size is 2.5 acres.

Meets Standards		Correctable at Current Location	
POSITIVE	Negative	POSITIVE	Negative

The existing facility meets the objectives of the current Enbridge GDP needs. The FCI and AI graph indicates recommendation to maintain the existing facility.

2.5 Property Evaluation

Property evaluation was not performed for Tecumseh Gas Operations Depot or the Tecumseh Engineering Building, as both properties support buildings that meet the physical and functional requirements of the current Enbridge GDP requirements.

2.6 Development Scenarios

The following is a comparison of the available options to address the deficiencies at:

SCENARIO	1- Tecumseh Engineering Building	1- Tecumseh Gas Building
DESCRIPTION	Maintain Existing	Maintain Existing
LAND ACQUISITION	\$ 0	\$ 0
LAND SALE	\$ 0	\$ 0
CONSTRUCTION COST	\$ 0	\$ 0
SOFT COST	\$ 0	\$ 0
TOTAL	\$ 0	\$ 0
FURNITURE	\$ 0	\$ 0
MEETS ENBRIDGE GDP STANDARDS	YES	YES
PRIORITY	1	1

Enbridge Gas Distribution Inc.
Tecumseh Engineering Operations Depot – Facility Assessment



APPENDIX A

Capital Expenditures Forecast



7.0 CAPITAL FORECAST

Tecumseh Gas and Engineering

3595 Tecumseh Road, Mooretown, ON

The following Capital Plan has been compiled from the following:

- 1 EGD Long Range Capital Plan (LRP)
- 2 EGD/FMG Property Inspection (FMG)
- 3 3rd Party Property Condition Assessment (PCA)
- 4 Non-Functional Standards Assessment - Section 5 (nFSA)
- 5 Electrical Safety Authority Inspection (ESA)
- 6 EGD Quarterly Health/Safety Inspection (HSI)

			1	2	3	4	5	6	7	8	9	10
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
SECTION	CATEGORY	DEFICIENCY	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD
Maintenance Deficiencies												
	Engineering Building											
	Leasehold Improvements	Retrofit T8 lighting to LED Engineering Building								\$ 20,000		
	PLMB	Replace domestic water heater Engineering Site							\$ 2,200			
	Site Work/Exterior Elements	Allowance for asphalt repairs for Egnengineering site						\$ 30,000			\$ 30,000	
	Site Work/Exterior Elements	Allowance to repair exit gate Engineering	\$ 1,000									
	Site Work/Exterior Elements	Replace wall mounted site lighting (upgrade to LED) Engineering Bldg										\$ 5,000
	Total Maintenance Deficiencies		\$ 1,000	\$ -	\$ -	\$ -	\$ -	\$ 30,000	\$ 2,200	\$ 20,000	\$ 30,000	\$ 5,000
	Cummulative FCI Engineering Site		0.00%	0.00%	0.00%	0.00%	0.00%	0.15%	0.16%	0.26%	0.40%	0.42%
Maintenance Deficiencies												
	Gas Building											
	PLMB	Replace domestic water heater Gas Site								\$ 3,200		
	Site Work/Exterior Elements	Allowance for asphalt repairs for Gas site										\$ 15,000
	Total Maintenance Deficiencies		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 3,200	\$ -	\$ 15,000
	Cummulative FCI Gas Site		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.14%	0.14%	0.81%
Functional Deficiencies												
	Functional Deficiencies		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Total			\$ 1,000	\$ -	\$ -	\$ -	\$ -	\$ 30,000	\$ 2,200	\$ 23,200	\$ 30,000	\$ 20,000

\$ 88,200

\$ 18,200

Enbridge Gas Distribution Inc.
Tecumseh Engineering Operations Depot – Facility Assessment



APPENDIX B

Photographs



3595 Tecumseh Rd, Mooretown, ON

Appendix B.1

1. Building Exterior



2. Yard



3. Loading Area



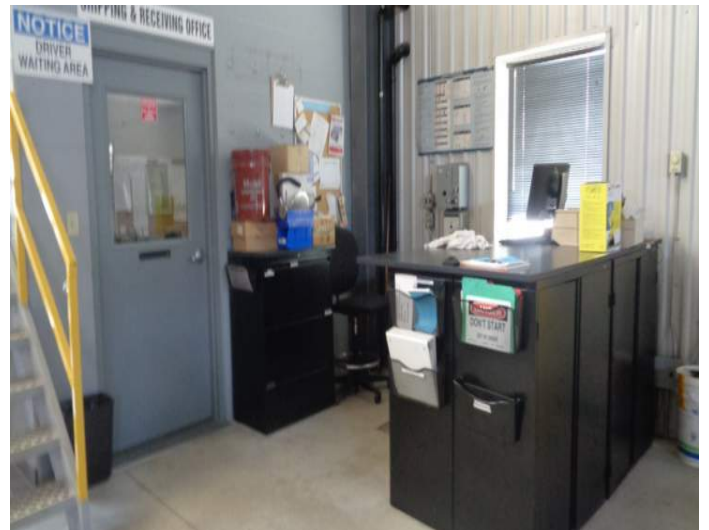
4. Lower Roof



5. Warehouse



6. Warehouse Desk





3595 Tecumseh Road, Mooretown, ON

Appendix B.2

1. Interior Lighting



2. Exterior Wall Mounted Lighting



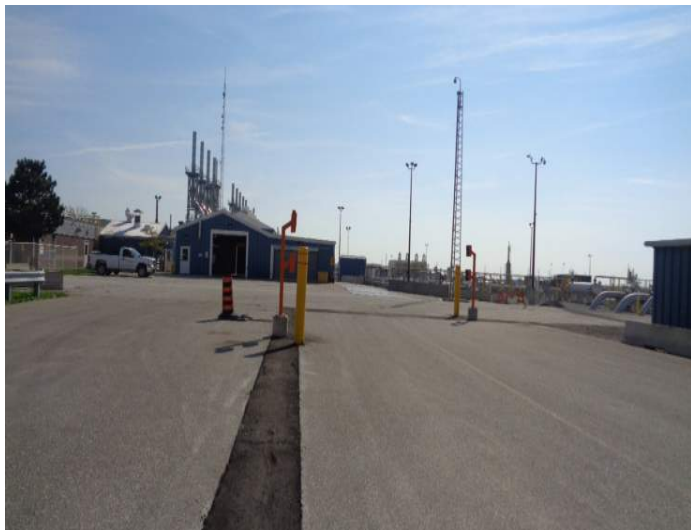
3. Northside Gate



4. Southside Gate



5. Warehouse



6. Water Heater



Enbridge Gas Distribution Inc.
Tecumseh Engineering Operations Depot – Facility Assessment



APPENDIX C

Program

Regional Operations Centre: Tecumseh Engineering

Description	Standard # per person	Quantity	Size	Area Factor	Area sq.ft.	Area sq.ft. Current	Area sq.ft. Variance	Notes
Tecumseh Engineering								
Main Vestibule	<		x	1.00	75	75	0	
Janitor			x	1.00	105	105	0	
Showers/Change/Washrooms (1 locker / field services staff)			x	1.00	357	357	0	
Universal Washroom		1	8.5	x 10	1.00	85	85	0
Mechanical/Electrical and IT Room			x	1.00	453	453	0	
Office	5				636	636	0	
Workstations	13		x		1,026	1,026	0	
Meeting Room (8-10 people) 1/70 staff			x		252	252	0	
Print Copy Rm/Mail Room					241	241	0	
Micro Kitchen/Ezone - 1/floor			x		312	312	0	
Warehouse (where required by business ops)			x		7,860	7,860	0	
Sub Total (not including circulation)					11,402	11,402		
Circulation/Structure	9.68%				1,104	1,104		
Total Occupied Out-Building Areas					12,506	12,506	0	

Site-Tecumseh Gas only								
Total Site Area:						212,199		
Building Footprint		per site				11,000	0	
Future Building Expansion		deficit of site program above				0	0	
Site Feature, Landscaping, etc.		per site				139,290	0	
Staff Parking	1 per employee	19	9	x 17	2.50	7,268	7,268	0
Visitor Parking	<	2	9	x 17	2.50	765	765	0
Sub Total					8,033	158,322	0	
Available Yard Area:					108,900	53,877	-55023	
Site Deficit:							-55023	

Regional Operations Centre: Tecumseh Gas

Description	Standard # per person	Quantity	Size	Area Factor	Area sq.ft.	Area sq.ft. Current	Area sq.ft. Variance	Notes
Tecumseh Gas								
General Building Infrastructure								
Main Vestibule	<	1	10	x 23	1.00	230	240	10
Waiting Area	<	1	21	x 24	1.00	500	235	-265
Alternate Entrance	<	5	10	x 7	1.00	338	338	0
Security / Reception	<	1	12	x 12	1.00	144	102	-42
Shipping & Receiving	<	1	31	x 20	1.00	616	616	-0
Showers/Change/Washrooms (1	71	1	5	x 6	1.00	2,130	1,716	-414
Office Washrooms	2 / floor	3	10	x 24	1.00	720	760	40
Universal Washroom	1 / floor	1	8	x 10	1.00	80	184	104
Janitor	1 / facility	1	10	x 15	1.00	150	113	-37
Fitness Centre	1 / facility	1	20	x 30	1.00	600	600	0
Mechanical/Electrical and IT Room	1 / facility				1.00	2,807	2,807	0
General Storage					1.00	1,854	1,854	0
Sub Total					10,168	9,564	-604	
Functional Building Area								
MPO Office	20% of office staff	14	10	x 10	1.00	1,400	1,073	-327
Cubicles Workstations	50% of office staff	36	8	x 6	2.00	3,456	3,391	-65
Meeting Room (8-10 people) 1/70 staff	1 per 70	4	16	x 11	1.50	1,056	1,112	56
Break out room (4 people) 1/50 staff	1 per 50	2	10	x 12	1.00	240	306	66
Focus Rooms (4 people) 1/50 staff	1 per 50	1	10	x 10	1.00	100	140	40
Hotel Station (2:1 of dynamic staff)	30% of office staff	4	6	x 3	1.50	91	813	722
Training Rm PC Training (12-24)	<	1	24	x 30	1.0	720	720	0
Micro Kitchen/Ezone - 1/floor	1/200	1	32	x 46	1.00	1,472	1,472	0
Print Copy Rm/Mail Room	1/ 100	1	35	40	1.00	250	421	171
Health room - required if three are 200 or more employees on any one shift.	<	0	11	x 10	1.00	0	0	0
Control Room	site specific	1	30	x 72	1.00	1,445	1,445	0
IT Room	<	2	11	x 11	1.00	242	343	101
Coat Storage	<	1	2	x 6	1.00	12	12	0
Mustering Room(1chair/person) +1 HR workstation with connectivity and large TV screen for training	10	1	3	x 5	4.00	600	600	0
Gas monitor calibration (1/10 people)		1	8	x 10	1.00	75	38	-37
Warehouse Instrumentation Shop		1	25	x 36	1.00	900	900	0
Measurement & Regulation Test/ Storage		1	12	x 20	1.00	240	240	0
Warehouse (where required by business ops)		1	60	x 80	1.00	4,800	4,800	0
Free Pick storage	1/Building	1	15	x 10	1.00	150	150	0
Locked Storage Room	<	1	10	x 15	1.00	150	203	53
Wash Bay / Repair Garage(if fleet exists)	1/Building	1	24	x 34	1.00	804	804	0
Welding Bay / Fabrication	1/Building			x	1.00	5,506	5,506	0
Boot wash		1	6	x 10	1.00	60	176	116
Washing Machine Area		1	6	x 10	1.00	60	112	52
Sub Total					23,829	24,777	948	
Total Building Area (not including circulation)					33,998	34,341	343	
Circulation/Structure	29.56%				10,050	10,151	101	
Total Building Area (not including out buildings)					44,048	44,492	445	

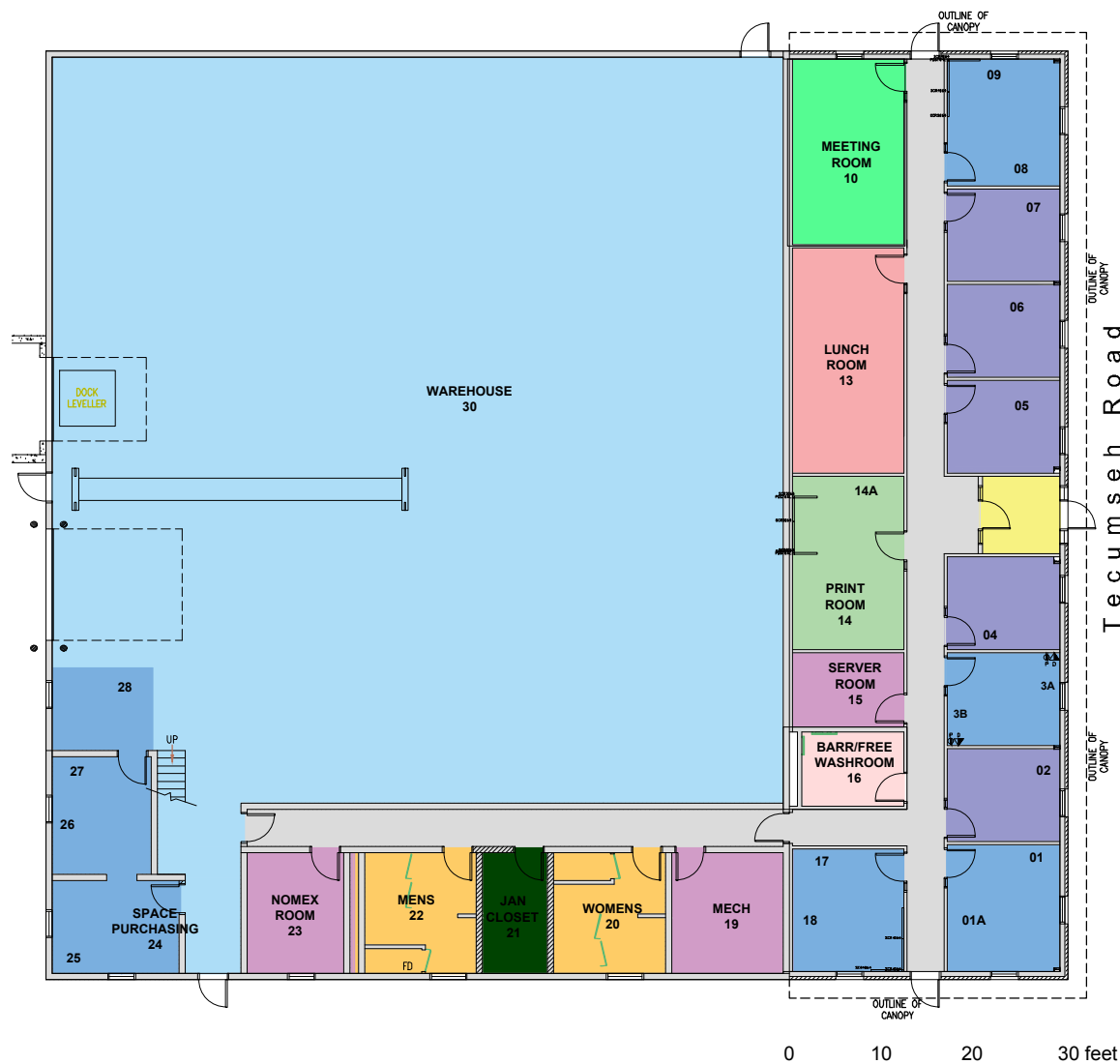
Site								
Total Site Area:						435,367		
Building Footprint						42,862	0	
Future Building Expansion		per site				0	0	
Site Feature, Landscaping, etc.		per site				305,115		
Staff Parking	1 per employee	71	9	x 17	2.50	27,158	27,168	11
Visitor Parking	<	9	9	x 17	2.50	3,443	2,445	-997
Total					30,600	377,590	-987	

Enbridge Gas Distribution Inc.
Tecumseh Engineering Operations Depot – Facility Assessment



APPENDIX D

Drawings



Floor Plan

General Building Infrastructure

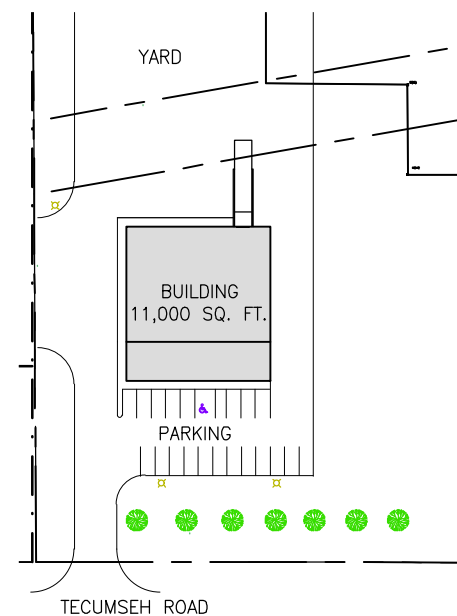
- Main Vestibule
- Showers-Change
- Universal Washroom
- Janitor
- Mech-Elec

Functional Building Area

- Office-MPO
- Workstations
- Meeting
- Micro Kitchen
- Print Mail
- Warehouse

MISC.

- Circulation



Site Plan

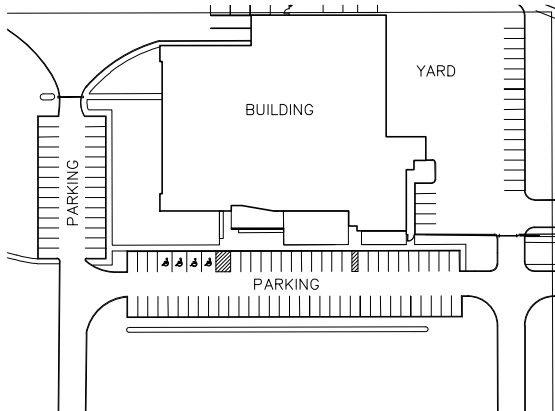
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Enbridge Tecumseh Engineering
3595 Tecumseh Rd, Mooretown, ON

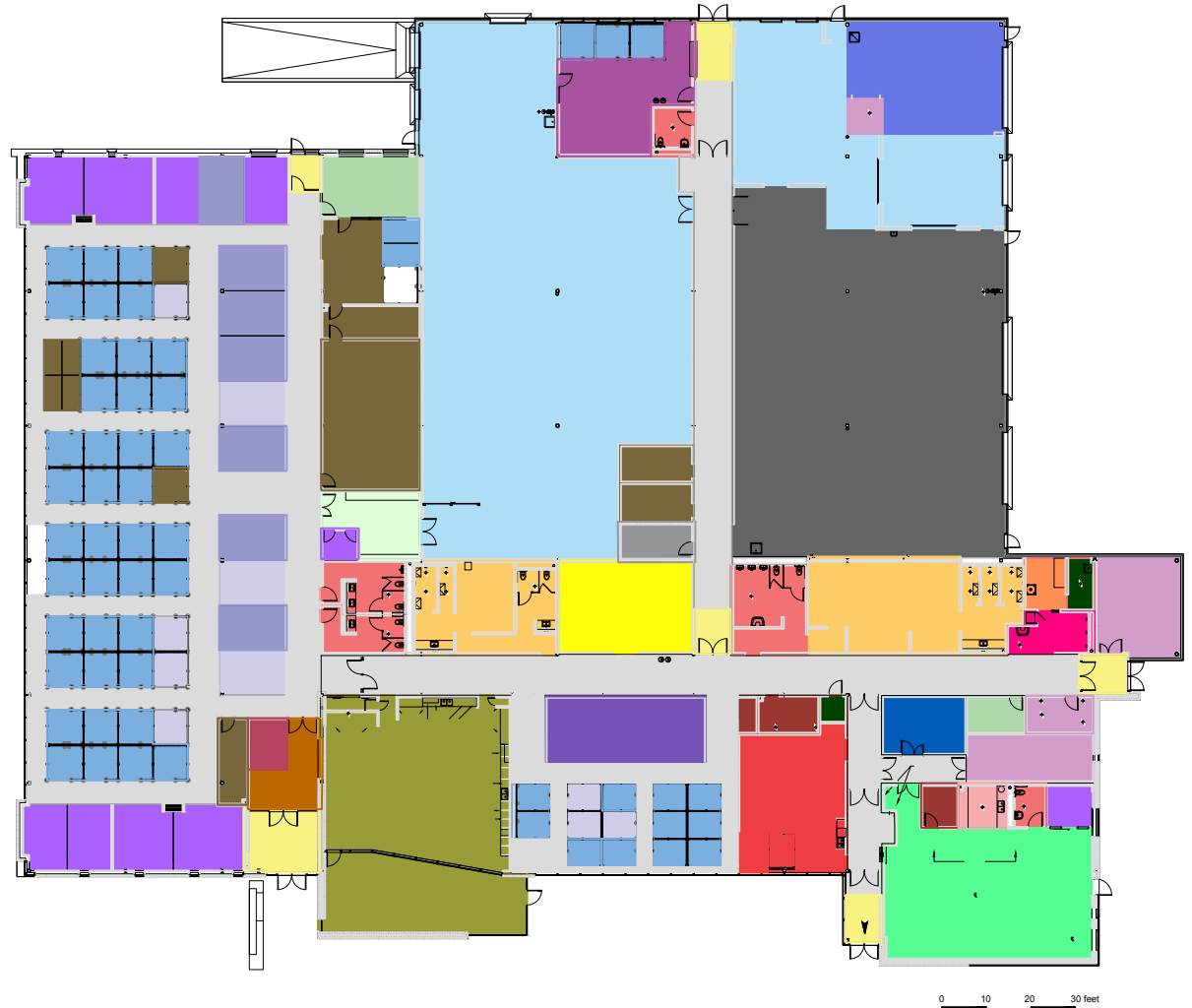
WALTERFEDY



- | | |
|---|--|
| General Building Infrastructure | |
| Main Vestibule-Waiting Area-Rear Entrance | Training |
| Lounge Lobby | Health |
| Security Reception | Micro Kitchen |
| Stairs | Hotel Station |
| Showers-Change | Boot Wash |
| Janitor | IT |
| Office Washrooms-Janitor-First Aid | Warehouse |
| Shipping Receiving | Wash Bay |
| Mech-Elec | Laundry |
| Telecom Lan | Cafeteria |
| Functional Building Area | |
| Office-MPO | Storage Facilities |
| Workstations | Storage-Locked |
| Meeting | Storage-File |
| Breakout | Storage-IT Control |
| Print Mail | MISC. |
| | Industrial |
| | Circulation |



Site Plan



Floor Plan

Enbridge Tecumseh Gas

3595 Tecumseh Rd, Mooretown, ON

2016-0613-05



3.14 FACILITY ASSESSMENT

ENBRIDGE GAS DISTRIBUTION INC.

STATION B OPERATIONS DEPOT

405 Eastern Avenue, Toronto

Project No.: 2016-0613-05

REV 1.0 - December 6, 2017

WALTERFEDY

ENBRIDGE GAS DISTRIBUTION INC.

FACILITY ASSESSMENT

Station B Operations Depot

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Appendix A - Capital Expenditures Forecast

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1.0 SUMMARY

1.1 Introduction

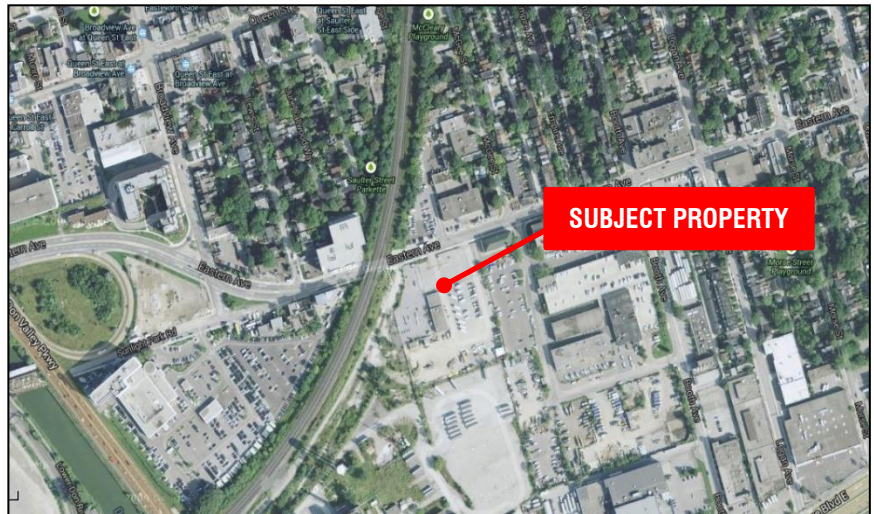
WalterFedy was retained by Enbridge to conduct a physical and functional assessment of the facility located at 405 Eastern Avenue in Toronto, Ontario for the purpose of identifying functional adequacy and physical renewal requirements for budgeting and planning purposes. The scope of the report includes a general visual inspection of visible civil, architectural, structural, mechanical, and electrical components. It also includes a brief Ontario Building Code (OBC) review to address barrier-free accessibility issues.

Following the initial report, a list of recommendations with estimated costs is provided for corrective and preventive maintenance items required.

1.2 Facility Description

The facility is categorized by Enbridge as Operations Depot. The original building was constructed in 1968. An approximately 0.7 acres completely fenced off gate station is located adjacent to the site on the northwest corner.

The facility is located on Eastern Avenue in the Studio District in Toronto. The surrounding area is a mix of residential, industrial, business and vacant lands. A CN rail line is located to the west of the building, with most of the industrial to the south and residential to the north. The Don Valley Parkway is less than one km to the west of the building and the Gardiner Expressway is less than one km to the south.



1.2.1 Property Summary

(1) General

Owned / Leased:	Owned
FCI score:	12.28 %
AI score:	49 %
Building Occupancy	51

(2) Physical Building Properties:

Gross Floor Area:	
Building Gross Floor Area	7,270± SF
Mezzanine Area	528± SF
Office Space	2,469± SF
Common Areas	1,048± SF
Industrial	2814± SF
Circulation	411± SF

(3) Site Characteristics:

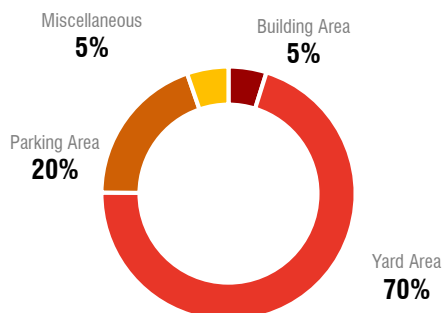
Site Area:	139,400± SF (3.2 ac.)
Gate Station	30,500± FE (0,7 ac.)
Existing Building Coverage:	4.8% (6,742 SF)
Building Coverage (After the Proposed Addition)	8.6% (11,987 SF)
Yard Area:	98,000 SF (2.3 ac.)
Parking:	27,300 SF (0.6 ac.)
Miscellaneous:	7,358 SF

(4) Zoning:

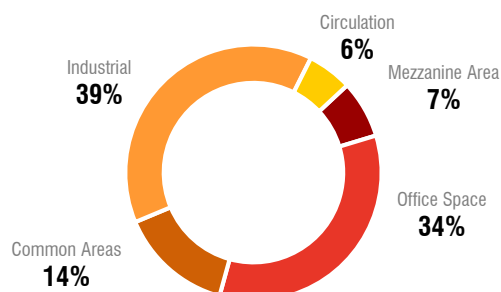
Zone:	Employment Industrial Zone E5 (x314)
Parking Required:	1.5 per 100m ² (1,076 SF) : 10
Parking provided:	40 cars/vans 30 trucks 16 equipment
Front Yard Depth (min.)	3.0 meters Provided 37 meters
Side Yard Width (min.)	3.0 meters Provided 43 meters
Rear Yard Depth (min.)	7.5 meters Provided 51 meters
Building Height (max.)	Office - 20.0 meters

(5) Building Systems:

HVAC:	Natural gas hot water boiler and fan coil units
Plumbing:	Municipal domestic water and septic tank sanitary
Electrical:	400 A/600 V, 3 phase
Building Automation/Security:	None



SITE AREA DISTRIBUTION



BUILDING AREA DISTRIBUTION

1.3 Scope Of Work

The scope of work for this assessment was approved by Enbridge and was completed in accordance with WalterFedy's fee proposal dated September 08, 2016.

The scope of work for the Asset Management Report will include a Functional Assessment, a Physical Assessment, and a Market Condition Assessment. The report will provide recommendations for strategic decisions based on the metrics reviewed in the assessments.

1.4 Assessment Methodology

The building condition assessment is based on general visual examination performed on September 21, 2016 by WalterFedy's Architectural and Facility Management departments.

The observations in this report were made using non-destructive methods through existing access points. Existing drawings provided by Enbridge for the building were also used to supplement site observations.

The guiding principles of this study is based upon the document from the National Research Council of Canada (NRC) "Protocols for Building Condition Assessment" published by The Institute For Research in Construction (IRC).

1.5 Limitation of Study

This assessment is based on our general review and walkthrough of the facility and it is not intended to form a detailed life safety analysis or Ontario Building and Fire Code assessment. The facility was built in 1968 and is not in full compliance with current Ontario Building and Fire Codes. It is recommended that a further detailed life safety review and assessment be carried out to determine what building systems upgrades would be required to meet the requirements of Ontario Building and Fire Codes to the satisfaction of the Fire Department.

This report was completed in accordance with the approved scope of work as described in Section 1.3. This report is limited and is not intended to be comprehensive or exhaustive, or to suggest a risk-free facility. The report may not address all existing issues associated with the facility and may omit issues that are or may be of interest to the Owner. The findings and statements in this report are based on general site observations of the current conditions as they existed during the time period of the investigation.

The purpose of this report is for the sole use of the Owner for budgetary planning purposes. Issues identified in this report require further detailed assessments to determine repair and maintenance work required. This report should not be used by third parties involved in any work related to the facility; such third parties should undertake their own investigations and studies to determine how the existing condition of the facility will affect their plans and work. WalterFedy accepts no responsibility for liabilities incurred by or damages suffered by any third party as a result of decisions made or actions taken, based upon this report.

The passage of time might affect the views, conclusions and recommendations provided in this report.

The report is a general guide only and is not intended to be used as a document for construction.

This study does not include hazardous materials review or inspection.

2.0 PHYSICAL AND FUNCTIONAL ASSESSMENT

2.1 Physical Assessment

2.1.1 Site and Landscaping

The site is a near rectangular-shaped property. The building occupies approximately 4.8% of the site.

The remainder of the site is occupied by asphalt pavement parking areas, cast-in-place concrete paving, concrete curbs, a perimeter fence with powered access gates and areas of soft landscaping (i.e., grass, shrubs, and trees). Wall mounted lighting units and pole mounted light standard provide illumination for the site. A new natural gas lighting standard at the front of the building was recently installed. During the site visit the asphalt paved areas were noted to be in poor condition overall with localized longitudinal and alligator cracking present in a number of areas. Site lighting is aged and consideration should be given to replacing the wall pack units and pole mounted lighting standards with LED fixtures for improved energy performance. The paint finish on the bolsters proving protection to the emergency power generator were noted to be worn and repainting/refinishing in the near future should be considered.

The property is secured by a four-foot chain link fence along the west side of the property. The fence has three operable gates at each of the entrances. Deteriorated sections of fencing were noted along the back portion of the property. The front gate was also showing signs of deterioration and the site representative indicated that the electro-mechanical operator was beginning to fail.

Since the inspection was limited to visible areas, no examination of the catch basins was performed and no review of the initial compliance with code was performed. The inspection of underground or concealed components is outside the scope of work.

2.1.2 Mechanical

Heating and cooling for the office area is provided by a York natural gas heated and electrically cooled packaged rooftop HVAC unit (M/N – ZF120N20N5AAA7A, S/N – N1C5525822). The package HVAC unit was replaced last year and has a rated heating output of 144,000 BTUH and a cooling output of approximately 10 tonnes.

Supplementary heating for the office and warehouse areas are provided by a natural gas fired hydronic heating boiler with an output capacity of 765,000 BTUH. The boiler is located in the southwest mechanical room. HVAC pumps distribute the hydronic heating water to wall mounted unit heaters in the office areas and ceiling mounted fan coil units in the warehouse area. Based on age and observed condition, an allowance has been provided to replace the central heating boiler along with the Reznor ceiling mounted fan coil unit located at the back of the warehouse within the next 10 years.

Domestic Hot Water (“DHW”) within the site building is provided by a RHEED RUUD domestic hot water tank (M/N – RFD82-156CE; S/N – 1097G04830) located within the warehouse area. Based on the name plate data on the equipment the domestic hot water tank was manufactured in 1997.

There was reportedly no shortage of DHW within the site building; however, based on WalterFedy’s experience the anticipated service life of a DHW is typically 10-15 years. Therefore based on age, replacement should be considered within the term of analysis.

Natural gas piping located on the east exterior of the building and supplying the rooftop packaged HVAC unit, the hydronic boiler and the domestic hot water tank was noted to be deteriorated with paint chipping and localized areas of corrosion. Therefore leak testing and repainting/refinishing of the natural gas piping is recommended.

2.1.3 Electrical

The electrical power for the site building is supplied from a pole-mounted transformer which is accessed from the north portion of the site and feeds the electrical distribution equipment within the site building.

Emergency power is provided by a natural gas fired CUMMINS Genset (M/N – GGHG 5673707; S/N – F040654828). Based on age, this Genset replacement should not require replacement within the next 10 years.

Interior lighting is predominately provided by T8 fluorescent T8 tube lighting fixtures. A leasehold improvement consideration should be given for an LED retrofit.

Combination battery pack units provide emergency lighting and exit signage within egress pathways. Due to age, approximately five units will require replacement within the next 10 years.

2.1.4 Structural

As outlined in the scope of work, a limited visual assessment of the condition of the structural elements was carried out on the elements which were visible at the time of the inspection. The site building is a slab on grade structure. The superstructure of the site building is comprised of concrete masonry block exterior walls, concrete columns, wood joists and concrete. No major visually identifiable structural deficiencies were noted at the time of the site inspection.

2.1.5 Building Envelope

The roof system atop the site building consists of a conventional built-up modified bitumen (BUR), near-flat, gravel ballasted roof system. The roof system is installed atop a layer of rigid insulation, atop a corrugated metal roof decking. Neither the presence of a vapour barrier, nor the type or the thickness of the insulation could be verified, as the scope of the work did not include destructive testing.

Drainage of the roof system is provided by internal roof drains which presumably drain to the municipal sewer system.

Penetrations through the roof system include plumbing stacks, an exhaust vent stack, internal roof drains, mechanical curbs, and service penetrations.

The exterior walls of the site building consist of architectural concrete block masonry with sections of corrugated metal cladding on the north and east elevations.

The window systems of the site building consist of fixed double glazed insulated (“IGU”) units set within aluminum frames in punched configurations. Exterior doors serving the site building are comprised of single glazed units set into metal frames. Metal doors within metal frames were observed serving the warehouse egresses and the site building. Two sectional metal overhead doors, accessed from the east elevation, were noted serving the warehouse areas. Replacement of caulking around windows within the office and warehouse areas are recommended based on age and observed condition, along with repair/refinishing of the deteriorated exterior door on the south elevation.

2.1.6 Finishes

The floor finishes within the site building consist of unsealed concrete slab-on-grade, ceramic and resilient floor tiles. The wall finishes within the site building consist of painted gypsum board and painted concrete masonry block. The ceiling finishes within the site building primarily consist of exposed structure, and painted suspended ceiling tile. A number of the suspended ceiling tiles were noted to be discoloured, stained and/or water damaged. Replacement of the affected ceiling tiles is recommended within the earlier portion of this analysis.

At the time of the site assessment the doors for the mechanical room were not adequately fire rated and did not have a functional door closure device. Therefore replacement of the two doors for the mechanical room with their fire rated equivalent (complete with ULC approved panic hardware) is recommended.

2.2 Functional Assessment

2.2.1 Site

The property is divided into two separate parts. The first part consists of approximately 0.7 acres completely fenced off, includes a secure gate station and is located adjacent to the site on the northwest corner. The remainder of the site consists of 3.2 acres and is used as operations depot.

The following functional deficiencies were observed during the walkthrough:

- The site has one operational point of access only. It is recommended that two points of entry/exit to be provided to and from the site in accordance with Enbridge design standards. There is a second entry gate along Eastern Avenue but this entrance is not used and is kept locked at all times for security reasons because the gate is not visible from the building and staff are unable to monitor the gate from the building.
- Vehicle flow in the parking lot is not safe and not efficient especially at the exit area due to the absence of a second point of exit.
- Site security system and cameras require upgrades for better coverage and enhanced surveillance at night.
- The adjacent lot on the westerly side is a vacant land with overgrown vegetation. Enhanced surveillance, lighting and upgraded secure fencing is recommended to prevent unauthorized access.
- Fencing around the property is lower than the standard required 6' fence height with barb wire on top. In some areas the fence is only 4.5' with barb wire. Fencing upgrade is recommended.
- An exit door with panic hardware was recently added to the fence along Eastern Avenue. It is recommended that a second exit door to be installed to provide a second means of egress from the site in case of an emergency.
- The security hut located at the main gate entrance is not being used. Currently the gate is monitored and controlled from the administration desk located in the office building near the front entrance.
- There is a sump pump enclosure located in the parking area. The location of the sump pump causes vehicular circulation problems in the parking and reduction in parking spots. Relocation and replacement of the sump pump is recommended to enhance the flow in the parking lot.

2.2.2 Interior Space Planning

The building consists of office space, amenity areas and a warehouse with mezzanine. The mezzanine is of steel frame construction that was added in 2015 and is currently used as a "free pick" storage shelving. The following are functional deficiencies observed during the walkthrough:

- The ladies washroom area is tight. The area of the lockers is not functional due to the limited space and limited access. The lockers were recently replaced to meet current standards.

- Staff noted the men's washroom area is limited in space especially during the morning hours.
- There is no cafeteria and lunch room with adequate kitchen in the facility. Currently there is a small coffee counter located in the main corridor.
- The janitor room is tight and additional space is recommended.
- It was noted by staff that there is no welding shop in the facility. A welding shop is not required. Welding in this facility can occur in the yard.
- The main warehouse area is also used as a wash bay. The wash area is adjacent to shelving with material that can't get wet. A separate wash bay area is recommended.
- A separate boot wash and washing machine area is required. There is no boot wash in the facility and the washing machine is currently located in the warehouse.
- The photocopier and filing cabinets/mail slots are all located in the main corridor next to the main entrance. The location is not suitable and it affects the flow and circulation in the corridor. A separate photocopier room is recommended.
- Fire rated door with proper hardware is required between the mechanical room and the warehouse. The existing door and hardware require replacement to achieve the needed fire rating.

2.2.3 Furniture

Existing furniture is legacy furniture throughout. All existing office furniture has reached the end of its life cycle and replacement is recommended to enhance the functional and environmental condition in the office area. The height of the existing cubicle partitions block natural light and access to existing windows from the core area. It is recommended, to meet Enbridge's office standards, the furniture be phased out and replaced with new.

2.2.4 Ontario Building Code – Life Safety

Section 3.2 - Building Fire Safety

The building falls under Part 3, Group F Division 2 and Group D major occupancies.

To meet current Ontario Building Code the building should satisfy the requirements of 3.2.2.71: Group F, Division 2, up to 2 Storeys:

- The building is not required to be sprinklered.
- Standpipe system is not required.
- The building is permitted to be of combustible construction or non-combustible construction used singly or in combination.
- Floor assemblies shall be fire separations and, if of combustible construction, shall have a fire-resistance rating not less than 45 minutes (Not applicable).
- Loadbearing walls, columns, and arches supporting an assembly required to have a fire-resistance rating shall have a fire resistance rating of 45 minutes or shall be of non-combustible construction.

Section 3.8 - Barrier-free Design

3.8.1.3. Barrier-free Path of Travel

3.8.1.3.(1) Every barrier path of travel shall provide an unobstructed width of at least 1100 mm for the passage of wheelchairs.

- 3.8.1.2. The facility has two entrances to the ground level. Both entrances are not equipped with barrier-free door operator and none of them qualify as barrier-free entrance. In accordance with article 3.8.1.2, a minimum of one barrier-free entrance to the building is required.

3.8.2.3. Washrooms required being barrier-free.

On the main floor there are currently two barrier-free washroom stalls located in the male and female washroom areas.

3.8.3.12. Universal (barrier-free) toilet rooms: There is one universal washroom in the facility in general compliance with 3.8.3.12. In order for the existing universal washroom to comply with current Ontario Building Code accessibility requirements; additional upgrades are required including the addition of a barrier-free power door operator and emergency call button.

2.3 Functional and Physical Condition Analysis

WalterFedy utilized a risk management approach taking into consideration the impact of failure of the building component on the long term serviceability of the building as well as the functional requirements associated with the building. Both Facility Condition Indexing (FCI) and Adequacy Indexing (AI) was utilized in order to help make the best possible decision related to the future of the site building and to determine whether or not to invest, maintain, repurpose or dispose of the asset.

FCI:

FCI is a condition index tool used to illustrate the condition of an asset expressed in a percentage ratio of required maintenance/repair costs divided by the replacement value of the asset expressed as:

$$\text{FCI} = (\text{Maintenance and Repair Costs}) / (\text{Cost to Replace the Building})$$

The replacement value of the building is based on industry standards for construction costs. Therefore, the lower a FCI is, the better the condition of the building. The resulting FCI at ten years is 12.28% which is classified as being in poor condition.

$$\text{FCI (Station B)} = (\$255,450) / (6,687 \times 311) = 12.28\%$$

AI:

AI is a condition index tool used to illustrate the functional condition of the asset expressed in a percentage ratio of required functional upgrade costs divided by the replacement value of the asset to meet the functional needs expressed as:

$$\text{AI} = \text{Functional Upgrade Costs} / \text{Cost to Replace the Building with its Functional Equivalent}$$

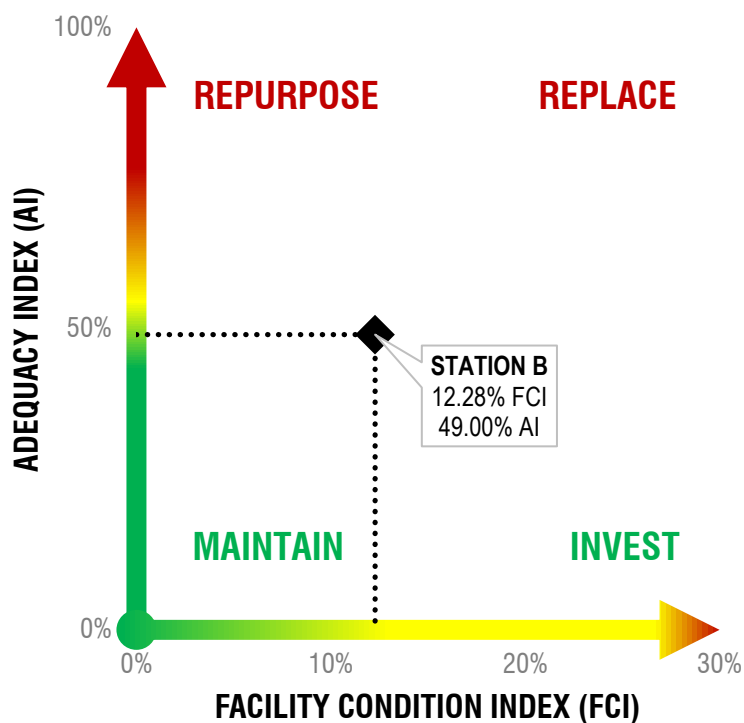
The Adequacy Index for Station B is calculated by dividing the current functional and physical renewal costs by the cost to replace the building with its functional equivalent size.

The cost to upgrade the facility to current Enbridge GDP standards is estimated at \$2,400,000. The estimated cost to build a new facility to ENBRIDGE GDP current standards based on 15,300 sf, the area required to accommodate current program, is \$4,896,000. This is based on current program 60% of office space at \$400/SF and 40% industrial space at \$200/SF.

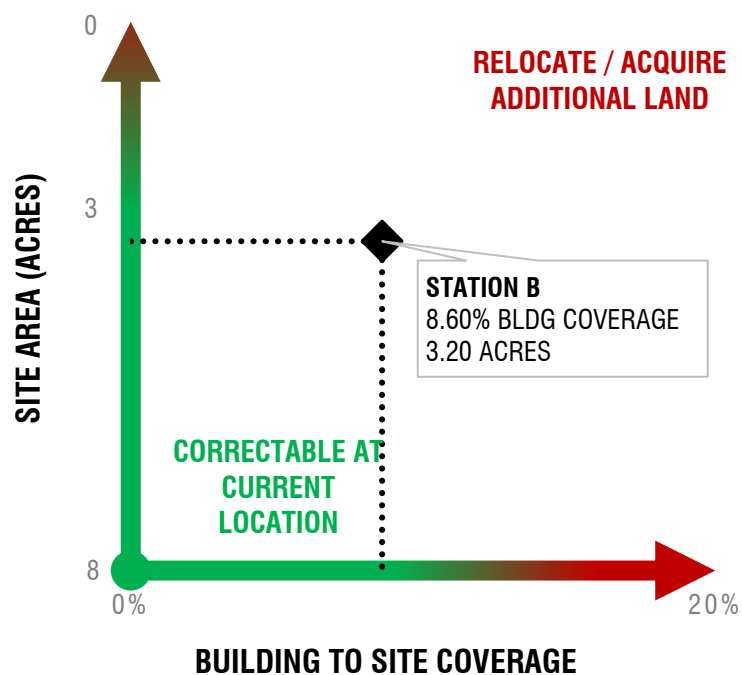
$$\text{AI (Station B)} = (\$2,400,000) / (\$4,896,000) = 49\%$$

With quantification of FCI and AI for your building, comes the ability to make comparisons between industry benchmarks, and drive decision making related to the future of the property. The chart below shows the relationship between FCI and AI and indicates visually where Station B falls within the decision making criteria.

FACILITY CONDITION & ADEQUACY GRAPH



SITE CONSTRAINTS GRAPH



2.4 Key Findings

- PHYSICAL OBSOLESCENCE:

The acceptable Enbridge standard for the physical condition is an FCI of 0 to 5%. The current FCI of the facility based on this study is 12.28% therefore the physical condition of the facility does not meet Enbridge acceptable standards.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	Positive	NEGATIVE

- FUNCTIONAL OBSOLESCENCE BUILDING :

The acceptable Enbridge standard for the functional condition is 0, anything between 0 to 50% is considered correctable at current location. The current facility AI index is 49%.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	POSITIVE	Negative

- FUNCTIONAL OBSOLESCENCE SITE:

The property is divided into two separate parts. The first part consists of approximately 0.7 acres completely fenced off, includes a secure Gate Station (MNR) and is located adjacent to the site on the northwest corner. The reminder of the site consists of 3.2 acres and is used as operations depot.

The site does not meet operational requirements for size and vehicular circulation. One point of access is provided to the site which poses circulation difficulties and poses operational inefficiencies. The yard size is marginally smaller than Enbridge standard yard size requirements. The current yard size is 2.25 acres. Enbridge standard yard size is 2.5 acres. It was noted by Enbridge staff that the existing yard size is adequate for current operations.

The existing building requires expansion by approximately 8,000 sf to meet the need for current staff and Enbridge functional requirements. Building an addition on the property will entail further reduction in the yard and parking areas. After the addition the yard area will be reduced to approximately 2 acres. Vertical building expansion is recommended to prevent further reduction in the yard area.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	POSITIVE	Negative

Overall the existing building is too small to meet current Enbridge Gas Distribution standards. In order to meet Enbridge GDP standards based on the number of current employees and addition of approximately 8,000sf is required.

The configuration of site functions and circulation is inefficient. The yard area is currently adequate to meet the operational requirements of the facility. Future building expansion on the same property will reduce the size of the yard area and will cause pressure on operations, parking and circulation.

Based on the site deficiencies and space limitations, vertical expansion to the existing building is required to minimize the impact of the new addition on the existing yard size. Due to the high Adequacy and FCI indices (49% and 12.28% respectively) it is recommended that the existing building be demolished to allow for a new two storey building that would accommodate current program needs. The two storey layout will allow for a reduced building footprint to maintain the current size of the yard.

2.5 Property Evaluation

In 2008 Wagner, Andrews & Kovacs Ltd completed appraisal report on the property at 405 Eastern Avenue in Toronto, The appraised amount based on the report in 2008 is \$9,750,000.

The following is a list of comparable industrial properties currently listed in the market.

	Cost	Sq. ft.	Acres	\$/sq. ft.	\$/Acre	Listing	Location
Toronto							distance from 405 Eastern Avenue, Toronto, ON
288 Geary Avenue, Toronto, ON M6H2C5	\$ 8,500,000	21,500	n/a	\$ 395.35	n/a	29min/13.9km	http://www.lc https://www.
858 EASTERNAVE, Toronto, Ontario M4L 1A1	\$ 5,995,000	17,538	0.39	\$ 341.83	\$ 15,371,795	5min/1.7km	http://francais https://www.
36 WAGSTAFF DR, Toronto, Ontario M4L 3W9	\$ 4,000,000	11,000	n/a	\$ 363.64	n/a	10min/3.3km	http://francais https://www.

At the time of the study there were no available industrial properties with suitable location in the service area, therefore the option to relocate to a new site was not investigated. Based on discussions with Enbridge staff an estimated value of \$8,000,000 per acre is used in development scenarios C and D below. Further market analysis study is required to confirm the assumed property values.

2.6 Development Scenarios

The following is a comparison of the available options to address the deficiencies at 405 Eastern Avenue:

Options C and D are based on the assumption the adjacent property 381 Eastern Ave located west of the Enbridge site is available for acquisition. The east part of the property is vacant fenced off land and the west section is used by a dealership for vehicle storage. Further investigation is required for additional information about the property and to confirm if the west section is available for acquisition.

SCENARIO	Option A	Option B	Option C	Option D
DESCRIPTION	Correct physical and functional deficiencies by expanding the existing facility on the existing site	Demolish the existing facility and build a new two story building with maintaining the area of the existing yard	Increase the site area by 1 acre by purchasing a section of the abutting vacant property and correct physical and functional deficiencies by expanding and renovating the existing facility	Increase the site area by 1 acre by purchasing a section of the abutting property, demolish the existing building on site, build new one storey facility on the same site
LAND ACQUISITION	\$-	\$-	\$8,000,000	\$8,000,000
LAND SALE	\$-	\$-	\$-	\$-
CONSTRUCTION COST	\$2,400,000*	4,896,000**	\$2,400,000	\$4,896,000**
SOFT COST	\$480,000	\$979,000	\$480,000	\$979,000
DEMOLITION COST		\$100,000		\$100,000
FURNATURE	\$500,000***	\$500,000***	\$500,000***	\$500,000***
TOTAL	\$3,380,000	\$6,475,000	\$11,380,000	\$14,475,000
MEETS EDG STANDARDS	NO	YES	YES	YES
PRIORITY		1 (reflected in the Capital Expenditure Matrix Appendix A)	2	3

* Based on 8,000 SF addition scope and \$300/SF blended construction rate for the office and industrial building components.

** Total construction cost is based on \$400/SF for the office area and \$200/SF for the industrial space. Total required gross floor area is 12,300 SF 40% industrial space and 60% office; amenity and circulation space is assumed.

*** Based on \$10,000 per employee.

Enbridge Gas Distribution Inc.
Station B – Facility Assessment



APPENDIX A

Capital Expenditures Forecast

1.8 CAPITAL FORECAST

405 Eastern Avenue, Toronto ON

Operations Depot

The following Capital Plan has been compiled from the following:

- 1 EGD Long Range Capital Plan (LRP)
- 2 EGD/FMG Property Inspection (FMG)
- 3 3rd Party Property Condition Assessment (PCA)
- 4 Non-Functional Standards Assessment - Section 5 (nFSA)
- 5 Electrical Safety Authority Inspection (ESA)
- 6 EGD Quarterly Health/Safety Inspection (HSI)

			1	2	3	4	5	6	7	8	9	10
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
SECTION	CATEGORY	DEFICIENCY	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD

Maintenance Deficiencies												
	Building Envelope	Recondition caulking around windows			\$ 5,500							
	Building Envelope	Repair damage to back exit doors		\$ 500								
	HVAC	Replace ceiling mounted heating units						\$ 5,500				
	HVAC	Leak test and repaint natural gas piping		\$ 1,500								
	HVAC	Replace hydronic heating boiler								\$ 20,000		
	Finishes/interiors	Stained/damaged ceiling tile replacements		\$ 1,000								
	Leasehold Improvements	Retrofit T8 lighting to LED				\$ 20,000						
	Life/Safety	Allowance to replace battery pack lighting units			\$ 2,500			\$ 2,500				
	Life/Safety	Allowance to replace egress doors for mechanical room	\$ 2,400									
	PLMB	Replace domestic water heater					\$ 2,500					
	Site Work/Exterior Elements	Repave asphalt surfaces (@\$3/sqf)			\$ 75,000	\$ 75,000						
	Site Work/Exterior Elements	Replace aged front access gate		\$ 2,500								
	Site Work/Exterior Elements	Repainting/resurfacing bolster around Genset (3 bolsters)			\$ 750							
	Site Work/Exterior Elements	Replace wall mounted and pole mounted site lighting					\$ 3,300			\$ 5,000		
	Site Work/Exterior Elements	Replace sections of deteriorated/corroded fencing around site					\$ 15,000					\$ 15,000
Total Maintenance Deficiencies			\$ 2,400	\$ 5,500	\$ 83,750	\$ 95,000	\$ 20,800	\$ -	\$ 8,000	\$ 25,000	\$ -	\$ 15,000
Cummulative FCI			0.12%	0.38%	4.41%	8.98%	9.98%	9.98%	10.36%	11.56%	11.56%	12.28%

Functional Deficiencies												
	Building Addition	12,000 sqf new structure						\$ 1,468,800	\$ 3,427,200			
	Demolition Cost							\$ 100,000				
	Furniture	Based on \$10,000 / employee							\$ 500,000			
	Soft Cost	20% of construction cost						\$ 979,000.00				
Total Functional Deficiencies			\$ -	\$ -	\$ -	\$ -	\$ -	\$ 2,547,800	\$ 3,927,200	\$ -	\$ -	\$ -

Total	\$ 2,400	\$ 5,500	\$ 83,750	\$ 95,000	\$ 20,800	\$ 2,547,800	\$ 3,935,200	\$ 25,000	\$ -	\$ 15,000
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Enbridge Gas Distribution Inc.
Station B – Facility Assessment



APPENDIX B

Photographs



405 Eastern Avenue, Toronto, ON

Appendix B.1

1. Bunkers



2. Building Exterior



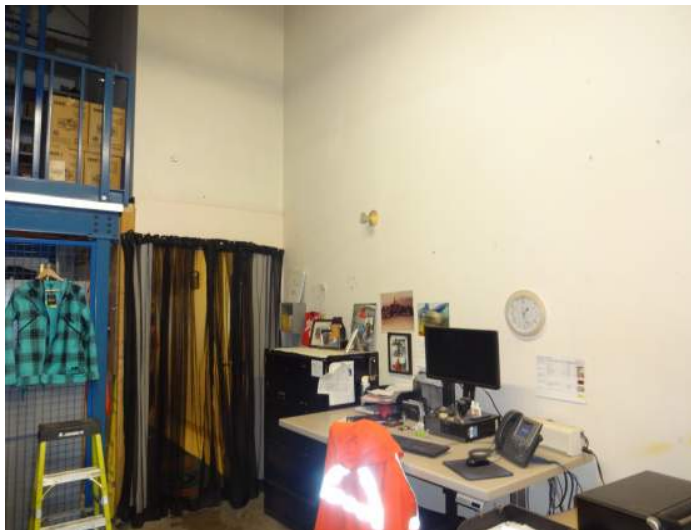
3. Parking Lot



4. Warehouse



5. Office



6. Yard





405 Eastern Avenue, Toronto, ON

Appendix B.2

1. Gate



2. Cracking Asphalt



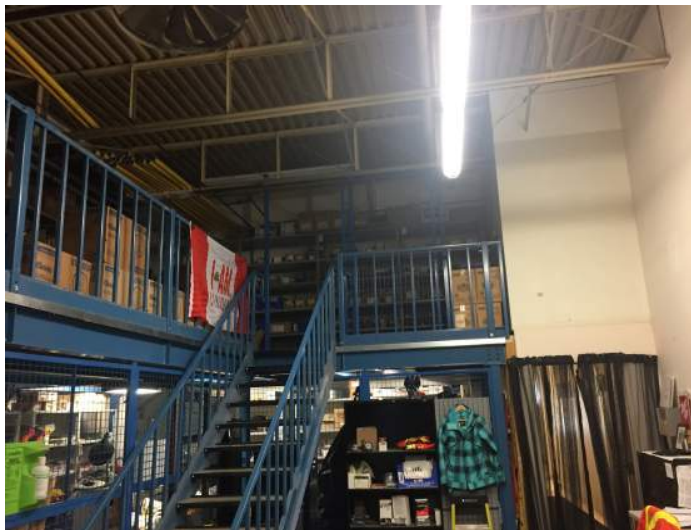
3. Window Caulking



4. Generator



5. Egress Area from Mezzanine



6. Rusted Fencing



Enbridge Gas Distribution Inc.
Station B – Facility Assessment



APPENDIX C

Program

Enbridge Operations Depot: EASTERN AVE

Description	Standard # per person	Quantity	Size	Area Factor	Area sq.ft.	Area sq.ft. Current	Area sq.ft. Variance	Notes
General Building Infrastructure								
Main Vestibule	<	1	9 x 5	1.00	45	66	21	
Waiting Area	<	1	9 x 5	1.00	45	0	-45	
Rear Entrance	<	1	7 x 5	1.00	35	35	0	
Showers/Change/Washrooms	45	1	5 x 6	1.00	1,350	938	-412	
Universal Washroom	1 / floor	1	8 x 10	1.00	80	60	-20	
Janitor	1 / facility	1	6 x 10	1.00	60	20	-40	
Mechanical/Electrical and IT Room	1 / facility	1	12 x 20	1.00	240	240	0	
Storage					200	200	0	
Sub Total					2,055	1,559	-496	
Functional Building Area								
MPO Office	20% of office staff	10	10 x 10	1.00	1,000	260	-740	
Cubicles Workstations (45 capacity employees)	50% of office staff	10	8 x 6	1.50	720	1,435	715	
Meeting Room (8-10 people) 1/70 staff	1 per 70	1	16 x 11	1.50	264	0	-264	
Mustering Room(1chair/person) +1 HR workstation with connectivity and large TV screen for training	30	1	4 x 5	4.00	2,400	624	-1776	
Break out room (4 people) 1/50 staff	1 per 50	1	10 x 12	1.00	120	0	-120	
Micro Kitchen/Ezone - 1/floor	1/200	1	15 x 20	1.00	300	15	-285	
Hotel Station (2:1 of dynamic staff)	30% of office staff	3	6 x 2.5	1.50	68	150	83	
Print Copy Rm/Mail Room	1/ 100				250	0	-250	
Health room - required if three are 200 or more employees on any one shift.	<	0	11 x 10	1.00	0		0	
Coat Storage	<	1	2 x 6	1.00	12	0	-12	
Gas monitor calibration (1/10 people)		1	8 x 8	1.00	60	0	-60	
Measurement & Regulation Test/Storage		1	12 x 20	1.00	240	200	-40	
Warehouse (where required by business ops)		1	30 x 78	1.00	2,150	2,000	-150	
Free Pick storage	1/Building	1	15 x 10	1.00	150	364	214	
Locked Storage Room	<	1	10 x 15	1.00	150	250	100	
Wash Bay / Repair Garage(if fleet exists)	1/Building	1	25 x 50	1.00	1,250	0	-1250	
Welding Bay / Fabrication	1/Building	1	35 x 54	1.00	0	0	0	
Boot wash		1	6 x 10	1.00	60	0	-60	
Washing Machine Area		1	6 x 10	1.00	60	0	-60	
Sub Total					9,254	5,298	-3956	
Total Building Area (not including circulation)					11,309	6,857	-4451	
Circulation	6.00%				679	411	-267	
Total Building Area (not including out buildings)					11,987	7,269	-4,718	

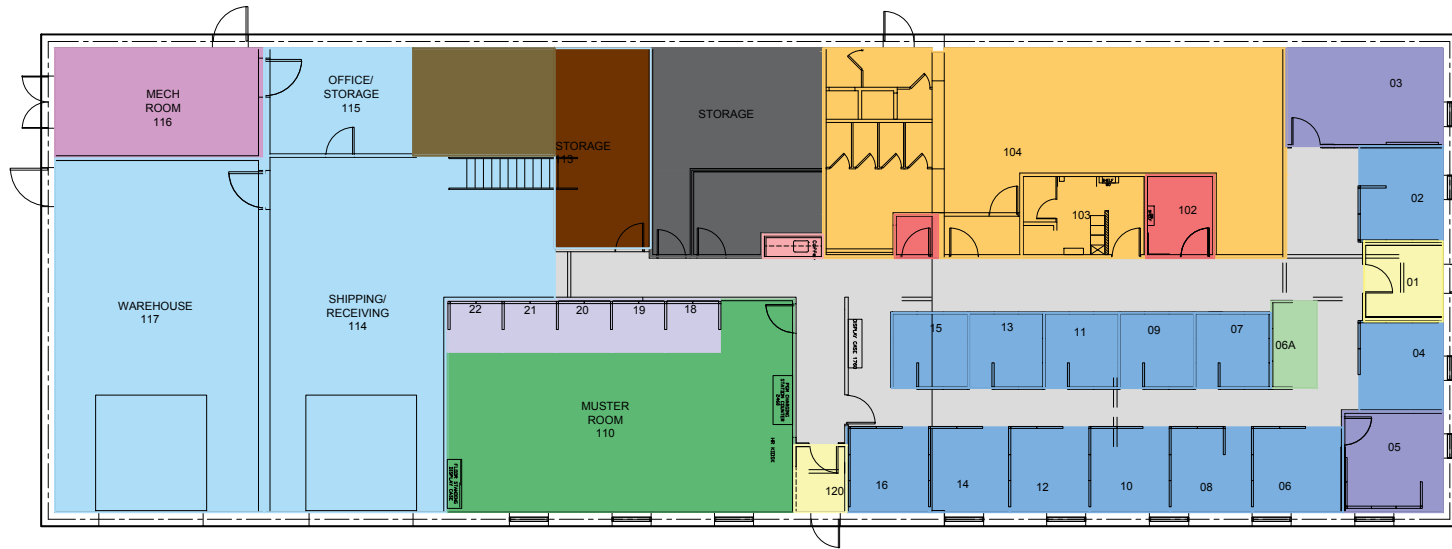
Site								
Total Site Area: (ft²)						168,429		
Building Footprint					6,762	6,762	0	
Future Building Expansion					4,718	4,718	0	
Landscaping				per site	0	0	0	
Staff Parking	1 per employee	51	9 x 18	4.00	33,048	27,300	-5748	36 spaces
Yard Area						98,000	10,900	
Visitor Parking	<	4	9 x 18	2.00	1,296	0	-1296	4 spaces
Sub Total					=	136,780	3,856	
Availible Yard Area:					#VALUE!	31,649	#VALUE!	Based on minimum 2.5 acres required
Site Deficit:							#VALUE!	

Enbridge Gas Distribution Inc.
Station B – Facility Assessment



APPENDIX D

Drawings



General Building Infrastructure

- Main Vestibule-Waiting Area-Rear Entrance
- Showers-Change
- Office Washrooms-Janitor-First Aid
- Mech Elec

Functional Building Area

- Office-MPO
- Workstations
- Print Mail
- Micro Kitchen
- Hotel Station
- Warehouse
- Measurement
- Mustering

Storage Facilities

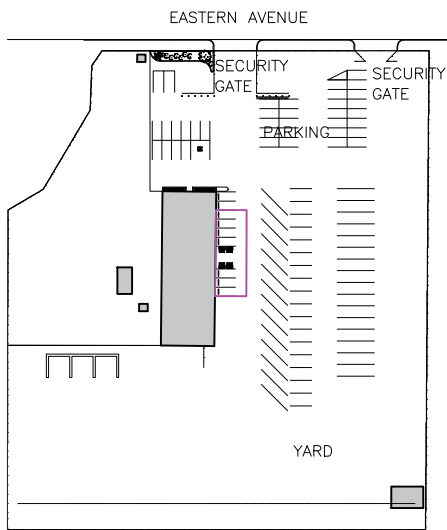
- Storage-File

MISC.

- Industrial
- Circulation

0 10 20 30 feet

Floor Plan



Site Plan

Enbridge Station B
405 Eastern Avenue, Toronto, ON

2016-0613-05



3.15 FACILITY ASSESSMENT

ENBRIDGE GAS DISTRIBUTION INC.

TORONTO VPC REGIONAL OPERATIONS DEPOT

500 Consumers Road, Toronto, ON

Project No.: 2016-0613-05

REV 1.0 - December 6, 2017

WALTERFEDY

ENBRIDGE GAS DISTRIBUTION INC.

FACILITY ASSESSMENT

Toronto VPC Regional Operations Depot

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1.0 SUMMARY

1.1 Introduction

WalterFedy was retained by Enbridge to conduct a physical and functional assessment of the facility located at 500 Consumers Road, Toronto, Ontario for the purpose of identifying functional adequacy and physical renewal requirements for budgeting and planning purposes. The scope of the report includes a general visual inspection of visible civil, architectural, structural, mechanical, and electrical components. It also includes a brief Ontario Building Code (OBC) review to address barrier-free accessibility issues.

Following the initial report, a list of recommendations with estimated costs is provided for corrective and preventive maintenance items required.

1.2 Facility Description

The facility is categorized by Enbridge as an administration building. The facility consists of a 5 storey office tower of approximately 225,000 SF of gross floor area; the link which connects the office tower to the energy plant, the energy plant which contains the main water chillers, boilers, generators and associated pumps. The tower building was constructed in or around 1968 as a two storey building with an addition in 1978 that included floors 3 to 5. A fleet garage of approximately 36,000 sqf is located on the west section of the site as a stand-alone building.



The facility is located in northeast Toronto on the north side of Highway 401, just east of Highway 404. The general area consists of predominantly older commercial development but major intensification is underway as a result of transportation infrastructure improvements to the surrounding highways. Adjacent properties are occupied by Stephenson Engineering (north) and Lifesaving Society (west).

1.2.1 Property Summary

- 1) General:

Owned / Leased:	Owned
FCI score:	5.59%
AI score:	11%
Current Occupancy:	1,154

- 2) Physical Building Properties:

Gross Floor Area	
Office Tower:	225,000 ±SF
Link/Annex - Office:	51,600 ±SF
Link/Annex – Meter Shop:	35,000 ±SF
Fleet Building:	35,000 ±SF
<i>Total Gross Floor Area:</i>	<i>346,600±SF</i>

- 3) Site Characteristics:

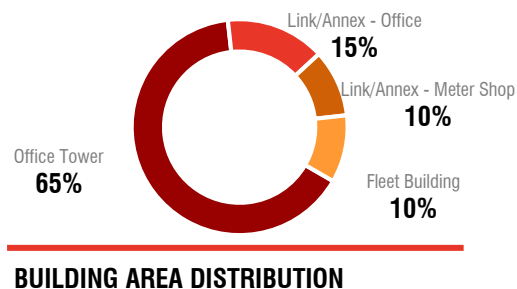
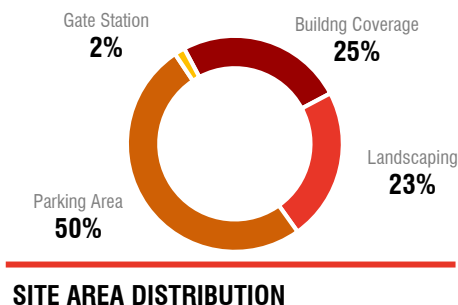
Site Area:	653,000±SF (15 acres)
Building Coverage:	163,500±SF (20.14%)
Yard	N/A
Parking	329,840±SF (7.5 acres)
Gate Station:	10,260 ±SF (0.25 acres)
Landscaping:	149,400±SF (3.5 acres)

- 4) Zoning:

Zone:	Former General Zoning By-Law 7625 (North York)
Parking required	1.5 per 100m ² (1076) of GFA = 483 spaces required
Parking provided	900 parking spaces provided including 40 for fleet
Loading Provided	1 Loading Space
Front Yard Depth (minimum)	<i>Information not available at time of report</i>
Side Yard Width (minimum)	<i>Information not available at time of report</i>
Rear Yard Depth (minimum)	<i>Information not available at time of report</i>

- 5) Building Systems:

HVAC:	2 gas-fired hot water boilers, 2 RTUs, 4 roof top air handling units, chillers.
Electrical:	1200A, 600V three phase
Plumbing:	Municipal water/sewer
Building Automation/Security:	None



1.3 Scope of Work

The scope of work for this assessment was approved by Enbridge and was completed in accordance with WalterFedy's fee proposal dated September 08, 2016.

The scope of work for the Asset Management Report will include a Functional Assessment, a Physical Assessment, and a Market Condition Assessment. The report will provide recommendations for strategic decisions based on the metrics reviewed in the assessments.

1.4 Assessment Methodology

The building condition assessment is based on general visual examination performed on October 05, 2016 by WalterFedy's Architectural and Facility Management departments.

The observations in this report were made using non-destructive methods through existing access points. Existing drawings provided by Enbridge for the building were also used to supplement site observations.

The guiding principles of this study is based upon the document from the National Research Council of Canada (NRC) "Protocols for Building Condition Assessment" published by The Institute For Research in Construction (IRC).

1.5 Limitation of Study

This assessment is based on our general review and walkthrough of the facility and it is not intended to form a detailed life safety analysis or Ontario Building and Fire Code assessment. The facility was built in 1960 and is not in compliance with current Ontario Building and Fire Codes. It is recommended that a further detailed life safety review and assessment is carried out to determine what building systems upgrades would be required to meet the requirements of Section 9.2 of Ontario Fire Code to the satisfaction of the Fire Department.

This report was completed in accordance with the approved scope of work as described in Section 1.3. This report is limited and is not intended to be comprehensive or exhaustive, or to suggest a risk-free facility. The report may not address all existing issues associated with the facility and may omit issues that are or may be of interest to the Owner. The findings and statements in this report are based on general site observations of the current conditions as they existed during the time period of the investigation.

The purpose of this report is for the sole use of the Owner for budgetary planning purposes. Issues identified in this report require further detailed assessments to determine repair and maintenance work required. This report should not be used by third parties involved in any work related to the facility; such third parties should undertake their own investigations and studies to determine how the existing condition of the facility will affect their plans and work. WalterFedy accepts no responsibility for liabilities incurred by or damages suffered by any third party as a result of decisions made or actions taken, based upon this report.

The passage of time might affect the views, conclusions and recommendations provided in this report.

The following report is a general guide only and is not intended to be used as a document for construction.

This study does not include hazardous materials review or inspection.

2.0 PHYSICAL AND FUNCTIONAL ASSESSMENT

2.1 Physical Assessment

2.1.1 Site and Landscaping

The site is a near rectangular-shaped property. The site building occupies approximately 20% of the site.

The remainder of the site is occupied by asphalt pavement parking areas, cast-in-place concrete paving, concrete curbs, a 6-foot high chain-link fence enclosing the north parking lot, a five-foot chain-link fence along the north edge of the property, and areas of soft landscaping (i.e., grass, shrubs, and trees). A new accessible concrete ramp with snow melting capabilities was installed along the front main entrance two years ago. The laneway entrance and parking area on the south side of the office tower is provided with approximately 44 standard and two barrier-free spaces. There is an employee parking area to the port of the office tower. This parking lot provides approximately 190 standard and five barrier-free parking spaces.

The poured concrete steps, ramps and landings at the north and south sides of the office tower and link, and at the east side of the office tower are in good condition overall and come equipped with steel railings.

The poured concrete sidewalks at the east side of the office tower and at the east perimeter of the energy plant as well as the interlock pavers walkways at the south side of the office tower and by the entrance to the link was noted to be in fair condition with only minor repairs to address cracks and potential slip and trip hazards recommended.

During the site visit the asphalt paved areas were noted to be in fair condition overall. However localized longitudinal and alligator cracking present on along the rear north parking area and along the side west parking/shipping receiving area next to the maintenance building.

Wall mounted lighting units and pole mounted light standards provide illumination for the site. The lighting standards at the front parking lot have recently been retrofitted with high efficiency LED fixtures; whereas the wall mounted lighting units on the buildings and lighting standards installed in the back parking lot are generally original to the date of most recent major conversion/renovations (1999). The wall pack units and backlot lighting standards are aged and consideration should be given to replacing them with LED fixtures for improved energy performance.

Since the inspection was limited to visible areas, no examination of the catch basins was performed and no review of the initial compliance with code was performed. The inspection of underground or concealed components is outside the scope of work.

2.1.2 Mechanical

Heating for the connected site buildings (office tower) is primarily supplied by two thermific hydronic heating boilers (Boiler #1: M/N – N3000-MFD; S/N – GY34-13-37236, and Boiler #2: M/N – N3000-MFD; S/N – GY34-13-37227) with a rated output of 2,580,000 BTUH each. These boilers were reportedly replaced in 2005. The heated water is distributed throughout the building through wall mounted forced air heating units along the office perimeters and common areas; through fan coil units in the mechanical penthouse, service room and within the energy plant; and through heating coils located in the six main air handling units. These air handling units are located in the third-floor mechanical room (Unit A – serves east side of floors B1 and B2), penthouse mechanical room (Unit B – serves west side of floors B1 and B2, Unit D – serves east side of floors 2, 4 and 5, Unit E – serves west side of floors 3, 4 and 5), Northeast Annex building roof (AHU 1- serves link lobby) and east penthouse mechanical room (AHU K – services energy plant and accreditation offices).

Central air handling units A, B, D and E are provided with humidification via Nortec natural gas-fired humidification units and a steam boiler located within the mechanical penthouse.

The air distribution system uses variable air volume (VAV) terminal boxes connected to the central supply air plenum to distribute airflow to zones in the building. Each zone has a thermostat that controls the VAV box to modulate the air flow to the rooms within that zone. The majority of these units are approximately 35 years old. Given a typical projected useful life of 20 to 30 years for these types of building components, an on-going replacement allowance has been included within the term of our analysis.

Process and sanitary exhaust is provided by rooftop exhaust units. Based on our site inspection and evaluation of project useful life of the currently installed units, we have provided a replacement allowance within the terms of our analysis.

There are nine heating and cooling pumps that circulate the heated and chilled water loops. Based on review of the nameplate data and physical condition review, WalterFedy recommends replacing four of the HVAC distribution pumps within the term of the analysis.

Domestic Hot Water (“DHW”) within the connected site buildings (office tower) is provided by an A.O. Smith domestic hot water tank (M/N – H610 962; S/N – Z14 R00 55246) associated domestic hot water storage tank located within the energy plant. Based on the name plate data on the equipment, the domestic hot water tank was manufactured in 2005 and has a capacity of 502,640 BTUH. The condition of the storage tank and covering insulation was noted to be in good condition overall. There was reportedly no shortage of DHW within the site building. However, based on WalterFedy’s experience the anticipated service life of a DHW is typically 10-15 years. Therefore based on age, replacement of the domestic hot water heater should not be required within the term of analysis.

The repair shop building is primarily heated and cooled by two Trane rooftop packaged HVAC units (RTU-1: M/N – YCD120BWHAEA, S/N – M02104334D; RTU-2: M/N – YCD120BWHAEA, S/N – M02104336D), two Carrier rooftop packaged HVAC units (RTU-1: M/N – 48TJE008---111QE, S/N – 0596G30678; RTU-2: M/N - UNKOWN, S/N – 2196G20906) and a Greenheck make-up air handling unit (MUA-1: M/N – PVF225H, S/N - 11542). There is also a make-up air handling unit in the mezzanine level with the shop floor area. A preheat A.O. Smith boiler (M/N – DB720 8 126, S/N – E02 28210) installed in the front service room provides heating to prevent freezing of the incoming make-up air. Supplementary heating is provided by two radiant tube heaters located within the general shop area. Based on age and observed condition as well as review of manufacturing dates of each piece of equipment, WalterFedy recommends replacement of the two Carrier rooftop packaged HVAC units, the mezzanine make-up air-handling unit and the preheat boiler within the term of the analysis.

Domestic Hot Water (“DHW”) within the repair shop is provided by a RHEED RUUD domestic hot water tank (M/N – G65-360-1; S/N – URNG1005G00115) located within the second floor utility room. Based on the name plate data on the equipment, the domestic hot water tank was manufactured in 2005 and has a capacity of 360,000 BTUH at 65 US gallons. There was reportedly no shortage of DHW within the site building. However based on WalterFedy’s experience, the anticipated service life of a DHW is typically 10-15 years. Therefore based on age, replacement of the domestic hot water heater should not be required within the term of analysis.

Plumbing fixtures within the customer service washrooms have not been upgraded recently. Based on age and observed condition, as a leasehold improvement, plumbing upgrades to two of the washrooms is recommended at the later portion of the analysis.

2.1.3 Electrical

The electrical power for the connected site buildings is supplied from a pad-mounted transformer that feeds the main electrical room within the site building.

The building is equipped with a Federal Pioneer 4,000 Ampere, 600 Volt, three phase service. Distribution panels provide power via copper conduit to the various secondary distribution panels for lighting and receptacles that are located within each section of the building. Much of the electrical systems were upgraded/replaced in 1998 as part of the major building renovations. Based on age and observed condition, major capital upgrades including replacement of the step down transformer and overhaul of the primary switchgear are expected within the term of the analysis.

Emergency power is provided by two natural gas fired generators located within the energy plant. The Waukesha genset (M/N – L5790GU, S/N - 144315) has a system load capacity of the 625 KVa at 500 KW and is used as a back-up generator to the Caterpillar genset. The Caterpillar genset (M/N – 500, S/N – 5WN02023) was installed in 2002 and has a system load capacity of the 1,563 KVa at 1,1250 KW. Based on age and observed condition, no major capital expenditures are expected within the term of the analysis.

Interior lighting for the connected site building is predominately provided by a mix of T8 fluorescent tube lighting fixtures and retrofitted LED fixtures that were recently converted from the lower efficiency T8 electronic ballasts and tubes when localized renovations occurred within the building.

Interior lighting for the repair shop building is predominately provided by a mix of T8 fluorescent tube lighting fixtures and high bay metal halide fixtures. As a leasehold improvement, consideration should be given to upgrade all remaining T8 fluorescent tube lighting to high efficient LED lighting near the end portion of the analysis.

Combination battery pack units provide emergency lighting and exit signage within egress pathways for both the connected site building and the repair shop building.

2.1.4 Structural

As outlined in the scope of work, a limited visual assessment of the condition of the structural elements was carried out on the elements which were visible at the time of the inspection. The buildings are comprised of the original structure built in 1969. The original structures include a poured concrete slab on grade foundation supported by a steel frame structure. The steel roof deck is supported by open web steel joists and the joists are supported by steel beams and columns.

The floors of the office tower consist of pre-cast concrete panels. The panels are supported by steel beams and steel and masonry columns.

The link building's poured concrete foundations support pre-cast-concrete panels exterior walls. The metal roof deck is supported by open web steel joists that are in turn supported by a network of steel beams and columns.

The energy plant's poured concrete foundations support pre-cast-concrete panels exterior walls. The structure consists of precast concrete panels supported by steel beams and columns.

The repair shop's foundation consists of a slab on grade structure. The superstructure of the site building is comprised of corrugated sheet metal exterior walls, steel columns, open web steel joists and a steel roof deck.

At the time of the site inspection major vertical cracking was observed along the south elevation of the energy plant. Given the extent of the cracking it is recommended that an in-depth structural investigation be performed to determine root cause and to develop a monitoring and/or repair strategy to address the noted deficiency.

2.1.5 Building Envelope

The roof system atop the office tower, main roof, penthouse mechanical room roof and north canopy roof, link roof, energy plan roof and repair shop roof consists of a single ply Polyvinyl Chloride Membrane (PVC), near-flat, mechanically fastened roof system that were replaced over the last ten years; with the most recent replacement being last year on the repair shop building. The roof systems are installed atop a layer of rigid insulation, atop a corrugated metal roof decking. Neither the presence of a vapour barrier, nor the type or the thickness of the insulation could be verified, as the scope of the work did not include destructive testing. The roofs were all in relatively good condition. The south canopy roof above the main entrance of the office tower is covered by a 2-ply modified bitumen assembly.

Drainage of the PVC roof systems is provided by internal roof drains which presumably drain to the municipal sewer system. A scupper drain is present on the perimeter of the north canopy roof. The office tower main and the penthouse roofs are also equipped with overflow scuppers. Significant ponding was observed on the mechanical penthouse roof and as such a review of roof drainage in this area is recommended.

Penetrations through the roof systems include plumbing stacks, an exhaust vent stack, internal roof drains, mechanical curbs, and service penetrations.

The exterior walls of the connected site buildings are clad with pre-cast concrete panels. The walls of the office tower penthouse mechanical room and the repair building are clad with corrugated metal siding.

The window systems of the site building consist of fixed single glazed insulated (“SG”) units set within aluminum frames in punched configurations. Exterior doors serving the connected site buildings are comprised of double single units set into aluminum frames. Metal doors within metal frames were observed serving the repair building egresses and the energy plant (personnel door). Approximately 15% of the punched windows associated with office tower has been completed since the original construction. Replacement of the remaining 85% due to age and observed condition is recommended over the term of this analysis. Replacement of the punched windows associated with the repair building are also recommended due to age and observed condition.

At the time of the site assessment a window/wall leak was reported within the office tower’s basement “Oak Room”. The room could not be accessed for further investigation. A building envelope investigation is recommended to identify the root cause and repair strategy for this reported deficiency. Repair may include exterior side excavation and installation of a new exterior waterproofing system.

2.1.6 Finishes

The floor finishes within the site building consist of unsealed concrete slab-on-grade, ceramic, carpet and resilient floor tiles. The wall finishes within the connected site buildings consist of painted gypsum board and painted concrete masonry block. The ceiling finishes within the site building primarily consist of exposed structure and painted suspended ceiling tile. A number of the suspended ceiling tiles were noted to be discoloured, stained and/or water damaged. Replacement of the affected ceiling tiles should be carried out under routine maintenance.

The overall condition of the interior components is good. Maintenance has noticeably been performed and ongoing upgrades have been undertaken. Most of the interior finishes have been upgraded within the last ten years. Modernization of the office tower passenger elevators has been completed within the last two years.

2.2 Functional Assessment

2.2.1 Site

VPC is located at the northwest corner of Victoria Park Avenue at the intersection with Consumers Road in the Consumers Road Business Park. The location is considered one of Toronto's more established office and industrial parks. The plan to extend the TTC's Sheppard Subway line combined with the proximity of the area to the 401 and 404 highways have increased the interest in the area including the VPC site for condominium and retail redevelopment.

There are three separate parking lots at the property, the east parking is designated for management and visitors and it consists of 46 parking spots, the lot has one access point and two exits. The parking adjacent to the Annex is designated for visitors to the customer service area, it consists of 15 parking stalls.

The main entrance to the employee parking is adjacent to the Annex building and it is controlled by automatic gates. It was noted by staff that the number of parking spaces is adequate, however parking pressure occur in the summer during the co-op students work term.

The site was found to be generally in compliance with Enbridge GDP standards. The following are functional deficiencies observed during the walkthrough:

- Tripping hazards observed at several entry/exit door locations, this is due to change in level between interior finished floors and outside grade in some locations.
- The exterior concrete slab/landing and the steps are deteriorating at the east tower emergency exit. Replacement of the concrete landing and the steps is recommended.
- The concrete and landing are deteriorated at the north west exterior exit in the Annex (exit #7). Replacement of the handrail and guard is recommended for safety and for compliance with Ontario Building Code for guard height and picket spacing.
- The landing, stairs and handrail/guardrail is deteriorated at the tower north east exit door and loading dock area. Replacement of the existing handrail and guard rail is recommended.
- The railing at the tower north loading dock area have reached the end of its life cycle and replacement is recommended.
- Additional way-finding signage is recommended at the entrance driveways for directions to employees and visitors parking areas.

2.2.2 Interior Space Planning

The facility consists of three components: the Tower, the Annex/link and the fleet building. The tower consists of five levels and a basement, the Annex/link is a one storey building and it houses the meter shop and the customer service area. The meter shop is currently under renovation. The fleet structure is a one storey stand-alone metal clad building and is located at the west side of the property.

Tower:

The tower consists of five above grade levels and a one underground level. The five above ground levels are used as office space and the underground level houses common functions such as meeting rooms, cafeteria and server space and mechanical/electrical rooms.

Interior renovation to the top three levels (levels 3, 4 and 5) was completed recently. The renovation work included new finishes and new furniture. The layout and interior finishes in the basement, the ground and second levels is dated and are from the original 1968 construction. The majority of the existing furniture in the basement, ground and second levels is legacy furniture and replacement is recommended. The executive wing located at the northwest section of the ground level was also recently renovated including the main entrance lobby and the adjacent board room.

It was noted by staff that water leakage through the existing windows in the tower is a constant issue. Between 10 to 20% of the existing windows have been replaced due to this issue. The age of the building indicate the existing windows have reached the end of its life cycle and replacement is recommended.

There is lack of natural light in the office space due to the layout of the existing windows. To address this issue complete replacement of the existing cladding system and exterior windows is recommended. Refer to development scenario 2 in section 2.9 for estimated cost.

Loading dock #2 elevator and leveler have reached the end of its life cycle and replacement is recommended.

The Link:

The link is a one storey building that connects the tower with the Annex. It has a gross floor area of approximately 14,000 sqf and it houses the main employee entrance and lobby, the power house and office space.

The following are functional deficiencies observed during the walkthrough:

- The front reception area including the counter is small and additional space is required. Renovation and renewal to the reception area is recommended.
- The finishes and furniture in the reception and lobby area are outdated and renewal is recommended.
- The furniture in the office area is legacy furniture and replacement is recommended.

The Annex:

The Annex is a one storey structure connected to the tower building through the link. It has a gross floor area of 72,000 sqf and it houses the main customer service area (5,600 sqf), office space (7,300 sqf) and the meter shop. At the time of this report the meter shop area was under renovation, the area under renovation is approximately 57,000 sqf, after renovation the area will house the meter shop and new office space.

The following are functional deficiencies observed during the walkthrough in the Annex area:

- The customer service entrance requires a vestibule and blinds for climate control. It was noted by staff that temperature control in the lobby area is difficult due to the southerly exposure and due to the large area of glass along the frontage.
- The finishes in the existing office space at the north east corner (not included in the current renovation) require renewal. The exiting furniture is legacy furniture and replacement is recommended.

The Fleet Garage:

The Fleet Garage is a stand-alone metal clad building located at the West side of the property. The building is approximately 37,000 SF and it consists of (15,500 SF), Industrial warehouse (16,000 SF), Mezzanine (2,000 SF) used as office space and washrooms. According to staff the current staff occupant load in the fleet building is 15.

The following are functional deficiencies observed during the walkthrough in the Annex area:

- The guard rail at the mezzanine stairs is not in compliance with Ontario Building Code for height and spacing between pickets. Replacement is recommended.
- The lighting level in the corridors at the ground level and in the mezzanine area is low, lighting renewal is recommended.

2.2.3 Furniture

Furniture in the following areas is new and is considered in compliance with Enbridge GDP standards:

- The top three levels in the tower (Levels 3, 4 and 5)
- The executive wing in the Ground Level
- The main entrance lobby in the Ground Level including the board room
- The customer service area in the Annex.

Furniture in the other areas is legacy furniture and replacement is recommended. The following are the areas that contain legacy furniture:

- The Underground Level
- The ground level with the exception of the executive wing and the front entrance lobby and the board room.
- The Second Level
- The office space in the link

2.2.4 Ontario Building Code – Life Safety

Section 3.2 - Building Fire Safety

The building falls under Part 3, Group F Division 2 and Group D major occupancies.

To meet current Ontario Building Code the building should satisfy the requirements of 3.2.2.49 Group D, any height any area and 3.2.2.69 Group F, Division 2, up to 6 Storeys:

- The building is required to be sprinklered.
- Standpipe system is required (the building is more than 3 storeys in building height)
- The building shall be of non-combustible construction
- Floor assemblies shall have a fire-resistance rating of not less than 2 hours.
- Mezzanines shall have a fire-resistance rating not less than 1 hour.
- Loadbearing walls, columns, and arches supporting an assembly shall have a fire-resistance rating not less than that required for this supported assembly

Section 3.8 - Barrier-free Design

3.8.1.3. Barrier-free Path of Travel

3.8.1.3. (1) Every barrier-free path of travel shall provide an unobstructed width of at least 1100 mm for the passage of wheelchairs.

- The building generally meets the requirements for barrier free path of travel.

3.8.2.3. Washrooms required being barrier-free.

- Barrier free stalls are not provided in the main washrooms on the Ground Level. This is considered an existing non-conforming condition for compliance with Ontario Building Code. There is no mandate in the current code to upgrade the existing facility. However in compliance with Part 11 of Ontario Building Code the addition of barrier-free washrooms and a universal washroom will be required in the event of extensive renovation in the building. It is recommended that a universal washroom to be added on the ground level.

3.8.3.12. Universal (barrier-free) toilet rooms:

- Universal Washrooms do not exist in the Tower building. This is considered an existing non-conforming condition for compliance with Ontario Building Code. There is no mandate in the current code to upgrade the existing facility for compliance with the Universal Barrier Free washroom requirements. However in compliance with Part 11 of Ontario Building Code the addition of a universal washroom will be required in the event of extensive renovation in the building.

2.3 Functional and Physical Condition Analysis

WalterFedy utilized a risk management approach taking into consideration the impact of failure of the building component on the long term serviceability of the building as well as the functional requirements associated with the building. Both Facility Condition Indexing (FCI) and Adequacy Indexing (AI) was utilized in order to help make the best possible decision related to the future of the site building and to determine whether or not to invest, maintain, repurpose or dispose of the asset.

FCI:

FCI is a condition index tool used to illustrate the condition of an asset expressed in a percentage ratio of required maintenance/repair costs divided by the replacement value of the asset expressed as:

$$\text{FCI} = (\text{Maintenance and Repair Costs}) / (\text{Cost to Replace the Building})$$

The replacement value of the building is based on industry standards for construction costs. Therefore, the lower a FCI is, the better the condition of the building. The resulting FCI at ten years is 5.59% which is classified as being in fair condition.

$$\text{FCI (Toronto VPC)} = (\$3,093,000) / (\$55,300,000) = 5.59\%$$

AI:

AI is a condition index tool used to illustrate the functional condition of the asset expressed in a percentage ratio of required functional upgrade costs divided by the replacement value of the asset to meet the functional needs expressed as:

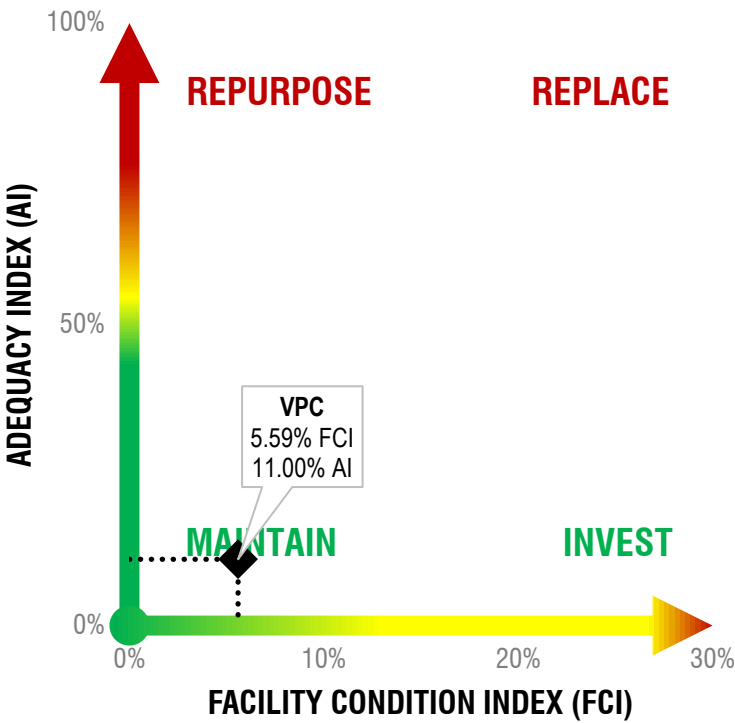
$$\text{AI} = \text{Functional Upgrade Costs} / \text{Cost to Replace the Building with its Functional Equivalent}$$

The cost to upgrade the facility to current Enbridge GDP standards is estimated at \$7,730,000. The estimated cost to build a new facility to Enbridge GDP current standards based on \$225,000 sqf the area required to accommodate current program is \$70,000,000.

$$\text{AI (VPC)} = \$7,730,000 / \$70,000,000 = 11\%$$

With quantification of FCI and AI for your building, comes the ability to make comparisons between industry benchmarks, and drive decision making related to the future of the property. The chart below shows the relationship between FCI and AI and indicates visually where VPC falls within the decision making criteria based on the capital expenditures forecast found in Appendix A of this report.

**FACILITY CONDITION &
ADEQUACY GRAPH**



2.4 Key Findings

- PHYSICAL OBSOLESCENCE:

The acceptable Enbridge standard for the physical condition is an FCI of 0 to 5%. The current FCI of the facility based on this study is 5.59% therefore the physical condition of the facility does not meet Enbridge acceptable standards.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	POSITIVE	Negative

- FUNCTIONAL OBSOLESCENCE BUILDING :

The acceptable Enbridge standard for the functional condition is 0, anything between 0 to 50% is considered correctable at current location. The current facility AI index is 11% which is considered correctable at current location without consideration of other factors including adequacy of land size and the FCI index.

Meets Standards		Correctable at Current Location	
Positive	NEGATIVE	POSITIVE	Negative

- FUNCTIONAL OBSOLESCENCE SITE:

The site area and parking provided are generally in compliance with Enbridge requirements.

Meets Standards		Correctable at Current Location	
POSITIVE	Negative	POSITIVE	Negative

VPC location is considered one of Toronto's more established office and industrial parks. The plan to extend the TTC's Sheppard Subway line combined with the proximity of the area to the 401 and 404 highways have increased the interest in the area including the VPC site for condominium and retail redevelopment. The area is currently in the process of Official Plan amendment to permit mid and high rise mixed use development with residential, retail and other commercial uses.

Three development scenarios are evaluated in this study. Refer to Section 2.6:

Development Scenario 1:

Status-quo: correct physical and functional deficiencies by renovating and renewing the existing facility, the following measures are included in this option:

- Interior renovation and upgrade to the tower ground and second floors including the underground level
- Interior renovation to the link area
- Interior renovation and upgrade to the existing stairwells in the tower
- Provide Universal Washroom in each floor for compliance with Ontario Building Code accessibility requirements
- Loading dock leveler and elevator replacement (Loading Dock 2) in the tower
- Interior renovation and upgrade to the mezzanine area in the fleet garage

Total Estimated Project Cost: **\$9,276,000**

Development Scenario 2:

Upgrade the existing facility to class A office building: correct physical and functional deficiencies by renovating and renewing the existing facility on the existing site, the following measures are included in this option:

- Interior renovation and upgrade to the tower ground and second floors including the underground level
- Interior renovation and upgrade to the existing stairwells in the tower
- Provide Universal Washroom on each floor for compliance with Ontario Building Code accessibility requirements
- Loading dock leveler and elevator replacement (Loading Dock 2) in the tower
- Upgrade finishes in the existing washroom areas
- Provide additional elevator in the main lobby area
- Replace existing exterior cladding system and windows in the tower
- Interior renovation and upgrade to the mezzanine area in the fleet garage

Total Estimated Project Cost: **\$19,896,000**

Development Scenario 3:

Sell the existing front section of the property (approximately 7.5 acres) and relocate the office component to the westerly side of the property. In this option the fleet garage will be demolished and replaced with a new fleet garage at Kennedy Site:

Total Estimated Project Cost: **\$85,525,000**

2.5 Property Evaluation

In 2010 Wagner, Andrews & Kovacs Ltd completed appraisal report on the property at 500 Consumer Road in Toronto. The appraised amount based on the report in 2010 for the entire 15 acre property is \$29,000,000. Based on the report the estimated value of the property is:

Land:	\$18,000,000
Building:	\$11,000,000 (office building only)
Total:	\$29,000,000

According to the report the estimated value for the east section of the site (approximately 7.5 acres) including the office tower is \$19,950,000. The estimated value for the westerly section of the site (approximately 7.5 acres) is \$9,000,000. The rear part of the property has a potential for redevelopment to more intensive uses.

2.6 Development Scenarios

The following is a comparison of the available options to address the deficiencies at 500 Consumers Road:

SCENARIO	1	2	3
DESCRIPTION	Correct physical and functional deficiencies by renovating and renewing the existing facility on the existing site (MAINTAIN EXISTING BUILDING AS CLASS B)	Correct physical and functional deficiencies by renovating and renewing the existing facility on the existing site (UPGRADE BUILDING TO CLASS A OFFICE)	Sell the existing front section of the property (approximately 7.5 acres) and relocate the office component to the westerly section of the current site
LAND SALE	-	-	\$9,975,000*
CONSTRUCTION COST	-	-	\$70,000,000
INTERIOR RENOVATION: TWO FLOORS + BASEMENT (INCL. FURNITURE)	\$6,000,000	\$6,000,000	-
INTERIOR RENOVATION TO THE LINK AREA	\$300,000	\$300,000	-
RENOVATE THREE STAIRCASES	\$750,000	\$750,000	-
PROVIDE UNIVERSAL WASHROOM ON EACH FLOOR	\$180,000	\$180,000	-
WASHROOMS UPGRADE	-	\$1,400,000	-
LOADING DOCK 2 UPGRADE + ELEVATOR REPLACEMENT	\$250,000	\$250,000	-
INTERIO RENOVATION AND UPGRADE TO THE MEZZANINE AREA IN THE FLEET GARAGE	\$250,000	\$250,000	-
ADDITIONAL ELEVATORS	-	\$700,000	-
UPGRADE (ADD TWO NEW ELEVATORS)	-	-	-
EXTERIOR CLADDING UPGRADE	-	\$6,750,000	-
SOFT COST	\$1,546,000	\$3,316,000	\$14,000,000
FURNITURE	INCL IN RENOVATION COST	INCL IN RENOVATION COST	\$11,500,000**
TOTAL	\$9,276,000	\$19,896,000	\$85,525,000
MEETS EDG STANDARDS	YES	YES	YES
PRIORITY	1 (reflected in the capital expenditure matrix in Appendix A)	2	3

Enbridge Gas Distribution Inc.
Ottawa Regional Operations Depot – Facility Assessment

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* Land sale proceeds is equal to 50% of the actual property evaluation/sale price. This is based on the “rate base split”/Enbridge portion of proceeds.

** Furniture cost is based on \$10,000 per employee.



APPENDIX A

Capital Expenditures Forecast



5.0 CAPITAL FORECAST

500 Consumers Road/2225 & 2235 Sheppard Ave E., Toronto, ON
Administration Buildings

The following Capital Plan has been compiled from the following:

- 1 2013/2014 EGD Long Range Capital Plan (LRP) has been moved forward to start in 2015
- 2 Non-Functional Standards Assessment - Section 5 (nFSA)

SECTION	CATEGORY	DEFICIENCY	1	2	3	4	5	6	7	8	9	10
			2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
			BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD	BUD
Maintenance Deficiencies												
	Building Envelope	Allowance for structural review and repairs to Energy Plant exterior wall	\$ 25,000									
	Building Envelope	Allowance to review roof draining on mechanical penthouse roof and allow for additional roof drainage if required.	\$ 15,000									
	Building Envelope	Replace windows on office tower		\$ 212,500	\$ 212,500	\$ 510,000	\$ 510,000					
	Building Envelope	Replace south canopy roof membrane		\$ 5,500								
	Building Envelope	Replace office tower main roof membrane									\$ 300,000	
	Building Envelope	Replace windows on maintenance building						\$ 75,000				
	HVAC	Replace rooftop airhandling units on Office Tower					\$ 180,000					
	HVAC	Replace Chiller water and condenser Pumps			\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000	\$ 20,000		
	HVAC	Replace maintenance building mezzanine MUA				\$ 10,500						
	HVAC	Replace two roof top HVAC units (maintenance building)						\$ 12,500		\$ 10,500		
	HVAC	Replace process and sanitary exhaust units			\$ 3,000		\$ 3,000		\$ 3,000		\$ 3,000	
	HVAC	Replace preheat boiler in maintenance building				\$ 18,000						
	HVAC	Replace VAV boxes				\$ 8,500	\$ 8,500	\$ 8,500	\$ 8,500			
	Electrical	Replace stepdown transformers			\$ 70,000							
	Electrical	Allowance for major electrical overhaul of primary switchgear		\$ 100,000								
	Leasehold Improvements	Washroom fixture replacements/upgrades with two office tower washrooms						\$ 20,000	\$ 20,000			
	Leasehold Improvements	LED lighting upgrade allowance									\$ 25,000	\$ 25,000
	Site Work/Exterior Elements	Replace wall pack lighting units with LED				\$ 25,000						
	Site Work/Exterior Elements	Replace back lighting standards with LED			\$ 150,000							
	Site Work/Exterior Elements	Replace chainlink fence										\$ 10,000
	Site Work/Exterior Elements	Replace asphalt paving along rear parking area			\$ 350,000							
	Site Work/Exterior Elements	Repair asphalt paving along west parking area along maintenance building				\$ 15,000	\$ 15,000					
	Site Work/Exterior Elements	Repair interlocked pavers to address potential slip and trip hazards	\$ 5,000									
Total Maintenance Deficiencies			\$ 45,000	\$ 318,000	\$ 805,500	\$ 607,000	\$ 736,500	\$ 136,000	\$ 51,500	\$ 30,500	\$ 328,000	\$ 35,000
Cummulative FCI			0.08%	0.66%	2.11%	3.21%	4.54%	4.79%	4.88%	4.94%	5.53%	5.59%

Functional Deficiencies												
	Renovation three floors			\$ -	\$ 3,000,000	\$ 3,000,000						
	Interior renovation to the link				\$ 150,000	\$ 150,000						
	Renovation three staircases				\$ 375,000	\$ 375,000						
	New Universal WRs				\$ 90,000	\$ 90,000						
	Loading Dock Upgrades				\$ 125,000	\$ 125,000						
	Interior renovation Fleet Garage				\$ 125,000	\$ 125,000						
	Soft Costs	20% of Construction Cost		\$ 1,546,000								
Total Functional Deficiencies			\$ -	\$ 1,546,000	\$ 3,865,000	\$ 3,865,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

Total			\$ 45,000	\$ 1,864,000	\$ 4,670,500	\$ 4,472,000	\$ 736,500	\$ 136,000	\$ 51,500	\$ 30,500	\$ 328,000	\$ 35,000
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APPENDIX B

Photographs



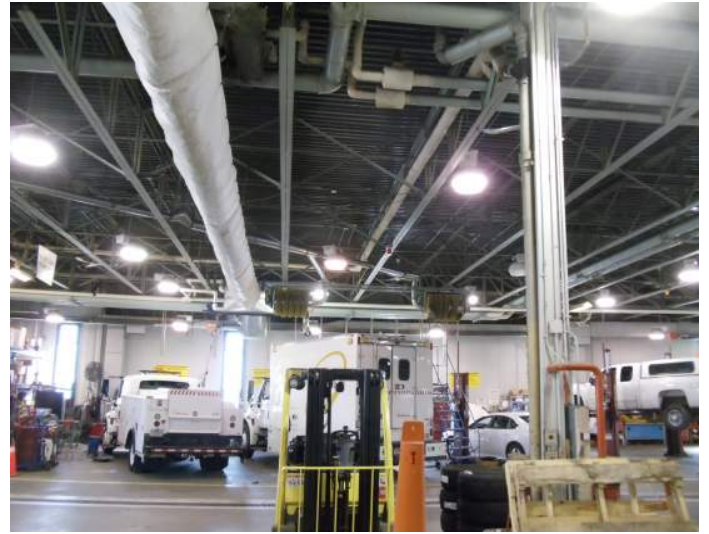
500 Consumers Road, North York, ON

Appendix B.1

1. Building Exterior



2. Garage



3. Roof



4. Kitchen



5. Office Area



6. Office Area





500 Consumers Road, North York, ON

Appendix B.2

1. Pumps



2. Rooftop HVAC Unit



3. Exterior Lighting



4. Electrical Switchboard



5. Roof Drainage



6. Boiler





APPENDIX C

Program

Regional Operations Centre: Toronto VPC

Description	Standard # per person	Quantity	Size	Area Factor	Area sq.ft.	B	1	2	3	4	5	Area sq.ft. Current	Area sq.ft. Variance	Notes
General Building Infrastructure														
Main Vestibule	<	1	10 x 23	3.00	690	690						690	0	
Waiting Area	<	1	21 x 24	3.00	1,500	1500						1,500	0	
Alternate Entrance	<	3	10 x 7	2.00	406							0	-406	
Security / Reception	<	1	13 x 13	1.50	254	254						254	1	
Shipping & Receiving	<	1	12 x 11	1.00	126							0	-126	
Showers/Change/Washrooms (1 locker / field services staff)	50	1	5 x 6	1.00	1,500	1236						1,236	-264	
Office Washrooms	2 / floor	6	25 x 25	1.00	3,750	761	485		925	795	824	3,790	-40	
Universal Washroom	1 / floor	6	8 x 10	1.00	480							0	-480	Two on First floor
Janitor	1 / facility	1	10 x 15	3.00	450	57		55	44	99	102	357	-93	
Cafeteria	1 / facility	1	45 x 50	2.50	5,631	5822						5,822	191	
Fitness Centre	1 / facility	1	25 x 50	2.00	2,500	2574						2,574	74	
Mechanical/Electrical and IT Room	1 / facility		x	1.00	13,323	3002	959	5771	1664	1051	876	13,323	0	
General Storage			x	1.00	6,492	3878	1288	320	65	556	385	6,492	0	
Sub Total					37,100							36,038	-1062	
Functional Building Area														
MPO Office	20% of office staff	231	10 x 10	1.00	23,100	475	9750	3805	1798	3904	3646	23,378	278	
Cubicles Workstations	50% of office staff	577	8 x 6	2.00	55,392	3516	13694	20057	21407	22807	21911	103,392	48,000	
Meeting Room (8-10 people) 1/70 staff	1 per 70	17	16 x 11	2.00	5,984	4783	3104	1129	1777	572	1971	13,336	7,352	
Break out room (4 people) 1/50 staff	1 per 50	24	10 x 12	1.00	2,880		643	102	586	868		2,199	-681	
Focus Rooms (4 people) 1/50 staff	1 per 50	24	10 x 10	1.00	2,400				616	1179	603	2,398	-2	
Hotel Station (2:1 of dynamic staff)	30% of office staff	346	6 x 3	2.00	10,546	67			69			136	-10410	
Training Rm PC Training (12-24)	<		x		1,680	1680						1,680	0	
Micro Kitchen/Ezone - 1/floor	1/200	6	15 x 20	1.00	1,800		429	152	1098	838	1002	3,519	1,719	
Print Copy Rm/Mail Room	1/ 100	12			250	2588	212		401	120	373	3,694	3,444	
Health room - required if there are 200 or more employees on any one shift.	<	1	11 x 10	1.00	110							0	-110	
IT Room	<	1	11 x 11	4	484	389						389	-95	
Coat Storage	<	6	2 x 6	2.00	144				47	90		137	-7	
Mustering Room (1chair/person) +1 HR workstation with connectivity and large TV screen for training	10	0	3 x 5	4.00	0							0	0	
Gas monitor calibration (1/10 people)		0	8 x 10	1.00	0							0	0	
Measurement & Regulation Test/ Storage		0	12 x 20	1.00	0							0	0	
Warehouse (where required by business ops)		0	30 x 77	1.00	0							0	0	
Free Pick storage	1/Building	0	15 x 10	1.00	0							0	0	
Locked Storage Room	<	0	10 x 15	1.00	0							0	0	
Wash Bay / Repair Garage (if fleet exists)	1/Building	0	25 x 50	1.00	0							0	0	
Welding Bay / Fabrication	1/Building	0	35 x 54	1.00	0							0	0	
Boot wash		0	6 x 10	1.00	0							0	0	
Washing Machine Area		0	6 x 10	1.00	0							0	0	
Sub Total					104,770							154,258	49,488	
Total Building Area (not including circulation)					141,871							190,296	48,425	
Circulation/Structure	19.29%				27,367							36,708	9,341	
Total Building Area (not including out buildings)					169,237							227,004	57,767	



APPENDIX D

Drawings



0 10 20 30 feet

Level 1 Floor Plan

General Building Infrastructure

Main Vestibule

Waiting Area

Security Reception

Office Washrooms

Mech-Elec

Storage-File

Functional Building Area

Office-MPO

Workstations

Meeting

Breakout

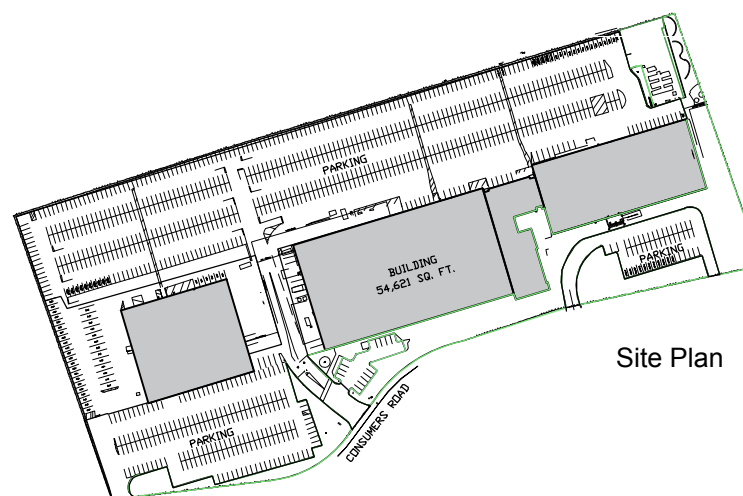
Micro Kitchen

Print Mail

MISC.

Industrial

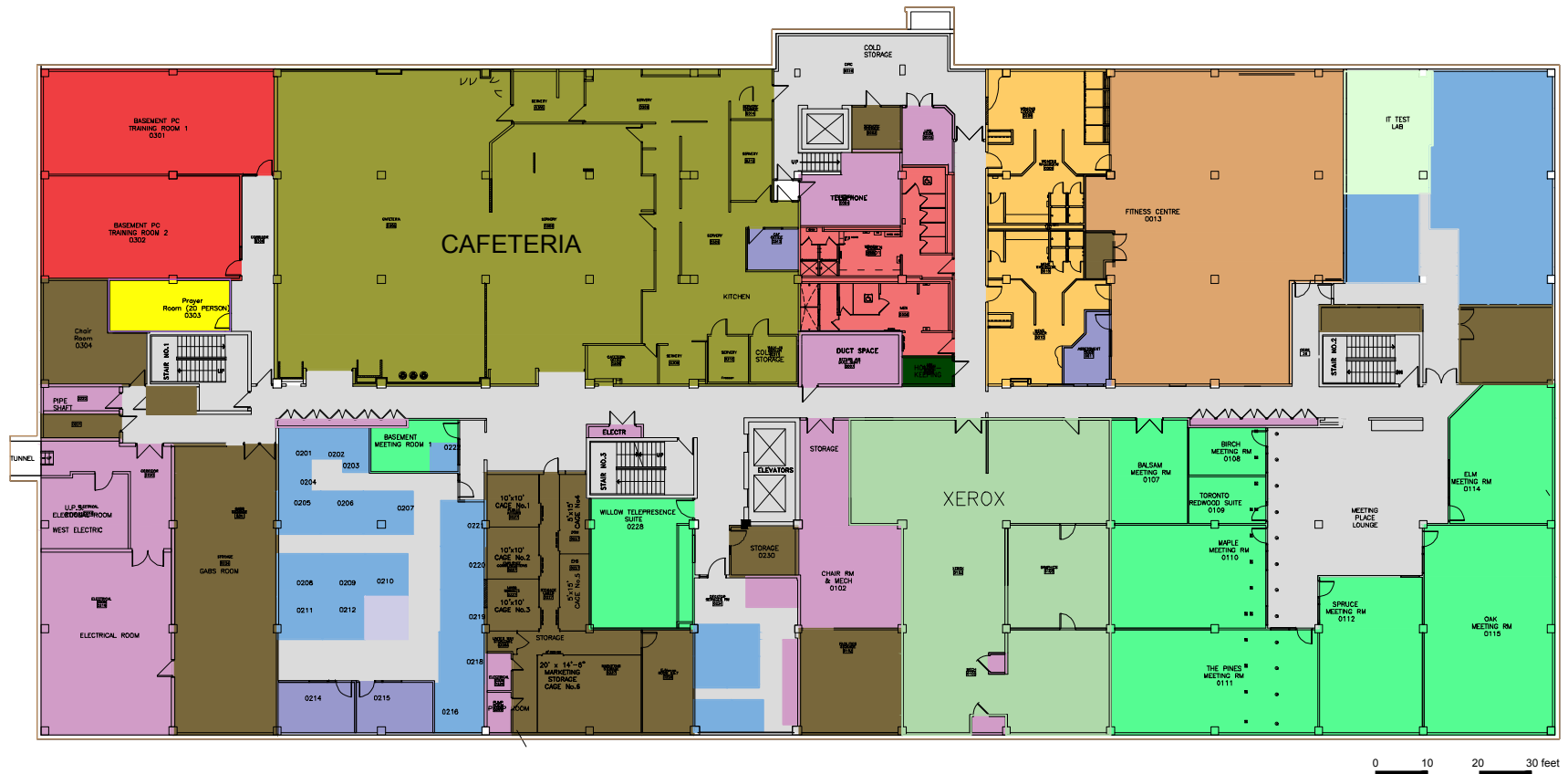
Circulation



Site Plan

Enbridge VPC
500 Consumers Drive, Toronto, ON

2016-0613-05



0 10 20 30 feet

General Building Infrastructure

- Showers-Change
- Office Washrooms
- Janitor
- Cafeteria
- Fitness Room
- Mech-Elec
- Storage-File

Functional Building Area

- Office-MPO
- Workstations
- Meeting
- Hotel Station
- Training
- Print Mail
- Health

IT

MISC.

Circulation

Basement Floor Plan

Enbridge VPC

500 Consumers Drive, Toronto, ON

2016-0613-05

WALTERFEDY



General Building Infrastructure

- Janitor
- Mech-Elec
- Storage-File

Functional Building Area

- Office-MPO
- Workstations
- Meeting
- Breakout
- Micro Kitchen
- MISC.
- Circulation

0 10 20 30 feet

Level 2 Floor Plan

Enbridge VPC
500 Consumers Drive, Toronto, ON

2016-0613-05



0 10 20 30 feet

Level 3 Floor Plan

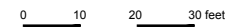
General Building Infrastructure

- Office Washrooms
- Janitor
- Mech-Elec
- Storage-File
- Breakout
- Training
- Print Mail
- Micro Kitchen
- Office-MPO
- Workstations
- Meeting
- MISC.
- Circulation













Enbridge VPC

500 Consumers Drive, Toronto, ON

2016-0613-05



General Building Infrastructure

- Functional Building Area**
- | | |
|--|---|
|  Office Washrooms |  Hotel Station |
|  Mech-Elec |  Micro Kitchen |
|  Storage-File |  Print Mail |
|  Office-MPO |  Storage-Coat |
|  Workstations | MISC. |
|  Meeting |  Circulation |
|  Breakout | |

2016-0613-05



0 10 20 30 feet

Level 5 Floor Plan

General Building Infrastructure

- Office Washrooms
- Mech-Elec
- Storage-File

Functional Building Area

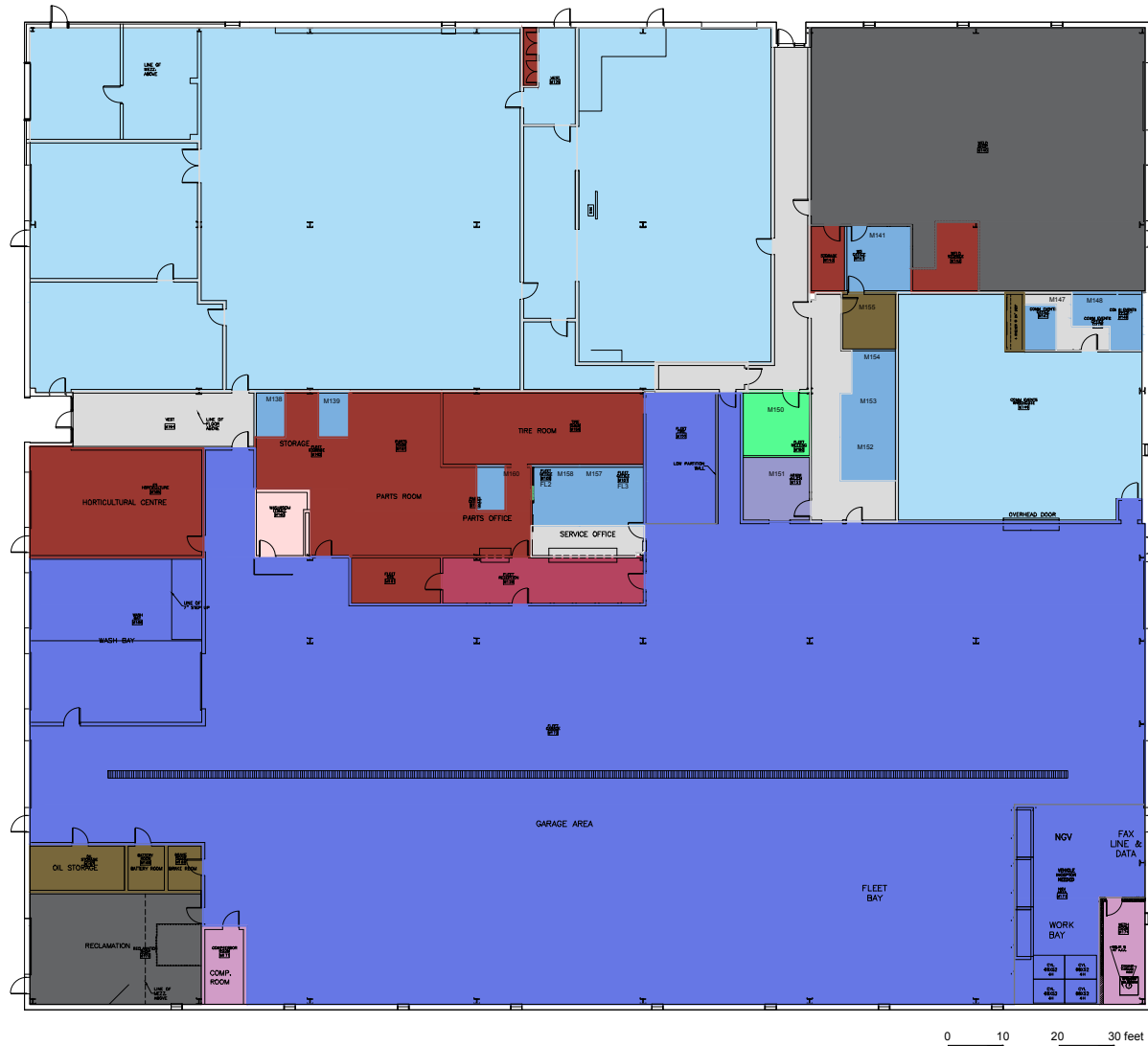
- Office-MPO
- Workstations
- Storage-Coat
- Meeting
- Focus
- Micro Kitchen
- Print Mail
- MISC.
- Circulation

Enbridge VPC

500 Consumers Drive, Toronto, ON

2016-0613-05

WALTERFEDY



General Building Infrastructure

- Security Reception
- Universal Washroom
- Mech-Elec
- Storage-File

Functional Building Area

- Office-MPO
- Workstations
- Meeting
- Storage-Locked
- Wash-Repair Bay
- Warehouse

MISC.

- Industrial
- Circulation

Level 1 Floor Plan

Enbridge MSB
500 Consumers Drive, Toronto, ON

2016-0613-05



- General Building Infrastructure
- Shower-Change
 - Office Washrooms-Janitor-First Aid
 - Cafeteria
 - Storage-File
- Functional Building Area
- Workstations
- MISC.
- Circulation

Level 2 Floor Plan

Enbridge MSB
500 Consumers Drive, Toronto, ON

2016-0613-05



To:	Pat Gribbon	From:	Robin Clysdale
	Enbridge Gas Inc.		Stantec Consulting Ltd.
File:	160951269	Date:	January 31, 2022

Reference: Stress and Vortex Induced Vibration Results from HID21627 Pipe Exposure Engineering Assessment

Enbridge Gas Inc. (EGI) identified an exposed NPS 4 pipeline on a watercourse during the 2021 Watercourse Crossing Management Program (HID 21627). The pipeline was identified as suspended (open spanning) with 8.46m undercut and 11.74m exposed at the time of survey.

STRESS / VORTEX INDUCED VIBRATIONS (VIV) ANALYSIS INPUTS AND ASSUMPTIONS

Stantec evaluated three load conditions associated with a pipeline exposure. The analysis is in accordance with CSA Z662-19 and DNV RP F105 (2006):

1. Combined stress due to operating conditions and bending due to buoyant and hydrodynamic loads. The acceptability criterion is based on CSA Z662-19 4.7.2.1.
2. Potential for fatigue due to vortex induced vibration, based on coincidence between ranges of structural vibrations of the pipe span and response to flow induced vibration.
3. Potential of impact by entrained particles to dent the pipe, based on "Full-scale Impact Tests on Pipelines," Palmer et al., 2006. Velocity of entrained particles are assumed to be low enough that strain rates are not significant and a quasi-static model can be employed with a dynamic load factor of 1.5. The acceptability criterion is based on CSA Z662-19 6.3.3.2, limiting potential indentation depth to less than 2% of the pipe OD.

The input parameters and assumptions for the analysis are summarized in Table 1.

Table 1: Input Parameters for VIV Analysis

Parameter	Symbol	Unit	Value
Pipe Specification			
Pipe OD (steel only)	Ds	m	0.1143
Pipe WT	ts	m	0.00478
Pipe SMYS	Y	MPa	241
Pipe Density	ρ_s	kg/m ³	7850
Pipe Modulus of Elasticity	Es	MPa	207000
Pipe Poisson's Ratio	ν		0.3
Pipe Expansion Coefficient	α_e		0.000012
Pipeline Buoyancy Control			Pipe is not buoyant.
Coating Density	ρ_c	kg/m ³	1300 (Assumed for coal tar/wrap)
Coating Thickness	tc	m	0.004 (Assumed for coal tar/wrap)
Surface Roughness	k	m	0.0033 (Assumed for coal tar/wrap)

January 31, 2022

Pat Gribbon

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Reference: Stress and Vortex Induced Vibration Results from HID21627 Pipe Exposure Engineering Assessment

Parameter	Symbol	Unit	Value
Pipe Condition			Assume nominal with no defects
Wall Thickness Reduction, Based on Flaw Size Mod B31G Burst Pressure			N/A
Service			
MOP	P	kPa	6895
Design Temperature	T1	°C	30 (Assumed)
Restraint Temperature	T2	°C	5 (Assumed)
Product Density	ρ_c	kg/m ³	56 (Assumed based on typical natural gas composition at 15°C and MOP)
Fatigue			
S-N Parameter log a	log a	log (MPa)	11.068 (S-N curve F3 from DNV RP C203 (2016,) table 2-4). See note 1 below.
S-N Parameter m	m		3
Operating Pressure Hoop Stress Cycle		MPa	N/A (only consider fatigue due to VIV)
Operating Pressure Cycles Per Year			N/A (only consider fatigue due to VIV)
Fatigue Life Criteria			One day. See note 1 below
Crossing/Flow Conditions			
Relative Angle (pipe to flow)	θ_{rel}	°	90
Mean Velocity	V	m/s	1.62 to 2.13 (Mean velocities corresponding to return periods from 2 years to 100 years) Additional mean velocities associated with VIV onset
Density of River Water	ρ_w	kg/m ³	1000
Kinematic Viscosity	ν	m ² /s	0.000001
Keulegan Carpenter Number	KC		0 (Assume there is no wave velocity)
Current Flow Ratio	α		1 (Assume there is no wave velocity)
Gap Ratio	e/D		0.80 (Averaged across current undercut span of 8.46m) See note 2 below
Trench Depth Ratio	Δ/D		0 (Assume there are no significant trench effects at exposure)
Span and Soil Boundary Conditions			
Span Length	L	m	8.46 (currently undercut) & 7.3 See note 2 below
Soil Type			Stiff Clay (Assumed)
Soil - Outer Layer Friction Coefficient			0.6 (Assumed)
Soil Stiffness (Static Lateral)	CL	(kN/m)/m	5000 (Assumed.)

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Reference: Stress and Vortex Induced Vibration Results from HID21627 Pipe Exposure Engineering Assessment

Parameter	Symbol	Unit	Value
DNV RP F105 Safety Factors			
Inline Response Onset Safety Factor	γ_{onIL}		1.1
Crossflow Response Onset Safety Factor	γ_{onCF}		1.2
Stability Parameter Safety Factor	γ_k		1.0 (The pipeline is considered to be low safety class per DNV F101)
Natural Frequency Safety Factor	γ_f		1.05 (The pipeline is considered to be low safety class per DNV F101 and the spans “well defined” per DNV F105 in that the current undercut span and gap have been measured.)
Stress Range Safety Factor	γ_s		1.3
Impact			
Entrained Spherical Particle Diameter	d	m	Diameters for return period mean velocities are assessed in the analysis
Specific Gravity of Particle	SG		2.65
Impact Factor	DLF		1.5
Geometry Factor	GF		1.5. See note 3 below
Notes:			
<ol style="list-style-type: none"> 1. Fatigue life considers cycles due to inline and crossflow VIV response. The fatigue life criteria of one day is based on a single event at sustained flow conditions with a given exposed span length. 2. Currently 11.74m is exposed at the top of the pipe, and 8.46m is undercut with average gap ratio of 0.8. The DNV F105 methodology has a number of empirical terms and parameters that are only applicable within certain ranges. With an undercut span of 8.46m, a “stability parameter” is no longer within the applicable range. A span of 7.3m was evaluated as a non-conservative case, though an alternate approach is to numerically model a post-buckling structural response of the pipe. 3. A geometry factor is included in the impact analysis as the methodology is based on experiments with a line load as opposed to a point load. However, the methodology also has other conservative assumptions, with the impact occurring square on the springline of the pipe with no angular momentum. 			

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Reference: Stress and Vortex Induced Vibration Results from HID21627 Pipe Exposure Engineering Assessment

RESULTS

Table 2 presents threshold velocities for the following conditions:

- Onset of inline VIV response (initially at negligible amplitude);
- Inline VIV response with moderate stress amplitudes (approximately 10 MPa);
- Pipe yield stress is exceeded due to combined stress including operating stress (pressure and temperature) quasi-static bending (buoyancy and hydrodynamic drag) and VIV cyclic stress range;
- Onset of cross-flow VIV response (initially at negligible amplitude);
- Cross-flow VIV response with moderate stress amplitudes (approximately 10 MPa).

These results are generated by varying the velocity with other input parameters fixed.

Table 2: Threshold Velocities

Span Length (m)	Threshold Velocities (m/s)				
	Inline VIV onset	Inline VIV (moderate stress amplitude)	Pipe yield stress exceeded	Cross-flow VIV onset	Cross-flow VIV (moderate stress amplitude)
8.46 (current undercut span, out of range of DNV F105 stability parameter)	0.4	0.46	0.91	0.84	0.9
7.3 (non-conservative span that satisfies stability parameter)	0.61	0.67	1.18	1.26	1.34

Table 3 presents combined stress and fatigue life at mean velocities of return period flow conditions.

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Reference: Stress and Vortex Induced Vibration Results from HID21627 Pipe Exposure Engineering Assessment

Table 3: Combined Stress and Fatigue Life at Return Period Velocities

Span Length (m)	Combined Stress and Fatigue Life			
	2-Year (1.62 m/s)	10-Year (1.79 m/s)	20-Year (1.90 m/s)	100-Year (2.13 m/s)
8.46 (current undercut span, out of range of DNV F105 stability parameter)	721 MPa 0 hours (pipe is subject to cross-flow VIV and fatigue life was likely exceeded before these conditions)	Acceptability criteria exceeded with 2-Year return period conditions		
7.3 (non-conservative span that satisfies stability parameter)	444 MPa 0 hours (pipe is subject to cross-flow VIV and fatigue life was likely exceeded before these conditions)			

Table 4 presents threshold span lengths of inline VIV onset and the corresponding combined stress at mean velocities of return period flow conditions. These results are generated by varying the undercut span length with other parameters fixed.

Table 4: Threshold Span Lengths and Combined Stress at Return Period Velocities

Inline VIV Onset Threshold Span Lengths			
2-Year (1.62 m/s)	10-Year (1.79 m/s)	20-Year (1.90 m/s)	100-Year (2.13 m/s)
4.43 m 136 MPa	4.17 m 137 MPa	4.02 m 138 MPa	3.73 m 140 MPa

Incipiently mobile particle sizes that may cause a dent of 2% of pipe OD if fully entrained in the flow were evaluated at return period flow conditions. Sizes ranged between 0.17 m diameter (at 100-Year flow) to 0.20 m diameter (at 2-Year flow.)

Free span deflections of the exposed spans due to distributed loads from buoyancy and hydrodynamic drag are minimal.

DISCUSSION

The undercut span of 8.46m is outside of the range of a stability parameter in the DNV F105 methodology. Rather than numerical modelling the post-buckling structural response of the pipe, a non-conservative shorter span of 7.3m was evaluated. The 7.3m span is subject to cross-flow VIV in the range of velocities evaluated,

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Reference: Stress and Vortex Induced Vibration Results from HID21627 Pipe Exposure Engineering Assessment

with the results indicating cyclic stresses in excess of the assumed pipe SMYS. **Stantec recommends mitigation to stabilize and protect the pipe as well as assessing its condition.**

Other engineering assessments, such as debris and ice loading and brittle fracture and girth weld bending can also affect the integrity of the pipeline. These assessments have not been completed at this time as mitigations are already recommended.

Should you have any questions regarding this memorandum, please contact Robin Clysdale at (403) 471-4459.

Stantec Consulting Ltd.

A handwritten signature in blue ink, appearing to read 'Robin Clysdale', is positioned above the printed name.

Robin Clysdale P.Eng.
Crossing Group Lead

Phone: 403 471 4459
robin.clysdale@stantec.com



**EGI Horner Creek NPS8 Exposure
Assessment**

Draft

November 23, 2021

Prepared for:

Enbridge Gas Inc.
50 Keil Drive North
Chatham, ON N7M 5M1

Prepared by:

Stantec Consulting Ltd.
300W-675 Cochrane Drive
Markham, ON L3R 0B8

Project Number: 160961436

Revision: B

EGI HORNER CREEK NPS8 EXPOSURE ASSESSMENT

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Prepared by _____
(signature)
Shannon Enes, EIT

Reviewed by _____
(signature)
Sheldon Smith, MES, P.Geol.



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APPENDIX C SURVEY

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Abbreviations

amsl	Above mean sea level
DOC	Depth of cover
EGI	Enbridge Gas Inc.
Eqn	equation
HEC-RAS	Hydraulic Engineering Center's River Analysis System
km	kilometre
kN	Kilonewton
L	litre
m	metre
mm	millimetre
MAF	Mean annual flow
MPa	Megapascal
N	Newton
NAPL	National Air Photo Library
NPS	Nominal pipe size
OEB	Ontario Energy Board



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OFAT	Ontario Flow Assessment Tool
Pa	pascal
RGA	Rapid geomorphic assessment
s	second
Stantec	Stantec Consulting Ltd.
VIV	vortex induced vibration
WCMP	Watercourse Crossing Management Program
WSC	Water Survey of Canada
XS	Cross section



EGI HORNER CREEK NPS8 EXPOSURE ASSESSMENT

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1.0 INTRODUCTION

Enbridge Gas Inc. (EGI) identified a pipeline exposure along the NPS8 pipeline in the Township of Blandford-Blenheim, Ontario, on Horner Creek (Figure 3.1) during the 2021 EGI Watercourse Crossing Management Program (WCMP). EGI retained Stantec Consulting Ltd. (Stantec) in 2021 for consulting services to identify the degree of exposure, calculate estimated scour depths, determine the meander belt width, complete vortex induced vibration (VIV) and integrity assessments as required, and recommend temporary mitigation measures as needed.

The pipeline exposure is located approximately 90 m north of Township Road 9 and 356 m west of Oxford Road 22. The pipeline crosses Horner Creek within a meandering reach of the watercourse and was originally installed in 1961. A site visit was conducted on April 20, 2021 during the WCMP to observe site conditions and conduct a depth of cover (DOC) survey.

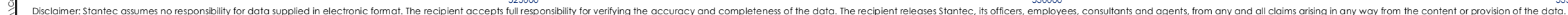
2.0 DESIGN CODES, STANDARDS, AND REGULATIONS

As indicated in CSA Z662-19 Oil & Gas Pipeline Systems, pipelines installed before the implementation of the standard are not subject to the standard from a design and construction perspective. The NPS 8 pipeline crossing Horner Creek is regulated by the Ontario Energy Board (OEB) and predates the implementation of CSA Z662 and the OEB's Guidelines for Hydrocarbon Pipelines in Ontario. Enbridge has internal operation and maintenance guidelines and procedures used to maintain the safety and integrity of its pipeline network.












3.0 FIELD ASSESSMENT

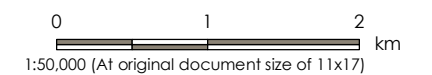
Site reconnaissance was conducted on April 20, 2021 to collect field data including topography, pipeline geometry, and fluvial geomorphology information, included in Appendix A. A photolog of site conditions is presented as Appendix B.





Legend

-
-  Exposure Location
 Expressway / Highway
 Major Road
 Minor Road
 Railway
 Watercourse
 Waterbody
 Wetland - Evaluated (Provincial)
 Wetland - Evaluated (Other)
 Wooded Area
 Municipal Boundary - Lower Tier
 Municipal Boundary - Upper Tier



Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2021.



Project Location
Township of
Blandford-Blenheim

160961436 REVA
Prepared by PRM on 2021-10-19
Technical Review by SE on 2021-10-19

Client/Project
ENBRIDGE GAS INC.
HORNER CREEK NPS 8 EXPOSURE

Figure No.

3.1

Title

Site Location

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3.1 TOPOGRAPHY AND PIPELINE GEOMETRY

The NPS8 pipeline runs north-south across Horner Creek on a slightly oblique angle. The pipeline was observed to be exposed for approximately 6.3 m in length, with 5.5 m suspended a maximum of 0.7 m above ground/channel bed elevation to the bottom of pipe. The exposure is located on the outer bank of a meander bend. The left bank (outer meander bend) was observed to be eroded and unstable with a steep and unvegetated bank face, while the right bank was observed to be undercut in some areas with sand bars both upstream and downstream of the exposure.

Trees have fallen into the watercourse, with a large fallen tree approximately 4 m upstream of the exposure extending over half the watercourse width of 16.5 m, and another 12 m downstream extending over the entire watercourse width and creating debris blockage and an elevated channel bed. The thalweg is located in line with channel morphology closer to the left bank toe toward the outside of the meander bend indicating the channel appears in phase.

Three channel cross-sections were completed: at the pipeline exposure, approximately 21 m upstream of the exposure, and 38 m downstream of the exposure. Ground elevation ranges from a bankfull height of 298.9 m amsl, to 295.9 m amsl at the thalweg (3 m bank height). The channel slope from the survey was found to be 0.69%. The results of the survey are presented in Appendix C.

3.2 SOILS AND SEDIMENT

The banks were found to be a mixture of cohesive and non-cohesive sediments and predominantly sand. The channel bed was also predominantly sand in a dune formation, with a sand bar observed on the right bank approximately 4 m upstream of the pipeline crossing, opposite to a fallen tree. The D_{50} was assumed to be 0.062 mm based on the fine sand particle size.

Surficial geology mapping from the Ontario Geological Survey (1983) Map 2599 Quaternary Geology of Southern Ontario indicates that the site is located within an area of modern alluvial deposits, consisting of clay, silt, sand, gravel, and some organic deposits.

Minimal surface protection was provided on either channel bank (20% on left bank, 30% on right bank) due to erosive nature of the watercourse creating the steep left bank face and sparsely vegetated right bank face.

3.3 HYDROLOGY AND FLUVIAL GEOMORPHOLOGY

At the time of assessment, the depth of water was 0.9 m from thalweg to surface elevation. Evidence of high flows were observed near debris on the right bank and elevated at the top of the woody debris within the channel.

A Rapid Geomorphic Assessment (RGA) of the site indicated that the channel is in a transitional state, with the dominant channel process being channel widening. Normal point bar development was observed on the right bank, while natural pool scour was observed towards the left bank and thalweg. Multiple observed features provided evidence of channel widening, including fallen/leaning trees, exposed tree



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roots, basal scour on inside of the meander bend, and exposure of the previously buried pipeline. However, Horner Creek has been anthropogenically realigned within the exposure reach, affecting the natural channel geomorphology. The occurrence of large organic debris, such as the large trees fallen into the watercourse both upstream and downstream of the exposure provides additional evidence of channel widening, consequently resulting in local scour and channel degradation. The transitional stability index calculated using observations in the anthropogenically realigned watercourse, identifies that the stream morphology of this reach of Horner Creek is transitioning from a disturbed state to a new equilibrium state.

The existing channel form, profile, material characteristics and morphology of Horner Creek were assessed against the Rosgen stream classification system for natural watercourses (Rosgen, 1994). However, as the channel has been realigned, the classification for both the natural and realigned channel were completed for comparison. Classifying the stream type helps to better understand the existing fluvial processes as well as stream behavior and function.

For the existing realigned channel, based on the entrenchment ratio, width/depth ratio, sinuosity, slope, and channel material, the creek would be characterized as Rosgen type A5. The entrenchment ratio is a function of the total width of the flood prone area available to the river compared to the bankfull width. As Horner Creek has a flood prone width similar to the bankfull width due to the tall banks, the watercourse is considered to be entrenched (1.3). The watercourse currently has a low width to depth ratio (6.9) and low sinuosity (1.1) due to the realignment that straightened the watercourse morphology. However, the existing slope of 0.0069 (0.69%) does not match the slope ranges for a type A watercourse due to the realigned (unnatural) nature of the watercourse reducing expected slope for a low sinuosity watercourse, and is assumed otherwise meet the criteria for type A stream. The classification of 5 is identified based on the dominant bed material of sand.

In comparison, the natural channel would be characterized as Rosgen type G5. The entrenchment ratio, width to depth ratio, stream slope, and channel material is assumed to remain the same as existing (realigned) conditions, with a change in the sinuosity of the watercourse. The sinuosity would be considered moderate (1.7), changing the stream type from an A to a G.

4.0 DESKTOP ANALYSIS

4.1 HYDROLOGY

At the area of exposure, Horner Creek is a 4th order watercourse which drains into Whitemans Creek and eventually into the Grand River. The exposure is located within agricultural land, with a catchment area at the crossing of approximately 88.8 km². The land use in the catchment area is predominantly agricultural and undifferentiated rural land use (89.5%).



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The design discharge and slope was obtained from the Ontario Flow Assessment Tool Version 3 (OFAT) (MNRF, 2015). OFAT is an online spatially based application generating watershed areas and stream flow statistics (mean annual flow, low flow, and peak flow) of a watercourse at a location of interest within Ontario. The estimated flow conditions for each return period at the watercourse crossings are based on the regression relationship between peak flow and drainage area using the Index Flood with Expected Probability Adjustment method (Moin & Shaw, 1985).

Table 4.1 Horner Creek Channel Flows (OFAT)

Return Period	Flow
	m ³ /s
Mean annual flow (MAF)	1.01
2-Year	31.0
5-Year	40.9
10-Year	48.6
20-Year	58.4
50-Year	70.3
100-Year	81.7

4.2 HYDRAULIC CONDITIONS

The hydraulic conditions (flow velocity, flow depth, wetted width) was modelled using the Hydraulic Engineering Center's River Analysis System (HEC-RAS) version 5 hydraulics modeling software (US Army Corps of Engineers, 2016). HEC-RAS performs hydraulic calculations for a variety of hydraulic element types, from pipes and open channels to inlets and weirs. The surveyed watercourse cross-section was used to set up the hydraulic model at each crossing along with watercourse and floodplain roughness values. The channel and floodplain roughness values were estimated based on the site visit performed by Stantec staff and corresponding with Manning's n for Channels (Chow, 1959).

In this report, the hydraulic model was simulated using the 1:2-year flow, 1:5-year flow, 1:10-year flow, 1:20-year flow, 1:50-year flow, and 1:100-year flow from OFAT. HEC-RAS solves water depth and velocity at each crossing location using the Manning's formula. The Manning's formula is developed under assumptions of uniform flow conditions and the slopes of the channel bed, energy grade line, and water surface being the same.

The normal depth, wetted width, and velocities from the HEC-RAS model results are presented in Table 4.2 below.



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Table 4.2 HEC-RAS Output

Return Period	Design Hydraulics		
	Water Depth	Wetted Width	Channel Velocity
	m	m	m/s
MAF	0.43	7.89	0.68
2-Year	1.67	11.53	2.23
5-Year	1.91	11.88	2.44
10-Year	2.09	12.14	2.59
20-Year	2.30	12.61	2.77
50-Year	2.53	13.17	2.99
100-Year	2.73	13.60	3.17

4.3 SCOUR POTENTIAL

Empirically derived approaches were used to assess scour in cases of cohesive and non-cohesive sediments. Empirical equations provided by Lacey (1931) and Blench (1970) were used to predict scour (vertical channel movement) for non-cohesive sediments. The maximum depth of channel scour during a flood is a function of channel geometry, obstruction created by a structure (if any), the velocity and shear stress of the flow, turbulence and size of bed material. The following equation by Lacey and Blench was used to predict general scour depth:

$$Z_t = K Q_d^a W_f^b D_{50}^c \quad \text{Eqn 1}$$

Where:

- Z_t = maximum scour depth (m)
- K = Coefficient (Table 4.3)
- Q_d = design discharge (m^3/s)
- W_f = flow width at design discharge (m)
- D_{50} = median size of bed material (mm)
- a, b, c = exponents (Table 4.3)

Table 4.3 Constants for Lacey and Blench Relations

Condition	Lacey				Blench			
	K	a	b	c	K	a	b	c
Straight reach	0.030	1/3	0	-1/6	0.162	2/3	-2/3	-0.1092
Moderate bend	0.059	1/3	0	-1/6	0.162	2/3	-2/3	-0.1092
Severe bend	0.089	1/3	0	-1/6	0.162	2/3	-2/3	-0.1092
Right angle bend	0.119	1/3	0	-1/6	0.337	2/3	-2/3	-0.1092
Vertical rock wall	0.148	1/3	0	-1/6	-	-	-	-



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The modelled area was considered to be located on a moderate bend. The maximum scour depth from the two methods (Lacey and Blench) informed a recommendation for the depth of cover at the watercourse crossings.

The design scour depths are presented in Table 4.4.

Table 4.4 Scour Analysis

Return Period	Hydrology	Scour Depth		Design Scour Depth
	Flow	Lacey	Blench	
	m ³ /s	m	m	
MAF	1.01	0.094	0.053	0.094
2-Year	31.00	0.294	0.358	0.358
5-Year	40.90	0.323	0.418	0.418
10-Year	48.60	0.342	0.459	0.459
20-Year	58.40	0.363	0.503	0.503
50-Year	70.30	0.387	0.549	0.549
100-Year	81.70	0.406	0.591	0.591

Due to the fine sand predominant throughout the channel bed, scour is expected to range from 0.09 m during the MAF up to 0.59 m during the 100-year return period. The design scour depths indicate that the pipeline is expected to become increasingly exposed with a potential for the spanning length of pipeline to increase.

4.4 HYDRAULIC LOADS

Hydraulic loads were estimated based on the pressure acting on the free spanning and exposed pipeline, perpendicular to flow, as a function of area of pipeline suspended below the water line and water velocity. Stream flow, ice pressure, and woody debris loads were estimated using methods found in the Manual for Railway Engineering (AREMA 2015) and standards of the American Association of State Highway and Transportation (AASHTO 2005).

4.4.1 Stream Flow Pressure

Stream currents produce forces acting on structures located in moving water. These forces produce pressure against the submerged structure and are computed as a function of stream velocity (Equation 2). The stream flow pressure computed by Equation 2 is applied to the area of the pipeline exposed to flow to obtain the resulting force. Although stream velocity varies with depth, a constant velocity for the full depth provides sufficiently accurate results (AASHTO 2005).



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The average pressure and force are estimated using equation 2, 3, with both multiplied by 2 to obtain the maximum pressure and force.

$$P_d = \frac{1}{2} \rho V^2 \quad \text{Eqn 2}$$

$$F = P_d A \quad \text{Eqn 3}$$

Where:

- P_d = dynamic pressure of stream flow (Pa)
- ρ = density of water (1,000 kg/m³)
- V = average water velocity (m/s)
- F = Force acting directly on pipeline (N)
- A = area of pipeline (m²)

The maximum stream flow pressure was calculated to be 10.05 kN/m² while the maximum force resulting from the pressure was calculated to be 3.77 kN.

4.4.2 Ice Pressure Forces

Factors affecting horizontal dynamic ice force include the thickness of ice in contact with the pipeline (assumed to be 100 mm), the width of the pipeline, and the ice pressure. Dynamic force of floating ice sheets and floes striking the structure was calculated using Equation 4 and 5.

$$C_a = \left(\frac{5t}{w} + 1 \right)^{0.5} \quad \text{Eqn 4}$$

$$F_c = C_a p t w \quad \text{Eqn 5}$$

Where:

- C_a = coefficient for effect of the pipeline width to ice thickness ratio where the floe fails by crushing
- t = thickness of ice in contact with structure (assumed to be 100 mm)
- w = width of pipeline at level of ice action (mm)
- F_c = Horizontal ice force on pipeline (kN)
- p = ice pressure based on assumption ice break up occurs at melting temperature, but the ice moves in large pieces and is internally sound (assumed to be 1.4 MPa)

The ice pressure force was calculated to be 383.4 kN. The ice loading assessment was based on ice force calculations applied to riverine bridge piers and represents crushing, rafting and jamming forces. The assessment is necessarily based on conservative assumptions and extreme design ice load conditions and as a result the estimated load forces are much higher than hydraulic forces alone.



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4.4.3 Debris Forces

Woody debris forces were determined based on calculations consistent with the US Federal Highway Administration Department of Transportation (2005) for superstructures. Factors influencing the debris forces include the water surface elevations, assumed debris accumulation, and the 100-year flow. The design blockage was assumed to be 1.0 m deep, with a subsequent 0.5 m change in surface water elevation due to the blockage. The hydrostatic force was calculated using Equation 6, while the drag force was calculated using Equation 7. The total debris force is equal to the drag force and hydrostatic force.

$$F_h = (\gamma h_{cu} A_{hu}) - (\gamma h_{cd} A_{hd}) \quad \text{Eqn 6}$$

$$F_D = C_D \gamma A_D \frac{V_r^2}{2g} \quad \text{Eqn 7}$$

Where:

F_h	=	hydrostatic force on superstructure (pipeline) accumulation (N)
γ	=	specific weight of water (N/m ³)
h_{cu}	=	vertical distance from upstream water surface to centroid of area (m)
A_{hu}	=	area of submerged portion of debris accumulation below upstream water surface (m ²)
h_{cd}	=	vertical distance from downstream water surface to centroid of area (m)
A_{hd}	=	area of submerged portion of debris accumulation below downstream water surface (m ²)
F_D	=	drag force (N)
C_D	=	drag coefficient
A_D	=	area of wetted debris based on upstream water surface elevation (m ²)
V_r	=	reference velocity (m/s)
g	=	acceleration of gravity (9.81 m/s ²)

The resulting hydrostatic force was found to be 1.47 kN, while the drag force was 3.01 kN, for a total debris force of 4.48 kN.

4.5 MEANDER BELT ANALYSIS

A meander belt width analysis is an effective tool in examining how a semi-confined or unconfined channel has changed its planform in the floodplain through time, and in predicting potential future changes through anticipated erosion and deposition of sediments. To establish a protocol for a consistent approach to meander belt width evaluations, PARISH Geomorphics Ltd. (2004) developed Belt Width Delineation Procedures. The report provided detailed procedures for undertaking a meander belt width evaluation under various hydrologic and morphologic scenarios and was used as guidance for this assessment.

The meander belt width analysis was completed using historical aerial photos to assess whether the alignment of each watercourse has shifted over time. Air photos were obtained from the archives of the National Air Photo Library (NAPL) in Ottawa for the years 1946, 1964, 1971, and 1989 and from First Base Solutions (2019) for the years 2006, 2010, and 2020, covering a total period of 75 years. The



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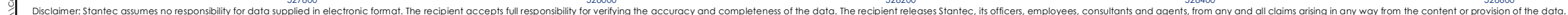
alignment of the watercourses for each photo year were referenced using common identifiable features and are superimposed on the 2020 aerial photo, as shown in Figure 4.1.

An observation made during the meander belt analysis looking at the progression of the site over the years shows anthropogenic straightening/realignment of the watercourse between 1971 and 1989. The installation of the pipeline in 1961 was prior to the channel realignment. The channel realignment shifted the channel at the pipeline crossing one bankfull width north (approximately 12 m), presumably exposing the previously buried pipeline. The realignment increased the length of the channel reach at the pipeline crossing and created a meander bend.

The meander belt width and historical movement of each watercourse was approximated by delineating the watercourse's alignment from the historical air photos and comparing its location over the intervening periods. The belt width analysis was then undertaken by drawing tangential lines following the outer meanders. The meander belt width could then be defined as the distance between two tangential lines at any point. The maximum meander belt width could also be estimated as the maximum distance between the two tangential lines across the entire reach of concern. Only years in which the channel was natural (i.e., prior to realignment) are considered during the meander belt width assessment. As Horner Creek was realigned between 1971 and 1989, the years 1946, 1964, and 1971 were included in the assessment. Therefore, the meander belt width is estimated to be 117.5 m.

The radius of curvature for Horner Creek was assessed by drawing a circle within the meander bends of natural sections of the creek within the study area for each year. The years 1946, 1964, and 1971 were included in the analysis as they occurred prior to channel realignment. The minimum, maximum and average radii of curvature was measured to be 7.2 m, 21.5 m, and 49.3 m, respectively.





Meander Belt Analysis

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5.0 INTEGRITY ASSESSMENT

5.1 VORTEX INDUCED VIBRATION

A VIV assessment was completed to evaluate three load conditions associated with a pipeline exposure in accordance with CSA Z662-19 and DNV RP F105 (2006). The results of the VIV assessment are included in Appendix D and are summarized below.

The results of the assessment showed that at the existing span length of 5.5 m, the inline VIV onset would be at a velocity between the 5-year and 10-year flood flow return period and the combined stresses would exceed yield at mean velocities between the 10-year and 20-year return periods. The combined stress and fatigue life at the 5-year flood flow return period for a 5.5 m span length with a 5-year velocity of 2.44 m/s was 249 MPa, the 10-year flood flow return period with a velocity of 2.59 m/s was 273 MPa, and the 20-year flood flow return period with a velocity of 2.77 m/s was 321 MPa. Future erosion and scour that could extend the span length in the future would result in an exceedance of the acceptable stress and fatigue life at a velocity less than the 5-year flood flow return period.

Therefore, given VIV onset with velocities between the 5-year and 10-year return periods, it is recommended that temporary mitigation measures be implemented to protect and stabilize the pipe while long-term solutions are determined.

5.2 STRESS, STRAIN, BRITTLE FRACTURE, AND GIRTH WELD SUSCEPTIBILITY

Additional integrity assessments were not completed for Horner Creek as the VIV assessment indicated that the pipeline is susceptible to failure as indicated in Section 5.1 without considering other integrity factors.

6.0 RECOMMENDATIONS

Based on the review of historical air photos, the Horner Creek channel was substantially realigned between 1964 and 1989, after pipeline installation in 1961. It appears that the original pipeline watercourse crossing was approximately one bankfull width (approximately 12 m) further to the south and that the realigned creek was originally in the footprint of the northern bank of the watercourse. Based on the geometry of pipeline slope between the existing crossing and the original crossing, it is estimated that the pipe elevation would have been up to 1.5 m lower at the original channel crossing. As such had the channel realignment maintained the channel in its original location and morphology at the pipeline crossing, the pipeline might not be currently exposed or free-spanning. The watercourse realignment is considered to be the main causal factor in the depth of cover issue.



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Possible temporary mitigation measures include:

- The addition of meter bags, sand bags, and articulated concrete matting to create a groin (bank protection structure in the form of an protrusion) to redirect water around the pipeline, prevent additional scour, and prevent pipeline strike (Figure 6.1 and Figure 6.2). Meter bags would be filled on-site or brought in pre-filled up to the pipeline elevation (maximum elevation of 0.7 m from ground elevation to invert elevation of pipeline) to support the suspended line and form the temporary groin. Sandbags would be placed on top of the meter bags with a geomembrane rock shield overlaying the sandbags to protect the pipeline from abrasion. Articulated concrete matting would be placed on top of the groin structure and anchored around it. Riverstone would be placed across the southern half of the watercourse to reduce scour from the diverted watercourse.
- Alternatively, a temporary sub-angular riverstone groin could be used. The pipeline would be protected with a bedding layer wrapped in geotextile to prevent direct contact with the riverstone. The riverstone groin would follow the same length, width, and elevation as the meter bag, sand bag, and articulated concrete mat option.

We understand the next step would be to determine and design temporary mitigation and subsequently develop a final (permanent) remedial solution.



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Figure 6.1 Meter Bag and Articulated Concrete Matting Temporary Mitigation Profile View

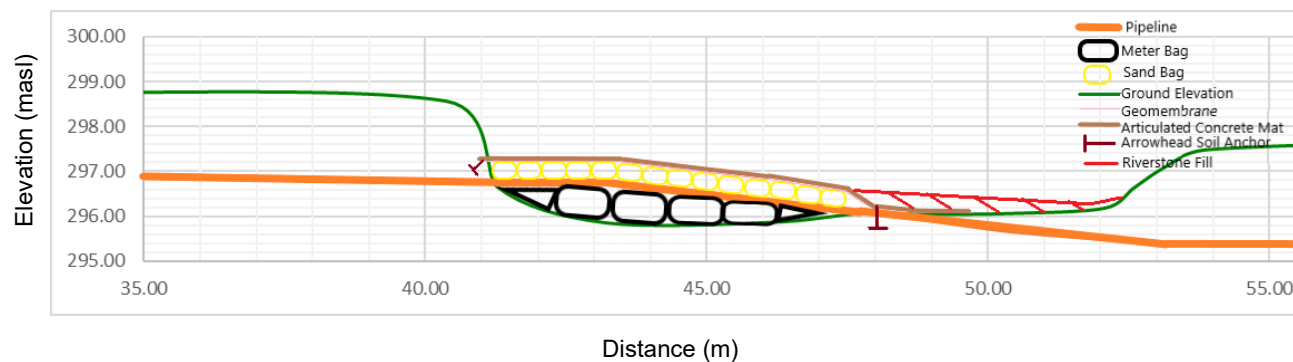
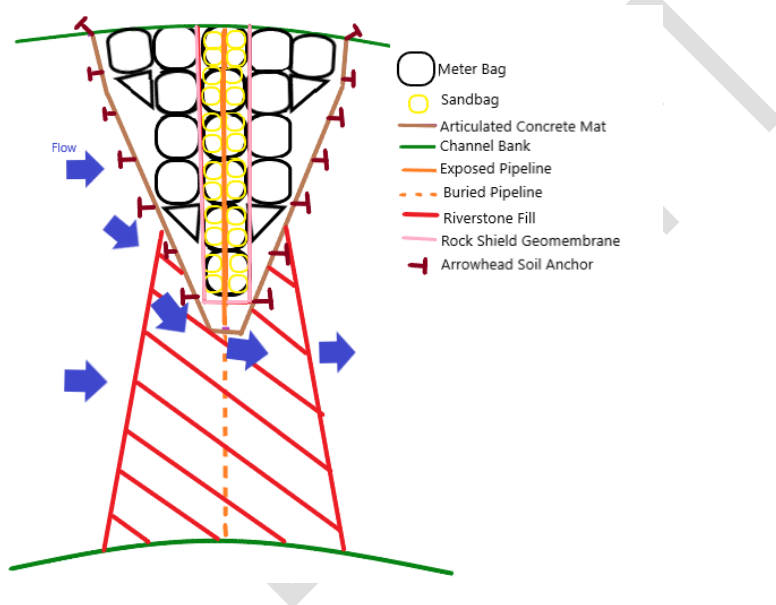


Figure 6.2 Meter Bag and Articulated Concrete Matting Temporary Mitigation Plan View



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7.0 SUMMARY AND CONCLUSION

EGI identified a pipeline exposure along its NPS8 pipeline along Horner Creek in the Township of Blandford-Blenheim, Ontario during the 2021 WCMP. The pipeline at the time of assessment was found to be exposed for approximately 6.3 m, with the pipeline elevated above ground level (spanning) for approximately 5.5 m.

The scour analysis determined that scour depth is expected to range from 0.09 m during the MAF up to 0.59 m during the 100-year return period, increasing the length of pipeline exposed and suspended. The historical air photo assessment identified that the channel morphology has changed since the pipeline installation in 1961, with anthropogenic realignment reduced the sinuosity of the watercourse between 1971 and 1989. The channel realignment appears to have exposed the previously buried pipeline and created a meander bend at the exposure location.

Temporary mitigation is recommended with either direct exposure cover protection through the creation of a groin with a combination of meter bags, articulated concrete matting, and riverstone, or through a blanket of riverstone. Temporary mitigation is recommended to protect the pipeline in the near term until a long-term pipeline re-routing solution is determined.



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8.0 REFERENCES

- AASHTO (2005) American Association of State Highway and Transportation, Highway Bridges, Article 3.18.1.
- AREMA (2015) Manual for American Railway Engineering. Online:
<https://www.arena.org/publications/index.aspx>
- ASTM Standard D2573 / D2573M – 18 (2018). ASTM: Standard Test Method for Field Vane Shear Test in Saturated Fine-Grained Soils.
- Blench, T. 1970. Regime Theory Design of Canals with Sand Beds. Journal of the Irrigation and Drainage Division. American Society of Civil Engineering, 96 IR2. Proc. Paper No. 7381.
- Canadian Standard Association. 2016. Z662-15 Oil and Gas Pipeline Systems, 6th Edition
- Hanson, G. J. & Simon, A. 2001. Erodibility of cohesive streambeds in the loess area of the midwestern USA. Hydrological Processes, 15:23-28.
- Kimiaghalam, N., Clark, P., and Ahmari, H. 2015. A comprehensive fluvial geomorphology study of riverbank erosion on the Red River in Winnipeg, Manitoba, Canada. Journal of Hydrology, 529(P3): 1488-1498.
- Kimiaghalam, N., Clark, P., and Ahmari, H. 2016. An experimental study on the effects of physical, mechanical, and electrochemical properties of natural cohesive soils on critical shear stress and erosion rate. International Journal of Sediment Research, 31(1): 1-15.
- Lacey, G. 1931. Regime Diagrams for the Design of Canals and Distributaries. Tech. Paper No.1 United Provinces, Public Works Department, Irrigation Branch.
- Leonard, L. & Richard, G. 2004. Estimation of runoff critical shear stress for soil erosion from soil shear strength. Catena, 57, 233–249.
- Maa, J. P. Y., Sanford, L., & Halka, J. P. (1998). Sediment resuspension characteristics in Baltimore Harbor, Maryland. Marine Geology, 146:137-145.
- Ministry of Natural Resources and Forestry (MNRF). 2015. Ontario Flow Assessment Tool Version 3 (OFAT).
- Moin, S. and M. Shaw. 1985. Canada/Ontario Flood Damage Reduction Program - Regional Flood Frequency Analysis for Ontario Streams. Vols. 1, 2 and 3. Environment Canada.
- Parish Geomorphic Ltd. 2004. Belt Width Delineation Procedures. Prepared for Toronto and Region Conservation Authority.
- Partheniades, E. 1965. Erosion and deposition of cohesive soils. Journal of Hydraulics Engineering, ASCE, 91(1), 105-138.



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Rosgen, D. 1995. A classification of natural rivers. *Catena*, 22(3), 169-199.

Simon, A. N., N. Pollen-Bankhead, and R. E. Thomas, 2011. Development and Application of Deterministic Bank Stability and Toe Erosion Model for Stream Restoration. In *Stream Restoration in Dynamic Fluvial Systems: Scientific Approaches, Analysis, and Tools*. Geophysical Monograph Series, Volume 194, Pages 453-474.

US Army Corps of Engineers. 2016. HEC-RAS River Analysis System Version 5.0 (HEC-RAS).

Federal Highway Administration Department of Transportation (FHWA). 2005. Debris Control Structures Evaluation and Countermeasures; Hydraulic Engineering Circular 9. Third Edition.

Wentworth, C. K. 1922. "A Scale of Grade and Class Terms for Clastic Sediments". *The Journal of Geology*, vol. 30, no. 5, pp. 377-392.

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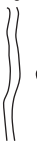






EGI HORNER CREEK NPS8 EXPOSURE ASSESSMENT








APPENDIX A
Field Notes

DRAFT



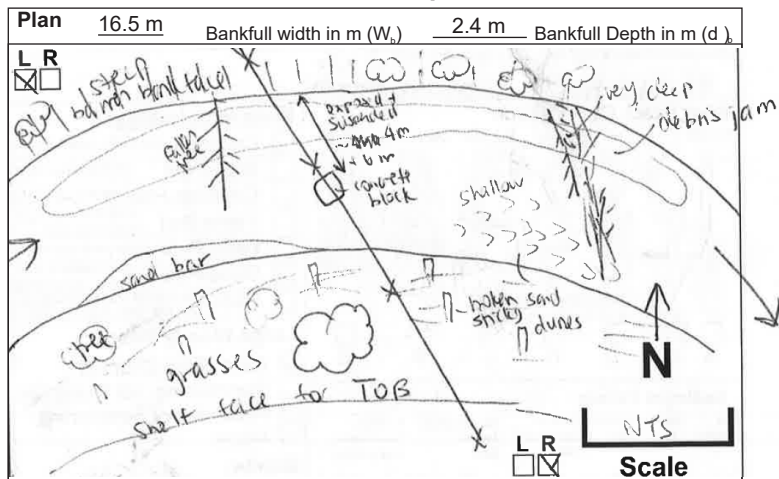
Reach #	Station # Hornor Creek	Date 04 / 08 / 2021	Mapper S. Enes	Elev (m.a.s.l.)
GPS Location (Indicate Lat/Long or UTM and Datum used) g) Lat/long: 43.24745048°, -80.65308444°				

<p>River Reach Channel Form</p> <div style="display: flex; justify-content: space-around; text-align: center;"> <div> <p>Straight</p>  <p><input type="checkbox"/> A</p> </div> <div> <p>Irregular</p>  <p><input checked="" type="checkbox"/> B</p> </div> <div> <p>Regular</p>  <p><input type="checkbox"/> C</p> </div> <div> <p>Tortuous</p>  <p><input type="checkbox"/> D</p> </div> <div> <p>Anastomosing</p>  <p><input type="checkbox"/> E</p> </div> <div> <p>Braided</p>  <p><input type="checkbox"/> F</p> </div> <div> <p>Meandering (main channel, anabranching not shown)</p>  <p><input type="checkbox"/> G</p> </div> </div>	<p>Field Morphology:</p> <p><input type="checkbox"/> Cascade (no pools - turbulent flow)</p> <p><input type="checkbox"/> Step-Pool (vertical steps req'd)</p> <p><input type="checkbox"/> Cascade-Pool (high D_{90}/d, pools)</p> <p><input type="checkbox"/> Plane-Bed (high W/d, mod D_{90}/d featureless bed)</p> <p><input type="checkbox"/> Riffle-Pool (bars, pools and riffles)</p> <p><input checked="" type="checkbox"/> Dune-Ripple (bed mobile at most stages, dune-forms)</p> <p><input type="checkbox"/> Run (trapezoidal shape, featureless bed, high d/W, weak thalweg)</p>
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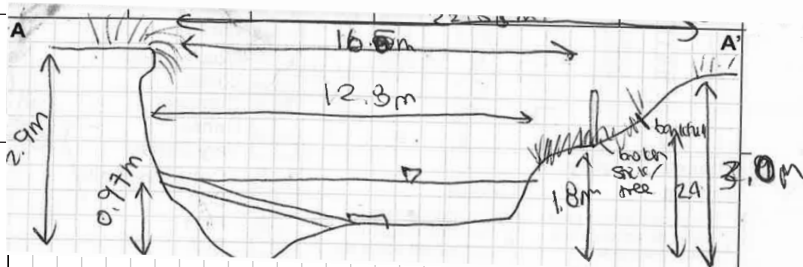
<p>Sediment Pattern</p> <div style="display: flex; justify-content: space-around; text-align: center;"> <div> <p>Not Evident</p>  <p><input type="checkbox"/> 1</p> </div> <div> <p>Stone Lines</p>  <p><input type="checkbox"/> 2</p> </div> <div> <p>Lateral Bars</p>  <p><input checked="" type="checkbox"/> 3</p> </div> <div> <p>Lateral and Medial Bars</p>  <p><input type="checkbox"/> 4</p> </div> <div> <p>Overlapping Medial Bars</p>  <p><input type="checkbox"/> 5</p> </div> <div> <p>Severely Overlapping Medial Bars</p>  <p><input type="checkbox"/> 6</p> </div> <div> <p>Severely Overlapping Medial Bars</p>  <p><input type="checkbox"/> 7</p> </div> </div>	<p>Large Woody Debris:</p> <p><input checked="" type="checkbox"/> Controlling Channel</p> <p><input type="checkbox"/> Functioning, not Dominant</p> <p><input type="checkbox"/> Present, not Functioning</p> <p><input type="checkbox"/> None</p> <p>Banks:</p> <p>L R Bedrock</p> <p><input type="checkbox"/> Weak</p> <p><input checked="" type="checkbox"/> Strong</p> <p>L R Coarse Soils</p> <p><input type="checkbox"/> Loose</p> <p><input checked="" type="checkbox"/> Compact</p> <p><input type="checkbox"/> Dense</p> <p><input type="checkbox"/> Very Dense</p> <p>L R Cohesive Soils</p> <p><input type="checkbox"/> Soft</p> <p><input checked="" type="checkbox"/> Firm</p> <p><input type="checkbox"/> Stiff</p> <p><input type="checkbox"/> Hard</p> <p>L R Vegetation</p> <p><input type="checkbox"/> Trees</p> <p><input checked="" type="checkbox"/> Shrub or Grass</p> <p><input type="checkbox"/> Not vegetated</p> <p>L R Landslides</p> <p><input type="checkbox"/> > 10 m slope length</p> <p><input checked="" type="checkbox"/> Banks in ROW</p> <p><input checked="" type="checkbox"/> Banks upstream</p> <p><input checked="" type="checkbox"/> Banks downstream</p> <p>Y N</p> <p><input checked="" type="checkbox"/> Exposed Pipeline</p> <p><input checked="" type="checkbox"/> Full Survey?</p>
---	---

<p>Channel Stability:</p> <p>Vertical</p> <p><input type="checkbox"/> I Physical Controls (weir, basal till, concrete bed etc...) limiting scour.</p> <p><input type="checkbox"/> II Vertically Stable (material transported through at replacement values) over period of interest.</p> <p><input checked="" type="checkbox"/> III Slow Incision (<20cm/yr) or sustained bed scour.</p> <p><input type="checkbox"/> IV Rapid Incision (>20cm/yr) or severe sustained aggradation likely result in avulsion. Knickpoints and disturbed banks common.</p> <p><input type="checkbox"/> V Severe Channel Erosion (>1m/yr) or imminent avulsion</p> <p>Lateral</p> <p><input type="checkbox"/> A Physical Controls (bedrock, mitigation works, hard points etc...) limiting lateral erosion.</p> <p><input type="checkbox"/> B Lateral erosion not evident or not significant over period of interest</p> <p><input type="checkbox"/> C Slow Lateral Erosion (<20cm/yr).</p> <p><input checked="" type="checkbox"/> D Rapid Lateral Erosion (>20cm/yr) or potential for bank failures to expose 0.2 - 1.0 m in a given year.</p> <p><input type="checkbox"/> E Pervasive Lateral Erosion with the potential to expose or erode >1m of new bank at the crossing in a given year.</p>	<p>Definitions</p> <p>Loose: Easily penetrated with rebar pushed by hand, easily excavated with shovel</p> <p>Compact: Easily penetrated with rebar driven by 5 lb. hammer. Hard to excavate with shovel.</p> <p>Dense: Penetrated 1 ft. with driven rebar, must be loosened with pick to excavate.</p> <p>Very Dense: Penetrated only a few inches with driven rebar, hard to excavate with pick</p> <p>Soft: Easily penetrated several cm with thumb</p> <p>Firm: Can be penetrated several cm with thumb with effort</p> <p>Stiff: Indented with thumb, but only penetrated with great effort</p> <p>Hard: Indented with difficulty by thumbnail.</p>
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Stantec Fluvial Geomorph



X-Section (Facing Downstream) Sketch ☐ Survey ☒ Minimum DOC EXPOSED



Profile

Mean gradient in % (s) _____

If stream crossed by a bridge, draw bridge on X-section, measure geometry of opening and deck thickness

Water Crossing Hazards

Bank Erosion	Lateral Migration or Encroachment	Bed Scour
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Channel Degradation	Avulsion	Mitigation Failure
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Bank Characteristics

Left	Right
<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>

Distance undercut (cm) Left bank _____

Right bank _____

Beaver Dam:

Condition

☐ Stable / Maintained

☐ Poor / Failing

☐ Relic / Abandoned





☒ None

Distance to Crossing

Upstream _____ m

Downstream _____ m

Drop Height _____ m

Reach #	Station #	Date	Mapper																					
	Horner Creek	04 08 2021	S. Enes																					
Y N (Please add comments as appropriate) <input type="checkbox"/> <input checked="" type="checkbox"/> Pipeline signs are present and in good condition <input checked="" type="checkbox"/> <input type="checkbox"/> I have taken <i>minimum</i> 4 photos (upstream, downstream, left bank and right bank) <input type="checkbox"/> <input checked="" type="checkbox"/> Landslide assessment completed?		Bank Erosion Hazard Index: <table border="1"> <thead> <tr> <th>L</th> <th>R</th> <th></th> </tr> </thead> <tbody> <tr> <td>A) 2.9</td> <td>3.0</td> <td>Bank Height (top of bank) (m)</td> </tr> <tr> <td>B) 2.4</td> <td>2.4</td> <td>Bankfull Height (m)</td> </tr> <tr> <td>C) 70</td> <td>35</td> <td>Bank Angle</td> </tr> <tr> <td>D) -</td> <td>-</td> <td>Root Depth (m)</td> </tr> <tr> <td>E) -</td> <td>-</td> <td>Root Density (%)</td> </tr> <tr> <td>F) 20</td> <td>30</td> <td>Surface Protection (%)</td> </tr> </tbody> </table>		L	R		A) 2.9	3.0	Bank Height (top of bank) (m)	B) 2.4	2.4	Bankfull Height (m)	C) 70	35	Bank Angle	D) -	-	Root Depth (m)	E) -	-	Root Density (%)	F) 20	30	Surface Protection (%)
L	R																							
A) 2.9	3.0	Bank Height (top of bank) (m)																						
B) 2.4	2.4	Bankfull Height (m)																						
C) 70	35	Bank Angle																						
D) -	-	Root Depth (m)																						
E) -	-	Root Density (%)																						
F) 20	30	Surface Protection (%)																						
Grain Size (mm): Clay and Silt (<0.062); Sand (0.062-2); Pebble (2-64); Cobble (64-256); Boulder (>256) Median moved (D_{50}) <u>0.062 mm</u> <input type="checkbox"/> clean <input checked="" type="checkbox"/> clean <input type="checkbox"/> algae Largest moved (D_{90}) _____		Stone Mobility: circle one:  Angular  Sub-Angular  Sub-Rounded  Rounded sand/silt/clay no stones																						
Comments (Surficial Geology, Fish Habitat, Velocity, Discharge, Cattle Trails, Vehicle Erosion, Mitigation Structures, etc.) -exposed NPS8 pipeline travelling north-south on Horner Creek at a meander. Exposure on outside of meander bend -pipeline suspended above bed for ~6 m and exposed for ~7 -appears creek has shifted towards the left bank and exposed the pipeline -Banks are non-cohesive (silty/clayey sand), while channel bed is predominantly sand overlaying silty/clayey sand mixture -left bank is severely eroded with a steep, barren bank face •trees have fallen into watercourse, one ~4 m upstream of exposure extending over half of watercourse width. Falling trees observed ~12 m downstream of crossing, extending over entire width and creating debris blockage and an elevated bed. -Dune (sand) ripples observed 4 m downstream of crossing -sand bar on right bank ~4 m upstream of crossing, opposite fallen tree -trees in watercourse also have some chewed ends (beaver activity) but no dams present -high flows common as evident by debris on right bank and in trees fallen in watercourse -concrete block on pipeline where it re-enters watercourse bed, approximately halfway through creek -torvane not used as banks and bed were predominantly sand with some clay and silt.																								

Pebble Count									
SITE:					Date:				
Location:									
Party:					HUC:				
.									
Inches	PARTICLE	Milimeters		Riffle	Pool	Comp	TOT #	ITEM %	% CUM
	Silt/Clay	<.062	S/C						
	Very Fine	.062-.125	S A N D						
	Fine	.125-.25							
	Medium	.25-.50							
	Coarse	.50-1.0							
.04-.08	Very Coarse	1.0-2							
.08-.16	Very Fine	2-4	G R A V E L						
.16-.22	Fine	4-5.7							
.22-.31	Fine	5.7-8							
.31-.44	Medium	8-11.3							
.44-.63	Medium	11.3-16							
.63-.89	Coarse	16-22.6							
.89-1.3	Coarse	22.6-32							
1.3-1.8	Very Coarse	32-45							
1.8-2.5	Very Coarse	45-64							
2.5-3.5	Small	64-90		C O B B L E					
3.5-5.0	Small	90-128							
5.0-7.1	Large	128-180							
7.1-10.1	Large	180-256							
10.1-14.3	Small	256-362	B O U L D E R						
14.3-20	Small	362-512							
20-40	Medium	512-1024							
40-80	Large-Very Large	1024-2048							
	Bedrock		DRK						
Total -->									

Not Applicable - very fine to fine sand, silt, and clay

STANTEC CONSULTING LIMITED			RAPID GEOMORPHIC ASSESSMENT		
Watercourse:		Collins Creek	Date:		August 4, 2021
Location:		East Channel	Reach:		
FORM/ PROCESS	GEOMORPHIC INDICATOR		PRESENT		FACTOR
	NO (2)	DESCRIPTION (3)	NO (4)	YES (5)	VALUE (6)
Evidence of Aggradation (AI)	1	Lobate bar	X		
	2	Coarse material in riffles embedded			
	3	Siltation in pools		X	
	4	Medial bars		X	
	5	Accretion on point bars	X		
	6	Poor longitudinal sorting of bed materials	X		
	7	Deposition in overbank zone		X	
		SUM OF INDICES			3/6=0.5
Evidence of Degradation (DI)	1	Exposed bridge footings			
	2	Exposed sanitary/storm sewer/pipeline/etc.		X	
	3	Elevated stormsewer outfall(s)			
	4	Undermined gabion baskets/concrete aprons/etc.			
	5	Scour pools d/s of culverts/stormwater outlets			
	6	Cut face on bar forms	X		
	7	Head cutting due to knick point migration	X		
	8	Terrace cut through older bar material	X		
	9	Suspended armour layer visible in bank			
	10	Channel worn into undisturbed overburden/bedrock	X		
		SUM OF INDICES			1/5=0.2
Evidence of Widening (WI)	1	Fallen/leaning trees/fence posts/etc.		X	
	2	Occurrence of large organic debris		X	
	3	Exposed tree roots		X	
	4	Basal scour on inside meander bends		X	
	5	Basal scour on both sides of channel through riffle			
	6	Gabion baskets/concrete walls/etc. out flanked			
	7	Length of basal scour > 50% through subject reach		X	
	8	Exposed length of previously buried pipeline/cable/etc.		X	
	9	Fracture lines along top of bank	X		
	10	Exposed building foundation			
		SUM OF INDICES			6/7=0.86
Evidence of Planimetric Form Adjustment (PI)	1	Formation of chutes	X		
	2	Single thread to multiple channel	X		
	3	Evolution of pool-riffle form to low bed relief form	X		
	4	Cutoff channel(s)	X		
	5	Formation of island(s)	X		
	6	Thalweg alignment out of phase with meander form	X		
	7	Bar forms poorly formed/reworked/removed	X		
		SUM OF INDICES			0/7=0
STABILITY INDEX (SI) = (AI + DI + WI + PI) / m					0.39

= TRANSITIONAL

EGI HORNER CREEK NPS8 EXPOSURE ASSESSMENT

APPENDIX B
Photolog

DRAFT





Photo 1: HID 11515 – Looking Upstream



Photo 2: HID 11515 – Looking Downstream



Photo 3: HID 11515 – Looking at the Left Bank



Photo 4: HID 11515 – Looking at the Right Bank



Photo 5: Exposed length of pipe



Photo 6: Woody debris causing elevated bed towards right bank downstream of exposure



Client/Project
Enbridge Gas Inc.
Horner Creek NPS8 Exposure
Woodstock, ON

Appendix B
PHOTOGRAPHIC RECORD

Date
20-Apr-2021
Project No.
160961436

Page
Page 1 of 2



Photo 7: Woody debris build up on left bank



Photo 8: Dune formation in sand



Photo 9: Right bank undercutting, animal burrow, and possible small rodent or mustelid prints



Photo 10: Beaver activity indicator; gnawed log



Photo 11: Organic sheen on right bank (forms clumps)

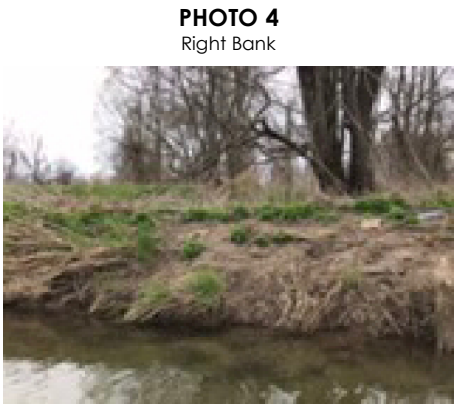
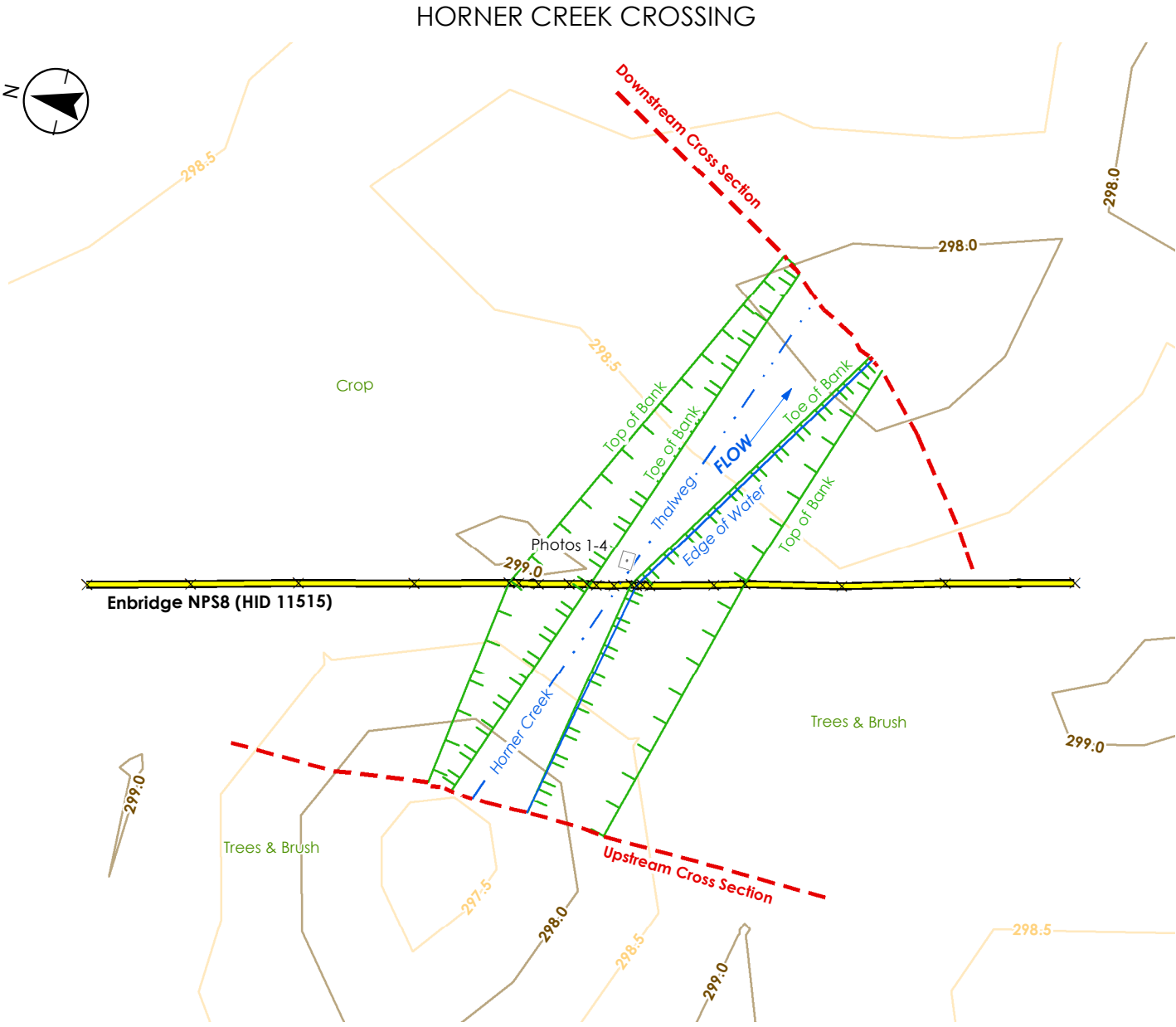
EGI HORNER CREEK NPS8 EXPOSURE ASSESSMENT

APPENDIX C
Survey





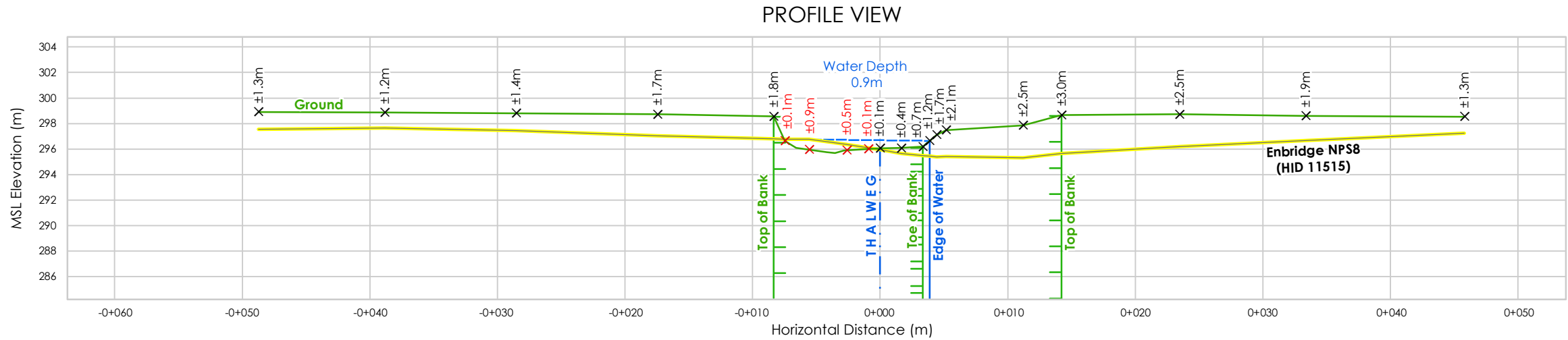
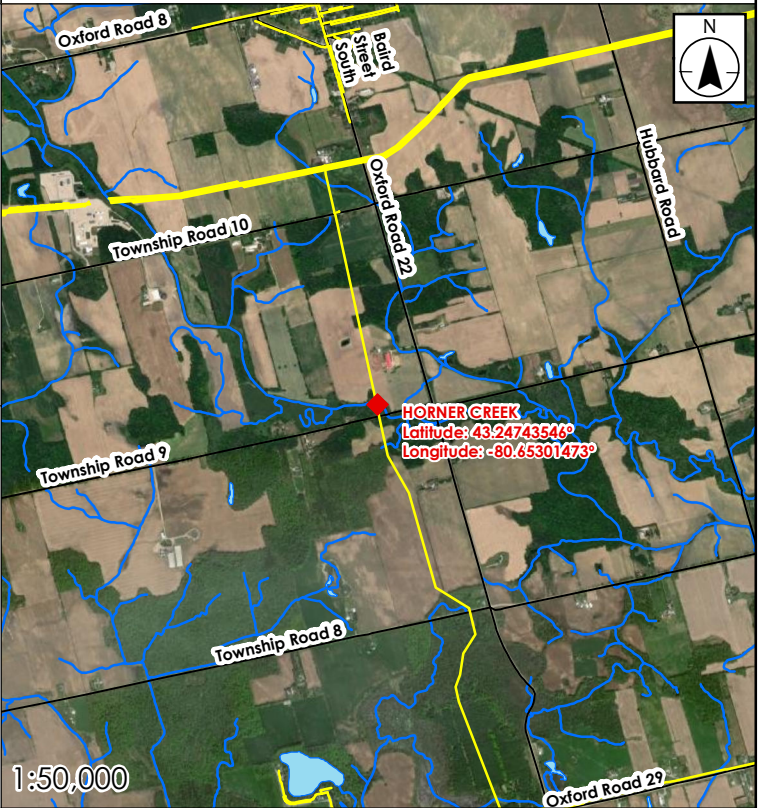
NO SIGN
PRESENT



NO SIGN
PRESENT



SKETCH OF
WATER CROSSING
WATER CROSSING ID HID - 11515
HORNER CREEK
IN
CITY OF LONDON, ONTARIO



Crossing Name:	HORNER CREEK
Crossing Number:	11515
Weather:	PARTLY CLOUDY
All Pipeline Warning Signs:	MISSING - LB & MISSING - RB
Minimum Depth of Cover:	±0.0m (PIPE EXPOSED; TOP OF PIPE 0.9m ABOVE GROUND)
Access:	±60m - BRUSH & GRASS
Right-of-Way Condition:	CLEAR
Right-of-Way Cover:	GRASS
Left Bank Slope:	VERTICAL
Left Bank Erosion:	SCOUR HOLE
Right Bank Slope:	VERTICAL
Right Bank Erosion:	SLUMPING

NOTES: EXPOSED AND PIPE SUSPENDED

		Datum / System: WGS84 UTMz17N Geoid: CGG2013				1:600	
REVISIONS		Survey Date: 2021/04/20		Surveyed By: DM		REV.	
REV	DESCRIPTION	FILE NO:	DATE	APPR	BY	2	
1	Revise Profile	160951269-11515	2021/05/27	CB	AL		
2	Revise Profile	160951269-11515	2021/09/08	CB	OP		

- ⊗

Bollard

⓪

Cathodic Protection

⦿

Control Point

△

Guy Wire

⦿

Hydrant

□

Photo Location

●

Power Pole

▲

Sign

◆

Site Location

—

Roadway (Asphalt)

- - -

Roadway (Gravel)

—

Proposed Access

—

Edge of Water

—

Toe of Bank

—

Top of Bank

—

Toe of Bank / Edge of Water

—

Lowest Point (Thalweg)

—

Comm - Overhead

—

Comm - UG

—

Power - Overhead

—

Power - UG

—

Gas - AG

—

Gas - UG

—

Target Pipeline

DISCLAIMER:
This plan represents the best information available at the time of survey. Stantec Geomatics and its employees take no responsibility for the location of any underground facilities whether shown on or omitted from this plan. All underground installations should be located by respective authorities prior to excavation or construction.

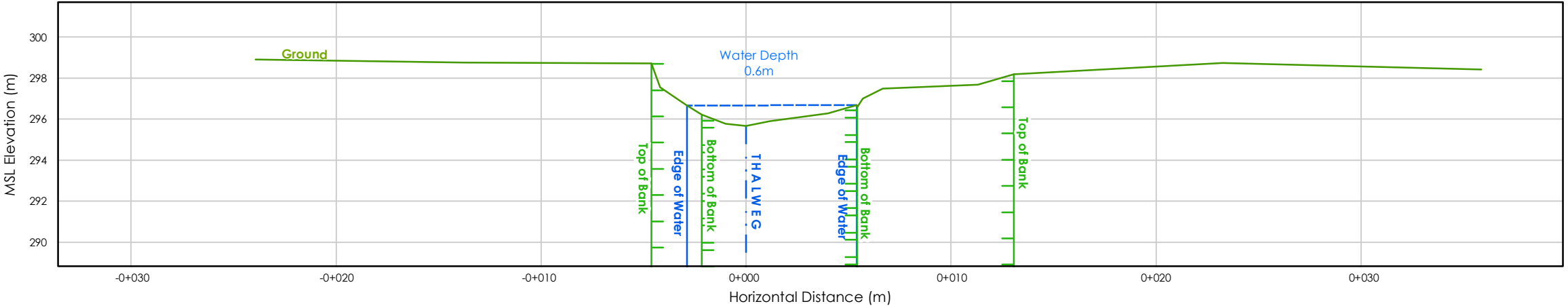
- Contours shown are based on the Provincial Digital Elevation Model - South
- Water Levels shown are at time of survey.
- Distances are in metres and decimals thereof.
- Only cross sections and pipeline were surveyed
- Combined scale factor 0.999569
- Control Network based on CanNET VRS.

Contact Ontario One Call prior to construction 1-800-400-2255 www.on1call.com

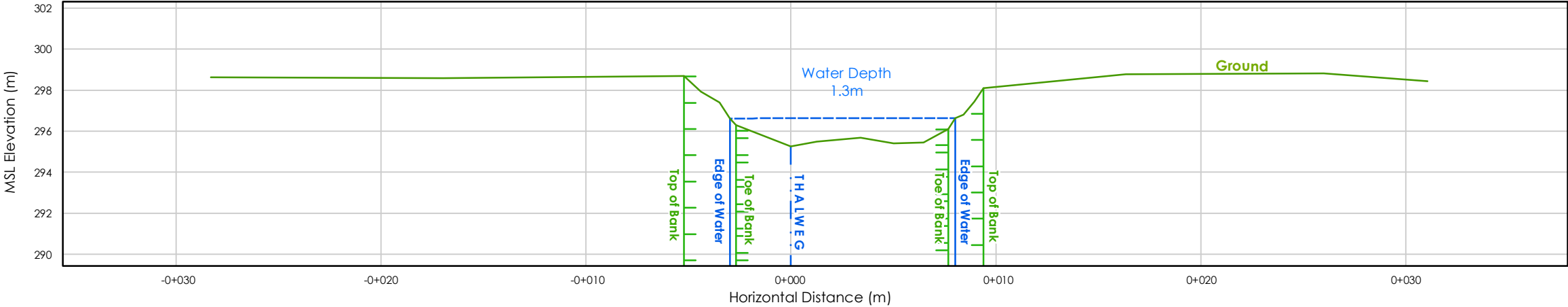


SKETCH OF
ADDITIONAL TRANSECTS
WATER CROSSING ID HID - 11515
HORNER CREEK

PROFILE VIEW - UPSTREAM



PROFILE VIEW - DOWNSTREAM



EGI HORNER CREEK NPS8 EXPOSURE ASSESSMENT

APPENDIX D
VIV Assessment

DRAFT



November 23, 2021

Derek Brecht

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Reference: Stress and Vortex Induced Vibration Results from Horner Creek Exposure Engineering Assessment

Parameter	Symbol	Unit	Value
Coating Thickness	tc	m	0.004 (Assumed for coal tar/wrap)
Surface Roughness	k	m	0.0033 (Assumed for coal tar/wrap)
Pipe Condition			Assume nominal with no defects
Wall Thickness Reduction, Based on Flaw Size Mod B31G Burst Pressure			N/A
Service			
MOP	P	kPa	6160
Design Temperature	T1	°C	50
Restraint Temperature	T2	°C	0
Product Density	ρ_c	kg/m ³	50 (Assumed based on typical natural gas composition at 15°C and MOP)
Fatigue			
S-N Parameter log a	log a	log (MPa)	11.068 (S-N curve F3 from DNV RP C203 (2016,) table 2-4). See note 1 below.
S-N Parameter m	m		3
Operating Pressure Hoop Stress Cycle		MPa	1500 (Assumed pressure cycles based on "Blandford Line Data.xlsx", half cycle between 11/26/2020 5:00 and 11/27/2020 18:00.)
Operating Pressure Cycles Per Year			120 (Assumed)
Fatigue Life Criteria			One day. See note 1 below
Crossing/Flow Conditions			
Relative Angle (pipe to flow)	θ_{rel}	°	90
Mean Velocity	V	m/s	2.23 to 3.17 (Mean velocities corresponding to return periods from 2 years to 100 years) Additional mean velocities associated with VIV onset
Density of River Water	ρ_w	kg/m ³	1000
Kinematic Viscosity	ν	m ² /s	0.000001
Keulegan Carpenter Number	KC		0 (Assume there is no wave velocity)
Current Flow Ratio	α		1 (Assume there is no wave velocity)
Gap Ratio	e/D		1.73 (Averaged across current undercut span of 5.5m) See note 2 below
Trench Depth Ratio	Δ/D		0 (Assume there are no significant trench effects at exposure)
Span and Soil Boundary Conditions			
Span Length	L	m	5.5 (currently undercut), 6.0, 6.5, 7.0 See note 2 below
Soil Type			Stiff Clay (Assumed)

Design with community in mind

c:\users\rclysdale\desktop\various\enbridge pipe exposures\mem_160961436_stress-vortex_induced_vibration_results_hornercreek_20211123_fnl.docx

November 23, 2021

Derek Brecht

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Reference: Stress and Vortex Induced Vibration Results from Horner Creek Exposure Engineering Assessment

Parameter	Symbol	Unit	Value
Soil - Outer Layer Friction Coefficient			0.6 (Assumed)
Soil Stiffness (Static Lateral)	CL	(kN/m)/m	5000 (Assumed. Pipe enters eroded bank with cover of ~1.8m, on other side it gradually enters the creek bed from free span to partially exposed to buried.)
DNV RP F105 Safety Factors			
Inline Response Onset Safety Factor	γ_{onIL}		1.1
Crossflow Response Onset Safety Factor	γ_{onCF}		1.2
Stability Parameter Safety Factor	γ_k		1.0 (The pipeline is considered to be low safety class per DNV F101)
Natural Frequency Safety Factor	γ_f		1.05 (The pipeline is considered to be low safety class per DNV F101 and the spans "well defined" per DNV F105 in that the current undercut span and gap have been measured. This factor is kept at the same value for future lateral scour for consistency between results and as the 6.0m, 6.5m and 7.0m undercut spans are chosen lengths for comparison.)
Stress Range Safety Factor	γ_s		1.3
Impact			
Entrained Spherical Particle Diameter	d	m	Diameters for return period mean velocities are assessed in the analysis
Specific Gravity of Particle	SG		2.65
Impact Factor	DLF		1.5
Geometry Factor	GF		1.5. See note 3 below
Notes: <ol style="list-style-type: none"> 1. Fatigue life considers cycles due to operating pressure changes as well as inline and crossflow VIV response. The fatigue life criteria of one day is based on a single event at sustained flow conditions with a given exposed span length. 2. Currently 6.3m is exposed at the top of the pipe, and 5.5 is undercut with average gap ratio of 1.73. In the DNV F105 methodology the gap ratio impacts hydrodynamic loads, switching between modes of loading when the gap ratio is 0.8. Different gap ratios greater than 0.8 result in the same outputs. The spans of 6.0, 6.5m, and 7.0m are included to consider future lateral scour of the bank. 3. A geometry factor is included in the impact analysis as the methodology is based on experiments with a line load as opposed to a point load. However, the methodology also has other conservative assumptions, with the impact occurring square on the springline of the pipe with no angular momentum. 			

November 23, 2021

Derek Brecht

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Reference: Stress and Vortex Induced Vibration Results from Horner Creek Exposure Engineering Assessment

RESULTS

Table 2 presents threshold velocities for the following conditions:

- Onset of inline VIV response (initially at negligible amplitude);
- Inline VIV response with moderate stress amplitudes (approximately 10 MPa);
- Pipe yield stress is exceeded due to combined stress including operating stress (pressure and temperature) quasi-static bending (buoyancy and hydrodynamic drag) and VIV cyclic stress range;
- Onset of cross-flow VIV response (initially at negligible amplitude);
- Cross-flow VIV response with moderate stress amplitudes (approximately 10 MPa).

Table 2: Threshold Velocities

Span Length (m)	Threshold Velocities (m/s)				
	Inline VIV onset	Inline VIV (moderate stress amplitude)	Pipe yield stress exceeded	Cross-flow VIV onset	Cross-flow VIV (moderate stress amplitude)
5.5 (current undercut span)	2.40	2.57	2.65	5.91	6.23
6.0	2.10	2.25	2.34	5.17	5.44
6.5	1.84	1.98	2.08	4.54	4.78
7.0	1.62	1.74	1.85	4.00	4.22

Table 3 presents combined stress and fatigue life at mean velocities of return period flow conditions.

Table 3: Combined Stress and Fatigue Life at Return Period Flows

		Combined Stress and Fatigue Life				
Span Length (m)	2-Year (2.23 m/s)	5-Year (2.44 m/s)	10-Year (2.59 m/s)	20-Year (2.77 m/s)	100-Year (3.17 m/s)	
5.5 (current undercut span)	249 MPa N/A	254 MPa N/A	273 MPa 631 hours	321 MPa 14.1 hours	Not evaluated – Shorter term return period conditions exceed acceptability criteria with stresses beyond linear range.	
6.0	259 MPa 2304 hours	316 MPa 17.7 hours				
6.5	331 MPa 9.63 hours					
7.0	397 MPa 1.78 hours					

Incipiently mobile particle sizes that may cause a dent of 2% of pipe OD if fully entrained in the flow were evaluated at return period flow conditions. Sizes ranged between 0.19 m diameter (at 100-Year flow of 3.17 m/s) to 0.24 m diameter (at 2-Year flow of 2.23 m/s.)

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Reference: Stress and Vortex Induced Vibration Results from Horner Creek Exposure Engineering Assessment

Free span deflections of the exposed spans due to distributed loads from buoyancy and hydrodynamic drag are minimal.

DISCUSSION

There is uncertainty how the partly undercut, partly exposed span will behave, though over time the exposed/undercut sections will grow due to scour. Based on the results in Table 2 and Table 3 the currently undercut 5.5m span is subject to inline VIV at mean velocities just below the 5-Year return condition, and combined stresses exceeding yield at mean velocities between 10-Year and 20-Year return conditions. **Given VIV onset with flows close to the 5-Year condition, Stantec recommends short term mitigations to protect and stabilize the pipe.**

The incipiently mobile particle sizes in the range of 0.19 m and 0.24 m (on the order of the pipe diameter) cannot be fully entrained in the flow at the flow rates/bed shear stresses. While saltation (intermittent “leaping” rather than suspension) of such particles might cause them to contact the pipe, they would not impart enough energy to dent the pipe.

Other engineering assessments, such as debris and ice loading and brittle fracture and girth weld bending can also affect the integrity of the pipeline. **Stantec does not consider further analysis to be warranted as mitigations are already being recommended.**

Should you have any questions regarding this memorandum, please contact Robin Clysdale at (403) 471-4459.

Stantec Consulting Ltd.



Robin Clysdale P.Eng.
Crossing Group Lead

Phone: 403 471 4459
robin.clysdale@stantec.com



To:	Pat Gribbon	From:	Robin Clysdale
	Enbridge Gas Inc.		Stantec Consulting Ltd.
File:	160951269	Date:	January 31, 2022

Reference: Stress and Vortex Induced Vibration Results from HID17990 Pipe Exposure Engineering Assessment

Enbridge Gas Inc. (EGI) identified an exposed NPS 8 pipeline on a watercourse during the 2021 Watercourse Crossing Management Program (HID 17990). The pipeline was identified as suspended (open spanning) with 17.85m undercut and 19.30m exposed at the time of survey.

STRESS / VORTEX INDUCED VIBRATIONS (VIV) ANALYSIS INPUTS AND ASSUMPTIONS

Stantec evaluated three load conditions associated with a pipeline exposure. The analysis is in accordance with CSA Z662-19 and DNV RP F105 (2006):

1. Combined stress due to operating conditions and bending due to buoyant and hydrodynamic loads. The acceptability criterion is based on CSA Z662-19 4.7.2.1.
2. Potential for fatigue due to vortex induced vibration, based on coincidence between ranges of structural vibrations of the pipe span and response to flow induced vibration.
3. Potential of impact by entrained particles to dent the pipe, based on "Full-scale Impact Tests on Pipelines," Palmer et al., 2006. Velocity of entrained particles are assumed to be low enough that strain rates are not significant and a quasi-static model can be employed with a dynamic load factor of 1.5. The acceptability criterion is based on CSA Z662-19 6.3.3.2, limiting potential indentation depth to less than 2% of the pipe OD.

The input parameters and assumptions for the analysis are summarized in Table 1.

Table 1: Input Parameters for VIV Analysis

Parameter	Symbol	Unit	Value
Pipe Specification			
Pipe OD (steel only)	Ds	m	0.219075
Pipe WT	ts	m	0.0048
Pipe SMYS	Y	MPa	241
Pipe Density	ρ_s	kg/m ³	7850
Pipe Modulus of Elasticity	Es	MPa	207000
Pipe Poisson's Ratio	ν		0.3
Pipe Expansion Coefficient	α_e		0.000012
Pipeline Buoyancy Control			Bare pipe is buoyant. Enbridge stated that pipe has concrete coating,
Coating Density	ρ_c	kg/m ³	2250 (Assumed for concrete coating)
Coating Thickness	tc	m	0.0254 (Assumed for concrete coating)

January 31, 2022

Pat Gribbon

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Reference: Stress and Vortex Induced Vibration Results from HID17990 Pipe Exposure Engineering Assessment

Parameter	Symbol	Unit	Value
Coating Modulus of Elasticity	E_c	MPa	10342.5 (Assumed for concrete coating)
Surface Roughness	k	m	0.0033 (Assumed for coal tar/wrap)
Pipe Condition			Assume nominal with no defects
Wall Thickness Reduction, Based on Flaw Size Mod B31G Burst Pressure			N/A
Service			
MOP	P	kPa	4670
Design Temperature	T1	°C	35 (Assumed) & 19 (to address issues with stability parameter. See note 2 below.)
Restraint Temperature	T2	°C	5 (Assumed)
Product Density	ρ_c	kg/m ³	36 (Assumed based on typical natural gas composition at 15°C and MOP)
Fatigue			
S-N Parameter log a	log a	log (MPa)	11.068 (S-N curve F3 from DNV RP C203 (2016,) table 2-4). See note 1 below.
S-N Parameter m	m		3
Operating Pressure Hoop Stress Cycle		MPa	N/A (only consider fatigue due to VIV)
Operating Pressure Cycles Per Year			N/A (only consider fatigue due to VIV)
Fatigue Life Criteria			One day. See note 1 below
Crossing/Flow Conditions			
Relative Angle (pipe to flow)	θ_{rel}	°	90
Mean Velocity	V	m/s	0.32 to 0.42 (Mean velocities corresponding to return periods from 2 years to 100 years) Additional mean velocities associated with VIV onset
Density of River Water	ρ_w	kg/m ³	1000
Kinematic Viscosity	ν	m ² /s	0.000001
Keulegan Carpenter Number	KC		0 (Assume there is no wave velocity)
Current Flow Ratio	α		1 (Assume there is no wave velocity)
Gap Ratio	e/D		3.7 (Averaged across current undercut span of 17.85m) See note 2 below
Trench Depth Ratio	Δ/D		0 (Assume there are no significant trench effects at exposure)
Span and Soil Boundary Conditions			
Span Length	L	m	17.85 (currently undercut) & 13 See note 2 below
Soil Type			Stiff Clay (Assumed)

January 31, 2022

Pat Gribbon

Page 3 of 6

Reference: Stress and Vortex Induced Vibration Results from HID17990 Pipe Exposure Engineering Assessment

Parameter	Symbol	Unit	Value
Soil - Outer Layer Friction Coefficient			0.6 (Assumed)
Soil Stiffness (Static Lateral)	CL	(kN/m)/m	5000 (Assumed.)
DNV RP F105 Safety Factors			
Inline Response Onset Safety Factor	γ_{onIL}		1.1
Crossflow Response Onset Safety Factor	γ_{onCF}		1.2
Stability Parameter Safety Factor	γ_k		1.0 (The pipeline is considered to be low safety class per DNV F101)
Natural Frequency Safety Factor	γ_f		1.05 (The pipeline is considered to be low safety class per DNV F101 and the spans "well defined" per DNV F105 in that the current undercut span and gap have been measured.)
Stress Range Safety Factor	γ_s		1.3
Impact			
Entrained Spherical Particle Diameter	d	m	Diameters for return period mean velocities are assessed in the analysis
Specific Gravity of Particle	SG		2.65
Impact Factor	DLF		1.5
Geometry Factor	GF		1.5. See note 3 below
<p>Notes:</p> <ol style="list-style-type: none"> 1. Fatigue life considers cycles due to inline and crossflow VIV response. The fatigue life criteria of one day is based on a single event at sustained flow conditions with a given exposed span length. 2. Currently 19.30m is exposed at the top of the pipe, and 17.85m is undercut with average gap ratio of 3.7. The DNV F105 methodology has a number of empirical terms and parameters that are only applicable within certain ranges. With an undercut span of 17.85m, a "stability parameter" is no longer within the applicable range. The following additional cases were considered (numerically modelling a post-buckling structural response of the pipe was not considered): <ol style="list-style-type: none"> a. A span of 17.85m was evaluated with an operating temperature of 19°C. Reducing the temperature brings the case within the range of the stability parameter as the reduced thermal stress reduces the instability to global buckling. b. A span of 13m (satisfying the stability parameter) was evaluated as a non-conservative case. 3. A geometry factor is included in the impact analysis as the methodology is based on experiments with a line load as opposed to a point load. However, the methodology also has other conservative assumptions, with the impact occurring square on the springline of the pipe with no angular momentum. 			

January 31, 2022

Pat Gribbon

Page 4 of 6

Reference: Stress and Vortex Induced Vibration Results from HID17990 Pipe Exposure Engineering Assessment

RESULTS

Table 2 presents threshold velocities for the following conditions:

- Onset of inline VIV response (initially at negligible amplitude);
- Inline VIV response with moderate stress amplitudes (approximately 10 MPa);
- Pipe yield stress is exceeded due to combined stress including operating stress (pressure and temperature) quasi-static bending (buoyancy and hydrodynamic drag) and VIV cyclic stress range;
- Onset of cross-flow VIV response (initially at negligible amplitude);
- Cross-flow VIV response with moderate stress amplitudes (approximately 10 MPa).

These results are generated by varying the velocity with other input parameters fixed.

Table 2: Threshold Velocities

Span Length (m)	Threshold Velocities (m/s)				
	Inline VIV onset	Inline VIV (moderate stress amplitude)	Pipe yield stress exceeded	Cross-flow VIV onset	Cross-flow VIV (moderate stress amplitude)
17.85 (current undercut span, out of range of DNV F105 stability parameter when operating temperature is 35°C)	0.19	0.21	N/A – Yield stress exceeded at 0m/s due to numerical behaviour of stability parameter	0.41	0.44
17.85 (current undercut span, <u>operating temperature reduced to 19°C</u> to satisfy stability parameter)	0.32	0.36	0.49	0.67	0.72
13 (non-conservative span that satisfies stability parameter)	0.54	0.59	0.68	1.13	1.20

Table 3 presents combined stress and fatigue life at mean velocities of return period flow conditions.

January 31, 2022

Pat Gribbon

Page 5 of 6

Reference: Stress and Vortex Induced Vibration Results from HID17990 Pipe Exposure Engineering Assessment

Table 3: Combined Stress and Fatigue Life at Return Period Velocities

Span Length (m)	Combined Stress and Fatigue Life			
	2-Year (0.32 m/s)	10-Year (0.38 m/s)	20-Year (0.38 m/s)	100-Year (0.42 m/s)
17.85 (current undercut span, out of range of DNV F105 stability parameter when operating temperature is 35°C)	424 MPa 99 hours (note that this does not account for reduced fatigue life from other cyclic loading in the pipeline's lifespan)	Acceptability criteria exceeded with 2-Year return period conditions		
17.85 (current undercut span, <u>operating temperature reduced to 19°C</u> to satisfy stability parameter)	168.8 MPa (for comparison with 13m span at 35°C, add back 39.74 MPa of "restrained thermal stress" for a comparable 208.6 MPa) 0 hours (pipe is not subject VIV)	187.2 MPa (for comparison with 13m span at 35°C, add back 39.74 MPa of "restrained thermal stress" for a comparable 226.9 MPa) 5135 hours (note that this does not account for reduced fatigue life from other cyclic loading in the pipeline's lifespan)	187.2 MPa (for comparison with 13m span at 35°C, add back 39.74 MPa of "restrained thermal stress" for a comparable 226.9 MPa) 5135 hours (note that this does not account for reduced fatigue life from other cyclic loading in the pipeline's lifespan)	204.8 MPa (for comparison with 13m span at 35°C, add back 39.74 MPa of "restrained thermal stress" for a comparable 244.6 MPa) 683 hours (note that this does not account for reduced fatigue life from other cyclic loading in the pipeline's lifespan)
13 (non-conservative span that satisfies stability parameter)	184.7 MPa 0 hours (pipe is not subject VIV)	184.9 MPa 0 hours (pipe is not subject VIV)	184.9 MPa 0 hours (pipe is not subject VIV)	185.0 MPa 0 hours (pipe is not subject VIV)

Table 4 presents threshold span lengths of inline VIV onset and the corresponding combined stress at mean velocities of return period flow conditions. These results are generated by varying the undercut span length with other parameters fixed.

Table 4: Threshold Span Lengths and Combined Stress at Return Period Velocities

Inline VIV Onset Threshold Span Lengths			
2-Year (0.32 m/s)	10-Year (0.38 m/s)	20-Year (0.38 m/s)	100-Year (0.42 m/s)
15.6 m 223 MPa	14.8 m 207 MPa	14.8 m 207 MPa	14.3 m 200 MPa

January 31, 2022

Pat Gribbon

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Reference: Stress and Vortex Induced Vibration Results from HID17990 Pipe Exposure Engineering Assessment

Incipiently mobile particle sizes that may cause a dent of 2% of pipe OD if fully entrained in the flow were evaluated at return period flow conditions. Sizes ranged between 0.68 m diameter (at 100-Year flow) to 0.82 m diameter (at 2-Year flow.) Note this evaluation is based on bare pipe, not accounting for the concrete coating.

Free span deflections of the exposed spans due to distributed loads from buoyancy and hydrodynamic drag (approximately 15.1kg/m at 0.42m/s) may be on the order of 50mm. Due to the length of the span, the pipe has flexibility to reposition itself, but the loading is not significant to displace the pipe significantly.

DISCUSSION

The undercut span of 17.85m is outside of the range of a stability parameter in the DNV F105 methodology. Rather than numerically modelling the post-buckling structural response of the pipe, two cases were considered: reducing the operating temperature to 19°C to satisfy the stability parameter, and a non-conservative shorter span of 13m. Neither of these cases exceeded acceptability criteria for stress, except for the 17.85m reduced temperature case when “adding back the restrained thermal stress” of the original temperature at the 100-Year flow conditions. The 17.85m span is subject to inline VIV at flows less than the 5-Year flow conditions, though the cyclic stresses are low. **Stantec recommends mitigation to stabilize and protect the pipe as well as assessing its condition:**

- **As the pipe was being exposed, shorter spans may have been subject to cyclic VIV loading.**
- **The long span has a greater probability of being subject to damage.**
- **The behaviour of the span under hydrodynamic loading will be complex. More sophisticated modelling may not increase accuracy or certainty in its results.**

The incipiently mobile particle sizes cannot be fully entrained in the flow at the flow rates/bed shear stresses. While saltation (intermittent “leaping” rather than suspension) of such particles might cause them to contact the pipe, they would not impart enough energy to dent the pipe.

Other engineering assessments, such as debris and ice loading and brittle fracture and girth weld bending can also affect the integrity of the pipeline. These assessments have not been completed at this time as mitigations are already recommended.

Should you have any questions regarding this memorandum, please contact Robin Clysdale at (403) 471-4459.

Stantec Consulting Ltd.



Robin Clysdale P.Eng.
Crossing Group Lead
Phone: 403 471 4459
robin.clysdale@stantec.com



To:	Pat Gribbon	From:	Robin Clysdale
	Enbridge Gas Inc.		Stantec Consulting Ltd.
File:	160951269	Date:	January 31, 2022

Reference: Stress and Vortex Induced Vibration Results from HID1044 Pipe Exposure Engineering Assessment

Enbridge Gas Inc. (EGI) identified an exposed NPS 10 pipeline on a watercourse during the 2021 Watercourse Crossing Management Program (HID 1044). The pipeline was identified as suspended (open spanning) with 30.31m undercut and 75.4m exposed at the time of survey.

STRESS / VORTEX INDUCED VIBRATIONS (VIV) ANALYSIS INPUTS AND ASSUMPTIONS

Stantec evaluated three load conditions associated with a pipeline exposure. The analysis is in accordance with CSA Z662-19 and DNV RP F105 (2006):

1. Combined stress due to operating conditions and bending due to buoyant and hydrodynamic loads. The acceptability criterion is based on CSA Z662-19 4.7.2.1.
2. Potential for fatigue due to vortex induced vibration, based on coincidence between ranges of structural vibrations of the pipe span and response to flow induced vibration.
3. Potential of impact by entrained particles to dent the pipe, based on "Full-scale Impact Tests on Pipelines," Palmer et al., 2006. Velocity of entrained particles are assumed to be low enough that strain rates are not significant and a quasi-static model can be employed with a dynamic load factor of 1.5. The acceptability criterion is based on CSA Z662-19 6.3.3.2, limiting potential indentation depth to less than 2% of the pipe OD.

The input parameters and assumptions for the analysis are summarized in Table 1.

Table 1: Input Parameters for VIV Analysis

Parameter	Symbol	Unit	Value
Pipe Specification			
Pipe OD (steel only)	Ds	m	0.27305
Pipe WT	ts	m	0.00635 (Unknown wall thickness, assumed to be 6.35mm thick pipe. Wall thicknesses of 4mm and 9.52mm were also evaluated, but recommendations are the same with all evaluated wall thicknesses.)
Pipe SMYS	Y	MPa	172 (Unknown grade, assumed to be 172 MPa)
Pipe Density	ps	kg/m ³	7850
Pipe Modulus of Elasticity	Es	MPa	207000
Pipe Poisson's Ratio	v		0.3
Pipe Expansion Coefficient	αe		0.000012
Pipeline Buoyancy Control			Pipe is buoyant at assumed wall thickness of 6.35mm (though not buoyant assuming wall thickness of 9.52mm.) No

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Reference: Stress and Vortex Induced Vibration Results from HID1044 Pipe Exposure Engineering Assessment

Parameter	Symbol	Unit	Value
			buoyancy control (coating or weights) is included in the analysis
Coating Density	ρ_c	kg/m ³	1300 (Assumed for coal tar/wrap)
Coating Thickness	t_c	m	0.004 (Assumed for coal tar/wrap)
Surface Roughness	k	m	0.0033 (Assumed for coal tar/wrap)
Pipe Condition			Assume nominal with no defects
Wall Thickness Reduction, Based on Flaw Size Mod B31G Burst Pressure			N/A
Service			
MOP	P	kPa	1380
Design Temperature	T1	°C	30 (Assumed) & 5 (to address issues with stability parameter. See note 2 below.)
Restraint Temperature	T2	°C	-5 (Assumed)
Product Density	ρ_c	kg/m ³	10 (Assumed based on typical natural gas composition at 15°C and MOP)
Fatigue			
S-N Parameter log a	log a	log (MPa)	11.068 (S-N curve F3 from DNV RP C203 (2016,) table 2-4). See note 1 below.
S-N Parameter m	m		3
Operating Pressure Hoop Stress Cycle		MPa	N/A (only consider fatigue due to VIV)
Operating Pressure Cycles Per Year			N/A (only consider fatigue due to VIV)
Fatigue Life Criteria			One day. See note 1 below
Crossing/Flow Conditions			
Relative Angle (pipe to flow)	θ_{rel}	°	90
Mean Velocity	V	m/s	3.24 to 4.85 (Mean velocities corresponding to return periods from 2 years to 100 years) Additional mean velocities associated with VIV onset
Density of River Water	ρ_w	kg/m ³	1000
Kinematic Viscosity	ν	m ² /s	0.000001
Keulegan Carpenter Number	KC		0 (Assume there is no wave velocity)
Current Flow Ratio	α		1 (Assume there is no wave velocity)
Gap Ratio	e/D		1.03 (Averaged across current undercut span of 30.31m) See note 2 below
Trench Depth Ratio	Δ/D		0 (Assume there are no significant trench effects at exposure)
Span and Soil Boundary Conditions			

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Reference: Stress and Vortex Induced Vibration Results from HID1044 Pipe Exposure Engineering Assessment

Parameter	Symbol	Unit	Value
Span Length	L	m	30.31 (currently undercut) & 16 See note 2 below
Soil Type			Stiff Clay (Assumed)
Soil - Outer Layer Friction Coefficient			0.6 (Assumed)
Soil Stiffness (Static Lateral)	CL	(kN/m)/m	5000 (Assumed.)
DNV RP F105 Safety Factors			
Inline Response Onset Safety Factor	γ_{onIL}		1.1
Crossflow Response Onset Safety Factor	γ_{onCF}		1.2
Stability Parameter Safety Factor	γ_k		1.0 (The pipeline is considered to be low safety class per DNV F101)
Natural Frequency Safety Factor	γ_f		1.05 (The pipeline is considered to be low safety class per DNV F101 and the spans “well defined” per DNV F105 in that the current undercut span and gap have been measured.)
Stress Range Safety Factor	γ_s		1.3
Impact			
Entrained Spherical Particle Diameter	d	m	Diameters for return period mean velocities are assessed in the analysis
Specific Gravity of Particle	SG		2.65
Impact Factor	DLF		1.5
Geometry Factor	GF		1.5. See note 3 below
<p>Notes:</p> <ol style="list-style-type: none"> Fatigue life considers cycles due to inline and crossflow VIV response. The fatigue life criteria of one day is based on a single event at sustained flow conditions with a given exposed span length. Currently 75.4m is exposed at the top of the pipe, and 30.31m is undercut with average gap ratio of 1.03. The DNV F105 methodology has a number of empirical terms and parameters that are only applicable within certain ranges. With an undercut span of 30.31m, a “stability parameter” is no longer within the applicable range. The following additional cases were considered (numerically modelling a post-buckling structural response of the pipe was not considered): <ol style="list-style-type: none"> A span of 30.31m was evaluated with an operating temperature of 5°C. Reducing the temperature brings the case within the range of the stability parameter as the reduced thermal stress reduces the instability to global buckling. A span of 16m (satisfying the stability parameter) was evaluated as a non-conservative case. A geometry factor is included in the impact analysis as the methodology is based on experiments with a line load as opposed to a point load. However, the methodology also has other conservative assumptions, with the impact occurring square on the springline of the pipe with no angular momentum. 			

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Reference: Stress and Vortex Induced Vibration Results from HID1044 Pipe Exposure Engineering Assessment

RESULTS

Table 2 presents threshold velocities for the following conditions:

- Onset of inline VIV response (initially at negligible amplitude);
- Inline VIV response with moderate stress amplitudes (approximately 10 MPa);
- Pipe yield stress is exceeded due to combined stress including operating stress (pressure and temperature) quasi-static bending (buoyancy and hydrodynamic drag) and VIV cyclic stress range;
- Onset of cross-flow VIV response (initially at negligible amplitude);
- Cross-flow VIV response with moderate stress amplitudes (approximately 10 MPa).

These results are generated by varying the velocity with other input parameters fixed.

Table 2: Threshold Velocities

Span Length (m)	Threshold Velocities (m/s)				
	Inline VIV onset	Inline VIV (moderate stress amplitude)	Pipe yield stress exceeded	Cross-flow VIV onset	Cross-flow VIV (moderate stress amplitude)
30.31 (current undercut span, out of range of DNV F105 stability parameter when operating temperature is 30°C)	N/A				
30.31 (current undercut span, <u>operating temperature reduced to 5°C</u> to satisfy stability parameter)	0.19	0.24	0.50	0.48	0.51
16 (non-conservative span that satisfies stability parameter)	0.57	0.63	0.71	1.36	1.44

Table 3 presents combined stress and fatigue life at mean velocities of return period flow conditions.

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Reference: Stress and Vortex Induced Vibration Results from HID1044 Pipe Exposure Engineering Assessment

Table 3: Combined Stress and Fatigue Life at Return Period Velocities

Span Length (m)	Combined Stress and Fatigue Life			
	2-Year (3.24 m/s)	10-Year (3.83 m/s)	20-Year (4.11 m/s)	100-Year (4.85 m/s)
30.31 (current undercut span, out of range of DNV F105 stability parameter when operating temperature is 30°C)	N/A			
30.31 (current undercut span, <u>operating temperature reduced to 5°C</u> to satisfy stability parameter)	1433 MPa 0 hours (pipe is subject to cross-flow VIV and fatigue life was likely exceeded before these conditions)	Acceptability criteria exceeded with 2-Year return period conditions		
16 (non-conservative span that satisfies stability parameter)	1181 MPa 0 hours (pipe is subject to cross-flow VIV and fatigue life was likely exceeded before these conditions)	Acceptability criteria exceeded with 2-Year return period conditions		

Table 4 presents threshold span lengths of inline VIV onset and the corresponding combined stress at mean velocities of return period flow conditions. These results are generated by varying the undercut span length with other parameters fixed.

Table 4: Threshold Span Lengths and Combined Stress at Return Period Velocities

Inline VIV Onset Threshold Span Lengths			
2-Year (3.24 m/s)	10-Year (3.83 m/s)	20-Year (4.11 m/s)	100-Year (4.85 m/s)
5.80 m 144 MPa	5.02 m 150 MPa	4.70 m 153 MPa	3.97 m 161 MPa

Incipiently mobile particle sizes that may cause a dent of 2% of pipe OD if fully entrained in the flow were evaluated at return period flow conditions. Sizes ranged between 0.15 m diameter (at 100-Year flow) to 0.20 m diameter (at 2-Year flow.)

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Reference: Stress and Vortex Induced Vibration Results from HID1044 Pipe Exposure Engineering Assessment

Free span deflections of the exposed spans due to distributed loads from buoyancy and hydrodynamic drag (approximately 160kg/m at 3.24m/s) may be on the order of 1m, and the pipe has flexibility to reposition itself.

DISCUSSION

The undercut span of 30.31m is outside of the range of a stability parameter in the DNV F105 methodology. Rather than numerically modelling the post-buckling structural response of the pipe, two cases were considered: reducing the operating temperature to 5°C to satisfy the stability parameter, and a non-conservative shorter span of 16m. Both spans are subject to cross-flow VIV in the range of velocities evaluated, with the results indicating cyclic stresses in excess of the assumed pipe SMYS. The long and flexible span will have deflected into a post-buckled shape with a lower natural frequency than the current DNV F105 approach models. **Stantec recommends mitigation to stabilize and protect the pipe as well as assessing its condition:**

- **As the pipe was being exposed, it is likely that shorter spans were subject to cyclic VIV loading.**
- **The long span has a greater probability of being subject to damage.**
- **The behaviour of the span under hydrodynamic loading will be complex, and due to buoyancy will have a tendency to unbury itself. Given the current uncertainties (wall thickness, pipe grade), more sophisticated modelling may not increase accuracy or certainty in its results.**

Other engineering assessments, such as debris and ice loading and brittle fracture and girth weld bending can also affect the integrity of the pipeline. These assessments have not been completed at this time as mitigations are already recommended.

Should you have any questions regarding this memorandum, please contact Robin Clysdale at (403) 471-4459.

Stantec Consulting Ltd.



Robin Clysdale P.Eng.
Crossing Group Lead

Phone: 403 471 4459
robin.clysdale@stantec.com



To:	Pat Gribbon	From:	Robin Clysdale
	Enbridge Gas Inc.		Stantec Consulting Ltd.
File:	160951269	Date:	January 31, 2022

Reference: Stress and Vortex Induced Vibration Results from HID17991 Pipe Exposure Engineering Assessment

Enbridge Gas Inc. (EGI) identified an exposed NPS 10 pipeline on a watercourse during the 2021 Watercourse Crossing Management Program (HID 17991). The pipeline was identified as suspended (open spanning) with 19.44m undercut and 21.40m exposed at the time of survey.

STRESS / VORTEX INDUCED VIBRATIONS (VIV) ANALYSIS INPUTS AND ASSUMPTIONS

Stantec evaluated three load conditions associated with a pipeline exposure. The analysis is in accordance with CSA Z662-19 and DNV RP F105 (2006):

1. Combined stress due to operating conditions and bending due to buoyant and hydrodynamic loads. The acceptability criterion is based on CSA Z662-19 4.7.2.1.
2. Potential for fatigue due to vortex induced vibration, based on coincidence between ranges of structural vibrations of the pipe span and response to flow induced vibration.
3. Potential of impact by entrained particles to dent the pipe, based on "Full-scale Impact Tests on Pipelines," Palmer et al., 2006. Velocity of entrained particles are assumed to be low enough that strain rates are not significant and a quasi-static model can be employed with a dynamic load factor of 1.5. The acceptability criterion is based on CSA Z662-19 6.3.3.2, limiting potential indentation depth to less than 2% of the pipe OD.

The input parameters and assumptions for the analysis are summarized in Table 1.

Table 1: Input Parameters for VIV Analysis

Parameter	Symbol	Unit	Value
Pipe Specification			
Pipe OD (steel only)	Ds	m	0.27305
Pipe WT	ts	m	0.0064
Pipe SMYS	Y	MPa	290
Pipe Density	ρ_s	kg/m ³	7850
Pipe Modulus of Elasticity	Es	MPa	207000
Pipe Poisson's Ratio	ν		0.3
Pipe Expansion Coefficient	α_e		0.000012
Pipeline Buoyancy Control			Bare pipe is buoyant. Enbridge stated that pipe has buoyancy control weights. The weights are assumed to be bolted on (stable) and to have a mass of 545kg, length of 1m and spacing of 10m. These assumptions give the pipe an effective buoyancy of 15%. To account for the weights affecting the pipe statically and dynamically, they are

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Reference: Stress and Vortex Induced Vibration Results from HID17991 Pipe Exposure Engineering Assessment

Parameter	Symbol	Unit	Value
			modelled as an average concrete coating with density of 2250kg/m and thickness of 0.0238m, but no stiffness. The results are interpreted in the discussion as for discrete weights.
Coating Density	ρ_c	kg/m ³	1300 (Assumed for coal tar/wrap)
Coating Thickness	t_c	m	0.004 (Assumed for coal tar/wrap)
Surface Roughness	k	m	0.0033 (Assumed for coal tar/wrap)
Pipe Condition			Assume nominal with no defects
Wall Thickness Reduction, Based on Flaw Size Mod B31G Burst Pressure			N/A
Service			
MOP	P	kPa	4670
Design Temperature	T1	°C	35 (Assumed) & 15 (to address issues with stability parameter. See note 2 below.)
Restraint Temperature	T2	°C	-5 (Assumed due to installation 1974-12-04)
Product Density	ρ_c	kg/m ³	36 (Assumed based on typical natural gas composition at 15°C and MOP)
Fatigue			
S-N Parameter log a	log a	log (MPa)	11.068 (S-N curve F3 from DNV RP C203 (2016,) table 2-4). See note 1 below.
S-N Parameter m	m		3
Operating Pressure Hoop Stress Cycle		MPa	N/A (only consider fatigue due to VIV)
Operating Pressure Cycles Per Year			N/A (only consider fatigue due to VIV)
Fatigue Life Criteria			One day. See note 1 below
Crossing/Flow Conditions			
Relative Angle (pipe to flow)	θ_{rel}	°	90
Mean Velocity	V	m/s	0.32 to 0.42 (Mean velocities corresponding to return periods from 2 years to 100 years) Additional mean velocities associated with VIV onset
Density of River Water	ρ_w	kg/m ³	1000
Kinematic Viscosity	ν	m ² /s	0.000001
Keulegan Carpenter Number	KC		0 (Assume there is no wave velocity)
Current Flow Ratio	α		1 (Assume there is no wave velocity)
Gap Ratio	e/D		2.31 (Averaged across current undercut span of 19.44m) See note 2 below
Trench Depth Ratio	Δ/D		0 (Assume there are no significant trench effects at exposure)

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Reference: Stress and Vortex Induced Vibration Results from HID17991 Pipe Exposure Engineering Assessment

Parameter	Symbol	Unit	Value
Span and Soil Boundary Conditions			
Span Length	L	m	19.44 (currently undercut), 14 & 10 See note 2 below
Soil Type			Stiff Clay (Assumed)
Soil - Outer Layer Friction Coefficient			0.6 (Assumed)
Soil Stiffness (Static Lateral)	CL	(kN/m)/m	5000 (Assumed.)
DNV RP F105 Safety Factors			
Inline Response Onset Safety Factor	γ_{onIL}		1.1
Crossflow Response Onset Safety Factor	γ_{onCF}		1.2
Stability Parameter Safety Factor	γ_k		1.0 (The pipeline is considered to be low safety class per DNV F101)
Natural Frequency Safety Factor	γ_f		1.05 (The pipeline is considered to be low safety class per DNV F101 and the spans "well defined" per DNV F105 in that the current undercut span and gap have been measured.)
Stress Range Safety Factor	γ_s		1.3
Impact			
Entrained Spherical Particle Diameter	d	m	Diameters for return period mean velocities are assessed in the analysis
Specific Gravity of Particle	SG		2.65
Impact Factor	DLF		1.5
Geometry Factor	GF		1.5. See note 3 below
<p>Notes:</p> <ol style="list-style-type: none"> 1. Fatigue life considers cycles due to inline and crossflow VIV response. The fatigue life criteria of one day is based on a single event at sustained flow conditions with a given exposed span length. 2. Currently 21.40m is exposed at the top of the pipe, and 19.44m is undercut with average gap ratio of 2.31. The DNV F105 methodology has a number of empirical terms and parameters that are only applicable within certain ranges. With an undercut span of 19.44m, a "stability parameter" is no longer within the applicable range. The following additional cases were considered (numerically modelling a post-buckling structural response of the pipe was not considered): <ol style="list-style-type: none"> a. A span of 19.44m was evaluated with an operating temperature of 15°C. Reducing the temperature brings the case within the range of the stability parameter as the reduced thermal stress reduces the instability to global buckling. b. A span of 14m (satisfying the stability parameter) was evaluated as a non-conservative case. c. A span of 10m was evaluated as the assumed buoyancy control weights may act as nodes for VIV response. This would assume one weight is in the middle of the span as one or two weights in the span with 10m spacing but arbitrarily positioned relative to the centre of the span would have complicated behaviour with coupled spans of different natural frequencies. 3. A geometry factor is included in the impact analysis as the methodology is based on experiments with a line load as opposed to a point load. However, the methodology also has other conservative assumptions, with the impact occurring square on the springline of the pipe with no angular momentum. 			

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Reference: Stress and Vortex Induced Vibration Results from HID17991 Pipe Exposure Engineering Assessment

RESULTS

Table 2 presents threshold velocities for the following conditions:

- Onset of inline VIV response (initially at negligible amplitude);
- Inline VIV response with moderate stress amplitudes (approximately 10 MPa);
- Pipe yield stress is exceeded due to combined stress including operating stress (pressure and temperature) quasi-static bending (buoyancy and hydrodynamic drag) and VIV cyclic stress range;
- Onset of cross-flow VIV response (initially at negligible amplitude);
- Cross-flow VIV response with moderate stress amplitudes (approximately 10 MPa).

These results are generated by varying the velocity with other input parameters fixed.

Table 2: Threshold Velocities

Span Length (m)	Threshold Velocities (m/s)				
	Inline VIV onset	Inline VIV (moderate stress amplitude)	Pipe yield stress exceeded	Cross-flow VIV onset	Cross-flow VIV (moderate stress amplitude)
19.44 (current undercut span, out of range of DNV F105 stability parameter when operating temperature is 35°C)	0.23	0.25	0.25	0.50	0.53
19.44 (current undercut span, <u>operating temperature reduced to 15°C</u> to satisfy stability parameter)	0.41	0.46	0.95	0.88	0.94
14 (non-conservative span that satisfies stability parameter)	0.70	0.76	0.68	1.50	1.58
10 (assumed effective span for VIV response node based on assumed buoyancy control weight spacing.)	1.38	1.48	1.72	2.96	3.12

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Reference: Stress and Vortex Induced Vibration Results from HID17991 Pipe Exposure Engineering Assessment

Table 3 presents combined stress and fatigue life at mean velocities of return period flow conditions.

Table 3: Combined Stress and Fatigue Life at Return Period Velocities

Span Length (m)	Combined Stress and Fatigue Life			
	2-Year (0.32 m/s)	10-Year (0.38 m/s)	20-Year (0.38 m/s)	100-Year (0.42 m/s)
19.44 (current undercut span, out of range of DNV F105 stability parameter when operating temperature is 35°C)	340 MPa 354 hours (note that this does not account for reduced fatigue life from other cyclic loading in the pipeline's lifespan)	Acceptability criteria exceeded with 2-Year return period conditions		
19.44 (current undercut span, <u>operating temperature reduced to 15°C</u> to satisfy stability parameter)	155.4 MPa (for comparison with 14m and 10m spans at 35°C, add back 49.68 MPa of "restrained thermal stress" for a comparable 205.1 MPa) 0 hours (pipe is not subject to VIV)	155.7 MPa (for comparison with 14m and 10m spans at 35°C, add back 49.68 MPa of "restrained thermal stress" for a comparable 205.4 MPa) 0 hours (pipe is not subject to VIV)	155.7 MPa (for comparison with 14m and 10m spans at 35°C, add back 49.68 MPa of "restrained thermal stress" for a comparable 205.4 MPa) 0 hours (pipe is not subject to VIV)	155.9 MPa (for comparison with 14m and 10m spans at 35°C, add back 49.68 MPa of "restrained thermal stress" for a comparable 205.6 MPa) 0 hours (pipe is not subject to VIV)
14 (non-conservative span that satisfies stability parameter)	190.4 MPa 0 hours (pipe is not subject to VIV)	190.6 MPa 0 hours (pipe is not subject to VIV)	190.6 MPa 0 hours (pipe is not subject to VIV)	190.7 MPa 0 hours (pipe is not subject to VIV)
10 (assumed effective span for VIV response node based on assumed buoyancy control weight spacing.)	178.2 MPa 0 hours (pipe is not subject to VIV)	178.3 MPa 0 hours (pipe is not subject to VIV)	178.3 MPa 0 hours (pipe is not subject to VIV)	178.4 MPa 0 hours (pipe is not subject to VIV)

Table 4 presents threshold span lengths of inline VIV onset and the corresponding combined stress at mean velocities of return period flow conditions. These results are generated by varying the undercut span length with other parameters fixed.

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Reference: Stress and Vortex Induced Vibration Results from HID17991 Pipe Exposure Engineering Assessment

Table 4: Threshold Span Lengths and Combined Stress at Return Period Velocities

Inline VIV Onset Threshold Span Lengths			
2-Year (0.32 m/s)	10-Year (0.38 m/s)	20-Year (0.38 m/s)	100-Year (0.42 m/s)
18.2 m 237 MPa	17.4 m 221 MPa	17.4 m 221 MPa	16.9 m 214 MPa

Incipiently mobile particle sizes that may cause a dent of 2% of pipe OD if fully entrained in the flow were evaluated at return period flow conditions. Sizes ranged between 0.92 m diameter (at 100-Year flow) to 1.12 m diameter (at 2-Year flow.)

Free span deflections of the exposed spans due to distributed loads from buoyancy and hydrodynamic drag (approximately 15.3kg/m at 0.42m/s) may be on the order of 28mm. Due to the length of the span, the pipe has flexibility to reposition itself, but the loading is not significant to displace the pipe significantly.

DISCUSSION

The undercut span of 19.44m is outside of the range of a stability parameter in the DNV F105 methodology. Rather than numerically modelling the post-buckling structural response of the pipe, three cases were considered: reducing the operating temperature to 15°C to satisfy the stability parameter, a non-conservative shorter span of 14m, and a non-conservative shorter span of 10m that may be a characteristic of a response if assumed buoyancy control weights act as nodes to constrain the pipe's hydrodynamic response. None of these cases exceeded acceptability criteria for stress or were subject to VIV. **Stantec recommends mitigation to stabilize and protect the pipe as well as assessing its condition:**

- **As the pipe was being exposed, shorter spans may have been subject to cyclic VIV loading.**
- **The long span has a greater probability of being subject to damage.**
- **The assumed buoyancy control weights may become unstable if in an undercut span. Depending on the position of the weights, then may cause the pipe to respond to hydrodynamic loads as a shorter span, but those spans will be coupled and may lead to more complex responses.**
- **The behaviour of the span under hydrodynamic loading will be complex. More sophisticated modelling may not increase accuracy or certainty in its results.**

The incipiently mobile particle sizes cannot be fully entrained in the flow at the flow rates/bed shear stresses. While saltation (intermittent "leaping" rather than suspension) of such particles might cause them to contact the pipe, they would not impart enough energy to dent the pipe.

Other engineering assessments, such as debris and ice loading and brittle fracture and girth weld bending can also affect the integrity of the pipeline. These assessments have not been completed at this time as mitigations are already recommended.

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Reference: Stress and Vortex Induced Vibration Results from HID17991 Pipe Exposure Engineering Assessment

Should you have any questions regarding this memorandum, please contact Robin Clysdale at (403) 471-4459.

Stantec Consulting Ltd.

A handwritten signature in blue ink, appearing to read 'Robin Clysdale', is positioned above the printed name.

Robin Clysdale P.Eng.
Crossing Group Lead

Phone: 403 471 4459
robin.clysdale@stantec.com



CORUNNA COMPRESSOR STATION

Sensitivity Case RAM Study Report

Enbridge Gas Inc.

Report No.: 10304304-2SC, Rev. 0

Date: 3rd March 2022





Project name: Corunna Compressor Station
 Report title: Sensitivity Case RAM Study Report
 Customer: Enbridge Gas Inc.
 Customer contact: Mike Hildebrand
 Date of issue: 3rd March 2022
 Project No.: 10304304
 Organisation unit: Energy Systems
 Report No.: 10304304-2SC, Rev. 0
 Applicable contract(s) governing the provision of this Report: Master Services Agreement with Enbridge Gas Inc.

DNV
 DNV Canada Ltd.
 Energy Systems
 Tel: 403 702 5679

Objective:

This report details the assumptions, basis, and results of the Corunna Compressor Station Sensitivity Case RAM Study.

Prepared by:

Joao Vasques
Senior Consultant

Verified by:

Neil Wragg
Senior Principal Consultant

Approved by:

Jeremy Johnson
Senior Engineer, DNV Canada Ltd.

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1 INTRODUCTION

The Corunna Compressor Station (CCS) is located near Mooretown ON. Currently, it uses 11 reciprocating compressor units to transport sweet natural gas to and from offsite underground storage facilities to transmission pipelines for eventual use in downstream distribution networks.

CCS has two modes of operation: injection and withdrawal. At the moment, the Injection operating mode takes gas from the two twin NPS 30 transmission pipelines (TR1/TR2) from Dawn and flows the gas through CCS to the offsite storage pools. Conversely, the Withdrawal operating mode takes gas from the storage pool pipelines and flows through CCS into the transmission pipelines back to the Dawn facility.

However, an alternative scenario is being considered, comprising an additional new pipeline (TR7), also linked to the Dawn facilities, which will play a supporting role in the compression operations required during the Injection and Withdrawal modes to and from the CCS. The shifting of a proportion of the compression operations to Dawn will effectively act as a replacement of the 7 MP compression units at CCS, which will be decommissioned. It is estimated that the new TR7 pipeline will be fully commissioned by November 2023.

Enbridge have asked DNV to undertake a Reliability, Availability and Maintainability (RAM) Study for the Corunna Compressor Station. The primary objective of this analysis is to forecast the current availability performance of the station and assess the impact of proposed modifications. DNV has already issued a report detailing the assumptions, basis and results of the Corunna Compressor Station RAM models covering the current availability performance of CCS in addition to a 5-year look-ahead period where the TR7 alternative scenario is not considered (Base Case).

However, this current report details the assumptions, basis and results for the Corunna Compressor Station RAM models, which take into consideration the impact of adoption of the commissioning of the TR7 pipeline as a Sensitivity Case, which will be compared against the Base Case results.



Figure 1.1 Corunna Compressor Station



2 RAM DEFINITIONS / ABBREVIATIONS

Definitions and descriptions for abbreviations are summarised in the table below:

Terminology/ Abbreviation	Definition/Description
Active Repair Time	Effective time to achieve repair of an item (see Figure 2.1)
Availability	$(\text{Time all required equipment is available}) / (\text{Time}) * 100\%$
CCS	Corunna Compressor Station
Critical (System)	Item or system required for gas flow
Critical Failure	Failure of an equipment unit that causes an immediate cessation of the ability to perform its function.
Demand	The level of gas flow to/from the CCS excluding all planned or unplanned losses.
Equipment Unit	Specific equipment within an equipment class as defined by its boundary.
Logistic Delay	Accumulated time during which maintenance cannot be carried out due to the time to acquire maintenance resources (personnel, spares, tools etc.), including any administrative delay.
$10^3\text{m}^3/\text{d}$	Thousand Cubic Metres per Day
Mobilisation Time	Time to secure all necessary resources to execute maintenance.
MTBF	Mean Time Between Failures: Total operating time divided by the number of failures (not including downtime) for an element in the model (hours)
MTTF	Meant Time To Fail: Expectation of the time to failures, excluding repair times $\text{MTTF} = \text{MTBF} - \text{MTTR}$
MTTR	Mean Time To Repair: Time taken to perform the corrective maintenance on a failed item (hours). Same as Active Repair Time
'N' Configuration	Resilience terminology used to represent an equipment or system that is designed to cover the baseline demand but has no redundancy in place to accommodate any failure or maintenance operation. This can either comprise 1 item that fulfils 100% of the baseline demand or multiple items that in aggregate fulfil 100% of the baseline demand (e.g., 2 x 50%).
OREDA	Offshore and Onshore Reliability Data
Production Efficiency	Production efficiency (PE): $(\text{Actual Volume}) / (\text{Target Production}) * 100\%$
RAM	Reliability: Probability of system/item non-failure in a given period Availability: Proportion of time that the system/item performs its intended function Maintainability: Probability of repair in a given time
Shortfall	Proportion or amount of demand not produced (% or 10^3m^3)
TJ/d	Terajoules per day
Total Downtime	Sum of Downtime due to Mobilisation & Preparation Delay, Active Repair Time and Restart Delays (see Figure 2.1)
Uptime	$(\text{Time non-zero flow is achieved}) / (\text{Time}) * 100\%$
Utilization	The percentage of output volume achieved as a ratio of the system potential volume

Table 2.1 Definitions

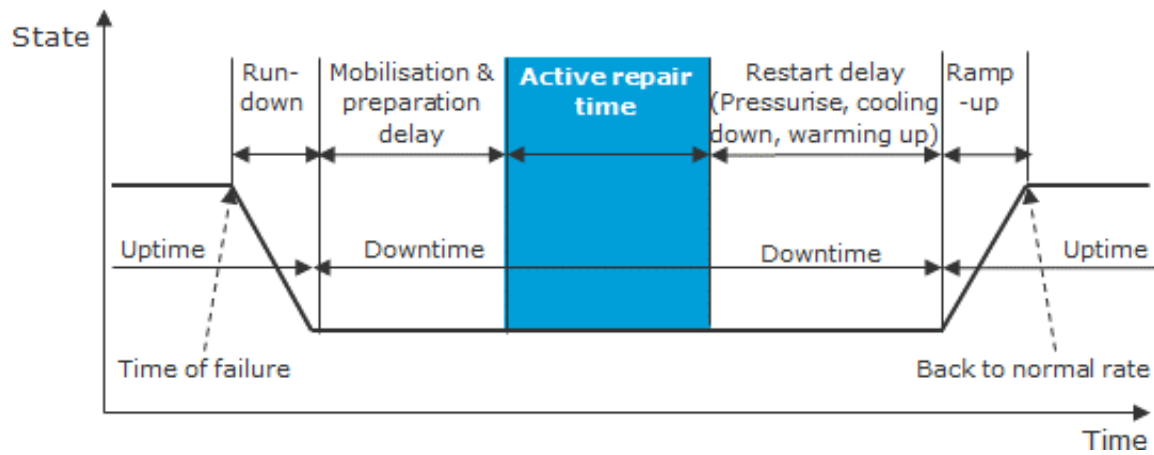


Figure 2.1 Active Repair Time



3 SCOPE OF WORK

3.1 Objectives

The objectives of this Sensitivity Case RAM study are as follows.

- Forecast Availability (%) and Uptime (%) of the CCS over the remaining operational life. The following operations will be assessed:
 - **Injection Mode:** Gas taken from Dawn facility and transferred to offsite storage pools between 6th of May and end of October each year.
 - **Withdrawal Mode:** Gas taken from offsite storage pools and transferred to Dawn facility between the 1st of November subsequent to injection and end of March.
- Comparison of the top-level results for the Sensitivity Case against Base Case results for both modes of operation.

3.2 Study Boundaries

The RAM study will consider all process and utility equipment critical to gas injection / withdrawal, within the following boundaries (represented diagrammatically in Figure 3.1) [1]:

Injection Mode

- Upstream: Inlet ESDVs from Dawn Facility (TR1/TR2)
- Downstream: Outlet ESDVs to Offsite Storage Pools* (Dow Moore/Mid Kimball-Colinville/ South Kimball-Colinville, Wikesport/Seckerton/Corunna/Ladysmith)

Withdrawal Mode

- Upstream: Inlet ESDV from Offsite Storage Pools* (Dow Moore/Mid Kimball-Colinville/ South Kimball-Colinville, Wikesport/Seckerton/Corunna/Ladysmith)
- Downstream: Outlet ESDV to Dawn Facility (TR1/TR2)

**Note: Availability will be measured on the total gas flow to/from all pools (flow to/from individual pools will be considered by equipment criticality only)*

It is important to note that, since they are not part of the scope of the Sensitivity Case RAM models, TR1 and TR2 pipelines will be assumed to be 100% available, therefore not considering the scheduled or unscheduled outages. The same applies to the new TR7 pipeline in addition to the Dawn facilities. It is therefore acknowledged that the criticality, and performance risk to CCS operations, associated with the MP compressors, will be shifted to Dawn. An integrated model accounting for all aforementioned facilities can be considered in the future.

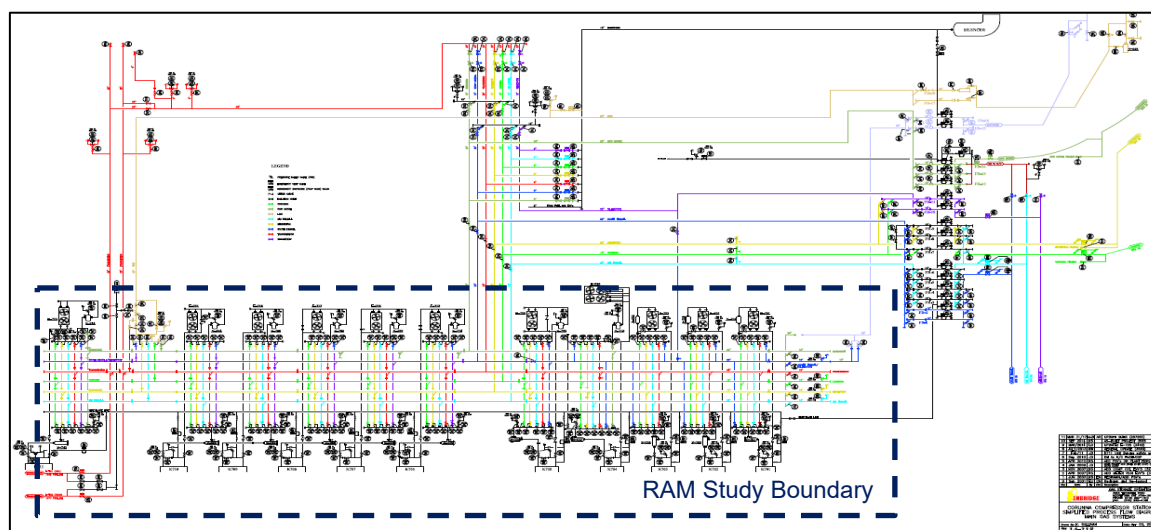


Figure 3.1 Corunna Compressor Station Simplified Flow Diagram (with RAM Study Boundary included)



3.3 Case Definition

3.3.1 Sensitivity Cases

As with the Base Cases, two Sensitivity Cases have been defined, pertaining to the Injection and Withdrawal modes of operation, which will be assessed separately.

It is important to note that since it is assumed that the TR7 pipeline will be available by November 2023, that the models will assume the following:

- The current compressor arrangement will remain the same until the third Injection season assessed (TR7 commissioning only impacts the injection mode from 2024 – 2 years in current configuration).
- The current compressor arrangement will remain the same until the second Withdrawal season assessed (TR7 commissioning impacts the withdrawal mode from 2023 – 1 year in current configuration).

4 SENSITIVITY CASE MODELLING ASSUMPTIONS

The following list details the Sensitivity Case models basis and assumptions, which are considered in more detail in the following sections:

- Period of study: This RAM study is based on a 5-year look-ahead period, starting in 2022.
- Two separate Sensitivity Case RAM models will be developed:
 - Injection (with compression).
 - Withdrawal (with compression).
- System demand: Availability will be measured against system demand. System demand is assumed to be equal to the injection/withdrawal profiles (see Section 4.1).
- Compressor Lineup (Section 4.2) [1] [2]:
 - List of compressors.
 - Lineup during compression modes (withdrawal and injection).
- Reliability data: Equipment level (See Section 4.3) [3].
- Maintenance and operations e.g., planned maintenance, logistic delays (Section 4.4).

4.1 Injection/Withdrawal Profiles

In this Sensitivity Case RAM Study, the Injection/Withdrawal demand profiles used to assess the performance of the Corunna facilities will be the same as the ones used in the Base Case models, thus allowing for a direct assessment of the impacts associated with the introduction of the TR7 pipeline, supported by MP compression at Dawn in November 2023. This introduction will therefore lead to a new compressor arrangement in both injection and withdrawal modes, which is detailed in Table 4.1 and Section 4.2.



Table 4.1 Operating Envelope Post November 2023 (TR7 Commissioning)

Season	Calendar Period		Operating Mode	Avg. Time in Mode	Target Flow Rate		Compressor Configuration
	Start	End		days	TJ/d	10 ³ m ³ /d	
Spring Shoulder	1 st May	5 th May	Outage on Main Plant	5	0	0	-
Injection	6 th May	26 th May	Free Flow	21	300	7,752	-
	27 th May	30 th Jun	Free Flow	35	650	16,796	-
	1 st Jul	31 st Jul	Free Flow	31	850	21,964	MP from Dawn
	1 st Aug	31 st Aug	Free Flow / Compression	31	850	21,964	MP from Dawn + HP at Corunna (both required) 2xHP
	1 st Sep	30 th Sep		30	700	18,088	MP from Dawn + HP at Corunna (both required) 2xHP
	1 st Oct	21 st Oct		21	350	9,044	MP from Dawn HP at Corunna (1 HP required)
	22 nd Oct	31 st Oct		10	280	7,235	MP from Dawn HP at Corunna (both HP required)
Fall Shoulder	1 st Nov	5 th Nov	Outage on Main Plant	5	0	0	-
Withdrawal	6 th Nov	26 th Nov	Free Flow	21	600	15,504	-
	27 th Nov	31 st Dec	Free Flow	35	850	21,964	To Dawn
	1 st Jan	27 th Jan	Free Flow / Compression	27	950	24,548	LP at Corunna (both required) + MP at Dawn
	28 th Jan	31 st Jan	Compression - PEAK	4	2415	62,400	MP at Dawn / LP / HP (4 out of 4 units at Corunna used)
	1 st Feb	27 th Feb	Free Flow / Compression	27	950	24,548	LP at Corunna (both required) + MP at Dawn
	28 th Feb	28 th Feb	Compression – Design Day	1	2415	62,400	MP at Dawn / LP / HP (3 out of 4 units at Corunna used – K711 as stand-by)
	1 st Mar	31 st Mar	Free Flow / Compression	31	950	24,548	LP at Corunna (both required) + MP at Dawn
	1 st Apr	30 th Apr		30	600	15,504	LP at Corunna (both required) + MP at Dawn



4.2 Compressor Nominal Capacity & Line-up

Table 4.2 summarises the compressor nominal capacity, which plays a key role in the determination of the nominal compressor line-up. Furthermore, the nominal compressor line-up, used to produce an accurate representation of the varying gas demand throughout the Injection and Withdrawal cycles over a calendar year is reported diagrammatically in Sections 4.2.1 and 4.2.2, respectively. For each compressor unit, a % contribution to target flow is given for each operating 'phase' of the pressure cycle.

Table 4.2 Compressor Nominal Capacity

Tag	Mode	Nominal Max Flow*		Nominal % of Flow Demand
		MMscfd	10 ³ m ³ /d	
K701**	MP	170	4814	See diagrams in Sections 4.2.1 and 4.2.2
K702**	MP	170	4814	
K703**	MP	170	4814	
K704	HP	135	3823	
K705**	MP	210	5947	
K706**	MP	210	5947	
K707**	MP	210	5947	
K708**	MP	210	5947	
K709	LP	260	7362	
K710	LP	260	7362	
K711	HP	185	5239	

*Actual Max Flowrate of each compressor varies +-30% on suction /discharge pressure

**Not in operation after November 2023



4.2.1 Nominal Compressor Line-up – Injection Mode

Calendar Period: 27th of May - 30th of June

Target Flowrate: 650 TJ/d | 16,796 x 10³m³/d)

Free Flow

Calendar Period: 1st of July - 31st of July

Target Flowrate: 850 TJ/d | 21,964 x 10³m³/d)

Free Flow

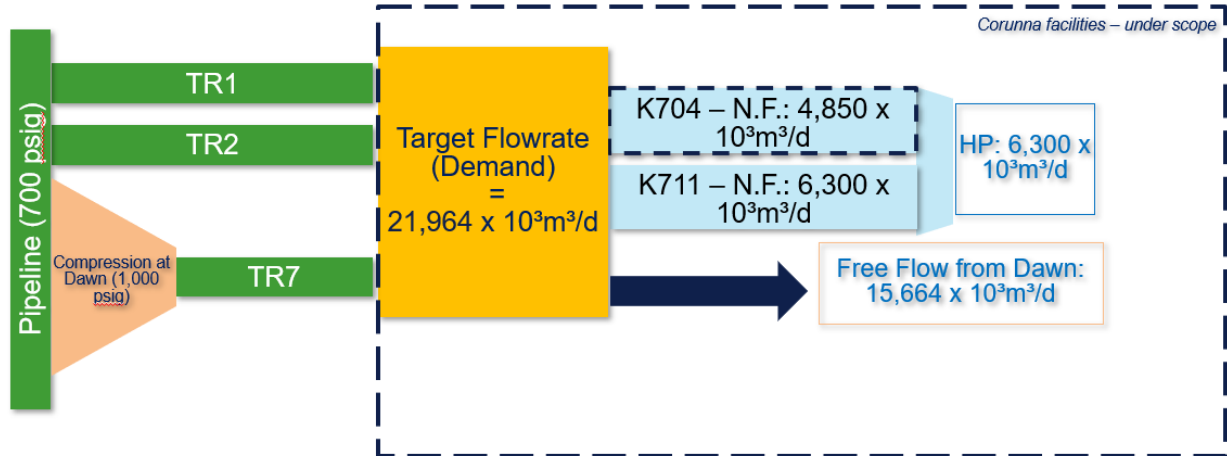


Calendar Period: 1st of August – 14th of August

Target Flowrate: 850 TJ/d | $21,964 \times 10^3 \text{m}^3/\text{d}$

Default Stand-by unit

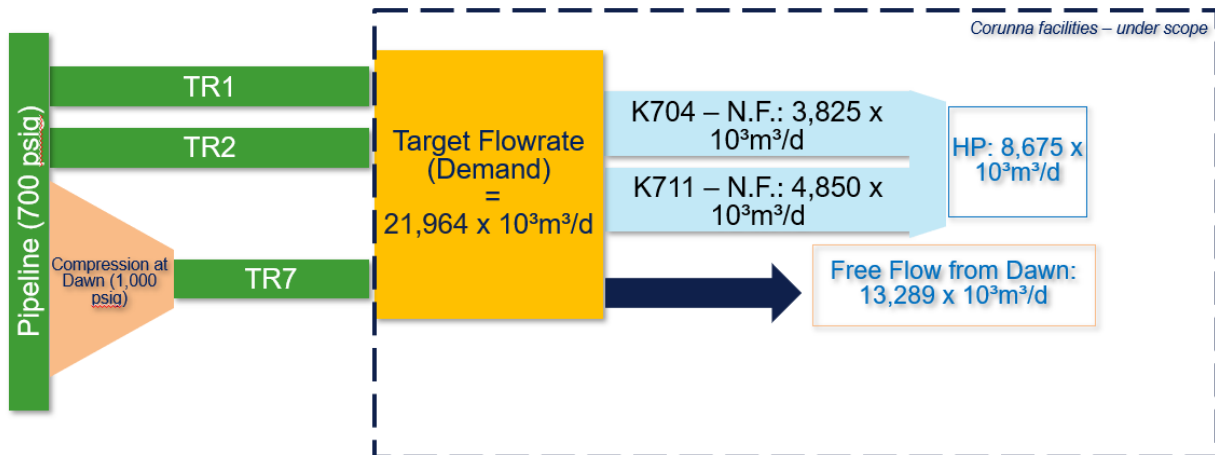
K711 used during this period



Compressor Configuration: MP from Dawn, HP at Corunna (1 unit required)

Calendar Period: 15th of August – 31st of August

Target Flowrate: 850 TJ/d | $21,964 \times 10^3 \text{m}^3/\text{d}$



Compressor Configuration: MP from Dawn, HP at Corunna (both required)

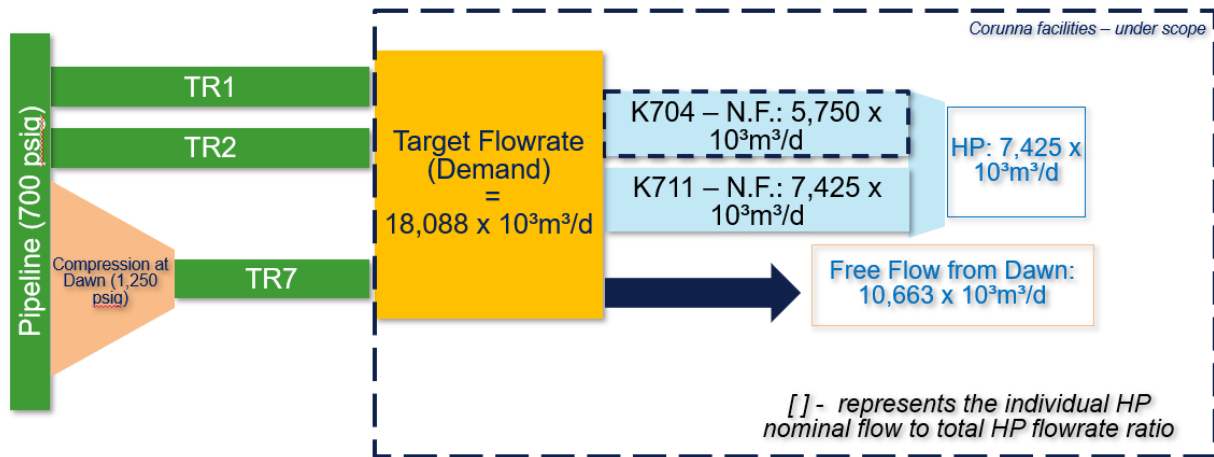


Calendar Period: 1st of Sep. – 14th of Sep

Target Flowrate: 700 TJ/d | $18,088 \times 10^3 \text{m}^3/\text{d}$

Default Stand-by unit

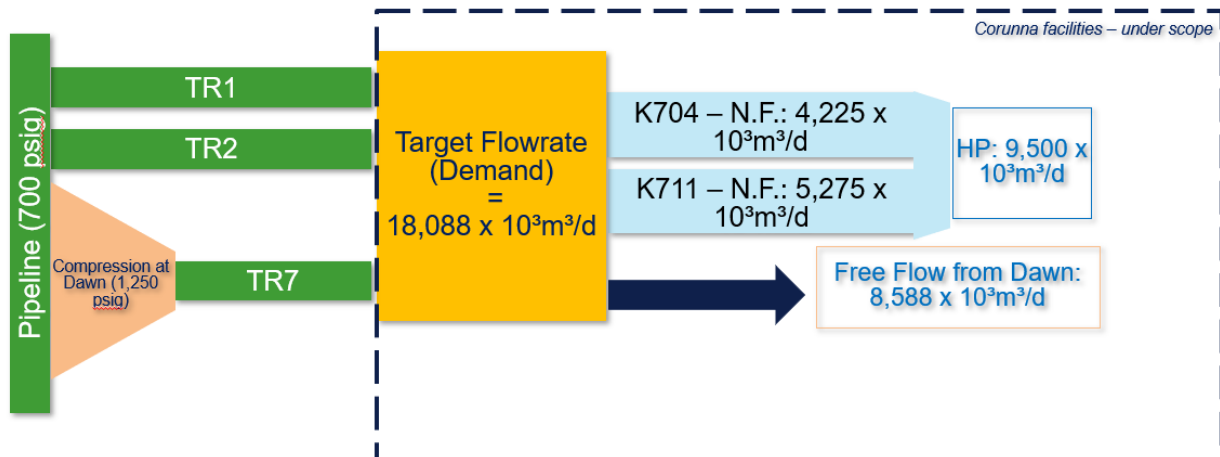
K711 used during this period



Compressor Configuration: MP from Dawn, HP at Corunna (1 unit required)

Calendar Period: 15th of Sep – 30th of Sep

Target Flowrate: 700 TJ/d | $18,088 \times 10^3 \text{m}^3/\text{d}$

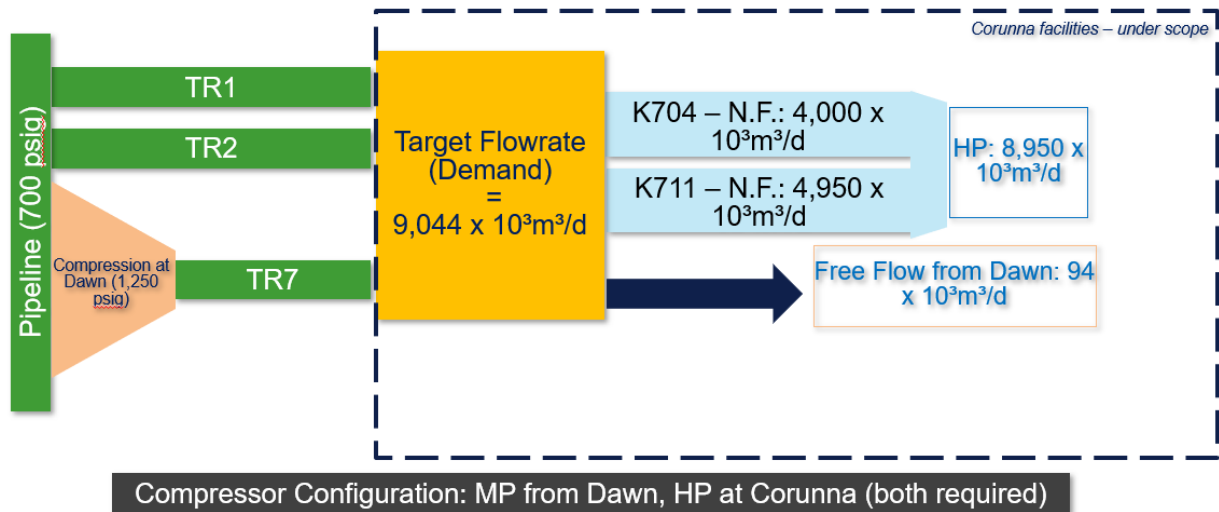


Compressor Configuration: MP from Dawn, HP at Corunna (both required)



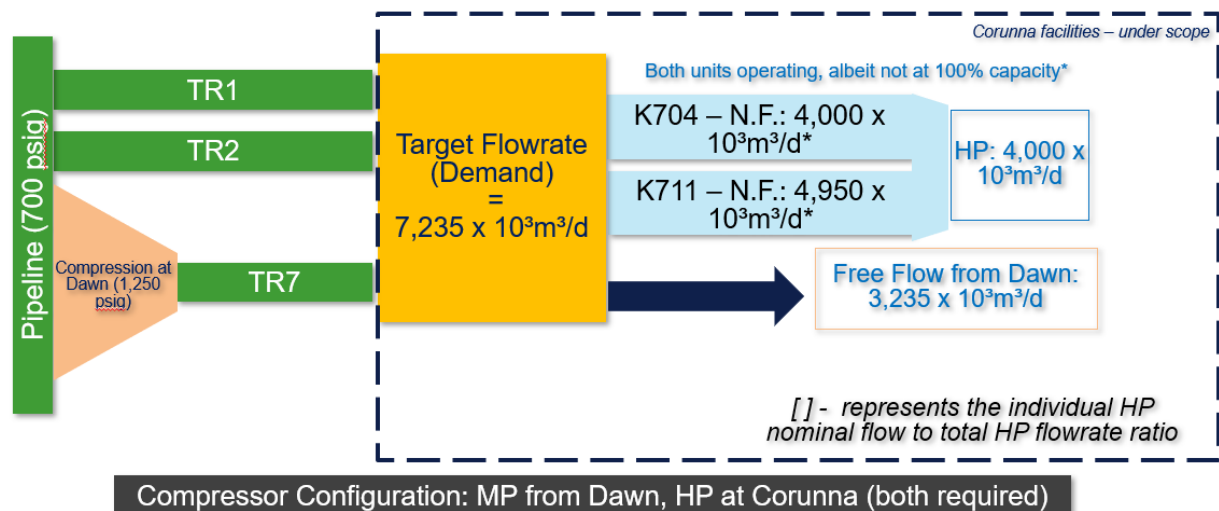
Calendar Period: 1st of Oct – 21st of Oct

Target Flowrate: 350 TJ/d | $9,044 \times 10^3 \text{m}^3/\text{d}$



Calendar Period: 22nd of Oct – 31st of Oct

Target Flowrate: 280 TJ/d | $7,235 \times 10^3 \text{m}^3/\text{d}$





4.2.2 Nominal Compressor Line-up – Withdrawal Mode

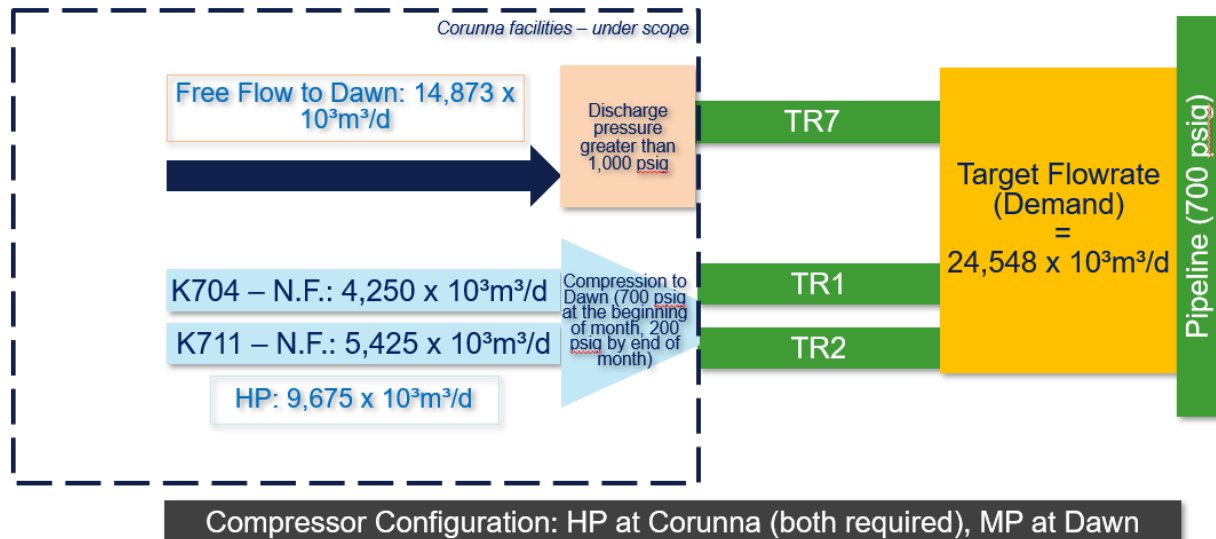
Calendar Period: 27th of Nov. – 31st of December (35 days)

Target Flowrate: 850 TJ/d | 21,964 x 10³m³/d)



Calendar Period: 1st of Jan – 15th of Jan

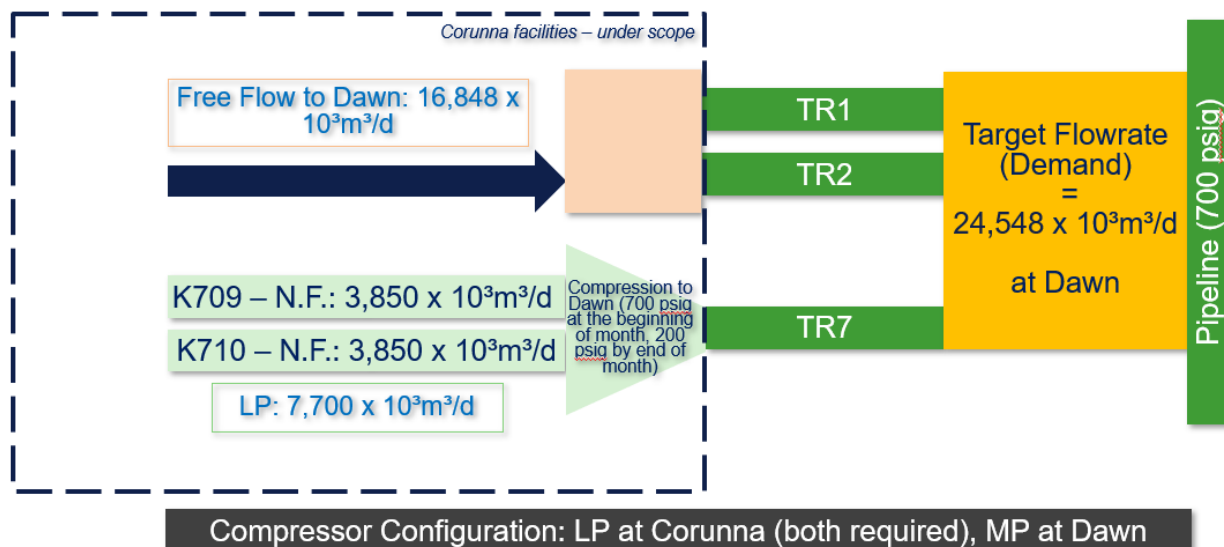
Target Flowrate: 950 TJ/d | 24,548 x 10³m³/d





Calendar Period: 16th of Jan – 27th of Jan

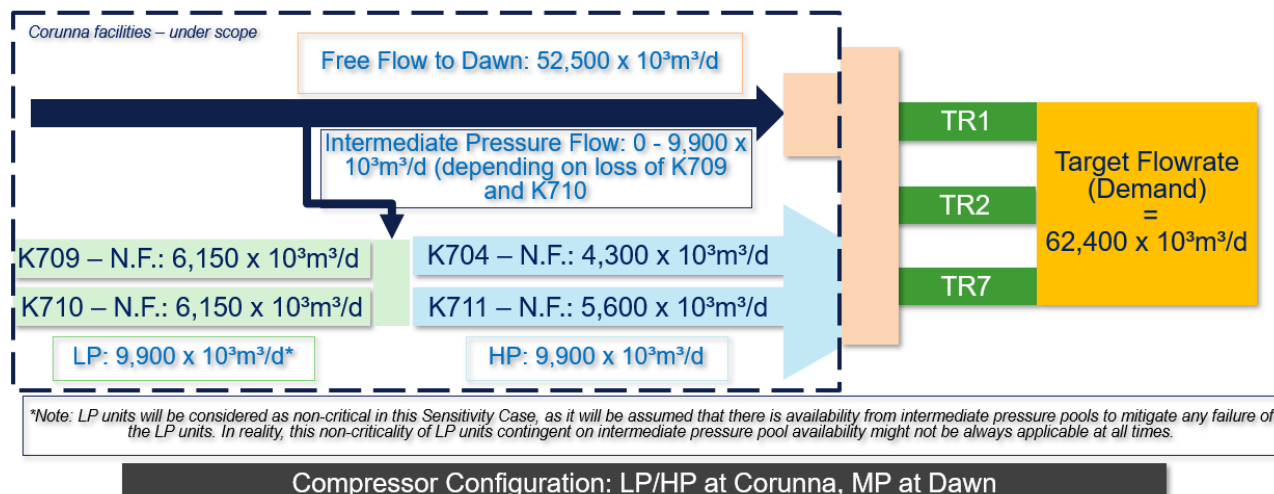
Target Flowrate: 950 TJ/d | $24,548 \times 10^3 \text{m}^3/\text{d}$



Peak Compression

Calendar Period: 28th of Jan. – 31st of Jan. (4 days)

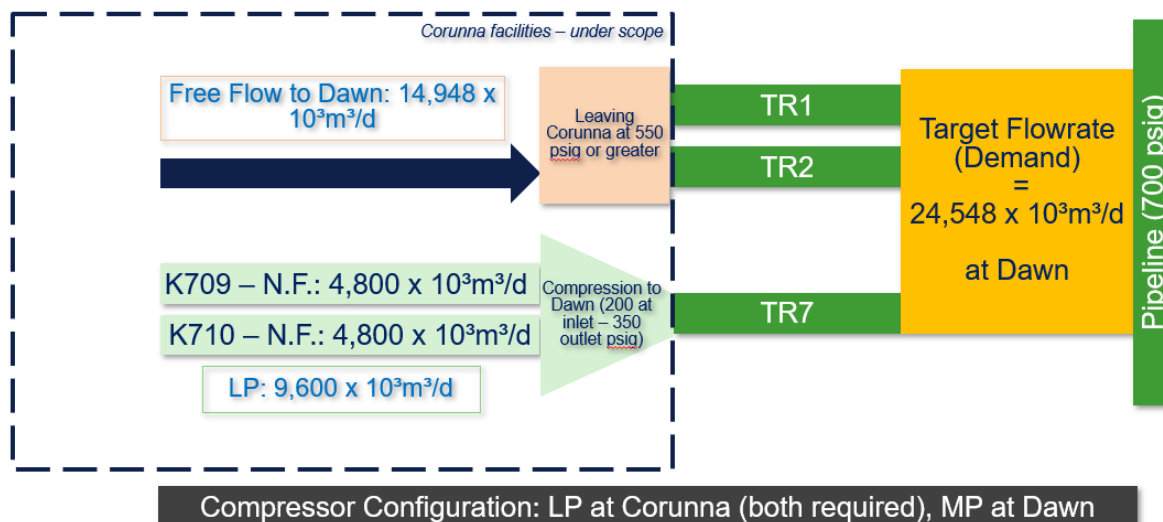
Target Flowrate: 2,415 TJ/d | $62,400 \times 10^3 \text{m}^3/\text{d}$





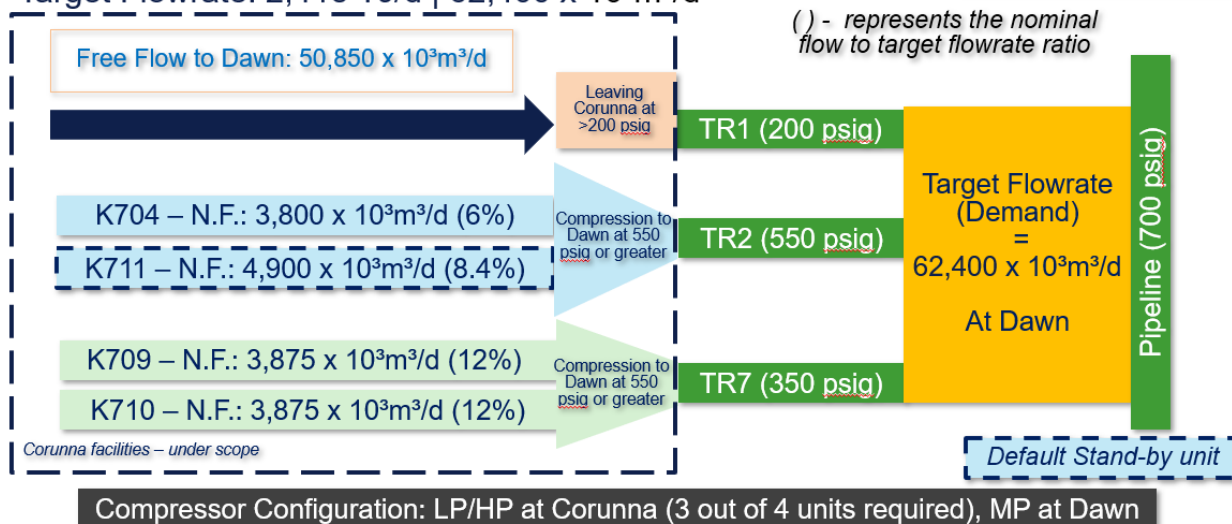
Calendar Period: 1st of Feb – 27th of Feb

Target Flowrate: 950 TJ/d | $24,548 \times 10^3 \text{m}^3/\text{d}$



Calendar Period: 28th of Feb – 28th of Feb

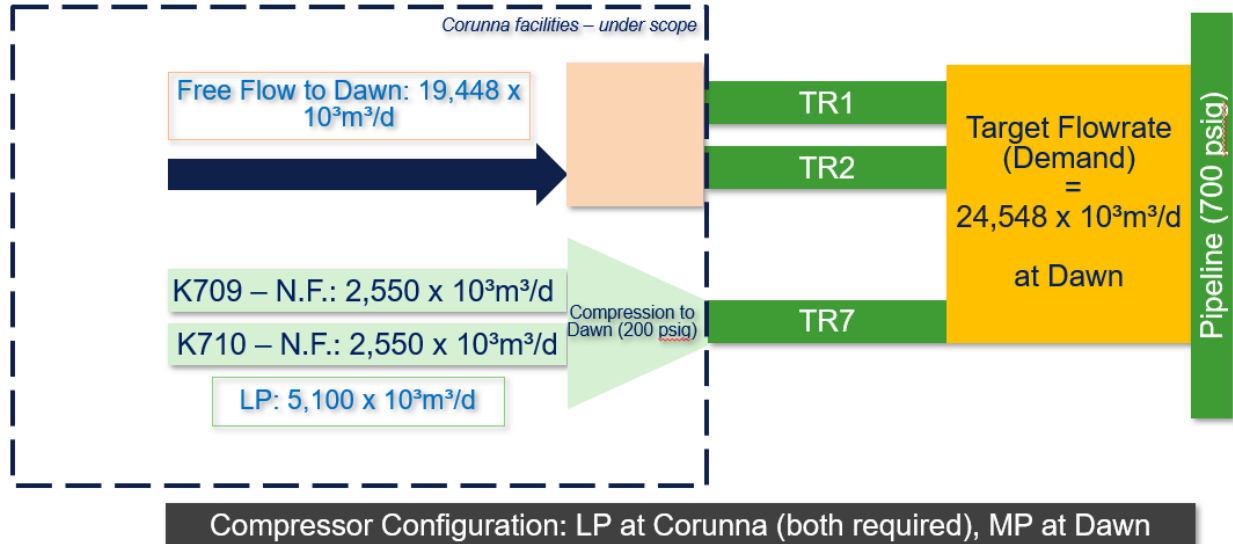
Target Flowrate: 2,415 TJ/d | $62,400 \times 10^3 \text{m}^3/\text{d}$





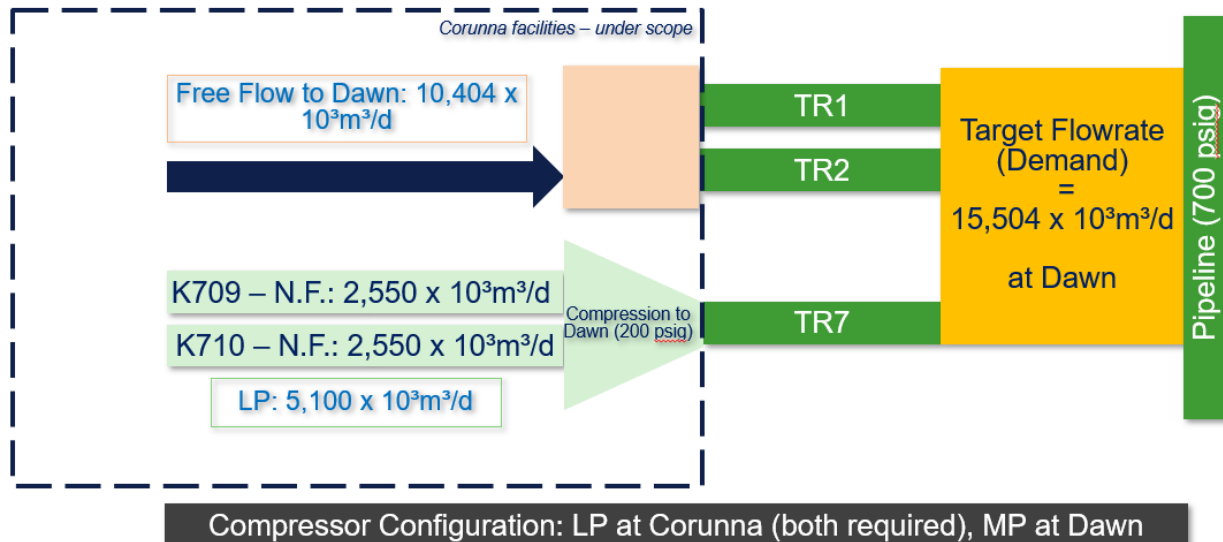
Calendar Period: 1st of March – 31st of March

Target Flowrate: 950 TJ/d | $24,548 \times 10^3 \text{m}^3/\text{d}$



Calendar Period: 1st of April – 30th of April

Target Flowrate: 600 TJ/d | $15,504 \times 10^3 \text{m}^3/\text{d}$





4.3 Reliability Data

Details on the reliability data used in the Sensitivity Case models can be found in Section 4.3 of the Base Case RAM Study Report (Report No.10304304-2) [4].

4.4 Maintenance and Operations

Details on the Maintenance and Operations incorporated in the Sensitivity Case models can be found in Section 4.4 of the Base Case RAM Study Report (Report No.10304304-2) [4].



5 RESULTS

In Sections 5.1 and 5.2, results are presented for the individually modelled Gas Injection and Gas Withdrawal modes of operation, respectively.

As in the Base Case models, the Gas Injection Sensitivity Case model considers the injection operation into the storage pools from the 27th of May to the 31st of October. Conversely, the Gas Withdrawal Sensitivity Case model assesses the gas withdrawal from the storage pools from the 27th of November to the 30th of April. The overall review period starts in 2022 and ends in 2026/2027.

5.1 Gas Injection Results

5.1.1 Overall Results Comparison

Table 5.1 presents the comparison of the overall results for Gas Injection Demand, Injection, Shortfall and Injection Efficiency between the Gas Injection Base and Sensitivity Cases, over the gas injection operating months for a period of 5 years.

Table 5.1 5-Year Comparison Between Gas Injection Base and Sensitivity Cases Overall Results

Case	Demand (x10 ³ m ³)	Injected (x10 ³ m ³)	Shortfall (x10 ³ m ³)	Injection Efficiency (%)	Shortfall (%)
Base	13,772,714	13,461,539	311,174	97.74%	2.26%
Sensitivity	13,772,714	13,551,059	221,654	98.39%	1.61%
Delta	-	+ 89,520	- 89,520	+ 0.65%	- 0.65%

Additionally, Table 5.2 presents the same level of comparison as above, focused on the last 3 years of Gas Injection (period where TR7 and Dawn are available for gas injection operations).

Table 5.2 3-Year Comparison Between Gas Injection Base and Sensitivity Cases Overall Results

Case	Demand (x10 ³ m ³)	Injected (x10 ³ m ³)	Shortfall (x10 ³ m ³)	Injection Efficiency (%)	Shortfall (%)
Base	8,263,628	8,090,047	173,581	97.90%	2.10%
Sensitivity	8,263,628	8,179,568	84,061	98.98%	1.02%
Delta	-	+ 89,520	- 89,520	+ 1.08%	- 1.08%

Figure 5.1 presents diagrammatically the estimated volumes of gas injected over the period of 5 years reviewed.

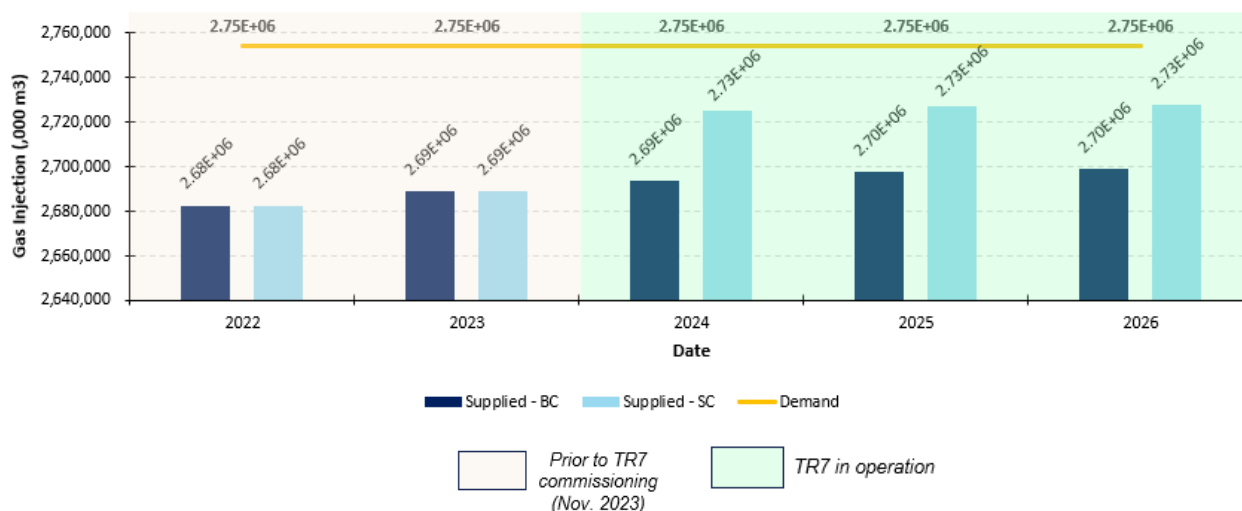


Figure 5.1 Yearly Gas Injection Breakdown Comparison Between Base and Sensitivity Cases (x10³m³)

Key observations are that:

- Over the entire 5 years of period reviewed, the implementation of the TR7 pipeline with the Dawn facilities supporting the MP operations (that would otherwise be conducted at CCS), will result in a performance improvement of 0.65% (from 97.74% to 98.39%). In overall terms, this means that an additional 89,520 x10³m³ of gas will be injected into the CCS serviced storage pools;
- If only the years where the TR7 pipeline is operational are considered, the improvement in Injection Efficiency is 1.08%;
- The aforementioned performance improvements are based on the assumption that the Dawn facilities can fully support the MP duties, with no unscheduled or scheduled events that can have an impact on its operation;
- Despite the replacement of the MP compressors post November 2023, there is still a loss of 84,061 x10³m³ of gas that will not be injected after the commissioning of TR7. This is due to failures in either of the remaining HP units operating at Corunna, which, for the majority of the compression period, operate in an 'N configuration' - failure in either of the units will immediately lead to an impact on gas injection.

5.1.2 Maintainable Item Contributors to Gas Injection Shortfall

A comparison of the relative contribution of the top-4 maintainable items to Gas Injection Shortfall, over the 5-year period considered between the Base and Sensitivity Cases, is shown in Table 5.3.

Table 5.3 Gas Injection 5-Year Maintainable Item Contributors to Shortfall by Case

Rank	Base Case		Sensitivity Case	
	Maintainable Item	Relative Gas Injection Shortfall (%)	Maintainable Item	Relative Gas Injection Shortfall (%)
1	Foundation	31.37%	Foundation	27.44%
2	Engine	23.46%	Engine	25.52%
3	Compressor	20.61%	Compressor	21.50%
4	Heating & Cooling	7.47%	Heating & Cooling	7.55%



Additionally, the contribution of maintainable items to Gas Injection Shortfall, over the 3 years of TR7 operation, is shown in Table 5.4.

Table 5.4 Gas Injection 3-Year Maintainable Item Contributors to Shortfall Subsequent to TR7 Commissioning (from Sensitivity Case)

Rank	Sensitivity Case	
	Maintainable Item	Relative Gas Injection Shortfall (%)
1	Engine	28.57%
2	Compressor	22.82%
3	Foundation	21.63%
4	Heating & Cooling	7.67%

The tables above demonstrate that:

- Over the 5-year review period considered, the ranking of the maintainable items that contribute to gas injection shortfall does not change between the Base and Sensitivity Cases, with Foundation failures being the highest shortfall contributor. This can be explained as follows:
 - There is a high likelihood of a foundation failure in units K-704 (HP) and K-701 (MP) in early years (with a very long associated downtime), which dominate the shortfall ranking in both Cases;
 - TR7 (supported by Dawn is replacing MP units, with the remaining HP units, which predominantly operate in an 'N configuration' still contributing the most to shortfall. Therefore, the overall shortfall contributor ranking is largely dominated by the maintainable item reliability associated with the HP units in both the Base and Sensitivity Cases.
- Analysis of results from the period where TR7 is operational alone validates the above statement regarding the potential incipient Foundation failure of unit K-704 in early years, as Foundation failures are now only the 3rd highest contributor to shortfall in the last 3 years of the reviewed period.



5.2 Gas Withdrawal Results

5.2.1 Overall Results Comparison

Table 5.5 presents the comparison of the overall results for Gas Withdrawal Demand, Withdrawal, Shortfall and Withdrawal Efficiency between the Gas Withdrawal Base and Sensitivity Cases, over the gas withdrawal operating months for a period of 5 years.

Table 5.5 5-Year Comparison between Gas Withdrawal Base and Sensitivity Cases Overall Results

Case	Demand (x10 ³ m ³)	Withdrawn (x10 ³ m ³)	Shortfall (x10 ³ m ³)	Withdrawal Efficiency (%)	Shortfall (%)
Base	18,162,204	17,872,477	289,727	98.40%	1.60%
Sensitivity	18,162,204	17,958,378	203,826	98.88%	1.12%
Delta	-	85,901	- 85,901	+ 0.47%	- 0.47%

Additionally, Table 5.6 presents the same level of comparison as above, focused on the last 4 years of Gas Withdrawal (period where TR7 and Dawn are available for gas withdrawal operations).

Table 5.6 4-Year Comparison between Gas Withdrawal Base and Sensitivity Cases Overall Results

Case	Demand (x10 ³ m ³)	Withdrawn (x10 ³ m ³)	Shortfall (x10 ³ m ³)	Withdrawal Efficiency (%)	Shortfall (%)
Base	14,529,763	14,298,480	231,283	98.41%	1.59%
Sensitivity	14,529,763	14,384,381	145,382	99.00%	1.00%
Delta	-	85,901	- 85,901	+ 0.59%	- 0.59%

Figure 5.2 presents diagrammatically the estimated volumes of gas withdrawn over the period of 5 years reviewed.

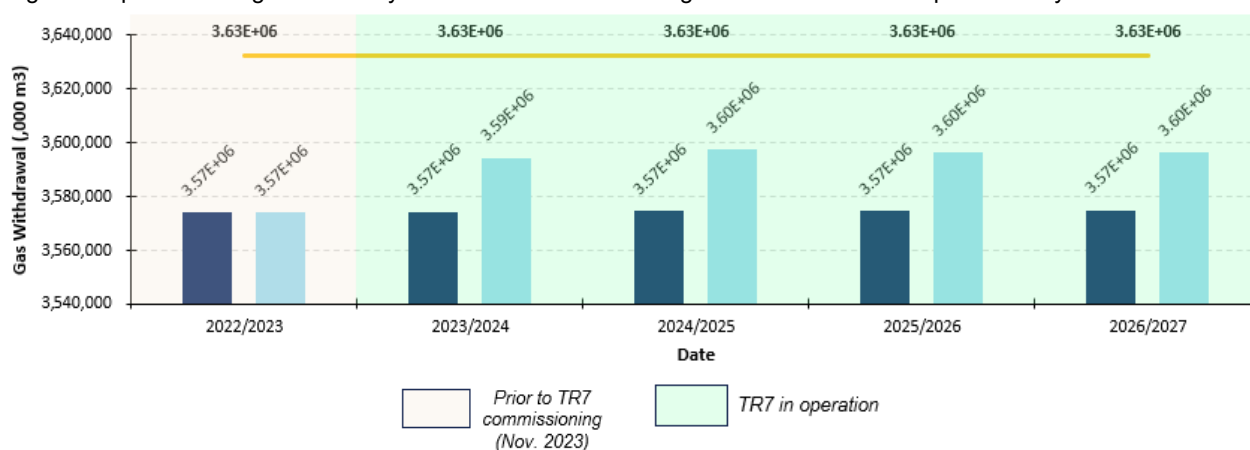


Figure 5.2 Yearly Gas Withdrawal Breakdown Comparison Between Base and Sensitivity Cases (x10³m³)

Key observations are that:

- Over the entire 5 years of period reviewed, the implementation of the TR7 pipeline with the Dawn facilities supporting the MP operations (that would otherwise be conducted at CCS), will result in a performance improvement of 0.47% (from 98.40% to 98.88%). In overall terms, this means that an additional 85,901 x10³m³ of gas will be withdrawn from the CCS serviced storage pools;
- If only the years where the TR7 pipeline is operational are considered, the improvement in Withdrawal Efficiency is 0.59%;



- The aforementioned performance improvements are based on the assumption that the Dawn facilities can fully support the MP duties, with no unscheduled or scheduled events that can have an impact on its operation;
- Despite the replacement of the MP compressors post November 2023, there is still a loss of $145,382 \times 10^3 \text{m}^3$ of gas that will not be withdrawn after the commissioning of TR7. This is mostly due to failures in either of the remaining LP units operating at Corunna, which for the majority of the compression period operate in an 'N configuration', where a failure in either of the units will immediately lead to an impact on gas withdrawal. Failures of HP units, which are also used in this operating mode, albeit for a shorter period of time than the LP units, which at times are also in an 'N configuration' further contribute to the reported gas shortfall.

5.2.2 Maintainable Item to Gas Withdrawal Shortfall

A comparison of the relative contribution of the top-4 maintainable items to Gas Withdrawal Shortfall, over the 5-year period considered between the Base and Sensitivity Cases is shown in Table 5.7.

Table 5.7 Gas Withdrawal 5-Year Maintainable Item Contributors to Shortfall by Case

Rank	Base Case		Sensitivity Case	
	Maintainable Item	Relative Gas Withdrawal Shortfall (%)	Maintainable Item	Relative Gas Withdrawal Shortfall (%)
1	Compressor	26.42%	Compressor	26.99%
2	Foundation	20.77%	Engine	21.50%
3	Engine	15.43%	Foundation	15.36%
4	Heating & Cooling	12.55%	Heating & Cooling	10.66%

Additionally, the contribution of maintainable items to Gas Withdrawal Shortfall over the 4 years of TR7 operation, is shown in Table 5.8.

Table 5.8 Gas Withdrawal 4-Year Maintainable Item Contributors to Shortfall Subsequent to TR7 Commissioning (from Sensitivity Case)

Rank	Sensitivity Case	
	Maintainable Item	Relative Gas Withdrawal Shortfall (%)
1	Compressor	27.22%
2	Engine	23.92%
3	Foundation	13.20%
4	Heating & Cooling	9.90%

The tables above demonstrate the following:

- In the Withdrawal mode of operation, TR7 is operational in the second year of the 5 years in withdrawal mode considered (versus the third in injection mode). This means that the pipeline replacement mitigates the impact that the potential incipient Foundation failure in unit K-701 would have on the withdrawal operation. This is confirmed by the decrease of the contribution of Foundation Failures in the shortfall ranking from 2nd to 3rd in the Base and Sensitivity Cases, respectively.
- As discussed previously, this Sensitivity Case assesses the replacement of MP units with TR7 supported by Dawn. In Gas Withdrawal, the remaining operating units, predominantly LP compressors but at times also HP



units, operate for large periods of time in an 'N configuration', thus still contributing the most to shortfall. Therefore, the overall shortfall contributor ranking reported above is largely dominated by the maintainable item reliability associated with the LP units in both the Base and Sensitivity Cases.



6 REFERENCES

- /1/ "14-218 CCS Headers Process Flow Diagram"
- /2/ "1. CCS Operating Modes.xlsx"
- /3/ Asset Health Report "StorageAHR-2021AHR-BF20210408.xlsx"
- /4/ Base Case RAM Study Report (Report No.10304304-2)



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CORUNNA COMPRESSOR STATION

RAM Study Report

Enbridge Gas Inc.

Report No.: 10304304-2, Rev. 0

Date: 11th February 2022

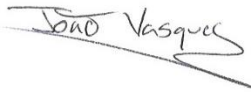
Project name: Corunna Compressor Station DNV
Report title: RAM Study Report DNV Canada Ltd.
Customer: Enbridge Gas Inc. Energy Systems
Customer contact: Mike Hildebrand Tel: 403 702 5679
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Objective:

This report details the assumptions, basis, and results of the Corunna Compressor Station RAM Study.

Prepared by:



Joao Vasques
Senior Consultant

Verified by:



Neil Wragg
Senior Principal Consultant

Approved by:



Jeremy Johnson
Engineer, DNV Canada Ltd.

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EXECUTIVE SUMMARY

The Corunna Compressor Station (CCS) is located near Mooretown, Ontario (ON). It uses 11 reciprocating compressor units to transport sweet natural gas to and from offsite underground storage facilities to transmission pipelines for eventual use in downstream distribution networks.

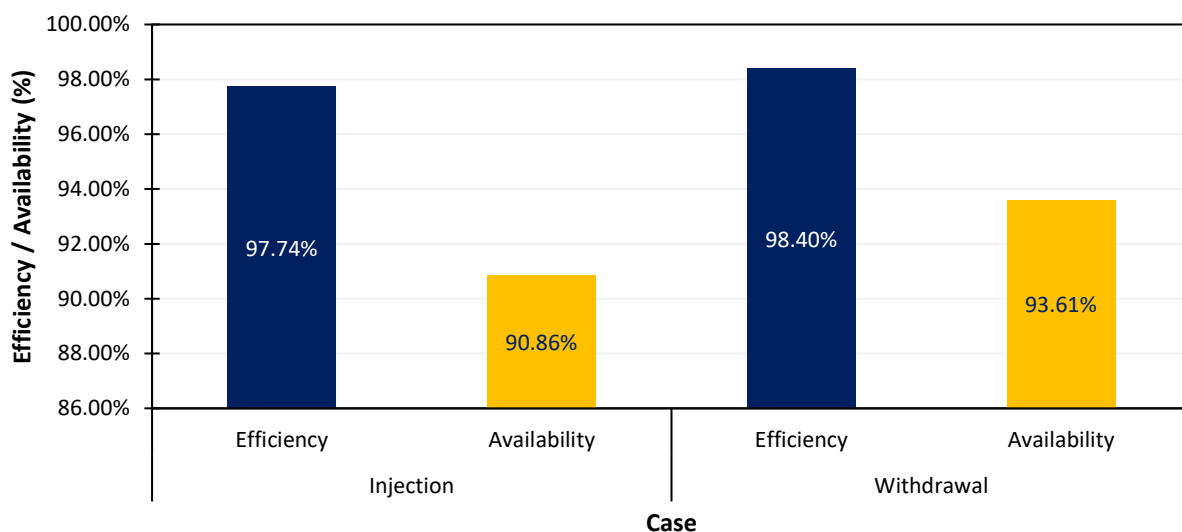
CCS has two main modes of operation: injection and withdrawal. Injection operating mode takes gas from the two twin 30 NPS transmission pipelines from Dawn and flows the gas through CCS to the offsite storage pools. Withdrawal operating mode takes gas from the storage pool pipelines and flows through CCS into the transmission pipelines back to the Dawn facility.

Enbridge have asked DNV to undertake a Reliability, Availability and Maintainability (RAM) Study for the Corunna Compressor Station. The primary objective of this analysis is to forecast the current availability performance of the station and assess the impact of proposed modifications. This report details the assumptions, basis, and results of the Corunna Compressor Station RAM model.

Results Summary

The table and figure below provide a summary of the performance of the Gas Injection Base Case and Gas Withdrawal Base Case cases investigated.

Case	Efficiency (%)	Availability (%)
Gas Injection Base Case	97.74%	90.86%
Gas Withdrawal Base Case	98.40%	93.61%

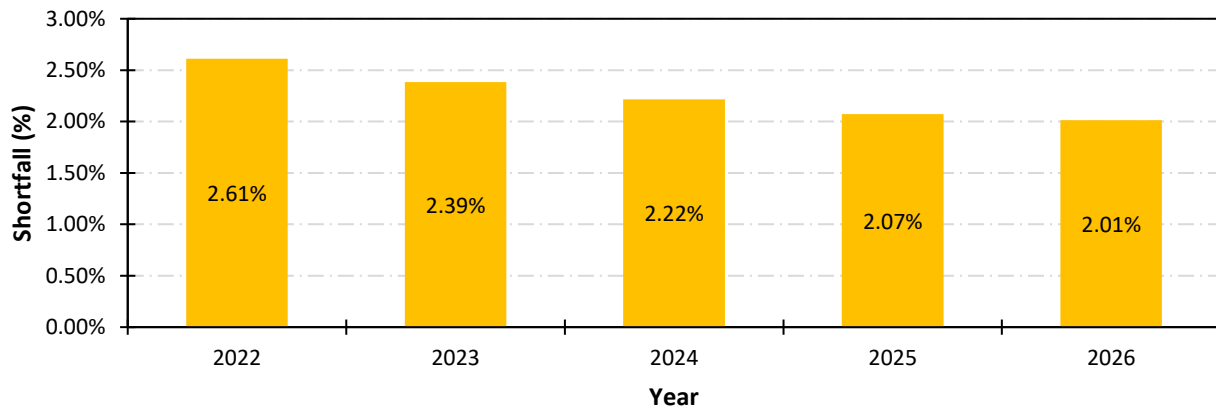


As can be seen from the results, the Efficiency of the Corunna facilities is lower during the Injection mode of operation (97.74%) than during the Withdrawal mode (98.70%). This is due to a higher number of days that the facilities will operate at Partial Capacity during Injection than in Withdrawal, as reflected by the Availability of these two modes of operation.

Gas Injection Base Case

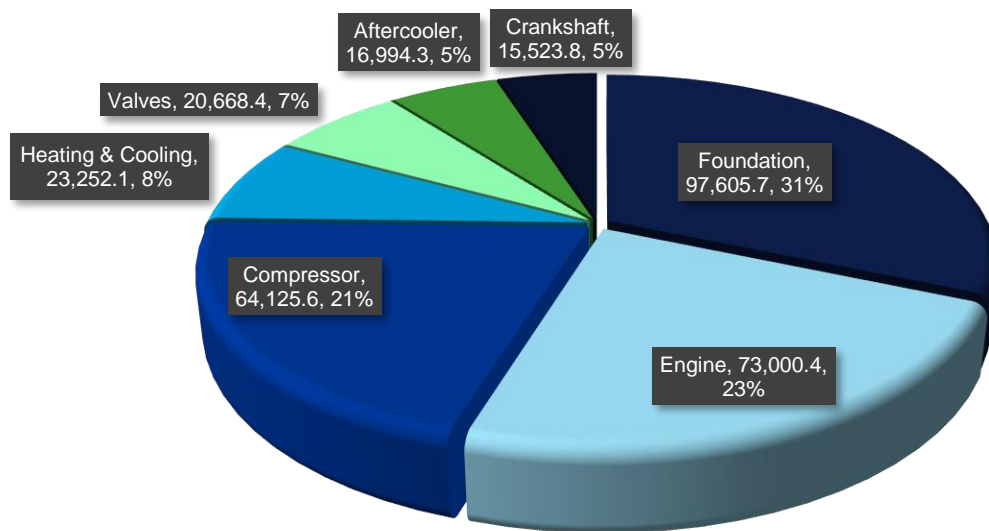
The figure below presents a yearly breakdown of the Base Case Gas Injection Shortfall over the 5-year review period. During the 5 years assessed, the mean Injection Efficiency of the Corunna facilities against Demand is 97.74%; 13,461,540 x10³ m³ of gas was injected against a Demand of 13,772,710 x10³ m³.

Additionally, despite the expected increase in plant deterioration each year, which results in higher number of failures each year, it is forecasted that Gas Injection Shortfall will decrease from 2022 to 2026. The higher shortfall in earlier years is caused by a higher likelihood of foundation failures of units K704 (HP duty) and K701 (MP duty) as compared to the other CCS units, with the former having a high impact in injection capability, given its low level of redundancy. The decreasing trend in later years can be attributed to the foundation corrective repairs, which is expected to significantly reduce the likelihood of future failures. This effect is dominant over the increasing shortfall associated with plant deterioration.



The table and figure below show the Equipment and Maintainable Item shortfall contributors, respectively, for the Gas Injection Base Case over the 5-year period considered.

Rank	Equipment	Gas Injection Shortfall			Total Aggregated Downtime (hrs)	Total Running Time (hrs)
		Absolute		Relative		
		x10 ³ m ³	%	%		
1	K-704	161,174.7	1.17%	51.80%	2,839	13,126
2	K-711	148,609.6	1.08%	47.76%	1,463	12,100
3	K-705	260.3	<0.01%	0.08%	1,551	14,450
4	K-706	251.8	<0.01%	0.08%	1,432	13,238
5	K-707	236.7	<0.01%	0.08%	1,165	10,142
6	K-708	228.6	<0.01%	0.07%	1,223	7,991
7	K-701	159.0	<0.01%	0.05%	2,426	9,730
8	K-702	128.1	<0.01%	0.04%	1,216	6,665
9	K-703	121.5	<0.01%	0.04%	1,192	5,734
Total		311,170.3	2.26%	100.00%	14,507	93,177



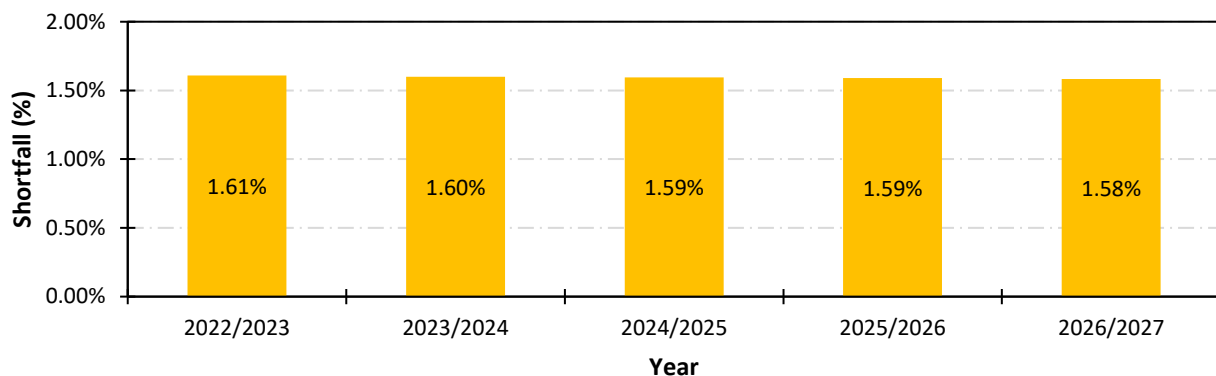
Key observations are that:

- Units K-704 and K-711 (HP units) are responsible for 99.56% of the total Gas Injection shortfall. In absolute terms, this represents 309,784.3 x10³ m³ of Gas Injection Shortfall (2.25%). This is attributed to the combined 'N' configuration that these units exhibit for the majority of the time that they are required to operate.
- Foundations are the most significant contributor to Gas Injection Shortfall, accounting for 31.37% of total shortfall (97,605.7 x10³ m³, 0.71% absolute). This is attributed to the long duration associated with the repair of this maintainable item.
- Next are the compressor Engines, which are responsible for 23.46% of total Gas Injection Shortfall (73,000.4 x10³ m³, 0.53% absolute). On average, Engines have a higher MTTF than Compressors. However, based on the downtime information detailed in Section 4.3, the average downtime duration of an engine is 425.6 hours, which is substantially higher than the 99.6 hours of average downtime required following a compressor failure.
- 3rd are the Compressor item of the entire compressor unit, predicted to cause 20.61% of the total shortfall (64,125.6 x10³ m³, 0.47% absolute).
- The following items, with the exception of the Crankshaft, have downtime durations below 50 hours and are therefore ranked as follows with regard to Gas Injection Shortfall:
 - Heating & Cooling – 7.47% of total shortfall (23,252.1 x10³ m³, 0.17% absolute) – predominantly due to glycol leaks.
 - Valve System – 6.64% of total shortfall (20,668.4 x10³ m³, 0.15% absolute).
 - Aftercooler – 5.46% of total shortfall (16,994.3 x10³ m³, 0.12% absolute).
 - Crank Assembly misalignment – 4.99% of total shortfall (15,523.8 x10³ m³, 0.11% absolute) – despite the high downtime associated with this item, it fails less frequently than the aforementioned items.
- Finally, it is important to note that the low frequency, high consequence (worst case scenario) failures associated with the Crankshaft, Engine, Aftercooler and Valve System items, despite their different nature, are not expected to contribute significantly to shortfall.

Gas Withdrawal Base Case

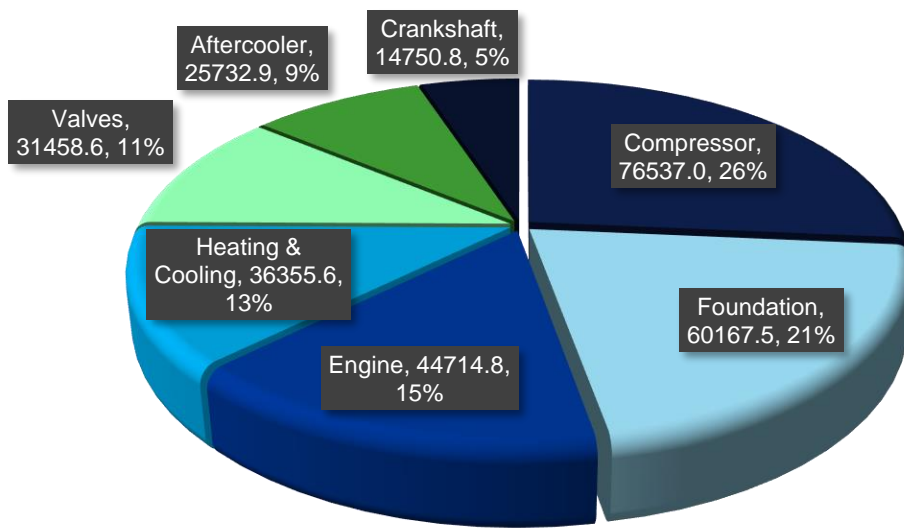
The figure below presents a yearly breakdown of the Base Case Gas Withdrawal Shortfall over the 5-year review period. During the 5 years assessed, the mean Withdrawal Efficiency of the Corunna facilities against Demand is 98.40%; 17,872,477 x10³ m³ of gas was withdrawn against a Demand of 18,162,200 x10³ m³.

Additionally, as reported in the analysis of the yearly breakdown in Gas Injection Shortfall, a decreasing trend in Gas Withdrawal Shortfall is observed between 2022 and 2026, attributed once more to the high likelihood of units K-704 and K-701 having their 1st foundation failures within the first years of the reviewed period. However, the usage of these units is generally reduced in comparison to Gas Injection. As a result, the decrease in shortfall over the reviewed years during Gas Withdrawal operations is considerably less pronounced than in Gas Injection.



The table and figure below show the Equipment and Maintainable Item shortfall contributors, respectively, for the Gas Withdrawal Base Case over the 5-year period considered.

Rank	Equipment	Gas Withdrawal Shortfall			Total Aggregated Downtime (hrs)	Total Running Time (hrs)
		Absolute		Relative		
		x10 ³ m ³	%	%		
1	K-710	127,590.3	0.70%	43.83%	1,240	11,116
2	K-709	125,034.0	0.69%	42.96%	1,332	13,111
3	K-705	6,325.6	0.04%	2.17%	1,707	15,675
4	K-706	6,231.7	0.03%	2.14%	1,664	15,436
5	K-707	5,688.8	0.03%	1.95%	1,359	11,977
6	K-701	4,977.5	0.03%	1.71%	2,752	13,076
7	K-708	4,945.6	0.03%	1.70%	1,090	6,350
8	K-703	3,652.3	0.02%	1.26%	1,557	9,774
9	K-702	3,634.8	0.02%	1.25%	1,689	11,966
10	K-711	1,567.0	0.01%	0.54%	485	498
11	K-704	1,436.3	0.01%	0.49%	1,790	561
Total		291,083.9	1.60%	100.00%	16,665	109,542



Key observations are that:

- Units K-710 and K-709 (LP units) are responsible for 86.77% of the total Gas Withdrawal shortfall. In absolute terms, this represents $252,624.3 \times 10^3 \text{ m}^3$ of Gas Withdrawal Shortfall (1.38%). This is attributed to the combined 'N' configuration that these units exhibit for the majority of the time that they are required to operate, which is particularly substantial.
- Compressors are the most significant contributor to Gas Withdrawal Shortfall, accounting for 26.42% of total shortfall ($76,537.0 \times 10^3 \text{ m}^3$, 0.42% absolute). This is attributed to the low compressor reliability associated with the critical units K-709 and K-710, which is significantly lower than all other units.
- Foundations are the 2nd highest contributor to Gas Withdrawal Shortfall, which is one of the main differences in comparison to the Gas Injection mode, accounting for 20.77% of total shortfall ($60,167.5 \times 10^3 \text{ m}^3$, 0.33% absolute). The change in shortfall ranking is attributed to the fact that foundation failures in this mode of operation affects mostly units that have a high level of redundancy (K-701 and K-704), which is not the case in Gas Injection. However, the long duration associated with the repair of this maintainable item still results in a high contribution towards shortfall by this maintainable item, albeit not the top contributor.
- Next are the compressor Engines, which are responsible for 15.43% of total Gas Withdrawal Shortfall ($44,714.8 \times 10^3 \text{ m}^3$, 0.25% absolute). As discussed previously, the average downtime duration of an engine is 425.6 hours, which is substantially higher than the 99.6 hours of average downtime required subsequent to a compressor failure. However, the low Compressor reliability of units K-709 and K-710 results in a higher ranking of this Compressor maintainable item versus Engines.
- As in Gas Injection, the following items, with the exception of the Crankshaft, have downtime durations below 50 hours and are therefore ranked as follows with regard to Gas Withdrawal Shortfall:
 - Heating & Cooling – 12.55% of total shortfall ($36,355.6 \times 10^3 \text{ m}^3$, 0.20% absolute) – predominantly due to glycol leaks.
 - Valve System – 10.86% of total shortfall ($31,458.6 \times 10^3 \text{ m}^3$, 0.17% absolute).
 - Aftercooler – 8.88% of total shortfall ($25,732.9 \times 10^3 \text{ m}^3$, 0.14% absolute).

- Crankshaft Assembly misalignment – 5.09% of total shortfall ($14,750.8 \times 10^3 \text{ m}^3$, 0.08% absolute) – despite the high downtime associated with this item, it fails less frequently than the aforementioned items.
- Finally, it is important to note that the low frequency, high consequence failures (worst case scenario) associated with the Crankshaft, Engine, Aftercooler and Valve System items, despite their different nature, are not expected to contribute significantly to shortfall.

Conclusions

This section summarises the key conclusions that can be drawn from the results of the Gas Injection and Withdrawal Base Cases:

- The Efficiency of the Corunna facilities is lower during the Injection mode of operation (97.74%) than during the Withdrawal mode (98.70%). This is due to a higher number of days that the facilities will operate at Partial Capacity during Injection than in Withdrawal. In absolute terms, over the 5-year review period, this means that:
 - With regard to Gas Injection, $13,461,540 \times 10^3 \text{ m}^3$ of gas was injected against a Demand of $13,772,710 \times 10^3 \text{ m}^3$.
 - With regard to Gas Withdrawal, $17,872,477 \times 10^3 \text{ m}^3$ of gas was withdrawn against a Demand of $18,162,200 \times 10^3 \text{ m}^3$.
- Despite the expected increase in plant deterioration each year, which results in higher number of failures each year, it is forecasted that both Gas Injection and Gas Withdrawal Shortfall will decrease from 2022 to 2026. This decreasing trend is attributed to the potential incipient 1st foundation failure of certain compressor units. The decreasing shortfall trend is more pronounced in the Gas Injection mode as in particular, the 1st foundation failure is likely to affect a unit (K-704) that is in an 'N' configuration, which is not the case in Gas Withdrawal (K-701 is likely to be affected in this mode, but it has significant levels of sparing).
- Units K-704 & K-711 (HP) and K-709 & K-710 (LP), which predominantly operate in an 'N' configuration, are the most critical items with regard to the operation of the Corunna facilities. These units are forecasted to account for 99.56% and 86.79% of the total gas shortfall of the Injection and Withdrawal modes, respectively.
- With regard to Maintainable Items, the following can be concluded:
 - Foundations are the most significant contributor to Gas Injection Shortfall, accounting for 31.37% of total shortfall. This is attributed to the long duration associated with the repair of this maintainable item (between 1-5 months), and the likelihood to affect unit K-704, which has no level of redundancy. Engines and Compressors make up the top 3 ranking of Maintainable Item shortfall contributors, accounting for 23.46% and 20.61% of the total shortfall, respectively.
 - With regard to Gas Withdrawal, Compressors are the most significant contributor to shortfall, accounting for 26.42% of the total shortfall. This is attributed to the low compressor reliability associated with the critical units K-709 and K-710, which is significantly lower than all other units. Foundations and Engines make up the top 3 ranking of Maintainable Item shortfall contributors, accounting for 20.77% and 15.43% of the total shortfall, respectively.
- Finally, it is important to note that the low frequency, high consequence failures associated with the Crankshaft, Engine, Aftercooler and Valve System items are not expected to contribute significantly to shortfall.

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1 INTRODUCTION

The Corunna Compressor Station (CCS) is located near Mooretown ON. It uses 11 reciprocating compressor units to transport sweet natural gas to and from offsite underground storage facilities to transmission pipelines for eventual use in downstream distribution networks.

CCS has two modes of operation: injection and withdrawal. Injection operating mode takes gas from the two twin NPS 30 transmission pipelines from Dawn and flows the gas through CCS to the offsite storage pools. Withdrawal operating mode takes gas from the storage pool pipelines and flows through CCS into the transmission pipelines back to the Dawn facility.

Enbridge have asked DNV to undertake a Reliability, Availability and Maintainability (RAM) Study for the Corunna Compressor Station. The primary objective of this analysis is to forecast the current availability performance of the station and assess the impact of proposed modifications. This report details the assumptions, basis and results of the Corunna Compressor Station RAM model.



Figure 1.1 Corunna Compressor Station

2 RAM DEFINITIONS / ABBREVIATIONS

Definitions and descriptions for abbreviations are summarised in the table below:

Terminology/ Abbreviation	Definition/Description
Active Repair Time	Effective time to achieve repair of an item (see Figure 2.1)
Availability	(Time all required equipment is available) / (Time)*100%
CCS	Corunna Compressor Station
Critical (System)	Item or system required for gas flow
Critical Failure	Failure of an equipment unit that causes an immediate cessation of the ability to perform its function.
Demand	The level of gas flow to/from the CCS excluding all planned or unplanned losses.
Equipment Unit	Specific equipment within an equipment class as defined by its boundary.
Logistic Delay	Accumulated time during which maintenance cannot be carried out due to the time to acquire maintenance resources (personnel, spares, tools etc.), including any administrative delay.
10 ³ m ³ /d	Thousand Cubic Metres per Day
Mobilisation Time	Time to secure all necessary resources to execute maintenance.
MTBF	Mean Time Between Failures: Total operating time divided by the number of failures (not including downtime) for an element in the model (hours)
MTTF	Meant Time To Fail: Expectation of the time to failures, excluding repair times MTTF = MTBF - MTTR
MTTR	Mean Time To Repair: Time taken to perform the corrective maintenance on a failed item (hours). Same as Active Repair Time
'N' Configuration	Resilience terminology used to represent an equipment or system that is designed to cover the baseline demand but has no redundancy in place to accommodate any failure or maintenance operation. This can either comprise 1 item that fulfils 100% of the baseline demand or multiple items that in aggregate fulfil 100% of the baseline demand (e.g., 2 x 50%).
OREDA	Offshore and Onshore Reliability Data
Production Efficiency	Production efficiency (PE): (Actual Volume) / (Target Production) *100%
RAM	Reliability: Probability of system/item non-failure in a given period Availability: Proportion of time that the system/item performs its intended function Maintainability: Probability of repair in a given time
Shortfall	Proportion or amount of demand not produced (% or 10 ³ m ³)
TJ/d	Terajoules per day
Total Downtime	Sum of Downtime due to Mobilisation & Preparation Delay, Active Repair Time and Restart Delays (see Figure 2.1)
Uptime	(Time non-zero flow is achieved) / (Time)*100%
Utilization	The percentage of output volume achieved as a ratio of the system potential volume

Table 2.1 Definitions

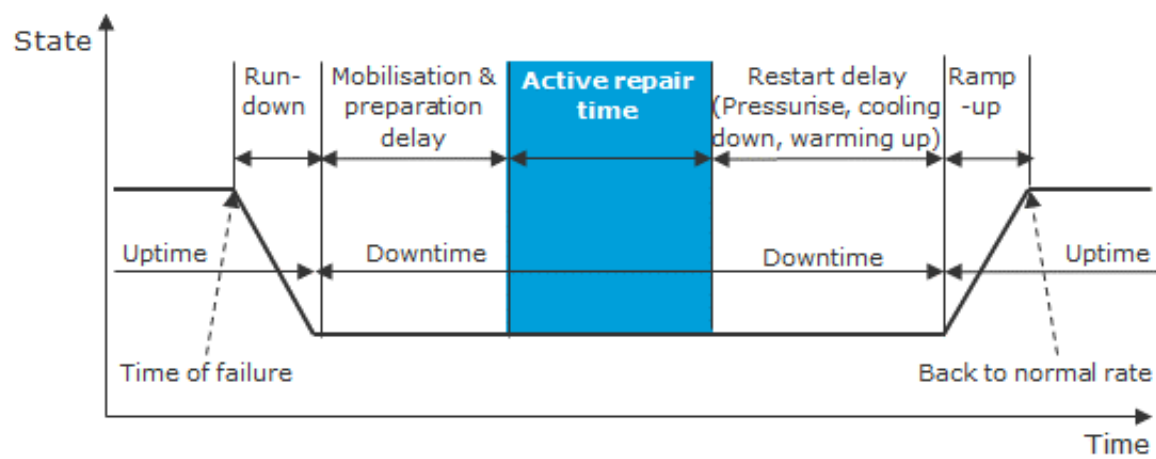


Figure 2.1 Active Repair Time

3 SCOPE OF WORK

3.1 Objectives

The objectives of the RAM study are as follows.

- Forecast Availability (%) and Uptime (%) of the CCS over the remaining operational life. The following operations will be assessed:
 - **Injection Mode:** Gas taken from Dawn facility and transferred to offsite storage pools.
 - **Withdrawal Mode:** Gas taken from offsite storage pools and transferred to Dawn facility.
- Identify key systems and equipment that result in Availability losses, and rank by system and equipment contributions (criticality analysis).
- Identify the potential area of performance improvement through consideration of defined sensitivity cases:
 - MP compressor replacement at Corunna by pipeline infrastructure (TR7), with the compression duty being shifted to the Dawn Facility.

3.2 Study Boundaries

The RAM study will consider all process and utility equipment critical to gas injection / withdrawal, within the following boundaries (represented diagrammatically in Figure 3.1) [1]:

Injection Mode

- Upstream: Inlet ESDVs from Dawn Facility (TR1/TR2)
- Downstream: Outlet ESDVs to Offsite Storage Pools* (Dow Moore/Mid Kimball-Colinville/ South Kimball-Colinville, Wikesport/Seckerton/Corunna/Ladysmith)

Withdrawal Mode

- Upstream: Inlet ESDV from Offsite Storage Pools* (Dow Moore/Mid Kimball-Colinville/ South Kimball-Colinville, Wikesport/Seckerton/Corunna/Ladysmith)
- Downstream: Outlet ESDV to Dawn Facility (TR1/TR2)

**Note: Availability will be measured on the total gas flow to/from all pools (flow to/from individual pools will be considered by equipment criticality only)*

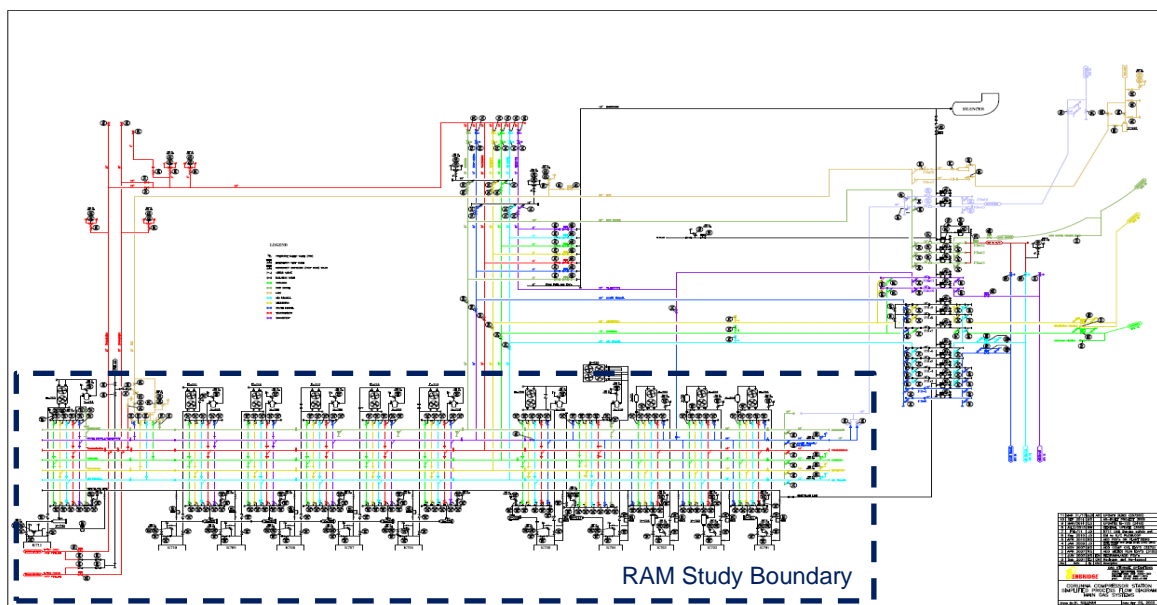


Figure 3.1 Corunna Compressor Station Simplified Flow Diagram (with RAM Study Boundary included)

3.3 Case Definition

3.3.1 Base Cases

Two Base Cases have been defined, pertaining to the Injection and Withdrawal modes of operation, which will be assessed separately. Moreover, as shall be seen in Section 4.1, the performance of the Corunna Station in both modes of operation will be assessed against a high demand scenario, to better understand the ability of the station to respond against worst case scenario (i.e., extreme winter) conditions. The outputs of the RAM Study Base Cases are detailed below:

Table 3.1 RAM Study Base Cases Output Parameters

Case	Outputs
Base Case Gas Injection	<ul style="list-style-type: none"> - Gas Injection Efficiency - Gas Injection Availability and Uptime - Identification of Gas Injection Shortfall Contributors (at an equipment level) - Forecasted Gas Compressor Downtime during the Injection cycle - Forecasted Gas Compressor Running Hours during the Injection cycle
Base Case Gas Withdrawal	<ul style="list-style-type: none"> - Gas Withdrawal Efficiency - Gas Withdrawal Availability and Uptime - Identification of Gas Withdrawal Shortfall Contributors (at an equipment level) - Forecasted Gas Compressor Downtime during the Withdrawal cycle - Forecasted Gas Compressor Running Hours during the Withdrawal cycle

4 BASE CASE MODELLING ASSUMPTIONS

The following list details the Base Case models basis and assumptions, which are considered in more detail in the following sections:

- Period of study: This RAM study is based on a 5-year look-ahead period.
- Two separate RAM models will be developed:
 - Injection (with compression).
 - Withdrawal (with compression).
- System demand: Availability will be measured against system demand. System demand is assumed to be equal to the injection/withdrawal profiles (see Section 4.1).
- Compressor Lineup (Section 4.2) [1] [2]:
 - List of compressors.
 - Lineup during compression modes (withdrawal and injection).
- Reliability data: Equipment level (See Section 4.3) [3].
- Maintenance and operations e.g., planned maintenance, logistic delays (Section 4.4).

4.1 Injection/Withdrawal Profiles

The Corunna Compressor Station transports sweet natural gas to and from offsite underground storage facilities to transmission pipelines for use in downstream distribution networks. The compressor station has two main modes of operation; injection and withdrawal. Injection operating mode takes gas from the two twin NPS 30 transmission pipelines from Dawn through metering before compression sends the gas to pool pipelines which transport the gas to the offsite storage pools. Withdrawal operating mode receives gas from the storage pool pipelines and “free flows” gas without the use of compression into the transmission pipelines until the reservoir pressure drops below a certain point. Once “free flow” is not possible due to the depressurization of the storage pools, the compressors are used to draw down the storage pools further and continue to export gas into the transmission pipelines.

A summary of the Injection and Withdrawal cycles over a ‘typical’ calendar year, that will be used in the RAM model, is summarised in Table 4.1.

Season	Calendar Period		Operating Mode	Avg. Time in Mode	Target Flow Rate		Compressor Configuration
	Start	End		days	TJ/d	10 ³ m ³ /d	
Spring Shoulder	1 st May	5 th May	Outage on Main Plant	5	0	0	-
Injection	6 th May	26 th May	Free Flow	21	300	7,752	-
	27 th May	30 th Jun	Compression	35	650	16,796	MP (single lift)
	1 st Jul	31 st Jul	Compression	92	850	21,964	MP (single lift) + MP/HP (series mode) 2xHP
	1 st Aug	31 st Aug			850	21,964	MP (single lift) + MP/HP (series mode) 2xHP
	1 st Sep	30 th Sep			700	18,088	MP (single lift) + MP/HP (series mode) 2xHP
	1 st Oct	21 st Oct		21	350	9,044	MP/HP (series mode) – 1x HP
	22 nd Oct	31 st Oct	Compression	10	280	7,235	HP mode (single lift) 2xHP
Fall Shoulder	1 st Nov	5 th Nov	Outage on Main Plant	5	0	0	-
Withdrawal	6 th Nov	26 th Nov	Free Flow	21	600	15,504	-
	27 th Nov	31 st Dec	Compression	35	850	21,964	MP (single lift)
	1 st Jan	27 th Jan	Compression	27	950	24,548	MP /LP (series mode) + MP (single lift)
	28 th Jan	31 st Jan	Compression - PEAK	4	2415	62,400	MP / LP / HP (10 of 11 units in parallel, single lift)
	1 st Feb	27 th Feb	Compression	27	950	24,548	MP /LP (series mode) + MP (single lift)
	28 th Feb	28 th Feb	Compression – Design Day	1	2415	62,400	MP / LP / HP (10 of 11 units in parallel, single lift)
	1 st Mar	31 st Mar	Compression	31	950	24,548	MP /LP (series mode) + MP (single lift)
	1 st Apr	30 th Apr	Compression	30	600	15,504	MP /LP (series mode)

Table 4.1 Typical Operating Envelope

4.2 Compressor Nominal Capacity & Line-up

Table 4.2 summarises the compressor nominal capacity, which plays a key role in the determination of the nominal compressor line-up. Furthermore, the nominal compressor line-up, used to produce an accurate representation of the varying Base Case gas demand throughout the Injection and Withdrawal cycles over a calendar year is reported diagrammatically in Sections 4.2.1 and 4.2.2, respectively. For each compressor unit, a % contribution to target flow is given for each operating 'phase' of the pressure cycle.

Table 4.2 Compressor Nominal Capacity

Tag	Mode	Nominal Max Flow*		Nominal % of Flow Demand
		MMscfd	10 ³ m ³ /d	
K701	MP	170	4814	See diagrams in Sections 4.2.1 and 4.2.2
K702	MP	170	4814	
K703	MP	170	4814	
K704	HP	135	3823	
K705	MP	210	5947	
K706	MP	210	5947	
K707	MP	210	5947	
K708	MP	210	5947	
K709	LP	260	7362	
K710	LP	260	7362	
K711	HP	185	5239	

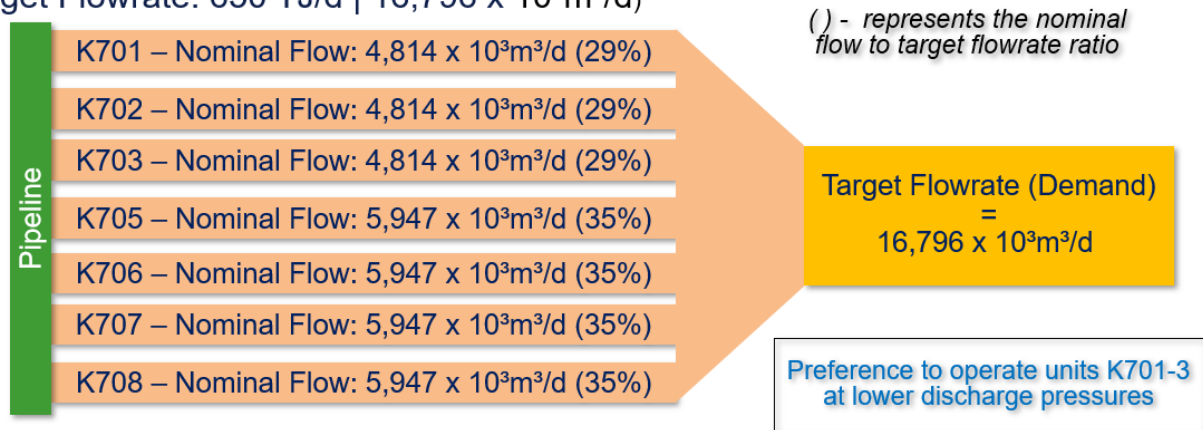
*Actual Max Flowrate of each compressor varies +-30% on suction /discharge pressure

It is important to acknowledge that the Base Case gas demand reported in the following sections represents a conservative scenario (i.e., cold Winter season).

4.2.1 Nominal Compressor Line-up – Injection Mode

Calendar Period: 27th of May - 30th of June

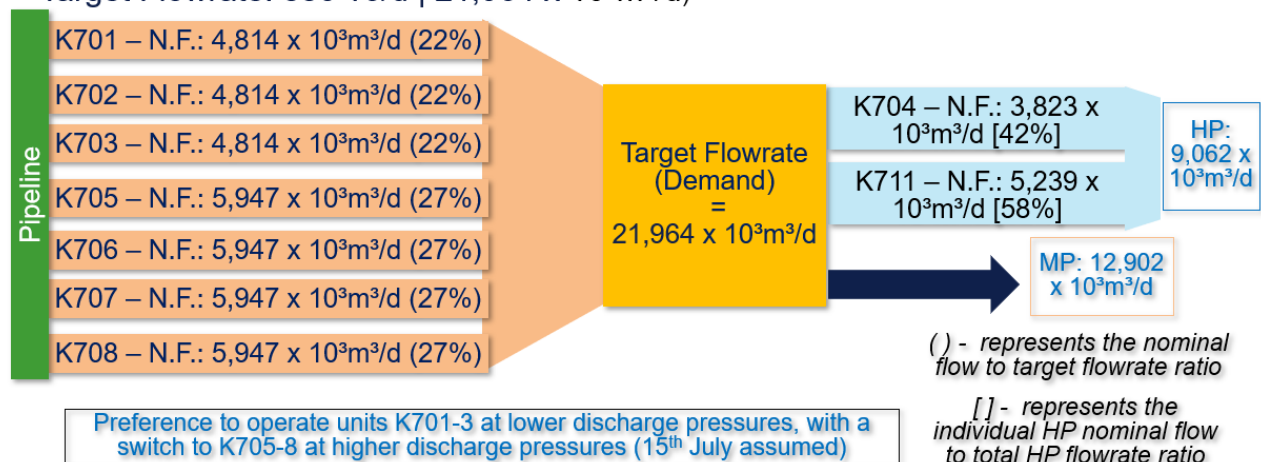
Target Flowrate: 650 TJ/d | $16,796 \times 10^3 \text{m}^3/\text{d}$



Compressor Configuration: MP (single lift)

Calendar Period: 1st of July - 31st of July

Target Flowrate: 850 TJ/d | $21,964 \times 10^3 \text{m}^3/\text{d}$



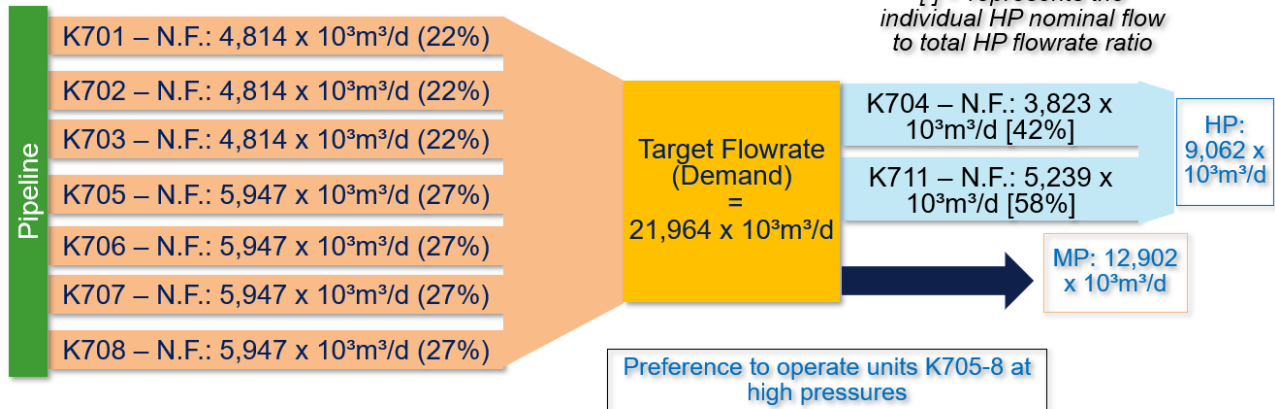
Compressor Configuration: MP (single lift), MP/HP (series mode) - 2 x HP

Calendar Period: 1st of August - 31st of August

Target Flowrate: 850 TJ/d | $21,964 \times 10^3 \text{m}^3/\text{d}$

() - represents the nominal flow to target flowrate ratio

[] - represents the individual HP nominal flow to total HP flowrate ratio



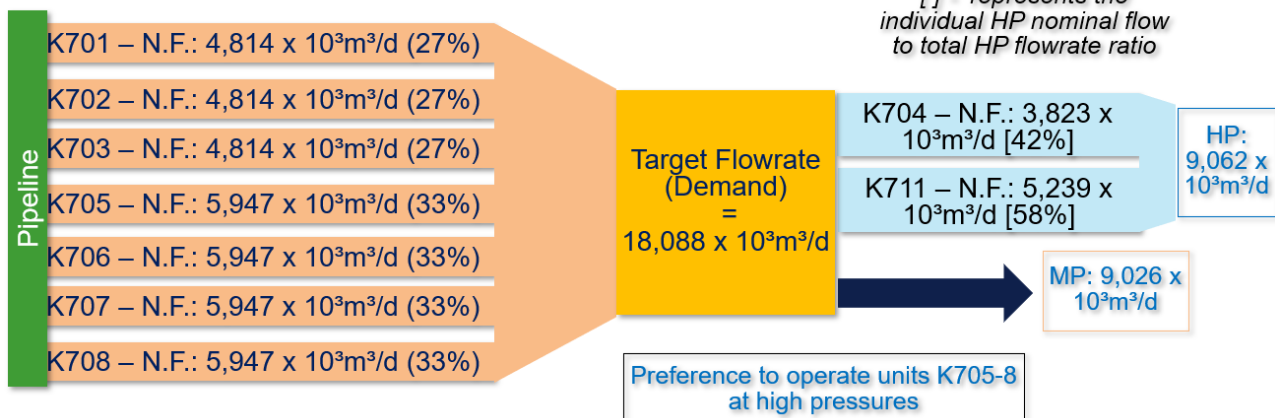
Compressor Configuration: MP (single lift), MP/HP (series mode) - 2 x HP

Calendar Period: 1st of Sept. - 30th of Sept.

Target Flowrate: 700 TJ/d | $18,088 \times 10^3 \text{m}^3/\text{d}$

() - represents the nominal flow to target flowrate ratio

[] - represents the individual HP nominal flow to total HP flowrate ratio



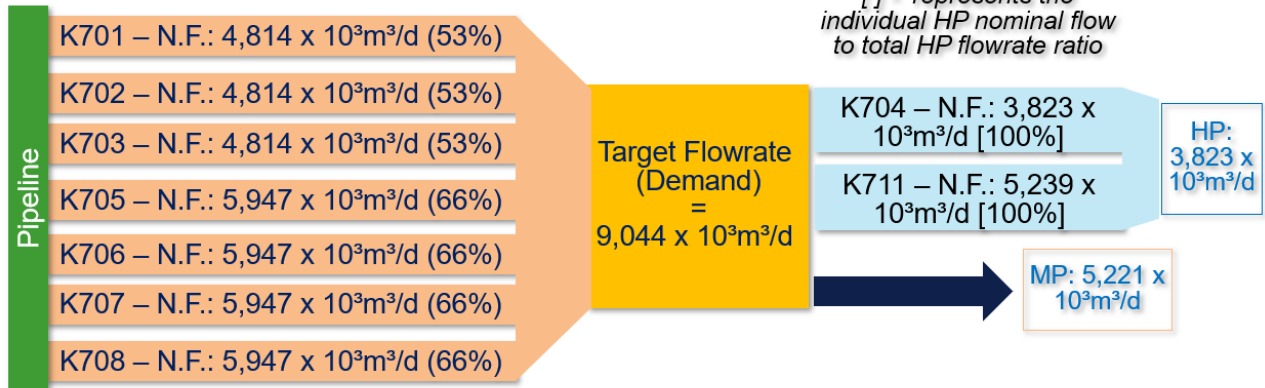
Compressor Configuration: MP (single lift), MP/HP (series mode) - 2 x HP

Calendar Period: 1st of Oct. - 21st of Oct.

Target Flowrate: 350 TJ/d | $9,044 \times 10^3 \text{m}^3/\text{d}$

() - represents the nominal flow to target flowrate ratio

[] - represents the individual HP nominal flow to total HP flowrate ratio



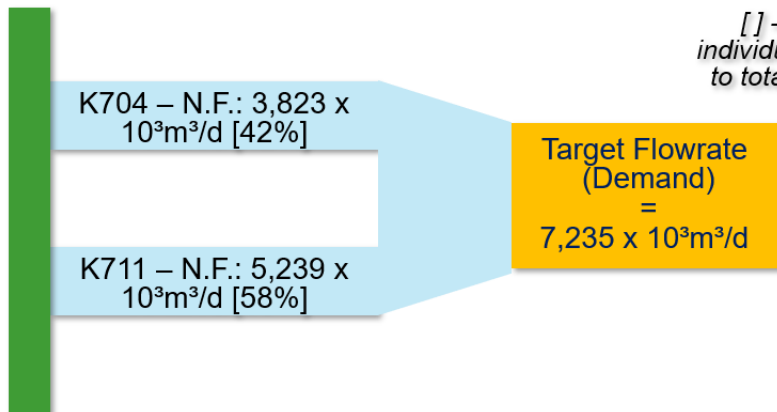
Compressor Configuration: MP/HP (series mode) - 1xHP

Calendar Period: 22nd of Oct. - 31st of Oct.

Target Flowrate: 280 TJ/d | $7,235 \times 10^3 \text{m}^3/\text{d}$

() - represents the nominal flow to target flowrate ratio

[] - represents the individual HP nominal flow to total HP flowrate ratio

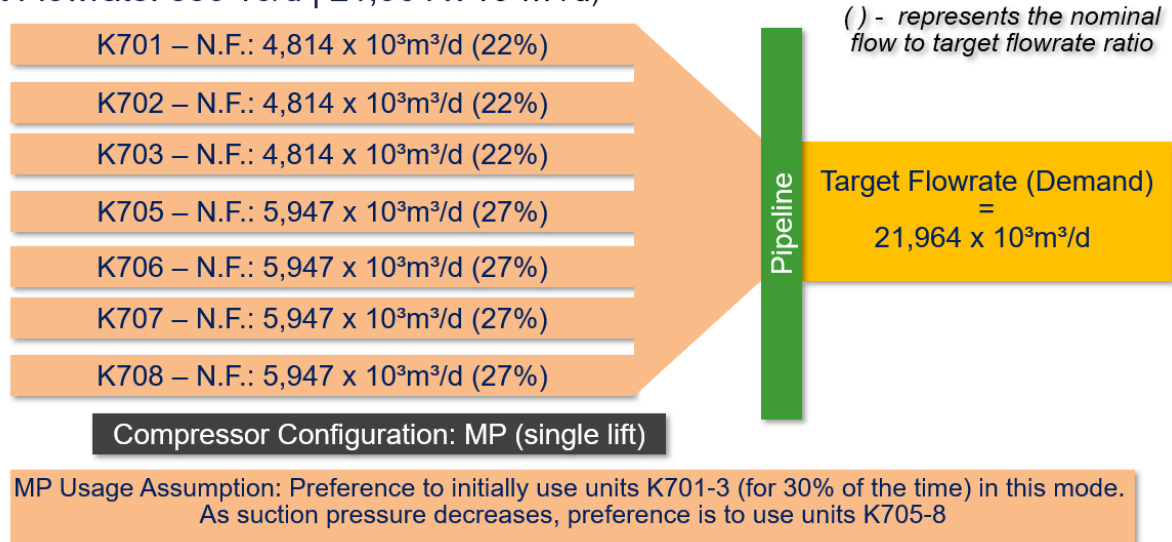


Compressor Configuration: HP (single lift) – 2 x HP

4.2.2 Nominal Compressor Line-up – Withdrawal Mode

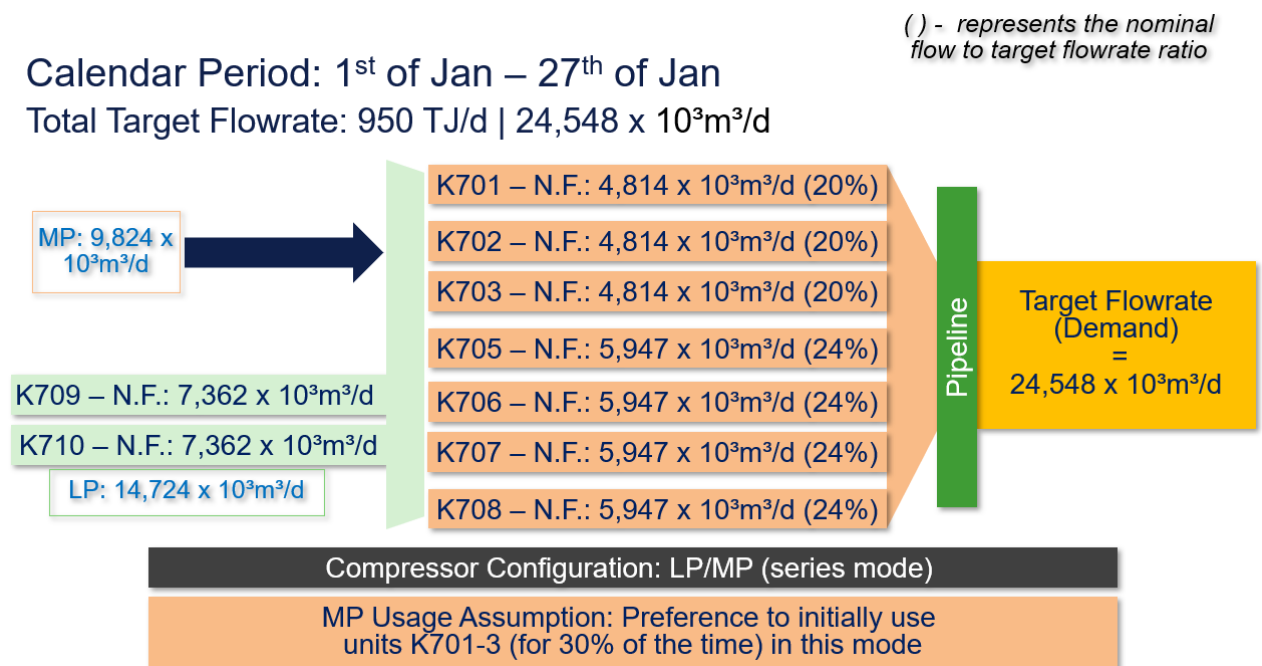
Calendar Period: 27th of Nov. – 31st of December (35 days)

Target Flowrate: 850 TJ/d | $21,964 \times 10^3 \text{m}^3/\text{d}$



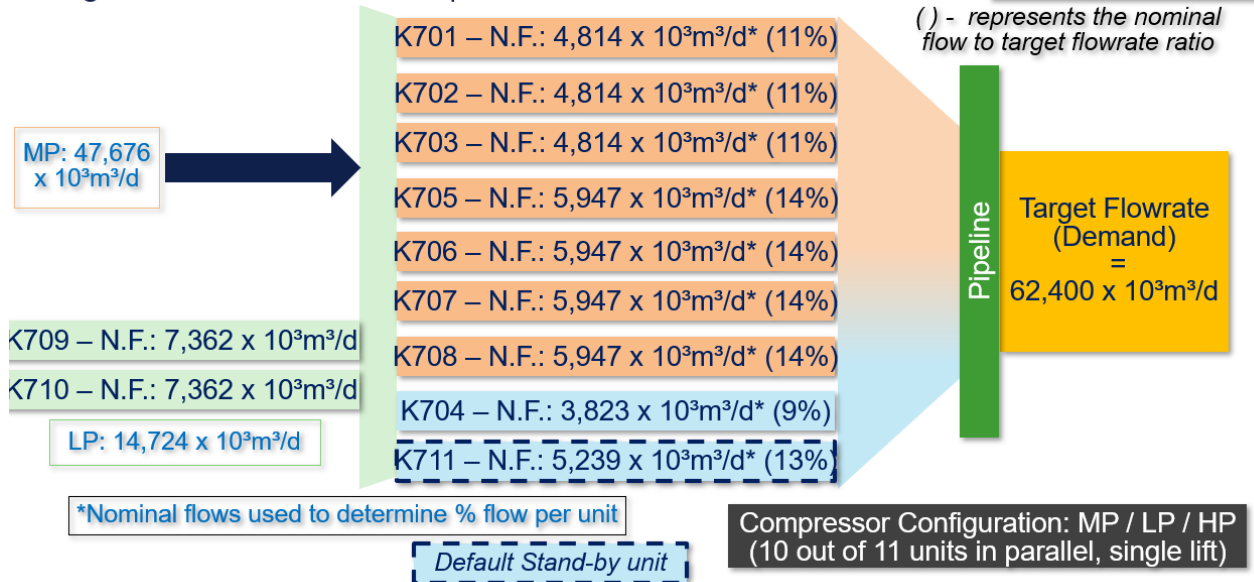
Calendar Period: 1st of Jan – 27th of Jan

Total Target Flowrate: 950 TJ/d | $24,548 \times 10^3 \text{m}^3/\text{d}$



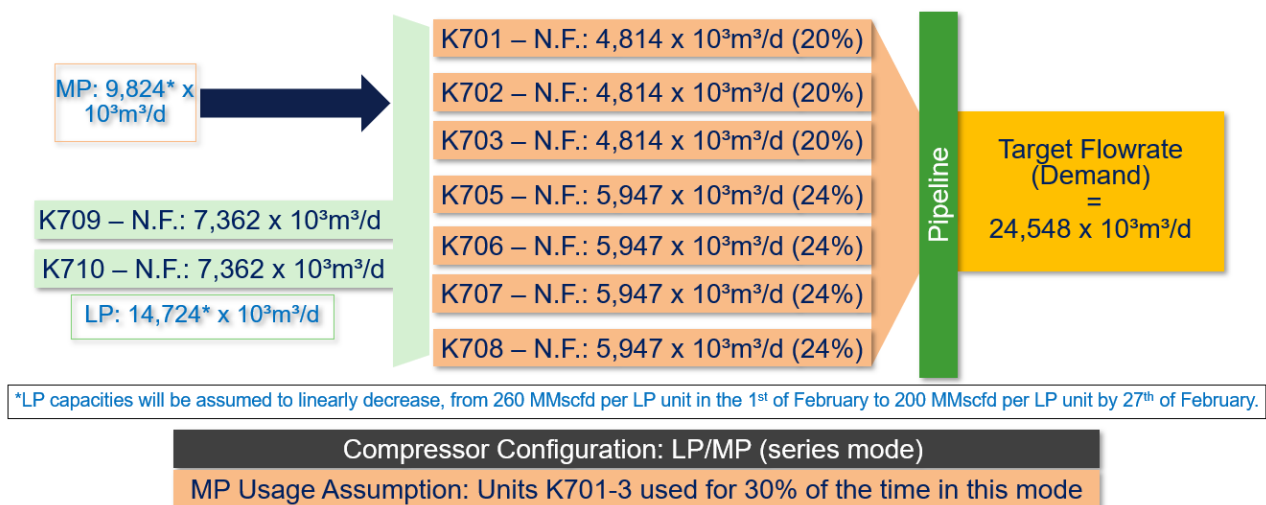
Calendar Period: 28th of Jan. – 31st of Jan. (4 days)

Target Flowrate: 2,415 TJ/d | 62,400 x 10³m³/d)



Calendar Period: 1st of Feb. – 27th of Feb.

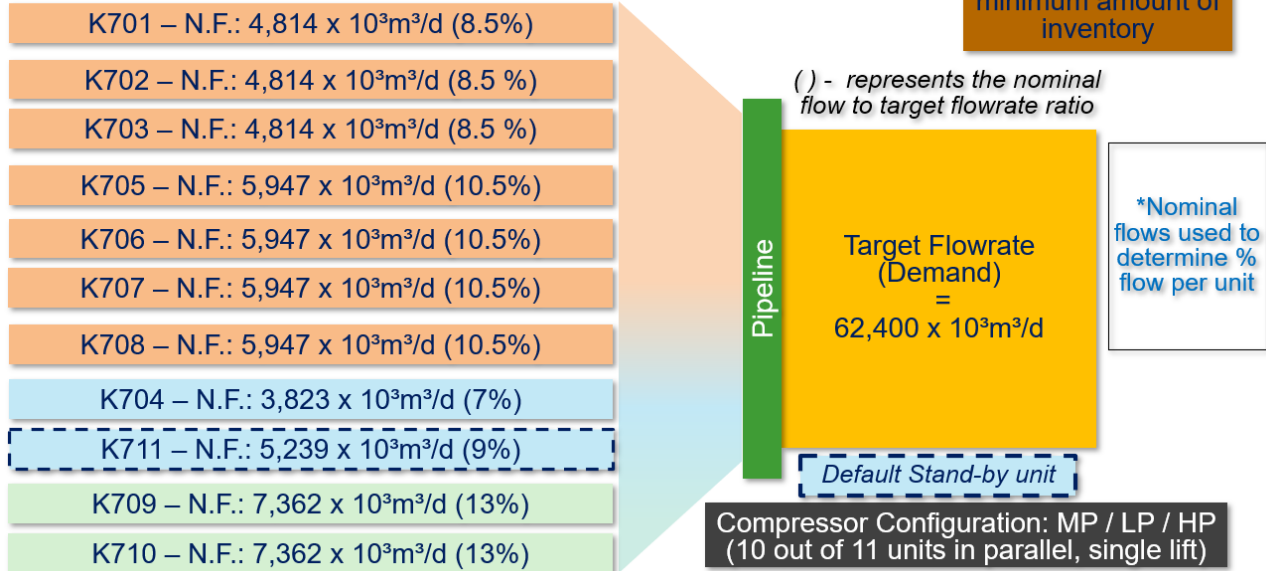
Total Target Flowrate: 950 TJ/d | 24,548 x 10³m³/d)



Calendar Period: 28th of Feb. – 28th of Feb. (1 day)

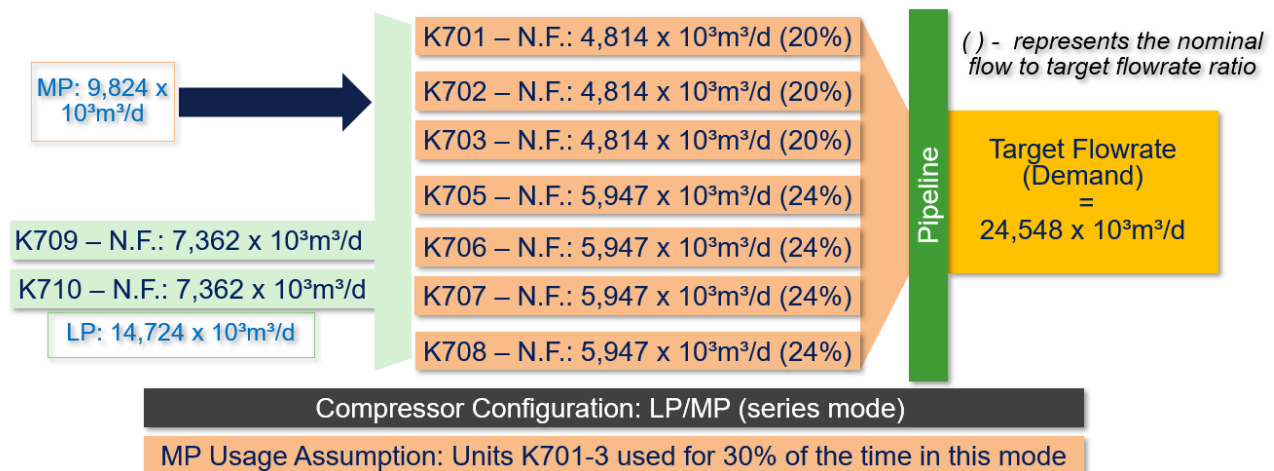
Target Flowrate: 2,415 TJ/d | 62,400 x 10³m³/d

Design Day –
comprises the
maximum flow
delivery with
minimum amount of
inventory



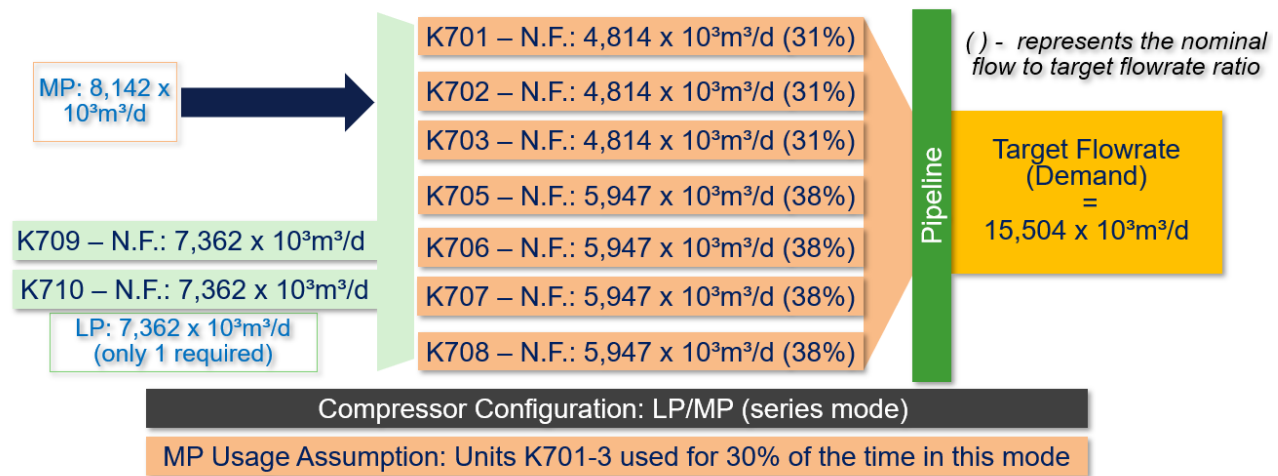
Calendar Period: 1st of Mar. – 31st Mar.

Total Target Flowrate: 950 TJ/d | 24,548 x 10³m³/d



Calendar Period: 1st of Apr. – 30th of Apr.

Total Target Flowrate: 600 TJ/d | $15,504 \times 10^3 \text{m}^3/\text{d}$



4.3 Reliability Data

The model will use reliability data specific to the Corunna facility, extracted from Asset Health Report “StorageAHR-2021AHR-BF20210408” [3] – this data is based on historical CMMS records (MAXIMO). Each compressor unit will be defined by the following systems:

- Foundation
- Crank Assembly
- Engine
- Compressor
- Aftercooler
- Heating & Cooling
- Valve System

The sub-systems and equipment items contained within each system are presented in Figure 4.1.

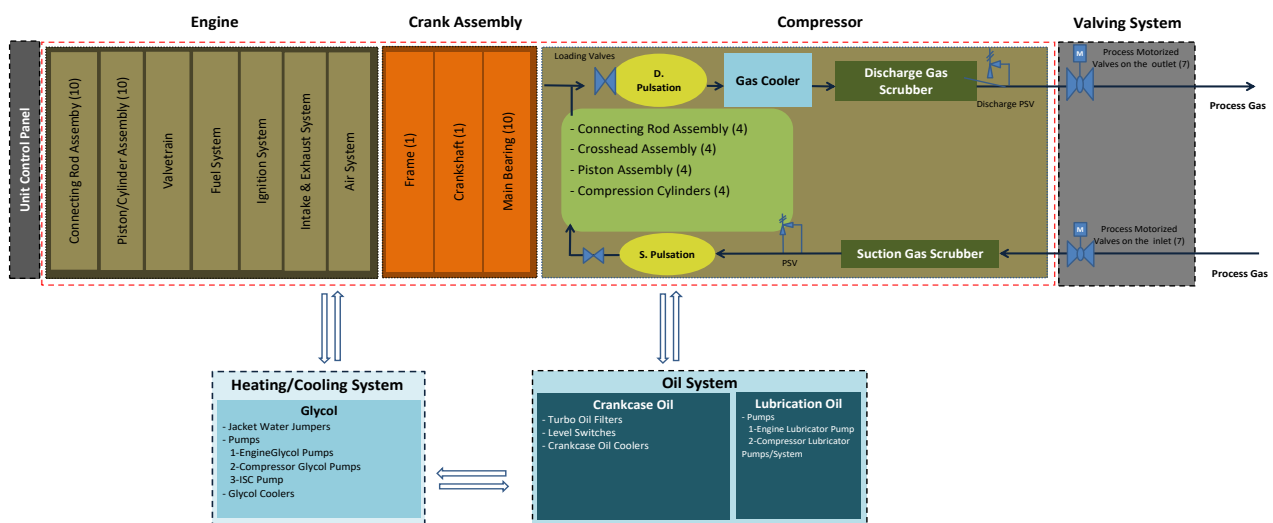


Figure 4.1 Compressor Unit Systems Envelope

Data to be used in the model will take consideration of each compressor unit's reliability, maintenance, and operating history. The following information provides the basis of the reliability data that will be used in the RAM models:

Table 4.3 MTBF Data from AHR Report for 1st Foundation Failure

Unit#	MTBF (hrs)
	Foundation
K701	6,143
K702	24,971
K703	22,685
K704	4,938
K705	56,762
K706	57,121
K707	56,717
K708	30,908
K709	52,669
K710	45,780
K711	38,882

Table 4.4 Characteristic Lifetime (η) Data from AHR Report to be used as MTTF in Remaining Failure Modes

Asset Sub-Class	Applicable Failure Mode	Model Parameters	
		β	η (hr)
Foundation	Degradation	3.3	93,034
Crankshaft	Misalignment	2.3	54,729
Engine (K701-708 & K711)	Critical Component Failure	1.49	10,596
Engine (K709 & K710)	Critical Component Failure	2.34	15,338
Compressor (K701-708 & K711)	Critical Component Failure	1.4	6,042
Compressor (K709&710)	Critical Component Failure	2.03	3,365
Aftercooler	Component Failure	1.35	8,683
Heating & Cooling System	Component Failure	1.1	23,034
	Glycol Leak	1.37	5,207
Valving System	Actuator/Leak/Failure to Operate	1.54	7,520

Table 4.5 Total Downtime Breakdown per Asset Subsystem & Additional Failure Information

Asset Subsystem	Total Downtime (Delay + Actual Repair) – Oct. 2021	Frequency	DNV Comment
Foundation	5 months replacement	4 replacements in total (not including 704) (since units' installation)	

Asset Subsystem	Total Downtime (Delay + Actual Repair) – Oct. 2021	Frequency	DNV Comment
	1-month temporary fix	6 repairs in total (since units' installation)	10 events in total. Based on the breakdown provided, a 40%/60% split of the individual Foundation MTBF will be assumed, as reflected in Table 4.7.
Crankshaft	Misalignment due to Main bearing failure (30% of failures) = 14 days	-	30% of the individual Crankshaft MTBF will be attributed to Misalignment due to bearing failure, as reflected in Table 4.7.
	Misalignment due to foundation (70% of failures) = temporary fix 1 month	-	Misalignment due to foundation will not be considered in the model as it is already accounted as part of the Foundation failure mode.
	Worst case Scenario: Broken Crank Replacement 18 months = crank needed to be ordered, 6-8 months to get the crank from England	1 in units' lifespan	Assumed MTTF = 660,000 hours (30 years x 2000* hours x 11 units) / 1 failure Assumed Downtime = 13,140 hours (18 months) <i>*2000 running hours per year assumed on average for each unit</i>
Engine	All repairs with the exception of 'Worst case scenario' assume all required parts are available, with the total downtime defined in the histogram in Table 4.7b	-	
	Worst case scenario Camshaft component broken: 3 weeks	1 in 30 years	Assumed MTTF = 660,000 hours (30 years x 2000* hours x 11 units) / 1 failure Assumed Downtime = 504 hours <i>*2000 running hours per year assumed on average for each unit</i>
Compressor	All repairs with the exception of 'Worst case scenario' assume all required parts are available, with the total downtime defined in the histogram in Table 4.7b	-	
Gas Aftercooler	All repairs with the exception of 'Worst case scenario' assume all required parts are available, with a total downtime of 1 day	-	
	Worst case scenario: Broken blades takes 2 weeks	2 in 30 years	Assumed MTTF = 330,000 hours (30 years x 2000* hours x 11 units) / 2 failures Assumed Downtime = 336 hours <i>*2000 running hours per year assumed on average for each unit</i>
Heating & Cooling Systems	All repairs with the exception of 'Worst case scenario' assume all required parts are available, with a total downtime of 2 days	-	
Valving System	All repairs with the exception of 'Worst case scenario' assume all required parts are available, with a total downtime of 1 day	-	
	Worst case scenario, taking apart the valves: 1 week the longest	3 in 30 years	Assumed MTTF = 110,000 hours (30 years x 2000* hours x 11 units) / 3 failures Assumed Downtime = 168 hours <i>*2000 running hours per year assumed on average for each unit</i>

Table 4.6 Projected Number of Failures (based on actual 5-year average of running hours for each unit)

	Foundation	Crank Assembly	Engine	Compressor	Aftercooler	Heating & Cooling System	Valve System
2021	1.247	1.566	7.975	9.638	5.007	8.499	7.472
2022	1.291	1.613	8.017	9.652	5.031	8.523	7.501
2023	1.337	1.661	8.057	9.665	5.054	8.546	7.529
2024	1.383	1.708	8.098	9.678	5.078	8.568	7.557
2025	1.429	1.755	8.137	9.690	5.100	8.590	7.583
2026	1.475	1.803	8.175	9.702	5.122	8.611	7.609

Table 4.7 summarises the reliability data for each compressor unit, using the following parameters:

- Mean Time To Fail (MTTF)
- Total Downtime per Failure
- Annual Deterioration Rate

For reference purposes, below are examples of how different parameters in Table 4.7 were calculated:

- Foundation 1st Failure MTTF (unit K701 used as an example):
 - $MTBF \text{ from Table 4.3} \times (\text{Hours in 1 Calendar Year} / \text{Assumed Compressor Running Hours}) = 6,143 \times (8,760 / 2,000) = 26,906 \text{ hours}$
- Foundation 2nd Failure MTTF (applicable to all units):
 - $\eta \text{ from Table 4.4} \times (\text{Hours in 1 Calendar Year} / \text{Assumed Compressor Running Hours}) = 93,034 \times (8,760 / 2,000) = 407,489 \text{ hours}$
- Crank Assembly Misalignment due to Bearing Failure MTTF (30% of the failures - applicable to all units):
 - $\eta \text{ from Table 4.4} / 0.3 = 54,729 / 0.3 = 182,430 \text{ hours}$
- Engine Failure MTTF (applicable to units K-701 – K-708 & K-711):
 - $\eta \text{ from Table 4.4} = 10,596 \text{ hours}$
- Engine Failure MTTF (applicable to units K-709 & K-710):
 - $\eta \text{ from Table 4.4} = 15,338 \text{ hours}$
- Compressor Deterioration Factor for Compressors in 2022 and 2026:
 - $2022: \text{Failure Count in 2022} / \text{Failure Count in 2021} = 9.652 / 9.638 = 1.001$
 - $2026: \text{Failure Count in 2026} / \text{Failure Count in 2021} = 9.702 / 9.638 = 1.007$

Table 4.7 RAM Study Reliability Data

Unit#	MTTF for OPTAGON (hrs)								
	Foundation 1st Failure*	Foundation - 2nd Failure*	Crank Assembly - Misalignment due to Bearing (30%) ¥	Engine ¥	Compressor ¥	Aftercooler ¥	Heating & Cooling (critical failure) ¥	Heating & Cooling (glycol leak) ¥	Valve System ¥
K701	26,906	407,489	182,430	10,596	6,042	8,683	23,034	5,207	7,520
K702	109,373	407,489	182,430	10,596	6,042	8,683	23,034	5,207	7,520
K703	99,360	407,489	182,430	10,596	6,042	8,683	23,034	5,207	7,520
K704	21,628	407,489	182,430	10,596	6,042	8,683	23,034	5,207	7,520
K705	248,618	407,489	182,430	10,596	6,042	8,683	23,034	5,207	7,520
K706	250,190	407,489	182,430	10,596	6,042	8,683	23,034	5,207	7,520
K707	248,420	407,489	182,430	10,596	6,042	8,683	23,034	5,207	7,520
K708	135,377	407,489	182,430	10,596	6,042	8,683	23,034	5,207	7,520
K709	230,690	407,489	182,430	15,338	3,365	8,683	23,034	5,207	7,520
K710	200,516	407,489	182,430	15,338	3,365	8,683	23,034	5,207	7,520
K711	170,303	407,489	182,430	10,596	6,042	8,683	23,034	5,207	7,520
Total Downtime per Failure (hours, unless stated otherwise)									
All	40% chance of 5 months, 60% chance of 1 month (temporary fix)		336	See below	See below	24	48	12 (assumed)	24
Annual Deterioration Factors									
2021 - Reference	1.000		1.000	1.000	1.000	1.000	1.000		1.000
2022	1.036		1.030	1.005	1.001	1.005	1.003		1.004
2023	1.072		1.060	1.010	1.003	1.010	1.005		1.008
2024	1.109		1.091	1.015	1.004	1.014	1.008		1.011
2025	1.146		1.121	1.020	1.005	1.019	1.011		1.015
2026	1.183		1.151	1.025	1.007	1.023	1.013		1.018

* Based on calendar time | ¥ Based on running hours

Table 4.7b Engine and Compressor Downtime

		Engine	Compressor
Time Range	Modelled Time (hrs)	% Failure	% Failure
<1 day	12	75%	70%
<1 week	90	5%	20%
1-4 weeks	420	6%	7%
1-3 months	1460	9%	3%
3-11months	5110	5%	0%

Note that in addition to the typical running failures listed in Table 4.7, the model will also consider the Worst Case Scenario failures pertaining to the Crankshaft, Engine, Aftercooler and Valve System items, as described in Table 4.5.

4.4 Maintenance and Operations

4.4.1 Planned Maintenance

It is assumed that all planned maintenance activities on Corunna will take place during the scheduled 5-day plant outages, in the spring and fall shoulder seasons. Therefore, any impact of planned maintenance outages will not be considered in the injection / withdrawal compression RAM models.

4.4.2 Mobilisation & Logistic Delays

Mobilisation time considers the time when the failure is detected up to the point when the repair can begin. This includes:

- Crew mobilisation
- Permit to start work
- Isolation/purging of equipment/cooldown
- Availability of required spares

Since operational reliability data (MAXIMO) is to be used in the model, the data shown in Section 4.3 takes into consideration mobilisation delays, in addition to actual repair times. No additional delays will be included in the model.

4.4.3 Spares

The Base Case model assumes that sufficient capital spares of all major equipment items are available within the downtimes given in Section 4.3.

4.4.4 Switching Delays

It is assumed that all standby equipment is auto start without impact on gas throughput.

5 RESULTS

In Sections 5.1 and 5.2, results are presented for the individually modelled Gas Injection and Gas Withdrawal modes of operation, respectively.

The Gas Injection Base Case model considers the injection operation into the storage pools that requires compression from the 27th of May to the 31st of October. Conversely, the Gas Withdrawal Base Case model assesses the gas withdrawal from the storage pools that requires compression from the 27th of November to the 30th of April.

5.1 Gas Injection Results – Base Case

5.1.1 Injection Efficiency

Table 5.1 presents the overall results for the Gas Injection Demand, Injection, Shortfall and Injection Efficiency for the Gas Injection Base Case, over the gas injection operating months for a period of 5 years. As well as presenting the Mean Average forecast, the likely spread of results is also given by the P5 and P95 forecasts. The P5 and P95 results present the 5% and 95% probability of exceeding the stated levels of Injection Efficiency.

Table 5.1 Base Case Gas Injection Overall Results

Case	Demand (x10 ³ m ³)	Injected (x10 ³ m ³)	Shortfall (x10 ³ m ³)	Injection Efficiency (%)	Availability (%)	Shortfall (%)
P5	13,772,710	13,713,991	58,720	99.57%	98.23%	0.43%
Mean	13,772,710	13,461,540	311,170	97.74%	90.86%	2.26%
P95	13,772,710	13,025,354	747,356	94.57%	77.24%	5.43%

This demonstrates that:

- The mean Injection Efficiency of the Corunna facilities across the 5-year review period against Demand is 97.74%; 13,461,540 x10³ m³ of gas was injected against a Demand of 13,772,710 x10³ m³.
- There is a 5% chance of exceeding an Injection Efficiency of 99.57% and a 95% chance of exceeding an Injection Efficiency of 94.57%.

Moreover, the yearly and monthly breakdown of Gas Injection Shortfall over the 5-year review period are presented in Figure 5.1 and Figure 5.2, respectively.

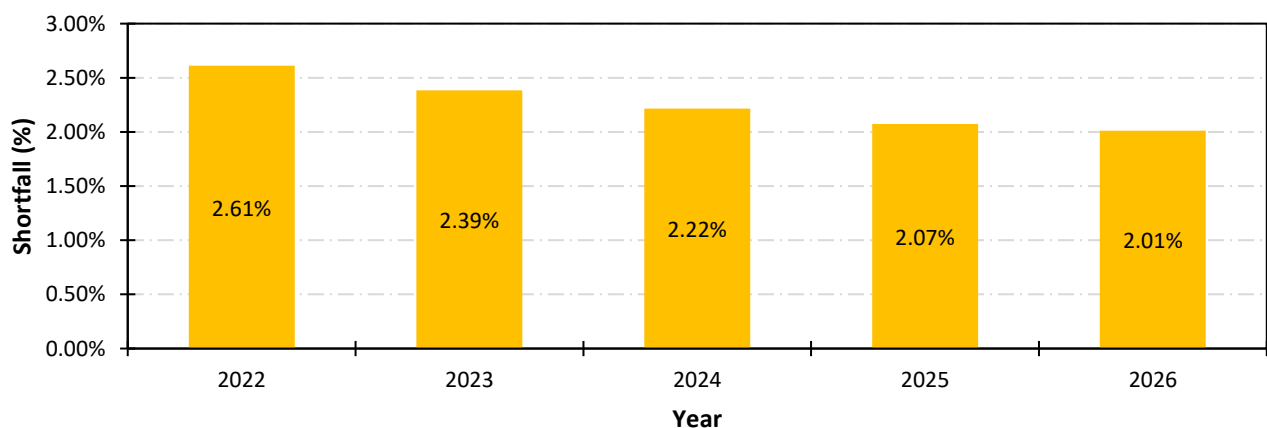


Figure 5.1 Yearly Breakdown of Base Case Gas Injection Shortfall

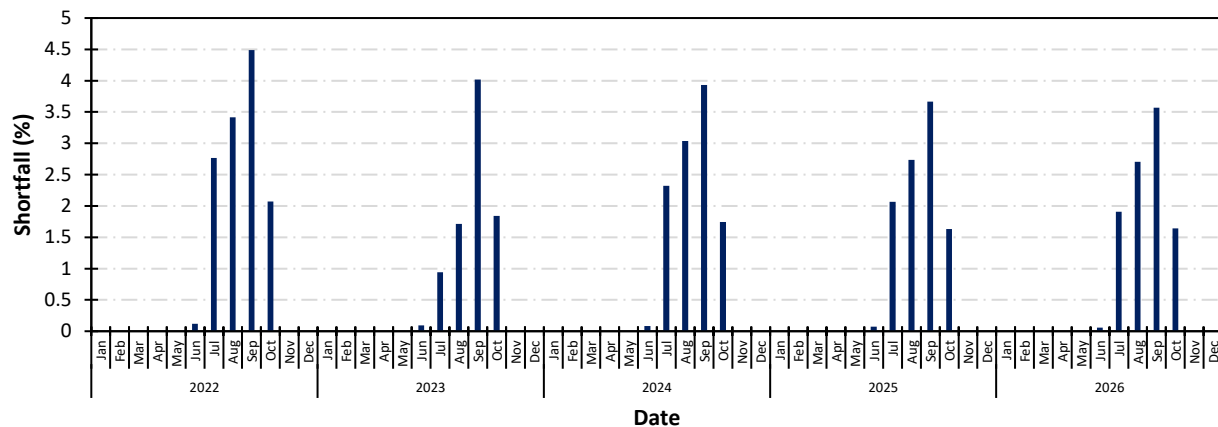


Figure 5.2 Monthly Breakdown of Base Case Gas Injection Shortfall

Key observations are:

- Despite the expected increase in plant deterioration each year, which results in higher number of failures each year, it is forecasted that Gas Injection Shortfall will decrease from 2022 to 2026. This decreasing trend is attributed to the potential incipient 1st foundation failure of units K704 (HP duty) and K701 (MP duty), likely to occur in early years due to them not yet being replaced (unlike other units), with the former having a high impact in injection capability, given its low level of redundancy. As a result, given the long downtime duration associated with this maintainable item (between 1-5 months), the high impact on shortfall in years surpasses the impact on shortfall associated with plant deterioration.
- Figure 5.2 shows that significantly reduced levels of shortfall are recorded in May - June each year, which is attributed to the high levels of sparing associated with the MP units, which are the only units required to operate during these months. As a result, shortfall is only observed if 4-5 MP compressor units fail to operate during this period (exact number dependant on which MP units fail, given the variation on their capacity).
- High levels of shortfall are recorded in months where both HP units are required to be operating (July, August and September), where failure of any of the HP compressors will immediately cause a loss in injection capability.
- Furthermore, it is also observed that the highest level of shortfall is recorded in September each year (total Demand of $18,088 \times 10^3 \text{ m}^3$ of gas injection, $9,062 \times 10^3 \text{ m}^3$ of gas requiring HP compression with the remaining gas being injected directly from the MP compressors – see Section 4.2.1). The compressor configuration and injection demand from the HP units is the same in August and September. However, given the reduction in total gas demand in September in comparison to August, means that any failure of the HP units will mathematically lead to a higher percentage of shortfall, and hence the higher levels of shortfall recorded in the month of September.
- Finally, in October, two different scenarios occur. From the 1st to the 21st of October, only 1 out of the HP units is required to operate, which greatly reduces the criticality of these units in relation to the entire injection operation. However, from the 22nd of October until the end of the month, the entire injection duty is entirely dependent on both HP units.

5.1.2 Shortfall Exceedance

The probability and frequency of exceeding various levels of Gas Injection Shortfall are presented in Table 5.2 and Figure 5.3.

Table 5.2 Summary of Shortfall Exceedance during the Injection Period

Shortfall (%)	Annual Average Probability of Exceedance (%)	Annual Average Frequency of Exceedance (Years)
0.000000%	100.00%	1.00
0.065305%	99.99%	1.00
1.0000000%	74.12%	1.35
2.0000000%	46.30%	2.16
3.0000000%	27.45%	3.64
4.0000000%	13.64%	7.33
5.0000000%	6.83%	14.64
19.54594%	0.001%	100,000.00

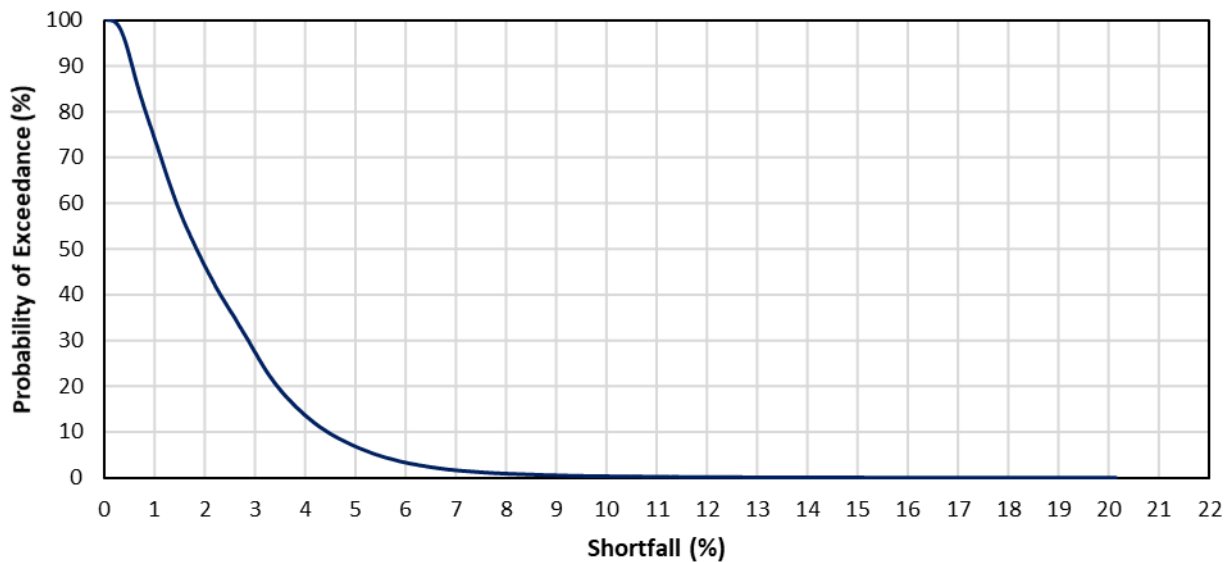


Figure 5.3 Shortfall Exceedance Probability during the Injection Period

As can be seen from these results:

- Gas Injection Shortfall is forecast to typically **lie in the range 1-5%**. There is a 67.29% probability that the predicted average shortfall will lie in this range, equivalent to a frequency of occurring every 1.5 years.
- Every 3.9 years (probability of 25.88%), it is predicted the Gas Injection Shortfall will be **less than 1.0%**.
- Every 2.2 years (probability of 46.30%), it is predicted the Gas Injection Shortfall will **exceed 2.0%**.
- Every 14.6 years (probability of 6.83%), it is predicted the Gas Injection Shortfall will **exceed 5.0%**.

5.1.3 Operational Availability (Time)

The predicted number of days in which the Corunna facility is operating at Full Injection, Partial Injection or Zero Injection is shown diagrammatically in Figure 5.4. Note that in OPTAGON, a calendar year of 365 days is equally spaced, with each month having 30.4 days. Results are also presented in a tabulated format in Appendix A.

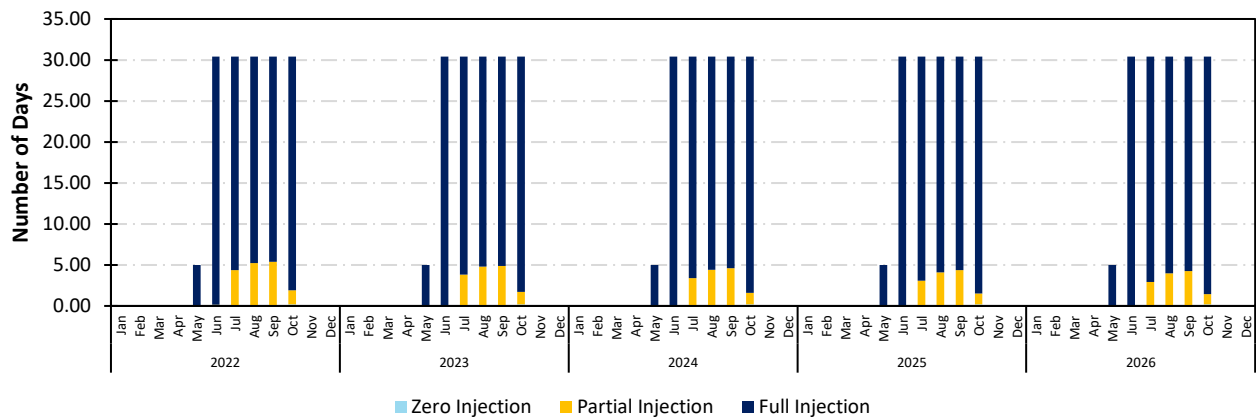


Figure 5.4 Gas Injection Operational Days

Key observations are that:

- Injection Availability of the Corunna facilities (i.e., proportion of time it is injecting at full rate over the total injection time) is **90.86%**, which demonstrates that Full Injection dominates the injection cycle.
- In May and June, where only the MP units are required to operate, Full Injection is reached in almost all required days, given the high level of redundancy discussed previously.
- Partial Injection is seen in months where the HP units are required to operate in support of MP compression (1st of July – 30th of September). This is mostly influenced by the low level of redundancy seen in the HP units (2 units in an 'N' configuration).
- Between the 1st of October – 21st of October, the HP units continue to support MP operations, albeit in a 'N+1' configuration and as a result, a lower level of partial production is recorded in October, as a single failure of a HP unit does not necessarily lead to injection shortfall.
- Between the 22nd of October – 31st of October, the HP units are required to cover the full injection duties and as a result, Zero Injection is reported in October, due to failure of both units. However, the contribution of not being able to inject at any rate towards Gas Injection Shortfall is small, given that it only occurs on average for 0.2 days every year (see Table A1 in Appendix A).

5.1.4 Shortfall Contributors

The contributors to Gas Injection Shortfall are given at equipment and maintainable item level in Sections 5.1.4.1 and 5.1.4.2, respectively.

5.1.4.1 Equipment Contributors to Gas Injection Shortfall

The equipment contributors to Gas Injection Shortfall over the 5-year period considered are shown in Table 5.3 and Figure 5.5. The shortfall caused by each equipment is quantified and ranked by its impact on Gas Injection at the point of failure, as defined by the Injection profiles. Also reported in Table 5.3 are the Total Aggregated Downtimes Repair and Running Times for each unit over the 5-year reviewed period.

Table 5.3 Gas Injection 5-Year Equipment Contributors to Shortfall

Rank	Equipment	Gas Injection Shortfall			Total Aggregated Downtimes (hrs)	Total Running Time (hrs)
		Absolute		Relative		
		x10 ³ m ³	%	%		
1	K-704	161,174.7	1.17%	51.80%	2,839	13,126
2	K-711	148,609.6	1.08%	47.76%	1,463	12,100
3	K-705	260.3	<0.01%	0.08%	1,551	14,450
4	K-706	251.8	<0.01%	0.08%	1,432	13,238
5	K-707	236.7	<0.01%	0.08%	1,165	10,142
6	K-708	228.6	<0.01%	0.07%	1,223	7,991
7	K-701	159.0	<0.01%	0.05%	2,426	9,730
8	K-702	128.1	<0.01%	0.04%	1,216	6,665
9	K-703	121.5	<0.01%	0.04%	1,192	5,734
Total		311,170.3	2.26%	100.00%	14,507	93,177

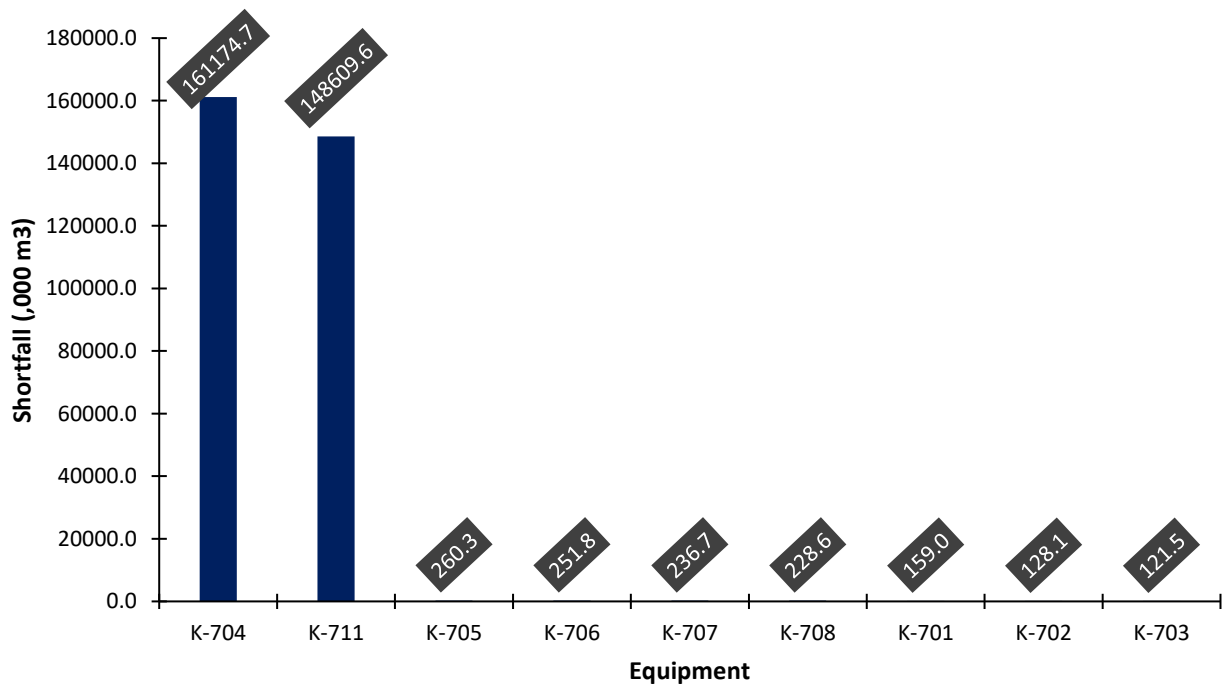


Figure 5.5 Gas Injection 5-Year Equipment Contributors to Shortfall (,000 m³)

Key observations are that:

- Units K-704 and K-711 (HP units) are responsible for 99.56% of the total Gas Injection shortfall. In absolute terms, this represents 309,784.3 x10³ m³ of Gas Injection Shortfall (2.25%). As discussed previously, this is attributed to the combined 'N' configuration that these units exhibit for the majority of the time that they are required to operate.

- K-704 contributes higher shortfall than K-711, due to the increased likelihood of a foundation failure to affect this unit (1st foundation failure MTTF of 21,628 hours for K-704 vs. 170,303 for K-711), which has an extended downtime associated with its repair.
- The remaining 0.44% of the total Gas Injection Shortfall is caused by the MP units, which require between 4 – 5 units not operating to impact gas injection operations.
- In total, the combined compressor downtime hours across the 5-year review period is 14,507 hours. Units K-704 and K-701 show the highest downtimes, forecasted to be down for a total of 2,839 and 2,426 hours, respectively. As discussed, this is attributed to high likelihood of foundation failures linked to these units (as defined in Section 4.3). Despite its high downtime, K-701 is reported to cause lower shortfall than units K-705 – K-708, which is explained by the lower injection flow capacity associated with unit K-701 (and in fact K-702 & K-703) versus units K-705 – K-708. Therefore, a failure of units K-705 – K-708 will result in higher levels of shortfall than would occur if units K701-K703 failed.
- The total combined compressor running hours across the 5-year review period is forecast to be 93,177 hours, which averages to approximately 2,071 hours run per compressor unit (9) each year. The high number of running hours recorded for the Injection cycle alone is indicative of the high-demand scenario that is being assessed in this RAM study. This high-demand scenario may not represent a typical year of operation, but it represents the extreme running conditions that the facilities must respond to when required (e.g., in response to extreme weather conditions). This scenario includes both the design day and 4-day peak demands.

5.1.4.2 Maintainable Item Contributors to Gas Injection Shortfall

The maintainable item contributors to Gas Injection Shortfall over the 5-year period considered are shown in Table 5.4 and Figure 5.6.

Table 5.4 Gas Injection 5-Year Maintainable Item Contributors to Shortfall

Rank	Maintainable Item	Gas Injection Shortfall		
		Absolute		Relative
		x10 ³ m ³	%	%
1	Foundation	97,605.7	0.71%	31.37%
2	Engine	73,000.4	0.53%	23.46%
3	Compressor	64,125.6	0.47%	20.61%
4	Heating & Cooling	23,252.1	0.17%	7.47%
5	Valves	20,668.4	0.15%	6.64%
6	Aftercooler	16,994.3	0.12%	5.46%
7	Crankshaft	15,523.8	0.11%	4.99%
Total		311,170.3	2.26%	100.00%

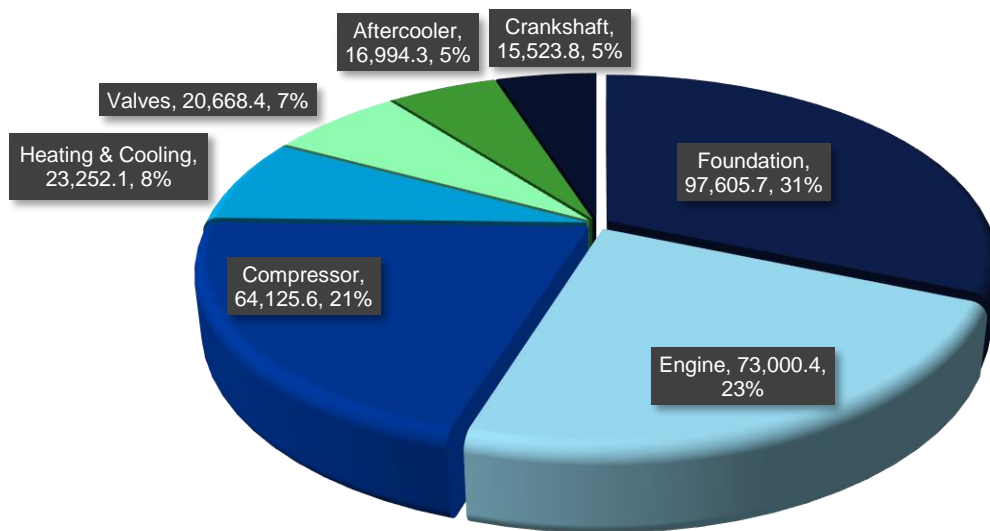


Figure 5.6 Gas Injection 5-Year Maintainable Item Contributors to Shortfall (,000 m³)

Key observations are that:

- Foundations are the most significant contributor to Gas Injection Shortfall, accounting for 31.37% of total shortfall (97,605.7 x10³ m³, 0.709% absolute). This is attributed to the long duration associated with the repair of this maintainable item.
- Next are the compressor Engines, which are responsible for 23.46% of total Gas Injection Shortfall (73,000.4 x10³ m³, 0.53% absolute). On average, Engines have a higher MTTF than Compressors. However, based on the reliability information detailed in Section 4.3 (more specifically, Table 7.4b, provided by Enbridge), the average downtime associated with an engine failure is 425.6 hours, which is substantially higher than the 99.6 hours of average downtime required following a compressor failure.
- 3rd are the Compressor item of the entire compressor unit, predicted to cause 20.61% of the total shortfall (64,125.6 x10³ m³, 0.47% absolute).
- The following items, with the exception of the Crankshaft, have downtime durations below 50 hours and are therefore ranked as follows with regard to Gas Injection Shortfall:
 - Heating & Cooling – 7.47% of total shortfall (23,252.1 x10³ m³, 0.17% absolute) – predominantly due to glycol leaks.
 - Valve System – 6.64% of total shortfall (20,668.4 x10³ m³, 0.15% absolute).
 - Aftercooler – 5.46% of total shortfall (16,994.3 x10³ m³, 0.12% absolute).
 - Crankshaft due to bearing misalignment – 4.99% of total shortfall (15,523.8 x10³ m³, 0.11% absolute) – despite the high downtime associated with this item, it fails less frequently than the aforementioned items.
- Finally, it is important to note that the low frequency, high consequence failures associated with the Crankshaft, Engine, Aftercooler and Valve System items (as defined in Table 4.5) are not expected to contribute significantly to shortfall.

5.2 Gas Withdrawal Results – Base Case

5.2.1 Withdrawal Efficiency

Table 5.5 presents the overall results for the Gas Withdrawal Demand, Withdrawn, Shortfall and Withdrawal Efficiency for the Gas Withdrawal Base Case, over the gas withdrawal operating months for a period of 5 years. As well as presenting the Mean Average forecast, the likely spread of results is also given by the P5 and P95 forecasts. The P5 and P95 results present the 5% and 95% probability of exceeding the stated levels of Withdrawal Efficiency.

Table 5.5 Base Case Gas Withdrawal Overall Results

Case	Demand (x10 ³ m ³)	Withdrawn (x10 ³ m ³)	Shortfall (x10 ³ m ³)	Withdrawal Efficiency (%)	Availability (%)	Shortfall (%)
P5	18,162,200	18,087,109	75,091	99.59%	98.30%	0.41%
Mean	18,162,200	17,872,477	289,723	98.40%	93.61%	1.60%
P95	18,162,200	17,431,297	730,903	95.98%	85.25%	4.02%

This demonstrates that:

- The mean Withdrawal Efficiency of the Corunna facilities across the 5-year review period against Demand is 98.40%; 17,872,477 x10³ m³ of gas was withdrawn against a Demand of 18,162,200 x10³ m³.
- There is a 5% chance of exceeding a Withdrawal Efficiency of 99.59% and a 95% chance of exceeding a Withdrawal Efficiency of 95.98%.

Moreover, the yearly and monthly breakdown of Gas Withdrawal Shortfall over the 5-year review period are presented in Figure 5.7 and Figure 5.8, respectively.

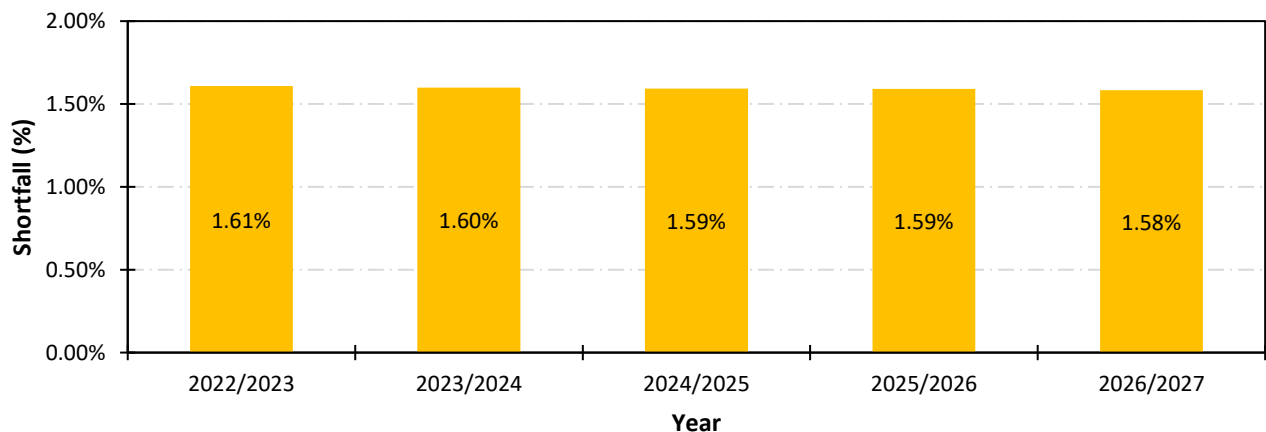


Figure 5.7 Yearly Breakdown of Base Case Gas Withdrawal Shortfall

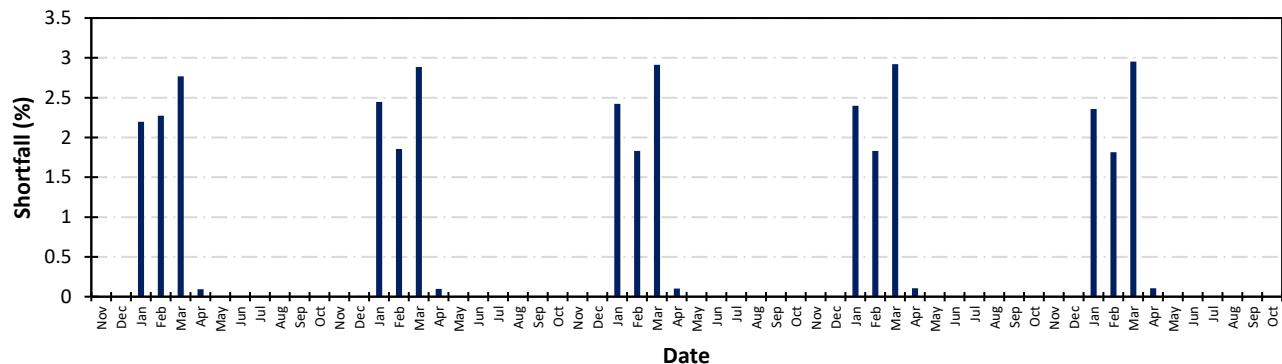


Figure 5.8 Monthly Breakdown of Base Case Gas Withdrawal Shortfall

Key observations are:

- A decreasing trend in Gas Withdrawal Shortfall is observed between 2022 and 2026, attributed to the high likelihood of units K-704 and K-701 having their 1st foundation failures within the first years of the reviewed period. However, this decreasing trend in shortfall during Gas Withdrawal operations is considerably less pronounced than in Gas Injection. This is because the criticality of these units is generally lower, in comparison to Gas Injection operations (unit K-701 operates for the majority of the year but has a high level of redundancy available; unit K-704 is only required to operate during the Peak Compression & Design Day periods).
- Figure 5.8 shows that, despite withdrawal operations starting on the 27th of November, no shortfall is forecasted in the November and December months. This is attributed to the high level of compressor sparing of the MP compressors that are required to meet the gas demand in these two months.
- Subsequent to 2022, where the effect from the 1st foundation failures is less pronounced, it can be seen (from Figure 5.8) that high levels of shortfall are recorded in months where both LP units are required to be operating (January, February and March), where failure of any of the LP compressors will immediately cause a loss in withdrawal capability. More specifically, the following observations can be drawn regarding these specific months:
 - In January, two different compressor arrangements exist – LP/MP compression in the first 27 days of the month ($24,548 \times 10^3 \text{ m}^3/\text{d}$ gas demand), followed by a LP/MP/HP peak compression ($62,400 \times 10^3 \text{ m}^3/\text{d}$ gas demand) for the last 5 days of the month. In both arrangements, with regard to the LP configuration, a single compressor failure results in immediate withdrawal shortfall, with various levels of sparing in the MP compressor side (sparing reduced to a single unit during peak compression).
 - In February, the overall gas demand in the first 27 days of the month is the same as in the first 27 days of January ($24,548 \times 10^3 \text{ m}^3/\text{d}$), with the final day of the month consisting of a typical Design Day compression ($62,400 \times 10^3 \text{ m}^3/\text{d}$). Despite the similarity between January and February in the first 27 days of each month with regard to overall gas demand and compressor configuration, over the beginning of February, the amount of bypassing the LP route and flowing directly to the MP compressors increases (i.e., greater than in January). Consequently, during this period, the impact of any LP compressor failure in February is reduced in comparison to January, which explains the reduction in shortfall percentage from January to February.
 - Over the entire month of March, the compressor configuration and gas demand are the same as during the first 27 days of January and February, which explains the high levels of shortfall observed in Figure 5.8. The higher shortfall percentage in March, in comparison to January and February, is due to the shortfall being reported in relative terms - given that January and February have high demand periods,

the loss of a given compressor has a relatively smaller impact than when the overall demand is lower, as in March.

- Finally, in April the demand is reduced, thus increasing the level of sparing in the MP side of the compressor configuration and most importantly, on the LP side, as only 1 LP compressor is required to operate. As a result, significantly reduced levels of shortfall are observed during this month.

5.2.2 Shortfall Exceedance

The probability and frequency of exceeding various levels of Gas Withdrawal Shortfall are presented in Table 5.6 and Figure 5.9.

Table 5.6 Summary of Shortfall Exceedance during the Withdrawal Period

Shortfall (%)	Probability of Exceedance (%)	Probability of Exceedance (Relative Years)
0.00%	100.00%	1.00
0.06%	100.00%	1.00
0.50%	90.59%	1.10
1.00%	59.56%	1.68
2.00%	25.79%	3.88
3.00%	12.57%	7.96
4.00%	5.12%	19.52
5.00%	2.07%	48.38
16.71%	0.00%	100,000.00

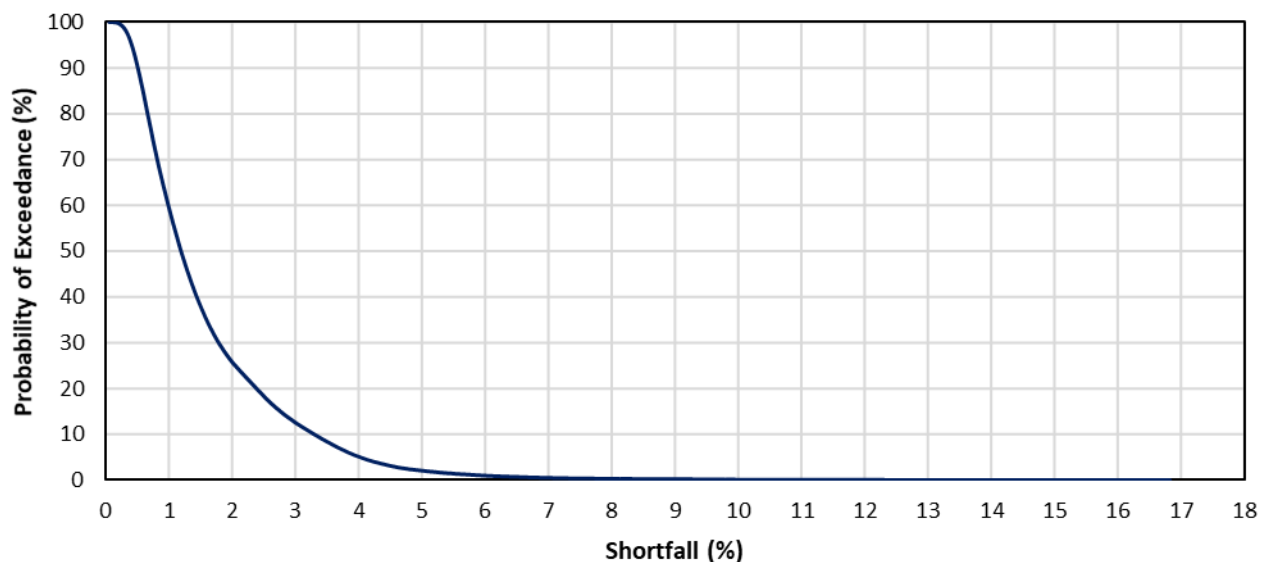


Figure 5.9 Shortfall Exceedance Probability during the Withdrawal Period

As can be seen from these results:

- Gas Withdrawal Shortfall is forecast to typically **lie in the range 0.5-5%**. There is an 88.52% probability that the predicted average shortfall will lie in this range, equivalent to a frequency of occurring every 1.1 years.

- Every 10.6 years (probability of 9.41%), it is predicted the Gas Withdrawal Shortfall will be **less than 0.5%**.
- Every 3.9 years (probability of 25.79%), it is predicted the Gas Withdrawal Shortfall will **exceed 2.0%**.
- Every 48.3 years (probability of 2.07%), it is predicted the Gas Withdrawal Shortfall will **exceed 5.0%**.

5.2.3 Operational Availability (Time)

The predicted number of days in which the Corunna facility is operating at Full Withdrawal, Partial Withdrawal or Zero Withdrawal, is shown diagrammatically in Figure 5.10. Results are also presented in a tabulated format in Appendix A.

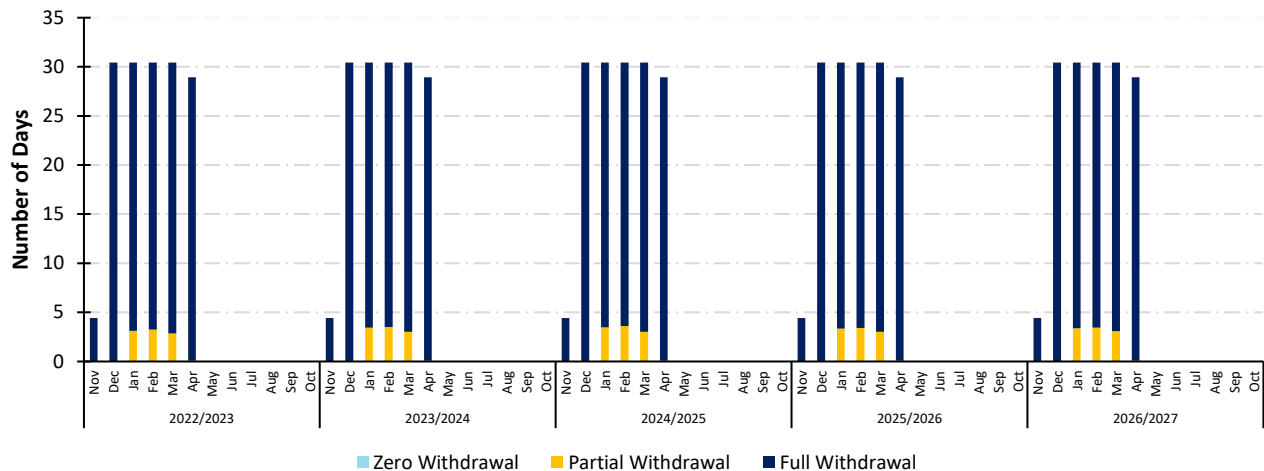


Figure 5.10 Gas Withdrawal Operational Days

Key observations are that:

- Withdrawal Availability of the Corunna facilities (i.e., proportion of time it is withdrawing at full rate over the total withdrawal time) is 93.61%, which demonstrates that Full Withdrawal dominates the withdrawal cycle.
- There are no instances where Zero Withdrawal (i.e., due to failure of all required units) is observed (see Table A2 in Appendix A).
- In November and December, where only the MP units are required to operate, Full Withdrawal is reached for the majority of time in these two months, given the high level of redundancy discussed previously.
- Partial Withdrawal is seen in months where the LP units are required to operate in support of MP compression (January, February and March). This is mostly influenced by the low level of redundancy seen in the LP units (2 units in an 'N' configuration).
- During the peak and design days (Withdrawal model assumes 4 days of peak compression in January and 1 single design day of compression in February each year), the following is concluded:
 - Of the total 600 hours that are run in peak and design mode over the 5-year review period, the demand is fully met for 386.2 hours, or approximately 64.4% of the required time. Additionally, of the 10 instances that gas demand is increased to the peak and design day levels ($62,400 \times 10^3 \text{ m}^3/\text{d}$), the demand is initially met 9.7 times. This means that peak and design day demand is almost always met initially, but during these periods, certain units fail, thus resulting on the demand being only met for 64.4% of the time that maximum withdrawal is required.
- In April, the HP units continue to support MP operations, albeit in a 'N+1' configuration and as a result, a lower level of partial production is recorded in April, as a single failure of a LP unit does not necessarily lead to withdrawal shortfall.

5.2.4 Shortfall Contributors

The contributors to Gas Withdrawal Shortfall are given at equipment and maintainable item level in Sections 5.2.4.1 and 5.2.4.2, respectively.

5.2.4.1 Equipment Contributors to Gas Withdrawal Shortfall

The equipment contributors to Gas Withdrawal Shortfall over the 5-year period considered are shown in Table 5.7 and Figure 5.11. The shortfall caused by each equipment is quantified and ranked by its impact on Gas Withdrawal at the point of failure, as defined by the Withdrawal profiles. Also reported in Table 5.7 are the Total Aggregated Downtimes and Running Times for each unit over the 5-year reviewed period.

Table 5.7 Gas Withdrawal 5-Year Equipment Contributors to Shortfall

Rank	Equipment	Gas Withdrawal Shortfall			Total Aggregated Downtimes (hrs)	Total Running Time (hrs)
		Absolute		Relative		
		x10 ³ m ³	%	%		
1	K-710	127,590.3	0.70%	43.83%	1,240	11,116
2	K-709	125,034.0	0.69%	42.96%	1,332	13,111
3	K-705	6,325.6	0.04%	2.17%	1,707	15,675
4	K-706	6,231.7	0.03%	2.14%	1,664	15,436
5	K-707	5,688.8	0.03%	1.95%	1,359	11,977
6	K-701	4,977.5	0.03%	1.71%	2,752	13,076
7	K-708	4,945.6	0.03%	1.70%	1,090	6,350
8	K-703	3,652.3	0.02%	1.26%	1,557	9,774
9	K-702	3,634.8	0.02%	1.25%	1,689	11,966
10	K-711	1,567.0	0.01%	0.54%	485	498
11	K-704	1,436.3	0.01%	0.49%	1,790	561
Total		291,083.9	1.60%	100.00%	16,665	109,542

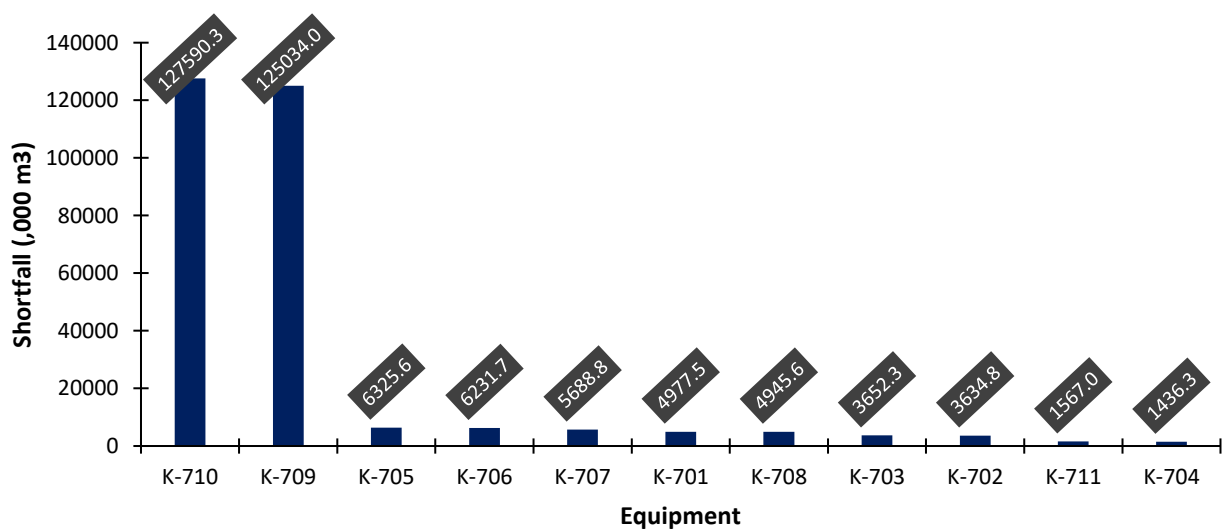


Figure 5.11 Gas Withdrawal 5-Year Equipment Contributors to Shortfall (,000 m3)

Key observations are that:

- Units K-710 and K-709 (LP units) are responsible for 86.79% of the total Gas Withdrawal shortfall. In absolute terms, this represents 252,624.3 x10³ m³ of Gas Withdrawal Shortfall (1.38%). As discussed previously, this is attributed to the combined 'N' configuration that these units exhibit for the majority of the time that they are required to operate, which is particularly substantial.
- K-710 trumps K-709 in the shortfall rankings due to the higher likelihood of a foundation failure to affect this unit (1st foundation failure MTTF of 200,516 hours for K-710 vs. 230,690 for K-709), which has discussed previously, has a high downtime associated with its repair.
- The remaining 13.21% of the total Gas Withdrawal Shortfall is caused by the MP units, which require 4 or 5 units not operating to impact gas withdrawal operations.
- In total, the combined compressor downtime hours across the 5-year reviewed period is 16,665 hours. As reported in the Gas Injection results, unit K-701 shows the highest downtime, namely forecasted to be down for a total of 2,752 hours. As discussed, this is attributed to high likelihood of foundation failure linked to this unit (as defined in Section 4.3). Unit K-704 also has a high likelihood of sustaining a foundation failure. However, given its low utilization (expected to operate for a total of 5 days during withdrawal), its contribution towards Gas Withdrawal Shortfall is reduced. Despite its high downtime, K-701 is reported to cause lower shortfall than units K-705 – K-708, which is explained by the lower withdrawal flow capacity associated with unit K-701 (and in fact K-702 & K-703) versus units K-705 – K-708. Therefore, a failure of units K-705 – K-708 will result in higher levels of shortfall than would occur if units K701-K703 failed.
- The total combined compressor running hours across the 5-year review period is forecast to be 109,542 hours, which averages to approximately 1,992 hours per compressor unit (11), each year.

5.2.4.2 Maintainable Item to Gas Withdrawal Shortfall

The maintainable item contributors to Gas Withdrawal Shortfall over the 5-year period considered are shown in Table 5.8 and Figure 5.12.

Table 5.8 Gas Withdrawal 5-Year Maintainable Item Contributors to Shortfall

Rank	Maintainable Item	Gas Withdrawal Shortfall		
		Absolute		Relative
		x10 ³ m ³	%	%
1	Compressor	76,537.0	0.42%	26.42%
2	Foundation	60,167.5	0.33%	20.77%
3	Engine	44,714.8	0.25%	15.43%
4	Heating & Cooling	36,355.6	0.20%	12.55%
5	Valves	31,458.6	0.17%	10.856%
6	Aftercooler	25,732.9	0.14%	8.88%
7	Crankshaft	14,750.8	0.08%	5.09%
Total		289,717.2	1.60%	100.00%

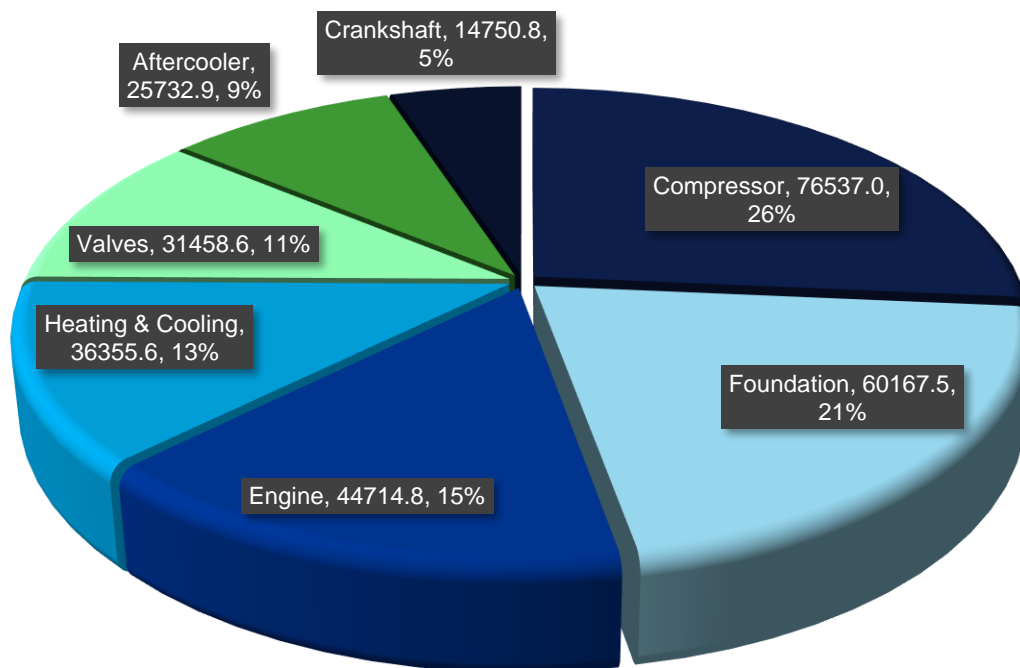


Figure 5.12 Gas Withdrawal 5-Year Maintainable Item Contributors to Shortfall (,000 m³)

Key observations are that:

- Compressors are the most significant contributor to Gas Withdrawal Shortfall, accounting for 26.42% of total shortfall (76,537.0 x10³ m³, 0.42% absolute). This is attributed to the low compressor reliability associated with the critical units K-709 and K-710, which is significantly lower than all other units.
- Foundations are the 2nd highest contributor to Gas Withdrawal Shortfall, which is one of the main differences in comparison to the Gas Injection mode, accounting for 20.77% of total shortfall (60,167.5 x10³ m³, 0.33% absolute). The change in shortfall ranking is attributed to the fact that foundation failures in this mode of operation affects mostly units that have a high level of redundancy (K-701 and K-704), which is not the case in Gas Injection. However, the long duration associated with the repair of this maintainable item still results in a high contribution towards shortfall by this maintainable item, albeit not the top contributor.
- Next are the compressor Engines, which are responsible for 15.43% of total Gas Withdrawal Shortfall (44,714.8 x10³ m³, 0.25% absolute). As discussed previously, the average downtime duration of an engine is 425.6 hours, which is substantially higher than the 99.6 hours of average downtime required subsequent to a compressor failure. However, the low Compressor reliability of units K-709 and K-710 results in a higher ranking of this Compressor maintainable item versus Engines.
- As in Gas Injection, the following items, with the exception of the Crankshaft, have downtime durations below 50 hours and are therefore ranked as follows with regard to Gas Withdrawal Shortfall:
 - Heating & Cooling – 12.55% of total shortfall (36,355.6 x10³ m³, 0.20% absolute) – predominantly due to glycol leaks.
 - Valve System – 10.86% of total shortfall (31,458.6 x10³ m³, 0.17% absolute).

- Aftercooler – 8.88% of total shortfall ($25,732.9 \times 10^3 \text{ m}^3$, 0.14% absolute).
 - Crankshaft due to bearing misalignment – 5.09% of total shortfall ($14,750.8 \times 10^3 \text{ m}^3$, 0.08% absolute) – despite the high downtime associated with this item, it fails less frequently than the aforementioned items.
- Finally, it is important to note that the low frequency, high consequence failures associated with the Crankshaft, Engine, Aftercooler and Valve System items (as defined in Table 4.5) are not expected to contribute significantly to shortfall.

6 SUMMARY & CONCLUSIONS

6.1 Summary

Table 6.1 and Figure 6.1 provide a summary of the performance of the Gas Injection and Gas Withdrawal Base Cases.

Table 6.1 Efficiency / Availability Results Summary by Case

Case	Efficiency (%)	Availability (%)
Gas Injection Base Case	97.74%	90.86%
Gas Withdrawal Base Case	98.40%	93.61%

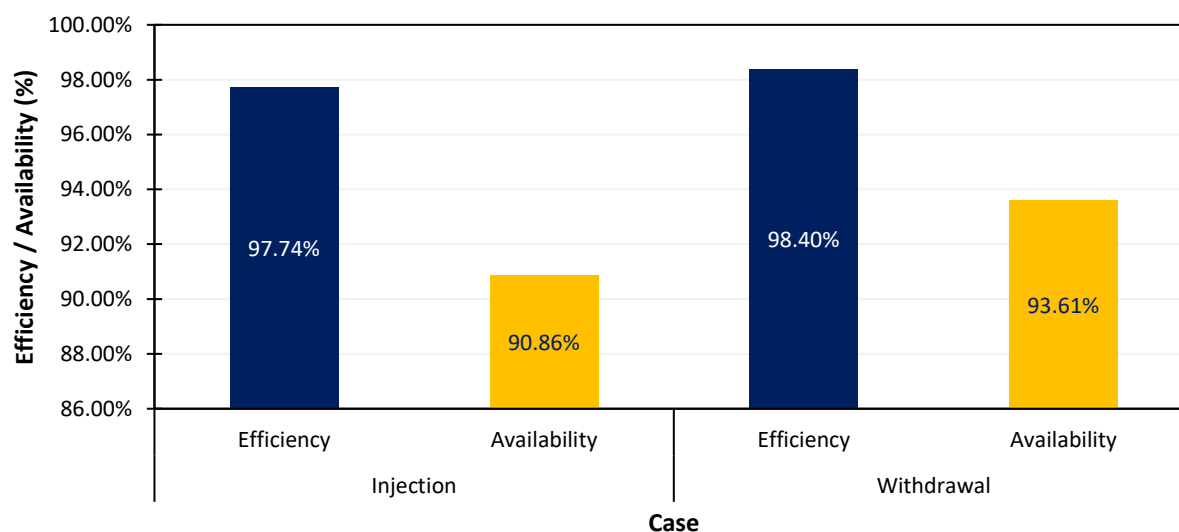


Figure 6.1 Efficiency / Availability Results Summary by Case

As can be seen from the results, the Efficiency of the Corunna facilities is lower during the Injection mode of operation (97.74%) than during the Withdrawal mode (98.40%). This is due to a higher number of days that the facilities will operate at Partial Capacity during Injection than in Withdrawal, as reflected by the Availability of these two modes of operation.

Gas Injection Base Case

Figure 6.2 presents a yearly breakdown of the Base Case Gas Injection Shortfall over the 5-year review period. During the 5 years assessed, the mean Injection Efficiency of the Corunna facilities against Demand is 97.74%; 13,461,540 x10³ m³ of gas was injected against a Demand of 13,772,710 x10³ m³.

Additionally, despite the expected increase in plant deterioration, which results in higher number of failures each year, it is forecasted that Gas Injection Shortfall will decrease from 2022 to 2026. This decreasing trend is attributed to the potential incipient 1st foundation failure of units K704 (HP duty) and K701 (MP duty), likely to occur in early years, with the former having a high impact in injection capability, given its low level of redundancy. As a result, given the long downtime duration associated with this maintainable item (between 1-5 months), the high impact on shortfall in early years surpasses the impact on shortfall associated with plant deterioration.

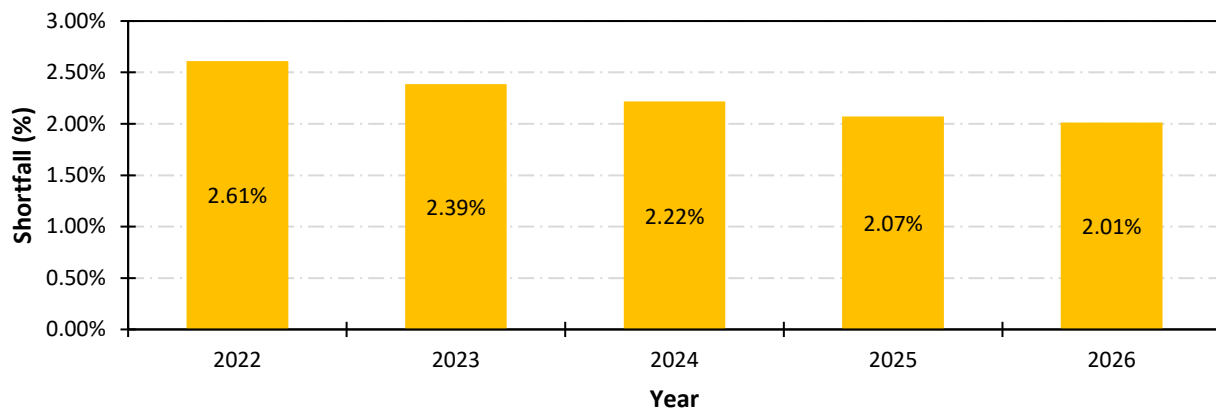


Figure 6.2 Yearly Breakdown of Base Case Gas Injection Shortfall (5 Years)

Gas Withdrawal Base Case

Figure 6.3 presents a yearly breakdown of the Base Case Gas Withdrawal Shortfall over the 5-year review period. During the 5 years assessed, the mean Withdrawal Efficiency of the Corunna facilities against Demand is 98.40%; 17,872,477 x10³ m³ of gas was withdrawn against a Demand of 18,162,200 x10³ m³.

A decreasing trend in Gas Withdrawal Shortfall is observed between 2022 and 2026, attributed to the high likelihood of units K-704 and K-701 having their 1st foundation failures within the first years of the reviewed period. However, this decreasing trend in shortfall during Gas Withdrawal operations is considerably less pronounced than in Gas Injection. This is because the criticality of these units is generally lower, in comparison to Gas Injection operations.

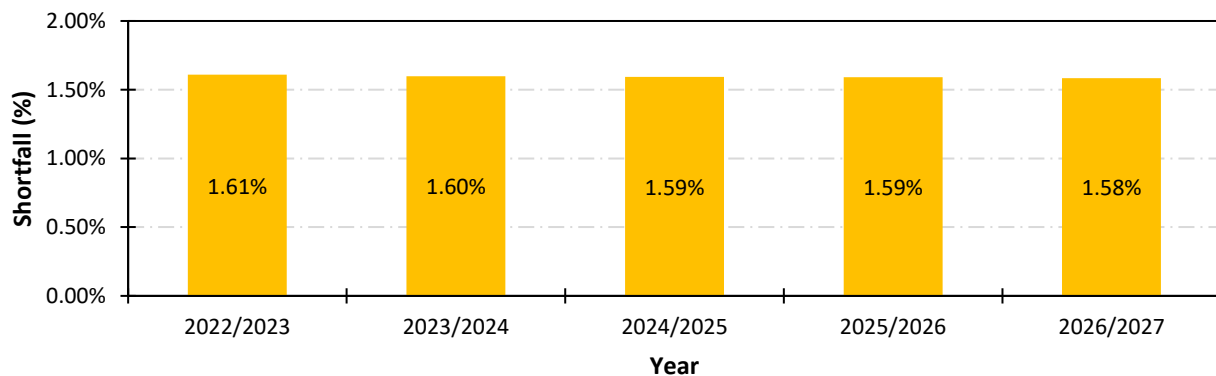


Figure 6.3 Yearly Breakdown of Base Case Gas Withdrawal Shortfall (5 Years)

6.2 Conclusions

This section summarises the key conclusions that can be drawn from the results of the Gas Injection and Withdrawal Base Cases:

- The Efficiency of the Corunna facilities is lower during the Injection mode of operation (97.74%) than during the Withdrawal mode (98.70%). This is due to a higher number of days that the facilities will operate at Partial Capacity during Injection than in Withdrawal. In absolute terms, over the 5-year review period, this means that:
 - With regard to Gas Injection, $13,461,540 \times 10^3 \text{ m}^3$ of gas was injected against a Demand of $13,772,710 \times 10^3 \text{ m}^3$.
 - With regard to Gas Withdrawal, $17,872,477 \times 10^3 \text{ m}^3$ of gas was withdrawn against a Demand of $18,162,200 \times 10^3 \text{ m}^3$.
- Despite the expected increase in plant deterioration each year, which results in higher number of failures each year, it is forecasted that both Gas Injection and Gas Withdrawal Shortfall will decrease from 2022 to 2026. This decreasing trend is attributed to the potential incipient 1st foundation failure of certain compressor units. The decreasing shortfall trend is more pronounced in the Gas Injection mode as in particular, the 1st foundation failure is likely to affect a unit (K-704) that is in an 'N' configuration, which is not the case in Gas Withdrawal (K-701 is likely to be affected in this mode, but it has significant levels of sparing).
- Units K-704 & K-711 (HP) and K-709 & K-710 (LP), which predominantly operate in an 'N' configuration, are the most critical items with regard to the operation of the Corunna facilities. These units are forecasted to account for 99.56% and 86.79% of the total gas shortfall of the Injection and Withdrawal modes, respectively.
- Foundations are the most significant Maintainable Item contributor to Gas Injection Shortfall, accounting for 31.37% of total shortfall. This is attributed to the long duration associated with the repair of this maintainable item (between 1-5 months), and the likelihood to affect unit K-704, which has no level of redundancy. Engines and Compressors make up the top 3 ranking of Maintainable Item shortfall contributors, accounting for 23.46% and 20.61% of the total shortfall, respectively.
- Compressors are the most significant Maintainable Item contributor to Gas Withdrawal shortfall, accounting for 26.42% of the total shortfall. This is attributed to the low compressor reliability associated with the critical units K-709 and K-710, which is significantly lower than all other units. Foundations and Engines make up the top 3 ranking of Maintainable Item shortfall contributors, accounting for 20.77% and 15.43% of the total shortfall, respectively.
- The low frequency, high consequence failures associated with the Crankshaft, Engine, Aftercooler and Valve System items are not expected to contribute significantly to shortfall.

7 REFERENCES

- /1/ "14-218 CCS Headers Process Flow Diagram"
- /2/ "1. CCS Operating Modes.xlsx"
- /3/ Asset Health Report "StorageAHR-2021AHR-BF20210408.xlsx"

APPENDIX A OPERATIONAL DAYS (INJECTION & WITHDRAWAL)

Table A1 Gas Injection Operational Days

Year	Month	Number of Days		
		Zero Injection	Partial Injection	Full Injection
2022	Jan	0.000	0.000	0.000
	Feb	0.000	0.000	0.000
	Mar	0.000	0.000	0.000
	Apr	0.000	0.000	0.000
	May	0.000	0.000	5.000
	Jun	0.000	0.158	30.258
	Jul	0.000	4.384	26.033
	Aug	0.000	5.215	25.202
	Sep	0.000	5.368	25.048
	Oct	0.201	1.690	28.526
	Nov	0.000	0.000	0.000
	Dec	0.000	0.000	0.000
2023	Jan	0.000	0.000	0.000
	Feb	0.000	0.000	0.000
	Mar	0.000	0.000	0.000
	Apr	0.000	0.000	0.000
	May	0.000	0.000	5.000
	Jun	0.000	0.126	30.291
	Jul	0.000	3.839	26.578
	Aug	0.000	4.779	25.637
	Sep	0.000	4.878	25.539
	Oct	0.203	1.500	28.714
	Nov	0.000	0.000	0.000
	Dec	0.000	0.000	0.000
2024	Jan	0.000	0.000	0.000
	Feb	0.000	0.000	0.000
	Mar	0.000	0.000	0.000
	Apr	0.000	0.000	0.000
	May	0.000	0.000	5.000
	Jun	0.000	0.100	30.317
	Jul	0.000	3.400	27.016
	Aug	0.000	4.423	25.994
	Sep	0.000	4.596	25.821
	Oct	0.204	1.392	28.820
	Nov	0.000	0.000	0.000
	Dec	0.000	0.000	0.000
2025	Jan	0.000	0.000	0.000

	Feb	0.000	0.000	0.000
	Mar	0.000	0.000	0.000
	Apr	0.000	0.000	0.000
	May	0.000	0.000	5.000
	Jun	0.000	0.083	30.334
	Jul	0.000	3.086	27.331
	Aug	0.000	4.094	26.323
	Sep	0.000	4.353	26.063
	Oct	0.205	1.299	28.913
	Nov	0.000	0.000	0.000
	Dec	0.000	0.000	0.000
2026	Jan	0.000	0.000	0.000
	Feb	0.000	0.000	0.000
	Mar	0.000	0.000	0.000
	Apr	0.000	0.000	0.000
	May	0.000	0.000	5.000
	Jun	0.000	0.073	30.344
	Jul	0.000	2.924	27.493
	Aug	0.000	3.986	26.431
	Sep	0.000	4.232	26.185
	Oct	0.207	1.250	28.960
	Nov	0.000	0.000	0.000
	Dec	0.000	0.000	0.000

Table A2 Gas Withdrawal Operational Days

Year	Month	Number of Days		
		Zero Withdrawal	Partial Withdrawal	Full Withdrawal
2022/2023	Nov	0.000	0.001	4.416
	Dec	0.000	0.032	30.385
	Jan	0.000	3.124	27.293
	Feb	0.000	3.253	27.164
	Mar	0.000	2.860	27.557
	Apr	0.000	0.075	28.842
	May	0.000	0.000	0.000
	Jun	0.000	0.000	0.000
	Jul	0.000	0.000	0.000
	Aug	0.000	0.000	0.000
	Sep	0.000	0.000	0.000
	Oct	0.000	0.000	0.000
2023/2024	Nov	0.000	0.003	4.414

	Dec	0.000	0.049	30.368
	Jan	0.000	3.441	26.976
	Feb	0.000	3.514	26.903
	Mar	0.000	3.021	27.395
	Apr	0.000	0.096	28.821
	May	0.000	0.000	0.000
	Jun	0.000	0.000	0.000
	Jul	0.000	0.000	0.000
	Aug	0.000	0.000	0.000
	Sep	0.000	0.000	0.000
	Oct	0.000	0.000	0.000
2024/2025	Nov	0.000	0.002	4.415
	Dec	0.000	0.048	30.369
	Jan	0.000	3.489	26.928
	Feb	0.000	3.601	26.816
	Mar	0.000	3.012	27.405
	Apr	0.000	0.089	28.827
	May	0.000	0.000	0.000
	Jun	0.000	0.000	0.000
	Jul	0.000	0.000	0.000
	Aug	0.000	0.000	0.000
	Sep	0.000	0.000	0.000
	Oct	0.000	0.000	0.000
2025/2026	Nov	0.000	0.001	4.415
	Dec	0.000	0.041	30.376
	Jan	0.000	3.344	27.073
	Feb	0.000	3.415	27.002
	Mar	0.000	3.037	27.380
	Apr	0.000	0.083	28.834
	May	0.000	0.000	0.000
	Jun	0.000	0.000	0.000
	Jul	0.000	0.000	0.000
	Aug	0.000	0.000	0.000
	Sep	0.000	0.000	0.000
	Oct	0.000	0.000	0.000
2026/2027	Nov	0.000	0.002	4.415
	Dec	0.000	0.036	30.380
	Jan	0.000	3.365	27.052
	Feb	0.000	3.442	26.974
	Mar	0.000	3.085	27.332
	Apr	0.000	0.104	28.812
	May	0.000	0.000	0.000

	Jun	0.000	0.000	0.000
	Jul	0.000	0.000	0.000
	Aug	0.000	0.000	0.000
	Sep	0.000	0.000	0.000
	Oct	0.000	0.000	0.000

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DAWN DEHYDRATION UNIT RAM STUDY

RAM Study Report

Enbridge Gas Inc.

Report No.: 10326158-2, Rev. 0

Date: 5 August 2022





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Report title:	RAM Study Report	Asset Performance Solutions Energy Systems
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Customer contact:	Mike Hildebrand	Holywell Park
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		Company Number: 03294136

Applicable contract(s) governing the provision of this Report:

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Objective:

This report presents the results of the Dawn Dehydration Unit RAM Study. In addition, the report also details the assumptions and basis used to develop the Dawn Dehydration Unit RAM model.

Prepared by:

Joao Vasques
Senior Consultant

Verified by:

Neil Wragg
Senior Principal Consultant

Approved by:

Jeremy Johnson, P.Eng.
Senior Engineer, DNV Canada Ltd.

Max Bannon
RAM Consultant

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Executive Summary

The Enbridge Gas Dawn Hub, located in southwestern Ontario, is one of the largest integrated natural gas storage facilities in North America. With multiple supply routes from western Canada, mid-continent, the Rockies, the Gulf of Mexico, as well as the ability to serve markets in the mid-west, eastern Canada and the U.S. Northeast, the Dawn Hub plays a key role as a trading hub, allowing shippers with direct access to North America's major supply basins.

Prior to being delivered to the Transmission System, withdrawn gas from Dawn's storage pools is dehydrated at the 'Dawn Dehydration Unit', to ensure that on-spec gas is delivered, ultimately avoiding the creation of hydrates that could hinder the performance of pressure reduction stations located downstream of the Dawn facilities.

Enbridge have asked DNV to evaluate the performance of the Dawn Dehydration Unit through a Reliability, Availability, and Maintainability (RAM) study. The primary objective of this analysis is to forecast the production efficiency of the Dehydration Unit and identify any potential areas of improvement.

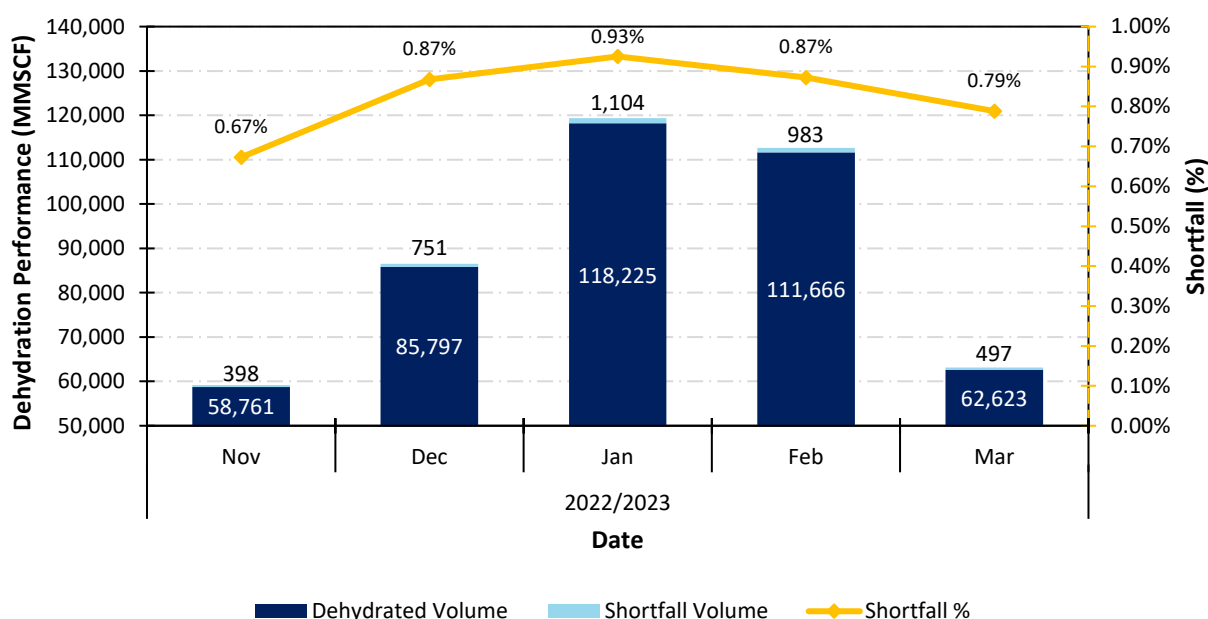
Top Level Performance and Full Shutdown Analysis

The table below provides a summary of the forecasted performance of the Dawn Dehydration Unit over the 10-year study period.

Case	Dehydration Efficiency (%)	Availability (%)
Base Case	99.20%	99.00%

As can be seen from the results, the Dawn Dehydration facilities exhibit high levels of dehydration performance, especially considering that a very conservative demand was assessed in this study. More specifically, it is forecasted over the 10-year study period, that the Dehydration Efficiency of the facilities will be 99.20% and that the facilities will meet 100% of the required demand for 99.00% of the time.

Moreover, the monthly breakdown of the Gas Dehydration Performance, for Year 1 of the 10-year study period, is presented in the figure below.

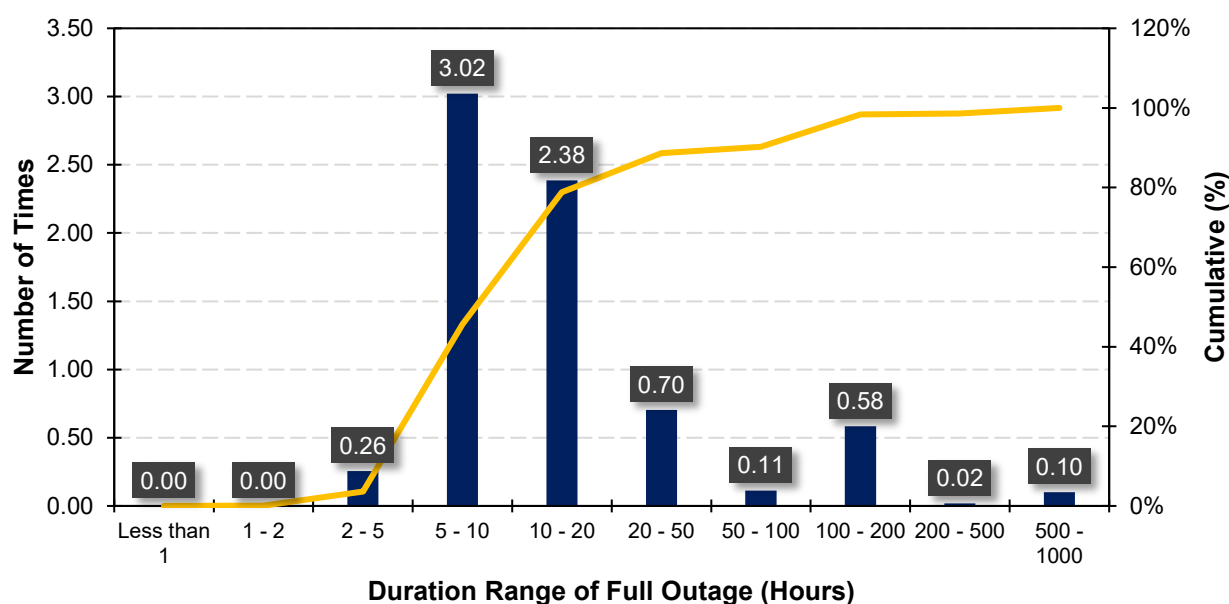




Key observations are:

- Gas Dehydration Performance is expected to be similar to that forecasted in Year 1 for all years of this study. It was assumed that deterioration of the Dawn Dehydration facilities was not significant, since components are within their useful life phase, where the failure rate is close to constant and independent of time. For this to be achieved, items are often replaced or refurbished before they reach the wear-out phase, thus reflecting some of the maintenance and replacement programs taking place at Dawn, given the criticality of the Dehydration Unit to the entire gas transmission operations.
- As the demand profile increases throughout the Winter season, there are slight increases in shortfall. This is attributed to the decrease in redundancy levels during high-demand periods, as a larger proportion of items are required to be in operation to meet demand (therefore equipment failures are more likely to impact performance). During low-demand periods, given the design capacity of certain equipment items, not all units will be required to operate under normal conditions, and therefore will only be used to mitigate the impact of a failure of the operating units.

Full unplanned facility shutdowns are responsible for the majority of the shortfall associated with the gas dehydration operation. A breakdown of the duration of each unplanned full shutdown over the 10-year study period is shown in the figure below.



Key observations are that:

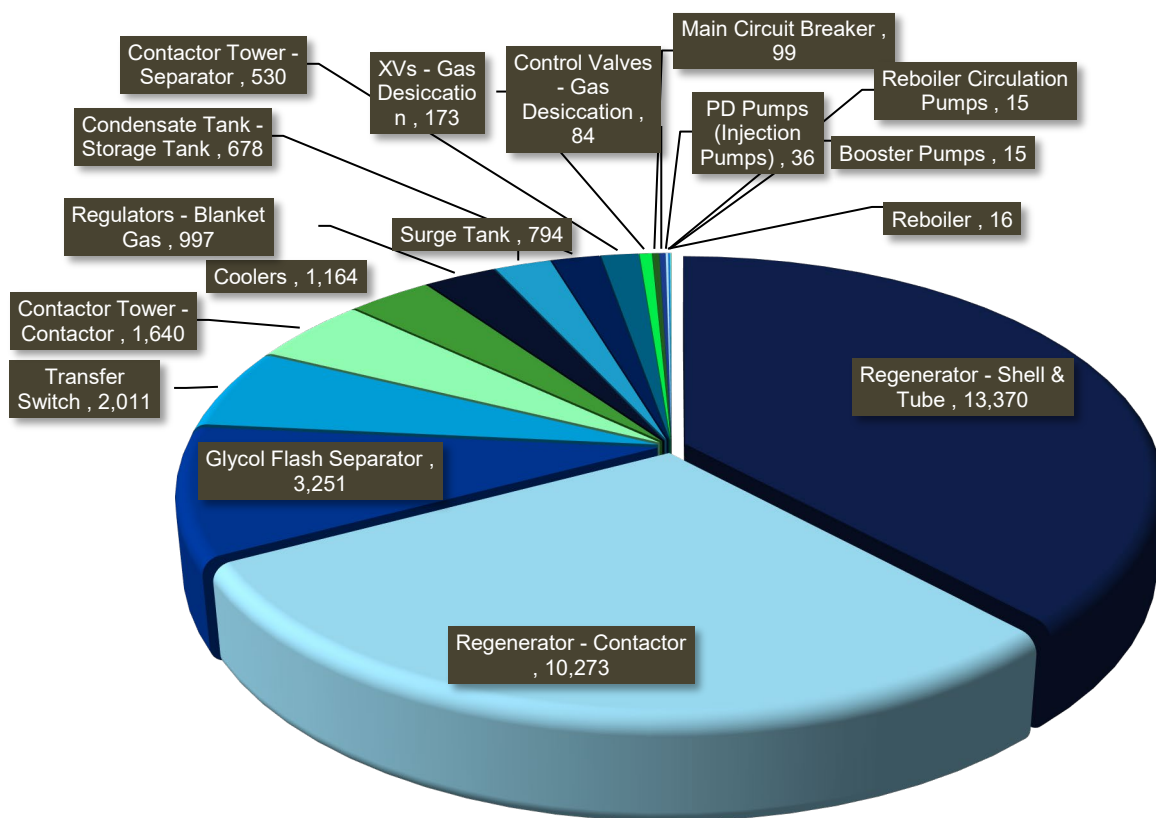
- It is estimated that there are 0.7 full unplanned shutdown events per year at the Dawn Dehydration facilities;
- 75% of the total outages have a duration that lies in the 5 -20 hour range;
- The mean average duration of a full unplanned shutdown event is 35.1 hours (this is skewed by a smaller number of longer outage events, with durations >50 hours).



Shortfall Contributors

The table and figure below show the Gas Dehydration shortfall contributors, at system and equipment level respectively, over the 10-year operation period considered.

Rank	System	Dehydration Shortfall		
		Absolute		Relative
		MMSCF	%	%
1	Glycol Regeneration	28,933	0.66%	82.32%
2	Gas Desiccation	2,428	0.06%	6.91%
3	Electrical System	2,110	0.05%	6.00%
4	Blanket Gas System	997	0.02%	2.84%
5	Incinerator System	678	0.02%	1.93%
Total		35,145	0.80%	100.00%





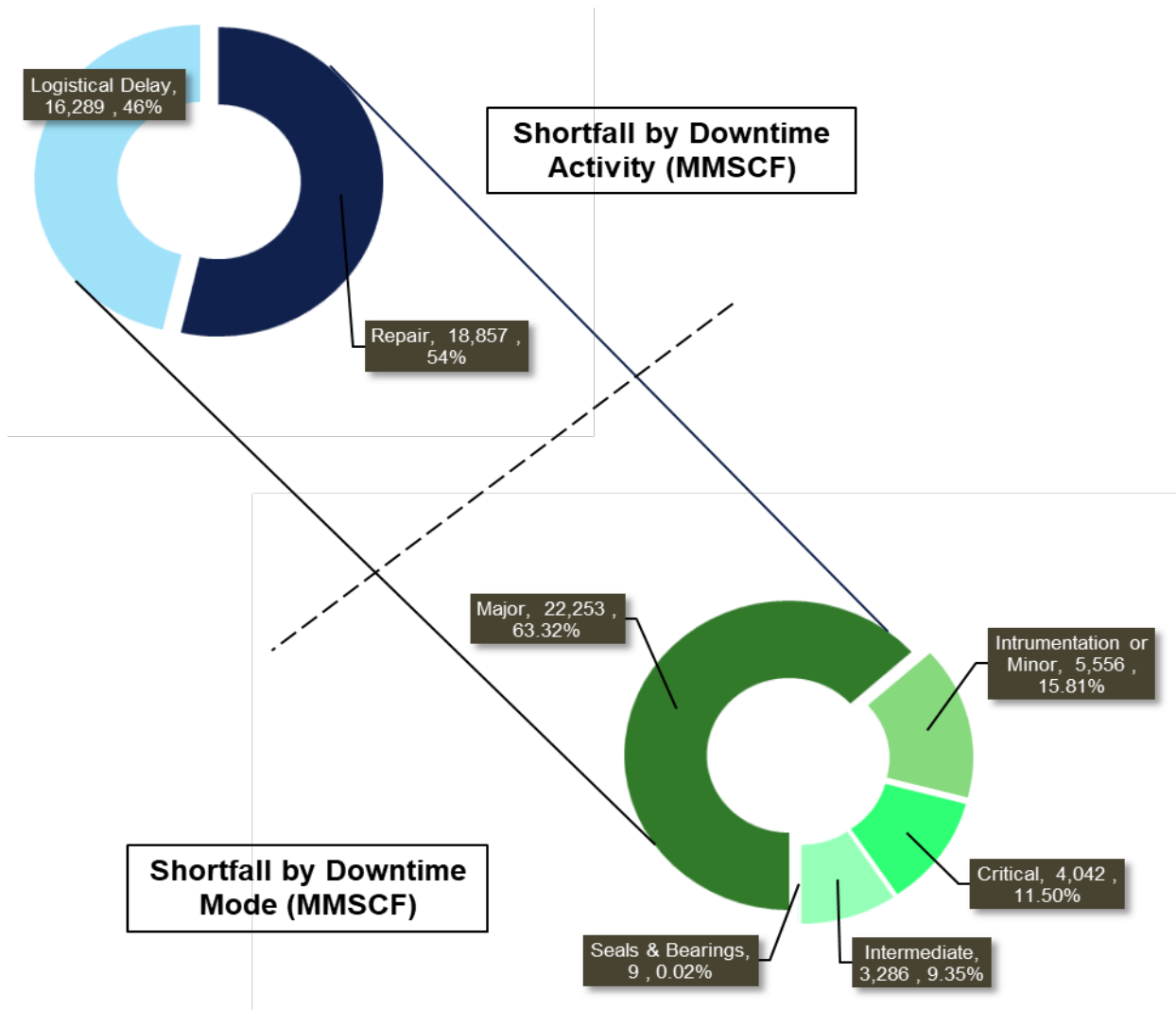
Key observations are that:

- The most significant contributor to gas dehydration shortfall is the Shell & Tube component of the Regenerator equipment item, which causes 13,370 MMSCF (0.30% of absolute shortfall, 38.04% in relative terms) gas dehydration loss over the 10-year period considered. The Regenerator has a 1 x 100% configuration (i.e. no redundancy), and therefore a failure of this equipment item results in a full facility shutdown, with the logistical delay associated with a major repair of this item responsible for the majority of shortfall attributed to this item;
- The second highest contributor to shortfall is the Contactor component of the Regenerator, accounting for 10,273 MMSCF (0.23% of absolute shortfall, 29.23% in relative terms) gas dehydration shortfall, with both active repair time and logistical delays associated with a major repair responsible for a considerable contribution towards shortfall;
- The Glycol Flash Separator, a 1 x 100% vessel, is predicted to be the third biggest shortfall contributor at an Equipment level, with 3,251 MMSCF shortfall (0.07% of absolute shortfall, 9.25% in relative terms). Both active repair and logistical delays associated with a major failure are responsible for the majority of shortfall attributed to this item;
- Fourth highest contributor is the Transfer Switch, a 1 x 100% electrical item, which is responsible for 2,011 MMSCF (0.05% of absolute shortfall, 5.72% in relative terms) gas dehydration shortfall;
- The Contactor component of the Contactor Towers, in a 4 x 25% configuration are the fifth highest contributor to gas dehydration shortfall, accounting for 1,640 MMSCF shortfall (0.04% of absolute shortfall, 4.76% in relative terms). This component exhibits the same reliability features as the Contactor component of the Regenerator. However, given the role of the Contactor Towers towards the dehydration operation, there is redundancy associated with this item, which benefits the performance of the overall process (hence its lower shortfall ranking);
- The Coolers (2 units, air cooled), each in a 1 x 100% configuration (i.e. any of the coolers can lead to a full facility shutdown), contribute 1,164 MMSCF (0.03% of absolute shortfall, 3.31% in relative terms) towards the gas dehydration shortfall;
- The remaining 13 items that are critical to the gas dehydration operation contribute, on aggregate, to less than 10% of the total shortfall.



Downtime Analysis

The figure below shows the breakdown of Shortfall, by Downtime Activity and Mode, associated with the failure events affecting the various equipment items that are part of the gas dehydration operations.



With regard to Downtime by Activity, it is demonstrated that:

- 54% of gas dehydration shortfall is attributed to active repair activities (including component replacement) subsequent to an unplanned failure event that has an impact on gas dehydration performance;
- The remaining 46% of shortfall is attributed to logistical delays (e.g. crew mobilisation & preparation, spare parts procurement, vendor specialist crew mobilisation) required to take place prior to the active repair / replacement activities.

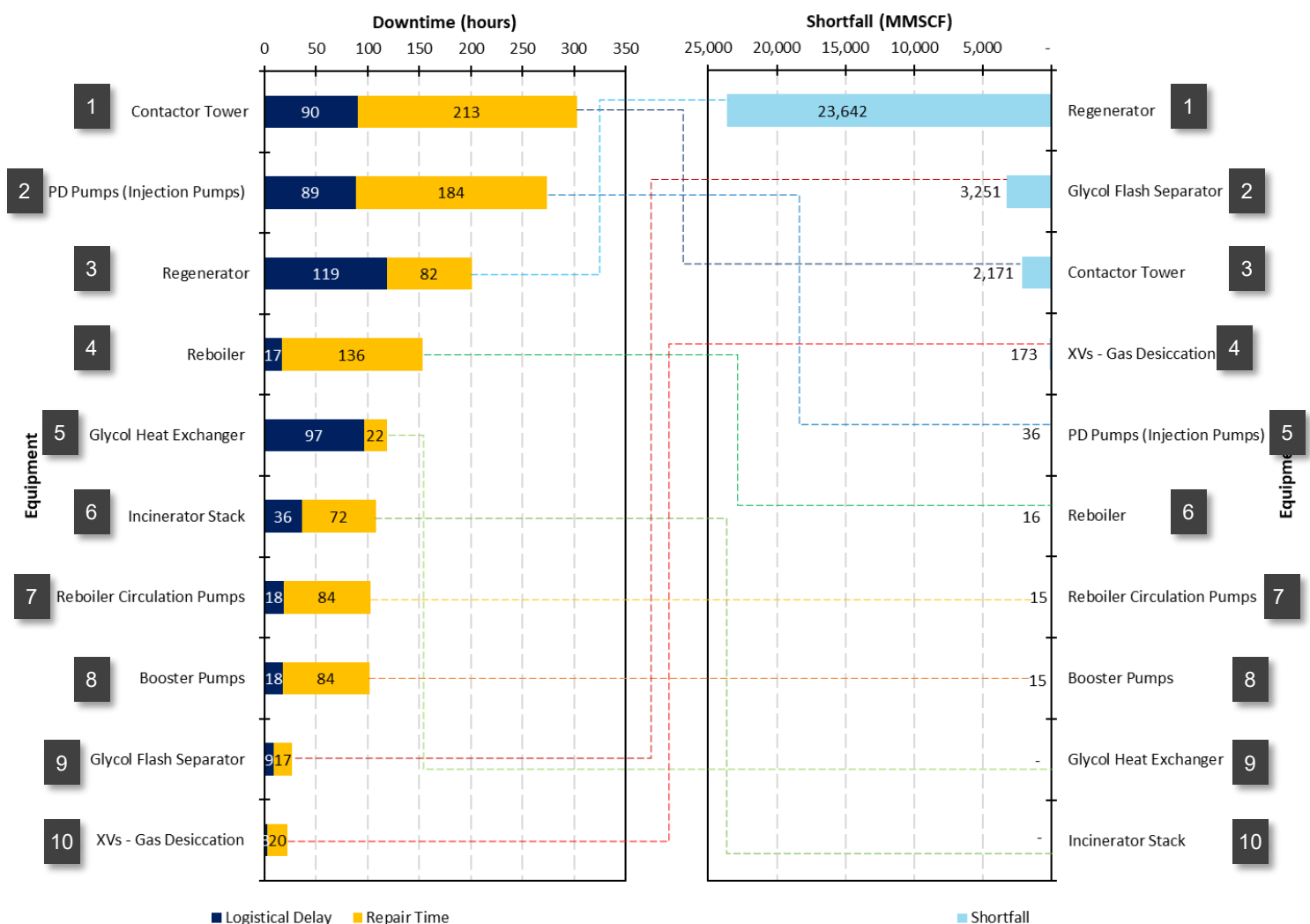
With regard to Downtime by Mode, it is demonstrated that:

- Despite their generally infrequent nature, Major Failures are responsible for 63.32% of the total shortfall, given the typically long duration of the active repair and logistical delays activities associated with this type of failures;
- Instrument and Minor failures, despite their short duration, are frequent enough to result in them being ranked 2nd with regard of shortfall by failure mode (15.81% of total shortfall);



- Next are critical failures associated with valves across the various gas dehydration systems (11.5% of total shortfall);
- Intermediate failures, which lie in between the Major and Minor categories with regard to duration and frequency, are predicted to account for 9.35% of the total shortfall;
- Finally, Seals & Bearings, which were explicitly modelled as part of pump failures, contribute by 0.02% of the total shortfall.

The relationship between equipment downtime subsequent to an equipment failure and associated shortfall impact on gas dehydration operations is not solely dependent on the duration required to restore the equipment to operating conditions, as demonstrated in the figure below. As can be seen from the figure below, factors such as equipment criticality, which is a function of the equipment configuration, or deferred effects upon failure (albeit no present in this study), are additional components that influence the impact that certain items have on operational performance.



It is worth noting that above figure only presents the top-10 contributors towards downtime and their associated shortfall.

For example:

- The Contactor Towers, which comprise both a Contactor and Separator components (considered as an aggregate in this phase of the analysis), exhibit the highest downtime across all equipment items that are part of the gas dehydration facilities. This is partly due to the reliability associated with each of its components, but also

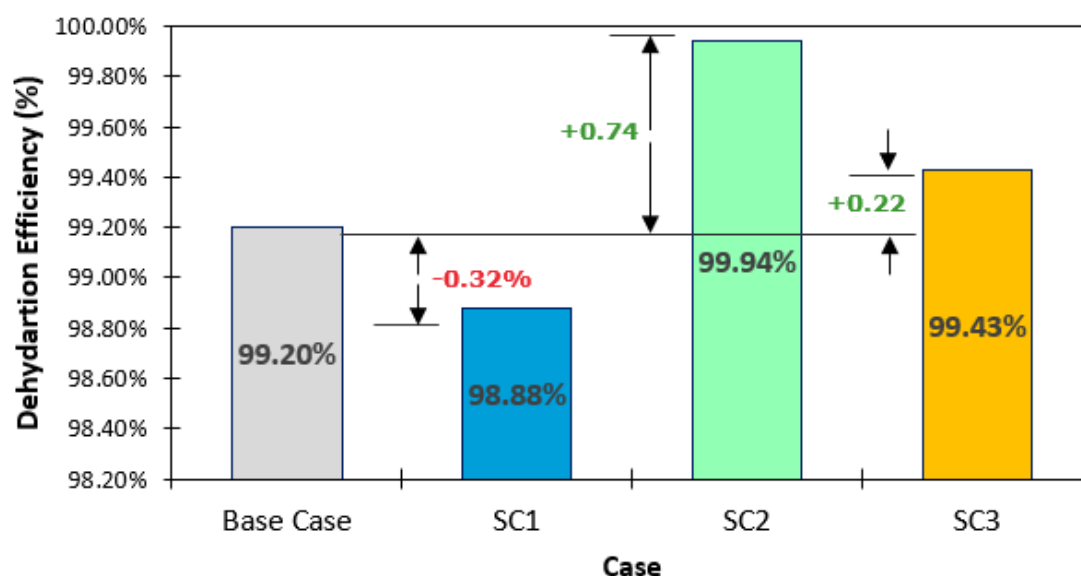


by the existence of 4 Towers, with a possibility of multiple failures to take place simultaneously, which compounds the downtime figure. Conversely, given its 4 x 25% configuration, there is an inherent level of redundancy (full redundancy in non-peak periods and partial in high demand periods) that benefits the operational performance of the facilities, which is reflected in 3rd ranking with regards to shortfall (on aggregated terms);

- The PD Injection pumps are another example of how an equipment item exhibiting a high downtime is benefited by installed redundancy, given that its 3 x 50% configuration mitigates the relative low reliability associated with reciprocating pumps;
- The Regenerator, comprising both a Shell & Tube Heat Exchanger and Contactor components, is ranked 3th with regard to total downtime, but is responsible to the highest amount of gas dehydration shortfall given its 1 x 100% configuration, whose failure results in a full facility shutdown which can only be restarted once the item is repaired;
- The Reboiler, in a 2 x 100% configuration with a hot stand-by is another example of how redundancy mitigates shortfall;
- The Glycol Heat Exchangers are ranked 5th with regard to downtime, but given its high level of redundancy (3 x 100%), are not estimated to result in any dehydration shortfall, given that a simultaneous failure of all 3 units would be required in order to have an impact on operations, which has an extremely low likelihood of occurrence;
- The Incinerator Stack is another example of an item that has downtime associated with its failure but actually does not lead to any impact on operations, as it is assumed to be fully backed-up by the Emergency Stack in this Base Case. More specifically, the Emergency Incinerator Stack is estimated to be used 1.8 times per year for an average of 6 hours;
- Finally, the Glycol Flash Separator is only ranked 9th with regard to total downtime but is responsible for the 2nd highest shortfall to dehydration operations, which as in the case of the Regenerator, is due to the non-redundancy of this equipment item. A similar trend is observed with regard to other single point items (relatively high levels of shortfall but low downtime), which are not featured in this downtime analysis.

Sensitivity Analysis - Results

Sensitivity Analysis was used to assess various design and operating assumptions, and their impact on dehydration performance over the reviewed period of 10 years. The results from these cases are summarised in the figure below.





Key observations are:

- Sensitivity Case 1: Full shutdown required when Inclinator Stack becomes unavailable - this results in a reduction in Dehydration Efficiency of 0.32%.
- Sensitivity Case 2: Redundant units installed for all single point items in the dehydration process - this results in an improvement in Dehydration Efficiency of 0.74%.
- Sensitivity Case 3: Reduced logistical delay on major repairs of Shell & Tube Heat Exchangers - this results in an improvement in Dehydration Efficiency of 0.22%.

Conclusions

The following conclusions can be drawn from the Dawn Dehydration Unit RAM study:

- The Dawn Dehydration facilities exhibit high levels of dehydration performance, especially considering that a very conservative demand has been assessed in this study. High performance levels are expected with regard to assets that play a critical role to gas transmission operations, as is the case of the Dawn Dehydration Unit, and as a result, it is important to nonetheless strive for reasonable improvements to the performance of these critical assets;
- Full unplanned facility shutdowns are responsible for the majority of the shortfall associated with the gas dehydration operation. The full facility shutdowns are resultant of failure of single point items within the gas dehydration process, namely Vessels and Heat Exchangers;
- More specifically, major failures associated with the aforementioned items are responsible for the majority of the full facility shutdowns, which can be mitigated though installed redundancy or additional holding of capital spares. The performance improvement associated with the aforementioned approaches can be assessed via Sensitivity Cases;
- It has been demonstrated that downtime associated with a particular equipment item is not necessarily linked to a high shortfall figure, given that equipment redundancy and capacity also plays a role in this relationship;
- If a full shutdown is required to take place when the Incinerator Stack is unavailable (driven by environmental concerns), this has a detrimental impact on Dehydration Performance;
- Highest levels of improvement in Dehydration Performance can be achieved by installing redundant units to all current single point items in operation, thus avoiding several full shutdown events. However, the applicability of such measure needs to be assessed by considering the financial benefit associated with such measure versus the added CAPEX and OPEX involved in this approach;
- Holding a spare Shell & Tube Heat Exchanger bundle in-stock also leads to improvements in Dehydration Performance, as it significantly reduces downtime from the logistical delay associated with mainly major repairs of the Regenerator unit, currently a single point item. As with the previous point, the financial benefit associated with this measure versus the added CAPEX and OPEX involved in this approach needs to be assessed.



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1 INTRODUCTION

The Enbridge Gas Dawn Hub, located in southwestern Ontario, is one of the largest integrated natural gas storage facilities in North America. With multiple supply routes from western Canada, mid-continent, the Rockies, the Gulf of Mexico, as well as the ability to serve markets in the mid-west, eastern Canada and the U.S. Northeast, the Dawn Hub plays a key role as a trading hub, allowing shippers with direct access to North America's major supply basins.

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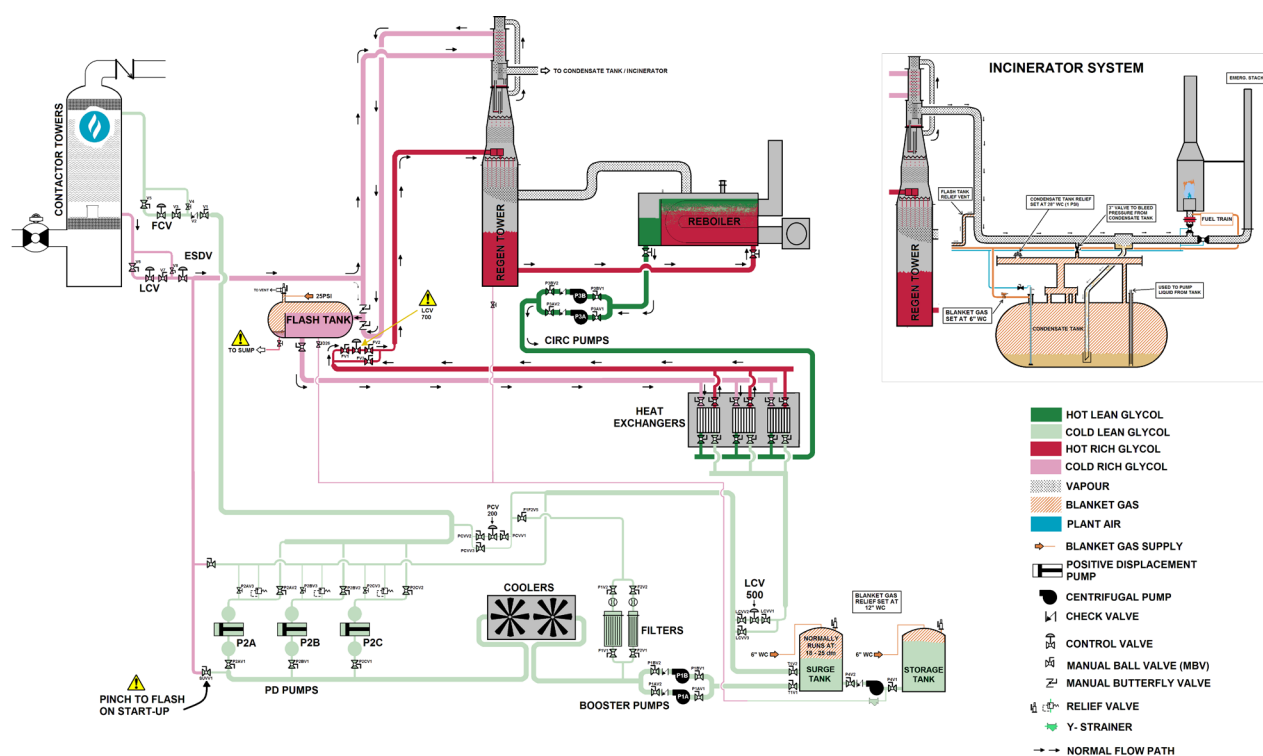


Figure 1-1 Process Diagram of Dawn Dehydration Operations [1]



2 RAM DEFINITIONS / ABBREVIATIONS

Definitions and descriptions for abbreviations are summarized in the table below:

Table 2-1 Definitions

Terminology / Abbreviation	Definition / Description
BCFD	Billion Cubic Feet per day
BDV	Blowdown Valve
Demand	The target level of gas treatment from the facility (BCFD)
EM	Electric Motor
ESD	Emergency Shutdown
F&G	Fire & Gas Systems
HVAC	Heating Ventilation and Air Conditioning
ICSS	Integrated Control and Safety System
IEEE	Institute of Electrical and Electronics Engineers
KO	Knock Out
MMSCFD	Million Standard Cubic Feet per day
MTTF	Mean Time To Failure: Average time that an item will function before it fails (years)
MTTR	Mean Time To Repair: Average time taken to perform corrective maintenance on (or replacement of) a failed item - excludes any logistic delays or restart times - (hours)
OREDA	Offshore and Onshore Reliability Data
PM	Planned Maintenance
Production Efficiency	(Actual Gas Treated) / (Potential Gas Treated) *100%
PSV	Pressure Safety Valve
RAM	Reliability: Probability of system/item non-failure in a given period Availability: (Time all required equipment is available) / (Time)*100% Maintainability: Probability of repair in a given time
S&T	Shell & Tube (Heat Exchanger)
SDV	Shutdown Valve
Shortfall	Proportion or amount of demand not produced (% or MMSCFD or BCFD)
Stb/d	Stock Tank Barrels per day (oil or water production rate)
TEG	Tri-ethylene Glycol
TEMPSC	Totally Enclosed Motor Propelled Survival Craft
Uptime	(Time non-zero liquefaction / regasification / compression) / (Time)*100%
XV	On / Off Valve



3 SCOPE OF WORK

3.1 Study Objectives

The key objectives of this scope of work were:

1. Forecast **Dehydration Efficiency (%)**, with corresponding **Availability (%)** and **Uptime (%)** of the Dawn Dehydration Unit over the remaining operational life:

$$\text{Dehydration Efficiency} = (\text{Actual Gas Treated}) / (\text{Potential Gas Treated}) * 100\%$$

$$\text{Availability (at Demand)} = (\text{Time all requirement equipment is available}) / (\text{time}) * 100\%$$

$$\text{Uptime (at any level)} = (\text{Time non-zero production is achieved}) / (\text{time}) * 100\%$$

2. Identify key systems and equipment that result in Production losses, and rank by system and equipment contributions (criticality analysis)
3. Identify any potential areas of performance improvement through consideration of defined sensitivity cases (3 sensitivity cases are included in this scope). For example, these may include:
 - o Equipment replacement / overhaul
 - o Alternative configurations
 - o Spares holding / logistic delays
 - o Maintenance strategies

3.2 Study Boundaries

The RAM study considered all critical process and utility equipment to gas dehydration, within the following boundaries:

- Upstream: ESDV(s) on gas inlet headers
- Downstream: ESDV(s) on gas outlet headers

3.3 Case Definition

3.3.1 Main Cases

A single gas treatment scenario was considered as part of the Base Case for this RAM Study. The Base Case considered all systems critical to gas dehydration operations, with its performance assessed against the demand profile defined in Section 4.1, with the outputs as defined in Section 3.1. The results of the Dawn Dehydration Unit Base Case model can be found in sections 5.1 - 5.5.

3.3.2 Sensitivity Cases

Three (3) Sensitivity Cases were defined in order to assess the impact that different design / operational decisions have on the overall performance of the Dawn Dehydration Unit. The Sensitivity Cases were defined as follows:

- Sensitivity Case 1 – Incinerator Stack: this Sensitivity Case assumed a full shutdown in dehydration operations when the Incinerator Stack is unavailable (Base Case assumes that 100% back-up is available through the Emergency Stack)
- Sensitivity Case 2 – Redundancy: this Sensitivity Case assessed the benefit that installed redundancy of all current single point items in the dehydration process have on performance



- Sensitivity Case 3 – Reduced Logistic Delays: this Sensitivity Case assessed the impact of reducing the logistical delay pertaining to major repair failures associated with Shell & Tube Heat Exchangers (Base Case assumes a 30-day logistical delay). In this Sensitivity Case, 1 Capital Spare (exchanger bundle – responsible for majority of major Shell & Tube failures), is assumed to be held on-site, accruing in 1-day of active replacement time, with 30 days of replenishment time assumed for the bundle to be re-stocked.

The results of the Dawn Dehydration Unit Sensitivity Cases can be found in section 5.6.

4 MODELLING ASSUMPTIONS

The following list details the basis and assumptions that have been considered for this RAM study, and are discussed in more detail in the following sections:

- Review period: 10 years
- Primary product: treated gas
- Production profiles: seasonal and daily production rates (Section 4.1)
- Dehydration Unit design capacity: 5.1 BCFD of gas
- Equipment criticality (Section 4.2) [1][2]
 - List of critical systems and equipment
 - Equipment configuration and type
- Reliability data: Industry standard data (e.g., OREDA) was primarily used (Section 4.4 and Appendix A) [3]
- Maintenance and operations assumptions, for example, spares, logistic delays, maintenance crews (Section 4.5).

4.1 Demand Profile

This section details the demand profile that was used in the Base Case, in order to assess the performance of the Dawn Dehydration Unit. The demand profile considered the typical campaign duration where Gas Dehydration is required, namely the 1st of November until the 31st of March, as provided by Enbridge. Given that current contractual requirements stipulate that the Dawn facilities shall meet any gas demand at all times, a conservative approach was selected. Therefore, in this study, the performance of the Dawn Dehydration Unit was assessed against the maximum volume figure of gas withdrawn from storage (excluding blending) for each day over the past 12 years (2010 – 2021). The Gas Dehydration demand profile is shown diagrammatically below and presented in tabulated form in Appendix B.

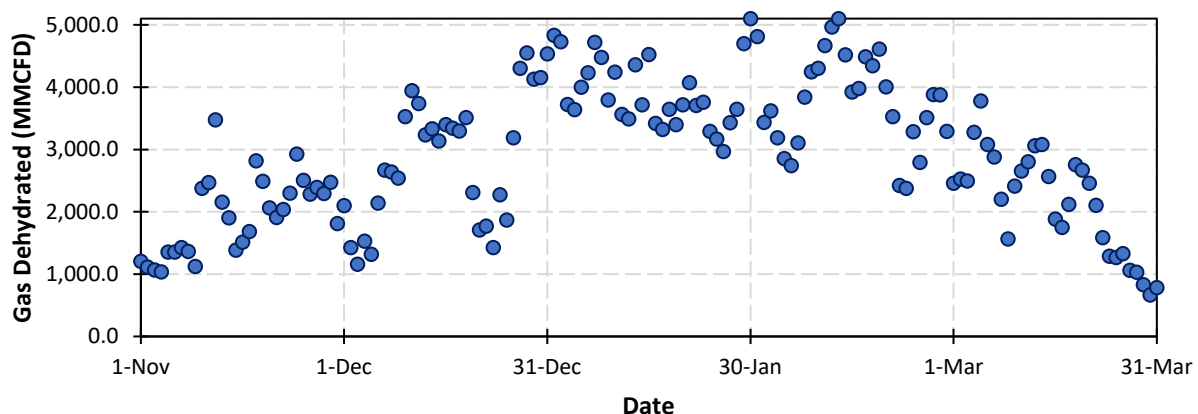


Figure 4-1 Dawn Dehydration Unit Treated Gas Profile



4.2 Dawn Dehydration Facility Systems and Equipment

The following facilities were considered within the scope of the RAM models:

- Process Systems
 - Gas Desiccation
 - Glycol Regeneration
 - Incineration System
- Utility Systems
 - Blanket Gas System.

In addition to the facilities listed above, the model also considered all supporting systems whose failures result in loss of production (e.g., ESD, Fire & Gas Systems). This did not include any installed out of service valves, which were considered as non-critical to the availability of the Dawn Dehydration unit.

4.2.1 Equipment Criticality Assessment

All facility systems and equipment that are critical to Gas Dehydration are listed in tables Table 4-1. For each equipment item, the following is presented:

- Equipment Tag number and description
- Configuration – equipment arrangement based on 100% requirement (i.e. maximum demand). This parameter is a function of how the design capacity of each equipment relates to the maximum demand level that the plant is required to operate at. This parameter therefore defines how many units are required to operate and what level of redundancy, if any, is in place for each equipment unit (e.g. if 3 pumps exist, with 2 required to operate during maximum demand and if production is at 50% of maximum demand when 2 out of 3 pumps fail, then the pumps configuration is 3 x 50%).
- Impact – confirmation if loss of each equipment item is critical to Gas Dehydration Availability
- Equipment type to be included in the RAM model, linked to the associated Reliability Data detailed in Appendix A
- Comments that provide insight to the operation of each item.



Table 4-1 Gas Dehydration Equipment Criticality

TAG NUMBER	NAME / EQUIPMENT	CONFIGURATION	CRITICAL	EQUIPMENT TYPE	COMMENTS
Gas Desiccation					
V-1A/B/C/D	Contactor Tower	4 x 25%	Y	Vessel – Separator & Vessel – Contactor	Each tower has individual automatic electric ball valves on the inlet and outlet with a 1-inch bypass around the inlet for pressuring up. [2] There is an integral two-phase separator where the inlet gas enters to remove all free liquids. [2] The inlet gas passes through a demister and enters the glycol contact section of the contactor. [2]
Glycol Regeneration					
V-2	Glycol Flash Separator	1 x 100%	Y	Vessel – Separator	
E-1	Glycol Heat Exchanger	3 x 100%	Y	Shell & Plate Heat Exchanger (to be modelled as Shell & Tube Heat Exchanger)	Normally one heat exchanger is on line at a time, unless the total glycol to the towers exceeds 170 usgm. [1] One heat exchanger is a standby unit to permit servicing a unit without being shut down. [2]
V-3	Regenerator	1 x 100%	Y	Shell & Tube Heat Exchanger & Vessel – Contactor	Includes a Shell & Tube reflux condenser on the top, two packed sections and an accumulator in the bottom. [2]
H-1	Reboiler	2 x 100%	Y	HC Fired Boiler	Direct fired twin tube heater using natural gas for fuel. [2] Temperature of the in-service boiler will be 190 degC for best regeneration of glycol. Stand-by boiler will be set at 180 degC to keep it hot. [1] The RAM model assumes that both are in operation and that either reboiler can achieve the full duty.
P-3A/B	Reboiler Circulation Pumps	2 x 100%	Y	Centrifugal EM Pump	There is 100% standby. [2] One circulating pump at a time A Booster Pump must be on to start one of the circulating pumps. [1]



TAG NUMBER	NAME / EQUIPMENT	CONFIGURATION	CRITICAL	EQUIPMENT TYPE	COMMENTS
T-1	Surge Tank	1 x 100%	Y	Vessel – Surge Tank	The surge tank is an insulated 250 barrel tank with a 5 kW electric heater to maintain the temperature at a minimum of 80 degF during a shutdown. [2] The 5 kW electric heater was not explicitly modelled.
T-2	Storage Tank	1 x 100%	N	Vessel – Storage Tank	
P-4	Glycol Make-up Pump	1 x 100%	N	Centrifugal EM Pump	
P-1A/B	Booster Pumps	2 x 100%	Y	Centrifugal EM Pump	
F-1	Glycol Filter	See comment	N	Filter	Small flow off booster pump discharge goes through filters, then back to the surge tank. [1] Non-normal flow (by-pass only).
F-2	Charcoal Filter	See comment	N	Filter	
	Coolers	See comment	Y	Air Coolers	The cooler is designed to operate at full capacity when the ambient air is 65 degF or lower. The two electric fans operate continuously. [2] 2 Air Coolers in series assumed
P-2A/B/C	PD Pumps (Injection Pumps)	3 x 50%	Y	Reciprocating EM Pump	Injection pumps can move approximately 120 USGM each. If the flow to the towers is above 120 USGM, 2 pumps will be required. Note that the PLC will not allow all 3 injection pumps to be running at once. [1]
Incinerator System					
	Condensate Tank	1 x 100%	Y	Vessel - Storage Tank	
	Incinerator Stack	1 x 100%	Y	Acid Gas Incinerator	
	Emergency Incinerator Stack	1 x 100%		See comment	To be used only when main Incinerator Stack is being repaired, and therefore considered as non-critical. The RAM model was used to predict the total time and frequency of operation of the Emergency Incinerator Stack.
Blanket Gas & Fuel Gas					
Fuel Gas equipment was not explicitly modelled as there are high levels of redundancy associated with this utility.					
	Regulators	See comment	Y	CV assumed	Two regulators in series controlling the supply of blanket gas feeding the Glycol Flash Separator



TAG NUMBER	NAME / EQUIPMENT	CONFIGURATION	CRITICAL	EQUIPMENT TYPE	COMMENTS
<i>Electrical System</i>					
	Main Circuit Breaker	1 x 100%	Y	Circuit Breaker	
	Auto Switch	1 x 100%	Y	Automatic Transfer Switch	
<i>Instrument Air</i>					
Instrument Air equipment was not explicitly modelled as there are high levels of redundancy associated with this utility.					



4.2.2 ESD and F&G systems

The modelling of individual trip events for ESD and F&G systems was not included. It is assumed that testing of ESD and F&G systems is performed upon opportunity. These tests do not cause any production shortfalls.

4.3 Model Indenture

RAM models were developed at the equipment level (e.g., vessel, heat exchanger). Failure modes for all equipment critical to plant operability were defined and considered in the modelling (as detailed in Section 4.2.1). Non-production critical systems and utilities were excluded.

Typically, not all valves are modelled in detail during RAM analysis. The following approach was used in this analysis:

- XVs, SDVs, BDVs and Control valves: valves that are production critical were included in the model. When valves are inside the normal equipment boundaries with respect to reliability data collection it is not required to consider them separately. However, if critical valves are found outside equipment boundaries, they are modelled.
- PSVs: PSVs are typically provided in a N+1 configuration, and therefore were be considered as critical.

4.4 Reliability Data

A summary of the reliability data used for this analysis is provided in Appendix A. The basis for the reliability data selection is discussed in the following sections. Furthermore, the mapping between the reliability data selected and each equipment item in the Dawn Dehydration facility is shown in the Equipment Criticality Tables (please refer to the Equipment Type column in Section 4.2.1).

4.4.1 Data Sources

The sources for reliability data proposed used for this analysis are the following:

1. OREDA:
 - a. 2015 handbook 6th edition – Volume 1 Topsides equipment
 - b. 2009 handbook 5th edition – Volume 1 Topsides equipment
 - c. Previous editions of OREDA handbook as required
2. IEEE Gold Book, 1998 – specifically for electrical equipment / components
3. DNV In-house Data – derived from operational experience and manufacturer's data from previous studies. Please note that these data sets are typically confidential and can only be used in anonymised format.
4. Asset data based on historical operating performance (e.g. CMMS) and Enbridge's operating experience

4.4.2 OREDA Handbooks

OREDA data is based on failure data supplied by a number of major United Kingdom (UK) -based offshore operators. A new edition of the handbook (OREDA 2015) was issued in 2016 and has been used, when appropriate, for sourcing OREDA failure data for this analysis. For certain equipment categories, OREDA 2009 data was used as it is deemed more relevant for this application.

For each of the included equipment items / failure modes the following data has been collated:

- Total number of failures
- Population
- Calendar / operational time during which failures were recorded
- Average repair times per failure mode.



Using this data, the Mean Time To Failure (MTTF) and Mean Time To Repair (MTTR) for each equipment item / failure mode can be determined. Exponential distributions are used in the model to represent the possible spread of data around both the MTTF and MTTR.

Failure rates are calculated from OREDA based on Operational Time (rather than Calendar Time) and assume the failure rate function is random and independent of time. The failure data does not reflect the burn-in or wear-out characteristics of equipment. It is assumed that the correct preventative maintenance is carried out and the equipment will be fit for purpose. MTTR represents the average time required to repair and return an item to a state where it is ready to resume its functions, assuming all manpower, spares are immediately available.

The OREDA project is restricted to gathering data on hardware components and systems, and unavailability of systems due to human error is generally not included. For this reason, human error is excluded from this RAM analysis.

The indenture level of the OREDA data is categorised into critical, degraded, incipient and unknown equipment failure modes:

- **Critical failure:** A failure which causes immediate and complete loss of a system's capability of providing its output.
- **Degraded failure:** A failure which is not critical, but which prevents the system from providing its output within specifications. Such a failure would usually, but not necessarily, be gradual or partial, and may develop into a critical failure in time.
- **Incipient failure:** A failure which does not immediately cause loss of a system's capability of providing its output, but which, if not attended to, could result in a critical or degraded failure in the near future.
- **Unknown failure:** Failure severity was not recorded or could not be detected.

4.4.3 Use of OREDA Data

4.4.3.1 Included Failure Modes

For the purpose of this study, only critical failure modes were considered. The failure data used in this study is rationalised by considering that if good maintenance practices are carried out (inspections / condition monitoring), then repairs for degraded, incipient and unknown type failure modes can be delayed until the next opportune moment in order to prevent impact on production. Hence, these failure modes will not normally result in additional unavailability, and these failure modes are therefore not included in the availability model.

4.4.3.2 Minimum Operating Hours

Whenever possible, DNV ensure that, when using data from OREDA, the data is representative of a large enough sample of equipment and collected over a significant number of operational hours. As a guideline, the following minimum values are considered to be sufficient:

- Minimum population of 10
- Minimum number of operational hours ~200,000.

The minimum population and the minimum number of operating hours are thresholds used for guidelines based on review and experience of OREDA records (the confidence level on the data is a function of many other factors). In most cases, the data used has been derived from data sources with population and operating hours well above the guideline thresholds indicated.

4.4.3.3 Mean Time to Repair

When using OREDA data, MTTR can be estimated by using the active repair hours provided in the handbook. When active repair hours are not available, the mean repair man-hours can be used to estimate active repair hours. These mean repair man-hours are divided by two using the assumption that maintenance will be performed by two people.



One limit of MTTRs estimated in this way is that they are constant and do not give an indication of the range of repair times that should be expected. This can have a significant impact on the overall performance of the facilities if restart times are modelled as a function of the duration of the outage. Also, OREDA points out that “it is highly recommended to use some kind of expert judgement in addition to the values given in the handbook” for the active repair times.

For these reasons, in this study the following methodology is used to estimate the MTTR when adopting OREDA data:

- OREDA tabulates for each equipment type a breakdown of the incurred failures by maintainable item (e.g., for a pump: instrumentation, seals, bearings, casing)
- A high-level review was carried out per equipment type to allocate each maintainable item to a failure category
- For example, for a Shell and Tube exchanger, the following maintainable items were associated with ‘major’ repair: tubes, body / shell, piping
- The percentage breakdown was then used to associate a separate repair time for each category of failure. This was done based on expert judgment. In most of the cases it has been ensured that the overall annual downtime for the equipment is comparable (within a factor of 2) with the annual downtime calculated using OREDA constant active repair time.

An example of this approach for centrifugal pumps is illustrated below:

Example: Centrifugal Pumps

Breakdown of all pump failures by maintainable item:

Table 4-2 Breakdown of all Pump Failures by Maintainable Item

Maintainable Item	% of Failures	Category	S&B	Min	Maj	Sum
Actuating device	0.69	Minor		0.69		
Radial bearing	0.21	S&B	0.21	-	-	
Thrust bearing	1.13	S&B	1.13	-	-	
Casing	0.43	Major	-	-	0.43	
Shaft	0.28	Major	-	-	0.28	
Impeller	0.78	Major	-	-	0.78	
Gearbox	0.96	Major	-	-	0.96	
Seals	12.22	S&B	12.22	-	-	
Bearing	0.16	S&B	0.16	-	-	
Unknown	22.31	-	-	-	-	
Remaining	60.83	Min	-	60.83	-	
Total	100.00		13.72	61.52	2.45	77.69
As % of not 'unknown'			17.7%	79.2%	3.2%	100%

Identified repair categories:

Table 4-3 Identified Repair Categories for Pumps

Failure Category	% of Failures
Seals & Bearings	18%
Minor other repairs	79%
Major repairs	3%
Total	100%

Resulting reliability and repair data:

Table 4-4 Reliability and Repair Data for Pumps

Type	Service	MTTF (yrs)	Repair Category	MTTF for repair category	Repair Time (hrs)		Source		Comment
					Min	Max	MTTF	Repair Time	
Pump - Centrifugal	Condensate Processing	0.47	Seals & Bearings	2.6	2.0	6.0	Oreda 2009	Expert Judgement	To be used for the NGL and condensate services, absorber bottom pumps.
			Minor other repairs	0.6	2.0	6.0			



Type	Service	MTTF (yrs)	Repair Category	MTTF for repair category	Repair Time (hrs)		Source		Comment
					Min	Max	MTTF	Repair Time	
			Major repairs	15.8	24.0	72.0			
	Generic Service	1.03	Seals & Bearings	5.7	8.0	22.0	Oreda 2009	Expert Judgement	To be used for the centrifugal pumps except for the condensate services, for example: LPG services, heating medium, wash water, demin water, amine pumps, flare pumps, cooling medium, reflux pumps, etc.
			Minor other repairs	1.3	8.0	22.0			
			Major repairs	34.2	48.0	120.0			

4.4.3.4 Common Mode Failures

The availability of a redundant unit is typically only marginally degraded by common mode failures. Therefore, these were not included in this RAM analysis.

4.5 Maintenance, Inspections and Operations Assumptions

4.5.1 Planned Maintenance & Inspections

In this study, the RAM model assumed that any planned maintenance and inspection activities on the plant's equipment will take place during the period of the year where these systems are not operating. Therefore, these activities will not incur any operational disruption and as a result, were not included in the models. More specifically, in this RAM study, the months of April to December are considered as non-production periods, where planned maintenance/inspection activities can take place.

4.5.2 Maintenance Crews, Mobilisation and Logistic Times / Delays

In this RAM study, maintenance crews were assumed as available at all times. This means that during planned and unplanned activities and/or a simultaneous occurrence, it was assumed that no shortfall will arise due to maintenance crew constraints to attend to the required activities. This assumption may be subsequently analysed as a separate sensitivity case.

In addition to the active repair time associated with a given equipment failure (please refer to Mean Time to Repair column in Appendix A), additional mobilisation / logistical time might be required, subject to the type of repair needed, as described below:

- **Time to Locate & Diagnose the Failure and Work Preparation:** maintenance time during which fault location, fault diagnosis and work preparation takes place. For all repairs with a 'Minor' Mobilisation Delay Category (please refer to the Mobilisation Delay column in Appendix A), **a delay equal to 2 hours was assumed**. As discussed above, this assumption may be subject of a sensitivity case.

For 'Major' and 'Specialist Crew' Mobilisation Delay Categories, any delay associated with Time to Locate & Diagnose the Failure and Work Preparation is included in the delay associated with Time to Acquire Resources / Spare Parts (see next bullet).

- **Time to Acquire Resources / Spare Parts:** accumulated time during which a maintenance action cannot be performed due to the necessity of acquiring maintenance resources due to, for example, pending arrival of spare parts, non-standard tools, specialists, test equipment and / or technical information. With regard to the different Mobilisation Delay Categories (refer to Appendix A), unless stated otherwise, the following delays are generally applicable:



- Minor: 0 hours (delay for this category already considered as part of the Time to Locate & Diagnose the Failure and Work Preparation)
- Major: **48 hours**
- Specialist Crew: **120 hours** – some complex equipment (e.g., major rotating equipment) may need special expertise such as vendor specialists who require additional time for major repair mobilisation.

4.5.3 Ramp-Down, Restart Times & Ramp-Up

It was assumed that failure of an equipment item will lead to an immediate ramp-down in production from the equipment in question and that, if the case, automatic and immediate switch-over will occur to the installed spared equipment unit (with no loss in production).

In the event of a unique equipment failing (i.e., with no installed spared capacity), there will be one full shutdown, which may require time for restarting and ramping-up of production once the affected item is repaired. These are defined as follows:

- Restart delays or Bring the Item Back into Service (BIST): delays associated with getting the process systems back online. During this period the production rate will still be zero. Generally, this is due to process cooling requirements. Required duration times for process cooling are specified below.
- Process ramp-up: the duration for the process to ramp-up to normal production rates. This process can be in the form of a linear or non-linear increase in production from zero until normal production rate is achieved.

The restart delay and ramp-up duration may be conditional upon the shutdown duration and the unit in question.

As a result, for the purpose of this RAM analysis, the following restart times were included in the model:

- **30 minutes restart time** subsequent to a full facility shutdown, independent of the duration of the full shutdown – **conditional on Dawn facilities having at least one boiler in operation**, critical to ensure that glycol is kept in warm conditions
- **12 hours restart time if both boilers are unavailable for more than 8 hours.**

4.5.4 Bypass Operations

During outages of equipment items, it is normally assumed that, unless there is a back-up redundant unit available, the associated system needs to be shut down and the process will be affected accordingly.

Unless otherwise indicated, this is the default assumption for the RAM analysis. However, there are a number of potential mitigation options, such as by-pass operations, which are considered during certain equipment outages, which prevent or reduce the impact on the production.

Any specific equipment items that could be bypassed during failure (and / or require partial turndown) are indicated in Section 4.2.1.



5 RESULTS

This section presents the results of the Dawn Dehydration Unit RAM study, which considers the performance of the facilities throughout the dehydration season (from 1st of November until the 31st of March), with a 10-year look-ahead period.

5.1 Dehydration Efficiency

Table 5-1 presents the overall results for the Gas Dehydration Demand, Injection, Shortfall and Dehydration Efficiency for the Dehydration Base Case. As well as presenting the Mean Average forecast, the likely spread of results is also given by the P5 and P95 forecasts. The P5 and P95 results present the 5% and 95% probability of exceeding the stated levels of Dehydration Efficiency.

Table 5-1 Base Case 10-Year Gas Dehydration Overall Results

Case	Demand (MMSCF)	Gas Dehydrated (MMSCF)	Shortfall (MMSCF)	Dehydration Efficiency (%)	Availability (%)	Shortfall (%)
P5	4,408,052	4,401,970	6,082	99.86%	99.77%	0.14%
Mean	4,408,052	4,372,907	35,146	99.20%	99.00%	0.80%
P95	4,408,052	4,272,401	135,650	96.92%	96.73%	3.08%

This demonstrates that:

- The mean Dehydration Efficiency of the Dawn facilities across the 10-year study period against Demand is 99.20%; 4.373 x10⁶ MMSCF of gas was injected against a Demand of 4.408 x10⁶ MMSCF;
- There is a 5% probability of exceeding a Dehydration Efficiency of 99.86% and a 95% probability of exceeding a Dehydration Efficiency of 96.92%.

Moreover, the monthly breakdown of the Mean Gas Dehydration Performance, for Year 1 of the 10-year study period is presented in Figure 5-1.

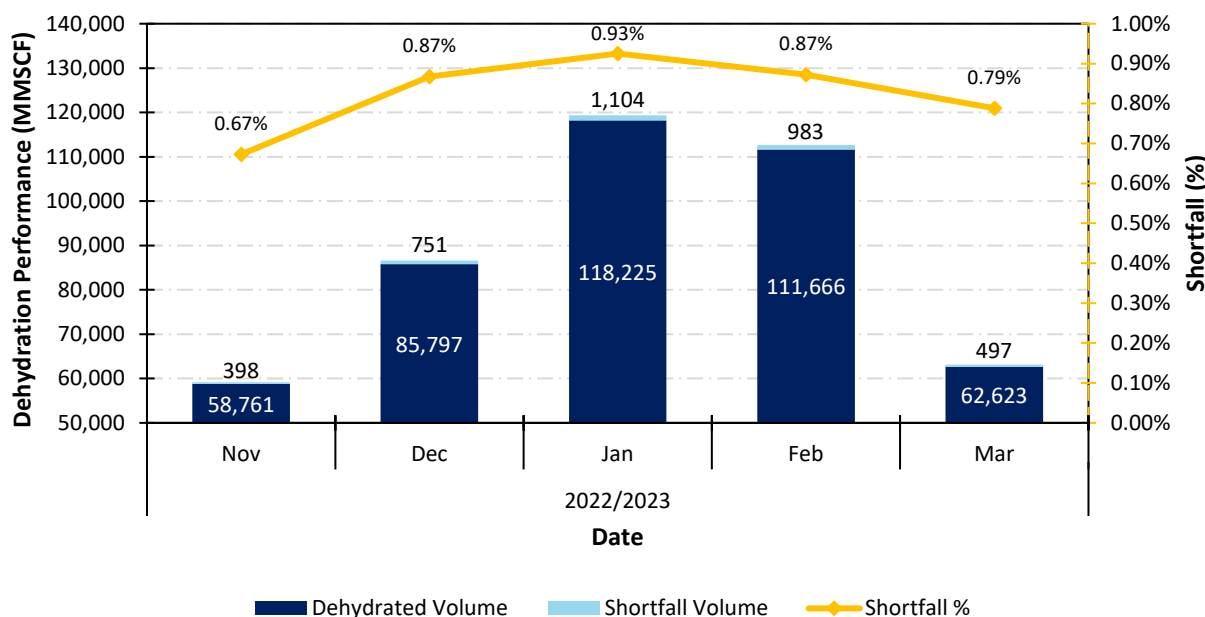


Figure 5-1 Monthly Breakdown of Mean Gas Dehydration Performance



Key observations are:

- Given that the same demand, with its seasonal variations, was assumed to be the same in each of the 10 years covered by this study, there is no major difference on the Gas Dehydration Performance over different seasons, and consequently, only the first year of the 10-year study period is presented in Figure 5-1. Another factor influencing the constant nature of the Gas Dehydration Performance is the assumption that no deterioration is taking place within the Dawn Dehydration facilities, as it is assumed that components are within their useful life phase, where the failure rate is close to constant and independent of time. For this to be achieved, items are often replaced or refurbished before they reach the wear-out phase, thus reflecting some of the maintenance and replacement programs taking place at Dawn, given the criticality of the Dehydration Unit to the entire gas transmission operations;
- As expected, as the demand profile increases throughout the Winter season, there are slight increases in shortfall. This is attributed to the decrease in redundancy levels during the high-demand periods, as a larger proportion of items are required to be in operation in order to meet the demand. Therefore, in this period, an equipment failure is likely to have an impact on the performance of the dehydration operation, including a partial impact. During the low-demand periods, given the design capacity of certain equipment items, not all units will be required to operate under normal conditions, and therefore will only be used to mitigate the impact of a failure of the operating units. This feature is reflected in the number of days the facilities are estimated to operate at full capacity, partial capacity or not to operate at all, which is discussed in more detail in section 5.3;
- Finally, the Dawn Dehydration facilities exhibit high levels of dehydration performance, especially considering that a very conservative demand has been assessed in this study.

5.2 Shortfall Exceedance

The probability and frequency of exceeding various levels of Gas Injection Shortfall are presented in Table 5-2 and Figure 5-2.

Table 5-2 Summary of Shortfall Exceedance during the Dehydration Period

Shortfall (%)	Annual Average Probability of Exceedance (%)	Annual Average Frequency of Exceedance (Years)
0.00000%	100.00%	1.00
0.01114%	99.99%	1.00
1.00000%	20.18%	4.96
2.00000%	9.68%	10.33
3.00000%	5.42%	18.45
4.00000%	0.83%	120.48
5.00000%	0.34%	294.12
6.00000%	0.12%	833.33
7.00000%	0.02%	5,000.00

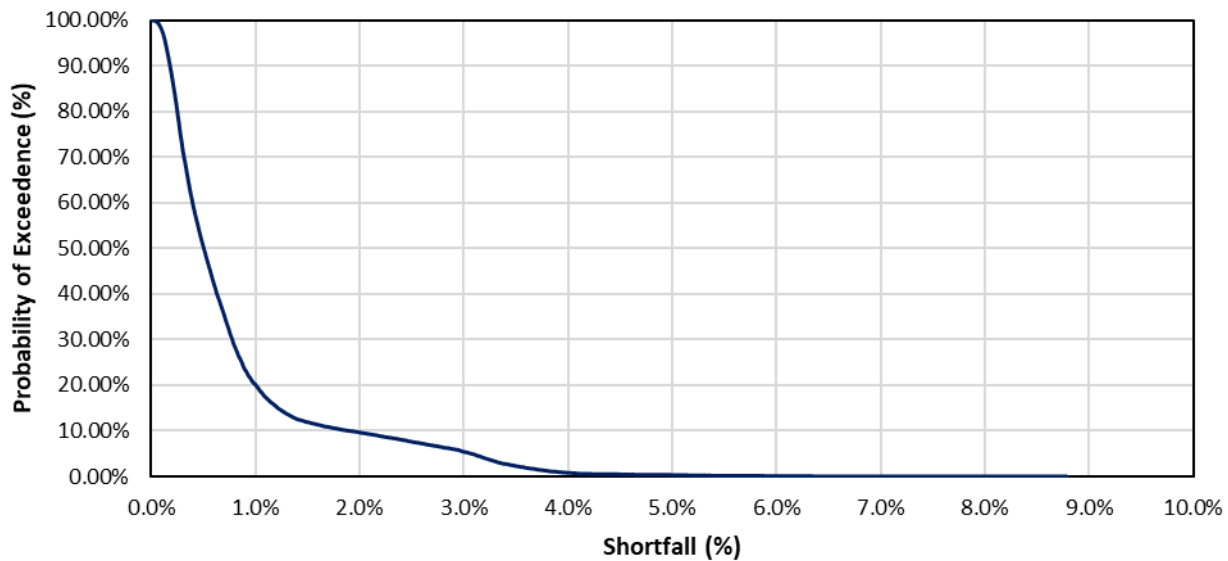


Figure 5-2 Shortfall Exceedance Probability during the Dehydration Period

As can be seen from these results:

- Gas Dehydration Shortfall is forecast to typically **lie in the range 0-3%**.
- Every 1.25 years (probability of 79.82%), it is predicted the Gas Dehydration Shortfall will be **less than 1.0%**.
- Every 10.33 years (probability of 9.68%), it is predicted the Gas Dehydration Shortfall will **exceed 2.0 %**.
- Every 18.45 years (probability of 5.42%), it is predicted the Gas Dehydration Shortfall will **exceed 3.0 %**.

5.3 Operational Availability (Time-Based)

The predicted number of days in which the Dawn Dehydration facility is operating at Full Dehydration, Partial Dehydration or Zero Dehydration is shown in Table 5-3. Note that in OPTAGON, a calendar year of 365 days is equally spaced, with each month having 30.4 days.

Table 5-3 Operational Availability Breakdown of the Dawn Dehydration Facilities (10 Years)

Operating Month*	Average Number of Days per Month			Average Operational Availability (%)	
	Full Demand	Partial Demand	Not Operating	Full Demand	At Any Dehydration Level
November	30.24	0.00	0.18	99.42%	99.42%
December	30.11	0.07	0.24	99.01%	99.23%
January	30.03	0.15	0.23	98.73%	99.24%
February	29.99	0.20	0.23	98.59%	99.24%
March	30.18	0.00	0.23	99.23%	99.24%
Total (10 years)	1,505.57	4.21	11.05	-	-
Mean (10 years)	30.11	0.08	0.22	99.00%	99.27%

Key observations are that:



- The Dehydration Availability of the Dawn facilities (i.e. proportion of time it is dehydrating at full rate over the total dehydration period) is **99.00%**, which demonstrates that Full Dehydration dominates the dehydration cycle, which is expected given the high criticality of this asset in relation to the entire gas transmission operation;
- In November, where the gas dehydration demand is low, the facilities are predicted to operate either at Full Dehydration (majority of time – average of 30.24 days) or Not Operate (average of 0.18 days). This is resultant from the high level of redundancy associated with the Contactor Towers and PD Injection Pumps during this period, where, since not all units are required to be in operation, a failure of a given unit will not have an impact on the gas dehydration operation. Consequently, only full facility shutdowns, effectively resultant from a single point item failure (i.e. no redundancy), can result in dehydration losses in this month;
- In December, the gas dehydration levels are higher than in November, especially towards the end of the month. As a result, there is a period of time where all Contactor Towers (4 x 25%) and 2 out of 3 PD Injection Pumps (3 x 50%) are required to be in operation, and therefore, a failure of a given unit will result in a partial impact on gas dehydration (on average, for a duration of 0.07 days). The amount of time that the plan is not operating is slightly higher than in November (0.24 days vs 0.18 days), as some of the events that resulted in full facility shutdowns may carry over into the December month, which compound with the failure events occurring the December itself (this feature will also be seen in subsequent months);
- In January, the average gas dehydration demand is higher than in December, although exhibiting a decreasing trend throughout the month before reaching peak levels in February. Consequently, the number of days that the facility operates at partial levels increases from 0.07 days in December to 0.15 days in January, up to 0.20 days in February;
- Finally in March, the gas dehydration demand levels exhibit a decreasing trend, reverting to similar levels recorded in November, where there is full redundancy of both the Contactor Towers and PD Injection Pumps. As a result, as in November, the facility will either operate at Full Dehydration levels or Not Operate.

Moreover, the breakdown of the duration of each unplanned full shutdown over the 10-year study period is shown in Table 5-4 and Figure 5-3.

Table 5-4 10-Year Unplanned Full Shutdown Analysis

Duration (Hours)	Number of Times	Total Time (Hours)
Less than 1	0.00	0.00
1 - 2	0.00	0.00
2 - 5	0.26	1.19
5 - 10	3.02	22.30
10 - 20	2.38	33.22
20 - 50	0.70	20.84
50 - 100	0.11	8.66
100 - 200	0.58	78.36
200 - 500	0.02	4.66
500 - 1000	0.10	82.68

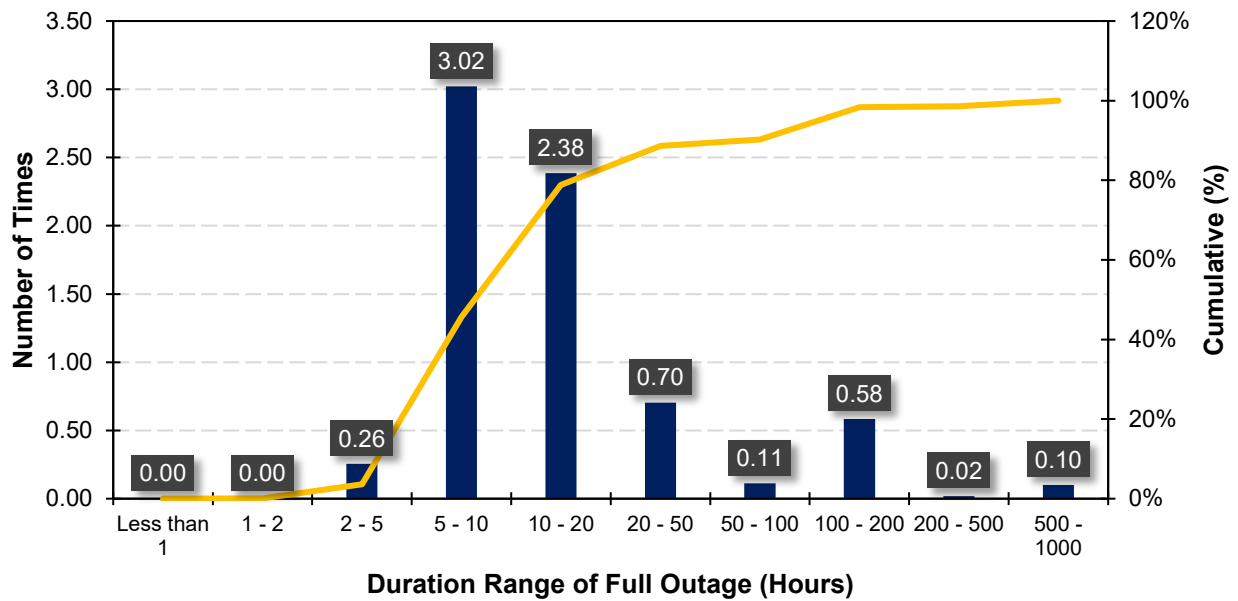


Figure 5-3 Breakdown of 10-Year Unplanned Full Shutdown Events

Key observations are that:

- It is estimated that there are 0.7 full unplanned shutdown events per year at the Dawn Dehydration facilities;
- 75% of the total outages have a duration that lies in the 5 – 10 and 10 – 20-hour ranges;
- Given that there are certain failures that have a duration above the 20-hour mark, the average duration of each full unplanned shutdown event is 35.1 hours.



5.4 Shortfall Contributors

The contributors to Gas Dehydration Shortfall are given at system, equipment and equipment category levels in sections 5.4.1, 5.4.2 and 5.4.3, respectively.

5.4.1 System Contributors to Shortfall

The system contributors to Gas Dehydration Shortfall over the 10-year period considered are shown in Table 5-5 and Figure 5-4. The shortfall caused by each system is quantified and ranked by its impact on Gas Dehydration at the point of failure, as defined by the Dehydration profiles.

Table 5-5 Gas Dehydration 10-Year System Contributors to Shortfall

Rank	System	Dehydration Shortfall		
		Absolute		Relative
		MMSCF	%	%
1	Glycol Regeneration	28,933	0.66%	82.32%
2	Gas Desiccation	2,428	0.06%	6.91%
3	Electrical System	2,110	0.05%	6.00%
4	Blanket Gas System	997	0.02%	2.84%
5	Incinerator System	678	0.02%	1.93%
Total		35,145	0.80%	100.00%

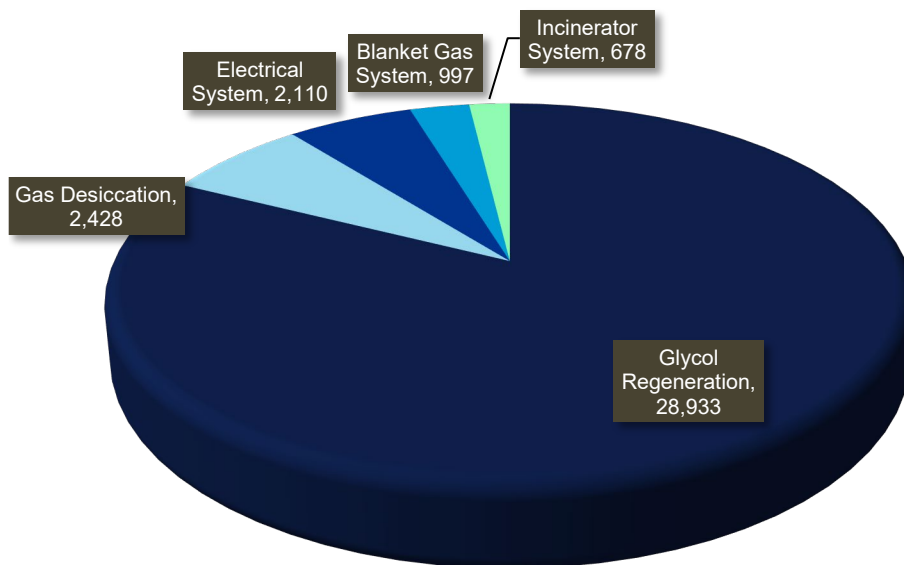


Figure 5-4 Gas Dehydration 10-Year System Contributors to Shortfall (MMSCF)



Key observations are that:

- The most significant contributor to gas dehydration shortfall is the Glycol Regeneration system (82.32% of total shortfall), as it comprises the majority of the equipment that supports the gas dehydration operation, namely the majority of non-redundant equipment items (more detail provided in the next sub-section). The Glycol Regeneration system causes 28,933 MMSCF (0.66% of absolute shortfall) over the 10-year study period;
- The Gas Desiccation system, comprising the 4 x 25% Contactor Towers and associated valves, causes 2,428 MMSCF (0.06% of absolute shortfall, 6.91% in relative terms) of gas dehydration shortfall;
- Next is the Electrical System, comprising a Transfer Switch and Main Circuit Breaker, each with no redundancy. The Electrical system accounts for 2,110 MMSCF (0.05% of absolute shortfall, 6.00% in relative terms) of gas dehydration shortfall;
- The Blanket Gas system is ranked 4th in terms of gas dehydration shortfall at system level, causing 997 MMSCF (0.02% of absolute shortfall, 2.84% in relative terms) across the 10-year study period. This shortfall is attributed to the two non-redundant Regulators that control the amount of gas fed into the Glycol Flash Separator;
- Finally, the Incinerator system accounts for 678 MMSCF (0.02% of absolute shortfall, 1.93% in relative terms) of gas dehydration shortfall. Given that it was assumed that the Emergency Incinerator Stack is able to fully cover the duty of the Main Incinerator Stack subsequent to a failure, all the shortfall associated with this system is attributed to the Condensate Tank, which has no redundancy.

5.4.2 Equipment Contributors to Shortfall

The equipment contributors to gas dehydration shortfall over the 10-year study period are shown in Table 5-6 and Figure 5-5. It is worth noting that the Regenerator and the Contactor Towers were modelled as combination of two components, in order to fully capture the various failure modes and associated repair and logistical delay activities that impact the different sections / operations of these equipment items.

Table 5-6 Gas Dehydration 10-Year Equipment Contributors to Shortfall

Rank	Equipment	Dehydration Shortfall		
		Absolute		Relative
		MMSCF	%	%
1	Regenerator - Shell & Tube	13,370	0.30%	38.04%
2	Regenerator - Contactor	10,273	0.23%	29.23%
3	Glycol Flash Separator	3,251	0.07%	9.25%
4	Transfer Switch	2,011	0.05%	5.72%
5	Contactor Tower - Contactor	1,640	0.04%	4.67%
6	Coolers	1,164	0.03%	3.31%
7	Regulators - Blanket Gas	997	0.02%	2.84%
8	Surge Tank	794	0.02%	2.26%



9	Condensate Tank - Storage Tank	678	0.02%	1.93%
10	Contactor Tower - Separator	530	0.01%	1.51%
11	XVs - Gas Desiccation	173	0.00%	0.49%
12	Main Circuit Breaker	99	0.00%	0.28%
13	Control Valves - Gas Desiccation	84	0.00%	0.24%
14	PD Pumps (Injection Pumps)	36	0.00%	0.10%
15	Reboiler	16	0.00%	0.04%
16	Reboiler Circulation Pumps	15	0.00%	0.04%
17	Booster Pumps	15	0.00%	0.04%
18	Glycol Heat Exchanger	0	0.00%	0.00%
19	Incinerator Stack	0	0.00%	0.00%
Total		35,145	0.80%	100.00%

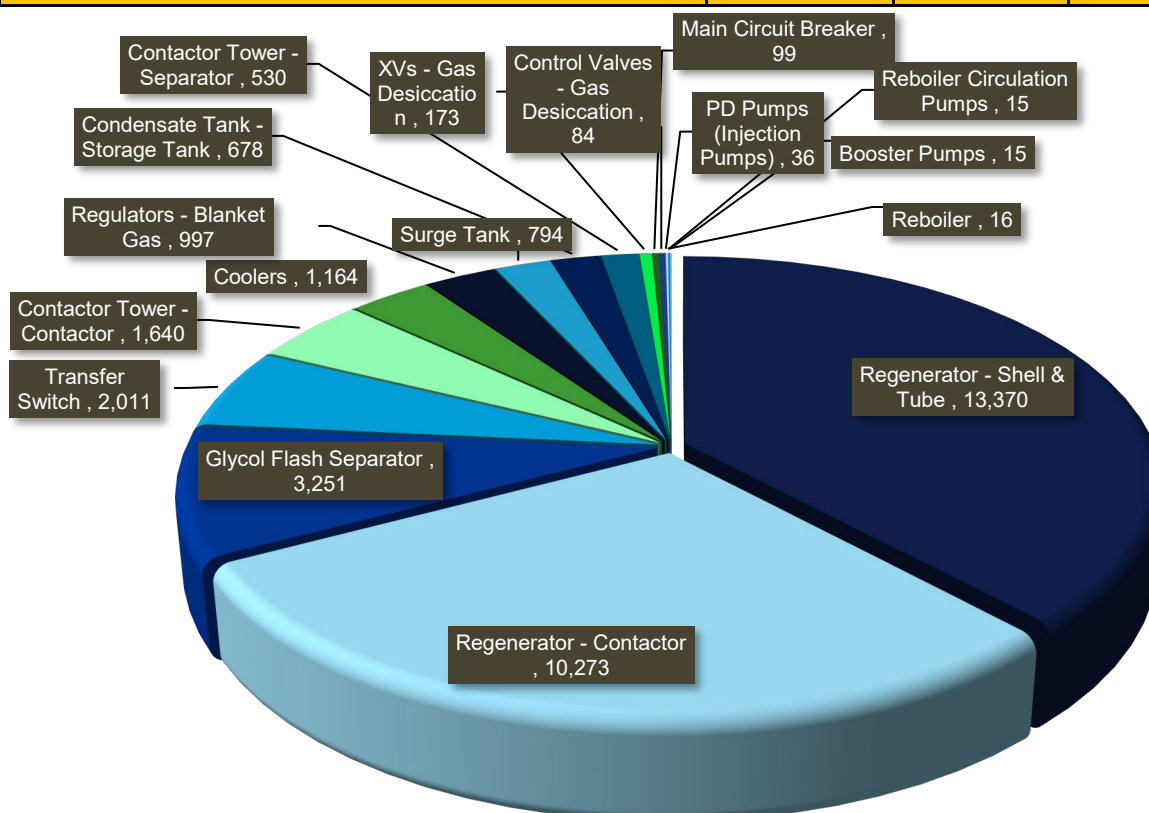


Figure 5-5 Gas Dehydration 10-Year Equipment Contributors to Shortfall (MMSCF)

Key observations are that:



- The most significant contributor to gas dehydration shortfall is the Shell & Tube component of the Regenerator equipment item, which causes 13,370 MMSCF (0.30% of absolute shortfall, 38.04% in relative terms) gas dehydration loss over the 10-year period considered. The Regenerator has a 1 x 100% configuration (i.e. no redundancy), and therefore a failure of this equipment item results in a full facility shutdown, with the logistical delay associated with a major repair of this item responsible for the majority of shortfall attributed to this item;
- The second highest contributor to shortfall is the Contactor component of the Regenerator, accounting for 10,273 MMSCF (0.23% of absolute shortfall, 29.23% in relative terms) gas dehydration shortfall, with both active repair time and logistical delays associated with a major repair responsible for a considerable contribution towards shortfall;
- The Glycol Flash Separator, a 1 x 100% vessel, is predicted to be the third biggest shortfall contributor at an Equipment level, with 3,251 MMSCF shortfall (0.07% of absolute shortfall, 9.25% in relative terms). Both active repair and logistical delays associated with a major failure are responsible for the majority of shortfall attributed to this item;
- Next is the Transfer Switch, a 1 x 100% electrical item, is responsible for 2,011 MMSCF (0.05% of absolute shortfall, 5.72% in relative terms) gas dehydration shortfall;
- The Contactor component of the Contactor Towers, in a 4 x 25% configuration are the 5th highest contributor to gas dehydration shortfall, accounting for 1,640 MMSCF shortfall (0.04% of absolute shortfall, 4.76% in relative terms). This component exhibits the same reliability features as the Contactor component of the Regenerator. However, given the role of the Contactor Towers towards the dehydration operation, there is redundancy associated with this item, which benefits the performance of the overall process (hence its lower shortfall ranking);
- The Coolers (2 units, air cooled), each in a 1 x 100% configuration (i.e. any of the coolers can lead to a full facility shutdown), contribute 1,164 MMSCF (0.03% of absolute shortfall, 3.31% in relative terms) towards the gas dehydration shortfall;
- The following items further contribute to lost dehydration over the 10-year period:
 - Blanket Gas Regulators (997 MMSCF, 0.02% of absolute, 2.84% in relative terms – modelled as 2 Control Valves in series);
 - Surge Tank (794 MMSCF, 0.02% of absolute, 2.26% in relative terms – 1 x 100% Surge Tank supporting the glycol regeneration);
 - Condensate Tank (794 MMSCF, 0.02% of absolute, 1.93% in relative terms – 1 x 100% Storage Tank supporting gas incineration);
 - Separator Component of the Contactor Towers (530 MMSCF, 0.01% of absolute, 1.51% in relative terms – 4 x 25% Separators);
 - XVs – Gas Desiccation (173 MMSCF, >0.01% of absolute, 0.49% in relative terms – 2 XVs modelled per Contactor Tower);
 - Main Circuit Breaker (99 MMSCF, >0.01% of absolute, 0.28% in relative terms – 1 x 100% Circuit Breaker);
 - Control Valves – Gas Desiccation (84 MMSCF, >0.01% of absolute, 0.24% in relative terms – 1 CV modelled per Contactor Tower);
 - PD Injection Pumps (36 MMSCF, >0.01% of absolute, 0.10% in relative terms – 3 x 50% Reciprocating Pumps);



- Reboiler (16 MMSCF, >0.01% of absolute, 0.04% in relative terms – 2 x 100% HC Fired Boiler with the redundant unit in hot stand-by);
- Reboiler Circulating and Booster Pumps (each 15 MMSCF, >0.01% of absolute, 0.04% in relative terms – each 2 x 100% Centrifugal Pumps);
- Glycol Heat Exchanger (no shortfall given the 3 x 100% configuration, with the current level of redundancy capable of accommodating any failure of a given unit or combination of units);
- Incinerator Stack (no shortfall given the assumption that the Emergency Stack is capable to fully cover the duty of the Main Incinerator Stack subsequent to a failure.

5.4.3 Equipment Category Contributors to Shortfall

The key equipment category contributors to gas dehydration shortfall over the 10-year study period are shown in Table 5-7 and Figure 5-6.

Table 5-7 Gas Dehydration 10-Year Equipment Category Contributors to Shortfall

Rank	Equipment Category	Dehydration Shortfall		
		Absolute		Relative
		MMSCF	%	%
1	Heat Exchangers - Shell & Tube	13,370	0.30%	38.04%
2	Vessels - Contactors	11,913	0.27%	33.90%
3	Vessels - Separators	3,782	0.09%	10.76%
4	Automatic Transfer Switch	2,011	0.05%	5.72%
5	Heat Exchangers - Air Coolers	1,164	0.03%	3.31%
6	CVs	1,081	0.02%	3.08%
7	Vessels - Surge Tanks	794	0.02%	2.26%
8	Vessels - Storage Tanks	678	0.02%	1.93%
9	XVs	173	0.00%	0.49%
10	Circuit Breaker	99	0.00%	0.28%
11	Reciprocating EM Pumps	36	0.00%	0.10%
12	Centrifugal EM Pumps	30	0.00%	0.08%
13	Heat Exchangers - HC Fired Boiler	16	0.00%	0.04%
15	Others - Acid Gas Incinerator	0	0.00%	0.00%
Total		35,145	0.80%	100.00%

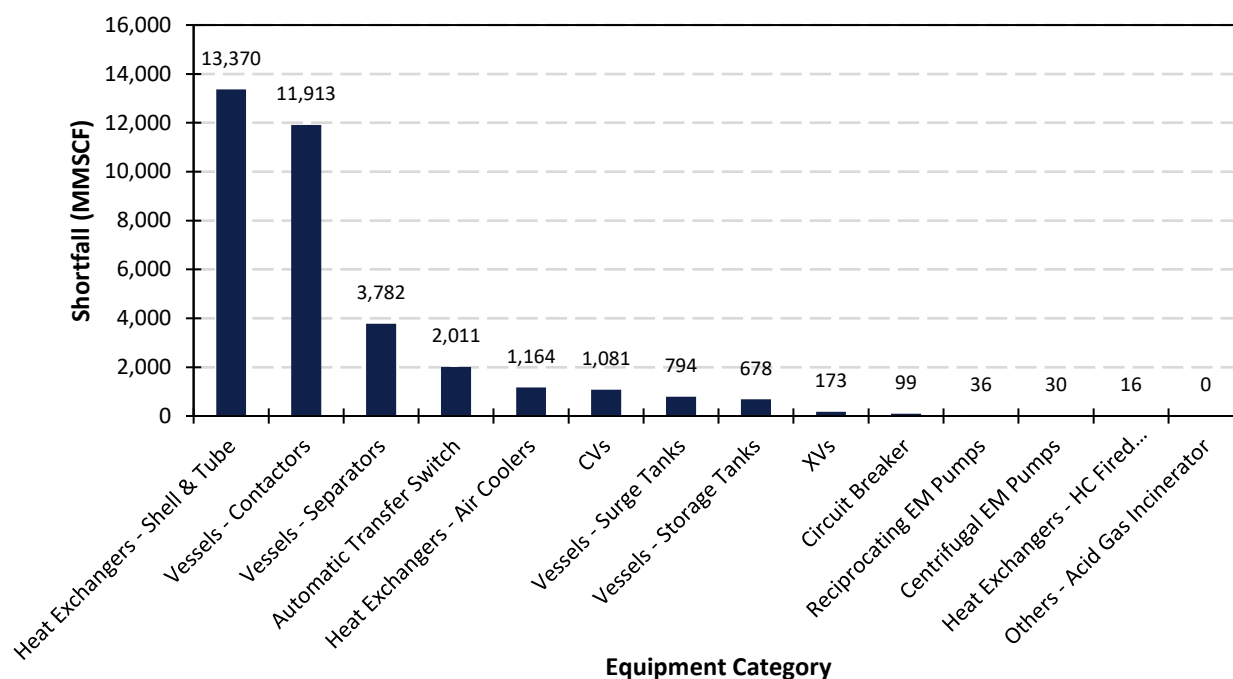


Figure 5-6 Gas Dehydration 10-Year Equipment Category Contributors to Shortfall (MMSCF)

Key observations are that:

- Single point items (i.e. no redundancy) are responsible for the majority of the gas dehydration shortfall;
- At an individual category level, Shell & Tube Heat Exchangers are the most significant contributor to gas dehydration shortfall, causing 38.04% of the total shortfall over the 10-year study period. More specifically, all the shortfall associated with this equipment category comes from the 1 x 100% Regenerator, given that the 3 x 100% redundancy of the of the Glycol Heat Exchanger has been demonstrated in the previous section to not produce any shortfall;
- Contactor Vessels, mostly as part of the Regenerator (1 x 100%) but also the Contactor Towers (4 x 25%) are ranked second with regard to equipment category contributors to gas dehydration shortfall, accounting for 33.90% of the total shortfall;
- Next are the Separator Vessels, mostly as part of the Glycol Flash Separator (1 x 100%) but also the Contactor Towers (4 x 25%) are predicted to cause 10.76% of the total shortfall. The discrepancy between the contribution of Contactor and Separator Vessels is attributed to the better reliability of the latter equipment category item;
- Ranked 4th is the Automatic Transfer Switch, also a single point item, which is predicted to cause 5.72% of the total shortfall;
- Air Coolers, namely the Coolers supporting the glycol regeneration process are ranked 5th with regard to gas dehydration shortfall (3.31% of total shortfall);
- Control Valves are predicted to contribute 3.08% of the total shortfall, and comprise the Blanket Gas Regulators (2 single point items) as well as the control valves associated with each Contactor Tower (4 x 25%);
- Other equipment categories are responsible for the remaining 8.26% of total gas dehydration shortfall.



5.5 Downtime Analysis

The following sub-sections provide further detail on the nature of the downtime events that are predicted to occur at the Dawn Dehydration facilities over the 10-year study period.

5.5.1 Shortfall by Downtime Activity and Mode

Figure 5-7 shows the breakdown of Shortfall by Downtime Activity and Mode associated with the failure events affecting the various equipment items that are part of the gas dehydration operations.

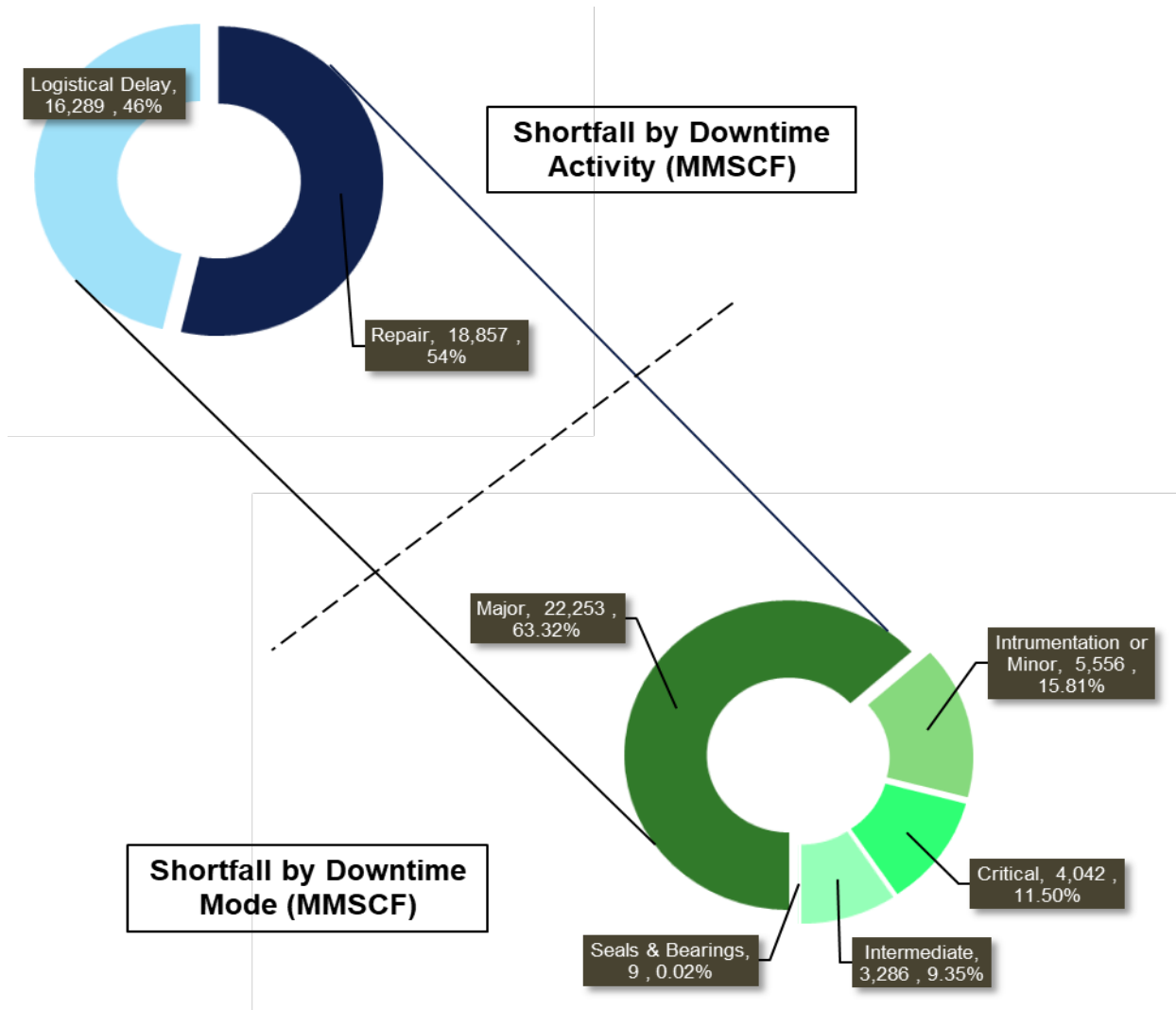


Figure 5-7 Breakdown of Shortfall by Downtime Activity (top left) and Mode (bottom right)

With regard to Downtime by Activity, it is demonstrated that:

- 54% of gas dehydration shortfall is attributed to active repair activities (including component replacement) subsequent to an unplanned failure event that has an impact on gas dehydration performance;
- The remaining 46% of shortfall is attributed to logistical delays (e.g. crew mobilisation & preparation, spare parts procurement, vendor specialist crew mobilisation) required to take place prior to the active repair / replacement activities.

With regard to Downtime by Mode, it is demonstrated that:

- Despite their generally infrequent nature, Major Failures are responsible for 63.32% of the total shortfall, given the typically long duration of the active repair and logistical delays activities associated with this type of failures;



- Instrument and Minor failures, despite their short duration, are frequent enough to result in them being ranked 2nd with regard of shortfall by failure mode (15.81% of total shortfall);
- Next are critical failures associated with valves across the various gas dehydration systems (11.5% of total shortfall);
- Intermediate failures, which lie in between the Major and Minor categories with regard to duration and frequency, are predicted to account for 9.35% of the total shortfall;
- Finally, Seals & Bearings, which were explicitly modelled as part of pump failures, contribute by 0.02% of the total shortfall.

5.5.2 Downtime and Shortfall Relationship

The relationship between equipment downtime subsequent to an equipment failure and associated shortfall impact on gas dehydration operations is not solely dependent on the duration required to restore the equipment to operating conditions, as demonstrated in Figure 5-8. As can be seen from Figure 5-8, factors such as equipment criticality, which is a function of the equipment configuration, or deferred effects upon failure (albeit not present in this study), are additional components that influence the impact that certain items have on operational performance.

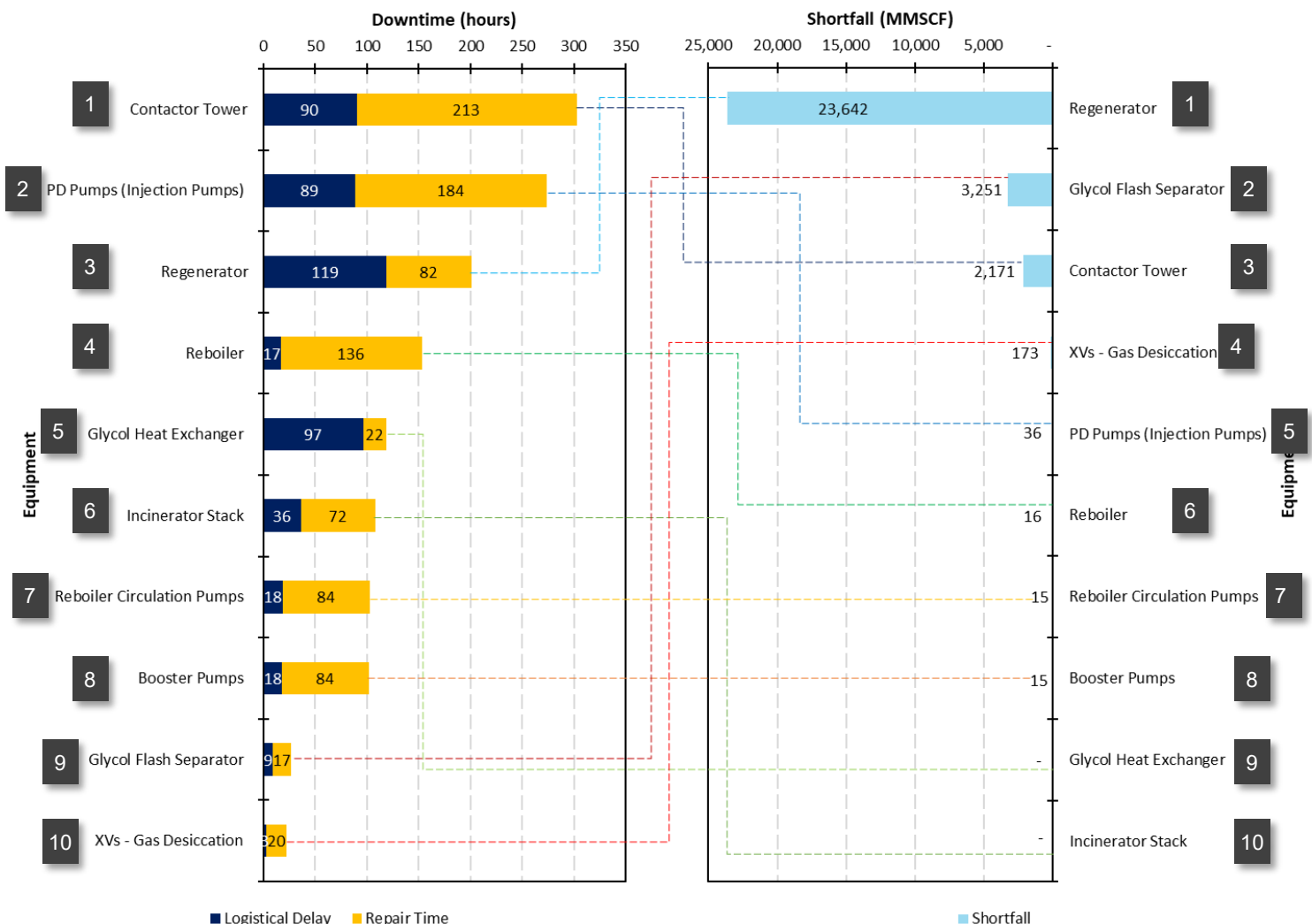


Figure 5-8 Breakdown of Downtime (Left) and Shortfall (Right) per Equipment Item (over 10 years)

It is worth noting that Figure 5-8 only presents the top-10 contributors towards downtime and their associated shortfall.



For example:

- The Contactor Towers, which comprise both a Contactor and Separator components (considered as an aggregate in this phase of the analysis), exhibit the highest downtime across all equipment items that are part of the gas dehydration facilities. This is partly due to the reliability associated with each of its components, but also by the existence of 4 Towers, with a possibility of multiple failures to take place simultaneously, which compounds the downtime figure. Conversely, given its 4 x 25% configuration, there is an inherent level of redundancy (full redundancy in non-peak periods and partial in high demand periods) that benefits the operational performance of the facilities, which is reflected in 3rd ranking with regards to shortfall (on aggregated terms);
- The PD Injection pumps are another example of how an equipment item exhibiting a high downtime is benefited by installed redundancy, given that its 3 x 50% configuration mitigates the relative low reliability associated with reciprocating pumps;
- The Regenerator, comprising both a Shell & Tube Heat Exchanger and Contactor components, is ranked 3rd with regard to total downtime, but is responsible to the highest amount of gas dehydration shortfall given its 1 x 100% configuration, whose failure results in a full facility shutdown which can only be restarted once the item is repaired;
- The Reboiler, in a 2 x 100% configuration with a hot stand-by is another example of how redundancy mitigates shortfall;
- The Glycol Heat Exchangers are ranked 5th with regard to downtime, but given its high level of redundancy (3 x 100%), are not estimated to result in any dehydration shortfall, given that a simultaneous failure of all 3 units would be required in order to have an impact on operations, which has an extremely low likelihood of occurrence;
- The Incinerator Stack is another example of an item that has downtime associated with its failure but actually does not lead to any impact on operations, as it is assumed to be fully backed-up by the Emergency Stack in this Base Case. More specifically, the Emergency Incinerator Stack is estimated to be used 1.8 times per year for an average of 6 hours;
- Finally, the Glycol Flash Separator is only ranked 9th with regard to total downtime but is responsible for the 2nd highest shortfall to dehydration operations, which as in the case of the Regenerator, is due to the non-redundancy of this equipment item. A similar trend is observed with regard to other single point items (relatively high levels of shortfall but low downtime), which are not featured in this downtime analysis.

5.6 Sensitivity Cases

The performance impact of several design and operating assumptions were assessed through the following Sensitivity Cases (full definition provided in section 3.3.2) over the reviewed period of 10 years:

- Sensitivity Case 1 – Incinerator Stack
- Sensitivity Case 2 – Redundancy
- Sensitivity Case 3 – Reduced Logistics

The Sensitivity Case results are presented in the following sub-sections.

5.6.1 Sensitivity Case 1: Incinerator Stack

The performance impact, from a requirement to shutdown dehydration operations when the Incinerator Stack is unavailable, is shown in Table 5-8 (Base Case assumes 100% back-up is available through the Emergency Stack).



Table 5-8 Results Summary for Sensitivity Case 1

Case	Demand (MMSCF)	Gas Dehydrated (MMSCF)	Shortfall (MMSCF)	Dehydration Efficiency (%)	Availability (%)	Shortfall (%)
BC Mean	4,408,052	4,372,907	35,146	99.20%	99.00%	0.80%
SC1 Mean	4,408,052	4,358,659	49,393	98.88%	98.67%	1.12%
SC1 Delta	-	-14,247	14,247	-0.32%	-0.32%	0.32%

This demonstrates the following:

- The mean Dehydration Efficiency of Sensitivity Case 1 is 98.88%, a decrease of 0.32% against the Base Case (absolute increase in shortfall of 14,247 MMSCF).
- The mean Availability of Sensitivity Case 1 is 98.67%, also a decrease of 0.32% against the Base Case.

Also shown in Table 5-9 and Figure 5-9 is the Shortfall Exceedance comparison between Sensitivity Case 1 and the Base Case.

Table 5-9 Shortfall Exceedance Summary for Sensitivity Case 1

Shortfall (%)	BC		SC1	
	Annual Average Probability of Exceedance (%)	Annual Average Frequency of Exceedance (Years)	Annual Average Probability of Exceedance (%)	Annual Average Frequency of Exceedance (Years)
0.00000%	100.00%	1.00	100.00%	1.00
0.01114%	99.99%	1.00	-	-
0.16979%	-	-	99.99%	1.00
1.00000%	20.18%	4.96	36.69%	2.73
2.00000%	9.68%	10.33	11.13%	8.98
3.00000%	5.42%	18.45	7.23%	13.83
4.00000%	0.83%	120.48	1.58%	63.29
5.00000%	0.34%	294.12	0.45%	222.22
6.00000%	0.12%	833.33	0.18%	555.56
7.00000%	0.02%	5,000.00	0.01%	10,000.00

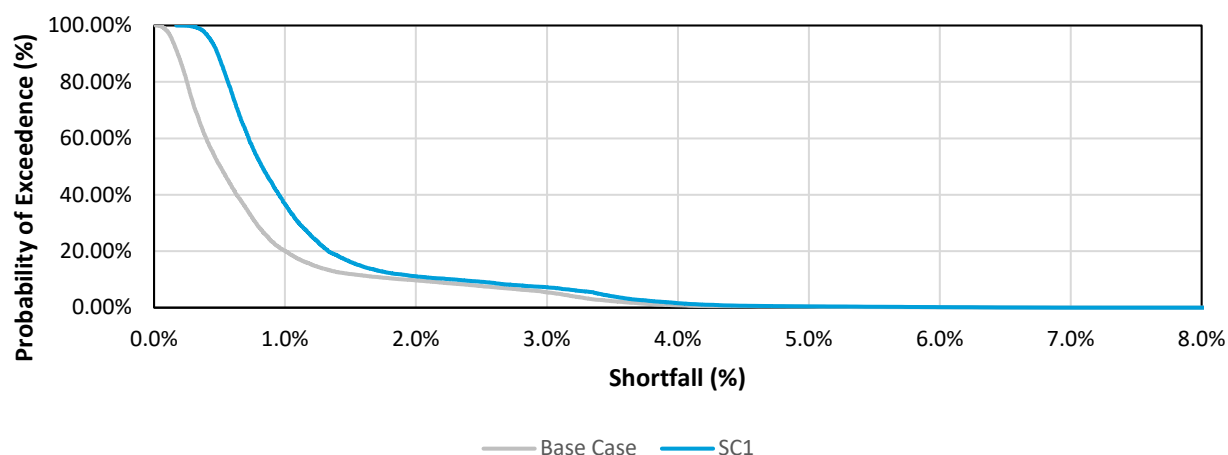


Figure 5-9 Probability of Exceedance Comparison for Sensitivity Case 1



Key observations are that:

- With the assumption that a full shutdown takes place when the Incinerator Stack is unavailable, it is forecasted that there are higher probabilities of dehydration shortfall to be observed in the dehydration operation.
- It is predicted that there is a 63.31% probability that the Gas Dehydration Shortfall will be **less than 1.0%** in Sensitivity Case 1, versus a 79.82% probability in the Base Case.
- It is predicted that there is a 11.13% probability that the Gas Dehydration Shortfall will **exceed 2.0 %** in Sensitivity Case 1, versus a 9.68% in the Base Case.
- It is predicted that there is a 7.23% probability that the Gas Dehydration Shortfall will **exceed 3.0 %** in Sensitivity Case 1, versus a 5.42% in the Base Case.

5.6.2 Sensitivity Case 2: Redundancy

The performance impact, of installing redundant units for all single point items (in the Base Case configuration), is shown in Table 5-10.

Table 5-10 Results Summary for Sensitivity Case 2

Case	Demand (MMSCF)	Gas Dehydrated (MMSCF)	Shortfall (MMSCF)	Dehydration Efficiency (%)	Availability (%)	Shortfall (%)
BC Mean	4,408,052	4,372,907	35,146	99.20%	99.00%	0.80%
SC2 Mean	4,408,052	4,405,418	2,634	99.94%	99.71%	0.06%
SC2 Delta	-	+32,512	-32,512	+0.74%	+0.72%	-0.74%

This demonstrates the following:

- The mean Dehydration Efficiency of Sensitivity Case 2 is 99.94%, an increase of 0.74% against the Base Case (absolute decrease in shortfall of 32,512 MMSCF).
- The mean Availability of Sensitivity Case 2 is 99.71%, an increase of 0.72% against the Base Case.

Also shown in Table 5-11 and Figure 5-10 is the Shortfall Exceedance comparison between Sensitivity Case 2 and the Base Case.

Table 5-11 Shortfall Exceedance Summary for Sensitivity Case 2

Shortfall (%)	BC		SC2	
	Annual Average Probability of Exceedance (%)	Annual Average Frequency of Exceedance (Years)	Annual Average Probability of Exceedance (%)	Annual Average Frequency of Exceedance (Years)
0.00000%	100.00%	1.00	99.99%	1.00
0.00003%	-	-	99.77%	1.00
0.01114%	99.99%	1.00	-	-
0.64264%	-	-	0.01%	10,000.00
1.00000%	20.18%	4.96	-	-
2.00000%	9.68%	10.33	-	-
3.00000%	5.42%	18.45	-	-
4.00000%	0.83%	120.48	-	-
5.00000%	0.34%	294.12	-	-
6.00000%	0.12%	833.33	-	-
7.00000%	0.02%	5,000.00	-	-

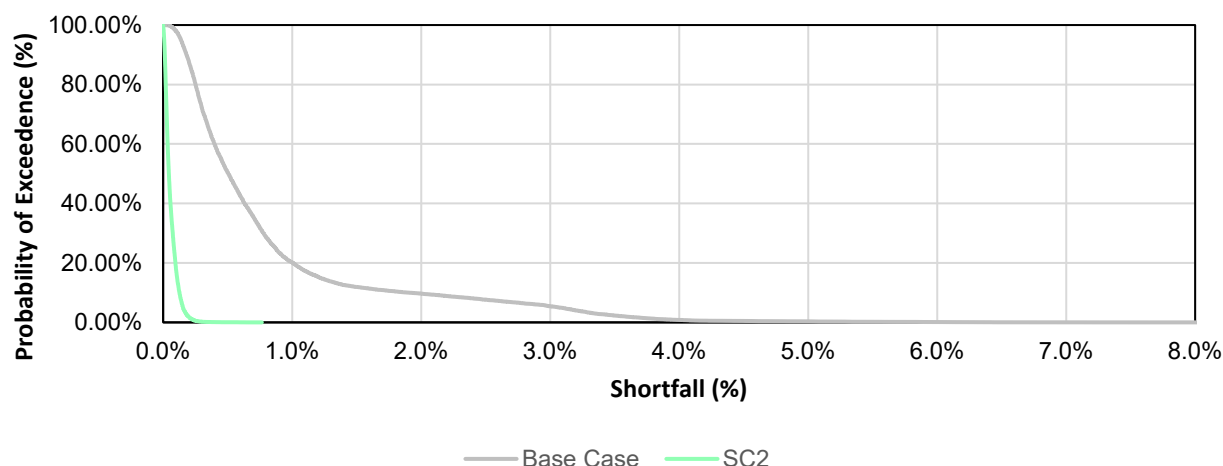


Figure 5-10 Probability of Exceedance Comparison for Sensitivity Case 2

Key observations are that:

- With all single point items in the dehydration process having installed redundancy, it is forecasted that there are significantly lower probabilities of dehydration shortfall to be observed.
- It is predicted that there is a 100% probability that the Gas Dehydration Shortfall will be **less than 1.0%** in Sensitivity Case 2, versus a 79.82% probability in the Base Case.

Also shown in Table 5-12 is the breakdown of the beneficial contribution of adding an installed redundant unit to each single point equipment item.

Table 5-12 Sensitivity Case 2 Contributors to Performance Improvement

Equipment Item	Performance Improvement (MMSCF)	Relative Contribution to Performance Improvement (%)
Regenerator	23,552	72.44%
Glycol Flash Separator	3,239	9.96%
Auto Switch	2,003	6.16%
Coolers	1,160	3.57%
Regulators	993	3.05%
Surge Tank	791	2.43%
Condensate Tank	675	2.08%
Main Circuit Breaker	99	0.30%
Total	32,512	100.00%

It is concluded that:

- Installing a redundant unit to each single point item almost entirely reduces the contribution of these items towards shortfall, as the Sensitivity Case shows an improvement of 32,512 MMSCF in dehydration performance versus their Base Case shortfall contribution of 32,637 MMSCF;



- The installation of a redundant Regenerator, a combination of a Contactor and a Shell & Tube, results to the highest performance improvement, namely contributing 72.44% in relative terms.

5.6.3 Sensitivity Case 3: Reduced Logistic Delays

The performance impact of reducing logistical delays on major repairs of Shell & Tube Heat Exchangers, is shown in Table 5-13. This reduction in logistical delay is assumed to be achieved by holding a spare bundle in-stock, to replace the failed items.

Table 5-13 Results Summary for Sensitivity Case 3

Case	Demand (MMSCF)	Gas Dehydrated (MMSCF)	Shortfall (MMSCF)	Dehydration Efficiency (%)	Availability (%)	Shortfall (%)
BC Mean	4,408,052	4,372,907	35,146	99.20%	99.00%	0.80%
SC3 Mean	4,408,052	4,382,784	25,268	99.43%	99.21%	0.57%
SC3 Delta	-	+9,878	-9,878	+0.22%	+0.21%	-0.22%

This demonstrates the following:

- The mean Dehydration Efficiency of Sensitivity Case 3 is 99.43%, an increase of 0.22% against the Base Case (absolute decrease in shortfall of 9,878 MMSCF). This performance improvement is mostly attributed to the shortfall mitigation achieved by reducing the logistical delay associated with major failures to the Shell & Tube component of the Regenerator (V-3), which is a single point item.
- The mean Availability of Sensitivity Case 3 is 99.21%, an increase of 0.21% against the Base Case.

Also shown in Table 5-14 and Figure 5-11 is the Shortfall Exceedance comparison between Sensitivity Case 3 and the Base Case.

Table 5-14 Shortfall Exceedance Summary for Sensitivity Case 3

Shortfall (%)	BC		SC3	
	Annual Average Probability of Exceedance (%)	Annual Average Frequency of Exceedance (Years)	Annual Average Probability of Exceedance (%)	Annual Average Frequency of Exceedance (Years)
0.00000%	100.00%	1.00	100.00%	1.00
0.00716%	-	-	99.99%	1.00
0.01114%	99.99%	1.00	-	-
1.00000%	20.18%	4.96	13.16%	7.60
2.00000%	9.68%	10.33	0.49%	204.08
3.00000%	5.42%	18.45	0.01%	10,000.00
4.00000%	0.83%	120.48	-	-
5.00000%	0.34%	294.12	-	-
6.00000%	0.12%	833.33	-	-
7.00000%	0.02%	5,000.00	-	-

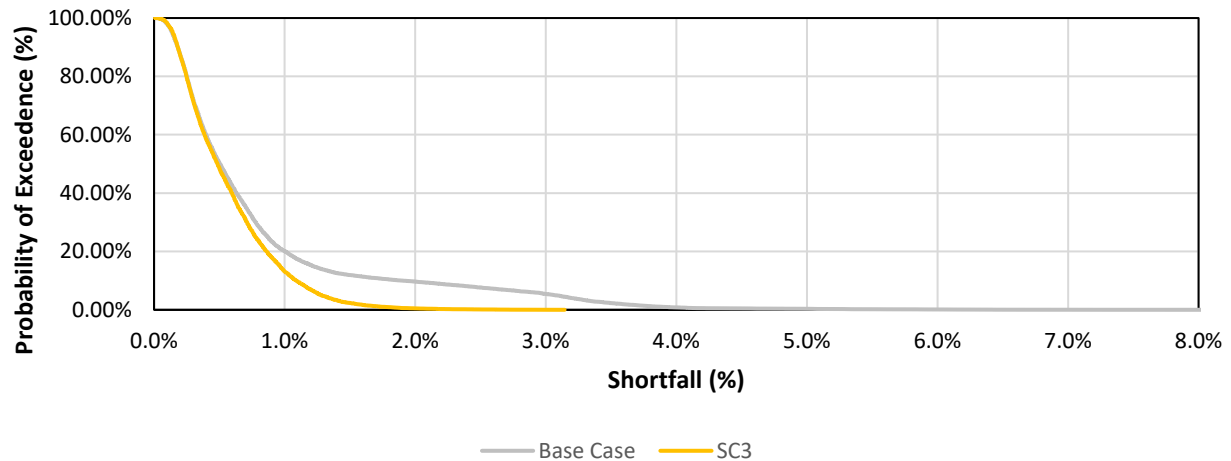


Figure 5-11 Probability of Exceedance Comparison for Sensitivity Case 3

Key observations are that:

- With reduced logistical delays on major repairs of Shell & Tube Heat exchangers, it is forecasted that there are lower probabilities of dehydration shortfall to be observed in the dehydration operation.
- It is predicted that there is a 86.84% probability that the Gas Dehydration Shortfall will be **less than 1.0%** in Sensitivity Case 3, versus a 79.82% probability in the Base Case.
- It is predicted that there is a 0.49% probability that the Gas Dehydration Shortfall will **exceed 2.0 %** in Sensitivity Case 1, versus a 9.68% in the Base Case.
- It is predicted that there is a 0.01% probability that the Gas Dehydration Shortfall will **exceed 3.0 %** in Sensitivity Case 1, versus a 5.42% in the Base Case.



6 SUMMARY & CONCLUSIONS

6.1 Summary

Top Level Performance and Full Shutdown Analysis

Table 6-1 provides a summary of the performance of the Dawn Dehydration Unit over the 10-year study period.

Table 6-1 Efficiency / Availability Results Summary

Case	Dehydration Efficiency (%)	Availability (%)
Base Case	99.20%	99.00%

As can be seen from the results, the Dawn Dehydration facilities exhibit high levels of dehydration performance, especially considering that a very conservative demand has been assessed in this study. More specifically, it is estimated that over the 10-year study period, that the Dehydration Efficiency of the facilities will be 99.20% and that the facilities will meet 100% of the required demand for 99% of the time.

Moreover, the monthly breakdown of the Gas Dehydration Performance for the first year of the 10-year study period is presented in Figure 6-1.

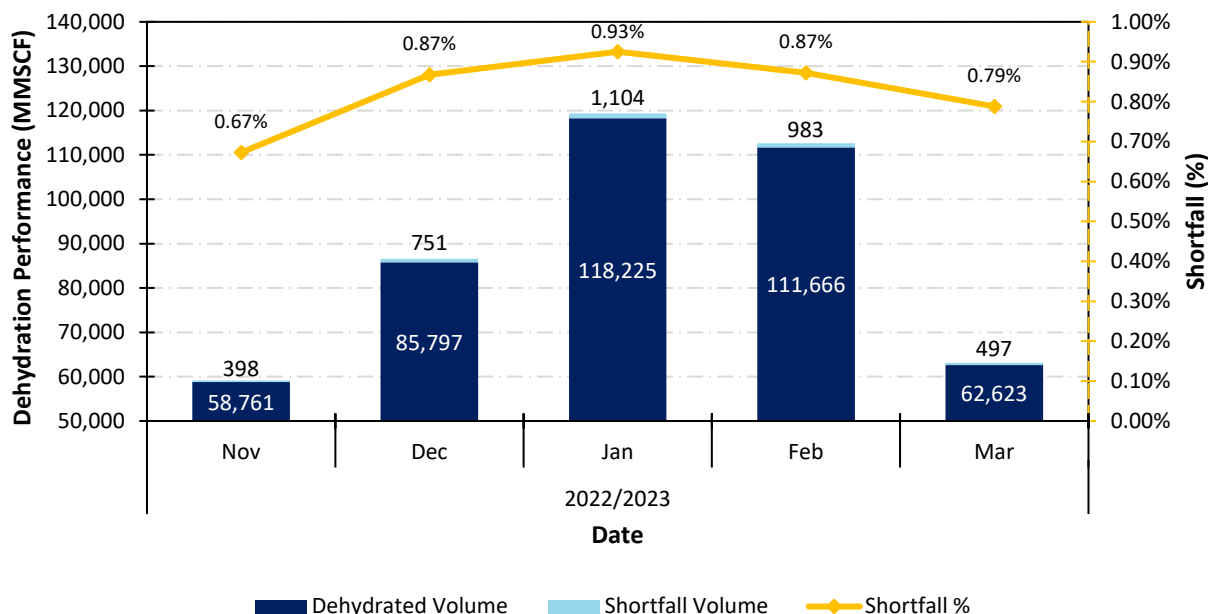


Figure 6-1 Monthly Breakdown of Gas Dehydration Performance

Key observations are:

- It was assumed that no deterioration is taking place with the Dawn Dehydration facilities, based on the assumption that components are within their useful life phase, where the failure rate is close to constant and independent of time. For this to be achieved, items are often replaced or refurbished before they reach the wear-out phase, thus reflecting some of the maintenance and replacement programs taking place at Dawn, given the criticality of the Dehydration Unit to the entire gas transmission operations. This results in a similar Gas Dehydration Performance to be seen in the remaining years of this RAM study;
- As expected, as the demand profile increases throughout the Winter season, there are slight increases in shortfall. This is attributed to the decrease in redundancy levels during the high-demand periods, as a larger proportion of



items are required to be in operation in order to meet the demand. Therefore, in this period, an equipment failure is likely to have an impact on the performance of the dehydration operation, including a partial impact. During the low-demand periods, given the design capacity of certain equipment items, not all units will be required to operate under normal conditions, and therefore will only be used to mitigate the impact of a failure of the operating units.

Full unplanned facility shutdowns are responsible for the majority of the shortfall associated with the gas dehydration operation. A breakdown of the duration of each unplanned full shutdown over the 10-year study period is shown in Figure 6-2.

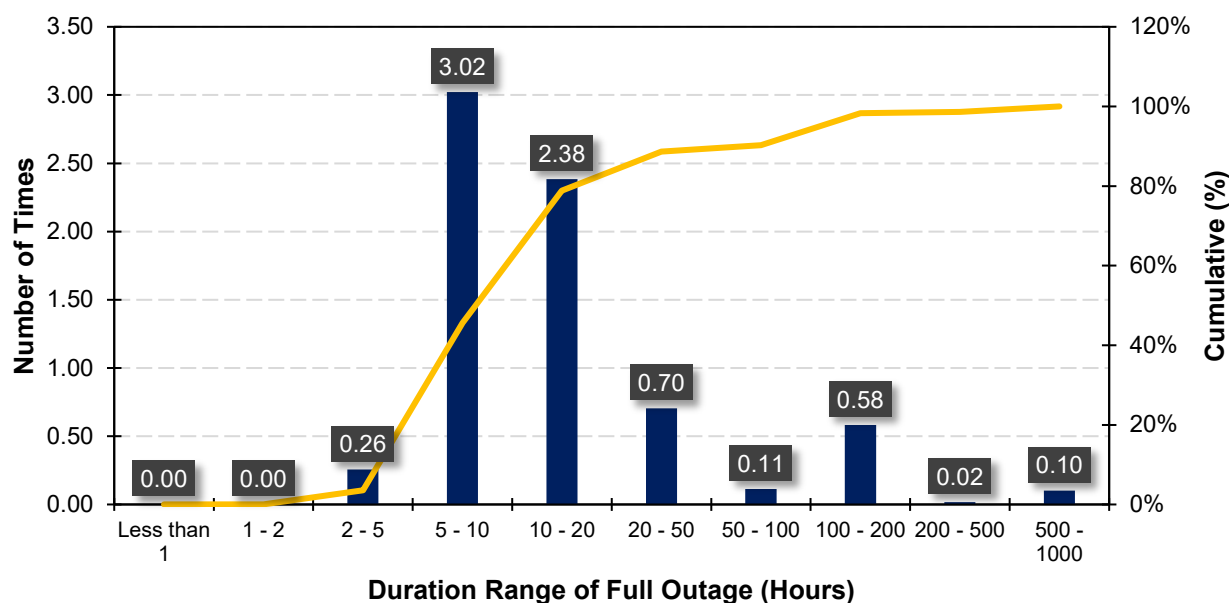


Figure 6-2 Breakdown of 10-Year Unplanned Full Shutdown Events

Key observations are that:

- It is estimated that there are 0.7 full unplanned shutdown events per year at the Dawn Dehydration facilities;
- 75% of the total outages have a duration that lies in the 5 – 10 and 10 – 20-hour ranges;
- Given that there are certain failures that have a duration above the 20-hour mark, the average duration of each full unplanned shutdown event is 35.1 hours.



Shortfall Contributors

Table 6-2 and Figure 6-3 show the System and Equipment gas dehydration shortfall contributors, respectively, over the 10-year operation period considered.

Table 6-2 Gas Dehydration 10-Year System Contributors to Shortfall

Rank	System	Dehydration Shortfall		
		Absolute		Relative
		MMSCF	%	%
1	Glycol Regeneration	28,933	0.66%	82.32%
2	Gas Desiccation	2,428	0.06%	6.91%
3	Electrical System	2,110	0.05%	6.00%
4	Blanket Gas System	997	0.02%	2.84%
5	Incinerator System	678	0.02%	1.93%
Total		35,145	0.80%	100.00%

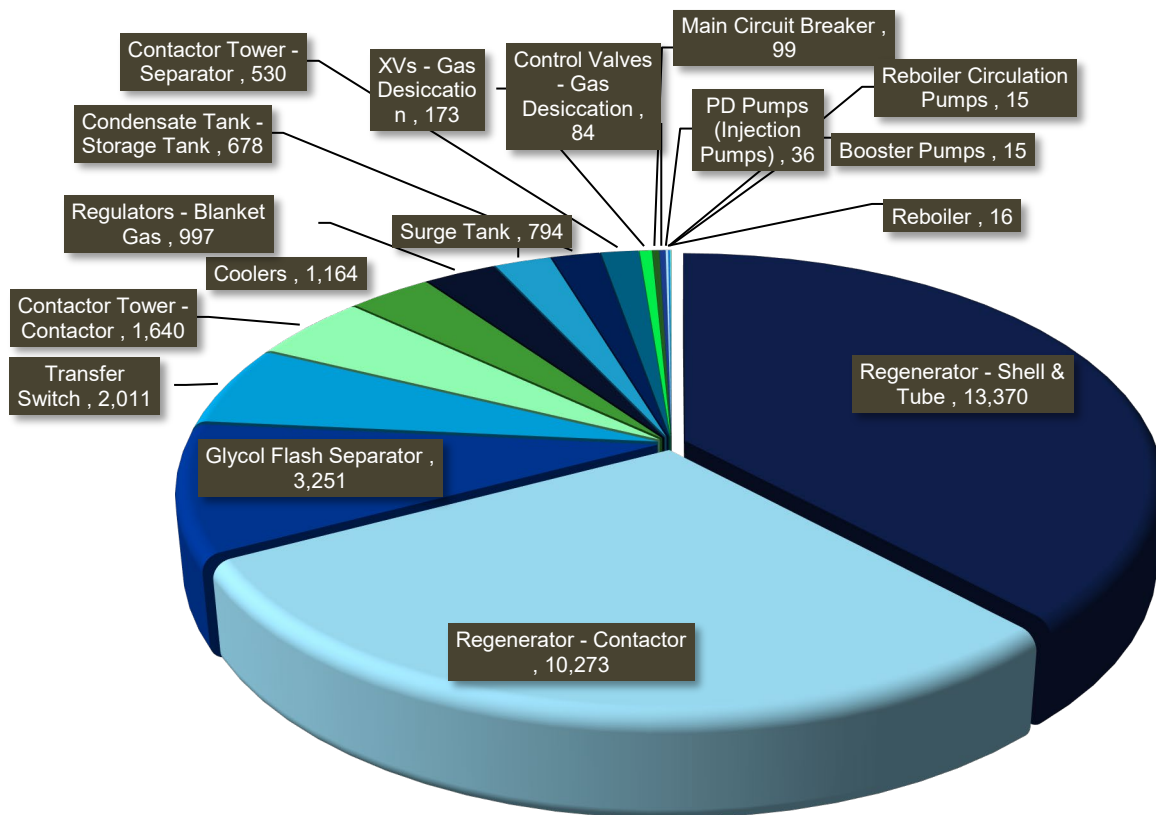


Figure 6-3 Gas Dehydration 10-Year Equipment Contributors to Shortfall (MMSCF)



Key observations are that:

- The most significant contributor to gas dehydration shortfall is the Shell & Tube component of the Regenerator equipment item, which causes 13,370 MMSCF (0.30% of absolute shortfall, 38.04% in relative terms) gas dehydration loss over the 10-year period considered. The Regenerator has a 1 x 100% configuration (i.e. no redundancy), and therefore a failure of this equipment item results in a full facility shutdown, with the logistical delay associated with a major repair of this item responsible for the majority of shortfall attributed to this item;
- The second highest contributor to shortfall is the Contactor component of the Regenerator, accounting for 10,273 MMSCF (0.23% of absolute shortfall, 29.23% in relative terms) gas dehydration shortfall, with both active repair time and logistical delays associated with a major repair responsible for a considerable contribution towards shortfall;
- The Glycol Flash Separator, a 1 x 100% vessel, is predicted to be the third biggest shortfall contributor at an Equipment level, with 3,251 MMSCF shortfall (0.07% of absolute shortfall, 9.25% in relative terms). Both active repair and logistical delays associated with a major failure are responsible for the majority of shortfall attributed to this item;
- Next is the Transfer Switch, a 1 x 100% electrical item, is responsible for 2,011 MMSCF (0.05% of absolute shortfall, 5.72% in relative terms) gas dehydration shortfall;
- The Contactor component of the Contactor Towers, in a 4 x 25% configuration are the 5th highest contributor to gas dehydration shortfall, accounting for 1,640 MMSCF shortfall (0.04% of absolute shortfall, 4.76% in relative terms). This component exhibits the same reliability features as the Contactor component of the Regenerator. However, given the role of the Contactor Towers towards the dehydration operation, there is redundancy associated with this item, which benefits the performance of the overall process (hence its lower shortfall ranking);
- The Coolers (2 units, air cooled), each in a 1 x 100% configuration (i.e. any of the coolers can lead to a full facility shutdown), contribute 1,164 MMSCF (0.03% of absolute shortfall, 3.31% in relative terms) towards the gas dehydration shortfall;
- The remaining 13 items that are critical to the gas dehydration operation contribute on aggregate to less than 10% of the total shortfall.



Downtime Analysis

Figure 6-4 shows the breakdown of Shortfall by Downtime Activity and Mode associated with the failure events affecting the various equipment items that are part of the gas dehydration operations.

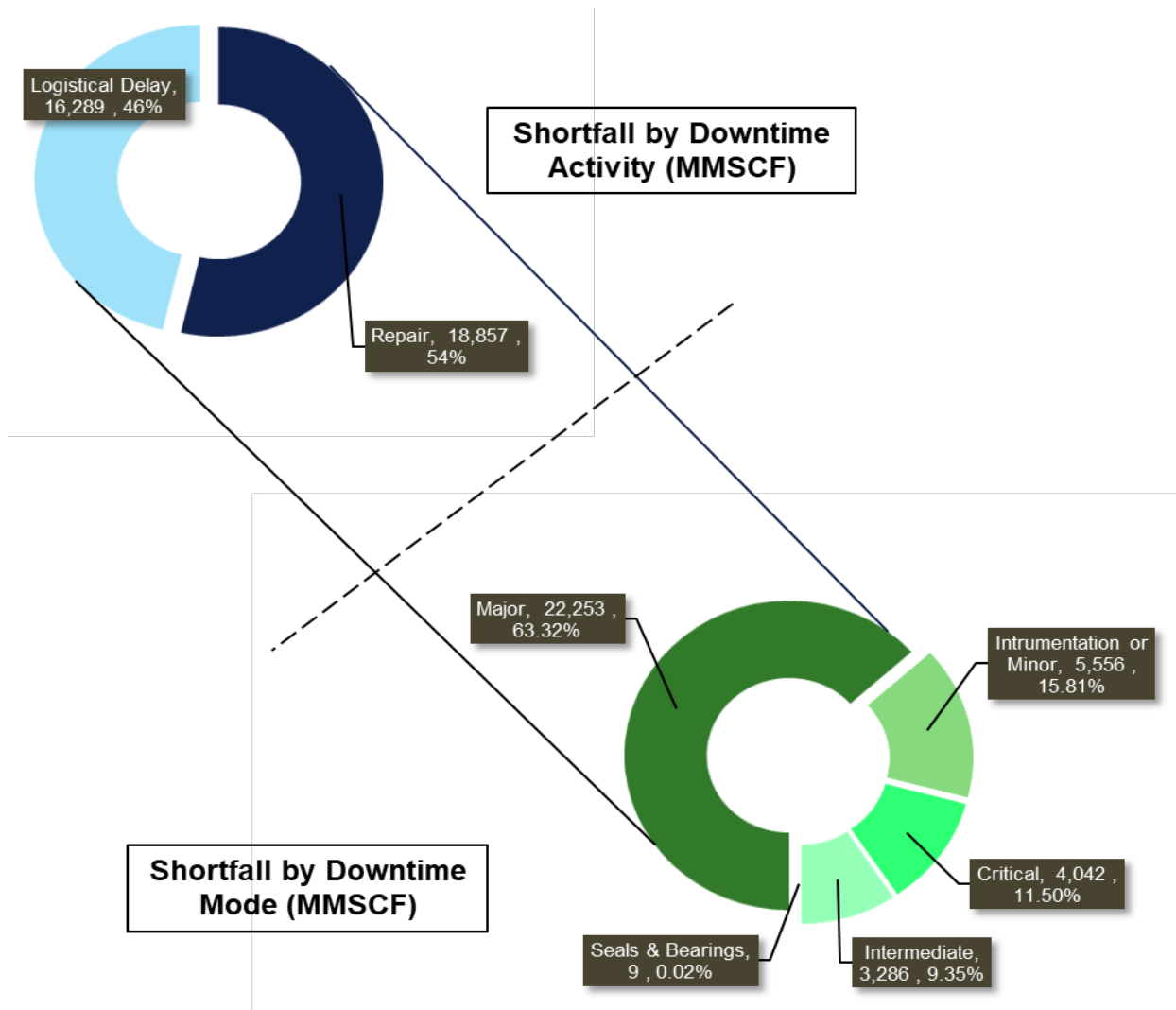


Figure 6-4 Breakdown of Shortfall by Downtime Activity (top left) and Mode (bottom right)

With regard to Downtime by Activity, it is demonstrated that:

- 54% of gas dehydration shortfall is attributed to active repair activities (including component replacement) subsequent to an unplanned failure event that has an impact on gas dehydration performance;
- The remaining 46% of shortfall is attributed to logistical delays (e.g. crew mobilisation & preparation, spare parts procurement, vendor specialist crew mobilisation) required to take place prior to the active repair / replacement activities.

With regard to Downtime by Mode, it is demonstrated that:

- Despite their generally infrequent nature, Major Failures are responsible for 63.32% of the total shortfall, given the typically long duration of the active repair and logistical delays activities associated with this type of failures;



- Instrument and Minor failures, despite their short duration, are frequent enough to result in them being ranked 2nd with regard of shortfall by failure mode (15.81% of total shortfall);
- Next are critical failures associated with valves across the various gas dehydration systems (11.5% of total shortfall);
- Intermediate failures, which lie in between the Major and Minor categories with regard to duration and frequency, are predicted to account for 9.35% of the total shortfall;
- Finally, Seals & Bearings, which were explicitly modelled as part of pump failures, contribute by 0.02% of the total shortfall.

The relationship between equipment downtime subsequent to an equipment failure and associated shortfall impact on gas dehydration operations is not solely dependent on the duration required to restore the equipment to operating conditions, as demonstrated in Figure 6-5. As can be seen from Figure 6-5, factors such as equipment criticality, which is a function of the equipment configuration, or deferred effects upon failure (albeit no present in this study), are additional components that influence the impact that certain items have on operational performance.

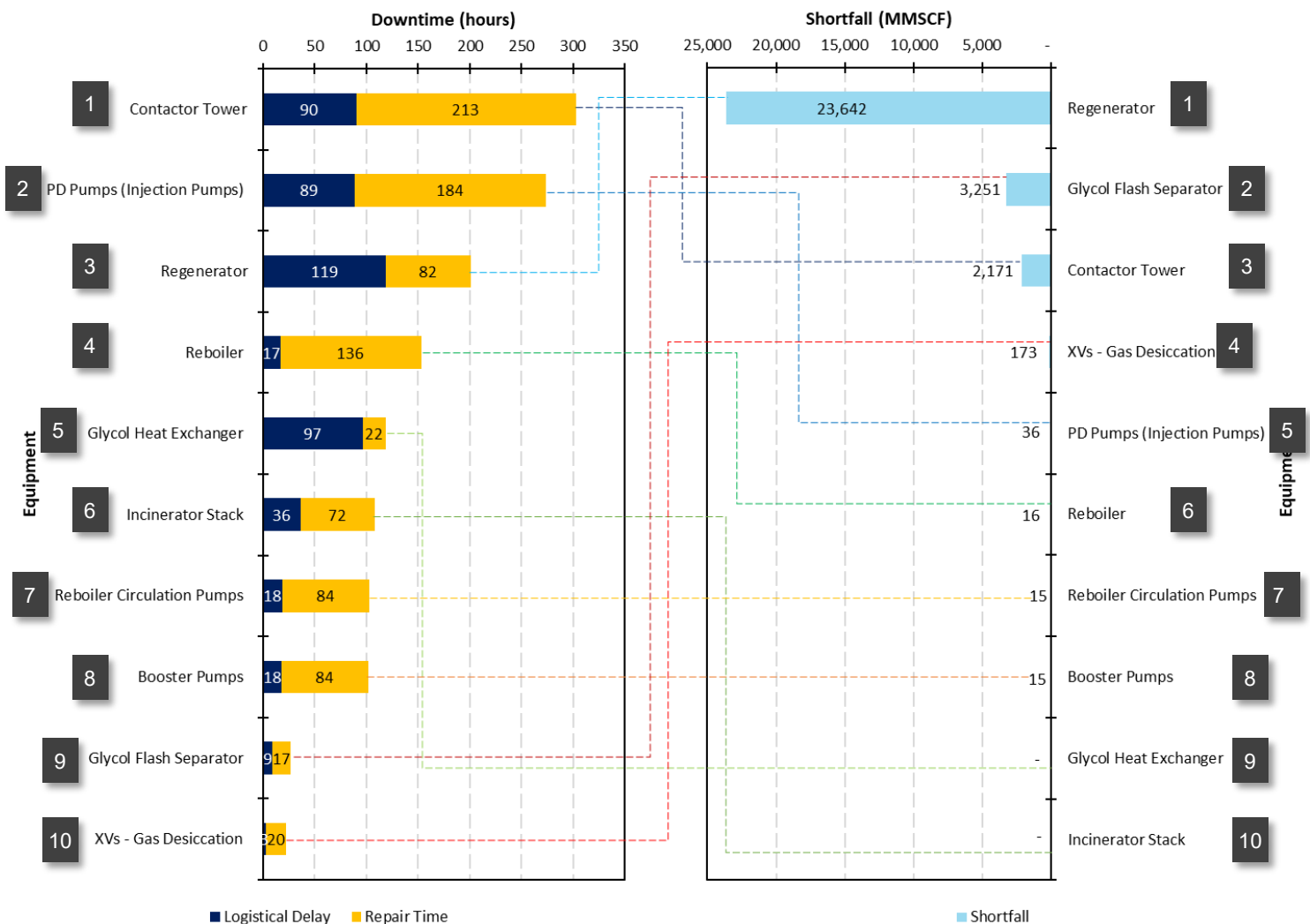


Figure 6-5 Breakdown of Downtime (Left) and Shortfall (Right) per Equipment Item (over 10 years)

It is worth noting that Figure 6-5 only presents the top-10 contributors towards downtime and their associated shortfall.

For example:



- The Contactor Towers, which comprise both a Contactor and Separator components (considered as an aggregate in this phase of the analysis), exhibit the highest downtime across all equipment items that are part of the gas dehydration facilities. This is partly due to the reliability associated with each of its components, but also by the existence of 4 Towers, with a possibility of multiple failures to take place simultaneously, which compounds the downtime figure. Conversely, given its 4 x 25% configuration, there is an inherent level of redundancy (full redundancy in non-peak periods and partial in high demand periods) that benefits the operational performance of the facilities, which is reflected in 3rd ranking with regards to shortfall (on aggregated terms);
- The PD Injection pumps are another example of how an equipment item exhibiting a high downtime is benefited by installed redundancy, given that its 3 x 50% configuration mitigates the relative low reliability associated with reciprocating pumps;
- The Regenerator, comprising both a Shell & Tube Heat Exchanger and Contactor components, is ranked 3rd with regard to total downtime, but is responsible to the highest amount of gas dehydration shortfall given its 1 x 100% configuration, whose failure results in a full facility shutdown which can only be restarted once the item is repaired;
- The Reboiler, in a 2 x 100% configuration with a hot stand-by is another example of how redundancy mitigates shortfall;
- The Glycol Heat Exchangers are ranked 5th with regard to downtime, but given its high level of redundancy (3 x 100%), are not estimated to result in any dehydration shortfall, given that a simultaneous failure of all 3 units would be required in order to have an impact on operations, which has an extremely low likelihood of occurrence;
- The Incinerator Stack is another example of an item that has downtime associated with its failure but actually does not lead to any impact on operations, as it is assumed to be fully backed-up by the Emergency Stack in this Base Case. More specifically, the Emergency Incinerator Stack is estimated to be used 1.8 times per year for an average of 6 hours;
- Finally, the Glycol Flash Separator is only ranked 9th with regard to total downtime but is responsible for the 2nd highest shortfall to dehydration operations, which as in the case of the Regenerator, is due to the non-redundancy of this equipment item. A similar trend is observed with regard to other single point items (relatively high levels of shortfall but low downtime), which are not featured in this downtime analysis.



Sensitivity Analysis - Results

Sensitivity Analysis was used to assess various design and operating assumptions, and their impact on dehydration performance over the reviewed period of 10 years. The results from these cases are summarised in Figure 6-6

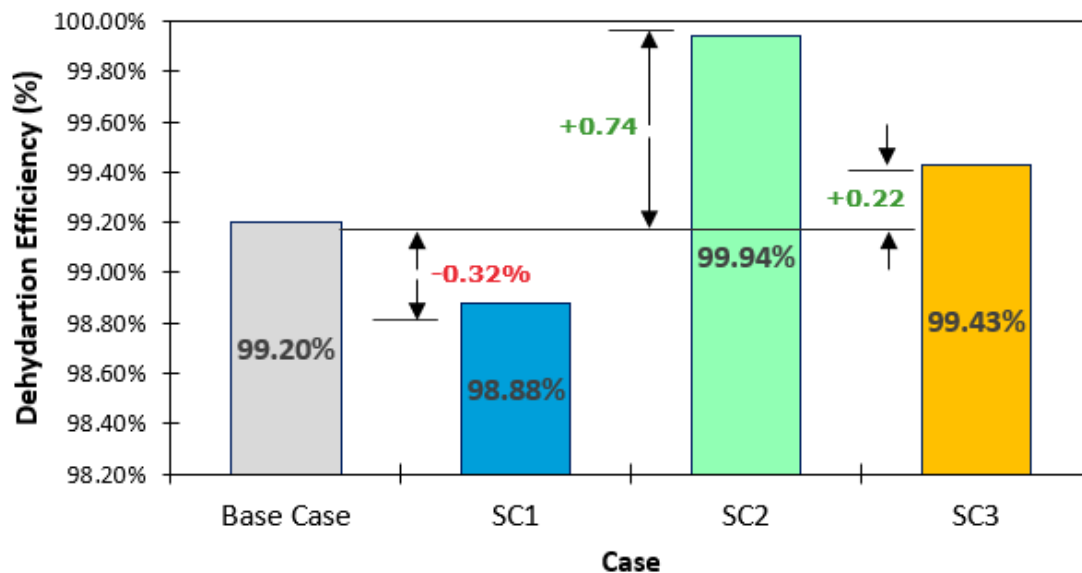


Figure 6-6 Sensitivity Cases Results Comparison Summary

Key observations are:

- Sensitivity Case 1: Full shutdown required when Inclinator Stack becomes unavailable - this results in a reduction in Dehydration Efficiency of 0.32%.
- Sensitivity Case 2: Redundant units installed for all single point items in the dehydration process - this results in an improvement in Dehydration Efficiency of 0.74%.
- Sensitivity Case 3: Reduced logistical delay on major repairs of Shell & Tube Heat Exchangers - this results in an improvement in Dehydration Efficiency of 0.22%.

6.2 Conclusions

The following conclusions can be drawn from the Dawn Dehydration Unit RAM study:

- The Dawn Dehydration facilities exhibit high levels of dehydration performance, especially considering that a very conservative demand has been assessed in this study. High performance levels are expected with regard to assets that play a critical role to gas transmission operations, as is the case of the Dawn Dehydration Unit, and as a result, it is important to nonetheless strive for reasonable improvements to the performance of these critical assets;
- Full unplanned facility shutdowns are responsible for the majority of the shortfall associated with the gas dehydration operation. There full facility shutdowns are resultant of failure of single point items within the gas dehydration process, namely Vessels and Heat Exchangers;
- More specifically, major failures associated with the aforementioned items are responsible for the majority of the full facility shutdowns. More specifically, major failures associated with the aforementioned items are responsible for the majority of the full facility shutdowns, which can be mitigated though installed redundancy or additional holding of capital spares. The performance improvement associated with the aforementioned approaches can be assessed via Sensitivity Cases;



- It has been demonstrated that downtime associated with a particular equipment item is not necessarily linked to a high shortfall figure, given that equipment redundancy and capacity also plays a role in this relationship;
- If a full shutdown is required to take place when the Incinerator Stack is unavailable (driven by environmental concerns), this has a detrimental impact on Dehydration Performance;
- Highest levels of improvement in Dehydration Performance can be achieved by installing redundant units to all current single point items in operation, thus avoiding several full shutdown events. However, the applicability of such measure needs to be assessed by considering the financial benefit associated with such measure versus the added CAPEX and OPEX involved in this approach;
- Holding a spare Shell & Tube Heat Exchanger bundle in-stock also leads to improvements in Dehydration Performance, as it significantly reduces downtime from the logistical delay associated with mainly major repairs of the Regenerator unit, currently a single point item. As with the previous point, the financial benefit associated with this measure versus the added CAPEX and OPEX involved in this approach needs to be assessed.



7 REFERENCES

- /1/ "Dehy Glycol Flow Schematic Nov 22"
- /2/ "Dawn North Plant Glycol Dehydration Facility Manual Excerpts"
- /3/ OREDA Reliability Handbooks (2002 – 2015)



APPENDIX A – RELIABILITY DATA

Appendix A presents the reliability data that will be used in the RAM models. The text in **green** represents the instances where proposed data was modified to reflect a particular asset-specific data input based on Enbridge's operating experience.

As discussed previously, the mapping between the reliability data shown below and each equipment item in the Dawn Dehydration facility is shown in the Equipment Criticality Tables (please refer to the Equipment Type / column in Section 4.2.1).

Pump Failure Data

Type	Service	MTTF (yrs)	Repair Category	MTTF for repair category	Repair Time (hrs)		Mobilisation Delay		Source		Comment
					Min	Max	Category	Delay (hrs)	MTTF	Repair Time	
Pump - Centrifugal	Condensate Processing	0.47	Seals & Bearings	2.6	2.0	6.0	Minor	2.0	OREDA 2009	Expert judgment	To be used for the NGL and condensate services, absorber bottom pumps.
			Minor other repairs	0.6	2.0	6.0	Minor	2.0			
			Major repairs	15.8	24.0	72.0	Major	48.0			
	Generic Service	1.03	Seals & Bearings	5.7	8.0	22.0	Minor	2.0	OREDA 2015	Expert judgment	To be used for the centrifugal pumps except for the condensate services, for example: LPG services, heating medium, wash water, demin water, amine pumps, flare pumps, cooling medium, reflux pumps
			Minor other repairs	1.3	8.0	22.0	Minor	2.0			
			Major repairs	34.2	48.0	120.0	Major	48.0			
Pump – Reciprocating	Generic Service	0.97	Seals & Bearings	16.2	48.0	120.0	Minor Adjusted	8.0	OREDA 2015	Expert judgment	To be used for reciprocating pumps in generic services.
			Minor other repairs	1.3	2.0	8.0	Minor	2.0			
			Major onshore repairs	4.6	24.0	120.0	Major	48.0			



Compressor and Generator Failure Data

Type	Service	MTTF (yrs)	Repair Category	MTTF for repair category	Repair Time (hrs)		Mobilisation Delay		Source		Comment
					Min	Max	Category	Delay (hrs)	MTTF	Repair Time	
Centrifugal Compressor	Generic service	0.57	instr./minor	1.1	4.0	4.0	Minor	2.0	OREDA 2015	Expert judgment	To be used for centrifugal compressors, independently from the driver. Separate data for drivers need to be used.
			Seals & Bearings	6.3	24.0	48.0	Minor	2.0			
			intermediate repair	1.5	24.0	48.0	Major	48.0			
			major repairs	18.9	240	720.0	Specialist Crew	120.0			
Reciprocating Compressor	Generic service	0.25	instr./minor	0.6	4.0	4.0	Minor	2.0	OREDA 2009	Expert judgment	To be used for EM driven reciprocating compressors. Separate data for drivers need to be used.
			Seals & Bearings	25.3	24.0	24.0	Minor	2.0			
			intermediate repair	0.5	12.0	24.0	Major	48.0			
			major repairs	25.3	72.0	240.0	Specialist Crew	120.0			
Screw Compressor	Generic service	0.81	instr./minor	1.5	4.0	4.0	Minor	2.0	OREDA 2009	Expert judgment	To be used for EM driven screw compressors. Separate data for drivers need to be used.
			Seals & Bearings	10.1	24.0	24.0	Minor	2.0			
			intermediate repair	2.4	12.0	24.0	Major	48.0			
			major repairs	27.1	72.0	240.0	Major	48.0			
Electrical Power Generator	Motor driven (diesel, gas motor)	3.80	instr./minor	5.9	4.0	4.0	Minor	2.0	OREDA 2015	Expert judgment	To be used for all electrical generators.
			intermediate repair	11.5	24.0	48.0	Minor	2.0			
			major repairs	95.0	120	720.0	Major	48.0			



Driver Failure Data

Type	Service	MTTF (yrs)	Repair Category	MTTF for repair category	Repair Time (hrs)		Mobilisation Delay		Source		Comment
					Min	Max	Category	Delay (hrs)	MTTF	Repair Time	
Pump Driver: Electric Motor	Condensate Processing	2.9	instr./minor	3.6	4.0	12.0	Minor	2.0	OREDA 2009	Expert judgment	To be used for EM of condensate processing pumps
			intermediate repair	24.1	12.0	24.0	Minor	2.0			
			major repair	41.4	48.0	120.0	Major	48.0			
	Generic service	5.82	instr./minor	7.2	4.0	6.0	Minor	2.0	OREDA 2015	Expert judgment	To be used for all other EM pump drivers.
			intermediate repair	48.5	12.0	24.0	Minor	2.0			
			major repair	83.2	48.0	240.0	Major	48.0			
Compressor Driver: Electric Motor	Generic service	4.11	instr./minor	5.1	4.0	6.0	Minor	2.0	OREDA 2015	Expert judgment	To be used for all electric motors driving compressors.
			intermediate repair	34.2	24.0	48.0	Minor	2.0			
			major repair	58.7	48.0	120.0	Major	48.0			
Compressor Driver: Industrial Gas Turbine	Generic service	0.21	instr./control valves	0.4	4.0	8.0	Minor	2.0	OREDA 2009	Expert judgment	To be used for industrial GT drivers
			minor failures	1.5	4.0	8.0	Minor	2.0			
			intermediate repair	0.6	24.0	48.0	Major	48.0			
			major repair	21.3	120.0	240.0	Specialist Crew	120.0			
Diesel/Gas Combustion Engine	Generic service	2.08	instr./minor	2.9	4.0	12.0	Minor	2.0	OREDA 2015	Expert judgment	To be used for all diesel/gas motors driving compressors
			intermediate repair	9.9	24.0	48.0	Minor	2.0			
			major repair	29.7	48.0	240.0	Major	48.0			



Heat Exchanger, Heater and Boiler Failure Data

Type	Service	MTTF (yrs)	Repair Category	MTTF for repair category	Repair Time (hrs)		Mobilisation Delay		Source		Comment
					Min	Max	Category	Delay (hrs)	MTTF	Repair Time	
Shell & Tube Heat Exchanger	Generic Service	4.49	instr./minor	7.2	4.0	6.0	Minor	2.0	OREDA 2015	Expert Judgment	To be used for all Shell & Tube Heat Exchangers in generic service: condensers, coolers, heaters.
			intermediate repair	18.7	24.0	48.0	Minor	2.0			
			major repair (assumed to account for 99% of major failures)	32.1	48.0	120.0	Major Adjusted	730.0			
			major replacement (assumed to account for 1% of major failures)	3,210.0	48.0	120.0	Major Adjusted	3360.0			
Plate Heat Exchanger	Generic Service	5.25	instr./minor	-	-	-	-	-	OREDA 2002	Expert Judgment	To be used for all plate and printed circuit heat exchangers.
			intermediate repair	-	-	-	-	-			
			major repair	5.2	48.0	120.0	Major	48.0			
Air Coolers	Generic Service	13.34	instr./minor	14.7	4.0	6.0	Minor	2.0	OREDA 2009	Expert Judgment	Air Cooler (Fin Fan Heat Exchanger). Data includes failure of the motors and fans
			intermediate repair	444.5	24.0	48.0	Minor	2.0			
			major repair	222.3	48.0	120.0	Major	48.0			
HC Fired Boiler	Generic Service	1.54	instr./minor	4.26	4.0	4.0	Minor	2.0	OREDA 2009	Expert Judgment	To be used for reboilers
			intermediate repair	2.44	24.0	48.0	Minor	2.0			
			major repair	153.50	48.0	240.0	Major Adjusted	120.0			



Vessel Failure Data

Type	Service	MTTF (yrs)	Repair Category	MTTF for repair category	Repair Time (hrs)		Mobilisation Delay		Source		Comment
					Min	Max	Category	Delay (hrs)	MTTF	Repair Time	
Molecular Sieve Dryer	Generic Service	3.91	instr./minor	5.4	4.0	12.0	Minor	2.0	OREDA 2015	Expert judgment	Use this for molecular sieve beds.
			Intermediate Repairs	24.4	12.0	24.0	Minor	2.0			
			Major Repairs	35.5	48.0	120.0	Major	48.0			
Filter	Normal Service	10.26	instr./minor	14.1	2.0	4.0	Minor	2.0	DNV	Expert judgment	No data in OREDA. Use this for generic filters, sock filters, carbon filters, basket filters, coalescers, filtration packages.
			intermediate repair	64.1	4.0	12.0	Minor	2.0			
			major repair	93.3	48.0	120.0	Major	48.0			
Separator	Generic Service	3.18	instr./minor	4.4	2.0	4.0	Minor	2.0	OREDA 2009	Expert judgment	Use this for Separators, slugcatchers, flare drums.
			intermediate repair	19.9	4.0	24.0	Minor	2.0			
			major repair	28.9	48.0	120.0	Major	48.0			
Scrubber	Generic Service	1.04	instr./minor	1.4	2.0	4.0	Minor	2.0	OREDA 2015	Expert judgment	Use this for scrubbers.
			intermediate repair	6.5	4.0	24.0	Minor	2.0			
			major repair	9.4	48.0	120.0	Major	48.0			
Surge Drums	Generic Service	16.89	instr./minor	23.1	4.0	12.0	Minor	2.0	OREDA 2009	Expert judgment	Use this for surge drums, expansion drums.
			intermediate repair	105.5	12.0	24.0	Minor	2.0			
			major repair	153.5	48.0	120.0	Major	48.0			
Contactor	Generic Service	1.25	instr./minor	1.7	4.0	12.0	Minor	2.0	OREDA 2009	Expert judgement	Use this for absorbers, amine contactors, regenerators.
			intermediate repair	7.8	12.0	24.0	Minor	2.0			
			major repair	11.4	48.0	120.0	Major	48.0			



Non-Generic Equipment Failure Data

Type	Failure Mode	MTTF (yrs)	Repair Time (hrs)		Mobilisation Delay		Source	Comment
			Min	Max	Category	Delay (hrs)		
Nitrogen generation package	Critical	7.5	12	12	Minor	2.0	DNV	-
Control Valve	Critical	16.5	14.2	14.2	Minor	2.0	OREDA 2002	-
Choke Valve	Erosion	6.9	60.0	60.0	Minor	2.0	DNV	-
On/Off Valve	Critical	31.8	2.0	4.0	Minor	2.0	OREDA 2009	-
PCV Valve	Spurious Closure	60.0	2.0	4.0	Minor	2.0	OREDA 2009	-
JT Valve	Critical	16.5	14.2	14.2	Minor	2.0	DNV	Effectively modelled as a Control Valve
Manual Valve	External Leakage	76.1	2.0	4.0	Minor	2.0	Exida 2008	-
Shutdown Valve	Critical	20.4	20.0	20.0	Minor	2.0	OREDA 2015	-
Blowdown Valve	Critical	13.2	16.0	16.0	Minor	2.0	OREDA 2015	-
Acid Gas Incinerator	Critical	0.23	4.0	4.0	Minor	2.0	DNV	-
Circuit Breaker	Critical	277.70	40.0		Minor	2.0	IEEE	Exponential repair distribution assumed
Automatic Transfer Switch	Critical	19.54	80.0		Minor	2.0	IEEE	Exponential repair distribution assumed



APPENDIX B – DAWN DEHYDRATION FACILITIES DEMAND PROFILE

Date	Flow (MMCFD)	Date	Flow (MMCFD)	Date	Flow (MMCFD)	Date	Flow (MMCFD)
01-Nov	1204.6	12-Dec	3738.9	22-Jan	3705.3	04-Mar	3277.1
02-Nov	1110.8	13-Dec	3233.1	23-Jan	3758.8	05-Mar	3778.9
03-Nov	1065.6	14-Dec	3330.0	24-Jan	3290.8	06-Mar	3077.5
04-Nov	1038.0	15-Dec	3138.5	25-Jan	3168.5	07-Mar	2881.2
05-Nov	1352.2	16-Dec	3398.1	26-Jan	2965.4	08-Mar	2203.2
06-Nov	1354.6	17-Dec	3340.0	27-Jan	3431.1	09-Mar	1566.5
07-Nov	1425.9	18-Dec	3293.9	28-Jan	3645.9	10-Mar	2411.9
08-Nov	1365.2	19-Dec	3508.9	29-Jan	4699.5	11-Mar	2652.6
09-Nov	1122.4	20-Dec	2311.2	30-Jan	5100.0	12-Mar	2802.4
10-Nov	2375.4	21-Dec	1709.7	31-Jan	4811.8	13-Mar	3059.0
11-Nov	2466.2	22-Dec	1771.9	01-Feb	3433.0	14-Mar	3077.8
12-Nov	3474.8	23-Dec	1424.0	02-Feb	3621.6	15-Mar	2564.6
13-Nov	2152.9	24-Dec	2271.7	03-Feb	3189.3	16-Mar	1884.8
14-Nov	1903.4	25-Dec	1867.2	04-Feb	2853.7	17-Mar	1748.9
15-Nov	1385.2	26-Dec	3187.2	05-Feb	2739.4	18-Mar	2118.5
16-Nov	1513.6	27-Dec	4301.9	06-Feb	3104.2	19-Mar	2757.7
17-Nov	1684.0	28-Dec	4548.3	07-Feb	3838.9	20-Mar	2668.7
18-Nov	2817.5	29-Dec	4127.0	08-Feb	4244.0	21-Mar	2460.1
19-Nov	2486.8	30-Dec	4153.5	09-Feb	4304.5	22-Mar	2102.3
20-Nov	2061.9	31-Dec	4531.9	10-Feb	4667.5	23-Mar	1586.0
21-Nov	1906.5	01-Jan	4831.8	11-Feb	4966.7	24-Mar	1288.0
22-Nov	2036.0	02-Jan	4728.3	12-Feb	5100.0	25-Mar	1268.2
23-Nov	2299.9	03-Jan	3719.9	13-Feb	4515.9	26-Mar	1329.8
24-Nov	2923.3	04-Jan	3639.8	14-Feb	3920.8	27-Mar	1063.2
25-Nov	2502.6	05-Jan	4001.4	15-Feb	3979.8	28-Mar	1029.5
26-Nov	2283.7	06-Jan	4231.3	16-Feb	4486.1	29-Mar	830.6
27-Nov	2390.6	07-Jan	4720.2	17-Feb	4341.2	30-Mar	663.7
28-Nov	2291.5	08-Jan	4479.0	18-Feb	4612.7	31-Mar	781.9
29-Nov	2473.7	09-Jan	3793.6	19-Feb	4005.9		
30-Nov	1810.6	10-Jan	4241.4	20-Feb	3528.2		
01-Dec	2100.8	11-Jan	3562.2	21-Feb	2424.1		
02-Dec	1425.2	12-Jan	3491.9	22-Feb	2378.1		
03-Dec	1159.2	13-Jan	4357.2	23-Feb	3283.9		
04-Dec	1529.3	14-Jan	3714.5	24-Feb	2792.2		
05-Dec	1317.3	15-Jan	4520.9	25-Feb	3513.4		
06-Dec	2140.3	16-Jan	3420.8	26-Feb	3883.5		
07-Dec	2668.7	17-Jan	3319.2	27-Feb	3876.5		
08-Dec	2636.6	18-Jan	3645.9	28-Feb	3290.7		
09-Dec	2543.2	19-Jan	3400.3	01-Mar	2458.4		
10-Dec	3529.1	20-Jan	3716.3	02-Mar	2526.9		
11-Dec	3941.6	21-Jan	4071.0	03-Mar	2494.7		



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HAGAR LIQUIFIED NATURAL GAS (LNG) RAM STUDY

Final Report

Enbridge Gas Inc.

Report No.: 10289507-RAM, Rev. 1

Date: 23 December 2021





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Objective:

This report details the assumptions, basis, and results of the Hagar Liquefied Natural Gas (LNG) facility RAM study.

Prepared by:

Joao Vasques
Senior Consultant

Verified by:

Neil Wragg
Senior Principal Consultant

Approved by:

Jeremy Johnson, P.Eng.
Engineer, DNV Canada Ltd.

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EXECUTIVE SUMMARY

Enbridge Gas Inc. (Enbridge) have requested DNV to conduct an evaluation of the condition of the Hagar peak shaving Liquefied Natural Gas (LNG) facility through a Reliability, Availability, and Maintainability (RAM) study. The aim of the RAM study is to quantify the risks of operational reliability being affected in the future, which will be used to inform development of a long-term plan for the facility.

As a peak shaving plant, its purpose is to ensure the reliability of natural gas supply to customers, shall conventional gas supply via pipeline fall below demand requirements due to prolonged cold weather conditions or due to disruptions in the upstream pipeline network. As such, natural gas feedstock is converted into liquid and stored in a cryogenic tank during off-peak summer and fall seasons and subsequently, LNG is vapourised back into natural gas during the winter season upon demand. In the event of full load demand, the capacity of the storage facility is able to supply the Sudbury market continuously for up to 6.67 days.

In addition to normal LNG management operations, a compressor station is also located within the peak shaving plant, responsible for re-compression of gas from the natural gas network.

The objectives of the Hagar LNG RAM study were as follows:

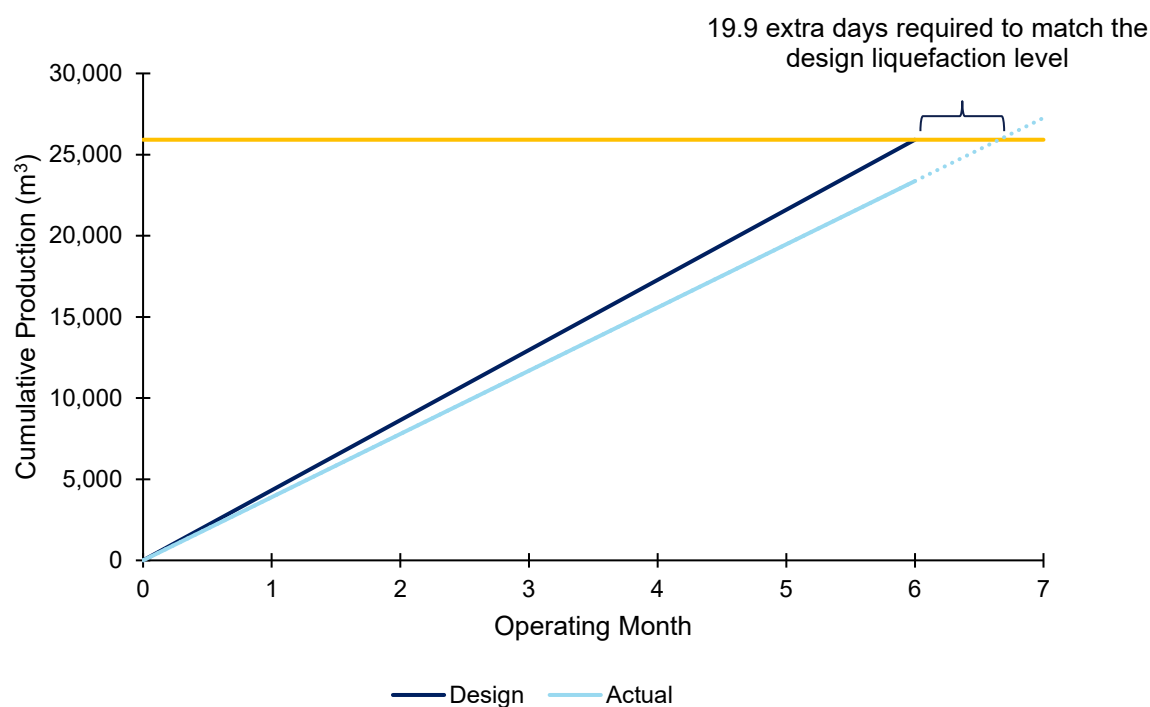
- Forecast Production Efficiency (%) and Availability (%), where appropriate, of the existing LNG Plant facilities over remaining operational life. The following operations will be assessed:
 - Liquefaction into LNG Storage Tank
 - Regasification from LNG Storage Tank to Transmission Main
 - Gas Compression as part of the Transmission Service
- Identify key systems and equipment that result in Production/Availability losses, and rank by system and equipment contributions (criticality analysis)
- Identify any potential areas of performance improvement through consideration of defined sensitivity cases

Key Results

Gas Liquefaction

The table below provides a summary of the performance of the Gas Liquefaction mode of operation, with the figure below presenting the monthly breakdown of the cumulative LNG production over a 6-month period.

Case	Demand (m ³)	Produced (m ³)	Shortfall (m ³)	Production Efficiency (%)	Average Hourly Production (m ³ /hr)	Availability (%)	Shortfall (%)
Mean	25,915	23,364	2,551	90.16%	5.33	89.2%	9.84%



Key observations are:

- The mean Production Efficiency (PE) of the Liquefaction system against Demand is 90.16%; 23,364 m³ of LNG are produced against a Demand of 25,915 m³.
- The mean average liquefaction rate over the 6-month period is 5.33 m³/hr;
- The minimum forecasted production volume, over a 6-month period, is 1,699 m³ (PE of 6.56% - more detail provided in section 5.1.3.2), while the maximum forecasted production volume is 25,915 m³ (i.e. no shortfall);
- In the mean average scenario, a PE of 90.16% means that 19.9 additional days would be required in order to match the design production rate of the liquefaction facility, which assumes that no production shortfall is incurred.

The table below shows the system contributors to gas liquefaction shortfall over the 6-month reviewed period.

Rank	System	Gas Liquefaction Shortfall			Extra Days Required
		Absolute		Relative	
		m ³	%	%	
1	Gas Liquefaction	1,421	5.48%	55.71%	11.10
2	Gas Desiccation & Metering	858	3.31%	33.63%	6.70
3	Instrument Air & Inert Gas Generation	122	0.47%	4.80%	0.96
4	Fuel Gas	85	0.33%	3.34%	0.66
5	Spurious Trips	56	0.21%	2.18%	0.43
6	Cooling Medium	9	0.04%	0.36%	0.07
Total		2,551	9.84%	100.00%	19.92



LNG Regasification

The table below provides a summary of the performance of the LNG Regasification mode of operation.

Case	Demand (MMSCF)	Produced (MMSCF)	Shortfall (MMSCF)	Production Efficiency (%)	Average Hourly Production (MMSCFD)	Availability (%)	Shortfall (%)
Mean	630.0	628.0	2.04	99.68%	89.71	99.46%	0.32%

This demonstrates that:

- The mean 6.67-day LNG Regasification Efficiency against Demand is 99.68%: 628.0 MMSCF of LNG are vapourised against a Demand of 630 MMSCF;
- The mean average daily vaporisation rate over the 6.67-day period is 89.71 MMSCFD.

The table below shows the system contributors to regasification shortfall over the 7-day reviewed period.

Rank	System	LNG Regasification Shortfall		
		Absolute		Relative
		MMSCF	%	%
1	LNG Pumping and Vaporisation	24.7	3.92%	98.37%
2	Instrument Air & Inert Gas Generation	0.4	0.06%	1.63%
Total		25.1	3.98%	100.00%

Gas Compression

The table below provides a summary of the performance of the Gas Compression mode of operation.

Case	Availability (%)	Unavailability (%)
Mean	99.45%	0.55%

It is demonstrated that on average the Gas Compression system is fully operable for 99.45% of the required time, and not operable for 0.55% over the 4 winter months considered (intermittent operation).

The key equipment contributors to Gas Compression Unavailability over the 192-hour period considered are shown in the table and figure below.

Rank	Equipment	Gas Compression Unavailability	
		Absolute	Relative
		%	%
1	Solar Gas Turbine	0.28%	51.11%
2	Solar Gas Turbine Compressor	0.27%	48.60%
3	Gas Compressor Suction Scrubber - Scrubber	<0.01%	0.30%
Total		0.55%	100.00%



Sensitivity Analysis

A sensitivity analysis has been carried out to assess the performance impact of the following cases:

- Sensitivity Case 1: New Plant Data;
- Sensitivity Case 2: Plant Deterioration.

Sensitivity Case 1:

Liquefaction

The performance impact of installing new equipment was assessed against the Liquefaction mode of operation. The table below presents the overall results for Production Efficiency and Extra Days Required.

Metric	Gas Liquefaction	
	Base Case	New Plant
Production Efficiency (%)	90.16%	93.85%
Improvement (%)		+3.70%
Extra Days Required	19.9	11.9
Day Improvement		-8.0

Key observations:

- Replacing the existing plant (with new) is predicted to result in a Gas Liquefaction Production Efficiency of 93.85%, an improvement of 3.70% on the availability forecast of the current plant (90.16%);
- A new plant is predicted to require an additional 11.9 days operating to match the design production level over a 6-month period (8 days improvement on the current plant forecast).
- **LNG Regasification**

The performance impact of installing new equipment was assessed against the LNG Regasification mode of operation. The table below presents the overall results for Production Efficiency.

Metric	LNG Regasification	
	Base Case	New Plant
Production Efficiency (%)	99.68%	99.88%
Improvement (%)		+0.21%

Vaporisers were responsible for 69.54% of the Base Case shortfall, and are also responsible for the majority of the PE improvement from installing new plant. With reduced logistical delays associated with their repair, overall shortfall is significantly reduced, from 1.42 MMSCF to 0.11 MMSCF.

Gas Compression

No visible changes were observed in this Sensitivity Case, given the low running hours and the level of sparing of gas compression equipment. As such, results are not presented for this mode of operation.



Sensitivity Case 2:

- Liquefaction

The performance impact of current equipment pertaining to the Liquefaction mode of operation deteriorating at different rates was assessed. With a **5%** deterioration rate per year, Production Efficiency reduces from **90.16%** in the **Base Case** (current year) to **86.24% after 10 years**. In absolute terms, this means that the current **over-run** of the system to match the designed liquefaction rate will need to **increase from 19.9 days to 29.1 days**;

With a **15%** deterioration rate per year, Production Efficiency reduces from **90.16%** in the **Base Case** (current year) to **79.82% after 10 years**. In absolute terms, this means that the current **over-run** of the system to match the designed liquefaction rate will need to **increase from 19.9 days to 48.7 days**.

- LNG Regasification

The performance impact of current equipment pertaining to the LNG Regasification mode of operation deteriorating at different rates was assessed. With a **5%** deterioration rate per year, Production Efficiency reduces from **99.68%** in the **Base Case** (current year) to **99.37% after 10 years**;

With a **15%** deterioration rate per year, Production Efficiency reduces from **99.68%** in the **Base Case** (current year) to **98.53% after 10 years**.

- Gas Compression

The performance impact of current equipment pertaining to the Gas Compression mode of operation deteriorating at different rates was assessed. With a **5%** deterioration rate per year, Availability reduces from **99.45%** in the **Base Case** (current year) to **99.42% after 10 years**;

With a **10%** deterioration rate per year, Availability reduces from **99.45%** in the **Base Case** (current year) to **99.36% after 10 years**;

Therefore, the low running hours associated with this mode of operation, together with the level of sparing of this system result in good levels of resilience of this system against equipment deterioration.



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1 INTRODUCTION

The Enbridge Gas Inc. (Enbridge) Hagar peak shaving Liquefied Natural Gas (LNG) facility is located outside of Sudbury Ontario, Canada. Originally, it was designed by Air Liquide and built in 1968, with the first gas send-out taking place in 1969. As a peak shaving plant, its purpose is to ensure the reliability of natural gas supply to customers, shall conventional gas supply via pipeline fall below demand requirements due to prolonged cold weather conditions or due to disruptions in the upstream pipeline network. As such, natural gas feedstock is converted into liquid and stored in a cryogenic tank during off-peak summer and fall seasons and subsequently, LNG is vapourised back into natural gas during the winter season upon demand. In the event of full load demand, the capacity of the storage facility is able to supply the Sudbury market continuously for up to 6.67 days.

In order to support the reliability of the natural gas supply network, the Hagar facility has the following availability targets:

- Achieve a full nominal capacity of 610 MMcf (gas equivalent) of stored LNG by the 1st of December, each year
- Delivering a tank vaporization rate of up to 90 MMSCFD.

In addition to normal LNG management operations, a compressor station is also located within the peak shaving plant, responsible for re-compression of gas from the natural gas network.

Given that the majority of all critical components to the process are original, DNV have been asked to evaluate the condition of the Hagar facility through a Reliability, Availability, and Maintainability (RAM) study. The aim of the RAM study is to quantify the risks of operational reliability being affected in the future, which will be used to inform development of a long-term plan for the facility.

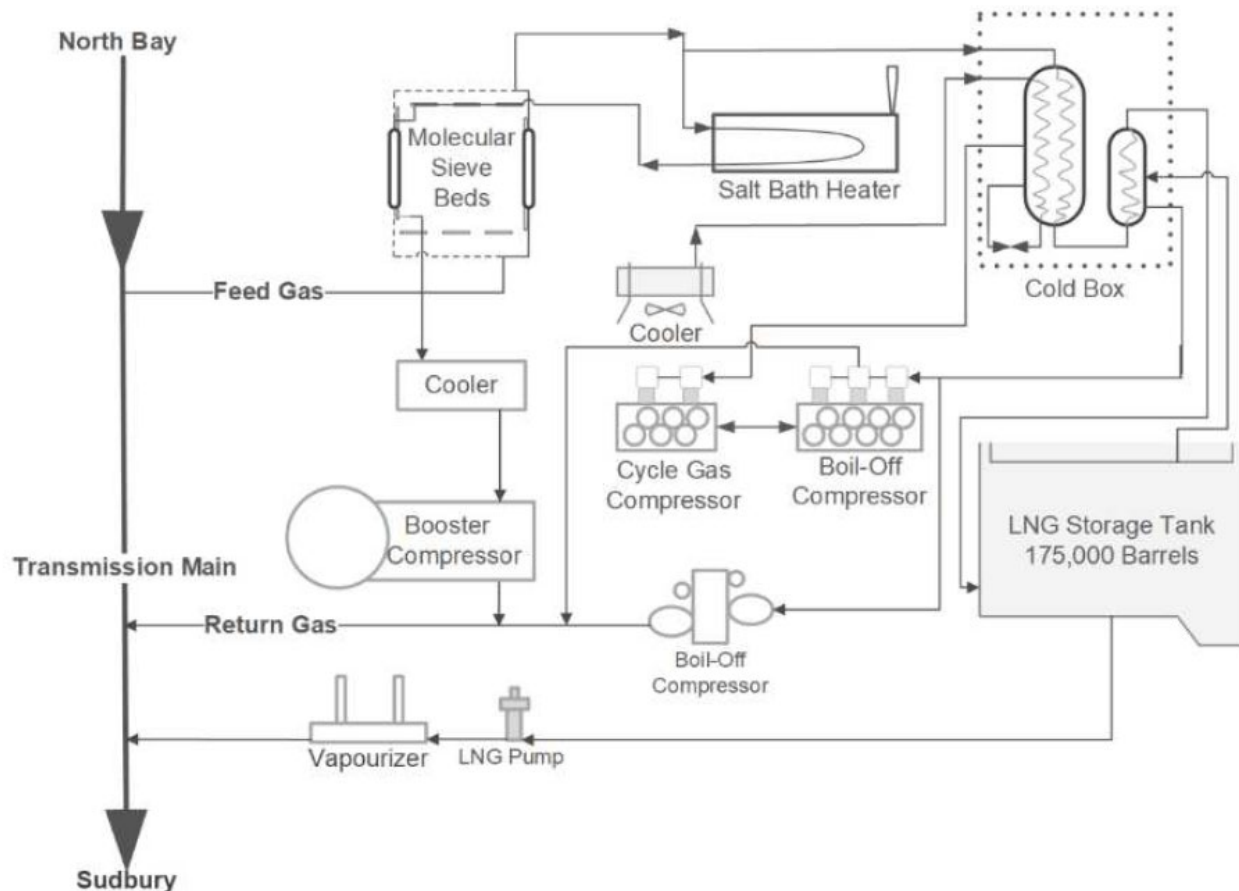


Figure 1.1 Process Diagram of LNG Management Operations



2 RAM DEFINITIONS / ABBREVIATIONS

Definitions and descriptions for abbreviations are summarized in the table below:

Table 2.1 Definitions

Terminology / Abbreviation	Definition / Description
BDV	Blowdown Valve
BOG	Boil-off Gas
Demand	The target level of liquefaction / regasification / compression from the facility (MMSCFD)
EM	Electric Motor
ESD	Emergency Shutdown
F&G	Fire & Gas Systems
HVAC	Heating Ventilation and Air Conditioning
ICSS	Integrated Control and Safety System
IEEE	Institute of Electrical and Electronics Engineers
KO	Knock Out
LNG	Liquefied Natural Gas
MMSCFD	Million Standard Cubic Feet per day
MTTF	Mean Time To Failure: Average time that an item will function before it fails (years)
MTTR	Mean Time To Repair: Average time taken to perform corrective maintenance on (or replacement of) a failed item - excludes any logistic delays or restart times - (hours)
OREDA	Offshore and Onshore Reliability Data
PM	Planned Maintenance
Production Efficiency	(Actual Gas Liquefied / LNG Vaporised) / (Potential Gas Liquefied / LNG Vaporised) *100%
PSV	Pressure Safety Valve
	Reliability: Probability of system/item non-failure in a given period
RAM	Availability: (Time all required equipment is available) / (Time)*100%
	Maintainability: Probability of repair in a given time
S&T	Shell & Tube (Heat Exchanger)
SDV	Shutdown Valve
Shortfall	Proportion or amount of demand not produced (% or MMSCFD)
Stb/d	Stock Tank Barrels per day (oil or water production rate)
TEG	Tri-ethylene Glycol
TEMPSC	Totally Enclosed Motor Propelled Survival Craft
Uptime	(Time non-zero liquefaction / regasification / compression) / (Time)*100%
XV	On / Off Valve



3 SCOPE OF WORK

3.1 Study Objectives

The key objectives of this scope of work are:

1. Forecast **Gas Liquefaction** and **LNG Regasification Production Efficiency**, with corresponding **Availability** and **Uptime** over a campaign period:

$$\text{Production Efficiency} = (\text{Actual Gas Liquefied} \mid \text{LNG Vaporised}) / (\text{Potential Gas Liquefied} \mid \text{LNG Vaporised}) * 100\%$$

$$\text{Availability (at Demand)} = (\text{Time all requirement equipment is available}) / (\text{time}) * 100\%$$

$$\text{Uptime (at any level)} = (\text{Time non-zero production is achieved}) / (\text{time}) * 100\%$$

2. Identify the main **Gas Liquefaction** and **LNG Regasification** Shortfall contributors ('bad actors') and itemise individual system and equipment contributions
3. Forecast **Availability (%)** and **Uptime (%)** of the **Gas Compression** mode of operation, including top contributors to **Unavailability** ('bad actors')
4. Identify any potential areas of performance improvement through consideration of defined sensitivity cases (e.g. installed spare equipment, increased insurance spares, reduced logistic delays).

3.2 Study Boundaries

The RAM study will consider all critical process and utility equipment, within the following boundaries:

System	Boundary Limits		Applicable Cases
	Upstream	Downstream	
LNG Plant	Feed to Feed Gas Filter	Feed to LNG Tank	Gas Liquefaction
LNG Plant	Feed to Cryogenic Pumps	Send-out to Transmission Main	LNG Regasification
Gas Compression Station	Feed to Gas Compressor Suction Scrubbers	Send-out to Transmission Main	Gas Compression

3.3 Case Definition

3.3.1 Main Cases

Given the seasonal nature of the LNG liquefaction and regasification campaigns, these operational activities will be considered in two separate models, each considering all systems critical to each operation. Additionally, a 'Gas Compression Station' model will be built in order to assess the performance of all equipment critical to Gas Compression as part of the gas network system. The outputs of the RAM Study Main Cases are detailed in Table 3.1.

Table 3.1 RAM Study Main Cases

Case	Outputs
Gas Liquefaction	<ul style="list-style-type: none"> Gas Liquefaction / LNG Regasification Production Efficiency Gas Liquefaction / LNG Regasification Availability and Uptime
LNG Regasification	<ul style="list-style-type: none"> Identification of main Production Shortfall contributors (at system and equipment level) Estimation of any potential additional days required to match the design production levels of each campaign
Gas Compression	<ul style="list-style-type: none"> Availability and Uptime Identification of main contributors to Unavailability (at system and equipment level)



3.3.2 Sensitivity Cases

Sensitivity Cases have been defined to assess the impact of certain design and operating assumptions on the performance of the various modes of operation at Hagar. The defined Sensitivity Cases are described below:

Case	Case Name	Description
1	New Plant Data	This Sensitivity Case will assess the replacement of the existing equipment across Hagar facilities with new equipment. It is estimated that the implementation of new equipment will lead to reductions in repair times and logistical delays associated with certain equipment failure modes, reflecting on improvements in the maintainability of equipment items and the improved availability of spare parts. The Reliability Data used in this Sensitivity Case is defined in Appendix B – New Plant Data
2	Plant Deterioration	This Sensitivity Case will assess the deterioration of the equipment at the Hagar facilities, thus evaluating the assumption that equipment is entering the wear-out phase of its life, given the age of the assets under review. At this stage, the determination of the exact rates of plant deterioration, which can vary across equipment items, is subject to a large level of uncertainty. As a result, the Sensitivity Cases will assess 3 deterioration rates for the Hagar facilities: 5%, 10% and 15%, applicable to all running failure modes of each equipment. Plant performance will be forecasted over a 10-year look-ahead period.

The above Sensitivity Cases will be assessed against all modes of operation, where applicable.



4 MODELLING ASSUMPTIONS

The following list details the basis and assumptions that have been considered for this RAM study, and are considered in more detail in the following sections:

- Review period: 1 year
- Primary product: LNG; gas send-out; compressed gas
- Production profiles: seasonal and daily production rates (Section 4.1)
- Liquefaction and Regasification design capacities:

Parameter	Capacity
LNG Storage Capacity	28,000 m ³ – LNG 0.6 Bcf – Gas
Gas Liquefaction Rate	5.89 m ³ /hr – LNG 3 MMSCFD – Gas
Shortest Possible Duration to Fill Storage	Approximately 200 days
Gas Product Send-out Rate (Vaporization Rate)	90 MMSCFD – Gas 106,188 Sm ³ /hr – Gas
Storage Provision Capacity at Full Product Send-out Rate	6.67 days

- Equipment criticality (Section 4.2)
 - List of critical systems and equipment
 - Equipment configuration and type
- Reliability data: whenever possible, asset specific data will be used. Industry standard data (e.g. OREDA) will be used whenever required to fill any data gaps (Section 4.4 and Appendix A)
- Project Availability targets for the LNG facility are as follows:
 - Full nominal capacity of 610 MMcf of stored LNG by the 1st of December, each year
 - Tank vaporization rate of up to 90 MMSCFD
- Maintenance and operations assumptions, for example, spares, logistic delays, maintenance crews (Section 4.5).

4.1 Profiles

This section details the different demand profiles that will be used in each Main Case, in order to assess the performance of the different operating modes of the Hagar LNG facility. The different demand profiles consider the typical campaign durations for Gas Liquefaction, LNG Regasification and Gas Compression, as provided by Enbridge. These are detailed in the sections below:

4.1.1 Gas Liquefaction

The operation of the Hagar facility has changed over the years. Historically, the Gas Liquefaction campaign consisted of filling the LNG tank from empty to a completely full level. However, in recent years, the LNG tank has not been completely emptied during the LNG Regasification period. As such, the Liquefaction campaign aims to re-fill the tank from the current level, typically from April to October. As a basis for the RAM model, the liquefaction system will operate continuously at a liquefaction rate of 5.89 m³/hr – LNG (3 MMSCFD of gas) for 6 months. The model will quantify the contributors to production shortfalls and predict the extra number of days that the plant would need to operate in order to match the ideal amount of gas liquified, if no production upsets took place during the campaign.



Major maintenance of Gas Liquefaction equipment typically takes place 'off-season', i.e. from November to March, therefore not having an impact on production. As a result, maintenance activities will not be considered in the Gas Liquefaction model.

4.1.2 LNG Regasification

Gas send-out usually occurs during December to April, and is dependent on market demand. In this RAM study, the LNG Regasification model will assume an extreme scenario, in which the full allowable provision of stored LNG is continuously required (6.67 days of storage). As a result, the model will consider a continuous operation of the LNG Regasification equipment, operating at a gas product send-out rate (vaporisation rate) of 90 MMSCFD until the allowable full provision of LNG is depleted (6.67 days).

4.1.3 Gas Compression

The demand profile for the Gas Compression model, depicting the operation of the facility's Gas Compression station is based on the worst-case scenario of running hours recorded since 2017, as provided by Enbridge, which totalled 188 hours. As a result, the demand profile for the Gas Compression model will be incorporated as follows:

- Gas Compression will be required for 4 months each year (Winter period)
- Specifically, in the 4 winter months, Gas Compression will be required 4 times each month for a duration of 12 hours, resulting in a total Gas Compression of 192 hours for the entire year (similar to the 188 hours registered in 2017)
- The model will estimate the Availability (time-based) of the system to compress gas when required, and quantify the contributors to loss of Availability.

4.2 Hagar Facility Systems and Equipment

The following facilities are considered within the scope of the RAM models:

- Process Systems
 - Gas Desiccation & Metering
 - LNG Liquefaction
 - LNG Storage
- Utility Systems
 - Cooling Medium
 - Fuel Gas
 - Instrument Air
 - Inert Gas
 - Diesel.

In addition to the facilities listed above, the model will also take consideration of any supporting systems whose failures may result in loss of production (e.g. ESD, Fire & Gas Systems).

4.2.1 Equipment Criticality Assessment

All facility systems and equipment that are critical to Liquefaction, Regasification and Gas Compression are listed in Table 4.1 to Table 4.3, respectively. For each equipment item, the following is presented:

- Equipment Tag number and description



- Configuration – equipment arrangement based on 100% requirement
- Impact – confirmation if loss of each equipment item is critical to Liquefaction / Regasification / Gas Compression Availability
- Equipment type and service to be included in the RAM models, linked to the associated Reliability Data detailed in Appendix A
- Comments that provide insight to the operation of each item.



4.2.1.1 Gas Liquefaction

The impact and configuration of all systems and equipment critical to the Gas Liquefaction operation is listed below:

Table 4.1 Gas Liquefaction Equipment Criticality

TAG NUMBER	NAME / EQUIPMENT	CONFIGURATION	CRITICAL	EQUIPMENT TYPE Service	COMMENTS	P&ID
Gas Desiccation & Metering						
-	Feed Gas Filter	1 x 100%	Y	Vessels – Separator <i>Clean Service</i>	Model 75H-1-FG336.	-
L-18 A/B	Molecular Sieve Beds	2 x 100%	Y	Vessels - Mol Sieve <i>Clean Service</i>	1 operating, 1 regenerating in a 2-hr cycle. Regeneration cycle comprises of 45 min of hot gas and 75 min of ambient temperature gas. L-18A Serial Number: 4710-311A. L-18B Serial Number: 4710-311B.	A444-00C
L-187	Dust Filter	1 x 100%	Y	Filters <i>Generic/Clean Service</i>	Burgess / Manning Company. Dust filter after passing through the sieve material.	A444-00C
L-188	Reactivation Salt Heater	1 x 100%	Y	See comments	Consist of a vessel, salt, heat exchanger tube bundles, burners and controls, operating at approximately 625 degrees F. Serial number: F141022.	A444-00C
L-184	Reactivation Gas Aftercooler	1 x 100%	Y	Exchanger – Air Cooler <i>Clean Service</i>	Cools gas from Molecular Sieve Beds before flowing into the Reactivation Gas Booster Compressor.	A444-00C
L-189	Reactivation Gas Booster Compressor	1 x 100%	Y	Compressor – Reciprocating (<i>Clean Service</i>), EM driven	Electrically driven, 30 HP Ingersoll Rand compressor, increases pressure of gas prior to being routed back to Sudbury lateral.	A444-00C
-	Reactivation Gas Meter	1 x 100%	N	Meter – Orifice Plate	Considered non-critical given the lack of credible failure modes.	A444-00I
Gas Liquefaction						
L-2 / L-3 / L-4 / L-5 A/B / L-6 / L-7 / L-8 / L9 – L-21 / L-36 / L-42	Cold Box	1 x 100%	Y	Cold Box <i>Cryogenic Service</i>	Consists of a series of 9 heat exchangers, multiple receivers and expansion valves as part of an Auto Refrigerated Cascade (ARC) system. Modelled as part of the Cold Box package	A444-00D
L-100	Main Cycle Compressor (KVGR)	1 x 100%	Y	Compressors – Reciprocating (<i>Clean Service</i>), Gas Engine	1,500 HP Ingersoll Rand compressor (2-stage), driven by 4-cycle gas engine. Engine Serial Number: 412FKP357.	A444-00G
L-20	1 st Stage KVGR Suction Drum	1 x 100%	Y	Vessels – Separator <i>Clean Service</i>	Collects liquid from the Cold Box.	A444-00C
L-116	2 nd Stage KVGR Suction Drum	1 x 100%	Y	Vessels – Separator <i>Clean Service</i>	Separates any condensed liquid from the 1 st stage discharge after the KVGR Inter-Stage Cooler.	A444-00C



TAG NUMBER	NAME / EQUIPMENT	CONFIGURATION	CRITICAL	EQUIPMENT TYPE <i>Service</i>	COMMENTS	P&ID
L-151	Sundyne Pump	1 x 100%	Y See Comments	Pump – Centrifugal, EM driven (<i>Condensate Processing</i>)	Partial impact of 80% on liquefaction operation upon failure. Pumps liquid from the 2 nd Stage KVGR Suction Drum. Pump Model Number: LMV-322. General Electric Motor Serial Number: 1405-322.	-
L-126	KVGR Discharge Drum	1 x 100%	Y	Vessels – Separator <i>Clean Service</i>	Separates any condensed liquid from the 2 nd stage discharge after the KVGR Inter-Stage Cooler and liquid from the Sundyne Pump.	A444-00C
L-114 / L-124	KVGR Inter-stage Cooler	See Comments	Y See Comments	Exchangers – Air Cooler <i>Clean Service</i>	L-124 for 1 st stage cooling, L-114 for 2 nd stage cooling in series. Impact on liquefaction operation dependant on failure mode: in the event of a minor or intermediate failure of one of the cooling stages, provided that the remaining stage is fully operable, liquefaction can resume at 50% of design capacity.	A444-00C
CW101	KVGR Engine Oil Cooler	1 x 100%	Y	Heat Exchanger – Shell & Tube <i>Generic Service</i>	Oil cooler cooled by cooling water.	-
902 Filter	Boil-off Gas Compressor Pre-Filter	1 x 100%	Y See Comments	Filter / Screen <i>Generic/Clean Service</i>	Partial impact of 90% on liquefaction operation upon failure, with the remaining 10% being covered by the Ariel BOG Compressor. Currently it is only used during the liquefaction campaign.	A444-00G
L-200	Boil-off Gas Compressor (JVG)	1 x 100%	Y See Comments	Compressors – Reciprocating (<i>Clean Service</i>), Gas Engine	Partial impact of 90% on liquefaction operation upon failure, with the remaining 10% being covered by the Ariel BOG Compressor. 240 HP Ingersoll Rand compressor (3-stage), driven by 4-cycle gas engine. Operated 24/7 until 2014. Currently it is only used during the liquefaction campaign.	A444-00G
L-214	Boil-off Gas Aftercooler	1 x 100%	Y	Exchanger – Air Cooler <i>Clean Service</i>	Partial impact of 90% on liquefaction operation upon failure, with the remaining 10% being covered by the Ariel BOG Compressor. Currently it is only used during the liquefaction campaign. Provides cooling after each compression stage of JVG Compressor. Air Cooled Exchanger from Happy Company. Model Number: 1F 0708 1060 MHV.	A444-00G



TAG NUMBER	NAME / EQUIPMENT	CONFIGURATION	CRITICAL	EQUIPMENT TYPE <i>Service</i>	COMMENTS	P&ID
Ariel	Ariel Boil-off Gas Compressor	1 x 100%	Y See Comments	Compressors – Reciprocating (<i>Clean Service</i>), EM driven	Partial impact of 10% on liquefaction operation upon failure, with the remaining 90% being covered by the JVG Compressor. Currently it is only used during the liquefaction campaign. Compressor Model JGA/4, driven by a 125 HP electric motor.	-
Ariel	Ariel BOG Cooler	1 x 100%	Y See Comments	Exchanger – Air Cooler <i>Clean Service</i>	Partial impact of 10% on liquefaction operation upon failure, with the remaining 90% being covered by the JVG Compressor. Currently it is only used during the liquefaction campaign.	-
CW201	JVG Oil Cooler	1 x 100%	Y	Heat Exchanger – Shell & Tube <i>Generic Service</i>	Oil cooler cooled by cooling water. Partial impact of 90% on liquefaction operation upon failure, with the remaining 10% being covered by the Ariel BOG Compressor.	-
<i>Make-up and Cycle Gas Storage Heavies Tank Farm</i>						
L-10	-	1 x 100%	N	Vessel	Considered non-critical. Used for storing heavier cycle mix after liquefaction run.	A444-00E
L-13	-	1 x 100%	N	Pump, EM-driven	Intermittent use, considered non-critical. 3 HP pump used to transfer butane and pentane (part of the refrigerant cycle mix) from storage to Cold Box	A444-00E
L-14	Propane Pump	1 x 100%	N	Pump, EM-driven	Intermittent use, considered non-critical. 3 HP pump used to transfer propane (part of the refrigerant cycle mix) from storage to Cold Box when tank pressure is below 80 psi.	A444-00E
L-103	Butane Tank	1 x 100%	N	Vessel – Storage Tank	Intermittent use, considered non-critical. Bulk storage of butane for cycle mix.	A444-00E
L-104	Pentane Tank	1 x 100%	N	Vessel – Storage Tank	Intermittent use, considered non-critical. Bulk storage of pentane for cycle mix.	A444-00E
L-107	Propane Tank	1 x 100%	N	Vessel – Storage Tank	Intermittent use, considered non-critical. Bulk storage of propane for cycle mix.	-
<i>Instrument Air & Inert Gas Generation</i>						
301 / 301A	Instrument Air Compressor	2 x 100%	Y	Compressors – Screw, EM-driven <i>Generic Service</i>	Model Number: VS20A. Operating Pressure: 100 psi. IA #1 Serial Number: S315051. IA #2 Serial Number: S315050.	A444-00F
L-304	Instrument Air Dryer	2 x 100%	Y	Vessel – Mol Sieve <i>Clean Service</i>	1 operating, 1 regenerating (duty-regen cycle)	A444-00F



TAG NUMBER	NAME / EQUIPMENT	CONFIGURATION	CRITICAL	EQUIPMENT TYPE <i>Service</i>	COMMENTS	P&ID
L-305	Dust Filter	1 x 100%	N	Filter	Considered non-critical. Dust filter after air dryer, can be bypassed.	A444-00F
L-500	Starting Air	See Comments	N	Compressor	Intermittent use, considered non-critical. Starting air compressor providing 220 psi air pressure for start-up of both JVG and KVGR compressors. 2 x 7.5HP motors. #1 operates between 215 to 240 psig. #2 operates between 205 to 230 psig.	-
L-303	Instrument Air Receiver	1 x 100%	Y	Vessel – Surge Drum <i>Clean Service</i>	Considered critical for safety reasons, although does not provide back-up during normal operation.	-
L-350	Nitrogen Generator Package	1 x 100%	Y	Nitrogen Generation Package	Considered immediately critical. Provides nitrogen purges for pipe duct, Cold Box, for pressurization of the first stage packing on JVG and Ariel Compressors, as well as purging out activities.	A444-00F
-	Nitrogen Receiver	1 x 100%	Y	Vessel – Surge Drum <i>Clean Service</i>	Considered critical for safety reasons, although does not provide back-up during normal operation.	A444-00K
<i>Fuel Gas</i>						
-	Fuel Gas Filter	1 x 100%	Y	Filter <i>Normal/Clean Service</i>	JVG and KVGR Fuel Gas filter. Supplied by Peerless MFG Co. Serial Number: D-691.	A444-00B
-	KVGR Fuel Gas Meter	1 x 100%	Y	Flowmeter	Model Number: R.M. 11000 T.C. Serial Number: 045631.	A444-00B
-	JVG Fuel Gas Meter	1 x 100%	Y	Flowmeter	Model Number: R.M. 3000 T.C. Serial Number: 830250-31s.	A444-00B
-	KVGR Gas Surge Drum	1 x 100%	Y	Vessels – Surge Drum <i>Clean Service</i>	-	A444-00B
-	JVG Gas Surge Drum	1 x 100%	Y	Vessels – Surge Drum <i>Clean Service</i>	-	A444-00B
<i>Diesel</i>						
-	Diesel Back-up Generators	See Comments	Y	Diesel Powered Generators	Provide back-up to Fuel Gas System to maintain normal operations. The model will assume that a 2 x 100% configuration during the liquefaction campaign, 2 CAT 650 HP diesel generators. Generator Model Number: 2671232. Generator 1 Serial Number: MJE00178. Generator 2 Serial Number: MJE00180.	-



TAG NUMBER	NAME / EQUIPMENT	CONFIGURATION	CRITICAL	EQUIPMENT TYPE <i>Service</i>	COMMENTS	P&ID
Cooling Medium						
CW103	Cooling Water Tower	See Comments	Y	Air Cooler <i>Clean Service</i>	Two cooling towers (to be modelled as two in series), each supporting the compressor and engine closed loop systems, respectively. A failure in either of the towers results in a full operational shutdown.	A444-00A
CW104 / 105	Cooling Water Fan South / North	See Comments	Y	Air Cooler <i>Clean Service</i>	The cooling water cooler has two sections (to be modelled as two in series) – CW104 provides cooling to JVG's and KVGR's engines; CW105 provides cooling to JVG and KVGR compressors and respective oil coolers and the sundyne pump. A failure in either of the coolers results in a full operational shutdown.	A444-00A
CW107 / 701-1	Compressor Side CW Pump	2 x 100%	Y	Centrifugal Pump, EM driven <i>Generic Service</i>	-	-

4.2.1.2 LNG Regasification

The impact and configuration of all systems and equipment critical to the LNG Regasification operation is listed below:

Table 4.2 LNG Regasification Equipment Criticality

TAG NUMBER	NAME / EQUIPMENT	CONFIGURATION	CRITICAL	EQUIPMENT TYPE	COMMENTS	P&ID
LNG Pumping and Vaporisation						
L-87	LNG Tank	1 x 100%	N	Vessels – Cryogenic Tank	No credible failures assumed in the models	A444-00K
L-51 A/B/C	Cryogenic Pumps	3 x 50%	Y	LNG Pump	Two pumps required to provide maximum send-out rate. 3 x 350 HP submerged pumps (960 psig – 15 stage), electrically driven (Westinghouse Motor 1, General Electric Motor 2)	A444-00K
L-52 A/B/C	Vaporisers	3 x 50%	Y	Vaporisers	Three vaporizers operated during normal operations. However, peak delivery can be achieved by two Vaporisers. 3 x Trican Model 46-4S submerged type vaporizers, water-based, warmed by hot combustion gases from gas burners	A444-00J
Instrument Air & Inert Gas Generation						



TAG NUMBER	NAME / EQUIPMENT	CONFIGURATION	CRITICAL	EQUIPMENT TYPE	COMMENTS	P&ID
301 / 301A	Instrument Air Compressor	2 x 100%	Y	Compressors – Screw <i>Generic Service</i>	Model Number: VS20A. Operating Pressure: 100 psi. IA #1 Serial Number: S315051. IA #2 Serial Number: S315050.	A444-00F
L-304	Instrument Air Dryer	2 x 100%	Y	Vessel – Mol Sieve <i>Clean Service</i>	1 operating, 1 regenerating (duty-regen cycle)	A444-00F
L-305	Dust Filter	1 x 100%	N	Filter	Considered non-critical. Dust filter after air dryer, can be bypassed.	A444-00F
L-500	Starting Air	See Comments	N	Compressor	Intermittent use, considered non-critical. Starting air compressor providing 220 psi air pressure for start-up of both JVGR and KVGR compressors. 2 x 7.5HP motors. #1 operates between 215 to 240 psig. #2 operates between 205 to 230 psig.	-
L-303	Instrument Air Receiver	1 x 100%	Y	Vessel – Surge Drum <i>Clean Service</i>	Considered critical for safety reasons, although does not provide back-up during normal operation.	-
L-350	Nitrogen Generator Package	1 x 100%	N	Nitrogen Generation Package	Considered non-critical during LNG regasification operation.	A444-00F
-	Nitrogen Receiver	1 x 100%	N	Vessel – Surge Drum	Considered non-critical during LNG regasification operation.	A444-00K
Fuel Gas						
-	Fuel Gas Meter	1 x 100%	N	Flowmeter	Can be bypassed, not considered critical.	A444-00I
-	Instrumentation Control	-	N	-	Considered as non-critical.	-
Diesel						



TAG NUMBER	NAME / EQUIPMENT	CONFIGURATION	CRITICAL	EQUIPMENT TYPE	COMMENTS	P&ID
-	Diesel Back-up Generators	See Comments	N	Diesel Powered Generators	Electricity generated from hydropower sources is used as primary energy source for this mode of operation. The Diesel Back-up Generators provide back-up in the event of any power disruption to maintain normal operations. When required, these operate in a 2 x 50% configuration during the vaporization campaign. However, due to the low probability of power disruptions, these will be considered non-critical in this model. 2 CAT 650 HP diesel generators. Generator Model Number: 2671232. Generator 1 Serial Number: MJE00178. Generator 2 Serial Number: MJE00180.	-
Gas Send-out Metering						
-	Send-out Gas Meter	1 x 100%	N	Flowmeter – Orifice Plate	Considered non-critical given the lack of credible failure modes	-

4.2.1.3 Gas Compression

The impact and configuration of all systems and equipment critical to the Gas Compression operation is listed below:

Table 4.3 Gas Compression Equipment Criticality

TAG NUMBER	NAME / EQUIPMENT	CONFIGURATION	CRITICAL	EQUIPMENT TYPE	COMMENTS	P&ID
Gas Compression						
-	Gas Compressor Suction Scrubber	2 x 100%	Y	Vessels – Scrubber <i>Clean Service</i>	Trained with Solar Gas Turbine Compressors.	A444-00H
-	Solar Gas Turbine Compressor	2 x 100%	Y	Compressors – Centrifugal, Gas Turbine driven (Industrial) <i>Generic Service</i>	2 x 1,100 HP units, each driven by a gas turbine.	A444-00H
Fuel Gas & Metering						
-	Fuel Gas Filter	1 x 100%	N	Filter	Can be bypassed Model Number: 3AGB-162-175-4A1 Serial Number: 973	A444-00H
-	Fuel Gas Meter	1 x 100%	N	Flowmeter	Can be by-passed	A444-00H



4.2.2 Integrated Control and Safety System (ICSS)

The Integrated Control and Safety System (ICSS) will be included in the RAM study by adding an element that represents the frequency and duration of spurious trips. At this stage, the modelling of individual trip events for input devices and fire and gas detectors is not appropriate. Instead, a generic spurious trip element for the Control, ESD and F&G systems will be used.

The following spurious trip frequency is assumed for each mode of operation, with a respective reset time:

- Control / ESD / F&G spurious trips: 1 trip per calendar year lasting 4 hours.

It is assumed that testing of ESD and F&G systems is performed upon opportunity. These tests do not cause any production/injection shortfalls.

4.3 Model Indenture

RAM models will be developed at the equipment level (e.g. vessel, heat exchanger). Failure modes for all equipment critical to plant operability will be defined and considered in the modelling (as detailed in Section 4.2.1). Non-production critical systems and utilities will be excluded.

Typically, not all valves are modelled in detail during RAM analysis. The following approach will be used in this analysis:

- XVs, SDVs, BDVs and Control valves: valves that are production critical will be included in the model. When valves are inside the normal equipment boundaries with respect to reliability data collection it is not required to consider them separately. However, if critical valves are found outside equipment boundaries, they will be listed and modelled.
- PSVs: If a PSV is provided in a N+1 configuration (typically the case), it will not be considered as critical. For non-spared PSVs, only 'fail to open on demand' failure mode will be included. PSV passing (spurious opening) will be considered as part of the spurious trip events.

4.4 Reliability Data

A review of historical reliability data was carried out on the Hagar facility in collaboration with Enbridge. This included the following activities:

- Detailed review of Computerized Maintenance Management System (CMMS) records
- Operating experience.

Where appropriate, historical asset data was used for selected equipment items. A summary of the reliability data proposed for this analysis is provided in Appendix A. The basis for the reliability data selection is discussed in the following sections.

4.4.1 Data Sources

The sources for reliability data proposed to be used for this analysis are the following:

1. Asset data based on historical operating performance (e.g. CMMS) and Enbridge's operating experience
2. OREDA:
 - a. 2015 handbook 6th edition – Volume 1 Topsides equipment
 - b. 2009 handbook 5th edition – Volume 1 Topsides equipment
 - c. Previous editions of OREDA handbook as required
3. IEEE Gold Book, 1998 – specifically for electrical equipment / components



4. DNV In-house Data – derived from operational experience and manufacturer's data from previous studies. Please note that these data sets are typically confidential and can only be used in anonymised format.

4.4.2 OREDA Handbooks

OREDA data is based on failure data supplied by a number of major United Kingdom (UK) -based offshore operators. A new edition of the handbook (OREDA 2015) was issued in 2016 and has been used, when appropriate, for sourcing OREDA failure data for this analysis. For certain equipment categories, OREDA 2009 data will be used as it is deemed more relevant for this application.

For each of the included equipment items / failure modes the following data has been collated:

- Total number of failures
- Population
- Calendar / operational time during which failures were recorded
- Average repair times per failure mode.

Using this data, the Mean Time To Failure (MTTF) and Mean Time To Repair (MTTR) for each equipment item / failure mode can be determined. Exponential distributions will be used in the model to represent the possible spread of data around both the MTTF and MTTR.

Failure rates are calculated from OREDA based on Operational Time (rather than Calendar Time) and assume the failure rate function is random and independent of time. The failure data does not reflect the burn-in or wear-out characteristics of equipment. It is assumed that the correct preventative maintenance is carried out and the equipment will be fit for purpose. MTTR represents the average time required to repair and return an item to a state where it is ready to resume its functions, assuming all manpower, spares are immediately available.

The OREDA project is restricted to gathering data on hardware components and systems, and unavailability of systems due to human error is generally not included. For this reason, human error is excluded from this RAM analysis.

The indenture level of the OREDA data is categorised into critical, degraded, incipient and unknown equipment failure modes:

- **Critical failure:** A failure which causes immediate and complete loss of a system's capability of providing its output.
- **Degraded failure:** A failure which is not critical, but which prevents the system from providing its output within specifications. Such a failure would usually, but not necessarily, be gradual or partial, and may develop into a critical failure in time.
- **Incipient failure:** A failure which does not immediately cause loss of a system's capability of providing its output, but which, if not attended to, could result in a critical or degraded failure in the near future.
- **Unknown failure:** Failure severity was not recorded or could not be detected.

4.4.3 Use of OREDA Data

4.4.3.1 Included Failure Modes

For the purpose of this study, only critical failure modes will be considered. The failure data used in this study is rationalised by considering that if good maintenance practices are carried out (inspections / condition monitoring), then repairs for degraded, incipient and unknown type failure modes can be delayed until the next opportune moment in order to prevent impact on production. Hence, these failure modes will not normally result in additional unavailability, and these failure modes are therefore not included in the availability model.



4.4.3.2 Minimum Operating Hours

Whenever possible, DNV ensure that, when using data from OREDA, the data is representative of a large enough sample of equipment and collected over a significant number of operational hours. As a guideline, the following minimum values are considered to be sufficient:

- Minimum population of 10
- Minimum number of operational hours ~200,000.

The minimum population and the minimum number of operating hours are thresholds used for guidelines based on review and experience of OREDA records (the confidence level on the data is a function of many other factors). In most cases, the data used has been derived from data sources with population and operating hours well above the guideline thresholds indicated.

4.4.3.3 Mean Time to Repair

When using OREDA data, MTTR can be estimated by using the active repair hours provided in the handbook. When active repair hours are not available, the mean repair man-hours can be used to estimate active repair hours. These mean repair man-hours will be divided by two using the assumption that maintenance will be performed by two people.

When using OREDA data MTTR can be estimated by using the active repair hours provided in the handbook. When active repair hours are not available, the mean repair man-hours can be used to estimate active repair hours. These mean repair man-hours will be divided by two using the assumption that maintenance will be performed by two people.

One limit of MTTRs estimated in this way is that they are constant and do not give an indication of the range of repair times that should be expected. This can have a significant impact on the overall performance of the facilities if restart times are modelled as a function of the duration of the outage. Also, OREDA points out that “it is highly recommended to use some kind of expert judgement in addition to the values given in the handbook” for the active repair times.

For these reasons, in this study the following methodology is used to estimate the MTTR when adopting OREDA data:

- OREDA tabulates for each equipment type a breakdown of the incurred failures by maintainable item (e.g. for a pump: instrumentation, seals, bearings, casing)
- A high-level review was carried out per equipment type to allocate each maintainable item to a failure category
- For example for a Shell and Tube exchanger, the following maintainable items were associated with ‘major’ repair: tubes, body / shell, piping
- The percentage breakdown was then used to associate a separate repair time for each category of failure. This was done based on expert judgment. In most of the cases it has been ensured that the overall annual downtime for the equipment is comparable (within a factor of 2) with the annual downtime calculated using OREDA constant active repair time.

An example of this approach for centrifugal pumps is illustrated below:

Example: Centrifugal Pumps

Breakdown of all pump failures by maintainable item:

Table 4.4 Breakdown of all Pump Failures by Maintainable Item

Maintainable Item	% of Failures	Category	S&B	Min	Maj	Sum
Actuating device	0.69	Minor		0.69		
Radial bearing	0.21	S&B	0.21	-	-	
Thrust bearing	1.13	S&B	1.13	-	-	
Casing	0.43	Major	-	-	0.43	
Shaft	0.28	Major	-	-	0.28	
Impeller	0.78	Major	-	-	0.78	
Gearbox	0.96	Major	-	-	0.96	
Seals	12.22	S&B	12.22	-	-	



Maintainable Item	% of Failures	Category	S&B	Min	Maj	Sum
Bearing	0.16	S&B	0.16	-	-	
Unknown	22.31	-	-	-	-	
Remaining	60.83	Min	-	60.83	-	
Total	100.00		13.72	61.52	2.45	77.69
As % of not 'unknown'			17.7%	79.2%	3.2%	100%

Identified repair categories:

Table 4.5 Identified Repair Categories for Pumps

Failure Category	% of Failures
Seals & Bearings	18%
Minor other repairs	79%
Major repairs	3%
Total	100%

Resulting reliability and repair data:

Table 4.6 Reliability and Repair Data for Pumps

Type	Service	MTTF (yrs)	Repair Category	MTTF for repair category	Repair Time (hrs)		Source		Comment
					Min	Max	MTTF	Repair Time	
Pump - Centrifugal	Condensate Processing	0.47	Seals & Bearings	2.6	2.0	6.0	Oreda 2009	Expert Judgement	To be used for the NGL and condensate services, absorber bottom pumps.
			Minor other repairs	0.6	2.0	6.0			
			Major repairs	15.8	24.0	72.0			
	Generic Service	1.03	Seals & Bearings	5.7	8.0	22.0	Oreda 2009	Expert Judgement	To be used for the centrifugal pumps except for the condensate services, for example: LPG services, heating medium, wash water, demin water, amine pumps, flare pumps, cooling medium, reflux pumps, etc.
			Minor other repairs	1.3	8.0	22.0			
			Major repairs	34.2	48.0	120.0			

4.4.3.4 Fail to Start

Fail to start on demand events are generally included in the OREDA critical failures, although not always the case. With regard to the compressors in the Gas Compression model, fail to start on demand events, although low in likelihood, can have a significant impact on the ability for this operating mode to operate when required, given the inherent intermittency nature of this mode of operation. As such, based on previous experience on gas compression stations, DNV proposes the addition of a 7% fail to start probability event to the critical failures (see Appendix A) assigned to Centrifugal Compressors.

As in the case of critical failures, minimum & maximum repair times and mobilisation delays are associated with a fail to start on demand event. For the purpose of this RAM study, the assumed times defined for these parameters are based on a weighted average calculation using the breakdown of repair categories as reference, as shown below:

Table 4.7 Calculation of Repair Times and Mobilisation Delay of Fail to Start on Demand Failures for Centrifugal Compressors

Failure Category	% of Failures	Repair Time (hours)		Mobilisation Delay (hours)
		Min	Max	
Instr./Minor	51.0%	4.0	4.0	2.0 (Minor)
Seals & Bearings	9.0%	24.0	48.0	2.0 (Minor)
Intermediate Repairs	37.0%	24.0	48.0	48.0 (Major)



Failure Category	% of Failures	Repair Time (hours)		Mobilisation Delay (hours)
		Min	Max	
Major Repairs	3%	240.0	720.0	120.0 (Specialist Crew)
Weighted Average	-	20.28	45.72	22.56

4.4.3.5 Common Mode Failures

The availability of a redundant unit is typically only marginally degraded by common mode failures. Therefore, these will not be included in this RAM analysis.

4.4.4 Reliability Data Selection

For equipment items used in an offshore environment, DNV would normally recommend use of the OREDA data handbooks. DNV have previously done some benchmarking on the expected impact of static equipment failures (exchangers and vessels / drums) on the processes similar to LNG services. DNV has found that OREDA failure rates (approximate average MTTF = 5 years for a pressure vessel and 13 years for a Shell & Tube exchanger) are too conservative for clean gas / processing service.

For onshore LNG and petrochemical plants, DNV normally uses an alternative data set for static equipment items, to reflect actual experience in the downstream industry. The MTTF for critical failures for pressure vessels is in the order of 15-25 years and the MTTF for S&T exchangers is in the order of 20-40 years. This is significantly more reliable than the OREDA failure data. This would only reflect critical failures, requiring actual immediate shut down of the process. In addition, there still would be degraded / incipient type failures which would be repaired / addressed during plant turnarounds. DNV have applied these numbers on a range of onshore production assets (LNG / refinery / petrochemical) and in general arrived at performance figures for static equipment items in line with historical data. Obviously, there are always exceptions with specific equipment items linked to service / condition but the above MTTF figures would reflect 'generic' performance.

The following approach is used for equipment types in clean service for this study:

- Use of generic MTTF from OREDA data calculated based on operating hours
- Multiply the OREDA MTTF values by a **factor 2.5**
- Breakdown of generic MTTF into minor / intermediate / major failure modes, or similar, based on Identified Repair Category information present in OREDA for each Equipment item (as seen in Section 4.4.3.1)
- Use the repair duration as per expert judgement, including received input from Enbridge
- Use of mobilisation delay as per expert judgement, including received input from Enbridge.

A similar procedure was taken with regard to equipment types in generic or condensate service, with the exclusion of the 2.5 multiplication factor.

As a result, the reliability data used in this study, which also includes non-generic and LNG-specific equipment is detailed in Appendix A. In addition to MTTF and repair time information associated with each equipment type, Appendix A also includes information of any additional time required for mobilisation / logistical delays, whose methodology is described in the following section.

Lastly, the link between the reliability data selected and each equipment item in the Hagar facility is shown in the Equipment Criticality Tables (please refer to the Equipment Type / Service column in Sections 4.2.1.1 - 4.2.1.3).

4.5 Maintenance, Inspections and Operations Assumptions

4.5.1 Planned Maintenance & Inspections

In this study, with regard to modes of operation (Gas Liquefaction, LNG Regasification and Gas Compression), the RAM models will assume that any planned maintenance and inspection activities on the plant's equipment will take place during



the period of the year where these systems are not operating, therefore not incurring any operational disruption and as a result, will not be included in the models. The following details the periods when these non-production periods take place:

- Gas Liquefaction mode: from November until March (starting date dependant on duration of liquefaction campaign)
- LNG Regasification mode: from May until November
- Gas Compression: from May until September.

4.5.2 Maintenance Crews, Mobilisation and Logistic Times / Delays

In this RAM study, maintenance crews will be assumed as available at all times. This means that during planned and unplanned activities and/or a simultaneous occurrence, it will be assumed that no shortfall will arise due to maintenance crew constraints to attend to the required activities. This assumption may be subsequently analyzed as a separate sensitivity case.

In addition to the active repair time associated with a given equipment failure (please refer to Mean Time to Repair column in Appendix A), additional mobilisation / logistical time might be required, subject to the type of repair needed, as described below:

- Time to Locate & Diagnose the Failure and Work Preparation: maintenance time during which fault location, fault diagnosis and work preparation takes place. For all repairs with a 'Minor' Mobilisation Delay Category (please refer to the Mobilisation Delay column in Appendix A), a delay equal to 2 hours will be assumed. As discussed above, this assumption may be subject of a sensitivity case.

For 'Major' and 'Specialist Crew' Mobilisation Delay Categories, any delay associated with Time to Locate & Diagnose the Failure and Work Preparation is included in the delay associated with Time to Acquire Resources / Spare Parts (see next bullet).

- Time to Acquire Resources / Spare Parts: accumulated time during which a maintenance action cannot be performed due to the necessity of acquiring maintenance resources due to, for example, pending arrival of spare parts, non-standard tools, specialists, test equipment and / or technical information. With regard to the different Mobilisation Delay Categories (refer to Appendix A), unless stated otherwise, the following delays are applicable:
 - Minor: 0 hours (delay for this category already considered as part of the Time to Locate & Diagnose the Failure and Work Preparation)
 - Major: 48 hours
 - Specialist Crew: 120 hours – some complex equipment (e.g. major rotating equipment) may need special expertise such as vendor specialists who require additional time for major repair mobilisation.
- Time to Take the Item out of Service (TOST): the accumulated time necessary to perform auxiliary technical actions associated with the maintenance action itself, including time required for insulation removal, scaffolding preparation, and warm up & drying time before any intervention to equipment working in cryogenic service. In this study, it is assumed that a 24-48 hour TOST is required for intervention in any equipment in the cryogenic service, namely for the Cold Box and Cryogenic Pumps. As a result, TOST will mostly be applicable in lieu of 'Minor' Mobilisation Delays (2 hours). For failure modes requiring longer duration mobilisation delays, it is assumed that these take place simultaneously.

4.5.3 Ramp-Down, Restart Times & Ramp-Up

It is assumed that failure of an equipment item will lead to an immediate ramp-down in production from the equipment in question and that, if the case, automatic and immediate switch-over will occur to the installed spared equipment unit (with no loss in production).



In the event of a unique equipment failing (i.e. with no installed spared capacity), there will be one full shutdown, which may require time for restarting and ramping-up of production once the affected item is repaired. These are defined as follows:

- Restart delays or Bring the Item Back into Service (BIST): delays associated with getting the process systems back online. During this period the production rate will still be zero. Generally, this is due to process cooling requirements. Required duration times for process cooling are specified below.
- Process ramp-up: the duration for the process to ramp-up to normal production rates. This process can be in the form of a linear or non-linear increase in production from zero until normal production rate is achieved.

The restart delay and ramp-up duration may be conditional upon the shutdown duration. For the purpose of this RAM analysis, the following set of restart and ramp-up assumptions are to be used:

- » 6-hour linear ramp-up for short duration shutdowns (≤ 4 hours)
- » 24-hour linear ramp-up for intermediate duration shutdowns ($4 \text{ hours} < \text{shutdown} < 48 \text{ hours}$)
- » 72-hour ramp-up for long duration shutdowns ($\geq 48 \text{ hours}$), with the following production levels achieved:
 - 75% of design production rate achieved within first 36 hours (linear increase)
 - Increase to 100% production rate achieved in the remaining 36 hours (linear increase).

The aforementioned ramp-up durations are only applicable to the Liquefaction operation mode. In the LNG Regasification and Gas Compression models, it will be assumed that 100% production rate is achieved instantly when required.

4.5.4 Bypass Operations

During outages of equipment items, it is normally assumed that, unless there is a back-up redundant unit available, the associated system needs to be shut down and the process will be affected accordingly.

Unless otherwise indicated, this is the default assumption for the RAM analysis. However, there are a number of potential mitigation options, such as by-pass operations, which are considered during certain equipment outages, which prevent or reduce the impact on the production.

Any specific equipment items that could be bypassed during failure (and / or require partial turndown) are indicated in Section 4.2.1.



5 RESULTS

In Sections 5.1 and 5.2 results are presented for the individually modelled Gas Liquefaction and LNG Regasification cases, respectively. Section 5.3 reports on the results for the model that assesses the contribution of critical items towards the Unavailability of the Gas Compression system.

5.1 Gas Liquefaction

This section presents the results of the Gas Liquefaction case, which assesses the Production Efficiency in terms of gas liquefied into the LNG Tank over a 6-month period.

5.1.1 Production Efficiency

Table 5.1 presents the overall results for Gas Liquefaction Demand, Production, Shortfall and Production Efficiency for the 6 months of Gas Liquefaction operation. As well as presenting the Mean Average forecast, the likely spread of results is also given by the P10, P90, minimum and maximum forecasts. The P10 and P90 results present the 10% and 90% probability of exceeding the stated levels of Production Efficiency. Moreover, in Figure 5.1 and Table 5.2, a monthly breakdown of the estimated cumulative Gas Liquefaction against Demand is provided for a single Liquefaction campaign.

Table 5.1 Gas Liquefaction Overall Results

Case	Demand (m ³)	Produced (m ³)	Shortfall (m ³)	Production Efficiency (%)	Average Hourly Production (m ³ /hr)	Availability (%)	Shortfall (%)
P10	25,915	25,443	472	98.18%	5.81	98.14%	1.82%
Mean	25,915	23,364	2,551	90.16%	5.33	89.21%	9.84%
P90	25,915	15,508	10,407	59.84%	3.54	59.68%	40.16%
Min	25,915	1,699	24,216	6.56%	0.39	1.60%	93.45%
Max	25,915	25,915	0	100.00%	5.92	100.00%	0.00%

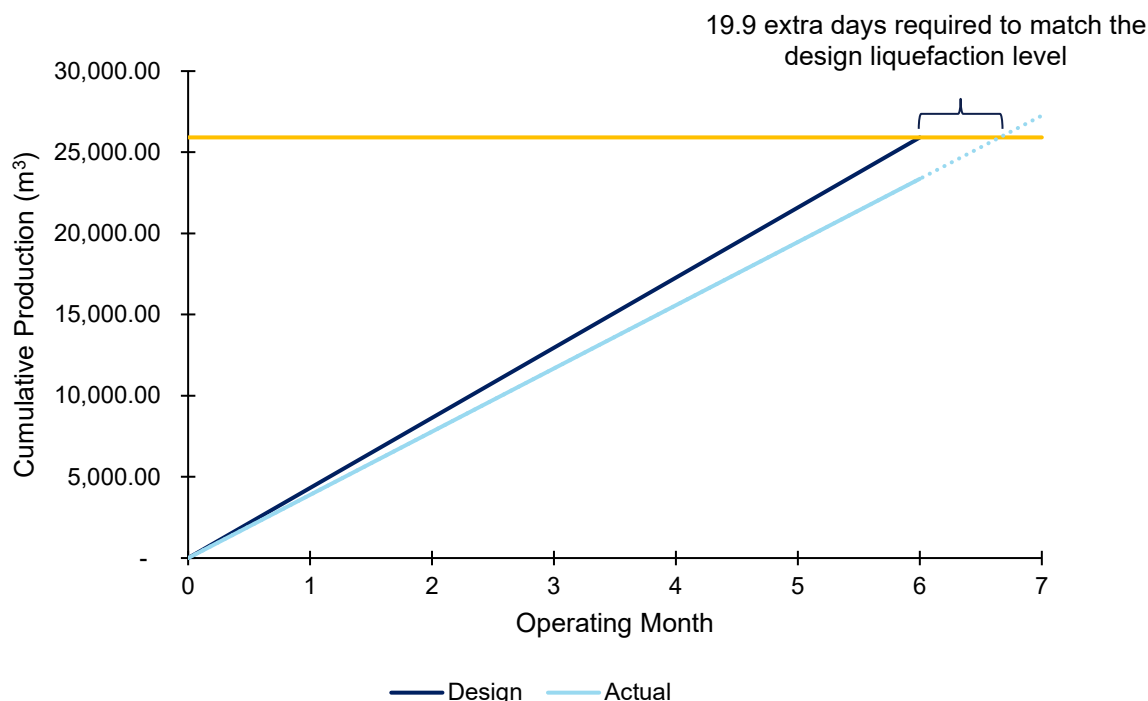


Figure 5.1 Gas Liquefaction Monthly Cumulative Production (m³)



Table 5.2 Gas Liquefaction Monthly Cumulative Production

Operating Month	Cumulative Design Production (m ³)	Cumulative Actual Production (m ³)
1	4,319	3,894
2	8,638	7,788
3	12,958	11,682
4	17,277	15,576
5	21,596	19,470
6	25,915	23,364

This demonstrates that:

- The mean Production Efficiency (PE) of the Liquefaction system against Demand is 90.16%; 23,364 m³ of LNG are produced against a Demand of 25,915 m³.
- The mean average liquefaction rate over the 6-month period is 5.33 m³/hr;
- There is a 10% chance of exceeding a Production Efficiency of 98.18% and a 90% chance of exceeding a Production Efficiency of 59.84%;
- The minimum forecasted production volume, over a 6-month period, is 1,699 m³ (PE of 6.56% - more detail provided in section 5.1.3.2), while the maximum forecasted production volume is 25,915 m³ (i.e. no shortfall);
- In the mean average scenario, a PE of 90.16% means that 19.9 additional days would be required in order to match the design production rate of the liquefaction facility, which assumes that no production shortfall is incurred.

5.1.2 Operational Availability (Time)

The predicted number of days in which the Liquefaction system is operational, producing at either Full or Partial Capacity, are shown annually in Figure 5.2.

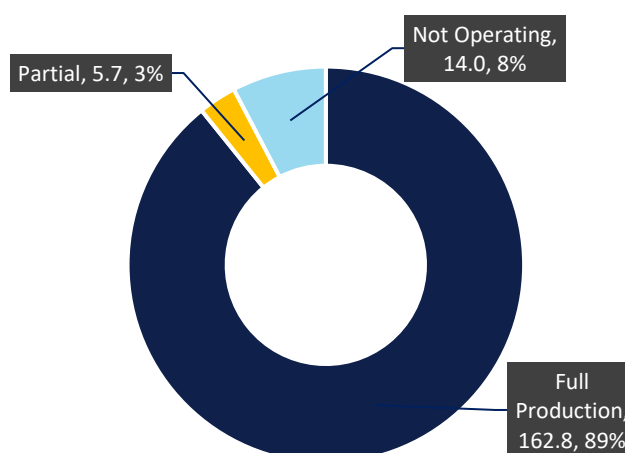


Figure 5.2 Liquefaction System Operational Days

It is forecast that the Availability of the Liquefaction system is 89.2%, which equates to 162.8 days of production at full Liquefaction rate over the 6-month period. Furthermore, the mean Uptime (time producing at any rate) is 92.3%, which comprises 5.7 days of partial production in addition to the 162.8 days at full production. Therefore, it is estimated that the



Liquefaction system will not be operable for a total duration of 14 days, over the 6-month period. This downtime is a result of the estimated 1 full unplanned shutdown event per month, with an average duration of 56.30 hours per unplanned shutdown.

5.1.3 Contributors to Lost Production

The contributors to Gas Liquefaction shortfall are given at system, equipment and equipment category level in Sections 5.1.3.1, 5.1.3.2 and 5.1.3.3, respectively.

5.1.3.1 System Contributors

The system contributors to Gas Liquefaction shortfall over the 6-month period considered are shown in Table 5.3 and Figure 5.3. The shortfall caused by each system is quantified by its impact on oil production at the point of failure, as defined by the production profiles.

Table 5.3 6-month System Contributors to Gas Liquefaction Shortfall

Rank	System	Gas Liquefaction Shortfall			Extra Days Required
		Absolute		Relative	
		m ³	%	%	
1	Gas Liquefaction	1,421	5.48%	55.71%	11.10
2	Gas Desiccation & Metering	858	3.31%	33.63%	6.70
3	Instrument Air & Inert Gas Generation	122	0.47%	4.80%	0.96
4	Fuel Gas	85	0.33%	3.34%	0.66
5	Spurious Trips	56	0.21%	2.18%	0.43
6	Cooling Medium	9	0.04%	0.36%	0.07
Total		2,551	9.84%	100.00%	19.92

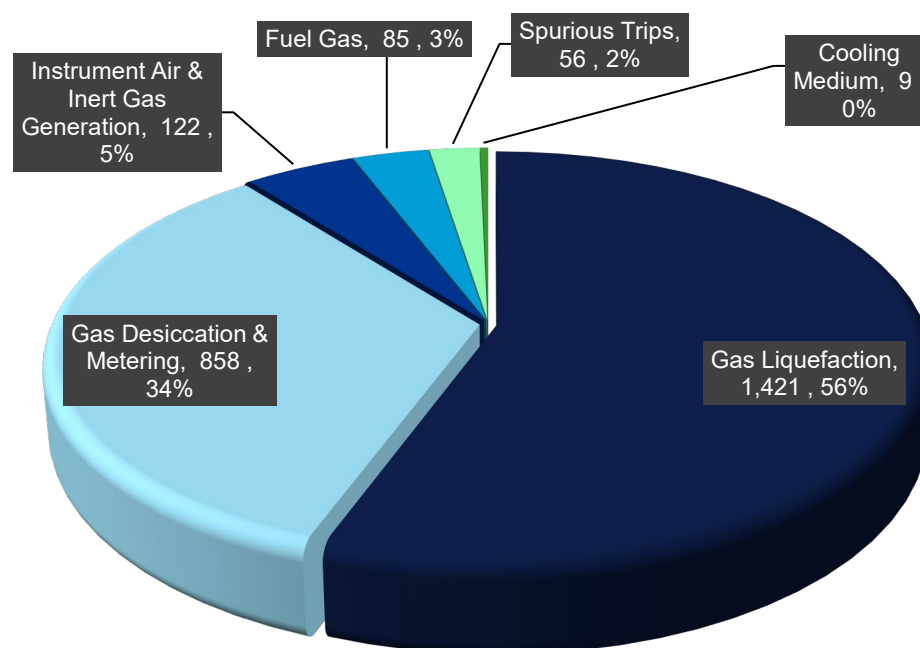


Figure 5.3 6-month System Contributors to Gas Liquefaction Shortfall (m³, %)



Key observations are that:

- The general non-spared nature of the equipment that comprises the Liquefaction facilities means that a single equipment failure is likely to lead to a full shutdown of the facility. Furthermore, in addition to the required repair activity to bring the equipment back into operation, a ramp-up procedure of the entire process will be required (ramp-up time is dependent on the duration of the repair - as determined in Section 4.5.3), which further contributes to the Gas Liquefaction shortfall. The shortfall contribution of the process ramp-up procedures is included as part of the shortfall of each equipment item discussed in subsequent sections;
- The most significant contributor to the Gas Liquefaction shortfall is the Gas Liquefaction process itself, due to its associated equipment, such as the Main Cycle Gas Compressor (KVGR), the Boil-off Gas Compressor (JVG), both KVGR and JVG Oil Coolers and KVGR Drums. The Gas Liquefaction process causes 1,421 m³ shortfall over the 6-month period (5.48% in absolute terms, 55.71% in relative terms). This shortfall requires that the plant must be operational for an additional 11.1 days to compensate;
- The Gas Desiccation & Metering system causes 858 m³ (3.31% in absolute terms, 33.63% in relative terms) shortfall across the 6-month period. The Reactivation Salt Heater, Reactivation Booster Compressor in addition to Molecular Sieve Beds are largely responsible for this system to be ranked second in shortfall terms. This system shortfall requires an additional 6.70 days of operation to compensate;
- The Instrument Air & Inert Gas Generation system causes 122 m³ of shortfall (0.47% in absolute terms). This is mainly due to the Instrument Air Dryers;
- The Fuel Gas system results in 85 m³ of shortfall (0.33% in absolute terms). This is largely caused by the Fuel Gas Filter;
- The following systems further contribute to Gas Liquefaction shortfall over the 6-month period:
 - Spurious Trips – on average 1 trip per annum for 4 hours;
 - Cooling Medium system – mainly the Cooling Water Towers and South/North Fans.

5.1.3.2 Equipment Contributors

The key equipment contributors to Gas Liquefaction shortfall over the 6-month period are shown in Table 5.4 and Figure 5.4.

Table 5.4 6-Month Equipment Contributors to Gas Liquefaction Shortfall

Rank	Equipment	Gas Liquefaction Shortfall			Extra Days Required
		Absolute	Relative		
		m³	%	%	
1	Main Cycle Gas Compressor (KVGR)	452	1.75%	17.73%	3.53
2	Reactivation Salt Heater	358	1.38%	14.02%	2.79
3	Boil-off Gas Compressor - JVG	306	1.18%	12.01%	2.39
4	Reactivation Gas Booster Compressor	283	1.09%	11.09%	2.21
5	KVGR Engine Oil Cooler	158	0.61%	6.21%	1.24
6	JVG Oil Cooler	134	0.52%	5.26%	1.05
7	Molecular Sieve Beds - Mol Sieve	91	0.35%	3.58%	0.71
8	Instrument Air Dryer - Mol Sieve	91	0.35%	3.58%	0.71
9	Sundyne Pump	85	0.33%	3.35%	0.67
10	2nd Stage KVGR Suction Drum - Separator	57	0.22%	2.22%	0.44
11	KVGR Discharge Drum - Separator	56	0.22%	2.19%	0.44
12	1st Stage KVGR Suction Drum - Separator	56	0.21%	2.18%	0.43



Rank	Equipment	Gas Liquefaction Shortfall			Extra Days Required
		Absolute	Relative		
		m³	%	%	
13	Spurious Trips	56	0.21%	2.18%	0.43
14	Feed Gas Filter - Separator	55	0.21%	2.16%	0.43
15	Dust Filter	43	0.17%	1.70%	0.34
16	Fuel Gas Filter	42	0.16%	1.63%	0.33
17	Cold Box	38	0.15%	1.50%	0.30
18	Boil-off Gas Pre-Filter	32	0.12%	1.26%	0.25
19	Ariel Boil-off Gas Compressor	20	0.08%	0.78%	0.16
20	SDVs - Gas Liquefaction	18	0.07%	0.71%	0.14
21	Other	119	0.46%	4.68%	0.93
Total		2,551	9.84%	100.00%	19.92

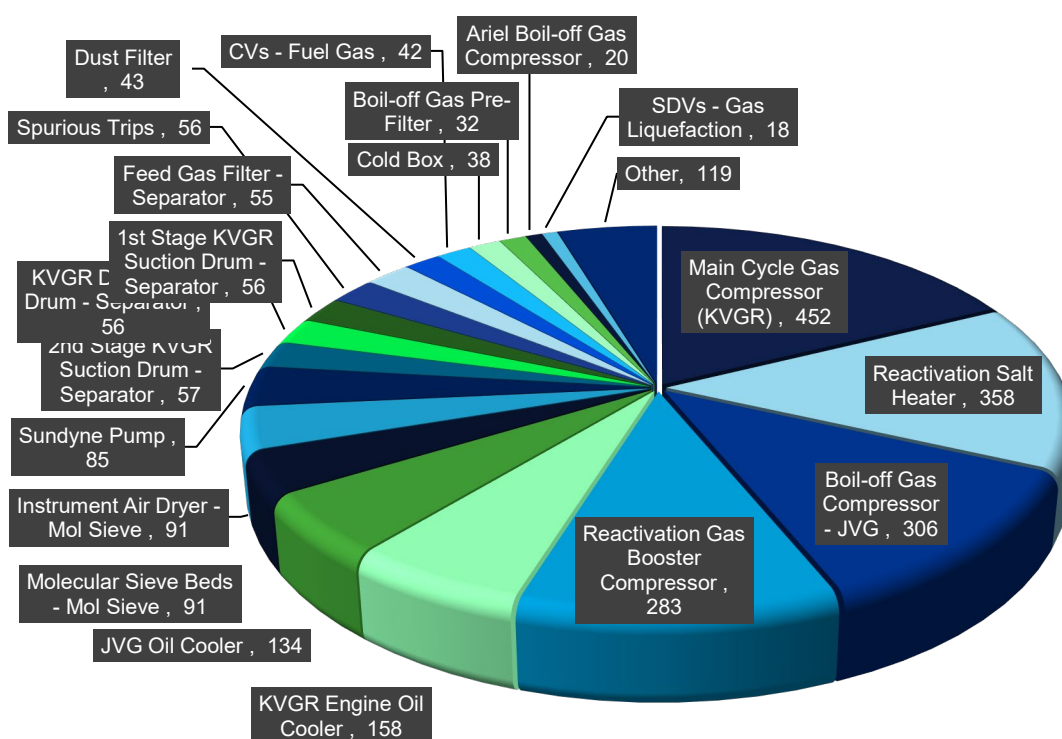


Figure 5.4 6-Month Equipment Contributors to Gas Liquefaction Shortfall (m³)

Key observations are that:

- The most significant contributor to Gas Liquefaction shortfall is the Main Cycle Gas Compressor (KVGR), which is a 1 x 100% Reciprocating Compressor (Clean Service) driven by a Gas Engine. Both units, especially the Gas Engine have long repair and logistical delays associated with a 'Major' failure that penalise production when these take place. As a result, in overall terms, this equipment causes 454 m³ (1.75% in absolute terms, 17.73% in relative terms) shortfall over the 6-month considered;
- The Reactivation Salt Heater, a Direct Hydrocarbon Fired Heater, is ranked second highest equipment contributor, with 358 m³ shortfall (1.38% in absolute terms, 14.02% in relative terms). The relatively low reliability of this 1 x 100% equipment item is responsible for its high position in the shortfall ranking;



- The Boil-off Gas Compressor (JVG) is predicted to be the third biggest shortfall contributor at an Equipment level, with 306 m³ shortfall (1.18% in absolute terms, 12.01% in relative terms). As with the KVGR Compressor, this item consists of a Reciprocating compressor (Clean Service) driven by a Gas Engine. However, unlike the KVGR, the JVG Compressor can be supported by the Ariel Compressor (up to 10% of full production rate) in the event of failure, which explains the lower shortfall contribution;
- The 4th biggest shortfall contributor is the Reactivation Gas Booster Compressor, a 1 x 100% Reciprocating Compressor (Clean Service), driven by an Electric Motor. The improved reliability of the Electric Motor in comparison to a Gas Engine is responsible for a lower ranking of this item than the KVGR and JVG Compressors, accounting for 283 m³ (1.09% in absolute terms, 11.09% in relative terms) shortfall;
- Next are the KVGR and the JVG Oil Coolers, each a Shell and Tube Heat Exchanger that cause 158 and 134 m³ Gas Liquefaction shortfall, respectively. As with the KVGR and JVG compressors, the different level of sparing due to the presence of the Ariel Compressor to support the JVG, means that a failure of the JVG Oil Cooler leads to a lower impact than a failure of the KVGR Oil Cooler;
- Molecular Sieve Beds and the Instrument Air Dryers, each a 2 x 100% Mol Sieve Bed (Clean Service), with one vessel in operation while the other is regenerating, cause each 91 m³ (0.35% in absolute terms, 3.58% in relative terms) shortfall;
- The Sundyne Pump, a 1 x 100% motor-driven Centrifugal Pump in Condensate Processing, whose failure results in a reduction of 80% in production, is ranked 9th in terms of shortfall contributors towards Gas Liquefaction, accounting for 85 91 m³ (0.33% in absolute terms) of shortfall;
- The 1st & 2nd Stage Suction Drums and the Discharge Drum associated with the cooling cycle of the KVGR (each a 1 x 100% Separator in Clean Service), are ranked 10th – 12th in terms of Gas Liquefaction shortfall, each accounting on average to approximately 56 m³ (0.22% in absolute terms) shortfall;
- Trips of the Integrated Control and Safety System (ICSS) are predicted to occur on average once a year for 4 hours, and contribute with 56 m³ (0.21% in absolute terms) shortfall;
- The Feed Gas Filter, also a 1 x 100% Separator (Clean Service) accounts for 55 m³ (0.21% in absolute terms) shortfall;
- The Dust and the Fuel Gas Filters, each a 1 x 100% Filter in the Desiccant & Metering and Fuel Gas systems, respectively, are ranked 15th – 16th in the shortfall contributors list. Each account for approximately 42.5 m³ (0.165% in absolute terms) shortfall;
- The Cold Box, essential for the Liquefaction process, is ranked 17th in terms of the contributors to Gas Liquefaction shortfall. Despite the significant repair/logistical delay associated with a 'Major' repair, its low failure frequency (high MTTF) means it does not significantly impact production. The Cold Box is therefore predicted to cause only 38 m³ (0.15% in absolute terms) shortfall. Furthermore, analysis of the 10 worst life-cycle simulations (of the total 100,000 run for the Liquefaction model) revealed that a Cold Box failure was not likely to impact an entire Liquefaction campaign. The high shortfall observed in those cases was attributed to multiple failure of equipment items with long repair times/logistical delays, but lower MTTF than the Cold Box, such as the KVGR, JVG & Reactivation Gas Booster Compressors and the Reactivation Salt Heater;
- The following items represent the 18th – 20th top contributors to Gas Liquefaction shortfall:
 - Boil-Off Gas Pre Filter (32 m³, 0.12% in absolute terms shortfall) – a Filter whose operation is supported by the existence of the Ariel Compressor;
 - Ariel Boil-Off Gas Compressor (20 m³, 0.08% in absolute terms shortfall) – a Reciprocating Compressor, motor-driven, that supports the JVG Compressor (up to 10% of full production rate);



- Multiple SDVs (mostly 1 x 100%) pertaining to Gas Liquefaction process (18 m³, 0.07%);
- Other equipment (119 m³, 0.46%).

5.1.3.3 Equipment Category Contributors

The key equipment category contributors to Gas Liquefaction shortfall over the 6-month period are shown in Table 5.5 and Figure 5.5.

Table 5.5 6-Month Equipment Category Contributors to Gas Liquefaction Shortfall

Rank	Equipment Category	Gas Liquefaction Shortfall			Extra Days Required
		Absolute		Relative	
		m ³	%	%	
1	Reciprocating Compressors	1,061.40	4.10%	25.67%	8.29
2	Vessels	447.71	1.73%	12.36%	3.50
3	HC Direct Fired Heater	357.60	1.38%	7.83%	2.79
4	S&T HEx	292.50	1.13%	7.62%	2.28
5	Filters	117.04	0.45%	6.44%	0.91
6	Centrifugal Pumps	85.44	0.33%	5.89%	0.67
7	Spurious Trips	55.51	0.21%	4.99%	0.43
8	SDVs	40.58	0.16%	3.90%	0.32
9	Cold Box	38.26	0.15%	3.56%	0.30
10	CVs	18.45	0.07%	3.02%	0.14
11	Exchangers - Air Cooler	14.86	0.06%	2.49%	0.12
12	XVs	11.63	0.04%	2.14%	0.09
13	Nitrogen Generator Package	9.33	0.04%	1.90%	0.07
14	Screw Compressors	0.37	0.00%	1.73%	0.00
Total		2,551	9.84%	100.00%	19.92

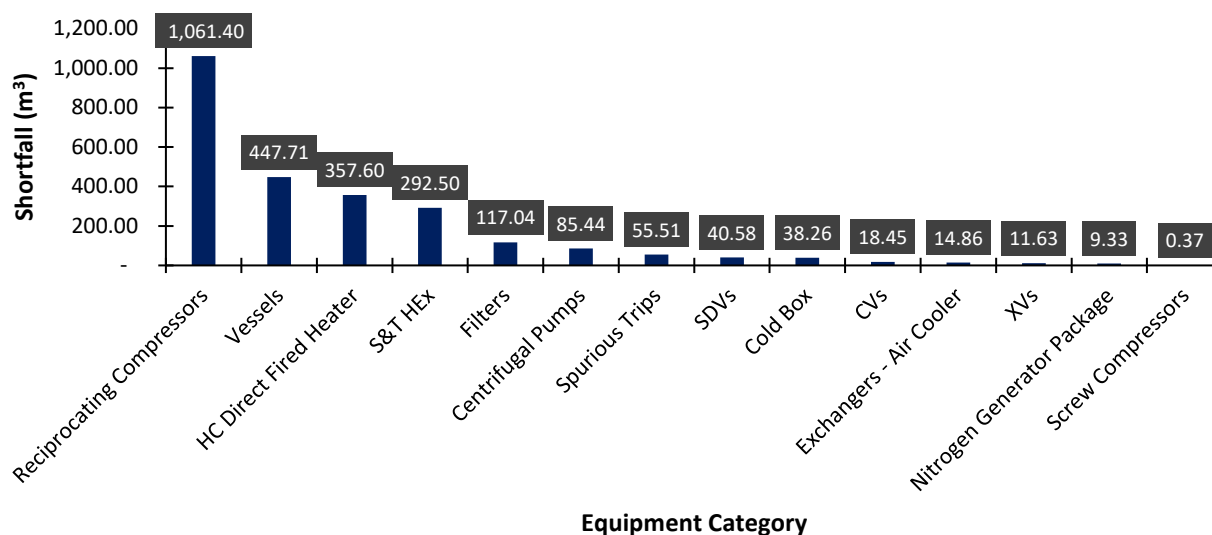


Figure 5.5 6-Month Equipment Category Contributors to Gas Liquefaction Shortfall (m³)



Key observations are that:

- Reciprocating Compressors (both Gas Engine and Motor driven) are the most significant equipment type contributor to Gas Liquefaction shortfall (25.67% of total shortfall), due to their general non-spared nature and the long repair/logistical delays associated with its 'Major' failure mode (720 hours repair time and 1460 hours logistical delays for KVGR and JVG Compressors). In overall terms, Reciprocating Compressors contribute 1,061.04 m³ (4.10%) Gas Liquefaction shortfall over the 6-month period reviewed;
- Vessels, of various types, are ranked second in terms of equipment category contributors to shortfall, also due to their 1 x 100% configuration and a 2-month logistical delay associated with its 'Major' failure mode. Vessels account for 12.36% of the total Gas Liquefaction shortfall (447.71 m³, 1.73%);
- HC Direct Fired Heater, in this case, the Reactivation Salt Heater, account for 357.6 m³ (1.38%) shortfall, due to its relatively low MTTF and non-spared nature;
- Shell & Tube Heat Exchangers account for 292.5 m³ (1.13%) shortfall. The performance of the Liquefaction plant is hindered by a 3-month logistical delay associated with a 'Major' failure of this equipment category;
- Filters, also 1 x 100% items in general with a 2-month logistical delay associated with its 'Major' failure mode, rank 5th in terms of equipment category contributors to shortfall, account to 117.04 m³ (0.45%) shortfall
- Centrifugal Pumps, mainly the Sundyne Pump (non-spared with a 80% impact on production upon failure) accrue for 85.44 m³ (0.33%) shortfall;
- Trips of the Integrated Control and Safety System (ICSS) are predicted to occur on average once a year for 4 hours, and contribute with 55.51 m³ (0.21%) to the Gas Liquefaction shortfall;
- The following items represent the 10th – 14th shortfall contributors at an equipment contributor type level:
 - SDVs (40.58 m³, 0.16% - the multiple number of this equipment type across the liquefaction facilities);
 - Cold Box (38.26 m³, 0.15%);
 - CVs, 1 x 100% control valves pertaining to the Fuel Gas and Liquefaction systems account for 18.45 m³ (0.07%) shortfall;
 - Air Coolers Exchangers pertaining to the Cooling Medium system (14.86 m³, 0.06%);
 - XVs, mainly around the Molecular Sieve Beds account for 11.63 m³, (0.04%) shortfall;
 - Nitrogen Generation Package (9.33 m³, 0.04%);
 - Screw Compressors, 2 x 100% items pertaining to the Instrument Air system account for 0.37 m³ (<0.01%) shortfall.



5.2 LNG Regasification

This section presents the results of the LNG Regasification case, which assesses the Production Efficiency in terms of LNG vapourised from the LNG Tank over a 6.67-day period (worst case scenario). For simplicity of modelling, the performance of the LNG Regasification facility was assessed against a full 7-day period (168 hours).

5.2.1 Production Efficiency

Table 5.6 presents the overall results for LNG Regasification Demand, Production, Shortfall, LNG Regasification Efficiency and Availability. As in the Gas Liquefaction Case, as well as presenting the Mean Average forecast, the likely spread of results is also given by the P10 and P90 forecasts.

Table 5.6 LNG Regasification Overall Results

Case	Demand (MMSCF)	Produced (MMSCF)	Shortfall (MMSCF)	Production Efficiency (%)	Average Hourly Production (MMSCFD)	Availability (%)	Shortfall (%)
P10	630.0	629.4	0.6	99.90%	89.91	99.88%	0.10%
Mean	630.0	628.0	2.04	99.68%	89.71	99.46%	0.32%
P90	630.0	625.4	4.6	99.27%	89.34	98.65%	0.73%

This demonstrates that:

- The mean 6.67-day LNG Regasification Efficiency against Demand is 99.68%: 628.0 MMSCF of LNG are vapourised against a Demand of 630 MMSCF;
- The mean average daily vaporisation rate over the 6.67-day period is 89.71 MMSCFD;
- There is a 10% chance of exceeding a Regasification Efficiency of 99.90% and a 90% chance of exceeding a Regasification Efficiency of 99.27%.

5.2.2 Operational Availability (Time)

The predicted number of days in which the LNG Regasification system is operational, vaporising at either Full or Partial Demand are shown in Figure 5.6.

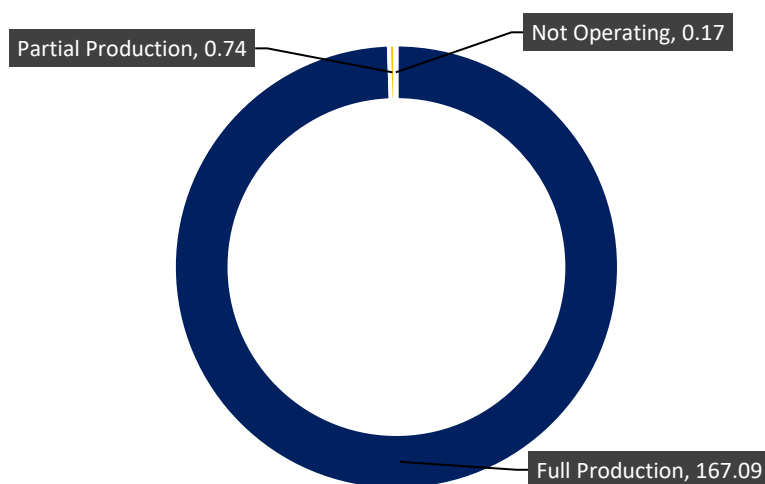


Figure 5.6 LNG Regasification Operational Hours



Figure 5.6 shows that over a 168-hour LNG Regasification campaign, that:

- The mean LNG Regasification Operational Availability of the facility is 99.46% (at Demand) and 99.90% (at Any Production);
- In absolute terms, this represents an average of 167.09 hours that the LNG Regasification facility will operate at Demand. Additionally, on average, the facility will operate at partial capacity for 0.74 hours and will not operate for 0.17 hours.

5.2.3 Contributors to Lost Production

The contributors to LNG Regasification shortfall are given at system and equipment level in Sections 5.2.3.1 and 5.2.3.2, respectively.

5.2.3.1 System Contributors

The system contributors to LNG Regasification over the 168-hour period considered are shown in Table 5.7 and Figure 5.7.

Table 5.7 LNG Regasification System Contributors to Shortfall

Rank	System	LNG Regasification Shortfall		
		Absolute		Relative
		MMSCF	%	%
1	LNG Pumping and Vaporisation	1.62	0.26%	79.48%
2	Instrument Air & Inert Gas Generation	0.42	0.07%	20.52%
Total		2.04	0.32%	100.00%

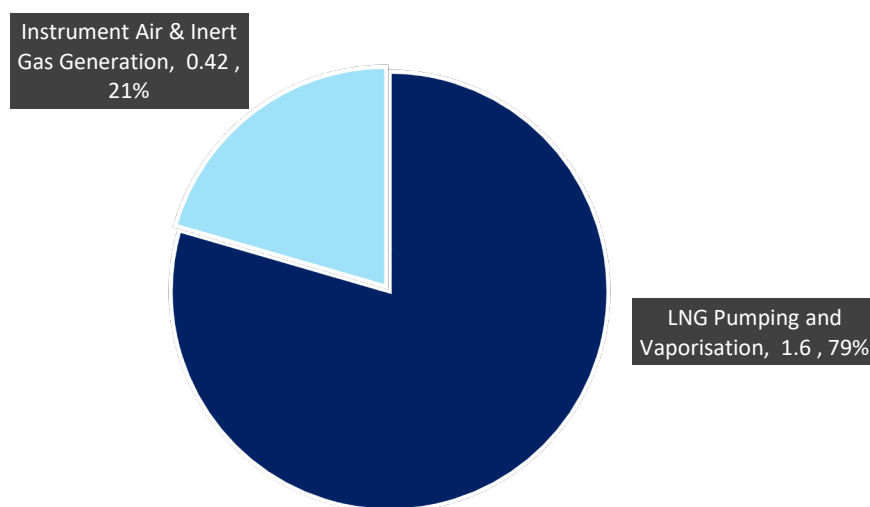


Figure 5.7 LNG Regasification System Contributors to Shortfall (MMSCF, absolute %)

The key observation is that the LNG Pumping and Vaporisation system is the biggest contributor towards LNG Regasification shortfall, with a relative shortfall percentage of 79.48%. This is mainly attributable to the Vaporisers, as demonstrated in the following section. The remaining 20.52% of relative shortfall is attributed to the Instrument Air and Inert Gas Generation system.



5.2.3.2 Equipment Contributors

The key equipment contributors to LNG Regasification shortfall over the 168-hour period considered are shown in Table 5.8 and Figure 5.8.

Table 5.8 LNG Regasification Equipment Contributors to Shortfall

Rank	Equipment	LNG Regasification Shortfall		
		Absolute		Relative
		MMSCF	%	%
1	Vaporisers	1.42	0.22%	69.54%
2	Instrument Air Dryer - Mol Sieve	0.37	0.06%	18.00%
3	SDVs - LNG Pumping & Vaporisation	0.20	0.03%	9.86%
4	Instrument Air Receiver - Surge Drum	0.04	0.01%	2.06%
5	Instrument Air Compressor	0.01	<0.01%	0.46%
6	CVs - LNG Pumping & Vaporisation	<0.01	<0.01%	0.06%
7	Cryogenic Pumps	<0.01	<0.01%	0.02%
Total		2.04	0.32%	100.00%

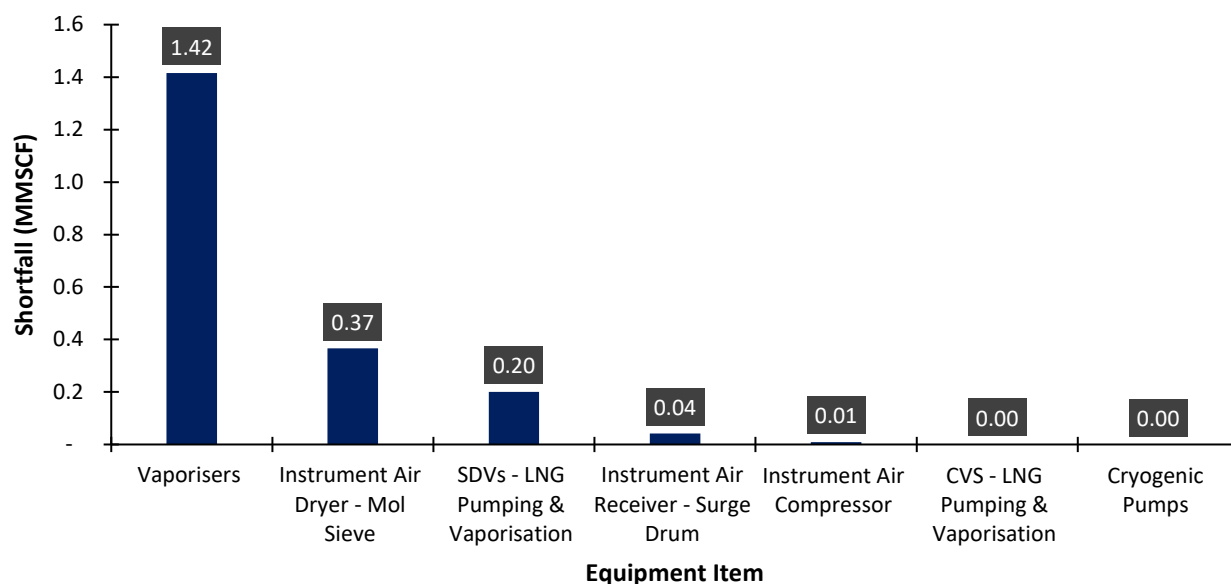


Figure 5.8 LNG Regasification Equipment Contributors to Shortfall (MMSCF)

Key observations are that:

- Vaporisers are the main equipment contributors to the LNG Regasification shortfall, accounting for 1.42 MMSCF shortfall (0.22% in absolute terms, 69.54% in relative terms). This is due to the relative low reliability nature of this equipment item;
- The following items contribute to the remaining 30.46% of relative shortfall:
 - Instrument Air Dryers (0.37 MMSCF shortfall, 0.06% in absolute terms, 18.00% in relative terms) – 2 x 100% Mol Sieves, 1 in operation while the other is in regeneration mode;
 - Multiple SDVs pertaining to the LNG Pumping & Vaporisation system (0.20 MMSCF shortfall, 0.03% in absolute terms, 9.86% in relative terms);
 - Instrument Air Receiver (0.04 MMSCF shortfall, 0.01% in absolute terms, 2.06% in relative terms) – a 1 x 100% Surge Drum;



- Instrument Air Compressor (0.01 MMSCF shortfall, <0.01% in absolute terms, 0.46% in relative terms)
– 2 x 100% Screw Compressors;
- Multiple CVs pertaining to the LNG Pumping & Vaporisation system (<0.01 MMSCF shortfall, <0.01% in absolute terms, 0.06% in relative terms);
- Finally, the Cryogenic Pumps accrue in no mentionable shortfall, given their 3 x 50% configuration and relatively high reliability nature.



5.3 Gas Compression

This section reports on the performance of the Gas Compression system over the 4 winter months considered, where the Gas Compression system is operated intermittently, as defined in Section 4.1.3.

5.3.1 Availability Summary

Table 5.9 presents the overall results for the Gas Compression Case, reported in terms of Availability. As well as presenting the Mean Average forecast, the likely spread of results is also given by the P10 and P90 forecasts.

Table 5.9 Gas Compression Availability Overall Results		
Case	Availability (%)	Unavailability (%)
P10	100.00%	0.00%
Mean	99.45%	0.55%
P90	100.00%	0.00%

Table 5.9 shows that on average the Gas Compression system is fully operable for 99.45% of the required time, and not operable for 0.55% over the 4 winter months considered (intermittent operation).

The somewhat unusual P10 and P90 results can be explained by the fact that, due to the high reliability of this system, there is <10% probability of experiencing ANY unavailability during the required time. From the Monte Carlo analysis, the mean average unavailability is an output from only the worst 5% life-cycles (of the 100,000 simulated).

5.3.2 Availability Breakdown

The Availability breakdown of the Gas Compression system is provided in Figure 5.9, reported in terms of hours at each running state out of the total 192 hours required each year (in an intermittent mode).

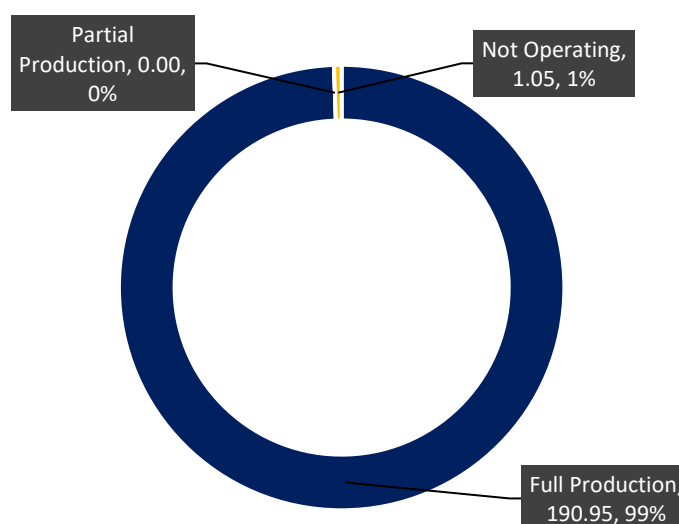


Figure 5.9 Availability Breakdown for the Gas Compression Case (hours)

Figure 5.9 shows that in absolute terms, the Gas Compression system is fully operable for 190.95 hours and not operable for 1.05 hours out of the total 192 hours required each year.



5.3.3 Contributors to Lost Production

The contributors to Gas Compression Unavailability are reported at an equipment level in Section 5.3.3.1.

5.3.3.1 Equipment Contributors

The key equipment contributors to Gas Compression Unavailability over the 192-hour period considered are shown in Table 5.10 and Figure 5.10.

Table 5.10 Equipment Contributors to Gas Compression Unavailability			
Rank	Equipment	Gas Compression Unavailability	
		Absolute	Relative
		%	%
1	Solar Gas Turbine	0.28%	51.11%
2	Solar Gas Turbine Compressor	0.27%	48.60%
3	Gas Compressor Suction Scrubber - Scrubber	<0.01%	0.30%
Total		0.55%	100.00%

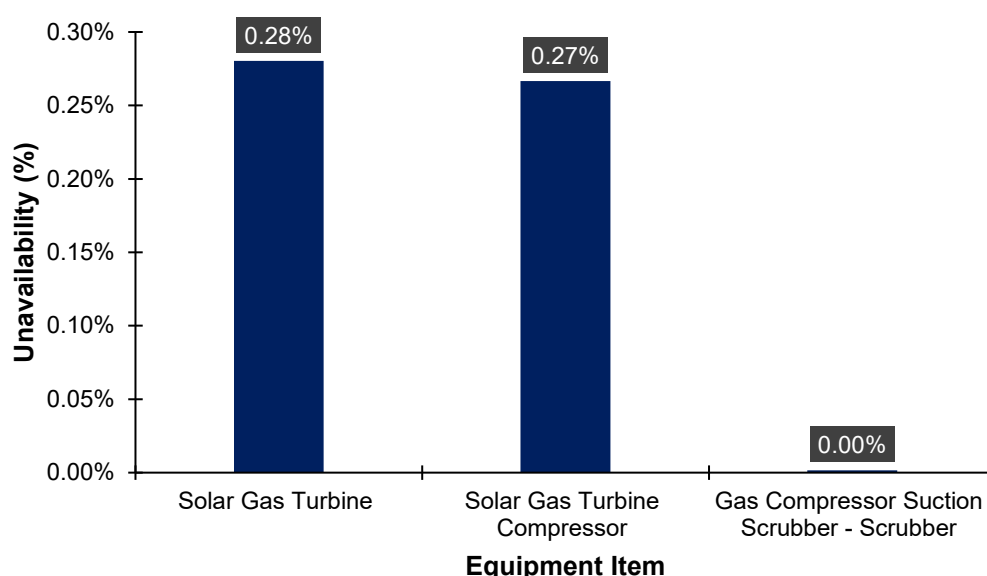


Figure 5.10 Equipment Contributors to Gas Compression Unavailability (%)

Key observations are:

- Fail to start on demand, as defined in Section 4.4.3.4, contribute to 99.4% of the total Unavailability (0.55% in absolute terms) of the Gas Compression system, with running failures responsible for the remaining 0.6%. This Unavailability has been equally assigned to the Solar Gas Turbine and Solar Gas Turbine Compressor;
- Solar Gas Turbines, used in a 2 x 100% configuration to drive the Compressors, result in 0.28% in absolute Unavailability (51.11% in relative terms, mainly due to failure to start on demand);
- Solar Gas Turbine Compressor, in a 2 x 100% configuration, result in 0.27% in absolute Unavailability (48.6% in relative terms, also mainly due to failure to start on demand. The slightly better reliability of Centrifugal Compressor in relation to Gas Turbines result in the marginally reduced Unavailability of this equipment item;
- Lastly, the Gas Compression Scrubbers, in a 2 x 100% configuration, account for less than 0.01% of the absolute Unavailability (0.30% in relative terms).



The high Availability recorded in the Gas Compression Case (99.45%) can be attributed to the 2 x 100% configuration of its equipment items and the low running nature of the Gas Compression campaign.

5.4 Sensitivity Cases

The performance impact of several design and operating assumptions are assessed through the following Sensitivity Cases (further definition provided in Section 3.3.2):

- Sensitivity Case 1: New Plant Data;
- Sensitivity Case 2: Plant Deterioration.

Sensitivity Case results are presented in the following sections.

5.4.1 Sensitivity Case 1: New Plant Data

5.4.1.1 Liquefaction Mode

The performance impact of installing new equipment was assessed against the Liquefaction mode of operation. Table 5.11 presents the overall results for Production Efficiency and Extra Days Required. In Figure 5.11 and Table 5.12 the comparison of the cumulative monthly production is reported.

Table 5.11 Results Summary for Sensitivity Case 1 – Liquefaction Mode

Metric	Gas Liquefaction	
	Base Case	New Plant
Production Efficiency (%)	90.16%	93.85%
Improvement (%)		+3.70%
Extra Days Required	19.9	11.9
Day Improvement		-8.0

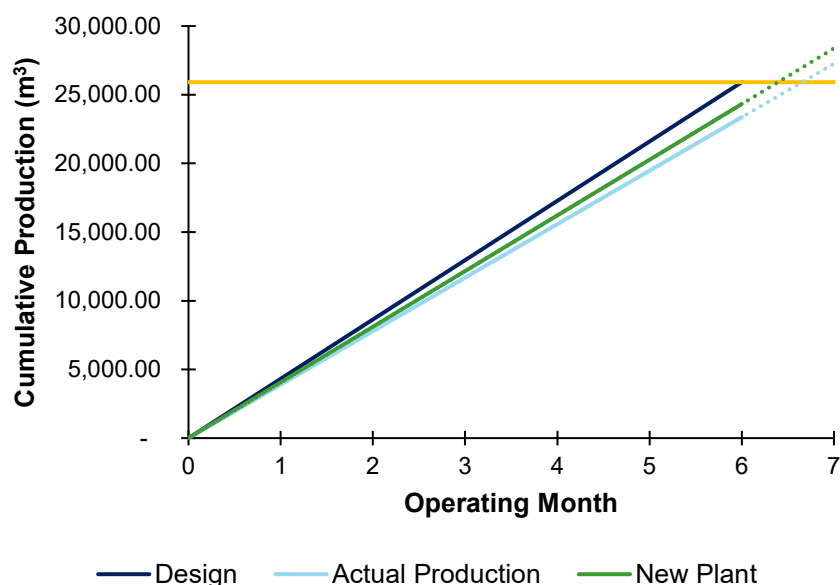


Figure 5.11 Gas Liquefaction Monthly Cumulative Production Comparison (m³)



Table 5.12 Gas Liquefaction Monthly Cumulative Production Comparison

Operating Month	Cumulative Design Production (m ³)	Cumulative Actual Production (m ³)	Cumulative New Plant Production (m ³)
1	4,319.17	3,894.06	4,053.75
2	8,638.34	7,788.11	8,107.50
3	12,957.51	11,682.17	12,161.25
4	17,276.68	15,576.22	16,215.00
5	21,595.85	19,470.28	20,268.75
6	25,915.02	23,364.33	24,322.50

Key observations are:

- Replacing the existing plant (with new) is predicted to result in a Gas Liquefaction Production Efficiency of 93.85%, an improvement of 3.70% on the availability forecast of the current plant (90.16%);
- A new plant is predicted to require an additional 11.9 days operating to match the design production level over a 6-month period (8 days improvement on the current plant forecast).

It is important to analyse the resultant changes in the equipment contributors to shortfall from the implementation of new plant equipment, which is shown in Table 5.13.

Table 5.13 6-Month Equipment Contributors to Gas Liquefaction Shortfall Comparison

Rank	Previous Ranking	Equipment	New Plant Gas Liquefaction Shortfall			Extra Days Required	Previous Extra Days Required
			Absolute	Relative	Relative		
			m ³	%	%		
1	2	Reactivation Salt Heater	371	1.43%	23.32%	2.79	2.79
2	1	Main Cycle Gas Compressor (KVGR)	316	1.22%	19.86%	2.37	3.53
3	4	Reactivation Gas Booster Compressor	279	1.08%	17.53%	2.09	2.21
4	3	Boil-off Gas Compressor - JVG	188	0.73%	11.82%	1.41	2.39
5	13	Spurious Trips	58	0.22%	3.62%	0.43	0.43
6	9	Sundyne Pump	56	0.22%	3.50%	0.42	0.67
7	17	Cold Box	31	0.12%	1.96%	0.23	0.30
8	5	KVGR Engine Oil Cooler	29	0.11%	1.85%	0.22	1.24
9	7	Molecular Sieve Beds - Mol Sieve	23	0.09%	1.43%	0.17	0.71
10	8	Instrument Air Dryer - Mol Sieve	23	0.09%	1.42%	0.17	0.71
11	19	Ariel Boil-off Gas Compressor	19	0.07%	1.22%	0.15	0.16
12	20	SDVs - Gas Liquefaction	19	0.07%	1.16%	0.14	0.14
13	6	JVG Oil Cooler	17	0.07%	1.09%	0.13	1.05
14	21	CVs - Fuel Gas	15	0.06%	0.91%	0.11	0.11
15	22	SDVs - Gas Desiccation & Metering	14	0.05%	0.89%	0.11	0.10
16	10	2nd Stage KVGR Suction Drum - Separator	12	0.05%	0.78%	0.09	0.44
17	14	Feed Gas Filter - Separator	12	0.05%	0.76%	0.09	0.43
18	11	KVGR Discharge Drum - Separator	12	0.05%	0.76%	0.09	0.44
19		XVs - Gas Desiccation & Metering	12	0.05%	0.75%	0.09	0.09
20	12	1st Stage KVGR Suction Drum - Separator	12	0.05%	0.75%	0.09	0.43
N/A	N/A	Other	74	0.28%	4.63%	0.55	0.93
Total			1,592	6.15	100.00%	11.95	19.92



The new shortfall contributor analysis shows that:

- Replacing the compressors units (compressor & respective driver), shows some improvements. This is more evident however in units being driven by a gas engine. However, given that the changes made only affect the repair / logistical delay times associated with infrequent failure modes, the more frequent failure modes still lead to production shortfall, leaving them still at the top of the contributors list;
- Similar changes in data were made to Vessels & Heat Exchangers. Given the high number of these equipment items across the plant, the benefit of replacing vessels & exchangers is more visible in the contributors list;
- Reducing the repair time associated with a Cold Box failure resulted in some, but no significant improvement;
- Sparing of equipment would be an additional alternative to reduce the existing production shortfall.

5.4.1.2 LNG Regasification Mode

The performance impact of installing new equipment was assessed for the LNG Regasification mode of operation. Table 5.14 presents the overall results for Production Efficiency. Installing new equipment results in a PE increase of 0.21% (from 99.68% to 99.88%).

Table 5.14 Results Summary for Sensitivity Case 1 – LNG Regasification Mode

Metric	LNG Regasification	
	Base Case	New Plant
Production Efficiency (%)	99.68%	99.88%
Improvement (%)		+0.21%

In Table 5.15 and Figure 5.12 the improvement in terms of Vaporiser performance, the highest contributor to shortfall in this mode of operation, is reported.

Table 5.15 Vaporiser Performance Improvement

Metric	Vaporiser Shortfall	
	Base Case	New Plant
Shortfall (MMSCF)	1.42	0.11
Improvement (MMSCF)		-1.31

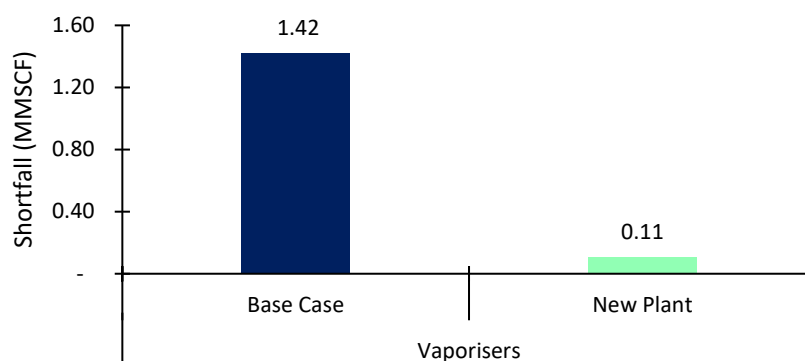


Figure 5.12 Vaporiser Performance Improvement (MMSCF)

Vaporisers were responsible for 69.54% of the Base Case shortfall, and are also responsible for the majority of the PE improvement from installing new plant. With reduced logistical delays associated with their repair, overall shortfall is significantly reduced, from 1.42 MMSCF to 0.11 MMSCF.

5.4.1.3 Gas Compression Mode

No visible changes were observed in this Sensitivity Case, given the low running hours and the level of sparing of gas compression equipment. As such, results are not presented for this mode of operation.



5.4.2 Sensitivity Case 2: Plant Deterioration

5.4.2.1 Liquefaction Mode

The performance impact of existing equipment deteriorating at different rates is presented in this section. Table 5.16, Table 5.17 and Table 5.18 show the detrimental impact that 5%, 10% and 15% deterioration rates per year have on Production Efficiency, respectively.

Table 5.16 5% per Year Deterioration Gas Liquefaction Case Results

		Year					
		Base Case	1	2	3	4	5
Production Efficiency (%)	P10	97.52%	97.33%	97.14%	96.93%	96.74%	96.54%
	Mean	90.16%	89.96%	89.58%	89.12%	88.72%	88.21%
	P90	72.20%	71.82%	70.19%	66.71%	65.15%	63.29%
Over-run (days)	P10	70.3	71.6	77.5	91.1	97.6	105.9
	Mean	19.9	20.4	21.2	22.3	23.2	24.4
	P90	4.6	5.0	5.4	5.8	6.1	6.5

Table 5.17 10% per Year Deterioration Gas Liquefaction Case Results

		Year					
		Base Case	1	2	3	4	5
Production Efficiency (%)	P10	97.52%	97.13%	96.74%	96.30%	95.89%	95.45%
	Mean	90.16%	89.57%	88.73%	87.80%	86.99%	86.21%
	P90	72.20%	70.12%	65.19%	62.70%	61.82%	61.00%
Over-run (days)	P10	70.3	77.8	97.5	108.6	112.7	116.7
	Mean	19.9	21.2	23.2	25.4	27.3	29.2
	P90	4.6	5.4	6.1	7.0	7.8	8.7

Table 5.18 15% per Year Deterioration Gas Liquefaction Case Results

		Year					
		Base Case	1	2	3	4	5
Production Efficiency (%)	P10	97.52%	97.13%	96.74%	96.30%	95.89%	95.45%
	Mean	90.16%	89.57%	88.73%	87.80%	86.99%	86.21%
	P90	72.20%	70.12%	65.19%	62.70%	61.82%	61.00%
Over-run (days)	P10	70.3	77.8	97.5	108.6	112.7	116.7
	Mean	19.9	21.2	23.2	25.4	27.3	29.2
	P90	4.6	5.4	6.1	7.0	7.8	8.7

Key observations are:

- With a **5%** deterioration rate per year, Production Efficiency reduces from **90.16%** in the **Base Case** (current year) to **86.24% after 10 years**. In absolute terms, this means that the current **over-run** of the system to match the designed liquefaction rate will need to **increase from 19.9 days to 29.1 days**;
- With a **10%** deterioration rate per year, Production Efficiency reduces from **90.16%** in the **Base Case** (current year) to **82.32% after 10 years**. In absolute terms, this means that the current **over-run** of the system to match the designed liquefaction rate will need to **increase from 19.9 days to 39.2 days**;
- With a **15%** deterioration rate per year, Production Efficiency reduces from **90.16%** in the **Base Case** (current year) to **79.82% after 10 years**. In absolute terms, this means that the current **over-run** of the system to match the designed liquefaction rate will need to **increase from 19.9 days to 48.7 days**.



5.4.2.2 LNG Regasification Mode

The performance impact of current equipment pertaining to the LNG Regasification mode of operation deteriorating at different rates is presented in this section. Table 5.19, Table 5.20 and Table 5.21 show the detrimental impact that 5%, 10% and 15% deterioration rates per year have on Production Efficiency, respectively.

Table 5.19 5% per Year Deterioration LNG Regasification Case Results

		Year						
		Base Case	1	2	3	4	5	10
Production Efficiency (%)	P10	99.90%	99.89%	99.88%	99.87%	99.85%	99.84%	99.76%
	Mean	99.68%	99.65%	99.62%	99.60%	99.57%	99.53%	99.37%
	P90	99.27%	99.23%	99.20%	99.16%	99.12%	99.08%	98.83%

Table 5.20 10% per Year Deterioration LNG Regasification Case Results

		Year						
		Base Case	1	2	3	4	5	10
Production Efficiency (%)	P10	99.90%	99.88%	99.85%	99.83%	99.79%	99.76%	99.56%
	Mean	99.68%	99.62%	99.57%	99.50%	99.44%	99.37%	98.98%
	P90	99.27%	99.20%	99.12%	99.04%	98.94%	98.83%	98.27%

Table 5.21 15% per Year Deterioration LNG Regasification Case Results

		Year						
		Base Case	1	2	3	4	5	10
Production Efficiency (%)	P10	99.90%	99.87%	99.83%	99.78%	99.73%	99.67%	99.29%
	Mean	99.68%	99.60%	99.50%	99.41%	99.30%	99.19%	98.53%
	P90	99.27%	99.16%	99.04%	98.88%	98.72%	98.55%	97.65%

Key observations are:

- With a **5%** deterioration rate per year, Production Efficiency reduces from **99.68%** in the **Base Case** (current year) to **99.37% after 10 years**;
- With a **10%** deterioration rate per year, Production Efficiency reduces from **99.68%** in the **Base Case** (current year) to **98.98% after 10 years**;
- With a **15%** deterioration rate per year, Production Efficiency reduces from **99.68%** in the **Base Case** (current year) to **98.53% after 10 years**.



5.4.2.3 Gas Compression Mode

The performance impact of current equipment pertaining to the Gas Compression mode of operation deteriorating at different rates is presented in this section. Table 5.22, Table 5.23 and Table 5.24 show the detrimental impact that 5%, 10% and 15% deterioration rates per year have on Availability, respectively.

Table 5.22 5% per Year Deterioration Gas Compression Case Results

		Year						
		Base Case	1	2	3	4	5	10
Availability (%)	P10	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
	Mean	99.45%	99.45%	99.44%	99.44%	99.45%	99.44%	99.42%
	P90	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	98.92%

Table 5.23 10% per Year Deterioration Gas Compression Case Results

		Year						
		Base Case	1	2	3	4	5	10
Availability (%)	P10	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
	Mean	99.45%	99.44%	99.45%	99.43%	99.43%	99.42%	99.38%
	P90	100.00%	100.00%	100.00%	99.65%	99.55%	98.92%	97.55%

Table 5.24 15% per Year Deterioration Gas Compression Case Results

		Year						
		Base Case	1	2	3	4	5	10
Availability (%)	P10	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
	Mean	99.45%	99.44%	99.43%	99.43%	99.42%	99.39%	99.36%
	P90	100.00%	100.00%	99.65%	99.36%	98.63%	98.01%	96.93%

Key observations are:

- With a **5%** deterioration rate per year, Availability reduces from **99.45%** in the **Base Case** (current year) to **99.42% after 10 years**;
- With a **10%** deterioration rate per year, Availability reduces from **99.45%** in the **Base Case** (current year) to **99.38% after 10 years**;
- With a **10%** deterioration rate per year, Availability reduces from **99.45%** in the **Base Case** (current year) to **99.36% after 10 years**;
- Therefore, the low running hours associated with this mode of operation, together with the level of sparing of this system result in good levels of resilience of this system against equipment deterioration.



5.5 Summary

Gas Liquefaction

Table 5.25 provides a summary of the performance of the Gas Liquefaction mode of operation, with Figure 5.13 presenting the monthly breakdown of the cumulative LNG production over a 6-month period.

Table 5.25 Gas Liquefaction Results Summary

Case	Demand (m ³)	Produced (m ³)	Shortfall (m ³)	Production Efficiency (%)	Average Hourly Production (m ³ /hr)	Availability (%)	Shortfall (%)
Mean	25,915	23,364	2,551	90.16%	5.33	89.2%	9.84%

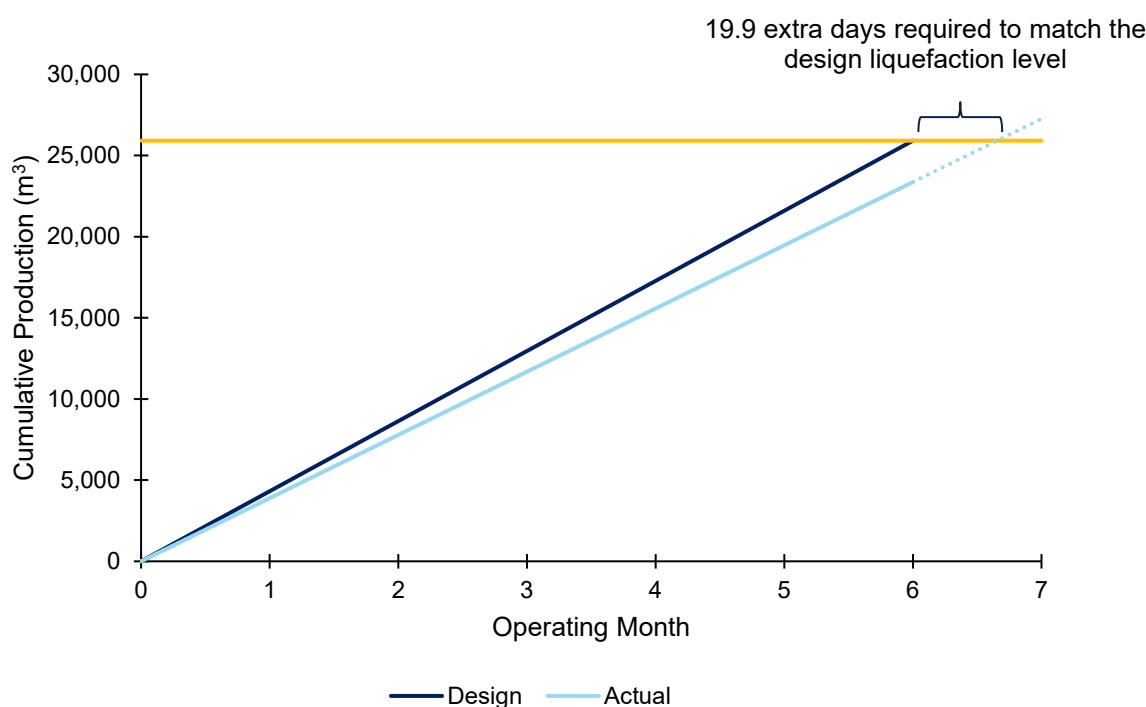


Figure 5.13 Gas Liquefaction Monthly Cumulative Production (m3)

Key observations are:

- The mean Production Efficiency (PE) of the Liquefaction system against Demand is 90.16%; 23,364 m³ of LNG are produced against a Demand of 25,915 m³.
- The mean average liquefaction rate over the 6-month period is 5.33 m³/hr;
- The minimum forecasted production volume, over a 6-month period, is 1,699 m³ (PE of 6.56% - more detail provided in section 5.1.3.2), while the maximum forecasted production volume is 25,915 m³ (i.e. no shortfall);
- In the mean average scenario, a PE of 90.16% means that 19.9 additional days would be required in order to match the design production rate of the liquefaction facility, which assumes that no production shortfall is incurred.

Table 5.26 and Figure 5.14 show the system and equipment contributors to gas liquefaction shortfall over the 6-month reviewed period.



Table 5.26 6-month System Contributors to Gas Liquefaction Shortfall

Rank	System	Gas Liquefaction Shortfall			Extra Days Required
		Absolute		Relative	
		m ³	%	%	
1	Gas Liquefaction	1,421	5.48%	55.71%	11.10
2	Gas Desiccation & Metering	858	3.31%	33.63%	6.70
3	Instrument Air & Inert Gas Generation	122	0.47%	4.80%	0.96
4	Fuel Gas	85	0.33%	3.34%	0.66
5	Spurious Trips	56	0.21%	2.18%	0.43
6	Cooling Medium	9	0.04%	0.36%	0.07
Total		2,551	9.84%	100.00%	19.92

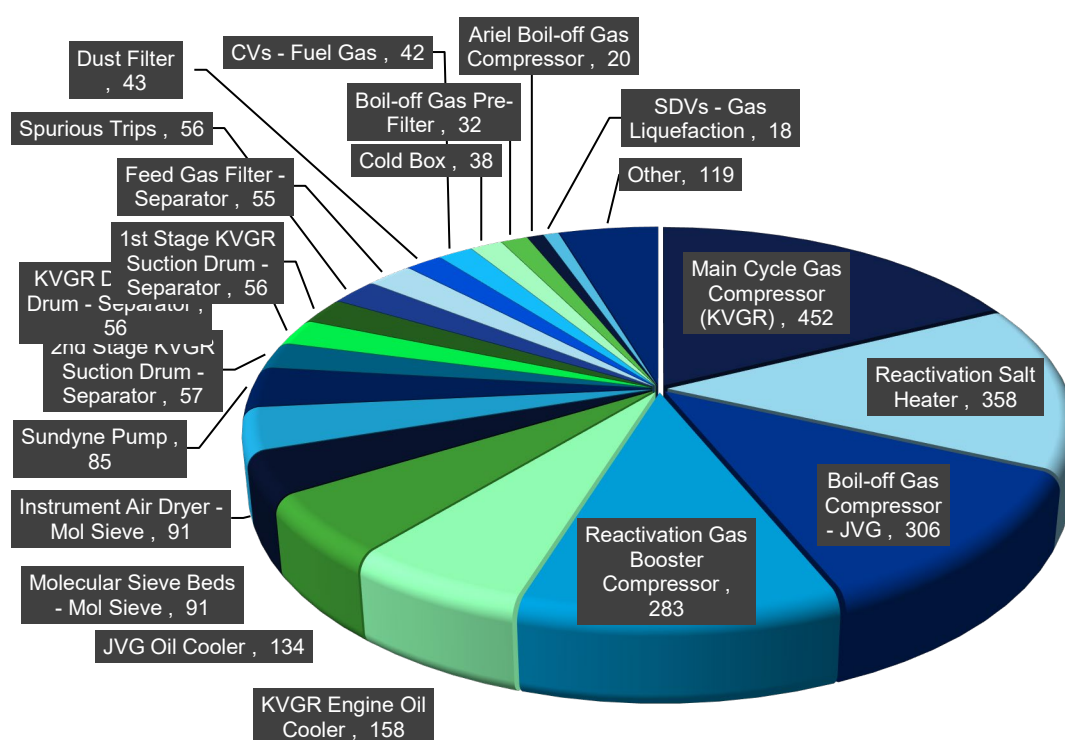


Figure 5.14 6-Month Equipment Contributors to Gas Liquefaction Shortfall (m3)

Key observations are that:

- The most significant contributor to Gas Liquefaction shortfall is the Main Cycle Gas Compressor (KVGR), which is a 1 x 100% Reciprocating Compressor (Clean Service) driven by a Gas Engine. Both units, especially the Gas Engine have long repair and logistical delays associated with a 'Major' failure that penalise production when these take place. As a result, in overall terms, this equipment causes 454 m³ (1.75% in absolute terms, 17.73% in relative terms) shortfall over the 6-month considered;
- The Reactivation Salt Heater, a Direct Hydrocarbon Fired Heater, is ranked second highest equipment contributor, with 358 m³ shortfall (1.38% in absolute terms, 14.02% in relative terms). The relatively low reliability of this 1 x 100% equipment item is responsible for its high position in the shortfall ranking;



- The Boil-off Gas Compressor (JVG) is predicted to be the third biggest shortfall contributor at an Equipment level, with 306 m³ shortfall (1.18% in absolute terms, 12.01% in relative terms). As with the KVGR Compressor, this item consists of a Reciprocating compressor (Clean Service) driven by a Gas Engine. However, unlike the KVGR, the JVG Compressor can be supported by the Ariel Compressor (up to 10% of full production rate) in the event of failure, which explains the lower shortfall contribution;
- The 4th biggest shortfall contributor is the Reactivation Gas Booster Compressor, a 1 x 100% Reciprocating Compressor (Clean Service), driven by an Electric Motor. The improved reliability of the Electric Motor in comparison to a Gas Engine is responsible for a lower ranking of this item than the KVGR and JVG Compressors, accounting for 283 m³ (1.09% in absolute terms, 11.09% in relative terms) shortfall;
- Next are the KVGR and the JVG Oil Coolers, each a Shell and Tube Heat Exchanger that cause 158 and 134 m³ Gas Liquefaction shortfall, respectively. As with the KVGR and JVG compressors, the different level of sparing due to the presence of the Ariel Compressor to support the JVG, means that a failure of the JVG Oil Cooler leads to a lower impact than a failure of the KVGR Oil Cooler;
- Molecular Sieve Beds and the Instrument Air Dryers, each a 2 x 100% Mol Sieve Bed (Clean Service), with one vessel in operation while the other is regenerating, cause each 91 m³ (0.35% in absolute terms, 3.58% in relative terms) shortfall;
- The Sundyne Pump, a 1 x 100% motor-driven Centrifugal Pump in Condensate Processing, whose failure results in a reduction of 80% in production, is ranked 9th in terms of shortfall contributors towards Gas Liquefaction, accounting for 85 91 m³ (0.33% in absolute terms) of shortfall;
- The 1st & 2nd Stage Suction Drums and the Discharge Drum associated with the cooling cycle of the KVGR (each a 1 x 100% Separators in Clean Service), are ranked 10th – 12th in terms of Gas Liquefaction shortfall, each accounting on average to approximately 56 m³ (0.22% in absolute terms) shortfall;
- Trips of the Integrated Control and Safety System (ICSS) are predicted to occur on average once a year for 4 hours, and contribute with 56 m³ (0.21% in absolute terms) shortfall;
- The Feed Gas Filter, also a 1 x 100% Separator (Clean Service) accounts for 55 m³ (0.21% in absolute terms) shortfall;
- The Dust and the Fuel Gas Filters, each a 1 x 100% Filter in the Desiccant & Metering and Fuel Gas systems, respectively, are ranked 15th – 16th in the shortfall contributors list. Each account for approximately 42.5 m³ (0.165% in absolute terms) shortfall;
- The Cold Box, essential for the Liquefaction process, is ranked 17th in terms of the contributors to Gas Liquefaction shortfall. Despite the significant repair/logistical delay associated with a 'Major' repair, its low failure frequency (high MTTF) means it does not significantly impact production. The Cold Box is therefore predicted to cause only 38 m³ (0.15% in absolute terms) shortfall. Furthermore, analysis of the 10 worst life-cycle simulations (of the total 100,000 run for the Liquefaction model) revealed that a Cold Box failure was not likely to impact an entire Liquefaction campaign. The high shortfall observed in those cases was attributed to multiple failure of equipment items with long repair times/logistical delays, but lower MTTF than the Cold Box, such as the KVGR, JVG & Reactivation Gas Booster Compressors and the Reactivation Salt Heater;
- The following items represent the 18th – 20th top contributors to Gas Liquefaction shortfall:
 - Boil-Off Gas Pre Filter (32 m³, 0.12% in absolute terms shortfall) – a Filter whose operation is supported by the existence of the Ariel Compressor;
 - Ariel Boil-Off Gas Compressor (20 m³, 0.08% in absolute terms shortfall) – a Reciprocating Compressor, motor-driven, that supports the JVG Compressor (up to 10% of full production rate);



- Multiple SDVs (mostly 1 x 100%) pertaining to Gas Liquefaction process (18 m³, 0.07%);
- Other equipment (119 m³, 0.46%).

With regard to the contributors to Gas Liquefaction shortfall in terms of Equipment Category, the main observations are:

- Reciprocating Compressors (both Gas Engine and Motor driven) are the most significant equipment type contributor to Gas Liquefaction shortfall (25.67% of total shortfall), due to their general non-spared nature and the long repair/logistical delays associated with its 'Major' failure mode (720 hours repair time and 1460 hours logistical delays for KVGR and JVG Compressors). In overall terms, Reciprocating Compressors contribute 1,061.04 m³ (4.10%) Gas Liquefaction shortfall over the 6-month period reviewed;
- Vessels, of various types, are ranked second in terms of equipment category contributors to shortfall, also due to their 1 x 100% configuration and a 2-month logistical delay associated with its 'Major' failure mode. Vessels account for 12.36% of the total Gas Liquefaction shortfall (447.71 m³, 1.73%);
- HC Direct Fired Heater, in this case, the Reactivation Salt Heater, account for 357.6 m³ (1.38%) shortfall, due to its relatively low MTTF and non-spared nature;
- Shell & Tube Heat Exchangers account for 292.5 m³ (1.13%) shortfall. The performance of the Liquefaction plant is hindered by a 3-month logistical delay associated with a 'Major' failure of this equipment category;
- Filters, also 1 x 100% items in general with a 2-month logistical delay associated with its 'Major' failure mode, rank 5th in terms of equipment category contributors to shortfall, account to 117.04 m³ (0.45%) shortfall
- Centrifugal Pumps, mainly the Sundyne Pump (non-spared with a 80% impact on production upon failure) accrue for 85.44 m³ (0.33%) shortfall;

LNG Regasification

Table 5.27 provides a summary of the performance of the LNG Regasification mode of operation.

Table 5.27 LNG Regasification Results Summary

Case	Demand (MMSCF)	Produced (MMSCF)	Shortfall (MMSCF)	Production Efficiency (%)	Average Hourly Production (MMSCFD)	Availability (%)	Shortfall (%)
Mean	630.0	628.0	2.04	99.68%	89.71	99.46%	0.32%

This demonstrates that:

- The mean 6.67-day LNG Regasification Efficiency against Demand is 99.68%: 628.0 MMSCF of LNG are vapourised against a Demand of 630 MMSCF;
- The mean average daily vaporisation rate over the 6.67-day period is 89.71 MMSCFD.



Table 5.28 and Figure 5.15 show the system and equipment contributors to gas liquefaction shortfall over the 7-day reviewed period.

Table 5.28 LNG Regasification System Contributors to Shortfall

Rank	System	LNG Regasification Shortfall		
		Absolute		Relative
		MMSCF	%	%
1	LNG Pumping and Vaporisation	1.62	0.26%	79.48%
2	Instrument Air & Inert Gas Generation	0.42	0.07%	20.52%
Total		2.04	0.32%	100.00%

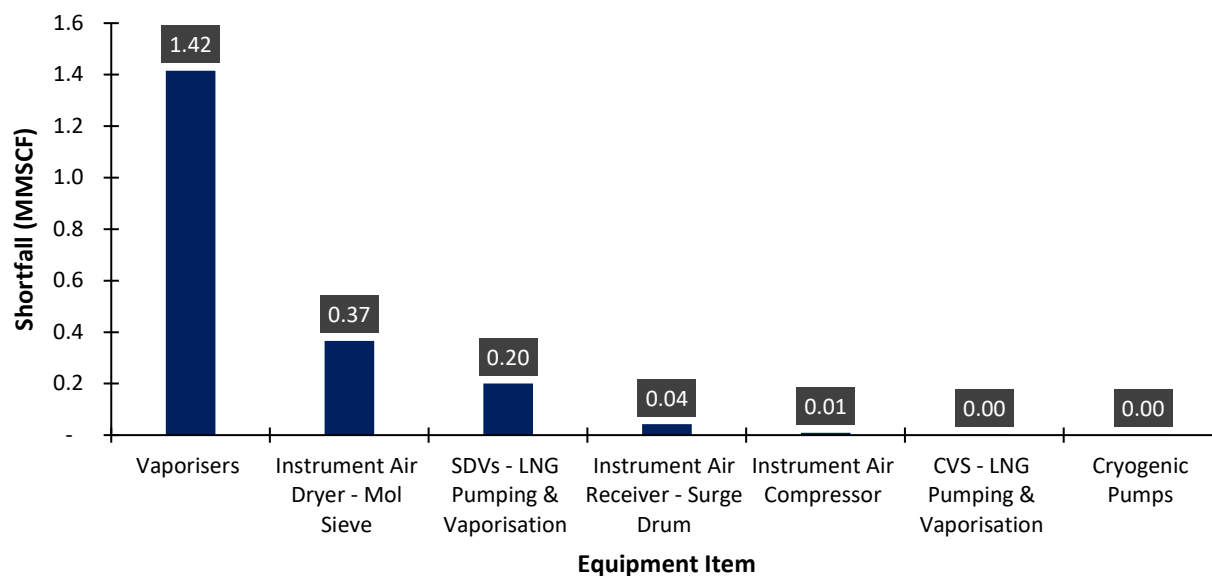


Figure 5.15 LNG Regasification Equipment Contributors to Shortfall (MMSCF)

Key observations are that:

- Vaporisers are the main responsible for the LNG Regasification shortfall, accounting for 1.42 MMSCF shortfall (0.22% in absolute terms, 69.54% in relative terms). This is due to the relative low reliability nature of this equipment item;
- The following items contribute to the remaining 30.46% of relative shortfall:
 - Instrument Air Dryers (0.37 MMSCF shortfall, 0.06% in absolute terms, 18.00% in relative terms) – 2 x 100% Mol Sieves, 1 in operation while the other is in regeneration mode;
 - Multiple SDVs pertaining to the LNG Pumping & Vaporisation system (0.20 MMSCF shortfall, 0.03% in absolute terms, 9.86% in relative terms);
 - Instrument Air Receiver (0.04 MMSCF shortfall, 0.01% in absolute terms, 2.06% in relative terms) – a 1 x 100% Surge Drum;
 - Instrument Air Compressor (0.01 MMSCF shortfall, <0.01% in absolute terms, 0.46% in relative terms) – 2 x 100% Screw Compressors;
 - Multiple CVs pertaining to the LNG Pumping & Vaporisation system (<0.01 MMSCF shortfall, <0.01% in absolute terms, 0.06% in relative terms);
 - Finally, the Cryogenic Pumps accrue no mentionable shortfall, given their 3 x 50% configuration and relatively high reliability nature.



Gas Compression

Table 5.29 provides a summary of the performance of the Gas Compression mode of operation.

Table 5.29 Gas Compression Results Summary		
Case	Availability (%)	Unavailability (%)
Mean	99.45%	0.55%

Table 5.29 shows that on average the Gas Compression system is fully operable for 99.45% of the required time, and not operable for 0.55% over the 4 winter months considered (intermittent operation).

The key equipment contributors to Gas Compression Unavailability over the 192-hour period considered are shown in Table 5.30 and Figure 5.16.

Table 5.30 Equipment Contributors to Gas Compression Unavailability			
Rank	Equipment	Gas Compression Unavailability	
		Absolute %	Relative %
1	Solar Gas Turbine	0.28%	51.11%
2	Solar Gas Turbine Compressor	0.27%	48.60%
3	Gas Compressor Suction Scrubber - Scrubber	<0.01%	0.30%
Total		0.55%	100.00%

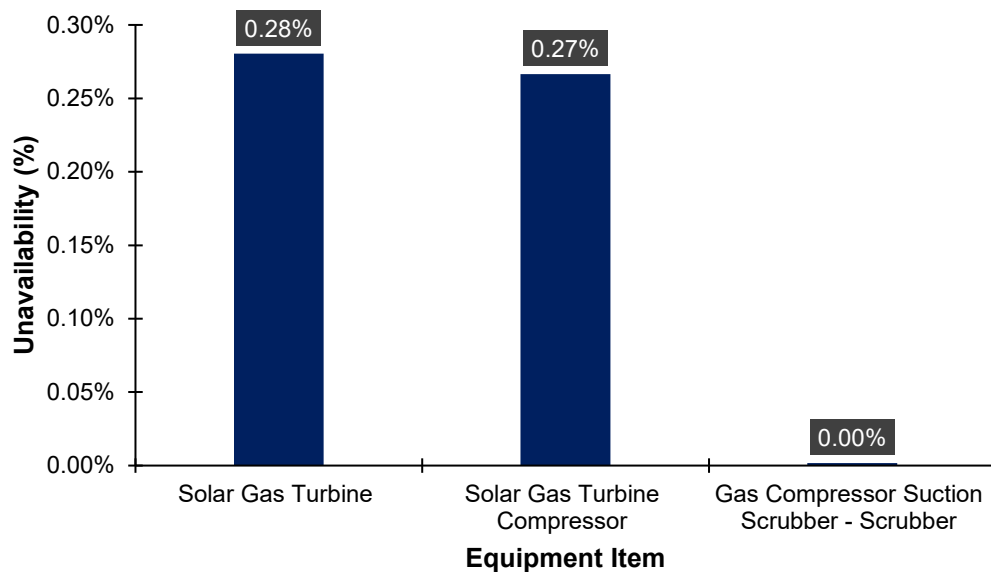


Figure 5.16 Equipment Contributors to Gas Compression Unavailability (%)

Key observations are:

- Fail to start on demand, as defined in Section 4.4.3.4, contribute to 99.4% of the total Unavailability (0.55% in absolute terms) of the Gas Compression system, with running failures responsible for the remaining 0.6%. This Unavailability has been equally assigned to the Solar Gas Turbine and Solar Gas Turbine Compressor;
- Solar Gas Turbines, used in a 2 x 100% configuration to drive the Compressors, result in 0.28% in absolute Unavailability (51.11% in relative terms, mainly due to failure to start on demand);



- Solar Gas Turbine Compressor, in a 2 x 100% configuration, result in 0.27% in absolute Unavailability (48.6% in relative terms, also mainly due to failure to start on demand. The slightly better reliability of Centrifugal Compressor in relation to Gas Turbines result in the marginally reduced Unavailability of this equipment item;
- Lastly, the Gas Compression Scrubbers, in a 2 x 100% configuration, account for less than 0.01% of the absolute Unavailability (0.30% in relative terms).

The high Availability recorded in the Gas Compression Case (99.45%) can be attributed to the 2 x 100% configuration of its equipment items and the low running nature of the Gas Compression campaign.

Sensitivity Cases

The performance impact of several design and operating assumptions are assessed through the following Sensitivity Cases:

- Sensitivity Case 1: New Plant Data;
- Sensitivity Case 2: Plant Deterioration.

Sensitivity Case 1:

- Liquefaction

The performance impact of installing new equipment was assessed against the Liquefaction mode of operation. Table 5.31 presents the overall results for Production Efficiency and Extra Days Required.

Table 5.31 Results Summary for Sensitivity Case 1 – Liquefaction Mode

Metric	Gas Liquefaction	
	Base Case	New Plant
Production Efficiency (%)	90.16%	93.85%
Improvement (%)		+3.70%
Extra Days Required	19.9	11.9
Day Improvement		-8.0

Key observations are:

- Replacing the existing plant (with new) is predicted to result in a Gas Liquefaction Production Efficiency of 93.85%, an improvement of 3.70% on the availability forecast of the current plant (90.16%);
- A new plant is predicted to require an additional 11.9 days operating to match the design production level over a 6-month period (8 days improvement on the current plant forecast).

The new shortfall contributor analysis shows that:

- Replacing the compressors units (compressor & respective driver), shows some improvements. This is more evident however in units being driven by a gas engine. However, given that the changes made only affect the repair / logistical delay times associated with infrequent failure modes, the more frequent failure modes still lead to production shortfall, leaving them still at the top of the contributors list;
- Similar changes in data were made to Vessels & Heat Exchangers. Given the high number of these equipment items across the plant, the benefit of replacing vessels & exchangers is more visible;
- Reducing the repair time associated with a Cold Box failure resulted in some, but no significant improvement;
- Sparing of equipment would be an additional alternative to reduce the existing production shortfall.



- LNG Regasification

The performance impact of installing new equipment was assessed for the LNG Regasification mode of operation. Table 5.32 presents the overall results for Production Efficiency. Installing new equipment results in a PE increase of 0.21% (from 99.68% to 99.88%).

Table 5.32 Results Summary for Sensitivity Case 1 – LNG Regasification Mode

Metric	LNG Regasification	
	Base Case	New Plant
Production Efficiency (%)	99.68%	99.88%
Improvement (%)		+0.21%

Vaporisers were responsible for 69.54% of the Base Case shortfall, and are also responsible for the majority of the PE improvement from installing new plant. With reduced logistical delays associated with their repair, overall shortfall is significantly reduced, from 1.42 MMSCF to 0.11 MMSCF.

- Gas Compression

No visible changes were observed in this Sensitivity Case, given the low running hours and the level of sparing of gas compression equipment. As such, results are not presented for this mode of operation.

Sensitivity Case 2:

- Liquefaction

The performance impact of existing equipment pertaining to the Liquefaction mode of operation deteriorating at different rates was assessed. Table 5.33 and Table 5.34 summarise the detrimental impact that 5% and 15% deterioration rates per year have on Production Efficiency, respectively.

Table 5.33 5% per Year Deterioration Gas Liquefaction Case Results

		Year						
		Base Case	1	2	3	4	5	10
Production Efficiency (%)	Mean	90.16%	89.96%	89.58%	89.12%	88.72%	88.21%	86.24%
Over-run (days)	Mean	19.9	20.4	21.2	22.3	23.2	24.4	29.1

Table 5.34 15% per Year Deterioration Gas Liquefaction Case Results

		Year						
		Base Case	1	2	3	4	5	10
Production Efficiency (%)	Mean	90.16%	89.57%	88.73%	87.80%	86.99%	86.21%	78.92%
Over-run (days)	Mean	19.9	21.2	23.2	25.4	27.3	29.2	48.7

Key observations are:

- With a **5%** deterioration rate per year, Production Efficiency reduces from **90.16%** in the **Base Case** (current year) to **86.24% after 10 years**. In absolute terms, this means that the current **over-run** of the system to match the designed liquefaction rate will need to **increase from 19.9 days to 29.1 days**;



- With a **15%** deterioration rate per year, Production Efficiency reduces from **90.16%** in the **Base Case** (current year) to **79.82% after 10 years**. In absolute terms, this means that the current **over-run** of the system to match the designed liquefaction rate will need to **increase from 19.9 days to 48.7 days**.

- LNG Regasification

The performance impact of current equipment pertaining to the LNG Regasification mode of operation deteriorating at different rates was assessed. Table 5.35 and Table 5.36 summarise the detrimental impact that 5% and 15% deterioration rates per year have on Production Efficiency, respectively.

Table 5.35 5% per Year Deterioration LNG Regasification Case Results

		Year						
		Base Case	1	2	3	4	5	10
Production Efficiency (%)	Mean	99.68%	99.65%	99.62%	99.60%	99.57%	99.53%	99.37%

Table 5.36 15% per Year Deterioration LNG Regasification Case Results

		Year						
		Base Case	1	2	3	4	5	10
Production Efficiency (%)	Mean	99.68%	99.60%	99.50%	99.41%	99.30%	99.19%	98.53%

Key observations are:

- With a **5%** deterioration rate per year, Production Efficiency reduces from **99.68%** in the **Base Case** (current year) to **99.37% after 10 years**;
- With a **15%** deterioration rate per year, Production Efficiency reduces from **99.68%** in the **Base Case** (current year) to **98.53% after 10 years**.

- Gas Compression

The performance impact of current equipment pertaining to the Gas Compression mode of operation deteriorating at different rates was assessed. Table 5.37 and Table 5.38 summarise the detrimental impact that 5% and 15% deterioration rates per year have on Availability, respectively.

Table 5.37 5% per Year Deterioration Gas Compression Case Results

		Year						
		Base Case	1	2	3	4	5	10
Availability (%)	Mean	99.45%	99.45%	99.44%	99.44%	99.45%	99.44%	99.42%

Table 5.38 15% per Year Deterioration Gas Compression Case Results

		Year						
		Base Case	1	2	3	4	5	10
Availability (%)	Mean	99.45%	99.44%	99.43%	99.43%	99.42%	99.39%	99.36%

Key observations are:

- With a **5%** deterioration rate per year, Availability reduces from **99.45%** in the **Base Case** (current year) to **99.42% after 10 years**;
- With a **10%** deterioration rate per year, Availability reduces from **99.45%** in the **Base Case** (current year) to **99.36% after 10 years**;
- Therefore, the low running hours associated with this mode of operation, together with the level of sparing of this system result in good levels of resilience of this system against equipment deterioration.



6 REFERENCES

- /1/ "Hagar LNG Asset Management Plan 2021 – 2025"
- /2/ Piping and Instrumentation Diagrams, A444-00A to A444-00L
- /3/ "Union Gas Hagar Plant Condition Assessment Preliminary Review", Jenmar Concepts Report, 17th May 2017
- /4/ "Hagar Peak Shaving Facility Operability"



APPENDIX A – RELIABILITY DATA

Appendix A presents the reliability data that will be used in the RAM models. The text in green represents the instances where OREDA data was modified to reflect a particular asset-specific data input based on Enbridge's operating experience.

Pump Failure Data

Type	Service	MTTF (yrs)	Repair Category	MTTF for repair category	Repair Time (hrs)		Mobilisation Delay		Source		Comment
					Min	Max	Category	Delay (hrs)	MTTF	Repair Time	
Pump - Centrifugal	Condensate Processing	0.47	Seals & Bearings	2.6	2.0	6.0	Minor	2.0	OREDA 2009	Expert judgment	To be used for the NGL and condensate services, absorber bottom pumps.
			Minor other repairs	0.6	2.0	6.0	Minor	2.0			
			Major repairs	15.8	24.0	72.0	Major	48.0			
	Generic Service	1.03	Seals & Bearings	5.7	8.0	22.0	Minor	2.0	OREDA 2015	Expert judgment (DNV & Enbridge)	To be used for the centrifugal pumps except for the condensate services, for example: LPG services, heating medium, wash water, demin water, amine pumps, flare pumps, cooling medium, reflux pumps
			Minor other repairs	1.3	8.0	22.0	Minor	2.0			
			Major repairs	34.2	48.0	80.0	Major	48.0			
Pump – Reciprocating	Generic Service	0.97	Seals & Bearings	16.2	1.0	4.0	Minor	2.0	OREDA 2015	Expert judgment	To be used for reciprocating pumps in generic services.
			Minor other repairs	1.3	1.0	4.0	Minor	2.0			
			Major onshore repairs	4.6	24.0	72.0	Major	48.0			



Compressor and Generator Failure Data

Type	Service	MTTF (yrs)	Repair Category	MTTF for repair category	Repair Time (hrs)		Mobilisation Delay		Source		Comment
					Min	Max	Category	Delay (hrs)	MTTF	Repair Time	
Centrifugal Compressor	Generic service	0.57	instr./minor	1.1	4.0	4.0	Minor	2.0	OREDA 2015	Expert judgment	To be used for centrifugal compressors, independently from the driver. Separate data for drivers need to be used.
			Seals & Bearings	6.3	24.0	48.0	Minor	2.0			
			intermediate repair	1.5	24.0	48.0	Major	48.0			
			major repairs	18.9	240	720.0	Specialist Crew	120.0			
Centrifugal Compressor	Liquefaction service	2.24	instr./minor	4.4	4.0	4.0	Minor	2.0	DNV Confidential	DNV Confidential	To be used for centrifugal compressors in liquefaction service (cycle compressor). Separate data for drivers need to be used.
			Seals & Bearings	24.9	24.0	48.0	Minor	2.0			
			intermediate repair	6.1	24.0	48.0	Major	48.0			
			major repairs	74.7	240	720.0	Specialist Crew	120.0			
Reciprocating Compressor	Generic service	0.25	instr./minor	0.6	4.0	4.0	Minor	2.0	OREDA 2009	Expert judgment	To be used for EM driven reciprocating compressors. Separate data for drivers need to be used.
			Seals & Bearings	25.3	24.0	24.0	Minor	2.0			
			intermediate repair	0.5	12.0	24.0	Major	48.0			
			major repairs	25.3	72.0	240.0	Specialist Crew	120.0			
Reciprocating Compressor	Clean service / Liquefaction service	0.63	instr./minor	1.4	4.0	4.0	Minor	2.0	OREDA 2009 Modified	Expert judgment (DNV & Enbridge)	To be used for reciprocating compressors. Separate data for drivers need to be used. Maximum 720-hr repair time applicable to KVGR, JVG, Ariel and Reactivation Gas Booster Compressors
			Seals & Bearings	63.1	24.0	24.0	Minor	2.0			
			intermediate repair	1.2	12.0	24.0	Major	48.0			
			major repairs	63.1	72.0	720.0	Specialist Crew	120.0			
Screw Compressor	Generic service	0.81	instr./minor	1.5	4.0	4.0	Minor	2.0	OREDA 2009	Expert judgment	To be used for EM driven screw compressors. Separate data for drivers need to be used.
			Seals & Bearings	10.1	24.0	24.0	Minor	2.0			
			intermediate repair	2.4	12.0	24.0	Major	48.0			



Type	Service	MTTF (yrs)	Repair Category	MTTF for repair category	Repair Time (hrs)		Mobilisation Delay		Source		Comment
					Min	Max	Category	Delay (hrs)	MTTF	Repair Time	
Electrical Power Generator	Motor driven (diesel, gas motor)	3.80	major repairs	27.1	72.0	240.0	Major	48.0	OREDA 2015	Expert judgment	To be used for all electrical generators.
			instr./minor	5.9	4.0	4.0	Minor	2.0			
			intermediate repair	11.5	24.0	48.0	Minor	2.0			
			major repairs	95.0	120	720.0	Major	48.0			



Driver Failure Data

Type	Service	MTTF (yrs)	Repair Category	MTTF for repair category	Repair Time (hrs)		Mobilisation Delay		Source		Comment
					Min	Max	Category	Delay (hrs)	MTTF	Repair Time	
Pump Driver: Electric Motor	Condensate Processing	2.9	instr./minor	3.6	4.0	12.0	Minor	2.0	OREDA 2009	Expert judgment (DNV & Enbridge)	To be used for EM of condensate processing pumps 720-hr "Major" mobilisation time applicable for Sundyne Pump, to allow for procurement delay, given the lack of spare inventory.
			intermediate repair	24.1	12.0	24.0	Minor	2.0			
			major repair	41.4	48.0	120.0	Major	48.0 720.0			
	Generic service	5.82	instr./minor	7.2	4.0	6.0	Minor	2.0	OREDA 2015	Expert judgment	To be used for all other EM pump drivers.
			intermediate repair	48.5	12.0	24.0	Minor	2.0			
			major repair	83.2	48.0	240.0	Major	48.0			
Compressor Driver: Electric Motor	Generic service	4.11	instr./minor	5.1	4.0	6.0	Minor	2.0	OREDA 2015	Expert judgment (DNV & Enbridge)	To be used for all electric motors driving compressors. 240-hr "Major" mobilisation time applicable for BOG Ariel Compressor Driver.
			intermediate repair	34.2	24.0	48.0	Minor	2.0			
			major repair	58.7	48.0	120.0	Major	48.0 240.0			
Compressor Driver: Industrial Gas Turbine	Generic service	0.21	instr./control valves	0.4	4.0	8.0	Minor	2.0	OREDA 2009	Expert judgment (DNV & Enbridge)	To be used for industrial GT drivers 1095-hr "Major" mobilisation time (~6 weeks), reflecting the possibility of engine core not being in stock.
			minor failures	1.5	4.0	8.0	Minor	2.0			
			intermediate repair	0.6	24.0	48.0	Major	48.0			
			major repair	21.3	120.0	240.0	Specialist Crew	1095.0			
Diesel/Gas Combustion Engine	Generic service	2.08	instr./minor	2.9	4.0	12.0	Minor	2.0	OREDA 2015	Expert judgment	To be used for all diesel/gas motors driving compressors 720-hr "Major" repair and 1460-hr "Major" mobilisation times applicable only to Diesel Gas Combustion Engines for JVG and KVGR compressors
			intermediate repair	9.9	24.0	48.0	Minor	2.0			
			major repair	29.7	48.0	240.0 720.0	Major	48.0 1460.0			



Heat Exchanger Failure Data

Type	Service	MTTF (yrs)	Repair Category	MTTF for repair category	Repair Time (hrs)		Mobilisation Delay		Source		Comment
					Min	Max	Category	Delay (hrs)	MTTF	Repair Time	
Shell & Tube Heat Exchanger	Generic Service	4.49	instr./minor	7.2	4.0	6.0	Minor	2.0	OREDA 2015	Expert Judgment (DNV & Enbridge)	To be used for all Shell & Tube Heat Exchangers in generic service: reboilers, condensers, coolers, heaters. 2190-hr "Major" mobilisation time (3 months), reflecting the time associated with the procurement of this item.
			intermediate repair	18.7	24.0	48.0	Minor	2.0			
			major repair	32.1	48.0	120.0	Major	2190.0			
Shell & Tube Heat Exchanger	Clean Service	11.24	instr./minor	18.1	4.0	6.0	Minor	2.0	OREDA 2015 modified	Expert Judgment (DNV & Enbridge)	To be used for all Shell & Tube Heat Exchangers in generic service: reboilers, condensers, coolers, heaters. 2190-hr "Major" mobilisation time (3 months), reflecting the time associated with the procurement of this item.
			intermediate repair	46.8	24.0	48.0	Minor	2.0			
			major repair	80.3	48.0	120.0	Major	2190.0			
Air Coolers	Clean Service	33.34	instr./minor	36.6	4.0	6.0	Minor	2.0	OREDA 2009 modified	Expert Judgment	Air Cooler (Fin Fan Heat Exchanger) in clean service. Data includes failure of the motors and fans
			intermediate repair	1111.3	24.0	48.0	Minor	2.0			
			major repair	555.6	48.0	120.0	Major	48.0			



Vessel Failure Data

Type	Service	MTTF (yrs)	Repair Category	MTTF for repair category	Repair Time (hrs)		Mobilisation Delay		Source		Comment
					Min	Max	Category	Delay (hrs)	MTTF	Repair Time	
Molecular Sieve Dryer	Generic Service	3.91	instr./minor	5.4	4.0	12.0	Minor	2.0	OREDA 2015	Expert judgment (DNV & Enbridge)	Use this for molecular sieve beds. 1460-hr "Major" mobilisation time (2 months), reflecting the time associated with the procurement of this item.
			Intermediate Repairs	24.4	12.0	24.0	Minor	2.0			
			Major Repairs	35.5	48.0	120.0	Major	1460.0			
Molecular Sieve Dryer	Clean Service	9.77	instr./minor	13.4	4.0	12.0	Minor	2.0	OREDA 2015 modified	Expert judgment (DNV & Enbridge)	Use this for molecular sieve beds. 1460-hr "Major" mobilisation time (2 months), reflecting the time associated with the procurement of this item.
			Intermediate Repairs	61.0	12.0	24.0	Minor	2.0			
			Major Repairs	88.8	48.0	120.0	Major	1460.0			
Filter	Normal Service	10.26	instr./minor	14.1	2.0	4.0	Minor	2.0	DNV	Expert judgment (DNV & Enbridge)	No data in OREDA. Use this for generic filters, sock filters, carbon filters, basket filters, coalescers, filtration packages. 1460-hr "Major" mobilisation time (2 months), reflecting the time associated with the procurement of this item.
			intermediate repair	64.1	4.0	12.0	Minor	2.0			
			major repair	93.3	48.0	120.0	Major	1460.0			
Separator	Generic Service	3.18	instr./minor	4.4	2.0	4.0	Minor	2.0	OREDA 2009	Expert judgment (DNV & Enbridge)	Use this for Separators, slugcatchers, flare drums. 1460-hr "Major" mobilisation time (2 months), reflecting the time associated with the procurement of this item.
			intermediate repair	19.9	4.0	24.0	Minor	2.0			
			major repair	28.9	48.0	120.0	Major	1460.0			
Separator	Clean Service	7.94	instr./minor	10.9	2.0	4.0	Minor	2.0	OREDA 2009 modified	Expert judgment (DNV & Enbridge)	Use this for Separators, slugcatchers, flare drums. 1460-hr "Major" mobilisation time (2 months), reflecting the time associated with the procurement of this item.
			intermediate repair	49.7	4.0	24.0	Minor	2.0			
			major repair	72.2	48.0	120.0	Major	1460.0			
Scrubber	Generic Service	1.04	instr./minor	1.4	2.0	4.0	Minor	2.0	OREDA 2015	Expert judgment (DNV & Enbridge)	Use this for scrubbers. 1460-hr "Major" mobilisation time (2 months), reflecting the time associated with the procurement of this item.
			intermediate repair	6.5	4.0	24.0	Minor	2.0			
			major repair	9.4	48.0	120.0	Major	1460.0			
Scrubber	Clean Service	2.59	instr./minor	3.5	2.0	4.0	Minor	2.0	OREDA 2015 modified	Expert judgment (DNV & Enbridge)	Use this for scrubbers. 1460-hr "Major" mobilisation time (2 months), reflecting the time associated with the procurement of this item.
			intermediate repair	16.2	4.0	24.0	Minor	2.0			
			major repair	23.6	48.0	120.0	Major	1460.0			



Type	Service	MTTF (yrs)	Repair Category	MTTF for repair category	Repair Time (hrs)		Mobilisation Delay		Source		Comment
					Min	Max	Category	Delay (hrs)	MTTF	Repair Time	
Surge Drums	Generic Service	16.89	instr./minor	23.1	4.0	12.0	Minor	2.0	OREDA 2009	Expert judgment(DNV & Enbridge)	Use this for surge drums, expansion drums. 1460-hr "Major" mobilisation time (2 months), reflecting the time associated with the procurement of this item.
			intermediate repair	105.5	12.0	24.0	Minor	2.0			
			major repair	153.5	48.0	120.0	Major	1460.0			
Surge Drums	Clean Service	42.22	instr./minor	57.8	4.0	12.0	Minor	2.0	OREDA 2009 modified	Expert judgment(DNV & Enbridge)	Use this for surge drums, expansion drums. 1460-hr "Major" mobilisation time (2 months), reflecting the time associated with the procurement of this item.
			intermediate repair	263.8	12.0	24.0	Minor	2.0			
			major repair	383.8	48.0	120.0	Major	1460.0			

Non-Generic Equipment Failure Data

Type	Failure Mode	MTTF (yrs)	Repair Time (hrs)		Mobilisation Delay		Source	Comment
			Min	Max	Category	Delay (hrs)		
Nitrogen generation package	Critical	7.5	12	12	Minor	2.0	DNV	-
Control Valve	Critical	16.5	14.2	14.2	Minor	2.0	OREDA 2002	-
Choke Valve	Erosion	6.9	60.0	60.0	Minor	2.0	DNV	-
On/Off Valve	Critical	31.8	2.0	4.0	Minor	2.0	OREDA 2009	-
PCV Valve	Spurious Closure	60.0	2.0	4.0	Minor	2.0	OREDA 2009	-
JT Valve	Critical	16.5	14.2	14.2	Minor	2.0	DNV	Effectively modelled as a Control Valve
Manual Valve	External Leakage	76.1	2.0	4.0	Minor	2.0	Exida 2008	-
Shutdown Valve	Critical	20.4	20.0	20.0	Minor	2.0	OREDA 2015	-
Blowdown Valve	Critical	13.2	16	16	Minor	2.0	OREDA 2015	-



LNG-Specific Equipment Failure Data

Cold Box Failure Data

Type	Failure Mode	MTTF (yrs)	Repair Time (hrs)		Source
			Min	Max	
Cold Box	Minor	50.0	240.0		DNV
	Major	200.0	504.0	2190.0	DNV & Enbridge

LNG Pump Failure Data

Type	Failure Mode	MTTF (yrs)	Repair Time (hrs)		Mobilisation Delay		Source	Comment
			Min	Max	Category	Delay (hrs)		
LNG Pump	Critical	50.0	168.0	336.0	Major	48.0	DNV	-

Vaporiser Failure Data

Type	MTTF (yrs)	Repair Category	MTTF for repair category	Repair Time (hrs)		Mobilisation Delay		Source		Comment
				Min	Max	Category	Delay (hrs)	MTTF	Repair Time	
Vaporiser	0.82	Minor	0.91	70.0	70.0	Minor	2.0	DNV	Expert Judgment (DNV & Enbridge)	The MTTF values for repair category assume a 90% (minor repair) / 10% (major repair) split of the generic MTTF. Repair times are assumed to be the same for each repair category. However, the "Major" repair category requires a "Major" mobilisation delay of 2190.0 hours (3 months) for procurement of replacement unit.
		Major	8.2	70.0	70.0	Major	2190.0			



APPENDIX B – NEW PLANT DATA

Type	Service	MTTF (yrs)	Repair Category	MTTF for repair category (years)	Current Reliability Data						Proposed "New Plant" Reliability Data						Difference
					Repair Time (hrs)		Mobilisation Delay		Downtime (hrs/year)	Reliability (%)	Repair Time (hrs)		Mobilisation Delay		Downtime (hrs/year)	Reliability (%)	
					Min	Max	Category	Delay (hrs)			Min	Max	Category	Delay (hrs)			
Rotating Equipment																	
Reciprocating Compressor	Clean service / Liquefaction service	0.63	instr./minor	1.4	4	4	Minor	2	4.3	99.23%	4	4	Minor	2	4.3	99.27%	0.04%
			Seals & Bearings	63.1	24	24	Minor	2	0.4		24	24	Minor	2	0.4		
			intermediate repair	1.2	12	24	Major	48	55.0		12	24	Major	48	55.0		
			major repairs	63.1	72	720	Specialist Crew	120	8.2		72	240	Specialist Crew	120	4.4		
Driver																	
Pump Driver: Electric Motor	Condensate Processing	2.9	instr./minor	3.6	4	12	Minor	2	2.8	99.74%	4	12	Minor	2	2.8	99.92%	0.19%
			intermediate repair	24.1	12	24	Minor	2	0.8		12	24	Minor	2	0.8		
			major repair	41.4	48	120	Major	720	19.4		48	120	Major	48	3.2		
Compressor Driver: Electric Motor	Generic service	4.11	instr./minor	5.1	4	6	Minor	2	1.4	99.91%	4	6	Minor	2	1.4	99.95%	0.04%
			intermediate repair	34.2	24	48	Minor	2	1.1		24	48	Minor	2	1.1		
			major repair	58.7	48	120	Major	240	5.5		48	120	Major	48	2.2		
Compressor Driver: Industrial Gas Turbine	Generic service	0.21	instr./control valves	0.4	4	8	Minor	2	20.0	97.43%	4	8	Minor	2	20.0	97.95%	0.52%
			minor failures	1.5	4	8	Minor	2	5.3		4	8	Minor	2	5.3		
			intermediate repair	0.6	24	48	Major	48	140.0		24	48	Major	48	140.0		
			major repair	21.3	120	240	Specialist Crew	1095	59.9		120	240	Specialist Crew	120	14.1		
Diesel/Gas Combustion Engine	Generic service	2.08	instr./minor	2.9	4	12	Minor	2	3.4	99.21%	4	12	Minor	2	3.4	99.84%	0.63%
			intermediate repair	9.9	24	48	Minor	2	3.8		24	48	Minor	2	3.8		
			major repair	29.7	48	720	Major	1460	62.1		48	240	Major	48	6.5		
Heat Exchanger																	
Shell & Tube Heat Exchanger	Generic Service	4.49	instr./minor	7.2	4	6	Minor	2	1.0	99.16%	4	6	Minor	2	1.0	99.92%	0.76%
			intermediate repair	18.7	24	48	Minor	2	2.0		24	48	Minor	2	2.0		
			major repair	32.1	48	120	Major	2190	70.8		48	120	Major	48	4.1		
Vessel																	
Molecular Sieve Dryer	Clean Service	9.77	instr./minor	13.4	4	12	Minor	2	0.7	99.79%	4	12	Minor	2	0.7	99.97%	0.18%
			Intermediate Repairs	61	12	24	Minor	2	0.3		12	24	Minor	2	0.3		
			Major Repairs	88.8	48	120	Major	1460	17.4		48	120	Major	48	1.5		
Filter	Normal Service	10.26	instr./minor	14.1	2	4	Minor	2	0.4	99.81%	2	4	Minor	2	0.4	99.98%	0.17%
			intermediate repair	64.1	4	12	Minor	2	0.2		4	12	Minor	2	0.2		
			major repair	93.3	48	120	Major	1460	16.5		48	120	Major	48	1.4		
Separator	Clean Service	7.94	instr./minor	10.9	2	4	Minor	2	0.5	99.75%	2	4	Minor	2	0.5	99.97%	0.22%
			intermediate repair	49.7	4	24	Minor	2	0.3		4	24	Minor	2	0.3		
			major repair	72.2	48	120	Major	1460	21.4		48	120	Major	48	1.8		
Scrubber	Clean Service	2.59	instr./minor	3.5	2	4	Minor	2	1.4	99.23%	2	4	Minor	2	1.4	99.91%	0.68%
			intermediate repair	16.2	4	24	Minor	2	1.0		4	24	Minor	2	1.0		
			major repair	23.6	48	120	Major	1460	65.4		48	120	Major	48	5.6		
Surge Drums	Clean Service	42.22	instr./minor	57.8	4	12	Minor	2	0.2	99.95%	4	12	Minor	2	0.2	99.99%	0.04%
			intermediate repair	263.8	12	24	Minor	2	0.1		12	24	Minor	2	0.1		
			major repair	383.8	48	120	Major	1460	4.0		48	120	Major	48	0.3		



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Report of Observations: Independent Asset Integrity Review

Enbridge Gas Inc.

Date December 20, 2021

Revision Revision 1

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Prepared for Enbridge Gas Inc. (EGI)
500 Consumers Road
North York Victoria Park, ON
Canada

Prepared by Dynamic Risk Assessment Systems, Inc.

Suite 1110, 333 – 11th Avenue SW
Calgary, Alberta, Canada
T2R 1L9
Phone: (403) 547-8638

www.dynamicrisk.net

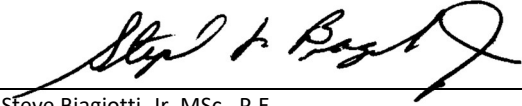
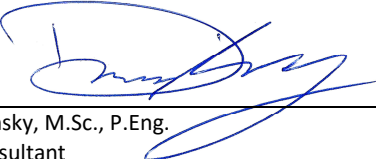
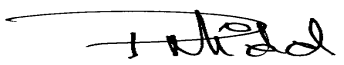
Waterway Plaza Two, Suite 250
10001 Woodloch Forest Drive
The Woodlands, TX 77380
Phone: (832) 482-0606

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Signatures

Prepared for	Enbridge Gas, Inc.
Prepared by	Signature 
	Steve Biagiotti, Jr, MSc., P.E. Principal Consultant
Reviewed by	Signature 
	Darren Skibinsky, M.Sc., P.Eng. Principal Consultant
Approved by	Signature 
	Phillip Nidd Senior Advisor, Technical Services

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Executive Summary

Dynamic Risk performed an Independent Asset Integrity Review (IAIR, the Review) of all Transmission Integrity Management Program (TIMP) pipelines as identified by Enbridge Gas Inc. (EGI) (559 pipelines, 3,675.47 km). The objective of the integrity asset review was to independently establish the level of confidence in EGI established fitness for service threat assessment conclusions for all EGI TIMP gas pipeline assets. Nine (9) designated gas pipeline integrity threats (and sub-threats) were assessed (see Section 1.2 for a list of threats.) The Review approach assessed TIMP data uncertainties with a focus on susceptibility assessment/conclusions; consideration of condition assessments conducted to date; application of controls (lagging indicator review) combined with planned activities (leading indicator review) designed to provide insight into the integrity condition assessment. The Review did not assess integrity program adequacy, execution, completeness, or design, but identified uncertainties in threat conditions.

The project was performed in two phases, initiating with the collaborative development of a technically-driven basis for the awareness of threat susceptibility indicators. The goal of this first phase was to determine to what extent EGI was using known factors to recognize a need for threat investigation. Logic Trees for each of the nine threats were developed as a basis to perform this assessment. The logic applied was not focused on historical degradation or an evaluation of preventive and mitigative measures. The second phase involved the application of EGI data using the developed Logic Trees to establish the level of uncertainty (or confidence) and understanding of threat management activity. This threat uncertainty analysis was not a Fitness for Service evaluation, nor an assessment of threat severity, but an analysis to determine the level of confidence in threat management as applied to each asset.

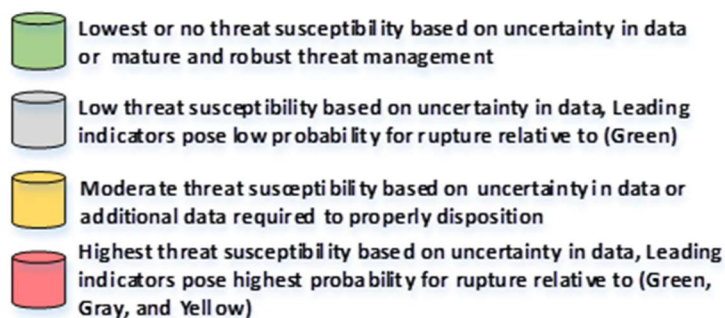
This review was conducted at the asset level. Assets were classified based on the application of the least certain or most conservative condition. Further investigation of the assets classified with high uncertainty, based on segmented information, may result in modified uncertainty conclusions.

Asset Review Summary

This threat uncertainty analysis performed was based on the premise that threat status could not be assumed; rather data was required to demonstrate that activities had been performed for the specific purpose of investigation into the existence of a threat. Operational or historical based assumptions not supported by sufficient data were not sufficient to establish confidence in threat management.

The threat uncertainty analysis did not evaluate the condition of assets or the extent to which EGI was following optimal integrity management principles. The uncertainty review analysis considered the data criteria necessary for an integrity engineer to understand the potential for a threat. The absence of a threat based on 'no historical experience' did not meet the threshold for an informed decision. Insight required for an informed decision had to be based upon an understanding of a threat mechanism or industry shared awareness of conditions. Specific threat evaluation details are presented in the Decision Logs, see Exhibits.

Assets were classified using a color-coded criterion based on confidence in the effective recognition and pursuit of a threat:



Most of the assets classified with high uncertainty levels (i.e., red) were classified as such based on insufficient data to support a conclusion that the threat was addressed (or not active). However, cases exist where opportunistic stress corrosion cracking (SCC), selective seam weld corrosion (SSWC), long seam cracking (LSC), hard spots (HS) and latent damage (LD) were reported at opportunistic excavations, yet the assets were not included in a threat specific investigation program. Cases such as these represent opportunities to enhance the response to leading indicators.

Asset Review Findings

Eight assets were classified with low uncertainty (green) for all nine designated threats – this is not to imply that all threats were present and actively managed on those assets, only that the threat uncertainty was the lowest (i.e., design conditions may have removed threat susceptibility). 311 assets did not exhibit any high threat uncertainty concerns. 248 assets exhibited at least one threat designated as high uncertainty

Number of High Uncertainty Threats per Asset	Count of Assets with Highest Uncertainty Level (red)
None	311
1 or 2	196
3 or 4	33
5 or 6	12
7 or more	7

This Review identified 146 assets (26%) with all threats classified with low uncertainty or actively managed (i.e., gray or green, respectively). However, 44% of assets were classified with high uncertainty (red) applied to at least one threat (see Section 4.3.2). Nineteen assets (3%) were classified with high uncertainty (red) for five or more threats.

Under-explored threats for the greatest number of assets include SCC, Circumferential SCC, SSWC, and Geohazards (see Section 5.1). Many assets were classified with high uncertainty for external metal loss, but this was largely associated with the challenges in aligning and evaluating corrosion control data with the asset naming convention. Internal corrosion was not an actively managed threat at EGI beyond the review of in-line inspection survey results.

Uncertainty Drivers

Uncertainty of threats affecting assets can be reduced through routine desktop engineering without costly and time intensive -assessment programs, however In line inspection remains a viable option for select assets. Records research for select assets during this project confirmed the validity of this approach. Table 1 identifies options for uncertainty reduction that leverage Logic Tree criteria.

Table 1: Uncertainty Reduction Options by Threat, non-ILI

External Corrosion	<ul style="list-style-type: none"> • Review records to validate pipe body and joint coating type gaps • Achieve 100% CP (cathodic protection) program criteria • Review additional excavation non-destructive evaluation (NDE) reports • Obtain asset temperatures
Internal Corrosion	<ul style="list-style-type: none"> • Obtain flow rate, moisture content and temperature data • Review mechanical cleaning and corrosion control history
Stress Corrosion Cracking	<ul style="list-style-type: none"> • Review records to validate pipe body and joint coating type • Review records for pressure test dates and pressures • Review additional excavation NDE reports • Obtain asset temperatures
Circumferential SCC	<ul style="list-style-type: none"> • Perform strain assessments • Additional geohazard review
Selective Seam Weld Corrosion	<ul style="list-style-type: none"> • Review records to validate pipe body and joint coating type • Maintain CP levels within program guidelines • Confirm grades and wall thickness values.
Long Seam Cracking	<ul style="list-style-type: none"> • Review records to discover NDE results, manufacturer, and seam type • Conduct Pressure Cycle Fatigue Analysis
Hard Spots	<ul style="list-style-type: none"> • Review records to determine line pipe manufacturer
Latent Damage	<ul style="list-style-type: none"> • Increase patrol frequencies
Geohazards	<ul style="list-style-type: none"> • Additional desktop screening and field verifications

Observations

- A. This review identified that EGI does not evaluate all TIMP assets consistently for the nine designated threats and associated sub-threats through a data-driven process.
- B. High threat uncertainty is associated with unpiggable assets (154 of 559 assets). More than 100 such assets had been in service more than 40 years. Similarly, 100 assets were less than 1 km in length.
- C. Access to structured information (i.e., as fields in a database) to support the alignment of information for informed decision making is a significant barrier to effective pipeline integrity management and reliability. This Review experienced the challenges of gathering and leveraging the various sources of data maintained throughout the organization. Evolution of the EGI data management system to incorporate all available data sources could facilitate broad asset reliability assessment advances.
- D. The Logic Trees can be used by EGI to augment existing threat assessment efforts if incorporated into the integrity assessment methodology. Threat susceptibility evolves over time for most threats. The use of a data-driven threat uncertainty approach as part of risk assessment and inspection planning will aid in enhancing asset reliability.

Results Summary

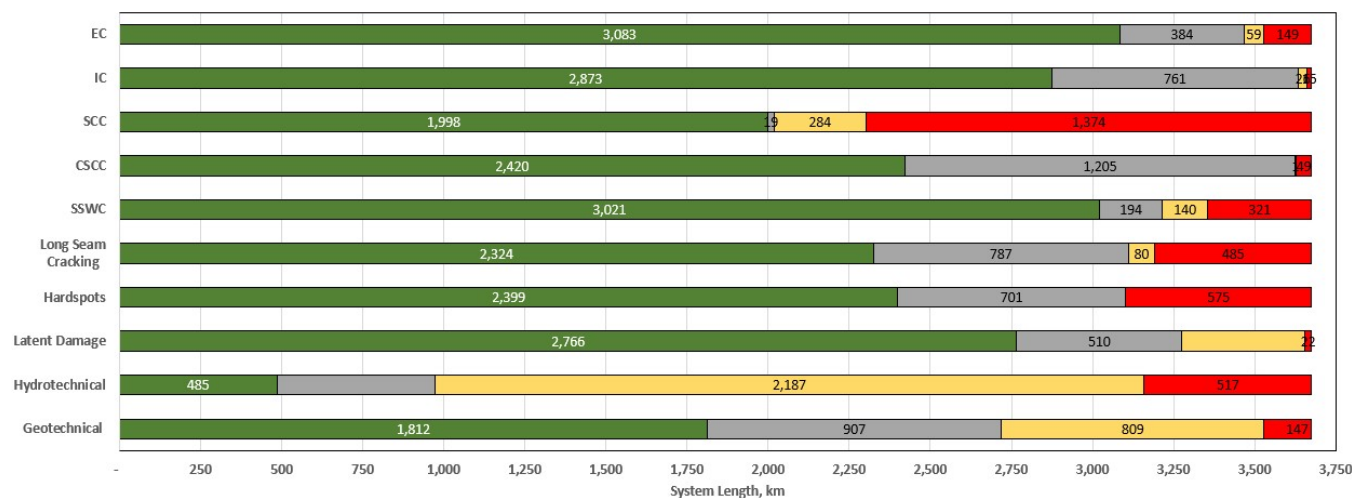
The uncertainty results can be viewed based on the asset count or the associated length. When considering shorter length assets, the threat uncertainty is best observed in the Tachometer view (see Section 4.2.1). The impact to total TIMP system length, an indicator better aligned with consequence exposure, is revealed in the stacked bar chart (see Section 4.2.2). Both are reproduced below. Details for each threat and asset impacted are presented in the Decision Logs (see **Exhibits**) and the Master Asset Registry (**Attachment 1**).



Tachometer view of Threat Uncertainty (by asset count)

How to Read the Display: The asset count analysis for each threat uncertainty category is provided in the inner arc and illustrates the susceptibility and prevalence of the threat in the EGI assets. The outer arc and the corresponding needle in each tachometer represent the EGI assets (by percentage of asset count) of a lower uncertainty (e.g., green and gray) based on known characteristics or actively addressed threat conditions.

EGI IAIR: Threat Assessment Confidence by Length (km)



Compiled Bar Chart of Asset Uncertainty (by asset Length, km)

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1 Introduction

Enbridge Gas Inc. (EGI) requested that Dynamic Risk perform an Independent Asset Integrity Review (IAIR, the Review) to explore how EGI considers nine (9) designated gas pipeline integrity threats as part of their Integrity Management program.

This uncertainty analysis reviewed available asset data (i.e., design, operation, prevention) to evaluate the susceptibility to a threat, then considered monitoring practices (i.e., inspections performed and scheduled) to establish a level of confidence that EGI had appropriately considered the need to detect, evaluate and mitigate the threat. The Review approach assessed Transmission Integrity Management Program (TIMP) data uncertainties with a focus on susceptibility assessment/conclusions; consideration of condition assessments conducted to date; application of controls (lagging indicator review) combined with planned activities (leading indicator review) designed to provide insight into the integrity condition assessment. Fitness for service was not assumed.

1.1 Objective

The objective of the integrity asset review was to independently establish the level of confidence in EGI's fitness for service threat assessment conclusions for all EGI TIMP gas pipeline assets. The Review did not assess integrity program adequacy, execution, completeness, or design, but identified uncertainties in threat conditions.

1.2 Designated Threats

This Review analyzed the threat awareness uncertainty of the following nine gas pipeline integrity threats (and sub-threats) designated by EGI.

1. External Metal Loss (EC, including microbiologically influenced corrosion (MIC) and alternating current / direct current (AC/DC) induced corrosion)
2. Internal Metal Loss (IC, including MIC and erosion corrosion)
3. Selective Seam Weld Corrosion (SSWC)
4. Stress Corrosion Cracking (SCC) (including high pH, near-neutral pH)
5. Long Seam Cracking (LSC)
6. Circumferential SCC (CSCC)
7. Hard Spots (HS, including pipe body and long seam)
8. Latent Damage (LD) from external interference and construction (including dents, wrinkles, and buckle)
9. Geohazards (GH, both geotechnical (GT) and hydrotechnical (HT)) related to ground movement and scour (including bending strain, latent damage, wrinkles, and buckles)

1.3 Scope

The scope of this review included all TIMP assets as identified by EGI, 559 pipelines with a total system length of 3,675.47 km.

1.4 Charter

This Review was:

- Undertaken by the project team. See Table 2 for a list of team members; and
- Directed by Enbridge Sponsors. See Table 3 for a list of Sponsors.

Table 2: Dynamic Risk Project Team

Team Representative	Subject Matter Specialty
Phillip Nidd	Technical Director
Monica Porter	Technical Manager / Document & Communications Control
Steve Biagiotti	Technical Lead – SCC, CSCC, HS
Darren Skibinsky	Technical Support – LD, GH
Yoko Nakazato	Technical Support – EC, IC
Dan Williams	Technical Support – SSWC, LSC
Mohamed Farag	Engineering Support
Richie Joseph	Engineering Support
Ben Mittelstadt	Subject Matter Expert
Gary Yoho	Subject Matter Expert

Table 3: Enbridge Sponsors

Team Representatives	Project Role
Ken Ocean	Program Sponsor
Erin Wishart	Project Supervisor
Nick Molnar	TIMP SME
Stephen Jehlicka	TIMP SME
Brad Jefferies	Corrosion Survey SME
David Shaw	TIMP SME
Mike Muhtaseb	Project Support

2 Approach

2.1 Project Overview

Dynamic Risk had recently reviewed the EGI TIMP threat assessment programs and had gained a familiarity of the EGI processes that influence threat and condition assessment information. This Review leveraged that familiarity together with an understanding of industry practices for the evaluation of threats and EGI asset data to classify assets based on EGI awareness of each threat.

This Review began with the collaborative design of Guiding Principles for the classification of assets. Threat uncertainty Logic Trees were designed to conform to industry recognized concerns while accommodating the unique experiences at EGI. The project team applied the uncertainty logic to the EGI TIMP assets to classify the assets into uncertainty categories defined in the Logic Trees for each threat. The process for each threat was documented in a Decision Log.

2.2 Project Timeline

This Review began at the end of March 2021. The first phase of the project was completed in seven weeks. As Logic Trees were approved by EGI, Phase 2 commenced. Phase 2 concluded July 30th with the assembly of the nine Decision Logs. In August, the project team reviewed the data analytics and assembled this report.

	Initiated	Complete
PHASE 1: Development of 9 Logic Trees: EC, IC, SCC, CCCC, SSWC, LS, HS. LD, GH	22-Mar	17-May
PHASE 2: INITIAL ANALYSIS, UNCERTAINTY RANKINGS	4-May	30-July
DASHBOARDS - Threat Tachometer (by Asset) and Stacked Bar Charts (by km)	25-May	13-Aug
PHASE 3: CLOSE-OUT	31-May	31-Aug
Publish Decision Logs (DL-00#) for each threat	31-May	30-July
Close-Out Report with Uncertainty Results interpretation	2-Aug	31-Aug

2.3 SME Workshops

The Review was performed in collaboration with EGI leadership and technical subject matter experts (SMEs). Bi-weekly workshops with EGI were an integral part of both the design of the Logic Trees and the documentation in the Decision Logs to review interim progress, discuss preliminary observations and solicit information to provide a clearer basis for asset classification. Nine 90-minute workshops were conducted. An agenda and slide deck were uploaded to the EGI SharePoint project site in advance of each workshop. Between workshops, sessions were conducted with EGI threat-specific SMEs to continue progress on Logic Tree design and Decision Log documentation.

2.4 Weekly Status Reporting

Status reports were provided to EGI each Friday. The status report included progress percentages of each Phase and sub-task, a chart of the budget and spend progress, and lists of what was completed the current week, planned for the next week, and specific assistance required from EGI to maintain project schedule.

3 Uncertainty Analysis Methodology

The uncertainty analysis process involved three interdependent activities:

- a) Establish the Guiding Principles that served as the basis for the analysis. Use the Guiding Principles as the lens through which all classifications were made.
- b) Rely on a technically based process capable of evaluating and quantifying EGI's current understanding of each threat and sub-threat grounded in published industry standards and technical references. Develop all decision criteria before the review of asset information to avoid bias based on data availability.
- c) Apply a data-driven approach to the uncertainty analysis. Confidence in threat awareness remains uncertain until data indicates otherwise. Avoid data assumptions and other SME opinions regarding information.

Uncertainty decisions were data-driven and supported by published industry references (listed in Appendix B of each threat Decision Log). To be data-driven, written information (e.g., data sheets, measurements) had to be available for review. Assumptions, corporate procedures, and standard practices did not qualify as information used in this analysis unless measured values could be provided.

The Logic Tree designs considered the absence of information to satisfy a criterion as the highest uncertainty condition, commonly resulting in a red classification. Absent data and its application were documented in the Decision Logs. The basis for this approach was to drive additional data discovery in subsequent project phases.

It must be emphasized that this uncertainty analysis was not an evaluation of the condition of an asset for a given threat, even based on the history of the threat. This review did not analyze the effectiveness¹ of the integrity management of an asset or of EGI Fitness for Service programs. As such, if an asset experienced a release or had a history of a specific threat, but the asset was included in an active integrity assessment program (i.e., in-line inspection (ILI), direct assessment (DA)), then the asset was classified with the lowest uncertainty level (green) since the condition was under evaluation, being dispositioned and mitigated.

3.1 Guiding Principles

In this review, Guiding Principles are a set of ideals common to all pipeline integrity threats (i.e., corrosion, geohazards, cracking, etc.). The threat uncertainty classifications were defined to establish whether an integrity management process was in place with the potential to successfully detect the adverse effects of a threat. Neither the effectiveness of threat management, nor the disposition of known anomalies was the focus of a classification.

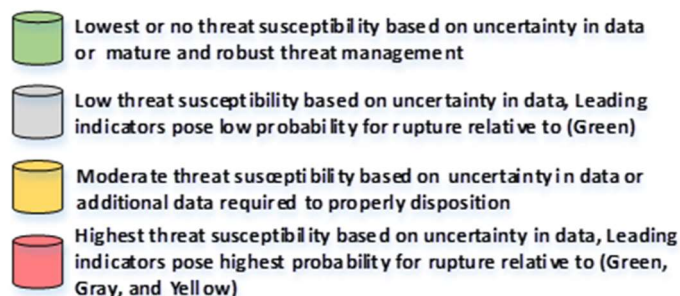


Figure 1: Uncertainty Classification Legend

¹ Threat Control Effectiveness, as used herein, is defined as a measure of the ability of the threat control program to reduce the number of Loss of Containment events (i.e., rupture incidents) through the application of a systematic, data-driven process of steps involving threat identification, susceptibility assessment, application of controls, control analysis, result documentation and control improvement recommendations while accounting for uncertainties within the process.

The project team and EGI project sponsors collaboratively designed the project Guiding Principles during the first two weeks of the project. The Guiding Principles were as follows:

- i. Leverage data to the maximum extent to establish levels of uncertainty/confidence in the awareness of threat severity based on current practices. All uncertainty decisions must be data driven.
- ii. Align with previous EGI integrity asset reviews such that threat management would not be assumed; identify the unknown unknowns.
- iii. Design uncertainty terminations where threat uncertainty could no longer be explored (i.e., categories). All logic bifurcations leverage known data conditions.
- iv. Document the technical basis for the uncertainty logic criteria used to screen threat potential. Document technical sources for analysis criteria.
- v. Consider scheduled inspections in 2021/2022; do not consider undocumented/unpublished plans that did not specify technologies.

3.2 Phase 1: Threat Uncertainty Classification Process

The project team designed a Logic Tree² (see Appendix A within each Decision Log included as an Exhibit to this document) for each of the nine designated threats and associated sub-threats (see Figure 2). Specific analytical and technical criteria supporting each decision diamond in the Logic Tree was documented in a “Logic Basis” included as Appendix B of each Decision Log (See Figure 3).

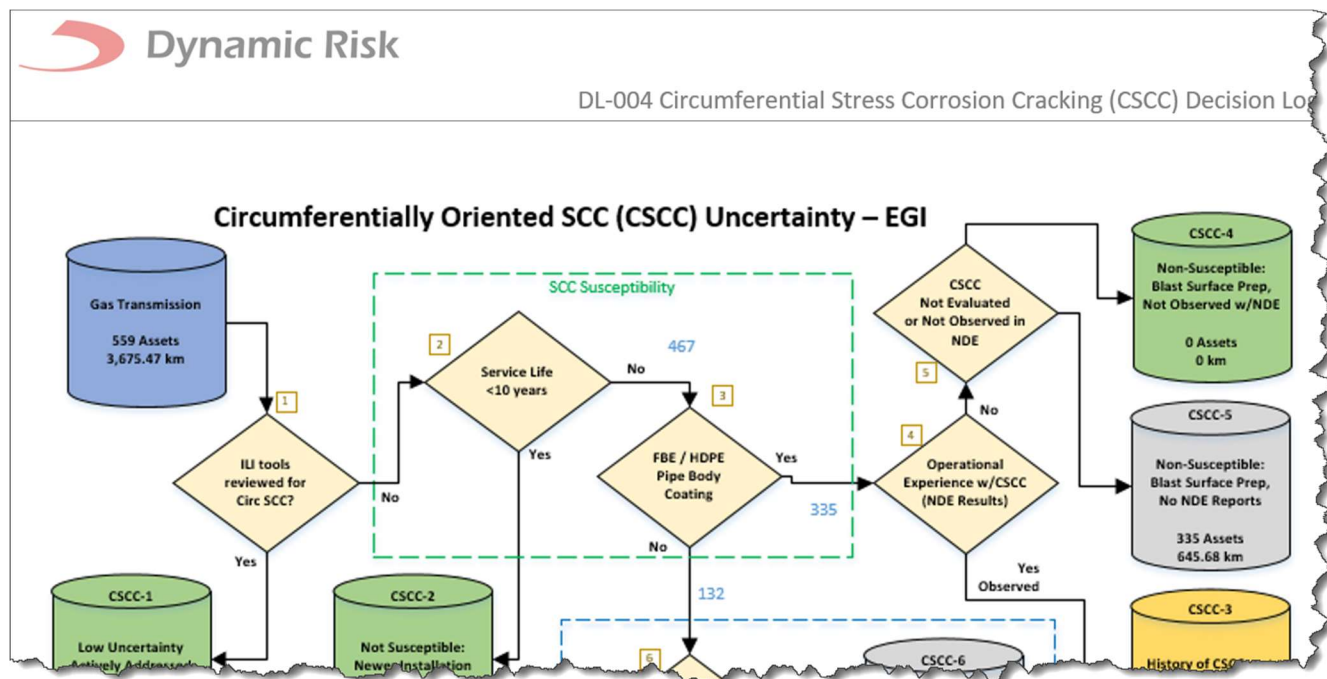


Figure 2: Sample Logic Tree

² A decision tree is a flowchart-like diagram that shows the various outcomes from a series of decisions. A Logic Tree is an organizational tool used to diagram adverse characteristic options. Typically, Logic Trees describe a development of an adverse condition, from minor to progressively more severe failure types. For this IAIR, Logic Trees and/or Logic Diagrams will be applied to link possible basic conditions (usually, at a level of component failure modes or human errors to a system-level failure event – in this case, a pipeline rupture), as basis to establish the level of confidence in fitness for service with respect to each of the nine designated threats.

Threat	Diamond	Text	Description of Why	Reference	Condition	Result	Master Registry Column
Circ SCC	1	ILI tools reviewed for Circ SCC?	<ul style="list-style-type: none"> C-MFL is the recommended tool to detect CSCC. EMAT has a lower reliability for CSCC. The detection of CSCC by multiple ILI systems that integrate axial and circumferential magnetic flux leakage (AMFL and CMFL) along with internal depth detection sensor arrays (IDD), a high precision geometry measurement unit (HP-GMU) and inertial mapping data (IMU) has been reported in the literature to begin to <u>shown</u> promise. This approach is an integrated methodology. 	<ul style="list-style-type: none"> Thompson, PPIM 2020 Gardner, PPIM 2021, 2020 & 2019 		CSCC-1	X
Circ SCC	2	Service Life <10 years	Industry has experienced higher potential for SCC occurrence in pipe >10 <u>yrs</u>	<ul style="list-style-type: none"> ASME B31.8S App A4.3 <u>Note:</u> CEPA §5.1.1.2 does not provide a stress limit, only suggests prioritizing by decreasing stress. 	No	CSCC-2	AR
Circ SCC	3	FBE / HDPE Pipe Body Coating	<ul style="list-style-type: none"> Blasting associated with FBE surface prep is credited with imparting compressive residual stresses that reduce occurrence of SCC initiation. HDPE has similar blast profile as FBE (See CSA Z-245 §6.1.2.2 blast profile), even though joints will be either shrink sleeve or tape wrap. However, no need to discount based on joint coating as the blasting had occurred for the joint. Bare pipe research was conducted to determine the effect of 	<ul style="list-style-type: none"> CEPA SCC §5.1.1.2 CEPA SCC §9.1.3 - HDPE (Yellow Jacket) also not susceptible <u>NOTE:</u> CSA Z245.20 does not address 	Yes/No	--	BI

Figure 3: Sample Logic Tree Basis

The Logic Trees began with susceptibility criteria to establish the population of assets with the potential for the specific threat. Then integrity assessment methods (i.e., ILI, DA, pressure test) condition assessments (historical and scheduled for 2021/2022) were considered to eliminate assets where degradation could be identified. Where the threats were not part of an inspection program, a series of criteria were developed to highlight adverse conditions with a potential for the threat and those lesser severity conditions where rupture was not the more likely consequence. A staged approach to asset classification created a list of assets (e.g., the red categories) where EGI could focus additional data discovery and analysis to further understand the threat.

The Logic Trees were reviewed with EGI SMEs to establish uncertainty categories that considered severity of threat, EGI ideals or business needs, industry experience, opportunistic practices that may discover a threat and characteristics of a potential release (i.e., potential for leak vs. rupture). The primary analysis focus was on rupture potentials.

As agreement on each uncertainty classification process was reached, Phase 2 for that threat was then initiated. The Logic Tree and Logic Basis for each threat are included as exhibits to this Review.

3.3 Phase 2: Initial Analysis, Uncertainty Rankings

Phase 2 involved the processing of data into the uncertainty classification categories defined in the Logic Tree for each threat. The perspective of this independent asset review was from the level of confidence in EGI awareness of a threat on an asset, considering available data and inspection knowledge. Fitness for service was not assumed. Rupture versus leak failure modes were considered.

The following elements were critical to Phase 2:

1. Assemble a Master Asset Registry reflecting current data. See **Attachment 1**.
2. Update Logic trees reflecting the number of assets satisfying each classification (by count and cumulative length of asset).
3. Update Logic Basis documents to identify the source column of data used from the Master Asset Registry.
4. Update dashboards that summarize the asset logic classifications.

The result of each threat uncertainty analysis was compiled into a comprehensive Decision Log. The nine Decision Logs are included as Exhibits DL-001 through DL-009. Each Decision Log presents data challenges, the basis for classification of assets, the Logic Trees and Logic Basis. Analysis outputs include tabular results of assets per classification, as well as visualization of aggregated results by asset count (i.e., tachometer) and asset length (bar chart).

3.3.1 Information Access

EGI information was subject to security protocols for information management in accordance with Dynamic Risk, *Document Control Guideline* (revision 3) issued May 20, 2021. IAIR project information was exchanged either on an EGI hosted project SharePoint site or within ProjectWise. More than 90 files were shared with the project team in support of this Review (see **Attachment 2**). EGI provided information as spreadsheets, PDF documents, email responses to inquiries and edits of interim work products.

3.3.2 Application of Data Policy

This review was unlike a risk assessment in that dynamic segmentation of the assets was not considered. Instead, asset data was reviewed, and the least certain attribute was applied to the entire asset. Assets were classified in their entirety, based on the most conservative known condition. For example, if coating type was unknown for a portion of an asset, the coating type for the entire asset was considered unknown. Similarly, if an asset contained multiple seam types or grades, the lowest grade was used to calculate the percentage of specified minimum yield strength (%SMYS), and the seam type with the greatest threat potential based on the threat (i.e., LF-ERW or DSAW for the SSWC threat and LF-ERW for the LSC threat) was applied to the entire asset.

The conservative consideration of data described above can bias the asset count and mileages reported in each high uncertainty classification.

The classification of an asset with high uncertainty (i.e., red) does not imply that the asset is nearing end of life or rupture. High uncertainty indicates insufficient information was known about the threat activity associated with the asset.

3.4 Decision Logs

For each of the designated threats, a Decision Log was produced to document the decision process used to evaluate assets and results. Each Decision Log provides a review of the threat uncertainty, supported by data aligned in a Master Asset Registry spreadsheet. A summary of the conditions leading to high threat uncertainties is provided in Section 6.2. **Exhibits DL-001 to DL-009** include the Decision Logs for these threats:

DL-001	External Metal Loss (EC)
DL-002	Internal Metal Loss (IC)
DL-003	Stress Corrosion Cracking (SCC)
DL-004	Circumferential Stress Corrosion Cracking (CSCC)
DL-005	Selective Seam Weld Corrosion (SSWC)
DL-006	Long Seam Cracking (LSC)
DL-007	Hard Spots (HS)
DL-008	Latent Damage (LD)
DL-009	Geohazards (both geotechnical and hydrotechnical) (GT and HT)

Decision Log Table of Contents

1. Document Control
2. Project Leadership
3. Revision History
4. Threat Basis
5. Data Sources Applied
6. Data Processing Notes
7. Data Observations
- Appendix A: Logic Tree
- Appendix B: Logic Tree Basis
- Appendix C: Highest Uncertainty Assets
- Appendix D: Leak versus Rupture Consideration (*IC threat only*)

4 Uncertainty Results

4.1 Master Asset Registry

The Master Asset Registry in Attachment 1 is a spreadsheet where all data necessary to support the threat logic criteria was aligned. The first ten columns of the spreadsheet provide the uncertainty classifications associated with each asset. Filtering is available, by name and color, to facilitate the review of results.

1 EC	2 IC	3 SCC	4 CSCC	5 SSWC	6 LSC	7 HS	8 LD	9 GH	9 HH	TIMP Pipeline
EC-7	IC-7	SCC-1	CSCC-12	SSWC-1	LSC-4	HS-1	LD-6	GT-1	HT-1	NPS 6 TCPL - Dryden TBS
EC-11	IC-12	SCC-13	CSCC-12	SSWC-12	LSC-10	HS-9	LD-10	GT-1	HT-1	NPS 4 TCPL - Vermillion Bay TBS
EC-13	IC-12	SCC-1	CSCC-12	SSWC-12	LSC-10	HS-3	LD-10	GT-1	HT-1	NPS 4 TCPL - South River TBS
EC-11	IC-12	SCC-1	CSCC-12	SSWC-4	LSC-9	HS-3	LD-12	GT-1	HT-1	NPS 3 TCPL - Dryden TBS
EC-11	IC-11	SCC-1	CSCC-12	SSWC-4	LSC-9	HS-3	LD-12	GT-1	HT-1	NPS 2 TCPL - SSM Airport
EC-13	IC-12	SCC-13	CSCC-12	SSWC-12	LSC-10	HS-10	LD-10	GT-1	HT-1	NPS 2 TCPL - South River TBS
EC-11	IC-12	SCC-1	CSCC-12	SSWC-12	LSC-10	HS-3	LD-12	GT-1	HT-1	NPS 2 TCPL - Keewatin TBS
EC-11	IC-12	SCC-13	CSCC-12	SSWC-12	LSC-10	HS-10	LD-10	GT-1	HT-1	NPS 2 TCPL - Beardmore
EC-1	IC-1	SCC-1	CSCC-12	SSWC-1	LSC-5	HS-1	LD-1	GT-1	HT-1	NPS 16 Corunna Gathering Pipeline
EC-10	IC-11	SCC-1	CSCC-12	SSWC-12	LSC-8	HS-3	LD-7	GT-1	HT-1	NPS 10 English River Lateral

4.2 Dashboard Summaries

Phase 2 results were consolidated into a series of dashboards detailing the level of confidence in the awareness of a threat such that the asset will not likely result in rupture. The source data used to generate the dashboard results is included in **Attachment 1: Master Asset Registry**.

4.2.1 Tachometer Views by Threat (by Asset count)

Tachometers, shown in Figure 4, are a means to view the aggregated uncertainty ranking³ as a function of asset count for the TIMP assets (559 assets, 3,675.47 km). Note that 146 assets were in an active integrity assessment program for the nine designated threats; confidence in awareness of the nine designated threats on these assets was high (i.e., assets were classified either green or gray). Eight assets were classified with the lowest uncertainty (green) for the nine designated threats. 248 assets were classified with high uncertainty (red) for at least one threat; 52 assets were classified with high uncertainty (red) for three threats, and 19 assets were classified with high uncertainty (red) for five or more threats— see Section 4.3.2.

³ See section 3.1 for an explanation of uncertainty color. Uncertainty ranking reflects lowest understanding of any portion of the asset and is not necessarily reflective of the entire asset length.

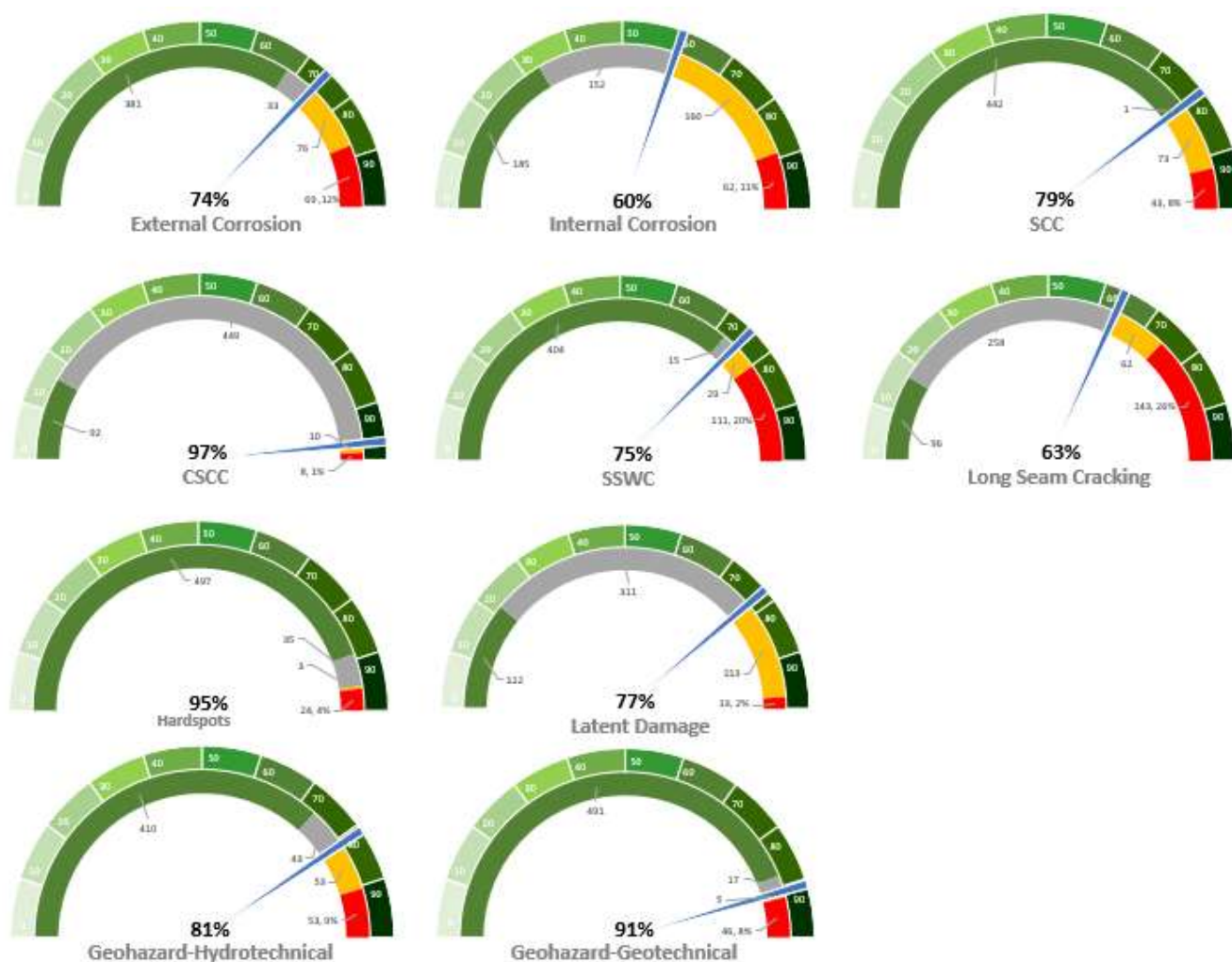


Figure 4: Tachometer view of Threat Uncertainty

How to Read the Display: The asset count analysis for each threat uncertainty category is provided in the inner arc and illustrates the susceptibility and prevalence of the threat to EGI assets. The outer arc and the corresponding needle in each tachometer represent the EGI assets (by percentage of asset count) of a lower uncertainty (e.g., green, and gray) based on known characteristics or actively addressed threat conditions.

4.2.2 Bar Chart (by Asset Length)

The EGI TIMP system uncertainty, per threat, based on asset length is presented in Figure 5.

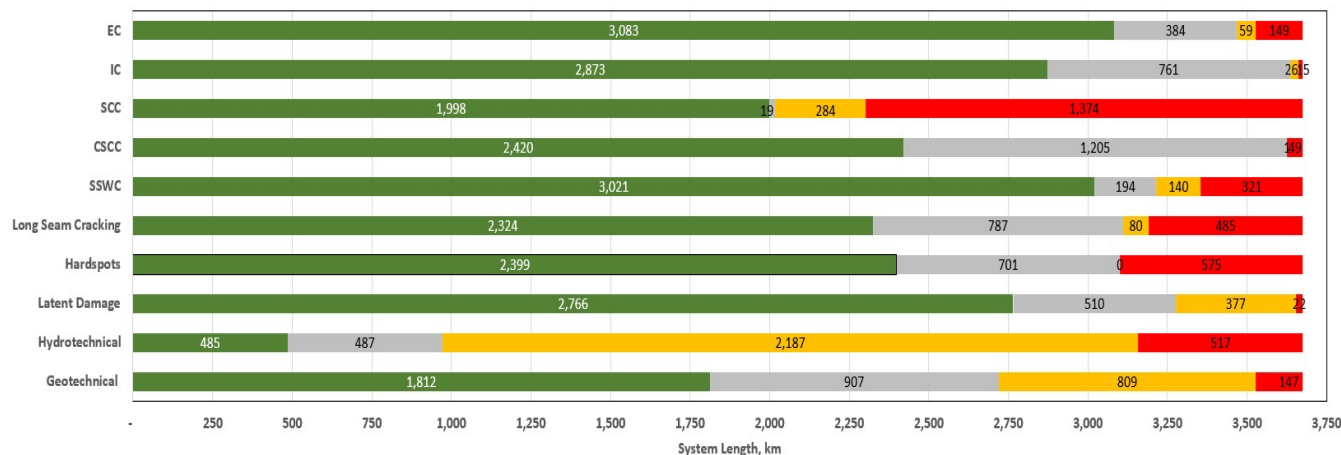


Figure 5: Compiled Bar Chart of Asset Uncertainty, by Length (km)

The tachometers and bar chart provide different views of the same uncertainty results. Some threats are better recognized and addressed based on geographic proximity, while the length of a shorter asset can limit threat investigation options. Conclusions based on mileage uncertainty should be used cautiously. For example, a cursory review of Table 5 suggests that the rate of hydrotechnical threat evaluation is lagging other threats. When reviewed together with the corresponding tachometer in Section 4.1.1, only ten percent of the assets were classified yellow (i.e., pending scheduled threat evaluation in 2021/2022), indicating that the majority of the hydrotechnical concerns were associated with the longer assets in the system. In contrast, ten percent of the assets were classified with high uncertainty (red) but comprise 53 shorter assets. Similarly, a larger fraction of assets by length (37%) had not been evaluated for the SCC threat and comprise eight percent of the total number of assets.

For further discussion of the highest uncertainty (red) classifications by threat, see Section 6.2.

4.3 Uncertainty Matrix

4.3.1 Findings by Threat

Table 4 summarizes the asset uncertainty classification information from the tachometers, by threat.

Table 4: Count of Assets based on Uncertainty Level, by Threat

Uncertainty Level	EC	IC	SCC	CSCC	SSWC	LSC	HS	LD	GT	HT
Low	381	185	442	92	404	96	497	122	410	491
Medium	33	152	1	449	15	258	35	311	43	17
Moderate	76	160	73	10	29	62	3	113	53	5
High	69	62	43	8	111	143	24	13	53	46

Note: Foremost uncertainty level highlighted by threat

Table 6 identifies the 16 assets with five or more high uncertainty threats sorted in descending order by count of high uncertainty threats. The high uncertainty threats are indicated in the third column.

Number of High Uncertainty Threats per Asset	Count of Assets with Highest Uncertainty Level (red)
None	260
1 or 2	248
3 or 4	35
5 or 6	12
7 or more	4

[illegible]Revision 1

4.4 Data Gaps Resulting in High Uncertainties

Each Decision Log includes Data Processing Notes that identify data gaps (i.e., dates of installation), and unavailable data (i.e., temperature, bacterial testing). EGI requested that decision criteria requiring information that was unavailable remain in the threat Logic Trees for future use.

No assumptions were made to complete data gaps. Data was considered based on the threat logic. Absent data continued through the logic, ultimately classifying as highest uncertainty. Example: unknown coating type – considered CP shielding during EC review, but a high performance coating for the AC corrosion analysis. The following is a list of data gaps for awareness:

- Pipe body coating type was provided for 524 assets (94%). 11 assets with unknown pipe body coating were classified with high uncertainty in the EC Logic Tree.
- Coating condition data and MIC testing results were not available. EGI indicated that EGI does not use CP adjustments to mitigate or manage the threat of MIC. As a result, 91 assets were classified with high and moderate uncertainties after the EC-MIC Logic Tree.
- EGI provided Yes/No values for 114 assets regarding whether CP met criteria. Ten assets with CP meets Criteria “N/A” were classified with moderate uncertainty in the EC Logic Tree.
- The operating temperature for assets was either inaccessible or unavailable. In the IC-MIC sub-threat Logic Tree, a surrogate parameter, within 32 km (20 miles) downstream of compression, was used for a temperature range between 15° to 45°C.
- Flow velocity data was either inaccessible or unavailable. As a result, 62 assets were classified with high uncertainty. Other data that was not available included:
 - MIC chemical treatment - EGI TIMP does not apply MIC chemical treatments.
 - Flow velocity
 - Solids observed after cleaning
 - Solids observed in filters
 - Erosion monitoring devices readings – EGI TIMP does not employ erosion monitoring devices.
 - Product temperatures
- Pressure Cycle Fatigue Analysis (PCFA) results were not available for this Review. As a result, 49 assets were classified with moderate or high uncertainty for LSC threat.
- Manufacturer name was not available for 98% of assets (by count) and some lacked seam type information. As a result, the uncertainty classifications for 152 assets were impacted in the HS, LSC and SSWC Logic Trees.
- CP measurements for test stations, casings, rectifiers and AC/DC interference were not available for review by the Dynamic Risk project team because of complications with the current asset naming convention at EGI. This data challenge could impact the overall risk and integrity management program.
- Five smaller diameter (NPS 2 or 4) assets did not have records of dates of installation, wall thickness or maximum operating pressure (MOP). EGI SMEs provided values upon request, but the source of the data could not be validated.
- EGI maintained and archived NDE excavation results individually by asset. Excavation forms contain a wealth of information that was not managed as structured data (i.e., stored in a searchable database) and leveraged for asset reliability.

5 Uncertainty Trends

Section 5 presents patterns observed in the uncertainty results. These observations are intended to guide EGI with planning actions to further reduce threat uncertainty. Detailed discussion on the data and results specific to a threat are presented in the corresponding Decision Log; see **Exhibits**.

5.1 Uncertainty Distribution

This Review identified that EGI may conclude varying levels of threat confidence based on individual assets. The variability difference, per threat, is shown in Figure 6.

- Not all assets had been evaluated for all designated threats. However, more than 81% of TIMP assets (78% by length) had been evaluated for likely relevant threats. The other assets either lacked the data to establish the threat potential, or the threat for the specific asset had not been investigated yet.
- The highest threat uncertainty (red bubbles in Figure 6) listed in decreasing order of asset count were: LSC, SSWC, EC, IC, HT, GT, SCC, HS, LD then CSCC. The cracking threats (i.e., SSC, CSSC, LSC) had the highest combined uncertainty and would benefit the most from additional data discovery or inspection.

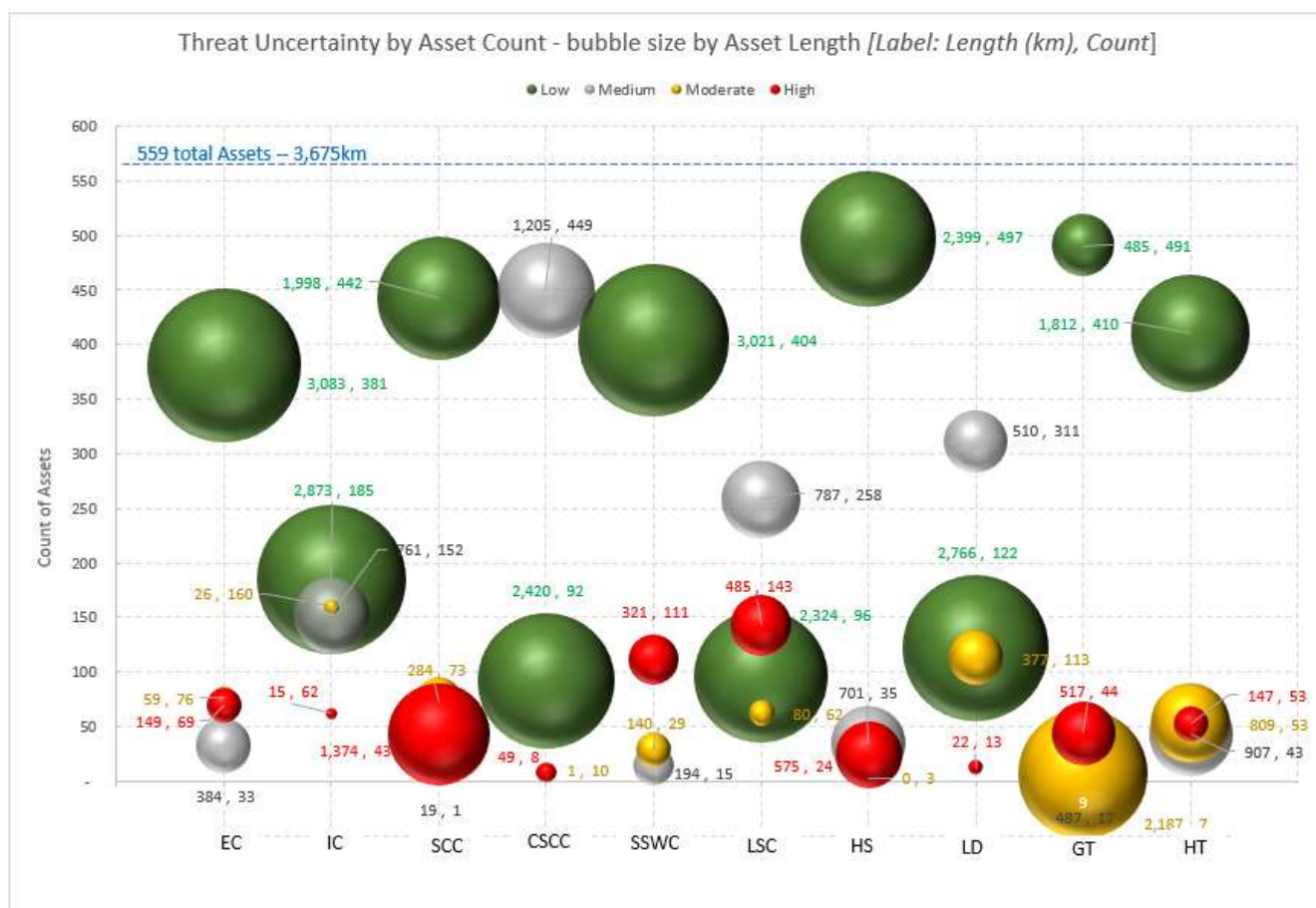


Figure 6: Combined Asset/Length Summary of Threat Uncertainty (labels are km, count)

How to Read the Display: A bubble diagram permits the display of four variables simultaneously – the asset threat uncertainty level^① (red, gray, yellow, green) by threat^② (x-axis), and the count^③ of assets per threat uncertainty level (vertical y-axis), plus the mileage^④ by uncertainty level (relative diameter of the bubble).

This display combines the data presented separately as a Tachometer (threat uncertainty by asset count) or as a bar chart (threat uncertainty by asset length) presented in Section 4.2 - Dashboards.

Interpreting the Display: High count/larger diameter green bubbles represent lower threat uncertainty
High count/larger diameter red bubbles represent greater threat uncertainty

Trends:

- 1) The majority of threat uncertainty, by mileage, is low (green) based on the diameter of the data points.
- 2) For most threats, the threat uncertainty is low (green or gray) for at least 60% of assets, by count (vertical position)
- 3) The assets with highest uncertainty (i.e., red) represent 2% to 25% of the asset count, but generally include shorter length assets (small bubble diameter).
- 4) Large SCC red diameter is predominantly associated with a few long lines – (i.e., parallel Trafalgar system)

5.2 Uncertainty Distribution by %SMYS

Threat uncertainty is not strongly associated with operating stress as shown in Figure 7. Across the spectrum of operating stress at EGI TIMP, the assets operating at lower stress were without high uncertainty.

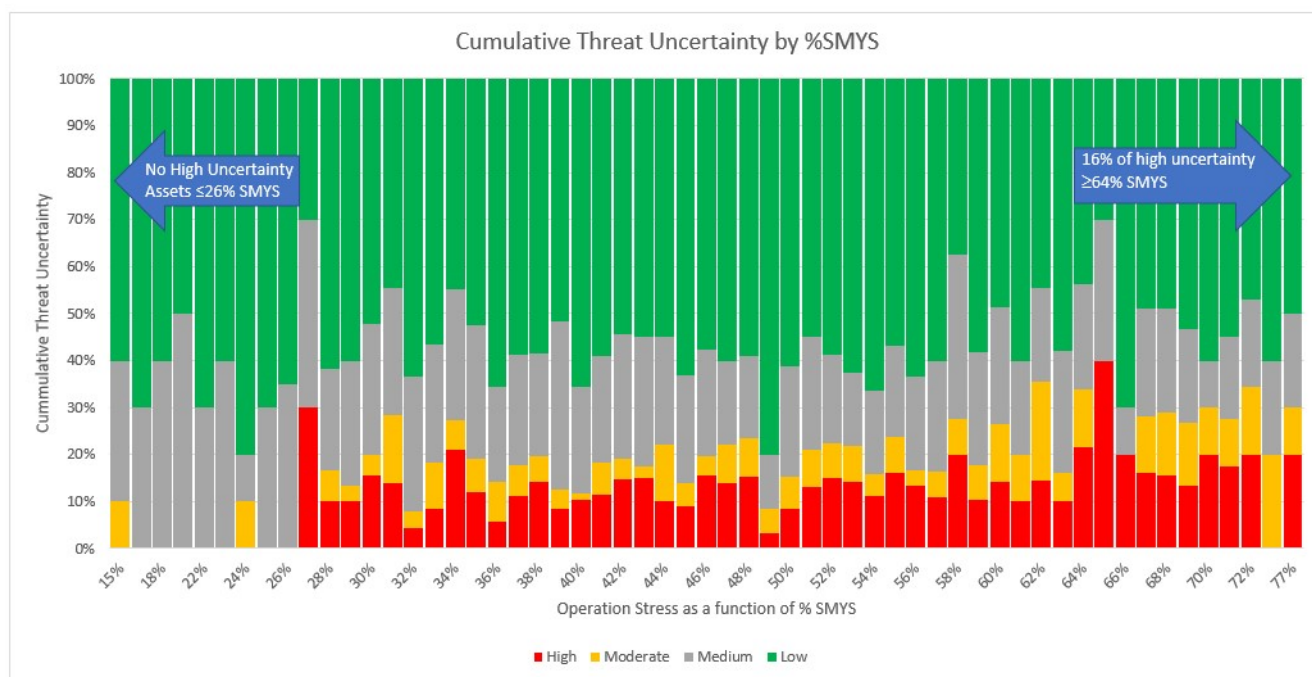


Figure 7: Distribution of Threat Uncertainty based on %SMYS

No assets operating at stress less than or equal to 26% SMYS were classified with high uncertainty. Assets operating at stress greater than or equal to 64% SMYS represent 16% of the high uncertainty assets.

5.3 By Region

Figure 8 summarizes each of the threat classifications for the 559 assets. Nine designated threats, including the geohazard threat sub-divided into geotechnical and hydrotechnical, yields a total of 5,590 (10 x 559) possible uncertainty outcomes.

STO was responsible for more than 64% of the asset count, with 5% classified with high uncertainty. Most regions trend progressively toward more green than red with the noticeable exception of GTA West & Niagara, Northern Region.

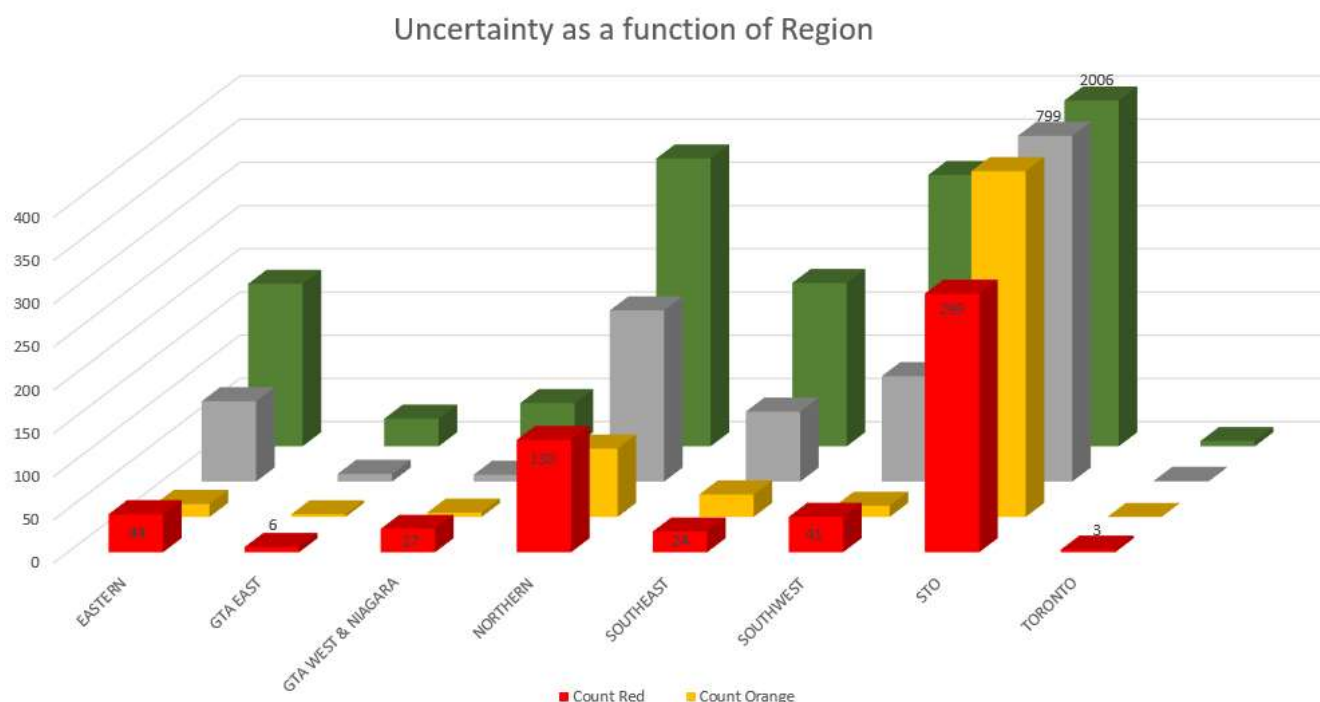


Figure 8: Uncertainty Distribution Across the 10 Ten Threat Categories, by Region

5.4 Distribution by Asset Class

High levels of uncertainty were distributed across the transmission, well laterals and take-off assets. 299 of the 559 assets evaluated had at least one high uncertainty threat. 16 assets had five or more high uncertainty threats – see Section 4.3.2.

5.4.1 High Uncertainty Transmission Assets

More than 55% of the transmission assets had at least one (1) threat with high uncertainty. Table 7 shows transmission assets associated with five or more high uncertainty threats.

The asset with the most high uncertainty threats (7) was *NPS 12 Blackhorse Gate Station to Forks Rd* with a length of 15.5km. *NPS 16 Corunna Transmission Pipeline* had five high uncertainty threats and was operating at 71% SMYS.

Table 7: High Uncertainty (≥ 5 Threats) for Transmission Assets

TIMP Pipeline	High Threats (Red)	Threats with High Uncertainty										Length (km)	% SMYS
		EC	IC	SCC	CSCC	SSWC	LSC	HS	LD	GT	HT		
NPS 12 Blackhorse Gate Station to Forks Rd	7	H			H	H	H		H	H	H	15.5	34%
NPS 8 Niagara Barron Rd to Cyanamid Stn	6	H			H	H	H			H	H	4.0	30%
NPS 8 Niagara Barron Rd to Turner Rd	6	H			H	H	H			H	H	4.0	30%
NPS 12 Niagara Blackhorse Gate to Barron Rd	5	H			H		H			H	H	1.2	34%
NPS 8 Ottawa East Innes Rd	5				H	H	H			H	H	1.7	31%
NPS 16 Corunna Transmission Pipeline	5	H		H		H	H	H				3.323	71%

5.4.2 High Uncertainty Well Laterals

The high uncertainty well laterals were located within 24 of the 38 EGI well pools (140 of 281 laterals), Figure 9.

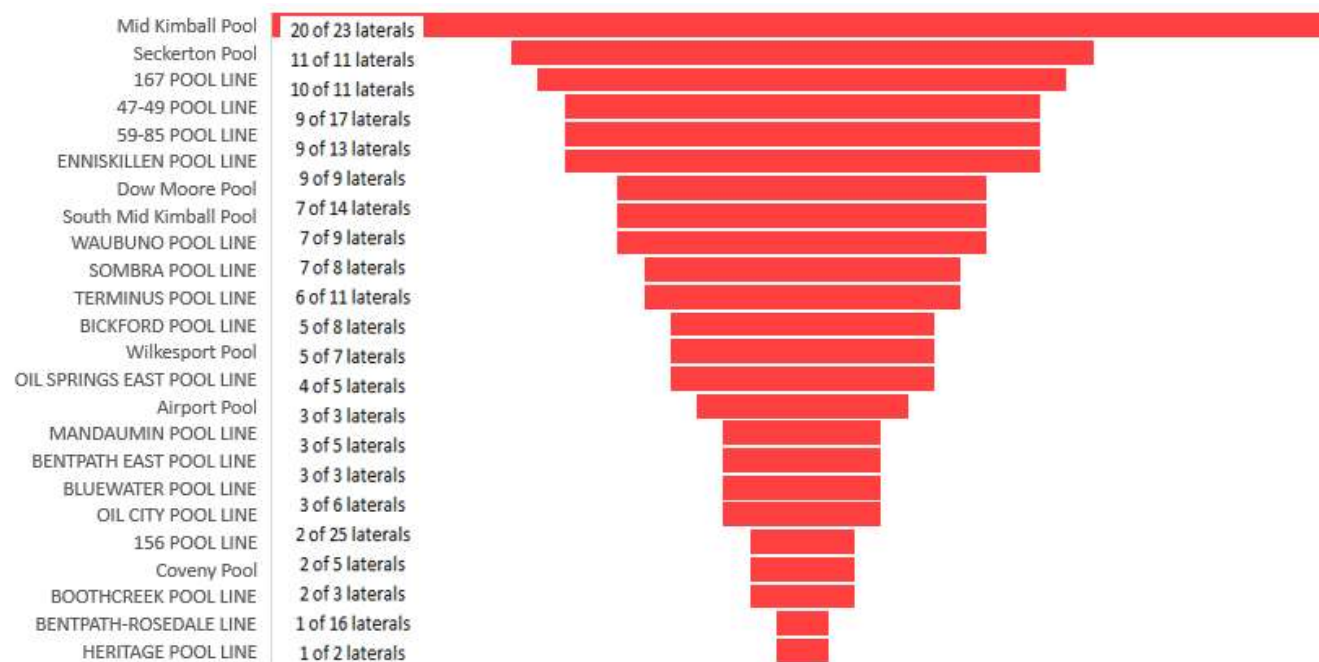


Figure 9: Count of High Uncertainty Well Laterals within Storage Pools (140 assets)

The greatest fraction (14%) of high uncertainty assets in the well pools was within the Mid Kimball Pool (Figure 9) with 87% of laterals with at least one high uncertainty threat (Figure 10). Twenty-one (21) of 24 well pools (see

Figure 10) had half or more of their laterals (i.e., separate assets) classified with high uncertainty because of at least one threat.

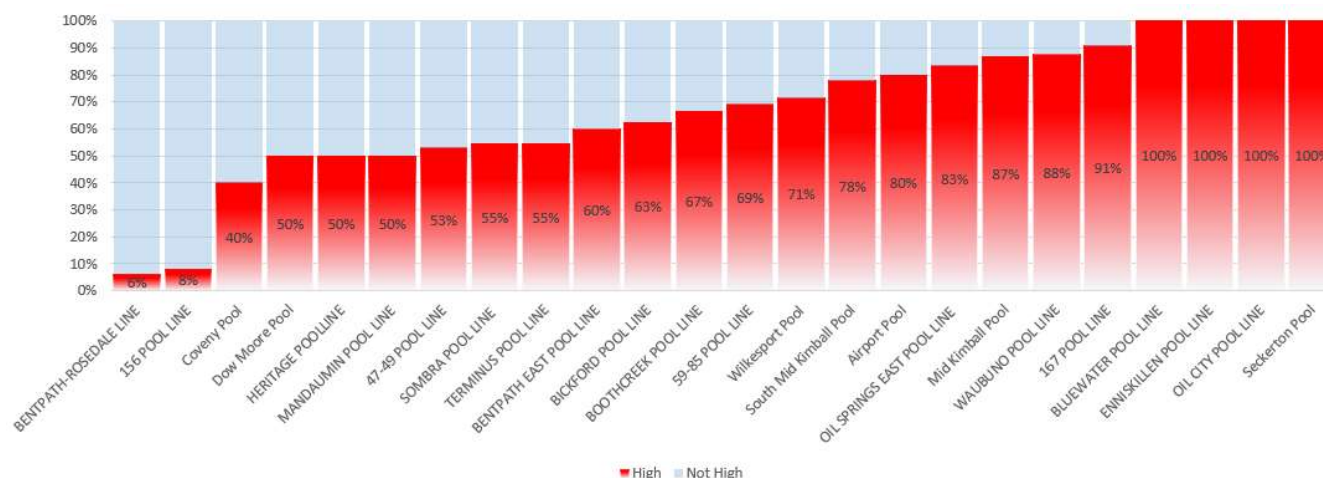


Figure 10: Percentage of Well Laterals within pool systems with one or more high uncertainty threat

Two Mid Kimball Pool laterals were classified with high uncertainty based on five or more threats (Table 8). The Seckerton Pool assets include about half the number of assets as the Mid Kimball Pool, but all (100%) had at least one high uncertainty threat.

Table 8: High Uncertainty (≥5 Threats) for Well Laterals

TIMP Pipeline	High Threats (Red)	Threats with High Uncertainty										Length (km)	% SMYS
		EC	IC	SCC	CSCC	SSWC	LSC	HS	LD	GT	HT		
NPS 10 South Mid Kimball Well Lateral-TKC 10	6	H			H	H	H			H	H	0.145	40%
NPS 10 South Mid Kimball Well Lateral-TKC 14	5	H				H	H			H	H	0.194	53%

6 Threat Uncertainty Analysis Discussion

The threat uncertainty analysis did not include evaluation of the condition of assets or a determination of whether EGI was following optimal integrity management principles. The analysis did consider the data criteria necessary for an integrity engineer to understand the potential for a threat. The absence of a threat based on 'no historical experience' did not meet the threshold for an informed decision. Insight required for an informed decision had to be based upon an understanding of a threat mechanism or industry shared awareness of conditions. Specific threat evaluation details are presented in the Decision Logs, see **Exhibits**.

6.1 Barriers to Certainty

Design requirements have been well established to minimize the potential for common pipeline threats (i.e., external corrosion, latent damage). These requirements are augmented by integrity management practices and prevention programs. However, this Review identified threats that were not being evaluated based on a data-driven process. Only by routinely evaluating data and conditions that support all threat mechanisms can threats be safely discounted while maintaining system reliability. To successfully evaluate conditions, decisions must be based on data.

The project team recognized that EGI is transitioning to a more data-driven enterprise. To facilitate the transition, the project team identified the following areas for consideration to enable the threat decision making process:

- EGI TIMP assets were referenced by two different naming conventions. This inhibits communication and comparison of data for integrity analysis. Convergence to a single asset naming convention across data management platforms would enhance use and benefit of existing data.
- EGI did not have a Master Asset Registry from which integrity engineers can quickly gain insight into asset information like that collected for this Review. EGI prepared more than 60 data responses, excluding the ProjectWise record access provided, to meet the Information Requests of this Review. Aligned data would facilitate consistent and expedited access to asset information.
- NDE excavation results were maintained individually and archived by asset. Excavation forms contain a wealth of information on many pipeline integrity topics (i.e., coating type/condition, pipe properties, soil type, CP measurements, active threat mechanism and anomaly dimensions) that was not managed as structured data (e.g., tabulated into database fields with attributes) that can be widely searched and compared for asset reliability. PDF records were digitally catalogued but were a form of unstructured information that cannot be queried for use in automated analyses. This information could provide valuable insight into asset performance.
- Condition assessment history, by technique or tool, was not maintained as a compiled resource. Should a new threat arise, research is required to determine if that threat could have been observed.
- EGI was transitioning to manually assembled Integrity Plans for each asset. Manage latest measured information to update/validate an Integrity Plan electronically. Integrity Plans are effective tools to inform stakeholders; however, unless holistically managed, analytics will not be effective at identifying emerging concerns and changing integrity patterns.

6.2 High Uncertainty Promoters

The Decision Logs attached to this report as Exhibits provide details describing the progression of an asset through each Logic Tree and the basis for its classification. Below are summaries extracted from the Decision Logs (see **Exhibits**) highlighting the threats on assets classified with high uncertainty and opportunities for EGI to reduce uncertainty.

6.2.1 External Metal Loss

69 assets (12%, 149 km) were classified with high threat uncertainty. The majority of those assets (54 of 69 assets, 45 km) were well pool assets and were not part of an ILI program. Three main categories of uncertainty were observed:

- AC Corrosion – 16 of 69 assets (23%). All but one of these assets were within 300m of HVAC powerlines with no previous AC study and an integrity assessment older than four years. The remaining asset had no previous assessment.
 - Uncertainty reduction options include an AC mitigation study and ILI.
- CP shielding – 26 of 69 assets (38%). These assets had no previous condition assessments and a coating type that could be susceptible to shielding. 60% of these assets operated at MOP > 30% SMYS.
 - Uncertainty reduction option includes an ILI.
- MIC – 27 of 69 assets (39%). These assets had no previous condition assessments, a coating type that could be susceptible to MIC and operating temperatures conducive to MIC.
 - Uncertainty reduction options include determining gas temperature and ILI.

6.2.2 Internal Metal Loss

62 assets (11%) were classified with high threat uncertainty and were not part of an IC mitigation program. The assets had not experienced bi-weekly maintenance pigging or received inhibition.

- All assets were upstream of dehydration with the potential to failure in a rupture mode (vs. leak) based on a Modified Ln-secant analysis based on design and operating conditions.
 - Uncertainty reduction options include confirmation of free water content and ILI.
- The flow velocity for 38 assets upstream of filtration was unknown. Assets that are not downstream of filtration could exceed the critical flow velocity and keep solids entrained. Without a velocity monitoring program, these assets were classified with high uncertainty for erosion corrosion.
 - Uncertainty reduction option includes confirmation of gas velocity before considering other options.
- The free water content, temperature and flow rate was not known for 24 assets. The assets had no history of failure, but also had no bacteria testing or monitoring with coupons. These assets were classified with a high uncertainty for the MIC sub-threat.
 - Uncertainty reduction options include temperature confirmation, bacterial testing, chemical treatment, mechanical cleaning, and ILI.

EGI relied on gas quality control practices (i.e., dry gas purchase specifications, dehydration at compression) and did not actively manage temperature, dew points, velocity or perform monitoring actions (i.e., cleaning, inhibition, probes) to establish confidence in the awareness of the IC threat beyond scheduled MFL inspections for piggable assets.

6.2.3 Stress Corrosion Cracking

43 assets (8%) were classified with high uncertainty for the SCC threat. These assets had susceptible or unknown coating types, no prior condition assessment for SCC, and either shared a right of way with other assets with confirmed SCC or had a history of SCC discovered during NDE. The NDE records reviewed did not include a 360° MPI inspection.

- Uncertainty reduction options include additional records research to establish coating type and operating temperature; NDE practices where 360° MPI or other surface crack detection techniques are employed to confirm the absence of SCC; and EMAT ILI.

6.2.4 Circumferential Stress Corrosion Cracking

Eight assets (<1%) were classified with high uncertainty for the CSCC threat. These assets were coated with non-FBE/HDPE pipe coatings and had been in-service for more than ten years without ILI data review (MFL-C or IMU strain analysis). The assets had pipe parameters (i.e., length longer than 500m, grade, vintage, diameter, or wall thickness (per PRCI PR-313)) with a strong correlation to industry incident data and did not have an established strain demand limit or a geotechnical assessment of potential external strain loads.

- Uncertainty reduction options include the completion of geohazard field investigations, strain assessments of prior IMU data and MFL-C ILI.

6.2.5 Selective Seam Weld Corrosion

111 assets (20%) were classified with high uncertainty for the SSWC threat. The assets were manufactured pre-1980, operated above 30% SMYS, and had not had an ILI to evaluate the seam condition or a pressure test above 125% MOP in the last ten years. SSWC was identified on one of the assets during an excavation. The remaining assets had a coating type susceptible to CP shielding (which could allow corrosion beneath the coating) or did not meet CP target criteria.

- Uncertainty reduction options include maintenance of CP protection levels and MFL-C ILI.

6.2.6 Long Seam Cracking

143 assets (26%) were classified with high uncertainty for the LSC threat. Three of the assets had a history with LSC. The other 140 assets were of a vintage and seam type susceptible to LSC, operated above 30% SMYS and lacked records that confirmed that the pipe was pressure tested to more than 125% of MOP. Pressure cycle fatigue analysis had not been performed on these assets.

- Uncertainty reduction options include additional records research to establish seam types and commissioning pressure test history, pressure cycle fatigue analysis and in-line inspection (MFL-C ILI or EMAT ILI).

6.2.7 Hard Spots

24 assets (4%) were classified with high uncertainty for the HS threat, a threat with a strong incident correlation to specific manufacturers and vintages of construction. One asset had a history of HS. Four other assets conform to the industry history with vintage and grade of the HS threat. The manufacturers of the remaining 19 assets could not be established, however corrosion control measures revealed CP potentials more electronegative than -1.2V, a condition known to induce embrittlement that can lead to cracking.

- Uncertainty reduction options include CP maintenance within program guidelines, additional records research to establish pipe manufacturer, and MOP reduction below 60% SMYS.

6.2.8 Latent Damage

Thirteen assets (~2%) were classified with high uncertainty of the LD threat due to prior LD, vintage of construction and high population density. EGI had experienced LD related incidents on four (4) assets without subsequent depth of cover data. One of those assets was not patrolled on a weekly basis. The remaining nine (9) assets classified with high uncertainty did not have depth of cover or weekly patrols.

- Uncertainty reduction options include making the assets piggable, depth of cover surveys and increased patrol frequency.

6.2.9 Geohazards

44 assets (~8%) were classified with high uncertainty of the GT threat, because they were not part of the baseline GH assessment program initiated by EGI in 2019.

- Uncertainty reduction option includes conducting a GH assessment of the assets.

53 assets (~9%) were classified with high uncertainty of the hydrotechnical (HT) geohazard threat. 44 of the assets were not part of the baseline GH assessment program initiated by EGI in 2019. The remaining nine (9) assets had a POF/susceptibility categorization higher than the “extremely remote” classification.

- Uncertainty reduction options include conducting a GH assessment of the assets, field-based site verification inspections and monitoring of the impact of the HT threat at pipe depth.

7 Key Observations

7.1 Identification of Threats

The Logic Trees collaboratively developed by the project teams will offer long-term value to EGI. A challenge to the application of the logic criteria was the availability of aligned data.

This project corroborated the challenge faced by the EGI integrity management team to readily access and leverage relevant and current data to perform comprehensive threat assessments. EGI pipeline design and monitoring program data such as flow rates, temperatures, CP measurements likely exist, but was not readily accessible by the integrity management team for use in a threat identification program on a system-wide basis. The lack of structured data (i.e., information accessible in a data table format) inhibits the ability to perform data-driven decision making, inherently creating uncertainty regarding the condition of an asset.

7.2 Uncertainty of Non-piggable Assets

82% of the asset mileage (190 assets, 3,004 km) were considered piggable using in-line tools, and these assets received the focus of condition assessments and, by association, were investigated for several degradation threats. Most longer assets, those with diameters NPS 8 and larger and operating pressures above 2,758 kPa (400 psi) were evaluated by ILI based on the ability and ease for monitoring threats.

At EGI, high threat uncertainty was predominantly associated with shorter, non-piggable assets. Figure 11 demonstrates that of the 369 non-piggable assets, 154 were classified with high uncertainty for at least one threat. 102 of those assets were shorter than one kilometer. More than 100 assets were classified with high uncertainty and had been in service for more than 40 years.

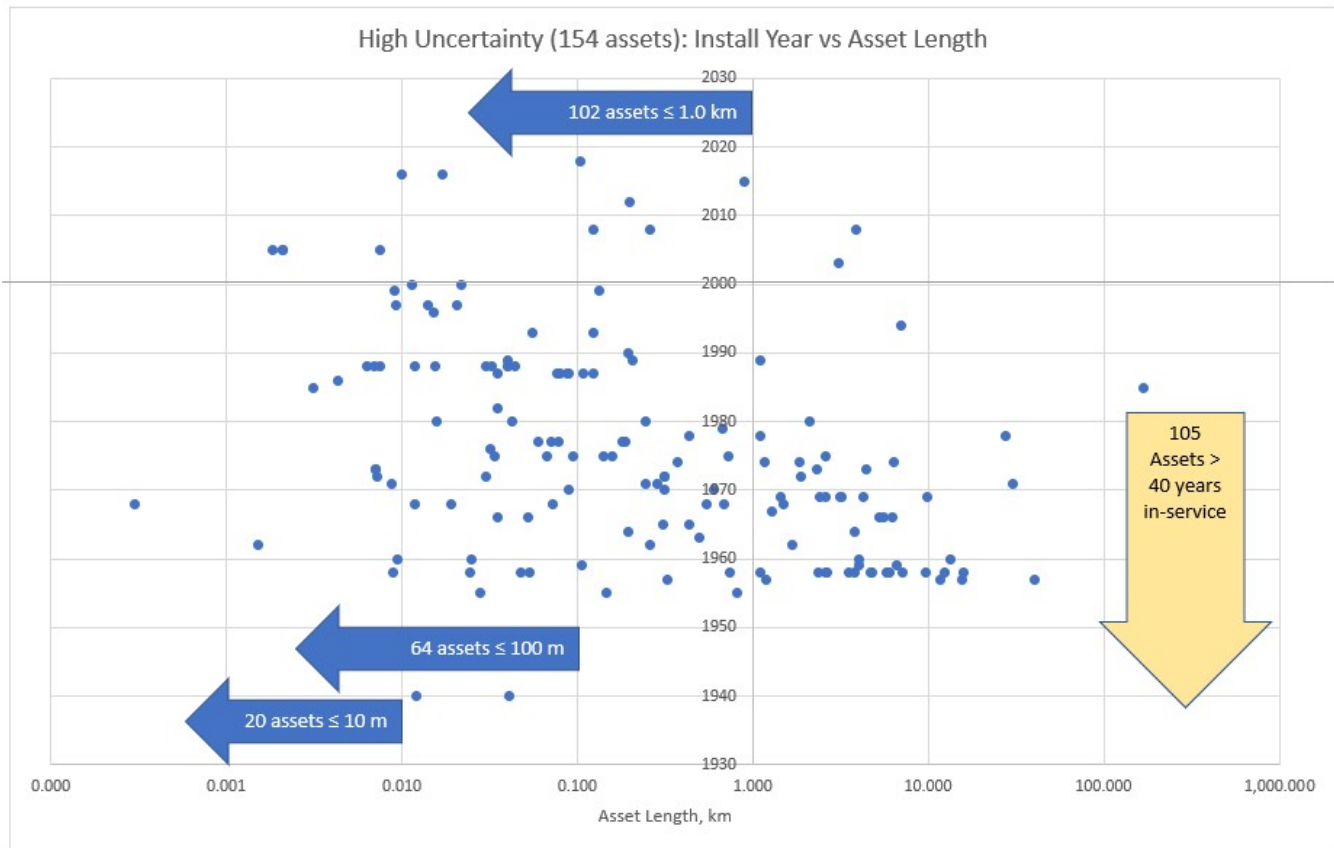


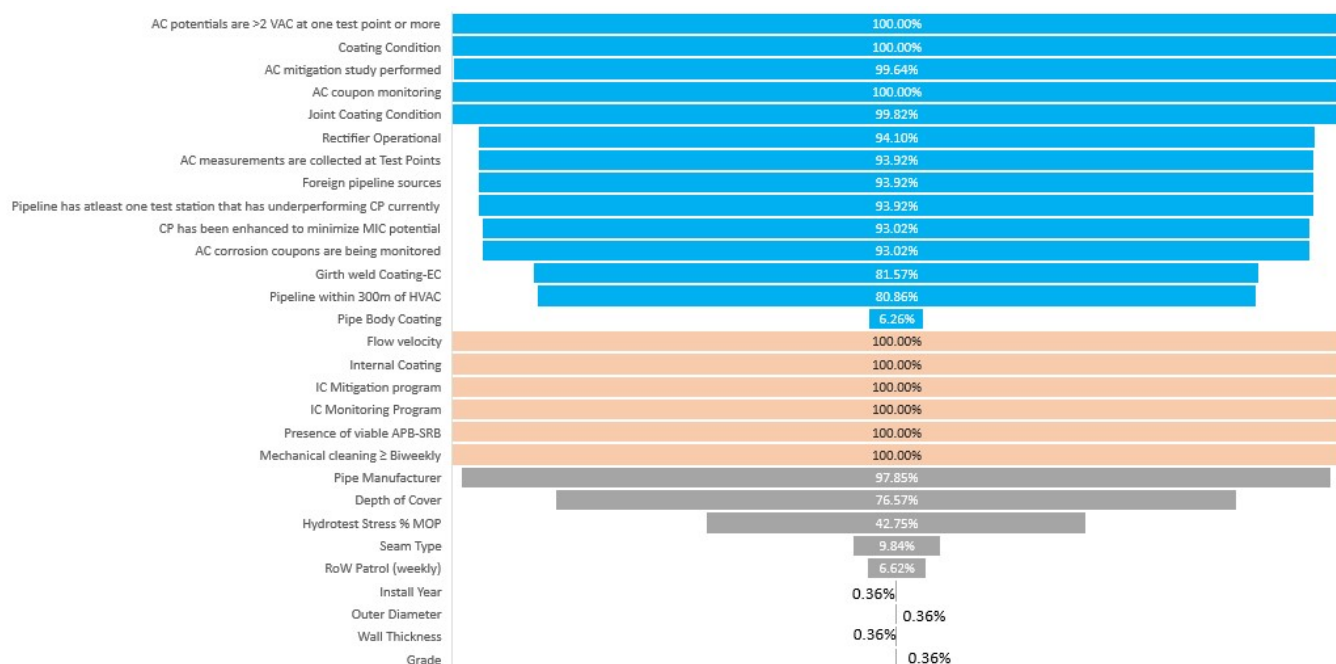
Figure 11: Non-piggable high uncertainty assets by vintage and length

External corrosion direct assessment (ECDA) was the inspection methodology for 220 assets ranging from NPS 2 to NPS 30. Unfortunately, unlike some ILI tools, ECDA can only be used to evaluate the external metal loss threat, leaving all other threats unevaluated.

7.3 High Uncertainty driven by Unknown Information

This Review intentionally developed the threat logic in advance of data alignment. This approach encouraged SMEs to assess what technical criteria could be considered to establish meaningful threat uncertainty unencumbered by available data.

Once data discovery ensued in this Review, unavailable and incomplete data inhibited the explicit evaluation of several criteria. Figure 12 identifies the Logic Tree decision criteria where evaluation of conditions was inhibited by data gaps or data that was not readily available. Data gaps ranged from only a limited number of criteria elements (i.e., installation year, outside diameter, wall thickness, pipe grade) to the entire criteria (100%) being unavailable as structured data for use in the Review. EGI elected to retain criteria in the logic trees for non-available data since the logic was technically based and would aide EGI in future data management endeavors that could enhance overall threat management processes. This is not to imply that data must be collected, only that it was not available for use during this review.



Factors impacting External metal loss are in blue, Internal metal Loss in tan, other threat factors in gray

Figure 12: Funnel diagram with data gaps for key criteria in this Review

Not reflected in Figure 12, a modification to the initial approach of the EC and IC threat and sub-threat uncertainty analyses was made to minimize the need for system-wide data, because it was not available. EGI requested that only those assets that required critical data (i.e., CP measured values) for uncertainty classification were included in the Master Asset Registry. Aligning data between Engineering (TIMP/GIS pipeline names), Corrosion Control (i.e., test stations, rectifiers, casings) and Gas Control (i.e., temperature, flow rates) was not practical for TIMP within the project schedule.

7.4 Threat Exposure

Most assets classified with high uncertainty (i.e., red) were classified so based on insufficient data that would otherwise indicate that the awareness of the threat was high (or that the threat was not active). However, as shown in Table 9, cases exist where opportunistic SCC, SSWC, LSC, HS and LD were reported at excavations, yet

the assets were not included in a threat specific investigation program. Cases such as these represent increased risk exposure for EGL.

Table 9: High Uncertainty based on Condition Awareness

High Uncertainty Category	Logic Tree Criteria Supporting a High Uncertainty Classification	Asset Name (Length, km)
SCC-8	<ul style="list-style-type: none"> ➤ Assets with SCC history ➤ Not subjected to integrity assessment through either spike pressure test within the last 7 years or an EMAT inspection (either previously performed or scheduled in the next 5 years) ➤ No SCCDA in the last 5 years ➤ SCC or uncharacterized cracking was also confirmed at NDE sites for these assets 	<ul style="list-style-type: none"> • NPS 8 Stratford (19.814) • NPS 8 Cardinal Co-Gen (7.051) • NPS 2 North Shore - North Shore Lateral PRS TAKE-OFF (0.004) • NPS 16 Panhandle (66.490) • NPS 12, 16 London West (24.057) • NPS 12 Marten River (104.025) • NPS 10 Sudbury - Gormanville Rd on Lateral-Ca PRS TAKE-OFF (0.003) • NPS 10 Guelph (15.004)
SSWC-9	<ul style="list-style-type: none"> ➤ No prior MFL-C inspection or future ILI scheduled ➤ Operating at 34% SMYS ➤ Not pressure tested for $\geq 125\%$ MOP in last 10 years ➤ NDE Findings of SSWC From Excavation 	<ul style="list-style-type: none"> • NPS 12 Oshawa (3.929)
LSC-7	<ul style="list-style-type: none"> ➤ No prior MFL-C or EMAT inspection performed; ILI planned for one asset in 2022 but no tool type specified for any assets ➤ Operating stress ranging from 36-62% SMYS ➤ Susceptible seam type (LF-ERW, ERW) for two (2) assets and unknown for one (1) asset ➤ Commissioning pressure test either $< 125\%$ MOP or no pressure cycling analysis performed ➤ Past Long Seam failures/findings 	<ul style="list-style-type: none"> • NPS 10 Timmins Loop (22.703) • NPS 8 Stratford (19.814) • NPS 16 Ottawa South- Rideau River Crossing (0.618)
HS-7	<ul style="list-style-type: none"> ➤ Asset with ERW seam type ➤ No history of Hard Spot or Hard Spot Inspection performed ➤ Operating at 72% SMYS ➤ Installed in 1964, 30" grade X60 ➤ Manufacturer is Welland Tube 	<ul style="list-style-type: none"> • NPS 30 Transmission System A Pipeline (18.971)
LD-7	<ul style="list-style-type: none"> ➤ All assets are non-piggable ➤ Operating at stress greater ranging from 51-68% SMYS ➤ PiMSlider failure frequency $\geq 1 \times 10^{-5}$ or unknown ➤ No ECDA with DCVG performed ➤ history of Latent Damage 	<ul style="list-style-type: none"> • NPS 10 English River Lateral (0.032) • NPS 10 Sudbury- NCGC Easement & Betty Rd PRS TAKE-OFF (0.009) • NPS 10 Sudbury-NCGC Easement & St Armour Rd TBS TAKE-OFF (0.016) • NPS 10 Sudbury- Gormanville Rd on Lateral-Ca PRS TAKE-OFF (0.003)

8 References

Technical references to support the threat review and uncertainty analysis are included in Appendix B of each Decision Log. See Exhibits.

9 Abbreviations

Table 10 provides meanings for abbreviations used in this report.

Table 10: Abbreviations

Abbreviation	Meaning
AC/DC	Alternating Current / Direct Current
CP	Cathodic Protection
CSCC	Circumferential Stress Corrosion Cracking
EC	External Corrosion, External Metal Loss (including MIC and AC/DC induced corrosion)
ECDA	External Corrosion Direct Assessment
EGI	Enbridge Gas, Inc.
EMAT	Electromagnetic Acoustic Transducer
GH	Geohazards related to ground movement and scour (including both geotechnical (GT) and hydrotechnical (HT) sub-threats)
GIS	Geographic Information System
HS	Hard Spots (including pipe body and long seam)
IAIR	Independent Asset Integrity Review
IC	Internal Corrosion, Internal Metal Loss (including MIC and erosion)
ILI	In-line inspection
IMU	Inertial Mapping Unit
km	Kilometer
LD	Latent Damage from external interference and construction (Including dents, wrinkles and buckles)
LEG	Legacy Enbridge Gas
LSC	Long Seam Cracking
LUG	Legacy Union Gas
MFL	Magnetic Flux Leakage
MIC	Microbiologically Influenced Corrosion
MOP	Maximum Operating Pressure
MPI	Magnetic Particle Inspection
NDE	Non-Destructive Evaluation
NPS	Nominal Pipe Size
PRIM	Pipeline Risk and Integrity Management, includes the PiMSlider risk software
SCC	Stress Corrosion Cracking (including high pH, near-neutral pH)
SME	Subject Matter Experts
SMYS	Specified Minimum Yield Strength



Report of Observations: Independent Asset Integrity Review

Abbreviation	Meaning
SSWC	Selective Seam Weld Corrosion
TIMP	Transmission Integrity Management Program

10 Exhibits: Decision Logs

DL-001	External Corrosion (EC) Decision Log
DL-002	Internal Corrosion (IC) Decision Log
DL-003	Stress Corrosion Cracking (SCC) Decision Log
DL-004	Circumferential Stress Corrosion Cracking (CSCC) Decision Log
DL-005	Selective Seam Weld Corrosion (SSWC) Decision Log
DL-006	Long Seam Cracking (LSC) Decision Log
DL-007	Hard Spots (HS) Decision Log
DL-008	Latent Damage (LD) Decision Log
DL-009	Geohazards (GH) Decision Log

NOTE: Decision Logs are provided as a companion PDF document (130 pages).

20210930 EGI IAIR Exhibits - Decision Logs (DL-001 to DL-009).PDF

‡ Two Decision Logs were updated in conjunction with this report Revision 1.

20211207_DL-002 rev2 Internal Corrosion.pdf

2021-11-10_DL-007 rev1 Hard Spots.pdf

Attachment 1: Master Asset Registry

The project team compiled and integrated the information received from EGI into a Master Asset Registry for use in this Review. Key features of this registry:

- 154 data columns (A thru EX)
- Rows 1 thru 9 identify the usage of the data field in a Logic Tree
- Row 12 corresponds to the Information Request containing the information received from EGI
- Columns A thru K are the Uncertainty Analysis results based on the corresponding Logic Tree.
- Column M, Index, is a field developed by the project team to allow for the unique alignment by asset name (i.e., TIMP Pipeline)



EGI Master Registry
(12-03-2021).xlsx

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ			
1	Master Asset Registry: Update July 2021												EC											EC-1, EC-3	EC-2									EC-4	EC-6				
2													IC									IC-1, IC-2, IC-4	IC-1													IC-4, IC5	IC-4, IC5		
3													SCC																										
4													CSCC																										
5													HS																										
6													SSWC																										
7													LSCrack																										
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A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE			
Master Asset Registry: Update July 2021												EC IC SCC CSCC HS SSWC LSCra LD GH	AK IC-4, IC5	AL IC-4, IC5	AM	AN EC-5 IC-3	AO EC-5 IC-3	AP AC-2	AQ	AR	AS	AT	AU SCC-3 CSCC-1,7SCC-12	AV CSCC-12	AW CSCC-9 HS-5,7,8 HS-5,7,8a-f,9	AX	AY HS-1 SSWC-1,2 LSC-1,5,9	AZ SSWC-8	BA	BB	BC LSC-7	BD	BE
												IR#1.6	[Document #]: D3a.4,103a [103a.4]		[103a.5]	[103a.7, 103a.8]	[102.d]	[102b,103a, 103a, 109a] IR 1.02 IR 1.02	[102b,] [1102], [1xx] IR 1.02 IR 1.02	[123, 135] IR 1.08	[113a] IR 1.08	[103.4a] [103.4a]		[102b]	[102b,109a]								
												IR Source:	IR 5	IR 1.05	IR 1.05	Subtotal: 5,675.47	IR 1.02 IR 1.02	IR 1.02 IR 1.02	IR 1.08	IR 1.08			IR 1.02										
559 count of pipelines																																	
1 EC	2 IC	3 SCC	4 CSCC	5 SSWC	6 LSC	7 HS	8 LD	9 GH	9 HH	TIMP Pipeline		Index	HydroTest Stress %MOP	Hydro Test Pressure Achieved (psi)	Integrity Assessment GW Date	Next ILL Tool Date (2021-2022)	Next ILL Tool Type (2021-2022)	Length (km)	ILL <100m	Install Year	NPS	OD (mm)	WT (mm)	Grade (MPa)	Grade, Calc (ksi)	Pipe Manufacturer	Seam Type (Seamless Y/N) (LF, EFW, BW or Unknown)	Initial Hydro ≥125% MOP (Y/N)	Hydro ≥ 100% MOP (Y/N)	Aggressive Pressure Cycling (PCFA)	MOP (psi)	MOP (kPa)	%SMYS Calculated
G-1	IC-1	CC-1	SCC-1	SWC-5	LSC-2	HS-3	LD-1	BT-2	HT-4	NPS 24 156 Pool Transmission		1	150%					3.464		1968	24	609.6	10.30	359	52.069	No Data	EFW				1000	6,895	57%
G-2	IC-8	CC-1	SCC-5	SSWC-LSC-5	HS-1	LD-5	BT-2	HT-2		NPS 8 156 Pool Well Lateral - D185		2	156%					0.340		1988	8	219.1	4.80	290	42.061	No Data	HF ERW				1000	6,895	54%
G-2	IC-8	CC-1	SCC-5	SSWC-LSC-5	HS-3	LD-5	BT-2	HT-2		NPS 30 156 Pool Well Lateral - D189		3	175%					1.514		1988	30	762	10.30	448	64.977	No Data	DSAW, HF ERW				1000	6,895	57%
G-2	IC-8	CC-1	SCC-5	SSWC-LSC-5	HS-1	LD-5	BT-2	HT-2		NPS 12 156 Pool Well Lateral - D206		4	209%					0.389		1988	12	323.9	7.10	290	42.061	No Data	HF ERW				1000	6,895	54%
G-2	IC-8	CC-1	SCC-5	SSWC-LSC-4	HS-1	LD-5	BT-2	HT-2		NPS 6 156 Pool Well Lateral - D219		5	156%					0.038		1988	6	168.8	7.10	290	42.061	No Data	HF ERW				1000	6,895	28%
G-2	IC-8	CC-1	SCC-5	SSWC-LSC-5	HS-1	LD-5	BT-2	HT-2		NPS 6 156 Pool Well Lateral - D220		5	156%					0.154		1988	6	168.8	4.80	290	42.061	No Data	HF ERW				1000	6,895	42%
G-2	IC-8	CC-1	SCC-5	SSWC-LSC-5	HS-3	LD-5	BT-2	HT-2		NPS 8 156 Pool Well Lateral - D223		7	156%					0.000		1968	8	219.1	4.80	290	42.061	No Data	LF ERW				1000	6,895	54%
G-2	IC-8	CC-1	CC-11	SWC-1	LSC-5	HS-3	LD-5	BT-2	HT-2	NPS 8 156 Pool Well Lateral - D226		8	156%					0.688		1968	8	219.1	4.80	290	42.061	No Data	LF ERW				1000	6,895	54%
-15	IC-8	CC-1	SCC-5	SSWC-LSC-5	HS-1	LD-9	BT-2	HT-2		NPS 12 156 Pool Well Lateral - D231		9	210%					0.125		1988	12	323.9	7.10	290	42.061	No Data	HF ERW				1000	6,895	54%
G-2	IC-8	CC-1	SCC-5	SSWC-LSC-5	HS-1	LD-5	BT-2	HT-2		NPS 16 156 Pool Well Lateral - D232		10	210%					0.298		1988	16	406.4	9.50	290	42.061	No Data	HF ERW				1000	6,895	51%
G-2	IC-8	CC-1	SCC-5	SSWC-LSC-5	HS-1	LD-5	BT-2	HT-2		NPS 12 156 Pool Well Lateral - D248		11	210%					0.166		1983	12	323.9											

[illegible]

Master Asset Registry: Update July 2021											EC	IC	SCC	CSCC	HS	SSWC	LSCra	LD	GH	IR#1.0	[Document #]:	[121a, 137]	[121a]	[149]	[112]	[143]	[122]	[132]	IR Source:	559 count of pipelines																				
1	2	3	4	5	6	7	8	9	9	EC	IC	SCC	CSCC	HS	SSWC	LSCra	LD	GH	IR#1.0	[Document #]:	[121a, 137]	[121a]	[149]	[112]	[143]	[122]	[132]	IR Source:	IR 1.07	IR 2.10	IR 2.04	IR 2.10	IR 4.05	IR 2.14	IR 2.13	IR 2.18	IR 2.18	IR 2.12	IR 2.15	IR 2.16	IR 2.04	IR 2.03	IR 2.17	IR 2.17						
1	2	3	4	5	6	7	8	9	9	EC	IC	SCC	CSCC	HS	SSWC	LSCra	LD	GH	IR#1.0	[Document #]:	[121a, 137]	[121a]	[149]	[112]	[143]	[122]	[132]	IR Source:	IR 1.07	IR 2.10	IR 2.04	IR 2.10	IR 4.05	IR 2.14	IR 2.13	IR 2.18	IR 2.18	IR 2.12	IR 2.15	IR 2.16	IR 2.04	IR 2.03	IR 2.17	IR 2.17						
1	2	3	4	5	6	7	8	9	9	EC	IC	SCC	CSCC	HS	SSWC	LSCra	LD	GH	IR#1.0	[Document #]:	[121a, 137]	[121a]	[149]	[112]	[143]	[122]	[132]	IR Source:	IR 1.07	IR 2.10	IR 2.04	IR 2.10	IR 4.05	IR 2.14	IR 2.13	IR 2.18	IR 2.18	IR 2.12	IR 2.15	IR 2.16	IR 2.04	IR 2.03	IR 2.17	IR 2.17						
C-1	IC-1	CC-1	SCC-1	SSWC-1	LSC-1	HS-1	D-1	ST-1	HT-1	NPS 24 156 Pool Transmission	1	No data	No data	#N/A	No data	No																																		
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C-2	IC-7	CC-1	SCC-5	SSWC-4	LSC-4	HS-1	D-5	ST-2	HT-2	NPS 6 156 Pool Well Lateral - D219	5	No data	No data	#N/A	No data	No																																		
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C-2	IC-8	CC-1	CC-11	SSWC-1	LSC-1	HS-3	D-5	ST-2	HT-2	NPS 8 156 Pool Well Lateral - D226	8	No data	No data	#N/A	No data	No																																		
-13	IC-8	CC-1	SCC-5	SSWC																																														

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Master Asset Registry: Update July 2021												EC																	IC-11												
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													[129]	[128]	[116,1,120]	105,138,145,152	[129]		[128]		[106]	[106]	[107]	[127,140]	[136]		[127,140,145]	[146]													
IR Source:													IR 5.x	IR 5.x	IR 3.01	IR 1.12	IR 5.x	IR 5.x	In Scope Per EC Rose Boxes Content Not Assessed Per EGI Clarification Response (06/03/21)										Received EGI Clarification Response (06/04/21)												
1	2	3	4	5	6	7	8	9	9			559 count of pipelines										In Scope Per EC Rose Boxes Content Not Assessed Per EGI Clarification Response (06/03/21)										Received EGI Clarification Response (06/04/21)									
EC	IC	SCC	CSCC	SSWC	LSC	HS	LD	GH	HH			TIMP Pipeline										Index	Geotech DoC, minimum (m)	Hydrotech DoC, minimum (m)	High Population Density (Class 3 or 4)	Geotech Included in BGC 2019/2020 Scope?	Geotech Screening PoF	Hydrotech Screening PoF	Geotech Hazard Identified for PoF Verification	Geotech Desktop Screening Miscall	Hydrotech Desktop Screening Miscall	Geotechnical Site Visit	IMU Bending Strain Performed?	IMU Axial Strain >0.4%	Tensile Strain >2.5%	Hydrotechnical Site Visit	Planned 2021/2022 Geotechnical Inspections	Planned 2021/2022 Hydrotechnical Inspections	Ln-Sec IC Leak (> 3.015")	TIMP Justification	
G-1	IC-1	CC-1	SCC-1	SSWC-5	LSC-2	HS-3	D-1	ET-2	HT-4			NPS 24 156 Pool Transmission										1		No DoC	Class 1 or 2	Yes	No Features	1.74E-06	No	No	No	No	Not Perform	--	--	No	-	No	>30% SMYS		
G-2	IC-8	CC-1	SCC-5	SSWC-1	LSC-5	HS-1	D-5	ET-2	HT-2			NPS 8 156 Pool Well Lateral - D185										2			Class 1 or 2	Yes	No Features	No Features	No	No	No	Not Perform	--	--	No	-	-	>30% SMYS			
G-2	IC-8	CC-1	SCC-5	SSWC-1	LSC-5	HS-3	D-5	ET-2	HT-2			NPS 30 156 Pool Well Lateral - D189										3			Class 1 or 2	Yes	No Features	No Features	No	No	No	Not Perform	--	--	No	-	-	>30% SMYS			
G-2	IC-8	CC-1	SCC-5	SSWC-1	LSC-5	HS-1	D-5	ET-2	HT-2			NPS 12 156 Pool Well Lateral - D206										4			Class 1 or 2	Yes	No Features	No Features	No	No	No	Not Perform	--	--	No	-	-	>30% SMYS			
G-2	IC-7	CC-1	SCC-5	SSWC-1	LSC-4	HS-1	D-5	ET-2	HT-2			NPS 6 156 Pool Well Lateral - D219										5			Class 1 or 2	Yes	No Features	No Features	No	No	No	Not Perform	--	--	No	-	-	>30% SMYS			
G-2	IC-8	CC-1	SCC-5	SSWC-1	LSC-5	HS-1	D-5	ET-2	HT-2			NPS 6 156 Pool Well Lateral - D220										6			Class 1 or 2	Yes	No Features	No Features	No	No	No	Not Perform	--	--	No	-	-	>30% SMYS			
G-2	IC-8	CC-1	SCC-5	SSWC-1	LSC-5	HS-3	D-5	ET-2	HT-2			NPS 8 156 Pool Well Lateral - D223										7			Class 1 or 2	Yes	No Features	No Features	No	No	No	Not Perform	--	--	No	-	-	>30% SMYS			
G-2	IC-8	CC-11	SCC-11	SSWC-1	LSC-3	HS-3	D-5	ET-2	HT-2			NPS 8 156 Pool Well Lateral - D226										8			Class 1 or 2	Yes	No Features	No Features	No	No	No	Not Perform	--	--	No	-	-	>30% SMYS			
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Attachment 2: Source Records provided by EGI for this Review

The following is a list of source files provided by EGI in response to information requests submitted by the project team.

Reference	Document Name
101	2021-04-12 1.01-1 EGI SME List
102	2021-04-16 1.02 TIMP Inventory
102a	2021-05-06 1.02 TIMP Inventory
102b	2021-06-24 1.02 TIMP Inventory
102c	2021-06-25 1.02 TIMP Inventory
102d	2021-07-07 1.02 TIMP Inventory
102e	2021-07-27 1.02 TIMP Inventory
102f	2021-07-29 1.02 TIMP Inventory
103	2021-04-16 1.04 Multi Year Inspection Plan
103a	2021-05-03 1.04 Multi Year Inspection Plan Rev. 1
103a.1	2021-05-25 IR 5 Master Registry Gaps_ILI
103a.2	2021-05-25 IR 5 Master Registry Gaps_ILI-HOU-T480S-0001
103a.3	2021-05-26 IR 5 Master Registry Gaps_ILI
103a.4	2021-05-26 IR 5 Master Registry Gaps_ILI
103a.5	2021-05-31 IR 5 Master Registry Gaps_ECDA
103a.6	2021-05-31 IR 5 Master Registry Gaps_Hydrotest
103a.7	2021-07-26 IR 5 Master Registry Gaps_ILI
103a.8	2021-07-29 IR 5 Master Registry Gaps_ILI
104	2021-04-19 1.05 Historical ILI Log
104a	2021-05-21 1.05 Historical ILI Log-CT
104b	2021-07-29 1.05 Historical ILI Log
105	2021-04-19 1.12 FGDB
106	2021-04-16 1.13-1 Geotechnical Hazard Report
107	2021-04-16 1.13-2 Hydrological Hazard Report
108	2021-04-20 1.14-2 LEG 2018 Depth of Cover survey
109	2021-05-02 2.01-1 LEG Pipebody Coating
109a	2021-05-31 IR 5 Master Registry Gaps_Coating
110	2021-05-02 2.01-2 LEG GirthWeld Coating
111	2021-05-02 2.05-1 LUG Cased Pipeline Crossings
112	2021-05-02 2.05-2 LEG Cased Pipeline Crossings
113	2021-05-02 3.02 Seam Types
113a	2021-05-31 IR 5 Master Registry Gaps_Seam
114	NPS 24 NEB Lisgar to Pine Valley_pdf
114a	NPS 24 NEB Lisgar to Pine Valley_pdf
115	2021-05-02 2.25 LUG NDE Field Procedure (2016)
116	2021-05-03 3.01 LUG Class Location Data IRSA 2020 Extract
116.1	2021-05-25 IR 5 Master Registry Gaps_Class
117	2021-05-02 3.03 Compressor Stations
117a	2021-06-30 3.03 Compressor Stations
118	2021-05-04 4.14 TSSA Oil and Gas Pipelines CAD Amendment - FS-253-20
119	2021-05-04 4.15 Depth of Cover Operating Standard
120	2021-05-05 3.01 EGS Class Location and HCA study
121	2021-05-13 IR-2 EC-XX Responses



Report of Observations: Independent Asset Integrity Review

Reference	Document Name
121a	2021-05-13 IR-2 EC-XX Responses
122	Powerlines Shapefile (folder)
123	2021-05-04 2.23 AO Smith Pipeline Review in EGI TIMP System
124	4.13 LUG and LEGS List of Aerially and Ground Patrolled Pipelines
125	2021-05-13 TIMP Pipeline with SMYS issues
126	2021-05-18 4.13 LEG List of Aerially and Ground Patrolled Pipelines
127	2020-05-20 IR 5.01 Ottawa Geohazard Assessment
128	2020-05-21 IR 5.02 HydroTechHazards_SourceOfTruth
129	2020-05-20 IR 5.03 EGI_GeotechnicalHazardInventory
130	2021-05-25 IR 5 Master Registry Gaps_Free Water
131	2021-05-31 IR 2.12 Incident History
132	2021-05-31 IR 5 Master Registry Gaps_DC
133	SSWC NDE Reports
134	2021-05-31 IR 5 Master Registry Gaps_SSWC NDE Reports
135	IR 5 Master Registry Gaps_Hydrotest
135a	2021-07-07 IR 5 Master Registry Gaps_Manufacturer
136	2021-06-01 Bending Strain Analysis
137	Master Registry Data Gaps - EC-XX responses - email
138	(5.02 and 5.03) Clarification - Geohazard Assessed Sites - email
139	WT Assumptions for NPS4 - email
140	(5.02 and 5.03) Clarification - Geohazard Assessed Sites - Golder - email
141	Crowland MOP - email
142	TIMP Pipelines with Missing Lengths - email
143	7_Hard Spot CP Levels update
144	2021-04-16 1.12
145	2020-06-17 IR 5.01 EGI Hydrological sites field visited by Stantec
146	2020-06-19 IR 5.01 Stantec 2021 WC Inspection Locations
147	Temp History NPS 16 59-85 Pool Well Lateral - D274
148	Clarification on Geohazard sites Pipeline Names - email
149	2021-06-17 CP Data Gap_Brad
150	2021-06-25 Fatigue Analysis
151	PE -Is it Tape or YJ - email
152	Geohazard Assessment - Screenshots - email
153	Owen Sound Section 1 SCC - email
154	PRIM - INT METAL LOSS EXPORT
155	Owen Sound Section 5 - email
156	PRIM_All_Features (7-13-2021)
157	PRIM INT METAL LOSS LATEST ILIs_2042872121
158	Comments on the IC Decision Log (DL-002)
159	20210721 DL-005 SSWC EGI Comments
160	NPS 10 Sombra Pool Transmission IC Leak - email
161	NPS 12 in Ottawa South Item 72 GW320 2010 ODO 93.871
162	NPS 12 Oshawa Gate to Taunton Item 149 at ODO 1004.786 2011 rev 2
163	RE_EGI IAIR_EC Decision Log Review Request (DL-001) - DRAFT A
164	RE_EGI IAIR_SSWC Decision Log Review Request (DL-005) - DRAFT A
200	2021-05-25 IR 5 Master Registry Gaps_ILI-HOU-T480S-0001

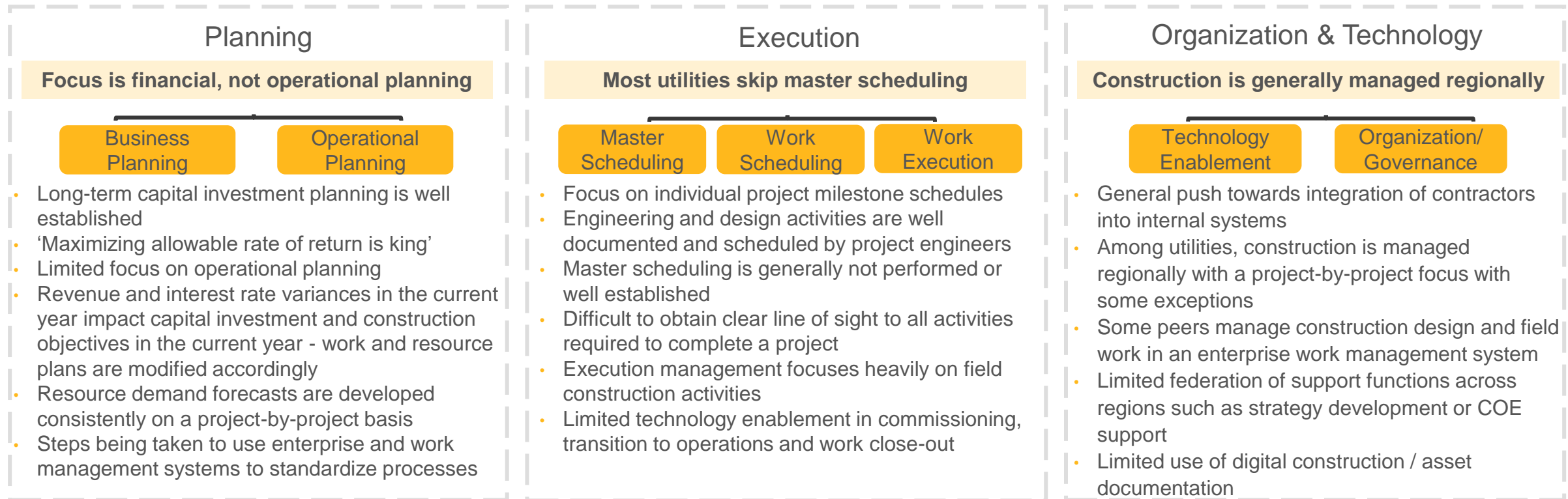
Construction Strategy PoV

Key Findings and Preliminary Recommendations

December 2022

Construction capability insights from peer utilities

P&U companies¹ are generally not managing construction as an end-to-end business capability. Their focus is centered on maximizing allowable rate of return versus optimizing construction performance



While prioritizing long term capital investment planning, **utilities should focus on managing construction as an E2E business capability**, taking into account cost efficiency and best practices, to find **opportunity for better linkage between rate making and operational planning**. In addition, the organization should capture **opportunity to consolidate leadership, processes and support**.

¹A limited group of P&U utility account teams was engaged to conduct internal interviews and discussions to identify key insights and themes around construction capability and operating models.

Emerging trends in construction

Industry analysis identified three key trends: Industrialization, Resourcing Strategy Optimization and Digitization

INDUSTRIALIZATION

Development perspectives are changing **from custom linear focus to a standard lifecycle** focus. Rather than executing projects one step at a time, owners are engaging partners to provide an end to end service (design through maintain).

TODAY



- Emphasis on immediate next steps along a linear value chain
- **Focus on immediate** customer, product / service, incremental innovations

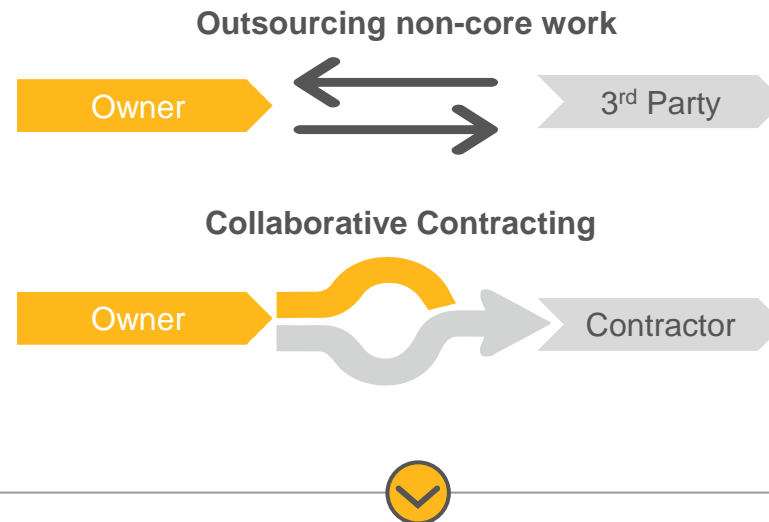
FUTURE



- **E2E view** with consideration of all costs and value chain parts
- Focus on **customized solutions**, and disruptive innovations with a move from an **assembly line to a packaged/industrial environment**

RESOURCING STRATEGY

Owners and leading constructors are moving beyond preferred partner agreements for specialty services to exploring **Collaborative Contracting** agreements built upon the concept of **Early Contractor Involvement (ECI)** in the construction process.



Collaborative Contracting via early contractor involvement (ECI) enables greater risk mitigation and planning capability, allowing for more predictable results and better value.

DIGITIZATION

Technology is a significant enabler for future construction opportunities with major developments in **data and analytics**, creating a **data-driven view** of all aspects of projects.



Improvement in **data management processes** for predictive capabilities across the construction lifecycle



Utilizing **Digital Twins, Building Information Models (BIM), the Internet of Things (IoT), AR and VR, big data and AI** to streamline each phase of the project lifecycle.



Use of **Smart Contracting and Blockchain** to increase **traceability of materials and transactions**

Innovation and technology development are leading a shift to modular construction - shifting construction hours from the field to factories.

Digital technologies will enable greater efficiency, improve performance, reduce project-management needs and simplify supply-chain management.

Suggested points for discussion

Combining the current state of construction with identified trends and peer utility analysis, we suggest considering the following opportunities for construction capability development



E2E construction capability and establishing line of sight into all construction work

- **Operational planning capability** that provides **line of sight** across the entire gas distribution construction portfolio of work and resources.
- Consolidating the **different types and sources of work** with a focus on similarities to end up with 1 process would be beneficial
- Opportunity to establish **a single E2E process** for managing capital programs and projects throughout their lifecycle
- Taking into **account current year revenue and interest rate variances** into the **operational planning process**



Simplification and consolidation of the construction organization structure

- Suggest defining in simple terms **all work** that gas distribution construction is responsible for managing (considering current regional construction scope, system improvement, STO, major and core projects)
- Potential to clarify and **streamline roles and responsibilities** between Asset Management, Capital Support and Execution and Construction.
- Consider **a management structure** with VP of construction having **cross regional responsibility** and functional direct reports for project / program management, Design and Drafting, Field Construction, Construction Support Services.



Improve existing resourcing strategies and explore broader construction trends in parallel with digitization

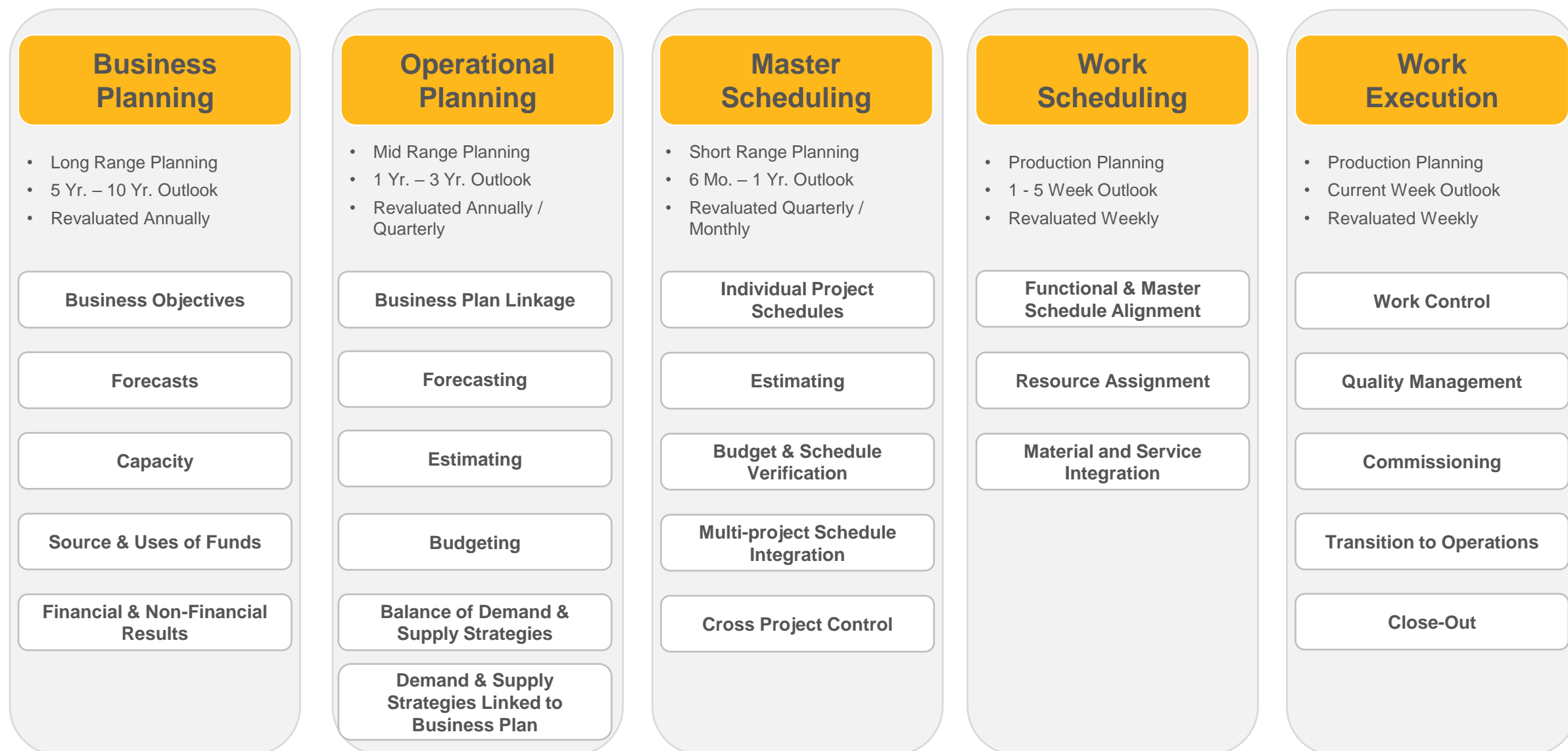
- Armed with a **complete line of sight** to all construction work arises the opportunity to **examine existing resourcing strategies** and identify **opportunities to improve**
- Opportunity to leverage and explore broader construction trends like **collaborative contracting and industrialization** to effectively **reduce costs and optimize construction practices**
- Chance to explore new tech enablement and digitization avenues to increase **transparency and efficiency** in the E2E construction process

Appendix

Construction Capability Model and Peer Utility Key Insights

Construction capability model

Overview of capabilities, sub capabilities, and strategic / operational timeframe



Definition of capabilities

Detailed explanation of construction capabilities included in capability model

Business Planning



- Construction business planning is developing a long range plan for the construction organization that defines at the highest level the business objectives that construction is challenged with achieving, the forecasted volume and timing of construction work and resources required by project category to achieve construction's business objectives. At this stage of planning work and resource volumes are converted to dollars and incorporated into the overall enterprise business plan.

Operational Planning



- Construction operational planning is developing and managing a mid-term plan for the construction organization that begins by translating work and resource requirements summarized in the business plan by project category to requirements for specific projects and resource types. From this refined work and resource requirements forecast resourcing strategies for internal staffing, subcontracted labor and services, material purchases and logistics are developed to verify that work demand and resource supply balance over a mid-term planning horizon. Operational plans are typically prepared / revised annually and updated quarterly.

Master Scheduling



- Master scheduling is developing and managing cross functional resource loaded schedules for individual projects as they are authorized and then combining functional schedules across projects to verify that resourcing strategies but function align with project schedules. Functions covered by this process typically include System Engineering, Design & Drafting, Procurement, construct crafts, materials, plant equipment, construction equipment and logistics.

Work Scheduling



- Work scheduling is the development of functional schedules for individual projects that link work activities to specific individuals and / or crews. Work schedules are linked to master schedule target dates. Work schedules are prepared 1 to 5 weeks in advance and are used as the basis for monitoring work execution progress. Depending upon project size and the management structure of resources work schedules can be organized by function across multiple projects or by function for an individual for management purposes.

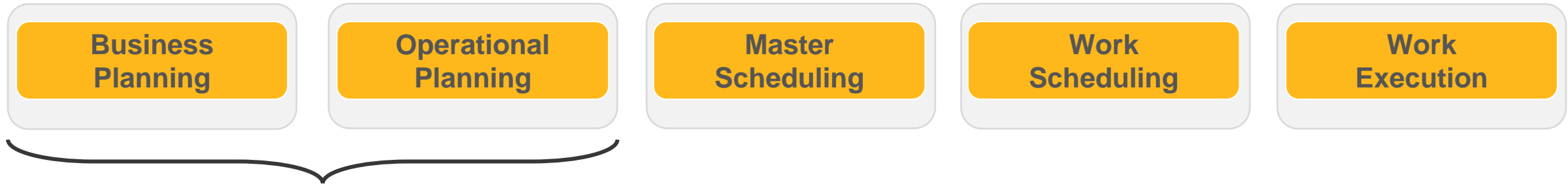
Work Execution



- Work execution is the completion, monitoring and control of work activities in accordance with work schedules by all functions. Work execution scope includes commissioning, transition to operations and close-out of projects. Work control includes quality monitoring, progress and cost tracking, variance analysis, action planning and performance reporting.

Key takeaways: Business and Operational Planning

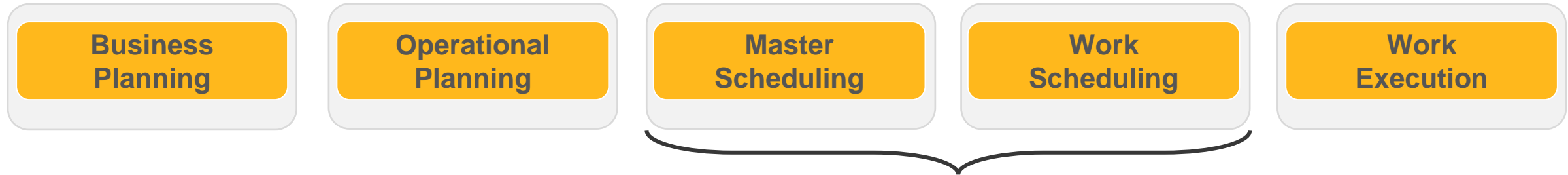
No evidence peer utilities manage construction as an end to end business capability. Long term capital investment planning is well established. Resource forecasting and management across projects is the exception



- Few utilities perform operational planning for an integrated construction business function.
- Achieving annual capital investment plan commitments is a higher priority than project execution efficiency.
- Some peer utilities aggregate resource demand from projects to programs, regions and business units to develop functional resourcing strategies.
- Despite the above, there are well documented, technically enabled long range business planning processes focused on capital investment prioritization and planning are in place and implemented consistently by peer utilities.
- Resource demand forecasts are developed consistently on a project by project basis by function.
- Variations in planned vs actual revenue or interest rates as well as unplanned events like natural disasters or system failures often cause major changes in the availability of funding during any given budget year.

Key takeaways: Scheduling

Peer utilities are not focusing on master scheduling. Individual project milestone schedules are the rule. Obtaining a clear line of sight to all activities required to complete a project is a challenge

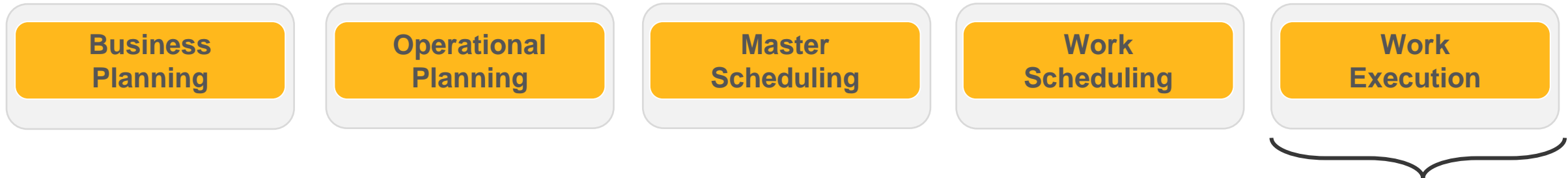


- A focus on master scheduling as a key construction work management capability was not identified at any peer utilities.
- Integrated milestone schedules with cross functional dependencies are developed on a project by project basis by project managers.
- Engineering and design activities are well documented and scheduled by project engineers and managed as part of an engineering and design schedule.
- It is difficult to obtain clear line of sight to all engineering and design activities required to complete a project.
- Construction work activities are documented and scheduled on individual work orders.
- Design and material required to in order to perform construction work orders are managed as work order prerequisites.
- It is difficult to obtain clear line of sight to all construction work orders to complete a project.
- It is difficult for project managers to obtain clear line of sight to all activities required to complete a project.

Key takeaways: Work Execution

Work execution management continues to be largely focused on field construction activities.

Digitization of the construction close-out process continues to be an aspirational goal



- Work control and quality management processes focus on tracking the progress and cost of site construction activities. Implementation of formal variance analysis and action planning are less common.
- Commissioning and transition to operations activities are documented and implemented on a project by project basis with limited technology enablement.
- Construction close-out processes are not fully digitized. The electronic capture of as built design, construction and configuration data into an integrated data management system remains an aspirational goal.

Key takeaways: Organization and Governance

All peer utilities manage construction regionally with a project by project focus. Several had limited federation across regions such as strategy development or COE support.

Organization and
Governance

Technology
Enablement

Leadership

- One electric utility had an SVP responsible for a construction COE that makes project and control, engineering and sourcing services available to regions. Use of these services by the regions is not required.
- One gas utility had VP of construction evaluating cross regional consolidation strategies.

Resourcing Strategies

- One gas utility has partnership agreements with companies that are responsible for delivering completed assets for multi-project programs. Delivery includes engineering, permitting, supply of materials and site construction.
- Several electric utilities have partnership agreements to perform to supply materials and perform construction materials on a project by project basis for all routine utility construction.
- Several utilities who have subcontracted a large percentage of their engineering and design work in the past are bring that work back in house. Skill shortages in the market, quality issues, stamping requirements and cost were all mentioned reasons for evaluating insourcing.
- Several utilities have experienced serious issues with traditional EPC agreements on mega-projects. These utilities are working to more responsibility for managing mega-projects themselves going forward. This is consistent with broader construction industry trends.

Key takeaways: Technology Enablement

Enterprise work management systems are used to manage construction work (engineering, material and field work) at some utilities. One utility has material traceability linkage from GIS element PO. item.

Organization and
Governance

Technology
Enablement

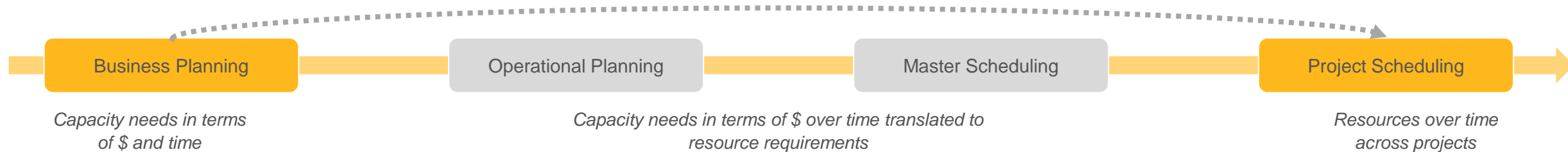
- Some utilities not using enterprise work management system for field construction work.
- Some utilities not using enterprise work management system for engineering work.
- Some utilities do not have materials linked to construction work orders.
- One utility links asset, location, design documents, work order, material usage and traceability data electronically.
- No utility links configuration and testing data to traceability records electronically.

Key findings on construction capabilities (1/2)

Initial findings from discussions with peer utility account teams

1

Most utilities today jump straight from business planning to project scheduling; there is opportunity for better linkage between rate making and operational planning – more planning and contingency management, less reacting.



- Most utilities have business planning processes focused on looking at capacity / reinforcement needs in terms of capacity and dollars. The level of construction spending is driven by the rate making process. As such, **capital budgetary and regulatory commitments take precedence over construction performance and efficiency improvements**
- While **some utilities incorporate 3-5 year long-range planning for capital management**, they have experienced challenges with capital program execution due to **lack of mature operational planning practices, labour/skill constraints, and regulatory burden on supply chains**
- Amount of capital put into different LOBs (e.g., transmission / distribution) generally varies year by year as **construction capital is looked at as a strategic investment rather than O&M**
- Some utilities run a centrally-governed strategy and budgeting process, keeping execution at OpCo level

Key findings on construction capabilities (2/2)

Initial findings from discussions with peer utility account teams

2

Utilities are experiencing changes in sourcing and service delivery transformation for capabilities such as master scheduling, work scheduling and execution.

- **Increased outsourcing of capabilities** (e.g., engineering and design, procurement, material storage, turnkey-type work) **through large EPC partners**; for these cases, there is a push towards integration of contractors into internal systems
- **However, in some cases, there are signs of companies bringing some construction functions in-house** due to 3rd party labour and skill shortages, as well as experiences with some EPCs that have not performed up to expectation or have gone out of business.
- **Some utilities have established centres of excellence (CoEs) to provide EPC services to OpCos** (e.g., engineering and design, supplier selection, lead times, budgeting, quality inspections). This is driving standardization across jurisdictions / states

3

Despite increased push for digitization, a **limited set of operational areas have been addressed by digital transformation** for peer utilities.

- There is an **increased push to leverage enterprise asset management (EAM) solutions** (e.g., Maximo) **for predictive analytics**, albeit traditional focus on maintenance instead of large capital projects and forecasting. This is due to lack of robust data management practices (e.g., historical data management)
- P&U organizations with multiple OpCos have implemented several instances of Maximo and combined with a Qlik front-end, primarily to provide greater flexibility and customization to each company's operational and reporting needs (e.g., differences between electric – nuclear, renewables, transmission, and gas utilities)
- **Greater efficiency in construction through digitization definitely exists, however makes it harder for smaller construction companies to flourish**

Insights on Utility A

Key takeaways from discussion with 'Utility A' account team

Construction Capabilities

How does Utility A perform operational/resource planning?

- At an OpCo level, each region has an annual capital budget total that they are allocated and a allowable rate of equity/return is established
- Meeting capital budget objectives is most important sometimes – results in less focus on efficiency
- Master scheduling is performed at a OpCo/functional level, but not at the enterprise level

Maximo Implementation

- Utility A Company has a vision to use Maximo as an asset management program, however the lack of historical data poses issues
- Maximo will be used as a way to document asset performance, life, to drive asset class decisions, to be more proactive and update their preventative maintenance schedules accordingly
- Utility A has multiple instances of Maximo based on functional team, not OpCo; Each instance is tailored to the needs of each team
- Maximo is used for maintenance primarily, not for large capital projects

Organization and Governance

How does Utility A manage construction?

Electric Generation

- Each region has their own engineering/construction team – functional teams are most likely sharing best practices, SRM programs but not at a mature level
- Organized functionally at a power delivery level

Gas

- Utility A Gas has a VP of construction - this individual is deciding on how the organization should be run going forward.
- Resources managed two different ways; Internally in some regions and completely by contractors in other regions
- Compliance is a huge driver for the gas business in Utility A

Centre of Excellence (CoE) – Generation and Energy Delivery

- Executive position within Utility A (SVP, Construction) responsible for a centre of excellence to provide services to OpCos (SES)
- CoE acts as a consultant supporting the OpCos, providing expertise re: scheduling, supplier selection, lead time, budgeting, and quality inspections
- CoE equipped to provide engineering/design services, use is at OpCo discretion

Contractors

- Utility A has moved towards bringing capabilities in-house following challenges experienced with third party EPC's
- Regulatory push, e.g. requirement that Utility A subcontract ~40% of construction to local minority owned businesses in one region

Insights on Utility B

Key takeaways from discussion with 'Utility B' account team

Construction Capabilities

Long-range capital planning

- High level plan is created 3-5 years ahead of time
- Amount of capital put into transmission/ distribution has varied year to year as well as during a given year based upon the needs of the organization to manage revenue variances and financing costs.
- No central PMO for capital program management, locally managed by regional directors
- Effort towards managing resources cross-project in order to meet increasing lead times

Contractor System Integration

- Utility B contractors currently are using their own systems
- There is a general push within the industry towards integration of contractors into internal systems

Organization and Governance

How does Utility B think about construction?

- Managing capital spend is a strategic priority to the organization - the amount of spend/work gets reported at the C suite
- There is a VP construction who works with centralized organizations such as supply chain, contractor management
 - Formal construction org. in each region

Is construction managed regionally or cross-regionally?

- Construction activities are all managed together in one organization per region

Contractors

- Shift towards contractors doing more - procuring, storing materials/turnkey type work (from engineering to construct)
- Contractor POs are managed project by project, but relationships with vendors are across jurisdictions and negotiated at an enterprise level

Insights on Utility C

Key takeaways from discussion with 'Utility C' account team

Construction Capabilities

How does Utility C oversee construction?

- Transmission has a holistic view, Central Transmission Design Group
- Distribution has a modular view; Work towards projects in a first come first serve order
- Central design will take a first pass when a project is identified, conduct field surveys, using GIS and radar scan
- Regional construction performs site construction activities

Utility C procurement and resource activity

- Done in-between both design and construction
- Milestones of 30-60-90% is used by Central Design Group:
 - 30% design completion: order long-lead materials;
 - 60-90%: request permits and document to get start
 - 90% engineering completion: request for short-lead time materials

How does Utility C manage construction planning and scheduling?

- Utility C manage a 5 year plan with constant replan
- Operational planning: 1 year ahead plan on system level
- Project management will lay out materials/resource forecast, escalated to manager level for approval
- Resources are booked 6 weeks in advance and maintained by region

Resource Reservation

- SAP 1995 version was used for construction, no longer supported by SAP
- SAP Ariba is used for supply chain
- Material traceability is maintained based on material issued to SAP work orders which are linked to GIS elements

Organization and Governance

Organizational structure

- Construction is executed regionally
- Central design has regional offices because municipalities have different requirements

Operational planning organizational structure flow

- Project management organizations put in forecasts
- Program Manager to approve project plan
- Manager starts out with detailed planning
- Moves to the program level
- Aggregated on a line of business level at final stage

Contractors

- Utility C has contract resources for design
- Evaluate contract to a small handful of firms for contract design
- Internal designer will decide on the approval

Appendix

Trends around Contracting

Utility-Specific Contracting Trends

From our conversations with EY account teams who serve peer utilities, there are two directions that are being explored in regard to construction contracting

- **Increased outsourcing of capabilities** (e.g., engineering and design, procurement, material storage, turnkey-type work) **through large EPC partners**; for these cases, there is a push towards integration of contractors into internal systems
- **However, in some cases, there are signs of companies bringing some construction functions in-house** due to 3rd party labour and skill shortages, as well as experiences with some EPCs that have not performed up to expectation or have gone out of business

Collaborative Contracting vs Competitive Hard Bidding

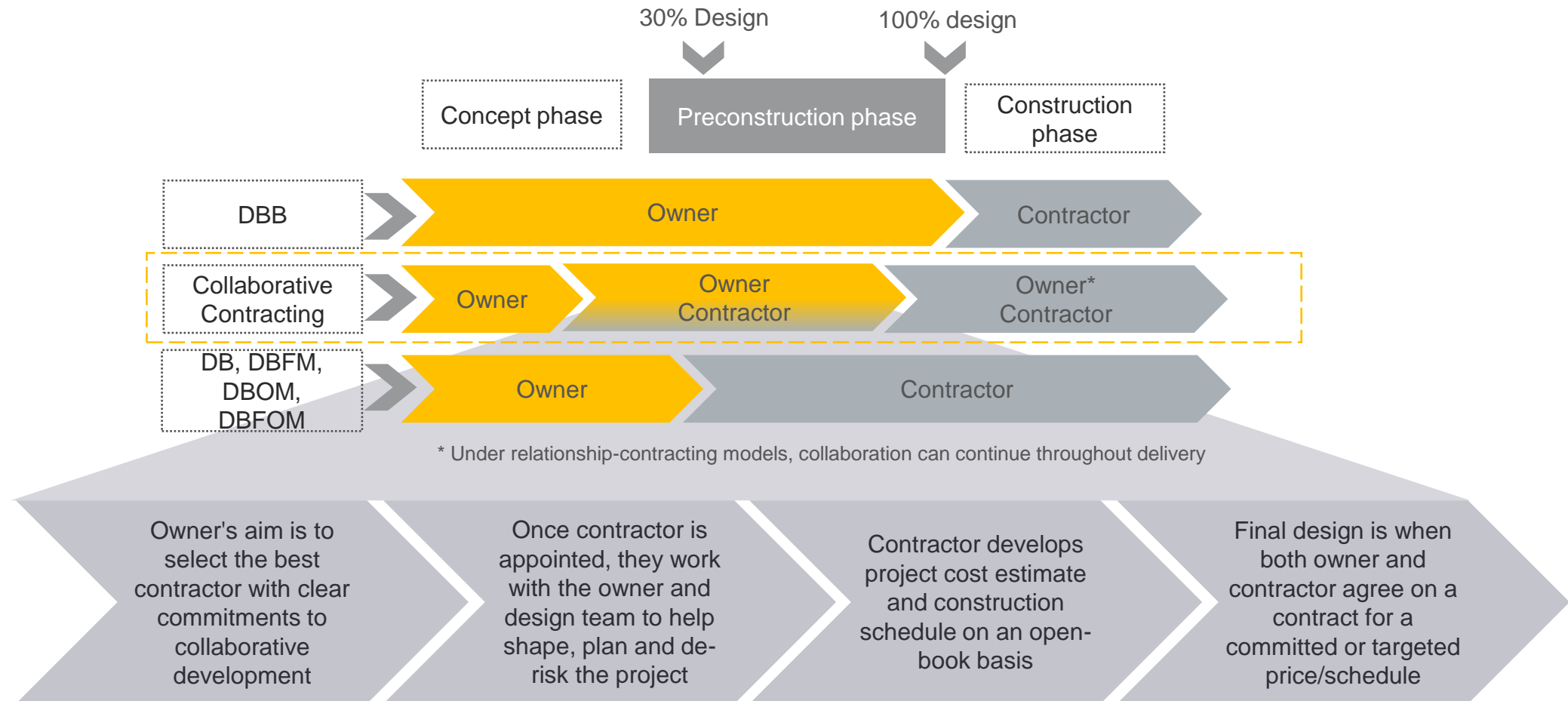
Leading constructors are exploring the concept of “collaborative contracting” which involves the contractor at an earlier stage than the traditional “competitive hard-bidding” model

Collaborative Contracting	Competitive Hard Bidding Contracting
<p>What is it?</p> <ul style="list-style-type: none"> Construction contracting model based on early contractor involvement (ECI) in the construction process <p>Why use it?</p> <ul style="list-style-type: none"> To achieve more predictable results and better value to owners in a less adversarial project delivery environment (fewer cost and schedule over runs, claims and disputes) 	<p>What is it?</p> <ul style="list-style-type: none"> Construction contracting model based on the owner planning and scoping out a project without a contractor’s input, following a release to the market and a price-dominated competitive procurement process <p>Why use it?</p> <ul style="list-style-type: none"> Contractors will bid low in order to win projects, project owner has more control over planning and scoping

Collaborative Contracting Models			
CMAR (Construction Manager at Risk) and GMC (Construction Manager-General Contractor)	P-DB (Progressive Design build) and PDA (Predevelopment Agreement)	DP (Delivery Partner)	Alliance and IPD (Integrated Project Delivery)
<ul style="list-style-type: none"> Owner appoints a design team and retains overall responsibility for design Owner appoints a construction manager, who works with the design team to build a guaranteed maximum price for proposal 	<ul style="list-style-type: none"> Owner initially appoints an Owner’s engineer to undertake concept stage design Contractor is engaged with its own design team to support development of specification, negotiate a DB contract price 	<ul style="list-style-type: none"> DP integrates with the Owner team to provide management services and resources to deliver the project or program DP is fully embedded into Owner team 	<ul style="list-style-type: none"> Owner enters into a multiparty relationship contract with designers, Contractors and other non-owner participants, forming a virtual project delivery vehicle

Contractor role within the collaborative contracting model

Collaborative contracting is defined by the idea of early contractor involvement contractor at an earlier stage than the traditional “competitive hard-bidding” model



Collaborative Contracting as part of the solution

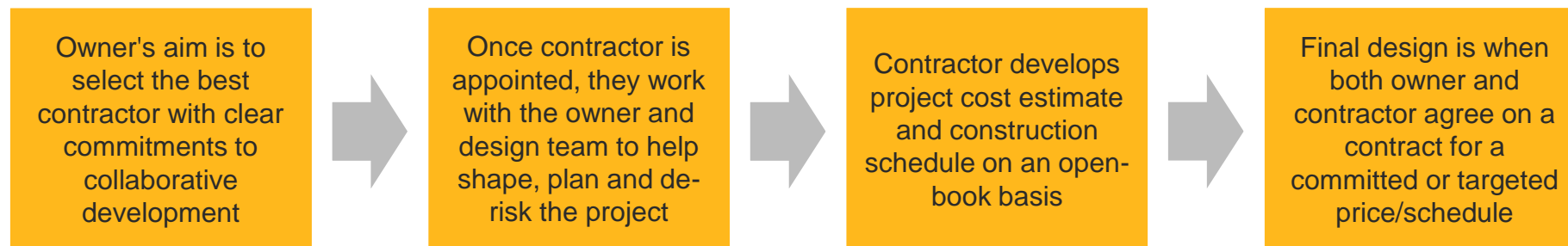
In-depth look into collaborative contracting and its variants, what ECI entails and the role of the contractor in the collaborative model

Two-Stage Contracting	Relationship-Contracting
<ul style="list-style-type: none"> Contractors appointed under a services arrangement during the concept/preconcept phase of the project Work collaboratively with the owner to develop the design and de-risk the project in advance 	<ul style="list-style-type: none"> Risks are shared between owner and contractor, driving collaboration and risk-sharing mechanisms

All this is driven by ECI:

- Contractor's input in overall scoping of the project and managing/mitigating project risk and uncertainty
- Early identification of cost/schedule challenge

Role of the Contractor in early stages of collaborative model



Factors Driving Collaborative Contracting Outcomes

Collaborative contracting must be set up for success by taking into consideration a number of key factors:

Use it for the “right” Projects

Owners should conduct a thorough procurement-options analysis, market sounding exercise and organizational-readiness assessment before embarking



Once selected, commit through investing in the right team and delivery framework

Experienced in-house and external resources supported with org and governance

Suitable change-management

Tailor a process and framework conducive to achieving value for money

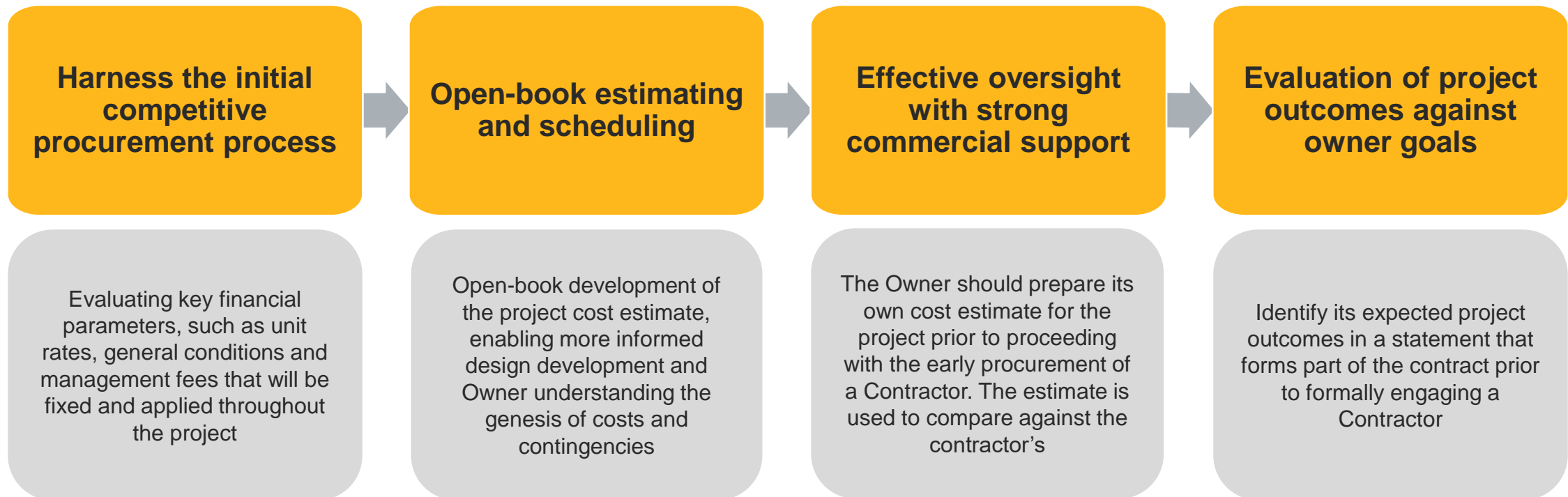


Set the right expectations, including appropriate off-ramps

Align Owner and Contractor expectations as early as possible regarding scope and affordability, as well as deal-breaker scenarios, and allow for off-ramps in the process to pursue another delivery method, if relevant

Value for Money in Collaborative Contracting

Breakdown of how to maximize collaborative contracting and ensure value for money in its adoption



Barriers to adoption of collaborative contracting

Collaborative contracting and ECI are still a novel concept and have some barriers to be considered prior to implementation

Contractor's perspective	Owner's perspective	Common strategic concerns
<ul style="list-style-type: none"> • Long-lead time before commitment to construction contract • Comfort levels around open-book pricing • Owner commitment to the process 	<ul style="list-style-type: none"> • Lack of experience • Lack of precedent or established delivery framework • Capacity, capability and culture • Governance structure • Legislative constraints • Strategic concerns and skepticism over public benefits of collaborative contracting models 	<ul style="list-style-type: none"> • How do I prevent collaborative contracting from further compromising already fleeting stakeholder support for my project? • Are off-ramp options practical? • Are collaborative contracting price and risk allocation negotiations likely to improve value compared to competitive hard bid?

Contractors/Owners Reacting to recent market changes

Major market changes have led to contractors and owners deriving key takeaways in the construction practice



Many contractors face high financial losses leading to notable market participants withdrawing from bidding on a large-scale and from competitive hard-bid contracting altogether



High selectivity and careful participation in procurements with established owner and stakeholder relationship with full confidence in their resources and supply chain has become the norm



Greater caution and fewer competitors led to even higher prices with inflated margins/contingencies to account for past losses

Lessons Learned:

Consider measures to mitigate major risks prior to procurement such as subsurface conditions, utility relocations and third-party relationships to allow contractors to better understand and predict project scope



Manage Rising Complexity:

Splitting "mega-projects" into more digestible program packages with the owner managing risks and interfaces between the packages

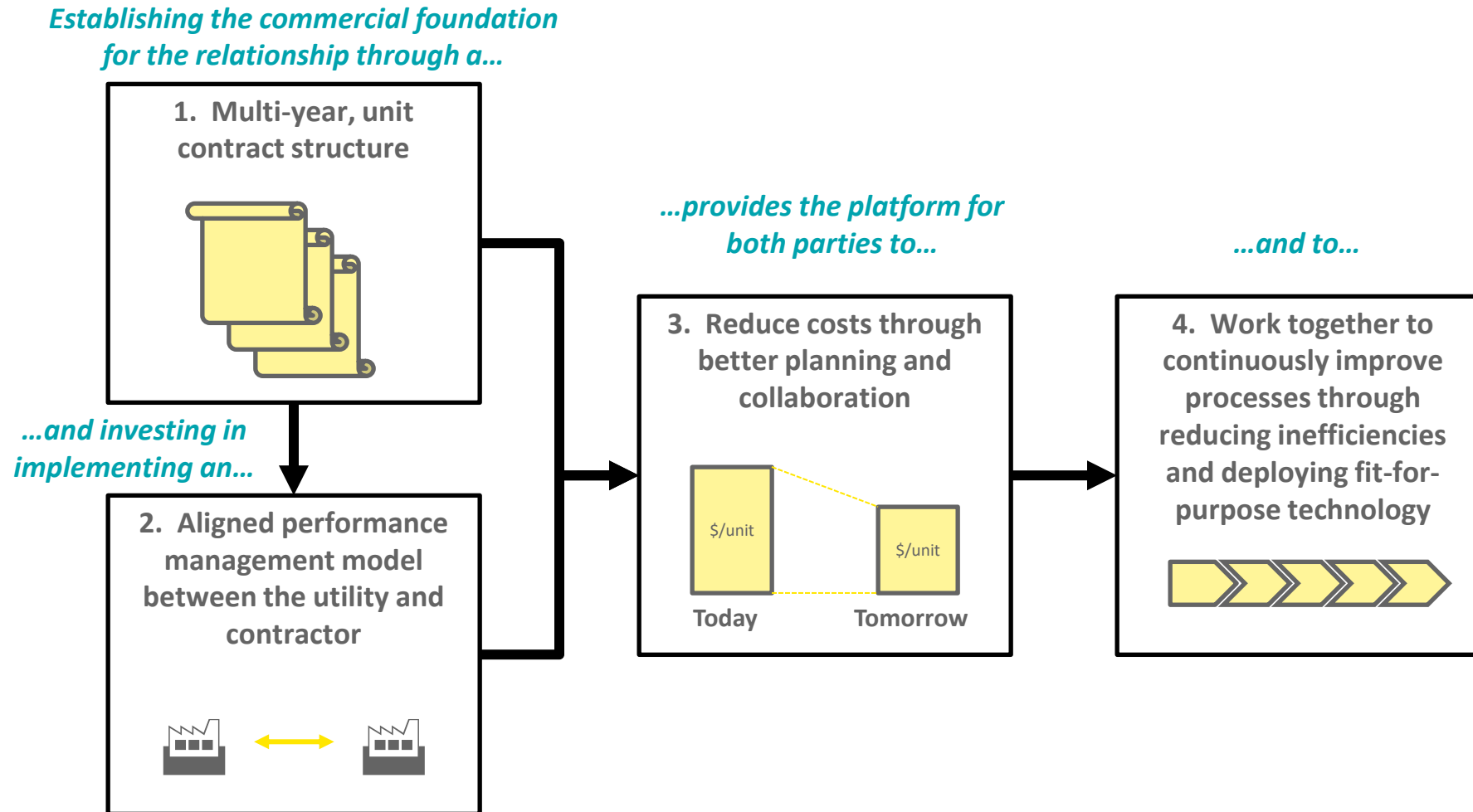
Collaborative approach to project planning/delivery through collaborative contracting methods

Appendix

EY Account Case Study – better partnerships with construction contractors

Utility Case Study Solution Highlight: Relationship Model

A model that will drive value for both the utility and its contractors

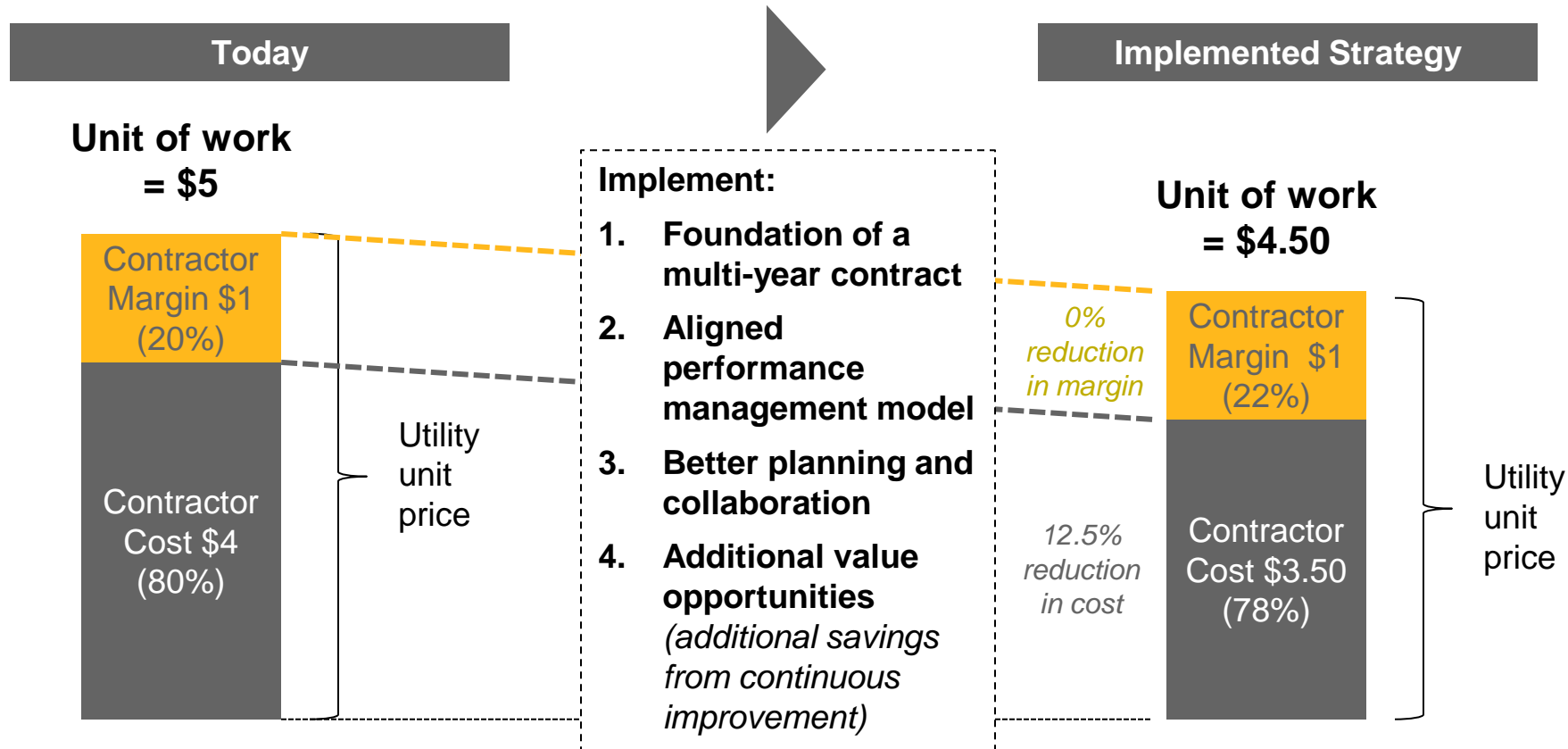




Utility Case Study Solution Highlight: Value Proposition

The business case for designing and deploying this model was focused on getting “bang for the buck” in terms of capital program spending. Other drivers included increased internal efficiency and scalability

Illustrative

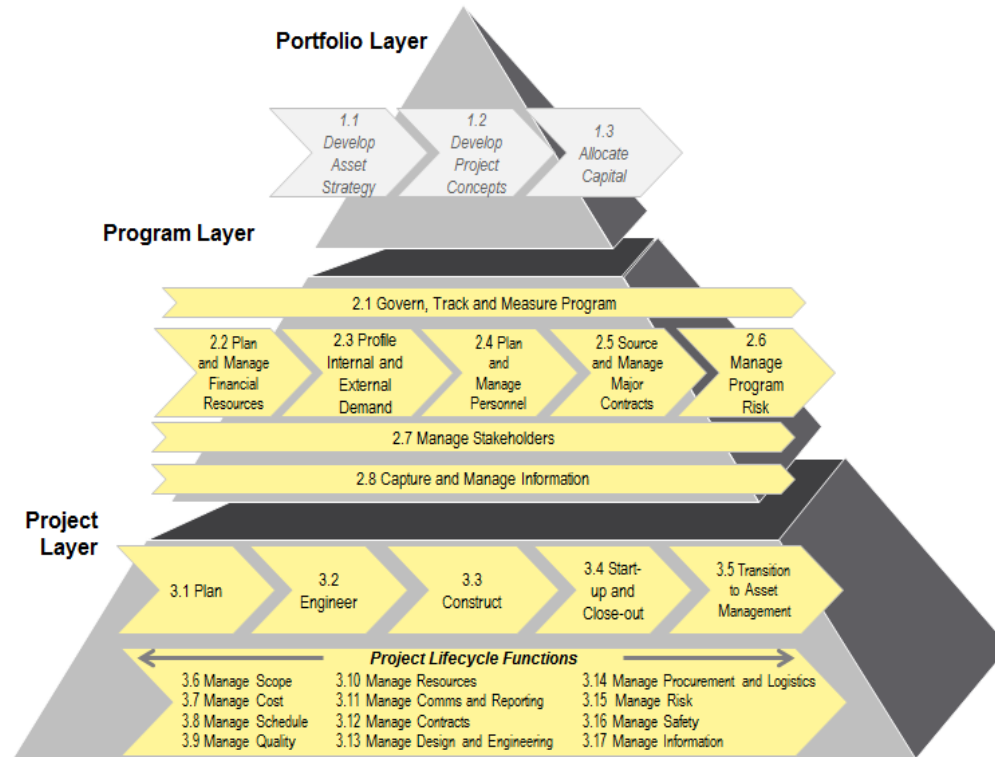


Utility Case Study Solution Highlight: Process Architecture



A comprehensive process architecture for the delivery of construction projects was assembled for this engagement using existing EY knowledge and refined to apply specifically to gas distribution construction work

Process Architecture



Level 2 Process Definitions

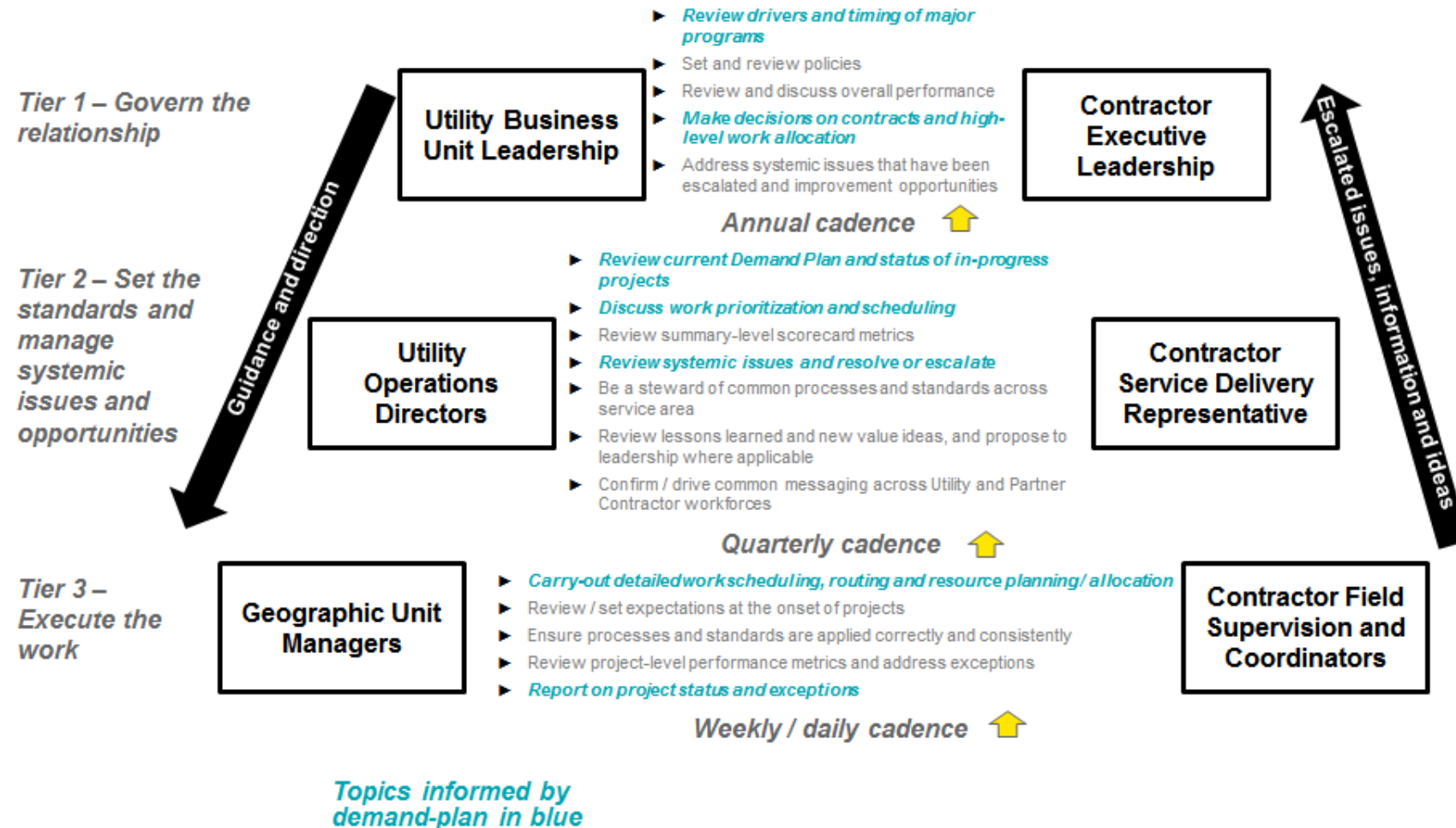
Gas Distribution Pipeline Construction Process Architecture

ID	Activity
2.0	Program Level
2.1	Govern, Track and Measure Program
2.1.1	Establish and execute program management office
2.1.2	Establish program vision, mission and goals
2.1.3	Obtain program sponsorship and assign steering committee
2.1.4	Develop and maintain program governance model
2.1.5	Develop and maintain project-level standards (scope, cost, schedule, quality, resource management, communications and reporting, contracts, design and engineering, procurement and logistics, risk, safety, information)
2.1.6	Establish and maintain standardized key performance indicators for projects and overall program
2.1.7	Develop and maintain program-level reporting (including program and project reporting cadence)
2.1.8	Develop and maintain program plan (aggregate view of project plans)
2.1.9	Present major decisions to program sponsor and steering committee and obtain sign-off
2.1.10	Provide strategic direction on project scope, sequencing, timing, resourcing and supply to project-level management
2.2	Plan and Manage Financial Resources
2.2.1	Maintain capital plan data across program
2.2.2	Develop and set high-level project budgets
2.2.3	Monitor capital spending by project
2.2.4	Assess and approve / reject major project budget variances
2.2.5	Aggregate project budget statuses and include in program reporting
2.2.6	Monitor and control supplier payments across program
2.2.7	Monitor and control time and expense charges across program
2.3	Profile Internal and External Demand
2.3.1	Obtain, organize and enrich demand plan data
2.3.2	Validate and summarize demand plan
2.3.3	Publish demand plan
2.3.4	Continuously update demand plan throughout project lifecycles
2.3.5	Evaluate demand plan accuracy and continuously improve
2.4	Plan and Manage Personnel
2.4.1	Develop and maintain personnel planning policies and strategies across program
2.4.2	Develop view of internal and external personnel needs across all projects
2.4.3	Understand internal and external resource availability by need / type
2.4.4	Recruit, source and hire internal personnel
2.4.5	Plan, source and manage contingent labor
2.4.6	Identify skill gaps and support project management to resolve
2.4.7	Balance skills and talent across projects



Utility Case Study Solution Highlight: Governance Model

The governance model that was designed required meetings between the utility and contractor multiple times per year (and up to weekly at the field level)

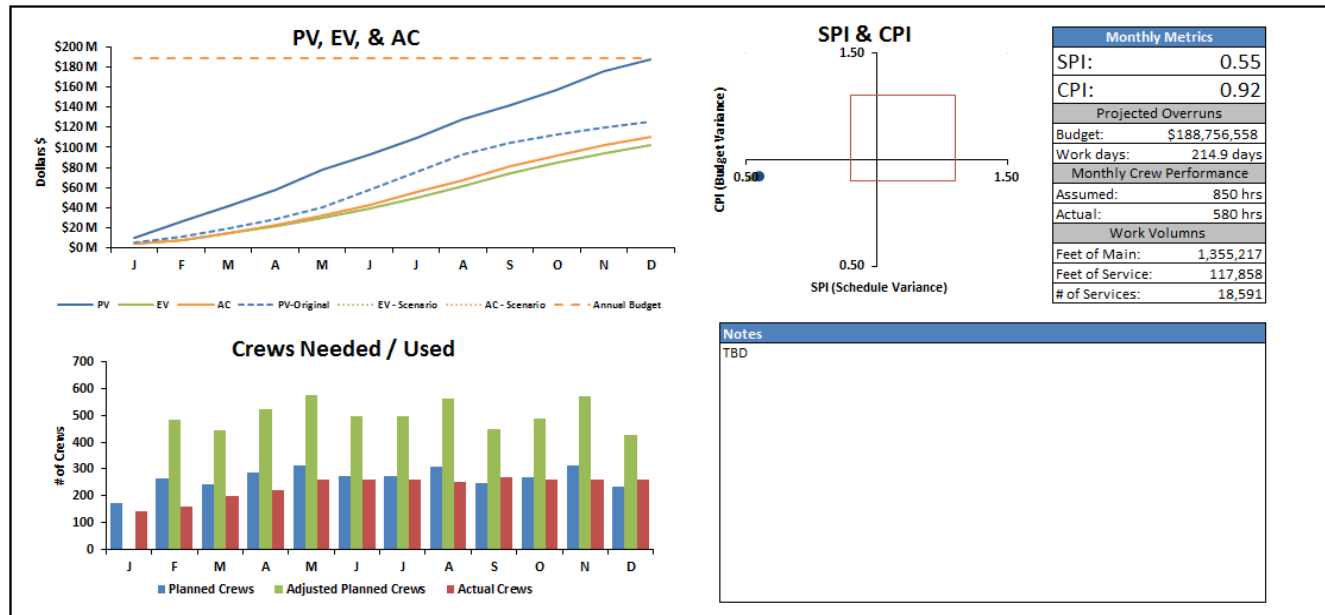


Utility Case Study Solution Highlight: Performance Metrics

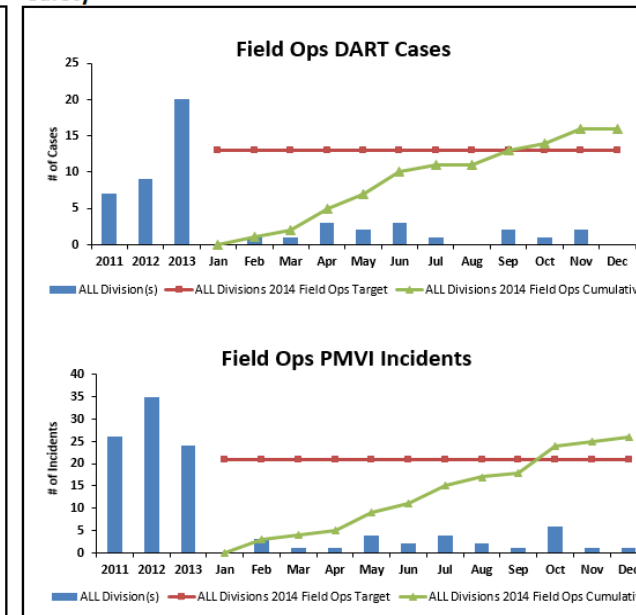


Performance management can also be time consuming to perform for too many contractors, but very worthwhile for a prioritized group

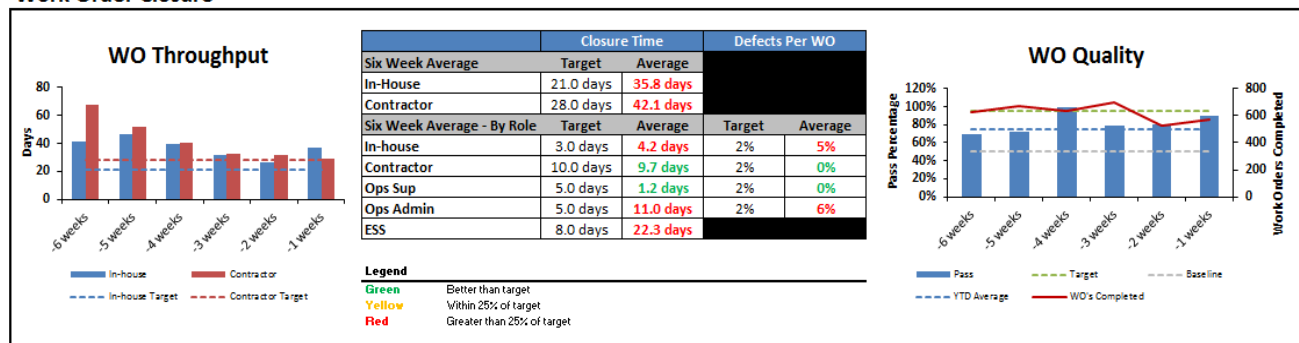
Construction



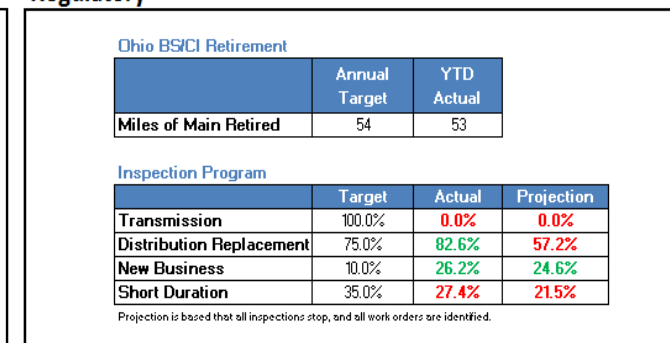
Safety



Work Order Closure

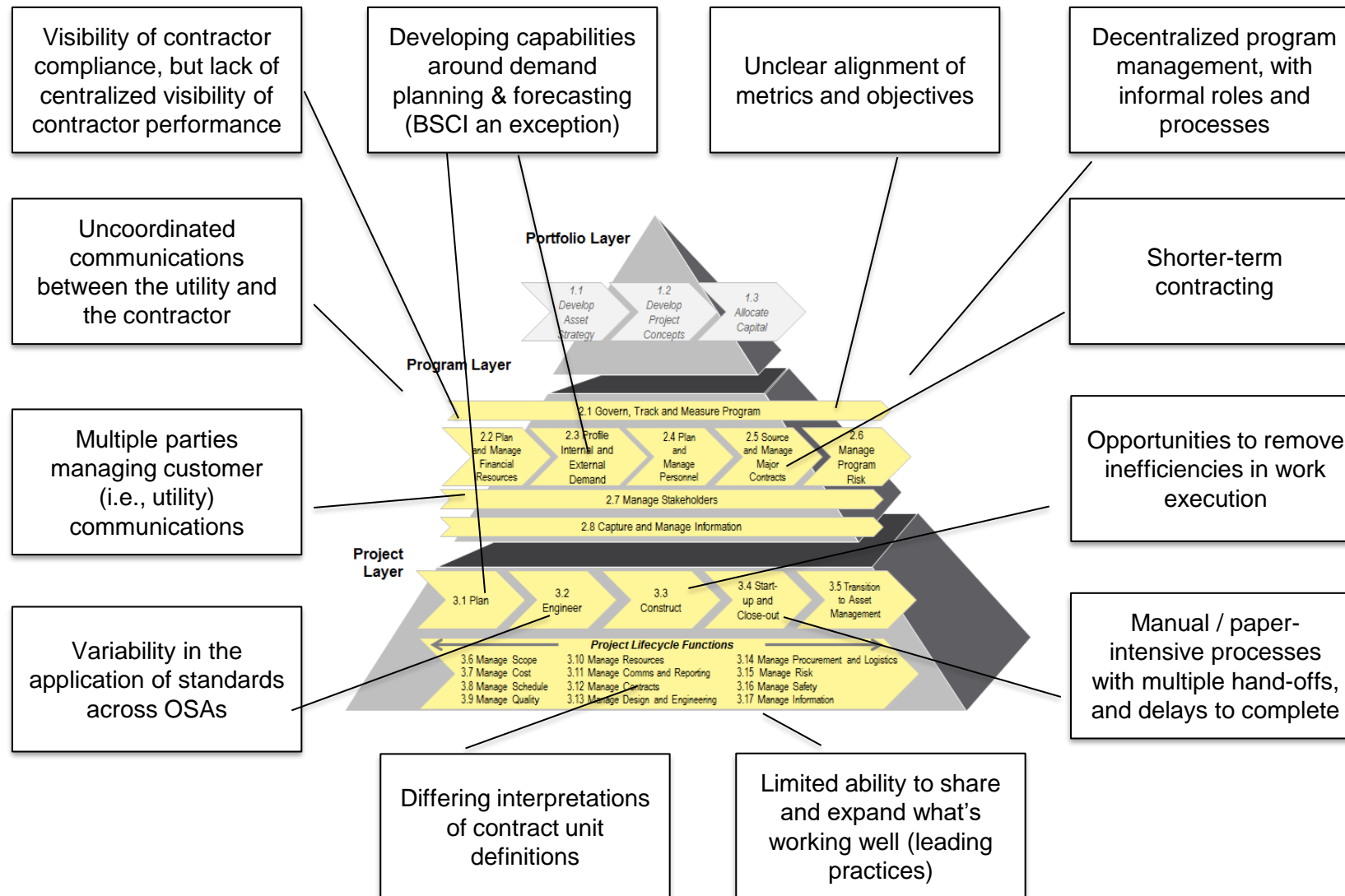


Regulatory





What to look for



Appendix

Trends around Industrialization, Digitization

COVID's disruption of construction's future value chain

COVID has led to major advancements in the technology, digitization and safety realm that must be considered in the development of the construction value chain

What will be changed?

- Adjusting fractured baseline contracts and reformulating insurance contingencies
- Contractors acknowledge their rights and incorporating defensive language in the contract is vital to project success for both sides
- Owners must realize this and award bids who are competitive but also responsible for worker safety

Opportunities and Outlooks:

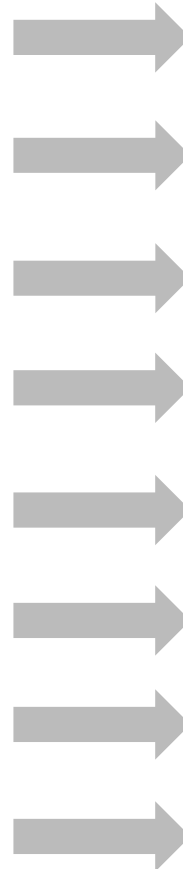
- Assess current and future construction projects business cases and determine whether it is worth pursuing given the current climate
- Revise contractual language to align safety and quality standards for employees during uncertain times
- Renegotiate insurance policies and bring contractor/vendors into discussions early to avoid performance issues down the line

Industrialization Development

Detailed breakdown industrialization and its effect on the subtleties of construction and its value chain

Today: **Linear and Focused** perspective...

Focus on a dedicated part and immediate next steps along the value chain
Focus primarily on direct downstream customer segments
Focus on the own product/service
Cost of installation view
Sustainability as a differentiator
Experience-driven intelligence
Linear incremental innovation
3-5 year planning horizons



... evolving into a data-driven **circular** 'construction space' perspective

End-to-End view/Consideration of all parts of the circular value chain
Focus on the investor thus indirectly on all customers of the circular value chain
Focus on customized/integrated solutions
Total cost of lifecycle view
Sustainability as core of the business
Data-driven insights
Disruptive innovation
More agile planning and more calculated risk-taking

Modular Construction

Detailed breakdown of modular construction and the direction industrialization is taking the construction industry

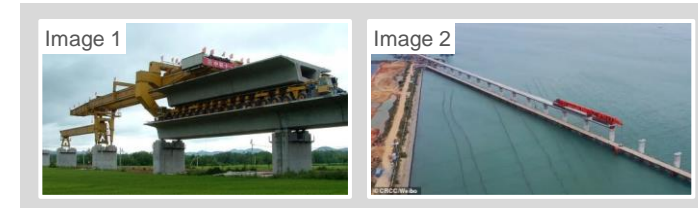
Industrialization development:

Modularization, managing construction in product packages as opposed to a purely linear supply chain

- Moving from assembly line to packaged/industrial environment
- Increased off-site construction:
 - Could shift procurement to factories with consolidated demand and relatively predictable planning horizons, reducing the need for store networks.

Modular construction:

- Opportunity:
 - Given increasing demand of projects that could be built using prefabricated components, industrialized methods are becoming increasingly adopted, especially in the East and offers opportunity to adopt a new “best practice”
- Examples:
 - "Iron Monster" Machine for Bridge construction (see image 1)
 - SLJ900/32
 - Kunlun – Meizhou Bridge construction (see image 2)
 - Tunneling: Freelance German engineering consultants
 - Borough as far as 10 m per day at a unit cost of 10 million USD per km vs 50 million per km in the US



Paradigm shift:

- Construction companies will need to evolve, most notably by abandoning the linear and singularly focused business models they're used to in favor of more data-driven and circular models.
- The historic focus on cost-of-installation is now evolving into a total-cost-of-ownership perspective, including initial acquisition costs, costs for planning and preparation, construction, operating and maintenance, as well as for demolition and recycling.
- Experience-based decisions are becoming less important in favor of data-driven decisions. Linear, incremental enhancements are giving way to more disruptive innovations. And planning horizons of three-to-five years are being displaced by increasingly agile approaches with a higher calculated willingness to take risks.

Managing Industrialization

6 key factors to consider to manage the industrializing construction industry

Recognize that the field of play spans across the whole value chain

Manage rising complexity efficiently

- Protect and optimize existing business through automation
- Enhance and extend through digital interaction and digitized value proposition
- Digitally enabled platforms, and smart contracts

Join platforms and networks

- Leverage alliance partners
- Groups of companies can collaborate, connect products and go to market with a coordinated value proposition
- Unlock previously unattainable technology and boost the quality of value propositions significantly through collaboration

Extend the Business Model

- Monetization of offerings beyond products
- Monetization of competencies throughout the entire lifecycle

Recognize the value of data

- Real-time budgeting
- Process management
- "Smart" predictive and preventive models

Integrating sustainability into the business model

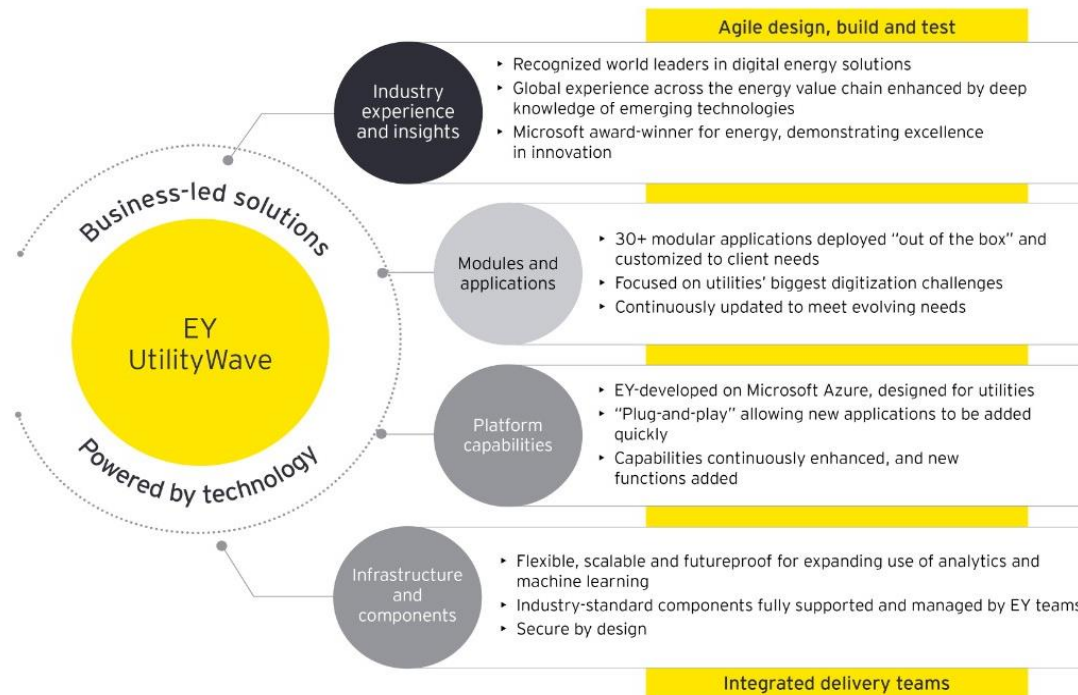
Digitization

Recognizing the significance of quality data to mitigate risk, and encourage tech implementation to enable future opportunities



Digitization

Recognizing the significance of quality data to mitigate risk, and encourage tech implementation to enable future opportunities



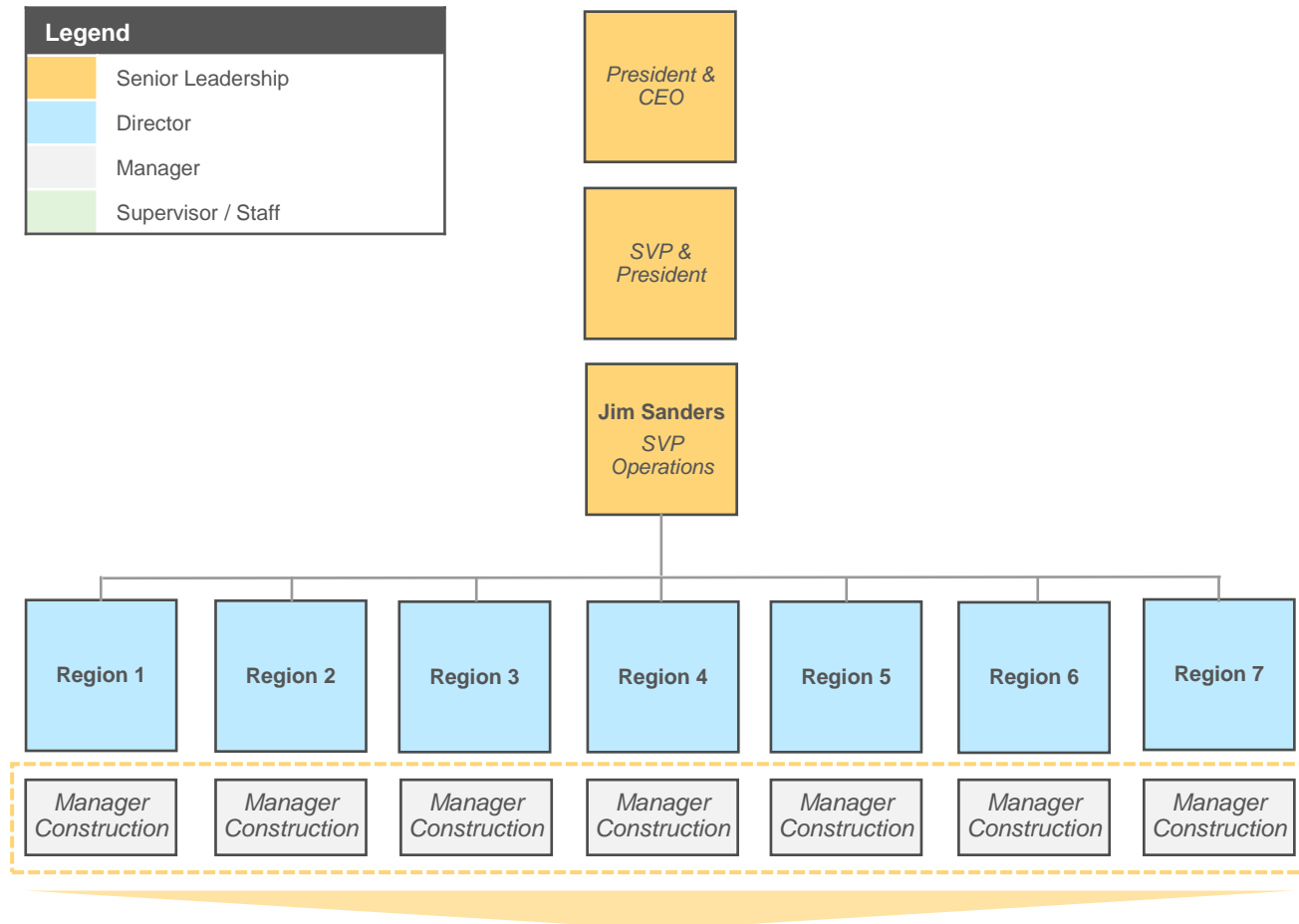
1. Energy customers are demanding new energy products and services that suit their needs and the needs of the planet, 86% of traditional energy consumers have expressed an interest in solar or other means.
2. EY UtilityWave is an award-winning, business-led data platform that helps companies transform how they manage, integrate and use data from enterprise systems, IoT devices and other sources to improve performance. Powered by Microsoft technology, EY UtilityWave supports clients in accelerating the digitization of network assets and operations, delivering new energy services and reshaping for the future.
3. EY teams helped guide an 'Energy Utility' as it invested to build out more robust customer segmentation profiles. Smart meters deployed across its service territory are fundamental to that goal.
4. 'Energy Utility' gains household energy usage data every 15 minutes vs. once a month, at a level of specificity that shows when a dishwasher or refrigerator kicks on. This abundance of data enables innovation around new products and services that will better address customer demands and allow customers to track and adjust their individual energy use.
5. 'Energy Utility' to get the most from smart meters, its website and its app — by housing the data, connecting all the infrastructure and supercharging the company's analytical capabilities.

Appendix

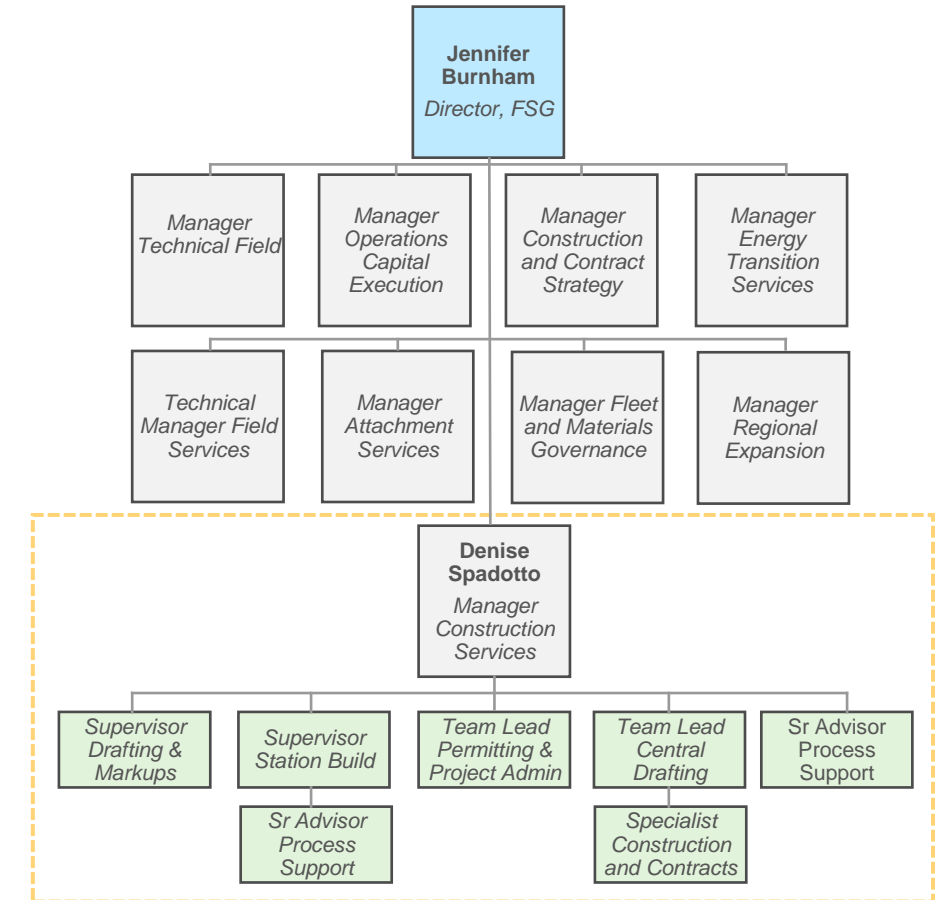
EGI Insights

EGI Regional Organizational Chart

Regionally there is one Manager Construction, which is responsible for multiple functions to support construction services field services and growth



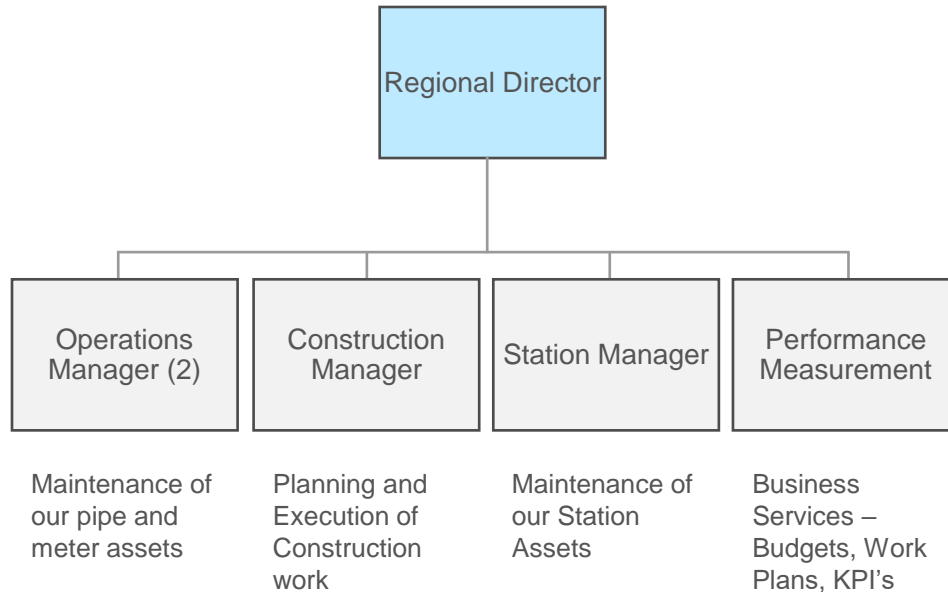
There is one dedicated Manager Construction for each region in EGI



Manager Construction Services oversees multiple functional service areas

EGI Regional Model and Central Services

EGI's organizational structure is designed with a regional focus with certain functions managed centrally



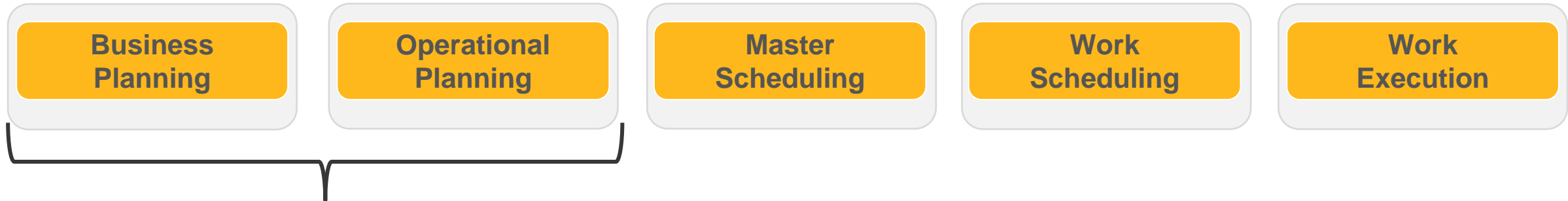
Supported by Centralized Services

- Work Management
- Customer Attachment
- Drafting – Regional, Central, Planning and Markups
- Distribution Protection
- Technical Field Services

Construction	Service inspectors + utility service representatives
	People Leaders (team leads, supervisors, managers)
	Senior Advisors, Advisors, Construction PM, Regional Engineers, Senior Advisor Construction Project Mgmt., Senior Analyst New Business, Team Lead New Business
	Drafters/Estimators (per region)
	Planning and Markups (per region)
	Customer Connection Field Reps
Customer Connections	CC Clerks + Work Mgmt. Coordinators
	Team Leads + Work Mgmt. Coordinators
	CC reps
	Builder Attach Clerks + Cust Attach Reps
Operations i.e., Utilization and Maintenance (U&M)	Utility Service Rep (USR)
	AR&I (includes gas techs)
	CS&C (includes utility fitters)
	Managers + Supervisors
	Advisors + Sr Advisor
Customer Service	People Leaders
	Individual Contributors
Station Ops	Supervisor
	Station Ops Technicians
Work Management	Scheduler, Shift Dispatch, Day Dispatch, Execution Support, Forecasting
Dist. Protection	Corrosion, Cross Bore, Distribution Protection Supervisors, Analysts and Technicians
Extended Alliance	Limited number of alliance partnerships with major EPCs

Business and Operational Planning

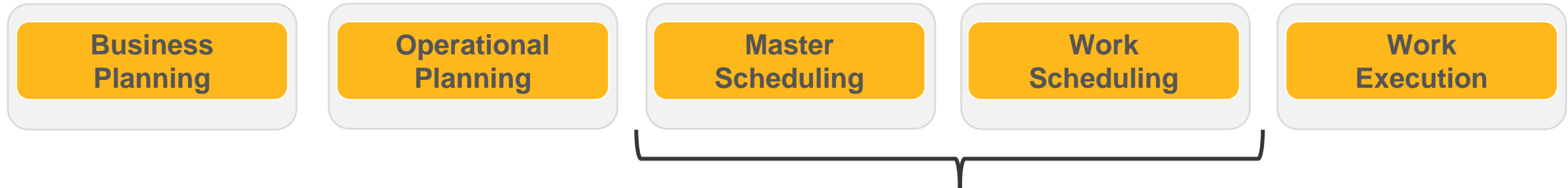
Detailed explanation of construction capabilities included in capability model



- A “blanket forecast” is created from a 10 year outlook by Asset Management (centralized team) – strictly focussed on dollars spent
 - Based on historical spend while adjusting for executability provided by SMEs
- Forecast is then refined in the year before execution, with a “Class 5 estimate”
 - Inconsistencies in detail included in estimates between regions
- Planning is heavily focused on capital spend – resources constraints are not considered during the planning phase
 - Results in inefficiencies due to competing priorities with other groups within the organization (Engineering, Corrosion) and limited availability of construction crews in each region
- No operational planning performed

Scheduling

Detailed explanation of construction capabilities included in capability model



- No focus on master scheduling
- Construction Team Lead performs the following activities:
 - Construction Project Managers meet every 2 weeks to understand upcoming work – CPM will input into Maximo based on information provided
 - Meet with Alliance partners to discuss forecasted costs

Work Execution

Detailed explanation of construction capabilities included in capability model

Business
Planning

Operational
Planning

Master
Scheduling

Work
Scheduling

Work
Execution

- Field construction activities are primarily contracted out to Alliance Partners (AECON, NPL) with oversight from internal field construction representatives
- During work execution, regular cadence (2 weeks) to update on invoiced work from Alliance Partners
- A final review of actuals to forecast is performed within 90 days post-construction completion
- As built done by Records department and majority is contracted out vs. little use of contractors at LEG
 - *Notes from LEG regions*
 - Receive as built from contractors in a timely manner (RMSI -10 days, drafts in system in 48 hrs)
 - Well integrated system where info can be immediately pushed out to field devices wirelessly
 - *Notes from LUG regions*
 - Timely upload of as-builts from APs and self managed as-builts

Organization & Governance

Detailed explanation of construction capabilities included in capability model

**Organization and
Governance**

**Technology
Enablement**

- No single executive leader/team responsible for implementing the construction portfolio, effective execution of all construction activities
- Highest “construction-specific” role (Manager, Construction) is a tactical role mainly focused on construction work execution – limited cross-functional oversight (operational planning, master scheduling)
- Process ownership is regionally focused, no ownership for performance across regions
- Inconsistencies in organization and governance structures between regions due to lack of integration of legacy organizations (e.g. Centralized team for permitting which serves LEG regions while this function is conducted on a regional basis within LUG regions)

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-1, p.18

Question(s):

In Figure 2, Enbridge provides a summary of the steps of its budget and long-range planning process. As it relates to the budget included in this application, please provide the dates each step was undertaken. If there are other important steps undertaken as part of the planning process and is not included in Figure 2, please include them and provide the details of when they were undertaken.

Response:

Please see the table for timing of steps in Figure 2:

Step	Completed (all months in 2022)
Customer and Volume Forecast	<ul style="list-style-type: none">• Customer Forecast: March• Volume Forecast: April
Asset Management Plan	April
Capital Budget	May
Gas Supply Plan	June
Distribution Revenue Budget	June
Storage and Transportation Revenue Budget	June
Operations and Maintenance Budget	June
Budget and LRP Consolidation	September
Executive Management Review and Approval	October

In addition to the above steps, the budget and long-range plan was approved by the Enbridge Inc. Board of Directors in November 2022.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-1, p.34

Question(s):

For each year between 2023 and 2028, please provide the annual spending, broken down by USP category and asset program. Please also provide the response in Excel format.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

Please see Attachment 1 for the Excel.

USP Category (\$ millions)	Asset Program (EGI)	2023F	2024F	2025F	2026F	2027F	2028F
General Plant	CS - Land/Structures - Improvements	0.7	0.5	1.1	1.1	3.6	3.8 /u
	FLEET - Equipment & Materials	2.5	8.9	9.5	11.6	13.2	15.9 /u
	FLEET - Tools	2.7	5.9	8.9	3.3	3.8	3.9 /u
	FLEET - Vehicles	3.8	16.7	17.0	25.2	28.8	32.4 /u
	LNG - Land/Structures - Improvements	-	0.2	0.5	-	-	- /u
	REWS - Furniture/Structures & Improvements	63.0	63.0	61.3	92.3	31.9	56.4 /u
	TIS Business Solutions	41.2	87.0	66.3	60.0	28.0	35.2 /u
	TIS Infrastructure	6.0	15.4	11.8	11.3	16.9	18.9 /u
	TPS - Land/Structures - Improvements	-	0.9	0.3	0.4	3.2	2.9 /u
General Plant Total		119.6	198.4	176.8	205.3	129.2	169.5 /u
System Access	CC - Commercial/Bulk-Metered - Conversion	4.6	1.9	3.3	3.5	3.6	3.6 /u
	CC - Commercial/Bulk-Metered - New	28.5	61.0	26.2	27.4	27.8	28.2 /u
	CC - Industrial - New	5.9	-	4.3	4.5	4.4	4.5 /u
	CC - Multi-Family/Apartment - New	5.3	-	4.0	4.2	4.3	4.3 /u
	CC - Residential - Conversion	43.4	27.8	44.4	46.6	47.3	48.0 /u
	CC - Residential - New	193.5	210.8	163.8	169.0	164.1	158.9 /u
	CC - Sales Station - Conversion	1.2	0.6	0.6	0.6	0.6	0.6 /u
	CC - Sales Station - New	3.9	1.8	1.8	1.8	1.9	1.9 /u
	CS - Growth	1.4	-	-	-	-	- /u
	DP - Relocations	36.5	40.9	43.4	43.5	44.7	56.4 /u
	DS - CNG	2.5	3.4	1.4	1.0	1.0	1.1 /u
	GTH - Hydrogen Blending	7.1	9.5	11.1	3.2	-	- /u
	TPS - Growth	39.4	6.9	73.6	136.9	216.8	125.5 /u
	UTIL - Meters (growth)	18.0	16.5	17.0	18.5	19.2	12.2 /u
	EA Fixed O/H - Gth	24.2	38.2	39.2	40.2	41.3	23.2 /u
	Community Expansion	20.6	11.2	19.6	20.5	21.5	7.3 /u
System Access Total		436.0	430.6	453.7	521.6	598.6	475.9 /u
System Renewal	CS - Improvements	10.4	8.2	2.9	2.3	2.0	2.0 /u
	CS - Overhauls	2.2	7.7	9.7	6.4	4.7	6.7 /u
	CS - Replacements	305.9	28.9	49.6	38.7	105.0	6.1 /u
	DP - Corrosion	4.8	20.2	10.6	11.2	10.9	10.4 /u
	DP - Main Replacement	61.5	132.0	244.7	69.6	54.0	133.5 /u
	DP - Service Relay	44.6	54.8	60.9	81.4	77.3	81.6 /u
	DS - Gate, Feeder & A Stations	37.4	38.2	59.5	54.5	48.6	65.9 /u
	DS - Inside Regulator & ERR Program	1.9	2.5	2.5	-	-	4.1 /u
	DS - Station Rebuilds & B and C Stations	25.2	32.5	41.2	43.0	23.2	38.8 /u
	LNG - Replacements	0.1	0.1	-	0.3	0.4	0.4 /u
	TPS - Improvements	0.7	9.0	3.7	3.4	1.3	3.1 /u
	TPS - Replacements	4.7	10.7	37.9	13.2	9.0	9.2 /u
	UTIL - Meters (mtc)	73.1	74.2	76.5	83.1	70.2	75.3 /u
	UTIL - Regulator Refit	65.1	60.3	64.9	69.5	60.4	78.4 /u
	UTIL - Remediation	1.3	1.3	1.7	2.0	2.2	2.5 /u
	EA Fixed O/H - Utilization	1.4	1.6	1.6	1.7	1.7	- /u
	RNG	23.7	94.6	33.9	18.3	18.0	25.6 /u
	CNG	7.6	30.0	10.0	10.0	10.0	10.2 /u
System Renewal Total		671.6	606.7	711.9	508.5	498.9	553.8 /u
System Service	CS - Integrity	0.8	0.6	0.3	0.1	0.1	0.1 /u
	DP - Class Location	3.6	2.5	2.5	6.6	6.7	6.9 /u
	DP - Integrity	86.5	106.7	52.9	70.7	56.7	27.7 /u
	DS - Integrity Initiatives	0.4	7.0	8.3	6.3	6.2	6.4 /u
	GTH - System Reinforcement	50.8	75.7	188.5	40.0	46.1	10.3 /u
	LNG - Improvements	0.1	0.4	-	1.2	11.9	- /u
	LNG - Integrity	0.3	-	-	-	-	- /u
	TPS - Class Location	0.3	2.8	2.8	18.7	7.0	7.2 /u
	TPS - Integrity	33.9	38.8	26.1	27.8	31.1	21.9 /u
System Service Total		180.0	234.6	281.4	171.4	165.7	80.3 /u
Grand Total		1,407.2	1,470.3	1,623.8	1,406.7	1,392.3	1,279.5 /u

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Question(s):

Please provide a similar version of the table requested in 2.6-SEC-112 on an in-service additions basis.

Response:

The following response has been updated to reflect the Capital Update provided at /u Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

Please see Table 1 and Attachment 1 for the Excel.

Table 1

Line No.	USP Category (\$ millions)	Asset Program (EGI)	2023F	2024F	2025F	2026F	2027F	2028F
1	General Plant	CS - Land/Structures - Improvements	-	0.5	3.1	1.1	3.6	3.8
2		FLEET - Equipment & Materials	2.5	8.9	9.5	11.6	13.2	15.9
3		FLEET - Tools	2.7	5.9	8.9	3.3	3.8	3.9
4		FLEET - Vehicles	3.8	16.7	17.0	25.2	28.8	32.4
5		LNG - Land/Structures - Improvements	-	0.2	0.5	-	-	-
6		REWS - Furniture/Structures & Improvements	32.1	19.2	72.9	203.7	23.2	88.5
7		TIS Business Solutions	27.7	53.5	41.6	131.8	28.0	35.2
8		TIS Infrastructure	6.0	15.4	11.8	11.3	16.9	18.9
9		TPS - Land/Structures - Improvements	-	-	-	-	-	2.9
10		TPS - Land/Structures - Growth	-	0.9	0.3	0.4	3.2	-
11	General Plant Total		74.7	121.1	165.8	388.4	120.6	201.5
12	System Access	CC - Commercial/Bulk-Metered - Conversion	4.6	1.9	3.3	3.5	3.6	3.6
13		CC - Commercial/Bulk-Metered - New	28.5	61.0	26.2	27.4	27.8	28.2
14		CC - Industrial - Conversion	-	-	-	-	-	-
15		CC - Industrial - New	5.9	-	4.3	4.5	4.4	4.5
16		CC - Multi-Family/Apartment - Conversion	-	-	-	-	-	-
17		CC - Multi-Family/Apartment - New	5.3	-	4.0	4.2	4.3	4.3
18		CC - Residential - Conversion	43.4	27.8	44.4	46.6	47.3	48.0
19		CC - Residential - New	193.5	210.8	163.8	169.0	164.1	158.9
20		CC - Sales Station - Conversion	1.2	0.6	0.6	0.6	0.6	0.6
21		CC - Sales Station - New	3.9	1.8	1.8	1.8	1.9	1.9

Table 1 (Continued)

Line No.	USP Category (\$ millions)	Asset Program (EGI)	2023F	2024F	2025F	2026F	2027F	2028F	
22		CS - Growth	1.4	-	-	-	-	-	/u
23		DP - Relocations	36.5	40.9	43.4	43.5	44.7	56.4	/u
24		DS - CNG	2.5	3.4	1.4	1.0	1.0	1.1	/u
25		GTH - Hydrogen Blending	4.8	9.5	11.1	3.2	-	-	/u
26		TPS - Growth	0.4	(0.0)	91.2	113.6	241.0	86.4	/u
27		UTIL - Meters (growth)	18.0	16.5	17.0	18.5	19.2	12.2	/u
28		EA Fixed OH	24.2	38.2	39.2	40.2	41.3	15.0	/u
29		Community Expansion	10.6	22.2	13.8	26.8	24.4	7.3	/u
30	System Access Total		384.8	434.7	465.5	504.6	625.7	428.5	/u
31	System Renewal	CS - Improvements	10.4	8.1	2.9	2.3	2.0	2.0	/u
32		CS - Overhauls	2.2	7.6	9.7	6.4	4.7	6.7	/u
33		CS - Replacements	347.4	26.3	37.0	6.5	4.3	6.1	/u
34		DP - Corrosion	4.8	20.2	10.6	11.2	10.9	10.4	/u
35		DP - Main Replacement	68.0	123.4	180.3	85.9	54.0	133.5	/u
36		DP - Service Relay	44.6	54.8	60.9	81.4	77.3	81.6	/u
37		DS - Gate, Feeder & A Stations	30.1	53.9	80.1	41.0	62.2	66.3	/u
38		DS - Inside Regulator & ERR Program	1.9	2.5	2.5	-	-	4.1	/u
39		DS - Station Rebuilds & B and C Stations	23.8	34.4	41.3	43.0	23.2	38.8	/u
40		LNG - Replacements	0.1	0.1	-	0.3	0.4	0.4	/u
41		TPS - Improvements	0.7	8.1	4.7	3.4	1.3	3.1	/u
42		TPS - Replacements	2.7	1.8	49.7	13.2	9.0	9.2	/u
43		UTIL - Meters (mtc)	73.1	74.2	76.5	83.1	70.2	75.3	/u
44		UTIL - Regulator Refit	65.1	60.3	64.9	69.5	60.4	78.4	/u
45		UTIL - Remediation	1.3	1.3	1.7	2.0	2.2	2.5	/u
46		EA Fixed OH	1.4	1.6	1.6	1.7	1.7	8.2	/u
47		RNG	4.5	42.0	31.6	18.3	18.0	25.6	/u
48		CNG	-	10.0	30.0	10.0	10.0	10.2	/u
49	System Renewal Total		682.1	530.6	686.1	479.0	411.7	562.4	/u
50	System Service	CS - Integrity	0.8	0.6	0.3	0.1	0.1	0.1	/u
51		DP - Class Location	10.1	2.4	3.8	6.6	6.7	6.9	/u
52		DP - Integrity	108.3	109.2	57.3	71.3	56.7	27.7	/u

Table 1 (Continued)*

Line No.	USP Category (\$ millions)	Asset Program (EGI)	2023F	2024F	2025F	2026F	2027F	2028F	
53		DS - Integrity Initiatives	0.4	7.0	8.3	6.3	6.2	6.4	/u
54		GTH - System Reinforcement	40.6	65.9	208.8	31.0	56.9	12.7	/u
55		LNG - Improvements	0.1	0.4	-	1.2	11.9	-	/u
56		LNG - Integrity	0.3	-	-	-	-	-	/u
57		TPS - Class Location	0.3	2.8	2.8	18.7	7.0	7.2	/u
58		TPS - Integrity	40.7	38.8	26.1	27.8	31.1	21.9	/u
59		UTIL - Monitoring Systems	3.3	0.0	0.0	-	-	-	/u
60	System Service Total		204.8	227.2	307.4	163.0	176.5	82.7	/u
60	Grand Total		<u>1,346.4</u>	<u>1,313.6</u>	<u>1,624.7</u>	<u>1,535.0</u>	<u>1,334.4</u>	<u>1,275.2</u>	<u>/u</u>

Excludes in-service additions for PREP of \$252M in 2024 and \$6.8M in 2025.

/u

		Table 1					
USP Category (\$ millions)	Asset Program (EGI)	2023F	2024F	2025F	2026F	2027F	2028F
General Plant	CS - Land/Structures - Improvements	-	0.5	3.1	1.1	3.6	3.8 /u
	FLEET - Equipment & Materials	2.5	8.9	9.5	11.6	13.2	15.9 /u
	FLEET - Tools	2.7	5.9	8.9	3.3	3.8	3.9 /u
	FLEET - Vehicles	3.8	16.7	17.0	25.2	28.8	32.4 /u
	LNG - Land/Structures - Improvements	-	0.2	0.5	-	-	- /u
	REWS - Furniture/Structures & Improvements	32.1	19.2	72.9	203.7	23.2	88.5 /u
	TIS Business Solutions	27.7	53.5	41.6	131.8	28.0	35.2 /u
	TIS Infrastructure	6.0	15.4	11.8	11.3	16.9	18.9 /u
	TPS - Land/Structures - Improvements	-	-	-	-	-	2.9 /u
	TPS - Land/Structures - Growth	-	0.9	0.3	0.4	3.2	- /u
General Plant Total		74.7	121.1	165.8	388.4	120.6	201.5 /u
System Access	CC - Commercial/Bulk-Metered - Conversion	4.6	1.9	3.3	3.5	3.6	3.6 /u
	CC - Commercial/Bulk-Metered - New	28.5	61.0	26.2	27.4	27.8	28.2 /u
	CC - Industrial - Conversion	-	-	-	-	-	- /u
	CC - Industrial - New	5.9	-	4.3	4.5	4.4	4.5 /u
	CC - Multi-Family/Apartment - Conversion	-	-	-	-	-	- /u
	CC - Multi-Family/Apartment - New	5.3	-	4.0	4.2	4.3	4.3 /u
	CC - Residential - Conversion	43.4	27.8	44.4	46.6	47.3	48.0 /u
	CC - Residential - New	193.5	210.8	163.8	169.0	164.1	158.9 /u
	CC - Sales Station - Conversion	1.2	0.6	0.6	0.6	0.6	0.6 /u
	CC - Sales Station - New	3.9	1.8	1.8	1.8	1.9	1.9 /u
	CS - Growth	1.4	-	-	-	-	- /u
	DP - Relocations	36.5	40.9	43.4	43.5	44.7	56.4 /u
	DS - CNG	2.5	3.4	1.4	1.0	1.0	1.1 /u
	GTH - Hydrogen Blending	4.8	9.5	11.1	3.2	-	- /u
	TPS - Growth	0.4	(0.0)	91.2	113.6	241.0	86.4 /u
	UTIL - Meters (growth)	18.0	16.5	17.0	18.5	19.2	12.2 /u
	EA Fixed OH	24.2	38.2	39.2	40.2	41.3	15.0 /u
	Community Expansion	10.6	22.2	13.8	26.8	24.4	7.3 /u
System Access Total		384.8	434.7	465.5	504.6	625.7	428.5 /u
System Renewal	CS - Improvements	10.4	8.1	2.9	2.3	2.0	2.0 /u
	CS - Overhauls	2.2	7.6	9.7	6.4	4.7	6.7 /u
	CS - Replacements	347.4	26.3	37.0	6.5	4.3	6.1 /u
	DP - Corrosion	4.8	20.2	10.6	11.2	10.9	10.4 /u
	DP - Main Replacement	68.0	123.4	180.3	85.9	54.0	133.5 /u
	DP - Service Relay	44.6	54.8	60.9	81.4	77.3	81.6 /u
	DS - Gate, Feeder & A Stations	30.1	53.9	80.1	41.0	62.2	66.3 /u
	DS - Inside Regulator & ERR Program	1.9	2.5	2.5	-	-	4.1 /u
	DS - Station Rebuilds & B and C Stations	23.8	34.4	41.3	43.0	23.2	38.8 /u
	LNG - Replacements	0.1	0.1	-	0.3	0.4	0.4 /u
	TPS - Improvements	0.7	8.1	4.7	3.4	1.3	3.1 /u
	TPS - Replacements	2.7	1.8	49.7	13.2	9.0	9.2 /u
	UTIL - Meters (mtc)	73.1	74.2	76.5	83.1	70.2	75.3 /u
	UTIL - Regulator Refit	65.1	60.3	64.9	69.5	60.4	78.4 /u
	UTIL - Remediation	1.3	1.3	1.7	2.0	2.2	2.5 /u
	EA Fixed OH	1.4	1.6	1.6	1.7	1.7	8.2 /u
	RNG	4.5	42.0	31.6	18.3	18.0	25.6 /u
	CNG	-	10.0	30.0	10.0	10.0	10.2 /u
System Renewal Total		682.1	530.6	686.1	479.0	411.7	562.4 /u
System Service	CS - Integrity	0.8	0.6	0.3	0.1	0.1	0.1 /u
	DP - Class Location	10.1	2.4	3.8	6.6	6.7	6.9 /u
	DP - Integrity	108.3	109.2	57.3	71.3	56.7	27.7 /u
	DS - Integrity Initiatives	0.4	7.0	8.3	6.3	6.2	6.4 /u
	GTH - System Reinforcement	40.6	65.9	208.8	31.0	56.9	12.7 /u
	LNG - Improvements	0.1	0.4	-	1.2	11.9	- /u
	LNG - Integrity	0.3	-	-	-	-	- /u
	TPS - Class Location	0.3	2.8	2.8	18.7	7.0	7.2 /u
	TPS - Integrity	40.7	38.8	26.1	27.8	31.1	21.9 /u
	UTIL - Monitoring Systems	3.3	0.0	0.0	-	-	- /u
System Service Total		204.8	227.2	307.4	163.0	176.5	82.7 /u
Grand Total		1,346.4	1,313.6	1,624.7	1,535.0	1,334.4	1,275.2

Excludes in-service additions for PREP of \$252M in 2024 and \$6.8M in 2025.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-1, p.34

Question(s):

SEC seeks to better understand the connection between approvals sought in this application and that sought/granted in other applications.

- a) Please provide a table that shows for each year between 2014 and 2028, total capital expenditures broken down into the following categories:
 - i. Granted leave to construct approval and approved as an ICM or Y-Factor
 - ii. Granted leave to construct approval only
 - iii. Leave to construct not required, project approved as an ICM or Y-Factor
 - iv. Leave to construct approval will be required
 - v. Other
- b) Please provide a version of table requested in part (a) on an in-service additions basis.
- c) Please explain what would happen if the OEB approves the 2024 in-service additions as applied for in this application, but subsequently, denies leave to construct for a specific project that is scheduled to go in-service in 2024.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023 /u

- a) Please see Attachment 1. /u
- b) Please see Attachment 1. Note that project level in-service details are not available for 2014 to 2018. Please also see response at Exhibit I.2.5-SEC-108, Attachment 1. /u
- c) In the event that the OEB approves the 2024 forecast rate base reflecting the forecast 2024 in-service additions, but then subsequently denies leave to construct

for a particular project that was forecast to be placed into service in 2024 (without any consideration for why it was denied and the corresponding implications), the Company expects that revenue requirement related to that project would be one of many positive or negative actual versus forecast variances that will be reflected in utility results for 2024.

As noted in Section 4.3.5 of the AMP at Exhibit 2, Tab 6, Schedule 2, page 56, the “identification of risks and the execution of projects is dynamic. During the year, project scopes may change or new projects may arise, resulting in cost pressures (increases or decreases) to the current portfolio. As these pressures are identified, trade-off decisions are made based on value and available capital, a direct demonstration of EGI’s Plan-Do-Check-Act cycle”.

Table 1 - Capital Expenditure View of LTC and ICM Projects

\$ millions	2014 Actual	2015 Actual	2016 Actual	2017 Actual	2018 Actual	2019 Actual	2020 Actual	2021 Actual	2022 Actual	2023 Bridge Year	2024 Forecast	2025 Forecast	2026 Forecast	2027 Forecast	2028 Forecast
Granted leave to construct approval and approved as an ICM or Y-Factor	154.6	352.6	690.8	368.0	156.2	119.1	59.4	127.4	105.3	34.0	-	-	-	-	-
Granted leave to construct approval only	207.0	597.9	147.6	25.8	28.8	63.4	67.6	63.0	42.3	293.2	14.5	-	-	-	-
Leave to construct not required, project approved as an ICM or Y-Factor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Leave to construct approval will be required	-	-	-	-	-	-	-	0.3	8.2	45.3	125.9	377.8	154.7	184.0	-
Other	727.6	756.2	789.4	758.6	747.5	904.9	880.1	1,120.1	1,247.1	1,054.7	1,329.7	1,246.0	1,252.1	1,208.2	1,279.5
Total	1,089.2	1,706.7	1,627.8	1,152.4	932.5	1,087.4	1,007.2	1,310.8	1,402.9	1,427.2	1,470.2	1,623.8	1,406.7	1,392.3	1,279.5

(1) Total capital expenditures excludes Panhandle Regional Expansion Project amounts of \$34.2 million in 2022, \$22.7 million in 2023, \$194.9 million in 2024 and \$6.7 million in 2025.

Table 2 - In-Service View of LTC and ICM Projects

\$ millions	2014 Actual	2015 Actual	2016 Actual	2017 Actual	2018 Actual	2019 Actual	2020 Actual	2021 Actual	2022 Actual	2023 Bridge Year	2024 Forecast	2025 Forecast	2026 Forecast	2027 Forecast	2028 Forecast
Granted leave to construct approval and approved as an ICM or Y-Factor						95.2	70.8	123.5	106.7	34.0	-	-	-	-	-
Granted leave to construct approval only						52.7	90.8	64.3	7.8	332.7	13.8	-	-	-	-
Leave to construct not required, project approved as an ICM or Y-Factor						-	-	-	-	-	-	-	-	-	-
Leave to construct approval will be required						-	-	-	-	-	88.1	438.6	133.7	241.2	-
Other						909.9	866.6	1,052.1	1,244.7	1,002.4	1,211.6	1,186.0	1,401.3	1,093.2	1,275.2
Total	-	-	-	-	-	1,057.8	1,028.2	1,239.9	1,359.3	1,369.1	1,313.6	1,624.7	1,535.0	1,334.4	1,275.2

(1) In-service actuals in detail are not available for 2014-2018

(2) Excludes in-service additions for PREP of \$252M in 2024 and \$6.8M in 2025.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-1, p.32

Question(s):

Please provide the table component of Figure 6 on an in-service additions basis. Please provide the response in Excel format.

Response:

Please see response at Exhibit I.2.6-SEC-113 Attachment 1.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-1, p.32

Question(s):

Please provide a revised version of Figure 7 that allocated ICM projects and overhead to specific USP categories.

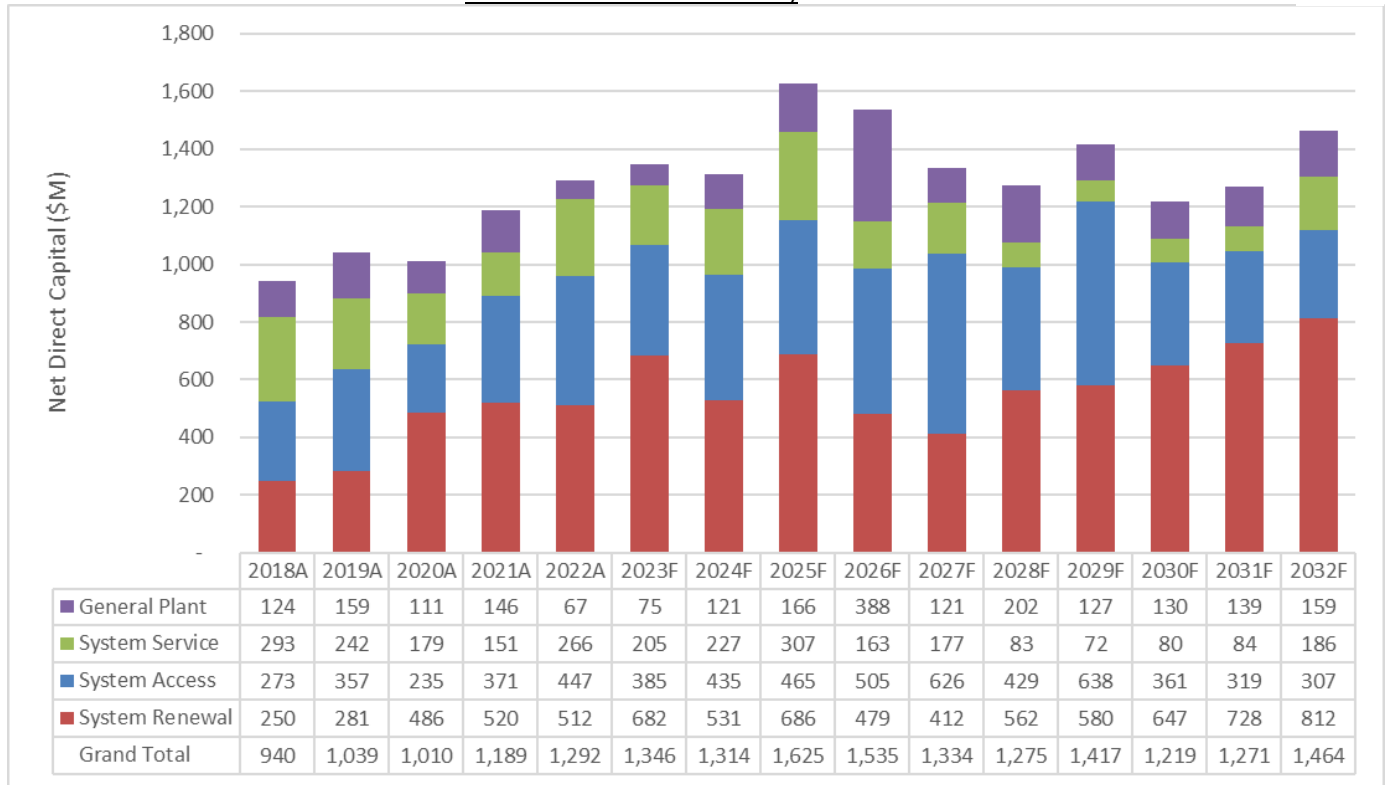
Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4 filed on June 16, 2023. /u

Please see below for the revised version of Figure 7 from Exhibit 2, Tab 6, Schedule 1. /u
Note that PREP in-service additions are excluded in 2024 and 2025.

Figure 7: Enbridge Gas's Capital Expenditure Summary (with proposed ICM project in-service spend identified from 2019 – 2023)

/u



ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-1, p.32

Question(s):

With respect to proposed investments that are subject to leave to construct:

- a) For each investment listed in Table 5, please provide the status of the leave to construct application, and if it has yet to be filed, the forecast month/year it will be filed.
- b) Please provide a similar table as Table 5 for each year between 2025 and 2028.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

- a) Please see Table 1, which is a revised version of Exhibit 2, Tab 6, Schedule 1, Table 5, for a description of the current status of LTC applications/proceedings and the forecast filing date of LTC applications, as applicable, for the projects contained therein. Please note that the forecast filing dates provided are best estimates and are subject to change. The total project cost column includes 2020 actuals excluding overheads, 2021 to 2022 actuals including overheads and the 2023 to 2032 forecast including overheads.

Table 1
2024 Investments Subject to LTC

Asset Class (\$)	Investment Code	Investment Name	2024 Direct Capital Forecast (includes Overheads)	2023 to 2032 Forecast	Total Project Cost	LTC Status / Forecast Filing Date	
Distribution Pipe	10290	St. Laurent Phase 3 - Coventry/ Cummings/St. Laurent (Plastic)	23,376,683	25,033,190	25,535,480	Q4 2024	/u
Distribution Pipe	10293	St. Laurent Phase 3 - North/South (NPS12/16 Steel)	12,165,299	121,804,1420	128,265,9817	Q4 2024	/u
Distribution Pipe	10294	St. Laurent Phase 4 – East/West (NPS 12 Steel)	51,230,980	53,906,876	54,474,506	Q4 2024	/u
Distribution Pipe	10292	St. Laurent Phase 3 - Montreal to Rockcliffe (Plastic)	192,083.67	4,228,710.93	4,692,402.04	Q4 2024	/u
Distribution Pipe	10288	St. Laurent Phase 4 - Lower Section (Plastic)	512,223.13	10,165,461.89	10,405,910.46	Q4 2024	/u
Growth	30500	NW 2103 Dundalk XHP Reinforcement SRP	6,525,722	7,226,627	7,226,627	Q4 2023	/u
Growth	736974	Hydrogen Blending Phase 2	1,920,837	9,026,516	9,026,516	2024	/u
Growth	736259	Hamilton Industrial Reinforcement	11,516,242	125,821,8541	126,122,554	2024	/u
Growth	734979	Grimsby-Lincoln Expansion Project - Natural Gas Expansion Program (NGEP)	1,677,530	9,115,779	9,188,478	2024	/u

Asset Class (\$)	Investment Code	Investment Name	2024 Direct Capital Forecast (includes Overheads)	2023 to 2032 Forecast	Total Project Cost	LTC Status / Forecast Filing Date	
Growth	30542	SRP_Southeast_Owen Sound_County Rd 40_Reinforcement_NPS12_11800m_4670kPa	2,667,445	33,636,530	33,636,530	Q1 2024	/u
Growth	30563	SRP_Southwest_Bluewater_New STN & Reinforcement_N PS4_7200m_3450 kPa	7,771,970.60	8,656,067.19	8,656,067.19	2024	/u
Compression Stations	100901	Dawn to Corunna	13,845,082	200,337,429	239,210,862	LTC Approved by the OEB November 3, 2022 ¹	/u
Transmission Pipe & Underground Storage	49758	Panhandle Regional Expansion Project	194,881,627	224,328,497	258,852,9646	Updated evidence filed June 16, 2023 ²	/u
Transmission Pipe & Underground Storage	740055	Panhandle Regional Expansion Project – Dawn Facilities	5,382,040	92,044,573	92,044,573	Updated evidence filed June 16, 2023	/u

¹ <https://www.rds.oeb.ca/CMWebDrawer/Record/760243/File/document>

² <https://www.rds.oeb.ca/CMWebDrawer/Record/796804/File/document>

- b) Please see Table 2, which is an updated version of Exhibit 2, Tab 6, Schedule 1, Table 5, for investments potentially subject to LTC between 2025 to 2028 and the expected forecast filing date of LTC applications, as applicable, for the projects contained therein. Please note that the forecast filing dates provided are best estimates and are subject to change.

/u

Table 2
2025 to 2028 Investments Subject to LTC

Asset Class (\$)	Investment Code	Investment Name	2025 Forecast	2026 Forecast	2027 Forecast	2028 Forecast	2023-2032 Forecast	LTC Status / Forecast Filing Date	
Compression Stations	48732	Waubuno Compression Lifecycle	\$26,414,524.55	124,001.99	-	-	29,218,620.07	Q2 2024, exact timing subject to ongoing risk assessment	/u
Distribution Pipe	11443	NPS 12 Martin Grove Rd Main Replacement: Lavington to St. Albans Rd.	3,185,590.84	26,076,273.43	1,351,721.17	-	30,613,585.45	Possibly 2025 subject to EDIMP Assessments	/u
Distribution Pipe	100295	Div_04: NPS 8 Port Stanley, London, Replacement	18,916,862.58	-	-	-	18,916,862.58	Possibly 2024 subject to EDIMP Assessments	/u
Growth	1024	NW 6581 Ottawa Reinforcement Phase 2 SRP	-	-	362,261	7,350,958.89	70,698,548.62	2027	/u
Growth	7727	Welland IP NW8925 Reinforcement	-	2,235,459.65	1,124,837	-	3,360,297.13	2025	/u
Growth	7743	NW 6587 L'Original Reinforcement SRP	4,842,098.08	-	-	-	6,578,765.30	2025	/u
Growth	16748	Erin IP System Reinforcement	-	-	2,313,008	3,817,964.07	6,130,972.56	2026	/u
Growth	30523	SRP_North_Parry Sound_Seguín Trail_Reinforcement_NPS6_8500m_4960kPa	-	-	2,799,569.	-	2,799,569.00	This project has been selected as an IRP project - Pilot Project	/u

Asset Class (\$)	Investment Code	Investment Name	2025 Forecast	2026 Forecast	2027 Forecast	2028 Forecast	2023-2032 Forecast	LTC Status / Forecast Filing Date
								evidence will be submitted to the OEB 2023 Q3
Growth	30555	SRP_Southwest_Kettle Point_Ravenswood Line_Reinforcement_NPS4_2000m_3450kPa	-	-	2,266,317.59	-	2,266,317.59	2026
Growth	100703	SRP_LUG East_Kingston_Creekford Rd_Reinforcement_NPS8_6200m_6895kPa	-	10,679,512.00	32,449,473.00	2,163,249.23	45,292,234.23	2026
Growth	501677	WATE - Speedvale Ave W Elmira Rd Northwest Guelph System Reinforcement	2,133,455.22	-	-	-	2,410,617.69	2024
Growth	501824	Huntmar Drive Reinforcement	1,270,203.38	3,928,909.34	-	-	5,200,410.69	2025
Growth	734744	King: Brighton Reinforcement	-	-	-	2,431,955.06	2,431,955.06	2027
Growth	738258	LOND - Strathroy Industrial Park Reinforcement - Strathroy	-	2,327,364.72	-	-	2,327,364.72	2025
Transmission Pipe &	48654	Dawn Parkway Expansion Project	-	50,866,105.21	177,429,434.98	21,799,036.98	251,357,572.31	2026

/u

/u

/u

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Asset Class (\$)	Investment Code	Investment Name	2025 Forecast	2026 Forecast	2027 Forecast	2028 Forecast	2023-2032 Forecast	LTC Status / Forecast Filing Date
Underground Storage		(Kirkwall-Hamilton NPS 48)						
Transmission Pipe & Underground Storage	100699	Dawn Parkway Expansion Project (Dawn-Enniskillen NPS 48)	-	-	32,811,147.47	67,062,366.61	332,803,727.89	2027
Transmission Pipe & Underground Storage	735972	PREP: NPS 36 looping to Comber Transmission	-	-	-	9,537,078.68	95,496,455.06	2026
Transmission Pipe & Underground Storage	736923	Panhandle Regional Expansion Project - Leamington Interconnect	26,732,986	85,142,928	6,593,683	-	119,307,4510	Updated evidence filed June 16, 2023 – scope to be determined
Transmission Pipe & Underground Storage	738677	Trafalgar 42 Saxton Rd	-	2,659,845.39	-	-	2,659,845.39	2025

/u

/u

/u

/u

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-1, p.48-49

Questions(s):

With respect to customer connection feasibility:

- a) For each year between 2013 and 2024, please provide the annual investment portfolio PI. Please provide all underlying calculations.
- b) Please provide the most recent 12-month rolling project portfolio (RPP) PI. Please provide all underlying calculations.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

Please see Table 1. Please note that the updated PI values for 2023 and 2024 investment portfolios are lower than originally filed. The reason for this decrease is the increase in the customer connections capital forecast, which is driven by inflationary pressures for these years.

/u

Table 1

EGI	PV of Cash Inflows¹ (\$million)	PV of Cash Outflows² (\$million)	PI
2013	\$254.8	\$209.1	1.22
2014	\$246.1	\$219.8	1.12
2015	\$228.9	\$217.0	1.06
2016	\$243.2	\$224.3	1.08
2017	\$253.3	\$199.2	1.27
2018	\$224.3	\$209.2	1.07
2019	\$263.9	\$241.6	1.09
2020	\$265.1	\$250.9	1.06
2021	\$262.9	\$301.3	0.87
2022	\$290.1	\$312.7	0.93
2023	\$266.7	\$293.5	0.91
2024	\$340.6	\$315.3	1.08

/u
/u

1-Present value of revenues net of ongoing operating costs plus CCA tax shield

2-Present value of capital investments

b) Please see Table 2 for the most recent 12-month Rolling Project Portfolio PI.

Table 2

Cash Inflow (\$million)	Cash Outflow (\$million)	PI
\$333.4	\$215.8	1.54

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-1, p.53-55

Question(s):

With respect to community expansion:

a) For each community expansion project, please provide the following information:

- i. Name of project
- ii. Budgeted capital costs
- iii. Forecast cost
- iv. Actual capital costs-to-date
- v. Forecast final capital costs
- vi. 10-year customer forecast
- vii. Actual customer forecast by year
- viii. Original forecast PI
- ix. Revised forecast PI based on the most recent forecast costs and customer attachment forecast
- x. SES term
- xi. If the PI in part (ix) is below 1.0, the forecast revenue shortfall

b) Enbridge states that during the 10-year rate stability period “the utility is to bear the risk of its customer attachment forecast and revenue requirements”. Please explain how Enbridge has ensured that this is the case in this application.

Response:

a) Please see Attachment 1 for response to part i, ii, vi, viii, and x.

For part iii, iv, v, vii, ix, and xi, please see response at Exhibit I.1.12-FRPO-21.

b) In order to bear the customer attachment and revenue requirement risk associated with Community Expansion projects, as part of its 2024 Rebasing forecast, Enbridge Gas has used the original estimate of capital costs, and customer attachment and

volumetric forecasts for all projects that are in-service or were forecast to be in-service by the end of 2024 (at the time of filing), and in the midst of their respective Rate Stabilization Periods ("RSPs). The actual capital cost and the actual customer attachment and volumetric forecasts associated with these projects will be brought forward to be included in the determination of rates, subject to OEB approval, as part of the rate rebasing proceeding following the end of each project's respective 10 year RSP. This treatment is consistent with the Company proposals and OEB determinations in prior applications, including the Company's SES/TCS/HAF Approval Application¹.

¹ EB-2020-0094.

Milverton and Rostock/Wartburg Community Expansion Project

[illegible]

Kettle and Stoney Point First Nation and Lambton Shores Community Expansion Project

[illegible]

Delaware Nation of Moraviantown Community Expansion Project

[illegible]

Prince Township Community Expansion Project

[illegible]

Fenelon Falls Community Expansion Project

[illegible]

Chippewa of the Thames First Nation Community Expansion Project

[illegible]

Saugeen First Nation Community Expansion Project

[illegible]

Northshore and Peninsula Rd Community Expansion Project

[illegible]

Scugog Island First Nation Community Expansion Project

[illegible]

Scugog Island First Nation Community Expansion Project

[illegible]

Brunner (Perth East) Community Expansion Project

[illegible]

Burk's Falls Community Expansion Project

[illegible]

Kenora District (Highway 594) Community Expansion Project

[illegible]

Stanley's Olde Maple Community Expansion Project

[illegible]

Haldimand Shores Community Expansion Project

[illegible]

Mohawk of Bay of Quinte Community Expansion Project

[illegible]

Hidden Valley Community Expansion Project

[illegible]

Selwyn Community Expansion Project

[illegible]

Cornwall Island First Nation Community Expansion Project

[illegible]

Hiawatha First Nation Community Expansion Project

[illegible]

Boblo Island Community Expansion Project

[illegible]

Cedar Springs Community Expansion Project

[illegible]

Neustadt Community Expansion Project

[illegible]

Cherry Valley (Prince Edward County) Community Expansion Project

[illegible]

Red Rock First Nation Community Expansion Project

[illegible]

Severn (Washago) Community Expansion Project

[illegible]

St. Charles Community Expansion Project

[illegible]

Tweed Community Expansion Project

[illegible]

Bobcaygeon Community Expansion Project

[illegible]

Caledon (Humber Station) Community Expansion Project

[illegible]

Chute-a-Blondeau Community Expansion Project

[illegible]

East Gwillimbury (North and East) Community Expansion Project

[illegible]

Glendale Subdivision Community Expansion Project

[illegible]

Lanark and Balderson Community Expansion Project

[illegible]

Merrickville-Wolford Community Expansion Project

[illegible]

Sandford Community Expansion Project

[illegible]

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.18

Question(s):

With respect to Figure 1.4-1, please provide in tabular format. Please also provide the information in Excel format.

Response:

Table 1 provides Figure 1.4-1 in tabular form. Please see Attachment 1 for the Excel.

Table 1

Final Ten Year Plan by Asset Class - EGI (Capital Expenditure)

Asset Class	2019A	2020A	2021A	2022F	2023B	2024F	2025F	
Corporate	207,909,220	208,468,100	218,031,714	-	-	-	-	/u
Distribution Pipe	173,885,587	192,764,416	363,964,279	458,502,020	261,938,656	368,260,186	333,290,275	/u
Distribution Stations	39,689,415	61,353,984	74,173,925	106,568,532	149,327,443	120,556,729	109,809,532	/u
Growth	337,358,049	248,686,250	251,173,093	273,320,777	275,268,930	354,284,041	422,142,520	/u
Utilization	99,282,465	62,903,204	65,600,703	120,299,728	136,506,691	146,479,796	148,485,654	/u
Compression Stations	25,694,179	25,331,329	33,806,633	87,120,135	238,483,315	38,595,459	71,408,475	/u
LNG	37,095	1,179,179	688,792	595,265	752,490	320,405	536,342	/u
Transmission Pipe & Underground Storage	19,780,551	33,457,585	64,840,620	102,533,777	280,718,280	171,674,953	99,347,794	/u
Fleet & Equipment	26,328,243	20,213,204	21,709,960	30,628,739	25,522,210	35,021,486	36,393,109	/u
Real Estate & Workplace Services	42,063,490	38,341,856	57,247,419	118,657,815	52,101,942	56,556,581	75,618,701	/u

Asset Class	2019A	2020A	2021A	2022F	2023B	2024F	2025F	
TIS	48,866,041	22,724,491	18,548,683	39,442,616	63,743,859	112,426,531	88,738,043	/u
EA Fixed O/H	16,727,888	19,463,636	25,400,213	21,343,272	21,673,996	21,949,891	22,241,315	/u
Grand Total	1,037,622,224	934,887,234	1,195,186,032	1,359,012,675	1,506,037,812	1,426,126,058	1,408,011,761	/u

Table 1 Continued
Final Ten Year Plan by Asset Class - EGI (Capital Expenditure)

Asset Class	2026F	2027F	2028F	2029F	2030F	2031F	2032F
Corporate	-	-	-	-	-	-	-
Distribution Pipe	268,726,207	292,265,638	316,416,276	343,250,257	412,065,311	492,492,938	518,229,629
Distribution Stations	111,404,843	106,475,959	116,290,254	110,439,089	102,816,670	100,203,290	104,156,959
Growth	291,086,203	268,933,469	260,389,458	246,228,202	257,998,254	261,583,607	326,282,666
Utilization	153,210,766	166,288,764	168,363,052	170,533,177	179,466,914	180,378,170	178,589,590
Compression Stations	115,562,504	32,301,082	18,738,422	10,939,139	9,930,921	11,043,930	16,175,824
LNG	1,172,900	12,767,235	412,852	409,896	424,425	8,115,816	55,655,914
Transmission Pipe & Underground Storage	203,971,094	128,584,596	169,856,220	256,167,553	80,306,757	46,475,993	43,358,732
Fleet & Equipment	40,498,814	53,560,301	52,273,362	52,569,059	55,230,475	56,478,725	49,694,837
Real Estate & Workplace Services	103,517,898	54,616,447	56,372,792	23,268,215	40,425,092	36,419,968	21,039,276
TIS	76,930,524	48,076,799	54,064,385	45,337,835	43,405,732	45,943,568	53,889,259
EA Fixed O/H	22,549,168	22,874,416	23,218,092	23,581,305	23,965,244	24,371,183	24,800,490
Grand Total	1,388,630,922	1,186,744,706	1,236,395,164	1,282,723,728	1,206,035,795	1,263,507,187	1,391,873,179

Final Ten Year Plan by Asset Class - EGI (Capital Expenditure)

Line No.	Particulars	2019A	2020A	2021A	2022F	2023B	2024F	2025F	2026F	2027F	2028F	2029F	2030F	2031F	2032F	
1	Asset Class															
2	Corporate	207,909,220	208,468,100	218,031,714	-	-	-	-	-	-	-	-	-	-	-	/u
3	Distribution Pipe	173,885,587	192,764,416	363,964,279	458,502,020	261,938,656	368,260,186	333,290,275	268,726,207	292,265,638	316,416,276	343,250,257	412,065,311	492,492,938	518,229,629	/u
4	Distribution Stations	39,689,415	61,353,984	74,173,925	106,568,532	149,327,443	120,556,729	109,809,532	111,404,843	106,475,959	116,290,254	110,439,089	102,816,670	100,203,290	104,156,959	/u
5	Growth	337,358,049	248,686,250	251,173,093	273,320,777	275,268,930	354,284,041	422,142,520	291,086,203	268,933,469	260,389,458	246,228,202	257,998,254	261,583,607	326,282,666	/u
6	Utilization	99,282,465	62,903,204	65,600,703	120,299,728	136,506,691	146,479,796	148,485,654	153,210,766	166,288,764	168,363,052	170,533,177	179,466,914	180,378,170	178,589,590	/u
7	Compression Stations	25,694,179	25,331,329	33,806,633	87,120,135	238,483,315	38,595,459	71,408,475	115,562,504	32,301,082	18,738,422	10,939,139	9,930,921	11,043,930	16,175,824	/u
8	LNG	37,095	1,179,179	688,792	595,265	752,490	320,405	536,342	1,172,900	12,767,235	412,852	409,896	424,425	8,115,816	55,655,914	/u
9	Transmission Pipe & Underground Storage	19,780,551	33,457,585	64,840,620	102,533,777	280,718,280	171,674,953	99,347,794	203,971,094	128,584,596	169,856,220	256,167,553	80,306,757	46,475,993	43,358,732	/u
10	Fleet & Equipment	26,328,243	20,213,204	21,709,960	30,628,739	25,522,210	35,021,486	36,393,109	40,498,814	53,560,301	52,273,362	52,569,059	55,230,475	56,478,725	49,694,837	/u
11	Real Estate & Workplace Services	42,063,490	38,341,856	57,247,419	118,657,815	52,101,942	56,556,581	75,618,701	103,517,898	54,616,447	56,372,792	23,268,215	40,425,092	36,419,968	21,039,276	/u
12	TIS	48,866,041	22,724,491	18,548,683	39,442,616	63,743,859	112,426,531	88,738,043	76,930,524	48,076,799	54,064,385	45,337,835	43,405,732	45,943,568	53,889,259	/u
13	EA Fixed O/H	16,727,888	19,463,636	25,400,213	21,343,272	21,673,996	21,949,891	22,241,315	22,549,168	22,874,416	23,218,092	23,581,305	23,965,244	24,371,183	24,800,490	/u
14	Grand Total	1,037,622,224	934,887,234	1,195,186,032	1,359,012,675	1,506,037,812	1,426,126,058	1,408,011,761	1,388,630,922	1,186,744,706	1,236,395,164	1,282,723,728	1,206,035,795	1,263,507,187	1,391,873,179	/u

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.42

Question(s):

Please provide a copy of Enbridge's risk matrix.

Response:

Please see EB-2020-0192 Exhibit.I.PP4 Attachment 1, Pages 13 and 15 for a copy of Enbridge's risk matrix. For convenience, the relevant pages are provided in Attachment 1 to this response.



Appendix A: Enbridge Standardized Operational Risk Matrix

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STANDARDIZED OPERATIONAL RISK MATRIX

Framework Standard - Risk Management
Effective Date September 17 2018

[illegible]

Hazard Identification and Risk Assessment for Common Register Procedure

Standardized Operational Risk Matrix - Copy of Consequence Details

	1	2	3	4	5	6	7
FINANCIAL	Total financial impact ≤\$10,000	Total financial impact ≤\$10k and ≤\$100k	Total financial impact ≤\$100k and ≤\$1M	Total financial impact ≤\$1M and ≤\$10M	Total financial impact ≤\$10M and ≤\$100M	Total financial impact ≤\$100M and ≤\$1B	Total financial impact ≤\$1B
HEALTH & SAFETY	Employee: No H&S impact Public: No H&S impact	Employee: Illness/injury requiring medical treatment or highly elevated stress levels Public: No impact	Employee: Illness / injury requiring medical aid; OSHA recordable; modified work restriction or stress-related leave of absence Public: Minor injuries and/or reversible health impacts to members of the public	Employee: Incident resulting in injury or occupational illness requiring long-term rehabilitation (physical or psychological); lost time injury (LTI) or equivalent; overnight hospitalization Public: Requires hospitalization and/or long-term care to members of the public	Public or Employee: One fatality and/or permanent disability affecting one person	Public or Employee: Two to ten (2-10) fatalities and/or permanent disability affecting two to ten (2-10) people	Employee or public: > 10 fatalities and/or permanent disability affecting > 10 people
ENVIRONMENTAL	No impact to environment	Impacts to surface gravel or soil within an Enbridge facility; able to be remediated by trained personnel quickly and effectively; no impact to offsite air quality	Offsite impact resulting in environmental damage covering 100m ² (1080 ft ²) to 1000m ² (0.25 acre)	Offsite impact resulting in environmental damage covering 1000m ² (0.25 acre) to 1.0 ha (2.5 acre) Impact to uplands and confined wetland	Offsite impact resulting in environmental damage covering 1 ha (2.5 acres) to 10 ha (25 acres) Impact to uplands and unconfined wetland or creek; no sensitive environmental receptors impacted (animal or plant species)	Offsite impact resulting in environmental damage covering 10 ha (25 acres) to 1 km ² (250 acres) Impact to uplands and lake or river; sensitive environmental receptors impacted (animal or plant species)	Offsite impact resulting in extreme environmental damage (> 1 km ²) Irreparable damage to lands or waterways; irreparable damage to sensitive environmental receptors (animal or plant species)
OPERATIONAL	No diversion of Enbridge resources No disruption to transportation customers No utility customer impact	Minor diversion of Enbridge resources Minor transportation customer disruption which can be quickly mitigated. Utility customer impact <100 customers	Moderate diversion of Enbridge resources Transportation customers impacted for a day or more to as much as one week. Utility customer impact 100-499 customers	Enbridge resources diverted and operational capability is significantly impacted. Short term disruption to transportation customers (1 week - 1 month) Utility customer impact 500-999 customers	Extended period of Enbridge resource diversion and operational capability impact (1-3 months) Considerable disruption and inconvenience to transportation customers (1-3 months) Utility customer impact 1000 - 4999 customers; or category B major customer	Long period of Enbridge resource diversion and operational capability impact (3-6 months) Long-term impact to transportation customers (3-6 months) Utility customer impact 5000 - 20,000 customers; or multiple category B customers; or a category A major customer	Enbridge resource diversion and operational capability impact exceeds 6 months. Indefinite unavailability of transportation assets (> 6 months) Utility customer impact > 20,000 customers; or multiple category A major customers
REPUTATIONAL	No known media coverage No unplanned regulatory engagement No public disruption	Isolated individual concern; at a municipal/county level, no media attention Regulator notification and/or informal and unplanned meetings or information requests from regulator; no monetary penalty imposed Minor public disruption	Localized concern with short term local media and interest group concerns A non-compliance issue identified by a regulator in writing without a monetary penalty. May require corrective actions; follow up communication with the regulator regarding the issue should be expected. Disruption or inconvenience affecting < 1,000 persons Evacuation of < 10 persons	State/Provincial concern, public and media attention beyond local area. Customer attention on the issue A non-compliance issue identified by a regulator in writing including a monetary penalty; may require corrective actions; follow up communication with the regulator regarding the issue should be expected; permit/approval conditions or approval agency change causing moderate operational impacts. Disruption or inconvenience affecting 1,000- <10,000 persons Evacuation of 10 - < 100 persons	National concern and extended media coverage; significant public response causing major impact on current and prospective customers A non-compliance issue identified by a regulator in writing that requires significant corrective actions; may include a monetary penalty; significant impacts to operation of a specific asset or facility and may require immediate steps to assure safety; operating permit/approval suspended causing significant operational impacts Disruption or inconvenience affecting 10,000-50,000 persons Evacuation of 100 - 1,000 persons	Extended national media coverage; significant public response causing major long term impact on customers; damaging reputation and resulting in the inability to expand operations A non-compliance issue identified by a regulator in writing and directs Enbridge to stop operating specific assets; includes criminal prosecutions and operating permit/approval canceled causing indefinite suspension to operations Disruption or inconvenience affecting > 50,000 persons Evacuation of > 1,000 persons	Extended national media coverage; severe public response causing potentially permanent impact on customers; irreparable reputation damage resulting in the inability to continue operations Unable to gain regulatory approval for continued operation; may require decommissioning of major facilities Criminal prosecution of Enbridge leadership

The confidential version is located in the Asset Management team's. All copies are unclassified. © Enbridge Inc.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.55

Question(s):

With respect to estimate class:

- a) Please explain how the contingency amount is determined for a given project/program based on the estimate class.
- b) Please provide a copy of any internal guidelines, standards or similar document that outline the level of contingency that is to be budgeted.

Response:

a-b) Contingency is described as the amount of funds set aside to account for unquantified costs at the time a cost estimate is completed and is intended to cover anticipated risks to the project/program. The contingency amount applied to a project/program is reflective of the status of project/program development, project/program risk profile and expected construction characteristics.

Enbridge Gas typically uses internal resources to plan and manage pipeline construction projects, and there are two primary project groups within Enbridge Gas who are responsible for these activities. Regional Operations handle smaller scale and routine growth and replacement projects, and Field Services and Growth handle more complex projects. Project teams within Regional Operations follow the Cost Estimating Standards provided at Attachment 1 and project teams within Field Services and Growth follow the Class Estimating Guidelines provided at Attachment 2. These standards are very similar though there are slight differences in the contingency approach due to the relatively repetitive nature of projects executed by Regional Operations. In addition to the projects executed by Enbridge Gas's project groups, some projects are managed by Enbridge Inc.'s Projects organization. This occurs when major projects that are not considered core work within Enbridge Gas's portfolio are required, and there are insufficient internal resources to execute these

projects. In these cases, the Contingency Estimating Process provided at Attachment 3 is followed. This process is generally more labour intensive and takes a more risk based, statistical approach in determining appropriate contingency levels based on the unique characteristics of a project.

In all cases, Enbridge Gas takes a risk-based approach to assigning contingency, which allows for variance ranges to be applied for each project/program based on its associated risk. As risks often impact more than one cost category at once, contingency is applied as a global percentage across all cost categories with the expectation that those funds will be spent and allocated to the appropriate cost category when and if risks materialize. Contingency amounts are not included in the capital costs that go into rate base unless required to be used in the completion of the project/program.

While Enbridge Gas has standard suggested contingency ranges based on the Class Level of the estimate, in some cases, these may be adjusted based on project/program specific circumstances such as a unique project risk profile or if the expected construction characteristics are uncommon.



Estimating and Contingency Standard

Distribution Operations

Published: February 2023

Standard

Company: Enbridge Gas Distribution and Storage

Owned by: Distribution Operations

Controlled Location: GDS DL, Operations Services, Construction Project Management



Estimating and Contingency Standard

1. Application

1.1 Purpose

The purpose of the Estimating and Contingency Standard is to provide an overview of the standard approach/methodology used for capital project cost estimating within Distribution Operations at Enbridge Gas Distribution and Storage (GDS).

1.2 Responsibilities

The following table lists the individuals and groups affected by this document and what their responsibilities are related to estimating.

Table 1.1: Cost Estimating Roles and Responsibilities

ROLES	RESPONSIBILITIES
Project Manager*	<ul style="list-style-type: none"> • Provide appropriate scope definition to allow for effective cost estimating as project progresses. • Generate the Design & Engineering spend and bill of materials (BOM) components of a project estimate. • Create and submit business cases in C55 for approval and prioritization using details from cost estimate. • Understand requirements to plan and schedule work. • Engage alliance partners for estimate inputs as required.
Execution Owner	<ul style="list-style-type: none"> • Provide field estimate component to project managers. • Revise field estimate as scope is more clearly defined and project progresses. • Conduct constructability review of project with Construction project managers. • Engage alliance partners for estimate inputs as required.
Asset Management	<ul style="list-style-type: none"> • Publish an optimized portfolio of capital projects for execution annually. • Monitor execution of the asset plan and re-prioritize as material changes arise. • Work with Distribution Operations to identify cost pressures and communicate solutions to the asset class directors for approval and to make the final decision on project trade-offs.

**Project manager includes Drafter/Estimator, Sr Analyst New Business (SANB), Customer Connections Field Rep (CCFR), Regional Engineer (RE), Advisor Construction Project Management (ACPM)*

2. Terms and Definitions

Click the following link to view a list of terms and acronyms.

[Terms and Definitions](#)

3. Requirements

3.1 General

Estimating within Distribution Operations is a collaborative process between the project managers and the execution groups to generate and refine estimates for capital projects. These estimates are approved by the Asset Management department to support the 10 Year Asset Plan.

COPPERLEAF (C55) is the tool used by project managers to propose projects to Asset Management for approval and prioritization. The output is a portfolio of projects for approval by the Asset directors and Executive Management Team (EMT). C55 acts as the source for project scope definition and estimates. All estimates and estimate details are entered into C55 by the project managers. Any estimate revisions need to be subsequently proposed and may be subject to re-prioritization and re-approval as cost pressures arise. Completeness of the business case in C55 is important as extractable information used to support the Company's Asset Management Plan.

3.2 Estimate Classes and Contingency Guidelines

Estimates for capital projects progress through industry standards for estimate classes; progressing from Class 5 to Class 1 as the project scope is progressively defined.

Initial business cases are based on Class 5 estimates, and then refined to a Class 3 before requesting final capital approval.

Table 3.1: Distribution Operations Class Level Guidelines is a chart used to define the stage, level of scope, and schedule at each estimate class (from Class 5 to Class 1).

Table 3.3: Distribution Operations Typical Project Risk & Contingency Matrix takes a risk-based approach to assigning contingency on projects at a Class 5 and Class 3 estimate level. The contingency allowance is the amount of funds set aside to account for unquantified project costs, to cover known risks to the project (known-unknowns).

A risk scorecard was used to evaluate typical project types at GDS in terms of the risks to deliver projects safely and consistently on time and on budget, while attaining the highest standards for safety, quality, customer satisfaction, environment, and regulatory compliance. The result is the Distribution Operations Typical Project Risk & Contingency Matrix. The resulting risk score can be converted into a suggested contingency for the class and project type.

Construction project managers / execution owners decide on a project contingency based on:

- Distribution Operations Class Level Contingency Guidelines
- Distribution Operations Typical Project Risk Scorecard
- Their expertise on similar project types

Table 3.1: Distribution Operations Class Level Guidelines

CLASS LEVEL		CLASS 5	CLASS 4	CLASS 3	CLASS 2	CLASS 1 (FORECAST)
PRIMARY Project Definition		0–2%	1–15%	10–40%	30–75%	65–100%
STAGE		Screening	Planning	Design & Procurement	Construction, Start-Up, and Close-Out	
DESCRIPTION		High-level estimate used for quick turnaround requests or to determine if a project is viable.	Project team estimate – used as gut-check when receiving preliminary third-party estimates. May also be used when project-specific information (rather than historical) is required before determining project feasibility.	Preliminary estimate used for budget authorization (AFE). May be used as control budget for less complex projects.	Control budget or contractor control bid/tender - Final estimate prior to construction start.	Cost tracking – detailed estimate used to manage and control a project's cost, track actual costs, and provide the Estimate at Completion (EAC), forecast.
SECONDARY	SCOPE	<ul style="list-style-type: none"> High-level scope Pressure class known Network connection points Primary components (Pipeline, Station) May involve multiple scenario costing (in-service years, pipeline routes, etc.) 	<ul style="list-style-type: none"> Single scenario preferable Rough sketch / BOM WBS 	<ul style="list-style-type: none"> Preliminary scope (60% / 90% / third-party design) Route design Station requirements Long lead time materials known 	<ul style="list-style-type: none"> Final scope Final design (HDD, BOM, tie-ins, etc.) 	<ul style="list-style-type: none"> Scope Change Management
	PROJECT STAGE	<ul style="list-style-type: none"> No drawings provided GIS maps Aerial maps Permit conditions unknown High-level Regulatory requirements known (LTC, NEB) 	<ul style="list-style-type: none"> Topographic surveys Third-party drawings High-level permit conditions known High-level permitting agencies identified Regulatory requirements known 	<ul style="list-style-type: none"> Preliminary drawings (EGD) Preliminary profile SUE, Level B Preliminary HDD profile Geotechnical Report Environmental Report Permits and general conditions for special permits known (MTO, TRCA, CN) LTC/NEB application 	<ul style="list-style-type: none"> Approved drawings (EGD 100%) SUE, Level A/B Permitting notes and conditions Permits granted LTC/NEB approved Contractor procurement (contract) completed 	<ul style="list-style-type: none"> Partial / final as-laid Contractor cost reports Weekly / monthly project reporting Scope changes
	SCHEDULE	<ul style="list-style-type: none"> High-level schedule (fiscal year) In service target year 	<ul style="list-style-type: none"> High-level schedule (fiscal year) In service target year Network restrictions 	<ul style="list-style-type: none"> Preliminary schedule (fiscal quarter) Stakeholder timelines Third-party restrictions (conservation timing windows, gas delivery dates, municipal requirements) 	<ul style="list-style-type: none"> Detailed schedule Third-party / permit restrictions Primary tasks identified 	<ul style="list-style-type: none"> Schedule tracking
COST ESTIMATE METHOD USED		<ul style="list-style-type: none"> Top-down estimate: Historical projects Per meter costs Rule of thumb (ROT) Unit rates Magnitude table 	<ul style="list-style-type: none"> Bottom-up estimate: Cost estimating tool Unit rates Stakeholder input 	<ul style="list-style-type: none"> Bottom-up estimate: Cost estimating tool with detailed rates Unit rates Stakeholder input Detailed contractor field estimates 	<ul style="list-style-type: none"> Bottom-up estimate: Cost estimating tool with detailed rates Detailed final field estimates Material and Service POs Detailed final third-party estimates 	<ul style="list-style-type: none"> See forecasting methods
SUGGESTED CONTINGENCY		20–50%	15–40%	10–30%	5–20%	5–10%

3.3 Suggested Cost Estimate Method Guidelines

Top-down (**desktop**) and bottom-up (**field**) estimating are two methods to determine the resources required to complete a construction project. The choice between these two methods is based on the level of detail and accuracy required for the project and the level of complexity of the project.

Top-down (**desktop**) estimating is performed when there is limited information available about the project, or when the project has a relatively simple and straight forward scope of work. This method involves using historical data, industry standards, unit rates, and general knowledge to generate a rough estimate of the resources required for the project. This method is quick and can be completed with minimal data, making it ideal for early-stage project planning.

Bottom-up (**field**) estimating, on the other hand, is performed when a high level of detail and accuracy is required for the project, or when the project has a high level of complexity. This method involves breaking down the project into individual tasks and components, and determining the resources required for each task, including performing site visits and obtaining information from alliance partners. This method provides a more detailed and accurate picture of the resources required for the project but can also be more time-consuming and resource intensive.

Table 3 outlines criteria to consider when determining when to perform field or desktop estimating for a particular project.

Table 3.2: Field and Desktop Criteria

CRITERIA	3R	NEW BUSINESS	STATION
Unit rates or bundled rates available	Desktop	Desktop	Desktop
Estimated value of less than \$50k	Desktop	Desktop	Desktop
Estimated value of greater than \$50k	Field	Field	Field
Projects with one or more of the following characteristics and considerations			
Pipe size of 4" and greater		Field	
Pipe pressure of over 690kPa/ HPPE/ 100psi		Field	
Pipe material - Steel		Field	
Projects deemed complex with the following characteristics:		Field	
Technical Field Services (TFS) required		Field	
Vital main or Transmission main		Field	
Pre-odorization required		Field	
District or Header Station		Field	
Unusual Construction Conditions:			
Rock		Field	
Existing utility congestion		Field	
Crossings (Utility, Water, Rail)		Field	

Wall-to-wall	Field
Improved *	Field
Presence of Trans-Canada Pipeline (TCPL)	Field
Soil condition	Field
Requires conservation permitting	Field
Major high-ways and main thorough-fare	Field
Soil contamination	Field
Non-destructive examination (NDE)	Field

* Improved: Areas where the installation lies under sod, hard surfaces, or pavement, such as in established or urban areas or existing residential developments. These areas require restoration.

Unimproved: Areas where the installation lies predominantly under unfinished landscape, such as subdivisions under construction or rural areas where sod is not required to restore the ground.

Table 3.3: Distribution Operations Typical Project Risk & Contingency Matrix

Project Risk Scorecard	TOTAL Risk Score	Contingency Class 5		Contingency Class 3	
		Suggested	Minimum	Suggested	Minimum
Operations Programs, Replacements and others	18	27%	20%	14%	10%
Subdivision	25	29%	20%	16%	10%
Headers /Sales Rebuilds	26	30%	20%	16%	10%
Scattered Services - all including residential, commercial etc	28	30%	20%	17%	10%
Residential Main Extension	29	31%	20%	17%	10%
Integrity Dig	33	32%	20%	18%	10%
Gate/feeder station partial upgrade	34	33%	20%	19%	10%
Pressure elevation	35	33%	20%	19%	10%
Relocations <NPS 12	35	33%	20%	19%	10%
Commercial/ Industrial	36	34%	20%	19%	10%
Reinforcement <NPS 12	37	34%	20%	19%	10%
Replacement / Class Location < NPS 12	38	34%	20%	19%	10%
Integrity Retrofit	38	34%	20%	20%	10%
Verticals including a noded header and rooftop	40	35%	20%	20%	10%
Rebillable Relocations <NPS12	43	36%	20%	21%	10%
District Stations rebuild program	44	36%	20%	21%	10%
Customer-driven Reinforcement <NPS 12	45	37%	20%	21%	10%
Gate/feeder station partial rebuild	45	37%	20%	21%	10%
Gate/feeder station full/New build	55	41%	20%	24%	10%
New Technology i.e. RNG	56	41%	20%	24%	10%
Replacements, Relocations, Reinforcements, Class Location > NPS 12	58	42%	20%	25%	10%
Transit relocations <NPS 12	58	42%	20%	25%	10%
LTC project	Contingency to be determined on a per-project basis				
Transit Program	Contingency to be determined on a per-project basis				
Community Expansion LTC	Contingency to be determined on a per-project basis				
BMS Station	Contingency to be determined on a per-project basis				

Some examples of projects where minimum contingency should be considered for estimating:

- Gas installation with detailed prework (test pits, soil samples, etc.)
- Main extension in areas with known favorable soil conditions based on past construction experiences.
- Multiple year replacement work – After first year of construction, execution understands the work area and pipe conditions. For the following year, a contingency closer to minimal value should be consider for estimating.

Some examples of projects where suggested contingency should be considered for estimating:

- Rebillable relocation work completed in conjunction with municipal roadwork in urban settings.
- Complicated drill shots under a creek crossing/roadways/highway
- Main installation in an area with unknown ground conditions or known poor constructability ground conditions.

3.4 Remarks on Estimates Accuracy

Accuracy in project estimates is crucial for effective asset management and cost control. Proper cost estimating is essential in ensuring that the project budget is aligned with the project goals, objectives, and requirements. It enables stakeholders to make informed decisions about the allocation of resources and the most cost-effective approach to achieving the project outcomes.

Accurate cost estimating is also critical in the development of a realistic project timeline and schedule, which can help to ensure that the project is completed on time and within budget. It also supports effective risk management, as it allows stakeholders to identify and quantify potential risks and allocate appropriate resources to mitigate them.

Proper cost estimating provides a foundation for effective budgeting, resource allocation, and project planning, which helps to ensure that assets are managed in a sustainable and cost-effective manner, and that the project outcomes meet the desired quality and performance standards.

4. Document Governance

For document governance purposes, the following tables capture important information related to this document.

Table 4.1: Document Control

Category	Value
Owned by:	Distribution Operations, Construction Services
Review interval:	Annual



Table 4.2: Revision History

Release Date	Version	Project Number	RFC Number	Prepared By	Approved By
2023-02-13	1.0.0	N/A	N/A	Danielle Kenny, Advisor Drafting & Permitting	Mike Miller, Manager, Construction
Document ID		Scope	Document & Section		Summary of Changes
ST-2C-F45A-F6D9		GDS	Estimating and Contingency Standard		Initial version.



System Improvement Class Estimating Guidelines

Class Estimating Guidelines

CLASS LEVEL		CLASS 5	CLASS 4	CLASS 3	CLASS 2	CLASS 1 (FORECAST)
PRIMARY PLGC Stage		Screening (Stage 1)	Initiation (Stage 2)	Design & Procurement (Stage 3)	Design & Procurement (Stage 3)	Construct, Start-Up and Close-Out (Stages 4 to 6)
PROJECT MATURITY		0 - 2%	1 - 15%	10 – 40%	30 – 75%	65 – 100%
DESCRIPTION		High-level estimate used for quick turnaround requests or to determine if a project is viable.	Project team estimate – used as gut-check when receiving preliminary third-party estimates. May also be used when project-specific information (rather than historical) is required before determining project feasibility.	Preliminary estimate used for Budget authorization (AFE). May be used as control budget for less complex projects	Control Budget or contractor control bid/tender - Final estimate prior to construction start.	Cost Tracking – detailed estimate used to manage and control a project's cost, track actual costs, and provide the Estimate at Completion (EAC, forecast)
SECONDARY Component Status	SCOPE	<ul style="list-style-type: none"> • High-Level Scope • Pressure Class Known • Network Connection Points • Primary Components (Pipeline, Station, etc.) • May involve multiple scenario costing (in-service years, pipeline routes, etc.) 	<ul style="list-style-type: none"> • Single scenario preferable • Rough sketch / Bill of Materials • WBS 	<ul style="list-style-type: none"> • Single Scenario • Preliminary Drawings (30/60%) • Route Design • Long Lead time materials known • Station Requirements • Design Basis Memorandum (DBM) 	<ul style="list-style-type: none"> • Final Scope • Final Design (HDD, BOM, tie-ins, etc.) 	<ul style="list-style-type: none"> • Scope Change Management
	PROJECT ACTIVITY	<ul style="list-style-type: none"> • No Drawings provided • GIS Maps • Aerial Maps • Permit Conditions Unknown • High-Level Regulatory Requirements identified (LTC, NEB) 	<ul style="list-style-type: none"> • Third Party Drawings • Topographical Surveys (if already available) • High-Level Permit conditions known • High-Level permitting agencies identified • Regulatory requirements known • Contractor Courtesy quotes (complex or unfamiliar projects) 	<ul style="list-style-type: none"> • Preliminary Drawings • Preliminary Profile • SUE Level B • Preliminary HDD Profile • Geotechnical Report • Environmental Report • Permits and General Conditions for Special Permits known (MTO, TRCA, CN) • LTC / NEB Application • Contractor Courtesy Quotes (all work) 	<ul style="list-style-type: none"> • Approved / Stamped Drawings • SUE Level A/B • Permitting Notes and Conditions Known • Permits Granted • LTC/NEB Approval Granted • Contractor Procurement (contract) Completed 	<ul style="list-style-type: none"> • Partial / Final As-Lays • Contractor Cost Reports • Weekly / Monthly project reporting • Scope Changes

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System Improvement Class Estimating Guidelines



System Improvement Class Estimating Guidelines

	SCHEDULE	<ul style="list-style-type: none">• High-Level Schedule (Fiscal Year)• In-Service Target Year	<ul style="list-style-type: none">• Class 4 Schedule• In-Service Target Year• Network Restrictions known	<ul style="list-style-type: none">• Class 3 Schedule• Stakeholder Timelines• Third Party Restrictions known (conservation timing windows, gas delivery dates, municipal requirements)	<ul style="list-style-type: none">• Class 2 Schedule• Third Party / Permit restrictions known• Primary Tasks Identified	<ul style="list-style-type: none">• Schedule Tracking
COST ESTIMATE METHOD USED		<ul style="list-style-type: none">• Top-Down Estimate:• Historical project costs• Per Meter Costs• Rule of Thumb (ROT)• Magnitude Table• Class 5 Cost Estimating Tool	<ul style="list-style-type: none">• Bottom-Up Estimate:• Cost estimating tool• Unit Rates• Stakeholder input• Contractor Courtesy quotes (complex or unfamiliar projects)	<ul style="list-style-type: none">• Bottom-Up Estimate:• Cost estimating tool• Unit Rates• Stakeholder input• Preliminary Construction/Field estimate• Contractor Courtesy Quotes (all work)• Material and Vendor Quotes	<ul style="list-style-type: none">• Bottom-Up Estimate:• Cost Estimating Tool with final contractor proposal• Final Field Estimates• Material and Service PO's• Final Third Party Estimates	<ul style="list-style-type: none">• See Forecasting Methods
ROUNDING		<ul style="list-style-type: none">• Simple rounding applied, based on total project cost.• \$0 - \$10 MM, round to \$100 k• \$10 - \$50 MM, round to \$500 k• \$50 MM +, round to \$1 MM	<ul style="list-style-type: none">• Provide key groups subtotals; rounding based on total project cost• \$0 - \$10 MM, round to \$10k• \$10 - \$50 MM, round to \$50k• \$50 MM +, round to \$100k	<ul style="list-style-type: none">• Rounded to nearest \$1,000	<ul style="list-style-type: none">• None	<ul style="list-style-type: none">• None
PREPARATION TIME		1 day - 1 week	2 – 4 weeks	8 - 10 weeks	8 - 10 weeks	Recurring until completion
SUGGESTED CONTINGENCY		20 – 50%	15 – 40%	10 – 30%	5 – 20%	5 – 10%
SUGGESTED RANGEABILITY		-50% to +100%	-30% to +50%	-20% to +30%	-15% to +20%	-10% to +15%

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System Improvement Class Estimating Guidelines



System Improvement Class Estimating Guidelines

Control and Maintenance

For document control and maintenance purposes, the following table captures important information related to this document.

Owned by	Operational Services and Governance
Review	Annually
Distribution	Enbridge Gas Distribution employees and contractors
Regulations	N/A
Related Documents	<ul style="list-style-type: none"> TBD

History of Changes

Changes made to this document are tracked in the following table.

VERSION	DATE	SUMMARY	PREPARED BY	APPROVED BY
1.0	2021-03-15	Initial Release	Francis Joncas, Team Lead Project Governance & Controls, System Improvement	Byron Madrid

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System Improvement Class Estimating Guidelines



Procedure

Contingency Estimating Process

Document No.: PRJ-PD-PROC-006
Effective Date: 2020-12-02
Version No.: 2.0
Version Date: 2022-12-21

Approvals	Name	Position	Department	Digital Signature
Originator	Alfonso Arciniega	Technical Manager	Cost Engineering	Alfonso Arciniega <small>Digitally signed by Alfonso Arciniega Date: 2022.12.22 07:28:11 -07'00'</small>
Reviewer	Nicholas Menon	Sr. Engineer	Cost Engineering	Nicholas Menon <small>Digitally signed by Nicholas Menon Date: 2022.12.23 15:53:32 -07'00'</small>
Approver	Nathan Len	Manager	Cost Engineering	Nathan Len <small>Digitally signed by Nathan Len Date: 2023.01.10 14:24:40 -07'00'</small>

CONTINGENCY ESTIMATING
PROCESS

Document No. PRJ-PD-PROC-006
Version Number 2.0
Version Date 2022-12-21



DOCUMENT VERSION REGISTER

Version Number	Version Date <yyyy-mm-dd>	Approved By	Summary of Changes
1.0	2020-12-02	Nathan Len	Initial document
2.0	2022-12-21	Nathan Len	Updates to process requirements, inclusion of Cost and Schedule Summary Form, and minor grammar/term edits

CONTINGENCY ESTIMATING
PROCESS

Document No. PRJ-PD-PROC-006
Version Number 2.0
Version Date 2022-12-21



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CONTINGENCY ESTIMATING
PROCESS

Document No. PRJ-PD-PROC-006
 Version Number 2.0
 Version Date 2022-12-21



1. Purpose

The purpose of this document is to describe the Contingency Estimating Process (the CyE Process) within the Projects organization of the Company. The main objective of the CyE Process is to estimate the contingency, referred to as a monetary amount added to the Base Estimate of a project to account for the probability of occurrence of unforeseeable events that may result in additional costs. Similarly, contingency may also be referred to as additional time to be added to the Base Schedule that might not be feasible nor convenient to be mitigated with additional funding.

2. Scope

The Cost Engineering department within Project Development & Assurance is responsible for leading the CyE Process for all applicable projects in the Projects Organization. The applicability and recommendation to follow the CyE Process are described in the Project Development and Sanctioning Process. As a general guidance, projects with a Base Estimate over \$25 million should follow the CyE Process. Projects with a Base Estimate under \$25 million may use other simplified contingency estimating tools when a Class 4 development is not required for the project to be sanctioned.

3. Terms and Definitions

Term / Acronym	Definition
AACE®	<u>AACE International</u> , the Association for the Advancement of Cost Engineering, is the leading institution in North America in cost engineering matters.
CyE	Contingency Estimating.
CyE Tool	Company-developed proprietary tool for estimating contingency, PRJ-PD-TOOL-003.
CyE Model	CyE Tool populated with data corresponding to a specific project.
CyE Session	Facilitated session during which project stakeholders match questions with corresponding alphanumeric answers to describe systemic risks and input the data into the CyE Model.

4. Roles and Responsibilities

Roles / Titles	Responsibilities
Project Manager or Director	Responsible for planning and coordinating the CyE Session. In coordination with the Cost Engineering Lead, they plan and set the time, date, and venue of the CyE Session; invite all required stakeholders; and ensure that key internal stakeholders from the Project Execution Team attend the CyE Session. They also ensure that the Cost Engineering Lead receives the documentation required for the CyE Session (see section Inputs) at least three business days in advance of the CyE Session. They acknowledge and endorse the current status of the project and its deliverables.
Business Development or Commercial Lead	Responsible for the Business Scope. Involved in CyE Processes for projects in development. Not required to participate in CyE Sessions for projects in execution unless requested. This role may not exist or may not have been appointed.
Project Development Lead	Responsible for the Project Scope. They assume the responsibilities of the Risk Assessment Lead , and the role of the Project Manager , when either one of these roles have not been appointed. Not required to participate in CyE Sessions for projects in execution unless requested.
Risk Assessment Lead	Responsible for related tasks as per the <i>Risk Management for Projects Standard</i> . In coordination with the Project Development Lead and the Project Execution Team, they prepare the Risk Register for the project and are responsible for its quality and accuracy of the data at the time of the CyE Session.

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Roles / Titles	Responsibilities
Cost Engineering Lead	Responsible for the CyE Process: Carrying out the process steps; reviewing the project documentation; preparing the CyE Model; facilitating the CyE Session; and issuing a CyE Report with the results.
Engineering Manager or Lead	Responsible for ensuring engineering-related documentation is available. They own and endorse the status and risks of the project regarding engineering.
Construction Manager or Lead	Responsible for ensuring construction-related documentation is available. They own and endorse the status and risks of the project regarding construction.
Project Controls Lead	Responsible for ensuring that project controls-related documentation is available. They are responsible for keeping and producing pertinent documentation, including supply chain matters and related risks. They are responsible for the Base Estimate and Base Schedule when the respective leads are not appointed; and when the Cost Engineering department and Non-Technical Risks Lead have not provided a Base Estimate and/or Base Schedule.
Cost Estimate Lead	Responsible for developing the Base Estimate and related documentation. They own and endorse cost-related documents.
Schedule Lead	Responsible for developing the Base Schedule and related documentation. They own and endorse schedule-related documents.
Non-Technical Risks Lead	Responsible for Law; Regulatory; Environmental; Public, Government, and Indigenous Engagement; and Legal matters-related documentation. They own and endorse the status and risks of the project regarding non-technical risk. They provide input to the Base Schedule in coordination with the Schedule Lead and should engage Law, Legal, and Regulatory stakeholders when related risks may impact the project.
Land Lead	Responsible for Lands and Right-of-Way (ROW) matters and related documentation. They own and endorse the status and risks of the project Land and ROW related matters.

5. Process Steps

5.1. Planning

- 5.1.1. The Project Development Lead or Project Manager requests the appointment of a Cost Engineering Lead by the Cost Engineering department, and a Risk Assessment Lead by the corresponding Project Controls department or the Project Management Office (PMO).
- 5.1.2. The Project Manager, in consultation with the Cost Engineering Lead and other stakeholders, arranges the day and time for the CyE Session. A 1-hour allotted time is required for an initial session. If the objective of the session is to update inputs to a previously held CyE Process within three months with minimum changes in scope, 30 minutes is adequate. If the CyE Session is held together with a PDRI Session, no additional time is required.
- 5.1.3. The Project Manager ensures the Cost Engineering Lead receives all documentation required for the CyE Session at least three business days in advance of the date of the session. If the documents are not received on time or the quality of the documents does not meet the requirements, the Cost Engineering Lead may request a postponement of the session until these conditions are met. See *Section 7. Inputs* for further details.

5.2. Pre-session Tasks

- 5.2.1. Project Documents Review: The Cost Engineering Lead reviews the documents received and confirms the information with the corresponding stakeholders.
- 5.2.2. Fixed Cost (Budget-at-Risk) Determination: The Cost Engineering Lead validates the amount of fixed or sunk costs that will not factor into estimating contingency and updates the *Cost and Schedule Summary Form* as required.

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- 5.2.3. The Project Manager and the Cost Engineering Lead discuss and agree upon the agenda, expectations, and details of the CyE Session at least one day prior to the session.
- 5.2.4. Contingency Modeling: The Cost Engineering Lead prepares the CyE Model by inputting the corresponding project data.

5.3. CyE Session

- 5.3.1. The Cost Engineering Lead is the facilitator of the session. The session starts with an introduction where the agenda, objectives, goals, and ground rules are communicated. The facilitator then validates the project information previously added to the CyE Model.
- 5.3.2. During the session, the attendees:
 - 5.3.2.1. Rate the completion questions associated with Scope, Planning, and Engineering. This is not done if a Project Definition Rating Index (PDR) value has been determined recently (no more than a month old) through the *Project Definition Rating Process*.
 - 5.3.2.2. Rate the confidence the stakeholders have on the accuracy and robustness of deliverables produced during development and the perceived complexity of the work ahead, with the assumption that there are no project-specific risks. The questions in this task act as modifiers to components feeding systemic contingency, as outlined here.
- 5.3.3. The Facilitator may request additional information and/or discuss the project-specific risks in the Risk Register that will be used in estimating the contingency. See *Section 8. Contingency Fundamentals* for more information on how systemic and project-specific risks are used in estimating contingency.

5.4. Contingency Estimating Reporting

- 5.4.1. The facilitator reviews and validates the inputs to the CyE Model. Running a Monte Carlo simulation, the CyE Model estimates a probability distribution of contingency amounts based on the probability of completing a project with the Base Estimate and Base Schedule, plus their respective contingency values. The CyE Model has been calibrated to recommend a P50 contingency, meaning a 50% confidence of underrun (i.e., 50% chance of completing the project below the Base Estimate and Base Schedule plus their estimated respective contingency values). The result of adding the P50 contingency to the Base Estimate is called the present-day estimate or Reference Estimate. In addition, the CyE Model estimates the accuracy (+/-) of the present-day estimate with an 80% confidence interval, which outlines the P10 and P90 percentile values. See *Section 8. Contingency Fundamentals* for more information on the probability distribution of contingency.
- 5.4.2. If there are no issues in the process, the facilitator prepares a CyE Report. After peer-review, a final CyE Report is issued to the Project Manager as a PDF, usually within two business days. The report includes the results described above, *Cost and Schedule Summary Form*, and risk register.

6. Timing and Frequency

Depending on their classification and type of development, projects may require different timing and frequency of contingency assessments. Generally, it is recommended that projects with a Base Estimate greater than \$25 million (in either CAD or USD) go through the CyE Process.

The recommended milestones to carry out this process for projects in development are as follows:

- Each time a Project Definition Rating Process is conducted (only during development);
- Once during a Class 5 development;

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- Twice in Stage 2 during a Class 4 or Class 3 development (mid-way through development, and prior to sanction);
- When changes in strategy, scope, and/or schedule result in significant changes in the Forecast at Completion (FAC) costs, Base Estimate, or escalation; and,
- When a re-assessment is requested by stakeholders due to changes in scope, schedule, teams, and/or management.

For projects in execution expected to last more than a year, it is recommended that the process is completed every six months, once prior to the start of construction, and once right after In-Service Date (ISD) if there are substantial outstanding remediation tasks.

7. Inputs

The documents listed below shall be provided by the respective stakeholders to the Cost Engineering Lead at least three business days in advance of the scheduled session:

- **Scope-related:** Business Scope and Project Scope. Documents containing scope information may include the Scoping Document, Document of Understanding – DOU (graphical representation of the project scope), Project Charter, and Design Basis Memorandum (DBM).
- **Cost Estimate-related:** Basis of Estimate, the Base Estimate, and *Cost and Schedule Summary Form* (with Cost Summary section populated). The Base Estimate, in spreadsheet format, shall be in the project's native currency and include all taxes, administrative, project general, overhead, and indirect costs. The Base Estimate shall **not** include contingency, escalation, allowance for funds used during construction (AFUDC), or management reserve.

A work breakdown structure (WBS) breakdown of the Base Estimate is preferable, if available.

- **Schedule-related:** Preliminary schedule or milestone, and Master Schedule Level 1 or better. The Schedule Summary in the *Cost and Schedule Summary Form* shall be populated if escalation using the *Escalation Estimating Model Process* is required. This is recommended for projects going into service more than 18 months from the date of the session.
- **Risk Register:** Developed by the Risk Assessment Lead in compliance with the Project Management Office's risk management framework (see *Risk Management for Projects Standard*). An EnCompass Contingency Cost Engineering Report should be issued if the risk register resides in EnCompass.

During early project development, a Risk Assessment Lead may not be appointed, and a formal risk register may not be available. In these cases, the Project Development Lead, in consultation with the Cost Engineering Lead, shall issue a list of project-specific risks, including their respective likelihoods, and resultant cost and/or schedule impacts based on optimistic, most likely, and worst-case scenarios.

8. Contingency Fundamentals

Enbridge follows the Association for the Advancement of Cost Engineering International (AACE®)'s recommended practices for classification of cost estimates and contingency management. According to AACE®, contingency is an amount (cost, time, or other planned resource) added to an estimate to allow for items, conditions, or events for which the state, occurrence, and/or effect is uncertain and that experience shows will likely result, in aggregate, in additional cost.

AACE® recommendations have been modified for their use in Company processes based on the cost engineering experience since 2008. Table 8.1 summarizes the AACE® and Enbridge-adjusted recommended project definition levels by estimate classification:

Table 8.1: Project Definition Levels by Estimate Classification

Estimate Classification	AACE® Recommended Project Definition	Enbridge Recommended Project Definition
Class 5	0 – 2%	1 – 8%
Class 4	1 – 15%	8 – 20%
Class 3	10 – 40%	18 – 32%

Enbridge estimate classification recommendations are used in project development stages, with Class 2 and Class 1 estimates oriented to project execution stages and therefore not covered by this process.

In typical infrastructure projects, contingency covers the following:

- Quantity variability (e.g., inaccuracy in estimating the cost of materials)
- Productivity variability (e.g., inaccuracy in estimating labor productivity)
- Compensation variability (e.g., wage increases not expected at the completion of the cost estimate)
- Pricing variability, excluding market escalation (e.g., vendors or contractors price changes)
- Inclusiveness, or accuracy in accounting for what needed to be included in the scope (e.g., material quantities, labor required, indirect costs, allowances)
- Complexity in engineering and construction (e.g., brownfield projects, new standards, environment issues, local requirements)
- Procurement issues (e.g., supply chain delays)
- Project-specific risks

Contingency **does not cover** the following:

- Contingency does not cover changes in Business Scope (e.g., changes in volume or delivery points are not covered by contingency)
- Contingency does not cover changes in Project Scope (e.g. Changes in length, size, equipment, etc. which together have an impact of over 5% of the base cost estimate are not covered by contingency)
- Opportunities (the CyE Process focuses only on threats; opportunities are the focus of the Value Engineering Process)
- Major unexpected work stoppages (i.e., force majeure situations that cause extensive delays)
- Operating risks or loss-of-revenue risks
- Market Price Escalation or inflation (This is the focus of the *Escalation Estimating Model Process*)
- Financial or Corporate risks (i.e., AFUDC, AIDC, AEDC, interest rates, political risks, required threshold, etc.)

Differences between systemic risks and project-specific risks:

- Systemic risks are uncertainties that are an artifact of an industry, company or project system, culture, strategy, complexity, technology, or similar over-arching characteristics

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- Project-specific risks are uncertainties related to events, actions, and other conditions that are specific to the scope of a project. (e.g., weather, soil conditions, etc.). The impacts of project-specific risks are unique to a project

Table 8.2 may be used in the identification of systemic or project-specific risks.

Table 8.2: Comparison of Systemic and Project-specific Risks

Systemic Risks	Project-specific Risks
All projects, regardless of scope, may have it.	Unique to a project at a particular time.
May be mitigated or even cancelled during development by reducing uncertainty (acquiring more knowledge).	Difficult to mitigate during development because depend on external circumstances that could happen during execution.
The words unclear, insufficient, lack of, unmatched, unknown, and unquantifiable may be associated with it.	The words large impact, regulatory, environment, weather, failures, underperformance, opposition, supply chain, external stakeholder (owner, contractor, public), markets, and quantifiable may be associated with it.

AACE® recommends the use of the parametric risk analysis for systemic risks, where the input parameters are risk drivers, and the output parameters are a quantification of risk. Parametric models are based on systemic modeling, producing relatively simple and quick assessments with probabilistic results with the help of simple risk registers. A parametric model is usually derived from regression analysis of historical data: Rating the level of scope definition achieved on past projects and study the rating's correlation with cost growth or schedule slip that occurred. Given the hundreds of projects Enbridge has developed and completed, the data has allowed to build and calibrate robust parametric models for estimating the systemic contingency of infrastructure projects.

AACE® recommends the use of the expected value (for cost) and the critical path modeling (CPM) practices (for schedule) for integrated cost and schedule risk analysis of project-specific risks. Expected value models involves evaluating the product of the probability of occurrence of risks and their probability of impact (risk-weighted measure), using a Monte Carlo simulation.

Enbridge's proprietary CyE Tool uses a combination of a parametric modeling approach for estimating the contingency of systemic risks and an expected value plus critical path modeling for estimating the overall contingency. The output of the parametric model becomes an input to the expected value plus CPM model. Figure 8.1 shows the flow of data and the modeling for estimating contingency.

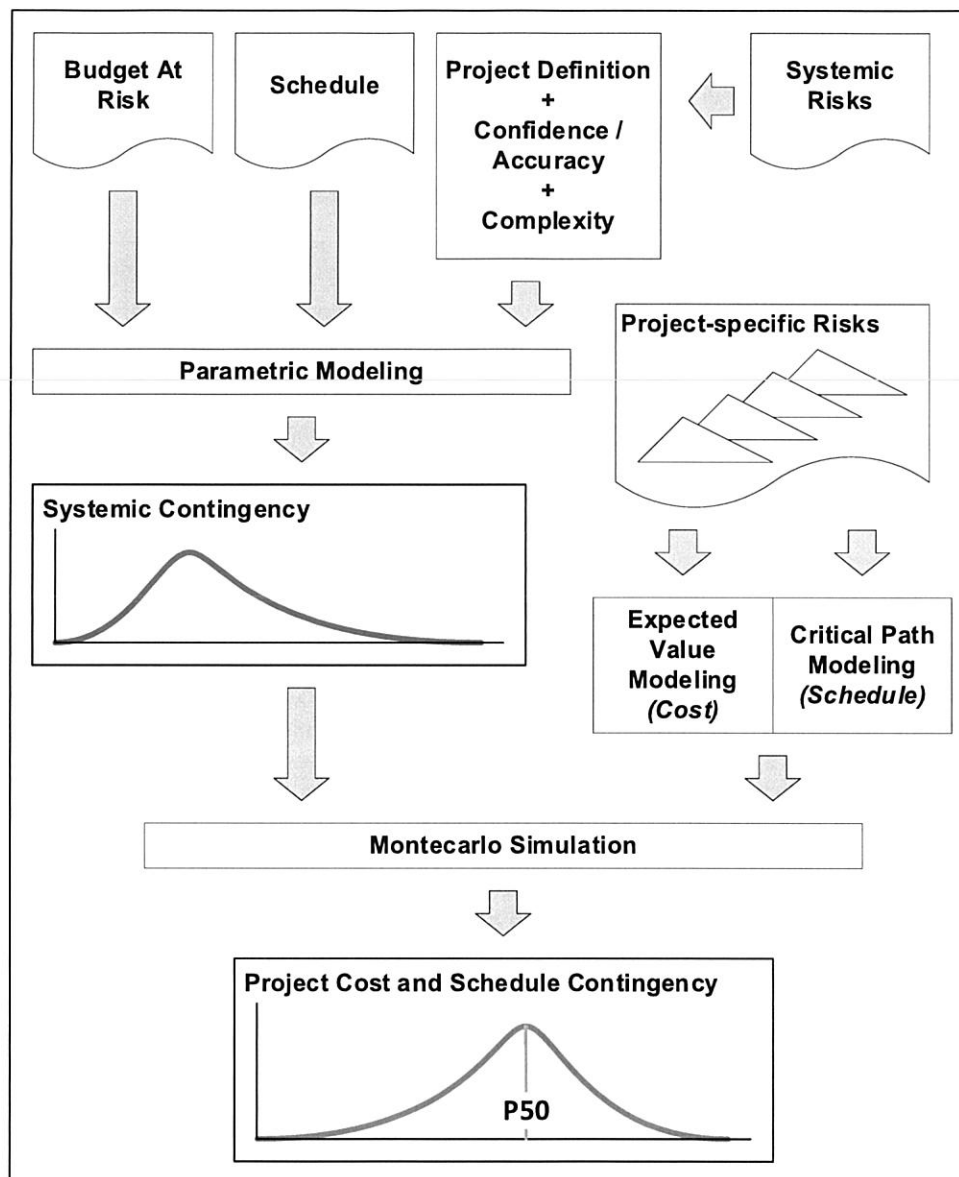


Figure 8.1: Contingency Estimating Modeling

Figure 8.2 shows the output of the contingency estimating as a probability distribution of the base cost plus the value of the estimated contingency. The recommended contingency is the value corresponding to a 50% chance that the overall cost of the project is below than the sum of the Base Estimate plus the estimated contingency. This is called the P50 contingency, and the cost is called the present-day estimate or Reference Estimate. The accuracy of the estimate is then referred as two standard deviations from the P50, corresponding to a P10 and P90, representing an 80% confidence interval for the project cost.

The same criteria apply to schedule; however, the result or recommendation is based on cases where schedule risks cannot be mitigated due to the schedule not having lags or allowances in the critical path and the in-service date is fixed.

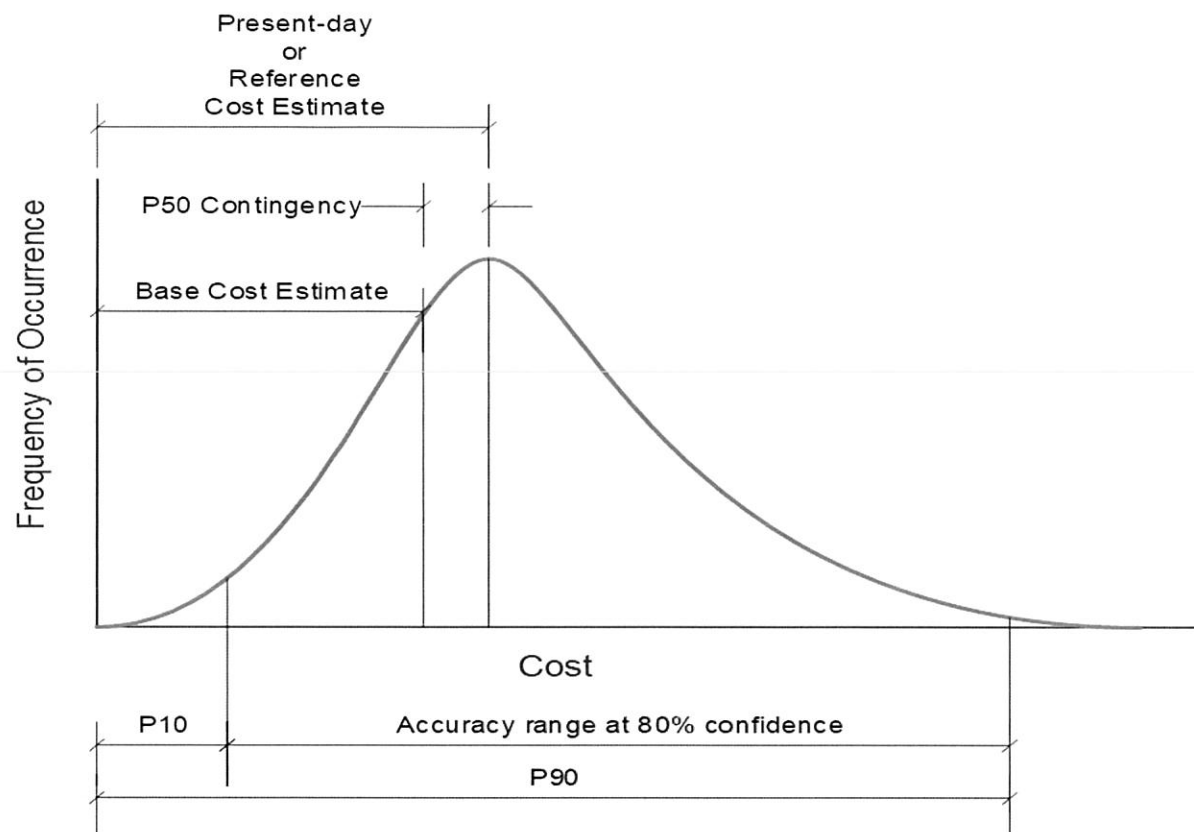


Figure 8.2: Contingency Probability Distribution

9. Process Benefits

The contingency estimating process ensures alignment between business scope, project scope, cost, schedule, and risks; estimating an amount to be added to the Base Estimate. The process also estimates potential additional time to the schedule, assuming the schedule risks are unmitigated. If schedule risks are mitigated with additional funds, then the schedule contingency may be reduced or even eliminated.

Having the appropriate contingency is key to the economic viability of a project, enabling the Company to maintain market competitiveness. The cost of capital (i.e., interest payable on borrowed money) set aside for a project may also be applicable to the contingency amount; and a higher cost of capital could lead to a higher cost of service (e.g., higher tolls and tariffs). In the same context, re-estimating the contingency of projects in execution may reduce the amount of contingency that has not been drawn down due to risks not realized.

10. Related Documents

Document Number	Document Title	Content
PRJ-PD-PROC-006F1	Cost and Schedule Summary Form	Form to input a summary of cost and schedule data into the Contingency Model for a particular project.

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11. References

Document Number	Document Title	Content
PRJ-PD-TOOL-003	Contingency Estimating Tool	Enbridge proprietary tool for estimating contingency of capital projects. When the Tool is filled with project data, it becomes the Contingency Model for that project.
<u>PRJ-PD-PROC-003</u>	Project Definition Rating Process	Covers the process to estimate the level of development of a project (or robustness of project development). This process serves a cold-eye review of a project in development. The PDRI rating output is an input to the CyE Process.
<u>PRJ-PD-PROC-001</u>	Project Development and Sanctioning Process	Covers the requirements to develop projects and their sanction.
<u>PRJ-PMO-STD-001</u>	Risk Management for Projects Standard	Covers the fundamentals of risk management practice for Projects. Contingency Assessment is a component of the Risk Management Framework.
AACE® RP 42R-08	Risk Analysis and Contingency Determination Using Parametric Estimating	Association for the Advancement of Cost Engineering International® - Rev. May 27, 2021 by Hollmann J. K.
AACE® RP 44R-08	Risk Analysis and Contingency Determination Using Expected Value	Association for the Advancement of Cost Engineering International® - Rev. May 27, 2021 by Hollmann J. K.
AACE® RP 65R-11	Integrated Cost and Schedule Risk Analysis and Contingency Determination Using Expected Value	Association for the Advancement of Cost Engineering International® - Rev. May 27, 2021 by Hollmann J. K.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.56-57

Question(s):

With respect to capital plan performance monitoring:

- a) Enbridge states: "During project planning and execution, periodic forecasts track project and program costs, and reports are generated on actual incurred costs." Please detail how Enbridge monitors and reports on the execution of its capital plan and provide a copy of the most recent report(s) that the company uses to monitor plan execution.
- b) Enbridge discusses its AIPM Performance Review. Please explain how the information is used within the company.
- c) Please provide the most recent reports for each of 'Scope Delivery to Plan', "Capital Budget Delivery to Plan", "Asset Class Objectives" and 'Assess Management Health Check'.

Response:

Attachment 1 and Attachment 4 have been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023. /u

- a) Enbridge Gas monitors and tracks the Annual Portfolio Plan on the project/program, asset class, and overall Company levels. Asset Class Managers are notified of project/program updates as they occur through Copperleaf and review and approve any updates to the portfolio plan. On a monthly basis, actual costs incurred become available and are reported and reviewed across all asset classes to compare actual costs to planned costs and the forecast is updated accordingly. Please see Attachment 1 for the most recent tracking report.

- b) The AIPM performance review is used in annual reviews undertaken with project teams responsible for capital execution to review variances to the approved plan, both in terms of capital spent and investments completed. Discussions during this review are used to identify improvement opportunities that inform changes in processes, reporting and communication.
- c) Please see Attachment 2 for a financial lookback file for the 2021 fiscal year which was shared with Enbridge Gas's Regional Project teams in early 2022. This is an example of a review of both Scope Delivery to Plan and Budget Delivery to Plan.

Please see Attachment 3 for the tracker used in the Value Assessment Quality Assurance Approach outlined in Exhibit 2, Tab 6, Schedule 2, page 15. The tracker is used to ensure investments included in the AMP are aligned to specific Asset Class Strategies, and where required, the appropriate Value Assessment Methodology.

Please see Attachment 4 for Enbridge Gas's most recent Asset Management Health Check.

/ u

GDS 2023 Core				Final Workplan				June											
Rate Zone	Core Capital Breakdown	Maintenance /Growth	2023 Final Approved Workplan - March	Approved Workplan Variance to Target - March	Approved Workplan Variance to Target - March	Comments - March	Submitted Scenario - June	Approved Scenario - June	Approved Variance to Submitted - June	AFE (minus Disincentivization) - June	YTD Actuals - May	Target Adjustments - June	AM Gov Approved	Approved Target - June	Approved Workplan Variance to Target - June	Approved Workplan Variance to Target - June	Comments - June		
EO	Customer Connections		107,883,607	958,933	1%		108,943,935	138,500,654	(13,147,411)	(1,247,915)	85,103,114	-	-	109,246,137	13,444,243	10%			
EO	CC - Commercial/Bulk-Metered - Conversion	Growth	2,934,558	(176,445)	-6%		3,966,588	3,966,588	-	1,001,917	1,455,957	-	-	3,966,588	0	0%			
EO	CC - Commercial/Bulk-Metered - New	Growth	17,911,971	246,040	0%		20,394,575	21,246,064	(7,147,911)	10,050,463	7,884,192	-	-	20,394,575	7,147,911	34%			
EO	CC - Industrial - Conversion	Growth	-	-	-		-	-	565	-	565	-	-	-	-	0%			
EO	CC - Industrial - New	Growth	3,422,983	711,846	20%		3,026,713	2,980,085	(37,628)	303,036	678,451	-	-	3,026,713	37,628	1%			
EO	CC - Multi-Family/Conversion	Growth	-	-	-		-	-	541,072	1,313,825	(83,807)	-	-	-	-	0%			
EO	CC - Multi-Family/Apartment - New	Growth	3,562,680	586,550	16%		4,067,632	4,177,159	(430,473)	1,922,683	1,506,567	-	-	4,067,632	430,473	10%			
EO	CC - Residential - Conversion	Growth	29,658,169	478,380	2%		25,368,659	28,061,753	2,693,094	233,472	7,098,304	-	-	25,368,659	(2,693,094)	-10%			
EO	CC - Residential - New	Growth	59,415,901	245,540	0%		61,125,001	73,133,299	(8,571,822)	28,421,425	35,831,299	-	-	61,125,001	6,571,822	12%			
EO	CC - Sales Station - Conversion	Growth	2,976,793	(14,608)	-0%		2,996,793	2,076,792	(220,001)	-	2,098,793	-	-	2,996,793	220,001	11%			
EO	CC - Sales Station - New	Growth	1,037,495	(623,738)	-38%		2,296,862	2,296,862	-	-	2,296,862	-	-	2,296,862	0	0%			
EO	CC Orphaned Actuals	Growth	-	-	-		-	-	-	-	319,173	-	-	-	-	0%			
EO	Customer Connections TCS		750,004	750,004	0%		950,004	450,000	(500,004)	723,390	291,029	-	-	950,004	500,004	111%			
EO	CC TCS - Commercial/Bulk-Metered - Conve	Growth	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	CC TCS - Commercial/Bulk-Metered - New	Growth	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	CC TCS - Industrial - Conversion	Growth	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	CC TCS - Industrial - New	Growth	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	CC TCS - Multi-Family/Apartment - Conversion	Growth	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	CC TCS - Multi-Family/Apartment - New	Growth	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	CC TCS - Residential - Conversion	Growth	750,004	750,004	0%		950,004	450,000	(500,004)	663,390	278,142	-	-	950,004	500,004	111%			
EO	CC TCS - Residential - New	Growth	-	-	0%		-	-	-	90,000	11,887	-	-	-	-	0%			
EO	CC TCS - Sales Station - Conversion	Growth	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	CC TCS - Sales Station - New	Growth	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	CC TCS Orphaned Actuals	Growth	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	Distribution Pipe		76,176,041	1,127,396	2%		75,844,596	75,570,299	(284,297)	16,195,111	32,894,899	-	-	74,713,312	(856,987)	-1%			
EO	DP - Corrosion	Maintenance	3,145,015	947,153	43%	Offset from L	2,390,460	2,390,460	-	809,794	877,891	-	-	2,390,460	123,900	5%			
EO	DP - Damage Prevention	Maintenance	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	DP - Integrity	Growth	8,457,072	(90)	-0%		8,567,162	1,338,920	1,089,305	-	8,563,072	-	-	8,563,072	15,910	0%			
EO	DP - Main Replacement	Growth	9,284,655	628,135	7%		11,561,702	11,480,933	(121,009)	4,486,664	4,580,736	-	-	9,463,896	(1,996,797)	-17%			
EO	DP - MCP	Growth	-	-	-		-	-	-	-	-	-	-	-	-	0%			
EO	DP - Relocations	Growth	1,876,598	-	-	-19% Additional \$1	193,572	(259,718)	(413,288)	(567,423)	2,721,495	-	-	740,284	1,000,000	-385%			
EO	DP - Service Relays	Growth	27,195,301	-	-		29,945,300	27,195,300	-	290,000	9,335,599	-	-	27,195,300	(0)	0%			
EO	NPS 20 Lake Shore Replacement (Cherry to	Growth	26,216,400	-	0%		16,099,244	16,099,244	-	-	13,402,197	-	-	16,099,244	-	0%			
EO	NPS20 KOL - Parliament St.	Growth	-	-	0%		10,117,156	10,117,156	-	-	11,868	-	-	10,117,156	-	0%			
EO	DP Orphaned Actuals	Growth	-	-	0%		-	-	-	-	656,908	-	-	-	-	0%			
EO	Distribution Stations		31,112,791	(927,362)	-3%		30,925,718	28,317,457	(608,261)	26,396,562	4,396,012	-	-	29,266,691	948,634	3%			
EO	DS - CNG	Growth	1,912,656	(70,000)	-4%	Program offs	1,397,710	1,397,710	-	461,289	133,906	-	-	1,397,710	-	0%			
EO	DS - Gate, Feeder & A Stations	Growth	21,000,795	1,086,959	5%		21,252,624	20,574,234	(683,390)	23,167,257	2,775,272	-	-	20,863,467	300,233	2%			
EO	DS - Inside Regulator & ERR Program	Growth	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	DS - Integrity Initiatives	Growth	5,000	(1,160,000)	-100%		(29,663)	33,100	62,763	5,000	(31,459)	-	-	33,100	-	0%			
EO	DS - Station Rebuilds & B and C Stations	Growth	6,192,220	(784,321)	-13%		6,300,047	6,312,413	12,366	2,743,016	1,478,675	-	-	6,561,814	639,401	10%			
EO	DS Orphaned Actuals	Growth	-	-	0%		-	-	-	-	36,616	-	-	-	-	0%			
EO	Growth		12,624,833	(3,578,430)	-22%		14,214,143	12,781,442	(1,432,701)	7,084,833	1,537,724	-	-	12,676,633	(104,809)	-1%			
EO	GTH - Hydrogen Blending	Growth	3,157,000	143,000	5%		3,157,000	3,300,000	(1,434,960)	3,300,000	376,722	-	-	3,157,000	(143,000)	-4%			
EO	GTH - System Reinforcement	Growth	9,444,333	(3,435,430)	-27%	Variance from	9,456,433	9,461,442	4,989	3,784,833	978,072	-	-	9,499,533	38,091	0%			
EO	Grimby-Lincoln Expansion Project - Natural	Growth	20,000	-	0%		20,000	20,000	-	-	-	-	-	20,000	-	0%			
EO	GTH Orphaned Actuals	Growth	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	Utilization		63,461,765	(2,000,030)	-3%		65,638,265	65,638,265	-	-	14,663,355	-	-	63,461,765	(2,176,500)	-3%			
EO	UTL - Integrity Survey	Growth	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	UTL - Meters (growth)	Growth	7,648,330	0	0%		7,648,330	7,648,330	-	-	2,300,231	-	-	7,648,330	(20)	0%			
EO	UTL - Meters (info)	Maintenance	28,895,537	(2,000,000)	-6%		30,895,547	30,895,547	-	3,731,969	28,895,537	-	-	28,895,537	(2,000,010)	-6%			
EO	UTL - Meters (info)	Growth	4,150,418	(0)	0%		4,150,428	4,150,428	-	19,472	4,150,418	-	-	4,150,418	(10)	0%			
EO	UTL - Monitoring Systems	Maintenance	2,600,000	-	0%		2,600,000	2,600,000	-	-	37,165	-	-	2,600,000	-	0%			
EO	UTL - Regulator Refit	Maintenance	19,389,110	(30)	0%		19,768,980	19,768,980	-	8,370,323	-	-	19,389,110	(379,870)	-2%				
EO	UTL - Remediation	Maintenance	878,410	(0)	0%		675,000	675,000	-	5,195	-	-	878,410	203,410	23%				
EO	UTL Orphaned Actuals	Maintenance	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	Compressor Stations		114,594,842	288,345	3%		106,832,714	106,432,714	(500,000)	154,606,021	27,771,082	-	-	107,103,688	670,744	9%			
EO	CS - Growth	Growth	969,829	337,545	35%		337,264	337,264	-	-	337,264	-	-	337,264	-	0%			
EO	CS - Improvements	Maintenance	1,896,193	(296,200)	-16%		1,066,171	1,066,171	-	1,440,249	538,696	-	-	1,459,080	92,889	6%			
EO	CS - Integrity	Growth	50,000	-	0%		-	-	-	-	-	-	-	50,000	50,000	0%			
EO	CS - Land/Structures - Improvements	Maintenance	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	CS - Land/Structures - Growth	Growth	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	CS - Overhauls	Maintenance	1,199,000	-	0%		1,634,000	1,634,000	-	928,000	340,367	-	-	1,634,000	-	0%			
EO	CS - Replacements	Maintenance	5,615,847	55,000	1%		5,165,487	4,665,487	(500,000)	3,608,000	2,629,365	-	-	5,193,342	527,855	11%			
EO	Dawn to Corona	Growth	105,368,080	-	0%		148,729,772	148,729,772	-	148,729,772	24,146,422	-	-	148,729,772	-	0%			
EO	CS Orphaned Actuals	Growth	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	Transmission Lines & Underground Storage		7,165,404	(5,104,850)	-2%		6,987,515	5,984,544	(1,662,971)	6,700,609	2,066,103	-	-	5,989,354	(594,810)	-11%			
EO	TPS - Growth	Growth	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	TPS - Improvements	Maintenance	185,250	(904,000)	-43%		164,000	70,000	(94,000)	37,368	-	-	164,000	94,000	134%				
EO	TPS - Integrity	Growth	4,667,223	1,544,195	33%	46% Still under in-	4,769,747	3,161,637	(1,628,719)	670,000	1,420,793	-	-	3,402,423	241,395	6%			
EO	TPS - Land/Structures - Growth	Growth	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	TPS - Land/Structures - Improvements	Maintenance	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	TPS - Replacements	Maintenance	2,302,931	(5,744,245)	-71%	Timing issue	2,013,768	2,053,516	39,748	6,030,000	598,432	-	-	2,302,931	249,415	12%			
EO	TPS Orphaned Actuals	Maintenance	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	Fleet & Equipment		3,594,000	(1,760,635)	-33%		3,749,913	3,749,913	-	286,460	224,992	-	-	3,332,000	(198,513)	-5%			
EO	FLEET - Equipment & Materials	Maintenance	1,250,000	(700,000)	-38%	Expecting m	1,250,000	1,250,000	-	-	26,776	-	-	1,250,000	-	0%			
EO	FLEET - Tools	Maintenance	850,000	(1,080,555)	-68%	Expecting m	1,048,513	1,048,513	-	286,450	233,571	-	-	850,000	(198,513)	-19%			
EO	FLEET - Vehicles	Maintenance	1,450,000	-	0%		1,450,000	1,450,000	-	-	34,445	-	-	1,450,000	-	0%			
EO	FLEET Orphaned Actuals	Maintenance	-	-	0%		-	-	-	-	-	-	-	-	-	0%			
EO	Real Estate & Workplace Services		33,760,800	-	-22%		45,985,800	43,235,800	(2,750,000)	18,764,800	26,495,281	-	-	43,260,800	25,000	0%			
EO	REWS - Furniture/Structures & Improvements	Maintenance	33,760,800	(9,875,000)	-22%		45,985,800	43,235,800	(2,750,000)	18,764,800	26,495,281	-	-	43					

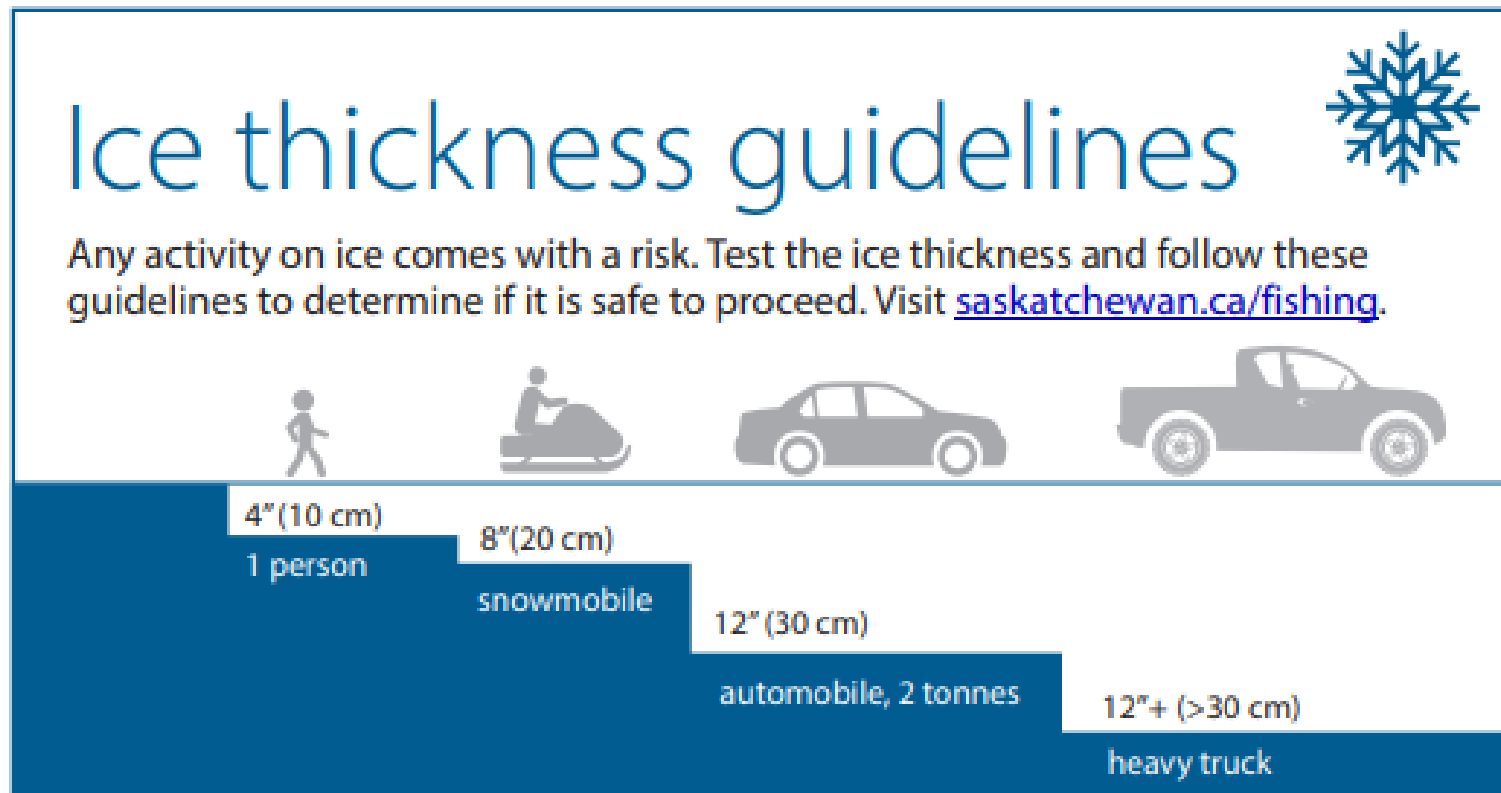
Customer Connections TCS	1,875,000	1,500,000	400%	1,455,014	375,010	(1,030,004)	-	99,848	-	1,405,014	1,030,004	275%
CC TCS - Commercial/Bulk-Metered - Come	Growth	-	-	-	-	-	-	52,438	-	-	-	0%
CC TCS - Commercial/Bulk-Metered - New	Growth	-	-	-	-	-	-	20,083	-	-	-	0%
CC TCS - Industrial - Conversion	Growth	-	-	-	-	-	-	-	-	-	-	0%
CC TCS - Industrial - New	Growth	-	-	-	-	-	-	-	-	-	-	0%
CC TCS - Multi-Family/Apartment - Conversion	Growth	-	-	-	-	-	-	(138,069)	-	-	-	0%
CC TCS - Multi-Family/Apartment - New	Growth	-	-	-	-	-	-	105	-	-	-	0%
CC TCS - Residential - Conversion	Growth	-	-	-	-	-	-	81,870	-	-	-	0%
CC TCS - Residential - New	Growth	1,875,000	1,500,000	400%	1,405,014	375,010	(1,030,004)	103,005	-	1,405,014	1,030,004	275%
CC TCS - Sales Station - Conversion	Growth	-	-	-	-	-	-	-	-	-	-	0%
CC TCS - Sales Station - New	Growth	-	-	-	-	-	-	-	-	-	-	0%
CC Ophanded Actuals - TCS	Growth	-	-	-	-	-	-	-	-	-	-	0%
Distribution Pipe	103,726,444	(9,077,983)	-4%	112,244,009	111,192,216	(1,071,793)	-	33,341,126	-	111,600,637	40,311	-
DP - Class Location	Growth	2,133,004	-	3,409,809	3,402,910	(7,113)	-	2,294,374	-	3,023,914	1,263,014	-
DP - Corrosion	Maintenance	564,485	(845,831)	-50%	1,848,843	1,432,600	(216,243)	288,841	-	1,424,139	(8,481)	-1%
DP - Damage Prevention	Maintenance	55,036,620	(5,587,589)	-5%	58,997,902	58,516,454	(441,448)	11,992,567	-	58,517,568	1,132	0%
DP - Integrity	Growth	11,749,270	(134,294)	-1%	1,000,802	1,032,363	(558,439)	5,770,659	-	11,749,270	(1,753,093)	-13%
DP - Main Replacement	Growth	-	-	-	-	-	-	-	-	-	-	0%
DP - MOP	Growth	26,456,875	(2,510,000)	-5%	26,956,575	26,656,575	-	12,147,415	-	29,026,575	2,370,000	9%
DP - Relocations	Growth	7,132,139	0	0%	7,443,878	7,443,878	-	2,670,200	-	7,243,878	(200,000)	-3%
DP - Service Relay	Growth	-	-	-	-	-	-	-	-	-	-	0%
DP Ophanded Actuals	Growth	21,172,620	(4,155,578)	-16%	21,992,274	21,961,374	(699,100)	216,780	-	20,879,620	(1,081,892)	-5%
Distribution Stations	1,321,000	-	-	3,471,161	33,224,299	(1,246,862)	-	8,830,508	-	35,688,874	2,344,575	0%
DS - CHG	Growth	7,395,351	914,179	15%	570,230	570,230	-	(234,894)	-	571,301	1,071	0%
DS - Gate, Feeder & A Stations	Growth	1,500,000	956,400	60%	7,601,679	7,640,550	(50,029)	2,095,809	-	8,048,873	407,723	5%
DS - Inside Regulator & ERR Program	Growth	-	-	-	1,500,000	1,500,000	-	102,578	-	1,500,000	-	0%
DS - Integrity Initiatives	Growth	-	(5,053,134)	-100%	206,348	206,348	-	22,927	-	21,314	(184,034)	-90%
DS - Station Relabels & B and C Stations	Growth	12,277,289	(812,020)	-5%	11,125,217	12,045,246	302,029	1,644,607	-	10,738,794	(1,306,452)	-11%
DS Ophanded Actuals	Growth	-	-	-	-	-	-	(34,216)	-	-	-	0%
Gas	30,098,805	474,857	0%	34,471,161	33,224,299	(1,246,862)	-	8,830,508	-	35,688,874	2,344,575	0%
Gas - Hydrogen Blending	Growth	-	-	-	-	-	-	-	-	-	-	0%
Gas - System Reinforcement	Growth	30,098,805	474,857	2% Hensel Rein	37,108,214	35,861,352	(1,246,862)	8,922,709	-	35,688,874	(202,478)	-1%
Gas - HAM: Hamilton Air Port Regional Expansion	Growth	-	-	-	(2,837,053)	(2,837,053)	-	-	-	2,837,053	-	-100%
Gas Ophanded Actuals	Growth	-	-	-	-	-	-	7,799	-	-	-	0%
Utilization	60,780,724	(128,030)	-0%	61,702,814	61,702,814	-	-	22,666,130	-	60,917,724	(768,090)	-1%
UTIL - Integrity Survey</												

GDs	Core Capital Breakdown	Maintenance iGrowth	2023 Final Approved Workplan - March	Approved Workplan Variance to Target - March	Approved Workplan Variance to Target - March	Comments March	Submitted Scenario - June	Approved Scenario - June	Approved Variance to Submitted - June	AFE (minus Disinvestment) - June	YTD Actuals - June	Target Adjustments - June	AM Gov Approved	Approved Target - June	Approved Workplan Variance to Target - June	Approved Workplan Variance to Target - June	Comments - June
GDs	GDs Core Total		1,372,940,192	(242,071,854)		-15%	1,423,230,139	1,391,632,195	(32,198,144)	274,480,043	469,563,950	-	-	1,416,292,174	25,269,979		
GDs	GDs Core Maintenance	Maintenance	209,151,990	(24,581,953)			305,469,973	300,495,977	(5,003,176)	24,242,763	116,296,130	-	-	299,708,151	(79,843)		-13%
GDs	GDs Core Growth		1,083,788,201	(217,489,851)			1,117,731,366	1,090,536,398	(27,194,968)	234,237,280	353,267,820	-	-	1,116,523,925	25,986,622		

2021 Year In Review

Toronto Operations

Winter Ice Safety





Agenda

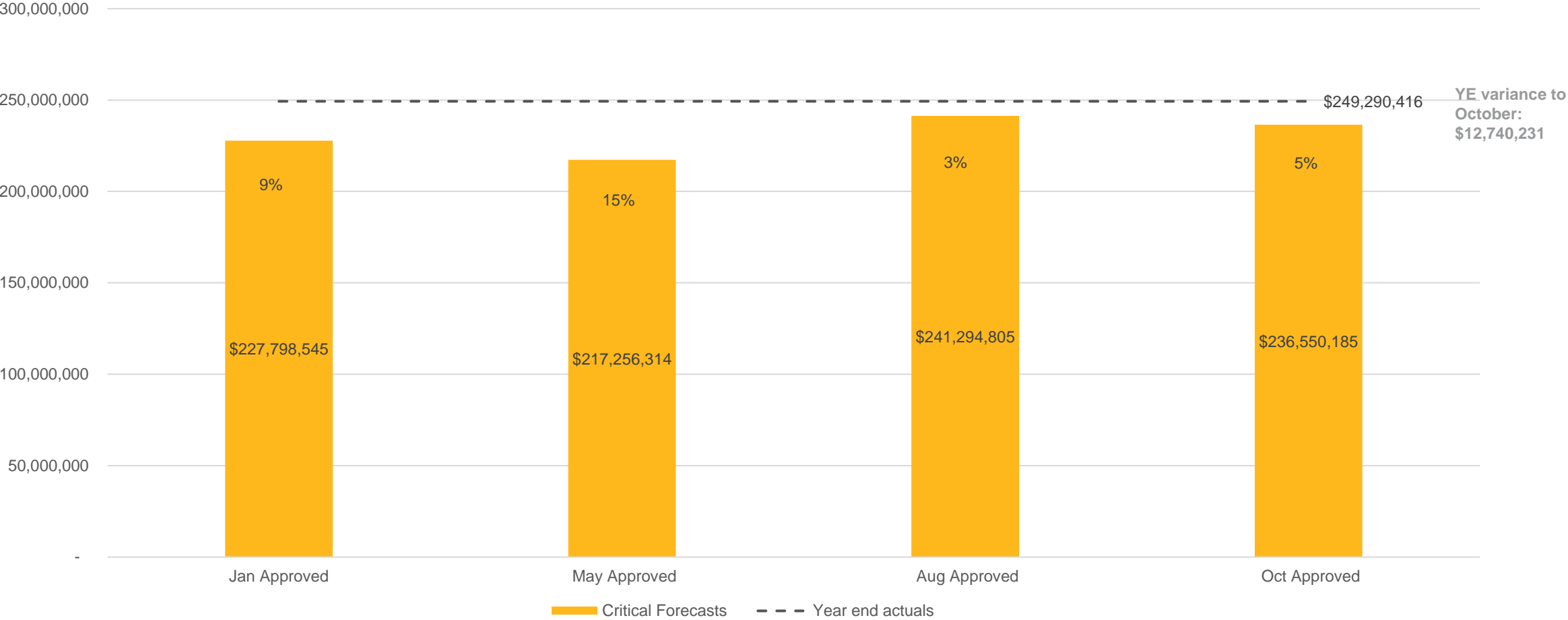
- Safety/Values moment – 4 min (TBD)
- Meeting Objectives – 1 min (Capital Execution)
- Data Review & Observations - 30 min (AM, Capital Execution)
- Regional Observations & Actions – 25 min (Region)



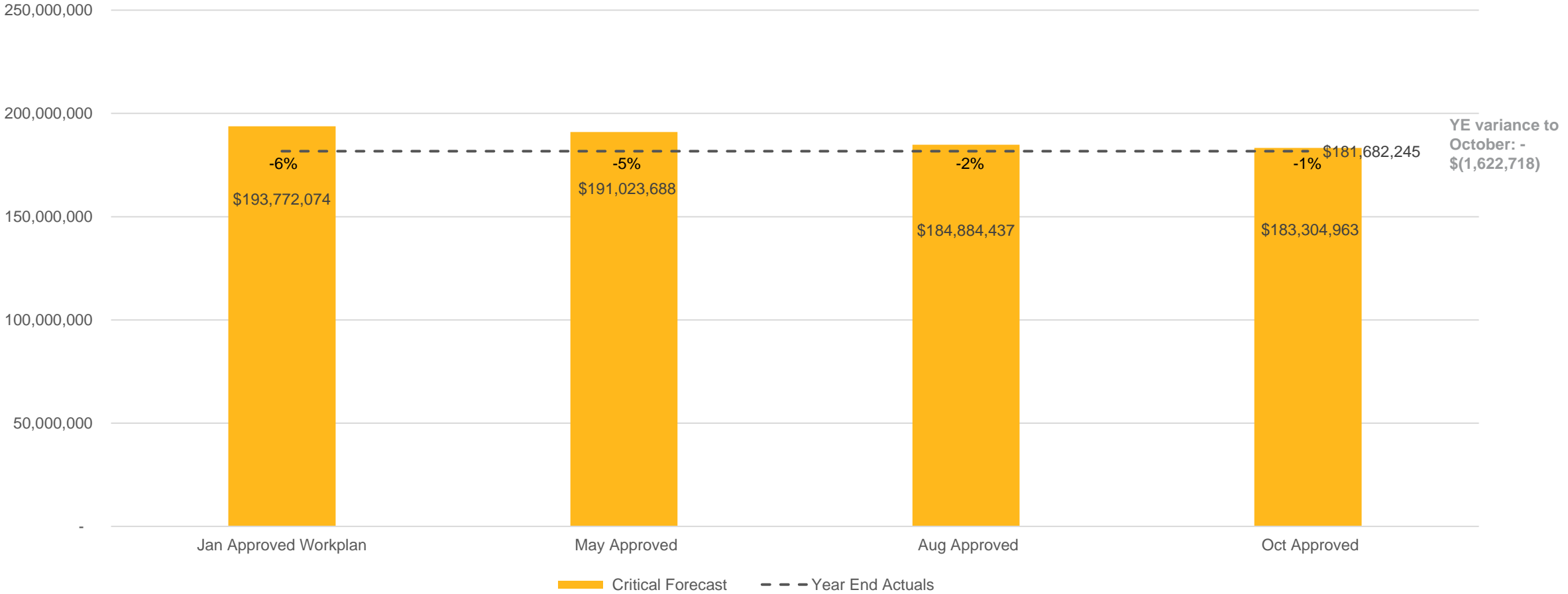
Objectives

- Review and understand portfolio performance data from 2021
- Identify successes and opportunities
- Identify execution risks for 2022 and actions based on 2021 Lessons Learned
- Understand Material Variances – **Regional Input**
 - projects/programs that had forecasts in December with large discrepancies to YE actuals
 - Delivery to plan – projects in and out of the portfolio
 - Customer Connections - understanding between November Forecast and YE actuals
 - Pipe and Stations – Explanations for material variances (+/- 10%)

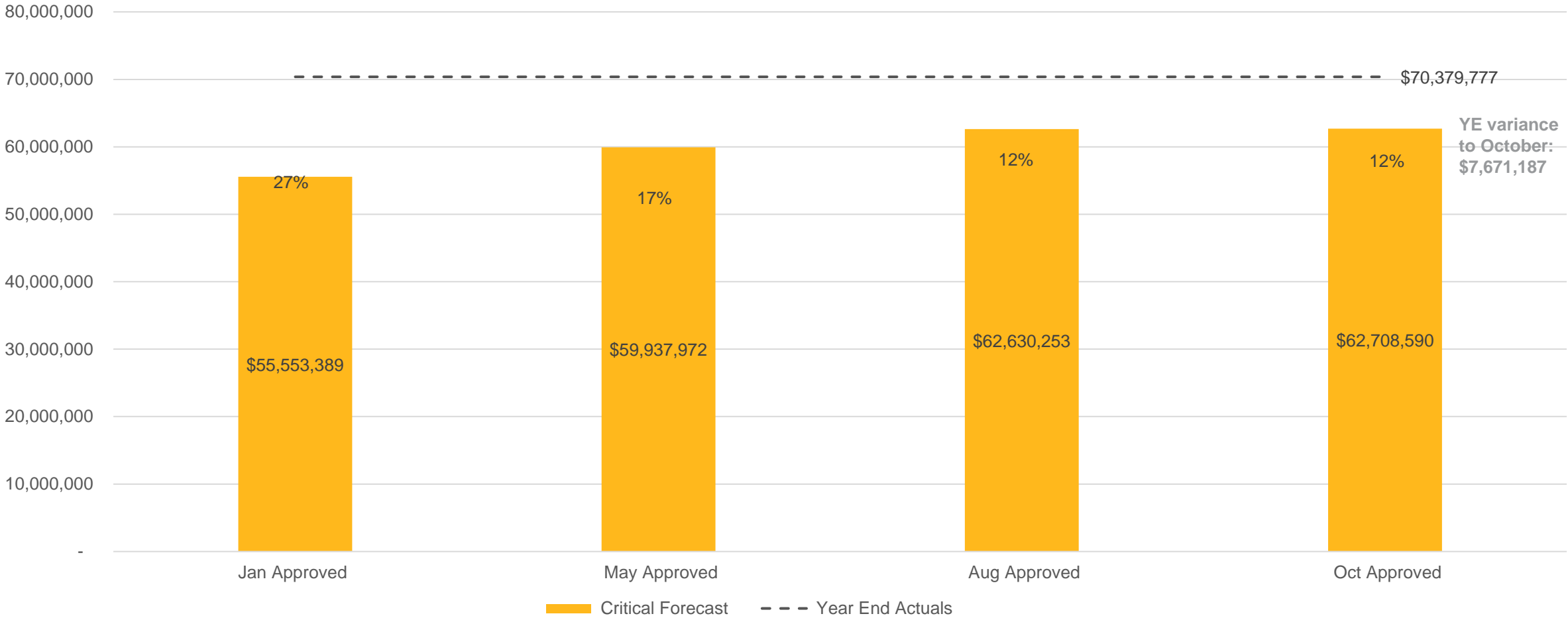
LEG – Consolidated



LUG – Consolidated



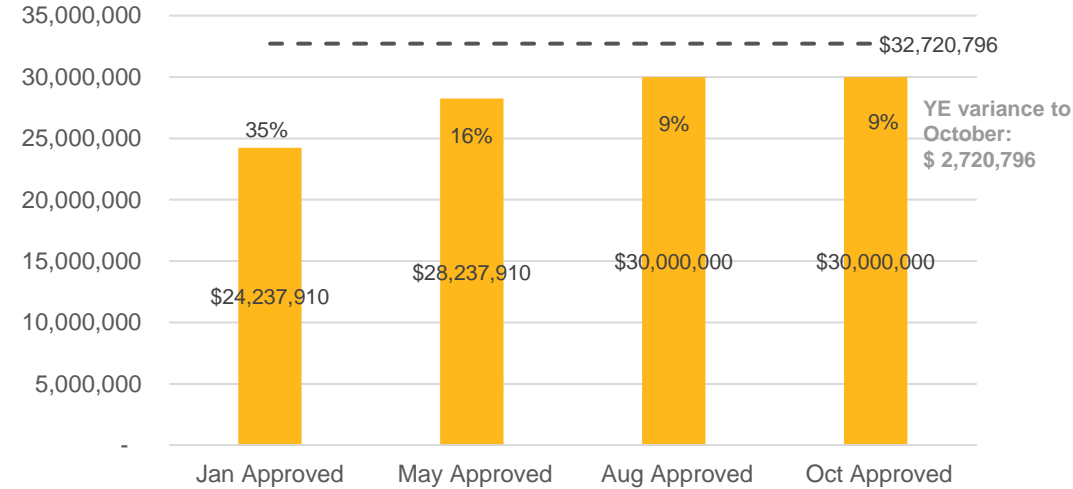
LEG – Toronto



LEG – Toronto

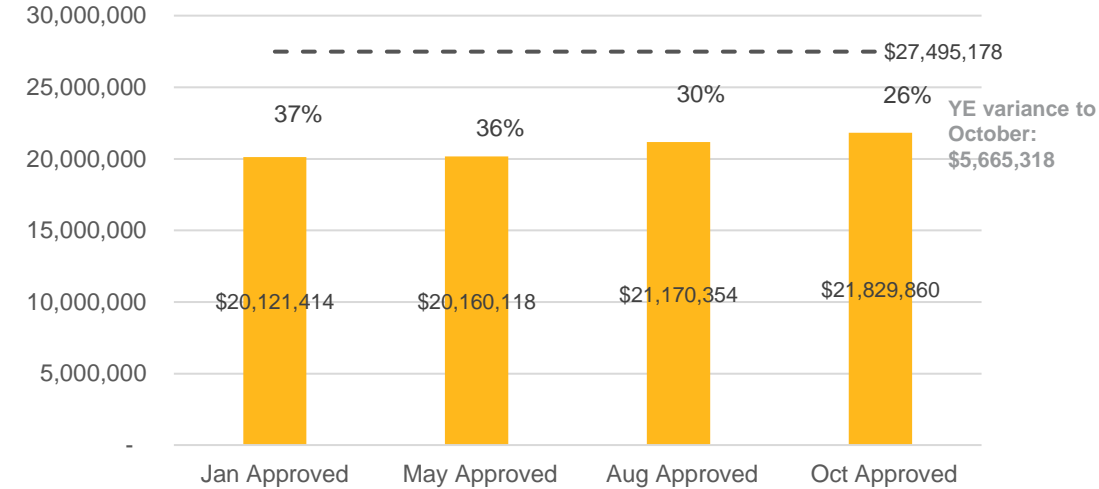


Toronto – Customer Connections



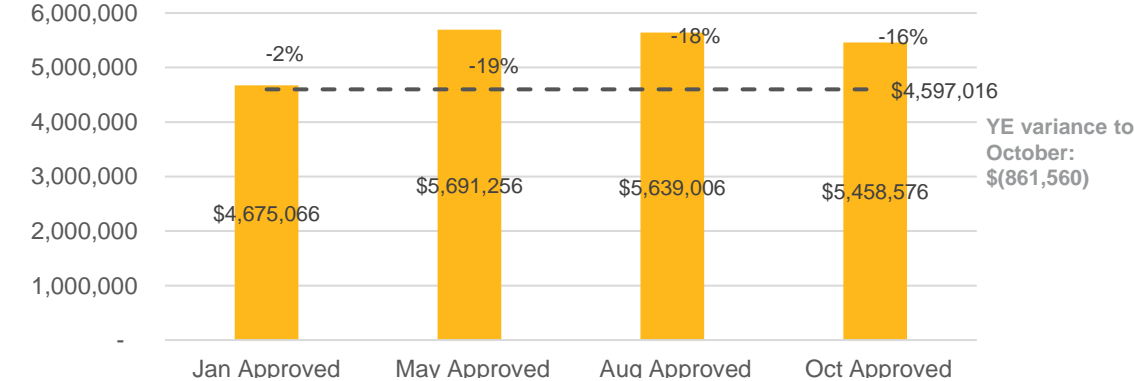
Critical Forecast Year End Actuals

Toronto – Distribution Pipe



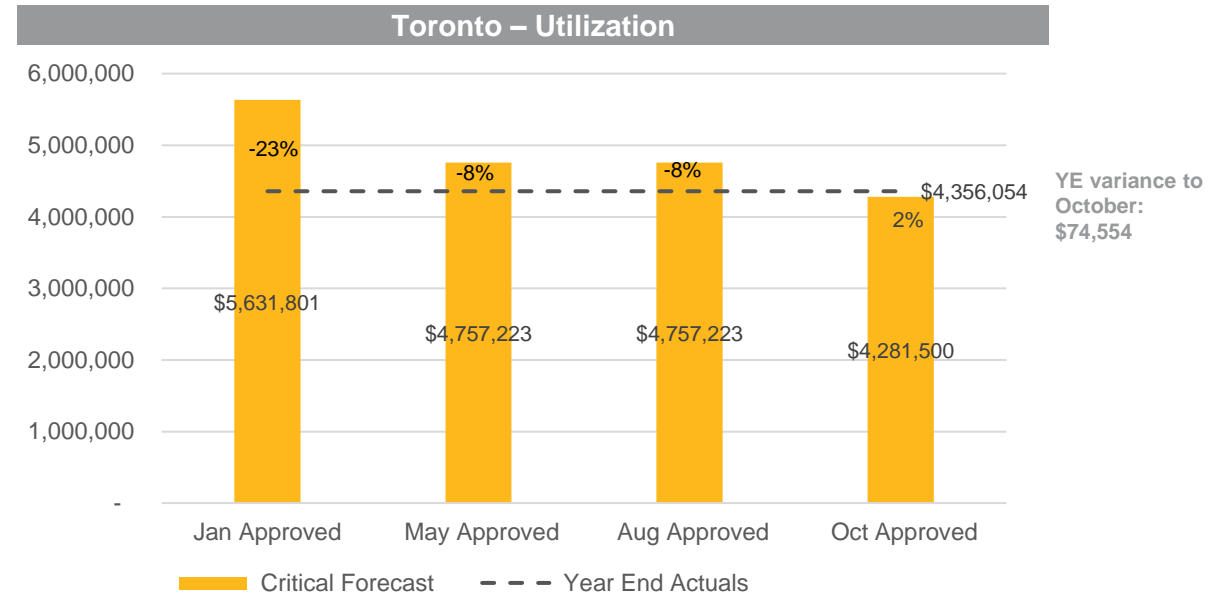
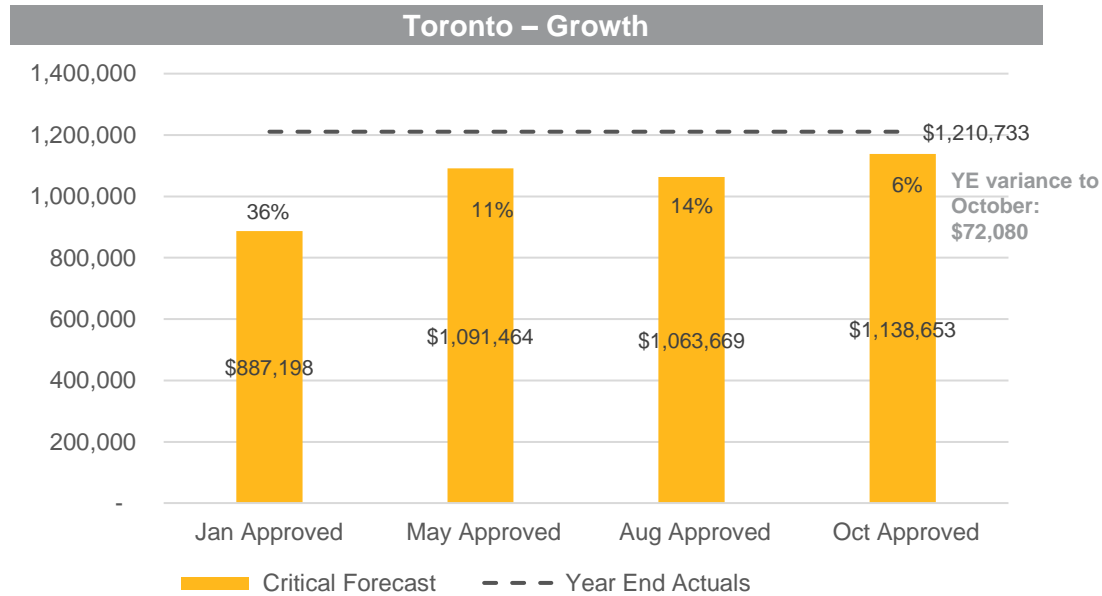
Critical Forecast Year End Actuals

Toronto – Distribution Station



Critical Forecast Year End Actuals

LEG – Toronto

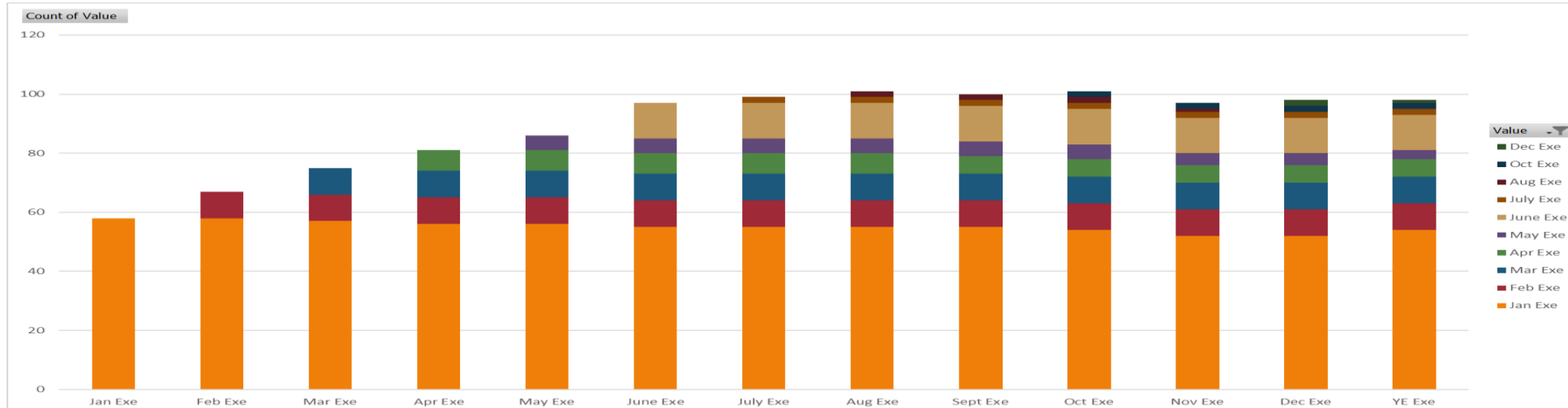


LEG – Toronto

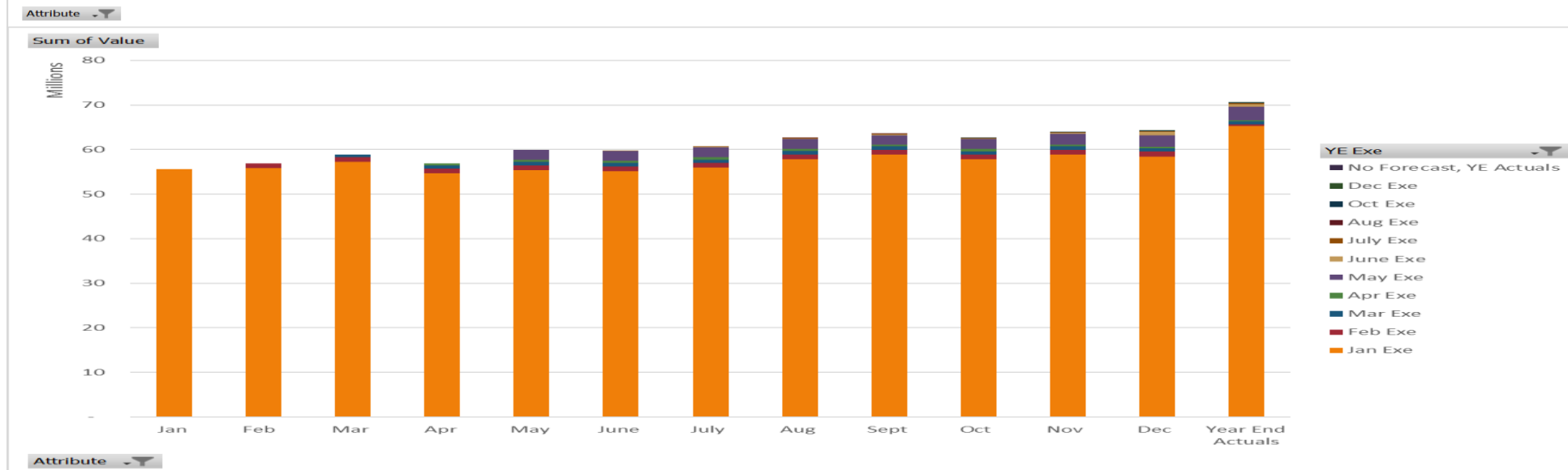
by Investment Count



Approved Forecasts by Count



Approved Forecasts by Spend



- Spent capital on 49 of 56 Investments from Approved Work Plan
 - 5 in DS,
 - 2 in DP
- Spent capital on 44 Investments not in Approved Work Plan
 - +15 DP – main repl
 - +1 DP – Corrosion
 - +19 DS – Rebuild
 - +8 DS – Gate/Feed
- Spend on Investments Approved Work Plan exceeded budget by \$9.7MM
- \$5.1MM spent on Emergent investments



2021 Financial Lookback – LEGD

Regional Dist Ops Review – Pipe Toronto

Operating Area (EGI)	Asset Program (EGI)	Year End Actuals	Jan Approved Workplan	Dec Approved	% Variance
10 - Toronto	DP - Corrosion	1,054,416	805,861	969,742	130.8%
	DP - Main Replacement	10,005,926	8,671,626	9,127,141	115.4%
	DP - Relocations	3,030,835	700,500	889,279	432.7%
	DP - Service Relay	13,404,001	11,344,427	11,162,381	118.2%
10 - Toronto Total		27,495,178	21,522,414	22,148,543	127.8%

- Overspend in Corrosion Projects (see below) and Relocations Blanket

Investment Code	Planning Portfolio	Investment Name	Jan Approved	Year End Actuals
3430	EGD - Core - DP - Corrosion - Anode Replacement Program	Anode Blanket - Area 10	\$ 761,971	\$ 926,683
501268	EGD - Core - DP - Corrosion - Corrosion	Kennedy & Merrian Rectifier	\$ 43,890	\$ 117,944
7544	EGD - Core - DP - Corrosion - Corrosion	McCowan&Eglinton Rectifiers	\$ -	\$ 9,789



2021 Lookback Dist Ops Review – DS TOR

Asset Program (EGI)	Investment Code	Investment Name	Jan Approved Workplan	Sum of May Approved	Sum of Aug Approved	Sum of Oct Approved	Sum of Nov App	Year End Actuals
DS - Station Rebuilds & B and C Stations			4,669,816	4,363,006	4,252,143	4,071,713	4,140,437	4,226,548
	1217	Parliament & Winchester Station Replac	1,262,852	5,000	-	-	-	-
	1632	AVENUE RD & MACPHERSON DISTRICT STA	142,450	2,500	2,500	2,500	2,500	750
	1666	BATHURST & ALCINA DISTRICT STATION RE	250,000	450,000	450,000	403,926	540,068	514,041
	1667	BATHURST & ROSELAWN DISTRICT STATIO	-	-	69,037	69,037	69,037	166,122
	1715	C.N.E. & LAKESHORE DISTRICT STATION RE	-	-	5,000	5,000	5,000	66,317
	1946	HARVIE & ST CLAIR W	-	-	-	-	-	34,457
	1988	INDIAN & WRIGHT DISTRICT STATION REB	-	-	5,000	7,700	7,700	14,276
	3484	2020 Header stations rebuilds	-	1,990	10,305	10,305	10,305	14,823
	3580	2020 Sales stations rebuilds Area 10	-	-	11,869	11,869	11,869	11,869
	6381	Shuter & Yonge District Station Rebuild	-	26,205	26,205	26,205	26,205	28,825
	7626	MIDLAND & PITFIELD DISTRICT	-	-	7,700	7,700	7,700	7,700
	7633	Victoria Park and McNicoll - STN 13082A	242,802	299,227	234,227	253,400	253,400	118,148
	10295	Station Emergency Replacement Blanket	200,000	200,000	200,000	200,000	200,000	88,711
	18485	YORK MILLS & FENN DISTRICT	3,740	111,304	111,304	111,304	111,304	87,418
	18504	KENNEDY & SHROPSHIRE DISTRICT	23,100	23,100	23,100	23,100	-	(12,852)
	18545	FAYWOOD & WILSON DISTRICT	-	4,307	4,307	4,307	4,307	10,842
	18548	LYTTON & DUPLEX DISTRICT	115,500	93,615	109,192	109,192	109,192	93,615
	18784	YORK MILLS / FENSIDE DISTRICT STATION	205,000	128,504	128,504	111,367	111,367	67,201
	18817	DIXON AND KIPLING DISTRICT	115,500	550,949	553,527	595,097	595,097	600,516
	18833	FINCH & ALAMOSA DISTRICT	-	-	5,000	5,000	5,000	4,002
	18835	FROBISHER & LASCELLES DISTRICT	200,000	597,127	255,565	255,565	255,565	224,680
	18890	MILTON & OXFORD DISTRICT	-	-	5,000	5,000	5,000	136,715
	18891	WARDEN & ST. CLAIR DISTRICT	350,000	108,410	108,410	108,410	108,410	63,460
	18892	MCGLASHAN & MCGLASHAN DISTRICT	-	-	5,000	5,000	5,000	3,562
	20375	EVANS & KIPLING DISTRICT	275,000	116,303	243,685	193,470	193,470	176,487
	21028	M&R Internal Work Scheduling	-	-	-	-	-	180
	21069	Meter and Instrument Exchanges	-	1,748	10,900	10,900	10,900	19,604
	21607	2020 Header stations rebuilds	-	1,990	16,537	16,537	16,537	16,621
	23125	YORK MILLS & VALENTINE DISTRICT STATIO	216,825	387,444	387,444	387,444	387,444	364,382
	23169	Millwood and Overlea District	215,704	215,704	215,704	215,704	215,704	188,669
	23170	Berry and Parklawn District Station	35,343	35,343	35,343	35,343	-	(37,781)
	100960	14943A - KIPLING & ADVANCE DISTRICT	170,000	204,178	189,178	189,178	189,178	199,972
	101000	2746401 - BIRCHMOUNT & ST. CLAIR DISTR	-	-	5,000	4,897	4,897	6,360
	101001	14365A - BIRMINGHAM & KIPLING DISTRICT	-	-	5,000	5,000	5,000	66,218
	501280	A10: Cibola and Chippewa Toronto Islan	-	-	-	-	-	4,500
	501423	A10: Alpha Ave, Toronto, Pressure Elevat	-	152,058	129,625	-	-	-
	502102	2021 Sales stations rebuilds Area 10	250,000	250,000	250,000	250,000	250,000	190,601
	502147	2021 HEADER PROGRAM - AREA 10	396,000	396,000	396,000	396,000	396,000	439,626
	503409	14131A- BAYVIEW & POST ROAD DISTRICT	-	-	5,000	4,281	4,281	67,072
	733809	Parliament & Winchester Station Replac	-	-	18,000	18,000	23,000	178,839
	734188	COXWELL & EASTERN AVENUE DISTRICT ST	-	-	13,975	13,975	-	-
			4,675,066	5,691,256	5,639,006	5,458,576	5,527,300	4,597,016

• Successes

- Forecast accuracy in green at key intervals vs YE

• Improvement Opps

- Accuracy at key forecasts in yellow

• Clarifications

- Sales and Headers Program – portfolio level met target regional view misleads as a large variance



2021 Lookback Growth: Toronto

Row Labels	Sum of Jan Approved	Sum of May Approved	Sum of Aug Approved	Sum of Oct Approved	Sum of Dec Approved	Sum of Year End Actuals
Customer Connections	\$ 24,237,910.00	\$ 28,237,910.00	\$ 30,000,000.00	\$ 30,000,000.00	\$ 30,500,000.00	\$ 32,720,796.00
CC - Commercial/Bulk-Metered - Conversion	\$ -	\$ 2,000,000.00	\$ 2,000,000.00	\$ 2,000,000.00	\$ 2,500,000.00	\$ 3,018,648.00
Area 10 - Commercial - Replacement	\$ -	\$ 2,000,000.00	\$ 2,000,000.00	\$ 2,000,000.00	\$ 2,500,000.00	\$ 3,018,648.00
CC - Commercial/Bulk-Metered - New	\$ 6,531,511.00	\$ 4,531,511.00	\$ 4,531,511.00	\$ 4,531,511.00	\$ 4,531,511.00	\$ 5,221,801.00
Area 10 - Commercial - New Construction	\$ 6,531,511.00	\$ 4,531,511.00	\$ 4,531,511.00	\$ 4,531,511.00	\$ 4,531,511.00	\$ 5,221,801.00
CC - Industrial - New	\$ 35,734.00	\$ 35,734.00	\$ 35,734.00	\$ 35,734.00	\$ 35,734.00	\$ -
Area 10 - Industrial - New Construction	\$ 35,734.00	\$ 35,734.00	\$ 35,734.00	\$ 35,734.00	\$ 35,734.00	\$ -
CC - Multi-Family/Apartment - New	\$ 2,662,796.00	\$ 2,662,796.00	\$ 2,662,796.00	\$ 2,662,796.00	\$ 2,662,796.00	\$ 2,587,372.00
Area 10 - Apartment Ensuite - New Construction	\$ 2,660,414.00	\$ 2,660,414.00	\$ 2,660,414.00	\$ 2,660,414.00	\$ 2,660,414.00	\$ 2,587,372.00
Area 10 - Apartment Traditional - New Construction	\$ 2,382.00	\$ 2,382.00	\$ 2,382.00	\$ 2,382.00	\$ 2,382.00	\$ -
CC - Residential - Conversion	\$ 3,920,237.00	\$ 6,920,237.00	\$ 7,561,765.00	\$ 7,561,765.00	\$ 7,561,765.00	\$ 7,462,015.00
Area 10 - Residential - Replacement	\$ 3,920,237.00	\$ 6,920,237.00	\$ 7,561,765.00	\$ 7,561,765.00	\$ 7,561,765.00	\$ 7,462,015.00
CC - Residential - New	\$ 11,087,632.00	\$ 12,087,632.00	\$ 13,208,194.00	\$ 13,208,194.00	\$ 13,208,194.00	\$ 14,430,960.00
Area 10 - Residential - New Construction	\$ 11,087,632.00	\$ 12,087,632.00	\$ 13,208,194.00	\$ 13,208,194.00	\$ 13,208,194.00	\$ 14,430,960.00
Customer Connections TCS	\$ -	\$ 1.00	\$ 1.00	\$ 1.00	\$ 1.00	\$ -
CC TCS - Residential - Conversion	\$ -	\$ 1.00	\$ 1.00	\$ 1.00	\$ 1.00	\$ -
Area 10 - Residential - Replacement TCS	\$ -	\$ 1.00	\$ 1.00	\$ 1.00	\$ 1.00	\$ -
Grand Total	\$ 24,237,910.00	\$ 28,237,911.00	\$ 30,000,001.00	\$ 30,000,001.00	\$ 30,500,001.00	\$ 32,720,796.00



2021 Lookback CC: Toronto

Row Labels	Sum of Jan Approved	Sum of May Approved	Sum of Aug Approved	Sum of Oct Approved	Sum of Dec Approved	Sum of Year End Actuals
Customer Connections	\$ 24,237,910.00	\$ 28,237,910.00	\$ 30,000,000.00	\$ 30,000,000.00	\$ 30,500,000.00	\$ 32,720,796.00
CC - Commercial/Bulk-Metered - Conversion	\$ -	\$ 2,000,000.00	\$ 2,000,000.00	\$ 2,000,000.00	\$ 2,500,000.00	\$ 3,018,648.00
Area 10 - Commercial - Replacement	\$ -	\$ 2,000,000.00	\$ 2,000,000.00	\$ 2,000,000.00	\$ 2,500,000.00	\$ 3,018,648.00
CC - Commercial/Bulk-Metered - New	\$ 6,531,511.00	\$ 4,531,511.00	\$ 4,531,511.00	\$ 4,531,511.00	\$ 4,531,511.00	\$ 5,221,801.00
Area 10 - Commercial - New Construction	\$ 6,531,511.00	\$ 4,531,511.00	\$ 4,531,511.00	\$ 4,531,511.00	\$ 4,531,511.00	\$ 5,221,801.00
CC - Industrial - New	\$ 35,734.00	\$ 35,734.00	\$ 35,734.00	\$ 35,734.00	\$ 35,734.00	\$ -
Area 10 - Industrial - New Construction	\$ 35,734.00	\$ 35,734.00	\$ 35,734.00	\$ 35,734.00	\$ 35,734.00	\$ -
CC - Multi-Family/Apartment - New	\$ 2,662,796.00	\$ 2,662,796.00	\$ 2,662,796.00	\$ 2,662,796.00	\$ 2,662,796.00	\$ 2,587,372.00
Area 10 - Apartment Ensuite - New Construction	\$ 2,660,414.00	\$ 2,660,414.00	\$ 2,660,414.00	\$ 2,660,414.00	\$ 2,660,414.00	\$ 2,587,372.00
Area 10 - Apartment Traditional - New Construction	\$ 2,382.00	\$ 2,382.00	\$ 2,382.00	\$ 2,382.00	\$ 2,382.00	\$ -
CC - Residential - Conversion	\$ 3,920,237.00	\$ 6,920,237.00	\$ 7,561,765.00	\$ 7,561,765.00	\$ 7,561,765.00	\$ 7,462,015.00
Area 10 - Residential - Replacement	\$ 3,920,237.00	\$ 6,920,237.00	\$ 7,561,765.00	\$ 7,561,765.00	\$ 7,561,765.00	\$ 7,462,015.00
CC - Residential - New	\$ 11,087,632.00	\$ 12,087,632.00	\$ 13,208,194.00	\$ 13,208,194.00	\$ 13,208,194.00	\$ 14,430,960.00
Area 10 - Residential - New Construction	\$ 11,087,632.00	\$ 12,087,632.00	\$ 13,208,194.00	\$ 13,208,194.00	\$ 13,208,194.00	\$ 14,430,960.00
Customer Connections TCS	\$ -	\$ 1.00	\$ 1.00	\$ 1.00	\$ 1.00	\$ -
CC TCS - Residential - Conversion	\$ -	\$ 1.00	\$ 1.00	\$ 1.00	\$ 1.00	\$ -
Area 10 - Residential - Replacement TCS	\$ -	\$ 1.00	\$ 1.00	\$ 1.00	\$ 1.00	\$ -
Grand Total	\$ 24,237,910.00	\$ 28,237,911.00	\$ 30,000,001.00	\$ 30,000,001.00	\$ 30,500,001.00	\$ 32,720,796.00



2021 Lookback Utilization: Toronto

Row Labels		Sum of Jan Approved	Sum of May Approved	Sum of Aug Approved	Sum of Oct Approved	Sum of Dec Approved	Sum of Year End Actuals
Utilization	\$	5,631,801.00	\$ 4,757,223.00	\$ 4,757,223.00	\$ 4,281,500.00	\$ 4,281,500.00	\$ 4,356,054.00
UTIL - Regulator Refit	\$	5,631,801.00	\$ 4,757,223.00	\$ 4,757,223.00	\$ 4,281,500.00	\$ 4,281,500.00	\$ 4,356,054.00
MXGI Area 10	\$	5,631,801.00	\$ 4,757,223.00	\$ 4,757,223.00	\$ 4,281,500.00	\$ 4,281,500.00	\$ 4,356,054.00
Grand Total	\$	5,631,801.00	\$ 4,757,223.00	\$ 4,757,223.00	\$ 4,281,500.00	\$ 4,281,500.00	\$ 4,356,054.00

/u



Health Check: MP-01 Asset Management

Date: April 6, 2023
Accountable Person: Bob Wellington
Lead: Bob Wellington

MP Quarterly Accomplishments & Key Deliverables		2023 YTD Objectives and Metrics				Regulatory Compliance Update &/or Legal & Regulatory Changes	
<ul style="list-style-type: none">Successful completion and submission of over 300 (includes subparts) IRRs within Regulatory timelinesFinalized the 2023 Workplan and circulated with StakeholdersSet Objectives and Metrics for 2023Participated in the 2024 Rebasing Technical Conference, completed and submitted ~25 undertakingsFiled updated AMP Appendix B with the latest status of IRP Assessments	Target End Date	% Complete	Annual Objective	Status	Requirement /Issue	Impact/Action	
	Oct-23	25%	Deliver 2024 AMP Addendum	On track	Enterprise Asset & Work Management Framework Standard – BU Acceptance scheduled for Q2 2023	Impact evaluation to be completed Q2 2023	
	Dec-23	10%	Value Based Decision Making Improvements	On track			
	Jun-24	5%	Initiate 2025-2034 AMP and update asset class strategies to support	On track			
	Sept-23	25%	Execute Phase 2 of TotEx Value Models (Life Cycle Value) Roadmap	On track			
	Nov-23	75%	Support Rebasing Regulatory Application	On track			
	Target	Actual YTD	Metrics	Status			
CER-Regulated Asset Activity		622.5M	645.1M	Core Capital Forecast vs Target (EGD)	Off Plan	Resource Adequacy Confirmation/TMR Ask	
Panhandle Replacement (aka Ojibway or Detroit River Crossing)	<ul style="list-style-type: none">Two meetings with ETP to date in Q1. Most recent meeting involved review of our current estimate. Follow up expected early Q2.Alternatives being developed/updated as result of recent risk reassessment	701.6M	691.8M	Core Capital Forecast vs Target (UGL)	Off Plan	<ul style="list-style-type: none">No TMR Ask	
		1,306 B		In-Service Capital (EGI)	N/A		
		282.8M	287.7M	Core Capital Maintenance (EGI)	Off Plan		

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.66

Question(s):

Enbridge states: "When the 2022 LRP including ET forecast was produced, EGI compared it to the 2022 LRP forecast without ET assumptions. The comparison showed that the ET assumptions reduced the capital expenditure forecast by ~\$60k in 2024 and by ~\$44M over the 2024- 2028 rebasing period.":

- a) Please detail the referenced ET assumptions.
- b) Please explain what capital expenditures were reduced because of these assumptions.
- c) Please confirm that while the AMP was not revised as a result, the reductions were made to the capital expenditure forecast in the application.

Response:

- a) A summary of the energy transition assumptions that have been incorporated into items informing the Long Range Plan is provided in response at Exhibit I.1.10-SEC-20.
- b) The comparison showed that the ET assumptions would have resulted in a reduction to forecasted capital for the Customer Connections asset class.
- c) No reductions were made to the customer connections capital expenditure forecast for the 2024 Test Year in the Application, as the impact of the ET assumptions on the Test Year would have been immaterial. The reductions in later years will have no impact on the test year which forms the basis for the requested rate adjustment. To confirm, although the reductions were not made to the customer connections expenditure forecast, the ET assumptions are reflected in all other aspects of AMP's capital expenditure forecast.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.66-67

Question(s):

With respect to the 10-year customer growth forecast:

- a) Please provide Figures 5.1-2 and 5.1-3 in tabular format.
- b) Please provide a similar forecast, by rate zone, of the number of customers disconnecting from the natural gas system over the same period.

Response:

- a) Please see Table 1 and Table 2 for Exhibit 2, Tab 6, Schedule 2, Figure 5.1-2 and Figure 5.1-3 in tabular format, respectively.

Table 1
10-Year Customer Growth Forecast - EGD Rate Zone

Year	Toronto	Mississauga	Richmond Hill	Central	Barrie	Ottawa	Niagara	Total
2023	1,969	3,052	4,094	4,120	2,230	8,316	2,259	26,040
2024	1,906	2,971	3,993	4,056	2,195	8,134	2,244	25,499
2025	1,824	2,868	3,865	3,938	2,132	7,891	2,201	24,719
2026	1,742	2,771	3,747	3,825	2,071	7,655	2,162	23,973
2027	1,651	2,626	3,553	3,652	1,974	7,275	2,077	22,808
2028	1,556	2,467	3,341	3,464	1,867	6,862	1,984	21,541
2029	1,471	2,344	3,184	3,293	1,778	6,542	1,905	20,517
2030	1,318	2,207	3,014	3,071	1,670	6,155	1,813	19,248
2031	1,182	2,100	2,880	2,878	1,579	5,824	1,741	18,184
2032	1,047	1,974	2,719	2,672	1,477	5,453	1,653	16,995

Table 2
10-Year Customer Growth Forecast - Union Rate Zones

Year	Windsor/ Chatham	London/ Sarnia	Waterloo/ Brantford	Hamilton/ Halton	Kingston	Northeast	Northwest	Total
2023	1,397	3,727	3,809	3,452	1,584	1,030	263	15,261
2024	1,361	3,700	3,718	3,370	1,544	951	249	14,893
2025	1,308	3,620	3,599	3,257	1,480	873	232	14,369
2026	1,258	3,541	3,484	3,148	1,419	800	216	13,866
2027	1,184	3,398	3,310	2,986	1,336	727	201	13,142
2028	1,115	3,231	3,128	2,811	1,256	661	183	12,385
2029	1,048	3,090	2,978	2,672	1,175	596	169	11,729
2030	984	2,964	2,827	2,532	1,100	533	154	11,094
2031	937	2,866	2,706	2,425	1,043	479	140	10,596
2032	882	2,742	2,569	2,294	976	427	125	10,015

- b) Enbridge Gas does not prepare a forecast of customers disconnections by rate zone. As provided at Exhibit 3, Tab 2, Schedule 6, Section 3, customer shrinkage (difference between forecasted customer additions and year-over-year customer change) in 2024 is expected to align with the five-year average observed. Please see response at Exhibit I.1.10-STAFF-31, Attachment 1, Table 4 for a forecast of the energy transition assumptions related to voluntary fuel-switching amongst existing customers that is assumed to begin in 2026.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.81-120

Question(s):

With respect to distribution pipe:

- a) [p.81] For each type of distribution pipe, and for each year between 2013 and 2028, please provide how many km per year have been:
 - i. replaced
 - ii. renewed
- b) [p.87] Does Enbridge classify the overall condition of its various types of distribution pipe through a scoring methodology or otherwise? If so, please explain the methodology and provide the most recent condition breakdown by each distribution pipe type.

Response:

- a)
 - i. Enbridge Gas's work and records management systems are not set up to track abandoned pipe by date upon which it was abandoned. In addition, for abandoned pipe that has been removed, Enbridge Gas does not have records available. Therefore, the requested information regarding length of pipe replaced by type is not available. Please see response at Exhibit I.2.6-SEC-129 part b) for estimated lengths of pipe that have been replaced under the various programs as provided at Exhibit 2, Tab 6, Schedule 2, pages 119 to 120, Table 5.2.3-4.
 - ii. Integrity Digs are the only type of capital investment that relates to renewal of pipe. Please see Table 1 for information on the approximate length of pipe renewed through Integrity Dig programs between 2013 to 2022.

Table 1
Lengths of Pipe – Integrity Dig Programs (Km)

Asset Class Strategy/ Investment Name	Program/ Project Name	2013A	2014A	2015A	2016A	2017A	2018A	2019A	2020A	2021A	2022A
TIMP Digs	Integrity	0.263	0.063	0.124	0.167	0.005	0.1895	0.241	0.068	0.204	1.137

- b) Enbridge Gas uses the DIMP Risk Model to assign relative risk values to Vintage Steel Mains. Please see Exhibit 2, Tab 6, Schedule 2, pages 95 to 96, Section 5.2.3.4.1.3.1, and response at Exhibit I.2.6-SEC-127 for more information about the DIMP Risk Model. For TIMP pipe, please see Exhibit 2, Tab 6, Schedule 2, pages 83 to 84 which describes the condition methodology used to prioritize maintenance on anomalous pipeline features identified through various condition monitoring methods. For information on the condition breakdown of distribution pipe, please see: Exhibit 2, Tab 6, Schedule 2, pages 87 to 88, Section 5.2.3.4.1.2.1 for pre-1970 Steel Mains, Exhibit 2, Tab 6, Schedule 2, page 97, Section 5.2.3.4.2.2 for post-1970 Steel Mains, Exhibit 2, Tab 6, Schedule 2, pages 83 to 84, Section 5.2.3.3.1 for TIMP Steel Mains and Exhibit 2, Tab 6, Schedule 2, pages 100 to 101, Section 5.2.3.5.2.1 for plastic pipe.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.95-96

Question(s):

With respect to the DIMP Risk Model:

- a) Please explain how the DIMP Risk Model is used by Enbridge in determining the capital work to be undertaken.
- b) Please provide a detailed explanation, including using illustrative examples, of the DIMP Risk Model calculation.
- c) Please provide a copy of any internal guidance document or explanation material regarding the DIMP Risk Model.
- d) Please provide the output of the DIMP Risk Model in a tabular format that shows the number of kilometers for each risk value at its current state.
- e) [p.96] The evidence states that the “platform allows the user to create systemic risk views for current or future years, based on the reliability curves from the Asset Health Review Reliability Models.” Please provide a revised version of part (c) that shows output of the DIMP Risk model at the end of the rate framework period (2028), both with and without the proposed capital expenditure and O&M plan.

Response:

- a) Please see Exhibit 2, Tab 6, Schedule 2, Section 5.2.3.6.3.2.
- b) Please see Attachment 1 – Pipeline Risk and Integrity Management (PRIM) Distribution Risk Model Risk Algorithm Document (RAD), Sections 1 to 3.
- c) Please see Attachment 1 – PRIM Distribution Risk Model RAD, and Attachment 2 – 2021 Asset Health Review (AHR) Analytics and Modelling Documentation for

Vintage Steel Mains Risk Model. Please also see the DIMP Risk Model provided at Exhibit 2, Tab 6, Schedule 2, Section 5.2.3.4.1.3.1.

- d) The DIMP Risk Model is only being used for the prioritization of Vintage Steel Mains investments. Please see the tables provided at Attachment 3, which provide a summary of both the Vintage Steel Mains risk and a summary of the entire system's risk. Note that The DIMP Risk Model is a relative risk assessment and a means to compare pipelines, but not in absolute terms. It involves the assessment of corrosion and cross bore threats and serves as a pointer tool to identify areas of concern based on these threats. As provided at Exhibit 2, Tab 6, Schedule 2, Section 5.2.3.6.3.2 of the AMP, the Vintage Steel Mains Program aims to proactively action future leaks. The 40-year leak projection rate based upon failure data shows accelerating failure rates which require timely treatment to ensure system reliability and minimize impact on ratepayers.
- e) This assessment is not currently available and would require onerous efforts (potentially over a few months) to complete. Further, it is worth emphasizing that the DIMP Risk Model is only being used as an input for the Vintage Steel Mains Program (Exhibit 2, Tab 6, Schedule 2, Section 5.2.3.6.3.2), which is not planned to begin until 2027. Based on current information, it is expected that approximately 97 km of Vintage Steel Main pipeline will be replaced in 2027 and 2028, which would have negligible impact on the systematic DIMP risk results. Accordingly, Enbridge Gas respectfully declines to produce the analysis sought.



PRIM Distribution Risk Model

Risk Algorithm Document

File Name: PRIM Distribution Risk Model - Risk Algorithm Document

Version Number: 1.0

Version Date: March 15, 2021

Owned by: Integrity Assessments

PRIM Distribution Risk Model

Version Number: 1.0
Version Date: March 15,
2021



Design Summary Document

Version Register

Version number	Version date	Written by	Approved by	Details of revision
1.0	March 15, 2021	Kai Ji Sr. Integrity Assessments Engineer	Miaad Safari Supervisor, Integrity Assessments	Initial Release

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PRIM Distribution Risk Model

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1 Introduction

1.1 Purpose

The GDS distribution network comprises approximately 78,000 kilometers of mains, 58,000 kilometers of services, and serves gas to approximately 3.7 million customers in the province of Ontario and Quebec. As part of a comprehensive Integrity and Asset Management strategy to ensure safe, reliable, and environmentally responsible service, a quantitative risk model was developed in order to assess the risk of loss of containment events on these gas-carrying assets. This risk model was built using the existing Pipeline Risk and Integrity Management (PRIM) software platform used at Enbridge Gas Inc., which is based around the implemented PiMSlider software solution. The model outputs will allow for proactive risk-based investment prioritization, enhanced integrity management, and monitoring of system-wide risk levels across the EGI distribution network.

The risk for each asset is calculated as the frequency of failure multiplied by the consequence of failure. Failure frequencies are derived based on a variety of pre-existing and novel quantitative models including AHR failure projections, a new Third Party Damage model, and cross-bore probabilities generated by the Spotlight algorithm. The consequence of failure calculations follow a combination of industry accepted modelling techniques and newly developed methodologies specific to the EGI distribution system. Risk is reported according to the Health & Safety, Financial, Environmental, Operational, and Reputational impact categories following the most up to date EGI risk governance guidelines.

Risk is calculated at the lowest sub-asset level and can be aggregated to any desired level of assessment. This includes viewing risk of all assets within an area selection on a map, on a per asset basis, on a per segment basis, or from the lens of any category of risk such as Health & Safety, Financial, Operational, etc. in order to facilitate the maximum versatility in project scoping, root causing, and monitoring against possible future risk thresholds.

The overall risk model is coded to allow projection of pipeline risk on a forward-looking basis. Risk projections up to 40 years into the future can be reviewed to identify areas of emerging risk and facilitate proactive asset planning.

1.2 Modelling Approach

Several levels of risk modelling complexity exist within the pipeline industry, ranging from qualitative index models to fully quantitative, probabilistic approaches. Qualitative models provide relative ranking scores and are suitable for basic prioritization or relatively simple systems, when data or models to support more quantitative methods are not available. Due to the reliance on judgement-based factors, outputs of a qualitative model are generally not proportional to outputs like failure frequency, probability, or expected loss. Pipeline operators should select risk models capable of supporting risk management decisions required as part of the pipeline IM programs as well as more general risk management decisions that may be required [1].

For situations where the degree of difference between different scenarios is important to quantify in absolute terms, such as for benefit-cost analysis, or comparison of risks across different asset classes or different integrity threats, a quantitative risk model in standard absolute risk units is required. This is best described in Table 1.1, referenced from the PHMSA Report “Pipeline Risk Modelling – Overview of Methods and Tools for Improved Implementations”[1].

Table 1.1 – Risk Model Types and Applicability to Decisions [1]

Decision Type	Model Category			
	Qualitative Model	Relative Assessment / Index Model	Quantitative System Model	Probabilistic Model
Risk Priorities for Baseline Integrity Assessment	A	A	A	BP
Preventive and Mitigative Measure Identification	A	A	A	BP
Preventive and Mitigative Measure Evaluation and Comparison	AI	AI	A	BP
Benefit-Cost Analysis for Risk Reduction Options	AI	AI	A	BP
Integrity Assessment Interval Determination	AI	AI	A	BP
General Risk Management Decision Making	AI	AI	A	BP

Legend:

Can be Applicable with Additional Inputs to Risk Assessment Process	AI
Can be Applicable	A
Best Practice	BP

PRIM Distribution Risk Model

Version Number: 1.0
Version Date: March 15,
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The Distribution Risk Model was developed using a quantitative approach in order to ensure applicability with the decision types described in Table 1.1. Likelihood of events are expressed in units of frequency per year and risk is expressed in dollars, allowing for quantification of risk in absolute values. As shown in Figure 1.1, although the risk model is generally categorized as a quantitative model, it does contain qualitative components when SME expertise is required and probabilistic components where more advanced methodologies are available.

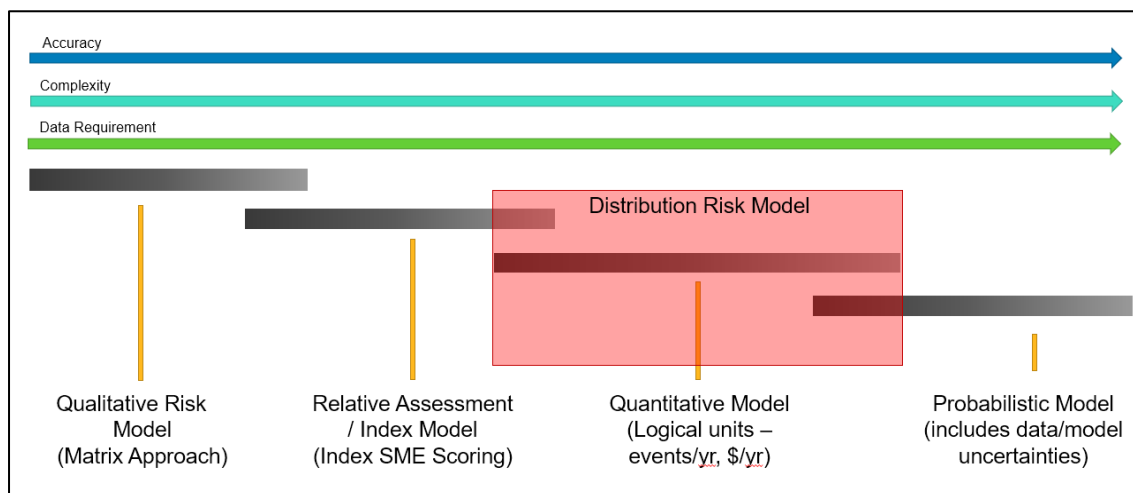


Figure 1.1

A key focus of the risk model and its implementation within the software was transparency. All data, modelling methodologies, and intermediate calculations are saved and fully transparent within the PiMSlider software and were written to facilitate ease of understanding, clarity, and future enhancements. Key input data to the risk model such as region-specific consequence tiles, detailed building data, pipeline properties, and third party damage hit frequency polygons are also viewable geospatially alongside a heat map of the final risk results.

1.3 PRIM Distribution Data Model

A vital component in building a system-wide data-driven risk model is a robust and integrated data model. Emphasis was placed on building an effective data model that can support multi-million record datasets with supplemental automated geo-spatial assessment of the data.

The PRIM/AI Distribution Data Warehouse has been created as a repository for all source information that feeds the risk assessment tool. The warehouse has also been developed with consideration on records management of datasets that are feeding the Risk Assessment tool. As such, the warehouse includes a snapshot of the asset populations that are taken on a yearly basis and used for all Integrity and Risk assessments. The snapshot of the Systems of Record allows for effective analysis and root cause of the risk results from any given year, even if the records have changed over time. It also ensures records are readily available during any review or audit of the Risk Assessments.

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In addition, the PRIM data model interfaces and stores assessments generated by other Integrity programs such as the Asset Health Review or the Crossbore probability results from Spotlight. These reliability assessments are directly included into the Risk Model and supplemented with detailed site-specific geographic data. A schematic of the PRIM Distribution Data Model and the connections to the various assessment and reporting tools is shown in Figure 1.2.

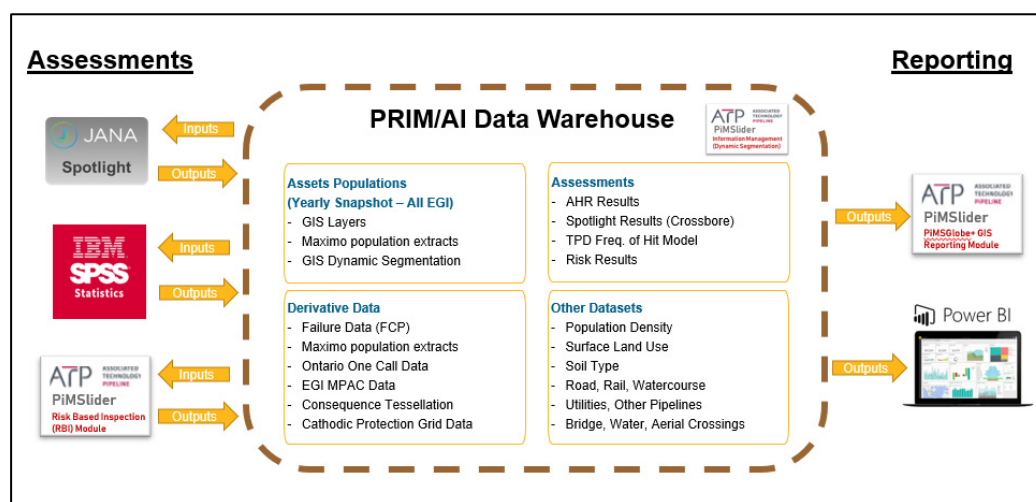


Figure 1.2

The PRIM sync tool has also been developed to supplement asset information by dynamically segmenting the assets based on site specific geospatial data. This tool has an input of 5.5 million assets that are dynamically segmented based on 2 million polygons with site-specific information such as population density, soil type, surface land use, etc. This results in a total of 7.1 million segmented assets. The full list of asset population data, dynamically segmented assets, and other site-specific geospatial datasets are shown in Figure 1.3.

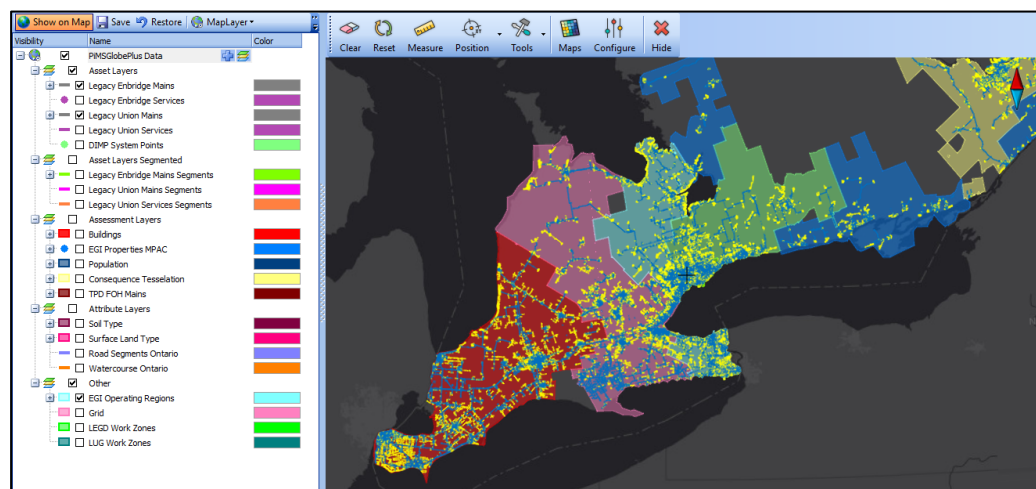


Figure 1.3

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1.4 PRIM Software

All model calculations are performed within the PiMSlider software using a combination of SQL and VBScript. Results of the model are saved in the software database and can be geospatially plotted using the software. Significant geospatial visualization enhancements allow smooth and user-friendly plotting of large amounts of geospatial data at significantly higher speeds than other software platforms such as ArcMap or Google Earth. The software database can also be connected to other reporting platforms such as Power BI for future reporting needs.

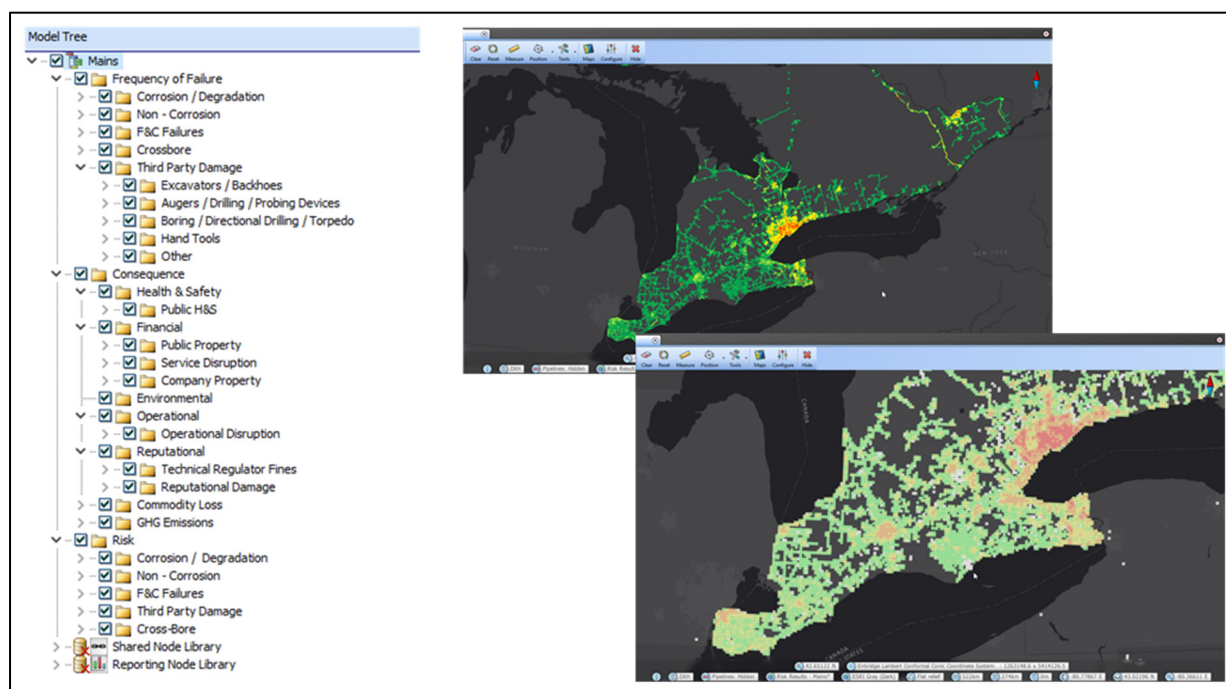


Figure 1.4

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2 Scope**2.1 Assets**

The following assets are included for Phase 1 of the Distribution Assets risk model:

- Mains
- Services
- AMP Fittings

Future iterations of the model will be expanded to include additional asset classes following similar modelling approaches on a priority basis.

2.2 Failure Frequency

The models that produce the frequency of failure for the Distribution Assets risk model are summarized below:

Mains:

Threat	Model
3 rd Party Damage	Novel Third Party Damage Model
Corrosion / Degradation	AHR
Non-Corrosion	AHR/Uplifts based on AHR
Fittings & Connections	Uplifts based on AHR
Cross-Bore	Spotlight tool (Number of Cross-bores)

Services:

Threat	Model
3 rd Party Damage	Novel Third Party Damage Model
Corrosion / Degradation	AHR
Fittings & Connections	Uplifts based on AHR
Cross-Bore	Spotlight tool (Number of Cross-bores)

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AMP Fittings:

Threat	Model
Erosion Deterioration	AHR

2.3 Consequence Categories

Consequence of failure is calculated according to the five Enbridge Operational Risk Matrix categories in alignment with the latest Value Framework Definition Document [2] and Impact Chart.

Consequence Category	Sub-Category	
Health & Safety	Public Health & Safety	Included
	Employee & Contractor Safety Risk	Excluded
Financial	Public Property	Included
	Company Property	Included
	Service Disruption	Included
Environmental	Environmental Rehabilitation	Excluded (Negligible)
Operational	Operational Disruption	Included
Reputational	Technical Regulator Fines	Included
	Reputational Damage	Included
GHG Emissions*	None	Included
Commodity Loss*	None	Included

**GHG Emissions and Commodity loss were previously included under the Environmental and Financial consequence categories respectively, but have been moved into separate value measure categories as per the latest Value Framework Definition Document Version 8.0. Values will be generated for both categories but will not be included in the risk summation.*

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3 Model Design

3.1 Overview

Risk is calculated as the frequency of failure multiplied by the consequence of failure at the asset level (or sub-asset level). The total frequency of failure for each asset or sub-asset is calculated as the summation of the applicable threats for the asset as shown in Figure 3.1:

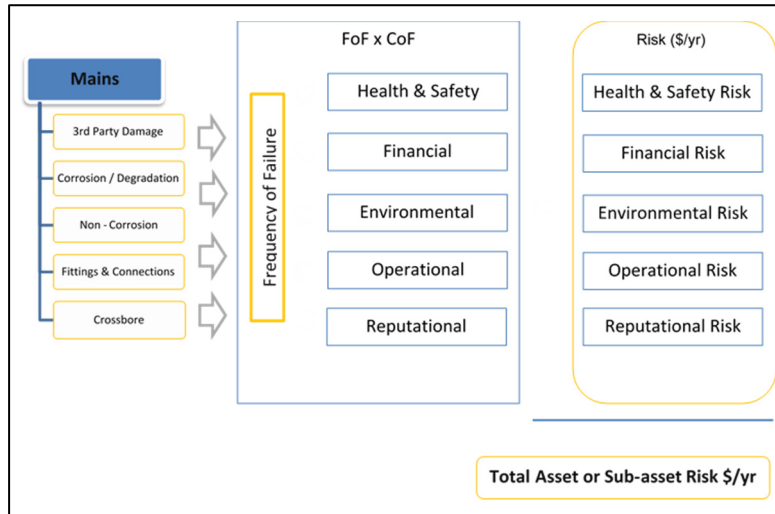


Figure 3.1

The risk of a cohort of assets or sub-assets can be calculated by summing the risk of the individual components as shown in Figure 3.2:

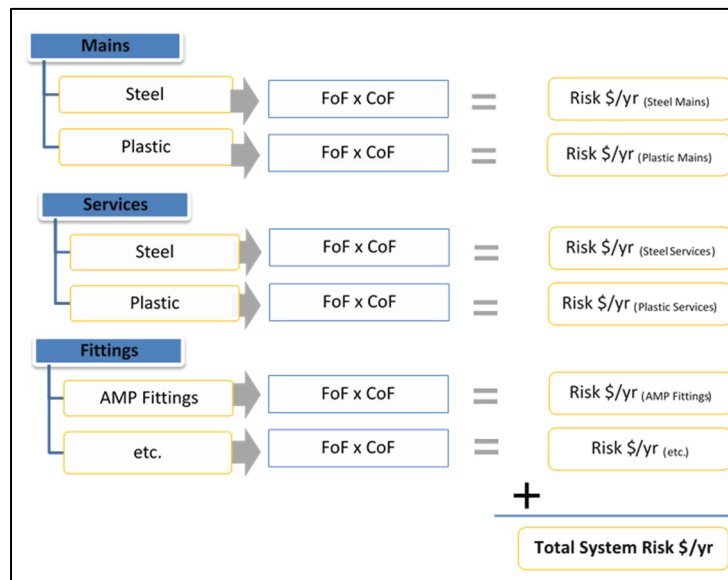


Figure 3.2

3.2 Dynamic Segmentation

When calculating risk for linear assets, it is desirable to account for changing conditions along the length of the asset that can impact the risk of failure. For example, a single main may span several hundred meters and span several different roads, land types, or travel from a highly urban environment into an area with relatively few consequence receptors. Changes in condition along the length of a linear asset can result in different levels of risk along the asset.

Dynamic segmentation is the process by which segments are created along the length of the asset any time there is a change in any core attribute which affects the risk calculation. In the current model, all mains are currently modelled as linear assets, and are thus dynamically segmented. The dynamic segmentation process ensures that each segment contains a unique combination of inputs for which risk can be calculated as shown in Figure 3.3.

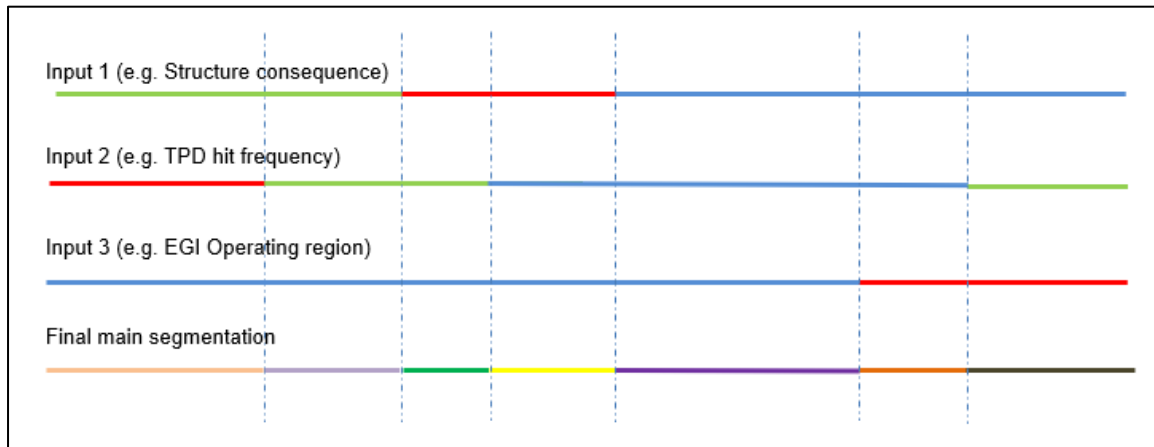


Figure 3.3

Dynamic segmentation is performed during the GIS sync process between the PRIM File Geodatabase and the PiMSlider database and includes the following input layers:

- Third Party Damage Hit Frequency
- Consequence Tessellation
- Population density
- EGI Operating Region
- LEGD and LUG Work Zones

Given that each segment represents a unique set of inputs to the risk calculation, dynamic segmentation avoids the requirement to select average or maximum inputs along the length of an asset, resulting in a more granular assessment and higher accuracy.

3.3 Event Trees

Quantitative risk assessment (QRA) requires modelling of the effects of loss of containment events to determine the consequences of failure. As release sizes and their consequences can vary depending on the mode of failure and can range from pinhole leaks to full-bore failures, it is conventional to subdivide the spectrum of possibilities into a number of categories and to calculate the consequences of each using a representative release size [3]. Applying this method, risk is proportioned across the spectrum of possible outcomes; as an example, accounting for the possibility that small leaks are more common but their consequences less significant.

In addition to release size, for a gas distribution system, consideration to whether the release occurs above ground or below ground will affect which consequences are most probable. Above ground failures (for example, from a third party backhoe strike) may result in outdoor ignitions at the source of the leak, whereas below ground releases where soil has not been removed may migrate through the soil, enter nearby structures, and create the potential for a Vapour Cloud Explosion (VCE).

Based on these considerations, the risk model follows the generalized event tree based on hole size shown in Figure 3.4.

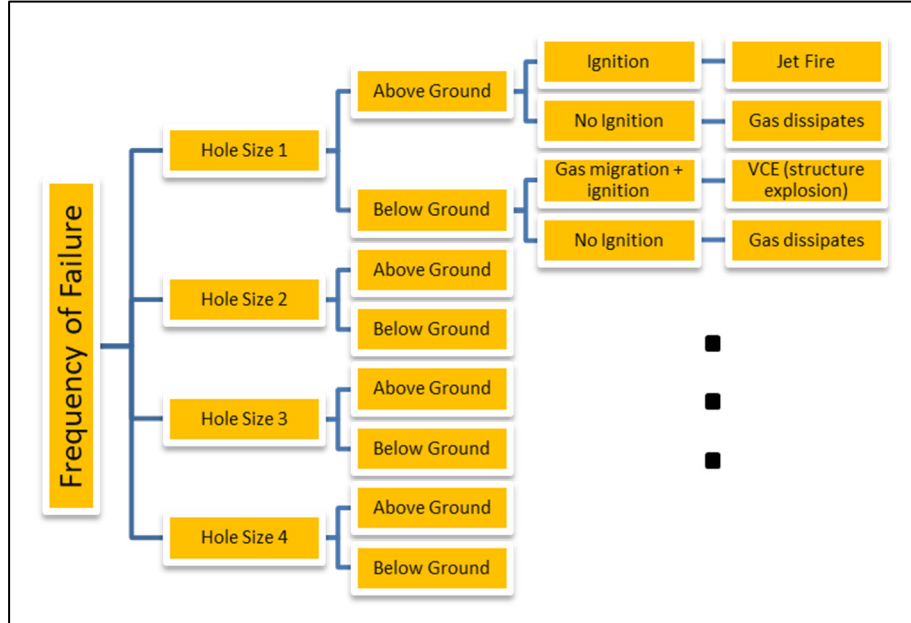


Figure 3.4

Further discussion on threat-specific event trees and the determination of each event probability can be found in the following sections.

4 Threat Models

4.1 Third Party Damage

A novel data driven model developed at LEGD was implemented to assess the system-wide frequency of failure from Third Party strikes for the EGI distribution system. Details of the EGI system-wide implementation and a review of key modelling decisions are discussed in this section. Model methodology and development details are thoroughly described in the “Modelling Third Party Damage Failure Frequency for Gas Distribution Steel Mains” report prepared by Risk Services [4].

Similar to the widely adopted “PRCI Reliability-based Prevention of Mechanical Damage to Pipelines” [5] model developed for transmission pipelines, the frequency of failure due to Third Party Damage is expressed as the product of 2 factors as described in Equation 4.1.

Equation 4.1

$$FoF_{TPD} = FoH_{TPD} \times P(Damage | Hit)$$

Where,

FoF_{TPD} = Frequency of failure due to Third Party Damage (Failures / km.yr)

FoH_{TPD} = Frequency of a Third Party Hit (Hits / km.yr)

$P(Damage | Hit)$ = Probability of Damage, given a hit

4.1.1 Hit Frequency

In the approach by Chen and Nessim, the frequency of hit factor is estimated based on a fault tree model that accounts for overall excavation frequency that occurs over the pipeline, the effectiveness of preventative measures, and likelihood that excavation depth exceeds the burial depth of the pipe.

A simplified view of the Chen and Nessim fault tree is shown in Figure 4.1.

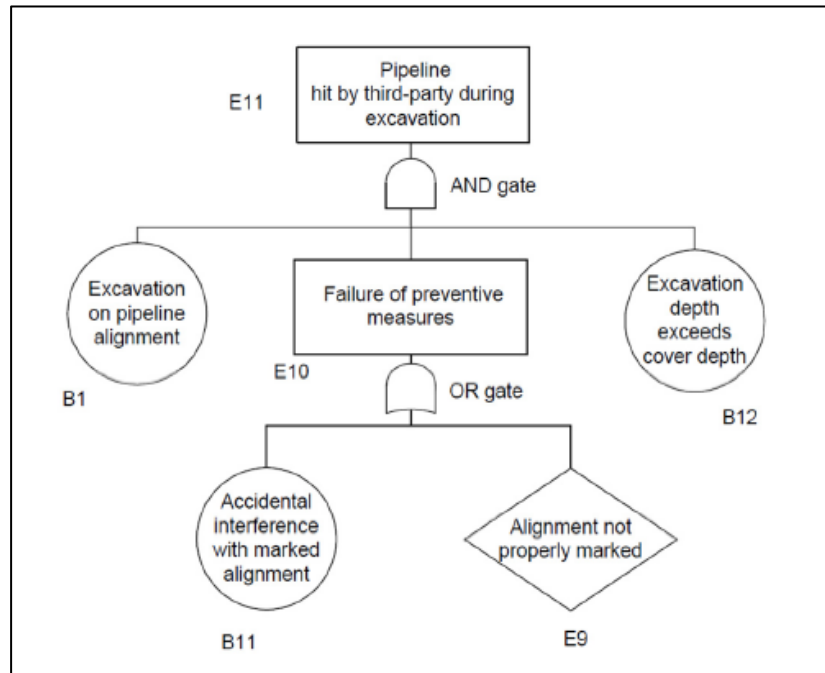


Figure 4.1

Due to the specificity of the Chen and Nessim fault tree for transmission pipelines (i.e. pipelines with well defined corridors and damage prevention barriers), and considering the dissimilar nature of the EGI distribution network from the operators that were surveyed by the authors (e.g. lack of dedicated corridors, urban sprawling environments), a novel approach was implemented in order to estimate the frequency of hit factor for the distribution system.

The approach uses an unsupervised machine learning clustering algorithm in order to determine geographic areas of similar excavation hit frequency within the EGI system. Based on engineering judgement and availability of data, clustering was completed on the following factors:

1. Excavation frequency (Ontario One-Call Locate tickets)
2. Past Damages (from LEGD and LUG Damage Prevention departments)
3. Overall exposure to damage (amount of pipe)

These three factors were selected on the basis that each was considered to significantly influence, based on tacit knowledge and consultation with damage prevention, the hit frequency within a particular region. Applicability of these factors is further discussed in the referenced report [4].

Locate tickets for LEGD and LUG were obtained containing data in years 2012 to 2020 from Ontario One-Call, with the historical cut-off corresponding with implementation of mandatory One-Call notifications. LUG and LEGD damage histories were obtained from each legacy company's respective damage prevention teams. Based on the availability of damage data for

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both LUG and LEGD, damages from 2016-2019 were selected for the clustering process. For system exposure (amount of pipe), GIS footprints of mains and services were taken from company GIS records.

A detailed discussion of data treatment, filtering, geocoding, and clean-up is described in Appendix A.

Clustering

Following data cleansing and geocoding, the previous described datasets were joined to a fishnet grid of 2 x 2 km square polygons covering the EGI system. A summary of the number of unique locate tickets, previous damages, and amount of pipe was summarized per unique Grid ID.

In order to normalize the input data for clustering, the values for ticket count, damage count, and amount of pipe were normalized to their z-scores as described in Equation 4.2.

Equation 4.2

$$Z_i = \frac{(X_i - m_i)}{\sigma}$$

Where,

Z_i = standardized z-score of the attribute

X_i = initial value of the attribute

m = sample mean of the attribute

σ = sample standard deviation of the attribute

A K-Means clustering algorithm using Euclidean distance was performed on the final grid layer in order to group grids of similar activity of past damages, locates, and exposure to damage. No spatial constraint was set, meaning that the final groups formed only as a result of the inherent attribute data (i.e. damage count, ticket count, and amount of pipe), not due to their geographic contiguity with each other.

Model Tuning and Performance

A total of 1963 damages at mains were used for the cluster analysis. As the K-Means algorithm requires the user to specify the number of clusters prior to clustering, it is desirable to have an objective method by which to select the optimal clusters.

Several iterations of K clusters were tested for the combined EGI dataset. It was found that for $K \geq 6$, a significant number of grids were clustered into groups where the overall count of damages was 0.

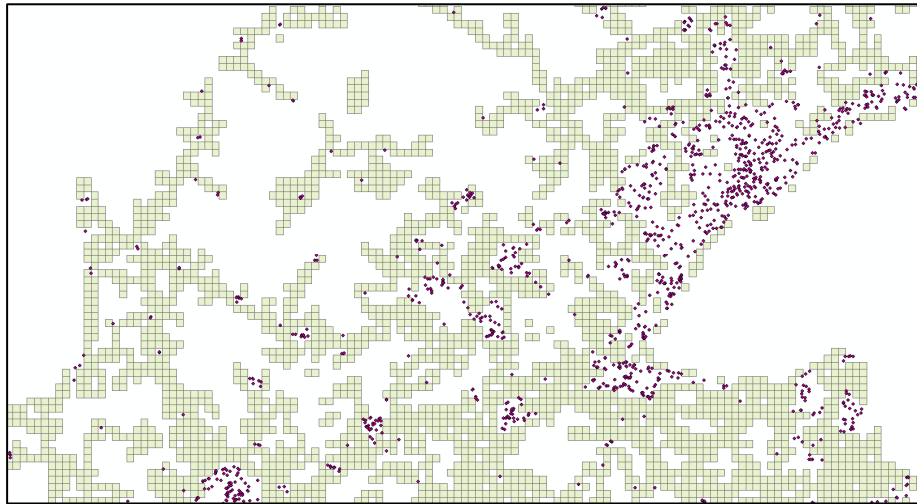


Figure 4.2

The results of clustering using $K = 6$ are shown in Figure 4.2. The grids shown in the figure belong to a cluster where no damages at mains were reported between 2016-2019, representing more than 80% coverage of the EGI system. Similar results were observed when clustering with higher values of K, with an increasing number of grids being clustered into groups with 0 damages.

From the perspective of system-wide risk assessment and considering the time-independent nature of third party damage, it was unrealistic to have a significant portion of the system show a 0 likelihood of a third party strike. For comparison, ticket density from 2014-2019 is shown for the same area in Figure 4.3.



Figure 4.3

This figure shows areas of significant excavation activity despite the lack of a reported main damage in a 4 year span, indicating a clear possibility for future damage. In essence, a choice of 6 or more clusters would have resulted in over-fitting to a relatively small sample set of damages, discounting the possibility of hits in areas where no damages were observed in a 4 year span.

Based on these considerations, 5 clusters were chosen as the optimal number of clusters in order to maximize the granularity of region-specific hit frequency, while also avoiding clusters of 0 damages. A visual representation of damages across the 5 clusters is shown in Figure 4.4.

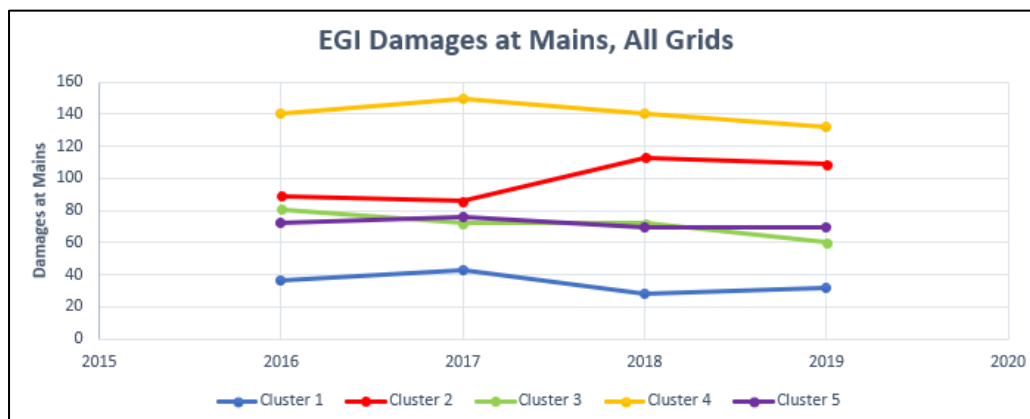


Figure 4.4

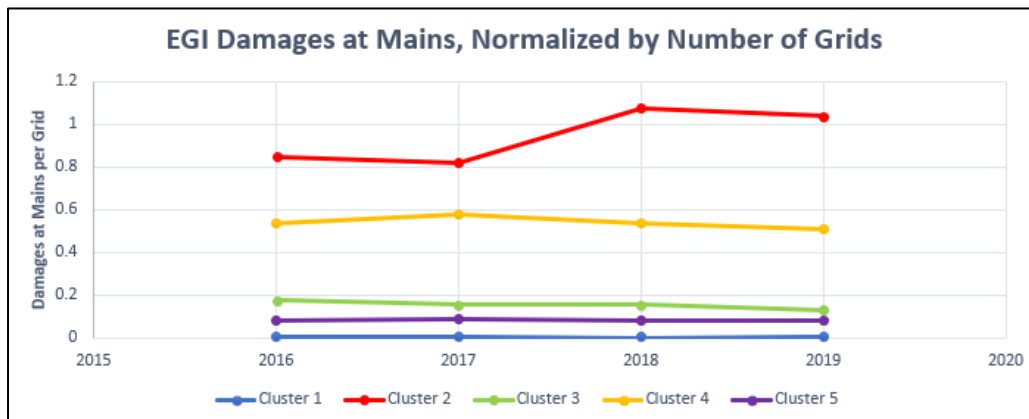


Figure 4.5

While some clusters appear similar when comparing number of damages, a parallel box plot of the 3 different attributes shows separations between clusters from the perspective of length of pipe, as well as number of tickets. As shown in Figure 4.6, although Cluster 3 and Cluster 5 appear to have similar numbers of damages, Cluster 3 represents areas with a higher overall density of locates and pipe. This leads to an interpretation that Cluster 3 represents areas of relatively low amount of damages when compared to the overall excavation activity exposure, potentially indicating the effectiveness of damage prevention. Conversely, Cluster 4 appears to have a high mean damages compared to overall excavation exposure, indicating potential areas where additional damage prevention measures may offer increased value.

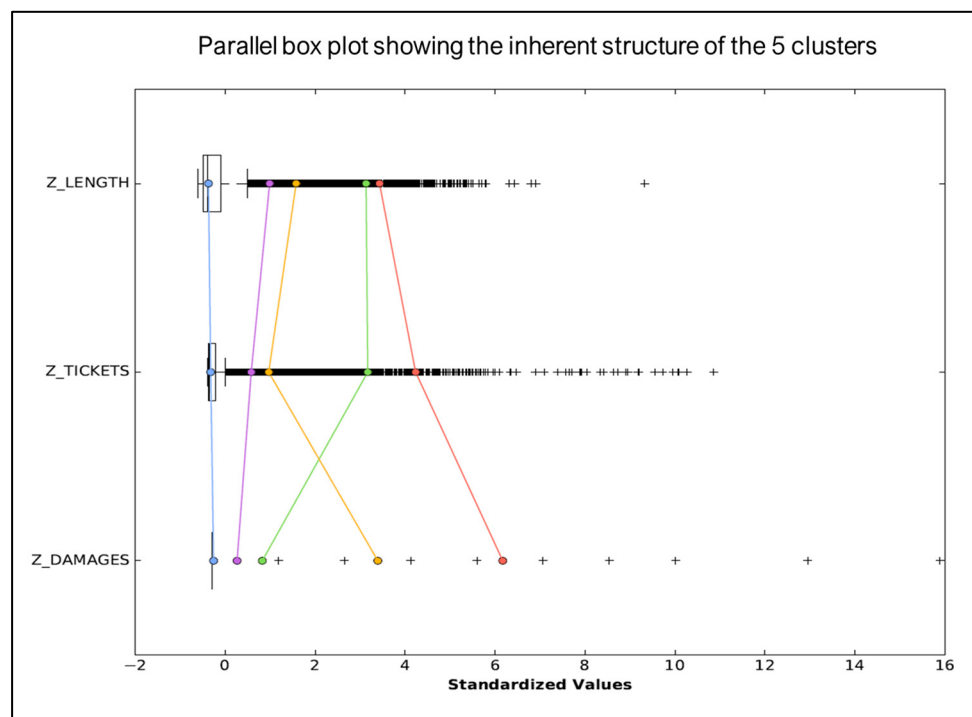


Figure 4.6

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Mains Hit Frequency

Following clustering, the hit frequency for each cluster was derived based on total number of damages and length of pipe across the cluster as detailed in Table 4.1. For hit frequency determination, only damages on plastic mains (and length of plastic mains) were considered due to the knowledge that many steel pipeline impacts could be unreported. It is assumed that all hits on plastic pipe will be reported as a damage, and thus the hit frequency per km.yr derived by looking at the total number of damages on plastic pipe (divided by the length of plastic pipe) can be directly transferrable to the hit frequency on steel pipe.

Table 4.1

Frequency of hit (hits / km.yr)						
Clusters	Auger / Vertical Drilling / Probing Device (Vertical Gas Escape)	Boring / Directional Drilling / Torpedo (Horizontal Gas Escape)	Excavator / Backhoe	Hand Tools	Other	Grand Total
1	2.61E-04	1.89E-04	1.76E-03	1.06E-04	1.04E-04	2.42E-03
2	2.57E-03	1.59E-03	2.02E-02	4.15E-03	5.84E-04	2.91E-02
3	4.83E-04	4.41E-04	3.49E-03	6.33E-04	5.35E-05	5.10E-03
4	1.84E-03	2.16E-03	2.06E-02	2.67E-03	6.94E-04	2.80E-02
5	5.83E-04	5.32E-04	4.53E-03	4.36E-04	1.29E-04	6.21E-03

The contribution of each equipment type was broken out per cluster by taking the overall average percent contribution from each equipment type per cluster as shown in Table 4.2.

Table 4.2

Contribution from each Equipment Type						
Clusters	Auger / Vertical Drilling / Probing Device (Vertical Gas Escape)	Boring / Directional Drilling / Torpedo (Horizontal Gas Escape)	Excavator / Backhoe	Hand Tools	Other	Grand Total
1	10.79%	7.91%	72.66%	4.32%	4.32%	100.00%
2	8.82%	5.54%	69.52%	14.11%	2.02%	100.00%
3	9.47%	8.77%	68.42%	12.28%	1.05%	100.00%
4	6.58%	7.83%	73.67%	9.43%	2.49%	100.00%
5	9.38%	8.68%	72.92%	6.94%	2.08%	100.00%

For the purposes of holistic modelling, five equipment categories were chosen to represent the spectrum of all types of offending equipment and their possible releases:

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Auger / Vertical Drilling / Probing Device – Represent above-ground drilling type tools where gas release will largely escape above ground. Such tools have a lower chance of below-ground migration.

Boring / Directional Drilling / Torpedo – Represent below-ground strikes from trenchless equipment where gas has a higher probability of migrating below-ground.

Excavator / Backhoe – Represent the highest offending equipment type across the system. Vertical gas release with a lower probability of below-ground migration. Due to the prevalence of this equipment type, mature empirical models exist to quantify the mechanism of damage from these machines.

Hand Tools – Represent the second highest contribution of total damages. Above ground strikes with a lower probability of damage on larger steel mains.

Other – Represent tools which do not fit into the above categories such as graders/scrapers, milling equipment, explosives, farm equipment, etc. These were modelled as above-ground releases.

Approximately 3% of all damages on mains had an unknown equipment type. These damages were distributed proportionally across each cluster.

The final heat map of third party hit frequency per km per year is shown in Figure 4.7.

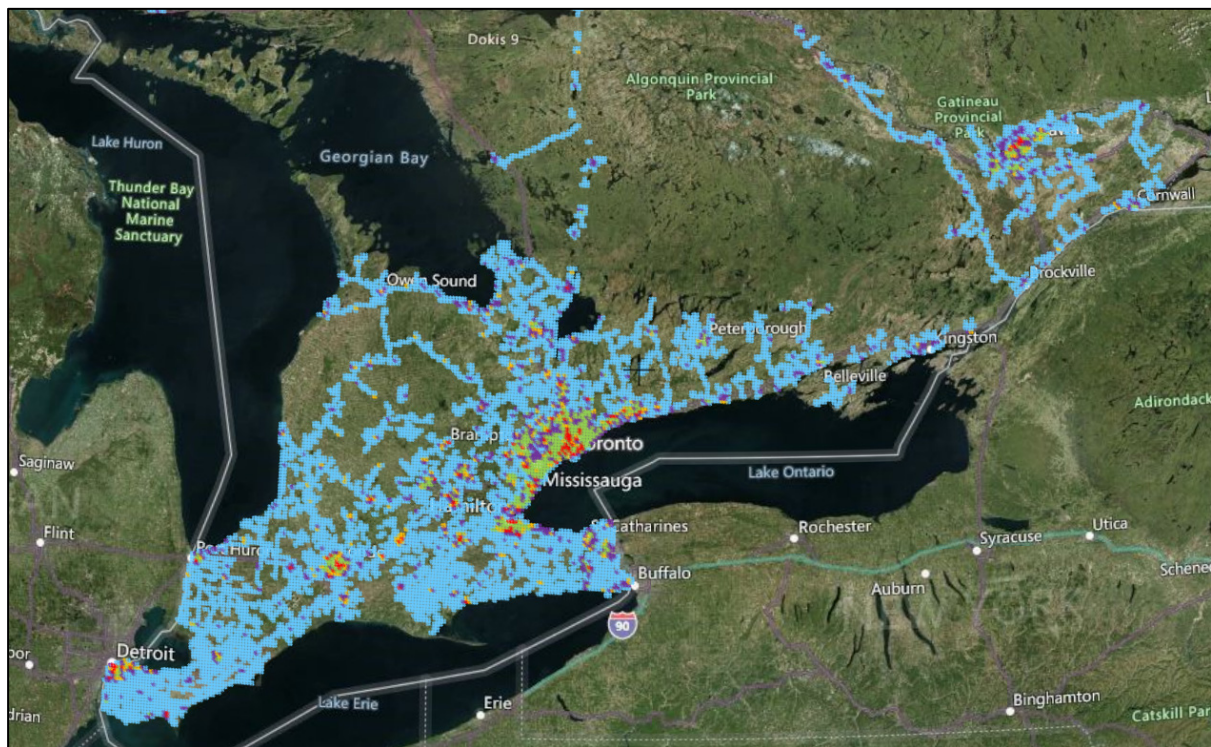


Figure 4.7

4.1.2 Probability of Damage, Given a Hit

Excavators / Backhoes:

For the excavator / backhoe equipment category, the probability of damage given a strike is calculated using a structural reliability model that estimates the impact force of the strike and pipeline's structural resistance to damage. Impact force and pipe resistance are modelled as random variables that account for the uncertainty in pipeline characteristics (e.g. wall thickness, UTS, charpy toughness, etc.), as well as the variation in load from the excavator. Conceptually, this can be represented by overlapping probability density functions that characterize the load and pipe resistance; the area where the impact load has exceeded the pipeline resistance represents the probability of failure as illustrated in Figure 4.8.

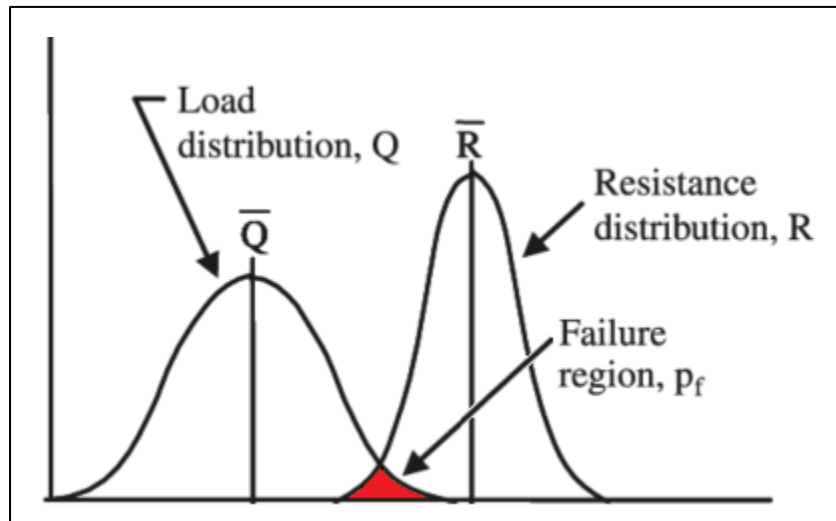


Figure 4.8

Two modes of failure are considered. The first is failure by bucket tooth puncture, which was explored by Chen and Nessim [5] and is represented by the limit state function described in Equation 4.3.

Equation 4.3

$$g_1 = R - F_N$$

Where,

R = Pipeline resistance to puncture, modelled as a random variable

F_N = Impact force normal to pipeline, modelled as a random variable

The second mode of failure is the gouge-in-dent failure mode, and is represented by the limit state function described in Equation 4.4.

Equation 4.4

$$g_2 = \sigma_c - \sigma_h$$

Where,

σ_c = Critical hoop stress of a dented and gouged pipe at which failure occurs, modelled as a random variable

σ_h = Operating hoop stress, modelled as a random variable

A limit state is defined as a state beyond which the pipeline no longer satisfies a particular design requirement [6]. Limit state functions may be understood as mathematical expressions that assume negative values when a limit state is reached (e.g. loss of containment) and a positive value if the limit state is not exceeded (i.e. no failure). Hence, the probability of failure by either limit condition can be understood as the probability that either limit state function takes on a value less than 0.

The final probability of failure can be expressed as the “OR-gate” probability of puncture or gouge-in-dent failure. As these are mutually exclusive events, probability of failure can be expressed as Equation 4.5.

Equation 4.5

$$Pf_{Total} = Pf_{puncture} + Pf_{gouge-in-dent}$$

The governing equations and random variable inputs for the load and resistance parameters are described in the following section. In order to solve the resulting system of equations, Monte Carlo simulation is performed with 1,000,000 iterations in order to determine the above probabilities of puncture and gouge-in-dent failure.

Excavator Force:

The maximum quasi-static force exerted by the excavator is strongly correlated to the mass of the machine. A relationship was described by Fuglem et al [7] based on data supplied by manufacturers on excavator mass and maximum load as described in Equation 4.6.

Equation 4.6

$$F_I = 16.5 \cdot W_E^{0.6919} + E_Q$$

Where,

F_I = Maximum quasi-static impact force, in N

W_E = excavator mass, in tonnes

E_Q = a random variable for model error (normal distribution with $\mu = 0$, $\sigma = 17.67$)

Fuglem et. al presented a method to characterize the mass of the excavator by location class. It was found that excavators used in Class 1 and Class 2 areas followed the prior bi-modal distribution described by Zimmerman [8], while excavators in Class 3 and Class 4 did not exceed a mass of 40 tonnes. Based on this, the full excavator mass distribution described by Zimmerman et al was used for Class 1 and Class 2 areas, and a truncated version of the distribution was used for Class 3 and Class 4 areas.

The full excavator mass distribution is characterized by a shifted gamma distribution with parameters $\alpha = 0$, $\beta = 17.67$, shift = 17.53. Truncation at 40 tonnes occurs at the 80th percentile as shown in Figure 4.9.

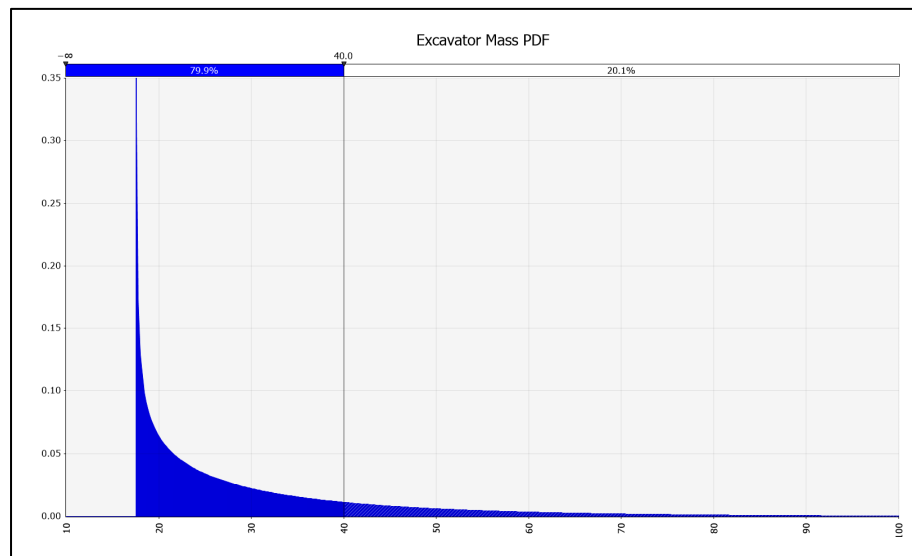


Figure 4.9

Class location was determined for the EGI distribution system based on population density from Statistics Canada. A cut-off of 3.3 people per hectare was chosen to separate between Class 1 & 2 and Class 3 & 4 based on data collected by Nessim and Zhou [9].

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The above model is appropriate only when the applied force is normal to the pipe wall. The normal component of the force that impacts the pipe is calculated by assuming that impact angle is equally likely from all approach angles as shown below; the reduction factor to calculate the normal force is taken as a uniform distribution between 0 and 1 [7] as describe by Equation 4.7.

Equation 4.7

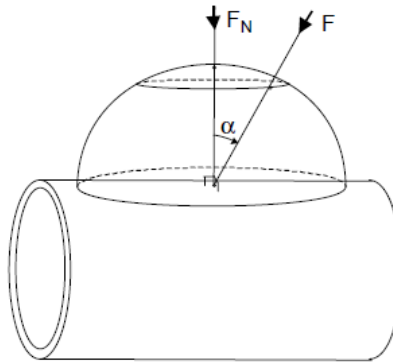
$$r = \frac{F_N}{F} = \text{RAND}(0,1)$$

Where,

r = reduction factor

F = Maximum quasi-static impact force

F_N = Normal component of impact force

**Puncture Failure:**

The pipeline resistance to puncture has been described empirically by Chen and Nessim [5] as described by Equation 4.8.

Equation 4.8

$$R = \left[1.17 - 0.0029 \left(\frac{D}{t} \right) \right] \cdot (L + W) \cdot t \cdot \sigma_U + E_R$$

Where,

R = Pipeline resistance to puncture, in N

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t = Wall thickness, in mm

L = Indentor tool length, in mm

W = Indentor tool width, in mm

σ_U = Ultimate tensile strength of the pipe, in MPa

E_R = Model error, in N (normal distribution with $\mu = 833$, $\sigma = 26700$)

Excavator tooth length and width distributions were taken from Fuglem et al based on a survey of excavator manufacturers.

Gouge-in-dent Failure:

The gouge-in-dent failure mode can occur when the dent and gouge from an impact are of sufficient depth, but the impact force is insufficient to cause puncture. In such cases, on removal of the indenter force, the pressure in the pipe pushes out on the created dent, causing a bending moment that opens cracks formed along the gouge tip during impact [7].

Gouge-in-dent failure has been described empirically by the NG-18 Q-factor relationship [10] shown in Equation 4.9 and Equation 4.10.

Equation 4.9

$$\sigma_c = \sigma_f \left(\frac{(Q - C_2)^{0.6}}{C_3} \right)$$

Equation 4.10

$$Q = C v_{2/3} \left[\frac{Rt}{D d_g c_g} \right]$$

Where,

σ_c = Critical hoop stress at failure

σ_f = Flow stress of the line-pipe steel = $\sigma_{yield} + 10000 \text{ MPa}$

Q = Gouge-in-dent severity factor

C_2 = Constant, 300 ft-lbs/in

C_3 = Constant, $90 \text{ (ft-lbs/in)}^{0.6}$

$C v_{2/3}$ = Upper shelf Charpy V-notch energy (2/3 specimen size)

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R = Pipe radius

c_g = Half-length of the gouge

d_g = Depth of the gouge

D = Maximum depth of dent at time of impact, prior to rerounding

Dent Depth:

Dent depth has been shown to be a function of pipe diameter, ultimate tensile strength, excavator tooth length, wall thickness, operating pressure, and excavator force[11] as described by Equation 4.11.

Equation 4.11

$$P_r = \sqrt{t^3 \cdot UTS \cdot L} \left[1 + 0.7 \left(\frac{MOP \cdot D}{t \cdot UTS} \right) \right]$$

Where,

UTS = Ultimate tensile strength

L = Excavator tooth length

MOP = Maximum operating pressure

D = Pipe diameter

t = Pipe wall thickness

P_r = Pipeline resistance parameter, where:

$$\text{If } P_r \leq 2000 \text{ mm}\sqrt{N}, H = \left(\frac{F_N}{0.007 \cdot P_r} \right)^2$$

$$\text{If } P_r > 2000 \text{ mm}\sqrt{N}, H = \left(\frac{F_N}{0.31\sqrt{P_r}} \right)^2$$

Where,

H = Dent depth after re-rounding

F_N = (Normal) denting force

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The depth of the dent prior to re-rounding can be estimated using the following relationship [11]:

$$D = 1.43 \cdot H$$

Where,

D = Maximum depth of dent at time of impact, prior to rerounding

Gouge Depth and Length:

A distribution of gouge depth and length was presented by UKOPA based on incident data up to 2010 [13]. Gouge dimensions are characterized by the following Weibull parameters [13]:

Gouge length: $\alpha = 0.573$, $\beta = 125.4$ (mm)

Gouge depth: $\alpha = 0.674$, $\beta = 0.916$ (mm)

Hoop Stress:

Hoop stress is the force exerted circumferentially (perpendicular to the axis and the radius of the object) in both directions on every particle in the cylinder wall. For thin-walled pipe applications (i.e. $D/t < 20$), hoop stress is calculated by applying Equation 4.12.

Equation 4.12

$$\sigma_h = \frac{MOP \cdot D}{2t}$$

Where,

σ_h = Hoop stress, in Mpa

MOP = Maximum operating pressure

D = Pipe diameter

t = Pipe wall thickness

Operator Control Factor:

As described by Fuglem et al [7], the operator will in most instances apply a load considerably less than the maximum quasi-static load, though it is possible to apply dynamic loads to approximately twice the maximum quasi-static load if required. The typical actual capacity at which the machine is used will depend on the soil type and how aggressively the operator digs.

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On meeting resistance, the operator may apply a larger force or may try to work around the object. The actions will likely vary significantly depending on whether the presence of a pipeline is suspected.

Due to the variability in the applied force by the operator, which exists independent of the relationship between the excavator mass and the maximum quasi-static force, a correction factor was applied to account for this variability as described in Equation 4.13.

Equation 4.13

$$F_N(\text{corrected}) = F_N \cdot OCF$$

Where,

F_N = Normal component of impact force

OCF = Operator control factor

The operator control factor was determined using the average number of reported excavator / backhoe damages on steel mains per year across the EGI system over 2016 - 2019. Based on damage prevention data, an average of 46 damages per year on steel mains were reported across EGI. Applying the hit frequency as determined in Section 4.1.1, Monte Carlo simulation using 100,000 iterations was performed multiple times until the simulation converged to the target number of system-wide failures. The operator control factor was determined to be 0.33.

Data Treatment:

A discussion of data treatment for inputs to the mechanical model is contained in Appendix A. Table 4.3 shows the summary of distribution used for the inputs into the Monte Carlo simulations.

Table 4.3

Model Parameters	Units	Distribution Type	Distribution parameters	Reference
Pipe Mechanical, Geometry and Operation Parameters				
Specified Minimum Yield Strength, SMYS (σ_{yield})	MPa	Normal	$\mu=1.1 \cdot \text{nominal}$, COV=3.5%	CSA Z662 Annex O
Ultimate Tensile Strength (UTS)	MPa	Normal	$\mu=1.12 \cdot \text{nominal}$, COV=3.5%	CSA Z662 Annex O
Charpy V notch energy $Cv_{2/3}$	J	Lognormal	$\mu=\text{nominal}$ $cov = 0.0223\mu^{0.46}$	Nessim & Zhou (2005)

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Pipe Outside Diameter, (D)	mm	Normal	$\mu=1.0*\text{nominal}$, COV=0.06%	CSA Z662 Annex O
Pipe wall thickness, (t)	mm	Normal	$\mu=1.01*\text{nominal}$, COV=0.06%	CSA Z662 Annex O
Pipe operating pressure (MOP)	MPa	Fixed at MOP	n/a	Fuglem et. al. (2001)
Pipe Defect Parameters				
Gouge depth (d_g)	mm	Weibull	shape = 0.674 scale=0.916	(Goodfellow, Haswell, & Turner, 2012)
Gouge length ($2c_g$)	mm	Weibull	shape = 0.573 scale=125.4	(Goodfellow, Haswell, & Turner, 2012)
Mechanical Load Parameters				
Excavator mass	tonnes	Gamma	$\alpha=0.632$, $\beta=21.638$, shift=17.53	(Ma, Zhang, & Desjardins, 2016)
Cross sectional length of the indenter, L	mm	Uniform	[40...140]	Fuglem et. al. (2001)
Cross sectional width of the indenter, T	mm	Uniform	[2...5]	Fuglem et. al. (2001)

Other Equipment Types:

Industry accepted models for probability of damage for equipment types other than the excavator / backhoe category for steel mains were not available at the time of model development. In absence of suitable models, the probability of damage given a hit for these tools was derived based on the average number of damages reported for each equipment per year divided by the hit frequency as described in Section 4.1.1 and Equation 4.14.

Equation 4.14

$$\text{Probability of Damage} = \frac{\sum \text{Failures per year}}{\sum (\text{Frequency of hit per km.yr} \cdot \text{Length})}$$

The derived probabilities of damage for the different equipment categories are shown in Table 4.4.

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Table 4.4

Equipment Type	Probability of Damage, Steel
Excavator / Backhoe	Mechanical model
Auger / Vertical Drilling / Probing Device (Vertical Gas Escape)	0.0646
Boring / Directional Drilling / Torpedo (Horizontal Gas Escape)	0.267
Hand Tools	0.109 for mains \leq NPS 4 0 for mains $>$ NPS 4
Other	0.903

For the hand tools category, it was considered unlikely that such tools would cause damage to steel pipes greater than 4". This was supported by the review of LUG damage data for this category, which showed no damages on steel mains greater than NPS 4 with hand tools. Thus, probability of damage for hand tools was derived assuming damage could only occur on steel mains \leq NPS 4.

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4.1.3 Outcomes**Hole Size:**

Hole size probabilities across the different equipment categories were determined from a review of LUG damage data from 2016 to 2019. A total of 5,323 incidents were available during this period - with 1,060 out of the 5,323 damages occurring on mains.

For the analysis, hole sizes and equipment type data were cleaned in order to normalize free-form text entries and remove invalid entries. Equipment types were also mapped to their respective categories. A detailed description of the data processing can be found in Appendix A.

Based on review of the data, 4 representative hole sizes were selected for the event tree:

- Outcome 1 - O1: 10mm² (pinhole)
- Outcome 2 - O2: 645 mm² (1in²)
- Outcome 3 - O3: 2580 mm² (4in²)
- Outcome 4 - O4: Full-bore sever

The hole size probabilities across the various equipment categories are summarized in Table 4.5.

Table 4.5

Equipment Category	Material	Pipe Size	O1	O2	O3	O4
Excavator / Backhoe	Steel	NPS < 2	0	0	0	1
		2 < NPS < 4	0	0.25	0.25	0.5
		NPS ≥ 4	0	0.5	0.5	0
	Plastic	NPS < 2	0	0	0	1
		2 < NPS < 4	0	0.25	0	0.75
		NPS = 4	0	0.2	0.5	0.3
		NPS > 4	0	0.5	0.5	0
	Augers / Drilling / Probing Devices	NPS < 2	0	0	0	1
		NPS ≥ 2	0	1	0	0
	Plastic	NPS < 1.25	0	0	0	1
		NPS = 1.25	0	0.5	0	0.5

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Equipment Category	Material	Pipe Size	O1	O2	O3	O4
		$1.25 < \text{NPS} \leq 2$	0	0.75	0	0.25
		$\text{NPS} > 2$	0	0.5	0.5	0
Boring / Directional Drilling / Torpedo	Steel	$\text{NPS} < 2$	0	0.5	0	0.5
		$\text{NPS} \geq 2$	0	0.5	0.5	0
	Plastic	$\text{NPS} \leq 1.25$	0	0.75	0	0.25
		$1.25 < \text{NPS} \leq 2$	0	0.5	0	0.5
		$\text{NPS} > 2$	0	1	0	0
Hand Tools	Steel	$\text{NPS} \leq 0.5$	0	0	0	1
		$0.5 < \text{NPS} \leq 2$	0.8	0	0	0.2
		$\text{NPS} > 2$	1	0	0	0
	Plastic	$\text{NPS} < 2$	0.5	0.2	0	0.3
		$\text{NPS} = 2$	0.5	0.3	0	0.2
		$\text{NPS} > 2$	1	0	0	0
Other	Steel*	$\text{NPS} < 2$	0	0	0	1
		$2 < \text{NPS} < 4$	0	0.25	0.25	0.5
		$\text{NPS} \geq 4$	0	0.5	0.5	0
	Plastic	$\text{NPS} \leq 2$	0	0	0	1
		$2 < \text{NPS} \leq 4$	0	0.25	0.5	0.25
		$\text{NPS} > 4$	0	0.5	0.5	0

*Due to lack of data for this category of damage, the same hole size distribution as the excavator / backhoe category was assumed

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4.2 AHR Models

The Asset Health Review (AHR) is an annual reliability assessment produced by the EGI Distribution System Integrity (DIMP) department that aims to project the number of leaks from time-dependent threats such as corrosion and plastic degradation. The AHR predicts expected leak frequency across assets for up to 40 years into the future. The PRIM Distribution Risk Model uses the outputs of the AHR directly as inputs into the yearly frequency of failure.

The AHR model outputs that are currently used in the Risk Model as described in the tables below.

Table 4.6 - Mains

Asset Subclass	Model	Model Type
Steel Mains	Steel Main Corrosion	Log-Linear NHPP
	Steel Main Non-Corrosion	
Pre-1977 PE Mains	Pre-1986 PE Main	
1977–1985 PE Mains		
Post–1985 PE Mains	Post-1985 PE Main	

Table 4.7 - Services

Asset Subclass	Model	Model Type
Steel Services	Steel Services	2 Parameter Weibull
Pre-1977 PE Services	Pre-1977 PE Services	
1977-1985 PE Services	1977-1985 PE Services	
Post-1985 PE Services	Post-1985 PE Services	

Table 4.8 – Copper Risers (AMP fittings)

Asset Subclass	Model	Model Type
Copper (AMP) Riser	Copper (AMP) Riser	2 Parameter Weibull

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The AHR reliability models produce the expected number of failures per year on a per-asset basis. In order to apply these projections to dynamic segmentation for risk calculation, the expected number of failures per year per asset are proportioned across the segments as described by Equation 4.15.

Equation 4.15

$$FoF_{Segment} = FoF_{Asset} \cdot \frac{Length_{Segment}}{Length_{Asset}}$$

The AHR modelling is described in the annual Asset Health Review report and associated modelling documentation.

Hole Size:

For the current scope of assets included in the Risk Model, it is assumed that all leaks arising from threats described in the AHR are below-ground leaks (i.e. will not form above-ground fires). In addition, all failures have been assigned a nominal hole size of 10mm², corresponding with the pinhole leak size used for corrosion leaks. An explicit hole size definition was not explored for AHR threats at this stage given that the current below-ground leak modelling does not apply physics-based models (e.g. models which are dependant on an estimation of release rate of gas). The below-ground leak model is further described in Section 5.1 - Below Ground Releases.

4.3 Fittings & Connections and Uplift Factors

The current iteration of the AHR assessment does not include leaks from certain threats. In order to account for the balance of leaks that are not included in the AHR, models from the previous Simplified Risk Assessment Tool (SRAT) algorithm have been included for the threats in the following section.

Steel Mains:

Failures due to fittings and connections on steel mains are accounted by an uplift factor on the number of corrosion and non-corrosion leaks as described by Equation 4.16.

Equation 4.16

$$FoF_{Fittings \& Connections} = \frac{(FoF_{Corrosion (AHR)} + FoF_{Non-Corrosion (AHR)})}{(1 - F\&C_{Fraction})} \cdot F\&C_{Fraction}$$

Where,

$FoF_{Corrosion (AHR)}$ = Frequency of failure due to Corrosion (from AHR)

$FoF_{Non-Corrosion (AHR)}$ = Frequency of failure due to Non-Corrosion (from AHR)

$F\&C_{Fraction}$ = An uplift factor, 0.231

Plastic Mains:

Failures due to fittings and connections on plastic mains are modelled with an exponential relationship as described by Equation 4.17.

Equation 4.17

$$FoF_{Fittings \& Connections} = a \cdot e^{(b \cdot Age)} * Length$$

Where,

$Length$ = Segment length, in m

Age = Age of segment, in years

a, b = Constants as shown in Table 4.9

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Table 4.9

NPS	Age	a	b
NPS ≤ 1.25	Age < 36	0.000000129978	0.04325939
	Age ≥ 36	3.123046E-11	0.281481
1.25 < NPS ≤ 3	Age < 40	0.000000366244	0.050173
	Age ≥ 40	5.91982E-13	0.383079
NPS > 3	Age < 36	0.0000005792019	0.05346518
	Age ≥ 36	0.00000001098263	0.1753869

Services:

Failures due to fittings and connections and non-corrosion / degradation threats on services are accounted by an uplift factor on the number of corrosion / degradation leaks as described by Equation 4.18.

Equation 4.18

$$FoF_{Other} = \frac{FoF_{(AHR)}}{(1 - Uplift_{Fraction})} \cdot Uplift_{Fraction}$$

Where,

$Uplift_{Fraction} = 0.39$ for steel services, 0.94 for plastic services

$FoF_{(AHR)}$ = Frequency of failure due to corrosion or degradation (AHR)

Hole Size:

The same rationale for assigning a holes size definition to the AHR threats applies to Fittings and Connections. For the current scope of assets included in the Risk Model, it is assumed that all leaks arising from the Fittings and Connections threats are below-ground leaks and all failures have been assigned a nominal hole size of 10mm².

4.4 Cross-Bore

The frequency of a cross-bore failure per year is expressed as the number of expected cross-bores per asset multiplied by the annual probability of puncture given the existence of a cross-bore as shown in Equation 4.19.

Equation 4.19

$$FoF_{Crossbore} = \text{Number of Crossbores per Asset} \times P(\text{Puncture} | \text{Crossbore})$$

The number of expected cross-bores per asset is taken from the Spotlight tool algorithm, which is based on factors such as installation method, region, SME input (from workshops between EGI and JANA), and post-installation camera inspections. Details on the Spotlight algorithm can be found in associated software documentation. The output from the Spotlight tool is used directly in the distribution assets risk model to determine the number of legacy cross-bores per asset.

Given the existence of a cross-bore and following puncture, gas may enter a nearby structure via the sewer and ignite. The full event tree for puncture of a legacy cross-bore is shown in Figure 4.10

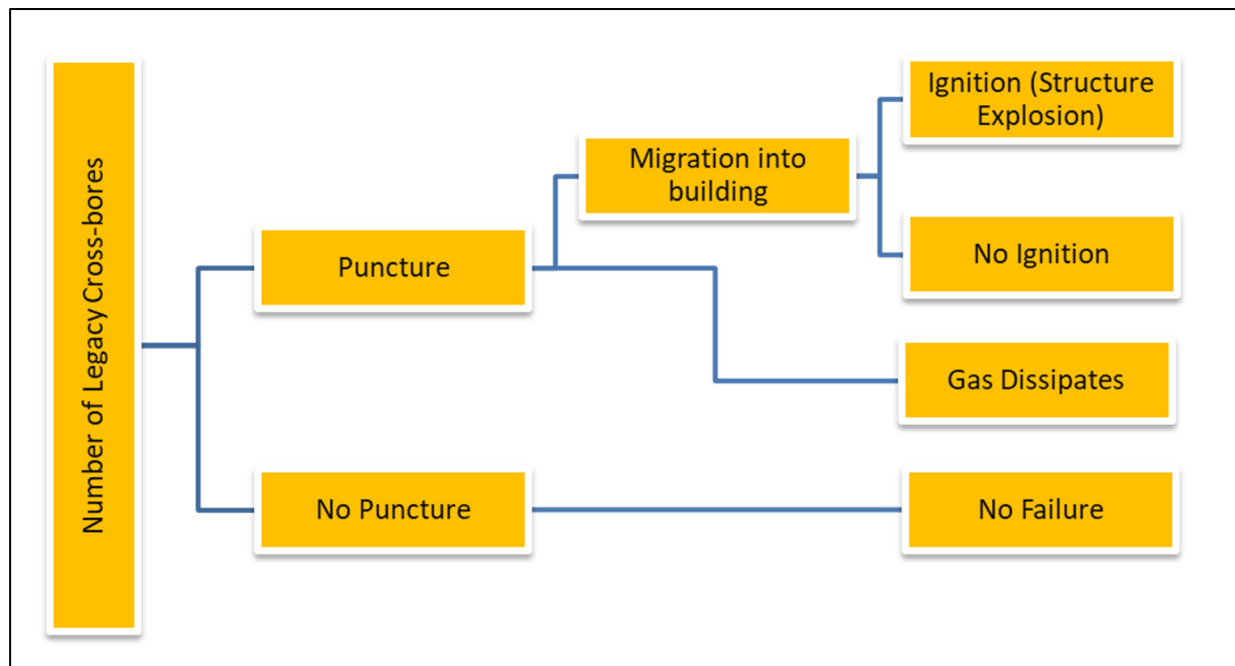


Figure 4.10

As described in Equation 4.20, the probability of having an ignition event due to cross-bore can be represented as the multiplication of consecutive conditional probabilities.

Equation 4.20

$$\begin{aligned}
 P(\text{Explosion} | \text{Crossbore}) \\
 &= P(\text{Puncture} | \text{Crossbore}) \times P(\text{Migration leading to LEL} | \text{Puncture}) \\
 &\quad \times P(\text{Ignition} | \text{Migration leading to LEL})
 \end{aligned}$$

In order arrive at a quantitative prediction of number cross-bore failures that is comparable to other threats in the system, an approach was adopted in order to derive the required probabilities by examining the overall frequency of catastrophic cross-bore incidents that have occurred at EGI. The approach is outlined in consequence model described in Section 5.8 - Crossbore.

Discussion and Exploratory Model Assessment

In order to determine annual probability of puncture from a first-principles basis, it would be desirable to know the frequency of sewer clearing activities and the vulnerability of various pipeline materials to damage from sewer clearing tools. Following puncture, the probability of migration into the building, reaching LEL, and subsequent ignition might be expected to be a function of release rate, the existence of a Excess Flow Valve (EFV), as well as type and size of the building as described below:

$$P(\text{Puncture} | \text{Crossbore}) = f(\text{sewer clearing frequency, intersection geometry, pipe material, pipe size, type of clearing tool})$$

$$P(\text{Migration leading to LEL} | \text{Puncture}) = f(\text{EFV, release rate, building size})$$

$$P(\text{Ignition} | \text{Migration}) = f(\text{ignition sources})$$

Due to a lack of knowledge on the frequency of sewer cleaning activity, types of tools used, and lack of empirical data to support a mechanical puncture model, determining a mechanistic quantitative model for probability of puncture poses a challenge. Validation of probability of puncture is also problematic as incident data for non-ignited cross-bore failures is limited. In order to arrive at a prediction for the probability of migration and ignition following puncture, mechanistic quantitative models might require an estimate on the amount of gas released, size and distance of the structure, ventilation rates, and whether or not ignition sources would be

present. Conservative estimates could be applied in absence of detailed modelling or data; however, these would necessarily have a high degree of uncertainty.

Another possible approach in absence of mechanistic quantitative models is to assign qualitative estimates to these individual probabilities based on subject matter experience. This has the advantage of being able to assign a higher or lower probability of explosion for different types of assets or regions based on tacit knowledge rather than quantitative models, and has the advantage of being flexible in accommodating varying amounts and quality of data.

In the context of a quantitative risk model however, assigning qualitative probabilities to these factors also poses some challenges:

- Qualitative probabilities (scores) include a high degree of subjectivity which hinges on the experience of the assessor, and may vary significantly between person to person.
- Risk results of qualitative models are generally not proportional to frequency or expected loss [1]. This means that comparing the risk outputs of a qualitative cross-bore model to those of other models that were calibrated on actual incident data would yield non-meaningful results (i.e. it would not be possible to compare cross-bore risk with risk from other threats such as third party damage, corrosion, or general fitting leaks).
- Qualitative modelling is applicable for prioritization of work or baseline Integrity assessments, but is limited in its use to support general risk management decision-making, cost-benefit analysis for risk reductions, or preventative or mitigative measure evaluation, without additional quantitative inputs to the risk assessment process[1].

5 Consequence Models

5.1 Below Ground Releases

5.1.1 Migration + Ignition

The vast majority of below ground leaks from the distribution network dissipate into the atmosphere with minimal Health & Safety consequence. However in rare cases, underground leaks may migrate through the soil or via below-ground infrastructure, reach an enclosed area or structure, accumulate to ignitable levels, and encounter an ignition source. Such incidents are rare, but have the potential to be catastrophic.

Exploratory literature review was completed and it was determined that there is no current industry prevalent methodology to model the phenomenon of below-ground gas migration from natural gas infrastructure. EGI specific incident data was also found to be deficient for use as described in the Discussion section.

Given limitations in existing model and EGI specific data, an approach was therefore adopted where the number of system-wide frequency of migration-related ignitions from PHMSA was derived in units of km per year. Using this estimate, the frequency of migration-related ignitions in the EGI system was estimated by applying the per km per year frequency to EGI mileage counts.

Model Development

The model development included evaluation of data sources for possibility of bias, a thorough manual review of PHMSA incident data, data treatment and refinement, and validation of results against tactic knowledge of EGI subject matter experts.

Evaluation of Possible Bias - U.S. system compared EGI system

The underlying assumption under this method of imputation is that the U.S. distribution system is broadly comparable to that of the EGI network in terms of key factors such as age, material, construction practices, leak rates, and consequence receptors, once system exposure is taken into account. To examine both systems, a comparison is shown using the available data published in the PHMSA annual mileage reports.

A comparison was completed of the aggregated U.S. distribution system with the EGI network for key properties so such pipe materials and pipe age as shown in the Tables and Figures below:

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Pipe Materials:

Table 5.1 – EGI System Materials by Length

Asset Subclass	LUG Total (km) ¹	LEGD Total (km) ²
Steel Mains	16,911.55	12,335
Pre-1977 PE Mains	85.73	981
1977-1985 PE Mains	3,689.30	4,411
Post-1985 PE Mains	18,530.11	19,942
Total	39,216.69	37,669

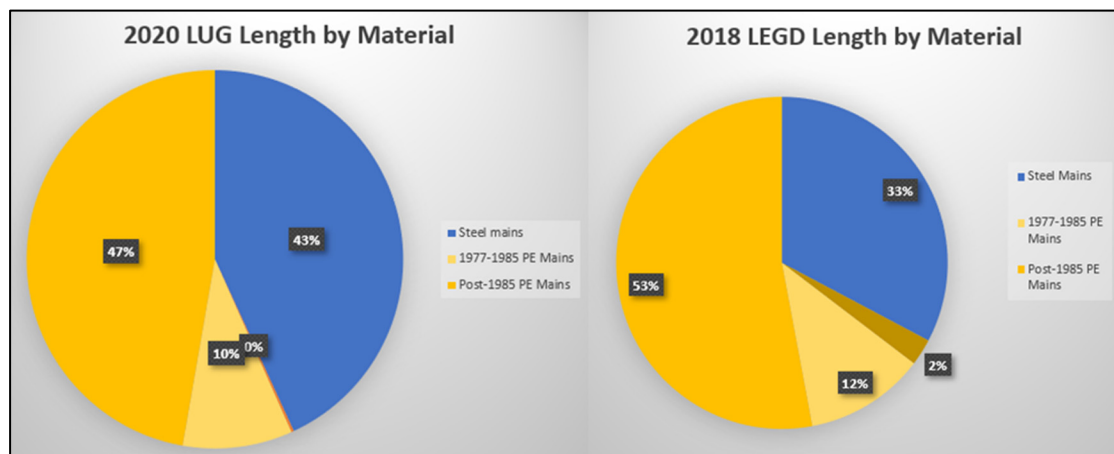


Figure 5.1 – EGI System Materials Breakdown

Table 5.2 – U.S. Gas Distribution System Materials by Length

Material	Length (km) ³
Steel	842,133.46
PE	1,239,261.2
Cast Iron	37,200.02

¹ LUG Based on GIS mains population extract² LEGD System Based on 2018 AHR Report³ PHMSA 2019 Annual Mileage Report

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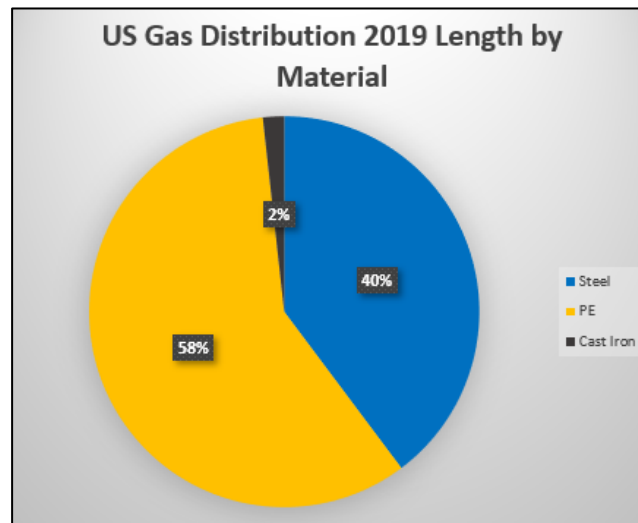


Figure 5.2 – U.S. Gas Distribution System Materials Breakdown

Pipe Age (Vintage):

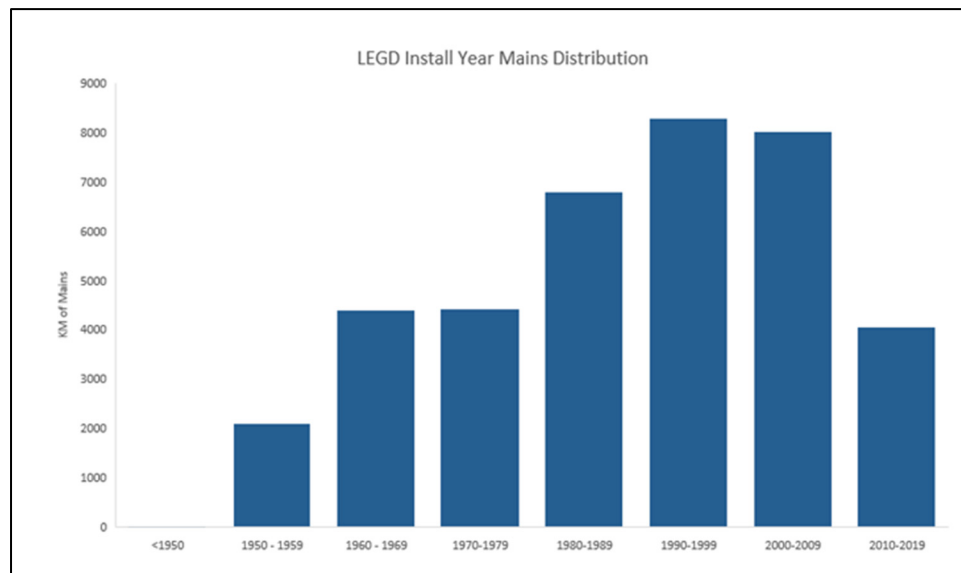


Figure 5.3 – LEGD Install Year Distribution

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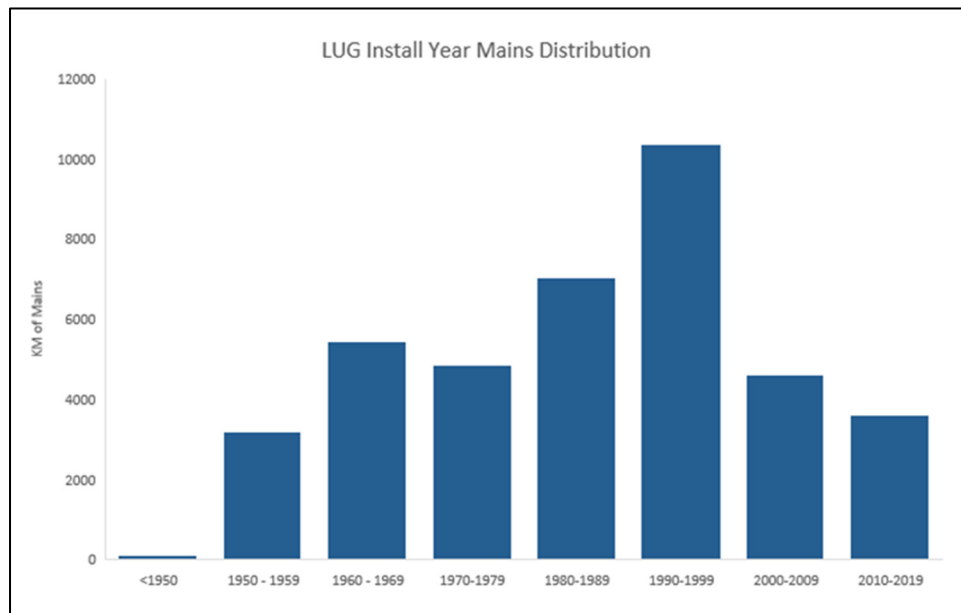


Figure 5.4 – LUG Install Year Distribution

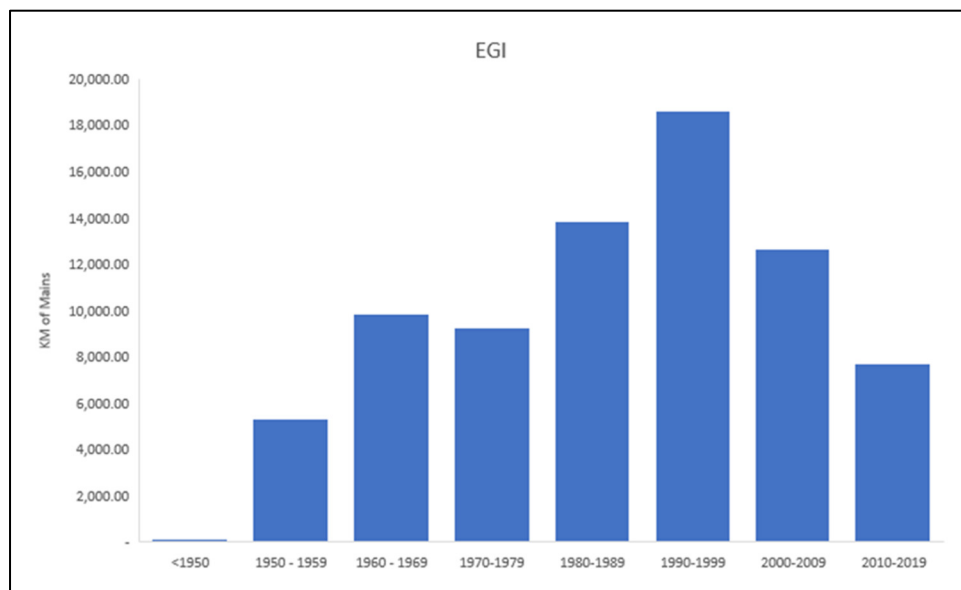


Figure 5.5 – Combined EGI Install Year Distribution

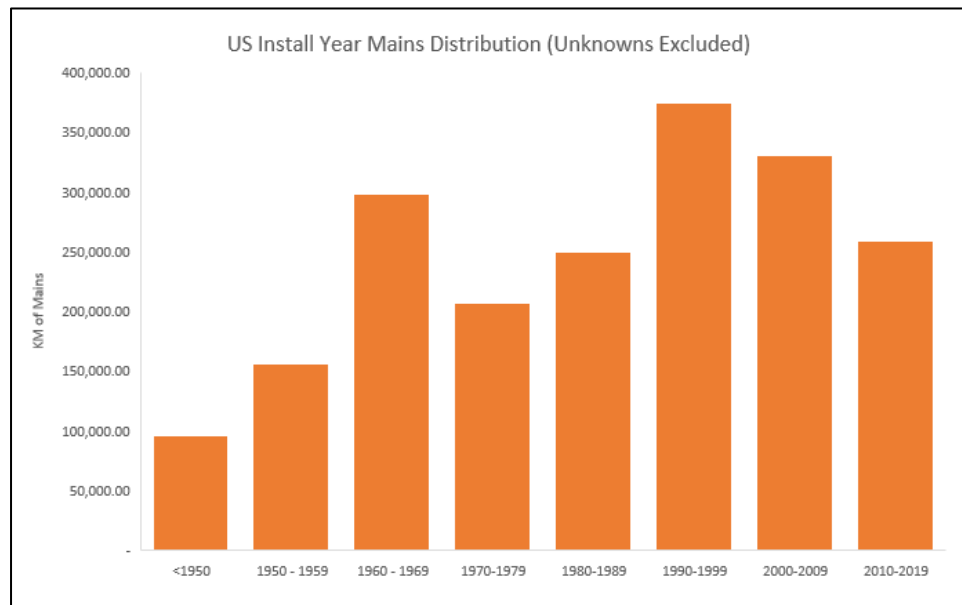


Figure 5.6 – U.S. Gas Distribution System Install Year Distribution

Comparisons between the EGI and U.S. gas distribution networks show broad similarities when comparing general material makeup and system age distribution. Excluding the cast iron mileage, overall composition of steel vs. plastic are similar. Additionally, a distribution of mileage by decade of installation show a broad similarity between the U.S. and EGI system age. It is noted that the U.S. system appears to have a higher proportion of pre-1950's pipe (it is possible that EGI data is truncated; tacit knowledge indicates that there are known older steel pipes in the LUG system) and pipe installed between 1960-1969, indicating that migration frequencies derived on the U.S. system may represent a conservative outlook when imputed on the EGI system.

It is recognized that such a comparison is broad, and that the above does not constitute a rigorous assessment of compatibility between the two systems from the perspective of migration frequency. However, considering the large sample size of the U.S. system, and also considering that the EGI system also represents a large and varied system with multiple historic operators, the comparison provides indications that the assumption that U.S. migration rates (normalized by amount of pipe in each system) are broadly comparable to EGI is reasonable.

A secondary applicability check was conducted following the methodology outlined in the next section to compare PHMSA derived migration-ignition incident rates with LEGD and LUG history.

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Data Treatment

PHMSA incident data from 2010 to 2019 for gas distribution operators was used for the assessment [12]. In order to identify incidents related to migration-ignitions with a high degree of confidence, a thorough manual review was conducted by individually examining the free-form narrative field for each incident record. For the 2010 to 2019 incident database, 1,145 individual records were reviewed and categorized into their respective threats as shown in Table 5.3 and Table 5.4.

Table 5.3 – Mains - Migration-Explosions Incidents

FOF model	Material	Count
Third party damage – Excavators, backhoes, hand digging tools, vertical drilling	Steel	6
	Plastic	9
Third Party damage – Horizontal Drilling / Boring / Torpedo	Steel	2
	Plastic	12
AHR – Corrosion	Steel	6
AHR – Non- Corrosion		7
AHR – Degradation	Plastic	7
F&C	Steel	4
	Plastic	8

Table 5.4 – Services - Migration-Explosions Incidents

FOF model	Material	Count
Third party damage – Excavators, backhoes, hand digging tools, vertical drilling	Steel	21
	Plastic	12
Third Party damage – Horizontal Drilling / Boring / Torpedo	Steel	3
	Plastic	9
AHR – Corrosion	Steel	6
AHR – Degradation	Plastic	9
F&C	Steel	4
	Plastic	3

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Incidents from certain threats were excluded from the assessment as the failure types were either not applicable for the EGI system (e.g. cast iron related), the current group of assets (e.g. above ground collisions), or not included in the current threat models. These exclusions are summarized in Table 5.5.

Table 5.5

Asset Type	Failure Type	Rationale
Mains	Cast Iron related	Not part of EGI system
	TPD - Collision	Not a currently modelled threat
	Natural Forces / Outside Forces (PE)	Not a currently modelled threat in PE mains model
Services	Customer-owned equipment related	Not in scope
	TPD - Collision	Not a currently modelled threat
	Natural Forces / Outside Forces	Not a currently modelled threat

For mains, migration-ignition incident counts were normalized into units of frequency per km per year by dividing the total number of incidents for each threat in a particular year by the mileage count during that year. Cast iron mileage counts were removed from the calculation. The average frequency per km per year taken across nine years of observation was then multiplied by the scope of the EGI system for which the threat is applicable to arrive at a prediction of migration-ignition incident frequency per year across EGI.

Model Results and Validation

The imputation results for mains are shown below. Summing the total contribution of all threats results in a frequency of 0.24 migration related ignitions per year for EGI mains, or 1 incident approximately every 4.2 years.

A similar process will be followed for services pending completion of services modelling. Preliminary results of the migration-ignition imputation process show an overall frequency of approximately 0.36 incidents per year at EGI, or approximately 1 incident every 2.8 years.

When summed, the above frequencies equal 0.6 events per year, which correspond well with the tacit knowledge obtained from LEGD and LUG subject matter experts in Emergency

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Management of approximately 0.57 incidents per year across EGI. This provides an additional applicability check that PHMSA can be used as a reasonable proxy for EGI in absence of detailed EGI specific incident data. Detailed migration-explosion frequency results by threat for Mains are shown in Table 5.6.

Table 5.6 – Mains - Migration–Explosions Frequency Results

Threat	Calibration Scope	System Scope (km)	PHMSA Migration Explosion Prediction (event/km.yr)	EGI System Wide Frequency Prediction using PHMSA
TPD - Excavators, backhoes, hand-digging tools, vertical auger	EGI Steel Mains	30,653.69	7.51E-07	0.023
TPD - Excavators, backhoes, hand-digging tools, vertical auger	EGI PE Mains	47,113.52	7.53E-07	0.035
TPD - Horizontal Drilling / Boring	EGI Steel Mains	30,653.69	2.56E-07	0.008
TPD - Horizontal Drilling / Boring	EGI PE Mains	47,113.52	1.00E-06	0.047
Corrosion	EGI Steel Mains	30,653.69	7.41E-07	0.023
Non-Corrosion	EGI Steel Mains	30,653.69	8.79E-07	0.027
Steel F&C	EGI Steel Mains	30,653.69	4.99E-07	0.015
Degradation	EGI PE Mains	47,113.52	5.81E-07	0.027
Plastic F&C	EGI PE Mains	47,113.52	6.62E-07	0.031
			Total	0.24

Probability of Migration + Ignition

In order to derive the probability of a migration and ignition given a failure, the migration-ignition frequency predictions per threat were divided by the total number of predicted current-day annual failures for the threat. As AHR projections were not available at the time of model development for the LUG system, probability of migration and ignition for these threats was done using the LEGD system only. The results are summarized in Table 5.7.

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2021**Design Summary Document****Table 5.7 – Mains – Probability of Migration + Ignition**

Threat	Calibration Scope	System Scope (km)	Migration Explosion Prediction / Scope	FOF Prediction / Scope	P (Migration + Explosion Failure)
TPD - Excavators, backhoes, hand-digging tools, vertical auger	EGI Steel Mains	30,653.69	2.30E-02	56.29312148	4.09E-04
TPD - Excavators, backhoes, hand-digging tools, vertical auger	EGI PE Mains	47,113.52	3.55E-02	395.4312875	8.97E-05
TPD - Horizontal Drilling / Boring	EGI Steel Mains	30,653.69	7.84E-03	4.767805096	1.64E-03
TPD - Horizontal Drilling / Boring	EGI PE Mains	47,113.52	4.72E-02	32.47494219	1.45E-03
Corrosion	LEGD Steel Mains	11,805.78	8.75E-03	48.894916	1.79E-04
Non-Corrosion	LEGD Steel Mains	11,805.78	1.04E-02	5.232383	1.98E-03
Steel F&C	LEGD Steel Mains	11,805.78	5.90E-03	16.25930568	3.63E-04
Degradation	LEGD PE Mains	25,188.32	1.46E-02	11.653597	1.26E-03
Plastic F&C	LEGD PE Mains	25,188.32	1.67E-02	45.52594738	3.66E-04

In the current state, the derivation of a probability of migration and ignition represents a system-wide calibration to the overall number of failures predicted by PHMSA for each threat. Since the calibration process imputes a frequency of incidents from a large and heterogeneous sample of U.S. operators to a smaller system, the validity of the calculated probabilities is likely to improve if the smaller system also represents a larger and more varied scope of assets. It is expected that the above calibration will be repeated once system-wide FOF values have been updated for the whole EGI system with the latest data and models.

Discussion and Exploratory Model Assessment

The phenomenon of below-ground gas migration from natural gas infrastructure is not well studied. Although there is literature available investigating individual aspects of subsurface movement of gas and there are scattered examples of models which have been produced for similar situations (TTAC propane model), at the time of writing there is no widely adopted

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industry model that is known to exist that holistically ties together the unique threats, system properties, data availability, and data limitations unique to a major gas distribution network.

In order to estimate probabilities of a migration – explosion event given a leak, a thorough examination of incident data was therefore conducted.

EGI Incident Data

Several attempts were made to obtain EGI specific incident records of migration related ignitions. Based on conversations with Emergency Management, a complete record of migration related ignitions was not possible to obtain due to either missing records or the sensitive nature of incident data for both LEGD and LUG. For similar reasons, following discussions with Emergency Management, an exploration of incident data kept by the TSSA was not pursued.

Tacit knowledge collected over a span of approximately 10 years of observation however provided a rough estimate of 1 migration-ignition incident every 6 years for LUG (2 incidents over the span of 12 years of observation), and an estimate of 1 incident every 2.5 years for LEGD (over approximately 10 years of observation).

Industry Incident Data

In absence of company specific incident data, PHMSA data was explored as a source for migration related incidents. In particular, PHMSA data has the following properties that support its applicability to system-wide risk assessment:

- 1) Reporting to PHMSA is mandated by the US Code of Federal Regulations 49 CFR Part 191.9 for all operators of natural gas pipelines in the US.
- 2) All incidents that exceed a certain threshold of damage must be reported. The definition of incidents that meet this threshold include releases that result in one or more of the following consequences (taken from 49 CFR Part 191.3):
 - a. A death, or personal injury necessitating in-patient hospitalization
 - b. Estimated property damage of \$50,000 or more, including a loss to the operator and others, or both, but excluding the cost of gas lost, or
 - c. Unintentional estimated gas loss of three million cubic feet or more
- 3) Annual mileage reports must be submitted to PHMSA as mandated by 49 CFR Part 191.11 for every operator. These reports contain mileage broken out by material, decade of installation, and NPS.

As of 2020, more than 1,300 individual pipeline operators report to PHMSA, representing more than 1.3 million miles of mains (~27 times the amount of mains in EGI) and more than 69 million services. In addition, over 40 years of observation are available. Thus the PHMSA database represents a large and heterogeneous sample size for overall exposure (i.e. km.years).

Secondly, due to the strict reporting criteria for incidents, it is reasoned that the PHMSA database represents a complete list of incidents that are of interest: namely, all catastrophic migration incidents where an ignition occurred that caused significant either property or safety consequence. It is therefore possible to draw conclusions on the overall frequency of migration ignitions from this database.

5.2 Above Ground Releases

An event tree for a typical QRA is shown in Figure 5.7 [13].

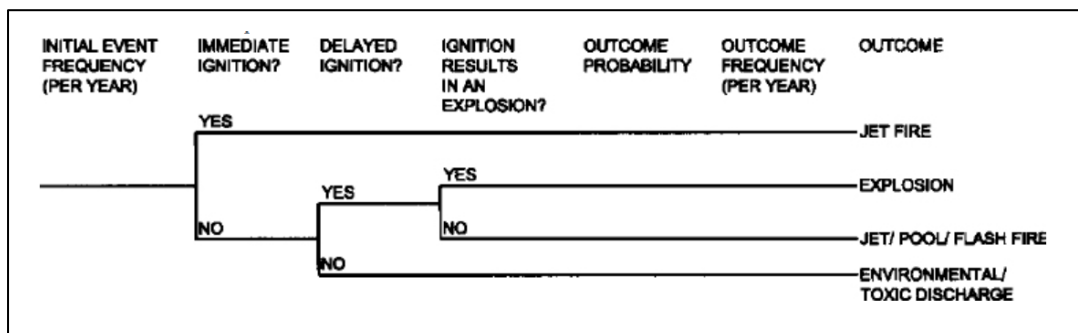


Figure 5.7

For above ground releases, whether ignition occurs before or after a substantial vapour cloud has formed influences what type of outcome is expected. Delayed vapour cloud ignitions may result in either flash fires or VCE depending on the degree of turbulent mixing, which usually depends on whether congestion or confinement is present [14]; immediate ignitions for natural gas pipelines are generally modelled as jet fires, which may be preceded by a short-lived fireball.

For above ground (outdoor) releases, small scale flash fires from excavation damage that caused nearby worker injuries have been observed in the PHMSA incident database. However, given that natural gas is lighter than air, the possibility of a significant flash fire that may affect an area outside of the immediate area of the leak site is considered extremely low due to the buoyant nature of the vapor [15]. For similar reasons, the possibility of an above-ground release resulting in a VCE is also considered unlikely.

Thus the model currently focuses on modelling jet fires with possible work to investigate appropriate delayed ignition and dispersion models in the future.

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Release Rate

The mass flowrate for gas outflow through an orifice can be estimated by Equation 5.1 [16].

Equation 5.1

$$q_s = C_d \cdot A_h \cdot \psi \cdot \sqrt{(\rho_0 \cdot P_0 \cdot \gamma \cdot (\frac{2}{\gamma + 1})^{(\gamma+1)(\gamma-1)})}$$

For critical flow,

Equation 5.2

$$\psi^2 = 1$$

For sub-critical flow,

Equation 5.3

$$\psi^2 = 2/(\gamma - 1) \cdot \left(\frac{\gamma + 1}{2}\right)^{\frac{\gamma+1}{\gamma-1}} \cdot \left(\frac{P_a}{P_0}\right)^{\frac{2}{\gamma}} \cdot \left(1 - \left(\frac{P_a}{P_0}\right)^{\left(\frac{\gamma-1}{\gamma}\right)}\right)$$

With,

Equation 5.4

$$\gamma = C_p/C_v$$

Where,

q_s = mass flow rate

C_d = discharge coefficient = 0.62 for holes, 1 for full-bore sever

A_h = cross-sectional area of hole

ψ = outflow coefficient

ρ_0 = initial gas density

P_0 = initial gas pressure

γ = Poisson ratio

C_p = specific heat at constant pressure

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A factor of 2 is applied to the flowrate for a full-bore sever to account for gas exiting from both ends of the pipe. No de-inventory reduction is accounted for in this model.

Probability of Ignition

Probability of ignition for above-ground releases is taken from the UKOOA lookup tables from the OGP Risk Assessment Data Directory as described in Table 5.8 [17].

Table 5.8 - Releases of flammable gases, vapour, or liquids significantly above their normal (NAP) boiling point from onshore cross-country pipelines running through rural areas

Release Rate (kg/s)	Ignition Probability
0.1	0.0010
0.2	0.0011
0.5	0.0013
1	0.0014
2	0.0016
5	0.0018
10	0.0020
20	0.0035
50	0.0073
100	0.0126
200	0.0220
500	0.0459
1000	0.0800

Ignition probabilities for intermediate release rate values are interpolated on a log scale as shown in Equation 5.5.

Equation 5.5

$$\log P_{ign} = \log P_{ignlower} + \frac{(\log Q - \log Q_{lower}) \cdot (\log P_{ignupper} - \log P_{ignlower})}{(\log Q_{upper} - \log Q_{lower})}$$

5.3 Health & Safety

5.3.1 Public Health & Safety

Above-ground fires

The number of fatalities anticipated by an above ground ignited release is a function of the expected thermal radiation dosage received by a consequence receptor.

For above ground fires, population density from Statistics Canada is used to estimate the number receptors that may be present. The population near the pipeline is calculated by treating 0.5 m width rings at progressively farther distances away from the leak as individual receptors as illustrated in Figure 5.8. The number of expected people within each ring is taken as the area of the ring multiplied by the population density.

The outer limits of the PIR are considered reached when the probability of fatality as calculated for an outdoor population reaches <1%.

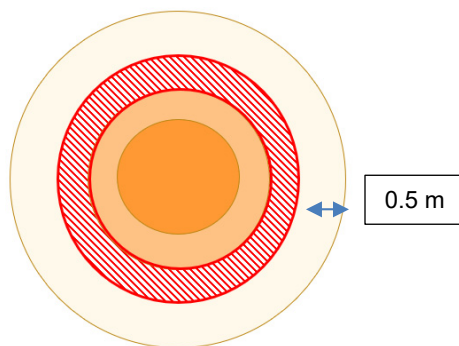


Figure 5.8

The expected thermal radiation flux was assigned to a receptor in the system based on the minimum distance from the receptor to the pipeline and the effective release rate. Assuming a point source model at ground level, the heat flux from a jet fire was calculated as follows [15]:

Equation 5.6

$$I = \frac{\eta X_g Q_{\text{eff}} H_c}{4\pi x^2}$$

Where,

- I = Heat flux (kW/m²)
 η = Methane combustion efficiency factor = 0.2
 Q_{eff} = Effective release rate as calculated in section 5.2

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 H_c = Heat of combustion (kJ/kg) X_g = emmissivity = 0.2**Outdoor Probability of Fatality**

The probability of fatality for outdoor receptors is described by a probit relationship as decribed by Equation 5.7 [18].

Equation 5.7

$$Pr = -36.38 + 2.56 \ln \left(\int I^{4/3} dt \right)$$

Where,

 Pr = Probits I = Heat flux (W/m^2), *and* t = Exposure time (20 seconds)

Probits are converted to probability using the probit function for a standard normal distribution shown in Equation 5.8.

Equation 5.8

$$Pr = \sqrt{2} \operatorname{erf}^{-1} (2p - 1) + 5$$

Where,

 p = Probability, *and* Pr = Probit

This allows probability of fatality to be expressed as a function of the thermal radiation intensity, which in turn can be expressed as a function of MOP, hole diameter, and distance between the receptor to the pipeline.

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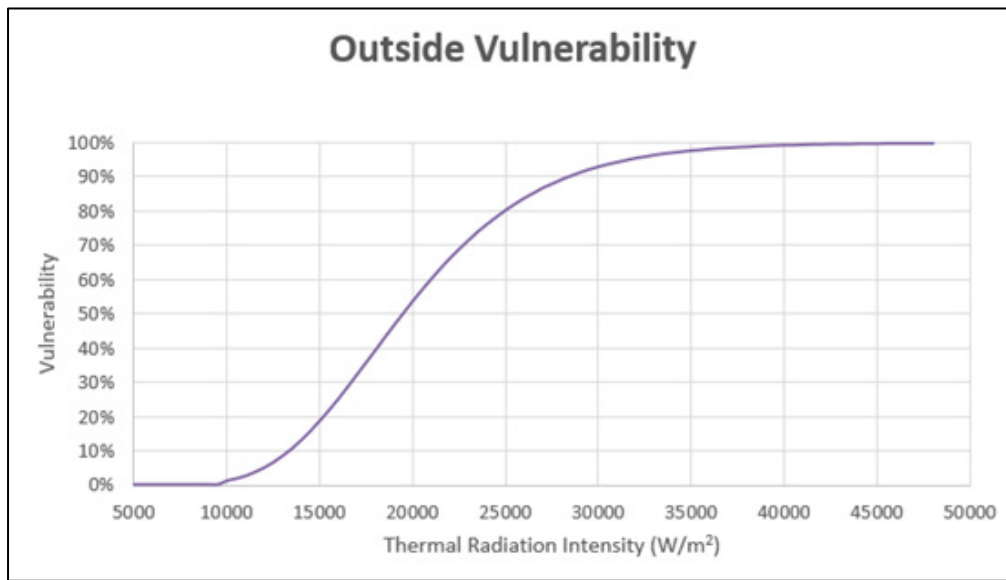


Figure 5.9

Indoor Probability of Fatality

The probability of fatality for indoor receptors is considered to be 100% within a thermal radiation intensity of 35 kW/m² and 0% outside this boundary [18] as shown in Figure 5.10.

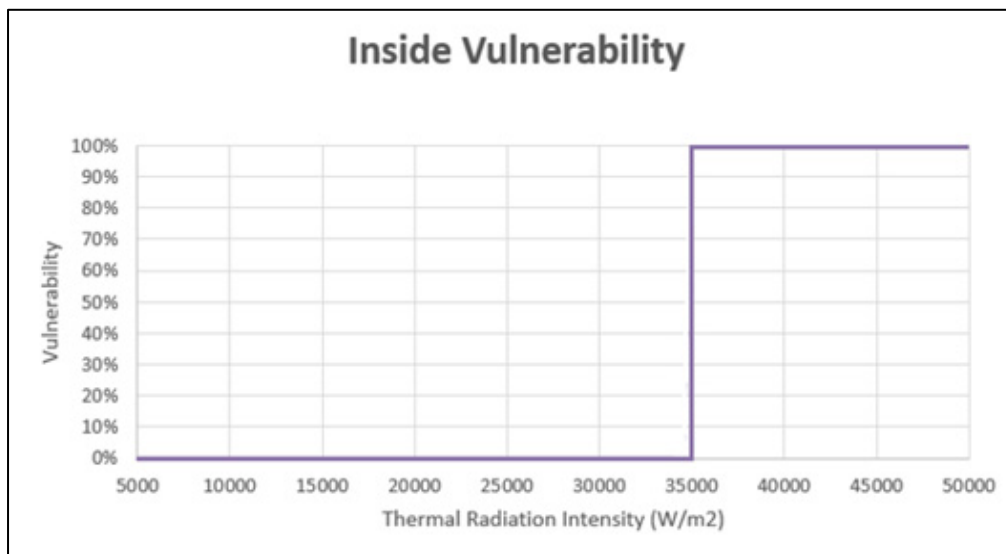


Figure 5.10

Thus the area defined by the 35 kW/m² radiation flux contour represents the area in which both indoor and outdoor people have a 100% probability of fatality.

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For the population outside this zone, only the outdoor population is considered vulnerable to fatality. The fraction of people outdoors is estimated as a constant 0.04 of the total population [18].

Table 5.9

	Fractions of population present indoors	Fractions of population present outdoors
Day time – 8:00 to 18:30	0.93	0.07
Night time – 18:30 to 8:00	0.99	0.01
Overall fraction	0.96	0.04

Consequence

A constant \$12,000,000 consequence is assigned per fatality following the LEGD Impact Matrix guidelines from Risk Governance.

Below-ground Migration + Ignitions

As discussed in section 5.1, the current model assigns a fixed probability of migration and ignition given failure for each specific threat as derived through an assessment of PHMSA incidents.

In the current state, the model does not explicitly include for region-specific susceptibility to having a migration event, such as type and number of structures nearby, distance to the nearest structure, soil type, surface land type, and neighboring underground infrastructure. Thus, given failure and assuming there is at least one structure within the vicinity of the pipeline (as determined using the method below), a leak from a specific threat in one area is considered equally as likely to result in a migration-ignition event as another. It is expected that this will be a continuing area of improvement pending availability of new data and research.

In order to estimate region-specific consequence for the EGI system that is compatible with the current granularity of the model, a novel approach was developed:

- MPAC (Municipal Property Assessment Corporation) property data was assigned a weighted average expected number of fatalities and injuries based on the type of structures on the property, weighted by the number of structures on the property. The weighting score (i.e. number of structures) for each property was also captured.
- The weighted average number of fatalities and injuries per property was aggregated to a tessellation of 300m sided hexagons covering the EGI system, again weighted by the number of structures per property.

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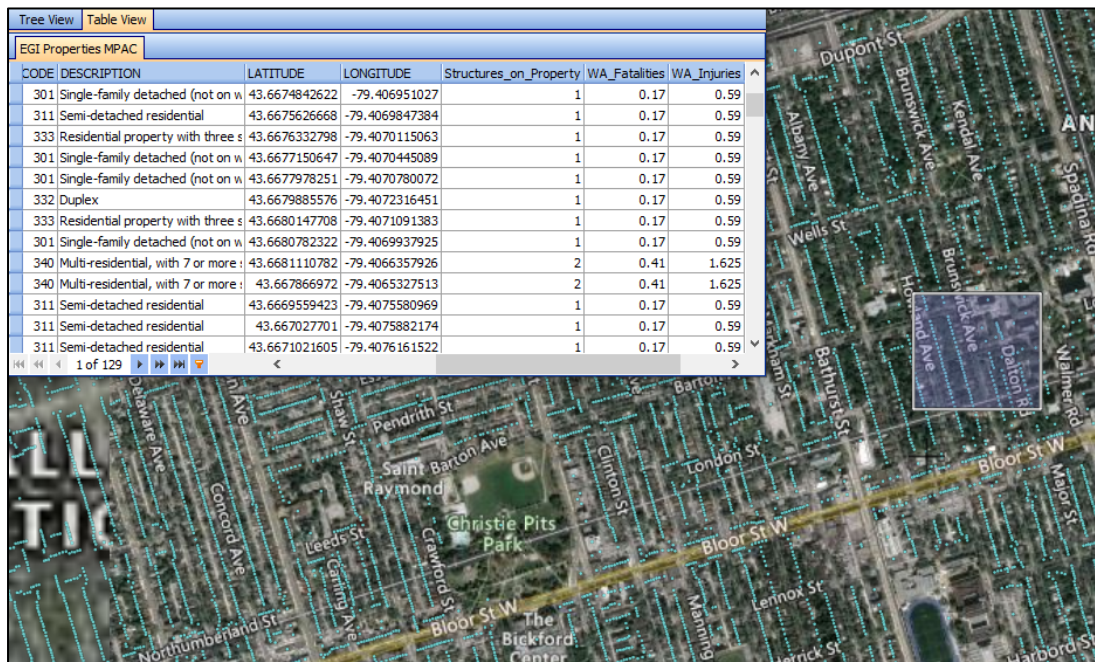


Figure 5.11

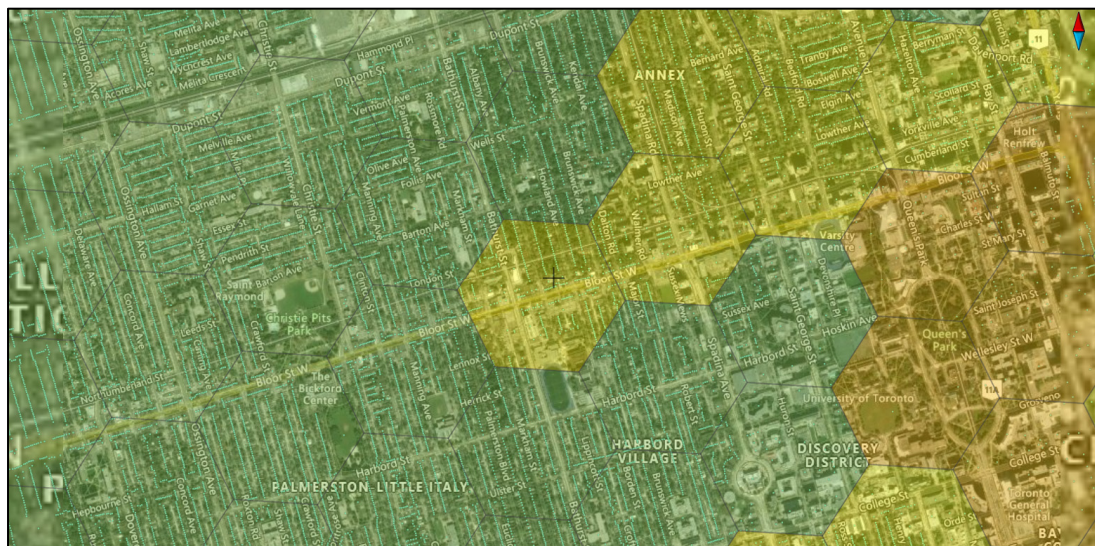


Figure 5.12

The final values for each hexagon represent the average of the number of expected fatalities and injuries that would be expected if a migration-ignition event occurred in a given area, assuming each structure was equally susceptible to migration. For example, if an area contained mostly single-residential homes and a single commercial structure, the number of expected fatalities and injuries in that region would be weighted towards the expected consequence in the more numerous single-dwelling homes.

It is also expected that this method can be extended to account for region-specific susceptibility factors for migration in order to introduce additional granularity into the assessment. Factors to investigate may include prevalence of other underground infrastructure within the hexagon, accounting for the number of structures, and additional metadata available from MPAC and other sources.

MPAC Data Treatment

MPAC data contains a mix of structure and property (parcel) level information covering all of Ontario. The data is categorized into 5 property categories:

- Residential and Farm Properties
 - Mostly comprised of single dwelling homes. Data for farm structures are also included in this database
- Multi-Residential Properties Greater than 6 Units
 - Apartment buildings, townhomes, etc. for residential use
- Residential Condominium Developments
 - Multi-residential buildings where ownership is shared among individuals
- Non-Residential Properties valued using the Income Approach
 - Commercial structures that generate an income such as restaurants, shops, industrial malls, office buildings
- Non-Residential Properties valued using the Cost Approach
 - Used for properties which are unique and rarely sold on the market such as general purpose industrial properties, warehouses, large and special purpose properties

In order to assign an estimated number of fatalities and injuries per property type, PHMSA incident data from 2004 to 2019 relating to migration ignition events were reviewed for fatalities and injuries. 336 incidents were able to be categorized based on the type of structure that was damaged into the above categories; the total number of fatalities and injuries were collected for each property type. These results are summarized in Table 5.10 and Figure 5.13.

Following categorization, in order to increase sample size, multi-residential and residential condominium property types were combined into a single category. This was confirmed by a Mann-Whitney U-Test which did not reveal a statistically significant difference in terms of fatalities or injuries for these property types.

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Table 5.10

Property Type	Count of incidents	Average Fatalities	Average Injuries
Residential	239	0.17	0.59
Mult-residential / Residential condominiums	49	0.51	1.88
Non-residential Income	35	0.31	1.37
Non-residential Cost	13	0.08	0.38

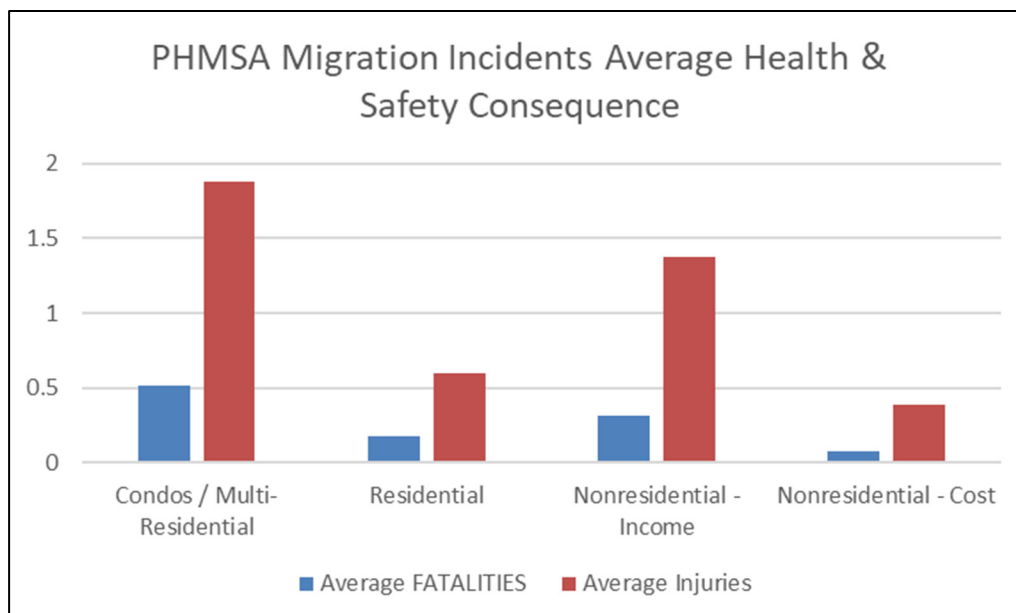


Figure 5.13

It is of note that through the incident review process, it was found that large majority of migration-related ignitions resulted in no fatalities or injuries. One possible explanation for a relatively low rate of injury is that, in addition to the rate of occupancy which is traditionally taken into account for immediate ignitions, there is also an additional barrier provided by the time delay in ignition for migration incidents where warning signs such as the detection of odourant may provide occupants an opportunity to evacuate. The histograms for PHMSA fatalities and injuries from all 393 migration incidents in 2004 to 2019 are shown in figures 5.14 and 5.15

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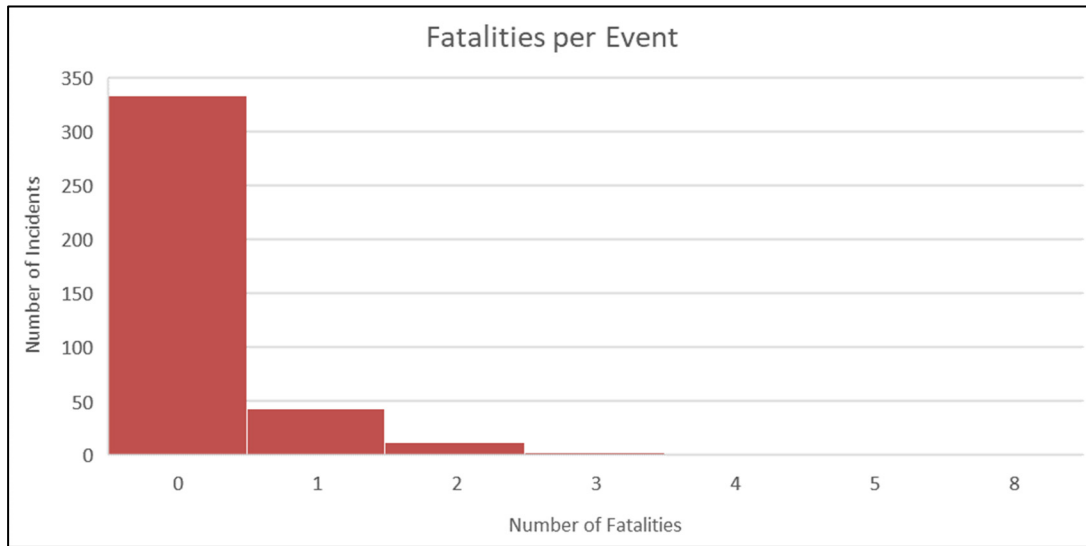


Figure 5.14

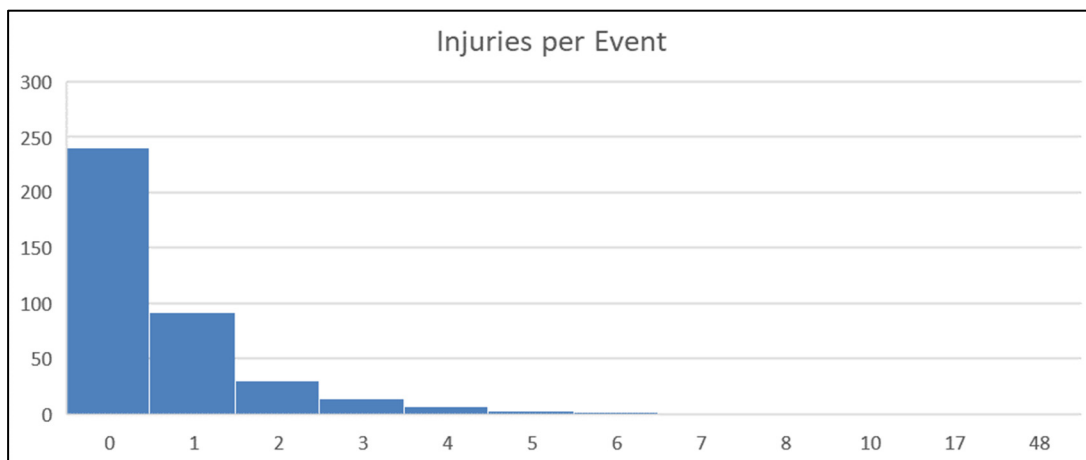


Figure 5.15

Consequence

A constant \$12,000,000 consequence is assigned per fatality and \$917,038 consequence is assigned per injury following the LEGD Impact Matrix guidelines from Risk Governance.

5.4 Financial

5.4.1 Public Property

Above-ground fires

Public property damage for above-ground fires is calculated by estimating the probability that a building is within the hazard zone of a failure where unpiloted ignition may occur.

The current models assign a probability of failure to a dynamic segment, where failure can occur with equal probability anywhere along that segment. Thus, the probability of a building being within the hazard zone of a leak that occurs somewhere along the segment can be estimated by the proportion of the segment that has a building within its hazard zone.

EGI mains follow utility ROWs which run parallel to streets and streetside buildings as shown in Figure 5.16. It can be seen that the proportion of a length of main which may expose a building to fire could be estimated by summing the side of all buildings which face the main, and dividing by the length of the main as described in Equation 5.9.

Equation 5.9

$$\text{Probability of building within hazard zone} = \frac{\sum \text{Building surfaces that face the main}}{\text{Length of main}} \leq 1$$



Figure 5.16

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The hazard zone for each asset was calculated as a function of the MOP of the asset and a range of representative hole sizes. A radiation threshold of 10,000 BTU/ft².hr was chosen based on a 65 second unpiloted auto-ignition time for a wooden structure [15]. The release rate and thermal radiation equations follow those listed in Section 5.2 - Above Ground Releases and Section 5.3.1 - Above-ground fires.

Using the calculated thermal radiation zone, a buffer representing the hazard zone was created in GIS. Three representative scenarios were calculated for:

- a severed 4 inch pipe,
- a severed 2 inch pipe,
- a 4 inch squared hole.

For each buffer size, the number of buildings and perimeter of each building that fell within the hazard zone was captured for each asset. In order to determine the length of building surfaces exposed to the main, each building was approximated as a square, meaning the surface length can be calculated by taking the total perimeter and dividing by 4. The buffer sizes for a range of MOP values are shown in the below tables.

Table 5.11 - Scenario 1: 4 inch severed pipe

MOP (psig)	Class	PIR (m) for unpiloted ignition wooden structures
2	LP	1.4
12	MP	3.41
64	IP	7.9
100	HPPE	9
175	HP	13
650	XHP	25.17

Table 5.12 - Scenario 2: 4 inch squared hole

MOP (psig)	Class	PIR (m) for unpiloted ignition wooden structures
2	LP	0.39
12	MP	0.95
64	IP	2.20
100	HPPE	2.75
175	HP	3.64
650	XHP	7.01

Table 5.13 - Scenario 3: 2 inch severed pipe

MOP (psig)	Class	PIR (m) for unpiloted ignition wooden structures
2	LP	1.4
12	MP	3.41
64	IP	7.9
100	HPPE	9
175	HP	13
650	XHP	25.17

Consequence

A constant consequence of \$274,837.50 was assigned for each ignition based on third party damage related above-ground fires incidents found in the PHMSA database from 2010 to 2019.

Below-ground migration ignitions

In order to assign region specific public property consequence for migration ignitions, reconstruction costs were estimated for the MPAC dataset using the square footage of the structure and an estimated cost per square foot. Following the same weighting method described in Section 5.3.1 - Below-ground Migration + Ignitions, the MPAC reconstruction costs were then aggregated to a tessellation of 300m hexagons in order to create a system-wide polygon layer that describes the estimated public property damage in the event of a migration ignition as illustrated in Figure 5.17.



Figure 5.17

The 2020 Altus Canadian Cost Guide was used to estimate the dollar per square foot construction costs for each MPAC structure. A mapping exercise was carried out where the structure categories in the cost guide were mapped to the structure and property definitions in MPAC. A detailed discussion of the data treatment can be found in Appendix B.

In order account for collateral damage and loss of building contents, a scaling factor was applied to bring the system-wide average estimated reconstruction costs for each MPAC category to the average costs recorded in the PHMSA database. 336 migration incidents were able to be categorized based on the type of structure that was damaged into MPAC categories. Box plots are displayed in Figure 5.18 that show the range of recorded costs incurred by operators for public and non-Operator private property damage.

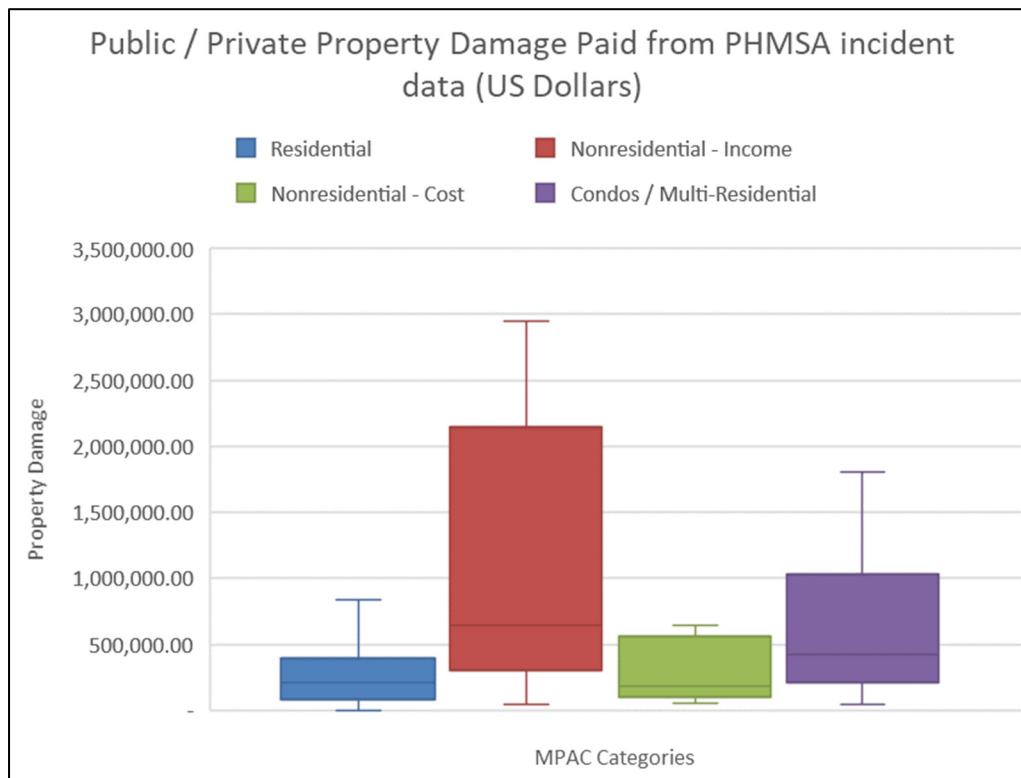


Figure 5.18

A comparison of the average system-wide costs estimated using MPAC and Altus data are shown in Table 5.14 along with the scaling factor applied in the final calculation.

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Table 5.14 – Average Building Cost by Type

Property Type	Count of incidents	Average PHMSA costs incurred (CAD)	Average EGI system-wide MPAC estimated costs based on Altus (CAD) (before scaling)	Scaling Factor
Residential	239	\$397,429.99	\$281,925.62	1.41
Multi-residential / Residential condominiums	49	\$1,275,442.50	-	-
Non-residential Income	35	\$3,380,948.22	\$1,724,973.58	1.96
Non-residential Cost	13	\$2,465,379.38	\$2,417,038.59	1.02

For the multi-residential and residential condominium category, the total square footage of the structure did not provide a meaningful way to estimate the reconstruction costs that might be expected in the event of a migration ignition as such events are not likely to affect the entire structure. For this category of structure, the estimated reconstruction costs applied in the final aggregation was taken as the average cost from PHMSA.

Consequence

The final weighted average consequence calculated in the final aggregation to the polygon grid is used directly in the risk calculation. In alignment from the latest guidance from Risk Governance, a \$1M CAD cap is placed on financial consequence to account for Enbridge's liability limit.

5.4.2 Service Disruption

The service disruption consequence calculated according to the latest Value Framework Definition Document [2].

In order to estimate the maximum number of customers that may be affected by an outage, the peak yearly flowrate through a main is divided by the estimated usage by each customer that is fed by the asset. Peak flowrate data was obtained from Network Analysis for the LEGD and LUG system.

A system-wide layer describing the different EGI work zones and the estimated percentage of apartment, residential, commercial, and industrial customers within each work zone were obtained from Asset Information.

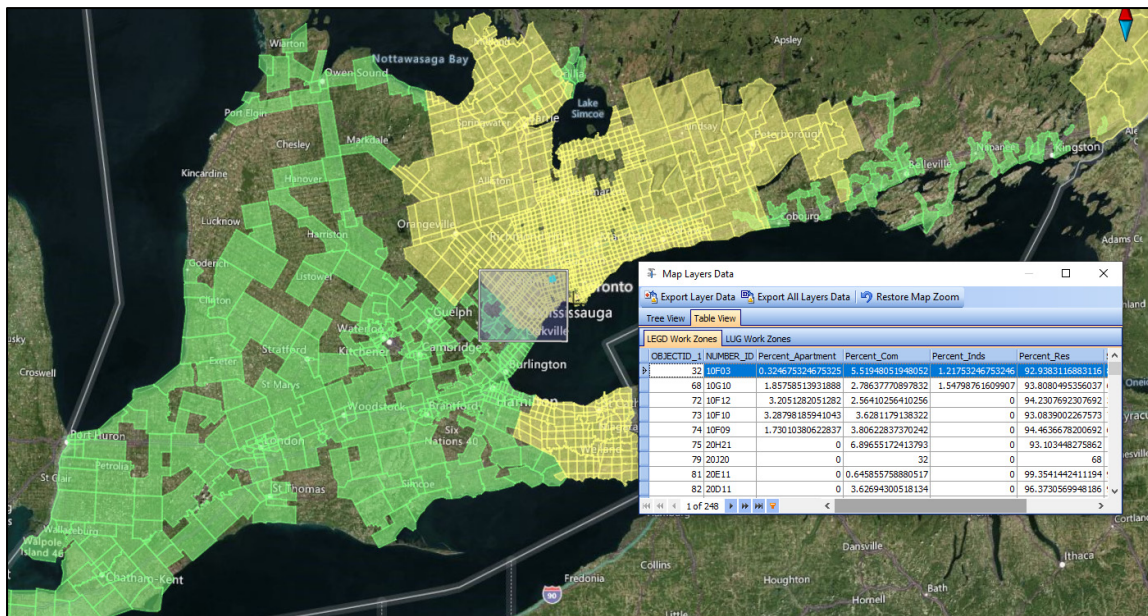


Figure 5.19

These polygons are part of the dynamic segmentation process, meaning each dynamic segment has a unique percentage of each customers associated with it.

The average usage per each customer type is taken from the VFDD as shown in Table 5.15.

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Table 5.15

Customer type	Peak usage (scm/h)
Average Customer Peak Usage Apartment CA	75.6
Average Customer Peak Usage Commercial CA	9.7
Average Customer Peak Usage Industrial CA	124.3
Average Customer Peak Usage Residential CA	1
Average Customer Peak Usage Mixed CA	2.3

The average peak gas usage per main is estimated by calculating a weighted average peak usage as described by Equation 5.10.

Equation 5.10

Average Peak Usage

$$= (Percent_{Apt} \cdot Peak\ usage_{Apt}) + (Percent_{Com} \cdot Peak\ usage_{Com}) + (Percent_{Ind} \cdot Peak\ usage_{Ind}) + (Percent_{Res} \cdot Peak\ usage_{Res})$$

If the percentage of each customer is not known for an asset, then Peak usage mixed is assumed.

Equation 5.11

$$Average\ Peak\ Usage = Peak\ usage_{Mixed}$$

The Maximum number of customers impacted in the event of a failure is calculated by dividing the annual peak usage by the average peak usage as shown in Equation 5.12.

Equation 5.12

$$Max\ Number\ of\ Customers\ Imapcted = \frac{Peak\ Flowrate}{Average\ Peak\ Usage}$$

To calculate the average number of customers that may be impacted, the max number of customers impacted is reduced by a reduction factor.

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Equation 5.13

$$\begin{aligned} & \text{Average Number of Customers Impacted} \\ &= \text{Max Number of Customers Impacted} \cdot \text{Percent Asset Peak Load Reduction} \end{aligned}$$

Where the percent load reduction is based on the region as shown in

Table 5.19.

Table 5.16

Region	Percent Asset Peak Load Reduction
GTA East	37.8
GTA West	37.8
Niagara	38.1
Toronto	37.8
Eastern	36.1
Northern	38.1
Southwest	38.1

The above VFDD calculation for estimating the average number of customers lost is meant to be applied in the event a leak forces an unplanned outage. From discussions with Operations personnel, outages on the scale predicted by the above calculations in the distribution system are rare. Operations will seek to minimize the number of lost customers unless absolutely necessary, such as in the event of a safety concern, or where there is no other alternative other than to isolate a 1 way fed main.

Data for mains that were one-way fed vs two-way fed was not available at this time. Based on SME feedback received from seven Field Supervisor's experience covering the Southwest, Northern, and Eastern regions, it is assumed that only 5% of general leaks (corrosion, fittings) and 10% of third party damage leaks will have the possibility of resulting in customer loss.

Consequence

A \$70 financial consequence is applied for each lost customer, representing the cost of relight.

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5.4.3 Company Property

Emergency repair costs were obtained by the Distribution Integrity department; a detailed description of the method used to derive the costs is listed in Appendix C.

LUG			LEGD				
Steel Mains (\$/ 8 m)			NPS	Weighted Average (Applies to release cats 1, 2 and 3 in SRAT)		Cut out with By Pass (Applies to release cats 4, 5 in SRAT)	
NPS	South (Hamilton, London, Waterloo, Windsor)	North (East, Northeast, Northwest)		Boulevard / Rural	Road / Urban / Area 10	Boulevard / Rural	Road / Urban / Area 10
<0.75	\$ 721.43	\$ 1,038.67	NPS ≤ 2	\$ 10,424.77	\$ 17,101.16	\$ 16,408.06	\$ 24,612.09
0.75< x ≤ 1.25	\$ 1,849.35	\$ 2,687.67					
1.25< x ≤ 2	\$ 5,860.92	\$ 5,863.54	NPS > 2 & NPS ≤ 4	\$ 11,429.06	\$ 18,105.44	\$ 17,539.65	\$ 25,743.68
2< x ≤ 3	\$ 7,933.67	\$ 5,988.41					
3< x ≤ 4	\$ 10,006.42	\$ 6,997.14	NPS > 4 & NPS ≤ 6	\$ 15,870.55	\$ 23,254.18	\$ 21,217.31	\$ 30,128.59
4< x ≤ 6	\$ 12,500.19	\$ 12,311.42					
6< x ≤ 8	\$ 12,164.27	\$ 16,230.35	NPS > 6 & NPS ≤ 8	\$ 22,631.80	\$ 29,704.24	\$ 28,997.00	\$ 36,069.44
8< x ≤ 10	\$ 18,457.24	\$ 20,876.29					
10< x ≤ 12	\$ 19,376.73	\$ 42,403.00	NPS > 8 & NPS ≤ 12*	\$ 147,318.60	\$ 149,944.60	\$ 351,884.00	\$ 404,404.00
12< x ≤ 16	\$ 35,513.46	\$ 47,371.84					
20	\$ 43,123.45	\$ 58,571.19	NPS > 12 & NPS ≤ 20*	\$ 215,069.40	\$ 215,069.40	\$ 709,020.00	\$ 709,020.00
24	\$ 51,414.45	\$ 70,976.67					
26	\$ 55,559.95	\$ 77,179.41	NPS > 20 & NPS ≤ 30*	\$ 252,883.80	\$ 252,883.80	\$ 866,580.00	\$ 866,580.00
30	\$ 63,850.95	\$ 89,584.88					
34	\$ 72,141.95	\$ 101,990.36	NPS > 30 & NPS ≤ 42*	\$ 276,345.32	\$ 276,345.32	\$ 996,033.79	\$ 996,033.79
36	\$ 76,287.45	\$ 108,193.10					
42	\$ 88,723.95	\$ 126,801.31					
48	\$ 101,160.45	\$ 145,409.53					

Figure 5.20 – Steel Mains Emergency Repair Costs

LUG			LEGD				
Plastic Mains (\$/ 8 m)			NPS	Cut out (Applies to release cats 1, 2 and 3 in SRAT)		Cut out with By Pass (Applies to release cats 4, 5 in SRAT)	
NPS	South (Hamilton, London, Waterloo, Windsor)	North (East, Northeast, Northwest)		Boulevard / Rural	Road / Urban / Area 10	Boulevard / Rural	Road / Urban / Area 10
<1.25	\$ 2,631.85	\$ 2,091.54	NPS ≤ 2	\$ 4,743.28	\$ 7,826.41	\$ 7,297.35	\$ 10,946.02
1.25 < x ≤ 2	\$ 2,520.53	\$ 2,780.74					
2 < x ≤ 4	\$ 4,179.26	\$ 2,216.84					
4 < x ≤ 6	\$ 7,694.00	\$ 5,688.24					
			NPS > 2 & NPS ≤ 4	\$ 5,655.45	\$ 9,331.48	\$ 8,391.95	\$ 12,587.93
			NPS > 4 & NPS ≤ 6	\$ 6,750.05	\$ 11,137.58	\$ 9,304.12	\$ 13,956.18
			NPS > 6 & NPS ≤ 8	\$ 9,486.55	\$ 15,652.81	\$ 12,223.06	\$ 18,334.59
			NPS > 8 & NPS ≤ 12	\$ 10,245.48	\$ 16,905.04	\$ 13,200.90	\$ 19,801.36

Figure 5.21 – Plastic Mains Emergency Repair Costs

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As described in Appendix C, the current LUG emergency repair costs are based on planned project costs with a 30% uplift factor for emergency work, and do not differentiate between repairs that do or do not require a bypass. In order to avoid a bias towards higher repair costs for LEGD that does not reflect an organic difference in the costs between both companies (i.e. the cost differences in this case are an artefact of how the costs were derived), the cut-out with bypass costs for LEGD are currently not applied.

There is a large increase in repair costs for steel mains NPS 8 or greater for the LEGD system, corresponding with the size at which LEGD field crew will opt to hire contractors to perform repair work. This increased repair cost does not apply for the LUG system as contractors are only used on a special basis.

Consequence

The above repair costs are applied as-is for every failure in the Risk modelling.

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5.5 Environmental

GHG Emissions have been moved into a separate category as per the latest VFDD version 8.0 and is not included as a risk value measure. The calculation for GHG Emissions is discussed in Section 6.1 - GHG Emissions.

Environmental rehabilitation was not considered applicable to the distribution system. As such no environmental consequence is applied in the distribution risk model.

5.6 Operational Reliability

5.6.1 Operational Disruption

The operational disruption consequence represents the societal cost of interrupted service to customers and is calculated based on the estimated amount of time it takes to restore service to lost customers. The calculation is taken from the latest version of the VFDD.

The average number of customers expected to be lost is calculated using the same methodology as the service disruption calculation as described in Section 5.4.2 - Service Disruption.

An estimation on the amount of time required to relight customers is calculated by the logic shown in Equation 5.14.

Equation 5.14

If *Average Number of Customers Impacted* = 0 Then

Relight Time = 0

Elseif *Average Number of Customers Impacted* < 150 Then

Relight Time = *TimetoRelight150Customers*

Elseif *Average Number of Customers Impacted* < 600 Then

Relight Time = *TimetoRelight600Customers*

Elseif *Average Number of Customers Impacted* ≤ 3000 Then

Relight Time

=
$$\frac{\text{Average Number of Customers Impacted} - 600}{(\text{FittersRelightperHour} \cdot \text{FittersMaxHours} \cdot \text{FittersSmallTeamSize}^{\text{FittersTeamEfficiencyDrop}})}$$

+ *TimetoRelight600Customers*

Else Then

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Relight Time

$$= \frac{\text{Average Number of Customers Impacted} - 3000}{(\text{FittersRelightperHour} \cdot \text{FittersMaxHours} \cdot \text{FittersLargeTeamSize}^{\text{FittersTeamEfficiencyDrop}})} + \text{TimetoRelight3000Customers}$$

Equivalent Outage Duration is the number of days in total required to resume service to customers. The relight duration is reduced by 50% to avoid overstating impact.

Equation 5.15

$$\text{Equivalent Outage Duration} = \frac{\text{Relight Time}}{2}$$

Customer Type Duration Cost is the societal cost per day of an average customer being affected by the outage. If percentages of customer types fed by the asset are known, an average cost per cubic meter is estimated, otherwise, the average cost per cubic meter for mixed customer types is used.

Equation 5.16

$$\begin{aligned} \text{Customer Type Duration Costs} \\ = (\text{Percent}_{\text{Apt}} \cdot \text{GasSocietalCost}_{\text{Apt}}) + (\text{Percent}_{\text{Com}} \cdot \text{GasSocietalCost}_{\text{Com}}) \\ + (\text{Percent}_{\text{Ind}} \cdot \text{GasSocietalCost}_{\text{Ind}}) + (\text{Percent}_{\text{Res}} \cdot \text{GasSocietalCost}_{\text{Res}}) \end{aligned}$$

The final societal consequence of interrupted gas flow is calculated by Equation 5.17.

Equation 5.17

$$\begin{aligned} \text{Operational Disruption Consequence} \\ = \text{Equivalent Outage Duration} \cdot \text{Average Number of Affected Customers} \\ \cdot \text{Customer Type Duration Costs} \end{aligned}$$

Similar to service disruption consequence, it is assumed that only 5% of general leaks (corrosion, fittings) and 10% of third party damage leaks will have the possibility of resulting in operational disruption consequence.

PRIM Distribution Risk ModelVersion Number: 1.0
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Configurable Field Name	Configurable Field Code	Configured Value	Units
Gas Societal Cost Apartment	GasSocietalCostApartment	3002.84	CA\$ / day
Gas Societal Cost Residential	GasSocietalCostResidential	39.72	CA\$ / day
Gas Societal Cost Industrial	GasSocietalCostIndustrial	1203.92	CA\$ / day
Gas Societal Cost Commercial	GasSocietalCostCommercial	180.30	CA\$ / day
Gas Societal Cost Mixed	GasSocietalCostMixed	87.27	CA\$ / day
Relight Cost – CA	RelightCostCA	70	CA\$
Fitters Maximum Work Hours Per Day	FittersMaxHours	12	hours
Fitters Relights Per Hour	FittersRelightsPerHour	4	relights / hour
Fitters Small Team Size	FittersSmallTeamSize	120	Fitters
Fitters Large Team Size	FittersLargeTeamSize	220	Fitters
Fitters Large Team Efficiency Drop	FittersTeamEfficiencyDrop	0.95	
Time to Relight 150 Customers	TimeToRelight150Customers	0.5	Days
Time to Relight 600 Customers	TimeToRelight600Customers	1	Days
Time to Relight 3000 Customers	TimeToRelight3000Customers	1.847	Days

5.7 Reputational

5.7.1 Technical Regulator Fines

Technical regulator fines are estimated based on historic incidents incurred by LEGD as described in the 2017 Impact chart, and are only applied for ignited outcomes. Consequence is scaled based on the severity of the failure, represented by number of fatalities as shown below.

For above-ground fires,

If *Number of Fatalities* ≥ 1 Then

Technical Regulator Fines Consequence = 187,500

Else,

Technical Regulator Fines Consequence = 62,500

For below-ground migration explosions,

Technical Regulator Fines Consequence = 187,500

Table 5.18 – Impact Chart – Technical Regulator

Category	Technical Regulator (TSSA, NEB, MOL, etc.)	Values
Minor	Record/locate missing/inaccurate	997
Moderate	Broken/omitted safety measure/near miss	1,296
Serious	Incident, no injuries	62,500
Major	Incident, single fatality	187,500
Critical	Incident, multiple fatalities	1,000,000

5.7.2 Reputational Damage

Reputational damage is calculated based on an estimate of the severity of the outcome as described in the 2017 Impact chart, and are only applied for ignited outcomes. Consequence is scaled based number of fatalities.

For above-ground fires,

If *Number of Fatalities* ≥ 1 Then

Technical Regulator Fines Consequence = 182,675

Else,

Technical Regulator Fines Consequence = 60,478

For below-ground migration explosions,

Technical Regulator Fines Consequence = 182,625

Table 5.19 – Impact Chart – Reputational Damage

Category	Descriptions	Values
Minor	Minor future or existing (<50) customer annoyance	370
Moderate	Measurable future or existing (50-200) customer annoyance	19,485
Serious	Town/city coverage; significant future or existing customer annoyance or impact to channel partner	60,478
Major	National news/paper; costs associated with public relations campaign to restore lost public opinion and confidence (if applicable)	182,675
Critical	Prolonged, adverse national media attention; significant loss of trust among stakeholders	1,486,246

5.8 Crossbore

Incidents where cross-bores were punctured and ignited were collected from the PHMSA database between 2004 and 2019. A total of 9 reportable incidents were found in the database during this period as shown in Table 5.17.

Table 5.20 – List of Crossbore Incidents since 2004

Year of Incident	Asset Type
2004	Service
2004	Service
2006	Service
2006	Main
2007	Main
2010	Main
2011	Service
2012	Service
2013	Service

When applied to the EGI system, the above frequency of ignited cross-bore incidents results in a frequency that is low when compared to historic incidents, which are known to have occurred in the EGI system. Additionally, based on discussions with cross-bore SMEs, several sources report an overall incident frequency of ~25 incidents over a span of 10 years from 2003 - 2013 [20].

The source behind the 25 incidents cited was not able to be confirmed. It is possible this count of incidents is conservative as it may include near misses, which were not reported in the PHMSA database. A comparison was conducted using this frequency and the number of known cross-bore incidents that have occurred at EGI.

EGI History

Based on best knowledge at time of model development from discussion with cross-bore SMEs, the below are the known cross-bore punctures that have been observed across EGI:

Table 5.21 – EGI SME-based Incident History

Year	Incident
2004	1 incident, ignition
2011	1 release, no ignition
2018	1 incident, ignition
2020	1 release, no ignition

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Proceeding with an assumption of an overall U.S. incident frequency of 25 incidents per 10 years, the number of cross-bore incidents on mains vs. services was taken as the proportion of the 9 incidents from the PHMSA database. Applying the U.S. frequency estimates on a per mile and per service basis to the EGI system, the predicted frequency of cross-bore-ignition incidents is calculated as 0.12 incidents per year, or 1 incident every ~8.25 years. This estimate aligns with estimates of EGI historic incidents (2 incidents over a span of 14 years and several near misses) and was carried forward into the model.

Table 5.22 – Crossbore Frequency Calibration

Asset	Proportion of Incidents	US crossbore incident frequency (ignition event / yr)	US Mileage estimate (average over 10 year span from 2003-2013)	Incident frequency per unit.yr	EGI asset scope	EGI predicted frequency
Mains	33%	0.83	1,932,131 km of mains	4.31E-07	77,767 km	3.35E-02
Services	67%	1.67	64,666,471 services	2.58E-8	3,400,000 services	8.76E-02
					Total	1.21E-01

Probability of Puncture + Migration + Ignition

In order to derive the probability of puncture and ignition given the existence of a cross-bore, a similar calculation was performed as described in Section 5.1 - Below Ground Releases. The predicted number of cross-bores was taken from the Spotlight results to arrive at a total number of legacy cross-bores across EGI.

In order to remove pipes that were unlikely to be punctured from sanitary sewer clearing tools, pipes greater than NPS 4 were not included in the calculation. Thus the total frequency of cross-bore ignitions on mains is currently distributed only across mains NPS 4 or smaller.

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Table 5.23 – Mains – Number of Crossbore (from Spotlight)

Pipe Size	Material	Number of Crossbores
2	PLASTIC	626.4929921
1.25	PLASTIC	592.89012
4	PLASTIC	192.8710581
2	STEEL	89.82305426
4	STEEL	47.36641881
1	STEEL	23.89768647
3	PLASTIC	11.78071295
1.25	STEEL	8.02398152
3	STEEL	6.96491771
1	PLASTIC	0.21246294
0.75	STEEL	0.19036256
0.75	PLASTIC	0.03680868
0.5	PLASTIC	0.03163678
2.5	STEEL	0.00429523
1.5	STEEL	0.00131967
0.5	STEEL	0.00112867
2	COPPER	0.0001362
	Total	1600.58

Targeting an overall frequency of 3.35E-02 for mains, the probability of migration and ignition given the existence of a cross-bore is calculated as 2.09E-5, applicable for mains less or equal to size NPS 4.

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6 Benefit / Cost Value Measures

6.1 GHG Emissions

Writeup pending availability of isolation time estimates

6.2 Commodity Loss

Writeup pending availability of isolation time estimates

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7 Risk Trees

7.1 Third Party Damage

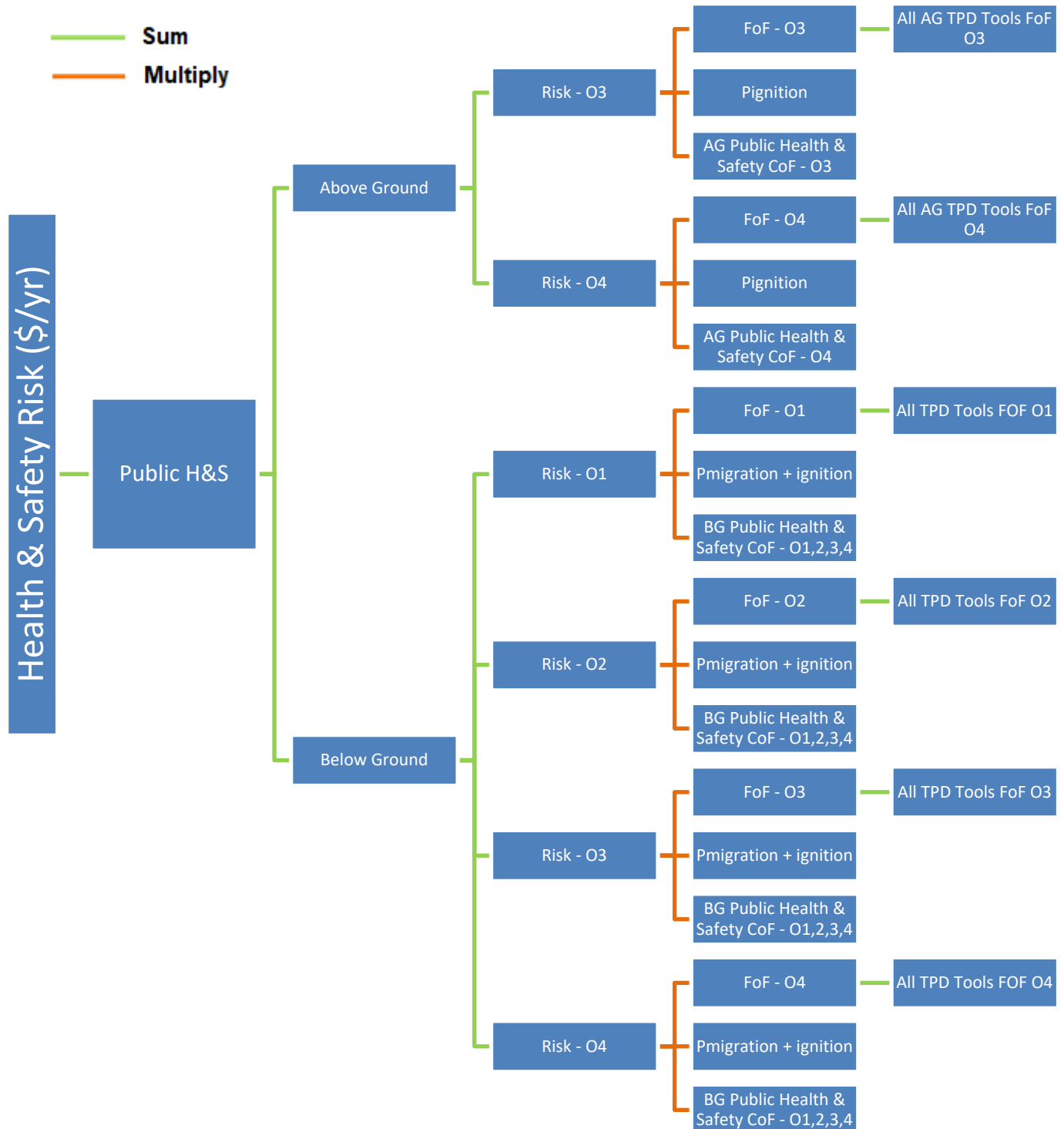


Figure 7.1

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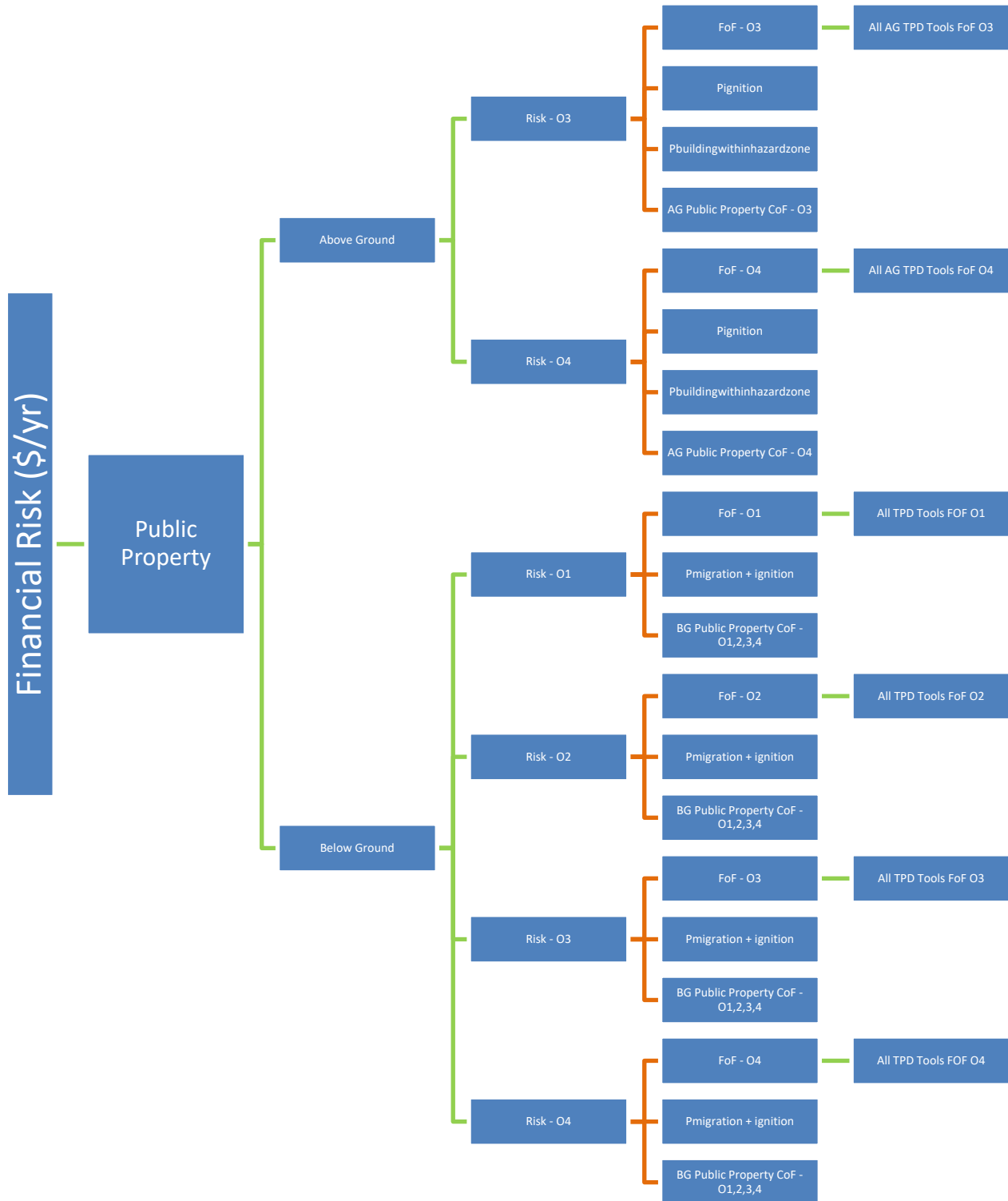


Figure 7.2

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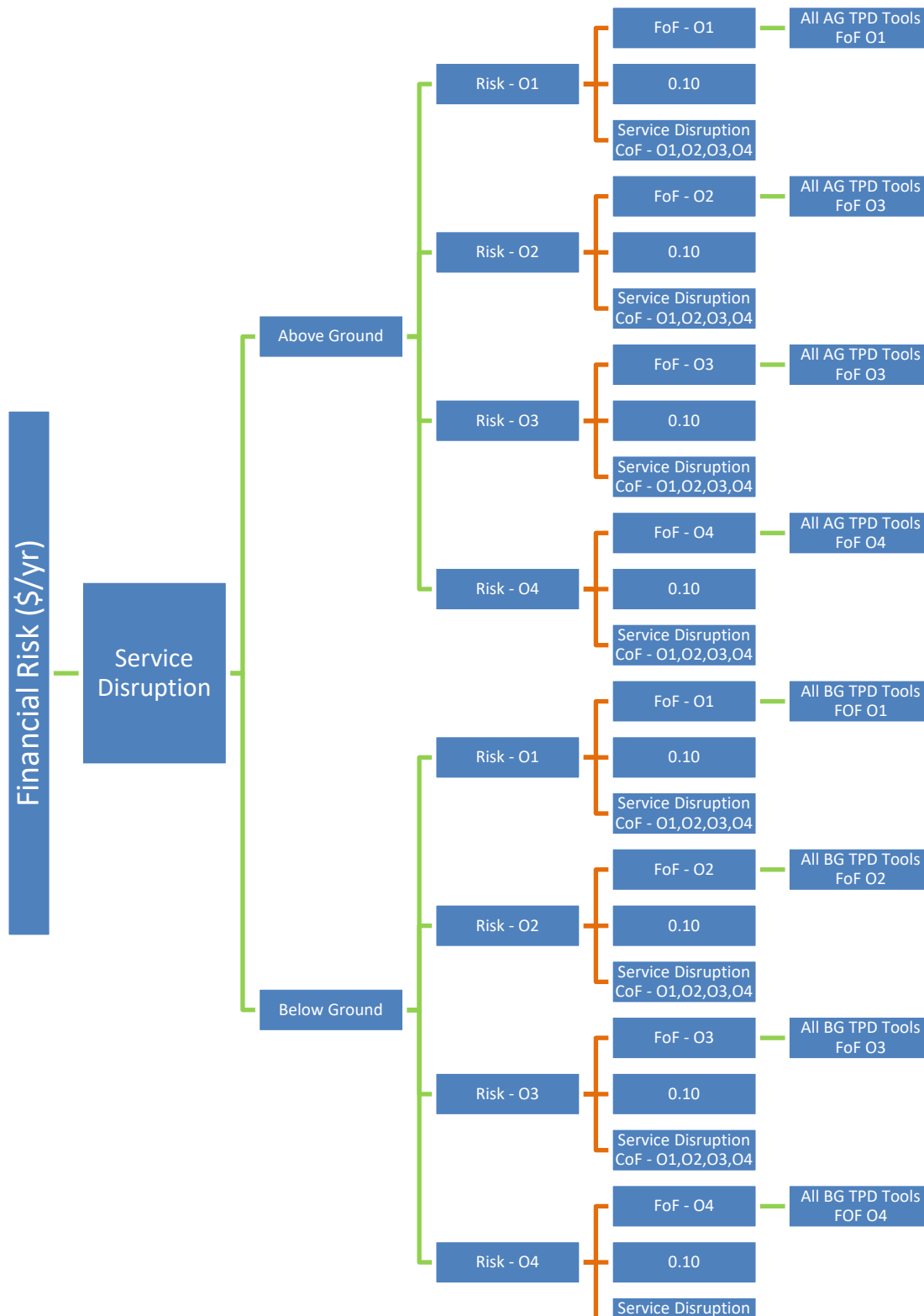


Figure 7.3

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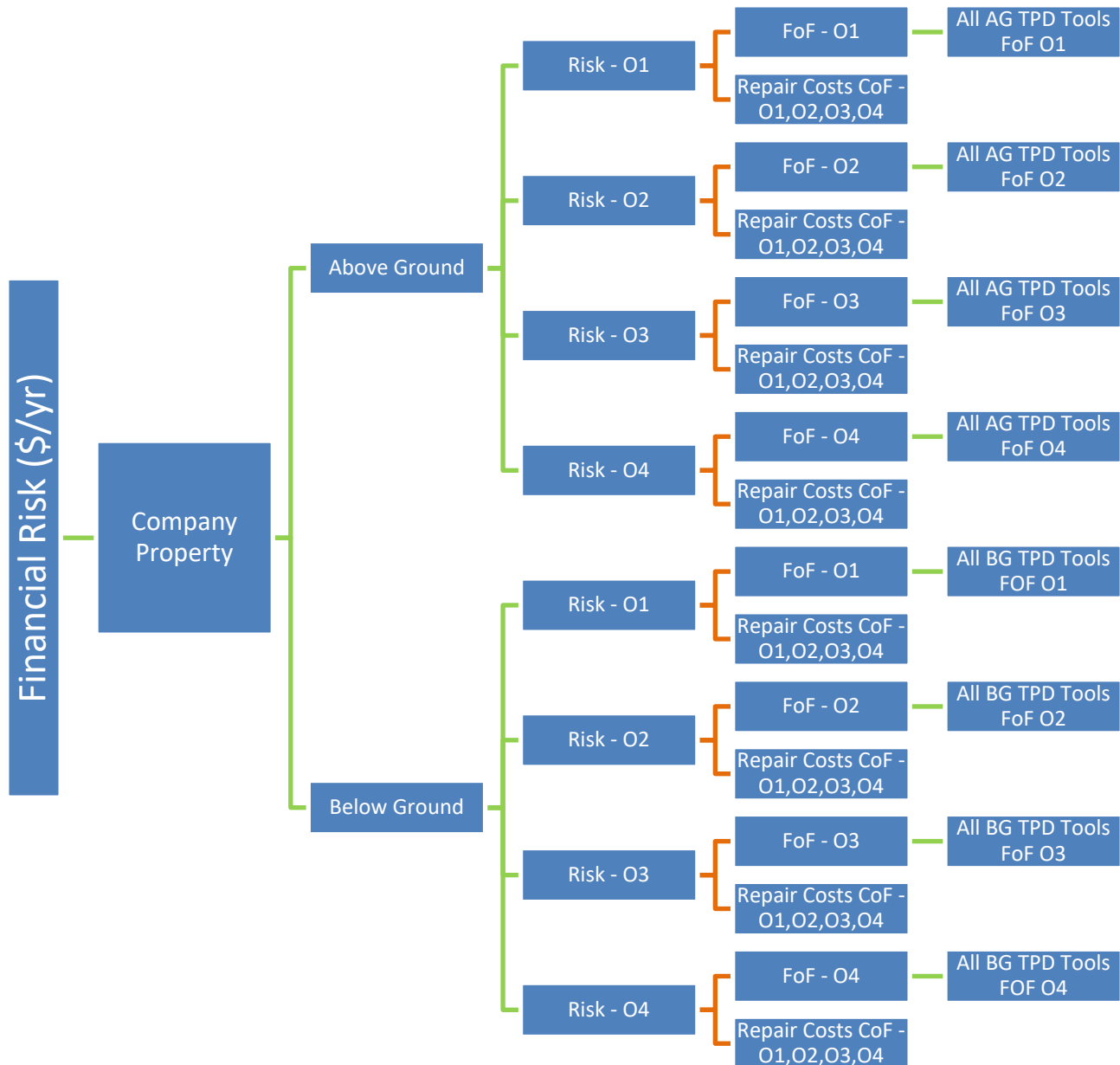


Figure 7.4

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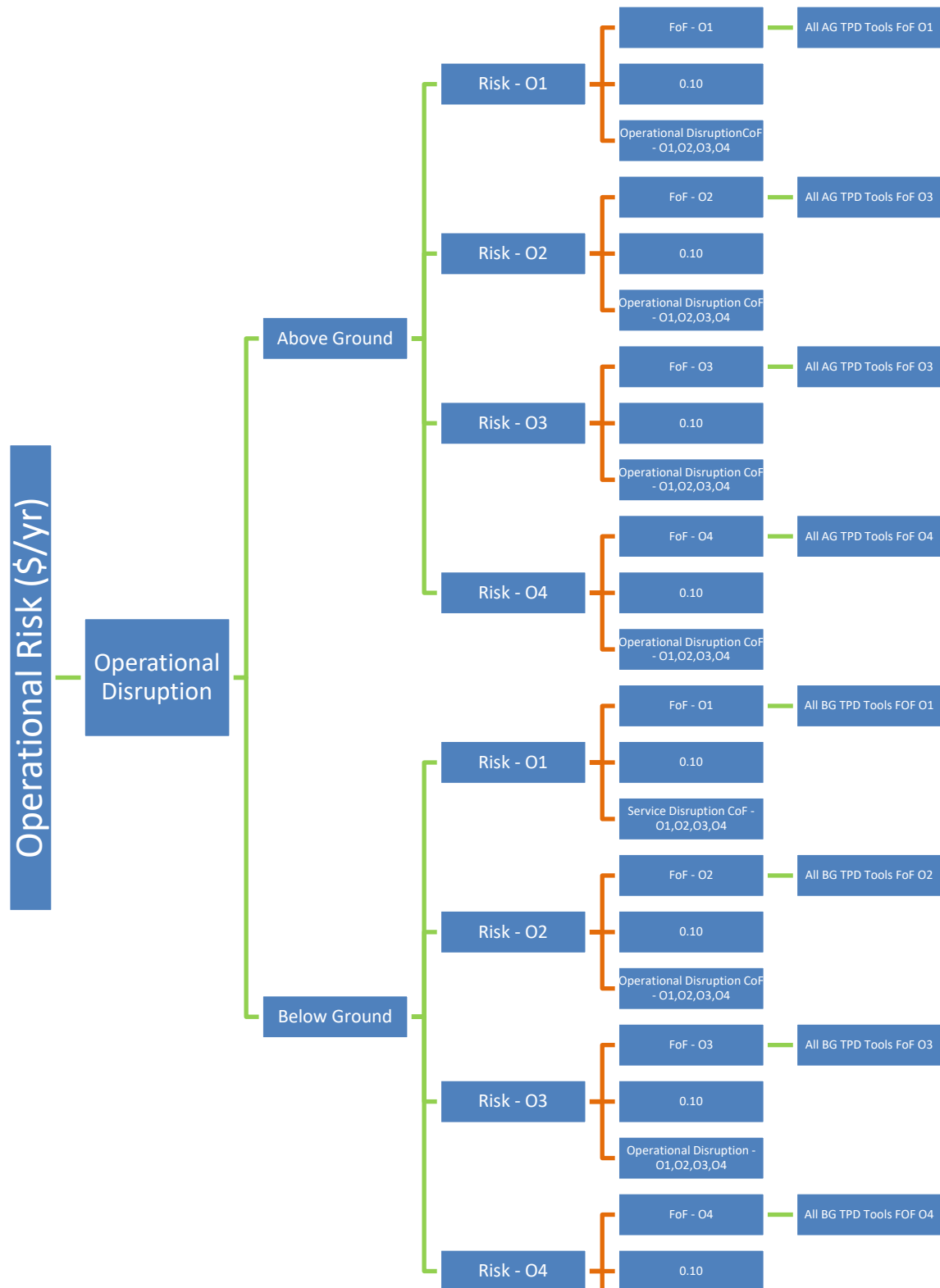


Figure 7.5

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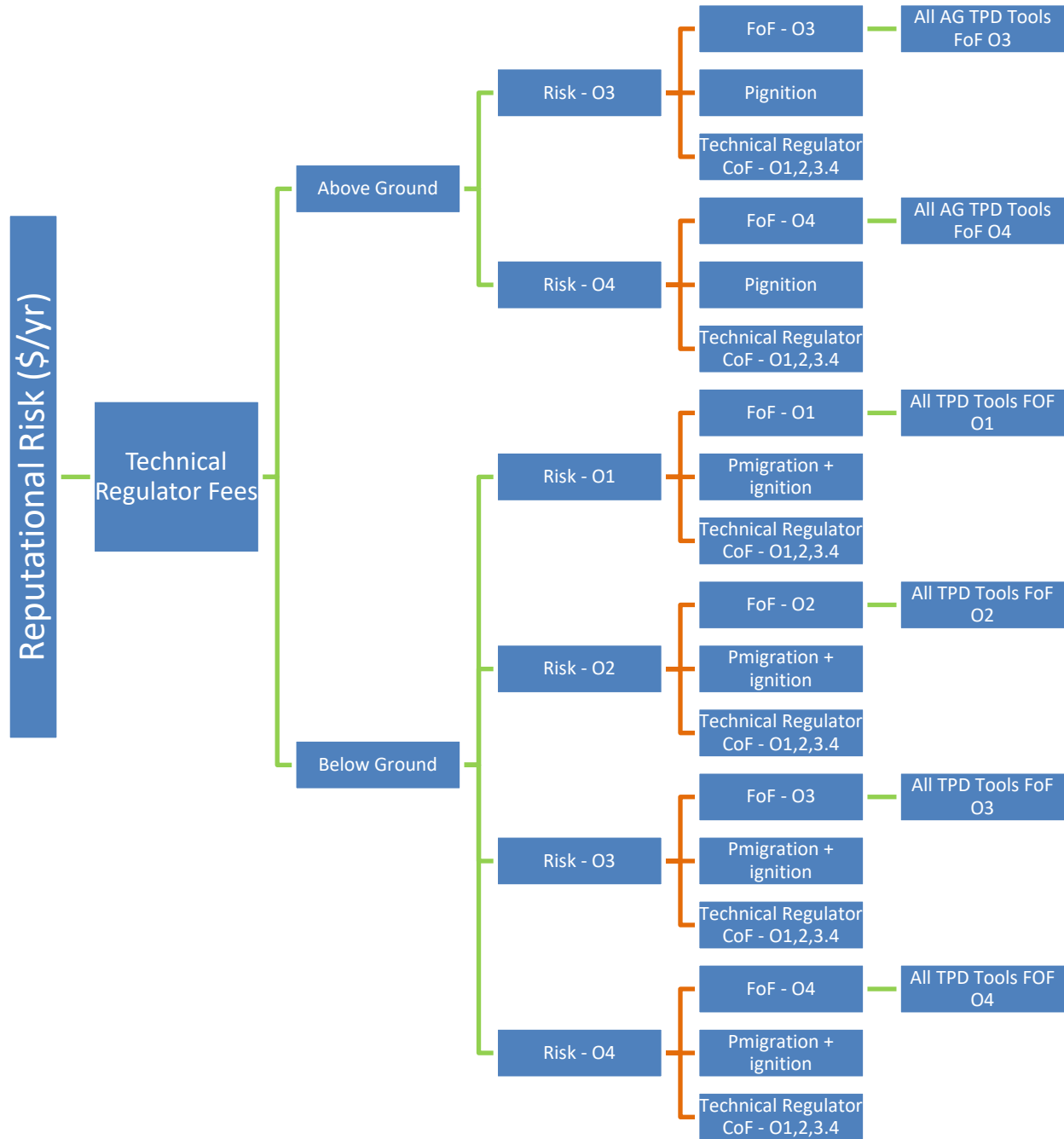


Figure 7.6

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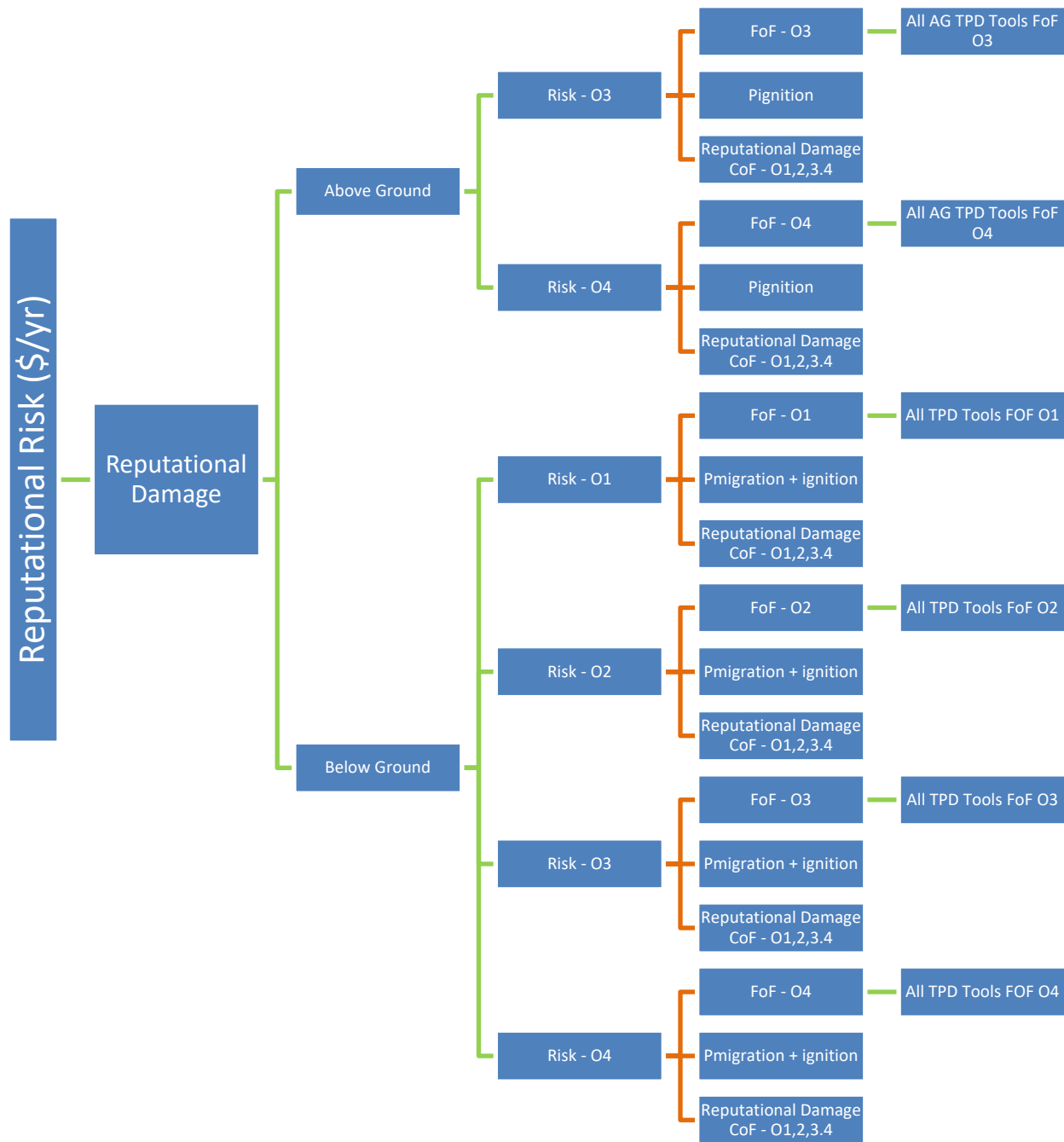


Figure 7.7

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7.2 AHR Threats and Uplifts

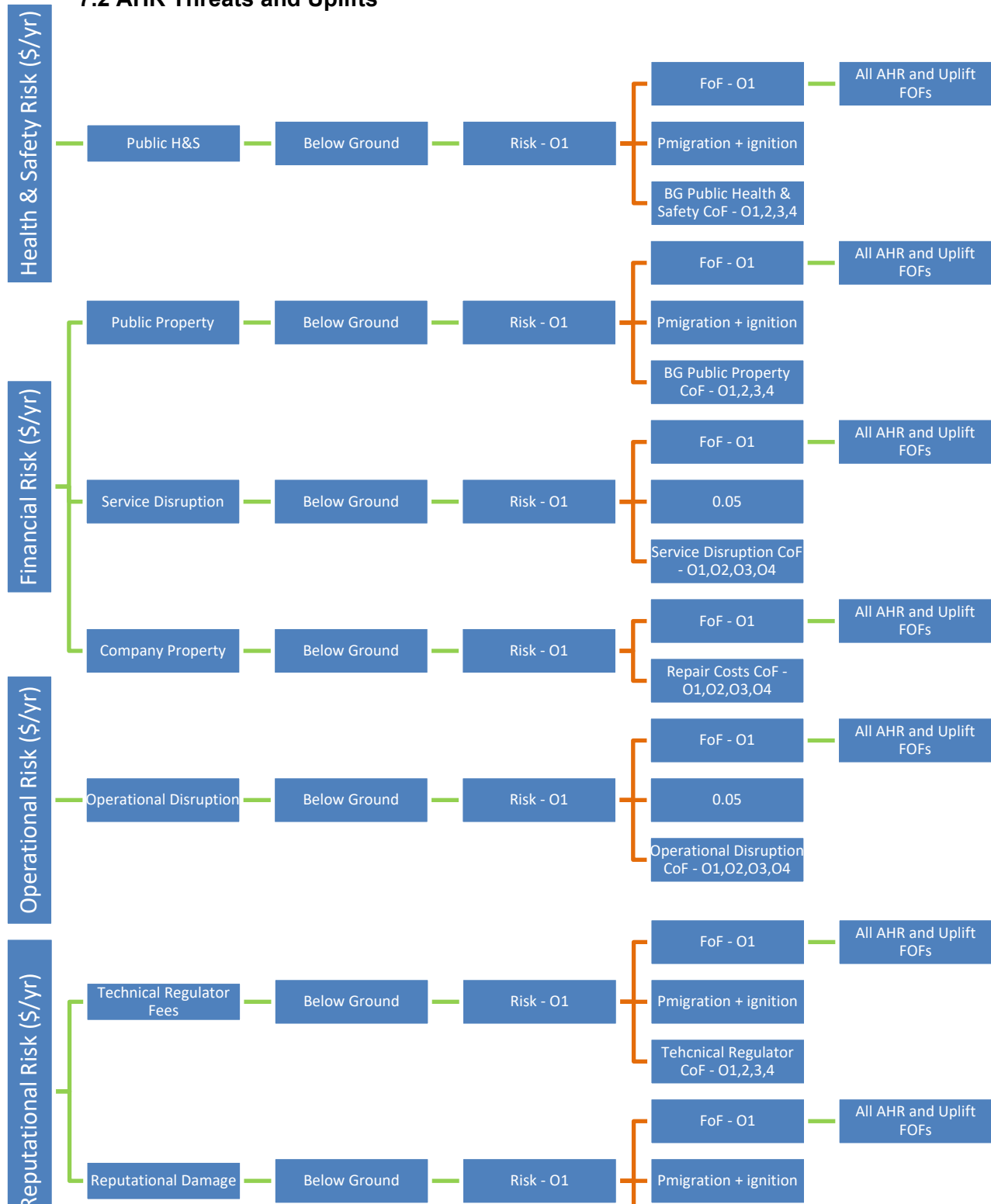


Figure 7.8

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7.3 Cross-Bore

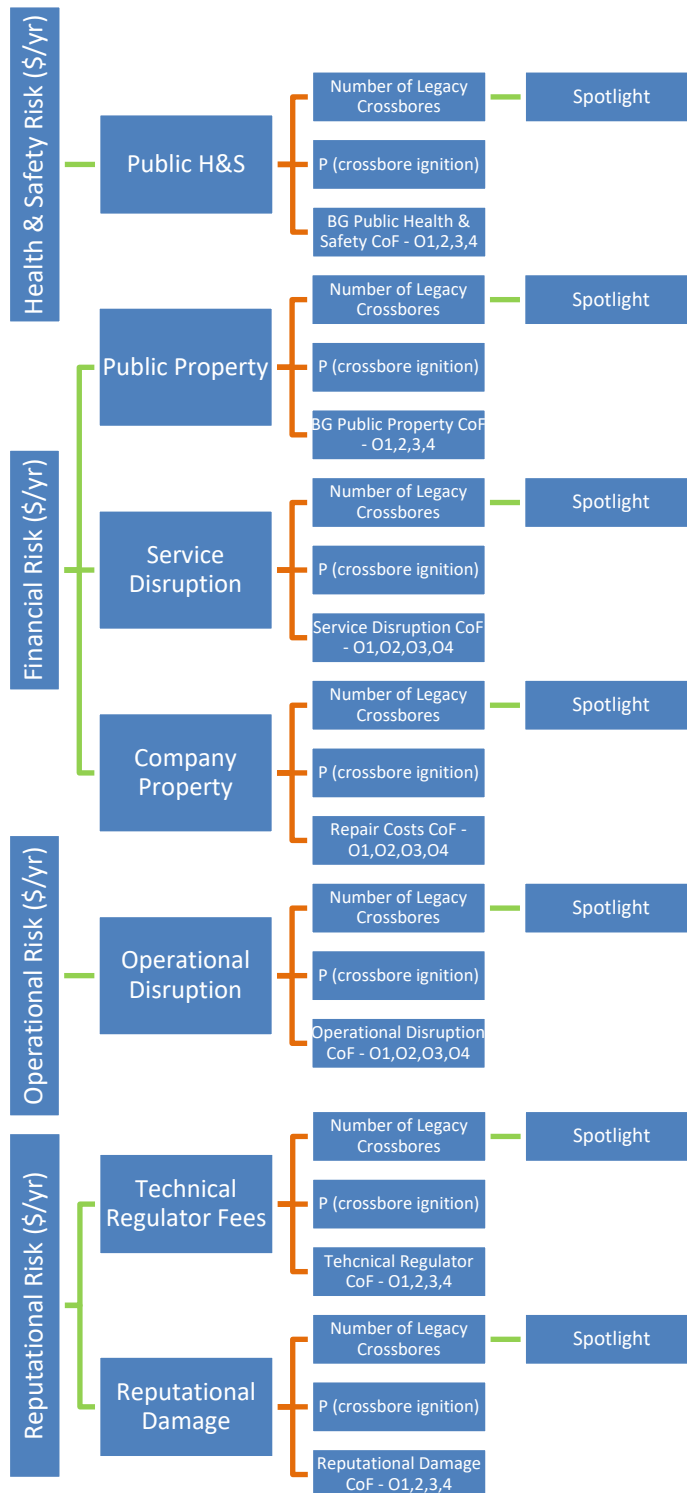


Figure 7.9

8 References

1. Pipeline and Hazardous Materials Safety Administration, “Pipeline Risk Modeling Overview of Methods and Tools for Improved Implementation”, 2020
2. EGI Value Framework Definition Document Version 8.0
3. Bain, B., Huser, A., Falck, A., Bolsover, A., Spitzenberger, C., “Modelling of Accidental Hydrocarbon Releases in QRAs: Hole Size Versus Initial Release Rate Basis”, 2014
4. Shabarchin, O., “Modelling Third Party Damage Failure Frequency for Gas Distribution Steel Mains”, 2018
5. Chen, Q., Nessim, M., “Reliability-based Prevention of Mechanical Damage to Pipelines”, 1999
6. Canadian Standards Association CSA Z662-19
7. Fuglem, M.K., Chen, Q., Stephens, M.J “Pipeline Design for Mechanical Damage”, 2001
8. Driver, R., Zimmerman, T., “A Limit States Approach to the Design of Pipelines for Mechanical Damage”, 1998
9. Nessim, M., Zhou, W., “Target Reliability Levels for Design and Assessment of Onshore Natural Gas Pipelines”, 2009
10. Eiber, R., Leis, B., “Fracture Control Technology for Natural Gas Pipelines”, 2001
11. Roovers et al, “EPRG Methods for Assessing the Tolerance and Resistance of Pipelines to External Damage, Proceedings of Joint EPRG/PRCI Conference on Pipeline Technology, Vol.II, 2000

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12. PHMSA Gas Distribution incident data, available: <https://www.phmsa.dot.gov/data-and-statistics/pipeline/data-and-statistics-overview>
13. CCPS Guidelines for Determining the Probability of Ignition of a Released Flammable Mass
14. CCPS Guidelines for Chemical Process Quantitative Risk Analysis, Second Edition
15. Stephens, M., "A Model for Sizing High Consequence Areas Associated with Natural Gas Pipelines", 2000
16. TNO, "Methods for the calculation of physical effects due to releases of hazardous materials (liquids and gases)", 'Yellow Book'
17. OGP Risk Assessment Data Directory, Report No. 434-6.1 "Ignition Probabilities", 2010
18. TNO, "Methods for the determination of possible damage to people and objects resulting from release of hazardous materials", 'Green Book'
19. Altus Group, "2020 Canadian Cost Guide"
20. OMBI Water & Wastewater Expert Panel Meeting Slideshow

Appendix A: Third Party Damage Data Treatment

Locates

Ontario One Call data from 2012-2020 was obtained in tabular format. The following processing steps were taken to clean the data and geocode the tickets based on address:

Loaded all tickets 2012-2020 (8,839,892)

Delete all request_type = 'REMARK' tickets (322,364) (tickets where a locate service provider did not immediately complete a locate and locate requester asked for a status update)

Delete all request_type = 'RELOCATE' tickets (980,040) (tickets where a locate requester required a refreshed locate due to previous one expiring)

DELETE all header_code = 'PLANNING' (19,698) (tickets that were requested to gain information for a project planning, i.e. no excavation)

DELETE all header_code = 'DAMAGE REPORT' (7,904) (we were advised by OOC to remove these)

DELETE all header_code = 'SEWER LATERAL' (125,223) (represent camera inspections)

= 7,384,553 records remaining

Filter all duplicate ticket #s (duplicate tickets for same excavation may go out to multiple station codes)

= 6,519,095 final records

Breakdown:

- Case 1: 5,052,975 records with a civic_address filled
- Case 2: 397,341 records with only 1 cross-street and no civic_address
- Case 3: 1,068,779 records with 2 cross streets and no civic address

Used Geocodio to map:

- Case 1 was mapped using the street_name and civic_address (Method 1)
- Case 2 was mapped using the intersection of street_name and intersection 1 (Method 2)
- Case 3 was mapped using a mix of cross-street 1 and cross-street 2 (Method 3):

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Run geocode on both intersection 1 and intersection 2 to obtain GPS for both

If accuracy score of 1 intersection was > 0.8 and score of other intersection was < 0.5, choose Lat/Long of higher accuracy

If accuracy score of 1 intersection was 0 and the other was > 0, choose Lat/Long of non-zero accuracy

Else, interpolate midpoint of Intersection 1 and 2 (accuracy score averaged)

Overall 97% of tickets were mapped and 90% of the records had an accuracy score ≥ 0.8 .

Damages

LEGD and LUG damage data was obtained from 2014-2019 and geocoded based on address.

Hole size:

Free-form text entries for LUG hole sizes from 2014-2019 were normalized according to the following:

For single hole size values:

- Sizes were rounded up to the nearest $\frac{1}{2}$ " increment
- Any sizes less than $\frac{1}{2}$ " were mapped to pinhole size

For hole sizes formatted as (___) x (___):

- Calculate $\text{sqrt}((__) \times (__))$ and round up to nearest $\frac{1}{2}$ " size

String values:

- Full-bore severers were identified according to a string search. The following terms were mapped to full-bore sever:

Table A.0.1

Severed	Cleanly severed	halfway split
1 1/4" Diameter	complete rip through	line cut in half
1 1/4" Full Port	complete tear	line cut on half
1 foot diameter	COMPLETELY SEVERED	pipe in half

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1" full diameter	cut	Pulled from tee
1" open line	cut in half	Pulled in half.
1" steel cut in half	Cut in half.	ripped apart
1/2 open line	Cut in two	sever
1/2" (severed line)	CUT line	severed
1/2" (severed)	cut open	severed
1/2" slice almost completely	cut threw	severed
100	cut through	severed in half
100%	Cut through pipe	severed in two
100%	full	severed line
100%	full 1/2"	severed pipe
12" AUGER	full break	severed
2" Tear	full cut	sheared
2" (Severed)	full cut off	Sheared in half
2" Severed	full open	shovel slice
3/4 (Severed)	full pipe diameter	torn in half
90 %	fully open line	torn in half (1 1/4")
Broke line	fully severed	torn off.

Following hole size standardization, the cleaned hole dimension was compared to the nominal diameter of the pipe. For sizes greater than the nominal pipe size, these were also considered conservatively as full-bore severers.

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Pipe properties

MOP:

LEGD MOP values were assigned based on their pressure class:

Table A.0.2

Pressure Class	Maximum Operating Pressure (psig)
LP	2
MP	12
IP	64
HPPE	100
HP	175
XHP	650

LUG MOP values were assigned based on the EOP values extract obtained from Asset Intelligence.

- N/A, 0, and -1 MOP values were assumed to be 420 kpag based on the most common EOP value present in the database (559,584 / 646,870)
- A cap of 4482 kpag (650 psig) was placed on MPO for LUG mains based on discussions with the GMO which revealed the LUG mains extract includes some number of transmission and gathering lines that were unable to be filtered out. This assumption affected 4,290 / 646,870 records.

Wall Thickness:

Mean wall thickness for steel mains was assigned based on the below logic for LEGD and LUG:

WHEN mv.MAINNPS < 1.25 THEN 3.38

WHEN mv.MAINNPS = 1.25 THEN 3.56

WHEN mv.MAINNPS = 2 THEN 3.91

WHEN (mv.MAINNPS > 2 AND mv.MAINNPS < 12) THEN 4.78

WHEN mv.MAINNPS = 12 THEN 6.40

ELSE 9.50

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Grade and UTS:

Grade values were assigned for LEGD and LUG based on the minimum steel grade which, using the above assumed MOP and wall thickness values, would result in a % SMYS less than 30%. Similarly, UTS values were assigned based on the assumed grade following the below values:

Table A.0.3

Mean Steel Grade (MPa)	Mean Ultimate Tensile Strength (MPa)
207	427
241	496
290	503
317	517
359	538
386	565
414	579
448	607
483	641

2/3 Charpy V-Notch Energy:

Mean Charpy toughness values were assumed using the following logic:

Table A.0.4

NPS	Year Built	2/3 specimen toughness
≤ NPS 14	≤ 1970	10 J
≥ NPS 16	≤ 1970	10 J
≤ NPS 14	>1970	20 J
≥ NPS 16	> 1970	27 J

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Appendix B: MPAC Data Treatment

MPAC structure definitions were mapped to the below Altus construction guide categories for the following MPAC property types:

- Residential
- Non-residential Income

For the non-residential cost category, the property description rather than the structure definition was utilized as the structure-definition field held over 630,000 unique entries, making a manual mapping exercise infeasible. 216 out of 265 unique property definitions for the non-residential cost category were mapped, representing 98% of all properties with a non-residential cost structure.

For the Multi-residential and Residential condominium category, reconstruction costs were estimated based on the average costs observed in PHMSA. No cost per square footage from Altus was assigned as no logic could be determined which reflected the expected damage based on the total square footage of the structure.

The residential category currently only includes mapping for primary structures on the property. Buildings identified as secondary or farm structures were excluded from the mapping.

The Altus construction costs per square foot are shown below.

Table B.1

Altus Cost Guide 2020 (Private Sector + Public Sector & Site Servicing - Combined)					
		BUILDING TYPE	GTA	Ottawa/Gatineau	
Private Sector Price per Square Foot	RESIDENTIAL	CONDOMINIUMS/ APARTMENTS	Up to 6 Storeys (Hybrid Construction)	217.5	210
			Up to 12 Storeys	237.5	217.5
			13-39 Storeys	242.5	222.5
			40-60 Storeys	267.5	n/a
			60+ Storeys	300	n/a
			Premium for High Quality	200	170
		WOOD FRAMED RESIDENTIAL (Dimensional Lumber)	Row Townhouse with Unfinished Basement	132.5	137.5
			Single Family Residential with Unfinished Basement	165	157.5
			3 Storey Stacked Townhouse	157.5	165
			Up to 4 Storey Wood Framed Condo	185	177.5
			5 to 6 Storey Wood Framed Condo	200	182.5
			Custom Built Single Family Residential	650	672.5
		SENIORS HOUSING	Independent / Supportive Living Residences	242.5	217.5
			Assisted Living Residences	265	235

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Public Sector & Site Servicing Price per Square Foot	COMMERCIAL		Complex Care Residences	310	282.5
		OFFICE BUILDINGS	Under 5 Storeys (Class B)	230	217.5
			5 - 30 Storeys (Class B)	242.5	225
			5 - 30 Storeys (Class A)	277.5	260
			31 - 60 Storeys (Class A)	332.5	n/a
			Interior Fitout (Class B)	82.5	72.5
			Interior Fitout (Class A)	152.5	122.5
		RETAIL	Strip Plaza	162.5	147.5
			Supermarket	197.5	180
			Big Box Store	185	167.5
			Enclosed Mall	267.5	237.5
		HOTELS	Budget	200	185
			Suite Hotel	285	265
			4 Star Full Service	330	300
			Premium for Luxury	200	145
		PARKING	Surface Parking	15	12.5
			Freestanding Parking Garages (Above Grade)	100	90
			Underground Parking Garages	147.5	137.5
			Underground Parking Garages (Single Level, Open Cut Excavation)	110	115
			Underground Parking Garages - Premium for Unusual Circumstances	190	155
	INDUSTRIAL	INDUSTRIAL FACILITIES	Warehouse	95	97.5
			Urban Storage Facility	97.5	102.5
			Data Centre - Tier III	900	772.5
			Pharmaceutical Lab	630	557.5
			Manufacturing Facility	327.5	310
	INSTITUTIONAL	EDUCATIONAL BUILDINGS	Elementary School	217.5	220
			Secondary School	250	250
			Private School	280	275
			Universities & Colleges - Teaching and Lecture Hall Building	462.5	410
			Universities & Colleges - Laboratories (Level 1 and 2)	617.5	557.5
			Universities & Colleges - Student Residence	250	220
		HEALTH CARE	General Hospital/Acute Care	705	660
			Medical Clinic/Treatment Centre	387.5	377.5
	CIVIC	TRANSPORTATION BUILDINGS	Regional Airport Terminal	390	345
			International Airport Terminal	710	647.5
			Bus Terminal/Garage	310	295

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	SERVICING & HIGHWAYS	GOVERNMENT BUILDINGS	Fire/EMS Station	425	310
			Police Station - Local Detachment	375	330
			Police Station - Regional Headquarters	400	330
			Court House	525	440
			Facilities Maintenance Building	312.5	295
			Penitentiary	410	382.5
			Municipal Office (including fit-up)	312.5	290
			Library	440	397.5
		RECREATION/ENTERTAINMENT BUILDINGS	Ice Arena	245	227.5
			Community Aquatic Facility	455	392.5
			Multi-Use Recreational Centre	317.5	295
			Casino Facility	645	602.5
			Performing Arts Building	615	475
			Museum / Gallery	550	457.5
	SERVICING & HIGHWAYS	SERVICING	Local Roads - 8m road width (per metre)	3850	3700
			Arterial Roads - 9m road width (per metre)	4200	4000
			Arterial Roads - 12m road width (per metre)	4950	4750
			Private Roads - 6m road width (per metre)	3150	2950
			Residential Row Townhouses (per unit)	27500	27800
			Industrial (per acre)	188500	182850
			Commercial (per acre)	267500	263700
		HIGHWAYS	Multi-Lane Highways (per lane km)	287900	2295500

Appendix C: Repair Costs

From Distribution System Integrity:

Legacy Union Gas

To obtain Legacy Union Gas unit costs for mains and services the UG-CostTrendAnalysisWorkbook was utilized. This was a tool using 2015-2017 LUG project data to develop unit costs on a per meter basis for steel and plastic mains and services. From the workbook, the "Replacement Cost" summary values were used for Northern and Southern regions as they best reflected planned replacement costs.

The file provides a direct cost as well as an indirect material cost, when summed give the total cost per meter.

As the values were derived in 2017 the Bank of Canada inflation rate from 2017 to 2020 was used which was 5.04%. All costs were uplifted by 5.04% to incorporate inflationary effects.

As the costs represented in the Workbook are planned replacement costs an uplift factor of 30% was utilized to obtain the Reactive costs. The 30% uplift value was determined as per the Value Framework Section 4.2.1.1 page 40, which states emergency repair and reactive costs are typically 30% greater than planned work.

Due to missing or unpractical cost values a number of unit costs had to be derived using the other available data.

Unit costs for the following were derived using an uplift factor based upon the average percent difference in unit costs of the two regions:

Table C.1

Asset Type	Region	NPS	Material
Services	North	6	Steel
		8	Steel
		4	Plastic
	South	0.75	Steel
		2	Steel
		4	Steel
Mains	North	16	Steel
		6	Plastic
	South	0.75	Steel

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Unit costs for the following were derived using a linear regression method based upon the unit costs which were available for each region:

Table C.2

Asset Type	Region	NPS	Material
Services	South	0.75	Plastic
Mains	North	3	Steel
		20	Steel
		24	Steel
		26	Steel
		30	Steel
		34	Steel
		36	Steel
		42	Steel
		48	Steel
	South	2	Steel
		3	Steel
		4	Steel
		20	Steel
		24	Steel
		26	Steel
		30	Steel
		34	Steel
		36	Steel
		42	Steel
		48	Steel

Legacy Enbridge Gas Distribution

To obtain Legacy Enbridge Gas Distribution unit costs for mains and services the “Main Repair Replacement Costs” for SRAT was utilized for mains and the “2016 Relay Unit Rates for Catherine M_Confidential” for SRAT was utilized for services. The files provide a planned replacement cost for services and a reactive/emergency repair cost for mains.

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As the main values were derived in 2017 the Bank of Canada inflation rate from 2017 to 2020 was used which was 5.04%. All costs were uplifted by 5.04% to incorporate inflationary effects. As the service values were derived in 2016 the Bank of Canada inflation rate from 2016 to 2020 was used which was 6.51%. All costs were uplifted by 6.51% to incorporate inflationary effects.

As the costs represented in the files are planned replacement costs for services, an uplift factor of 30% was utilized to obtain the Reactive costs of services. The 30% uplift value was determined as per the Value Framework Section 4.2.1.1 page 40, which states emergency repair and reactive costs are typically 30% greater than planned work. As the costs represented in the files are reactive costs for mains, a decrease of 30% was utilized to obtain the planned replacement costs of mains. Additionally the reactive costs for mains was based upon an 8 meter repair, so dollar values were normalized using the Release Cat 1, 2 and 3 costs to obtain a per meter cost basis for planned replacement.

The following costs were derived by an unknown method for SRAT and were kept in this analysis:

Table C.3

Asset Type	Region	NPS	Material
Services	Rural	8	Steel
		12	Steel
		20	Steel
		8	Plastic
		12	Plastic
	Urban	8	Steel
		12	Steel
		20	Steel
		8	Plastic
		12	Plastic
Mains	North	16	Steel
		6	Plastic
	South	0.75	Steel

The total number of services represented by the above table is only 52 of 2.17 million.

Cost Comparison

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A comparison of costs between LEGD and LUG for mains and services showed unit costs within the same magnitude of one another. To review the comparison for services an estimated average unit length of 17 metres was used that is the assumed standard value for a LEGD service line.

2021 AHR Analytics and Modelling Documentation for Vintage Steel Mains Risk Model

Distribution Integrity Management Program (DIMP)

Report
The Enbridge logo, featuring a stylized orange 'e' followed by the word 'ENBRIDGE' in bold black capital letters.

February 24, 2023

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1 Introduction

1.1 PURPOSE/ MODEL OBJECTIVES

This document outlines the data used, analysis, and modelling methodology completed to determine the population, failure history, and modelling parameters for asset sub-classes part of the Asset Health Review (AHR). The scope of this document is limited to the asset sub-classes used in the Vintage Steel Mains Replacement Risk Model.

1.2 STAKEHOLDERS

During the course of the development of the AHR modelling, the following departments were consulted:

- Operations – Model Input
- Asset Management – Model Input
- Asset Information – Model Input
- Integrity Assessments & Risk – Model Input
- Distribution Integrity Management Program (DIMP) – Sign Off

Model input stakeholders were engaged at the beginning of the modelling process. The active asset population used with the AHR for failure projections and condition assessment is provided by Asset Information and is derived from the Data Requirements documentation owned by Asset Information. Asset Information, Integrity Assessments & Risk, and Asset Management were engaged as part of the AHR modelling peer review. Sign-off of the AHR models was completed by DIMP.

1.3 RESPONSIBILITIES

The following table lists the individuals and groups affected by this document and what their accountabilities are in regard to this document. For full details of the roles and responsibilities please refer to the Integrity and Asset management RACI.

GROUP	ACCOUNTABILITIES
Operations	<input type="checkbox"/> Provide input into the population, failure mechanisms and model factors
Asset Management	<input type="checkbox"/> Utilize the AHR models for asset management and planning
Asset Information	<input type="checkbox"/> Provide population and failure data for use in the AHR models, maintains data Requirements documentation
DIMP	<input type="checkbox"/> Perform AHR modelling
Integrity Assessments & Risk	<input type="checkbox"/> Utilize AHR modelling in risk model calculation.

1.4 TERMS AND DEFINITIONS

The following is a list of terms found in this document and their definitions.

TERM	DEFINITION
Asset Attribute	Data or information about an asset that does not change with time (e.g., size, material, etc.).
Asset Health Review (AHR)	The IMS MP-05 Operating Program for assessing the condition of assets within scope.
Asset Subclass	Asset category or group applicable to a specific failure mode and degradation behaviour (e.g. anodeless risers).
Censoring	Condition in which the asset or failure data is only partially known.
Conditional POF	Probability that the asset will fail over the projected period sometime in the future, given it has survived to the present.
Degradation Process	This is the way in which an asset decays over time that ultimately causes failure and end of life.
Event	An occurrence that is either a failure or potential failure that gives rise to consequence.
Failure	When an asset fails to correctly perform its intended function which gives rise to consequence.
Failure Mechanism	The process by which physical, chemical, electrical, thermal or other process leads to failure.
Failure Mode	Ways or modes in which an asset might fail (e.g. corrosion, failure to lock-up, etc.).
Failure Factors	Failure factors increase the failure probability of the asset based on demographic or environmental factors, such as location or manufacturer that are expected to increase the rate of degradation relative to the rest of the asset subclass.
Failure Intensity	Anticipated number of occurrences an item will fail in a specified time period, given that it was as good as new at time zero and is functioning at time t.
Final Year of Analysis	Denotes that the year to be utilized should be that where final full year of failure data is available. When completing statistical modelling, utilizing the present year may add extra survival time to the assets during analysis which would skew the results.
Hazard/Failure Rate	The total number of failures within a subclass population, divided by the total number of life units expended by that population, during a particular measurement interval under stated conditions.
Probability of Failure (POF)	The likelihood that an asset will fail in a given year.
Random Failure	Failure whose occurrence is predictable only in the probabilistic or statistical sense. This applies to all distributions.
Reliability	The probability that a material, component, or system will perform its intended function under defined operating conditions for a specified period of time.
Survival POF	Probability that the asset survives to a specific time in the future regardless of its propensity to fail.
Tacit Knowledge	Information that is based on the knowledge and experience of individuals.

2 Pipe Assets

2.1 DISTRIBUTION GAS MAINS

2.1.1 Population

The Legacy Enbridge Gas Distribution (LEGD) steel mains population extract was produced by combining data extracts from Maximo, GIS (number of connections), and cathodic protection system of record while the Legacy Union Gas (LUG) steel mains population was produced using an extract from GIS. See **Table 2.1-1** and **Table 2.1-2** for LEGD and LUG population filtering criteria.

Table 2.1-1: LEGD Steel Mains Population Filtering Criteria

ASSET SUBCLASS	INSTALL YEAR	MATERIAL	HEADER SERVICES (HDRSRVC)	WAMS_ADMIN_AREA	STATUS
Steel Mains	All years	Steel, Steel Bare, Steel Coated	N	10, 20, 30, 40, 50, 60, 80 (Area 90 excluded)	Active, Pending Decommission

Table 2.1-2: LUG Steel Mains Population Filtering Criteria

ASSET SUBCLASS	INSTALL YEAR	MATERIAL	CLASSIFICATION	STATUS
Steel Mains	All years	Steel	Distribution, Transmission	Constructed, Proposed-Abandoned, Proposed-Removed, In-Service, Out-of-Service

2.1.2 Failure Data

The LEGD historical failure database was used to extract the complete list of main failures to be applied in the steel main asset subclass reliability model. This extract was limited to LEGD failures that occurred from 2007 to 2019 as a result of applicable time-dependent failure modes as per the filtering shown in **Table 2.1-3**. The LUG mains failure data is currently not structured to support reliability modeling, however, there is an ongoing project aimed at classifying LUG historical failure data which will be incorporated in the future.

Table 2.1-3: LEGD Historical Failure Database Filtering Criteria

ASSET CLASS	AREA	INSTALL YEAR	INCIDENT CATEGORY	HAZARD CATEGORY	HAZARD SUBCATEGORY	ASSET TYPE	ASSET CATEGORY	ASSET SUBCATEGORY	ASSET COMPONENT
Steel Mains	10, 20, 30, 40, 50, 60, 80 (Area 90 excluded)	≥ 1950	Failure Incident (Leak)	Corrosion/ Degradation	Metal Loss	Distribution Pipe Segment	Mains	Distribution Pipe	Bare Steel Pipe, Coated Steel Pipe, Steel Pipe

Any failures associated with a header service or a header system were removed from the failure list. The steel mains failure data was connected to their original (parent) asset numbers using the EGD Mains With Parent Extract in SPSS to identify repeat failures and consolidate their attributes. Any failures associated with non-main asset numbers were identified by cross-referencing asset numbers in the historical failure database with the LEGD population extract (containing all statuses including abandoned assets) and removed. All additional removals, reclassifications and consolidation of repeat failures were documented. Duplicated failure records for a single failure were identified using Work Order remarks and removed. Any failure records containing more than one leak on a single main were identified through a review of Work Order remarks and separated to document and account for multiple failures of the given main. All changes have been incorporated into the overall historical failure database stored in the PRIM Data Warehouse.

2.1.3 Multipliers/Factors

As part of the DIMP Coated Steel Main Integrity Assessment, a number of potential covariates were identified through industry research and Subject Matter Advisor (SMA) input. For steel mains, the Log-Linear Non-Homogeneous Poisson Process (NHPP) analysis identified five covariates with a statistically significant contribution to the corrosion reliability model used for LEGD steel mains. However, for LUG steel mains, the completeness of the current dataset only allowed for the inclusion of three covariates. Pressure class is not available in the current LUG mains population extract and will be incorporated once the LEGD and LUG pressure classification standard is integrated based on the Maximum Operating Pressure (MOP). The current LUG Cathodic Protection (CP) data is not structured to support connection with individual main Feature IDs (FIDs), however, there is an ongoing project aiming at associating corrosion areas to main FIDs. The LUG CP history will be incorporated in the future model after the data has been properly structured and validated. **Table 2.1-4** lists the covariates used for LEGD and LUG steel mains.

Table 2.1-4: Log-linear NHPP Model Covariates for Steel Mains Corrosion Model

SUB-CLASS	COVARIATE	COMMENTS
LEGD Steel Mains	Length (m)	A longer pipe length allows for increased opportunities for coating holidays and corrosion to take place.
	Cathodic Protection (CP) Percentage of Good Readings	Poor CP allows for corrosion to take place in areas of compromised pipe coating.
	Wall Thickness (mm)	Thicker pipe walls require more time to fully corrode through.
	Pressure Class	Correlation analysis of historical failure data revealed that increasing pressure, would increase the failure rate.
	Total Fittings	Field-applied coatings are required at fittings which could increase the potential of poor pipe coatings.
LUG Steel Mains	Length (m)	Longer length of pipe allows for increased opportunity for coating holidays and corrosion to take place.
	Wall Thickness (mm)	Thicker pipe walls require more time to fully corrode through.
	Total Fittings	Field-applied coatings are required at fittings which could increase the potential of poor pipe coatings.

All covariates listed in the table above, except for pressure class, used a direct value for the individual assets from the population extract as part of the Log-linear NHPP failure intensity calculation. The values for the Pressure Class covariate for LEGD steel mains model were assigned based upon a ranking of failure rates (total corrosion failures between 2007 to final year of analysis / count of assets) from lowest to highest as shown in **Table 2.1-5**.

Table 2.1-5: Pressure Class Covariate Values for LEGD Steel Mains Corrosion Model

PRESSURE CLASS	VALUE
Extra High Pressure (XHP)	1
High Pressure (HP)	2
Intermediate Pressure (IP)	3
Medium Pressure (MP)	4
Low Pressure (LP)	5

LEGD Cathodic Protection (CP) data was utilized from WAMS Datamart for data from 1989 to 2016 and CSMS from 2017 and beyond. The LEGD mains CP dataset captures data starting from 1989 to final year of analysis. The dataset identifies the number of bad CP counts, the number of good CP counts and the status of the corrosion area across EGD franchise area. Any reading more positive than -0.850 Volts was considered a bad CP reading as it is below protection criteria. The CP history classification was determined based on the percentage of good. Any assets with an unmatched or #NA value within the data table were assigned given a value of 0%.

2.1.4 Model

The mains population filtering criteria described in section 2.1.1 2.1.1 was further filtered for modelling purposes to exclude all assets with invalid installation dates. LEGD steel mains installed prior to 1950 were considered invalid and removed. The validity of pre-1950 LUG mains pipe will be re-assessed and may be incorporated in the future. The analysis was conducted and completed on a main leg/segment basis.

Mains are classified as repairable assets based on their treatment in the field upon failure. When a failure (a leak) is observed on a main, the portion of the pipe that is leaking will be repaired instead of replacing the entire main leg. Repairable models assume the asset can fail multiple times over its lifetime before removal. The Non-Homogeneous Poisson Process (NHPP) is the most common approach for modelling of repairable assets and was identified as the appropriate modelling framework based on a trend test. Both Power-Law and Log-linear NHPP models were experimented, however, the Log-linear NHPP model had the least fitting error compared to the power-law method and therefore was selected for the analysis. Furthermore, this approach has been validated by the Reliability, Risk and Maintenance Research Laboratory (RRMR Lab) at Toronto Metropolitan University in 2021 based on analysis that compared the fit of 4 candidate distributions (Proportional, Log-linear, Homogeneous, and Power Law NHPP).

SAS software was used to estimate the parameters and the covariate coefficients for all the statistically significant asset attributes. The analysis was performed using the time unit of days based on review of historical failure data and SMA feedback indicating that for a given main multiple failures are not expected. The age of the asset was determined by subtracting the installation year from the final year of analysis (suspended assets) or failure year (failed assets) and was multiplied by 365 to determine the age in days. **Table 2.1-6** contains a summary of the models for the applicable mains asset subclasses.

Table 2.1-6: Steel Mains Model Summary

SUB-CLASS	MODEL	MODELLING METHOD
Steel Mains Corrosion	Log-Linear NHPP	MLE (right censoring)

The NHPP models are calculated based on the main leg lengths. To apply the NHPP formulas to the segmented main legs, the full main leg length is used within the NHPP formula and then the calculated failure intensity is prorated based upon the percent of the segment length of the full main leg length using the following equation. This approach has been validated by the RRMR Lab at TMU.

Segment Intensity = Main Leg Intensity * (Segment Length/Main Leg Length).

2.2 SERVICES

2.2.1 Population

The following table shows the filtering applied for each service asset subclass to show the total population of services in LEGD.

Table 2.2-1: LEGD Service Pipe Filtering Criteria

ASSET SUBCLASS	INSTALL YEAR	WAMS_ADMIN_AREA	STATUS	SERVICE TYPE
Steel Services	All Years			
Pre 1977 PE Services	< 1977	10, 20, 30, 40, 50, 60, 80, (exclude area 83 and 90)	Active, Inactive, Live Stub, Pending Decommission	Basic Service, Primary Service (remove Headers)
1977 - 1985 PE Services	1977 to 1985			
Post 1985 PE Services	> 1985			

For services with multiple pipe materials the extract logic cycles through the pipes to select the one that corresponds to the riskiest subclass in the following order: pre-1977 PE, 1977 - 1985 PE, steel, post 1985 PE.

For LUG, as a result of each service pipe segment having a unique asset number (causing an over-estimated service pipe population), the service connection population is used as a proxy for service pipe population. **Table 2.2-2** shows applicable filtering criteria for LUG services.

Table 2.2-2: LUG Service Pipe Filtering Criteria

ASSET SUBCLASS	INSTALL YEAR	REGION	STATUS	SERVICE TYPE
Steel Services	All Years	All	In-service, Proposed-abandoned, Proposed-removed, Constructed	All
Vintage Plastic Services	< 1984	Northern		
Intermediate Plastic Services	1984 to 1985			
Modern Plastic Services	> 1985			
Intermediate Plastic Services	< 1987	Southeast, Southwest, Eastern		
Modern Plastic Services	> 1998			
Unknown Plastic Services	All other install years			

2.2.2 Failure Data

The LEGD historical failure database was used to extract the complete list of service failures to be applied in the service asset subclass reliability models. This extract was limited to LEGD failures that occurred from 2007 to 2019 as a result of applicable time-dependent failure modes as per the filtering shown in **Table 2.2-3**. The applicable modelled hazard category for each asset-subclass is summarized in **Table 2.2-4**. For LUG, the failure data is not currently structured to support reliability analysis, however, there is an ongoing project aimed at classifying LUG historical failure data which will be incorporated in the future.

Table 2.2-3: LEGD Service Pipe Historical Failure Database Filtering Criteria

ASSET CLASS	CD_DIST (AREA)	INSTALL YEAR	INCIDENT CATEGORY	HAZARD CATEGORY	ASSET TYPE	ASSET CATEGORY	ASSET SUBCATEGORY	ASSET SUBCOMPONENT
Steel Services		1955 to final year of analysis						Bare Steel Pipe, Coated Steel Pipe
Pre 1977 PE Services	10, 20, 30, 40, 50, 60, 80 (remove 90)	1955 to 1976	Failure Incident (Leak)	Corrosion/Degradation, Equipment Malfunction, Incorrect Operation, Material Manufacturing or Construction Defect, Natural Forces, Unable to Classify	Distribution Pipe Segment, Pipe	Services	Distribution Pipe	PE Pipe, PE Service Stub
1977 to 1985 PE Services		1977 to 1985						
Post 1985 PE Services		1986 to final year of analysis						

Table 2.2-4: LEGD Service Pipe Modelled Hazards

SUB-CLASS	HAZARD CATEGORY MODELLED	INCIDENT
Steel Services	Corrosion	Failure incident (leak)
Pre 1977 PE Services	Degradation	Failure incident (leak)
1977 - 1985 PE Services	Degradation	Failure incident (leak)
Post 1985 PE Services	Degradation	Failure incident (leak)

2.2.3 Multipliers/Factors

Failure factors applied to Steel Services and Pre 1977 PE Services are shown in the table below. No failure factors are applied to 1977-1985 PE Services or Post 1985 PE Services.

Table 2.2-5: LEGD Service Pipe Summary of Factors

SUB-CLASS	CRITERION	COMMENTS
Steel Services	Lack of CP	CP History of Very Good (VG), Good (G), and Moderate (M)
		CP History of Poor (P) or no history record
Pre-1977 PE Services	Rock Impingement	Stoniness Classifications of 3 or greater.

2.2.4 Model

For modelling, additional population filtering is applied to remove unknown installation years and out-of-scope service types and further categorize PE services by vintage as per the following table.

Table 2.2-6: Additional LEGD Service Pipe Model Filtering

ASSET SUBCLASS	INSTALL YEAR	PARENT_SVCTYPE
Steel Services	1955 to final year of analysis	Primary Service, Basic Service, Header Service, (Blanks) (remove Garage, Vertical, and Rooftop Headers)
Pre 1977 PE Services	1955 to 1976	
1977 - 1985 PE Services	1977 to 1985	
Post 1985 PE Services	1986 to final year of analysis	

The failure data is filtered to remove infant mortalities. For Steel Services infant mortalities are considered from age 0-3yrs inclusive. For Post 1985 PE Services they are from 0-3yrs inclusive.

Population and failure data is utilized in Reliasoft software to solve for a failure distribution for each asset subclass. The following table summarizes the model and methods utilized for the service asset-subclasses.

Table 2.2-7: LEGD Service Pipe Reliability Model Summary

SUB-CLASS	MODEL	ANALYSIS METHOD	RANKING METHOD	RANK METHOD
Steel Services	2 Parameter Weibull	MLE	SRM	MED
Pre 1977 PE Services	2 Parameter Weibull	MLE	SRM	MED
1977 - 1985 PE Services	2 Parameter Weibull	MLE	SRM	MED
Post 1985 PE Services	2 Parameter Weibull	MLE	SRM	MED

LEGD failure data was used as a proxy to determine shapes and scales utilized in the LUG services model. There is an on-going program to collect and review LUG failure data such that it can be incorporated into the LUG services reliability model in the future.

2.3 RISERS

2.3.1 Population

The Copper (AMP) riser population was derived based on the size, pressure, age, and material of the service line as well as area and installation date and verified through field surveys. The current Copper (AMP) risers population extract is maintained and updated by Asset Information. Note that Copper (AMP) Risers have historically only been used within LEGD and are not applicable within LUG.

Table 2.3-1: Copper (AMP) Riser Population Filtering Criteria

ASSET SUBCLASS	INSTALL YEAR	SERVICE LINE DIAMETER	SERVICE LINE MATERIAL	WAMS_ADMIN_AREA	STATUS	SERVICE TYPE
Copper (AMP) Risers	1969-1984	NTS ½	Plastic	10, 20, 30, 40, 50, 60, 80 (Area 90 excluded)	Active, Inactive, Pending Decommission	Basic Service, Primary Service

2.3.2 Failure Data

The historical failure database that includes the last full year of failure data is utilized for the modelling analysis. The following table shows the filtering applied to the file to produce the failures applicable to Copper (AMP) Risers.

Table 2.3-2: LEGD Copper (AMP) Riser Failure Data Filtering Criteria

ASSET CLASS	CD_DIST (AREA)	INSTALL YEAR	INCIDENT CATEGORY	THREAT CATEGORY	ASSET TYPE	ASSET CATEGORY	ASSET SUBCATEGORY	ASSET SUBCOMPONENT
Copper (AMP) Risers	10, 20, 30,40,50,60, 80 (remove 90)	1969 to 1984	Failure Incident (Leak)	Corrosion/Degradation, Equipment Malfunction, Material Manufacturing or Construction	Above Ground Assets, Distribution Pipe Segment	Customer Meter Sets, Services	Fittings & Connectors, Riser Types	Amp Fitting, Copper Riser, Copper Service Tubing

In addition to the above criteria, any duplicated asset failures were removed by reviewing Work Order remarks. Additionally, any failures associated with Copper (AMP) Riser within the historical failure database whose asset numbers did not correspond to the population extract were removed.

2.3.3 Multipliers/Factors

There are no multiplier/factors applicable to Copper (AMP) Risers.

2.3.4 Model

Any Copper (AMP) Risers with unknown installation dates were excluded from modelling.

To ensure that risers that were removed in the past, but not due to a failure, were given credit for surviving up to their removal age, all the risers with statuses of “Abandoned”, “Abandoned with Main”, and “Cut off at Main” were cross-referenced against the failures within the historical failure database window of 2007-2019. The risers that did not appear within the failure database window were considered a part of the censored population for modelling. The risers that were abandoned prior to 2007 were removed from modelling as their status upon removal (failed or survived) is unknown.

Population and failure data were used in a Left-Truncated Right-Censored (LTRC) MATLAB method to solve for the failure distribution parameters. The following model and software methods were utilized.

Table 2.3-3: LEGD Copper (AMP) Risers Model Summary

SUB-CLASS	MODEL	ANALYSIS METHOD	RANKING METHOD	CONFIDENCE BOUNDS METHOD	RANK METHOD
Copper (AMP) Risers	2-Parameter Weibull	LTRC	N/A	N/A	N/A

3 Validation

The following methods can be utilized for the validation of AHR models. Each asset sub-class could use a single or multiple methods in the validation of the results of the modelling.

- A. DIMP Peer Review – Internal review by DMIP to ensure learnings are incorporated from prior experience and modelling and to discover any analytical concerns.
- B. Multi-department Peer Review – Review by select SMAs from several departments to ensure learnings are incorporated from prior experience and modelling and to discover any analytical concerns.
- C. Stakeholder Review - Review by stakeholders to comment on modelling methodology and results.
- D. External Review – Review by external consultants to validate modelling methodology approaches.
- E. Factor and/or Parameter Reasonable Checks – Review of parameters and factors to ensure they make physical sense and meet understanding of the failure mechanisms.
- F. Comparison against actual failures – Comparison of projected failures against actual to ensure the model is predicting a reasonable number of leaks.
- G. Comparison against industry norms – Comparison against industry norms for parameter values, known causation factors and expected material lifetimes.

4 Revision History

REVISION DATE	SUMMARY OF CHANGES	PREPARED BY	RECOMMENDED BY	APPROVED BY
February 24, 2023	Initial version	Daniel Zanini (DIMP Engineering Specialist II), James Smith (Sr DIMP Advisor), Michael Sabatini (DIMP EIT II), Marko Pejic (DIMP EIT I), Suzanne Malec (DIMP EIT II)	Fred Butrico (Supervisor DIMP)	Johana Gomez (Technical Manager DIMP)

Summary of DIMP Risk Data **Total System**

- Only includes risk of main assets
- Only includes steel mains
- Only includes Corrosion and Crossbore threats

Risk Level (\$/km.yr)	Length (KM) (2020 Risk)	Length (KM) (2030 Risk Projection)
<1	3017.3	1264.7
1 to 10	7074.5	5097.8
10 to 100	15412.3	11289.7
100 to 1K	5930.3	12802.5
1K to 10K	343.3	1272.1
10K to 100K	15.4	62.9
100K to 1M	3.8	6.0
1M+	2.1	3.3
TOTAL	31798.9	31798.9

Summary of DIMP AHR FOF Data **Total System**

- Only includes FOF of main assets
- Only includes steel mains
- Only includes Corrosion and Crossbore threats

FOF Level (FOF/km.yr)	Length (KM) (2020 Risk)	Length (KM) (2030 Risk Projection)
<0.001	10468.7	7268.2
0.001 to 0.01	15526.5	10689.9
0.01 to 0.1	5522.0	12881.7
0.1 to 1	261.4	882.1
1 to 10	14.7	68.5
10 to 100	3.5	5.4
100 to 1000	2.0	2.4
1000+	0.0	0.7
TOTAL	31798.9	31798.9

Summary of DIMP Risk Data **VSM Program**

- Only includes risk of main assets included in VSM Program
- Only includes steel mains
- Only includes Corrosion and Crossbore threats

Risk Level (\$/km.yr)	Length (KM) (2020 Risk)	Length (KM) (2030 Risk Projection)
<1	0.0	0.0
1 to 10	1.8	0.0
10 to 100	28.6	10.4
100 to 1K	49.0	56.1
1K to 10K	6.7	18.2
10K to 100K	0.4	1.7
100K to 1M	0.0	0.2
1M+	0.0	0.0
TOTAL	86.7	86.7

Summary of DIMP AHR FOF Data **VSM Program**

- Only includes FOF of main assets included in VSM program
- Only includes steel mains
- Only includes Corrosion and Crossbore threats

FOF Level (FOF/km.yr)	Length (KM) (2020 Risk)	Length (KM) (2030 Risk Projection)
<0.001	1.0	0.1
0.001 to 0.01	30.9	11.4
0.01 to 0.1	48.2	60.4
0.1 to 1	5.9	12.3
1 to 10	0.6	2.3
10 to 100	0.1	0.2
100 to 1000	0.0	0.0
1000+	0.0	0.0
TOTAL	86.7	86.7

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.95-96

Question(s):

With respect to predicted failure projected in Figure 5.2-50, and 5.2-51:

- a) For each year between 2024 and 2028, how many kilometers of vintage steel pipe does the Enbridge plan to renew? How many kilometers of vintage steel pipe were (or are forecast to be) renewed each year between 2013 and 2023?
- b) If Enbridge's strategy was to maintain the number of failures (leaks) per year, please provide the number of kilometers of vintage steel pipe that would need to be replaced in each year between 2024 and 2028.

Response:

- a) The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

The number of kilometers of vintage steel pipe is provided at Table 1 for the period of 2024 to 2028 and Table 2 for the period of 2013 to 2023.

Table 1
Steel Pipe – 2024 to 2028

Steel Mains by Year Installed	Abandoned per year (km) (1)				
	2024	2025	2026	2027	2028
EGI Total Vintage Steel (<= 1970)	8.5	6.3	13.1	17.6	59.3

/u

Note:

- (1) Accuracy of lengths provided for 2024-2026, expected to have a +/- 10% margin of error.

Table 2
Steel Pipe – 2013 to 2023

Steel Mains by Year Installed	Abandoned per year (km) (1)										
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
EGI Total Vintage Steel (<= 1970)	78.8	84.7	80.6	61.4	72.5	116.2	79.0	93.5	82.0	112.6	8.1

Note:

(1) Accuracy of lengths provided for 2023-2026, expected to have a +/- 10% margin of error.

- b) Assuming the leak trend would continue to follow what is provided at Exhibit 2, Tab 6, Schedule 2, pages 90 to 91, Figure 5.2-16 and Figure 5.2-17 at 67 leaks/year based on a 5-year average, Enbridge Gas would need to replace the lengths of pipe per year (km) as identified in Table 3.

Table 3
Replacement Lengths of Pipe Per Year

	2024	2025	2026	2027	2028
Km	1,336	399	363	327	294

The 1,336 km in 2024 represents a “backlog” of Vintage Steel pipe with a high likelihood for leaking. Once this backlog has been replaced, pipe replacement lengths per year become more consistent. This approach was not adopted for the Vintage Steel Replacement Program, as it front-loads the replacement. Additionally, not all leaks have the same risk. Enbridge Gas took a risk-based approach by selecting pipe to be replaced that would maximize the risk reduction.

The historical replacement lengths in Table 2 are representative of a repair approach with limited proactive replacement and are not aimed at reducing the future number of leaks per year, but rather addressing active leaks or other risks tied to existing pipelines. Through this approach, some pipe replacement projects may only address leak repairs on short lengths of pipe, which are found to be in poor condition when exposed. This approach does not address other pipe in the vicinity of the replacement which may leak in the near future, or the broader condition of the pipeline and potential for future leaks which may occur in other areas. The lengths presented in Table 3 assume the replacement of an entire section of gas main where the reliability model predicts a high likelihood of a leak. If that main is 100 m

long, Enbridge Gas would need to replace all 100 m to prevent the leak, as it does not know where along that pipe a leak may occur.

As provided at Exhibit 2, Tab 6, Schedule 2, page 109, Section 5.2.3.6.3.2, the goal of the Proactive Vintage Steel Replacement Program is to avoid the risk that these aging assets pose by renewing them before they fail. While the DIMP Risk model provides a strong basis to predict which segments of pipe will fail before others and the estimated change in failure rate over time, it cannot predict exactly when and where a leak will occur, which would allow for more targeted action can be taken to prevent leaks. Therefore, a broader replacement program which prioritizes replacement projects based on relative risk is necessary to adequately mitigate this risk. Please note that of the 5,100 km of Vintage Steel main that has been targeted for replacement in the first 20 years of the program, as described at Exhibit 2, Tab 6, Schedule 2, page 110, there is no overlap with the steel main to be included in the Enhanced Distribution Integrity Management Program provided at Exhibit 1, Tab 13, Schedule 3. The majority of the piping targeted is less than NPS 6 and cannot be inspected through in-line technologies to assess and monitor pipe condition.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.19-120

Question(s):

Please provide a revised version of Table 5.2.3-4 that includes the following:

- a) 2013 to 2022 actual information on a similar basis.
- b) For each asset class strategy/investment name, the number of kilometers replaced/renewed for each year.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, /u
filed on June 16, 2023.

a) Table 5.2.3-4 provided below has been provide in Excel at Attachment 1.

EGI - Table 5.2.3-4

Asset Class Strategy/Investment Name	Program/Project Name	2014A	2015A	2016A	2017A	2018A	2019A	2020A	2021A	2022A
TIMP Retrofits and Digs	Integrity	-	-	-	-	-	-	0.0	0.5	9.5
Inspection Program										
Integrity Retrofits and Digs		-	-	-	-	-	-	44.7	86.2	107.2
Depth of Cover	Integrity	-	-	-	-	-	-	-	-	-
	Mains Replacement	-	-	-	-	-	-	0.0	-	-
	Class Location	-	-	-	-	-	-	6.7	7.1	15.9
Class Location Program	Class Location	-	-	-	-	-	-	6.7	7.1	15.9
Corrosion Prevention Program	Corrosion	-	-	-	-	-	-	6.7	11.3	15.4
Emergency Replacement Program	Mains Replacement	-	-	-	-	-	-	2.6	3.2	5.6
General Replacement Program		-	-	-	-	-	-	26.9	31.5	33.9
Service Replacement Program	Service Relays	-	-	-	-	-	-	21.3	34.2	40.7
Relocation Program	Relocations	-	-	-	-	-	-	15.0	56.0	41.0
Bare and Unprotected Program	Mains Replacement	-	-	-	-	-	-	5.3	23.2	19.4

EGI - Table 5.2.3-4

Asset Class Strategy/Investment Name	Program/Project Name	2014A	2015A	2016A	2017A	2018A	2019A	2020A	2021A	2022A
Vintage Steel Replacement	Service Relays	-	-	-	-	-	-	11.1	25.8	46.2
Kirkland Lake Lateral Repl		-	-	-	-	-	-	-	1.4	25.9
London Lines Replacement		-	-	-	-	-	-	6.3	76.5	38.3
Windsor Line Replacement		-	-	-	-	-	-	32.9	36.9	5.1
Port Stanley Replacement		-	-	-	-	-	-	-	0.3	0.0
Bruce Lake Lateral		-	-	-	-	-	12.1	8.4	11.8	0.0
NPS 30 Don River Replacement		-	-	-	-	-	-	1.5	-	-
Lakeshore KOL Replacement		-	-	-	-	-	0.2	0.5	20.9	66.0
NPS 12 St. Laurent Aviation Pkwy		-	-	-	-	-	0.2	0.2	1.0	-
Copper Services Replacement Program		-	-	-	-	-	-	1.7	3.7	2.6
AMP Fitting Replacement Program		-	-	-	-	-	-	1.0	15.6	4.8
Class Locations		16.7	14.4	26.7	27.2	19.7	22.0	-	-	-
Integrity		23.3	19.4	23.0	27.1	26.7	10.6	-	-	-
Main Replacement		37.8	25.6	27.9	25.1	57.6	63.0	-	-	-
Service Relays		13.7	16.8	25.4	26.6	24.7	31.4	-	-	-

EGI - Table 5.2.3-4

Asset Class Strategy/Investment Name	Program/Project Name	2014A	2015A	2016A	2017A	2018A	2019A	2020A	2021A	2022A
Corrosion		5.8	6.0	6.6	8.6	7.8	8.6	-	-	-
Relocations		22.2	38.3	34.3	29.6	3.4	26.9	-	-	-
Total		119.6	120.5	144.0	144.2	139.8	175.1	192.8	447.2	477.5

Overheads included in 2021 & 2022 actuals

The 2014-2019 historical actuals do not map directly to the asset class strategy as

the strategy categorization was not in place

Not able to provide 2013 Actuals as the details for that year resides in an enterprise financial system we can no longer access

- b) Tables outlining the number of km or number of projects are found below. However, prior to 2020, historical data for some programs (Integrity) under the strategies outlined in Table 5.2.3-4 is not available. This is because Copperleaf was not implemented as Enbridge Gas's investment planning tool until January of 2020; and prior to 2019, capital expenditure was not tracked against these specific strategies as identified in part a).

See Table 2 for estimated number of kilometres replaced or units of work completed by year where kilometres replaced is not available. Units are represented in brackets for each line item:

Table 2

Asset Class Strategy/Investment Name	Program/ Project Name	2014A	2015A	2016A	2017A	2018A	2019A	2020A	2021A	2022A
TIMP Retrofits and Digs ⁵ (Number of Pipelines Retrofitted)	Integrity	-	-	-	-	-	-	13	21	17
Inspection Program Integrity Retrofits and		-	-	-	-	-	-	17	13	21

Digs ⁶ (Number of Pipe Segments Dug)										
Depth of Cover (km)	Integrity	-	-	-	-	-	-	-	-	0.223
	Mains Replacement	-	-	-	-	-	-	-	-	-
Class Location Program ¹ (km)	Class Location	-	-	-	-	-	9.1	2.2	0.75	1.1
Corrosion Prevention Program ²	Corrosion	-	-	-	-	-	3,871	3,470	3,998	2,915
Emergency Replacement Program ³	Mains Replacement	-	-	-	-	-	-	-	-	-
General Replacement Program ³		-	-	-	-	-	-	-	-	-
Service Replacement Program ³	Service Relays	-	-	-	-	-	-	-	-	-
Relocation Program ³	Relocations	-	-	-	-	-	-	-	-	-
Bare and Unprotected Program (km)	Mains Replacement	16.2	5.1	4.9	7.2	7.5	9.8	13.2	21.3	19.8
Vintage Steel Replacement (km)		84.7	80.6	61.4	72.5	116.2	79.0	93.5	82	112.
Kirkland Lake Lateral Repl (km)		-	-	-	-	-	4.0	-	0.023	8.0
London Lines Replacement (km)		-	-	-	-	-	-	-	80.9	-
Windsor Line Replacement (km)		-	-	-	-	-	-	64.0	-	-
Port Stanley Replacement (km)		-	-	-	-	-	-	-	-	-
Bruce Lake Lateral (km)		-	-	0.058	-	-	0.011	0.12	0.014	-
NPS 30 Don River Replacement (km)		-	-	-	-	-	0.2	-	-	-
Lakeshore KOL Replacement (km)		-	-	-	-	-	-	-	-	4.5
NPS 12 St. Laurent Aviation Pkwy (km)		-	-	-	-	-	5	-	-	-
Copper Services Replacement Program (km)	Service Relays	4.4	5.4	8.3	14.1	20.4	25.3	7.6	8.8	9.0

AMP Fitting Replacement Program ⁴ (Number of Services)	2296	4758	6993	8401	5059	7243	3405	5572
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Notes

¹ Class Location work is not available pre-2019 due to systems integration between EGD and Union.

2 Corrosion units are listed as number of units of anodes installed and rectifiers added or replaced rather than km of pipe.

3 Length of pipe replaced is not tracked in EGI's systems and therefore cannot be provided.

4 Data not yet available for year end completion in 2022.

5 TIMP Retrofits and Digs describes the number of projects in which connections are added to piping systems for in-line inspection. These are generally not measured in lengths within EGI's mapping system and are therefore counted by discrete projects for the purposes of this response. Length of pipe renewed in each case would typically be < 100m.

6 Inspection Program Integrity Retrofits and Digs describes dig projects initiated in response to pipeline anomalies discovered through in-line inspection. Dig programs will cover an entire section of pipe that has been subject to in-line inspection, and lengths that have been replaced or renewed after anomalies are discovered and assessed for serviceability. The numbers included in this row of Table 1 reflect the number of pipeline sections that were subject to dig programs following in-line inspection and it is expected that total length of pipe replaced or renewed within each project will be less than 100m.

See Table 3 for forecasted kilometres replaced or units of work completed by year for 2023 to 2032 where kilometres replaced is not available. Units are represented in brackets for each line item

Table 3

[illegible]

[illegible]

Copper Services Replacement Program (Number of Services)	Service Relays	460	444	173	0	0	0	0	0	0	0
AMP Fitting Replacement Program (Number of Services)		5971	7042	10400	10400	13000	13000	13000	13000	13000	13000

* Program dollars are included in the forecast but have not yet been assigned to discrete pipeline assets. Therefore, the number of assets listed may not represent total assets that will be subject to some replacement/renewal in a given year as the specific projects are not yet identified.

1 Class Location work is not available pre-2019 due to systems integration between EGD and Union.

2 Corrosion units (anodes and rectifiers) are not forecasted using number of units, rather is determined based off of historical spend

3 Length of pipe replaced is not tracked in EGI's systems and therefore cannot provide be provided.

4 TIMP Retrofits and Digs describes projects in which connections are added to piping systems for in-line inspection. These are generally not measured in lengths within EGI's mapping system and are therefore counted by discrete projects for the purposes of this response. Length of pipe renewed in each case would typically be < 100m.

5 Inspection Program Integrity Retrofits and Digs describes dig projects initiated in response to pipeline anomalies discovered through in-line inspection. Because in-line inspections are not yet complete, the total number of dig projects and associated asset renewal/replacement work will not be understood until in-line inspection is completed.

6 Glenridge year of replacement is subject to Enhanced DIMP assessment results

/u

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.133, p.137

Question(s):

With respect to distribution station condition:

- a) Enbridge states that “Utilizing the aggregated ranking of each sub-system based on their criticality to the station level, Figure 5.2-67 helps to illustrate the findings of the condition assessments and provides insight into the mitigation levels required for the current replacement program.” Please explain, using illustrative examples, of how Enbridge aggregates the ranking for each sub-station to determine the overall distribution system station condition.
- b) For each of the system and customer stations, please provide the total number of stations at each condition level (i.e. recommended mitigation work, plan for mitigation, to be monitored, minor degradation, no issue, unknown) for both the EGD and Union rate zones.
- c) For each of the system and customer stations, and for each sub-system, please provide the total number of systems for each condition level, for both EGD and Union rate zones.

Response:

- a) The section referenced in Exhibit 2, Tab 6, Schedule 2, Figure 5.2-67, page 133 relates to EGD rate zone assets only as described in Section 5.2.4.4.2 and is based on the station condition assessments. Enbridge Gas completes an analysis where all available condition inspection criteria are ranked based on the field observations for each of the respective inspection criteria.
 - i. EGD Rate zone - The ranking system for each subsystem and its failure mode is customized to reflect the observed condition. Each inspection criteria is ranked on a scale of 1 to 5 for each sub-system, with 1 being indicative of like-new condition to 5 indicative of poor condition with intervention required. The full list of

degradation rating scales and their corresponding descriptions for each inspection criteria is listed in Table 1:

Table 1

DEGRADATION PROCESS	DEGRADATION RATING	DESCRIPTION
Corrosion	1	Like new
	2	Some minimal surface corrosion or evidence of aging
	3	Moderate surface corrosion
	4	Pitting corrosion
	5	Severe localized or extensive corrosion
Pipe Coating	1	Like new
	2	Minimal peeling or disbondment
	3	Partial disbondment or paint touch up
	4	Moderate disbondment or partial repaint
	5	Severe disbondment - repaint
Heaving	1	No Heaving
	2	Unknown reason
	3	Settlement
	4	Lack of Heating
	5	Improper Construction
Valve Functionality	1	No issue
	2	Minimal difficulty
	3	Works with difficulty
	4	Does not seal the flow
	5	Seized/Damaged
Pressure Control System Performance	1	No Issue
	2	Regulator locks up slower than normal
	3	Regulator locks up past set point
	4	Regulator does not fully lock up
	5	Regulator fails to lock up
Vegetation	Yes	Threat from Vegetation growth
	No	No Threat
Issue with Fence	Yes	Threat from improper fencing
	No	No Threat
Water Build-up	Yes	Threat from water Build-up
	No	No Threat

To better understand the roll-up methodology, a scoring mechanism was used to combine the ranking assessment of different components of a system station in to one score based on the criticality of each component. For example, a Pipe Coating degradation rating would be multiplied by the corresponding criticality weight to give a component level score. This scoring mechanism was utilized for all components, the sum of the station components was used to indicate the overall condition of the station.

- ii. Union rate zone (UG) - Please see the description in Exhibit 2, Tab 6, Schedule 2, section 5.2.4.4.2, page 133 that indicates the basis for the Union rate zone condition findings that were based on a corrosion assessment.

Stations were ranked on the available information which was limited to the assessed corrosion condition based on ASTM International D 610-01. The scoring was used to group the findings into 5 categories in alignment with the EGD rate zone corrosion findings.

- b) For each of the EGD Distribution System and Customer stations, the total number of stations at each condition level is summarized below in the following Table 2:

Table 2
EGD Station Condition Summary

Recommended action	System Station (EGD)	Customer Station (EGD)	Combined UG Stations *
Recommended mitigation work	10	16	474
Plan for mitigation	11	14	472
To be monitored	61	68	602
Normal wear out	61	78	2,271
No issue	2,278	3,922	893
Unknown	2,586	8,594	12,947

* UG Stations related to piping only as described in a) ii (Exhibit 2, Tab 6, Schedule 2, section 5.2.4.4.2, page 133).

c) DIMP stations are comprised of three main subsystems: pressure control, valving, and piping as outlined in Tables 3 and 4.

i.

Table 3
EGD Distribution System Station Sub System Distribution

Station Sub-System	No Issue	Minor degradation	To be monitored	Plan for mitigation	Recommended mitigation work
Valving					
Valve Corrosion	2420				
Valve Functionality	2417	2	1		
Piping					
Pipe Corrosion	2304	36	39	28	13
Pipe Coating/Paint	2312	26	39	15	28
Pipe Heaving	2395	10	10	2	3
Pressure Control					
Pressure Control System Corrosion	2347	13	50	6	4
Pressure Control System Performance	2377	8	9	10	16

Table 4:
EGD Customer System Station Sub System Distribution

ii.

Station Sub-System	No Issue	Minor degradation	To be monitored	Plan for mitigation	Recommended mitigation work
Valving					
Valve Corrosion	4097				
Valve Functionality	4097	1			
Piping					
Pipe Corrosion	3950	73	44	23	8
Pipe Coating/Paint	3913	56	55	36	38
Pipe Heaving	4050	6	38	1	3
Pressure Control					
Pressure Control System Corrosion	4023	39	26	7	3
Pressure Control System Performance	4071	9	5	3	10

iii. For the Union rate zones combined, only condition data for the piping subsystem is available and is described in part b).

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.p.142-143

Question(s):

Please provide a revised version of Table 5.2.4-8 that includes the following:

- a) 2013 to 2022 actual information on a similar basis.
- b) For each asset class strategy/investment, name the number of assets replaced/renewed each year.

Response:

The following response has been updated to reflect the Capital Update provided at /u
Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

- a) Please see Table 1.

Table 1
Distribution Stations Capital Summary (\$ millions)

Distribution Stations Asset Program	2014	2015	2016	2017	2018	2019	2020	2021	2022
DS - CNG	-	-	-	-	-	0.4	1.6	1.5	0.5
DS - Gate, Feeder & A Stations	-	-	-	-	-	18.6	46.3	46.4	66.7
DS - Inside Regulator & ERR Program	-	-	-	-	-	0.3	0.5	0.3	0.7
DS - Integrity Initiatives	-	-	-	-	-	2.8	-0.2	7.6	3.3
DS - Station Rebuilds & B and C Stations	-	-	-	-	-	17.6	13.3	35.5	26.0
Distribution Stations Total	27.2	32.6	38.7	38.9	38.1	39.7	61.4	91.2	97.1

2013 actuals are not available by the Asset Class, and 2014 to 2018 actuals are not available by Asset Program breakdown for either dollars spent or project completed, as historical information in those years was reported by another format.

- b) Prior to 2020, historical data for discrete investments under the strategies outlined in Exhibit 2, Tab 6, Schedule 2, Table 5.2.4-8 is not available. This is because Copperleaf was not implemented as Enbridge Gas's investment planning tool until January of 2020; and prior to 2019, capital expenditure was not tracked against these specific strategies as provided in response at part a). Additionally, investments are not tracked by scope. So in some cases, a discrete capital investment for a given strategy may involve partial replacement or refurbishment of an asset; and in other cases, the investment will represent a complete replacement of the asset. Consequently, costs can range from thousands of dollars to millions of dollars for investments under a given program.

Also, in the cases of the Compliance Remediation Strategy, Odourization System Strategy, Telemetry Strategy, Header Station Replacement Strategy, Inside Regulator Room Strategy, and Stations Painting Program, work has not been tracked and is not currently forecasted on a discrete asset replacement/renewal level. In these cases, regional accounts are set up for strategies listed under Exhibit 2, Tab 6, Schedule 2, Table 5.2.4-8 and charges for work under these programs are directed to those accounts. Therefore, discrete asset replacements/renewals are not tracked in Enbridge Gas's central tracking systems. Finally, because the Company does not have complete condition data for all assets in the Distribution Station Asset Class, blanket forecasts have been included in the 2023 to 2032 planning horizon to address uncertainties in asset condition which have yet to be discovered through condition methodologies provided at Exhibit 2, Tab 6, Schedule 2, page 125, Table 5.2.4-2.

With these considerations in mind, Enbridge Gas is able to provide the following data in Table 2 which identifies investments assigned to discrete assets between the years 2020 and 2032 which are being partially or completely replaced or renewed under the listed program.

/u/

[illegible]

In addition, please note the data in Table 3 which identifies those programs and strategies which also have blanket accounts to which capital expenditures have been made or planned, for which the number of discrete assets replaced or renewed is not available:

/u

[illegible]

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.p.142-143

Question(s):

For each type of measurement system, please provide the number of assets in each condition category (like new, some minimal surface corrosion or evidence of aging, moderate surface corrosion, pitting corrosion, severe localized or extensive corrosion).

Response:

This question refers to pages 142 to 143 of Exhibit 2, Tab 6, Schedule 2 for the Distribution Stations asset class, however the question asks about measurement systems which can be found on Page 144 residing within the Utilization asset class. As measurement systems pertain to Utilization, the question is being answered on that assumption.

For measurement systems (meters and electronic volume correctors) Enbridge Gas does not use the condition categories as identified in this question, the monitoring and evaluation used for measurement systems is provided at Exhibit 2, Tab 6, Schedule 2, Section 5.2.5.5, which must meet Measurement Canada's strict requirements and specifications. In-service meters that qualify for sample inspection are evaluated through the Seal Extension Program and can be granted in-service Extensions as provided at Exhibit 2, Tab 6, Schedule 2, Section 5.2.5.5.1. Those meters that do not qualify for the sample inspection, or have reached the end of life and can no longer be sampled or performed poorly in the last sampling are then managed through the Government Inspection Meter Exchange (MXGI) Program, and become the program exchanges for the year of meter life expiry. As such, there are three categories that Enbridge Gas monitors for meters – New, Reverified (Refurbished), Renew.

Table 1

System Measurement Type	New	Reverified (Refurbished)	Renew
200 Series	3522809	79128	0
400 Series	139932	3556	0
800 Series	0	284	0
1000 Series	2259	7622	0
Ultrasonic	34669	0	2538
Rotary	32152	32947	0
Turbine	118	34	445
Electronic Volume Corrector	40103	14831	0

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.172

Question(s):

Please provide a revised version of Table 5.2.5-9 that includes the following:

- a) 2013 to 2022 actual information on a similar basis.
- b) For each asset class strategy and program name, the number of assets meters installed/replaced in each year.

Please also provide the response in Excel format.

Response:

- a) Please see the Table 1. Attachment 1 provides the same table in Excel format.

Table 1
Utilization Capital Summary (\$ millions) – 2014 to 2022

Asset Class Strategy	Program Name	2014	2015	2016	2017	2018	2019	2020	2021	2022
Capital Expenditures in \$millions										
Meter Purchases	Meters (growth)	4.0	5.2	10.3	11.6	9.1	13.9	11.4	22.7	9.7
Meter Purchases	Meters (mtc)	21.0	22.8	22.1	26.2	25.5	44.7	27.9	27.8	33.8
AMI Pilot	Monitoring System	0	0	0	0	0	0	0	0.2	0.3
MXGI Program	Regulator Refit	35	38.4	38.3	33.5	36.5	40.3	22.9	30.1	54.8
Targeted Inspection and Remediation Program	Remediation	6.9	5.2	2.6	3.3	4.1	0.5	0.7	0	-0.2
Total		66.9	71.6	73.3	74.6	75.2	99.4	62.9	80.7	98.4

We are unable to provide 2013 actual in the requested format due to comparability with data in the historical enterprise financial system.

b) Please see Table 2 and Table 3. Attachment 2 provides the same tables in Excel format.

Table 2
Number of Meters – 2013 to 2022

		EGI Historical									
Asset Class Strategy	Program Name	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Meter Purchases*	Meters (growth)	228,771	41,313	28,236	52,768	104,767	40,601	52,409	45,286	74,119	29,159
	Meters (mtc)		216,891	124,392	112,133	144,679	90,371	149,163	110,873	90,589	103,383
AMI Pilot	Monitoring systems	not applicable, no pilot program during this time frame									
MXGI Program	Regulator Refit	88,653	106,266	111,100	118,325	81,524	102,254	94,787	100,719	95,101	142,767
Targeted inspection and Remediation Program**	Remediation	121	66	35	51	35	21	39	57	46	39
	Inspection										

* Meter Purchases in units are based on a percentage of overall dollars spent as shown in response to question a). Actuals for 2013 could not be provided, so a percentage split between growth and exchange (mtc) could not be completed. The fluctuations in meter purchases were due to the variations in the EGD Rate Zone's non-levelized workload patterns prior to integration.

**Targeted inspection and Remediation Program: Historical numbers do not include yearly inspections. As well this table only shows the EGD Rate Zone, as there was no specific program in place for the Union Rate Zone during this period.

Table 3
Number of Meters – 2023 to 2032

		EGI Forecast									
Asset Class Strategy	Program Name	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Meter Purchases*	Meters (growth)	28,201	28,765	29,340	29,927	30,526	31,136	31,759	32,394	33,042	33,703
	Meters (mtc)	128,683	131,257	133,882	136,559	139,291	142,076	144,918	147,816	150,773	153,788
AMI Pilot	Monitoring systems	Refer to response for Exhibit I.2.6-SEC-151									
MXGI Program	Regulator Refit	142,056	143,637	145,236	146,854	148,489	150,143	151,816	153,508	155,219	156,950
Targeted inspection and Remediation Program**	Remediation	141	285	285	333	379	428	503	503	503	503
	Inspection	3,300	6,000	6,000	7,000	8,000	9,000	10,581	10,581	10,581	10,581

*Meter Purchase dollar forecasts are estimated based on most recent budget planning year plus an inflationary factor. This table also represents a percentage split between Meters (growth) and Meters (mtc), based on the most recent budget planning year.

**Targeted inspection and Remediation Program: Forecast includes yearly inspections along with remediation work for both Rate Zones

EGI Utilization Summary

Asset Class Strategy	Program Name	2014	2015	2016	2017	2018	2019	2020	2021	2022
Capital Expenditures in \$millions										
Meter Purchases	Meters (growth)	4.0	5.2	10.3	11.6	9.1	13.9	11.4	22.7	9.7
Meter Purchases	Meters (mtc)	21.0	22.8	22.1	26.2	25.5	44.7	27.9	27.8	33.8
AMI Pilot	Monitoring Systems	0	0	0	0	0	0	0	0.2	0.3
MXGI Program	Regulator Refit	35	38.4	38.3	33.5	36.5	40.3	22.9	30.1	54.8
Targeted Inspection and Remediation Program	Remediation	6.9	5.2	2.6	3.3	4.1	0.5	0.7	0	-0.2
Total		66.9	71.6	73.3	74.6	75.2	99.4	62.9	80.7	98.4

		EGI Historical									
Asset Class Strategy	Program Name	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Meter Purchases*	Meters (growth)	228,771	41,313	28,236	52,768	104,767	40,601	52,409	45,286	74,119	29,159
	Meters (mtc)		216,891	124,392	112,133	144,679	90,371	149,163	110,873	90,589	103,383
AMI Pilot	Monitoring systems	not applicable, no pilot program during this time frame									
MXGI Program	Regulator Refit	88,653	106,266	111,100	118,325	81,524	102,254	94,787	100,719	95,101	142,767
Targeted inspection and Remediation Program**	Remediation	121	66	35	51	35	21	39	57	46	39
	Inspection										

		EGI Forecast									
Asset Class Strategy	Program Name	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Meter Purchases*	Meters (growth)	28,201	28,765	29,340	29,927	30,526	31,136	31,759	32,394	33,042	33,703
	Meters (mtc)	128,683	131,257	133,882	136,559	139,291	142,076	144,918	147,816	150,773	153,788
AMI Pilot	Monitoring systems	Refer to response for Exhibit I.2.6-SEC-151									
MXGI Program	Regulator Refit	142,056	143,637	145,236	146,854	148,489	150,143	151,816	153,508	155,219	156,950
Targeted inspection and Remediation Program**	Remediation	141	285	285	333	379	428	503	503	503	503
	Inspection	3,300	6,000	6,000	7,000	8,000	9,000	10,581	10,581	10,581	10,581

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.185

Question(s):

With respect to compressors:

- a) Please provide a similar asset health index table (as was shown in Table 5.3.5-2) for all compressors that Enbridge plans to replace between 2024 and 2028.
- b) For all compressors Enbridge replaced or plans to replace between 2014 and 2023, that were not subject to an ICM, capital pass-through, or leave to construct application, please provide a similar asset health index table (as was shown in Table 5.3.5-2) or other document, that shows the condition of all compressors before they were replaced.

Response:

- a) Two compressors have been identified for Life Cycle Replacement, between 2024-2028. Enbridge Gas is currently undertaking an Asset Health Review as provided at Exhibit 2, Tab 6, Schedule 2, page 183, paragraph 4, which will support a third-party Reliability, Availability and Maintainability study to quantify shortfall risks associated with asset failures. These activities will support detailed alternatives analysis and final scoping which will inform an updated project cost estimate and business case.
 - i. Please see Exhibit 2, Tab 6, Schedule 2, page 189, 5.3.5.4.1 Compression Modernization, Waubuno Compression Life Cycle and Exhibit 2, Tab 6, Schedule 2, Appendix A, page 8, Waubuno Compression Life Cycle.
 - ii. Please see Exhibit 2, Tab 6, Schedule 2, page 189, 5.3.5.4.1 Compression Modernization, Dawn C Compression Life Cycle and Exhibit 2, Tab 6, Schedule 2, Appendix A, page 4, Dawn C Compression Life Cycle.

- b) All compressors replaced between 2014 and 2023 were subject to capital pass through or the leave to construct application. Please see Union's 2017 Dawn Parkway Project Application¹, Replacement of Dawn B compressor² and Replacement of K701-K703 & K705-K708 compressors³ for more specifics about these projects.

¹ EB-2015-0200, Decision and Order.

² Ibid.

³ EB-2022-0086, Decision and Order.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.194

Question(s):

Please provide a revised version of Table 5.2.5-3 that includes 2013 to 2022 actual information on a similar basis.

Please also provide the response in Excel format.

Response:

Please see Attachment 1 for the Excel, for a revised version of the table on page 194. Note that overheads are included in the actuals for 2021 and 2022 (consistent with capital reported in the annual Earning Sharing Mechanism (ESM) reports and the Asset Management Plan (AMP), and that 2013 actuals are not available by asset class due to compatibility challenges with the previous financial systems. Also note that the 2014 to 2019 historical actuals do not map directly to the asset class strategy as the strategy categorization was not in place until 2020.

Table 5.4.8-1: Compression Stations Capital Summary (\$ Millions) - EGI 2014 to 2022 Actual

Asset Class Strategy/Investment Name	Asset Program	2014A	2015A	2016A	2017A	2018A	2019A	2020A	2021A	2022A
Dawn C Compression Lifecycle		-	-	-	-	-	-	-	-	-
Dawn to Corunna	Replacements	-	-	-	-	-	-	-	0.5	62.1
Dawn to Corunna (Dawn Tie-in)		-	-	-	-	-	-	-	-	1.6
Waubuno Compression		-	-	-	-	-	-	-	-	-
SCOR:Meter Area-Upgrade (Phase 1)	Growth	-	-	-	-	-	-	1.3	14.0	0.1
SCOR:Meter Area-Upgrade (Phase 2)		-	-	-	-	-	-	0.1	2.2	7.0
Foundation Block Replacements	Improvements	-	-	-	-	-	-	1.2	0.0	-
	Replacements	-	-	-	-	-	-	1.7	1.0	-
Facilities Integrity Management Program	Integrity	-	-	-	-	-	-	-	0.4	0.0
Dehydration Expansion	Improvements	-	-	-	-	-	-	0.0	-	-
Overhauls	Overhauls	-	-	-	-	-	-	0.2	1.1	9.8
	Growth	-	-	-	-	-	-	-	-	0.0
Header and Isolation Valve Replacements	Improvements	-	-	-	-	-	-	0.1	0.3	0.0
	Replacements	-	-	-	-	-	-	0.8	0.2	0.1
Valve Replacements	Growth	-	-	-	-	-	-	-	-	0.0
	Improvements	-	-	-	-	-	-	-	-	0.0
	Replacements	-	-	-	-	-	-	-	-	1.0
Condition-based Replacements	Growth	-	-	-	-	-	-	-	-	0.7
	Improvements	-	-	-	-	-	-	0.4	0.8	1.1
	Integrity	-	-	-	-	-	-	-	-	0.1
	Land/Structures Improvements	-	-	-	-	-	-	-	-	0.0
	Replacements	-	-	-	-	-	-	2.8	4.7	7.8
Time-Based Replacements	Growth	-	-	-	-	-	-	-	-	0.0
	Improvements	-	-	-	-	-	-	0.7	0.7	1.2
	Replacements	-	-	-	-	-	-	0.4	0.2	0.4
Run to Failure Based Programs	Growth	-	-	-	-	-	-	-	-	(0.1)
	Improvements	-	-	-	-	-	-	3.1	6.2	0.5
	Land/Structures Improvements	-	-	-	-	-	-	0.2	1.1	1.5
	Replacements	-	-	-	-	-	-	1.9	1.0	9.3
Siemens Valve Controller Replacements	Improvements	-	-	-	-	-	-	-	-	0.3
	Replacements	-	-	-	-	-	-	0.8	0.9	0.8
High Performance Coating	Improvements	-	-	-	-	-	-	0.4	0.2	0.5
	Integrity	-	-	-	-	-	-	-	0.5	-
GHG Emissions Reductions	Improvements	-	-	-	-	-	-	0.2	0.1	-
	Replacements	-	-	-	-	-	-	-	-	-
Strategic Land Purchases	Land/Structures Improvements	-	-	-	-	-	-	9.2	5.3	1.0
	Improvements	-	-	-	-	-	-	0.6	0.2	0.2
Hagar Modernization	Integrity	-	-	-	-	-	-	-	0.2	0.0
	Land/Structures Improvements	-	-	-	-	-	-	0.5	0.2	0.0
	Replacements	-	-	-	-	-	-	0.1	0.3	(0.2)
Compressor Stations		36.7	44.2	19.9	22.6	50.4	25.5	-	-	-
Total		36.7	44.2	19.9	22.6	50.4	25.5	26.5	42.3	106.8

Notes:

- (1) 2013 Actuals are not available in the asset class format due to system compatibility issues
- (2) Actuals for 2021 and 2022 are inclusive of overheads
- (3) Asset Class categorization not available for 2014-2019

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.202-203

Question(s):

Please provide a revised version of Table 5.3.6-1 that includes the following:

- a) 2013 to 2022 actual information on a similar basis.
- b) For each asset class strategy /investment name and program name, the number of assets or (km of pipe as applicable) installed/improved/replaced each year.

Please also provide the response in Excel format.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023. /u

- a) Please see Attachment 1 for Excel. Note that overheads are included in the actuals for 2021 and 2022, and that 2013 actuals are not available by Asset Class due to compatibility challenges with the previous financial systems. Also note that the 2014 to 2019 historical actuals do not map directly to the asset class strategy as the strategy categorization was not in place.
- b) Please see Attachment 2 for Excel. Please also see Tables 1, 2, 3 and 4.

For Transmission Pipe and Underground Storage, a summary of the length (km) of pipe forecast to be installed / improved / replaced each year between 2023 to 2032 is tabulated in Table 1.

Table 1
Transmission Pipe and Underground Storage Length (km) of Pipe to be Installed / Improved / Replaced

Asset Strategy / Investment Name	Asset Program	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Well Casing Inspection, Maintenance & Replacements	Replacements	-	-	-	0.10	0.10	0.10	0.10	0.10	0.10	0.10	/u
Well Testing and Acid Stimulations	Improvements	-	-	-	0.00	-	-	-	-	-	-	/u
TIMP Retrofits and Digs	Integrity	0.18	0.30	2.69	3.11	3.12	0.41	0.41	0.47	0.51	0.41	/u
Depth of Cover Program	Integrity	0.71	25.44	0.80	0.10	0.15	0.11	0.12	0.12	0.12	0.12	/u
Class Location Program	Class Location	-	0.70	0.70	1.43	0.74	0.75	0.75	1.00	0.75	1.00	/u
MOP Verification Program	Replacements	-	-	-	0.20	0.20	0.20	0.20	0.20	0.20	0.20	/u
Panhandle Line Replacement		-	-	1.36	-	-	-	-	-	-	-	
Time-Based Replacement	Replacements	-	0.01	-	-	-	-	-	-	-	-	/u
GHG Emissions Reductions	Improvements	-	-	0.03	-	-	-	-	-	-	-	
Dawn Parkway Expansion Project (Dawn-Enniskillen NPS 48)	Growth	-	-	-	-	-	-	17.20	-	-	-	
Dawn Parkway Expansion Project (Kirkwall-Hamilton NPS 48)		-	-	-	-	10.00	-	-	-	-	-	
Panhandle Regional Expansion Project		-	19.70	-	-	-	-	-	-	-	-	
Panhandle Regional Expansion Project - Leamington Interconnect		-	-	-	11.00	-	-	-	-	-	-	
PREP: NPS 36 looping to Comber Transmission		-	-	-	-	-	-	-	12.00	-	-	
Grand Total		0.89	46.15	5.58	15.93	14.31	1.57	18.78	13.89	1.68	1.83	/u

For Transmission Pipe and Underground Storage, a summary of the number¹ of assets forecast to be installed / improved / replaced each year between 2023-2032 is tabulated in Table 2.

Table 2
Transmission Pipe and Underground Storage Number of Assets/Units to be Installed / Improved / Replaced

Asset Strategy / Investment Name	Asset Program Section 5	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Well Casing Inspection, Maintenance & Replacements	Improvements		7		4	4	5	4	5	4	5	/u
	Integrity	1	1	1	1	1	1	1	1	1	1	
	Replacements		1	3		2	2	2	2	1	1	/u
Wellhead Upgrades	Improvements		2		1		1		1		1	/u
	Integrity		1	1	1	1	1	1	1	1	1	/u
Crowland (PCRW) Wells-Upgrade	Replacements	2	2	11								/u
Well Testing and Acid Stimulations	Improvements		1		4	4	4	4	4		4	/u
Well Accessibility	Land/Structures - Improvements	2		1	1	1	1	1	1	1		/u
TIMP Retrofits and Digs	Integrity			4	1	2			1	1		/u
Time-Based Replacement	Replacements		1			1	1	1	1	1	1	/u
Run-to-Failure Based Programs	Improvements		1									/u
	Land/Structures - Improvements	1	1	1	1							/u
	Replacements	1	3		3	3	3	3	3	2	2	/u
STCO Strategic Land Purchases	Land/Structures - Improvements				1	1	1	1	1	1		/u
Grand Total		7	21	22	18	20	20	18	21	13	16	/u

¹ Number of assets refers to assets not typically measured in length/km such as production or observation wells, wellhead assemblies, valves, atmospheric tanks, laneways, cathodic protection's ground-bed installations, electrical controls & telemetry equipment etc.

For Transmission Pipe and Underground Storage, a summary of the length (km) of pipe installed / improved / replaced each year between 2013 to 2022 is tabulated in Table 3.

Prior to 2020, historical data for most programs under the strategies outlined in Table 5.3.6-1 is not available. This is because Copperleaf was not implemented as Enbridge Gas's investment planning tool until January of 2020; and prior to 2019, capital expenditure was not tracked against these specific strategies as identified in part a).

Table 3
Transmission Pipe and Underground Storage Length (km) of Pipe Installed / Improved / Replaced

Asset Strategy / Investment Name	Asset Program	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Depth of Cover Program	Integrity									0.30	0.90
Dawn- Cuthbert											0.78
Class Location Program	Class Location								1.88		
2020 Sarnia Expansion Project	Growth									1.35	
2015 Sarnia Expansion Project				4.80							
2015 Dawn-Parkway Expansion Brantford-Kirkwall Project				13.90							
2016 Dawn-Parkway Expansion Hamilton-Milton Project					20.00						
2017 Panhandle Reinforcement Project						40.00					
Grand Total²		2.11	11.53	22.32	25.76	43.30	1.64	0.28	0.20	0.08	3.32

² Source is EGI's mapping system which could lag construction information.

For Transmission Pipe and Underground Storage, a summary of the number³ of assets/units installed / improved / replaced each year between 2013 to 2022 is tabulated in Table 4.

Table 4
Transmission Pipe and Underground Storage Number of Assets/Units Installed / Improved / Replaced

Asset Strategy / Investment Name	Asset Program	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Well Casing Inspection, Maintenance & Replacements	Improvements								12	5	3
	Integrity									4	1
	Land/Structures - Improvements									45	
	Replacements								1		1
Well Testing and Acid Stimulations	Improvements								12	10	7
Well Accessibility	Land/Structures - Improvements								1	1	1
TIMP Retrofits and Digs⁴	Integrity								8	19	83
MOP Verification Program	Replacements								1	3	
Time-Based Replacement	Replacements										2
Run-to-Failure Based Programs	Improvements								1	1	9
	Land/Structures - Improvements									3	1
	Replacements								5	2	7
STCO Strategic Land Purchases	Land/Structures - Improvements								1	2	
Atmospheric Storage Tank Level Instrumentation	Improvements										1
Cathodic Protection	Integrity										1
Grand Total		NA	NA	NA	NA	NA	NA	NA	42	95	117

³ Number of assets refers to assets or units not typically measured in length/km such as production or observation wells, wellhead assemblies, valves, atmospheric tanks, laneways, cathodic protection ground-bed installations, electrical controls & telemetry equipment etc.

⁴ TIMP Retrofits and Digs describes the number of projects in which connections are added to piping systems for in-line inspection ILI . Number refers to discrete projects for the purposes of this response. Length of pipe renewed in each case would typically be < 100m.

Table 5.3.6-1: Transmission Pipe and Underground Storage Capital Summary (\$ Millions) - EGI 2014 to 2022 Actual

Asset Class Strategy/Investment Name	Program Name	2014A	2015A	2016A	2017A	2018A	2019A	2020A	2021A	2022A
Well Casing Inspection, Maintenance & Replacements	Improvements	-	-	-	-	-	-	1.9	4.4	0.7
	Integrity	-	-	-	-	-	-	-	0.2	0.0
	Land/Structures	-	-	-	-	-	-	-	0.1	0.0
	Replacements	-	-	-	-	-	-	0.7	1.2	2.5
Wellhead Upgrades	Improvements	-	-	-	-	-	-	-	-	0.0
	Integrity	-	-	-	-	-	-	-	-	-
Corwland (PCRW):Wells-Upgrade	Replacements	-	-	-	-	-	-	-	-	-
Well Testing and Acid Stimulations	Improvements	-	-	-	-	-	-	0.4	0.6	0.3
Well Accessibility	Land/Structures	-	-	-	-	-	-	0.0	0.1	0.1
TIMP Retrofits and Digs		-	-	-	-	-	-	11.0	16.0	18.7
Cathodic Protection	Integrity	-	-	-	-	-	-	-	0.1	3.1
Depth of Cover Program		-	-	-	-	-	-	-	2.3	6.5
Class Location Program	Class Location	-	-	-	-	-	-	5.4	(0.7)	5.5
MOP Verification Program		-	-	-	-	-	-	7.9	12.4	1.4
Panhandle Line Replacement	Replacements	-	-	-	-	-	-	-	0.0	-
Time-Based Replacement		-	-	-	-	-	-	-	0.1	0.2
Run-to-Fail Based Programs	Improvements	-	-	-	-	-	-	0.2	0.5	0.1
	Land/Structures	-	-	-	-	-	-	0.1	0.6	0.0
	Replacements	-	-	-	-	-	-	0.8	1.0	0.9
Strategic Land Purchases	Land/Structures	-	-	-	-	-	-	1.3	6.5	0.0
Atmospheric Storage Tank Level Instrumentation	Improvements	-	-	-	-	-	-	-	-	0.1
GHG Emissions Reductions	Improvements	-	-	-	-	-	-	-	-	-
Telemetry Strategy	Replacements	-	-	-	-	-	-	0.0	0.0	0.0
Transmission Reinforcement	Improvements	-	-	-	-	-	-	(0.0)	-	-
Dawn to Cuthbert	Integrity	-	-	-	-	-	-	-	0.9	19.1
Sarnia Expansion	Growth	-	-	-	-	-	-	0.9	31.8	2.9
Dawn Parkway Expansion Project (Dawn-Enniskillen NPS 48)		-	-	-	-	-	-	-	-	-
Dawn Parkway Expansion Project (Kirkwall-Hamilton NPS 48)		-	-	-	-	-	-	2.8	1.1	(0.0)
Panhandle Regional Expansion Project		-	-	-	-	-	-	-	0.3	34.0
Panhandle Regional Expansion Project - Leamington Interconnect		-	-	-	-	-	-	-	-	0.6
PREP:NPS 36 looping to Comber		-	-	-	-	-	-	-	-	-
Transmission		-	-	-	-	-	-	-	-	-
Transmission Pipe & Underground Storage		20.7	41.7	13.0	21.5	58.2	20.3	-	-	-
Total		20.7	41.7	13.0	21.5	58.2	20.3	33.5	79.5	96.8

This page is intentionally left blank. Due to size, this Attachment has not been included.

Please see Exhibit I.2.6-SEC-136 Attachment 2.xlsx on the OEB's RDS.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.215

Question(s):

With respect to the Enbridge Facility Assessment Results:

- a) What is the basis for Enbridge's standard (i.e. FCI scores between 0-5% are considered good, etc.)?
- b) For each property where the summary strategy is disposition, please detail when Enbridge plans to dispose of the property and the forecast proceeds from disposition.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

- a) Enbridge Standards are based on Facility Condition Assessments (FCAs) that are comprehensive evaluations of the physical state of a building or infrastructure system. The basis of an FCA typically involves a detailed examination of various elements of the facility, including its mechanical, electrical, plumbing, and structural systems, as well as its overall layout and organization. The National Research Council of Canada (NRC) "Protocols for Building Condition Assessment" published by The Institute for Research in Construction (IRC) and ASTM E 2018-01 Standard Guide for Property Condition Assessments: Baseline Property Condition Assessment Process are real estate industry standards used to inform Enbridge Gas's standard. This process is one used by many municipalities in establishing the conditions of assets when determining capital planning needs.

A component of the assessment is the AI (Adequacy Index) which is determined based on a set of programmatic criteria that Enbridge Gas established to ensure functional operations. These items include barrier free accessibility, programmatic needs to ensure safe operating conditions for staff (i.e., dedicated welding spaces if

welding is taking place) and functional needs to support the work force located at the facility.

- b) Properties planned for disposition and forecasted disposition year along with forecasted proceeds are shown in Table 1.

Table 1

Property Name	Revitalization Program	Forecasted year	Estimated Proceeds Value Range
London Operations Centre	Disposition	2027	TBD - Uncertainty of market conditions at future time of sale
Milton Operations Centre	Disposition	2025-26	\$13.9M to \$15.25M
St. Thomas Operations Centre	Disposition	2027	TBD - Uncertainty of market conditions at future time of sale
Brampton Operations Centre	Disposition	2025-26	\$14.9M to \$16.5M
Burlington Operations Centre	Disposition	2025-26	\$9.7M to \$10.3M
Ottawa Regional Operations and Admin	Disposition	2025	\$20M firm
SMOC Operations Centre	Disposition	2024	\$6.3M estimate

/u

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.231

Question(s):

For each year, between 2013 and 2032, how much has been spent or is forecast to spend on each of the light, medium, and heavy vehicles?

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

The requested information cannot be provided as Enbridge Gas did not consistently track capital expenditures by the vehicle types requested in this interrogatory. The table below summarizes the total capital spent and forecast to be spent on vehicles which includes light, medium and heavy vehicles. Light and medium vehicles make up a large portion of these expenditures. Overhead allocations are included in the figures for 2021 onwards.

Table 1

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Vehicles	15.8M	18.7M	7.1M	16.6M	14.0M	17.7M	16.8M	18.7M	23.0M	6.2M

/u

Table 1 Continued

Year	2024	2025	2026	2027	2028	2029	2030	2031	2032
Vehicles	25.5M	26.5M	36.8M	42.0M	41.6M	41.2M	43.6M	45.8M	45.0M

/u

Enbridge Gas is unable to provide 2013 actual data in this format due to lack of compatibility with the historical data.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.233

Question(s):

Please provide a revised version of each of the following tables that includes 2013 to 2022 actual information on a similar basis:

- a) [p.209] Table 5.2.7-1
- b) [p.224] Table 5.4.8-1
- c) [p.250] Table 5.6.9-1

Response:

- a) Enbridge Gas notes the Table on page 209 is Table 5.3.7-1. Please see the updated table below, which is also provided in Excel in Attachment 1. Note that 2013 actuals are not available in the requested view. Also note that overheads are excluded from 2014 to 2020 and are included for 2021 and 2022.

Table 5.3.7-1

LNG Table 5.3.7-1										
Asset Class Strategy/Investment Name	Program Name	2014A	2015A	2016A	2017A	2018A	2019A	2020A	2021A	2022A
JVG Boil-ff Gas (BOG) Compressor Replacement	Replacements	-	-	-	-	-	-	-	-	-
KVGR Cycle Gas Compressor Replacement		-	-	-	-	-	-	-	-	-
Cold Box Replacement	Integrity	-	-	-	-	-	-	-	-	-
Valve Replacement	Replacements	-	-	-	-	-	-	-	-	-
Time-Based Replacement		-	-	-	-	-	-	-	-	-
Run-to-Failure Based Programs	Improvements	-	-	-	-	-	-	-	-	-
	Land/Structures Improvements	-	-	-	-	-	-	-	-	-
	Replacements	-	-	-	-	-	-	-	-	-
GHG Emissions Reductions	Improvements	-	-	-	-	-	-	-	-	-
Hagar Modernization	Replacements	-	-	-	-	-	-	0.1	0.3	(0.2)
	Integrity	-	-	-	-	-	-	-	0.2	0.0
	Improvements	1.0	0.2	1.1	2.4	0.1	0.0	0.6	0.2	0.4
	Land/Structures Improvements	-	-	-	-	-	-	0.5	0.2	0.0
	Total	1.0	0.2	1.1	2.4	0.1	0.0	1.2	0.8	0.3

b) Please see the updated table below, which is also provided in Excel in Attachment 2. Note that 2013 actuals are not available in the requested view. Also note that overheads are excluded from 2014 to 2020 and are included for 2021 and 2022.

Table 5.4.8-1

REWS Table 5.4.8-1

Asset Class Strategy/Investment Name	Program Name	2014A	2015A	2016A	2017A	2018A	2019A	2020A	2021A	2022A
Property Upgrade Strategy	Furniture/Structures & Improvements	-	-	-	-	-	-	0.7	2.9	10.5
Kennedy Road Expansion	Furniture/Structures & Improvements	-	-	-	-	-	-	10.3	2.6	0.2
SMOC/Coventry Facility Consolidation	Furniture/Structures & Improvements	-	-	-	-	-	-	0.0	15.7	11.0
Station B New Building	Furniture/Structures & Improvements	-	-	-	-	-	-	2.6	1.2	10.9
VPC Core and Shell	Furniture/Structures & Improvements	-	-	-	-	-	-	-	-	-
New London Site	Furniture/Structures & Improvements	-	-	-	-	-	-	3.6	3.3	0.3
Kelfield Operations Centre - Land Purchase	Furniture/Structures & Improvements	-	-	-	-	-	-	-	-	-
Kelfield Operations Center New Building	Furniture/Structures & Improvements	-	-	-	-	-	-	-	-	-
Thorold Regional Office - Building & Site	Furniture/Structures & Improvements	-	-	-	-	-	-	-	0.1	5.5
Dawn Administrative Center	Furniture/Structures & Improvements	-	-	-	-	-	-	0.0	0.2	0.0
Sudbury Regional Operations Centre	Furniture/Structures & Improvements	-	3.5	-	-	-	-	-	-	-
Building Systems Program	Furniture/Structures & Improvements	-	-	-	-	-	-	1.7	6.6	5.3
GHG and Energy Reductions Program	Furniture/Structures & Improvements	-	-	-	-	-	-	0.2	0.2	0.2
Micro-Operations Depot Revitalization	Furniture/Structures & Improvements	-	-	-	-	-	-	-	0.4	1.1
Workplace Furnishings Replacement Program	Furniture/Structures & Improvements	-	-	-	-	-	-	0.2	0.3	0.9
Renovating existing facilities; maintenance of current site	Furniture/Structures & Improvements	-	-	-	-	-	-	17.4	36.9	11.8
REWS - Furniture/Structures & Improvements	Furniture/Structures & Improvements	20.3	20.6	23.6	13.4	21.2	21.3	-	-	-
Metershop Relocation	Furniture/Structures & Improvements	-	-	6.7	4.0	(0.0)	0.0	-	-	-
TOC Site Expansion	Furniture/Structures & Improvements	-	-	-	-	-	20.6	(0.2)	-	-
VPC Dispatch - COVID19 Impacts	Furniture/Structures & Improvements	-	-	-	-	-	-	1.9	0.1	-
Brockville - New Build	Furniture/Structures & Improvements	-	-	-	-	-	-	-	-	6.7
Ed Centre	Furniture/Structures & Improvements	4.6	12.1	0.0	0.0	-	-	-	-	-

REWS Table 5.4.8-1

Asset Class Strategy/Investment Name	Program Name	2014A	2015A	2016A	2017A	2018A	2019A	2020A	2021A	2022A
	Total	24.9	36.3	30.3	17.4	21.2	42.0	38.3	70.5	64.4

c) Please see the updated table below, which is also provided in Excel in Attachment 3. Note that 2013 actuals are not available in the requested view. Also note that overheads are excluded from 2014 to 2020 and are included for 2021 and 2022.

Table 5.6.9-1

TIS Table 5.6.9-1										
Asset Class Strategy/Investment Name	Program Name	2014A	2015A	2016A	2017A	2018A	2019A	2020A	2021A	2022A
Laptop/Desktop Renewal Strategy	TIS Infrastructure	-	-	-	-	-	-	2.0	0.8	2.3
Desktop Sustainment Equipment Strategy		-	-	-	-	-	-	0.9	0.6	0.6
Core Infrastructure and Security Renewal Strategy		-	-	-	-	-	-	6.9	6.4	5.0
Developed and Packaged Applications Renewal Strategy	TIS Business Solutions	-	-	-	-	-	-	11.5	14.4	17.8
Application Infrastructure Renewal Strategy		-	-	-	-	-	-	0.0	0.2	0.7
Contract Market Harmonization		-	-	-	-	-	-	-	-	-
Contract Market Systems-Technology Obsolescence		-	-	-	-	-	-	-	-	-
General Service Rebasing Changes		-	-	-	-	-	-	-	-	-
Records Management Upgrade		-	-	-	-	-	-	-	-	-
Mobile Device Renewal Strategy	TIS Infrastructure	-	-	-	-	-	-	0.1	0.1	0.0
Field Device Renewal Strategy	TIS Business Solutions	-	-	-	-	-	-	1.2	0.2	1.6

TIS Table 5.6.9-1										
Asset Class Strategy/Investment Name	Program Name	2014A	2015A	2016A	2017A	2018A	2019A	2020A	2021A	2022A
	TIS Infrastructure	-	-	-	-	-	-	-	-	-
Asset Program	IT Implementation	20.0	20.8	18.6	27.7	32.8	30.6	-	-	-
	Infrastructure	5.2	3.7	4.1	1.8	2.4	4.4	-	-	-
	Business Solutions	23.4	22.3	19.8	20.6	21.4	13.9	-	-	-
	Total	48.5	46.8	42.6	50.1	56.6	48.9	22.7	22.8	28.1

Table 5.3.7-1: Liquefied Natural Gas Capital Summary (\$ Millions) - EGI 2014 to 2022 Actual

Asset Class Strategy/Investment Name	Program Name	2014A	2015A	2016A	2017A	2018A	2019A	2020A	2021A	2022A
JVG Boil-off Gas (BOG) Compressor Replacement	Replacements	-	-	-	-	-	-	-	-	-
KVGR Cycle Gas Compressor Replacement		-	-	-	-	-	-	-	-	-
Cold Box Replacement	Integrity	-	-	-	-	-	-	-	-	-
Valve Replacement	Replacements	-	-	-	-	-	-	-	-	-
Time-Based Replacement		-	-	-	-	-	-	-	-	-
Run-to-Failure Based Programs	Improvements	-	-	-	-	-	-	-	-	-
	Land/Structures Improv	-	-	-	-	-	-	-	-	-
	Replacements	-	-	-	-	-	-	-	-	-
GHG Emissions Reductions	Improvements	-	-	-	-	-	-	-	-	-
Hagar Modernization	Replacements	-	-	-	-	-	-	0.1	0.3	(0.2)
	Integrity	-	-	-	-	-	-	-	0.2	0.0
	Improvements	1.0	0.2	1.1	2.4	0.1	0.0	0.6	0.2	0.4
	Land/Structures Improv	-	-	-	-	-	-	0.5	0.2	0.0
Total		1.0	0.2	1.1	2.4	0.1	0.0	1.2	0.8	0.3

Table 5.4.8-1: REWS Capital Summary (\$ Millions) - EGI 2014 to 2022 Actual

Asset Class Strategy/Investment Name	Program Name	2014A	2015A	2016A	2017A	2018A	2019A	2020A	2021A	2022A
Property Upgrade Strategy	Furniture/Structures & Improvements	-	-	-	-	-	-	0.7	2.9	10.5
Kennedy Road Expansion	Furniture/Structures & Improvements	-	-	-	-	-	-	10.3	2.6	0.2
SMOC/Coventry Facility Consolidation	Furniture/Structures & Improvements	-	-	-	-	-	-	0.0	15.7	11.0
Station B New Building	Furniture/Structures & Improvements	-	-	-	-	-	-	2.6	1.2	10.9
VPC Core and Shell	Furniture/Structures & Improvements	-	-	-	-	-	-	-	-	-
New London Site	Furniture/Structures & Improvements	-	-	-	-	-	-	3.6	3.3	0.3
Kelfield Operations Centre - Land Purchase	Furniture/Structures & Improvements	-	-	-	-	-	-	-	-	-
Kelfield Operations Center New Building	Furniture/Structures & Improvements	-	-	-	-	-	-	-	-	-
Thorold Regional Office - Building & Site	Furniture/Structures & Improvements	-	-	-	-	-	-	-	0.1	5.5
Dawn Administrative Center	Furniture/Structures & Improvements	-	-	-	-	-	-	0.0	0.2	0.0
Sudbury Regional Operations Centre	Furniture/Structures & Improvements	-	3.5	-	-	-	-	-	-	-
Building Systems Program	Furniture/Structures & Improvements	-	-	-	-	-	-	1.7	6.6	5.3
GHG and Energy Reductions Program	Furniture/Structures & Improvements	-	-	-	-	-	-	0.2	0.2	0.2
Micro-Operations Depot Revitalization	Furniture/Structures & Improvements	-	-	-	-	-	-	-	0.4	1.1
Workplace Furnishings Replacement Program	Furniture/Structures & Improvements	-	-	-	-	-	-	0.2	0.3	0.9
Renovating existing facilities; maintenance of current site	Furniture/Structures & Improvements	-	-	-	-	-	-	17.4	36.9	11.8
REWS - Furniture/Structures & Improvements	Furniture/Structures & Improvements	20.3	20.6	23.6	13.4	21.2	21.3	-	-	-
Metershop Relocation	Furniture/Structures & Improvements	-	-	6.7	4.0	(0.0)	0.0	-	-	-
TOC Site Expansion	Furniture/Structures & Improvements	-	-	-	-	-	20.6	(0.2)	-	-
VPC Dispatch - COVID19 Impacts	Furniture/Structures & Improvements	-	-	-	-	-	-	1.9	0.1	-
Brockville - New Build	Furniture/Structures & Improvements	-	-	-	-	-	-	-	-	6.7
Ed Centre	Furniture/Structures & Improvements	4.6	12.1	0.0	0.0	-	-	-	-	-
Total		24.9	36.3	30.3	17.4	21.2	42.0	38.3	70.5	64.4

Table 5.6.9-1: Technology and Information Services Capital Summary (\$ Millions) - EGI 2014 to 2022 Actual

Asset Class Strategy/Investment Name	Program Name	2014A	2015A	2016A	2017A	2018A	2019A	2020A	2021A	2022A
Laptop/Desktop Renewal Strategy	TIS Infrastructure	-	-	-	-	-	-	2.0	0.8	2.3
Desktop Sustainment Equipment Strategy		-	-	-	-	-	-	0.9	0.6	0.6
Core Infrastructure and Security Renewal Strategy		-	-	-	-	-	-	6.9	6.4	5.0
Developed and Packaged Applications Renewal Strategy	TIS Business Solutions	-	-	-	-	-	-	11.5	14.4	17.8
Application Infrastructure Renewal Strategy		-	-	-	-	-	-	0.0	0.2	0.7
Contract Market Harmonization		-	-	-	-	-	-	-	-	-
Contract Systems-Technology Obsolescence		-	-	-	-	-	-	-	-	-
General Service Rebased Changes		-	-	-	-	-	-	-	-	-
Records Management Upgrade		-	-	-	-	-	-	-	-	-
Mobile Device Renewal Strategy	TIS Infrastructure	-	-	-	-	-	-	0.1	0.1	0.0
Field Device Renewal Strategy	TIS Business Solutions	-	-	-	-	-	-	1.2	0.2	1.6
	TIS Infrastructure	-	-	-	-	-	-	-	-	-
Asset Program	IT Implementation	20.0	20.8	18.6	27.7	32.8	30.6	-	-	-
	Infrastructure	5.2	3.7	4.1	1.8	2.4	4.4	-	-	-
	Business Solutions	23.4	22.3	19.8	20.6	21.4	13.9	-	-	-
	Total	48.5	46.8	42.6	50.1	56.6	48.9	22.7	22.8	28.1

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.255

Question(s):

With respect to pre-optimized spending profile:

- a) Please provide Figure 6.1-2 in tabular format. Please also provide in Excel format.
- b) In Figure 6.1-1, Enbridge presents the information by rate zone. Does Enbridge plan by rate zone? If so, please explain how.
- c) On the same basis as provided in Figure 6.1-2, please provide the number of investment (as opposed to cost of the investment costs). Please provide in tabular format and also provide in Excel format.
- d) On the same basis as provided in Figure 6.1-2, please provide a breakdown of each investment category (i.e. growth, distribution stations, TIS, etc.), by planning group (i.e. compliance – fixed timing, mandatory – fixed timing, etc.). Please provide in tabular format and also provide in Excel format.

Response:

- a) Table 1 represents Exhibit 2, Tab 6, Schedule 2, Figure 6.1-2 in tabular form. The Excel file is provided at Attachment 1.

Table 1
Pre-Optimized Spend Profile - EGI (Capital Expenditure \$) – 2023 to 2027

Asset Class	2023	2024	2025	2026	2027
Distribution Pipe	335,625,988	385,784,774	313,689,919	384,772,987	418,846,063
Distribution Stations	159,405,212	148,320,565	111,127,380	114,078,721	111,045,977
Growth	334,192,995	370,151,921	389,461,836	355,664,227	312,564,542
Utilization	117,235,677	145,714,686	153,124,319	157,235,554	165,182,727
Compression Stations	261,577,553	62,305,452	59,733,404	110,927,161	30,708,805
LNG	1,775,355	11,178,934	351,089	245,654	395,588
Transmission Pipe & Underground Storage	277,617,967	177,830,810	110,834,563	192,311,293	114,406,991
Fleet & Equipment	37,200,833	39,752,799	42,247,114	42,506,170	44,945,063
Real Estate & Workplace Services	120,350,154	91,399,996	70,647,008	20,351,866	22,210,515
TIS	85,952,040	93,441,153	64,096,297	62,872,919	57,260,932
EA Fixed O/H	22,727,890	23,449,892	23,828,139	24,304,712	24,790,805
Grand Total	1,753,661,663	1,549,330,981	1,339,141,069	1,465,271,264	1,302,358,008

Table 1 (Continued)
Pre-Optimized Spend Profile - EGI (Capital Expenditure \$) – 2023 to 2027

Asset Class	2028	2029	2030	2031	2032
Distribution Pipe	464,005,975	491,281,949	568,953,255	587,277,215	582,500,185
Distribution Stations	112,203,661	107,523,525	112,725,520	116,690,931	116,039,646
Growth	254,132,914	279,837,508	226,101,966	215,595,260	230,479,766
Utilization	167,099,338	164,894,604	175,892,910	182,822,695	186,319,710
Compression Stations	18,706,764	10,219,087	9,541,843	11,067,011	17,034,111
LNG	9,491,206	53,079,465	32,719,017	432,892	431,307
Transmission Pipe & Underground Storage	132,361,316	288,897,304	88,118,140	47,707,418	46,064,127
Fleet & Equipment	43,575,100	42,921,541	45,838,781	48,798,595	49,843,419
Real Estate & Workplace Services	50,486,108	33,169,000	29,314,411	11,315,846	11,015,841
TIS	66,077,134	44,295,639	43,132,854	59,175,485	68,460,463
EA Fixed O/H	25,286,620	25,792,352	26,308,202	26,834,362	27,371,051
Grand Total	1,343,426,137	1,541,911,972	1,358,646,899	1,307,717,710	1,335,559,628

- b) The 2023 to 2032 Asset Management Plan has been created and presented with the view of the EGD and Union rate zones, given that in 2023 there will continue to be three distinct rate zones including EGD, Union North and Union South. Looking forward, Enbridge Gas will continue to work towards a more integrated view and approach for future Asset Management Plans, but within those AMPs will also continue to identify any remaining differences in asset data and associated planning activities that have not been fully integrated.
- c) Table 2 represents Exhibit 2, Tab 6, Schedule 2, Figure 6.1-2 in tabular form by investment count. As many investments have multi-year spends or may be programmatic in nature, they are captured in the count in all years that they have capital spend. The Excel file is provided at Attachment 2.

Table 2
2023-2032 Pre-Optimized Spend Profile - EGI Investment Count

Asset Class	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Compression Stations	111	70	61	45	37	41	29	27	26	26	/u
Distribution Pipe	280	216	142	128	111	112	103	102	100	97	/u
Distribution Stations	171	131	104	105	61	47	48	38	39	41	/u
EA Fixed O/H	19	19	19	19	19	19	19	19	19	19	/u
Fleet & Equipment	7	7	7	7	7	7	7	7	7	7	/u
Growth	111	90	83	75	71	72	67	71	65	68	/u
LNG	5	5	1	2	3	7	6	5	3	3	/u
Real Estate & Workplace Services	26	30	22	15	18	18	21	16	11	10	/u
TIS	99	83	73	73	65	67	70	64	67	68	/u
Transmission Pipe & Underground Storage	57	51	44	32	35	28	29	29	26	25	/u
Utilization	32	31	31	30	30	30	30	30	29	29	/u
Grand Total	918	733	587	531	457	448	429	408	392	393	

- d) Table 3 represents Exhibit 2, Tab 6, Schedule 2, Figure 6.1-2 in tabular form categorized by the planning groups outlined at Exhibit 2, Tab 6, Schedule 2, Table 6.1-1. The Excel file is provided at Attachment 3.

Table 3
Pre-Optimized Spend Profile by Asset Class & Planning Group – 2023 to 2027

Asset Class (\$)	2023	2024	2025	2026	2027
Compression Stations	261,577,553	62,305,452	59,733,404	110,927,161	30,708,805
Compliance - Fixed Timing	1,298,714	1,030,115	1,514,832	1,299,044	1,384,673
Mandatory - Fixed Timing	52,783,882	18,703,566	21,795,846	14,584,484	9,571,106
Significant Investments (>\$10M) - Fixed Timing	236,061	15,001,408	33,030,965	91,972,955	16,456,459
Value Driven - Fixed Timing	202,551,005	26,260,143	3,391,761	3,070,678	3,296,566
Value Driven - Value Framework	4,707,891	1,310,219	-	-	-

Asset Class (\$)	2023	2024	2025	2026	2027
Distribution Pipe	335,625,988	385,784,774	313,689,919	384,772,987	418,846,063
Compliance - Fixed Timing	122,824,821	156,598,690	116,375,048	132,725,434	116,354,036
Executing - Re-Optimize	16,298,300	80,215,645	3,591,596	-	-
Executing Flagged for Optimize	15,671,178	3,836,152	-	-	-
Mandatory - Fixed Timing	48,375,310	(3,232,894)	44,349,010	42,798,096	46,259,322
Value Driven - Fixed Timing	78,889,325	98,423,215	127,383,669	196,189,569	249,536,169
Value Driven - Value Framework	53,567,053	49,943,966	21,990,594	13,059,888	6,696,537
Distribution Stations	159,405,212	148,320,565	111,127,380	114,078,721	111,045,977
Compliance - Fixed Timing	19,520,721	14,167,790	13,654,022	12,285,415	10,849,536
Compliance - Optimize	-	-	-	570,052	320,913
Compliance - Re-Optimize	-	-	673,250	933,682	353,771
Executing - Re-Optimize	29,599,278	4,219,767	-	3,511,558	-
Executing Flagged for Optimize	17,985,427	180,305	-	-	-
Mandatory - Fixed Timing	12,622,423	18,917,044	21,437,913	17,369,243	21,015,422
Value Driven - Fixed Timing	32,025,689	10,450,375	28,821,116	24,605,888	46,551,896
Value Driven - Value Framework	47,651,673	100,385,285	46,541,080	54,802,884	31,954,440
EA Fixed O/H	22,727,890	23,449,892	23,828,139	24,304,712	24,790,805
Overheads	22,727,890	23,449,892	23,828,139	24,304,712	24,790,805
Fleet & Equipment	37,200,833	39,752,799	42,247,114	42,506,170	44,945,063
Mandatory - Fixed Timing	37,200,833	39,752,799	42,247,114	42,506,170	44,945,063
Growth	334,192,995	370,151,921	389,461,836	355,664,227	312,564,542
Mandatory - Fixed Timing	332,186,480	368,408,969	389,461,836	355,664,227	312,564,542
Value Driven - Fixed Timing	2,006,515	1,742,952	-	-	-
LNG	1,775,355	11,178,934	351,089	245,654	395,588
Compliance - Fixed Timing	500,628	-	-	-	-
Executing Flagged for Optimize	1,062,272	10,698,120	-	-	-
Mandatory - Fixed Timing	35,409	120,204	-	-	-
Value Driven - Fixed Timing	-	-	-	-	-
Value Driven - Value Framework	177,045	360,611	351,089	245,654	395,588
Real Estate & Workplace Services	120,350,154	91,399,996	70,647,008	20,351,866	22,210,515

Asset Class (\$)	2023	2024	2025	2026	2027
Executing - Re-Optimize	19,356,965	21,636,646	2,646,712	-	-
Executing Flagged for Optimize	6,491,665	3,738,332	4,883,184	-	-
Mandatory - Fixed Timing	7,744,184	8,215,186	8,798,254	8,735,296	9,274,385
Value Driven - Fixed Timing	79,376,829	16,212,870	901,752	892,547	923,443
Value Driven - Value Framework	7,380,511	41,596,962	53,417,107	10,724,023	12,012,688
TIS	85,952,040	93,441,153	64,096,297	62,872,919	57,260,932
Mandatory - Fixed Timing	36,696,965	39,232,652	21,262,508	27,935,582	42,897,825
Value Driven - Fixed Timing	24,305,415	15,032,689	10,328,714	10,053,800	10,799,697
Value Driven - Value Framework	24,949,660	39,175,812	32,505,075	24,883,537	3,563,410
Transmission Pipe & Underground Storage	277,617,967	177,830,810	110,834,563	192,311,293	114,406,991
Compliance - Fixed Timing	54,401,178	58,099,495	45,464,948	43,032,616	45,833,055
Mandatory - Fixed Timing	218,642,932	87,698,181	58,062,921	146,307,129	65,607,067
Value Driven - Fixed Timing	4,573,857	32,033,135	7,306,694	2,971,548	2,966,869
Utilization	117,235,677	145,714,686	153,124,319	157,235,554	165,182,727
Compliance - Fixed Timing	108,447,847	131,603,839	138,658,853	143,100,398	151,252,802
Mandatory - Fixed Timing	8,787,830	14,110,847	14,465,466	14,135,156	13,929,925
Grand Total	1,753,661,663	1,549,330,981	1,339,141,069	1,465,271,264	1,302,358,008

Table 3 (Continued)
Pre-Optimized Spend Profile by Asset Class & Planning Group – 2028 to 2032

Asset Class (\$)	2028	2029	2030	2031	2032
Compression Stations	18,706,764	10,219,087	9,541,843	11,067,011	17,034,111
Compliance - Fixed Timing	1,446,373	1,354,341	1,436,436	1,498,986	1,494,047
Mandatory - Fixed Timing	13,781,209	5,626,930	4,662,170	5,960,593	9,112,338
Significant Investments (>\$10M) - Fixed Timing	-	-	-	-	-
Value Driven - Fixed Timing	3,479,181	3,237,816	3,443,237	3,607,431	3,594,228
Value Driven - Value Framework	-	-	-	-	2,833,499
Distribution Pipe	464,005,975	491,281,949	568,953,255	587,277,215	582,500,185
Compliance - Fixed Timing	94,240,888	89,861,093	93,698,534	97,211,457	98,271,560

Asset Class (\$)	2028	2029	2030	2031	2032
Executing - Re-Optimize	-	-	-	-	-
Executing Flagged for Optimize	-	-	-	-	-
Mandatory - Fixed Timing	54,567,294	43,250,332	45,732,650	47,220,444	47,100,738
Value Driven - Fixed Timing	309,690,250	354,816,146	427,270,194	436,701,790	437,127,888
Value Driven - Value Framework	5,507,544	3,354,378	2,251,877	6,143,525	-
Distribution Stations	112,203,661	107,523,525	112,725,520	116,690,931	116,039,646
Compliance - Fixed Timing	10,500,898	10,142,970	10,842,020	11,367,576	11,529,124
Compliance - Optimize	307,722	295,330	-	-	-
Compliance - Re-Optimize	-	-	-	-	-
Executing - Re-Optimize	-	-	-	-	-
Executing Flagged for Optimize	-	-	-	-	-
Mandatory - Fixed Timing	19,151,648	32,481,906	34,615,134	21,989,609	37,147,514
Value Driven - Fixed Timing	53,120,091	54,022,339	58,954,069	59,325,991	59,787,961
Value Driven - Value Framework	29,123,303	10,580,979	8,314,297	24,007,755	7,575,046
EA Fixed O/H	25,286,620	25,792,352	26,308,202	26,834,362	27,371,051
Overheads	25,286,620	25,792,352	26,308,202	26,834,362	27,371,051
Fleet & Equipment	43,575,100	42,921,541	45,838,781	48,798,595	49,843,419
Mandatory - Fixed Timing	43,575,100	42,921,541	45,838,781	48,798,595	49,843,419
Growth	254,132,914	279,837,508	226,101,966	215,595,260	230,479,766
Mandatory - Fixed Timing	254,132,914	279,837,508	226,101,966	215,595,260	230,479,766
Value Driven - Fixed Timing	-	-	-	-	-
LNG	9,491,206	53,079,465	32,719,017	432,892	431,307
Compliance - Fixed Timing	-	-	-	-	-
Executing Flagged for Optimize	-	-	-	-	-
Mandatory - Fixed Timing	-	-	-	-	-

Asset Class (\$)	2028	2029	2030	2031	2032
Value Driven - Fixed Timing	-	-	-	-	-
Value Driven - Value Framework	9,491,206	53,079,465	32,719,017	432,892	431,307
Real Estate & Workplace Services	50,486,108	33,169,000	29,314,411	11,315,846	11,015,841
Executing - Re-Optimize	-	-	-	-	-
Executing Flagged for Optimize	-	-	-	-	-
Mandatory - Fixed Timing	9,605,021	9,280,908	9,944,473	11,315,846	10,063,808
Value Driven - Fixed Timing	2,164,924	5,164,174	930,075	-	952,033
Value Driven - Value Framework	38,716,162	18,723,918	18,439,863	-	-
TIS	66,077,134	44,295,639	43,132,854	59,175,485	68,460,463
Mandatory - Fixed Timing	50,839,868	27,122,423	28,158,686	43,763,926	53,534,398
Value Driven - Fixed Timing	9,644,469	9,734,985	9,853,919	10,285,070	9,796,456
Value Driven - Value Framework	5,592,797	7,438,231	5,120,250	5,126,489	5,129,609
Transmission Pipe & Underground Storage	132,361,316	288,897,304	88,118,140	47,707,418	46,064,127
Compliance - Fixed Timing	39,262,068	37,382,996	39,316,336	42,522,255	40,984,099
Mandatory - Fixed Timing	90,305,336	248,727,451	45,924,224	2,304,077	2,197,188
Value Driven - Fixed Timing	2,793,913	2,786,857	2,877,580	2,881,087	2,882,840
Utilization	167,099,338	164,894,604	175,892,910	182,822,695	186,319,710
Compliance - Fixed Timing	153,925,921	152,695,725	163,782,191	171,103,957	175,234,935
Mandatory - Fixed Timing	13,173,417	12,198,878	12,110,719	11,718,738	11,084,776
Grand Total	1,343,426,137	1,541,911,972	1,358,646,899	1,307,717,710	1,335,559,628

2023-2032 Pre-Optimized Spend Profile - EGI (Capital Expenditure)

Line No.	Asset Class (\$)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
1	Distribution Pipe	335,625,987	385,784,773	313,689,918	384,772,987	418,846,063	464,005,975	491,281,948	568,953,254	587,277,215	582,500,185
2	Distribution Stations	159,405,211	148,320,564	111,127,380	114,078,720	111,045,977	112,203,661	107,523,524	112,725,519	116,690,930	116,039,645
3	Growth	334,192,994	370,151,920	389,461,836	355,664,227	312,564,541	254,132,914	279,837,508	226,101,966	215,595,260	230,479,765
4	Utilization	117,235,676	145,714,686	153,124,319	157,235,553	165,182,727	167,099,337	164,894,603	175,892,910	182,822,694	186,319,710
5	Compression Stations	261,577,552	62,305,451	59,733,404	110,927,160	30,708,804	18,706,763	10,219,086	9,541,842	11,067,010	17,034,111
6	LNG	1,775,354	11,178,933	351,088	245,654	395,587	9,491,206	53,079,464	32,719,016	432,891	431,307
7	Transmission Pipe & Underground Storage	277,617,967	177,830,809	110,834,562	192,311,292	114,406,991	132,361,316	288,897,303	88,118,139	47,707,418	46,064,127
8	Fleet & Equipment	37,200,833	39,752,798	42,247,113	42,506,169	44,945,062	43,575,100	42,921,540	45,838,781	48,798,595	49,843,419
9	Real Estate & Workplace Services	120,350,154	91,399,996	70,647,008	20,351,865	22,210,515	50,486,107	33,168,999	29,314,411	11,315,846	11,015,840
10	TIS	85,952,039	93,441,152	64,096,297	62,872,918	57,260,932	66,077,133	44,295,638	43,132,854	59,175,484	68,460,463
11	EA Fixed O/H	22,727,890	23,449,892	23,828,139	24,304,712	24,790,805	25,286,620	25,792,352	26,308,202	26,834,362	27,371,051
12	Grand Total	1,753,661,663	1,549,330,981	1,339,141,069	1,465,271,264	1,302,358,008	1,343,426,137	1,541,911,972	1,358,646,899	1,307,717,710	1,335,559,628

2023-2032 Pre-Optimized Spend Profile - EGI Investment Count

Line No.	Asset Class	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
1	Compression Stations	111	70	61	45	37	41	29	27	26	26	/u
2	Distribution Pipe	280	216	142	128	111	112	103	102	100	97	/u
3	Distribution Stations	171	131	104	105	61	47	48	38	39	41	/u
4	EA Fixed O/H	19	19	19	19	19	19	19	19	19	19	/u
5	Fleet & Equipment	7	7	7	7	7	7	7	7	7	7	/u
6	Growth	111	90	83	75	71	72	67	71	65	68	/u
7	LNG	5	5	1	2	3	7	6	5	3	3	/u
8	Real Estate & Workplace Services	26	30	22	15	18	18	21	16	11	10	/u
9	TIS	99	83	73	73	65	67	70	64	67	68	/u
10	Transmission Pipe & Underground Storage	57	51	44	32	35	28	29	29	26	25	/u
11	Utilization	32	31	31	30	30	30	30	30	29	29	/u
12	Grand Total	918	733	587	531	457	448	429	408	392	393	

2023-2032 Pre-Optimized Spend Profile by Asset Class & Planning Group

Line No.	Asset Class (\$)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
1	Compression Stations	261,577,552	62,305,451	59,733,404	110,927,160	30,708,804	18,706,763	10,219,086	9,541,842	11,067,010	17,034,111
2	Compliance - Fixed Timing	1,298,713	1,030,115	1,514,831	1,299,044	1,384,673	1,446,373	1,354,340	1,436,436	1,498,986	1,494,046
3	Mandatory - Fixed Timing	52,783,882	18,703,566	21,795,846	14,584,483	9,571,105	13,781,209	5,626,929	4,662,169	5,960,593	9,112,338
4	Significant Investments (>\$10M) - Fixed Timing	236,060	15,001,408	33,030,964	91,972,954	16,456,458	-	-	-	-	-
5	Value Driven - Fixed Timing	202,551,004	26,260,143	3,391,761	3,070,678	3,296,566	3,479,181	3,237,816	3,443,237	3,607,431	3,594,227
6	Value Driven - Value Framework	4,707,890	1,310,219	-	-	-	-	-	-	-	2,833,498
7	Distribution Pipe	335,625,987	385,784,773	313,689,918	384,772,987	418,846,063	464,005,975	491,281,948	568,953,254	587,277,215	582,500,185
8	Compliance - Fixed Timing	122,824,821	156,598,690	116,375,047	132,725,434	116,354,035	94,240,887	89,861,093	93,698,533	97,211,457	98,271,559
9	Executing - Re-Optimize	16,298,299	80,215,644	3,591,596	-	-	-	-	-	-	-
10	Executing Flagged for Optimize	15,671,178	3,836,151	-	-	-	-	-	-	-	-
11	Mandatory - Fixed Timing	48,375,310	(3,232,894)	44,349,010	42,798,095	46,259,321	54,567,293	43,250,332	45,732,650	47,220,443	47,100,737
12	Value Driven - Fixed Timing	78,889,324	98,423,215	127,383,669	196,189,568	249,536,168	309,690,249	354,816,145	427,270,193	436,701,789	437,127,887
13	Value Driven - Value Framework	53,567,053	49,943,965	21,990,594	13,059,888	6,696,536	5,507,543	3,354,377	2,251,877	6,143,524	-
14	Distribution Stations	159,405,211	148,320,564	111,127,380	114,078,720	111,045,977	112,203,661	107,523,524	112,725,519	116,690,930	116,039,645
15	Compliance - Fixed Timing	19,520,721	14,167,789	13,654,021	12,285,414	10,849,535	10,500,897	10,142,970	10,842,019	11,367,576	11,529,124
16	Compliance - Optimize	-	-	-	570,052	320,912	307,721	295,329	-	-	-
17	Compliance - Re-Optimize	-	-	673,249	933,681	353,771	-	-	-	-	-
18	Executing - Re-Optimize	29,599,278	4,219,766	-	3,511,557	-	-	-	-	-	-
19	Executing Flagged for Optimize	17,985,427	180,305	-	-	-	-	-	-	-	-
20	Mandatory - Fixed Timing	12,622,423	18,917,043	21,437,913	17,369,242	21,015,422	19,151,648	32,481,906	34,615,133	21,989,608	37,147,514
21	Value Driven - Fixed Timing	32,025,688	10,450,374	28,821,115	24,605,887	46,551,895	53,120,090	54,022,338	58,954,068	59,325,990	59,787,961
22	Value Driven - Value Framework	47,651,672	100,385,284	46,541,079	54,802,883	31,954,439	29,123,303	10,580,978	8,314,297	24,007,754	7,575,046
23	EA Fixed O/H	22,727,890	23,449,892	23,828,139	24,304,712	24,790,805	25,286,620	25,792,352	26,308,202	26,834,362	27,371,051
24	Overheads	22,727,890	23,449,892	23,828,139	24,304,712	24,790,805	25,286,620	25,792,352	26,308,202	26,834,362	27,371,051
25	Fleet & Equipment	37,200,833	39,752,798	42,247,113	42,506,169	44,945,062	43,575,100	42,921,540	45,838,781	48,798,595	49,843,419
26	Mandatory - Fixed Timing	37,200,833	39,752,798	42,247,113	42,506,169	44,945,062	43,575,100	42,921,540	45,838,781	48,798,595	49,843,419
27	Growth	334,192,994	370,151,920	389,461,836	355,664,227	312,564,541	254,132,914	279,837,508	226,101,966	215,595,260	230,479,765
28	Mandatory - Fixed Timing	332,186,479	368,408,968	389,461,836	355,664,227	312,564,541	254,132,914	279,837,508	226,101,966	215,595,260	230,479,765
29	Value Driven - Fixed Timing	2,006,514	1,742,952	-	-	-	-	-	-	-	-
30	LNG	1,775,354	11,178,933	351,088	245,654	395,587	9,491,206	53,079,464	32,719,016	432,891	431,307
31	Compliance - Fixed Timing	500,627	-	-	-	-	-	-	-	-	-
32	Executing Flagged for Optimize	1,062,272	10,698,119	-	-	-	-	-	-	-	-
33	Mandatory - Fixed Timing	35,409	120,203	-	-	-	-	-	-	-	-
34	Value Driven - Fixed Timing	-	-	-	-	-	-	-	-	-	-
35	Value Driven - Value Framework	177,045	360,610	351,088	245,654	395,587	9,491,206	53,079,464	32,719,016	432,891	431,307
36	Real Estate & Workplace Services	120,350,154	91,399,996	70,647,008	20,351,865	22,210,515	50,486,107	33,168,999	29,314,411	11,315,846	11,015,840
37	Executing - Re-Optimize	19,356,964	21,636,646	2,646,711	-	-	-	-	-	-	-
38	Executing Flagged for Optimize	6,491,665	3,738,331	4,883,183	-	-	-	-	-	-	-
39	Mandatory - Fixed Timing	7,744,183	8,215,185	8,798,253	8,735,296	9,274,384	9,605,021	9,280,907	9,944,473	11,315,846	10,063,808
40	Value Driven - Fixed Timing	79,376,829	16,212,869	901,751	892,546	923,442	2,164,924	5,164,173	930,075	-	952,032
41	Value Driven - Value Framework	7,380,511	41,596,962	53,417,106	10,724,022	12,012,687	38,716,162	18,723,918	18,439,862	-	-
42	TIS	85,952,039	93,441,152	64,096,297	62,872,918	57,260,932	66,077,133	44,295,638	43,132,854	59,175,484	68,460,463
43	Mandatory - Fixed Timing	36,696,964	39,232,651	21,262,508	27,935,581	42,897,824	50,839,867	27,122,422	28,158,685	43,763,926	53,534,398
44	Value Driven - Fixed Timing	24,305,415	15,032,689	10,328,713	10,053,800	10,799,697	9,644,469	9,734,985	9,853,918	10,285,069	9,796,455
45	Value Driven - Value Framework	24,949,659	39,175,811	32,505,075	24,883,536	3,563,410	5,592,796	7,438,230	5,120,249	5,126,488	5,129,608
46	Transmission Pipe & Underground Storage	277,617,967	177,830,809	110,834,562	192,311,292	114,406,991	132,361,316	288,897,303	88,118,139	47,707,418	46,064,127
47	Compliance - Fixed Timing	54,401,178	58,099,494	45,464,948	43,032,615	45,833,055	39,262,068	37,382,995	39,316,335	42,522,254	40,984,098
48	Mandatory - Fixed Timing	218,642,932	87,698,180	58,062,920	146,307,129	65,607,067	90,305,335	248,727,451	45,924,223	2,304,076	2,197,188
49	Value Driven - Fixed Timing	4,573,857	32,033,134	7,306,693	2,971,547	2,966,868	2,793,912	2,786,857	2,877,580	2,881,086	2,882,840
50	Utilization	117,235,676	145,714,686	153,124,319	157,235,553	165,182,727	167,099,337	164,894,603	175,892,910	182,822,694	186,319,710
51	Compliance - Fixed Timing	108,447,846	131,603,839	138,658,853	143,100,397	151,252,802	153,925,920	152,695,725	163,782,191	171,103,957	175,234,934
52	Mandatory - Fixed Timing	8,787,830	14,110,847	14,465,466	14,135,156	13,929,924	13,173,416	12,198,878	12,110,719	11,718,737	11,084,775
53	Grand Total	1,753,661,663	1,549,330,981	1,339,141,069	1,465,271,264	1,302,358,008	1,343,426,137	1,541,911,972	1,358,646,899	1,307,717,710	1,335,559,628

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.257

Question(s):

With respect to the post-optimized and final 10-year capital plan:

- a) [p.256] The evidence discusses that an optimized solution could not be obtained, and so certain adjustments had to be made. Please explain the list of constraints, and the basis for them, that were inputted into Copperleaf that led to a solution that cannot be optimized.
- b) [p.257] Please explain the changes to the constraints that were inputted into Copperleaf that led to the final optimized plan (i.e. final 10 year capital plan).
- c) [p.257] Please provide Figure 6.1-3 in tabular format. Please also provide in Excel format.
- d) [p.257] On the same basis as provided in Figure 6.1-3, please provide the number of investments (as opposed to cost of the investment). Please provide in tabular format and also provide in Excel format.
- e) [p.255, p.257] On the same basis as provided in Figure 6.1-3, please provide a breakdown of each investment category (i.e. growth, distribution stations, TIS, etc.), by planning group (i.e. compliance – fixed timing, mandatory – fixed timing, etc.). Please provide in tabular format and also provide in Excel format.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

/u

- a-b) The only constraint for optimization was to annual capital expenditure. Please see response at Exhibit I.FRPO-30, part a) for the additional information requested.
- c) Table 1 below represents Exhibit 2, Tab 6, Schedule 2, Figure 6.1-3 in tabular form. The Excel file can be found in Attachment 1.

Table 1
10-Year Plan by Asset Class – Enbridge Gas

Asset Class (\$)	2023	2024	2025	2026	2027	
Distribution Pipe	216,583,430	344,793,026	241,928,696	272,670,252	250,187,920	/u
Distribution Stations	62,331,211	80,899,753	90,191,077	104,340,606	79,032,223	/u
Growth	337,500,483	380,258,249	344,305,552	294,335,538	299,693,790	/u
Utilization	160,737,353	152,303,366	160,186,484	172,980,774	152,033,605	/u
Compression Stations	33,648,471	31,704,889	71,037,086	16,951,462	14,583,450	/u
LNG	546,228	738,852	525,714	1,462,915	12,264,778	/u
Transmission Pipe & Underground Storage	39,964,089	62,197,584	70,804,896	63,499,881	51,563,850	/u
Fleet & Equipment	8,861,923	31,478,468	35,408,203	40,111,977	45,720,145	/u
Real Estate & Workplace Services	49,995,423	37,350,716	49,379,401	75,032,237	11,492,714	/u
TIS	36,467,999	79,601,343	55,423,857	57,787,580	44,935,466	/u
EA Fixed O/H	25,571,378	39,846,629	40,844,125	41,878,953	42,953,168	/u
Distribution Pipe >\$50M	20,896,371	12,165,299	173,106,004	10,378,458	-	/u
Growth >\$50M	3,867,383	11,516,242	103,788,615	6,649,613	362,261	/u
Compression Stations >\$50M	292,503,302	13,845,083	15,311,843	32,173,490	100,752,481	/u
Transmission Pipe & Underground Storage >\$50M	61,684,764	201,744,063	80,332,948	136,898,166	216,834,266	/u
Real Estate & Workplace Services >\$50M	12,979,722	25,611,157	11,921,570	17,218,601	20,360,487	/u
TIS >\$50M	10,669,331	22,832,346	22,719,634	13,565,649	-	/u
Grand Total	1,374,808,862	1,528,887,066	1,567,215,704	1,357,936,152	1,342,770,606	/u

Table 1 (Continued)
10-Year Plan by Asset Class – Enbridge Gas

Asset Class (\$)	2028	2029	2030	2031	2032	
Distribution Pipe	323,696,858	342,167,591	393,788,314	507,721,402	668,249,657	/u
Distribution Stations	116,636,713	121,501,197	117,022,097	117,712,834	109,841,101	/u
Growth	261,031,317	246,781,189	235,714,142	228,900,604	205,857,039	/u
Utilization	188,726,332	188,345,626	201,596,514	209,492,981	208,826,902	/u
Compression Stations	18,972,787	10,679,011	9,637,323	10,936,812	16,150,188	/u
LNG	1,798,421	403,361	410,609	7,996,264	52,819,296	/u
Transmission Pipe & Underground Storage	49,646,140	41,287,395	44,475,477	44,242,219	42,621,239	/u
Fleet & Equipment	45,535,468	45,059,621	47,692,707	49,964,914	49,055,660	/u
Real Estate & Workplace Services	41,530,876	34,542,812	35,917,270	9,276,733	10,819,025	/u
TIS	56,722,399	46,529,731	45,263,048	48,879,062	55,611,395	/u
EA Fixed O/H	28,712,869	29,112,327	29,708,261	30,271,731	30,426,646	/u
Distribution Pipe >\$50M	687,262	2,628,758	28,429,964	1,401,328	-	/u
Growth >\$50M	7,350,959	61,867,820	741,953	375,556	-	/u
Compression Stations >\$50M	17,842,512	-	-	-	-	/u
Transmission Pipe & Underground Storage >\$50M	98,398,482	218,067,178	91,171,749	9,650,664	-	/u
Real Estate & Workplace Services >\$50M	-	-	-	-	-	/u
TIS >\$50M	-	-	-	-	-	/u
Grand Total	1,257,289,395	1,388,973,616	1,281,569,426	1,276,823,103	1,450,278,147	/u

d) Table 2 below represents Exhibit 2, Tab 6, Schedule 2, Figure 6.1-3 in tabular form by investment count. As many investments have multi-year spends or may be programmatic in nature, they are captured in the count in all years that they have capital spend. The Excel file can be found in Attachment 2.

Table 2
10-Year Plan by Asset Class – Enbridge Gas Investment Count

Asset Class (\$)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Distribution Pipe	269	188	117	129	167	203	230	254	310	337	/u
Distribution Stations	200	147	68	95	50	67	55	44	40	40	/u
Growth	185	131	108	101	91	90	84	87	75	77	/u
Utilization	42	41	38	36	36	36	36	36	36	36	/u
Compression Stations	76	75	58	54	38	41	29	27	26	26	/u
LNG	5	4	2	3	4	4	3	3	6	6	/u
Transmission Pipe & Underground Storage	47	48	24	34	33	27	27	27	26	24	/u
Fleet & Equipment	13	11	11	7	7	7	7	7	7	7	/u
Real Estate & Workplace Services	26	20	3	5	2	18	20	16	4	10	/u
TIS	69	77	50	61	64	66	69	63	66	66	/u
EA Fixed O/H	4	4	4	4	4	4	4	4	4	4	/u
Distribution Pipe >\$50M	1	1	2	2	-	1	1	1	1	0	/u
Growth >\$50M	1	1	1	1	1	1	1	1	1	0	/u
Compression Stations >\$50M	3	1	1	1	1	1	0	0	0	0	/u
Transmission Pipe & Underground Storage >\$50M	3	4	3	3	3	3	2	2	1	0	/u
Real Estate & Workplace Services >\$50M	1	1	1	1	1	0	0	0	0	0	/u
TIS >\$50M	1	1	1	1	0	0	0	0	0	0	/u
Grand Total	946	755	492	538	502	569	568	572	603	633	/u

e) Table 3 represents Exhibit 2, Tab 6, Schedule 2, Figure 6.1-3 in tabular form categorized by the planning groups outlined in Exhibit 2, Tab 6, Schedule 2, Table 6.1-1. The Excel file can be found in Attachment 3.

Table 3
10-Year Plan by Asset Class & Planning Group – 2023 to 2027

Line No.	Asset Class	2023	2024	2025	2026	2027	
1	Distribution Pipe	216,583,430	344,793,026	241,928,696	272,670,252	250,187,920	/u
2	Compliance - Fixed Timing	135,862,352	172,963,256	105,603,871	132,610,938	116,994,260	/u
3	Executing - Re-Optimize	178,262	4,747,894	17,616,836	11,742,808	495,029	/u
4	Executing Flagged for Optimize	6,478,981	5,516,820	-	-	970,890	/u
5	Mandatory - Fixed Timing	47,826,369	44,598,902	43,785,412	47,832,624	49,923,002	/u
6	Value Driven - Fixed Timing	24,384,169	109,020,245	68,654,792	44,807,466	48,085,362	/u
7	Value Driven - Value Framework	1,853,298	7,945,909	6,267,784	35,676,416	33,719,377	/u
8	Distribution Stations	62,331,211	80,899,753	90,191,077	104,340,606	79,032,223	/u
9	Compliance - Fixed Timing	14,830,761	9,122,611	6,574,371	8,323,673	7,320,444	/u
10	Compliance - Optimize	-	-	-	-	-	
11	Compliance - Re-Optimize	-	-	-	-	-	
12	Executing - Re-Optimize	1,810,671	302,974	19,994,814	6,175,363	-	/u
13	Executing Flagged for Optimize	2,903,506	3,288,658	1,847,118	708,849	464,595	/u
14	Mandatory - Fixed Timing	10,384,266	13,921,640	1,475,335	8,591,105	6,535,527	/u
15	Value Driven - Fixed Timing	30,372,900	40,811,112	14,881,108	26,455,727	36,139,385	/u
16	Value Driven - Value Framework	2,029,107	13,452,758	45,418,332	54,085,889	28,572,273	/u
17	Growth	337,500,483	380,258,249	344,305,552	294,335,538	299,693,790	/u
18	Mandatory - Fixed Timing	329,379,346	357,973,554	331,484,849	289,262,466	297,792,940	/u
19	Overheads	3,399,525	2,776,960	1,734,847	1,859,098	1,900,850	/u
20	Value Driven - Fixed Timing	4,283,308	9,514,690	11,085,856	3,213,974	-	/u
21	Value Driven - Value Framework	438,303	9,993,045	-	-	-	/u
22	Utilization	160,737,353	152,303,366	160,186,484	172,980,774	152,033,605	/u
23	Compliance - Fixed Timing	139,235,405	129,596,563	136,774,221	147,651,725	127,578,206	/u
24	Mandatory - Fixed Timing	21,501,948	22,706,803	23,412,263	25,329,050	24,455,399	/u

Line No.	Asset Class	2023	2024	2025	2026	2027	
25	Compression Stations	33,648,471	31,704,889	71,037,086	16,951,462	14,583,450	/u
26	Compliance - Fixed Timing	468,136	1,517,226	507,182	1,397,342	1,401,644	/u
27	Mandatory - Fixed Timing	25,451,191	12,357,770	42,408,846	14,938,046	9,848,987	/u
28	Value Driven - Fixed Timing	3,934,565	14,128,447	27,219,232	124,002	3,332,820	/u
29	Value Driven - Value Framework	3,794,579	3,701,446	901,827	492,071	-	/u
30	LNG	546,228	738,852	525,714	1,462,915	12,264,778	/u
31	Compliance - Fixed Timing	(119,059)	423,103	-	-	-	/u
32	Executing Flagged for Optimize	-	-	-	1,196,930	11,864,839	/u
33	Mandatory - Fixed Timing	-	126,300	-	-	-	/u
34	Value Driven - Fixed Timing	471,917	-	-	-	-	/u
35	Value Driven - Value Framework	193,369	189,449	525,714	265,985	399,938	/u
36	Transmission Pipe & Underground Storage	39,964,089	62,197,584	70,804,896	63,499,881	51,563,850	/u
37	Compliance - Fixed Timing	38,676,734	57,685,382	36,023,140	55,408,038	47,281,490	/u
38	Mandatory - Fixed Timing	1,287,355	3,045,661	2,176,163	3,247,678	1,243,690	/u
39	Value Driven - Fixed Timing	-	1,466,541	32,605,593	4,844,165	3,038,669	/u
40	Fleet & Equipment	8,861,923	31,478,468	35,408,203	40,111,977	45,720,145	/u
41	Mandatory - Fixed Timing	8,861,923	31,478,468	35,408,203	40,111,977	45,720,145	/u
42	Real Estate & Workplace Services	49,995,423	37,350,716	49,379,401	75,032,237	11,492,714	/u
43	Executing - Re-Optimize	322,282	315,749			-	/u
44	Executing Flagged for Optimize	451,195	833,577	-	-	-	/u
45	Mandatory - Fixed Timing	3,499,128	8,059,089	-	-	-	/u
46	Value Driven - Fixed Timing	6,510,316	8,436,639	-	-	-	/u
47	Value Driven - Value Framework	39,212,502	19,705,662	49,379,401	75,032,237	11,492,714	/u
48	TIS	36,467,999	79,601,343	55,423,857	57,787,580	44,935,466	/u
49	Mandatory - Fixed Timing	17,513,870	29,227,564	15,385,684	24,766,870	30,265,675	/u
50	Value Driven - Fixed Timing	13,208,358	22,146,419	11,070,734	10,380,200	11,020,144	/u
51	Value Driven - Value Framework	5,745,770	28,227,359	28,967,439	22,640,510	3,649,647	/u

Line No.	Asset Class	2023	2024	2025	2026	2027	
52	EA Fixed O/H	25,571,378	39,846,629	40,844,125	41,878,953	42,953,168	/u
53	Overheads	25,571,378	39,846,629	40,844,125	41,878,953	42,953,168	/u
54	Distribution Pipe >\$50M	20,896,371	12,165,299	173,106,004	10,378,458	-	/u
55	Executing - Re-Optimize	-	-	69,828,151	4,017,468	-	/u
56	Value Driven - Fixed Timing	20,896,371	12,165,299	103,277,853	6,360,991	-	/u
57	Growth >\$50M	3,867,383	11,516,242	103,788,615	6,649,613	362,261	/u
58	Mandatory - Fixed Timing	3,867,383	11,516,242	103,788,615	6,649,613	362,261	/u
59	Compression Stations >\$50M	292,503,302	13,845,083	15,311,843	32,173,490	100,752,481	/u
60	Significant Investments (>\$10M) - Fixed Timing	257,826	-	15,311,843	32,173,490	100,752,481	/u
61	Value Driven - Fixed Timing	292,245,477	13,845,083	-	-	-	/u
62	Transmission Pipe & Underground Storage >\$50M	61,684,764	201,744,063	80,332,948	136,898,166	216,834,266	/u
63	Mandatory - Fixed Timing	61,684,764	201,744,063	80,332,948	136,898,166	216,834,266	/u
64	Real Estate & Workplace Services >\$50M	12,979,722	25,611,157	11,921,570	17,218,601	20,360,487	/u
65	Executing - Re-Optimize	-	-	11,921,570	17,218,601	20,360,487	/u
66	Value Driven - Fixed Timing	12,979,722	25,611,157	-	-	-	/u
67	TIS >\$50M	10,669,331	22,832,346	22,719,634	13,565,649	-	/u
68	Mandatory - Fixed Timing	10,669,331	22,832,346	22,719,634	13,565,649	-	/u
69	Grand Total	1,374,808,862	1,528,887,066	1,567,215,704	1,357,936,152	1,342,770,606	/u

Table 3 (Continued)
10-Year Plan by Asset Class & Planning Group – 2028 to 2032

Line No.	Asset Class	2028	2029	2030	2031	2032	
1	Distribution Pipe	327,210,138	345,704,046	397,460,315	511,494,125	671,846,939	/u
2	Compliance - Fixed Timing	97,218,151	93,932,518	93,905,280	94,732,347	92,514,500	/u
3	Executing - Re-Optimize	-	-	-	-	3,361,499	/u
4	Executing Flagged for Optimize	61,854	2,870,817	-	-	-	/u
5	Mandatory - Fixed Timing	51,822,977	49,360,810	51,136,775	51,520,784	50,997,239	/u
6	Value Driven - Fixed Timing	102,988,820	84,863,153	76,297,080	73,108,435	99,679,936	/u
7	Value Driven - Value Framework	75,118,336	114,676,748	176,121,180	292,132,559	425,293,766	/u
8	Distribution Stations	116,636,713	121,501,197	117,022,097	117,712,834	109,841,101	/u
9	Compliance - Fixed Timing	11,119,607	10,604,853	11,091,994	11,356,137	11,014,319	/u
10	Compliance - Optimize	340,325	313,121	-	-	-	/u
11	Compliance - Re-Optimize	-	-	-	-	-	
12	Executing - Re-Optimize	-	-	-	-	-	
13	Executing Flagged for Optimize	-	-	-	-	-	
14	Mandatory - Fixed Timing	19,510,014	31,810,313	33,153,255	22,709,152	33,163,272	/u
15	Value Driven - Fixed Timing	60,250,177	71,635,105	63,911,651	60,622,962	58,753,347	/u
16	Value Driven - Value Framework	25,416,589	7,137,805	8,865,198	23,024,582	6,910,163	/u
17	Growth	263,012,814	248,775,756	237,785,158	231,028,428	207,885,913	/u
18	Mandatory - Fixed Timing	261,031,317	246,781,189	235,714,142	228,900,604	205,857,039	/u
19	Overheads	1,981,497	1,994,567	2,071,016	2,127,824	2,028,874	/u
20	Value Driven - Fixed Timing	-	-	-	-	-	
21	Value Driven - Value Framework	-	-	-	-	-	
22	Utilization	188,726,332	188,345,626	201,596,514	209,492,981	208,826,902	/u
23	Compliance - Fixed Timing	160,946,870	160,605,955	171,670,233	178,255,981	177,376,060	/u
24	Mandatory - Fixed Timing	27,779,462	27,739,671	29,926,281	31,237,000	31,450,842	/u
25	Compression Stations	18,972,787	10,679,011	9,637,323	10,936,812	16,150,188	/u
26	Compliance - Fixed Timing	1,431,770	1,408,747	1,438,943	1,449,866	1,363,225	/u

27	Mandatory - Fixed Timing	14,134,917	5,908,925	4,776,641	6,040,281	8,496,305	/u
28	Value Driven - Fixed Timing	3,406,100	3,361,340	3,421,739	3,446,666	3,221,946	/u
29	Value Driven - Value Framework	-	-	-	-	3,068,712	/u
30	LNG	1,798,421	403,361	410,609	7,996,264	52,819,296	/u
31	Compliance - Fixed Timing	-	-	-	-	-	
32	Executing Flagged for Optimize	-	-	-	-	-	
33	Mandatory - Fixed Timing	-	-	-	-	-	
34	Value Driven - Fixed Timing	-	-	-	-	-	
35	Value Driven - Value Framework	1,798,421	403,361	410,609	7,996,264	52,819,296	/u
36	Transmission Pipe & Underground Storage	49,646,140	41,287,395	44,475,477	44,242,219	42,621,239	/u
37	Compliance - Fixed Timing	44,674,294	37,381,757	39,459,679	40,299,083	37,819,557	/u
38	Mandatory - Fixed Timing	1,881,914	950,914	1,898,209	792,950	1,679,533	/u
39	Value Driven - Fixed Timing	3,089,932	2,954,724	3,117,588	3,150,186	3,122,149	/u
40	Fleet & Equipment	45,535,468	45,059,621	47,692,707	49,964,914	49,055,660	/u
41	Mandatory - Fixed Timing	45,535,468	45,059,621	47,692,707	49,964,914	49,055,660	/u
42	Real Estate & Workplace Services	41,530,876	34,542,812	35,917,270	9,276,733	10,819,025	/u
43	Executing - Re-Optimize	-	-	-	-	-	
44	Executing Flagged for Optimize	3,337,978	-	-	-	-	/u
45	Mandatory - Fixed Timing	9,836,627	9,711,418	10,208,638	868,763	9,881,852	/u
46	Value Driven - Fixed Timing	2,332,462	5,465,228	964,433	-	937,172	/u
47	Value Driven - Value Framework	26,023,809	19,366,166	24,744,198	8,407,970	-	/u
48	TIS	56,722,399	46,529,731	45,263,048	48,879,062	55,611,395	/u
49	Mandatory - Fixed Timing	40,291,226	28,505,186	29,427,662	32,537,286	40,140,009	/u
50	Value Driven - Fixed Timing	10,245,811	10,138,271	10,288,076	10,736,462	9,915,960	/u
51	Value Driven - Value Framework	6,185,362	7,886,274	5,547,310	5,605,313	5,555,426	/u
52	EA Fixed O/H	23,218,092	23,581,305	23,965,244	24,371,184	24,800,490	/u
53	Overheads	23,218,092	23,581,305	23,965,244	24,371,184	24,800,490	/u
54	Distribution Pipe >\$50M	687,262	2,628,758	28,429,964	1,401,328	-	/u

55	Executing - Re-Optimize	687,262	2,628,758	28,429,964	1,401,328	-	/u
56	Value Driven - Fixed Timing	-	-	-	-	-	
57	Growth >\$50M	7,350,959	61,867,820	741,953	375,556	-	/u
58	Mandatory - Fixed Timing	7,350,959	61,867,820	741,953	375,556	-	/u
59	Compression Stations >\$50M	17,842,512	-	-	-	-	/u
60	Significant Investments (>\$10M) - Fixed Timing	17,842,512	-	-	-	-	/u
61	Value Driven - Fixed Timing	-	-	-	-	-	
62	Transmission Pipe & Underground Storage >\$50M	98,398,482	218,067,178	91,171,749	9,650,664	-	/u
63	Mandatory - Fixed Timing	98,398,482	218,067,178	91,171,749	9,650,664	-	/u
64	Real Estate & Workplace Services >\$50M	-	-	-	-	-	
65	Executing - Re-Optimize	-	-	-	-	-	
66	Value Driven - Fixed Timing	-	-	-	-	-	
67	TIS >\$50M	-	-	-	-	-	
68	Mandatory - Fixed Timing	-	-	-	-	-	
69	Grand Total	1,257,289,395	1,388,973,616	1,281,569,426	1,276,823,103	1,450,278,147	/u

10-Year Plan by Asset Class - EGI Updated for 2024 Budget

Line No.	Asset Class	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
1	Distribution Pipe	216,583,430	344,793,026	241,928,696	272,670,252	250,187,920	327,210,138	345,704,046	397,460,315	511,494,125	671,846,939	/u
2	Distribution Stations	67,476,430	80,899,753	90,191,077	104,340,606	79,032,223	116,636,713	121,501,197	117,022,097	117,712,834	109,841,101	/u
3	Growth	337,500,483	380,258,249	344,305,552	294,335,538	299,693,790	263,012,814	248,775,756	237,785,158	231,028,428	207,885,913	/u
4	Utilization	160,737,353	152,303,366	160,186,484	172,980,774	152,033,605	188,726,332	188,345,626	201,596,514	209,492,981	208,826,902	/u
5	Compression Stations	28,748,186	31,704,889	71,037,086	16,951,462	14,583,450	18,972,787	10,679,011	9,637,323	10,936,812	16,150,188	/u
6	LNG	546,228	738,852	525,714	1,462,915	12,264,778	1,798,421	403,361	410,609	7,996,284	52,819,296	/u
7	Transmission Pipe & Underground Storage	39,964,089	62,197,584	70,804,896	63,499,881	51,563,850	49,646,140	41,287,395	44,475,477	44,242,219	42,621,239	/u
8	Fleet & Equipment	8,861,923	31,478,468	35,408,203	40,111,977	45,720,145	45,535,468	45,059,621	47,692,707	49,964,914	49,055,660	/u
9	Real Estate & Workplace Services	49,995,423	37,350,716	49,379,401	75,032,237	11,492,714	41,530,876	34,542,812	35,917,270	9,276,733	10,819,025	/u
10	TIS	36,467,999	79,601,343	55,423,857	57,787,580	44,935,466	56,722,399	46,529,731	45,263,048	48,879,062	55,611,395	/u
11	EA Fixed O/H	25,571,378	39,846,629	40,844,125	41,878,953	42,953,168	23,218,092	23,581,305	23,965,244	24,371,184	24,800,490	/u
12	Distribution Pipe >\$50M	20,896,371	12,165,299	173,106,004	10,378,458	-	687,262	2,628,758	28,429,964	1,401,328	-	/u
13	Growth >\$50M	3,867,383	11,516,242	103,788,615	6,649,613	362,261	7,350,959	61,867,820	741,953	375,556	-	/u
14	Compression Stations >\$50M	292,503,302	13,845,083	15,311,843	32,173,490	100,752,481	17,842,512	-	-	-	-	/u
15	Transmission Pipe & Underground Storage >\$50M	61,684,764	201,744,063	80,332,948	136,898,166	216,834,266	98,398,482	218,067,178	91,171,749	9,650,664	-	/u
16	Real Estate & Workplace Services >\$50M	12,979,722	25,611,157	11,921,570	17,218,601	20,360,487	-	-	-	-	-	/u
17	TIS >\$50M	10,669,331	22,832,346	22,719,634	13,565,649	-	-	-	-	-	-	/u
18	Grand Total	1,369,908,576	1,528,887,066	1,567,215,704	1,357,936,152	1,342,770,606	1,257,289,395	1,388,973,616	1,281,569,426	1,276,823,103	1,450,278,147	/u

10-Year Plan by Asset Class - EGI Investment Count

Line No.	Asset Class	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
1	Distribution Pipe	269	188	117	129	167	203	230	254	310	337	/u
2	Distribution Stations	200	147	68	95	50	67	55	44	40	40	/u
3	Growth	185	131	108	101	91	90	84	87	75	77	/u
4	Utilization	42	41	38	36	36	36	36	36	36	36	/u
5	Compression Stations	76	75	58	54	38	41	29	27	26	26	/u
6	LNG	5	4	2	3	4	4	3	3	6	6	/u
7	Transmission Pipe & Underground Storage	47	48	24	34	33	27	27	27	26	24	/u
8	Fleet & Equipment	13	11	11	7	7	7	7	7	7	7	/u
9	Real Estate & Workplace Services	26	20	3	5	2	18	20	16	4	10	/u
10	TIS	69	77	50	61	64	66	69	63	66	66	/u
11	EA Fixed O/H	4	4	4	4	4	4	4	4	4	4	/u
12	Distribution Pipe >\$50M	1	1	2	2	-	1	1	1	1	0	/u
13	Growth >\$50M	1	1	1	1	1	1	1	1	1	0	/u
14	Compression Stations >\$50M	3	1	1	1	1	1	0	0	0	0	/u
15	Transmission Pipe & Underground Storage >\$50M	3	4	3	3	3	3	2	2	1	0	/u
16	Real Estate & Workplace Services >\$50M	1	1	1	1	1	0	0	0	0	0	/u
17	TIS >\$50M	1	1	1	1	0	0	0	0	0	0	/u
18	Grand Total	946	755	492	538	502	569	568	572	603	633	/u

10-Year Plan by Asset Class & Planning Group

Line No.	Asset Class	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
1	Distribution Pipe	216,583,430	344,793,026	241,928,696	272,670,252	250,187,920	327,210,138	345,704,046	397,460,315	511,494,125	671,846,939
2	Compliance - Fixed Timing	135,862,352	172,963,256	105,603,871	132,610,938	116,994,260	97,218,151	93,932,518	93,905,280	94,732,347	92,514,500
3	Executing - Re-Optimize	178,262	4,747,894	17,616,836	11,742,808	495,029	-	-	-	-	3,361,499
4	Executing Flagged for Optimize	6,478,981	5,516,820	-	-	970,890	61,854	2,870,817	-	-	-
5	Mandatory - Fixed Timing	47,826,369	44,598,902	43,785,412	47,832,624	49,923,002	51,822,977	49,360,810	51,136,775	51,520,784	50,997,239
6	Value Driven - Fixed Timing	24,384,169	109,020,245	68,654,792	44,807,466	48,085,362	102,988,820	84,863,153	76,297,080	73,108,435	99,679,936
7	Value Driven - Value Framework	1,853,298	7,945,909	6,267,784	35,676,416	33,719,377	75,118,336	114,676,748	176,121,180	292,132,559	425,293,766
8	Distribution Stations	62,331,211	80,899,753	90,191,077	104,340,606	79,032,223	116,636,713	121,501,197	117,022,097	117,712,834	109,841,101
9	Compliance - Fixed Timing	14,830,761	9,122,611	6,574,371	8,323,673	7,320,444	11,119,607	10,604,853	11,091,994	11,356,137	11,014,319
10	Compliance - Optimize	-	-	-	-	-	340,325	313,121	-	-	-
11	Compliance - Re-Optimize	-	-	-	-	-	-	-	-	-	-
12	Executing - Re-Optimize	1,810,671	302,974	19,994,814	6,175,363	-	-	-	-	-	-
13	Executing Flagged for Optimize	2,903,506	3,288,658	1,847,118	708,849	464,595	-	-	-	-	-
14	Mandatory - Fixed Timing	10,384,266	13,921,640	1,475,335	8,591,105	6,535,527	19,510,014	31,810,313	33,153,255	22,709,152	33,163,272
15	Value Driven - Fixed Timing	30,372,900	40,811,112	14,881,108	26,455,727	36,139,385	60,250,177	71,635,105	63,911,651	60,622,962	58,753,347
16	Value Driven - Value Framework	2,029,107	13,452,758	45,418,332	54,085,889	28,572,273	25,416,589	7,137,805	8,865,198	23,024,582	6,910,163
17	Growth	337,500,483	380,258,249	344,305,552	294,335,538	299,693,790	263,012,814	248,775,756	237,785,158	231,028,428	207,885,913
18	Mandatory - Fixed Timing	329,379,346	357,973,554	331,484,849	289,262,466	297,792,940	261,031,317	246,781,189	235,714,142	228,900,604	205,857,039
19	Overheads	3,399,525	2,776,960	1,734,847	1,859,098	1,900,850	1,981,497	1,994,567	2,071,016	2,127,824	2,028,874
20	Value Driven - Fixed Timing	4,283,308	9,514,690	11,085,856	3,213,974	-	-	-	-	-	-
21	Value Driven - Value Framework	438,303	9,993,045	-	-	-	-	-	-	-	-
22	Utilization	160,737,353	152,303,366	160,186,484	172,980,774	152,033,605	188,726,332	188,345,626	201,596,514	209,492,981	208,826,902
23	Compliance - Fixed Timing	139,235,405	129,596,563	136,774,221	147,651,725	127,578,206	160,946,870	160,605,955	171,670,233	178,255,981	177,376,060
24	Mandatory - Fixed Timing	21,501,948	22,706,803	23,412,263	25,329,050	24,455,399	27,779,462	27,739,671	29,926,281	31,237,000	31,450,842
25	Compression Stations	33,648,471	31,704,889	17,037,086	16,951,462	14,583,450	18,972,787	10,679,011	9,637,323	10,936,812	16,150,188
26	Compliance - Fixed Timing	468,136	1,517,226	507,182	1,397,342	1,401,644	1,431,770	1,408,747	1,438,943	1,449,866	1,363,225
27	Mandatory - Fixed Timing	25,451,191	12,357,770	42,408,846	14,938,046	9,848,987	14,134,917	5,908,925	4,776,641	6,040,281	8,496,305
28	Value Driven - Fixed Timing	3,934,565	14,128,447	27,219,232	124,002	3,332,820	3,406,100	3,361,340	3,421,739	3,446,666	3,221,946
29	Value Driven - Value Framework	3,794,579	3,701,446	901,827	492,071	-	-	-	-	-	3,068,712
30	LNG	546,228	738,852	525,714	1,462,915	12,264,778	1,798,421	403,361	410,609	7,996,264	52,819,296
31	Compliance - Fixed Timing	(119,059)	423,103	-	-	-	-	-	-	-	-
32	Executing Flagged for Optimize	-	-	-	1,196,930	11,864,839	-	-	-	-	-
33	Mandatory - Fixed Timing	-	126,300	-	-	-	-	-	-	-	-
34	Value Driven - Fixed Timing	471,917	-	-	-	-	-	-	-	-	-
35	Value Driven - Value Framework	193,369	189,449	525,714	265,985	399,938	1,798,421	403,361	410,609	7,996,264	52,819,296
36	Transmission Pipe & Underground Storage	39,964,089	62,197,584	70,804,896	63,499,881	51,563,850	49,646,140	41,287,395	44,475,477	44,242,219	42,621,239
37	Compliance - Fixed Timing	38,676,734	57,685,382	36,023,140	55,408,038	47,281,490	44,674,294	37,381,757	39,459,679	40,299,083	37,819,557
38	Mandatory - Fixed Timing	1,287,355	3,045,661	2,176,163	3,247,678	1,243,690	1,881,914	950,914	1,898,209	792,950	1,679,533
39	Value Driven - Fixed Timing	-	1,466,541	32,605,593	4,844,165	3,038,669	3,089,932	2,954,724	3,117,588	3,150,186	3,122,149
40	Fleet & Equipment	8,861,923	31,478,468	35,408,203	40,111,977	45,720,145	45,535,468	45,059,621	47,692,707	49,964,914	49,055,660
41	Mandatory - Fixed Timing	8,861,923	31,478,468	35,408,203	40,111,977	45,720,145	45,535,468	45,059,621	47,692,707	49,964,914	49,055,660
42	Real Estate & Workplace Services	49,995,423	37,350,716	49,379,401	75,032,237	11,492,714	41,530,876	34,542,812	35,917,270	9,276,733	10,819,025
43	Executing - Re-Optimize	322,282	315,749	-	-	-	-	-	-	-	-
44	Executing Flagged for Optimize	451,195	833,577	-	-	-	3,337,978	-	-	-	-
45	Mandatory - Fixed Timing	3,499,128	8,059,089	-	-	-	9,836,627	9,711,418	10,208,638	868,763	9,881,852
46	Value Driven - Fixed Timing	6,510,316	8,436,639	-	-	-	2,332,462	5,465,228	964,433	-	937,172
47	Value Driven - Value Framework	39,212,502	19,705,662	49,379,401	75,032,237	11,492,714	26,023,809	19,366,166	24,744,198	8,407,970	-
48	TIS	36,467,999	79,601,343	55,423,857	57,787,580	44,935,466	56,722,399	46,529,731	45,263,048	48,879,062	55,611,395
49	Mandatory - Fixed Timing	17,513,870	29,227,564	15,385,684	24,766,870	30,265,675	40,291,226	28,505,186	29,427,662	32,537,286	40,140,009
50	Value Driven - Fixed Timing	13,208,358	22,146,419	11,070,734	10,380,200	11,020,144	10,245,811	10,138,271	10,288,076	10,736,462	9,915,960
51	Value Driven - Value Framework	5,745,770	28,227,359	28,967,439	22,640,510	3,649,647	6,185,362	7,886,274	5,547,310	5,605,313	5,555,426
52	EA Fixed O/H	25,571,378	39,846,629	40,844,125	41,878,953	42,953,168	23,218,092	23,581,305	23,965,244	24,371,184	24,800,490
53	Overheads	25,571,378	39,846,629	40,844,125	41,878,953	42,953,168	23,218,092	23,581,305	23,965,244	24,371,184	24,800,490
54	Distribution Pipe >\$50M	20,896,371	12,165,299	173,106,004	10,378,458	-	687,262	2,628,758	28,429,964	1,401,328	-
55	Executing - Re-Optimize	-	-	69,828,151	4,017,468	-	687,262	2,628,758	28,429,964	1,401,328	-
56	Value Driven - Fixed Timing	20,896,371	12,165,299	103,277,853	6,360,991	-	-	-	-	-	-
57	Growth >\$50M	3,867,383	11,516,242	103,788,615	6,649,613	362,261	7,350,959	61,867,820	741,953	375,556	-
58	Mandatory - Fixed Timing	3,867,383	11,516,242	103,788,615	6,649,613	362,261	7,350,959	61,867,820	741,953	375,556	-
59	Compression Stations >\$50M	292,503,302	13,845,083	15,311,843	32,173,490	100,752,481	17,842,512	-	-	-	-
60	Significant Investments (>\$10M) - Fixed Timing	257,826	-	15,311,843	32,173,490	100,752,481	17,842,512	-	-	-	-
61	Value Driven - Fixed Timing	292,245,477	13,845,083	-	-	-	-	-	-	-	-
62	Transmission Pipe & Underground Storage >\$50M	61,684,764	201,744,063	80,332,948	136,898,166	216,834,266	98,398,482	218,067,178	91,171,749	9,650,664	-
63	Mandatory - Fixed Timing	61,684,764	201,744,063	80,332,948	136,898,166	216,834,266	98,398,482	218,067,178	91,171,749	9,650,664	-
64	Real Estate & Workplace Services >\$50M	12,979,722	25,611,157	11,921,570	17,218,601	20,360,487	-	-	-	-	-
65	Executing - Re-Optimize	-	-	11,921,570	17,218,601	20,360,487	-	-	-	-	-
66	Value Driven - Fixed Timing	12,979,722	25,611,157	-	-	-	-	-	-	-	-
67	TIS >\$50M	10,669,331	22,832,346	22,719,634	13,565,649	-	-	-	-	-	-
68	Mandatory - Fixed Timing	10,669,331	22,832,346	22,719,634	13,565,649	-	-	-	-	-	-
69	Grand Total	1,374,808,862	1,528,887,066	1,567,215,704	1,357,936,152	1,342,770,606	1,257,289,395	1,388,973,616	1,281,569,426	1,276,823,103	1,450,278,147

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2

Question(s):

Please detail all changes to Enbridge's planning process, including but not limited to, condition and risk assessment methodologies, since its most recent filed Asset Management Plan filed in EB-2019-0195.

Response:

Enbridge Gas's most recent Asset Management Plan was filed in EB-2020-0181. Please see Exhibit 2, Tab 6, Schedule 2, pages 13 to 16, Section 1.3 "Advancing Asset Management" which highlights key changes to Enbridge Gas's planning processes and programs that support those processes since the most recently filed Asset Management Plan.

In addition to those items outlined in the aforementioned reference, Enbridge Gas is also proposing to implement an Enhanced Distribution Integrity Management Program, as provided at Exhibit 1, Tab 13, Schedule 3.

Not expressly detailed in the aforementioned references, the following additional changes have been or are being implemented to support Enbridge Gas's Asset Management planning processes and condition and risk assessment methodologies:

- a) Updated reliability modelling for Vintage Steel mains to include the Union Gas rate zone. Please see Exhibit 2, Tab 6, Schedule 2, pages 91 to 94 and EB-2020-0181, Exhibit C, Tab 2, Schedule 1, pages 102 to 103.
- b) Enhanced hazard assessment and maintenance programs to identify geohazards and long seam anomalies in "Transmission Integrity Management Program (TIMP) Pipe". Please see Exhibit 2, Tab 6, Schedule 2, page 82, Table 5.2.3-2 and EB-2020-0181, Exhibit C, Tab 2, Schedule 1, page 23, Table 1.8.2. Recent industry incidents have been attributed to geohazards such as slope movement and erosion. Enbridge Gas has reviewed industry incidents and best practices and is developing

and implementing enhancements to its Geohazard Management Program.

- c) Enbridge Gas has also commissioned a third-party review of TIMP assets. Please see response at Exhibit I.2.6-SEC-110, Attachment 5 for the TIMP review. The intent of this review is to identify where uncertainty exists in the assessment of TIMP assets. To reduce uncertainty and ensure safe and reliable operations, Enbridge Gas is implementing additional condition monitoring programs and undertaking retrofits to enhance condition assessments. In instances where condition monitoring methods would not be effective or cannot be practically implemented, other solutions may be required, such as partial or full replacement of assets. TIMP pipelines in the Union Gas rate zone have been further integrated into the prioritization process provided at Exhibit 2, Tab 6, Schedule 2, page 84, which is used for scheduling inspection and maintenance activities on anomalous pipeline features. Enbridge Gas has adjusted its planning process for 200 and 400 series meter exchanges, as detailed in response at Exhibit I.2.6-CCC-61 part b).
- d) Remote first cut regulator sets have been removed from the survey cycle of the Leak Survey program. Please see Exhibit 2, Tab 6, Schedule 2, page 150 in Table 5.2.5-3, and EB-2020-0181, Exhibit C, Tab 2, Schedule 1, page 63, Table 1.8.4.
- e) Completion of additional Reliability, Availability and Maintainability Assessments on additional Compression and LNG Assets which have been flagged as areas potentially requiring investment. Please see response at Exhibit I.2.6-SEC-110, Attachment 2.
- f) Monitoring and measuring building utilization and practices adopted across marketplace to inform future real estate strategies. Please see Exhibit 2, Tab 6, Schedule 2, page 213, section 5.4.5.2.
- g) Migration to an enterprise-wide fleet management service provider to leverage fleet management software to inform planning of fleet vehicle renewal. Please see Exhibit 2, Tab 6, Schedule 2, page 229, Section 5.5.5.1 and EB-2020-0181, Exhibit C, Tab 2, Schedule 1, page 231, Section 5.7.5.1.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.260

Question(s):

For each year of 2024 and 2025, please provide a similar table that compares, on a combined basis (EGI), the difference between the budgets as proposed in the 2021-2025 AMP and 2023-2032 AMP.

Response:

Table 1 compares the difference in forecasts as proposed in the 2021 to 2025 AMP and the 2023 to 2032 AMP on a combined Enbridge Gas basis for 2024. Instances where discrepancies exist between the variance column and variance explanations are due to multiple immaterial changes (e.g., cost, scope, and timing) across the asset class.

Table 1
2024 Enbridge Gas Capital Forecast Variances

Asset Class (AMP)	2024 Forecast (2021-2025 AMP)	2024 Forecast (2023-2032 AMP)	Variance	Variance Explanation
Growth	\$264.0 M	\$354.3 M	\$90.3 M	<ul style="list-style-type: none">• +\$35.9 M - Increase in customer connections based on forecast and connection costs• +\$8.9M - New Enbridge Gas hydrogen blending investments• +\$45.6M - Changes in reinforcement timing and scope due to changes in the growth forecast
Distribution Pipe	\$289.5 M	\$368.3 M	\$78.7 M	<ul style="list-style-type: none">• +45.6M – Variance in integrity management projects and programs including new integrity programs driven by 3rd party assessment results

				<p>(TIMP Independent Asset Integrity Review), Depth of Cover mitigation program and TIMP Geohazard mitigation program</p> <ul style="list-style-type: none"> • +\$35.7M – Variance due to shifts in main replacement project timing and scope. Including: St Laurent Phase 3 Placeholder (\$78.7M), NPS 12 Martin Grove (-\$21.5M) and various smaller investments.
Distribution Stations	\$52.6 M	\$120.6 M	\$67.9 M	<ul style="list-style-type: none"> • +\$37.6M – Overall increase in Gate, Feeder & A Stations driven by operational and integrity concerns, fire suppression compliance remediation and increased execution costs • +\$25.1M – Net increase in station rebuilds B & C driven by Inside Regulator & ERR program, LP Station rebuilds and operational integrity concerns and increased execution costs
Utilization	\$123.4 M	\$146.5 M	\$23.1 M	<ul style="list-style-type: none"> • +\$23.5M - Increase in meter exchange program driven by change to material costs and pacing. See response at Exhibit I.2.6-CCC-61 part b) for details.
Compression Stations	\$303.2 M	\$38.6 M	-\$264.6 M	<ul style="list-style-type: none"> • -\$207.7 M – Decrease driven by the updated timing of Dawn to Corunna • -\$35.4M – Timing of Dawn C shifted from 2024 to 2026 • -\$12.9M – Timing of Waubuno compressor updated from 2024 to 2025
LNG	\$0.2 M	\$0.3 M	\$0.1 M	<ul style="list-style-type: none"> • No significant variance

Transmission Pipe & Underground Storage	\$173.9 M	\$171.7 M	-\$2.2 M	<ul style="list-style-type: none"> No significant variance
Fleet & Equipment	\$24.6 M	\$35.0 M	\$10.5 M	<ul style="list-style-type: none"> +\$8.8M - Increase in fleet to meet vehicle replacement strategy Fluctuations in the equipment and materials and tools programs
Real Estate & Workplace Services	\$37.8 M	\$56.6 M	\$18.7 M	<ul style="list-style-type: none"> +\$25.3M – Adjusted timing of Kennedy Road Expansion from 2024 to 2025 also reflects 2021 Statscan Construction inflation rate of 15.3% with projected further increases. Items such as Steel products increased 127%, Plastics products increased 34%, concrete products increased 8.5%. +\$11.5M – Adjusted timing of Station B from 2021 to 2024 also reflects 2021 Stats Can Construction inflation rate of 15.3% with projected further increases. Items such as Steel products increased 127%, plastics products increased 34%, concrete products increased 8.5%. -\$12.4M – Adjusted timing of VPC core and shell from 2025 to 2032
TIS	\$64.6 M	\$112.4 M	\$47.8 M	<ul style="list-style-type: none"> Variance in TIS business solutions reflects evolving business needs including: +\$22.8M – Contract Market Harmonization - See response at Exhibit I.SEC-148 part b) for details. +\$17.9M – General service rebasing changes.
EA Fixed O/H	\$18.8 M	\$21.9 M	\$3.2 M	<ul style="list-style-type: none"> The variance reflects increases to alliance partner fixed overheads that began in 2020 but would not have been captured at the time the

				AMP 2021 – 2025 was developed.
Grand Total	\$1352.6 M	\$1426.1 M	\$73.5 M	

Table 2 compares the difference in forecasts as proposed in the 2021 to 2025 AMP and the 2023 to 2032 AMP on a combined Enbridge Gas basis for 2025.

Table 2
2025 Enbridge Gas Capital Forecast Variances

Asset Class (AMP)	2025 Forecast (2021-2025 AMP)	2025 Forecast (2023-2032 AMP)	Variance	Variance Explanation
Growth	\$429.6 M	\$422.1 M	-\$7.4 M	<ul style="list-style-type: none"> • +\$22.5M - Increase in customer connections based on forecast and connection costs • +\$10.3M - New Enbridge Gas hydrogen blending investments • -\$40.3M - Changes in reinforcement timing and scope due to changes in the growth forecast
Distribution Pipe	\$255.4 M	\$333.3 M	\$77.9 M	<ul style="list-style-type: none"> • +28.3M – Variance in integrity management projects and programs including new integrity programs driven by 3rd party assessment results (Independent Asset Integrity Review), Depth of Cover mitigation program and TIMP Geohazard mitigation program • +\$62.6M – Variance due to shifts in main replacement project timing and scope. Including: St Laurent Phase 3 (\$36.8M), Wilson Ave VSM replacement (\$53.8M), various smaller investments and recategorization of the Class Location Program (-\$13.0M).
Distribution Stations	\$53.0 M	\$109.8 M	\$56.8 M	<ul style="list-style-type: none"> • +\$30.6M – Overall increase in Gate, Feeder & A Stations driven by

				<p>operational and integrity concerns, Fire suppression compliance remediation and increased execution costs</p> <ul style="list-style-type: none"> • +\$20.0M – Net increase in Station Rebuilds B & C driven by Inside Regulator & ERR program, LP Station rebuilds and operational integrity concerns and increased execution costs
Utilization	\$124.8 M	\$148.5 M	\$23.6 M	<ul style="list-style-type: none"> • +\$23.0M - Increase in meter exchange program driven by change to material costs and pacing. See response at Exhibit I.2.6-CCC-61 part b) for details.
Compression Stations	\$28.9 M	\$71.4 M	\$42.5 M	<ul style="list-style-type: none"> • +\$26.6M – Timing of Dawn C shifted from 2024 to 2026 • +\$17.5M – Timing of Waubuno compressor updated from 2024 to 2025
LNG	\$8.7 M	\$.5 M	-\$8.1 M	<ul style="list-style-type: none"> • -\$8.3M – Updated timing of Hagar Cold Box
Transmission Pipe & Underground Storage	\$34.1 M	\$99.3 M	\$65.3 M	<ul style="list-style-type: none"> • +\$49.4M – Updated timing of Dawn Parkway Expansion (Kirkwall-Hamilton NPS 48) from 2022 to 2026 • +\$12.8M – Increase in driven by integrity programs including the TIMP Independent Asset Integrity Review
Fleet & Equipment	\$26.7 M	\$36.4 M	\$9.7 M	<ul style="list-style-type: none"> • +\$7.9M - Increase in fleet to meet vehicle replacement strategy • Fluctuations in the equipment and materials and tools programs
Real Estate & Workplace Services	\$73.4 M	\$75.6 M	\$2.2 M	<ul style="list-style-type: none"> • No significant variance

TIS				Variance in TIS business solutions reflects evolving business needs including: <ul style="list-style-type: none"> • +\$23.0M – Contract Market Harmonization Technology Obsolescence • +\$11.2M – Records management upgrade • -\$16.7M – Nominations Application Replacement
	\$58.0 M	\$88.7 M	\$30.7 M	
EA Fixed O/H				<ul style="list-style-type: none"> • The variance reflects increases to alliance partner fixed overheads that began in 2020 but would not have been captured at the time the AMP 2021 – 2025 was developed.
	\$18.9 M	\$22.2 M	\$3.3 M	
Grand Total	\$1111.5 M	\$1408.0 M	\$296.5 M	

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, p.280

Question(s):

Please provide, as soon as each document is available, each of the following:

- a) The report of the subcommittee of the IRP Working Group dealing with the DCF+ test.
- b) The Applicant's final (or if not then finalized, the draft two days before the technical conference in this proceeding) proposal for the DCF+ Guide it intends to file with the first non-pilot IRP project.
- c) The 2021 annual report of the IRP Working Group dated June 9, 2022.
- d) The 2022 annual report of the IRP Working Group, when finalized.

Response:

- a) At the time of this response, the Report of the DCF+ subcommittee of IRP Working Group is still being drafted. Enbridge Gas plans to file the Report with its DCF+ Guide as part of the first IRP Plan Application expected to be filed later in 2023.
- b) Please see the response to part a).
- c) Please see Attachment 1 for Enbridge Gas's 2021 IRP Annual Report.
- d) Enbridge Gas will file its 2022 IRP Annual Report as part of its 2022 Deferral and Earnings Sharing Application in Q2 2023.

INTEGRATED RESOURCE PLANNING

2021 Annual Report

Enbridge Gas Inc.
May 31, 2022



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1. Introduction:

This inaugural Enbridge Gas Inc. (“Enbridge Gas”) 2021 IRP Annual Report (the “Report”) encompasses the period from July 22, 2021, through December 31, 2021.¹ Where appropriate, Enbridge Gas has included information on relevant IRP-related activities subsequent to the end of the 2021. This Report has been filed per the Ontario Energy Board’s (“OEB”) Integrated Resource Planning (“IRP”) Decision and Order (dated July 22, 2021) establishing an IRP Framework for Enbridge Gas (the “Framework”), where the OEB directed:

“Enbridge Gas shall file an Annual IRP Report with the OEB as part of its annual Non-Commodity Deferral Account Clearance and Earnings Sharing Mechanism application, the proceeding in which it may seek disposition of balances in the IRP Costs deferral accounts.

The OEB does not intend to approve the annual IRP report, but it could impact the OEB’s findings on the disposition of amounts in the IRP Costs deferral accounts or inform future proceedings.

The annual IRP report and the report from the IRP Technical Working Group are to be filed for information regardless of whether Enbridge Gas is seeking approval to clear any balances in the IRP Costs deferral accounts. The annual IRP report should include the following information:

- A summary of IRP stakeholdering activities from the past year
- A summary of IRP engagement or consultation activities with Indigenous peoples
- Updates on IRP pilot projects underway
- Updates on incorporating IRP into asset management planning
- Updates on status of potential IRP Plans
- Updates on status of approved IRP Plans, including details of adjustments made by Enbridge Gas
- Annual and cumulative summaries of actual peak demand reductions/energy savings generated by each IRP Plan to-date, including comparisons to the initial forecast reduction/energy savings and the actual amount of expenditure on each IRP Plan to-date
- The most recent results of Enbridge Gas’s IRP Assessment Process for system needs, including reporting on those system needs where a negative binary screening or technical/economic evaluation resulted in no further assessment of IRPAs
- A summary of best available information on demand-side IRPAs, including types of IRPAs, estimates of cost, peak demand savings, status in Ontario, potential role and relevance to Enbridge Gas’s system, and learnings from pilot projects and other jurisdictions
- Efforts taken to explore the use of interruptible rates for meeting system needs, including how customers have been provided the opportunity to consider this option
- Any other IRP-related matters established by the OEB.”²

¹ Future IRP annual reports will include the full calendar year.

² EB-2020-0091, Decision and Order, Appendix A, p. 22



2. IRP Integration

The establishment of the Framework has allowed Enbridge Gas to commence formally integrating IRP into its existing planning practices. Accordingly, Enbridge Gas reviewed its distribution and transmission planning practices and implemented changes including, implementation of the OEB approved IRP assessment process, and stakeholder engagement activities. In addition, Enbridge Gas is expanding existing processes to enable the effective evaluation and implementation of IRP alternative³ (“IRPA”) pilot and non-pilot projects.

In support of these integration activities Enbridge Gas is guided by the Guiding Principles established by the OEB in the IRP Decision:

- “Reliability and safety – In considering IRPAs as part of system planning processes, Enbridge Gas’s system design principles cannot be compromised, and the reliable and safe delivery of firm contracted peak period natural gas volumes to Enbridge Gas’s customers must remain of paramount importance.
- Cost-effectiveness – IRPAs must be cost-effective (competitive) compared to traditional Facility Alternatives⁴ and other IRPAs, including taking into account impacts on Enbridge Gas customers.
- Public policy – IRP will be considered in a manner to ensure that it is supportive of and aligned with public policy, and in particular the OEB’s statutory objectives for the natural gas sector.
- Optimized scoping – Recognizing that reviewing IRPAs for every forecast infrastructure project would be extremely time intensive, binary screening should be undertaken, to confirm which forecast need(s) should undergo evaluation of IRPAs, and to ensure a focus at the outset on efficient and effective IRPA investment.
- Risk management – Economic risks associated with both Facility Alternatives and IRPAs in meeting system needs are evaluated and appropriately mitigated. Risks and rewards are allocated appropriately between Enbridge Gas and its customers.”⁵

More detailed discussion of the steps towards IRP integration taken by Enbridge Gas follow:

Stakeholder Engagement

Stakeholder engagement activities are ongoing. Following the completion and filing of the Company’s 2023-2032 Asset Management Plan (“AMP”) in the fall of 2022, Enbridge Gas will commence IRP-related regional and geo-targeted stakeholder engagement. Stakeholder feedback received through these engagement activities will be reviewed and responded to (where appropriate) and will inform the Company’s consideration and development of potential IRP projects as well as future AMPs. For

³ The types of eligible alternatives are described in EB-2020-0091, Decision and Order, Section 7

⁴ Per the IRP Framework (EB-2020-0091, Appendix A, p.4), Facility Alternative is “synonymous with a traditional or conventional facility project”

⁵ EB-2020-0091, Decision and Order, p.27-28



a summation of the stakeholder engagement activities undertaken in 2021 see Section 4: Stakeholder and Indigenous Engagement Update.

Forecasting and Planning

Enbridge Gas regularly updates its long-term peak demand forecast and AMP (both comprehensive and limited updates depending upon timing and purpose). The objective of peak demand forecasting, and planning is to amass data, input, and insights to identify potential future system needs and constraints as well as their magnitude and timing. Early identification of future system needs and constraints is critical as the Company is obligated to reliably serve the firm contracted peak period demands of its customers.

A comprehensive discussion of Enbridge Gas' forecast and planning processes and any changes that have been made as a result of the establishment and implementation of the Framework will be filed in the Company's 2024 Rate Rebasing application in fall of 2022.

Need Identification

Following the completion of the forecasting process, Enbridge Gas compares the future forecast to the capacities of its existing facilities. A new system need/constraint is identified when Enbridge Gas determines that its current facilities cannot balance the new peak demand forecast with existing system facilities safely and reliably. When a constraint is initially identified, Enbridge Gas will verify its model with existing actual physical data, including pressure and temperature compensated consumption or flow, to ensure that the constraint is properly forecasted.

Baseline Facility Setting

Following the identification of a system need, Enbridge Gas develops the baseline facility that is required to meet the system need, absent any non-facility or IRPAs. It is necessary to understand this baseline facility as early as possible, as it provides a helpful point of comparison for other alternatives including IRPAs.

Binary Screening

Following the identification of a system need, Enbridge Gas will review the need relative to the Binary Screening Criteria established by the OEB in the Framework. If the system need passes Binary Screening, Enbridge Gas will then review and assess IRPAs or combinations of IRPAs that could meet the capacity requirements of the system need.

Binary Screening includes:

- **“Emergent Safety Issues:** If an identified system constraint/need is determined to require a facility project for Enbridge Gas to offer safe and reliable service or to meet an applicable law, an IRP evaluation is not required. An example of such a system constraint/need, and an emergent safety issue, would be if an existing pipeline sustained unanticipated damage and



needed to be replaced as quickly as possible to ensure the safety of local communities and Enbridge Gas's broader transmission and distribution systems. Longer-term safety related system constraints/needs may be appropriate for an IRP Plan and should be considered on a case-by-case basis.

- **Timing:** If an identified system constraint/need must be met in under three years, an IRP Plan could not likely be implemented and its ability to resolve the identified system constraint could not be verified in time. Therefore, an IRP evaluation is not required. Exceptions to this criterion could include consideration of supply-side IRPAs and bridging or market-based alternatives where such IRPAs can address a more imminent need.
- **Customer-Specific Builds:** If an identified system need has been underpinned by a specific customer's (or group of customers') clear request for a facility project and either the choice to pay a Contribution in Aid of Construction or to contract for long-term firm services delivered by such facilities, then an IRP evaluation is not required.
- **Community Expansion and Economic Development:** If a facility project has been driven by government legislation or policy with related funding explicitly aimed at delivering natural gas into communities, then an IRP evaluation is not required.
- **Pipeline Replacement and Relocation Projects:** If a facility project is being advanced for replacement or relocation of a pipeline and the cost is less than the minimum project cost that would necessitate a Leave to Construct approval [\$2 million], then an IRP evaluation is not required."⁶

IRPA Technical Feasibility Assessment

For all system needs that pass Binary Screening, Enbridge Gas will assess which IRPAs could technically be used to defer, avoid or reduce the need/constraint relative to facility infrastructure. In other words, Enbridge Gas will ensure that the IRPA can serve the identified need prior to evaluating the IRPA on an economic basis.

Economic Evaluation

Enbridge Gas will test and compare the technical feasibility of both the baseline facility and any IRPAs on an economic basis using the OEB-approved DCF+ cost test. In the Decision, the OEB determined that Enbridge Gas has "some discretion in selecting an alternative to meet a system need that does not have the highest score on phase 1 of the DCF+ test, as there may be considerations or factors that are important in phase 2 and 3 or are difficult to quantify."⁷ The IRPA, or combination of IRPAs, that can technically and economically meet the system need and satisfy the Framework's Guiding Principles, will be incorporated into the AMP for inclusion into its broader planning activities, stakeholder touchpoints and for implementation at the appropriate time.

⁶ EB-2020-0091, Decision and Order, p.47-49

⁷ IBID, p.56



Project Development

Following the identification of IRPAs and the inclusion in the AMP, Enbridge Gas will begin work to develop and subsequently file an IRP Plan application and supporting evidence with the OEB for approval (where appropriate). Enbridge Gas will ensure that all details related to IRPAs and the underlying system needs that they are intended to address will be fully refined in this step and will continue to monitor the need as part of its planning activities until such time that the project is implemented.

IRPA Project Implementation

Enbridge Gas' IRP Plan applications will:

- detail anticipated savings or peak period impacts (on an hourly basis for distribution system assets and on a daily basis for transmission and storage system assets) together with the costs and ownership/operationalization arrangements proposed for IRPA investments;
- seek approval to spend and subsequently recover costs associated with investing in an IRPA(s);
- include additional applicable details for IRPAs such as design, administration, implementation, monitoring and reporting.

As is the case with traditional applications to the OEB seeking an Order of the Board for Leave to Construct facilities LTC applications, Enbridge Gas intends to consult with impacted landowners (where applicable), municipal governments, First Nations, Indigenous groups, and other affected stakeholders prior to filing its IRP Plan application with the OEB.

Monitoring and Reporting

Following implementation of approved IRPAs, the Company will carefully monitor their effectiveness in meeting the identified system need to ensure system constraints are being sufficiently resolved. Enbridge Gas will provide an annual report of IRPA effectiveness to the OEB as part of either its annual Rates application or Non-Commodity Deferral Account Clearance and Earnings Sharing Mechanism application, or as otherwise directed by the OEB. If any IRPA is not meeting the identified system need for which it was implemented, Enbridge Gas will propose corrective action in its report which may include, but not be limited to, proposals to implement additional IRPAs or new facilities.

3. IRP Pilot Projects

The OEB Directed Enbridge Gas to “select and deploy”⁸ two IRP pilot projects by the end of 2022.

⁸ EB-2020-0091, Decision and Order, p.94



The concept of developing and implementing two IRP pilots received universal support during the IRP proceeding.⁹ Parties recognized that these IRP pilots would be an effective approach to better understand and evaluate how IRP can be implemented to avoid, delay or reduce facility projects required to meet the identified need.

The Technical Working Group was created to, among other matters, provide input and insight into the selection and development of the IRP pilots.

At the time of writing this Report the specific pilot projects and associated IRPAs have not been determined.

Enbridge Gas plans to file the two IRP pilot applications by December 31, 2022 for OEB review and implementation based on the following schedule:

June – August 2022	Review potential IRP Pilot projects
September	Select two pilot projects
September - December 2022	Develop IRP pilot evidence and applications
January – April 2023	OEB Procedural process
May 2023	IRP pilot project implementation

4. IRP Stakeholder and Indigenous Engagement Update

As part of the Decision in the IRP Framework proceeding “the OEB has determined that the components of Enbridge Gas’s proposed Stakeholder Engagement Process will provide valuable input into Enbridge Gas’s IRP activities and shall be incorporated in the IRP Framework. The OEB also directs the establishment of a website by Enbridge Gas to facilitate the broad sharing of information on IRP stakeholdering efforts.”¹⁰

IRP Website

In December 2021, an Enbridge Gas IRP website went live.¹¹ This is the initial phase of the website and allows for individuals to identify which regions are of interest and to register for any stakeholder engagement that will occur within the region(s) of interest. Individuals are welcome to register for as many regional engagement activities as they feel appropriate. By registering their emails,

⁹ EB-2020-0091, Decision and Order, p.90

¹⁰ IBID, p. 66

¹¹ <https://www.enbridgegas.com/sustainability/regional-planning-engagement>



individuals give permission to receive emails from Enbridge Gas in the future thus meeting the requirements of Canada's Anti-Spam Legislation (CASL).

The next phase of the website design is underway. This next phase will be available when a pilot project or IRP Plan is developed, and it will include additional regional functionality. The next phase will also allow interested individuals to sign up for webinars, in-person engagements, and to receive information about any presentations and/or responses to stakeholder feedback that is posted. It is anticipated that the second phase of the website design will be available prior to the launch of the first pilot project or IRP Plan.

Enbridge Gas has also implemented an internal working group that includes representation from Enbridge Gas' Municipal, Stakeholder and Community Engagement Group, Community and Indigenous Engagement and the IRP group to ensure that the internal resourcing and IT infrastructure developed to conduct, gather, and respond to the ongoing stakeholder engagement efforts in support of IRP will be sufficient to inform future planning efforts. This internal working group brings extensive stakeholder engagement experience and insight to the future IRP Stakeholder engagement plans. Enbridge Gas' various stakeholder engagement groups support efficient project execution with engagement activities in the field with project-area residents, local governments, and local organizations, in support of project objectives and business goals. They also regularly engage with key partners, including local municipal officials, business leaders, key landowners, emergency responders, and non-government organizations. Enbridge Gas anticipates engagement with Indigenous groups to commence in 2022 as IRP Plans are developed.

5. IRP Plan Update

Enbridge Gas has not developed or filed any IRP Plans with the OEB that can be reported at this time. Please see Appendix B for a list of projects that Enbridge Gas has completed the binary screening process following the OEB's IRP Decision.

6. Asset Management Plan (AMP) Update

The IRP Decision indicated that "for this first-generation IRP Framework, the OEB finds the process proposed by Enbridge Gas to identify system constraints or needs is acceptable. Recording potential system needs/constraints up to ten years in the future in the AMP will allow time for a detailed examination of IRPAs. The OEB agrees with Enbridge Gas's proposal that the first version of the AMP reflecting this updated process be filed in Fall 2022."¹²

¹² EB-2020-0091, Decision and Order, p.42



Enbridge Gas will file the 2023-2032 AMP in Fall 2022 with the 2024 Rate Rebasing application. The AMP will include the binary screening results for all facility projects, greater than \$2 million, as noted in the IRP Assessment process description above. In addition, the AMP will include IRP assessment information for the projects, including IRPAs, where possible.

7. Integrated Resource Planning Alternatives Update

Discussion during the IRP regulatory proceeding included the request by some parties to have available a listing or menu of IRPAs being considered by Enbridge Gas. The OEB concluded that a “document on best available information for demand-side alternatives would promote more timely development of IRP Plans and directs Enbridge Gas to include a listing in its annual IRP Report.”¹³

Appendix C lists the preliminary IRPAs and includes information on these specific IRPAs as suggested by OEB Staff including “types of IRPAs, estimates of cost, peak demand savings, status in Ontario, potential role and relevance to Enbridge Gas’s system, and learnings from pilot projects and other jurisdictions.”¹⁴ Enbridge Gas recognizes that this IRPA information is preliminary and will become more refined over time as the Company becomes more familiar with the actual impacts of these IRPAs on system peak demands and with the inclusion of more granular meter reading through an Automated Metering Infrastructure (AMI) application. Enbridge Gas also anticipates that the IRP pilot projects will provide further information allowing for the refinement and updating of the impacts of some of the IRPAs listed.

8. Technical Working Group Summary

The OEB’s July 22, 2021, Decision further instructed the OEB to establish an IRP Technical Working Group (TWG) led by OEB staff, to provide input on IRP issues that will be of value to both Enbridge Gas in implementing IRP, and to the OEB in its oversight of the IRP Framework.

The inaugural meeting for the IRP TWG was held on Tuesday January 18, 2022. Any updates or summaries of IRP TWG meetings held in 2022 will be included in and reported on in the 2022 IRP Annual Report. All documents and presentations with respect to the IRP Technical working group can be found on the OEB web site under proceeding EB-2021-0246.¹⁵

The Report of the Technical Working Group is included as Appendix D.

¹³ EB-2020-0091, Decision and Order, p.36

¹⁴ IBID, p.34

¹⁵ <https://www.oeb.ca/consultations-and-projects/policy-initiatives-and-consultations/natural-gas-integrated-resource>



9. Interruptible Rates Update

The use of interruptible rates as an IRPA was reviewed as part of the IRP Framework proceeding. The discussion centered around a few key issues: “Customers on interruptible rates pay a lower rate in exchange for the ability of Enbridge Gas to curtail delivery if capacity is not available on the system. Interruptible volumes are not included in Enbridge Gas’s design day assumptions. Therefore, increased use of interruptible rates could potentially reduce the amount of firm peak demand Enbridge Gas is obligated to serve, helping address a system need. For this reason, Enbridge Gas indicated that it does consider interruptible rates to be a type of IRPA. Enbridge Gas already offers interruptible rates to its Contract Rate customers (larger commercial, institutional and industrial customers). However, Enbridge Gas noted that customers have been moving away from interruptible rates as they value certainty of supply over cost reduction.”¹⁶

In response Enbridge Gas indicated that it would “investigate the drivers for recent declines in the use of interruptible services and could potentially file revised interruptible and firm seasonal services/rates to make them more attractive to customers as part of its 2024 rebasing application.”¹⁷

The OEB determined that “the impact of interruptible rates to meet a system need/constraint should be considered in an IRP Plan in combination with demand-side or supply-side alternatives.”¹⁸

Enbridge Gas will file an interruptible rates study as part of its Rate Rebasing application in fall of 2022.

10. DCF+ Review

As part of the IRP Framework Decision the OEB found that “the OEB accepts the categories of benefits and costs proposed by Enbridge Gas for the three phases of the DCF+ test (shown in Table 2) for the use of this test in the IRP Framework. The OEB recognizes that the DCF+ test could be improved to better identify and define the costs and benefits of Facility Alternatives and IRPAs and clarify how these costs and benefits should be considered within the DCF+ test. This could include expanding the inputs to recognize increasing carbon costs, the risk that a constraint remains unresolved, and impact on gas supply costs. The OEB directs Enbridge Gas to study improvements to the DCF+ test for IRP.”¹⁹

The OEB further recognized that “this test could be improved to better list and define the costs and benefits of facility projects and IRP Alternatives and clarify how these costs and benefits should be considered within the test. Enbridge Gas is expected to study improvements to the Discounted Cash Flow-plus test for IRP, in consultation with the IRP Technical Working Group that will be established

¹⁶ EB-2020-0091, Decision and Order, p,30

¹⁷ IBID, p. 30-31

¹⁸ IBID, p.35

¹⁹ IBID, p.56-57

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as part of the IRP Framework and using IRP pilot projects as a testing ground. Enbridge Gas shall file an enhanced Discounted Cash Flow-plus test for approval as part of the first non-pilot IRP Plan.”²⁰

Enbridge Gas has begun the process of reviewing the DCF+ test approved by the OEB. Enbridge Gas will consult with the Technical Working Group on any proposed enhancements to the DCF+ test prior to filing this cost benefit analysis with the first IRP non-pilot application.

²⁰ EB-2020-0091, Decision and Order, p. 5-6



Appendix A: OEB IRP Direction

The table below provides Enbridge Gas' progress with respect to meeting the Directions as ordered by the OEB in the IRP Decision.

Direction Item	Reference in the Decision	Direction	Status
Interruptible rates	Section 7 p.35	The OEB directs Enbridge Gas to study its interruptible rates to determine how they might be modified to increase customer adoption of this alternative service.	In progress – will be included with Enbridge Gas Rebasing Application (2023-2032)
Documentation of demand side IRPAs	Section 7 p.36	The OEB concludes that a document on best available information for demand-side alternatives would promote more timely development of IRP Plans and directs Enbridge Gas to include a listing in its annual IRP Report. The OEB agrees with Enbridge Gas that supply-side alternatives require case-by-case examination and therefore are not required to be included in the listing.	Completed – preliminary list
Asset Management Plan	Section 8 p.42	The OEB directs that the AMP include information about Enbridge Gas' system needs. This includes providing the status of consideration of IRP Plans in regard to meeting system needs, the result of the binary screening, and details on the evaluation.	In progress – will be filed with the Enbridge Gas Rebasing Application
DCF+ test enhancement	Section 8 p.56-57	The OEB directs Enbridge Gas to study improvements to the DCF+ test for IRP and, as applicable, file an enhanced DCF+ test for approval as part of the first non-pilot IRP Plan.	In progress
IRP Website	Section 10 p.66	The OEB also directs the establishment of a website by Enbridge Gas to facilitate the broad sharing of information on IRP stakeholder engagement efforts.	Phase 1 – Completed Phase 2 – In progress



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Technical Working Group	Section 10 p.67	Establishment of a TWG with the OEB directing that membership should include Enbridge Gas, OEB staff, independent experts, and experienced non-utility stakeholders	Completed
IRP Deferral accounts	Section 15 p.87	The OEB directs Enbridge Gas to prepare a Draft Accounting Order for the two IRP Costs deferral accounts, consistent with the direction in this decision.	Completed



Appendix B: Binary Screening Results

Appendix B: Binary Screening Results for Projects Filed							
OEB Proceeding Docket	Project Name	Customer Specific Build	Timing	Pipeline Replacement >\$2M	Emergent Safety Issue	Community Expansion & Economic Development	Binary Pass or Fail
EB-2022-0111	Bobcaygeon Community Expansion Project					Fail	Fail
EB-2022-0086	Dawn to Corunna Replacement Project		Fail				Fail
EB-2022-0088	Haldimand Shores Community Expansion Project					Fail	Fail
EB-2022-0003	NPS 20 Waterfront Relocation Project		Fail				Fail
EB-2020-0293	St. Laurent Ottawa North Replacement Project		Fail				Fail
EB-2021-0205	Greenstone Pipeline Project	Fail					Fail
EB-2021-0248	Coveny and Kimball-Colinville Well Drilling Project		Fail				Fail



Appendix C: Integrated Resource Planning Alternatives

Integrated Resource Planning Demand-Side Alternatives – Best Available Information

As per the IRP Decision, the IRP Annual Report is to include “a summary of best available information on demand-side IRPAs, including types of IRPAs, estimates of cost, peak demand savings, status in Ontario, potential role and relevance to Enbridge Gas’s system, and learnings from pilot projects and other jurisdictions”.²¹

Demand-side IRPAs

IRPA Name	Enhanced Targeted Energy Efficiency (ETEE)
ETEE IRPA Overview	
<p>Enhanced targeted energy efficiency (ETEE) programs focus on achieving necessary reductions in a specific geographical area to reduce peak period system demands. The mix of offerings and measures utilized in an ETEE program is dependent upon the scope of the facility investment project under consideration, customer characteristics in the specific project service area, past demand side management DSM participation etc. ETEE programs could include refining existing broad-based DSM offerings through enhanced incentives and targeted marketing or introducing new geo-targeted programs not offered through broad-based DSM.</p> <p>Broad-based DSM programs have been delivered throughout the Enbridge Gas service areas since 1993. The 2023-2027 DSM Plan (EB-2021-0002) is currently under consideration of the OEB to guide broad-based DSM programming over that time frame. As defined by the Ontario Energy Board in their DSM Letter, the objective of broad-based DSM is “assisting customers in making their homes and businesses more efficient in order to help better manage their energy bills”.²²</p> <p>Separately, Enbridge Gas proposes to undertake IRP pilots to review and understand the potential impacts of energy efficiency programs on peak period system demands within a geo-targeted area, and whether the impacts are significant enough to be considered an infrastructure alternative.</p> <p>Potential ETEE measures include those space heating equipment, water heating equipment and building envelope upgrades that could impact peak.</p>	

²¹ The IRP Alternatives do not include electricity-based alternatives per the OEB’s EB-2020-0091 Decision where it stated “The OEB has concluded that as part of this first-generation IRP Framework, it is not appropriate to provide funding to Enbridge Gas for electricity IRP Alternatives.” p.4

²² EB-2019-0003, OEB Letter Post-2020 Natural Gas Demand Side Management Framework (December 1, 2020), p. 2.



IRPA Peak Impacts
<p>Forecast peak impacts will be estimated on a case-by-case basis depending on the ETEE program.</p> <p>Enbridge Gas Inc. (EGI) worked with Posterity Group to build an end-use model of its service territory with the 2019 Achievable Potential Study (APS) being the starting point for the model creation. First, a mirror model of the APS was created and then several adjustments were made to better reflect EGI's knowledge and experience of the Ontario DSM market, EGI's current TRM assumptions and known changes to applicable standards. Then Posterity Group worked with EGI to develop peak factors which were added to the model so that enhanced targeted energy efficiency peak hour impacts estimates could be developed for each region, sector, segment and end use. Posterity Group and EGI plan to continue to evolve this model by refining assumptions and assessment methodologies to refine and improve forecasting of peak hourly flow reduction potential.</p>
IRPA Cost Details
<p>Costs will be determined on a case-by-case basis depending on the ETEE program.</p> <p>The Posterity model described above also included cost assumptions for ETEE programs. Posterity Group and EGI plan to continue to evolve this model by refining assumptions and assessment methodologies so it can be used to assess project specific costs for an ETEE program.</p>
EGI Deployment Strategy
<p>Which energy efficiency measures are chosen and what ETEE deployment strategy is undertaken will be dependent upon the scope of the facility investment project under consideration, customer characteristics in the specific project service area, past DSM participation etc.</p> <p>An IRP ETEE pilot project would provide insights that could guide the deployment strategy of a future IRP ETEE program, including to what degree Automated Metering Infrastructure (AMI) may be required to inform the objectives of the pilot.</p>
Learnings from Pilot Projects/Other Jurisdictions
<p>Enbridge Gas has engaged Guidehouse to undertake a jurisdictional review of ETEE (Enhanced Targeted Energy Efficiency) and DR (demand response) gas pilots implemented for the objective to defer or avoid infrastructure. Findings from the review are anticipated to inform potential pilots for natural gas IRP implementation.</p> <p>Enbridge Gas filed a Geo-Target Demand Side Management Case Study in EB-2020-0091 at Exhibit C, Appendix A. The objectives of the case study were:</p>



<p>1.Assessment of the impacts of geo-targeted DSM programs on reducing peak hour demand.</p> <p>2.Assessment of the costs of geo-targeted DSM program implementation.</p> <p>The results from this case study only illustrate the impacts geo-targeted DSM had on the town of Ingleside and although informative and directional, the results cannot be generally applied due to the specific nature of customer composition.</p>	
IRPA Name	Demand Response (DR)
IRPA Overview	
<p>Natural Gas Demand Response aims to reduce demand by natural gas customers during peak periods. For residential and commercial customers, this is usually in the form of heating demand reduction via thermostat control or water heater temperature settings. For contract customers, this can be done through leveraging Interruptible Rates.</p>	
IRPA Peak Impacts	
<p>Peak impacts will be determined on a case-by-case basis depending on the DR program.</p>	
IRPA Cost Details	
<p>DR IRPA costs will be determined on a case-by-case basis depending on the DR program.</p>	
EGI Deployment Strategy	
<p>The deployment strategy will be determined on a case-by-case basis depending on the DR program. An IRP Demand Response pilot project would provide insights that could guide the deployment strategy of a future Demand Response program, including to what degree Automated Metering Infrastructure (AMI) may be required to inform the objectives of the pilot.</p>	
Learnings from Pilot Projects/Other Jurisdictions	
<p>Enbridge Gas has engaged Guidehouse to undertake a jurisdictional review of ETEE (Enhanced Targeted Energy Efficiency) and DR (demand response) gas pilots implemented for the objective to defer or avoid infrastructure. Findings from the review are anticipated to inform potential pilots for natural gas IRP implementation.</p>	



Appendix D: Technical Working Group Report

Review of Enbridge Gas Inc. 2021 Integrated Resource Planning (IRP) Annual Report and Update on IRP Working Group Activities

From: Integrated Resource Planning
Technical Working Group

June 9, 2022

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1. Introduction

An Integrated Resource Planning (IRP) Framework for Enbridge Gas was established by the OEB through its [July 22, 2021 Decision and Order](#) (the IRP Decision). The IRP Decision directed the OEB to establish an IRP Technical Working Group (Working Group) and required a report from the Working Group to the OEB (Working Group report) to be filed in the same proceeding in which Enbridge Gas's annual IRP report is filed. The IRP Decision indicated that the Working Group report should include any comments on Enbridge Gas's annual IRP report, including material concerns that remain unresolved within the Working Group, and may also describe other activities undertaken by the Working Group in the previous year.

This report has been prepared by OEB staff with input from all Working Group members, and approved by all Working Group members, as an accurate summary of the Working Group's activities.¹ Where views expressed in the report do not reflect the views of all members, this is clearly indicated.

2. Establishment and Initiation of Working Group

The IRP Decision instructed the OEB to establish a Working Group led by OEB staff, to provide input on IRP issues that will be of value to both Enbridge Gas in implementing IRP, and to the OEB in its oversight of the IRP Framework.

The IRP Decision further required the OEB to establish a terms of reference and select the membership for the Working Group. On October 19, 2021, the OEB issued a [letter](#) seeking nominations from individuals interested in participating on the Technical Working Group as non-utility members. The OEB selected seven non-utility members from the twenty nominations received, and announced the establishment and initial membership of the Working Group in a [letter](#) issued December 6, 2021. In addition to non-utility members, the Working Group includes

¹ The IRP Technical Working Group includes observers from the Independent Electricity System Operator and EPCOR Natural Gas LP. As noted in the Working Group's Terms of Reference, any materials authored by the IRP Working Group (including this report) should not be considered to represent the views of Working Group observers, or their organizations.

representatives from the OEB and Enbridge Gas, and observers from the Independent Electricity System Operator and EPCOR Natural Gas LP.

The current membership of the Working Group is shown below.

Table 1: IRP Working Group Membership

Name	Role
Michael Parkes	OEB staff representative (Working Group chair)
Stephanie Cheng	OEB staff representative
Chris Ripley	Enbridge Gas representative
Whitney Wong (replacing Amrit Kuner)	Enbridge Gas representative
Amber Crawford, Association of Municipalities of Ontario	Non-utility member
John Dikeos, ICF Consulting Canada Inc.	Non-utility member
Tamara Kuiken, DNV Inc.	Non-utility member
Cameron Leitch, EnWave Energy Corporation	Non-utility member
Chris Neme, Energy Futures Group	Non-utility member
Dwayne Quinn, DR Quinn & Associates Ltd.	Non-utility member
Jay Shepherd, Shepherd Rubenstein Professional Corporation	Non-utility member
Kenneth Poon, EPCOR Natural Gas LP	Observer
Steven Norrie, Independent Electricity System Operator	Observer

The inaugural meeting of the Working Group was held on January 18, 2022. Meetings have subsequently been held on a monthly basis, with five meetings completed as of the date of this report.

Meeting notes and meeting materials for IRP Working Group meetings are published on the OEB's website following meetings to allow stakeholders to follow the Working Group's

progress.² These materials can be found at: <https://www.oeb.ca/consultations-and-projects/policy-initiatives-and-consultations/natural-gas-integrated-resource>.

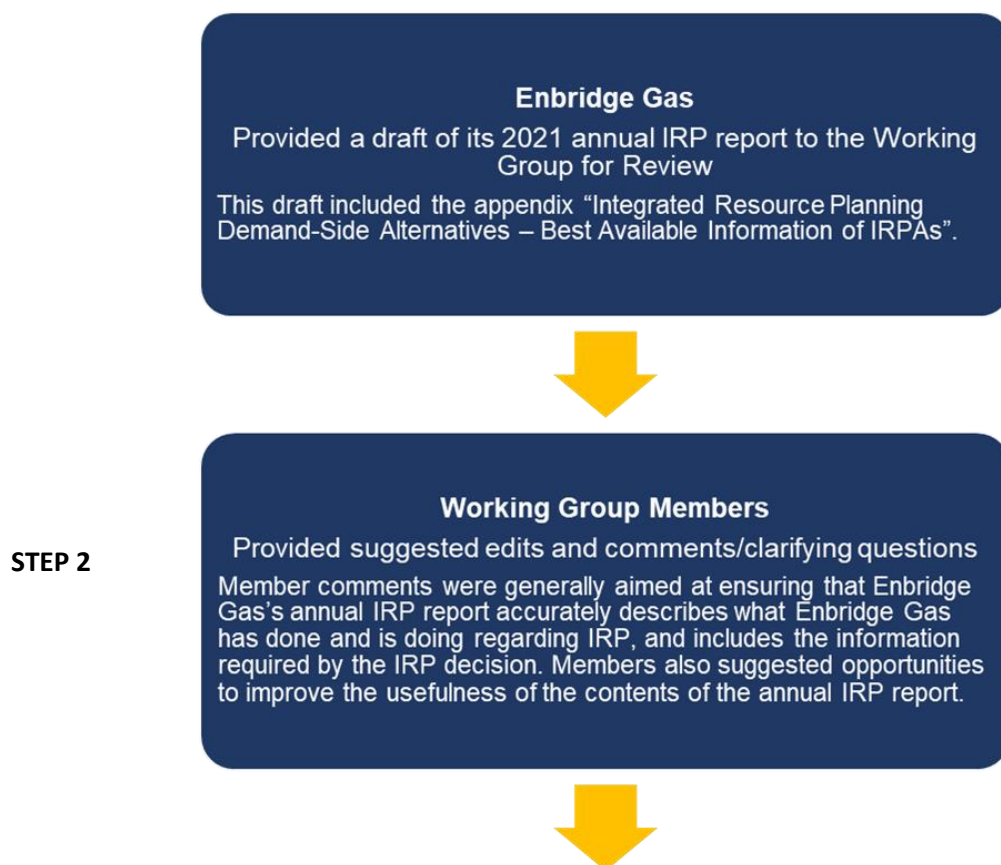
As required by the IRP Decision, a draft terms of reference for the Working Group was developed by OEB staff. Following review and input from Working Group members at the initial meeting, a [final terms of reference](#) was issued by the OEB on February 17, 2022.

² Meeting materials are typically posted online shortly after the meeting. Meeting notes are not typically posted until after the following meeting, to allow for members to review draft notes and identify any omissions or inaccuracies.

3. Review of Enbridge Gas's Annual IRP Report and Comments on Implementation of the IRP Framework

The IRP Decision notes that the Working Group is expected to review a draft of Enbridge Gas's annual IRP report, with the review coordinated by OEB staff, and that Enbridge Gas should provide a draft of the annual IRP report to the Working Group far enough in advance of its planned filing to the OEB to allow the Working Group time to review and comment. The IRP Decision also indicates that the Working Group report should include any comments on Enbridge Gas's annual IRP report, including material concerns that remain unresolved within the Working Group.

The Working Group's review took the following steps:



STEP 3

Enbridge Gas

Revised and finalized its annual IRP report

Enbridge Gas provided a revised draft to the Working Group, documenting how it had taken into account comments from Working Group members, and (after a second stage of review), finalized its annual IRP report. Final determinations as to the contents of Enbridge Gas's annual IRP report were made by Enbridge Gas, not the Working Group.



STEP 4

Working Group Members

Provided final comments on implementation of IRP Framework
Member comments are discussed further below in section 3.1

3.1. Working Group Comments on Implementation of the IRP Framework

All Working Group members (with the exception of observers) were asked the following question:

Question: Having reviewed Enbridge Gas's final annual IRP report's description of Enbridge's IRP activities in the previous year and having also participated on the IRP Working Group, do you have any comments or concerns with the implementation of the IRP Framework to date?

To varying degrees, all non-Enbridge Gas Working Group members expressed some concerns. These concerns relate primarily to: (1) the pace of Enbridge Gas's efforts to implement the IRP Framework since the IRP Decision in July 2021; and (2) the ability of the Working Group to make progress on its identified priorities (discussed in chapter 4 of this report) and meaningfully contribute to Enbridge Gas's IRP implementation, due in part to Enbridge Gas's determinations regarding the topics and level of detail that it has brought forward to the Working Group to date. More specifics are provided in the comments from individual members in Table 2, and the comments of Enbridge Gas Working Group members follow in Table 3.

Several members (including Enbridge Gas representatives) noted that more frequent meetings or focused subgroups may help advance progress on IRP implementation. The Working Group has agreed to add a second monthly meeting, with a subgroup focusing on the discounted cash flow-plus (DCF+) test, beginning in July 2022.

Table 2: Individual Comments of IRP Working Group Members

Working Group Member	Comments (optional)
Amber Crawford (non-utility member)	<p>Since the Decision and Order was published on July 22, 2021, Enbridge Gas and OEB jointly created the nomination for membership of the IRP Technical Working Group. There have been five meetings held in 2022, and the following observations can be made thus far:</p> <p>Little Progress Made on IRP Pilot Projects: According to the Decision and Order, “the OEB expects that the [two] IRP pilot projects will be selected and deployed by the end of 2022.” (p.24). Meetings to date have discussed pilots at a very high-level, and have not yet seen substantive materials that would help the IRP Technical Working Group provide input on. While this may be in part due to Enbridge’s Asset Management Plan being developed this year, the criteria and potential choices should be further along to meet Enbridge’s deadline.</p> <p>Lack of Transparency and Reliance on 2024 Rate Rebasing: When asked to see data pertaining to pilots, the DCF+ test, binary screening results, best practices in other jurisdictions, or Enbridge’s Asset Management Plan, it has often been denied or mentioned it will be part of the 2024 Rate Rebasing in the Fall. Enbridges view that these topics are better addressed through testing of the evidence within the rebasing application. If this group is to provide input and expertise, it is incumbent on Enbridge to provide those details as otherwise, the consultation will not be meaningful.</p> <p>Minimal Information in Annual IRP Report: As a function of the slow progress in 2021, the Annual IRP Report fails to include details on key sections that would have been helpful and set up the 2022 year better (e.g. Sections 2, 6, 9). The Working Group’s review has been quite limited and question whether input to date has had a meaningful impact on Enbridge’s annual IRP report.</p>

John Dikeos (non-utility member)	<p>I agree with many of the comments from other Working Group members that Enbridge's progress on identifying and screening potential IRPA pilots and updating its DCF+ cost-effectiveness approach has been relatively slow. There was very limited progress on these items in advance of the first Working Group meeting in January 2022 and progress since has been slow as well. To date, this has limited the Working Group's ability to provide more meaningful contributions to the future of IRPA planning in Ontario.</p> <p>I noted the following additional items based on my review of Enbridge's final 2021 IRP Annual Report:</p> <p>Evolution of binary screening criteria: Enbridge has included high-level details regarding its binary screening criteria for IRPAs. Although the criteria appear to be reasonable at this stage given the current knowledge and experience with IRPAs, Enbridge should be encouraged to revisit and evolve the criteria on an ongoing basis. For example, the Timing criteria should likely be condensed as Enbridge gains additional knowledge and experience with demand-side IRPAs.</p> <p>Interruptible rates: Enbridge notes that it is completing a study on interruptible rates, which will be filed as part of its rebasing application in fall 2022. As part of this study, Enbridge should investigate alternative and/or enhanced approaches to interruptible rates, such as the pilot projects that are being run by some utilities in New York (e.g., ConEd).</p>
Tamara Kuiken (non-utility member)	<p>I agree with many of the comments made by other reviewers, including those related to the lack of progress made on IRP pilots, the lack of progress made on improving the DCF+ test, communication about IRP elements delayed until the rebasing application, all initial IRPAs failing the binary test, and the perfunctory IRP Report.</p> <p>In my opinion, Enbridge shows little urgency toward advancing the IRP process, despite their commitment to deploy pilots before the end of 2022. The initial stated reason was a desire to engage with the TWG prior to making commitments; however, the lack of progress since the TWG was initiated suggests that other barriers exist.</p>
Cameron Leitch (non-utility member)	<p>From the definitions within the IRP Framework, this process is meant to address system needs by considering alternatives to conventional facility projects. At the core of this process is clarity on the determination of system needs, and without</p>

	<p>insight into this determination (outside of the future AMP submission), it is difficult for the Working Group to provide meaningful feedback. Comments by other members of the Working Group are insightful, and my repetition of them will not provide added value to the reader.</p>
Chris Neme (non-utility member)	<p>While there have been some good initial discussions, and the tone of those discussions has been appropriately congenial and open-minded, I have several concerns about the effectiveness of the working group (WG) thus far. The most important are as follows:</p> <ol style="list-style-type: none">1. Input on key IRP issues related to the Company's next Asset Management Plan (AMP) and rate-basing application has essentially been taken off the table. Among those key issues are (A) the Company's approach to load forecasting in light of Canada's energy transition commitment, fast-increasing carbon taxes and the potential for the Company to partially control demand growth through limitations on new connections; (B) how binary screening criteria are to be assessed/applied, including the how the timing of needs is to be determined (given the binary screening criterion that says alternatives to traditional infrastructure investments should not be considered if the system need is within three years); and (C) how risks of stranded assets are to be addressed (e.g. if load grows in the near term but then declines as electrification takes hold). Had the Company been willing to engage on these issues prior to its filing in the Fall, some progress eliminating issues – or at least surfacing key issues and ensuring that the filing provided data/info likely to be important – could have been made, saving the Board time and making the filing a better product. These kind of collaborative working groups – speaking here to a groups addressing a range of topics, not just IRP – routinely provide such construction feedback in other jurisdictions.2. Little progress on pilots – and therefore likely failure to begin deploy IRPAs as part of pilots before the end of 2022. This is particularly concerning given that it is essentially one of just two issues that the WG has effectively prioritized for 2022. While I appreciate that the Company may not have wanted to get too far in planning for the pilots until the

	<p>WG had formed, it still could have done a lot of groundwork identifying potential projects/locations for pilots (e.g. maybe developing an initial short list of 10-12) so that we could have jumped right into selection once the WG had talked through priorities.</p> <p>3. No progress on the revisions to the DCF+ cost-effectiveness test. This also has relevance to the Company's upcoming AMP and rate-basing application, so it would have been ideal to have worked through some issues in greater detail in the first half of 2022.</p> <p>4. Enbridge's first IRP Report is largely perfunctory, with little useful information. This seems a function of two related things: (A) no IRPAs have been identified yet for deployment; and (B) the Company has decided that all planning related to IRPA consideration will be addressed in its AMP and rate-basing application. As stated above, the Company's decision to not bring its draft approach to applying the IRP framework to its AMP is an unfortunate missed opportunity. Hopefully next year's IRP report will be more substantive.</p> <p>Note that greater progress on the items above may have been hindered by having just one meeting a month among a dozen or more people. That might suggest the need for some subgroups focused on particular topics (e.g. cost-effectiveness test) and perhaps with fewer people involved to meet more often. Those subgroups could then report back draft recommendations for the full WG to consider. This model is being used very effectively, for example, by the Illinois Stakeholder Advisory Group (SAG) for energy efficiency. They have full working group meetings quarterly (used to be monthly) but have numerous subcommittees (also with regular meetings) and working groups (more episodically meeting to address specific topics that have more time-sensitive needs). See www.ilsag.info.</p>
Dwayne Quinn (non-utility member)	<p>As the last non-utility member to comment, instead of "piling on" regarding the lack of opportunity for the IRP WG to understand the lack of progress by the utility or even the behind the scene processes, we will simply support contributions of each of the other non-utility members. I am concerned that the Enbridge comments seem to dismiss consensus comments by the group. I believe the reality lies in the fact that Enbridge has not advanced even one single</p>

	<p>concrete example of a potential pilot, which could have been used to allow input from the WG on process matters. The cumulative years of experience and aggregated intellectual capital of the committee is being wasted as we await something substantive to review and to initiate collaboration.</p>
Jay Shepherd (non-utility member)	<p><i>Very Little Has Been Done To Date.</i> This Report demonstrates that little was done from July 22 to December 31, 2021 to advance IRP in Ontario. The Report discloses that the following steps were taken in that 5+ month period:</p> <ol style="list-style-type: none">1. A bare bones website was created (perhaps a day's work), in which the primary functionality is the ability of customers to indicate their interest in regional constraints and the related IRPAs. However, there are no regional constraints or IRPAs identified, and will not be until the end of 2022 at the earliest. Enbridge promises future enhancements to the website late in 2022 or early in 2023.2. A committee of the stakeholder engagement folks at Enbridge has been created, but they will have nothing to do until late 2022, when constraints and potential IRPAs have been identified. <p>Nothing else appears to have been done. No preliminary work was done on the pilots, or the DCF+ test, or best practices in other jurisdictions, etc. Or, if there was, none of it was brought to the attention of the IRP Working Group.</p> <p><i>Asset Management Plan – Refusal to Disclose.</i> In parallel, Enbridge has moved forward with its 2024-2028 Asset Management Plan, but does not appear to have incorporated IRP into that process. Further, when asked to provide information to the IRP Working Group on the process of the AMP, and how it was influenced by IRP, Enbridge refused to do so. Members of the working group sought a draft of the AMP, which should be substantially finalized at this point, but that disclosure was refused.</p> <p><i>Load and Demand Forecast – Refusal to Disclose.</i> Related to this, Enbridge has, in 2021 and 2022, been preparing its ten year load forecast for the AMP to be filed in the rebasing application, but has declined to share any information on that forecast with the IRP working group. It does not appear that Enbridge has taken any action so far to</p>

	<p>influence that forecast downward through, for example, longer term planning for, or forecasting of, IRPAs.</p> <p><i>Posterity Group Model – Refusal to Disclose.</i> Another refusal from Enbridge was the request from the IRP working group to see the Posterity Group model that Enbridge plans to use to assess IRPAs. Enbridge will not provide that model unless compelled to do so by the OEB.</p> <p><i>Interruptible Rates Study – No Consultation with IRPWG.</i> At the same time, Enbridge has proceeded (in 2022, not 2021) with an interruptible rates study as it relates to IRP, but has not brought any information on that study to the IRP working group, and apparently does not intend to do so.</p> <p><i>100% Fail Rate in Binary Screening.</i> To date, Enbridge has used binary screening on seven projects, and all have failed, in most cases because of Enbridge's determination that the need must be met in under three years. One of these was the St. Laurent Phase 3 and 4 project, which the OEB determined in the EB-2020-0293 LTC application would not proceed at this time. It is not known yet whether the others that failed the screening can stand up to a similar independent review. No information on that binary screening has been provided to the IRP working group.</p> <p><i>Pilot Projects – Non-Compliance with OEB Direction.</i> Enbridge also discloses in the attached Report that they will not comply with the OEB direction to “select and deploy” two IRP pilot projects by the end of 2022. They have unilaterally determined, without input from the IRP working group, that they will complete the “select” stage by the end of the year, but will not have the pilot projects “deployed” until the winter of 2023, rather than the winter of 2022.</p> <p>Against this contextual background, Enbridge has been adding to rate base at an average rate of \$100 million of capital additions per month since the IRP Decision, and is continuing to do so.</p> <p>The inescapable conclusion from this Report, and from the actions of Enbridge to date, is that their strategy is a “slow walk” of IRP, consistent with their past resistance to the concept.</p>
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<p>Mike Parkes/Stephanie Cheng (OEB staff representatives)</p>	<p>In OEB staff's view, Enbridge Gas is taking the initial steps (as documented in Enbridge's annual IRP report) to implement the IRP Framework in accordance with the OEB's direction. This includes participating in good faith on the IRP Working Group. Implementation of the IRP Framework is still at a preliminary stage. At this time, OEB staff provides additional comments on three topics:</p> <ul style="list-style-type: none"> <p>Slow start on IRP Pilots (section 3 of Enbridge Gas annual IRP report): The IRP Framework indicated that Enbridge Gas should develop and implement two IRP pilot projects, with the expectation that the pilot projects would be selected and deployed by the end of 2022.</p> <p>Based on the description in the annual IRP report and the information that has been shared with the Working Group, the amount of preparatory work done by Enbridge Gas in the months following the IRP decision in July 2020 to lay the groundwork for these pilots (in advance of seeking input from the IRP Working Group) was very limited.</p> <p>While OEB staff recognizes that this was in part because Enbridge Gas did not want to overly constrain pilot design prior to receiving input from the Working Group, the result is that it is unlikely that pilots will be deployed (if "deployed" is interpreted to include having received an OEB approval) by the end of 2022, which was the expectation of the IRP Decision. The consequence is that there will be a related delay in transferring learnings from the pilots into Enbridge Gas's system planning decisions. It will be important for Enbridge Gas to make use of learnings from the pilots while they are still in-flight, to inform Enbridge Gas's consideration of IRP alternatives in system planning.</p> <p>Insufficient information base to compare IRP Alternatives Versus Facility Projects (sections 2,7, appendix B of Enbridge Gas annual IRP report): Under the IRP Framework, Enbridge will use a four-step IRP Assessment Process to determine the best approach to meeting system needs. Where such system needs pass an initial binary screening, Enbridge Gas is required to assess the technical and economic feasibility of IRP Alternatives in comparison with traditional facility solutions.</p>
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	<p>The level of detail in appendix B (<i>Integrated Resource Planning Demand-Side Alternatives – Best Available Information</i>) of Enbridge’s initial annual IRP report regarding IRP Alternatives, including their cost and peak demand reduction potential, is generally insufficient to assist Enbridge Gas in completing this step of IRP assessment, and will need to be improved in future annual IRP reports.</p> <p>Information on IRP Alternatives will be informed and improved by the results of Enbridge Gas pilots. However, Enbridge Gas will need to conduct IRP assessments prior to completion of the pilots (e.g. for potential system needs identified in Enbridge’s rebasing application). In OEB staff’s view, Enbridge will need to supplement the information obtained from IRP pilots with other sources of information on the expected cost and peak demand reduction potential of IRP Alternatives (including results from other jurisdictions), to assist it in completing IRP Assessments (and to assist the OEB in reviewing Enbridge Gas’s determinations). Otherwise, the risk is that no IRP Alternatives will advance past this stage of IRP Assessment for many years.</p> <ul style="list-style-type: none"> Limited information and Working Group review of IRP elements of rebasing application (sections 2, 6, 9 of Enbridge Gas annual IRP report): The OEB’s review of Enbridge Gas’s rebasing application (expected to be filed in November 2021) will have significant consequences for implementing the IRP Framework. Issues of particular importance noted briefly in the annual IRP report include: Enbridge Gas’s updated asset management plan and its approach (and conclusions) regarding screening system needs for IRP alternatives and reporting on the status of such consideration (section 6), Enbridge Gas’s approach to demand forecasting (section 2), and Enbridge Gas’s approach to studying the potential for interruptible rates (section 9). In OEB staff’s view, Enbridge Gas’s approach to demand forecasting in light of the energy transition to lower-carbon energy sources will likely have significant implications for IRP and system planning, both regarding identification of system needs and the role of IRP Alternatives as potential solutions.
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	<p>These issues are only mentioned briefly in the annual IRP report, and the Working Group has not to date been provided with substantive details of how these topics will be addressed in Enbridge Gas's rebasing application, and has not commented on them. At this point in time, if any review by the Working Group occurs, it will likely be quite limited. Reasons for this include: these topics were not identified as a priority for the Working Group in the IRP Framework; Enbridge Gas's view that these topics are better addressed through testing of the evidence within the rebasing application; and views of some Working Group members that input at this stage is unlikely to have a meaningful impact on Enbridge Gas's application. The consequence is that these issues will be addressed in the rebasing application without significant prior input from the Working Group.</p>
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Table 3: Comments of Enbridge Gas IRP Working Group Members

Working Group Member	Comments (optional)
Chris Ripley/Whitney Wong (Enbridge Gas representatives)	<p>Enbridge Gas has structured its comments to follow the Working Group Participant comments above. For context, Enbridge notes that the Working Group's focus, per the Terms of Reference and the OEB's IRP Decision, are three main issues: the IRP Annual Report, the DCF+ cost/benefit test and the IRP Pilots. Enbridge Gas does not agree with the negative tone of many of the Working Group Participant comments. Enbridge Gas has been working diligently on IRP implementation and engaging responsibly with the Working Group, in a manner consistent with the OEB's directions and expectations from the IRP Framework. As described below, Enbridge Gas expects that the pace of Working Group progress and activities will increase in the coming months.</p> <p>Minimal Information in Annual IRP Report: As noted above, the 2021 IRP Annual Report is reporting on 2021 activities and information. While progress has been made on the three main Working Group tasks; Annual Report, DCF+ and pilots the work has been largely completed in 2022 and will appear in the 2022 IRP Annual Report. In addition, in Enbridge's view there is a mismatch between the IRP Annual Report, which relates to 2021, before the Working Group held its first</p>

	<p>meeting, and the comments from the Working Group members on that Report, almost all of which relate to the experience of the Working Group in 2022. Over the next few months, the Working Group will discuss potential pilot projects and review Enbridge Gas' proposals for the DCF+ Test.</p> <p>Little Progress Made on IRP Pilot Projects: Enbridge does not agree with the Working Group comments suggesting Enbridge Gas made little effort on the IRP Pilots Projects. The OEB's IRP Decision stated "the OEB expects that the [two] IRP pilot projects will be selected and deployed by the end of 2022." (p.24). Enbridge acknowledges deployment by the end of 2022 is not possible, this is entirely due to the timing of Enbridge's demand forecast and planning processes being completed in Q2 of 2022. The 2023-2032 Asset Management Plan ("AMP"), generated in May 2022, identifies the needs on Enbridge's system. The pilot projects need to be, and will be, based on actual system needs that have been identified in Enbridge Gas' AMP. Enbridge Gas has included an updated IRP pilot schedule in its Annual Report. Enbridge Gas will bring 4-5 actual system needs for each of the two proposed IRP Pilots to the Working Group, including all relevant information to the need. Enbridge Gas will discuss the system needs brought forward with the Working Group, select two IRP Pilot projects and then prepare an application for the OEB's review and approval. In order to complete the IRP Pilot selection process quickly, Enbridge Gas proposed to increase the number of Working Group meetings from once per month to twice per month.</p> <p>DCF+ Test: Enbridge Gas engaged Guidehouse Consulting to conduct a review of the DCF+ test approved by the OEB in the IRP Decision. Enbridge Gas expects to receive the Guidehouse Final Report in June 2022 and will use the Guidehouse report in its review of the DCF+ test and in any proposed changes. Enbridge Gas will be communicating the Guidehouse Report and Enbridge Gas' proposed changes in the July IRP Working Group meeting. As discussed at the Working Group, a sub-group will be established to review the Guidehouse Report and Enbridge's associated proposed changes to the DCF+ Test. This review and discussion will happen prior to the cost test being applied to the IRP Pilot projects or an IRPA Plan.</p>
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	<p>Lack of Transparency and Reliance on 2024 Rate Rebasing: Enbridge Gas is filing its 2024 Rebasing Application in Fall 2022 which will include a comprehensive review of Enbridge Gas' planning processes, the demand forecast and the Asset Management Plan. Enbridge Gas never understood the Working Group would provide input on the demand forecast process and the asset management requirements. The appropriate time to review Enbridge Gas' planning processes and the Asset Management Plan is in the Rebasing proceeding, not at the IRP Working Group. Enbridge Gas is holding a Rebasing Stakeholder meeting in June 2022 where Enbridge will provide information about the upcoming filing. Enbridge Gas notes there is no direction to review or provide the planning processes, demand forecast or the Asset Management Plan to the Working Group in the OEB's IRP decision or the IRP Working Group Terms of Reference</p> <p>Posterity Model: The Working Group have requested Enbridge Gas to provide the model used by Posterity Group to assess energy efficiency opportunities on Enbridge Gas' system. Enbridge Gas does not own the Posterity model and cannot provide it. Enbridge Gas will explain the model, how it is used and the inputs/outputs as it develops the IRP Pilots.</p> <p>Interruptible Rates: In its IRP Decision, the OEB ordered Enbridge Gas "to study its interruptible rates to determine how they might be modified to increase customer adoption of this alternative service. This initiative is expected to help reduce peak demand, and the study should be filed as part of the next rate rebasing application". (p.35). Enbridge is completing this direction and it will be filed in the Rebasing Application. Enbridge Gas notes there is no direction to review the Interruptible Rates study with the Working Group in the OEB's IRP decision or the IRP Working Group Terms of Reference.</p>
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4. Description of Other Key Activities to Date

The Working Group's Terms of Reference confirmed the following items noted in the IRP Decision as the highest initial priorities for the Working Group (in addition to the review of Enbridge Gas's annual IRP report):

- **Consideration of IRP pilot projects to better understand how IRP can be implemented to avoid, delay or reduce facility projects.**
 - The IRP Framework indicated that Enbridge Gas is expected to develop and implement two IRP pilot projects. The pilots are expected to be an effective approach to understand and evaluate how IRP can be implemented to avoid, delay or reduce facility projects. The IRP Framework indicated that the OEB expects that the IRP pilot projects will be selected and deployed by the end of 2022.
 - Working Group activities: The Working Group has had several discussions to provide input to Enbridge Gas on pilot design, focusing primarily on the pilot objectives, the criteria that will be used to select and prioritize pilots, and the types of IRP Alternatives should be a priority to test in the pilots. Enbridge Gas has proposed four potential pilots built on different types of IRP Alternatives: (1) enhanced targeted energy efficiency in combination with a bridging supply-side solution; (2) a peak shaving supply-side IRP Alternative using either compressed natural gas or liquefied natural gas; (3) a demand response program focused on general service customers' heating loads; and (4) a demand response/interruptible rates initiative focused on Enbridge Gas's larger contract customers. Enbridge Gas is also considering a geographical IRP pilot that may address multiple needs within a specific area and include a suite of IRP alternatives, potentially including demand-side and supply-side IRP alternatives, as well as considering enhanced inspection/integrity management measures. In the coming months, it is expected that Enbridge Gas will propose specific projects that match these potential pilots to real system needs identified in its Asset Management Plan, for Working Group review, prior to Enbridge Gas's final selection of pilots. Additional discussion and refinement of the pilot proposals will take place by the Working Group, prior to Enbridge Gas filing pilot applications to the

OEB for approval.

- **Enhancements or additional guidance in using the Discounted Cash Flow-plus economic evaluation methodology to assess and compare the costs and benefits of using either facility solutions or IRP alternatives to meet system needs.**
 - The IRP Framework established a three-phase discounted cash flow-plus (DCF+) test as the economic evaluation that will be used to compare the costs and benefits of different approaches to meeting system need (IRP alternatives, facility alternatives, or a combination). The OEB concluded that the DCF+ test could be improved to better identify and define the costs and benefits of Facility Alternatives and IRP Alternatives, and clarify how these costs and benefits should be considered within the DCF+ test. This could include expanding the inputs to recognize increasing carbon costs, the risk that a constraint remains unresolved, and impact on gas supply costs. Enbridge Gas was directed to study improvements to the DCF+ test, and encouraged to consult with the Working Group, and use the IRP pilot projects as a testing ground. Enbridge Gas was directed to file an enhanced DCF+ test for approval as part of the first non-pilot IRP Plan.
 - Working Group activities: The Working Group has had several preliminary discussions on this topic. This included an analysis and *presentation* by Working Group member and cost-effectiveness expert Chris Neme, which made several proposals to improve or refine the DCF+ test, while remaining consistent with the OEB's guidance on this topic in the IRP Decision. Enbridge Gas is also planning to propose several refinements to the DCF+ test, but these have not yet been discussed with the Working Group. In the coming months, the Working Group plans further discussion, with the goal of agreeing on a preliminary approach to cost-effectiveness that can be used for the IRP Pilot applications. Additional work will be done as needed to address issues that were not completely resolved at the time of filing the pilot applications, and may include development of a supporting guidance document regarding use of the DCF+ test.

The Working Group has also discussed whether to give any consideration to the IRP-related aspects of Enbridge Gas's rebasing application, which would likely be contingent on the degree

of information that Enbridge Gas will provide regarding its application. Enbridge Gas has recently indicated that it will bring forward information on one IRP issue that will be part of rebasing - Enbridge Gas's approach to interpreting the IRP Framework's criteria for screening system needs - for discussion at an upcoming Working Group meeting, and is considering whether other IRP-related aspects of the rebasing application, including the draft Asset Management Plan, can be discussed with the Working Group.

Other potential areas of work for the Working Group in the future may include addressing:

- Learnings from natural gas IRP in other jurisdictions
- Performance metrics for IRP
- Accounting treatment of IRP costs
- Treatment of stranded assets in system planning
- Other activities relevant to the IRP Framework, as identified by the Working Group or as directed by the OEB

The Working Group has not to date discussed these topics in any depth (with the exception of some consideration of IRP in other jurisdictions with regards to pilot proposals).

A draft Work Plan is maintained for the Working Group and updated on a regular basis, outlining workstreams and expected timing of key deliverables.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, Appendix A, p.4

Question(s):

With respect to the Dawn C: Compression Lifecycle Project.

- a) Please reconcile the total cost of the project shown (\$125M) in the with the amount shown in Exhibit 2, Tab 6, Schedule 1, p.46, Table 6 (\$163.4M).
- b) Please provide the full business case for the proposed project.
- c) Is the project expected to go in-service in 2027, or will parts go in-service earlier? If so, please provide details of the amounts that will go in-service by year.

Response:

- a) The total cost of the Dawn C Compression Lifecycle Project provided at Exhibit 2, Tab 6, Schedule 2 - Appendix A, page 4 (\$125 million) does not include overhead allocations, whereas the amount provided at Exhibit 2, Tab 6, Schedule 1, page 46, Table 6 (\$163.4 million) includes overhead allocations.
- b) Please see Exhibit 2, Tab 6, Schedule 2 - Appendix A, page 4 for the project justification. A business case for the project has not yet been completed. Enbridge Gas is currently undertaking an Asset Health Review as provided at Exhibit 2, Tab 6, Schedule 2, page 183 of 288, paragraph 4. Included in that review will be a third-party Reliability, Availability and Maintainability Study to quantify risks associated with asset failures. This study will support detailed alternatives analysis and final scoping for the Dawn C Compression Lifecycle project which will in turn inform the project cost estimate and business case.
- c) The entire project is expected to go into service in 2026.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, Appendix A, p.11

Question(s):

With respect to the A10: Wilson Ave, VSM Replacement Project:

- a) Please reconcile the total cost of the project shown (\$72M) in the with the amount shown in Exhibit 2, Tab 6, Schedule 1, p.46, Table 6 (\$91.2M).
- b) Please provide the full business case for the proposed project.
- c) Is the project expected to go in-service in 2026, or will parts go in-service earlier? If so, please provide details of the amounts that will go in-service by year.
- d) Please provide details regarding status of the consideration of IRP alternatives for the project are.

Response:

- a) Please see response at Exhibit I.2.6-ED-100 part a).
- b) Please see Exhibit 2, Tab 6, Schedule 2 Appendix A, Page 11. Additionally, please see response at Exhibit I.2.6-ED-100, part f) which describes Enbridge Gas's intent to conduct further condition assessment of this pipeline which will support additional scope refinement under the Enhanced Distribution Integrity Program.
- c) The project is expected to go in-service in two parts;
 - i. at a direct cost of \$28,199,920 which covers 1.8km from Lovilla Blvd to Jethro Rd in 2024, and
 - ii. at a direct cost of \$41,647,950 covering the remaining 6.7km in 2025.

d) Please see response at Exhibit I.2.6-ED-102.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, Appendix A, p.35

Question(s):

With respect to the Kennedy Road Expansion project:

- a) Please provide the full business case for the proposed project.
- b) Is the project expected to go in-service in 2025, or will parts go in-service earlier? If so, please provide details of the amounts that will go in-service by year.

Response:

- a) Please see Exhibit I.2.6-FRPO-45 for the value assessment. Kennedy development assessed three solution options. Option one, do nothing, which was not deemed acceptable. The impacts of not executing the project can be found in response Exhibit I.2.6-CCC-66. Option two was to sell and purchase a new right size property. This was not chosen as a property was not available for Enbridge Gas's use. Option three was to purchase the adjacent property, demolish the existing building and build a new facility on the combined site. Option three was chosen and is currently in execution.
- b) The land \$10,190,390 was placed into service in 2020 and the building is forecasted to go into service in 2025. The total estimated in-service cost for the building is \$46,595,406 per Exhibit 2, Tab 6, Schedule 2, Appendix A, page 36.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, Appendix A, p.47

Question(s):

With respect to the Contract Market Systems – Technology Obsolescence Project:

- a) Please reconcile the total cost of the project shown (\$53.2M) in the with the amount shown in Exhibit 2, Tab 6, Schedule 1, p.46, Table 6 (the business ca).
- b) Please provide a full business case for the proposed project.
- c) Please explain how Enbridge forecast the cost of this program,
- d) Is the project expected to go in-service in 2026, or will parts go in-service earlier? If so, please provide details of the amounts that will go in-service by year.

Response:

- a) The cost for the Contract Market Systems – Technology Obsolescence Project provided at Exhibit 2, Tab 6, Schedule 1, Table 6 is \$68.4 million which includes overhead allocations. The cost for the project provided at Exhibit 2, Tab 6, Schedule 2, Appendix A, page 47 does not include overhead allocations.
- b) Please see Attachment 1.
- c) Cost estimates were determined through a combination of past experience with projects of this scale, complexity, duration and Request for Proposal.
- d) The project is expected to fully go into service in 2026 and not earlier.

Contract Market Systems – Technology Obsolescence

Scope and Justification

The Contract Market Systems – Technology Obsolescence program will replace aging technologies which execute the key systems and processes for contract markets, including large volume distribution, direct purchase, storage and transmission, gas procurement, and gas accounting.

Large Volume Distribution: Large industrial and commercial users of natural gas such as manufacturers (e.g. automotive, steel, chemical), greenhouses, and power generators.

Storage and Transportation: Users of our Dawn storage facilities and our transmissions pipelines to trade, store, and move gas across the North American natural gas marketplace.

Direct Purchase: Customers and/or natural gas vendors who provide their own gas supply to meet their consumption demands. Direct purchase service include delivery, balancing and billing/collection service options.

Gas Management – Nominating, Validating, Confirming, Scheduling – This process and application is an integral component of the daily operational planning and accounting of EGL's system that is available on a 24/7/365 basis for (a) as an operator for shippers, including EGL, in the scheduling of GDS transportation, distribution, and storage assets as well as with interconnecting pipelines to the GDS system. (b) as a shipper on pipelines to nominate and schedule in franchise markets on other pipeline operator systems.

Gas Procurement and Accounting: the automated process used to administer procurement of gas commodity and storage and transportation services, manage contracting and inventory management, complete vendor payment, and account for gas costs and related deferrals.

Key processes include, but are not limited to, customer onboarding, contracting, GDAR-governed transaction processing, gas management (nominations, scheduling, validating, confirming as both an operator and a shipper), load balancing, billing/remittances, collections and payment, gas procurement, gas accounting, customer web self-serve and financial management.

These processes are currently using highly customized, aging, disparate systems that are 20-30 years old and are built using technology that is, or will become, unsupported and requires replacement. Failure to refresh aging systems and applications puts our business at risk with increased chance of major incidents, compromised contractual and regulatory compliance, service outages, degraded performance, business and customer interruptions, increased cost, difficulty in acquiring support and inability to address cybersecurity risks.

The following is the high-level summary of custom applications supporting large volume contracting, storage and transmission, and gas management business functions.

No	LEGACY ENTITY	APPLICATION	BUSINESS FUNCTION	CUSTOMER MARKET
1	Union	ConTrax	Contracting and Billing	Large Volume Distribution, Storage & Transportation (S&T), and Direct Purchase
2		CARE	Gas Management	
3		Enerline	Customer Portal	
4	EGD	Entrac	Contracting, Billing, and customer portal	Large Volume Distribution, Direct Purchase
5		URICA	Billing	A small set of Large Volume Distribution Customers
6	Enterprise Legacy	SAP ERP East	Gas Accounting Gas Procurement	

Project Drivers and Benefits

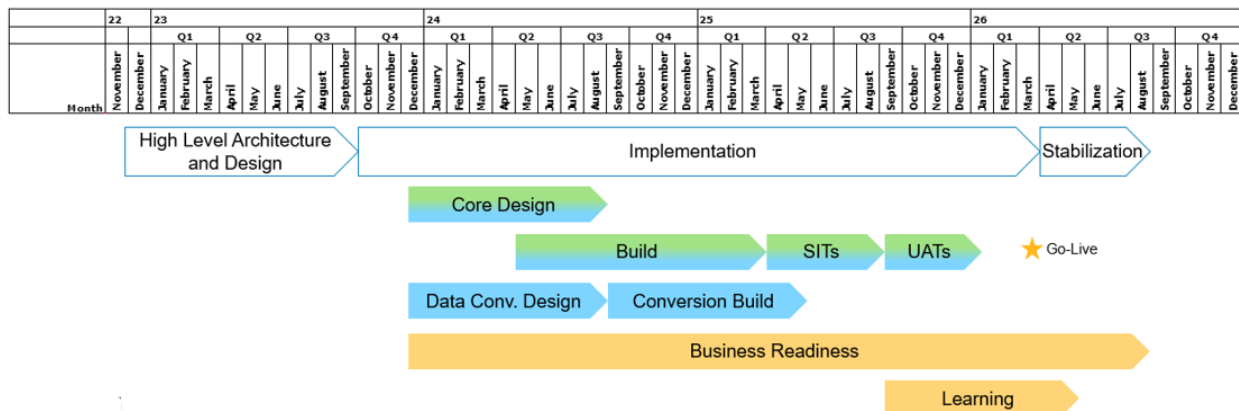
Business Drivers	Technology Drivers
<ol style="list-style-type: none"> 1. Simplification/Efficiencies - simplify and rationalize systems and processes 2. Single Company: operate as one legal entity with aligned systems and processes 3. Growth Potential: – align processes and systems to create a foundation to support future service offerings 	<ol style="list-style-type: none"> 1. Aging and end of life technology 2. Highly customized, complex and disparate systems and applications 3. High Enhancement and sustainment costs including resource knowledge / skills availability

4. Customer Experience – improve customer and employee experience through aligned processes and systems, improved data insights and modernized customer engagement technologies	4. Increased cybersecurity threats and compliance 5. Reliability and limited ability to scale
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Business Benefits	TIS Benefits
<ol style="list-style-type: none"> 1. Alignment, simplification, and automation of business processes 2. Reduction in training and testing efforts, resulting from aligned systems and processes 3. Establish aligned, modernized, and reliable platform to enable future service enhancements and/or new product/service offerings 4. Improved ease of use when transacting with aligned Enbridge systems 	<ol style="list-style-type: none"> 1. \$3,000,000 annual O&M 2. Reduced complexity and total cost of ownership for contract and gas management systems and support 3. Improved support, sustainment and cyber security 4. Avoid capital investments on aging and end of life hardware in the data centre

Project Timelines – High level Milestones

A program of this magnitude takes significant time to plan and execute effectively. To meet the 2026 implementation date, significant activities need to occur in advance.



Project Budget

Forecasted costs during 2024 through 2026 related to this project are outlined below. Activities in 2023 are largely preparatory and as such costs are lower than the other years. The capital cost in 2024 is greater than 2023 due to the need for technology purchases and detailed design to be done in that year. It will also see the start of build and business readiness activities. The build, business readiness, and license purchases will continue in 2025 along with most of the testing. Activities in 2026 relate to deployment, business readiness, stabilization, and project close-out. Cost estimates were determined through a combination of past experience with projects of this scale, complexity, duration and Request for Proposal.

	Forecast in '000				Total
	2023	2024	2025	2026	
Capital Cost Total	7,450	17,830	17,830	10,130	53,240

Enbridge Gas is proposing to implement the solution in April 2026 with warranty extending through the end of 2026. Similar to Enbridge Gas's other large information systems, the technology asset will be depreciated over 10 years.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-6-2, Appendix A

Question(s):

With respect to the material capital investments included in the Appendix to the AMP:

- a) Please provide the total number of projects and total cost.
- b) How many projects, and what is the total costs, for those that meet each of the following Enbridge investment categories:
 - i. Compliance - Compliance Investment
 - ii. Must Do – Must DO Investment
 - iii. Must Do – Intolerable Risk (EGI)
 - iv. Mist Do – Third-Party Relocation (EGI)
 - v. Must Do – Program work with sufficient history and risk to warrant continuation (EGI)

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023. /u

- a) 46 Projects valued at \$2.27 billion not including overhead allocations. /u
- b) Please note the Compliance and Must Do descriptions under the Investment Overview section of each Investment Summary Report does not map directly into the Investment Categories summarized at Exhibit 2, Tab 6, Schedule 2, page 46 of 288, Table 4.1-2. In particular there are no fields for Value-Driven Projects and there are compliance components flagged for value driven investments. The requested information is provided in parts i-v.

- i. Compliance: /u
0 Projects
- ii. Must Do – Must Do: /u
12 Projects with an estimated cost of \$1.08 billion
- iii. Must Do – Intolerable Risk (EGI): /u
1 Project with an estimated cost of \$29.8 million*
*\$347 million for Dawn to Corunna has not been accounted for in this category, for mapping reasons as described above. However, it is considered an investment which addresses a risk exceeding EGI's upper threshold and is a mandatory investment and, therefore, should be considered as part of this category.
- iv. Must Do – Third Party Relocation (EGI)
0 Projects
- v. Must Do – Program with sufficient history to warrant continuation (EGI)
0 Projects.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Vulnerable Energy Consumers Coalition (VECC)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 1

Question(s):

- a) Please modify Table 5 (page 44) to produce a table list by separate year, subject to LTC which are anticipated to go into service in either 2023, 2024 and 2025. Please also add to the table any projects that may not require LTC approval but would require franchise or other regulatory approvals (specify).
- b) For each project in the table requested above please show:
 - i. project related capitalized overheads separately from the total estimated project costs;
 - ii. the expected start and completion/in-service date by month/year;
 - iii. the current application status (i.e., expected filing date or filed date, notice date, decision date etc.).

Response:

- a) Please see response at Exhibit I.2.6-SEC-117 for updates to Table 5. The in-service dates for investments subject to LTC are provided at Exhibit I.2.6-ED-98. LTC applications with an anticipated 2023 in-service date have already been filed with the Ontario Energy Board.
- b)
 - i. Please see response at Exhibit I.2.6-ED-98.
 - ii. The specific details on project timing will be outlined in the LTC applications.
 - iii. Please see response at Exhibit I.2.6-SEC-117.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Vulnerable Energy Consumers Coalition (VECC)

Interrogatory

Reference:

Exhibit 2, Tab 6, Schedule 1, Table 4

Question(s):

With respect to Table 4 the evidence is *“Enbridge Gas does not anticipate seeking ICM recovery for these projects.”*

- a) What circumstances would need to change for EGI to revisit its current anticipation of no ICM requests during the rate period?

Response:

- a) Please see response at Exhibit I.2.6-ED-90 part c).

ENBRIDGE GAS INC.

Answer to Interrogatory from
Vulnerable Energy Consumers Coalition (VECC)

Interrogatory

Reference:

Exhibit 2, Tab 6, Section 5.4.7 (REWS)

Question(s):

- a) Please provide a list of all properties that were sold in each year 2019 through 2022 and provide the net (of fees) sale price.
- b) Please provide a list of the forecast sales of properties in 2023 and 2024 and the current assessed value of those properties.
- c) Please provide a list of the properties forecast to be purchased in 2023 and 2024 and the current actual or forecast cost of those properties.

Response:

The following response has been updated to reflect the Capital Update provided at Exhibit 2, Tab 5, Schedule 4, filed on June 16, 2023.

a) Properties sold in the years 2019 through 2022 are as follows:

- 2019 to 2021 - None
- 2022 - 3401 Schmon Parkway, Thorold. Net sale price \$12,246,500

b) The properties forecast for disposition in 2023 and 2024 are as follows:

/u

- 2023 - 335 Prichard Rd, Hamilton. Sold, net sale price \$3,033,250
- 2024 - 90 Bill Leathem Drive, Nepean, South Merivale Operation Centre (SMOC), \$6.3M estimate

Upon disposition of a property, Enbridge Gas calculates a separate gain (or loss) for the land and building by apportioning the sale proceeds between the land and building in accordance with U.S. GAAP. As prescribed in the OEB's Uniform System of Accounts for Class A Gas Utilities, the gain (or loss) on the sale of land is

recorded to income. The gain (or loss) on the building sale is captured in accumulated depreciation and is recovered through depreciation expense over the remaining life of the assets left within the group, based on subsequent depreciation studies.

Enbridge Gas has forecasted dispositions of property at net book value, as gains or losses on disposition are only determined at the time of sale.

- c) One property is forecasted for purchase in 2023: 209 Cambridge Ave, Iroquois Falls at a forecast price of \$61,000. No properties are forecast to be purchased in 2024.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Canadian Manufacturers & Exporters (CME)

Interrogatory

Reference:

Exhibit 2, Tab 7, Schedule 2, p. 6 of 6

Question(s):

- a) Please confirm whether EGI is seeking any approvals with respect to AMI as part of this proceeding.

Response:

- a) Enbridge Gas is not seeking any approvals with respect to AMI as part of this proceeding.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 7, Schedule 1

Question(s):

- a) In relation to page 19, why is the contractual minimum delivery pressure to Brighton Beach Generating Station 1724 kPag whereas it is higher for some other generating stations?
- b) What equipment could Brighton Beach Generating Station install to allow for receipt of gas at a lower delivery pressure?
- c) If that constraint location was resolved, what constraint location would take its place, if any?

Response:

- a) Power generating customers request parameters such as hourly and daily flow rate and minimum pressure, to meet their unique business operational requirements. These requirements are based on their chosen equipment which has parameter specifications to operate. Similar businesses do not use the same equipment or operational set-up. The ultimate contractual minimum delivery pressure is dependent upon several factors including the ability of the particular natural gas system to provide the pressure.

Enbridge Gas confirmed with BBGS that the existing delivery pressure will continue to be required going forward. Please see response at EB-2022-0157, Exhibit I.EP.6d.

- b) Please see response at EB-2022-0157, Exhibit I.EP.7.
- c) The next constraint would be the minimum inlet pressure at West Windsor Power which is located next door to BBPG. As further explained in EB-2022-0157, Exhibit I.FRPO.13 and in the technical conference in both the presentation exhibit KT1.1, slide 10 and Technical Conference – Day 1 Transcript at pages 23 and 24:

The second, which is labelled number 2, is the minimum delivery pressure to the Brighton Beach power generator. This customer's equipment requires 1724 kPa and is thus contracted by the customer. Enbridge Gas cannot lower the pressure in this area to increase the system capacity as there are other customers and distribution systems in the immediate area which require pressures like that of Brighton Beach power generator.

This was further discussed during a line of questioning during the technical conference during day 1 starting at page 31, lines 1 and page 33 line 20. The following is a quote from that line of questioning.

There are other customers in the immediate area of Brighton Beach Generation Station, specifically West Windsor Power that is located next door to Brighton Beach. It has the same minimum inlet pressure to its customer station. So, fixing up or lowering the inlet pressure to Brighton Beach does not reduce the minimum inlet pressure requirements next door to West Windsor Power. The Panhandle system would continue to have to maintain pressures on the system as they are today. And there are other distribution systems in the immediate area that operate at 1900 kPa, which is higher than Brighton Beach's minimum inlet pressure. The inlet pressures to these systems also need to be maintained for the downstream systems to operate

Brighton Beach currently is the controlling constraint on the system. It's the furthest west, highest pressure minimum inlet pressure on the system. So, if you fixed up the minimum inlet to that particular station, another constraint becomes the controlling constraint. It happens that the next controlling constraint is right next door at West Windsor Power. So, if you then fixed up West Windsor Power, the next controlling constraint is the -- there's three stations located at Ojibway. Spruce Wood Station, ADM Agri Cogen and the LaSalle gate take off, they all require 1900 kPa for their systems to work. Then the next constraint on the system is Turkey Creek Station, which requires 1724 kPa. So, like all of the systems in the area require about the same pressure that Brighton Beach and West Windsor Power do. So, fixing up one constraint doesn't help the system because there's other constraints in the area that would become immediately the next constraint.

There is no capacity to be gained in the system by reducing the current pressure constraints on the system unless extensive work was completed on the distribution system to replace the pipelines in the area that are operating at 1900 kPag.

Generally, it is a valid approach to reduce minimum inlet pressures to stations to ultimately attempt to increase system capacity, however in this case, there are so many local constraints that this approach is not feasible. As a regular practice at Enbridge Gas, when stations are rebuilt, effort is made to reduce the station pressure drop to reduce the minimum inlet pressure to the station.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 7, Schedule 1

Question(s):

- a) Please reproduce Table 1 on page 22, including ex-franchise demand.
- b) Please provide a breakdown of the forecast design day demand increases set out in Table 1.
- c) Please provide a table showing the demand on the Dawn Parkway System with rows for (i) the peak day from 2010 to today, (ii) the computed design day demand from 2010 to 2032, and the (iii) capacity

Response:

- a) Table 1 on page 22 includes ex-franchise demand. Please also see response at Exhibit I.2.7-FRPO-63.
- b) Please see Attachment 1.
- c) Please see Table 1.

Table 1

<u>Dawn Parkway System Demands for Exhibit I.2.7-ED-113</u>				
Line No.	Winter	Peak Day Demand (TJ/d)	Computed Design Day Demand (TJ/d)	Capacity (TJ/d)
		(i)	(ii)	(iii)
1	2009/2010	6,132	6,914	6,568
2	2010/2011	5,499	7,044	6,660
3	2011/2012	4,776	6,974	6,787
4	2012/2013	5,152	6,953	6,838
5	2013/2014	5,968	6,877	6,960
6	2014/2015	5,875	6,651	6,842
7	2015/2016	4,756	6,998	7,018
8	2016/2017	5,316	7,416	7,482
9	2017/2018	6,311	7,762	7,888
10	2018/2019	6,228	7,760	7,873
11	2019/2020	5,507	7,905	7,878
12	2020/2021	6,032	7,911	7,915
13	2021/2022	6,458	8,038	7,966
14	2022/2023	Note (1)	7,916	7,989
15	2023/2024	-	7,892	7,981
16	2024/2025	-	7,766	7,873
17	2025/2026	-	7,992	7,977
18	2026/2027	-	8,012	8,030
19	2027/2028	-	8,035	8,029
20	2028/2029	-	8,062	8,025
21	2029/2030	-	8,089	8,179
22	2030/2031	-	8,115	8,178
23	2031/2032	-	8,142	8,178
<u>Note:</u>				
(1)	Data unavailable until Q3, 2023			

/u

/u

/u

Line No.	Winter	Total Union South Rate Zone (TJ/d)	Union South Increase (TJ/d)	Total Union North Rate Zone (TJ/d)	Union North Increase (TJ/d)	Total EGD Rate Zone (TJ/d)	EGD Increase (TJ/d)	Ex-Franchise Dawn to Kirkwall (TJ/d)	Ex-Franchise Increase D-K (TJ/d)	Ex-Franchise Dawn to Parkway (TJ/d)	Ex-Franchise Dawn to Parkway Increase (TJ/d)	Ex-Franchise Kirkwall to Parkway (TJ/d)	Ex-Franchise Kirkwall to Parkway Increase (TJ/d)	Ex-Franchise (M17) (TJ/d)	Ex-Franchise (M17) Increase (TJ/d)	Design Day Demand Total
1	W2023/24	1,915	-25	435	-4	3,185	0	50	0	1,891	-13	408	-14	9	0	7,892
2	W2024/25	1,923	8	435	0	3,203	18	50	0	1,883	-8	264	-143	9	0	7,766
3	W2025/26	2,048	125	434	0	3,217	14	50	0	1,969	86	264	0	9	0	7,992
4	W2026/27	2,056	8	436	1	3,228	11	50	0	1,969	0	264	0	9	0	8,012
5	W2027/28	2,065	8	437	1	3,241	13	50	0	1,969	0	264	0	9	0	8,035
6	W2028/29	2,073	8	438	1	3,258	17	50	0	1,969	0	264	0	9	0	8,062
7	W2029/30	2,082	9	439	1	3,275	17	50	0	1,969	0	264	0	9	0	8,089
8	W2030/31	2,091	9	441	1	3,291	16	50	0	1,969	0	264	0	9	0	8,115
9	W2031/32	2,100	9	442	1	3,308	16	50	0	1,969	0	264	0	9	0	8,142

ENBRIDGE GAS INC.

Answer to Interrogatory from
Environmental Defence (ED)

Interrogatory

Reference:

Exhibit 2, Tab 7, Schedule 1

Question(s):

- a) Please reproduce Table 2 on page 23, including ex-franchise demand.
- b) Please provide a breakdown of the forecast design day demand increases set out in Table 2.
- c) Please provide a table showing the demand on the Panhandle system with rows for (i) the peak day from 2010 to today, (ii) the computed design day demand from 2010 to 2032, and the (iii) capacity

Response:

- a) Please see Exhibit 2, Tab 7, Schedule 1, paragraph 17. Ex-franchise customer gas flowing on paths which are opposite in direction (counter flowing) to the prevailing flow direction (i.e. Ojibway to Dawn) are not considered to be available for network analysis purposes on design day. The utilization of this path on design day is not controlled by Enbridge Gas and there is no contractual guarantee that ex-franchise customers will flow on this path. Because the Ex-franchise customers are not controlled by Enbridge Gas they are not available to increase design day capacity.
- b) Table 2 has been recreated to show the breakdown of the forecast design day demand increases denoted in columns (b,i) and (b,ii).

Table 2

Line No.	Winter	System Capacity (TJ/d)	Design Day Demand (TJ/d)				Surplus (negative is shortfall)
				General Service Rate	General Service Increase	Contract Rate	
						Contract Rate Increase	
		(a)	(b,i)	(b,ii)	(b,iii)	(b,iv)	(c)
1	2023/2024	846	298	0.5	445	42.8	103
2	2024/2025	929	298	0.6	526	81.2	105
3	2025/2026	929	299	0.7	550	23.9	80
4	2026/2027	929	300	0.8	574	23.9	55
5	2027/2028	929	301	0.9	598	23.9	30
6	2028/2029	929	302	1.0	622	23.9	6
7	2029/2030	1,251	303	1.0	646	23.9	303
8	2030/2031	1,251	304	1.1	669	23.9	278
9	2031/2032	1,251	305	1.2	693	23.9	253

c) The table below shows the (i) Peak Day Demands , (ii) Design Day Demands and (iii) System Capacity , as available from 2010 through 2031 in TJ/d.

Line No.	Winter	Peak Day Demand (TJ/d) Actuals	Design Day Demand (TJ/d)	System Capacity (TJ/d)	
		(i)	(ii)	(iii)	
1	2010/2011	396	429	490	/u
2	2011/2012	n/a ¹	464	490	
3	2012/2013	447	490	490	/u
4	2013/2014	461	515	527	/u
5	2014/2015	463	527	529	/u
6	2015/2016	388	528	529	/u
7	2016/2017	400	557	562	/u
8	2017/2018	466	612	666	/u
9	2018/2019	517	618	665	/u
10	2019/2020	370	640	734	/u
11	2020/2021	404	657	725	/u
12	2021/2022	487	672	713	/u

¹ Due to a warmer than normal winter season, no analysis was performed

Line No.	Winter	Peak Day Demand (TJ/d) Actuals	Design Day Demand (TJ/d)	System Capacity (TJ/d)
		(i)	(ii)	(iii)
13	2022/2023	n/a ²	699	726
14	2023/2024	n/a	742	846
15	2024/2025	n/a	824	929
16	2025/2026	n/a	849	929
17	2026/2027	n/a	874	929
18	2027/2028	n/a	898	929
19	2028/2029	n/a	923	929
20	2029/2030	n/a	948	1251
21	2030/2031	n/a	973	1251
22	2031/2032	n/a	998	1251

² Data will be available Q3, 2023

ENBRIDGE GAS INC.

Answer to Interrogatory from
Energy Probe Research Foundation (EP)

Interrogatory

Reference:

Exhibit 2, Tab 7, Schedule 1, Page 1, *Advanced Metering Infrastructure*

Question(s):

Is EGI expecting that AMI can be implemented without an ICM application?

Response:

At this time, Enbridge Gas does not anticipate the use of an ICM for the purposes of a future AMI proposal.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 7, Schedule 1, pg. 5

Preamble:

EGL evidence states: *On design day, the flow of gas is easterly from Dawn towards Parkway. Additional supply is received at Kirkwall and Parkway which reduces the need for pipeline infrastructure and diversifies gas supply pathways.*

Question(s):

Can Bundled-T customers deliver at Kirkwall and deliver a prorated PDCI relative to their impact on making these facilities smaller?

- a) If not, why not?
- b) If so, what would need to be done to undertake this change? Please explain fully.

Response:

Currently Bundled-T customers cannot be obligated to deliver to Kirkwall, and as such there is no "PDCI like" payment available for deliveries to this point.

- a-b) There is no rate structure or OEB approval to offer a "PDCI like" payment for deliveries to this point. Obligated deliveries to Kirkwall are not required based on the currently installed facilities. In addition, system changes would be required to implement this option.

Enbridge Gas evaluates commercial alternatives including, but not limited to, upstream transportation services to enable the delivery of supply to a point on Enbridge Gas's system, peaking supply transactions, delivered supply transactions, exchanges, and third-party assignments of transportation capacity as part of an IRPA. The use of third-party commercial services introduces risks such as availability, term and price. The value of using Kirkwall as an alternate obligated receipt point to limit future expansion facilities would be considered and fully explored as part of an IRPA process if/when expansion facilities may be required.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 7, Schedule 1, pg. 13

Preamble:

EGL evidence states: *Ex-franchise customers include customers in Québec, the Maritime provinces and the Midwestern and Northeastern United States, other Ontario based natural gas utilities, unbundled in-franchise customers and **Union South rate zone in-franchise customers transporting their PDO. (emphasis added).***

Question(s):

Please identify the transportation contracts that are currently being used, either by the customer or by a third party, to meet an in-franchise customer's Parkway Delivery Obligation.

- a) Please specify what amount of PDO deliveries are met by Dawn deliveries coupled with M12 capacity.

Response:

Currently there are no in-franchise customers holding Dawn Parkway M12 capacity to meet their PDO. Enbridge Gas is not able to discern whether other customers holding M12 capacity are transporting volumes from Dawn to meet in-franchise customers PDO.

- a) Enbridge Gas is unable to determine what amount of PDO deliveries are met by Dawn deliveries coupled with M12 capacity.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 7, Schedule 1, pg. 17

Preamble:

EGL evidence states: *Enbridge Gas's transmission systems have operating criteria to ensure safe and reliable operation. Each transmission system:*

- a) Cannot operate above its MOP;*
- b) Must operate above minimum contractual delivery pressures contained in customer contracts;*
- c) Must operate above minimum suction pressure at compressor stations;*
- d) Must operate within the aero assembly flow and head boundary conditions at the compressor stations;*

Question(s):

Please explain these compressor stations terms and how they affect design.

- a) Please provide the aero assembly flow and head boundary conditions for the compressors on the Dawn Parkway system (including Dawn transmission and Parkway).

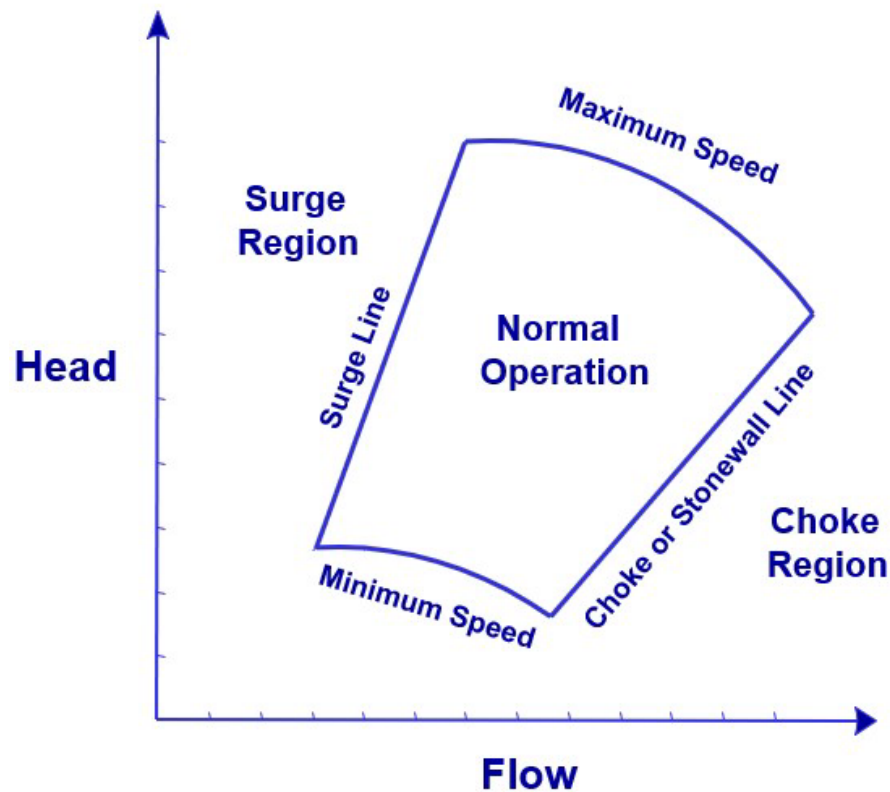
Response:

Please see Exhibit 2, Tab 7, Schedule 1, page 17 to 20 for a description of the compressor station terms and how they affect design. Please see part a) for a description of the aero assembly flow and head boundary conditions.

- a) Compressor flow in actual cubic feet per minute (ACFM) and head (roughly proportional to pressure ratio) in foot-pounds per pound (ft-lb/lb) form the axes of the boundary diagram for an aero assembly in a centrifugal compressor. This boundary diagram is commonly referred to in industry as a wheel map and describes the compressor's behaviour according to aerodynamic fan laws. The wheel map is bound by the minimum and maximum machine speed at the bottom and top respectively. The surge limit lies to the left and represents the region at which the

flow through the compressor becomes unstable due to insufficient flow relative to the energy added to the gas. The choke or stonewall limit lies to the right and represents the maximum flow that the compressor can manage at a given speed. All four limits are set by the machine manufacturer. Please see Figure 1 for a graphic depiction of a centrifugal compressor wheel map.

Figure 1: Compressor Wheel Map



While the compressors on the Dawn Parkway System are designed to operate in an integrated system, each has a unique wheel map that is matched to the individual machine's minimum and maximum speed limits, and the available horsepower. Individual compressors will operate at many different points within the wheel map depending on the overall system demand day-to-day. For the various compressors in the system, minimum speeds range from 2,910 to 5,000 rpm and maximum speeds range from 5,040 to 12,000 rpm. Flow ranges from 2,000 – 43,000 ACFM and head ranges from 3,000 to 91,000 ft-lb/lb.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 7, Sch. 1, pg. 22-26, Table 1 & EB-2019-0159 Ex. A, Tab 7, pg 17 & Sch 1

Question(s):

For Table 1, please break out the total Design Day Demand numbers in column (b) of Table 1 to show the projected design day demands for 2023/2024 through 2031/2032 for each of the following categories: (1) Total Union South Rate Zone, (2) Total Union North Rate Zone, (3) Total EGD Rate Zone, (4) Ex-Franchise Dawn-to-Kirkwall, (5) Ex-Franchise Dawn-to-Parkway, (6) Ex-Franchise Kirkwall-to-Parkway.

Response:

Please see Table 1. The growth in the Union South, Union North and EGD rate zones is assumed to be served from Dawn. However, the ability to serve those rate zones growth will be evaluated by Gas Supply when demand exceeds the capability in the Gas Supply Plan.

Table 1
Dawn Parkway System Design Day Demands

Line No.	Winter	Total Union South Rate Zone (TJ/d)	Total Union North Rate Zone (TJ/d)	Total EGD Rate Zone (TJ/d)	Ex-Franchise Dawn to Kirkwall (TJ/d)	Ex-Franchise Dawn to Parkway (TJ/d)	Ex-Franchise Kirkwall to Parkway (TJ/d)	Ex-Franchise (M17) (TJ/d)	Design Day Demand Total (TJ/d)
1	W2023/24	1,915	435	3,185	50	1,891	408	9	7,892
2	W2024/25	1,923	435	3,203	50	1,883	264	9	7,766
3	W2025/26	2,048	434	3,217	50	1,969	264	9	7,992
4	W2026/27	2,056	436	3,228	50	1,969	264	9	8,012
5	W2027/28	2,065	437	3,241	50	1,969	264	9	8,035
6	W2028/29	2,073	438	3,258	50	1,969	264	9	8,062
7	W2029/30	2,082	439	3,275	50	1,969	264	9	8,089
8	W2030/31	2,091	441	3,291	50	1,969	264	9	8,115
9	W2031/32	2,100	442	3,308	50	1,969	264	9	8,142

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 7, Sch. 1, pg. 22-26, Table 1 & EB-2019-0159 Ex. A, Tab 7, pg 17 & Sch 1

Question(s):

From EB-2019-0159, please update Table 7-2 with annualized actuals and extend the information through January 1, 2024.

- a) Please provide the contract details for the Dawn to Parkway capacity of 12,334 GJ that was turned back in 2019/2020, and the 88,728 GJ that was turned back in 2020/21.

Response:

Please see Table 1.

Table 1
Dawn Parkway System Capacity Position (Shortfall/Surplus)

<u>Line No.</u>	<u>Forecast Shortfall Change</u>	<u>GJ/d¹</u>
1	2019/2020 System Surplus (Nov 1, 2019)	-26,544
	<u>2020/2021 In-franchise Capacity Requirements</u>	
2	Union South rate zone	16,535
3	Union North rate zone	9,563
4	EGD rate zone	-2,693
	<u>2020/2021 Ex-franchise Capacity Requirements</u>	
5	Dawn to Parkway	-15,015
6	M17	-4,792
7	Parkway Delivery Obligation Reduction	-14,440

Table 1 (Continued)*
Dawn Parkway System Capacity Position (Shortfall/Surplus)

Line No.	Forecast Shortfall Change	GJ/d ¹
8	SWAHV	41,534
9	2020/2021 System Shortfall (Nov 1, 2020)	4,147
	<u>2021/2022 In-franchise Capacity Requirements</u>	
10	Union South rate zone	-8,979
11	Union North rate zone	-12,711
12	EGD rate zone	-120,131
13	Parkway Delivery Obligation Reduction	24,119
	<u>2021/2022 Ex-franchise Capacity Requirements</u>	
14	Dawn to Parkway	-63,814
15	Dawn to Parkway turn back	100,213
16	SWAHV	5,514
17	2021/2022 System Shortfall (Nov 1, 2021)	-71,642
	<u>2022-2023 In-franchise Capacity Requirements</u>	
18	Union South rate zone	27,889
19	Union North rate zone	1,618
20	EGD rate zone	7,758
21	Parkway Delivery Obligation Reduction	5,497
	<u>2022/2023 Ex-franchise Capacity Requirements</u>	
22	Dawn to Parkway	-19,670
23	Dawn to Parkway turn back	128,317
24	SWAHV	-19,781
	2022/2023 System Shortfall (Nov 1, 2022)	59,986
	<u>2023/2024 In-franchise Capacity Requirements</u>	
25	Union South rate zone	-9,414
26	Union North rate zone	910
27	EGD rate zone	0
28	Parkway Delivery Obligation Reduction	-3,160

Table 1 (Continued)*
Dawn Parkway System Capacity Position (Shortfall/Surplus)

Line No.	Forecast Shortfall Change	GJ/d ¹
<u>2023/2024 Ex-franchise Capacity Requirements</u>		
29	Dawn to Parkway turn back	13,182
30	Kirkwall to Parkway turn back	3,325
31	Transition to Harmonized Method	23,735
32	2023/2024 System Shortfall (Nov 1, 2023) ²	88,564

Notes:

1 – Negative sign denotes an increased capacity need which creates a shortfall; positive sign denotes a reduced capacity need which creates a surplus.

2 – Provided system shortfall information up to start of Winter 2023 (November 1st, 2023). The forecasted shortfall positions are recorded for the start of a winter (November 1st), so there is not an individual value for January 1st, 2024 (per the original request).

a) Please see Table 2.

Table 2
Contract Details of Turnback

Line No.	Shipper	Contract ID	Start Date	End Date	Path	Quantity (GJ)
1	Stelco Inc.	M12085	Sept. 16, 2014	Oct. 31, 2020	Dawn – Parkway	11,087
2	Ag Energy Co-operative Ltd.	M1215	Nov. 1, 2008	Oct. 31, 2020	Dawn – Parkway	1,247
3	Énergir, L.P. by its General Partner Énergir Inc.	M12176	Apr. 1, 2011	Mar. 31, 2021	Dawn – Parkway	88,728

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 7, Sch. 1, pg. 22-26, Table 1 & EB-2019-0159 Ex. A, Tab 7, pg 17 & Sch 1

Question(s):

From EB-2019-0159 Schedule 1, please provide the same Dawn Parkway System Demands schematic with data for Winter 2023/2024.

Response:

Please see response at Exhibit I.2.7-FRPO-117.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 7, Sch. 1, pg. 22-26, Table 1 & EB-2019-0159 Ex. A, Tab 7, pg 17 & Sch 1

Question(s):

For the winter of 2023/24, please provide schematics in the same format for the:

- a) Panhandle System (with & without the proposed expansion of EB-2022-0157)
- b) Sarnia Industrial Line System
- c) In each of the schematic, please identify the constraints that define the capacity and any surplus or shortage at those locations.

Response:

- a) Please see Attachment 1 (with the proposed expansion) and Attachment 2 (without the proposed expansion).
- b) Please see Attachment 3.
- c) Please see Exhibit 2, Tab 7, Schedule 1, paragraphs 50 and 51 for the constraints identified for the Panhandle Transmission System and the Sarnia Industrial System respectively.

Panhandle Transmission System

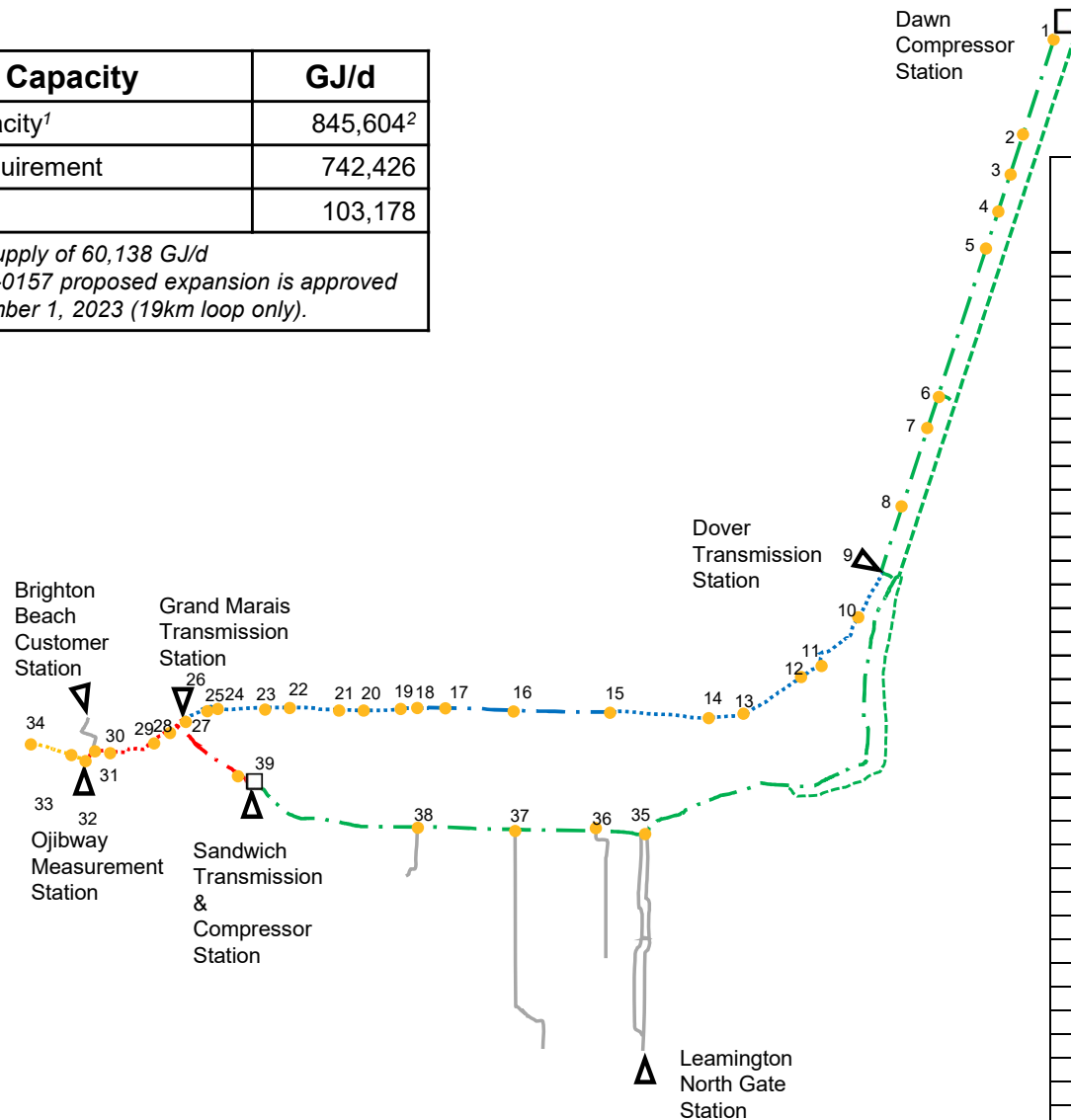
Winter Design Day Schematic

Winter 2023/2024, with EB-2022-0157 proposed expansion



System Capacity	GJ/d
Total System Capacity ¹	845,604 ²
Total Demand Requirement	742,426
Surplus (Shortfall)	103,178

¹ Includes Ojibway Supply of 60,138 GJ/d
² Assuming EB-2022-0157 proposed expansion is approved and in service November 1, 2023 (19km loop only).



	Station Name	Kilometre Post (km)	Demand (GJ/d)	Pressure (kPag)
1	Dawn / Dawn West Lines	0	20100	6040
2	Tolloch & Mandaumin	4.3	0	6022
3	Chatham Gore Conc 4	10	0	5999
4	Lindsay Tile Yard	12.9	43	5987
5	Tupperville	15.2	3878	5978
6	Dover Centre	27	81427	5923
7	Cartier	29.4	0	5915
8	Bechard	34.9	2078	5895
9	Dover Transmission	40	0	5876
10	Bradley	44.1	0	3921
11	T. N. Lighthouse	48.9	197	3718
12	Tilbury North TO	50.7	2885	3640
13	Tilbury Conc 2	55.8	0	3393
14	Stoney Point	58.7	1265	3247
15	St Joachim	65.4	333	2903
16	Belle River	72.6	4228	2777
17	Puce	77.8	2274	2687
18	Wallace	79.4	130	2655
19	Patillo	80.9	4981	2630
20	Elmstead	83	1630	2486
21	Manning	85.2	7597	2333
22	Lauzon TO	88.9	48229	2075
23	Ford Marentette TO	90.7	2046	2030
24	TransAlta / East Windsor TO	94.2	36224	1946
25	Walker	94.9	37920	1941
26	Grand Marais	97.1	27310	1939
27	NPS 16/20 Interconnect	108.1	0	1922
28	Bruce	109.4	4511	1914
29	California	111.4	17318	1882
30	Titcombe	114.9	7646	1854
31	Brighton Beach and WWP*	116.2	71931	1831
32	Ojibway Measurement	116.6	29304	1848
33	Ojibway Valve	117.9	0	1872
34	River Crossing	118.6	0	1914
35	Comber**	71.2	171568	5076
36	Mersea	75	44189	5006
37	Kingsville	80	90018	4938
38	Essex	88.1	6940	4903
39	Sandwich Transmission	101.1	14229	4860
Total			742426	

* Brighton Beach Generation Station minimum inlet pressure is maintained at or above 1831 kPag (this is higher than the minimum pressure required of 1827 kPag).
 ** The Leamington North Gate Station is located downstream of Comber Transmission. The minimum inlet pressure to the Leamington North Gate station is maintained at or above 4134 kPag, above the minimum of 2275 kPag.

Legend

Nominal Diameter (in)	MOP (kPag)
36	6040
36	6040
20	6040
20	4140
16	4140
20	3450
16	3450
16	2930

Lateral
 Regulating Station
 Compressor Station
 Demand Location

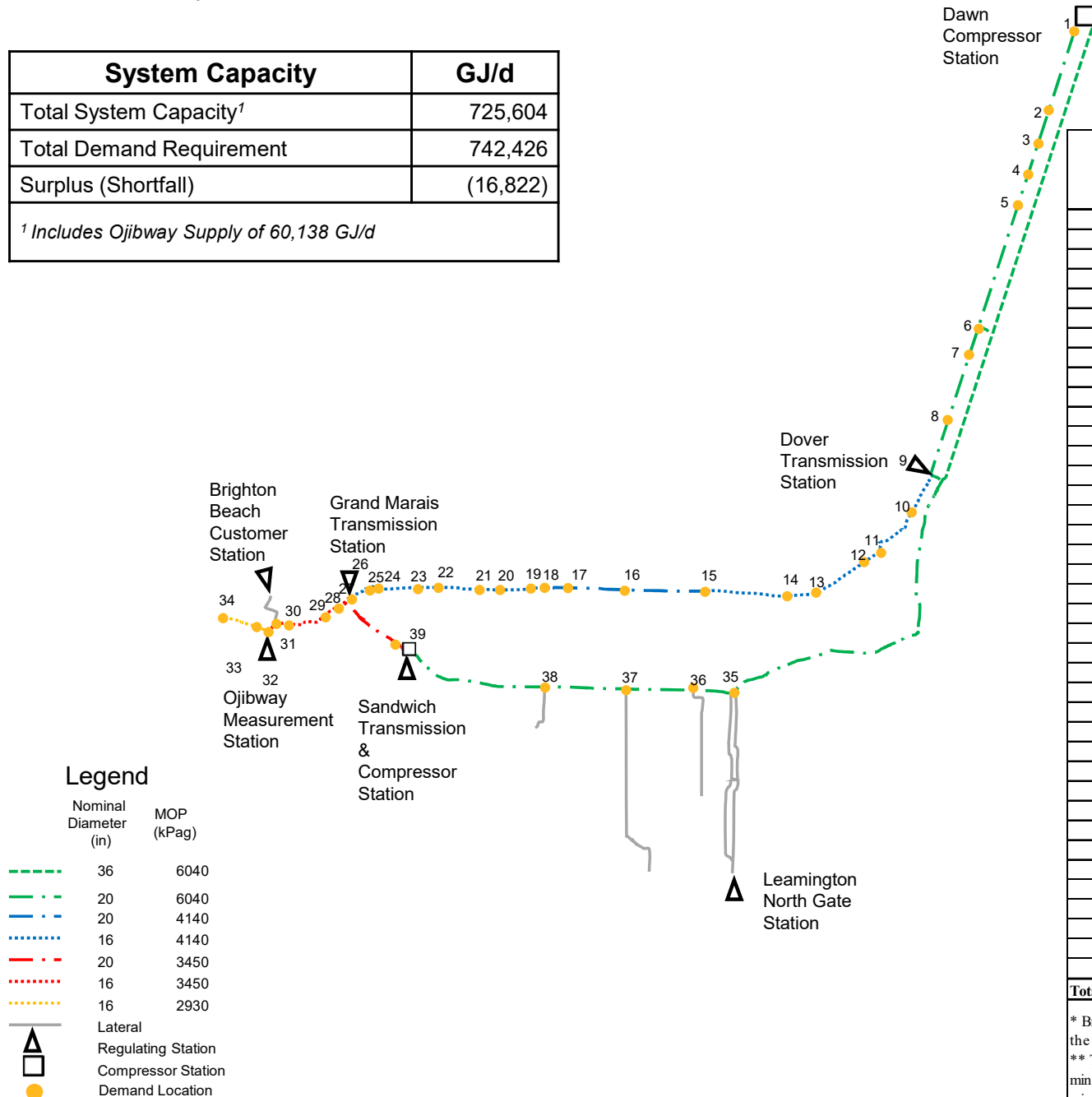
Panhandle Transmission System

Winter Design Day Schematic

Winter 2023/2024 without reinforcements



System Capacity	GJ/d
Total System Capacity ¹	725,604
Total Demand Requirement	742,426
Surplus (Shortfall)	(16,822)
¹ Includes Ojibway Supply of 60,138 GJ/d	



	Station Name	Kilometre Post (km)	Demand (GJ/d)	Pressure (kPag)
1	Dawn / Dawn West Lines	0	20100	5985
2	Tolloch & Mandaumin	4.3	0	5968
3	Chatham Gore Conc 4	10	0	5946
4	Lindsay Tile Yard	12.9	43	5987
5	Tuppersville	15.2	3878	5926
6	Dover Centre	27	81427	5874
7	Cartier	29.4	0	5865
8	Bechard	34.9	2078	5847
9	Dover Transmission	40	0	5829
10	Bradley	44.1	0	3920
11	T. N. Lighthouse	48.9	197	3718
12	Tilbury North TO	50.7	2885	3639
13	Tilbury Conc 2	55.8	0	3392
14	Stoney Point	58.7	1265	3246
15	St Joachim	65.4	333	2901
16	Belle River	72.6	4228	2774
17	Puce	77.8	2274	2683
18	Wallace	79.4	130	2651
19	Patillo	80.9	4981	2626
20	Elmstead	83	1630	2482
21	Manning	85.2	7597	2327
22	Lauzon TO	88.9	48229	2067
23	Ford Marentette TO	90.7	2046	2021
24	TransAlta / East Windsor TO	94.2	36224	1937
25	Walker	94.9	37920	1932
26	Grand Marais	97.1	27310	1931
27	NPS 16/20 Interconnect	108.1	0	1914
28	Bruce	109.4	4511	1906
29	California	111.4	17318	1873
30	Titcombe	114.9	7646	1844
31	Brighton Beach and WWP*	116.2	71931	1824
32	Ojibway Measurement	116.6	29304	1837
33	Ojibway Valve	117.9	0	1862
34	River Crossing	118.6	0	1903
35	Comber**	71.2	171568	3656
36	Mersea	75	44189	3562
37	Kingsville	80	90018	3471
38	Essex	88.1	6940	3424
39	Sandwich Transmission	101.1	14229	3361
Total			742426	

* Brighton Beach Generation Station minimum inlet pressure is as low as 1824 kPag (this is below the minimum pressure required of 1827 kPag).

** The Leamington North Gate Station is located downstream of Comber Transmission. The minimum inlet pressure to the Leamington North Gate station is as low as 2233kPag, below the minimum of 2275 kPag.

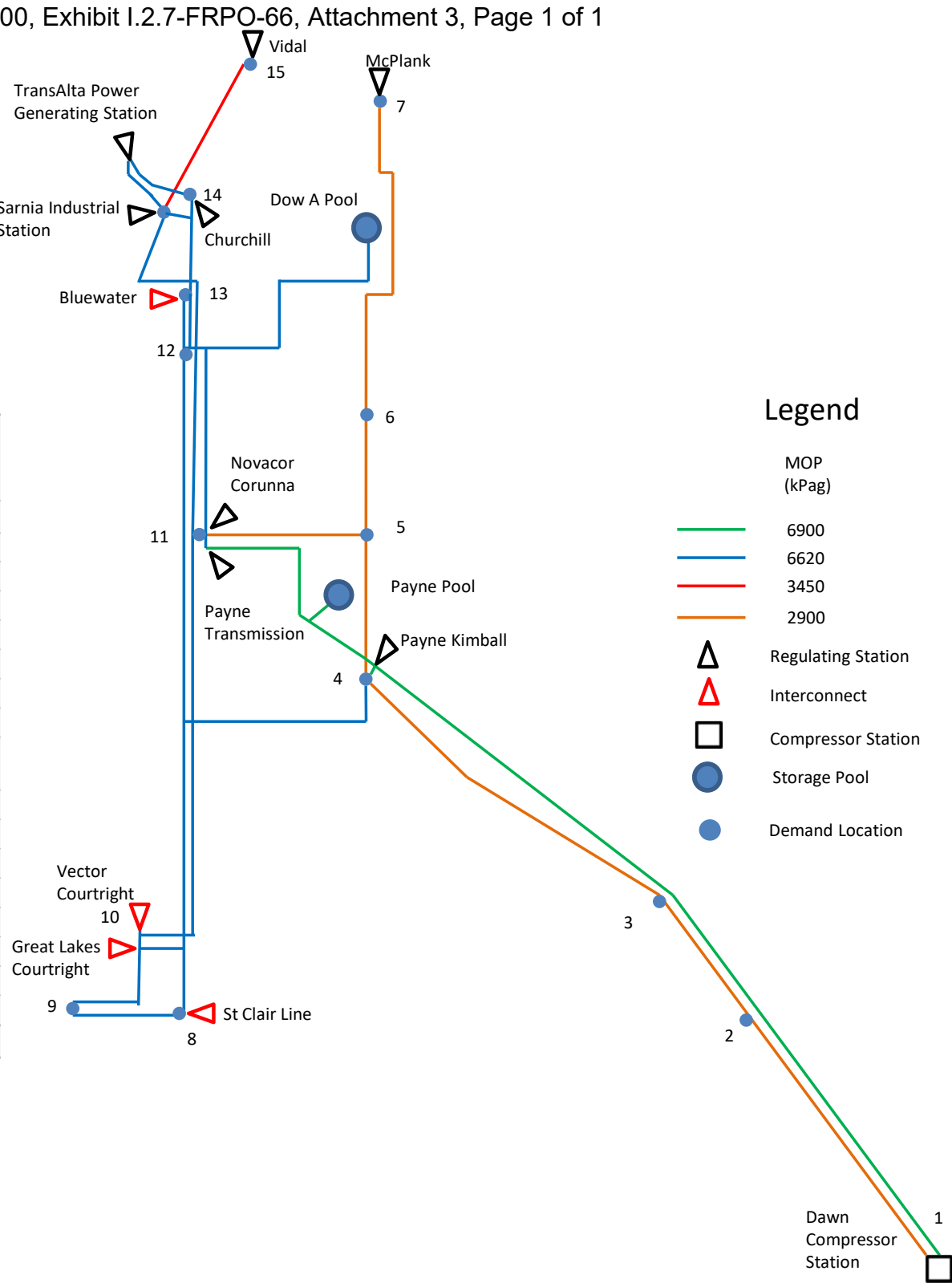
Sarnia Industrial Line System

Winter Design Day Schematic

Winter 2023/2024

System Capacity	GJ/d
Total System Capacity	702,891
Total Demand Requirement	689,780
Surplus	13,111

	Station Name	Kilometre Post (km)	Demand (GJ/d)	Pressure (kPag)
Distance from Dawn				
1	Dawn	0.0	0	2895
2	Sombra Lot 28 Conc 15	6.8	4	2717
3	Moore Young Line	10.1	24	2627
4	Payne Kimball	19.2	482	2358
5	Allied Petrosar	22.2	3003	2289
6	Corunna	24.6	1066	2055
7	McPlank	32.4	33846	1613
Distance from St. Clair Line Station				
8	St. Clair Line	0.0	0	4889
9	Terra Area	0.0	50262	4826
10	Great Lakes / Vector	1.4	0	4826
11	Novacor Corunna Area	10.5	128819	4185
12	Dow Area	14.8	198581	4096
13	Bluewater	16.3	118	4075
14	Churchill / SRCP Area	18.8	181124	3627
15	Vidal Area	21.5	92442	2903
Total			689780	



ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Exhibit 2, Tab 7, Schedule 1

Question(s):

Please file a business case for any North American Gas only utility that shows a positive NPV for AMI.

Response:

Enbridge Gas is not requesting approval of an AMI solution in this Application. Once the best overall AMI strategy is developed, comprehensive evidence with all supporting material will be filed with the OEB in a future application.

ENBRIDGE GAS INC.

Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario (FRPO)

Interrogatory

Reference:

Ex. 2, Tab 7, Schedule 1, pg. 7

Preamble:

EGI evidence states: *Would EGI consider a delivery commitment credit available at Ojibway structured in a similar way to the PDCI as an IRPA? If not, why not.*

Question(s):

Can Bundled-T customers deliver at Ojibway and deliver a prorated PDCI relative to their impact on making these facilities smaller?

- a) If not, why not?
- b) If so, what would need to be done to undertake this change? Please explain fully.

Response:

This question was submitted as number 155 on page 20 and has been renamed by Enbridge Gas as number 201 to differentiate it from another question submitted with the same number. Enbridge Gas also notes the preamble is misstated and is not part of its evidence.

Currently Bundled-T customers cannot be obligated to deliver to Ojibway, and as such there is no "PDCI like" payment available for deliveries to this point.

- a-b) There is no rate structure or OEB approval to offer a "PDCI like" payment for deliveries to this point. Obligated deliveries to Ojibway are not required based on the currently installed facilities. In addition, system changes would be required to implement this option.

Enbridge Gas evaluates commercial alternatives including, but not limited to, upstream transportation services to enable the delivery of supply to a point on Enbridge Gas's system, peaking supply transactions, delivered supply transactions,

exchanges, and third-party assignments of transportation capacity as part of an IRPA. The use of third-party commercial services introduces risks such as availability, term and price. The value of utilizing Ojibway as an alternate obligated receipt point in order to limit future expansion facilities would be considered and fully explored as part of an IRPA process if/when expansion facilities may be required.

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

2-7-1, p.22

Question(s):

Please provide a Dawn-Parkway design day schematic (similar to file EB-2022-0133, Exhibit I.FRPO.5, Attach 1) for each winter between 2022/2023 and 2028/2029.

Response:

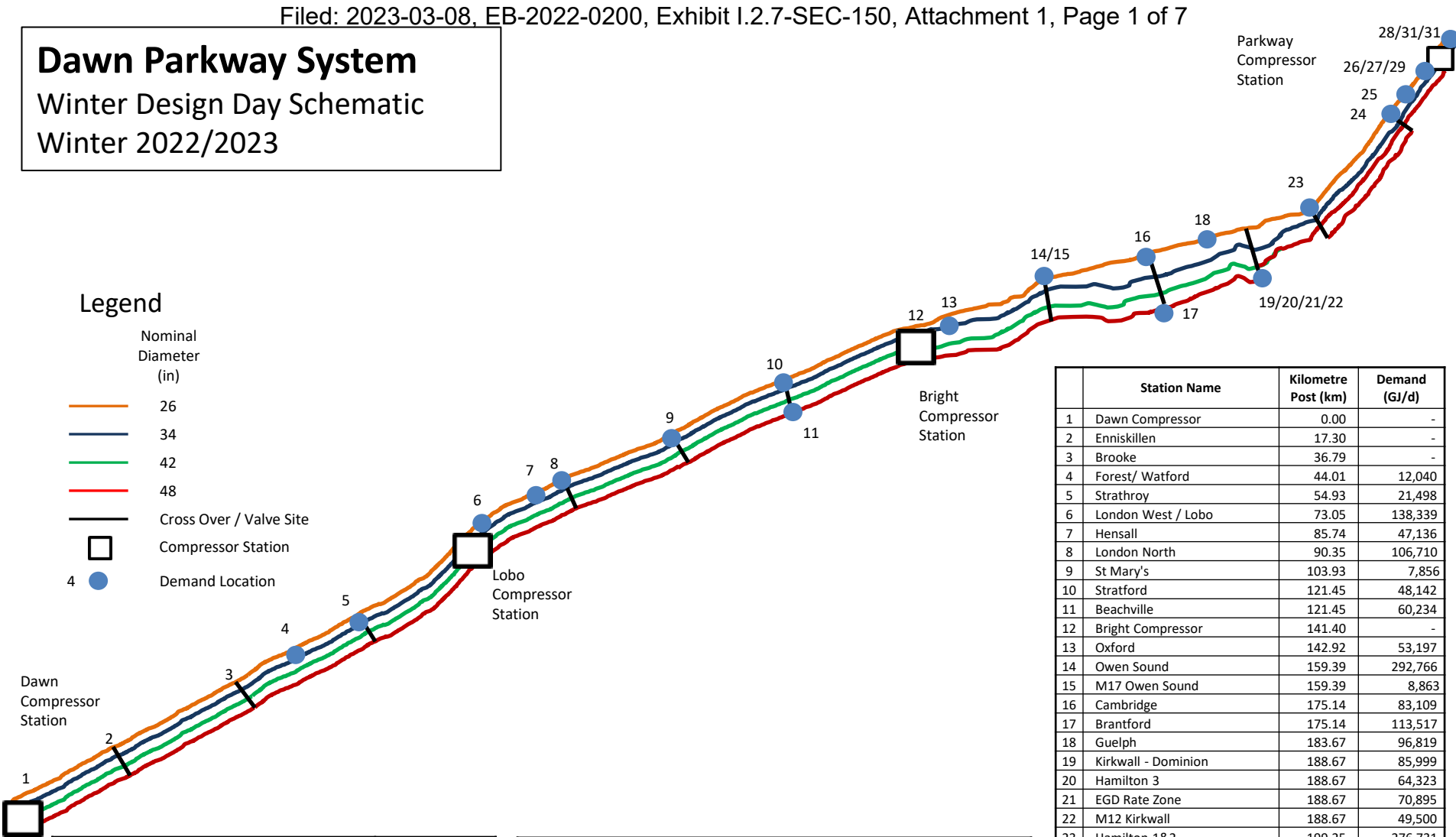
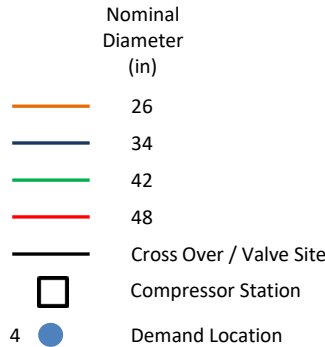
Please see Attachment 1.

Dawn Parkway System

Winter Design Day Schematic

Winter 2022/2023

Legend



System Capacity	GJ/d
Total System Capacity ^{1 2}	8,007,974
Total Demand Requirement	7,947,988
Surplus (Shortfall)	59,986
¹ Includes Parkway Delivery Obligation 256,484 GJ/d	
² Includes Supply at Kirkwall for M12 Contracts and Union Sales Service customers 442,256 GJ/d	

Compressor Station Operating Conditions			
Station	Lobo	Bright	Parkway
Power Available (MW)	102.9	129.0	88.1
Power Required (MW)	102.9	129.0	88.1
Suction Pressure (kPag)	3778	3522	3613
Discharge Pressure (kPag)	5571	5964	6454
Compression Ratio	1.5	1.7	1.8
Flow (GJ/d)	7,376,523	6,945,661	4,316,824
Daily Fuel (GJ/d)	34,354	28,148	17,953

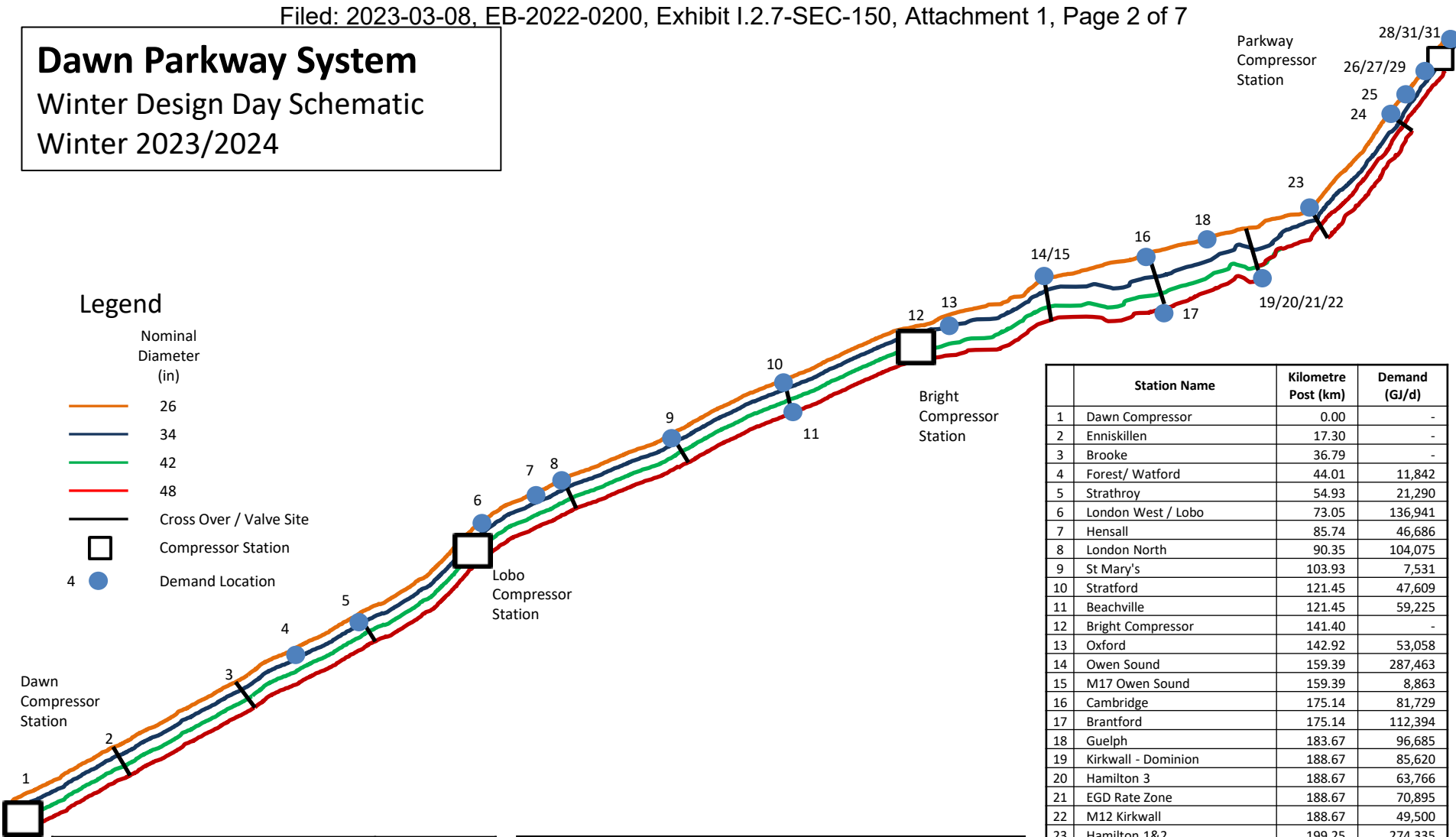
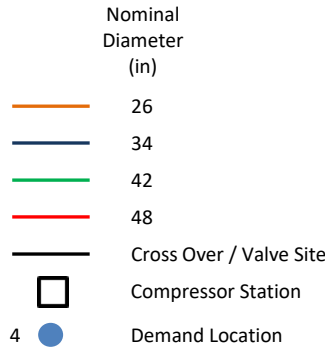
	Station Name	Kilometre Post (km)	Demand (GJ/d)
1	Dawn Compressor	0.00	-
2	Enniskillen	17.30	-
3	Brooke	36.79	-
4	Forest/ Watford	44.01	12,040
5	Strathroy	54.93	21,498
6	London West / Lobo	73.05	138,339
7	Hensall	85.74	47,136
8	London North	90.35	106,710
9	St Mary's	103.93	7,856
10	Stratford	121.45	48,142
11	Beachville	121.45	60,234
12	Bright Compressor	141.40	-
13	Oxford	142.92	53,197
14	Owen Sound	159.39	292,766
15	M17 Owen Sound	159.39	8,863
16	Cambridge	175.14	83,109
17	Brantford	175.14	113,517
18	Guelph	183.67	96,819
19	Kirkwall - Dominion	188.67	85,999
20	Hamilton 3	188.67	64,323
21	EGD Rate Zone	188.67	70,895
22	M12 Kirkwall	188.67	49,500
23	Hamilton 1&2	199.25	276,731
24	Milton	218.09	72,102
25	Halton Hills	221.61	145,598
26	Parkway Greenbelt	228.94	24,359
27	Burlington / Bronte	228.94	189,671
28	North Rate Zone	228.94	439,241
29	EGD Rate Zone Suction	228.94	1,393,961
30	EGD Rate Zone Discharge	228.94	1,720,246
31	M12 Parkway	228.94	2,325,135
Total South Rate Zone			1,940,147
Total North Rate Zone			439,241
Total EGD Rate Zone			3,185,102
Total Ex-franchise			2,383,498
Total Design Day Demand			7,947,988

Dawn Parkway System

Winter Design Day Schematic

Winter 2023/2024

Legend



	Station Name	Kilometre Post (km)	Demand (GJ/d)
1	Dawn Compressor	0.00	-
2	Enniskillen	17.30	-
3	Brooke	36.79	-
4	Forest/ Watford	44.01	11,842
5	Strathroy	54.93	21,290
6	London West / Lobo	73.05	136,941
7	Hensall	85.74	46,686
8	London North	90.35	104,075
9	St Mary's	103.93	7,531
10	Stratford	121.45	47,609
11	Beachville	121.45	59,225
12	Bright Compressor	141.40	-
13	Oxford	142.92	53,058
14	Owen Sound	159.39	287,463
15	M17 Owen Sound	159.39	8,863
16	Cambridge	175.14	81,729
17	Brantford	175.14	112,394
18	Guelph	183.67	96,685
19	Kirkwall - Dominion	188.67	85,620
20	Hamilton 3	188.67	63,766
21	EGD Rate Zone	188.67	70,895
22	M12 Kirkwall	188.67	49,500
23	Hamilton 1&2	199.25	274,335
24	Milton	218.09	70,754
25	Halton Hills	221.61	145,048
26	Parkway Greenbelt	228.94	23,896
27	Burlington / Bronte	228.94	185,107
28	North Rate Zone	228.94	434,948
29	EGD Rate Zone Suction	228.94	1,393,961
30	EGD Rate Zone Discharge	228.94	1,720,246
31	M12 Parkway	228.94	2,298,408
Total South Rate Zone			1,915,055
Total North Rate Zone			434,948
Total EGD Rate Zone			3,185,102
Total Ex-franchise			2,356,771
Total Design Day Demand			7,891,876

System Capacity	GJ/d
Total System Capacity ^{1 2}	7,980,440
Total Demand Requirement	7,891,876
Surplus (Shortfall)	88,564
¹ Includes Parkway Delivery Obligation 253,356 GJ/d	
² Includes Supply at Kirkwall for M12 Contracts and Union Sales Service customers 428,711 GJ/d	

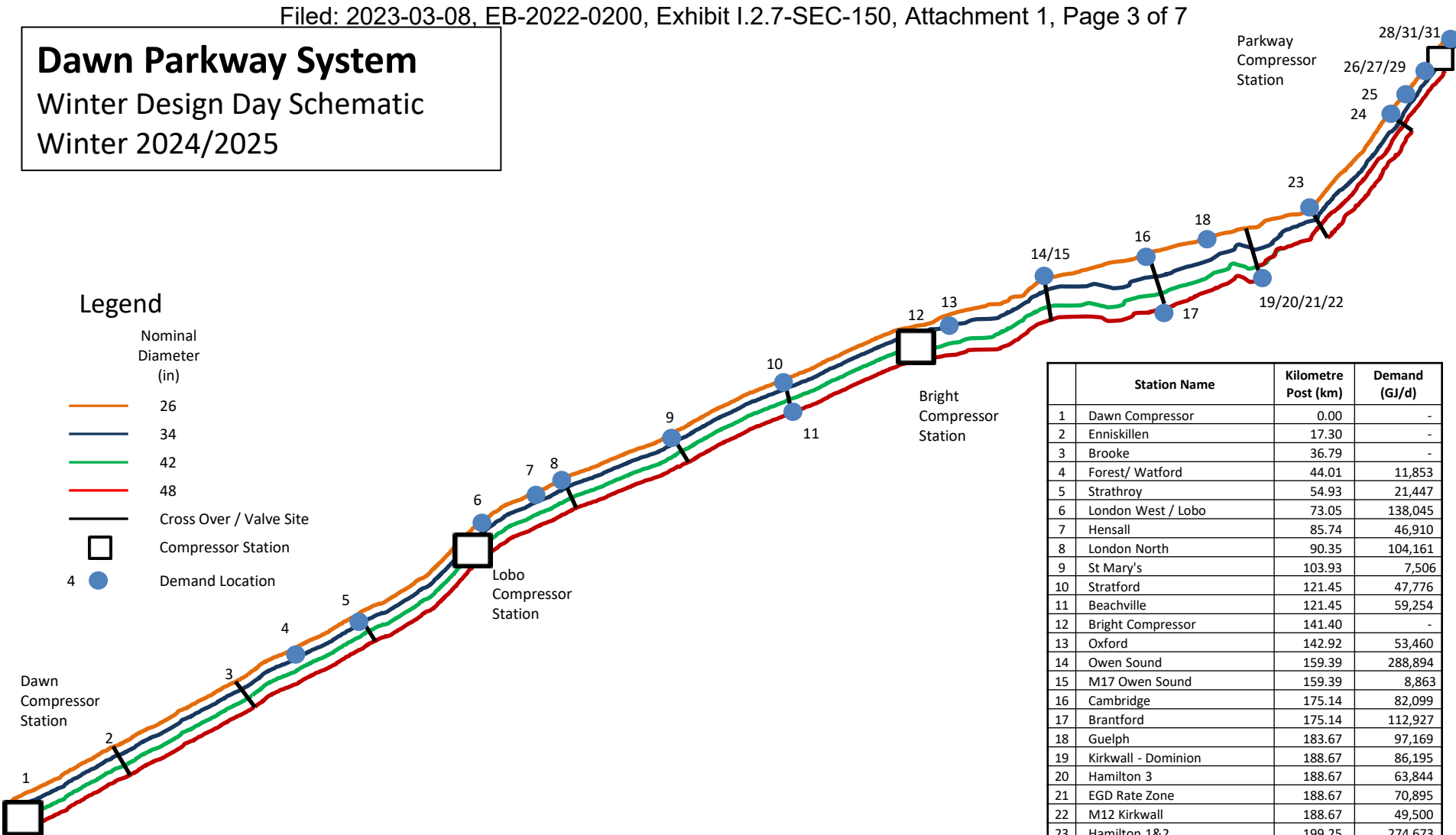
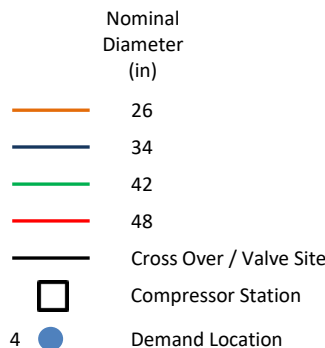
Compressor Station Operating Conditions			
Station	Lobo	Bright	Parkway
Power Available (MW)	102.9	129.0	88.1
Power Required (MW)	102.9	129.0	88.0
Suction Pressure (kPag)	3781	3530	3621
Discharge Pressure (kPag)	5578	5976	6454
Compression Ratio	1.5	1.7	1.8
Flow (GJ/d)	7,349,054	6,930,035	4,317,613
Daily Fuel (GJ/d)	34,319	27,676	18,045

Dawn Parkway System

Winter Design Day Schematic

Winter 2024/2025

Legend



System Capacity	GJ/d
Total System Capacity ^{1 2}	7,872,685
Total Demand Requirement	7,766,408
Surplus (Shortfall)	106,277
¹ Includes Parkway Delivery Obligation 252,909 GJ/d	
² Includes Supply at Kirkwall for M12 Contracts and Union Sales Service customers 285,484 GJ/d	

Compressor Station Operating Conditions			
Station	Lobo	Bright	Parkway
Power Available (MW)	102.9	129.0	88.1
Power Required (MW)	102.9	129.0	87.8
Suction Pressure (kPag)	3771	3487	3562
Discharge Pressure (kPag)	5556	5902	6454
Compression Ratio	1.5	1.7	1.8
Flow (GJ/d)	7,360,457	6,934,906	4,202,369
Daily Fuel (GJ/d)	34,319	28,783	17,934

	Station Name	Kilometre Post (km)	Demand (GJ/d)
1	Dawn Compressor	0.00	-
2	Enniskillen	17.30	-
3	Brooke	36.79	-
4	Forest/ Watford	44.01	11,853
5	Strathroy	54.93	21,447
6	London West / Lobo	73.05	138,045
7	Hensall	85.74	46,910
8	London North	90.35	104,161
9	St Mary's	103.93	7,506
10	Stratford	121.45	47,776
11	Beachville	121.45	59,254
12	Bright Compressor	141.40	-
13	Oxford	142.92	53,460
14	Owen Sound	159.39	288,894
15	M17 Owen Sound	159.39	8,863
16	Cambridge	175.14	82,099
17	Brantford	175.14	112,927
18	Guelph	183.67	97,169
19	Kirkwall - Dominion	188.67	86,195
20	Hamilton 3	188.67	63,844
21	EGD Rate Zone	188.67	70,895
22	M12 Kirkwall	188.67	49,500
23	Hamilton 1&2	199.25	274,673
24	Milton	218.09	71,373
25	Halton Hills	221.61	145,014
26	Parkway Greenbelt	228.94	24,106
27	Burlington / Bronte	228.94	186,248
28	North Rate Zone	228.94	434,722
29	EGD Rate Zone Suction	228.94	1,393,961
30	EGD Rate Zone Discharge	228.94	1,737,835
31	M12 Parkway	228.94	2,147,681
Total South Rate Zone			1,922,952
Total North Rate Zone			434,722
Total EGD Rate Zone			3,202,691
Total Ex-franchise			2,206,044
Total Design Day Demand			7,766,408

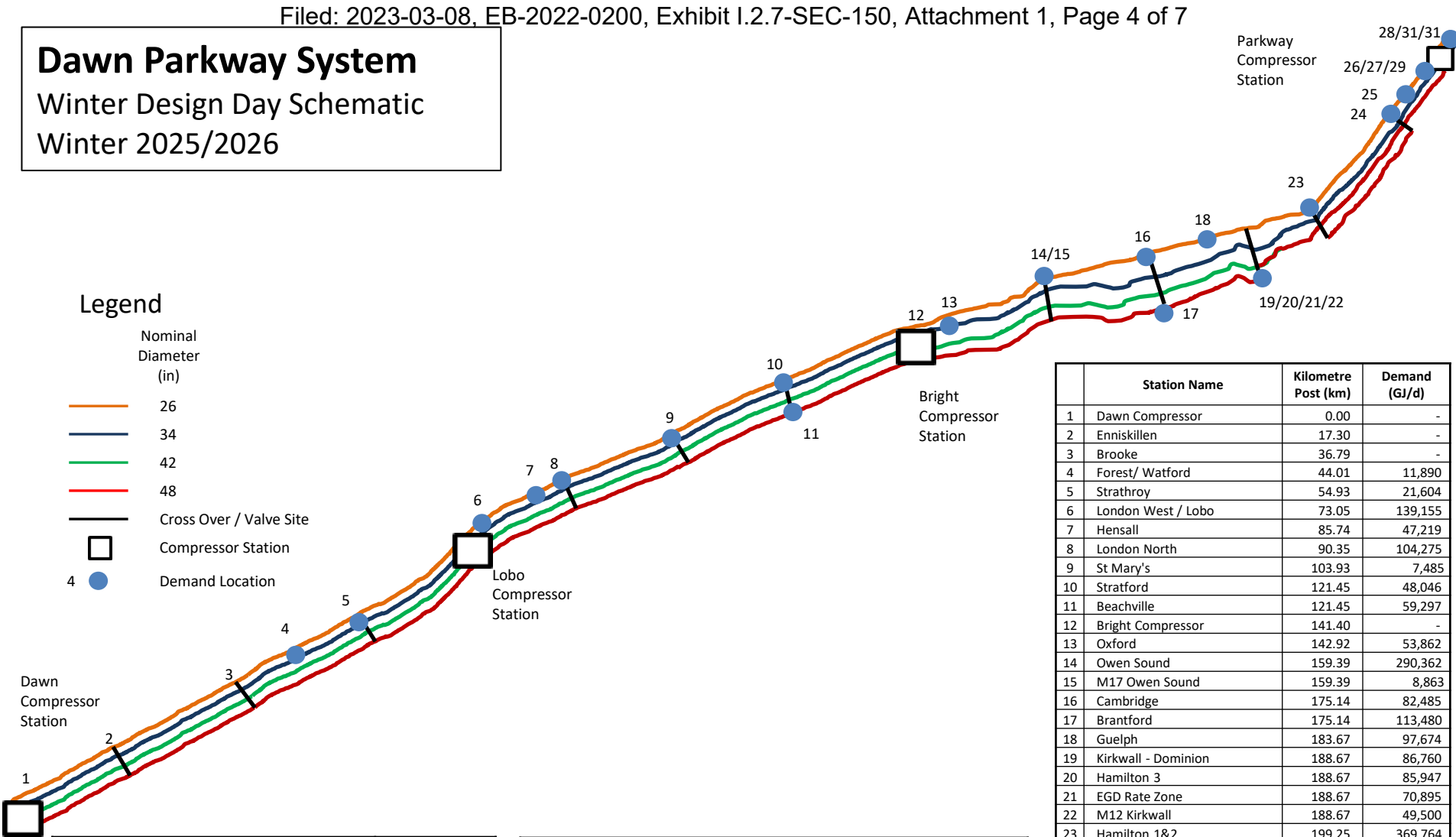
Dawn Parkway System

Winter Design Day Schematic

Winter 2025/2026

Legend

- Nominal Diameter (in)
- 26
 - 34
 - 42
 - 48
- Cross Over / Valve Site
- Compressor Station
- 4 Demand Location



System Capacity	GJ/d
Total System Capacity ^{1 2}	7,976,708
Total Demand Requirement	7,991,653
Surplus (Shortfall)	-14,945
¹ Includes Parkway Delivery Obligation 338,650 GJ/d	
² Includes Supply at Kirkwall for M12 Contracts and Union Sales Service customers 285,484 GJ/d	

Compressor Station Operating Conditions			
Station	Lobo	Bright	Parkway
Power Available (MW)	102.9	129.0	88.1
Power Required (MW)	102.9	129.0	87.1
Suction Pressure (kPag)	3765	3464	3525
Discharge Pressure (kPag)	5545	5861	6454
Compression Ratio	1.5	1.7	1.8
Flow (GJ/d)	7,366,877	6,940,220	4,095,650
Daily Fuel (GJ/d)	34,319	29,669	17,713

	Station Name	Kilometre Post (km)	Demand (GJ/d)
1	Dawn Compressor	0.00	-
2	Enniskillen	17.30	-
3	Brooke	36.79	-
4	Forest/ Watford	44.01	11,890
5	Strathroy	54.93	21,604
6	London West / Lobo	73.05	139,155
7	Hensall	85.74	47,219
8	London North	90.35	104,275
9	St Mary's	103.93	7,485
10	Stratford	121.45	48,046
11	Beachville	121.45	59,297
12	Bright Compressor	141.40	-
13	Oxford	142.92	53,862
14	Owen Sound	159.39	290,362
15	M17 Owen Sound	159.39	8,863
16	Cambridge	175.14	82,485
17	Brantford	175.14	113,480
18	Guelph	183.67	97,674
19	Kirkwall - Dominion	188.67	86,760
20	Hamilton 3	188.67	85,947
21	EGD Rate Zone	188.67	70,895
22	M12 Kirkwall	188.67	49,500
23	Hamilton 1&2	199.25	369,764
24	Milton	218.09	71,980
25	Halton Hills	221.61	144,983
26	Parkway Greenbelt	228.94	24,313
27	Burlington / Bronte	228.94	187,389
28	North Rate Zone	228.94	434,455
29	EGD Rate Zone Suction	228.94	1,393,961
30	EGD Rate Zone Discharge	228.94	1,752,268
31	M12 Parkway	228.94	2,233,742
Total South Rate Zone			2,047,969
Total North Rate Zone			434,455
Total EGD Rate Zone			3,217,124
Total Ex-franchise			2,292,105
Total Design Day Demand			7,991,653

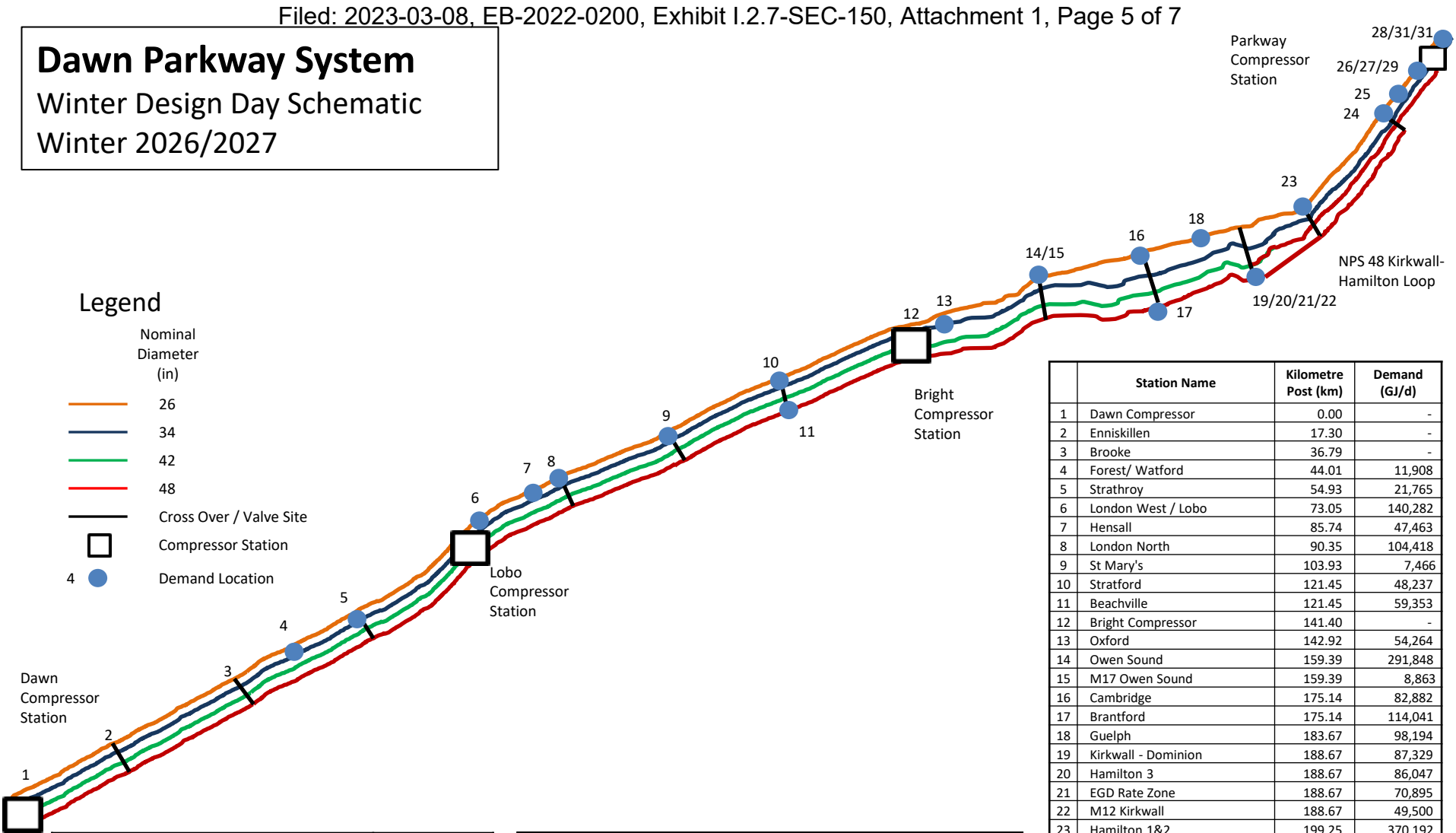
Dawn Parkway System

Winter Design Day Schematic

Winter 2026/2027

Legend

- Nominal Diameter (in)
- 26
 - 34
 - 42
 - 48
- Cross Over / Valve Site
- Compressor Station
- 4 Demand Location



System Capacity	GJ/d
Total System Capacity ^{1 2}	8,030,409
Total Demand Requirement	8,012,142
Surplus (Shortfall)	18,266
¹ Includes Parkway Delivery Obligation 336,109 GJ/d	
² Includes Supply at Kirkwall for M12 Contracts and Union Sales Service customers 285,484 GJ/d	

Compressor Station Operating Conditions			
Station	Lobo	Bright	Parkway
Power Available (MW)	102.9	129.0	88.1
Power Required (MW)	102.9	120.1	87.5
Suction Pressure (kPag)	3761	3448	3539
Discharge Pressure (kPag)	5536	5638	6454
Compression Ratio	1.5	1.6	1.8
Flow (GJ/d)	7,370,531	6,939,223	4,143,474
Daily Fuel (GJ/d)	34,319	29,890	16,938

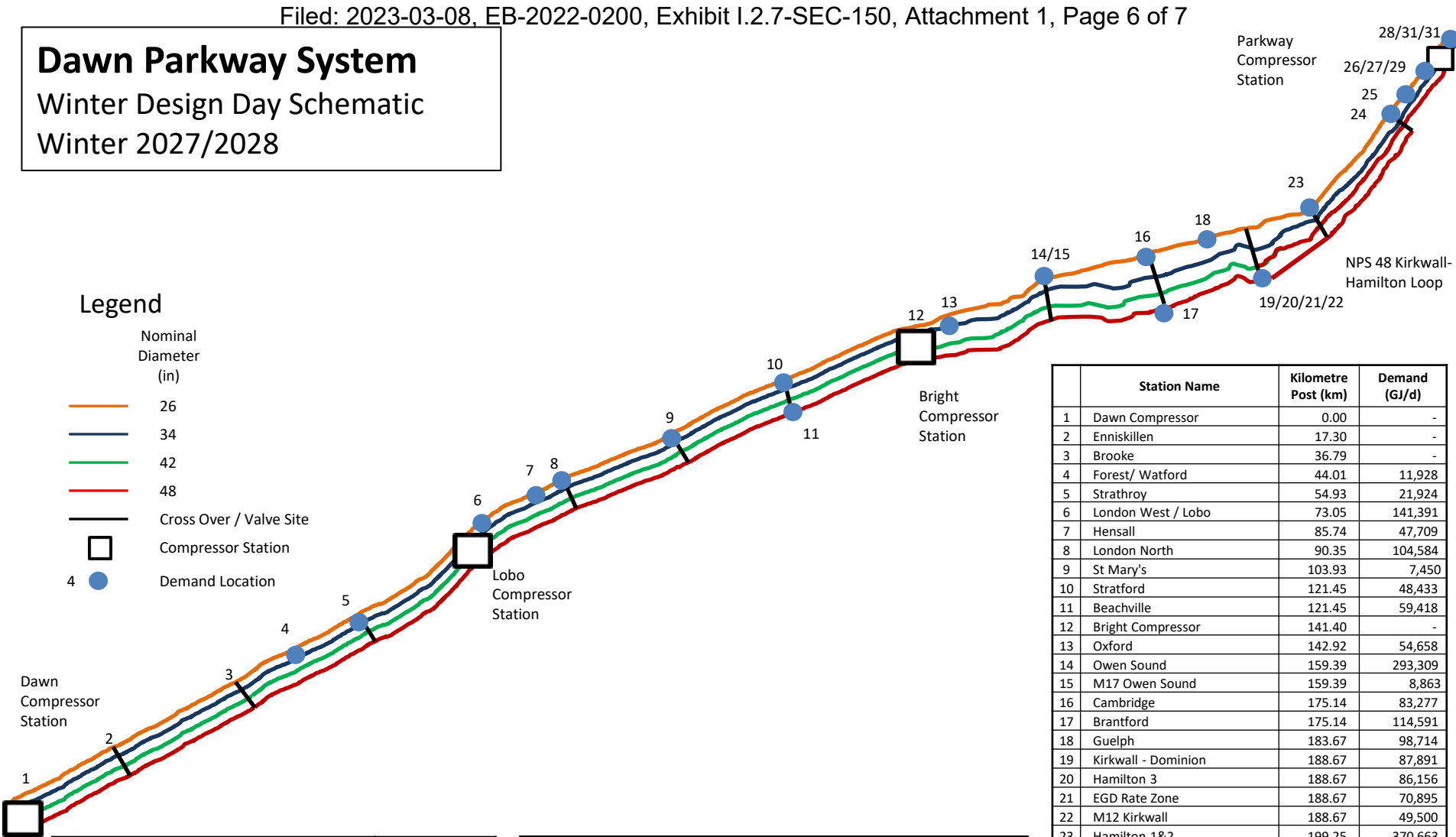
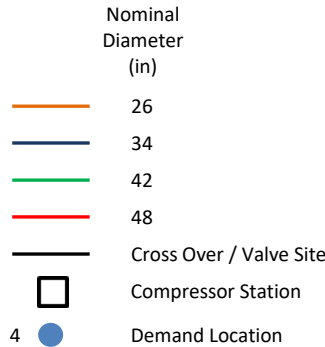
	Station Name	Kilometre Post (km)	Demand (GJ/d)
1	Dawn Compressor	0.00	-
2	Enniskillen	17.30	-
3	Brooke	36.79	-
4	Forest/ Watford	44.01	11,908
5	Strathroy	54.93	21,765
6	London West / Lobo	73.05	140,282
7	Hensall	85.74	47,463
8	London North	90.35	104,418
9	St Mary's	103.93	7,466
10	Stratford	121.45	48,237
11	Beachville	121.45	59,353
12	Bright Compressor	141.40	-
13	Oxford	142.92	54,264
14	Owen Sound	159.39	291,848
15	M17 Owen Sound	159.39	8,863
16	Cambridge	175.14	82,882
17	Brantford	175.14	114,041
18	Guelph	183.67	98,194
19	Kirkwall - Dominion	188.67	87,329
20	Hamilton 3	188.67	86,047
21	EGD Rate Zone	188.67	70,895
22	M12 Kirkwall	188.67	49,500
23	Hamilton 1&2	199.25	370,192
24	Milton	218.09	72,593
25	Halton Hills	221.61	144,956
26	Parkway Greenbelt	228.94	24,522
27	Burlington / Bronte	228.94	188,560
28	North Rate Zone	228.94	435,607
29	EGD Rate Zone Suction	228.94	1,393,961
30	EGD Rate Zone Discharge	228.94	1,763,254
31	M12 Parkway	228.94	2,233,742
Total South Rate Zone			2,056,321
Total North Rate Zone			435,607
Total EGD Rate Zone			3,228,110
Total Ex-franchise			2,292,105
Total Design Day Demand			8,012,142

Dawn Parkway System

Winter Design Day Schematic

Winter 2027/2028

Legend



	Station Name	Kilometre Post (km)	Demand (GJ/d)
1	Dawn Compressor	0.00	-
2	Enniskillen	17.30	-
3	Brooke	36.79	-
4	Forest/ Watford	44.01	11,928
5	Strathroy	54.93	21,924
6	London West / Lobo	73.05	141,391
7	Hensall	85.74	47,709
8	London North	90.35	104,584
9	St Mary's	103.93	7,450
10	Stratford	121.45	48,433
11	Beachville	121.45	59,418
12	Bright Compressor	141.40	-
13	Oxford	142.92	54,658
14	Owen Sound	159.39	293,309
15	M17 Owen Sound	159.39	8,863
16	Cambridge	175.14	83,277
17	Brantford	175.14	114,591
18	Guelph	183.67	98,714
19	Kirkwall - Dominion	188.67	87,891
20	Hamilton 3	188.67	86,156
21	EGD Rate Zone	188.67	70,895
22	M12 Kirkwall	188.67	49,500
23	Hamilton 1&2	199.25	370,663
24	Milton	218.09	73,200
25	Halton Hills	221.61	144,934
26	Parkway Greenbelt	228.94	24,730
27	Burlington / Bronte	228.94	189,736
28	North Rate Zone	228.94	436,874
29	EGD Rate Zone Suction	228.94	1,393,961
30	EGD Rate Zone Discharge	228.94	1,776,564
31	M12 Parkway	228.94	2,233,742
Total South Rate Zone			2,064,697
Total North Rate Zone			436,874
Total EGD Rate Zone			3,241,420
Total Ex-franchise			2,292,105
Total Design Day Demand			8,035,096

System Capacity	GJ/d
Total System Capacity ^{1 2}	8,029,008
Total Demand Requirement	8,035,096
Surplus (Shortfall)	-6,089
¹ Includes Parkway Delivery Obligation 331,641 GJ/d	
² Includes Supply at Kirkwall for M12 Contracts and Union Sales Service customers 285,484 GJ/d	

Compressor Station Operating Conditions			
Station	Lobo	Bright	Parkway
Power Available (MW)	102.9	129.0	88.1
Power Required (MW)	102.9	120.0	87.4
Suction Pressure (kPag)	3761	3448	3539
Discharge Pressure (kPag)	5535	5635	6454
Compression Ratio	1.5	1.6	1.8
Flow (GJ/d)	7,373,077	6,939,998	4,138,160
Daily Fuel (GJ/d)	34,319	29,890	16,827

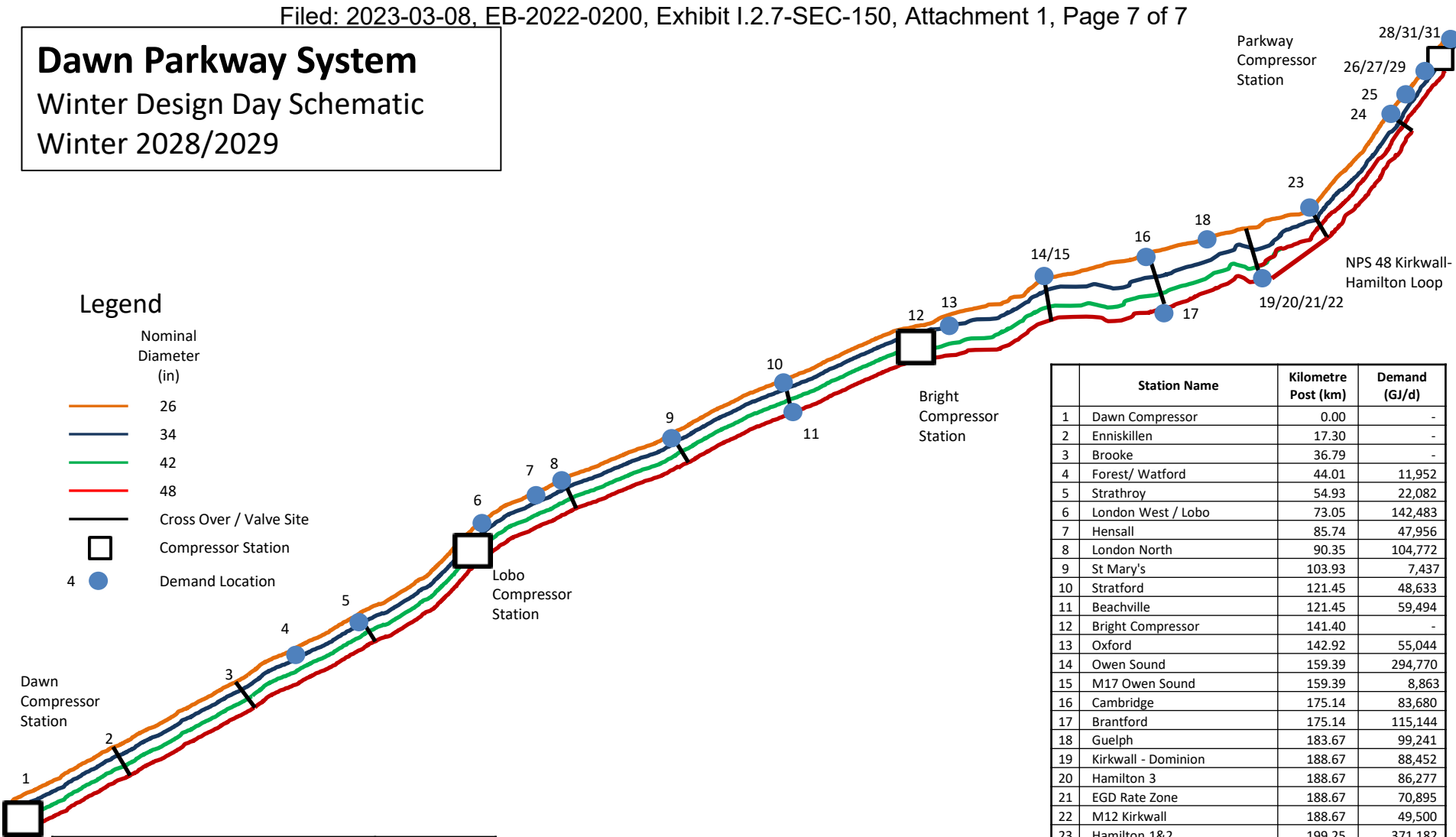
Dawn Parkway System

Winter Design Day Schematic

Winter 2028/2029

Legend

- Nominal Diameter (in)
- 26
 - 34
 - 42
 - 48
- Cross Over / Valve Site
- Compressor Station
- 4 Demand Location



System Capacity	GJ/d
Total System Capacity ^{1 2}	8,024,596
Total Demand Requirement	8,061,683
Surplus (Shortfall)	-37,086
¹ Includes Parkway Delivery Obligation 329,056 GJ/d	
² Includes Supply at Kirkwall for M12 Contracts and Union Sales Service customers 285,484 GJ/d	

Compressor Station Operating Conditions			
Station	Lobo	Bright	Parkway
Power Available (MW)	102.9	129.0	88.1
Power Required (MW)	102.9	119.8	87.2
Suction Pressure (kPag)	3760	3448	3539
Discharge Pressure (kPag)	5534	5633	6454
Compression Ratio	1.5	1.6	1.8
Flow (GJ/d)	7,370,974	6,936,124	4,127,865
Daily Fuel (GJ/d)	34,319	29,890	16,827

	Station Name	Kilometre Post (km)	Demand (GJ/d)
1	Dawn Compressor	0.00	-
2	Enniskillen	17.30	-
3	Brooke	36.79	-
4	Forest/ Watford	44.01	11,952
5	Strathroy	54.93	22,082
6	London West / Lobo	73.05	142,483
7	Hensall	85.74	47,956
8	London North	90.35	104,772
9	St Mary's	103.93	7,437
10	Stratford	121.45	48,633
11	Beachville	121.45	59,494
12	Bright Compressor	141.40	-
13	Oxford	142.92	55,044
14	Owen Sound	159.39	294,770
15	M17 Owen Sound	159.39	8,863
16	Cambridge	175.14	83,680
17	Brantford	175.14	115,144
18	Guelph	183.67	99,241
19	Kirkwall - Dominion	188.67	88,452
20	Hamilton 3	188.67	86,277
21	EGD Rate Zone	188.67	70,895
22	M12 Kirkwall	188.67	49,500
23	Hamilton 1&2	199.25	371,182
24	Milton	218.09	73,806
25	Halton Hills	221.61	144,916
26	Parkway Greenbelt	228.94	24,938
27	Burlington / Bronte	228.94	190,933
28	North Rate Zone	228.94	438,155
29	EGD Rate Zone Suction	228.94	1,393,961
30	EGD Rate Zone Discharge	228.94	1,793,376
31	M12 Parkway	228.94	2,233,742
Total South Rate Zone			2,073,191
Total North Rate Zone			438,155
Total EGD Rate Zone			3,258,232
Total Ex-franchise			2,292,105
Total Design Day Demand			8,061,683

ENBRIDGE GAS INC.

Answer to Interrogatory from
School Energy Coalition (SEC)

Interrogatory

Reference:

Exhibit 2, Tab 7, Schedule 2, page 6

Question(s):

Enbridge states “Enbridge Gas plans to file a stand-alone AMI Application as soon as practically possible requesting approval from the OEB for the funding and implementation of an AMI solution.”:

- a) Please explain when Enbridge expects to file this application and its expected scope.
- b) Please provide any existing estimate of costs, even at this early stage.
- c) Please explain how this stand-alone AMI application fits in to its proposed rate-setting framework.

Response:

- a) Enbridge Gas continues to evaluate the best overall strategy for AMI working alongside industry experts to determine overall scope, cost, savings and other benefits. Enbridge Gas will file a comprehensive application to the OEB as soon as practically possible.
- b) Enbridge Gas is not in a position at this time to provide any preliminary costs until the broader evaluation of this opportunity is complete.
- c) Given that there are no costs associated with the AMI assessment project included in the Rebasing Application, there are no considerations for AMI within the proposed rate framework. Enbridge Gas’s proposal for regulatory treatment of costs associated with AMI will be included in a future application to the OEB.