Metrolinx Electrification Project

Metrolinx Contract No. RQQ-2011-PP-032

Metrolinx Project No. 109503

UP EXPRESS UTILITY REPORT

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Submitted to

METROLINX
An agency of the Government of Ontario

Submitted by

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1.0 Executive Summary

The 25-km Union Pearson Express (UP Express) Project will provide an express rail service between Canada's two busiest transport hubs – Toronto's Union Station and Lester B. Pearson International Airport. The UP Express will operate along the USRC and Weston subdivision from Union Station to Highway 427 and the UP Express Spur line into Terminal 1 of Lester B. Pearson International Airport.

Metrolinx is proceeding with traction power electrification design of UP Express. Electrification of UP Express will consist of a 2x25 kV ac system (1x25 kV on UP Express Spur) delivering power to trains via an overhead contact system (OCS), and collected by roof-mounted pantograph current collectors on each train's locomotive or electric multiple unit (EMU) vehicles.

The impact due to electrification of the UP Express on existing utilities within the rail corridor has been evaluated in this report. Overhead utilities may encroach into OCS electrical clearances. Sensitive utilities attached externally to bridges may be exposed to unsafe touch-step potential energy levels. Buried metallic utilities or utility covers within the zone of influence may experience unsafe step and touch potential. Utilities may conflict spatially with proposed OCS foundation locations.

The measures recommended to mitigate the impacts due to electrification of the UP Express have been identified. Overhead utilities must maintain minimum electrical clearances. Sensitive utilities attached externally to bridges must be immunized. Metallic buried utilities or utility covers within the electrical Zone of Influence must be grounded and bonded. Where OCS foundations and utilities conflict spatially, the OCS foundation will be repositioned, where possible, or the utility must be diverted around the OCS foundation or reconstructed to avoid the OCS foundation.

Typical unit costs for utility mitigations are included in Section 6 of this report. These costs are assumed to be borne by the individual utility companies, but a review of specific obligations under individual board orders and easement agreements will be carried out during the detailed design.

2.0 Introduction

2.1 Purpose

The purpose of this report is: to provide a summary of known utilities routed across or parallel to the UP Express Corridor between Union Station and the Airport Spur turn off from the Weston Sub; to identify the crossings that require mitigation measures due to electrification; and to provide the estimated cost range to complete the mitigation measures.

2.2 Scope

Requirements for this commission are defined in Metrolinx Contract *RQQ-2011-PP-032, Appendix B Consultant's Scope of Services, Clauses 7(ii)(A)(II), 7(iv)(C), and 7(iv)(E)* as defined on page 23, 24, and 38. The report addresses the requirement to identify all utilities beside the corridor and on bridges, to identify any conflicts or impacts with these utilities due to electrification, to develop a mitigation plan, and to provide a cost estimate for any required modifications and utility relocations.

2.3 Reference Documents

The analysis undertaken in this report is based on the references, design terminology, and engineering standards defined in the following appendices –

- Appendix A – Abbreviations and Acronyms
- Appendix B – Definitions
- Appendix C – Applicable Engineering Standards
- Appendix D – Reference Documents Log
- Appendix E – Induced, Conducted and Radiated Interference Protection of Utilities.

2.4 Structure of the Report

This report is comprised of seven sections, the section headings of the remaining five sections are as follows –

- Section 3 – Utilities in the UP Express Corridor
- Section 4 – Impacts on Utilities
- Section 5 – Mitigation Measures
- Section 6 – Conflict Mitigation Cost Estimate
- Section 7 – Next Steps.

3.0 Utilities in the UP Express Corridor

As part of the UP Express Electrification EA, existing public and private utilities and underground infrastructure (utilities) have been identified within the study area. The locations of these utilities are based on plans received from the individual utility companies and municipalities during the Georgetown South (GTS) Expansion study process and survey information in the Union Station Rail Corridor. It is noted that there are a significant number of utilities being relocated as part of the GTS construction work that is currently ongoing. As a result, the assessment of any additional utility conflicts due to UP Express electrification will need to be reviewed by Metrolinx as part of the detailed design phase. Notwithstanding this, the following section summarizes the existing utilities in the vicinity of the study area.

There are numerous utilities located along the rail corridor. The majority of these utilities are local distribution utilities that cross the existing corridor providing services to residential neighbourhoods and commercial and industrial areas on both sides of the rail right-of-way. These utilities typically traverse the corridor at the existing road crossings; however, there are some utilities located in between the road crossings. There are also long distance transmission pipelines and hydro lines which cross the existing rail corridor.

3.1 Pipelines

There are apparently four existing pipelines (with possibly four owners) crossing the existing rail right-of-way in the existing hydro corridor at approximately Mile 11.1, just west of Kipling Avenue. There is an additional oil pipeline, owned by the City of Toronto at approximately Mile 6.1, near Old Weston Rd.

Error! Reference source not found. summarizes National Energy Board (NEB) applicability and equirements related to any relocation work that may be necessary as part of the works if identified in the detailed design phase. No relocation, lowering and extension of the existing protections were identified through preliminary design for the proposed work. These pipelines are –

- Sun-Canadian Pipe Line Company Ltd.: oil pipelines – size to be determined
- Interprovincial Pipelines/Imperial Oil – Sarnia Products Pipeline: high pressure oil pipelines
- Interprovincial Pipelines/Trans-Northern Pipelines: high pressure petroleum products pipeline
- Enbridge Pipelines: 300mm diameter high pressure crude oil pipeline.

3.2 Water Mains

The City of Toronto has approximately 65 water mains located within the study area from approximately Mile 1.57 to Mile 13.6. City of Toronto water mains vary from 150mm to 1500mm in diameter and most intersect the rail corridor at existing road crossings. The total number of water mains and those at road crossings will be confirmed during the detailed design phase.

3.3 Storm Sewers

The City of Toronto has approximately 41 storm sewers located within the study area from approximately Mile 1.34 to Mile 13.5 .City of Toronto storm sewers vary from 300mm to 2400mm in diameter and most intersect the rail corridor at existing road crossings. City of Toronto storm sewers also traverse the rail corridor away from existing road crossings. The total number of storm sewers and those at road crossings will be confirmed during the detailed design phase.

3.4 Sanitary Sewers

The City of Toronto has approximately 54 sanitary sewers and 32 combined sewers located within the study area. The City of Toronto also maintains numerous combined sewers of various sizes within the study area. City of Toronto sanitary sewers vary from 200mm to 2100mm in diameter and most intersect the rail corridor at existing road crossings. City of Toronto sanitary and combined sewers also traverse the rail corridor away from existing road crossings. The total number of sanitary sewers and those at road crossings will be confirmed during the detailed design phase.

3.5 Hydro One Transmission Corridors

Hydro One high-voltage transmission corridors cross the Weston Subdivision at four separate locations with a total of seven crossings. This is comprised of two 115 kVA underground pipe-type plant crossings just east of Strachan Avenue at Tecumseth Street (approximately Mile 1.25) and five high-tension power lines crossing the Weston Subdivision, one between St. Clair Avenue and Rogers Road (approximately Mile 5.63), three at Kipling Avenue (approximately Mile 11.1), and one at Highway 27 (approximately Mile 12.21).

Due to the proximity of the proposed UP Express electrification cables and the Hydro One transmission corridors, Hydro One will need to complete an analysis of the minimum clearance between the cables as many factors, such as wind, temperature, and cable loading, affect the height of the transmission lines. Although, at this preliminary design stage, the overhead crossings appear to have sufficient vertical clearance between the OCS wires and Hydro One's HV transmission wires, three lines are assumed to require raising for cost estimating purposes only. If contrary information arises during the detailed design stage, mitigation measures will be developed jointly between Hydro One and Metrolinx to resolve any conflict.

3.6 Toronto Hydro Distribution Lines

Toronto Hydro is the main hydro supplier within the City of Toronto and has significant aerial and buried plant (approximately 83 items) located within the study area. Most of the Toronto Hydro plant intersects the rail corridor at existing road crossings. Toronto Hydro also maintains a pole line along the west side of Carlingview Drive that continues along the rail corridor west of Carlingview Avenue and connects to Enersource (Hydro Mississauga) plant at Highway 427.

3.7 Gas Mains

Enbridge Gas maintains approximately 42gas mains located within the study area. The gas mains vary from 75mm to 900mm in diameter and most intersect the rail corridor at existing road crossings. The total number of gas mains and those at road crossings will be confirmed during the detailed design phase.

3.8 Bell Canada

Bell Canada maintains numerous aerial cable, buried cable and duct structures (approximately 35 in total) within the study area. All existing Bell plant intersects the rail corridor at existing road crossings.

3.9 Rogers Cable

Rogers Cable maintains aerial and buried fibre optic TV plant and aerial and buried coaxial TV plant within the study area. It appears that all existing Rogers Cable plant intersects the rail corridor at existing road crossings. At the rail crossings all plant is buried.

3.10 MTS Allstream

MTS Allstream maintains underground conduits and duct banks within the study area, crossing the rail corridor at Highway 401 (approximately Mile 10.7) and Ray Avenue (approximately Mile 7.2).

3.11 Utilities Parallel to the Rail Corridor

Utilities are also located within the existing rail corridor running parallel to the existing track alignment. These utilities include CN/CP signals and communications cable and fibre optic cable maintained by various communications companies including 360 Networks, Ledcor Communications and Rogers Communications (formerly Sprint Canada). The signals and communications cables provide power, signal control, wayside communications and telecommunications for railway operations. The fibre optic cable is utilized by a variety of services such as cable, banking, national defence, air traffic control and emergency communications.

3.12 Canada Packers

Canada Packers maintains six utilities, at approximately St. Clair (Mile 5.26 & 5.3), comprising three underground conduits, a water main, steam pipe, and a hydrogen pipeline.

3.13 Private Owner

At approximately Mile 5.26, a storm drain is identified within the study area belonging to a private owner. The private owner will be confirmed during the detailed design phase.

3.14 Canadian Gypsum Co.

A ditch culvert at approximately Mile 9.44, has been identified as belonging to the Canadian Gypsum Co.

3.15 TELUS

A duct bank, maintained by TELUS, is located at approximately Mile 12.37.

3.16 Woodbine Racetrack

Woodbine Racetrack maintains three utilities at approximately Mile 13.06, comprising two water mains and one sanitary sewer.

3.17 List of Known Utilities

There are apparently 374 known discrete utilities routed across or parallel to the UP Express rail corridor which were determined by reviewing available utility documentation. It is noted that based on consultation with GTAA, there is an underground jet fuel line of unknown size and material in the vicinity of the UP Express spur line. This fuel line will be further investigated and mitigation measures developed (as required), as part of the more detailed Utility assessment to be carried out during the detailed design phase. Field investigations and detailed utility searches were not undertaken within the study area, nor at the UP Express spur line. Those investigations would be undertaken at the start of a subsequent detailed design phase.

To review the potential impacts to utilities and applicable mitigation measures, **Table 3-2** was established in order to group similar utilities by distinct characteristics.

The following utilities have been identified in the UP Express rail corridor –

1. City of Toronto Sewer
2. City of Toronto Water Main
3. City of Toronto Gas
4. City of Toronto Other
5. Toronto Hydro Overhead Lines
6. Toronto Hydro Underground Conduits
7. Enbridge Gas
8. Enbridge Oil
16. Rogers Buried Duct Bank
17. Rogers Overhead Line
18. TTC Underground Conduit
19. TTC Overhead Line
20. Canada Packers Underground Conduit
21. Canada Packers Water Main
22. Canada Packers Hydrogen/Steam Pipeline
23. Woodbine Water Main

9. Enbridge Other
10. Bell Canada Underground Conduit
11. Bell Canada Buried Duct Bank
12. Bell Canada Overhead Line
13. Hydro One Oil Filled Pipe
14. Hydro One Overhead Line
15. Rogers Underground Conduit
24. Allstream Underground Conduit
25. Allstream Duct Bank
26. Interprovincial Pipelines Oil Pipeline
27. Canada Gypsum Co Ditch Culvert
28. Private Owner Storm Main
29. Sun Canadian Oil Pipeline
30. Telus Duct Bank.

Table 3-1 Utility Classification Table

No.	Category	Description
1	**Overhead Utilities**	Aerial utilities routed either crossing the track routing or parallel to the track routing within the rail corridor, but not associated with a specific bridge structure.
2	**Utilities on/attached to bridges**	Aerial utilities attached externally to bridge structures and underground utilities embedded within a bridge structure.
3	**Buried Utilities – Crossing ROW**	Underground utilities crossing rail tracks with an orientation varying up to 45° from a perpendicular direction to track routing.
3.1	Linear	Utilities where depth, bends, and slope are critical (ie. storm sewers, sanitary sewers, culverts, subdrains)
3.2	Semi-linear	Utilities where depth, bends, and slope impact provision of service, but with a limited effect (ie. Water mains, steam/gas/oil pipelines, hydro)
3.3	Non-linear	Utilities where depth, bends, and slope do not impact provision of service (ie. fibre optics, signal cables, telecoms);
4	**Buried Utilities – Parallel to ROW**	Underground utilities routed parallel to rail tracks with an orientation varying up to 45° from a parallel direction to track routing.
4.1	Linear	Utilities where depth, bends, and slope are critical (ie storm sewers, sanitary sewers, culverts, subdrains)
4.2	Semi-linear	Utilities where depth, bends, and slope impact provision of service, but a limited effect (ie Water mains, steam/gas/oil pipelines, hydro)
4.3	Non-linear	Utilities where depth, bends, and slope do not impact provision of service (ie fibre optics, signal cables, telecoms);

Table 3-2 shows the 374 discrete utilities with their approximate location and classification type. **Table 3-4** summarizes the total number of utilities for each owner.

Table 3-2 List of Known Utilities Routed Across or Parallel to the UP Express Rail Corridor

Item	Mile	Station	EA Sect	Owner	Utility Class	Description	Approximate Location
1	0.58	0+935	1	Toronto Hydro - to be Confirmed during detailed design Phase	1	Overhead Wire	Near Spadina Ave.
2	0.7	1+125	1	Toronto Hydro	3.2	Overhead Wire	Spadina Ave.
3	1.22	1+965	1	Enbridge	3.2	150mm Gas Main	Tecumseh St.
4	1.22	1+965	1	Enbridge	3.2	75mm Gas Main	Tecumseh St.
5	1.25	2+010	1	Hydro One	3.2	Oil-filled pipes	Crossing Tecumseh St.
6	1.25	2+010	1	Hydro One	3.2	Oil-filled pipes	Crossing Tecumseh St.
7	1.34	2+155	1	City of Toronto	3.1	2400mm Storm (Garrison Creek Sewer)	Crossing West of Tecumseh St.
8	1.57	2+525	1	City of Toronto	3.2	Utility Tunnel - 300mm watermain (SS)	Strachan Ave.
9	1.57	2+525	1	City of Toronto	3.2	Utility Tunnel - 600mm sanitary force main	Strachan Ave.
10	1.57 5	2+525	1	City of Toronto	3.2	Utility Tunnel - 600mm sanitary force main	Strachan Ave.
11	1.58	2+545	1	Toronto Hydro	3.3	Street Lighting	Strachan Ave.
12	1.58	2+545	1	Toronto Hydro	3.2	Underground Conduit	Strachan Ave.
13	1.59	2+559	1	Toronto Hydro	3.3	Street Lighting	Strachan Ave. Bridge
14	1.59	2+559	1	City of Toronto	3.3	Traffic Signals Conduit	Strachan Ave. Bridge
15	1.59	2+560	1	Bell Canada	3.3	Underground Conduit	Strachan Ave.
16	1.59	2+560	1	City of Toronto	3.1	3000mm CSO Siphon Tunnel	Strachan Ave.
17	1.59	2+560	1	City of Toronto	3.1	3075mm Combination Sewer	Strachan Ave.
18	1.59	2+560	1	City of Toronto	3.1	675mm Sanitary Sewer	Strachan Ave.
19	1.59	2+560	1	City of Toronto	3.1	675mm Sanitary Sewer	Strachan Ave.
20	1.59	2+560	1	City of Toronto	3.2	150mm Water Main	Strachan Ave.
21	1.59	2+560	1	City of Toronto	3.2	300mm Water Main	Strachan Ave.
22	1.59	2+560	1	Enbridge	3.2	300mm Gas Main	Strachan Ave.
23	1.59	2+560	1	Enbridge	3.2	200mm Gas Main	Strachan Ave.
24	1.59	2+560	1	Toronto Hydro	3.3	Street Lighting	Strachan Ave.

Item	Mile	Station	EA Sect	Owner	Utility Class	Description	Approximate Location
25	1.59	2+560	1	Toronto Hydro	1	Overhead Wire	Strachan Ave.
26	1.6	2+575	1	Toronto Hydro	3.2	Utility Tunnel	Strachan Ave.
27	1.75	2+815	1	Toronto Hydro	3.2	Underground Conduit	Douro St. / Western Battery Rd.
28	1.86	2+995	1	City of Toronto	3.2	150mm Water Main	Sudbury St. & Dovercourt Rd.
29	1.99	3+205	1	City of Toronto	3.2	825mm Combined Sewer	King St.
30	1.99	3+205	1	City of Toronto	1	1200mm Storm Sewer	King St.
31	1.99	3+205	1	City of Toronto	3.2	1100mm Sanitary Sewer	King St.
32	1.99	3+205	1	City of Toronto	3.2	300mm Water Main	King St.
33	1.99	3+205	1	City of Toronto	3.2	600mm Gas Main	King St.
34	1.99	3+205	1	Enbridge	3.2	400mm Gas Main	King St.
35	1.99	3+205	1	Toronto Hydro	3.3	Underground Conduit	King St.
36	1.99	3+205	1	Toronto Hydro	3.3	Underground Conduit	King St.
37	1.99	3+205	1	Toronto Hydro	3.3	Underground Conduit	King St.
38	1.99	3+205	1	TTC	1	Overhead Wire	King St.
39	2	3+220	1	Toronto Hydro	1	Overhead Wire	Sudbury St. / Dovercourt Rd.
40	2	3+220	1	Toronto Hydro	3.2	Underground Conduit	King St. West
41	2.17	3+490	1	City of Toronto	3.2	400mm Water Main	Sudbury St. / Lisgar St.
42	2.19	3+525	1	Enbridge	3.2	300mm Gas Main	Sudbury St.
43	2.4	3+860	1	Bell Canada	3.3	Underground Conduit	West of Queen St.
44	2.46	3+960	1	Bell Canada	3.3	Ducts in Sidewalk	Queen St.
45	2.46	3+960	1	City of Toronto	3.1	1100mm Storm Sewer	Queen St.
46	2.46	3+960	1	City of Toronto	3.1	300mm Combined Sewer	Queen St.
47	2.46	3+960	1	City of Toronto	3.2	300mm Water Main	Queen St.
48	2.46	3+960	1	Enbridge	3.2	200mm Gas Main	Queen St.
49	2.46	3+960	1	Enbridge	3.2	300mm Gas Main	Queen St.
50	2.46	3+960	1	Enbridge	3.2	100mm Gas Main	Queen St.
51	2.46	3+960	1	Toronto Hydro	3.3	Street Lighting	Queen St.
52	2.46	3+960	1	TTC	1	Overhead Wire	Queen St.
53	2.46	3+960	1	Toronto Hydro - to be Confirmed during detailed design Phase	1	Overhead Wire	Dufferin St.

Item	Mile	Station	EA Sect	Owner	Utility Class	Description	Approximate Location
54	2.52	4+055	1	City of Toronto	3.2	300mm Water Main	Dufferin St.
55	2.52	4+055	1	Enbridge	3.2	100mm Gas Main	Dufferin St.
56	2.54	4+090	1	City of Toronto	3.1	Storm Sewer – Size to be Confirmed during detailed design Phase	Noble St.
57	2.54	4+090	1	City of Toronto	3.1	Sanitary Sewer – Size to be Confirmed during detailed design Phase	Noble St.
58	2.55	4+105	1	Toronto Hydro - to be Confirmed during detailed design Phase	1	Overhead Wire	Dufferin St. / Noble St.
59	2.56	4+120	1	City of Toronto	3.1	375mm Combined Sewer	Noble St.
60	2.58	4+150	1	City of Toronto	3.2	500mm Water Main	Earnbridge St.
61	2.78	4+475	1	City of Toronto	3.1	2550mm Combined Sewer	Near Brock Ave.
62	2.79	4+490	1	Bell Canada	3.3	Underground Duct Structure	Brock Ave.
63	2.79	4+490	1	Bell Canada	3.3	Underground Conduit	Brock Ave.
64	2.79	4+490	1	City of Toronto	3.1	375mm Combined Sewer	Brock Ave.
65	2.79	4+490	1	City of Toronto	3.2	300mm Water Main	Brock Ave.
66	2.79	4+490	1	Enbridge	3.2	200mm Gas Main on North side of corridor	Brock Ave.
67	2.79	4+490	1	Toronto Hydro	3.3	Street Lighting	Brock Ave.
68	2.8	4+505	1	Bell Canada	3.3	Underground Conduit	West side of Brock Ave.
69	2.95	4+750	1	Toronto Hydro	3.3	Underground Conduit	O'Hara Ave.
70	3.04	4+890	1	City of Toronto	3.2	900mm Water Main	East of Lansdowne Ave.
71	3.11	5+005	1	City of Toronto	3.2	900mm Water Main	Near Lansdowne Ave.
72	3.12	5+020	1	Bell Canada	3.3	Tile Duct	Lansdowne Ave.
73	3.12	5+020	1	City of Toronto	3.2	300mm Water Main	Lansdowne Ave.
74	3.12	5+020	1	City of Toronto	3.1	600mm Storm Sewer	Lansdowne Ave.
75	3.12	5+020	1	City of Toronto	3.1	1950mm Storm	Lansdowne

Item	Mile	Station	EA Sect	Owner	Utility Class	Description	Approximate Location
						Sewer	Ave.
76	3.12	5+020	1	City of Toronto	3.1	525mm Storm Sewer	Lansdowne Ave.
77	3.12	5+020	1	City of Toronto	3.1	450mm Storm Sewer	Lansdowne Ave.
78	3.12	5+020	1	Enbridge	3.2	300mm Gas Main	Lansdowne Ave.
79	3.12	5+020	1	Toronto Hydro	3.3	Street Lighting	Lansdowne Ave.
80	3.12	5+020	1	Toronto Hydro	3.3	Underground Conduit	Lansdowne Ave.
81	3.12	5+020	1	Toronto Hydro	3.3	Underground Conduit	Lansdowne Ave.
82	3.45	5+550	1	City of Toronto	3.1	2100mm Sanitary Sewer	Dundas St.
83	3.45	5+550	1	City of Toronto	3.2	300mm Water Main	Dundas St.
84	3.45	5+550	1	Toronto Hydro	1	Overhead Wire	Dundas St.
85	3.45	5+550	1	Toronto Hydro	3.3	Underground Conduit	Dundas St.
86	3.45	5+550	1	TTC	1	Overhead Wire	Dundas St.
87	3.46	5+582	1	City of Toronto	3.3	Traffic Signals Conduit	Dundas St. Bridge
88	3.46	5+582	1	Toronto Hydro	3.3	Street Lighting	Dundas St. Bridge
89	3.46	5+582	1	TTC	1	Overhead Wire	Dundas St. Bridge
90	3.47	5+585	1	City of Toronto	3.2	300mm Water Main	West of Dundas St.
91	3.96	6+375	1	Bell Canada	3.3	Underground Duct Structure	Bloor St.
92	3.96	6+375	1	City of Toronto	3.1	1200mm Combined Sewer	Bloor St.
93	3.96	6+375	1	City of Toronto	3.2	300mm Water Main	Bloor St.
94	3.96	6+375	1	City of Toronto	3.2	300mm Gas Main	Bloor St.
95	3.96	6+375	1	Toronto Hydro	3.3	Underground Conduit	Bloor St.
96	3.96	6+375	1	TTC	3.3	Underground Conduit	Bloor St.
97	4.01	6+455	1	TTC	3.1	Underground Conduit	Bloor Station
98	4.27	6+870	2	Bell Canada	3.3	Underground Conduit	Near Wallace Ave.
99	4.27	6+870	2	Bell Canada	3.3	Underground 4-Duct Structure	Near Wallace Ave.
100	4.27	6+870	2	City of Toronto	3.1	1800mm x 2650mm Combined Sewer	Near Wallace Ave.

Item	Mile	Station	EA Sect	Owner	Utility Class	Description	Approximate Location
101	4.3	6+920	2	City of Toronto	3.1	1500mm Storm Sewer	Ruskin Ave. & Jerome St.
102	4.3	6+920	2	City of Toronto	3.1	1125mm Combined Sewer	Ruskin Ave. & Jerome St.
103	4.3	6+920	2	Enbridge	3.2	300mm Gas Main	Ruskin Ave. & Jerome St.
104	4.31	6+935	2	Bell Canada	3.3	Underground 4-Duct Structure	Wallace Ave.
105	4.36	7+015	2	City of Toronto	3.1	1500mm Storm Sewer	Ruskin Ave.
106	4.37	7+035	2	Enbridge	3.2	300mm Gas Main	Ruskin Ave.
107	4.38	7+050	2	City of Toronto	3.1	1125mm Combo Sewer	Ruskin Ave.
108	4.4	7+080	2	City of Toronto	3.1	1125mm Sewer	Jerome St. & Ruskin Ave.
109	4.4	7+080	2	Toronto Hydro	3.3	Underground Conduit	Ruskin Ave.
110	4.44	7+145	2	City of Toronto	3.2	1350mm Water Main	Near Humberside Ave.
111	4.45	7+160	2	City of Toronto	3.2	900mm Water Main	Humberside Ave.
112	4.48	7+210	2	City of Toronto	3.2	1350mm Water Main	Humberside Ave.
113	4.5	7+240	2	City of Toronto	3.2	900mm Water Main	Humberside Ave. / Edwin Ave.
114	4.6	7+405	2	Bell Canada	3.3	Underground Conduit	Dupont Ave.
115	4.6	7+405	2	City of Toronto	3.2	400mm Water Main	Dupont Ave.
116	4.6	7+405	2	City of Toronto	3.1	900mm Combined Sewer	Dupont Ave.
117	4.6	7+405	2	Enbridge	3.2	100mm Gas Main	Dupont Ave.
118	4.6	7+405	2	Enbridge	3.2	100mm Gas Main	Dupont Ave.
119	4.6	7+405	2	Toronto Hydro	3.3	Underground Conduit	Dupont Ave.
120	4.62	7+435	2	Bell Canada	3.3	Underground Conduit	Dupont Ave. / Annette St.
121	4.77	7+675	2	City of Toronto	3.1	1450mm Sewer	Old Weston Rd.
122	4.8	7+725	2	Bell Canada	3.3	Underground Conduit	Old Weston Rd. / Watkinson Ave.
123	4.8	7+725	2	Toronto Hydro - to be Confirmed during detailed design Phase	1	Overhead Wire	Old Weston Rd.
124	4.99	8+030	2	City of Toronto	3.2	300mm Water Main	Cawthra Ave.
125	4.99	8+030	2	City of Toronto	3.2	1200mm Water	Cawthra Ave.

Item	Mile	Station	EA Sect	Owner	Utility Class	Description	Approximate Location
						Main	
126	4.99	8+030	2	Toronto Hydro	3.3	Underground Conduit	Cawthra Ave.
127	5	8+045	2	City of Toronto	3.1	450mm Sewer	Cawthra Ave.
128	5	8+045	2	City of Toronto	3.2	300mm Water Main	Cawthra Ave.
129	5.1	8+210	2	City of Toronto	3.1	100mm Sewer	Old Weston Rd. / St. Clair Ave.
130	5.14	8+270	2	Enbridge	3.2	100mm Gas Main	Cawthra Ave.
131	5.23	8+415	2	Toronto Hydro	3.3	Underground Conduit	St. Clair Ave.
132	5.25	8+450	2	Bell Canada	3.3	Underground Conduit	St. Clair Ave.
133	5.26	8+465	2	Canada Packers	3.3	Underground Conduit	St. Clair Ave.
134	5.26	8+465	2	Canada Packers	3.2	200mm Water Main	St. Clair Ave.
135	5.26	8+465	2	Canada Packers	3.2	Hydrogen Pipeline	St. Clair Ave.
136	5.26	8+465	2	Canada Packers	3.3	Underground Conduit	Gunns Rd.
137	5.26	8+465	2	Canada Packers	3.2	Steam Pipe	St. Clair Ave.
138	5.26	8+465	2	City of Toronto	3.1	1350mm Sewer	St. Clair Ave.
139	5.26	8+465	2	City of Toronto	3.1	675mm Concrete Pipe	Symes Rd.
140	5.26	8+465	2	Enbridge	3.2	900mm Gas Main	St. Clair Ave.
141	5.26	8+465	2	Toronto Hydro	3.3	Underground Conduit	St. Clair Ave.
142	5.26	8+465	2	Toronto Hydro	3.3	Underground Conduit	St. Clair Ave.
143	5.26	8+465	2	Private Owner - to be Confirmed during detailed design Phase	3.1	300mm Storm Drain	St. Clair Ave.
144	5.3	8+530	2	Bell Canada	3.3	Duct in Sidewalk	St. Clair Ave.
145	5.3	8+530	2	Canada Packers	3.3	Underground Conduit	St. Clair Ave.
146	5.3	8+530	2	City of Toronto	3.1	1200mm Sewer	St. Clair Ave.
147	5.3	8+530	2	City of Toronto	3.1	600mm Combined Sewer	St. Clair Ave.
148	5.3	8+530	2	City of Toronto	3.1	1275mm Combined Sewer	St. Clair Ave.
149	5.3	8+530	2	City of Toronto	3.1	300mm Combined Sewer	St. Clair Ave.
150	5.3	8+530	2	City of Toronto	3.2	600mm Water Main	St. Clair Ave.
151	5.3	8+530	2	City of Toronto	3.2	500mm Water Main	St. Clair Ave.
152	5.3	8+530	2	Enbridge	3.2	500mm Gas Main	St. Clair Ave.
153	5.3	8+530	2	Enbridge	3.2	200mm Gas Main	St. Clair Ave.
154	5.3	8+530	2	Enbridge	3.2	300mm Gas Main	St. Clair Ave.

Item	Mile	Station	EA Sect	Owner	Utility Class	Description	Approximate Location
155	5.3	8+530	2	Toronto Hydro	3.3	Underground Conduit	St. Clair Ave.
156	5.3	8+530	2	TTC	1	Overhead Wire	St. Clair Ave.
157	5.31	8+545	2	Toronto Hydro	3.3	Duct in Sidewalk	St Clair Ave.
158	5.34	8+595	2	Bell Canada	3.3	Underground Conduit	St Clair Ave.
159	5.37	8+640	2	Toronto Hydro	1	Overhead Wire	North of St Clair Ave.
160	5.39	8+675	2	City of Toronto	3.1	1000mm Brick Storm Sewer	St Clair Ave.
161	5.49	8+835	2	City of Toronto	3.1	1800mm Storm Sewer	North of St. Clair Ave.
162	5.5	8+850	2	City of Toronto	3.1	1950mm Combined Sewer	Northland Ave.
163	5.5	8+850	2	Toronto Hydro	1	Overhead Wire	North of St. Clair Ave.
164	5.62	9+045	2	Enbridge	3.2	Pipe Crossing in 750mm Casing	North of St. Clair Ave.
165	5.63	9+060	2	Hydro One	1	12 Overhead Wires on one Tower	North of St. Clair Ave.
166	5.65	9+095	2	Toronto Hydro	1	Overhead Wire	Weston Rd./ St. Clair Ave.
167	5.67	9+125	2	City of Toronto	3.1	2400mm Storm Sewer	North of St. Clair Ave.
168	5.7	9+175	2	City of Toronto	3.2	300mm Water Main	Nashville Ave.
169	5.85	9+415	2	City of Toronto	3.1	200mm Brick Trunk Sewer	North of St. Clair Ave.
170	6.1	9+815	2	City of Toronto	3.2	Oil Pipeline	Old Weston Rd.
171	6.12	9+850	2	Toronto Hydro	1	Overhead Wire	Rogers Rd.
172	6.13	9+863	2	City of Toronto	3.3	Traffic Signals Conduit	Rogers Rd. Bridge
173	6.13	9+863	2	Toronto Hydro	3.3	Street Lighting	Rogers Rd. Bridge
174	6.14	9+880	2	Bell Canada	3.3	Underground Conduit	Rogers Rd.
175	6.14	9+880	2	Enbridge	3.2	200mm Gas Main	West of Rogers Rd.
176	6.24	10+040	2	Toronto Hydro	3.3	Underground Conduit	East of Black Creek
177	6.3	10+140	2	City of Toronto	3.2	300mm Water Main	Porter Ave.
178	6.4	10+300	2	City of Toronto	3.1	450mm Sanitary Sewer	Black Creek Dr.
179	6.42	10+330	2	City of Toronto	3.1	1675mm Sewer	West of Black Creek Dr.
180	6.45	10+380	2	City of Toronto	3.1	To be Confirmed during detailed	Black Creek Dr.

Item	Mile	Station	EA Sect	Owner	Utility Class	Description	Approximate Location
						design phase	
181	6.45	10+380	2	Toronto Hydro	3.2	To be Confirmed during detailed design phase	West of Black Creek Dr.
182	6.81	10+960	2	Bell Canada	3.2	To be Confirmed during detailed design Phase	Eglinton Ave.
183	6.81	10+960	2	City of Toronto	3.2	1050mm Water Main	Near Eglinton Ave.
184	6.82	10+975	2	City of Toronto	3.1	1200mm Storm Sewer	Eglinton Ave.
185	6.82	10+975	2	Enbridge	3.2	300mm Gas Main	Eglinton Ave.
186	6.82	10+975	2	Toronto Hydro	3.2	To be Confirmed during detailed design phase	Eglinton Ave.
187	6.83	10+990	2	City of Toronto	3.2	400mm Water Main	Near Eglinton Ave.
188	6.83	10+990	2	Enbridge	3.2	300mm Gas Main	Eglinton Ave.
189	6.84	11+010	2	City of Toronto	3.2	400mm Water Main	North of Eglinton Ave.
190	6.94	11+170	2	Toronto Hydro	1	Overhead Wire	North of Eglinton Ave.
191	7.17	11+540	2	Bell Canada	3.3	Underground Conduit	Ray Ave.
192	7.17	11+540	2	City of Toronto	3.1	1000mm Storm Sewer	Ray Ave.
193	7.17	11+540	2	City of Toronto	3.1	1050mm Sanitary Sewer	Ray Ave.
194	7.17	11+540	2	City of Toronto	3.1	1050mm Storm Sewer	Ray Ave.
195	7.17	11+540	2	City of Toronto	3.2	300mm Water Main	Ray Ave.
196	7.17	11+540	2	City of Toronto	3.1	375mm Sanitary Sewer	Ray Ave.
197	7.17	11+540	2	Enbridge	3.2	150mm Gas Main	Ray Ave.
198	7.17	11+540	2	Rogers	1	Overhead Wire	Ray Ave.
199	7.17	11+540	2	Toronto Hydro	1	Overhead Wire	Ray Ave.
200	7.17	11+540	2	Allstream	3.3	Fibre Crossing in Underground Conduit	Ray Ave.
201	7.2	11+585	2	City of Toronto	3.2	300mm Water Main	West of Ray Ave.
202	7.2	11+585	2	City of Toronto	3.2	150mm Water Main	Bartonville Ave. East
203	7.2	11+585	2	Enbridge	3.2	200mm Gas Main	Ray Ave.
204	7.2	11+585	2	Toronto Hydro	1	Overhead Wire	Ray Ave.
205	7.43	11+955	2	Toronto Hydro	1	Overhead Wire	East of Jane St.

Item	Mile	Station	EA Sect	Owner	Utility Class	Description	Approximate Location
206	7.5	12+070	2	Toronto Hydro - to be Confirmed during Detailed design Phase	1	Overhead Wire	East of Jane St.
207	7.69	12+375	2	Toronto Hydro	3.3	Street Lighting	Jane St. Bridge
208	7.69	12+375	2	City of Toronto	3.3	Traffic Signals Conduit	Jane St. Bridge
209	7.69	12+375	2	Toronto Hydro - to be Confirmed during Detailed design Phase	1	Overhead Wire	East of Jane St.
210	7.7	12+390	2	Bell Canada	3.3	Underground Conduit	Jane St.
211	7.7	12+390	2	City of Toronto	3.2	150mm Water Main	Jane St.
212	7.7	12+390	2	Enbridge	3.2	300mm Gas Main	Jane St.
213	7.8	12+555	2	City of Toronto	3.1	200mm Sanitary	Lippincott St. East
214	7.8	12+555	2	Toronto Hydro	1	Overhead Wire	Lippincott St. East
215	7.89	12+700	2	Enbridge	3.2	150mm Gas Main	Lippincott St. East
216	7.95	12+795	2	Bell Canada	3.3	Underground Duct Structure encased in wood	Denison Rd.
217	7.95	12+795	2	City of Toronto	3.2	150mm Water Main	Denison Rd.
218	7.95	12+795	2	City of Toronto	3.2	300mm Water Main	Denison Rd. East
219	7.95	12+795	2	Enbridge	3.2	150mm Gas Main	Denison Rd.
220	7.96	12+810	2	City of Toronto	3.2	300mm Water Main	Denison Rd. - North side
221	7.96	12+810	2	City of Toronto	3.1	825mm Storm Sewer	Denison Rd.
222	7.96	12+810	2	City of Toronto	3.1	550mm Storm Sewer	Denison Rd.
223	7.96	12+810	2	City of Toronto	3.1	225mm Sanitary Sewer	Denison Rd.
224	7.96	12+810	2	City of Toronto	3.1	225mm Sanitary Sewer	Denison Rd.
225	7.96	12+810	2	City of Toronto	3.2	Pumping Station	Denison Rd.
226	7.96	12+810	2	Enbridge	3.2	300mm Gas Main	Denison Rd.
227	7.96	12+810	2	Enbridge	3.2	300mm Gas Main	Denison Rd.
228	7.96	12+810	2	Toronto Hydro	3.3	Street Lighting	Denison Rd.
229	7.96	12+810	2	Toronto Hydro	3.3	Street Lighting	Denison Rd.
230	8	12+875	2	City of Toronto	3.1	750mm Combined Sewer	Denison Rd. West
231	8.2	13+195	2	Toronto Hydro	1	Overhead Wire	Wright Ave.
232	8.25	13+275	2	City of Toronto	3.1	450mm Sanitary Sewer	Wright Ave.

Item	Mile	Station	EA Sect	Owner	Utility Class	Description	Approximate Location
233	8.25	13+275	2	City of Toronto	3.1	1050mm Sanitary Sewer	Wright Ave.
234	8.25	13+275	2	Toronto Hydro	1	Overhead Wire	Wright Ave.
235	8.34	13+420	2	City of Toronto	3.1	1200mm Combined Sewer	South of Lawrence Ave.
236	8.4	13+520	2	City of Toronto	3.1	300mm Sanitary Sewer	South of Lawrence Ave.
237	8.4	13+520	2	City of Toronto	3.1	1050mm Storm Sewer	Lawrence Ave.
238	8.4	13+520	2	City of Toronto	3.1	450mm Combined Sewer	Lawrence Ave.
239	8.4	13+520	2	City of Toronto	3.1	1200mm Combined Sewer	Lawrence Ave.
240	8.42	13+550	2	City of Toronto	3.1	1300mm Storm Sewer	Lawrence Ave.
241	8.44	13+585	2	Bell Canada	3.3	Underground Conduit in 760mm dia. pipe	Lawrence Ave.
242	8.44	13+585	2	City of Toronto	4.2	900mm Water Main	Lawrence Ave.
243	8.44	13+585	2	City of Toronto	3.1	1650mm Storm Sewer	Lawrence Ave.
244	8.44	13+585	2	City of Toronto	3.1	450mm Storm Sewer	Lawrence Ave.
245	8.44	13+585	2	City of Toronto	3.2	900mm Water Main	Lawrence Ave.
246	8.44	13+585	2	City of Toronto	3.2	900mm Water Main	Lawrence Ave.
247	8.44	13+585	2	Enbridge	3.2	300mm Gas Main	Lawrence Ave.
248	8.44	13+585	2	Toronto Hydro	3.3	Street Lighting	Lawrence Ave.
249	8.45	13+600	2	Toronto Hydro	1	Overhead Wire	Lawrence Ave.
250	8.6	13+840	2	Toronto Hydro	1	Overhead Wire	Weston Station
251	8.63	13+890	3	Bell Canada	3.3	Underground Conduit	East Side of John St.
252	8.63	13+890	3	Bell Canada	3.3	Underground Conduit Encased in 75mm Concrete	John St.
253	8.63	13+890	3	City of Toronto	3.2	300mm Water Main	John St.
254	8.63	13+890	3	City of Toronto	3.2	300mm Water Main	John St.
255	8.63	13+890	3	City of Toronto	3.1	200mm Sanitary Sewer	John St.
256	8.63	13+890	3	Enbridge	3.2	150mm Gas Main	John St.
257	8.63	13+890	3	Toronto Hydro	1	Overhead Wire	John St.
258	8.74	14+065	3	City of Toronto	3.1	675mm Storm Sewer	King St.
259	8.74	14+065	3	City of Toronto	3.2	150mm Water Main	King St.

Item	Mile	Station	EA Sect	Owner	Utility Class	Description	Approximate Location
260	8.74	14+065	3	City of Toronto	3.2	150mm Water Main	King St.
261	8.74	14+065	3	City of Toronto	3.1	Storm Sewer – Size to be Confirmed during detailed design phase	King St.
262	8.74	14+065	3	Enbridge	3.2	100mm Gas Main	King St.
263	8.74	14+065	3	Toronto Hydro	3.3	Street Lighting	King St.
264	8.93	14+370	3	City of Toronto	3.2	150mm Water Main	Church St.
265	8.94	14+390	3	City of Toronto	3.1	Storm Sewer – Size to be Confirmed during detailed design phase	Church St.
266	8.94	14+390	3	City of Toronto	3.2	300mm Water Main	Church St.
267	8.94	14+390	3	City of Toronto	3.2	300mm Water Main	Church St.
268	8.94	14+390	3	City of Toronto	3.1	225mm Sanitary Sewer	Church St.
269	8.94	14+390	3	City of Toronto	3.2	Pumping Station	Church St.
270	8.94	14+390	3	Enbridge	3.2	200mm Gas Main	Church St.
271	8.94	14+390	3	Rogers	3.3	Underground Conduit	Church St.
272	8.95	14+405	3	Toronto Hydro	1	Overhead Wire	West Side of Church St.
273	8.95	14+405	3	Toronto Hydro	1	Overhead Wire	Church St.
274	9.34	15+030	3	Bell Canada	3.3	Underground Conduit	Holley Ave.
275	9.44	15+190	3	Canadian Gypsum Co.	3.1	Ditch Culvert	Parke St.
276	9.5	15+290	3	Toronto Hydro	1	Overhead Wire	Weston Rd.
277	9.51	15+305	3	Bell Canada	3.3	Large Duct Structure	Weston Rd.
278	9.51	15+305	3	Bell Canada	3.3	Large Duct Structure	Weston Rd.
279	9.51	15+305	3	City of Toronto	3.2	400mm Water Main	Weston Rd.
280	9.51	15+305	3	City of Toronto	3.2	250mm Water Main	Weston Rd.
281	9.51	15+305	3	City of Toronto	3.1	300mm Sanitary Sewer	Weston Rd.
282	9.51	15+305	3	City of Toronto	3.1	300mm Storm Sewer	Weston Rd.
283	9.51	15+305	3	City of Toronto	3.1	300mm Sanitary Sewer	Weston Rd.
284	9.51	15+305	3	Enbridge	3.2	150mm Gas Main	Weston Rd.
285	9.65	15+530	3	City of Toronto	3.1	1650mm Storm Sewer	Weston Golf and Country Club
286	9.66	15+545	3	City of Toronto	3.1	1650mm Sanitary Sewer	Weston Golf & Country Club
287	9.66	15+545	3	City of Toronto	3.1	1650mm Sanitary	Weston Golf &

Item	Mile	Station	EA Sect	Owner	Utility Class	Description	Approximate Location
						Sewer	Country Club
288	9.66	15+545	3	City of Toronto	3.1	750mm Sanitary Sewer	Weston Golf & Country Club
289	9.75	15+690	3	City of Toronto	3.1	900mm Storm Sewer	Weston Golf and Country Club
290	10.35	16+655	3	City of Toronto	3.2	600mm Water Main	Islington Ave.
291	10.35	16+655	3	City of Toronto	3.2	400mm Water Main	Islington Ave.
292	10.4	16+735	3	City of Toronto	3.2	400mm Water Main	Islington Ave.
293	10.4	16+735	3	Rogers	1	Overhead Wire	Islington Ave.
294	10.41	16+755	3	Bell Canada	1	Overhead Wire	Islington Ave.
295	10.41	16+755	3	City of Toronto	3.1	375mm Sanitary Sewer	Islington Ave.
296	10.41	16+755	3	City of Toronto	3.2	350mm Water Main	Islington Ave.
297	10.41	16+755	3	City of Toronto	3.1	1050mm Storm Sewer	Islington Ave.
298	10.41	16+755	3	City of Toronto	3.1	375mm Sanitary Sewer	Islington Ave.
299	10.41	16+755	3	Enbridge	3.2	300mm Gas Main	Islington Ave.
300	10.41	16+755	3	Toronto Hydro	3.3	Underground Conduit	Islington Ave.
301	10.42	16+770	3	City of Toronto	3.1	Culvert	Islington Ave.
302	10.42	16+770	3	Toronto Hydro	1	Overhead Wire	Islington Ave.
303	10.68	17+190	3	City of Toronto	3.1	375mm Combined Sewer	Highway 401
304	10.7	17+220	3	Allstream	2	Underground Duct Bank	Highway 401
305	11	17+705	3	City of Toronto	3.1	150mm Sewer in 300mm Casing	East of Kipling Ave.
306	11.04	17+765	3	Enbridge	3.2	300mm Gas Main	East of Kipling Ave.
307	11.07	17+815	3	Bell Canada	3.3	Underground Conduit	Kipling Ave.
308	11.07	17+815	3	City of Toronto	3.1	1050mm Storm Sewer	Kipling Ave.
309	11.07	17+815	3	City of Toronto	3.2	400mm Water Main	Kipling Ave.
310	11.07	17+815	3	City of Toronto	3.1	1200mm Storm Sewer	Kipling Ave.
311	11.0	17+815	3	City of Toronto	3.2	400mm Water Main	Kipling Ave.

Item	Mile	Station	EA Sect	Owner	Utility Class	Description	Approximate Location
	7						
312	11.07	17+815	3	Enbridge	3.2	300mm Gas Main	Kipling Ave.
313	11.07	17+815	3	Rogers Cable	3.2	Underground Conduit	Kipling Ave.
314	11.07	17+815	3	Toronto Hydro	1	Overhead Wire	Kipling Ave.
315	11.07	17+815	3	Toronto Hydro	3.3	Street Lighting	Kipling Ave.
316	11.08	17+830	3	City of Toronto	3.2	Water Main – Size to be Confirmed during detailed design phase	Near Kipling Ave.
317	11.1	17+865	3	Interprovincial Pipelines/Imperial Oil	3.2	High pressure oil pipeline	West of Kipling Ave.
318	11.1	17+865	3	Interprovincial Pipelines/Trans-Northern Pipelines - to be Confirmed during Detailed design Phase	3.2	High pressure oil pipeline	West of Kipling Ave.
319	11.11	17+880	3	City of Toronto	3.2	1500mm Water Main	West of Kipling Ave.
320	11.12	17+895	3	Bell Canada	3.3	Underground Conduit	Kipling Ave. and Bethridge Rd.
321	11.13	17+910	3	Hydro One	1	6 Overhead Wires on One Tower	West of Kipling Ave.
322	11.15	17+945	3	Enbridge	3.2	300mm Oil Pipeline	West of Kipling Ave.
323	11.15	17+945	3	Hydro One	1	6 Overhead Wires on One Tower	West of Kipling Ave.
324	11.17	17+975	3	Hydro One	1	6 Overhead Wires on One Tower	West of Kipling Ave.
325	11.18	17+990	3	Sun Canadian Pipeline	3.2	Oil Pipeline – Size to be Confirmed during detailed design phase	Namco Rd.
326	11.22	18+055	3	City of Toronto	3.1	1050mm Storm Sewer	West of Kipling Ave.
327	11.35	18+265	3	City of Toronto	3.1	1800mm Storm Sewer	Near Martin Grove Rd.
328	11.43	18+395	3	City of Toronto	3.1	2275mm Storm Sewer	East of Martin Grove Rd.
329	11.73	18+880	3	Bell Canada	3.2	Underground Conduit	West Side of Martin Grove Rd.
330	11.73	18+880	3	City of Toronto	3.2	450mm Water Main	Martin Grove Rd.

Item	Mile	Station	EA Sect	Owner	Utility Class	Description	Approximate Location
331	11.73	18+880	3	City of Toronto	3.1	375mm Storm Sewer	At Martin Grove Rd.
332	11.73	18+880	3	City of Toronto	3.2	400mm Water Main	At Martin Grove Rd.
333	11.73	18+880	3	Enbridge	3.2	300mm Gas Main	West of Martin Grove Rd.
334	11.73	18+880	3	Rogers Cable	3.3	Underground Conduit	Martin Grove Rd.
335	11.73	18+880	3	Toronto Hydro	1	Overhead Wire	Martin Grove Rd. - East side
336	11.75	18+910	3	Enbridge	3.2	Gas Main – Size to be Confirmed during detailed design phase	Martin Grove Rd. - West side
337	11.76	18+925	3	Bell Canada	3.2	Underground Conduit	Martin Grove Rd. - West side
338	11.76	18+925	3	Rogers Cable	3.3	Underground Conduit	Martin Grove Rd. - West side
339	11.76	18+925	3	Toronto Hydro	1	Overhead Wire	Martin Grove Rd. - East side
340	11.76	18+925	3	Toronto Hydro	1	Overhead Wire	Martin Grove Rd. - East side
341	11.78	18+960	3	Enbridge	3.2	100mm Gas Main	Martin Grove Rd. - West side
342	12.13	19+520	3	Toronto Hydro	1	Overhead Wire	East of Hwy 27
343	12.21	19+650	3	Hydro One	1	18 Overhead Wires on One Large Gantry	East of Hwy 27
344	12.32	19+825	3	City of Toronto	3.1	1200mm Storm	East of Hwy 27
345	12.32	19+825	3	Toronto Hydro	1	Overhead Wire	East of Hwy 27
346	12.37	19+910	3	City of Toronto	3.2	400mm Water Main	East of Hwy 27
347	12.37	19+910	3	City of Toronto	3.2	1200mm Water Main	East of Hwy 27
348	12.37	19+910	3	Rogers	3.3	Duct West side of South Lanes	Hwy 27
349	12.37	19+910	3	TELUS	3.3	Duct Bank	Hwy 27 East side of North Lanes
350	12.37	19+910	3	Toronto Hydro	1	Overhead Wire	Hwy 27 Southwest
351	12.37	19+910	3	Toronto Hydro	1	Overhead Wire	Hwy 27 Southeast
352	12.7	20+550	3	Toronto Hydro	1	Overhead Wire	East of

Item	Mile	Station	EA Sect	Owner	Utility Class	Description	Approximate Location
	7						Carlingview Dr.
353	12.8	20+600	3	Toronto Hydro	1	Overhead Wire	East of Carlingview Dr.
354	12.8	20+600	3	Toronto Hydro	1	Overhead Wire	East of Carlingview Dr.
355	13.06	21+020	3	Bell Canada	3.3	Underground Conduit	Carlingview Dr.
356	13.06	21+020	3	Bell Canada	3.3	Underground Conduit	Carlingview Dr.
357	13.06	21+020	3	City of Toronto	3.1	750mm Storm Sewer	Carlingview Dr.
358	13.06	21+020	3	City of Toronto	3.1	825mm Storm Sewer	Carlingview Dr.
359	13.06	21+020	3	City of Toronto	3.1	900mm Storm Sewer	Carlingview Dr.
360	13.06	21+020	3	City of Toronto	3.1	900mm Storm Sewer	Carlingview Dr.
361	13.06	21+020	3	Toronto Hydro	1	Overhead Wire	Carlingview Dr.
362	13.06	21+020	3	Toronto Hydro	1	Aerial Hydro	Carlingview Dr.
363	13.06	21+020	3	Woodbine	3.2	300mm Water Main	East of Carlingview Dr.
364	13.06	21+020	3	Woodbine	3.2	300mm Water Main	East of Carlingview Dr.
365	13.06	21+020	3	Woodbine	3.1	Sanitary Sewer – Size to be Confirmed during detailed design phase	Carlingview Dr.
366	13.3	21+405	3	Toronto Hydro	1	Overhead Wire	East of Highway 427
367	13.5	21+725	3	City of Toronto	3.1	1050mm Storm Sewer	Near Highway 427
368	13.5	21+725	3	City of Toronto	3.2	400mm Water Main	Near Highway 427
369	13.5	21+725	3	City of Toronto	3.2	Water Main – Size to be Confirmed during detailed design Phase	Highway 427
370	13.5	21+725	3	Toronto Hydro	1	Overhead Wire	Highway 427
371	13.51	21+740	3	Toronto Hydro	3.3	Street Lighting	Highway 427 Bridge
372	13.51	21+740	3	City of Toronto	3.3	Traffic Signals Conduit	Highway 427 Bridge
373	13.6	21+885	3	City of Toronto	3.2	400mm Water Main	Goreway Dr.
374	13.6	21+885	3	Toronto Hydro	1	Overhead Wire	Goreway Dr.

Table 3-3 Utility Summary by Owner

Owner	Utilities
Allstream	2
Bell Canada	35
Canada Packers	6
Canadian Gypsum Co	1
City of Toronto - Sewer	95
City of Toronto - Water	65
City of Toronto - Other	14
Enbridge	44
Hydro One	7
Interprovincial Pipelines	2
Private Owner	1
Rogers	7
Sun Canadian Pipeline	1
TELUS	1
Toronto Hydro	83
TTC	7
Woodbine	3
Total	**374**

4.0 Impacts on Utilities

Utilities are impacted by UP Express electrification primarily in two ways: spatial conflicts of utilities with OCS foundation locations or electrical clearances; utilities externally mounted to bridge structures within the electrical Zone of Influence may experience unsafe step and touch potentials; buried metallic utilities or utility covers crossing the ROW within the electrical Zone of Influence may experience unsafe step and touch potential; and, buried metallic utilities or utility covers routed parallel to the ROW within the electrical Zone of Influence may experience unsafe step and touch potential.

The operation of the existing utilities is not anticipated to be affected during construction, as backup provisions will be put in place during construction. Metrolinx authorization is required to access any plant within the rail corridor, and rail flagmen would still be employed for the work. The main difference being that the affected tracks would be de-energized for the utility work, as would occur with normal rail maintenance works. Upon completion of construction and during subsequent operations of the electrified system, it is not anticipated that maintenance of utilities will be affected.

4.1 Aerial Utilities

An aerial utility is defined within this report as any above ground utility routed across or parallel the rail corridor, but not associated with any bridge structure. These include high-voltage (HV) electricity transmission lines, low-voltage local electricity distribution lines, and communication cables.

4.1.1 High-Voltage (HV) Transmission Lines

There are four locations, with a total of seven crossings, where HV electricity transmission lines cross the rail corridor as indicated in section 3.5. These locations are summarized in **Table 4-1**. Although, at this preliminary design stage, the overhead crossings appear to have sufficient vertical clearance between the OCS wires and Hydro One's HV transmission wires, three lines are assumed to require raising for cost estimating purposes only. Special consideration of HV transmission lines is required during the detailed design stage to confirm the Hydro One analysis. See **Figure 4-1** for a typical overhead transmission line.

No potential negative impacts to Hydro One HV transmission lines have been identified.

Table 4-1 High-Voltage Transmission Line Locations

Item	Mile	Station	Approximate Location
1	1.25	2+010	East of Strachan Ave at Tecumseth Street (two underground oil-filled pipes)
2	5.630	9+060	Between St. Clair Avenue and Rogers Road (one overhead crossing)
3	11.1	17+910	West of Kipling Avenue (three overhead crossings)
4	12.21	19+650	East of Highway 27 (one overhead crossing)

Figure 4-1 Mile 5.7 Weston Sub. - Overhead Transmission Lines

4.1.2 Local Electricity Distribution Lines less than 44kV

There are approximately forty-four (44) Toronto Hydro, two (2) Rogers, and one (1) Bell Canada locations with local electricity distribution lines less than 44kV entering the rail corridor ROW. These locations are summarized in **Table 4-2**. As per the Ontario Electrical Safety Code, Section 75, only overhead lines with voltages higher than the OCS voltage (25kV) are allowed to be routed above the OCS. As such, utilities with voltages less than 44 kV, namely 600, 4.16, 13.8, and 27.6 Volts as well as communication cables shall be buried. TTC overhead streetcar lines are excluded and do not require any mitigation.

Table 4-2 Less than 44kV Local Distribution Line Locations

Item	Mile	Station	Owner	Approximate Location	Mitigation Measure
1	0.58	0+935	Toronto Hydro - to be Confirmed during detailed design phase	Near Spadina Ave.	buried below tracks
2	0.7	1+125	Toronto Hydro	Spadina Ave.	buried below tracks
3	1.59	2+560	Toronto Hydro	Strachan Ave.	buried below tracks
4	2	3+220	Toronto Hydro	Sudbury St. / Dovercourt Rd.	buried below tracks
5	2.46	3+960	Toronto Hydro - to be Confirmed during detailed design phase	Dufferin St.	buried below tracks
6	2.55	4+105	Toronto Hydro - to be Confirmed during detailed design phase	Dufferin St. / Noble St.	buried below tracks
7	3.45	5+550	Toronto Hydro	Dundas St.	buried below tracks
8	4.8	7+725	Toronto Hydro - to be Confirmed during detailed design phase	Old Weston Rd.	buried below tracks
9	5.37	8+640	Toronto Hydro	North of St Clair Ave.	buried below tracks
10	5.5	8+850	Toronto Hydro	North of St. Clair Ave.	buried below tracks
11	5.65	9+095	Toronto Hydro	Weston Rd./ St. Clair Ave.	buried below tracks
12	6.12	9+850	Toronto Hydro	Rogers Rd.	buried below tracks
13	6.94	11+170	Toronto Hydro	North of Eglinton Ave.	buried below tracks
14	7.17	11+540	Rogers	Ray Ave.	buried below tracks
15	7.17	11+540	Toronto Hydro	Ray Ave.	buried below tracks
16	7.2	11+585	Toronto Hydro	Ray Ave.	buried below tracks
17	7.43	11+955	Toronto Hydro	East of Jane St.	buried below tracks
18	7.5	12+070	Toronto Hydro - to be Confirmed during detailed design phase	East of Jane St.	buried below tracks
19	7.69	12+375	Toronto Hydro - to be Confirmed during detailed design phase	East of Jane St.	buried below tracks
20	7.8	12+555	Toronto Hydro	Lippincott St. East	buried below tracks

Item	Mile	Station	Owner	Approximate Location	Mitigation Measure
21	8.2	13+195	Toronto Hydro	Wright Ave.	buried below tracks
22	8.25	13+275	Toronto Hydro	Wright Ave.	buried below tracks
23	8.45	13+600	Toronto Hydro	Lawrence Ave.	buried below tracks
24	8.6	13+840	Toronto Hydro	Weston Station	buried below tracks
25	8.63	13+890	Toronto Hydro	John St.	buried below tracks
26	8.95	14+405	Toronto Hydro	West Side of Church St.	buried below tracks
27	8.95	14+405	Toronto Hydro	Church St.	buried below tracks
28	9.5	15+290	Toronto Hydro	Weston Rd.	buried below tracks
29	10.4	16+735	Rogers	Islington Ave.	buried below tracks
30	10.41	16+755	Bell Canada	Islington Ave.	buried below tracks
31	10.42	16+770	Toronto Hydro	Islington Ave.	buried below tracks
32	11.07	17+815	Toronto Hydro	Kipling Ave.	buried below tracks
33	11.73	18+880	Toronto Hydro	Martin Grove Rd. - East side	buried below tracks
34	11.76	18+925	Toronto Hydro	Martin Grove Rd. - East side	buried below tracks
35	11.76	18+925	Toronto Hydro	Martin Grove Rd. - East side	buried below tracks
36	12.13	19+520	Toronto Hydro	East of Hwy 27	buried below tracks
37	12.32	19+825	Toronto Hydro	East of Hwy 27	buried below tracks
38	12.37	19+910	Toronto Hydro	Hwy 27 Southwest	buried below tracks
39	12.37	19+910	Toronto Hydro	Hwy 27 Southeast	buried below tracks
40	12.77	20+550	Toronto Hydro	East of Carlingview Dr.	buried below tracks
41	12.8	20+600	Toronto Hydro	East of Carlingview Dr.	buried below tracks
42	12.8	20+600	Toronto Hydro	East of Carlingview Dr.	buried below tracks
43	13.06	21+020	Toronto Hydro	Carlingview Dr.	buried below tracks

Item	Mile	Station	Owner	Approximate Location	Mitigation Measure
44	13.06	21+020	Toronto Hydro	Carlingview Dr.	buried below tracks
45	13.3	21+405	Toronto Hydro	East of Highway 427	buried below tracks
46	13.5	21+725	Toronto Hydro	Highway 427	buried below tracks
47	13.6	21+885	Toronto Hydro	Goreway Dr.	buried below tracks

4.1.3 Communications & Other Cables

There are numerous locations where above ground communications or other cables enter the rail corridor ROW. The exact number and locations to be confirmed in the detailed design phase. The analysis of the OCS EMI effects on these utilities is that no potential negative impacts exist.

4.2 Utilities Related to Bridge Structures

There are four types of utilities related to bridge structures. These are embedded utilities in overhead structures, externally mounted utilities on overhead structures, embedded utilities at grade separations, and externally mounted utilities at grade separations.

4.2.1 Embedded Utilities in Overhead Structures (Road/Rail over Rail)

At the existing grade separations, where the tracks cross under existing roadways or railways, impacts to existing utilities and underground infrastructure will depend on the work required at the existing grade separation structures (ie, lowering of tracks) and subsequent as-built conditions as a result of ongoing new works. No relocations are anticipated as part of UP Express electrification, as all utilities are located with the road right-of-way and no structure modifications are proposed. At Islington Avenue, the specific solution for the Resource Road Maintenance Facility may require localized utility relocations to be identified in the detailed design stage.

4.2.2 Externally Mounted on Overhead Structures (Road/Rail over Rail)

Similarly, at the existing grade separations, where the tracks cross under existing roadways or railways, impacts to existing utilities and underground infrastructure will depend on the work required at the existing grade separation structures (ie, lowering of tracks) and subsequent as-built conditions as a result of ongoing new works. No relocations are anticipated as part of UP Express electrification, as all utilities are located with the road right-of-way and no structure modifications are proposed. At Islington Avenue, the specific solution for the Resource Road Maintenance Facility may require localized utility relocations to be identified in the detailed design stage.

4.2.3 Embedded Utilities in Grade Separations (Rail over Road)

At the existing grade separations, where the tracks cross over existing roadways, impacts to existing utilities and underground infrastructure will depend on the work required at the existing grade separation structures (ie, widening or new structure). No relocations are anticipated as part of UP Express electrification, as all utilities are located with the road right-of-way and no structure modifications are proposed. If any modifications to the existing structures or replacement of the existing structure are identified during the detailed design stage, localized utility relocations may be required. These will be permanent relocations within the existing road allowance so as not to affect future utility maintenance and repair.

4.2.4 Externally Mounted on Grade Separations (Rail over Road)

Similarly, at the existing grade separations, where the tracks cross over existing roadways, impacts to existing utilities and underground infrastructure will depend on the work required at the existing grade separation structures (ie, widening or new structure). No relocations are anticipated as part of UP Express electrification, as all utilities are located with the road right-of-way and no structure modifications are proposed. If any modifications to the existing structures or replacement of the existing structure are identified during the detailed design stage, localized utility relocations may be required. These will be permanent relocations within the existing road allowance so as not to affect future utility maintenance and repair.

4.3 Underground Utilities Crossing Rail ROW

There are three categories of underground utilities that cross the rail corridor ROW. These are linear utilities, semi-linear utilities, and non-linear utilities.

4.3.1 Linear Utilities Crossing the Rail ROW

These are buried utilities where their depth, turns and bends, and slope are critical to performance. These are typically gravity based systems such as sanitary sewers, storm sewers, culverts and subdrains. Impact to these utilities will depend on the work required to install the OCS foundations and if they are within the electrical zone of influence depending on their depth and location. Where repositioning of the OCS foundation is not possible, the utility is to be reconstructed to avoid the OCS foundations. Determination of the specific impacts for these utilities will be confirmed during the detailed design stage.

4.3.2 Semi-Linear Utilities Crossing the Rail ROW

These are buried utilities where their depth, turns and bends, and slope impact the provision of service but with a limited effect. These are typically pressure based systems such as water mains, steam/gas/oil pipelines as well as hydro conduits and duct banks. Impact to these utilities will depend on the work required to install the OCS foundations and if they are within the electrical zone of influence depending on their depth and location. Where repositioning of the OCS foundation is not possible, the utility is to be reconstructed to avoid the OCS foundations. Determination of the specific impacts for these utilities will be confirmed during the detailed design stage.

4.3.3 Non-Linear Utilities Crossing the Rail ROW

These are buried utilities where their depth turns and bends, and slope do not impact the provision of service. These are typically communications systems such as fibre optics, signal cables, and telecoms. Impact to these utilities will depend on the work required to install the OCS foundations and if they are within the electrical zone of influence depending on their depth and location. Where repositioning of the OCS foundation is not possible, the utility is to be reconstructed to avoid the OCS foundations. Determination of the specific impacts for these utilities will be confirmed during the detailed design stage.

4.4 Underground Utilities Routed Parallel to Rail ROW

There are three categories of underground utilities routed parallel to the rail corridor ROW. These are linear utilities, semi-linear utilities, and non-linear utilities.

4.4.1 Linear Utilities Parallel to the Rail ROW

These are buried utilities where their depth, turns and bends, and slope are critical to performance. These are typically gravity based systems such as sanitary sewers, storm sewers, culverts and subdrains. Impact to these utilities will depend on the work required to install the OCS foundations and if they are within the electrical zone of influence depending on their depth and location. Where repositioning of the OCS foundation is not possible, the utility is to be reconstructed to avoid the OCS foundations. Determination of the specific impacts for these utilities will be confirmed during the detailed design stage.

4.4.2 Semi-Linear Utilities Parallel to the Rail ROW

These are buried utilities where their depth, turns and bends, and slope impact the provision of service but with a limited effect. These are typically pressure based systems such as water mains, steam/gas/oil pipelines as well as hydro conduits and duct banks. Impact to these utilities will depend on the work required to install the OCS foundations and if they are within the electrical zone of influence depending on their depth and location. Where repositioning of the OCS foundation is not possible, the utility is to be reconstructed to avoid the OCS foundations. Determination of the specific impacts for these utilities will be confirmed during the detailed design stage.

4.4.3 Non-Linear Utilities Parallel to the Rail ROW

These are buried utilities where their depth, turns and bends, and slope do not impact the provision of service. These are typically communications systems such as fibre optics, signal cables, and telecoms. Impact to these utilities will depend on the work required to install the OCS foundations and if they are within the electrical zone of influence depending on their depth and location. Where repositioning of the OCS foundation is not possible, the utility is to be reconstructed to avoid the OCS foundations. Determination of the specific impacts for these utilities will be confirmed during the detailed design stage.

4.4.3.1 Communications Utilities within the Rail ROW

The exact locations of the existing signalling, communications and fibre optic cables located within the rail right-of-way will be determined during the detailed design stage. If the signalling, communications and fibre optic cables are not relocated to the edge of the rail corridor during the construction of the Georgetown South Corridor Expansion project, unidentified conflicts may result and require mitigation during the detailed design or construction stages.

5.0 Mitigation Measures

For utility conflicts with OCS supports (portals), there are a number of potential mitigation methods as follows –

- Relocation of the OCS support to avoid the utility, if possible (longitudinally for transverse utilities and laterally for parallel utilities)
- Diversion of the utilities around the OCS support, where the orientation of the utilities is not critical (e.g. telecoms, railroad signal cables, electricity cables)
- Reconstruction of the utilities to avoid the OCS support, where orientation of the utilities is critical (e.g. water mains, sewers, oil/gas pipelines).

Where potential plant conflicts exist and in order to negotiate an agreement in principle to resolve the specific conflict, the exact locations and depths of these utilities will be determined during the detailed design phase. Based on the requirements of each utility company, these utilities will be relocated deeper or protected to allow for the electrification construction works and allow trains to pass above without damage.

Utilities may be affected by UP Express electrification primarily in three ways –

- Overhead (aerial) utility conflicts with OCS wires (e.g. Hydro One, Toronto Hydro)
- Utility conflicts with OCS support structure (ie, portals, cantilevers) locations
- Metallic utilities (e.g. copper communication cables, steel sewers and culverts, reinforced-concrete encasement) without existing grounding or bonding measures.

For overhead utility conflicts, minimum electrical clearances must be maintained between the OCS wires and the aerial utility. Therefore, these clearances will be assessed as part of the detailed design phase to ensure that the vertical separation complies with the minimum electrical clearances.

For utility conflicts with OCS support structures, there are a number of mitigation methods to be considered. These methods will be considered in descending order of invasiveness and cost –

- Relocation of the OCS support structure to avoid the utility, if possible (longitudinally for transverse utilities and laterally for parallel utilities)
- Diversion of the utilities around the OCS support structure, where the orientation of the utilities is not critical (e.g. telecoms, railroad signal cables, electricity cables)
- Reconstruction of the utilities to avoid the OCS support structure, where orientation of the utilities is critical (e.g. water mains, sewers, oil/gas pipelines).

For metallic utilities (e.g. copper communication cables, steel sewers and culverts, reinforced-concrete encasement) in the vicinity of the UP Express electrification components, the mitigation measure may require grounding and bonding of underground utilities.

Utilities affected by construction will be temporarily relocated along the roadway and railway right-of-way. The staging and relocations approach will be determined during the detailed design stage. The relocations of these utilities will occur prior to or in conjunction with the construction of this project.

Consultation with the pipeline owners will occur during detailed design and construction as warranted. All necessary agreements with the pipeline owners will be obtained to ensuring that potential effects are minimized and effectively mitigated through design and construction.

Conflicts of OCS supports with existing signalling, communications and fibre optic cables can be resolved by utilizing the cable slack to reroute the cable around the OCS support. When the location for the supports is to be laid out, the cables must be hand dug to determine if they must be moved to allow for the installation or construction of the OCS support.

Utility conflict mitigation options are summarized in **Table 5-1**.**Table 5-2** summarizes proposed mitigation measures for each category of utility and related impact.

Table 5-1 Utility Conflict Mitigation Options

No.	Utility Category	Mitigation Description
1	Buried Non-metal	No mitigation required.
2	Buried Reinforced Concrete	Provide two grounding connections between the utility and the static wire, one at either edge of the rail ROW. Each connection shall consist of a stranded copper wire (min. 25 mm^2) exothermically welded to the embedded rebar or via heavy duty rebar clamps, and a pole to connect to the static wire.
3	Buried Metal	Provide two grounding connections between the utility and the static wire, one at either edge of the rail ROW. Each connection shall consist of a stranded copper wire (min. 25 mm^2) exothermically welded to the metal pipe or via grounding clamps, and a pole to connect to the static wire. Also replace two 2m sections of the pipe at the edge of the rail ROW beyond the ground connection with insulated joints (non-metal pipe).
4	Overhead with Adequate Clearance	No mitigation required.
5a	Overhead with Inadequate Clearance	Toronto Hydro/Rogers/Bell (less than 44kV overhead wires) – mitigate by relocating under tracks.
5b	Overhead with Inadequate Clearance	Hydro One (high voltage wires) – mitigate by raising cables.
6	Copper Communications Wires	For unshielded copper communications wires within 10m of Electrified Tracks, replace copper wires with fibre optic lines.
7	Others Requiring Re-location of OCS support	As a first option, at a utility and OCS support conflict, the OCS support is relocated to avoid impact to utility. This is the premise of the OCS preliminary design.
8	Others Requiring Diversion of Utility	At a utility and OCS support conflict, and the OCS support cannot be relocated, the utility is locally diverted around the OCS support.
9	Others Requiring Re-construction of Utility	At a utility and OCS support conflict, and the OCS support cannot be relocated, reconstruct the utility in a new location to completely avoid the OCS support.

Table 5-2 Potential Utility Impacts & Proposed Mitigation Measures

No.	Category	Potential Impacts Related to Electrification
1	**Overhead Utilities**	New or existing overhead utilities may encroach into OCS electrical clearances. Unsafe step and touch potentials may exist in the metallic parts
1.1	Containing Communications Systems	Communications system degradation of performance due to EMI may occur.
2	**Utilities On/Attached to Bridges or Within Enclosures**	New or existing utilities attached externally to bridge structures may be exposed to unsafe touch-and-step potential energy levels.
2.1	Containing Communications Systems	Communications system degradation of performance due to EMI may occur.
3	**Buried Utilities- Crossing ROW**	Metallic utilities or utility covers within the zones of influence that may experience unsafe touch-and-step potential. Utilities may conflict with proposed OCS foundation locations.
3.1	Linear	Utilities where depth, bends, and slope are critical (ie storm sewers, sanitary sewers, culverts, subdrains) and may conflict with proposed OCS foundation locations.
3.2	Semi-Linear	Utilities where depth, bends, and slope impact provision of service, but with a limited effect (ie water mains, steam/gas/oil pipelines, hydro) and may conflict with proposed OCS foundation locations.
3.3	Non-Linear	Utilities where depth, bends, and slope do not impact provision of service (ie fibre optics, signal cables, telecoms) and may conflict with proposed OCS foundation locations.
4	**Buried Utilities- Parallel to ROW**	Metallic utilities or utility covers within the zones of influence that may experience unsafe touch-and-step potential. Utilities may conflict with proposed OCS foundation locations.
4.1	Linear	Utilities where depth, bends, and slope are critical (ie storm sewers, sanitary sewers, culverts, subdrains) and may conflict with proposed OCS foundation locations.
4.2	Semi-Linear	Utilities where depth, bends, and slope impact provision of service, but with a limited effect (ie water mains, steam/gas/oil pipelines, hydro) and may conflict with proposed OCS foundation locations.
4.3	Non-Linear	Utilities where depth, bends, and slope do not impact provision of service (ie fibre optics, signal cables, telecoms) and may conflict with proposed OCS foundation locations.

Table 5-3 Zones of Influence

Zone	From	To
1	Centreline of nearest track	10m from centreline of nearest track
2	10m from centreline of nearest track	50m from centreline of nearest track
3	50m from centreline of nearest track	250m from centreline of nearest track

Table 5-4 Proposed Mitigation Measures

Utility Owner	Utility Type		Estimated Quantity	Utility Sub Type	% of total	Utility Category	Mitigation #	Mitigation Description
City of Toronto	Sewer			Plastic	0%	Non-metal	1	Not required
			24	Concrete	25%	Non-metal	1	Not required
				Other Non-metal (eg: brick)	0%	Non-metal	1	Not required
			60	Reinforced Concrete	63%	Reinforced -concrete	2	Two Grounding Connections
			11	Metallic	12%	Metal	3	Two Grounding Connections and insulated joints
				Encased in Steel Casing Pipe		Metal		
	Sewer total	**95**			**100%**			
	Water			Plastic	0%	Non-metal		
				Concrete	0%	Non-metal		
				Other Non-metal	0%	Non-metal		
			32	Reinforced Concrete	49%	Reinforced -concrete	2	Two Grounding Connections
			33	Metallic	51%	Metal	3	Two Grounding Connections and insulated joints
				Encased in Steel Casing Pipe	0%	Metal		
	Water total	**65**			**100%**			
	Gas			Plastic	0%	Non-metal		
				Concrete	0%	Non-metal		
				Other Non-metal	0%	Non-metal		
				Reinforced Concrete	0%	Reinforced -concrete		

Utility Owner	Utility Type		Estimated Quantity	Utility Sub Type	% of total	Utility Category	Mitigation #	Mitigation Description
			2	Metallic	100%	Metal	3	Two Grounding Connections and insulated joints
				Encased in Steel Casing Pipe	0%	Metal		
	Gas Total	2			100%			
	Other		5	Plastic (includes traffic signals)	42%	Non-metal		
				Concrete	0%	Non-metal		
				Other Non-metal	0%	Non-metal		
			6	Reinforced Concrete	50%	Reinforced -concrete	2	Two Grounding Connections
			1	Metallic	8%	Metal	3	Two Grounding Connections and insulated joints
				Encased in Steel Casing Pipe	0%	Metal		
	Other Total	12			100%			
Toronto Hydro	Overhead Line		0	Adequate electrical clearance	0%	Overhead	4	No mitigation required
			44	Inadequate electrical clearance	100%	Overhead	5a	Relocate overhead wires to under tracks.
				Has copper communication lines	0%	Overhead		
				Doesn't have copper communication lines	0%	Overhead		
	Overhead Total	44			100%			
	Underground conduit			Metallic	0%	Metal		
			20	Plastic	100%	Non-metal	1	Not required

Utility Owner	Utility Type		Estimated Quantity	Utility Sub Type	% of total	Utility Category	Mitigation #	Mitigation Description
	Underground Total	**20**			**100%**			
	Street lighting cables buried underground in conduit or mounted to bridges			Metallic	0%	Metal		
			15	Plastic	100%	Non-metal	1	Not required
	Street Lighting Total	**15**			**100%**			
	Utility Tunnel		2	Reinforced concrete	100%	Reinforced concrete	2	Two Grounding Connections
	Utility Tunnel Total	**2**			**100%**			
	Duct bank			Concrete	0%	Non-metal		
	Duct Bank Total	**0**			**0%**			
	Other		2	Metallic	100%	Metal	3	Two Grounding Connections and insulated joints
	Other Total	**2**			**100%**			
Enbridge	Gas		1	Plastic	2%	Non-metal	1	Not required
				Concrete	0%	Non-metal		
				Other Non-metal	0%	Non-metal		
				Reinforced Concrete	0%	Reinforced -concrete		

Utility Owner	Utility Type		Estimated Quantity	Utility Sub Type	% of total	Utility Category	Mitigation #	Mitigation Description
			41	Metallic	98%	Metal	3	Two Grounding Connections and insulated joints
				Encased in Steel Casing Pipe	0%	Metal		
	Gas Total	**42**			**100%**			
	Oil		1	Metallic	100%	Metal	3	Two Grounding Connections and insulated joints
	Oil Total	**1**			**100%**			
	Other		1	Metallic	100%	Metal	3	Two Grounding Connections and insulated joints
	Other Total	**1**			**100%**			
Bell Canada	Underground Conduit		8	Metallic	25%	Metal	3	Two Grounding Connections and insulated joints
			24	Plastic	75%	Non-metal	1	Not required
	Underground Conduit Total	**32**			**100%**			
	Duct Bank		1	Concrete	100%	Non-metal	1	Not required.
	Duct Bank Total	**1**			**100%**			
	Overhead Line		2	Inadequate electrical clearance	100%	Overhead	5a	Relocate overhead wires to under tracks.
	Overhead Line Total	**2**			**100%**			
Hydro One	Oil Filled Pipe		2	Metallic	100%	Metal	3	Two Grounding Connections and insulated joints

Utility Owner	Utility Type		Estimated Quantity	Utility Sub Type	% of total	Utility Category	Mitigation #	Mitigation Description
	Oil Filled Pipe Total	**2**			**100%**			
	Overhead Line		5	Electrical clearance to be confirmed, in conjunction with Hydro, One during detailed design.	100%	Overhead	TBD	TBD
	Overhead Line Total	**5**			**100%**			
Rogers	Underground Conduit		4	Metallic	100%	Metal	3	Two Grounding Connections and insulated joints
				Plastic	0%	Non-metal		
	Underground Conduit Total	**4**			**100%**			
	Duct Bank		1	Concrete	100%	Non-metal	1	Not required.
	Duct Bank Total	**1**			**100%**			
	Overhead Line		2	Inadequate electrical clearance	100%	Overhead	5a	Relocate overhead wires to under tracks.
			0	Adequate electrical clearance	0%	Overhead	4	No mitigation required
	Overhead Line Total	**2**			**100%**			
TTC	Underground Conduit		2	Metallic	100%	Metal	3	Two Grounding Connections and insulated joints
				Plastic	0%	Non-metal	1	Not required.
	Underground Conduit Total	**2**			**100%**			

Utility Owner	Utility Type		Estimated Quantity	Utility Sub Type	% of total	Utility Category	Mitigation #	Mitigation Description
	Overhead Line		0	Inadequate electrical clearance	0%	Overhead	5a	Relocate overhead wires to under tracks
			5	Adequate electrical clearance	100%	Overhead	4	No mitigation required
	Overhead Line Total	**5**			**100%**			
Canada Packers	Underground Conduit		3	Metallic	100%	Metal	3	Two Grounding Connections and insulated joints
				Plastic	0%	Non-metal		
	Underground Conduit Total	**3**			**100%**			
	Water			Plastic	0%	Non-metal		
				Concrete	0%	Non-metal		
				Other Non-metal	0%	Non-metal		
				Reinforced Concrete	0%	Reinforced -concrete		
			1	Metallic	100%	Metal	3	Two Grounding Connections and insulated joints
				Encased in Steel Casing Pipe	0%	Metal		
	Water Total	**1**			**100%**			
	Hydrogen/Steam Pipeline		2	Metallic	100%	Metal	3	Two Grounding Connections and insulated joints
	Hydrogen/Steam Total	**2**			**100%**			
Woodbine	Water			Plastic	0%	Non-metal		

Utility Owner	Utility Type		Estimated Quantity	Utility Sub Type	% of total	Utility Category	Mitigation #	Mitigation Description
				Concrete	0%	Non-metal		
				Other Non-metal	0%	Non-metal		
			1	Reinforced Concrete	33%	Reinforced -concrete	2	Two Grounding Connections
			2	Metallic	67%	Metal	3	Two Grounding Connections and insulated joints
				Encased in Steel Casing Pipe	0%	Metal		
	Water Total	**3**			**100%**			
Allstream	Underground Conduit		1	Metallic	100%	Metal	3	Two Grounding Connections and insulated joints
	Underground Conduit Total	**1**			**100%**			
	Duct Bank		1	Concrete (100%)	100%	Non-metal	1	Not required
	Duct Bank Total	**1**			**100%**			
Interprovincial Pipelines	Oil Pipeline			Plastic	0%	Non-metal		
				Concrete	0%	Non-metal		
				Other Non-metal (wood, etc...)	0%	Non-metal		
				Reinforced Concrete	0%	Reinforced -concrete		
			2	Metallic (100%)	100%	Metal	3	Two Grounding Connections and insulated joints
	Oil Total	**2**			**100%**			
Canada Gypsum Co	Ditch Culvert		1	Metallic (100%)	100%	Metal	3	Two Grounding Connections and insulated joints
	Ditch Culvert Total	**1**			**100%**			
Private	Storm		1	Metallic (100%)	100%	Metal	3	Two Grounding Connections and

Utility Owner	Utility Type		Estimated Quantity	Utility Sub Type	% of total	Utility Category	Mitigation #	Mitigation Description
Owner								insulated joints
	Storm Total	**1**			**100%**			
Sun Canadian Pipeline	Oil Pipeline			Plastic	0%	Non-metal		
				Concrete	0%	Non-metal		
				Other Non-metal (wood, etc...)	0%	Non-metal		
				Reinforced Concrete	0%	Reinforced -concrete		
			1	Metallic (100%)	100%	Metal	3	Two Grounding Connections and insulated joints
	Oil Total	**1**			**100%**			
Telus	Duct Bank		1	Reinforced Concrete (100%)	100%	Reinforced Concrete	2	Two Grounding Connections
	Duct Bank Total	**1**			**100%**			
Total Utilities		**374**	**374**					

5.1 Aerial Utilities

An aerial utility is defined within this report as any above ground utility routed across or parallel to the rail corridor, but not associated with any bridge structure. These include high-voltage (HV) electricity transmission lines, low-voltage local electricity distribution lines, and communication cables.

5.1.1 High-Voltage Transmission Lines

Minimum electrical clearances must be maintained between the Hydro One HV lines and the OCS wires. Although, at this preliminary design stage, it appears that the required minimum clearances will be maintained, three of five lines are assumed to require raising for cost estimating purposes only. A review and confirmation of the clearances will need to be done during the detailed design stage.

5.1.2 Local Electricity Distribution Lines Less Than 44kV

Minimum electrical clearances must be maintained between the electricity distribution lines less than 44kV and the OCS wires. As per the Ontario Electrical Safety Code section 75, only overhead lines with voltages higher than the OCS voltage (25 kV) are allowed to be routed above the OCS. As such, utilities with voltages less than 44 kV, namely 600, 4.16, 13.8 and 27.6 Volts as well as communication cables shall be buried.

5.2 Utilities Related to Bridge Structures

There are four types of utilities related to bridge structures. These are embedded utilities in overhead structures, externally mounted utilities on overhead structures, embedded utilities at grade separations, and externally mounted utilities at grade separations.

5.2.1 Utilities at Overhead Structures (Road/Rail over Rail)

It is expected that utilities are bonded to the support metal structure and the structure is grounded to a local ground electrode. This needs to be verified during the detailed design phase. Furthermore, metal structures within 10m of the nearest rail should be bonded to the rails by impedance bonds via two separate stranded copper wires.

Embedded or externally attached metallic utilities or utility covers within the electrical zone of influence must be grounded. Utilities containing communication systems must be immunized.

5.2.2 Utilities at Grade Separations (Rail over Road)

It is expected that utilities are bonded to the support metal structure and the structure is grounded to a local ground electrode. This needs to be verified during the detailed design phase. Furthermore, metal structures within 10m of the nearest rail should be bonded to the rails by impedance bonds via two separate stranded copper wires.

Embedded or externally attached metallic utilities or utility covers within the electrical zone of influence must be grounded. Utilities containing communication systems must be immunized.

5.3 Underground Utilities Crossing Rail ROW

It is expected that underground utilities are already grounded to local ground electrodes. It is not expected that additional grounding will be needed. However, the requirements of the utilities operating the underground utilities should be met at the detailed design stage.

5.4 Underground Utilities Routed Parallel to Rail ROW

It is expected that underground utilities are already grounded to local ground electrodes. It is not expected that additional grounding will be needed. However, the requirements of the utilities operating the underground utilities should be met at the detailed design stage.

6.0 Conflict Mitigation Cost Estimate

The conflict mitigation cost estimates include the utility relocation construction cost and required professional services cost. They do not, however, include contingency. As indicated in **Section 4.3.1**, the cost estimate does not include the cost of relocating buried utilities.

Table 6-1 Summary of Total Utility Mitigation Costs

Category #	Mitigation Description	Cost/ Mitigation	Counted Mitigations	Totals
1	Non-Metal - No mitigation required	$0.00	92	$0.00
2	Reinforced Concrete - mitigate with two grounded connections	$25,000.00	102	$2,550,000.00
3	Metal - mitigate with two grounded connections and insulated joints	$50,000.00	122	$6,100,000.00
4	Overhead with Adequate Electrical Clearance - no mitigation required	$0.00	7	$0.00
5a	Overhead with Inadequate Electrical Clearance Toronto Hydro/Rogers/Bell - mitigate by relocating under tracks	$700,000.00	48	$33,600,000.00
5b	Overhead with Inadequate Electrical Clearance Hydro One - mitigate by raising cables	$1,500,000.00	3	$4,500,000.00
6	Copper Communication Cables - mitigate by replacing copper cables with fibre optic cables	$30,000.00	0	$0.00
7	Relocate OCS support to avoid Utility	varies	0	$0.00
8	Divert Utility to avoid OCS Support	varies	0	$0.00
9	Reconstruct Utility to avoid OCS Supports	varies	0	$0.00
	Totals		**374**	**$46,750,000.00**

The following **Tables 6-2** to **6-16** provide a summary breakdown of estimated utility mitigation costs for each identified utility owner.

Table 6-2 Mitigation Costs for City of Toronto Utilities

Category #	Mitigation Description	Cost / Mitigation	Counted Mitigations	Totals
1	Non-Metal - No mitigation required	$0.00	29	$0.00
2	Reinforced Concrete - mitigate with two grounded connections	$25,000.00	98	$2,450,000.00
3	Metal - mitigate with two grounded connections and insulated joints	$50,000.00	47	$2,350,000.00
4	Overhead with Adequate Electrical Clearance - no mitigation required	$0.00	0	$0.00
5a	Overhead with Inadequate Electrical Clearance - mitigate by relocating under tracks	$700,000.00	0	$0.00
5b	Overhead with Inadequate Electrical Clearance - mitigate by raising cables	$1,500,000.00	0	$0.00
6	Copper Communication Cables - mitigate by replacing copper cables with fibre optic cables	$30,000.00	0	$0.00
	Totals		**174**	**$4,800,000.00**

Table 6-3 Mitigation Costs for Toronto Hydro Utilities

Category #	Mitigation Description	Cost / Mitigation	Counted Mitigations	Totals
1	Non-Metal - No mitigation required	$0.00	35	$0.00
2	Reinforced Concrete - mitigate with two grounded connections	$25,000.00	2	$50,000.00
3	Metal - mitigate with two grounded connections and insulated joints	$50,000.00	2	$100,000.00
4	Overhead with Adequate Electrical Clearance - no mitigation required	$0.00	0	$0.00
5a	Overhead with Inadequate Electrical Clearance - mitigate by relocating under tracks	$700,000.00	44	$30,800,000.00
5b	Overhead with Inadequate Electrical Clearance - mitigate by raising cables	$1,500,000.00	0	$0.00
6	Copper Communication Cables - mitigate by replacing copper cables with fibre optic cables	$30,000.00	0	$0.00
	Totals		**83**	**$30,950,000.00**

Table 6-4 Mitigation Costs for Enbridge Utilities

Category #	Mitigation Description	Cost / Mitigation	Counted Mitigations	Totals
1	Non-Metal - No mitigation required	$0.00	1	$0.00
2	Reinforced Concrete - mitigate with two grounded connections	$25,000.00	0	$0.00
3	Metal - mitigate with two grounded connections and insulated joints	$50,000.00	43	$2,150,000.00
4	Overhead with Adequate Electrical Clearance - no mitigation required	$0.00	0	$0.00
5a	Overhead with Inadequate Electrical Clearance - mitigate by relocating under tracks	$700,000.00	0	$0.00
5b	Overhead with Inadequate Electrical Clearance - mitigate by raising cables	$1,500,000.00	0	$0.00
6	Copper Communication Cables - mitigate by replacing copper cables with fibre optic cables	$30,000.00	0	$0.00
	Totals		**44**	**$2,150,000.00**

Table 6-5 Mitigation Costs for Bell Canada Utilities

Category #	Mitigation Description	Cost / Mitigation	Counted Mitigations	Totals
1	Non-Metal - No mitigation required	$0.00	25	$0.00
2	Reinforced Concrete - mitigate with two grounded connections	$25,000.00	0	$0.00
3	Metal - mitigate with two grounded connections and insulated joints	$50,000.00	8	$400,000.00
4	Overhead with Adequate Electrical Clearance - no mitigation required	$0.00	0	$0.00
5a	Overhead with Inadequate Electrical Clearance - mitigate by relocating under tracks	$700,000.00	2	$1,400,000.00
5b	Overhead with Inadequate Electrical Clearance - mitigate by raising cables	$1,500,000.00	0	$0.00
6	Copper Communication Cables - mitigate by replacing copper cables with fibre optic cables	$30,000.00	0	$0.00
	Totals		**35**	**$1,800,000.00**

Table 6-6 Mitigation Costs for Hydro One Utilities

Category #	Mitigation Description	Cost / Mitigation	Counted Mitigations	Totals
1	Non-Metal - No mitigation required	$0.00	0	$0.00
2	Reinforced Concrete - mitigate with two grounded connections	$25,000.00	0	$0.00
3	Metal - mitigate with two grounded connections and insulated joints	$50,000.00	2	$100,000.00
4	Overhead with Adequate Electrical Clearance - no mitigation required	$0.00	2	$0.00
5a	Overhead with Inadequate Electrical Clearance - mitigate by relocating under tracks	$700,000.00	0	$0.00
5b	Overhead with Inadequate Electrical Clearance - mitigate by raising cables	$1,500,000.00	3	$4,500,000.00
6	Copper Communication Cables - mitigate by replacing copper cables with fibre optic cables	$30,000.00	0	$0.00
	Totals		**7**	**$4,600,000.00**

Table 6-7 Mitigation Costs for Rogers Utilities

Category #	Mitigation Description	Cost / Mitigation	Counted Mitigations	Totals
1	Non-Metal - No mitigation required	$0.00	1	$0.00
2	Reinforced Concrete - mitigate with two grounded connections	$25,000.00	0	$0.00
3	Metal - mitigate with two grounded connections and insulated joints	$50,000.00	4	$200,000.00
4	Overhead with Adequate Electrical Clearance - no mitigation required	$0.00	0	$0.00
5a	Overhead with Inadequate Electrical Clearance - mitigate by relocating under tracks	$700,000.00	2	$1,400,000.00
5b	Overhead with Inadequate Electrical Clearance - mitigate by raising cables	$1,500,000.00	0	$0.00
6	Copper Communication Cables - mitigate by replacing copper cables with fibre optic cables	$30,000.00	0	$0.00
	Totals		**7**	**$1,600,000.00**

Table 6-8 Mitigation Costs for TTC Utilities

Category #	Mitigation Description	Cost / Mitigation	Counted Mitigations	Totals
1	Non-Metal - No mitigation required	$0.00	0	$0.00
2	Reinforced Concrete - mitigate with two grounded connections	$25,000.00	0	$0.00
3	Metal - mitigate with two grounded connections and insulated joints	$50,000.00	2	$100,000.00
4	Overhead with Adequate Electrical Clearance - no mitigation required	$0.00	5	$0.00
5a	Overhead with Inadequate Electrical Clearance - mitigate by relocating under tracks	$700,000.00	0	$00.00
5b	Overhead with Inadequate Electrical Clearance - mitigate by raising cables	$1,500,000.00	0	$0.00
6	Copper Communication Cables - mitigate by replacing copper cables with fibre optic cables	$30,000.00	0	$0.00
	Totals		**7**	**$100,000.00**

Table 6-9 Mitigation Costs for Canada Packers Utilities

Category #	Mitigation Description	Cost / Mitigation	Counted Mitigations	Totals
1	Non-Metal - No mitigation required	$0.00	0	$0.00
2	Reinforced Concrete - mitigate with two grounded connections	$25,000.00	0	$0.00
3	Metal - mitigate with two grounded connections and insulated joints	$50,000.00	6	$300,000.00
4	Overhead with Adequate Electrical Clearance - no mitigation required	$0.00	0	$0.00
5a	Overhead with Inadequate Electrical Clearance - mitigate by relocating under tracks	$700,000.00	0	$0.00
5b	Overhead with Inadequate Electrical Clearance - mitigate by raising cables	$1,500,000.00	0	$0.00
6	Copper Communication Cables - mitigate by replacing copper cables with fibre optic cables	$30,000.00	0	$0.00
	Totals		**6**	**$300,000.00**

Table 6-10 Mitigation Costs for Canadian Gypsum Co. Utilities

Category #	Mitigation Description	Cost / Mitigation	Counted Mitigations	Totals
1	Non-Metal - No mitigation required	$0.00	0	$0.00
2	Reinforced Concrete - mitigate with two grounded connections	$25,000.00	0	$0.00
3	Metal - mitigate with two grounded connections and insulated joints	$50,000.00	1	$50,000.00
4	Overhead with Adequate Electrical Clearance - no mitigation required	$0.00	0	$0.00
5a	Overhead with Inadequate Electrical Clearance - mitigate by relocating under tracks	$700,000.00	0	$0.00
5b	Overhead with Inadequate Electrical Clearance - mitigate by raising cables	$1,500,000.00	0	$0.00
6	Copper Communication Cables - mitigate by replacing copper cables with fibre optic cables	$30,000.00	0	$0.00
	Totals		**1**	**$50,000.00**

Table 6-11 Mitigation Costs for Interprovincial Pipelines Utilities

Category #	Mitigation Description	Cost / Mitigation	Counted Mitigations	Totals
1	Non-Metal - No mitigation required	$0.00	0	$0.00
2	Reinforced Concrete - mitigate with two grounded connections	$25,000.00	0	$0.00
3	Metal - mitigate with two grounded connections and insulated joints	$50,000.00	2	$100,000.00
4	Overhead with Adequate Electrical Clearance - no mitigation required	$0.00	0	$0.00
5a	Overhead with Inadequate Electrical Clearance - mitigate by relocating under tracks	$700,000.00	0	$0.00
5b	Overhead with Inadequate Electrical Clearance - mitigate by raising cables	$1,500,000.00	0	$0.00
6	Copper Communication Cables - mitigate by replacing copper cables with fibre optic cables	$30,000.00	0	$0.00
	Totals		**2**	**$100,000.00**

Table 6-12 Mitigation Costs for Sun Canadian Pipeline Utilities

Category #	Mitigation Description	Cost / Mitigation	Counted Mitigations	Totals
1	Non-Metal - No mitigation required	$0.00	0	$0.00
2	Reinforced Concrete - mitigate with two grounded connections	$25,000.00	0	$0.00
3	Metal - mitigate with two grounded connections and insulated joints	$50,000.00	1	$50,000.00
4	Overhead with Adequate Electrical Clearance - no mitigation required	$0.00	0	$0.00
5a	Overhead with Inadequate Electrical Clearance - mitigate by relocating under tracks	$700,000.00	0	$0.00
5b	Overhead with Inadequate Electrical Clearance - mitigate by raising cables	$1,500,000.00	0	$0.00
6	Copper Communication Cables - mitigate by replacing copper cables with fibre optic cables	$30,000.00	0	$0.00
	Totals		**1**	**$50,000.00**

Table 6-13 Mitigation Costs for Telus Utilities

Category #	Mitigation Description	Cost / Mitigation	Counted Mitigations	Totals
1	Non-Metal - No mitigation required	$0.00	0	$0.00
2	Reinforced Concrete - mitigate with two grounded connections	$25,000.00	1	$25,000.00
3	Metal - mitigate with two grounded connections and insulated joints	$50,000.00	0	$0.00
4	Overhead with Adequate Electrical Clearance - no mitigation required	$0.00	0	$0.00
5a	Overhead with Inadequate Electrical Clearance - mitigate by relocating under tracks	$700,000.00	0	$0.00
5b	Overhead with Inadequate Electrical Clearance - mitigate by raising cables	$1,500,000.00	0	$0.00
6	Copper Communication Cables - mitigate by replacing copper cables with fibre optic cables	$30,000.00	0	$0.00
	Totals		**1**	**$25,000.00**

Table 6-14 Mitigation Costs for Woodbine Utilities

Category #	Mitigation Description	Cost / Mitigation	Counted Mitigations	Totals
1	Non-Metal - No mitigation required	$0.00	0	$0.00
2	Reinforced Concrete - mitigate with two grounded connections	$25,000.00	1	$25,000.00
3	Metal - mitigate with two grounded connections and insulated joints	$50,000.00	2	$100,000.00
4	Overhead with Adequate Electrical Clearance - no mitigation required	$0.00	0	$0.00
5a	Overhead with Inadequate Electrical Clearance - mitigate by relocating under tracks	$700,000.00	0	$0.00
5b	Overhead with Inadequate Electrical Clearance - mitigate by raising cables	$1,500,000.00	0	$0.00
6	Copper Communication Cables - mitigate by replacing copper cables with fibre optic cables	$30,000.00	0	$0.00
	Totals		**3**	**$125,000.00**

Table 6-15 Mitigation Costs for Allstream Utilities

Category #	Mitigation Description	Cost / Mitigation	Counted Mitigations	Totals
1	Non-Metal - No mitigation required	$0.00	1	$0.00
2	Reinforced Concrete - mitigate with two grounded connections	$25,000.00	0	$0.00
3	Metal - mitigate with two grounded connections and insulated joints	$50,000.00	1	$50,000.00
4	Overhead with Adequate Electrical Clearance - no mitigation required	$0.00	0	$0.00
5a	Overhead with Inadequate Electrical Clearance - mitigate by relocating under tracks	$700,000.00	0	$0.00
5b	Overhead with Inadequate Electrical Clearance - mitigate by raising cables	$1,500,000.00	0	$0.00
6	Copper Communication Cables - mitigate by replacing copper cables with fibre optic cables	$30,000.00	0	$0.00
	Totals		**2**	**$50,000.00**

Table 6-16 Mitigation Costs for Private Owner Utilities

Category #	Mitigation Description	Cost / Mitigation	Counted Mitigations	Totals
1	Non-Metal - No mitigation required	$0.00	0	$0.00
2	Reinforced Concrete - mitigate with two grounded connections	$25,000.00	0	$0.00
3	Metal - mitigate with two grounded connections and insulated joints	$50,000.00	1	$50,000.00
4	Overhead with Adequate Electrical Clearance - no mitigation required	$0.00	0	$0.00
5a	Overhead with Inadequate Electrical Clearance - mitigate by relocating under tracks	$700,000.00	0	$0.00
5b	Overhead with Inadequate Electrical Clearance - mitigate by raising cables	$1,500,000.00	0	$0.00
6	Copper Communication Cables - mitigate by replacing copper cables with fibre optic cables	$30,000.00	0	$0.00
	Totals		**1**	**$50,000.00**

7.0 Next Steps

- During the detailed design phase, meetings should be held with individual utility companies to review the information contained within this report and the UP Express Electrification drawings.

- Where potential utility conflicts exist, exact field locations should be determined through a scanning technique such as LIDAR or ground penetrating RADAR (GPR).

- Once the exact physical location is determined, further analysis of the positioning of OCS support foundations should be undertaken to determine if it is possible to relocate the OCS support foundation.

- If during the detailed design phase the OCS support foundation cannot be relocated to avoid a potential conflict, a review of the applicable Board Orders /Cross Agreements will be undertaken.

- An Electromagnetic Interference (EMI) study along the railroad ROW is recommended to identify and mitigate potential unsafe step, touch, rail to rail, and rail to ground voltages at metallic infrastructure within or adjacent to the railroad ROW, such as fences, pipelines and railway tracks, that may present a hazardous exposure to the public and rail or utility employees.

APPENDIX A– ABBREVIATIONS & ACRONYMS

ac	Alternating Current	**kV**	kilo-Volt
AREMA	American Railway Engineering and Maintenance-of-Way Association	**MH**	Morrison Hershfield Ltd.
EMC	Electromagnetic compatibility	**Mx**	Metrolinx
EMF	Electromagnetic field	**OCS**	Overhead contact system
EMI	Electromagnetic interference	**PB**	Parsons Brinckerhoff Halsall, Inc.
EMU	Electric multiple unit	**PD**	Preliminary design
G&B	Grounding and bonding	**ROW**	Right of Way
HO	Hydro One	**UP Express**	Union-Pearson Express
HV	High Voltage	**US**	Union Station
IEEE	Institute of electrical and Electronics Engineers	**USRC**	Union Station Rail Corridor

APPENDIX B– DEFINITIONS

AREMA
This is the acronym for American Railway Engineering and Maintenance of-Way Association. AREMA is the organization that represents the engineering function of the North American railroads.

Catenary
An assembly of overhead wires consisting of, as a minimum, a messenger wire, carrying vertical hangers that support a solid contact wire which is the contact interface with operating electric train pantographs, and which supplies power from a central power source to an electrically powered vehicle, such as a train.

Contact Wire
A solid grooved, bare overhead electrical conductor, which is part of an OCS that is suspended above the rail vehicles and which supplies the electrically powered vehicles with electrical energy through roof-mounted current collection equipment pantographs, and with which the current collectors make direct electrical contact.

EMU
Electric Multiple Unit; a set of self-propelled electric rail cars usually operable singly or with other EMUs comprising a train.

Grounding
Connecting to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity to limit the build-up of voltages to levels below that which may result in undue hazard to persons or to connected equipment.

kV
Abbreviation for kilovolt and equal to 1000 volts.

Messenger Wire
In catenary construction, the OCS Messenger Wire is a longitudinal bare stranded conductor that physically supports the contact wire or wires either directly or indirectly by means of hangers or hanger clips, and is electrically common with the contact wire(s).

Overhead Contact System (OCS)
The physical aerial apparatus that provides electrical energy supply to rail vehicles.

Pantograph
Device of variable height on the top of a locomotive or EMU; it includes a transverse contact strip, which slides along the contact wire to conduct electric power from the catenary to the train.

Preliminary Design
The design of a proposed project (including a preliminary detailed cost estimate that is refined as the design progresses) to a level that demonstrates that the project is buildable within the given parameters of the design scope.

Rail Potential
Rail Potential is defined as the voltage between running rails and ground occurring under operating conditions when the running rails are utilized for carrying the traction return current or under fault conditions.

Spur
A railroad track that diverges from the main track to service a specific location or industry.

Static Wire (Aerial Ground Wire)
A wire, usually installed aerially adjacent to or above the catenary conductors and negative feeders, that connects OCS supports collectively to ground or to the grounded running rails to protect people and installations in case of an electrical fault. In an ac electrification system, the static wire forms a part of the traction power return circuit and is connected to the running rails at periodic intervals and to the traction power facility ground grids. If mounted aerially, the static wire may also be used to protect the OCS against lightning strikes. It is sometimes termed "aerial ground wire".

APPENDIX C – APPLICABLE STANDARDS

General

Unless specifically noted otherwise herein, the latest editions of the code, standards, and regulations that are applicable at the time the design have been used. If a new edition or amendment to a code, regulation or standard is issued before the design is completed, the design will be updated to conform to the new requirement(s) to the extent practical.

Standards

American Railway Engineering and Maintenance-of-Way Association (AREMA)
(These are not standards but guidelines or recommended practices)

- Manual for Railway Engineering, Volume 3 Infrastructure and Passenger, Chapter 33 Electric Energy Utilization
- American railway Engineering and Maintenance-of-Way (AREMA) Communications and Signals Manual of Recommended Practice.

Canadian Standards Association (CSA) Standards

- CAN/CSA-C22.1 – Canadian Electrical Code, Part I
- CAN/CSA-C22.3 No. 1- M87 – Overhead Systems
- CAN/CSA-C22.3 No. 3 – Inductive Coordination (Definitions, Principles, and Practices)
- CAN/CSA-C22.3 No 8-M91 (Reaffirmed 2003) Canadian Railway Electrification Guidelines

Provincial/Federal Standards and Governing Acts

- Ontario Electrical Safety Code (OESC)

European Standards (EN)/European Committee for Electro-technical Standardization (CENELEC)

- EN 50119 – 2001 - Railway Applications – Fixed Installations – Electric Traction Overhead Contact Lines
- EN 50122-1 – Protective Provisioning Against Electric Shock

International Electro-technical Commission (IEC) Standards

- IEC 60479 - Effects of Current on Human Beings and Livestock – Part 1 General Aspects

Institution of Electrical and Electronics Engineers (IEEE)

- IEEE 80 – IEEE Guide for Safety in ac Substation Grounding
- IEEE 81 – IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potential of a Ground System
- IEEE 142 – Recommended Practice for Grounding of Industrial and Commercial Power Systems
- IEEE 776 – Recommended Practice for Inductive Coordination of electric Supply and Communication Lines

APPENDIX D – REFERENCE DOCUMENTS LOG

Source Documents

The documents in the following table represent the key inputs to the TPSS design process. These documents are not industry standards but are documents developed either during past studies, by Metrolinx/GO Transit for existing operations, or by Parsons Brinckerhoff during earlier stages of the design. The documents are not listed in a specific order and all are considered relevant and are discussed in the report.

Ref #	Document Title	Owner
1.	Contract No. RQQ-2011-PP-032 Appendix B and Appendix D	Metrolinx
2.	GO Electrification Study Final Report – December 2010	DELCAN/ARUP
3.	ESP-03000 – Grounding and Bonding	Parsons Brinckerhoff
4.	ESP-04000 – Electromagnetic Control and Interference	Parsons Brinckerhoff
5.	GO Transit Design Requirements Manual	Metrolinx
6	UP Express Preliminary Design Report Version 00	Parsons Brinckerhoff
7.	Utility Crossings Report – KI1 Rail Corridor	Morrison Hershfield
8	Utility Crossings Report – KI2, KI3, LE1. LE2, LW1, LW2, LW3, US1 and US2 Rail Corridors	Morrison Hershfield

APPENDIX E – INDUCED, CONDUCTED AND RADIATED INTERFERENCE PROTECTION OF UTILITIES

Prior to applying grounding and bonding and immunization from electromagnetic interference (EMI), the following studies are recommended in order to determine the appropriate immunization measure. It should be noted that the studies thereof are to be performed during the detailed design stage and not at this preliminary stage, due to the fact that the electrified railway will be designed and built many years from this preliminary design stage, and as such, some utilities may be replaced, re-routed or removed, additional utilities may be constructed, and there may be technological advancements in communication systems immunity and grounding and bonding, as well as changes in the standards, guidelines and recommended practices for electromagnetic compatibility, grounding and bonding, inductive coordination and railway right of way analysis.

1. Inductive Coordination:

A traction power supply and overhead contact system may interfere with a communications system by means of electromagnetic induction, electromagnetic radiation, and ground potential rise. Due to the complexity of the systems involved there is no simple solution to interference problems, and no generic mitigation method. Thus, interference studies should be made to provide a sound basis for inductive coordination, as per CSA C22.3 No. 3, CSA C22.3 No. 8-M91, AREMA C&S Manual part 20.1.4 and IEEE Std. 776. The engineering and design groups of both the railway and the telecommunications organization must cooperate, in order to ensure that inductive coordination is achieved effectively and economically.

Inductive coordination is a cooperative effort in the location, design, construction, operation and maintenance of electrified railway and communications systems. Historically, inductive coordination has been accomplished through the cooperative efforts of the railway and telecommunications companies. Generic inductive coordination as specified in the aforementioned standards should be performed for both companies as good engineering practice to avoid present and/or future interference issues.

Where situations arise which in the opinion of either company require specific inductive coordination, an inductive coordination study should be performed in order to calculate the induction between the overhead catenary system (OCS) and telecommunication lines at the interference point, and the calculated induction should be field verified at the interference by use of a probe wire after applying mitigation or determination that no mitigation is needed.

The following mitigation undertakings are typical for specific inductive coordination measures.

1.1 Mitigation Undertakings for Telecommunications Systems

Mitigation undertakings for deviations to CSA C22.3 No. 3 and IEEE Std. 776 should be taken as necessary based on the results of the inductive coordination study. The choice of mitigation is to be decided between the telecommunications company and the railway electrification detailed design consultant and will depend on many factors such as the estimated induced voltages in the telecommunication lines, cost, measurements as needed, environmental factors, reliability, significance of the communication circuit, and maintenance practices. The following are common mitigation techniques for communications systems.

Shielding

Shielding the communication circuit, or placing a grounded conductor between the OCS and communications conductor (which acts as a shield for 60 Hz electric field) will reduce EMI. It should be noted that communication cable pairs in grounded shield are immune to electric induction. Cable shields should be designed, built, and maintained to minimize malfunctions that may result from the influence of OCS EMI. Cable sheath continuity should be maintained.

Applying supplementary shielding such as tape armor on cables, iron conduit, and supplementary shield wires for additional shielding should be considered for inductive coordination purposes.

Replacement

Some communications equipment is inherently less susceptible to interference than others. For example, underground cable facilities are less susceptible than overhead open wire. Carrier derived circuits are normally immune to interference, although the supply of carrier power may be affected. Fibre optic circuits are immune to electrical interference, although the metallic pairs normally associated with fibre optic cable are susceptible and their shields and support wires are also affected by electromagnetic induction.

Replacing circuit components that are unbalanced or susceptible with those designed to operate in a higher electromagnetic environment should be considered for inductive coordination. Replacing the communication wire with fibre optic, carrier system, radio or shielded and twisted pairs/triads instead of open wire-lines will mitigate EMI effects. Closely spaced twister pairs should be used to minimize differences in induced voltages of each side of the circuit. In any case, communication circuits should be designed, built, and maintained to minimize malfunctions that may result from the influence of power lines.

Grounding and Bonding

Grounding the cable metallic shields is an important factor in reduction of 60 Hz electric and magnetic fields. As part of mitigation, the resistance of the existing ground system and the integrity of the grounding connections should be assessed, and improved grounding and bonding schemes (such as the use of additional ground rods, chemical ground electrodes, soil treatment or additional bonding connections to lower the shield resistance to ground) should be prescribed as needed. Installing and maintaining additional cable sheath grounding can maximize shielding effectiveness.

Longitudinal Balance and Susceptibility

The telecommunications circuits can be redesigned or modified and maintained to minimize the unbalance of series impedance and admittance to earth of the two sides of the circuit. Use of earth as part of the circuit should be avoided if practical.

Protection

Circuit protection should be modified, redesigned, and maintained to avoid excessive interruptions, interference, or damage caused by the OCS EMI.

Route Separation
Relocating or Route separation is an effective way of reducing EMI exposure. The cost, inconvenience, practicability, and all pertinent factors related to the use of an alternative route should be evaluated and weighed against the cost and complexity of mitigation measures that may be required to ensure acceptable service. Varying the separation between paralleling power and communications lines has a limited effect on power line influence at 60 Hz. For example, increasing the horizontal separation from 7.62 to 91.44 m will only reduce the influence by a factor of one-half. At the harmonic noise frequencies the effect is much improved and reductions in the order of nine-tenths can be expected.

Use of Voltage to Ground Control Devices
Voltage to ground can be reduced by the use of drainage circuits that provide a low impedance path to ground for 60 Hz currents without affecting circuit operation. These are very effective at the station end of a subscriber's circuit where the impedance to ground is normally quite high.

The use of drainage circuits may result in excessive flow of longitudinal current. This can be controlled by means of longitudinal chokes. Induction control transformers, which are multi-pair chokes, are useful in controlling longitudinal voltage on a number of pairs at one time. Isolating transformers can be used to divide a circuit into shorter lengths longitudinally, and thus reduce the maximum voltage to ground.

It should be noted that applying special devices such as ringer isolators, neutralizing transformers, isolation transformers, longitudinal chokes, drainage coils, and special protective devices is costly and should only be considered for inductive coordination purposes.

1.2 Mitigation Undertakings for the OCS/Electric Locomotives

Depending on the cost and the results of the inductive coordination study, it may be more cost effective to mitigate the EMI from the OCS by modifying it at areas near sensitive communications systems to control electromagnetic emanation. Below are typical mitigation methods.

Earth Residual Current Control
Return currents flowing through ground should be minimized especially at areas of underground communication. Use of earth as part of the circuit should be limited, and the majority of the return current should flow through the running rails and the negative feeder.

Harmonics
Onboard locomotive harmonic filters should be used to reduce harmonic currents, which are generated in electric locomotives, from being propagated back into OCS lines. Filters should also be used at substations and feeder points to reduce the propagation of harmonic currents back into the power lines serving the traction power supply system and OCS.

Furthermore, using transformers that do not generate high levels of harmonics and connecting transformers phase to phase rather than phase to ground can reduce harmonic exposure for sensitive communications facilities.

Capacitor banks in the TPF, when used on traction power supply systems, must be designed and located with care to avoid system resonances at harmonic frequencies. Adding a neutral reactor to the capacitor limits propagation of harmonics along the OCS.

Shielding
Placing a ground wire or shield between the OCS and sensitive communication lines reduces EMI to those lines. The continuity and adequate sizing of the static wire should be maintained. Larger sizes or additional overhead ground conductors should be considered for additional shielding.

Conductor Configuration
The configuration of the negative feeder and OCS can be modified to reduce inductive influence. For instance, use of close spacing (especially between the NF, OCS, and static wire), transpositions, and cables contributing to reducing influence. Copper communication cables should be twisted if practical to increase immunity.

Protection
Protection and switching apparatus should be built and maintained to minimize transient disturbances and fault clearing times. This will reduce EMI due to transient overcurrents and overvoltages.

Special Devices
Special devices, such as booster transformers, phase-reversal transformers, resonant shunts, filters, and special protection should be considered to limit fault current and time duration if necessary for inductive coordination only.

Relocation
Relocation or routing of the electromagnetic source(s) to reduce inductive exposure may be considered.

Radio-Frequency Interference (RFI) Control
As part of the electrified railway overall commissioning phase, radio-frequency emissions by the electric railway should be tested against the limits set forth in CAN3-C108.3.1 and EN 50121 part 2. These standards provide protection to LF, HF, VHF, and UHF bands of communication circuits. Areas of deviation should be mitigated and re-tested, for instance, a defective insulator on the OCS will produce arcing in the radio-frequency range above the limits of the aforementioned standards, in which the mitigation would be to replace or repair the defective insulator.

2. Grounding and Bonding

These structures are pipes, cable metallic shields, fences, buildings, rail tracks, etc... They should be grounded as per CSA C22.3 No. 8-M91, IEEE Std. 80 and CSA C22.1. Furthermore, a railway "right-of-way" study is recommended to mitigate potential unsafe step, touch, rail to rail and rail to ground voltages at metals nearby the tracks, such as fences, pipelines and railway tracks.

2.1 Right-of-Way Study

Electromagnetic interference caused by the electrified railway and nearby conductors such as railways can cause degradation of performance for the utility signal and protection systems, and cause unacceptable touch, step, rail to ground, and rail to rail voltages under both normal load and fault conditions. Buried and aboveground conductors such as fences, railway tracks, and pipelines should be included in a right of way study. The AC induced interference shall be computed, and based on the results of the study, grounding and bonding of the utilities should be modified as needed. Such right of way studies can be conveniently performed using computer modeling techniques, such as the SES technologies right of way software module.

2.2 Grounding of Utilities Adjacent to the Electrified Rail Tracks

All structures, buildings, and utilities on or adjacent to the railway right of way that may present a hazardous exposure to the public and railway employees due to induced or transferred potentials from the OCS should be adequately grounded. Grounding is installed for operational purposes such as satisfactory operation of adjacent signalling and communications circuits that may be affected by ground return currents, as well as electric safety and shock protection, keeping the voltage to ground to a safe level (not more than 50 Volts).

For the purpose of electrical safety grounding, three zones of influence are defined:

Zone 1 – Within 10 m of the nearest rail
Zone 2 – Within 10-50 m of the nearest rail
Zone 3 – Within 50-250 m of the nearest rail

2.2.1 Grounding in Zone 1

Structures
All metal structures, including metal roofs of buildings, shall be grounded to a local ground electrode and bonded to the rails, running two separate stranded copper wires of not less than 25 mm each. Metal roofs shall be checked for electrical continuity between parts of the roof, which, if necessary, shall be implemented by running a copper wire around the roof. Metal water and drainage pipes connected into the building shall have a plastic or other non-metal insert of approximately 3 m length in the approach away from the tracks.

Furthermore, fences in Zone 1 shall be grounded to a ground rod and bonded to the rails at intervals not greater than 300 m. The point of bonding shall be marked on the fence post. Fences crossing from Zone 1 into Zone 2 shall have a non-metal section inserted at the point of crossing into Zone 2. This can be of wood or any insulating material and shall be at least 2 m long.

Pipelines
Pipelines running parallel to or crossing an electrified railway are exposed to induced voltages from the operating and fault currents in the OCS and the ground potential transferred from the rails to the pipe. The degree of exposure also depends on whether the pipe is located on the surface or buried, the type of coating on the pipe, and cathodic protection. The method of grounding protection shall be agreed with the utility operating the pipeline.

Above Ground Fuel Tanks
Fuel tanks shall not generally be situated in Zone 1. However, when they are, fuel tanks shall be placed on a ground mat of 2 m wire spacing installed under the tanks and extending at least 1 m beyond the fence of the installation. Each tank shall have separate ground connections to the ground mat. The ground mat shall be grounded to the rails. The ground mat under the tanks shall be either buried not deeper than 1 m or embedded in the concrete slab on which the tank(s) are installed. All federal,

provincial, and municipal laws, bylaws, and other requirements shall be applicable. In every other respect, the installation shall be treated in the same way as buildings in Zone 1.

Other Utilities
Care must be taken to coordinate the grounding and isolation requirements with that required by other utilities.

2.2.2 Grounding in Zone 2

Structures
Bonding to rails is not required. Metal structures and metal roofs shall be grounded to a local ground electrode. Continuity of metal roofs shall be ensured.

Fences
Metal fences running parallel to the tracks shall be grounded to a ground rod at intervals of not less than 500 m. The point of grounding shall be marked. Fences crossing from Zone 2 into Zone 3 do not need any special grounding measures.

Pipelines
Pipelines running parallel to or crossing an electrified railway are exposed to induced voltages from the operating and fault currents in the OCS and the ground potential transferred from the rails to the pipe. The degree of exposure also depends on whether the pipe is located on the surface or buried, the type of coating on the pipe, and cathodic protection. The method of grounding protection shall be agreed with the utility operating the pipeline.

Above Ground Fuel Tanks
The treatment in Zone 2 shall be the same as in Zone 1, except that the ground mat need not be bonded to the rail. Otherwise, the installation shall be treated the same way as buildings in Zone 2.

2.2.3 Grounding in Zone 3

Structures
Only local grounding is required in accordance with normal building practices and relevant standards.

Fences
Fences running parallel to the tracks shall be grounded at intervals not exceeding 1000 m.

Pipelines
Pipelines running parallel to or crossing an electrified railway are exposed to induced voltages from the operating and fault currents in the OCS and the ground potential transferred from the rails to the pipe. The degree of exposure also depends on whether the pipe is located on the surface or buried, the type of coating on the pipe, and cathodic protection. The method of grounding protection shall be agreed with the utility operating the pipeline.

Above Ground Fuel Tanks
Grounding of above ground fuel tanks in Zone 3 shall be the same as in Zone 2. Otherwise, the installation in Zone 3 shall be treated the same way as buildings in Zone 3.

3 Corrosion Protection

As per EN 50122-2: the European standard on railway applications: provisions against the effects of stray currents caused by DC traction systems, experience for several decades has not shown evident corrosion effects from A.C. traction systems. As such, corrosion standards only provide D.C. corrosion provisions. Specifically, the future UP express 2x25 kV A.C. traction system will not have any significant corrosion effects on utilities.