Investigation of Spare Duct Banks to be Used for Cable Circuit Replacement Feeders A32T-A33T

Final Draft Report

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Project Overview

METSCO was asked by Exhibition Place to provide investigation and inspection services for the duct banks of 13.8 kV underground cables of Feeders A32T and A33T. The existing cable infrastructure is comprised of oil-filled cables (13.8 kV PILC 500 MCM). An asset management study in 2017, deemed the A32T and A33T feeder cables to be most critical for replacement, based on the high frequency of failure events.

The scope of work in this project was to inspect the duct banks of two feeders A32T and A33T by accessing 20 manholes located between Toronto Hydro Strachan TS and the World SUB (TWX). The duct bank investigation was carried out between 9th and 16th December 2019 over five working days with the Toronto Hydro owned stretch (manholes 5062 to 5064) completed on December 19th, 2019. Suitable precautionary measures were undertaken to ensure that there were no oil leaks, following which water was pumped out of the manholes of interest. Prior to entering the manholes, thermal infrared scanning was done on the existing cable infrastructure to eliminate the possibility of thermal anomalies.

The comprehensive investigation was carried out by confined space trained crew, with the provision of the requisite rescue and gas detection apparatus. The spare conduits were visually inspected using a rigid endoscopic camera – Model 39328-14063. The mechanical inspection was performed using a mandrel to ensure that the spare PVC conduits were free from physical deformations or damages.

Visual inspection being conducted using an endoscopic camera in Manhole #120

Summary of Duct Bank Investigation

The following tabulation shows a summary of the duct bank investigation work carried out in the manholes (in scope) between the Toronto Hydro Strachan TS and the World SUB (TWX):

Manhole #	Duct configuration	Spare ducts availability (a minimum of two)	Camera	Roped	Mandrel
5064	North from THESL station	No	-	-	-
	South to Manhole #5063	Yes	-	Yes	-
5063	Not investigated				
5062	North to Manhole #5063	Yes	Yes	-	-
	South to Manhole #60B	Yes	Yes	Yes	Yes
60B	West to Manhole #60A	Yes	Yes	Yes	Yes
60A	South to Manhole #60	Yes	Yes	-	Yes
60	East to Manhole #59	No	-	-	-
59	West to Manhole #68	No	-	-	-
58	North to Manhole #59	Yes	Yes	Yes	-
68	West to Manhole #67	No	-	-	-
67	West to Manhole #66	No	-	-	-
66	South to Manhole #120	Yes	Yes	Yes	-
120	South to Manhole #18	Yes	Yes	-	-
18	West to Manhole #19	Yes	Yes	Yes	-
19	West to Manhole #20	Yes (1 duct)	Yes	-	-
20	South to Manhole #130B	No	-	-	-
130B	South to Manhole #204	Yes	Yes	Yes	-
204	West to Manhole #203	Yes	Yes	Yes	Yes

Manhole #	Duct configuration	Spare ducts availability (a minimum of two)	Camera	Roped	Mandrel
203	West to Manhole #202	Yes	Yes	Yes	-
202	West to Manhole #201	Yes	Yes	Yes	-
201	North to Vault TWX	Yes	Yes	-	-

During the duct bank investigation, anomalies such as splice issues, the presence of dirt/corrosion/grime and oil residue were observed in certain manholes.

Splice anomaly observed in Manhole #202

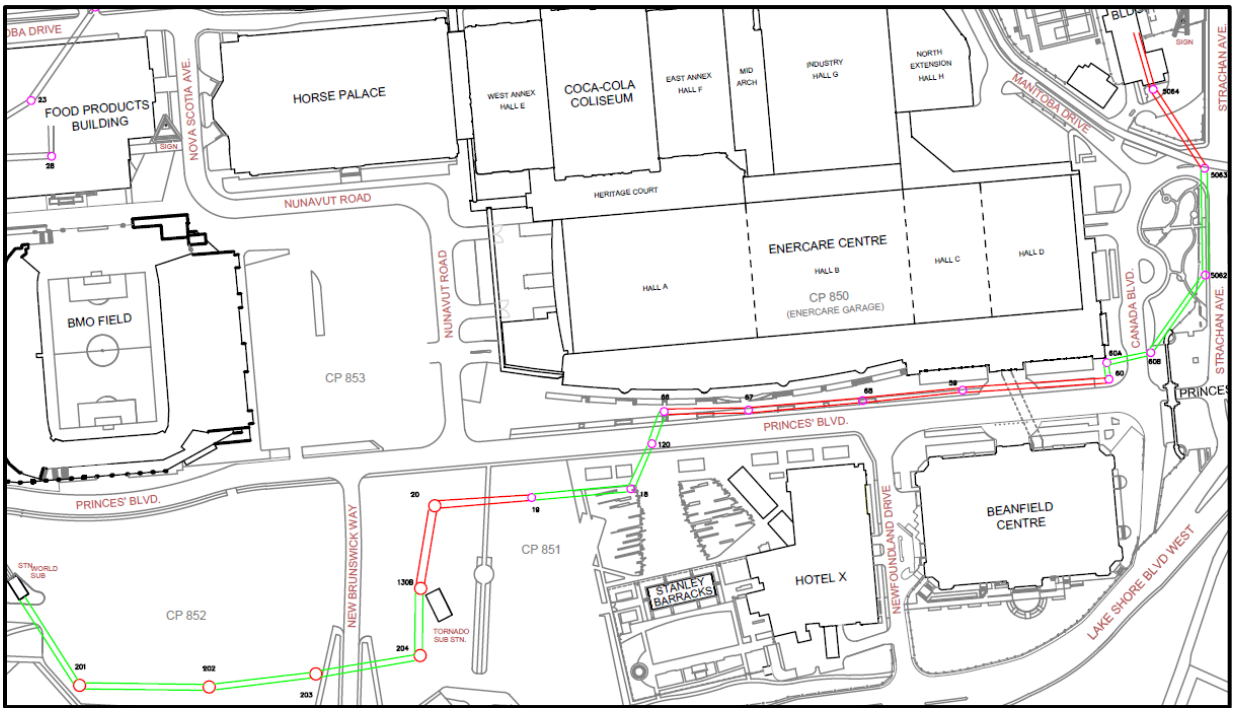
Excessive grime observed in Manhole #130B

Oily residue observed in Manhole #120

In manholes #5064, #60 and #59 the 13.8 kV cables were suspected to be wrapped in asbestos-containing material (ACM). Thereby samples were extracted from these manholes to test for asbestos. However, results from the laboratory testing confirmed the absence of asbestos in the aforementioned manholes. The corresponding laboratory test report is available in Appendix B of this report.

A detailed visual guideline for the manholes investigated between the Toronto Hydro Strachan TS and the World SUB is provided below, alongside the additional observations made:

Overview of the duct-bank runs investigated:

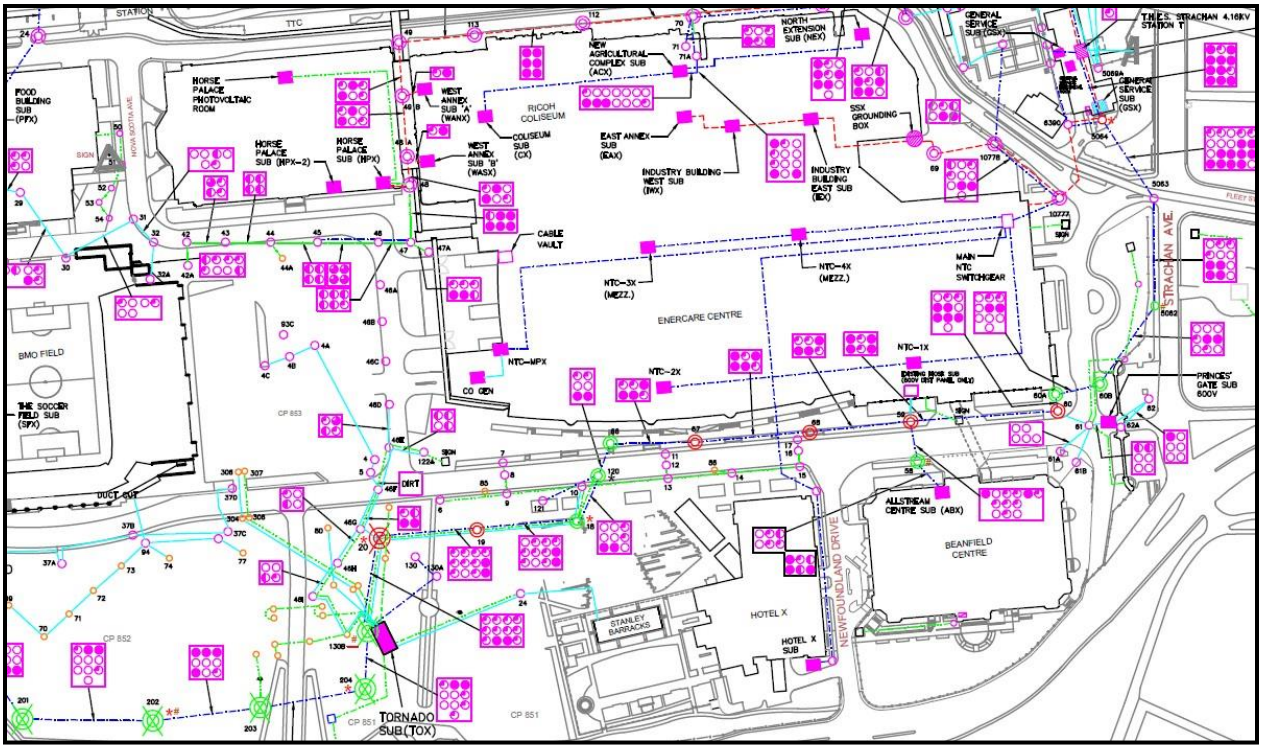


LEGEND

A32T/A33T WITH AVAILABLE DUCT

A32T/A33T WITHOUT AVAILABLE DUCT

Detailed overview of the condition of manholes investigated:



LEGEND - MANHOLE COLOR CODING

◎ ○	SPARE DUCTS AVAILABLE
◎ ○	NO SPARE DUCTS AVAILABLE
◎ ○	NOT INVESTIGATED
*	SPLICE ANOMALY
#	DIRT/CORROSION/GRIME
*	OILY RESIDUE

Manhole #	Duct configuration	Spare ducts availability (a minimum of two)	Visual representation	Additional observations
5064	North from THESL station	No	◎	
	South to Manhole #5063	Yes		* Splice anomaly
5063	Not investigated			
5062	North to Manhole #5063	Yes	○	# Dirt and corrosion

Manhole #	Duct configuration	Spare ducts availability (a minimum of two)	Visual representation	Additional observations
	South to Manhole #60B	Yes		
60B	West to Manhole #60A	Yes		
60A	South to Manhole #60	Yes		
60	East to Manhole #59	No		
59	West to Manhole #68	No		
58	North to Manhole #59	Yes		**# Dirt and corrosion**
68	West to Manhole #67	No		
67	West to Manhole #66	No		
66	South to Manhole #120	Yes		
120	South to Manhole #18	Yes		*** Oily residue**
18	West to Manhole #19	Yes		*** Splice anomaly**
19	West to Manhole #20	Yes (1 duct)		
20	South to Manhole #130B	No		*** Splice anomaly**
130B	South to Manhole #204	Yes		**# Excessive grime**
204	West to Manhole #203	Yes		*** Splice anomaly**
203	West to Manhole #202	Yes		

Manhole #	Duct configuration	Spare ducts availability (a minimum of two)	Visual representation	Additional observations
202	West to Manhole #201	Yes		* Splice anomaly # Dirt
201	North to Vault TWX	Yes		

Detailed Investigation Results

The detailed field results are presented in this section, with respect to the duct configuration in each manhole and any additional observations that were made during the investigation.

Manhole #1 (on our list)

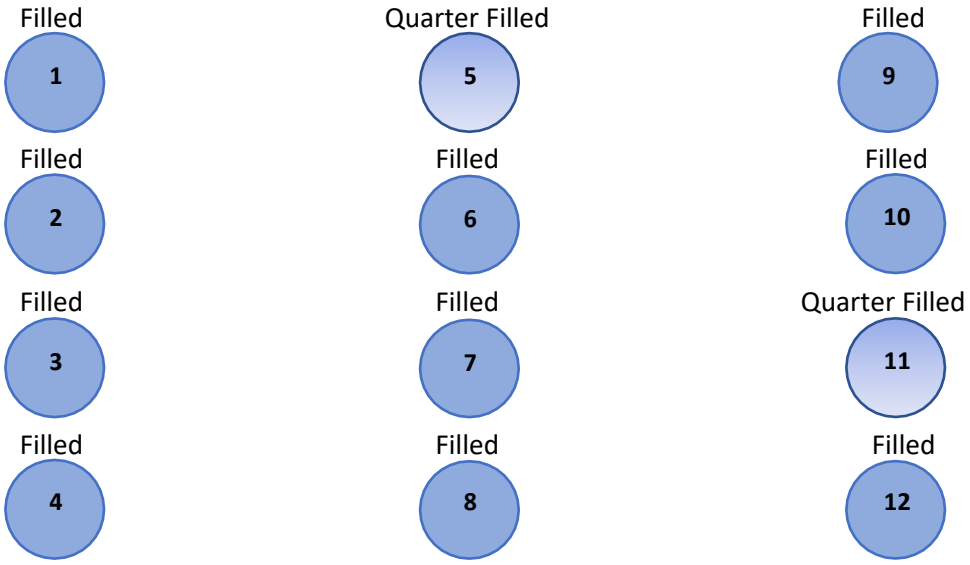
Nomenclature: 5064 (Toronto Hydro Owned)

Location: GEN. SER. BLDG. CNE. MAIN

Approximate Distance to Manhole #2: ~163'

Duct Configurations:

North from THESL station:



South to Manhole #2 (Nomenclature: 5063):

Quarter Filled	Quarter Filled	Empty	Quarter Filled	Quarter Filled	Quarter Filled
1	5	9	13	17	21
Empty	Empty	Empty	Filled	Filled	Filled
2	6	10	14	18	22
Empty	Filled	Filled	Filled	Filled	Empty (Roped)
3	7	11	15	19	23
Filled	Filled	Filled	Filled	Empty (Roped)	Filled
4	8	12	16	20	24

Notes:

- Approximately 4” gap between 3x4 duct banks going South to Manhole #2 (5063). Need to enter Manhole #2 (5063) to know how many ducts make it there
- Unable to send the endoscopic camera through to Manhole #2 due to deformed splice found
- Duct #4 has a 13.8 kV cut off cable that can be used as a spare in the ducts going South to Manhole#2
- The manhole contains 13.8 kV and 4.16 kV cables

Manhole #2 (on our list)

Nomenclature: 5063 (Toronto Hydro Owned)

Location: Intersection of Strachan and Manitoba, halfway through the crosswalk on the West side of Strachan

Approximate Distance to Manhole #3: ~179'

Duct configuration:

The duct configurations can be inferred by the duct runs from the South of Manhole #1 (5064) and the North of Manhole #3 (5062).

Notes:

- Due to the manhole's proximity to a TTC streetcar track, this could only be entered at night through communication with TTC to ensure that the streetcar track is out of service. Entry will also require a pay duty cop for traffic control in the intersection. Owing to the additional costs involved, CNE decided to skip it

Manhole #3 (on our list)

Nomenclature: 5062 (Toronto Hydro Owned)

Location: West side of Strachan, just off of the sidewalk between Manitoba and CNE main gates

Approximate Distance to Manhole #4: ~168'

Duct Configurations:

North to Manhole #2 (Nomenclature: 5063):

Empty 1	Quarter Filled 5	Quarter Filled 9
Quarter Filled 2	Empty (Camera) 6	Empty (Camera) 10
Filled 3	Filled 7	Empty (Camera) 11
Filled 4	Filled 8	Empty (Camera) 12

South to Manhole #4 (Nomenclature: 60B):

Empty (Camera, Mandrel, Roped)	Empty (Camera, Mandrel, Roped)	Empty
1	4	7
Quarter Filled	Filled	Filled
2	5	8
Empty	Quarter Filled	Empty
3	6	9

Notes:

- Contains a lead splice and a Raychem splice
- Endoscopic camera sent North to Manhole #2 in ducts 2, 3, 4, and 6. Excessive dirt and corrosion prevented the camera from reaching beyond ~150'. Ducts looked good otherwise and appear to just need cleaning
- Endoscopic camera and mandrel sent South to Manhole #4 in ducts 1 and 4. Ropes left in ducts.

Manhole #4 (on our list)

Nomenclature: 60B

Location: Just North of Prince's Gate on East side of Canada Blvd

Approximate Distance to Manhole #5: ~79'

Duct Configurations:

West to Manhole #5 (Nomenclature: 60A):

Empty (Camera, Mandrel, Roped)	Quarter Filled	Quarter Filled
1	4	8
Empty (Camera, Mandrel, Roped)	Filled	Filled
2	5	9
Empty	Empty	Empty
3	6	10
	Empty	
	7	

Manhole #5 (on our list)

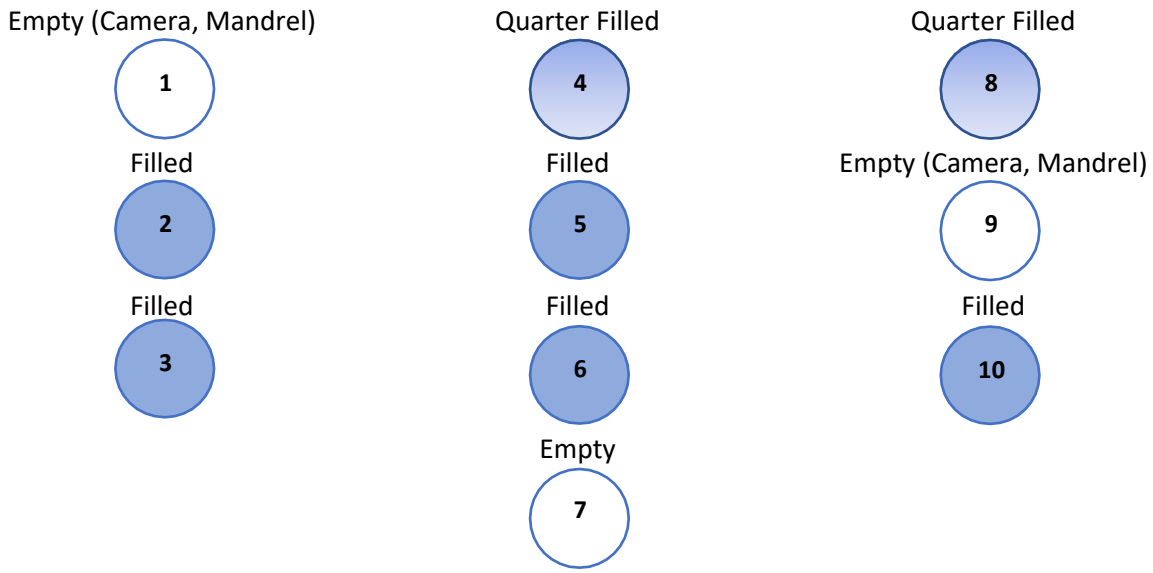
Nomenclature: 60A

Location: Northwest corner of Prince's Blvd and Canada Blvd on the sidewalk

Approximate Distance to Manhole #6: ~26'

Duct Configuration:

South to Manhole #6 (Nomenclature: 60):



Notes:

- Duct #7 was found to be visually clear
- Duct #5 had a 13.8 kV cut off cable that can be used as a spare
- Distance to ground ~10' similar to manhole #4

Manhole #6 (on our list)

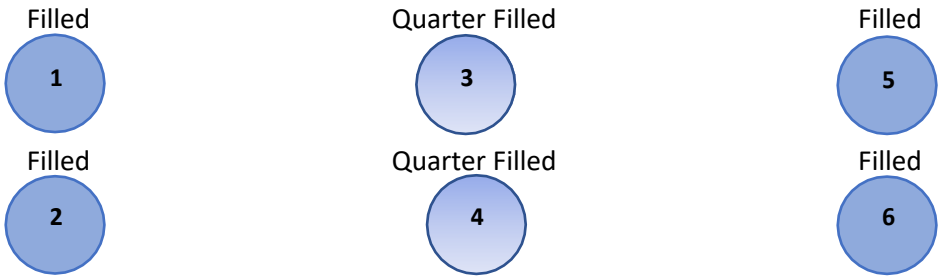
Nomenclature: 60

Location: Northwest corner of Prince's Blvd and Canada Blvd on the sidewalk (Just South of Manhole #5)

Approximate Distance to Manhole #7: ~252'

Duct Configuration:

East to Manhole #7 (Nomenclature: 59):



Notes:

- Distance to ground ~10'
- 13.8 kV cable wrapped in suspected ACM (sample was taken, but asbestos was not detected through lab testing)

Manhole #7 (on our list)

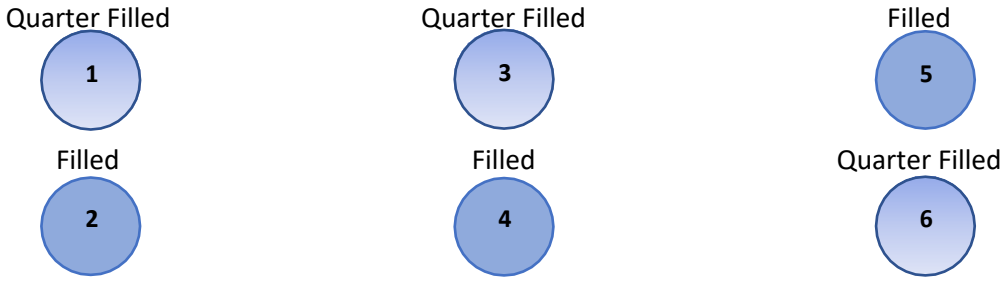
Nomenclature: 59

Location: On the North side of Prince's Blvd across from Beanfield Centre, on the grass just South of the sidewalk

Approximate Distance to Manhole #9: ~174'

Duct Configuration:

West to Manhole #9 (Nomenclature: 68):



Notes:

- Distance to ground ~10'
- 13.8 kV cable wrapped in suspected ACM (sample was taken; but asbestos was not detected through lab testing)
- No ducts available going west to Manhole #9, however, the 13.8 kV cable in duct 5 has been cut off
- Manhole #7 also contains an offshoot from the main 13.8 kV run that goes south to Manhole #8.

Manhole #8 (on our list)

Nomenclature: 58

Location: On the South side of Prince's Blvd, West of the entrance to Beanfield Centre, on the grass just North of the sidewalk

Approximate Distance to Manhole #7: ~68'

Duct Configuration:

North to Manhole #7 (Nomenclature: 59):

Filled	Empty (Camera, Roped)	Quarter Filled	Quarter Filled	Filled	Quarter Filled
1	2	5	8	11	12
	Quarter Filled	Quarter Filled	Quarter Filled		
	3	6	9		
	Empty (Camera)	Quarter Filled	Empty (Camera)		
	4	7	10		

Notes:

- Distance to ground ~10’
- Endoscopic camera and ribbon sent North to Manhole #7 in duct 2. Could not get mandrel through more than 5’ of the duct. Could not observe any anomalies with the camera. Ribbon left in the duct.
- Endoscopic camera sent North to Manhole #7 in ducts 4 and 10. Excessive dirt and corrosion prevented the camera from reaching beyond approximately 22 and 27 meters respectively.
- This manhole contains an abundance of low voltage and communication cables going South, likely into the building. (Out of scope)

Manhole #9 (on our list)

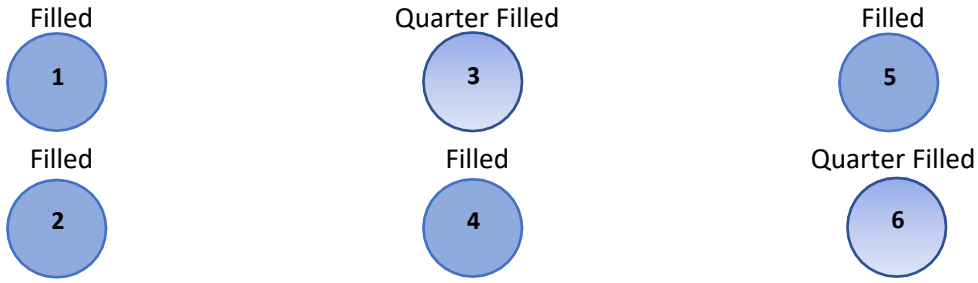
Nomenclature: 68

Location: Northwest side of the intersection of Prince's Blvd and Newfoundland Drive, at the top of the stairway

Approximate Distance to Manhole #10: ~200'

Duct Configuration:

West to Manhole #10 (Nomenclature: 67):



Notes:

- Distance to ground ~16' (Contains ~6' "chimney")
- No ducts available heading to Manhole #10, however, duct 4 contains an old 13.8 kV PILC cable that has been cut
- Duct 5 contains a 13.8 kV PILC cable that has been cut in Manhole #10

Manhole #10 (on our list)

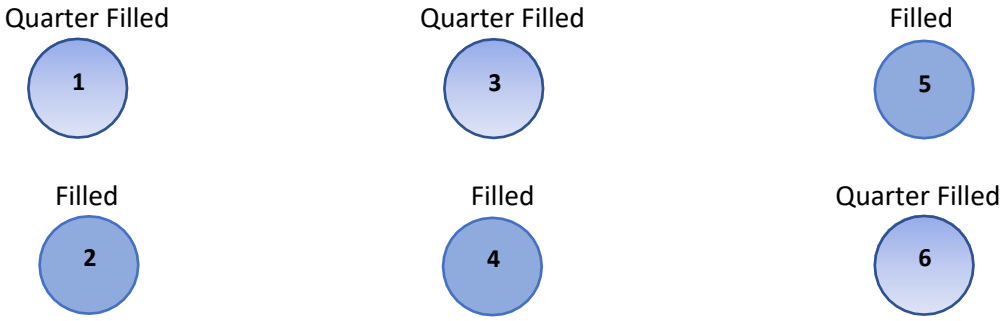
Nomenclature: 67

Location: Just South of the walkway by Enercare Centre, North of Prince's Blvd and West of Newfoundland Drive

Approximate Distance to Manhole #11: ~142'

Duct Configuration:

West to Manhole #11 (Nomenclature: 66):



Notes:

- Distance to ground approximately 16' (contains ~6' "chimney")
- No ducts available going West to Manhole #11, however, 13.8 kV cable has been cut off in duct 4

Manhole #11 (on our list)

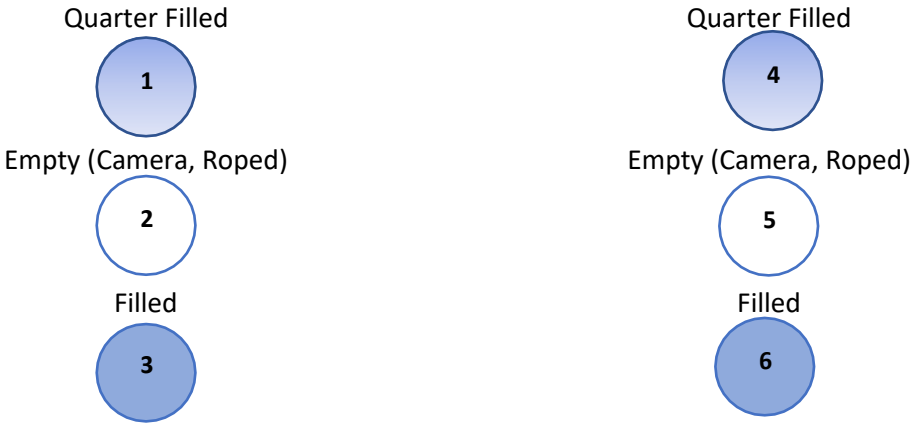
Nomenclature: 66

Location: North of Prince's Blvd between Newfoundland Drive and Nunavut Rd on the walkway South of Enercare Centre

Approximate Distance to Manhole #12: ~59'

Duct Configuration:

South to Manhole #12 (Nomenclature: 120):



Notes:

- Distance to ground ~16' (Contains ~6' "chimney")
- Endoscopic camera and Mandrel sent South to Manhole #12 in ducts 2 and 5
- Mandrel went through duct 2 but got stuck in duct 5, about 10' South of Manhole #11. We had no choice but to abandon it

Manhole #12 (on our list)

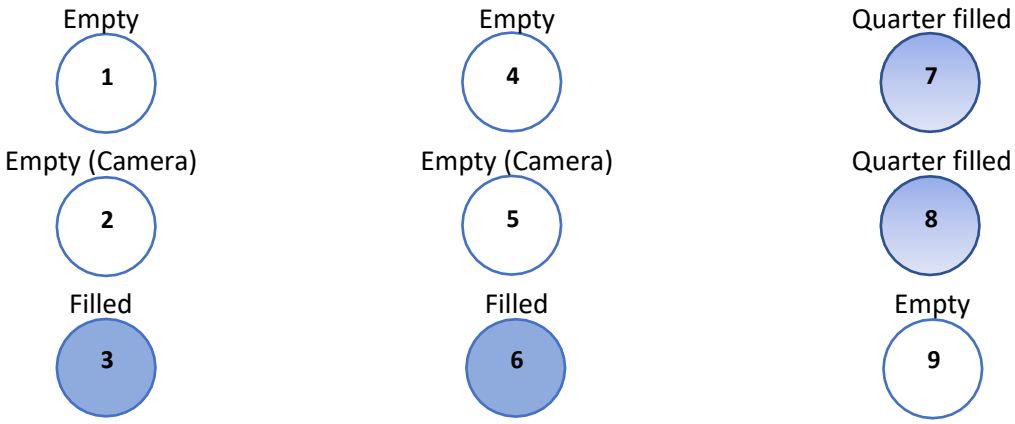
Nomenclature: 120

Location: In the eastbound lane of Prince's Blvd, between Newfoundland Drive and Nunavut Rd

Approximate Distance to Manhole #13: ~84'

Duct Configuration:

South to Manhole #13 (Nomenclature: 18):



Notes:

- Distance to ground approximately 13' (Contains ~3' "chimney")
- Had to grind tacks off of manhole lid prior to opening. This will need to be rewelded in the future as required
- Some cut off 13.8 kV PILC cables contain oily residue as do some splices on other cables
- Endoscopic camera sent South to Manhole #13 through ducts 2 and 5. No anomalies noted

- Due to a deformed splice found in Manhole #13, we could not send the mandrel through either duct

Manhole #13 (on our list)

Nomenclature: 18

Location: South of Prince's Blvd, East of the parking lot located South of the entrance to Nunavut Rd

Approximate Distance to Manhole #14: ~174'

Duct Configuration:

West to Manhole #19:

Empty (Camera, Roped)	Quarter Filled	Quarter Filled	Quarter Filled
1	4	7	10
Quarter Filled	Quarter Filled	Quarter Filled	Filled
2	5	8	11
Quarter Filled	Empty (Camera, Roped)	Quarter Filled	Filled
3	6	9	12

Notes:

- Distance to ground approximately 14' (Contains ~4' "chimney")
- Found a deformed 13.8 kV PILC splice just off of the floor

- Endoscopic camera sent through ducts 1 and 6. It could not reach the entire stretch but it went through very easily with no noted anomalies. Ducts both found roped.
- Entry into the manhole was very difficult due to an abundance of LV cables coiled around the chimney

Manhole #14 (on our list)

Nomenclature: 19

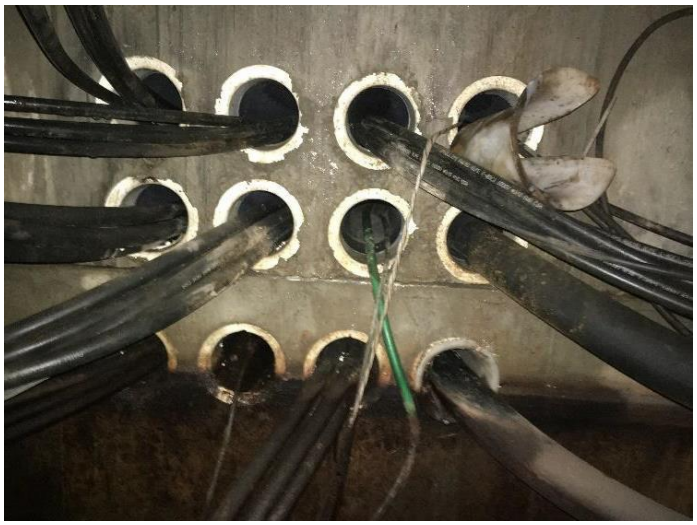
Location: In the parking lot between Newfoundland Drive and Nunavut Rd, South of Prince's Blvd

Approximate Distance to Manhole #15: ~168'

Duct Configuration:

West to Manhole #15 (Nomenclature: 20):

Quarter Filled 1	Quarter Filled 4	Quarter Filled 7	Quarter Filled 10
Quarter Filled 2	Quarter Filled 5	Quarter Filled 8	Filled 11
Quarter Filled 3	Empty (Camera) 6	Quarter Filled 9	Filled 12



Notes:

- Distance to ground ~15'
- Endoscopic camera sent most of the way through duct 6. Looked satisfactory but hit water about two-thirds of the way through. Could not make it all the way.
- Cut off communication cable has been left in duct 6 as found.
- Mandrel not sent due to compressed splice anomaly found in Manhole #15

- Entry into the manhole was very difficult due to an abundance of LV cables coiled around the chimney

Manhole #15 (on our list)

Nomenclature: 20

Location: In the parking lot between Newfoundland Drive and Nunavut Rd, South of Prince's Blvd

Approximate Distance to Manhole #16: ~163'

Duct Configuration:

South to Manhole #16 (Nomenclature: 130B):

Quarter Filled	Quarter Filled	Quarter Filled	Quarter Filled
1	4	7	10
Quarter Filled	Quarter Filled	Quarter Filled	Quarter Filled
2	5	8	11
Quarter Filled	Filled	Filled	Quarter Filled
3	6	9	12

Notes:

- Distance to ground ~15’
- Found deformed 13.8 kV PILC cable splice. Splice was compressed and the technician could feel the heat coming off of it
- Infrared camera was unable to detect any heat but it may have been an emissivity issue. Heat could also be emitting from the bottom of the splice, undetectable at the top where it was scanned
- Entry was difficult due to an abundance of LV cables at the top of the manhole

Manhole #16 (on our list)

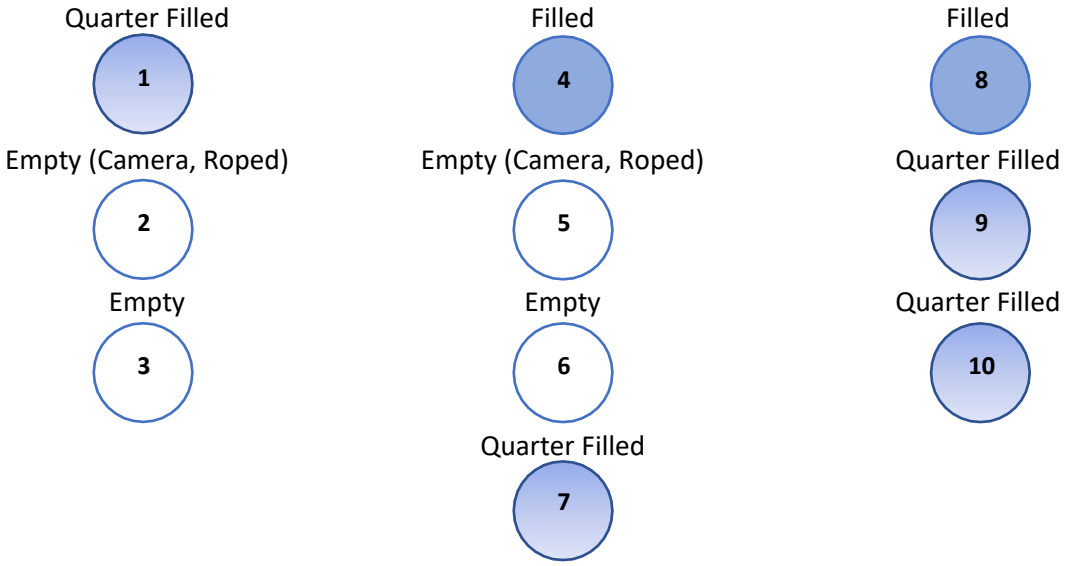
Nomenclature: 130B

Location: In the parking lot between Newfoundland Drive and Nunavut Rd, South of Prince's Blvd. Northwest corner of Vault TOX.

Approximate Distance to Manhole #17: ~95'

Duct Configuration:

South to Manhole #17 (Nomenclature: 204):



Notes:

- This Manhole appears to be utilized as a hub of sorts being located right at Vault TOX. There are many other ducts going multiple directions that were out of our scope
- The most confusing aspect was that the duct bank running north towards Manhole #15 had the 13.8 kV feeds in the bottom middle two ducts and the accompanying ground in the bottom east duct as expected. However, all the other ducts were empty. No way of knowing where they are going/coming from
- Sent the camera through two ducts (2 and 5) but could not make it through the whole stretch due to excessive grime. Pulled on the twine at each end to confirm continuity. Ducts will need to be blasted clean
- This manhole is particularly filthy compared to the others

Manhole #17 (on our list)

Nomenclature: 204

Location: In the parking lot between Newfoundland Drive and Nunavut Rd, South of Prince's Blvd. South of Vault TOX.

Approximate Distance to Manhole #18: ~184'

Duct Configuration:

West to Manhole #18 (Nomenclature: 203):

Filled	Filled	Filled
1	4	7
Quarter Filled	Empty (Camera, Roped, Mandrel)	Filled
2	5	8
Quarter Filled	Empty (Camera, Roped, Mandrel)	Quarter Filled
3	6	9

Notes:

- Distance to ground approximately 12’
- Compressed splice found on 13.8 kV cable in duct 8. It didn’t look as bad as some of the others so the technician was comfortable working near it for a short time
- Endoscopic camera and mandrel sent West to Manhole #18 in ducts 5 and 6
- Rope left in ducts after sending through the mandrel

Manhole #18 (on our list)

Nomenclature: 203

Location: In the parking lot South of Prince's Blvd and BMO Field. Manhole near stored Yachts.

Approximate Distance to Manhole #19: ~184'

Duct Configuration:

West to Manhole #19 (Nomenclature: 202):

Filled	Filled	Filled
1	4	7
Empty (Camera, Roped)	Empty (Camera, Roped)	Empty
2	5	8
Filled	Empty	Quarter Filled
3	6	9

Notes:

- Distance to ground ~15’
- Sent the endoscopic camera through ducts 2 and 5 (from inside 18), but were unable to make it all the way. The stretch that we did look good and was clear aside from some water build-up
- Found existing twine in all empty ducts
- We could not send the mandrel through due to the splice anomaly found in manhole #19

Manhole #19 (on our list)

Nomenclature: 202

Location: In the parking lot South of Prince's Blvd and BMO Field. Manhole near stored Yachts.

Approximate Distance to Manhole #20: ~221'

Duct Configuration:

West to Manhole #20 (Nomenclature: 201):

Quarter Filled	Filled	Filled
1	4	8
Empty (Camera, Roped)	Empty (Camera, Roped)	Empty (Roped)
2	5	9
Empty (Roped)	Empty (Roped)	Quarter Filled
3	6	10
	Empty (Roped)	
	7	

Notes:

- Distance to ground ~15’
- We found another splice anomaly. It had a compressed area on it as well as some bulges
- We sent the endoscopic camera through ducts 2 and 5. The camera couldn’t reach the whole stretch and we found it to have a lot of dirt/contamination built up as we approached the end. Ducts will have to be blasted clean but looked good overall
- We were unable to send the mandrel through due to the splice anomaly in Manhole #19

Manhole #20 (on our list)

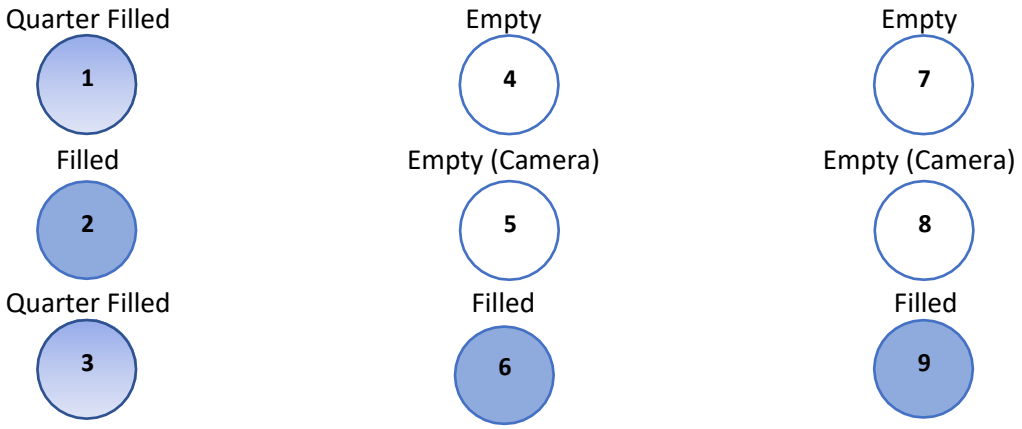
Nomenclature: 201

Location: In the parking lot South of Prince's Blvd and BMO Field. Southwest side of BMO Field.

Approximate Distance to Vault "TWX": ~184'

Duct Configuration:

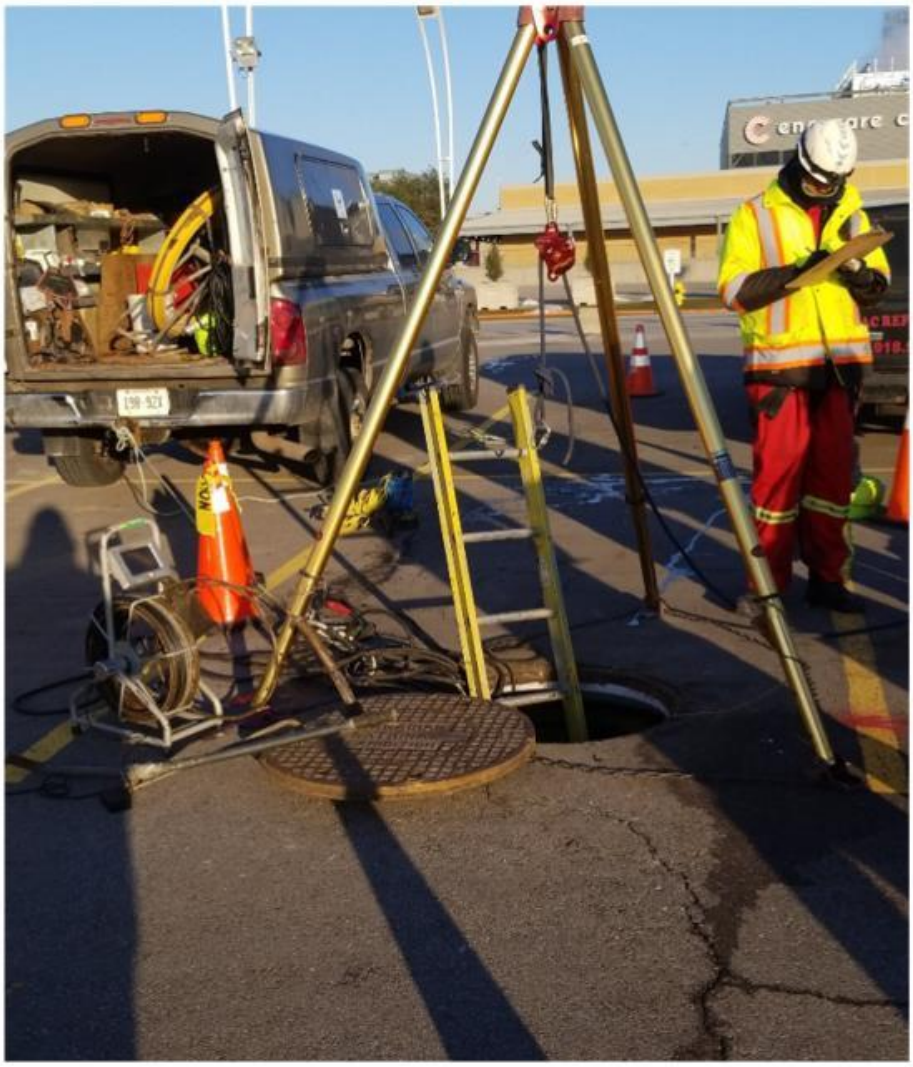
North to Vault TWX:

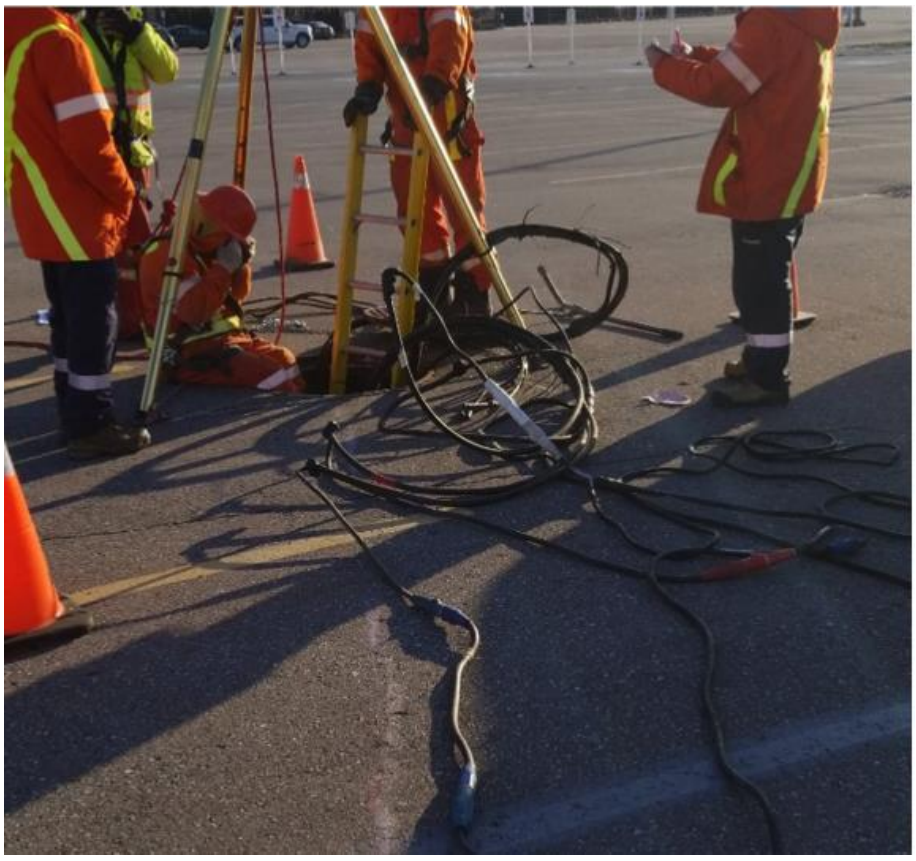


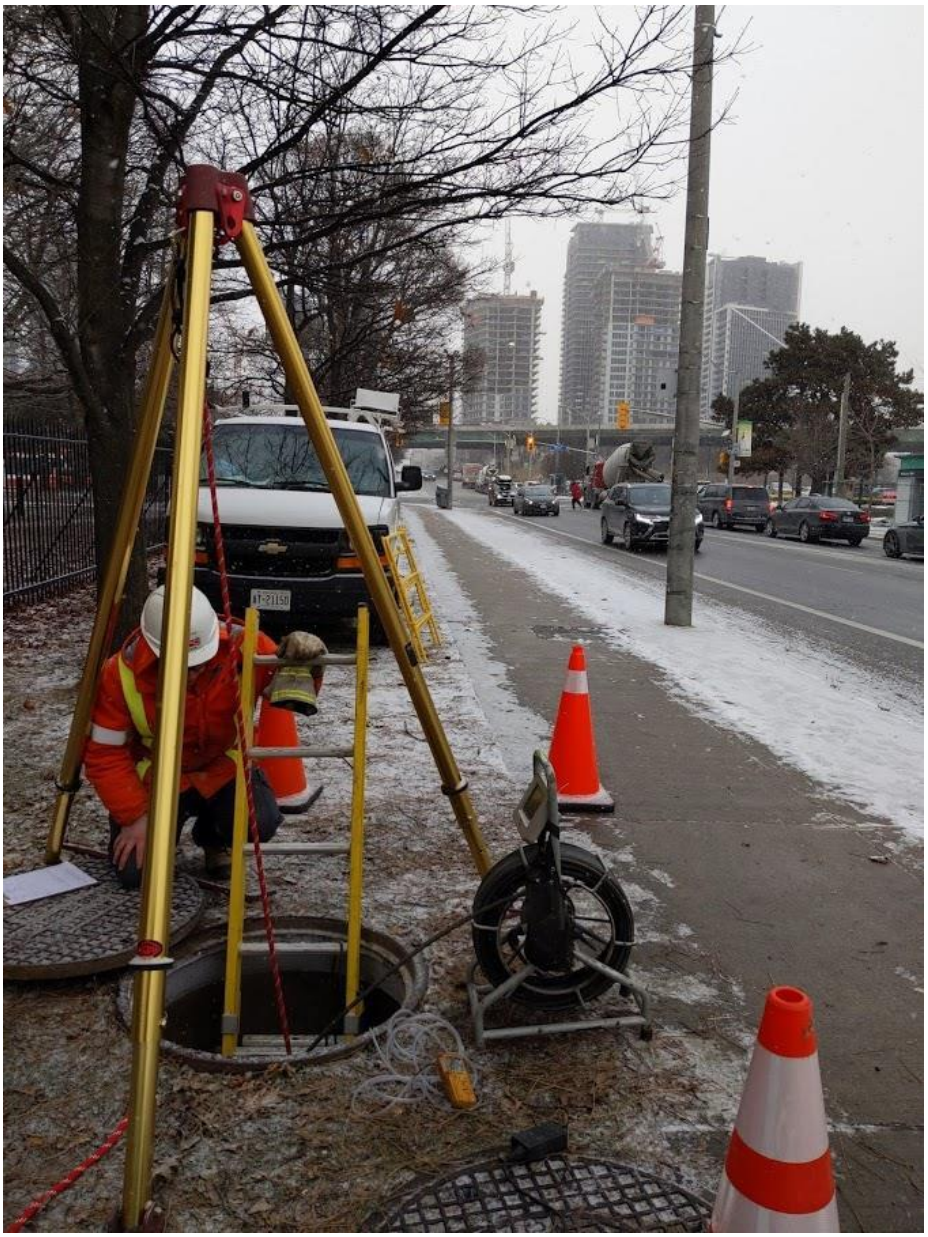
Notes:

- Distance to ground ~12'
- Final stretch out of scope, but the information is pertinent
- Many spare ducts are available

Appendix A: Field Photographs







Appendix B: Laboratory report confirming the absence of asbestos

FISHER ENVIRONMENTAL LABORATORIES

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FAX: 905 475-7718
www.fisherenvironmental.com

Client: K.P.C. Power Electrical Ltd.
Address: 395 Westney Road South
Ajax, ON
L1S 6M6
Tel.: (289) 314-5764
Fax: N/A
E-mail: sstead@kpcpower.com
Attn.: Sean Stead

F.E. Job #: 19-3841
Project Name: Metsco- CNE- Investigation of 20 Manholes
Project ID: 191M-5369
P.O. #: N/A
Date Sampled: 19-Dec-2019
Date Received: 23-Dec-2019
Date Reported: 27-Dec-2019
Location: N/A

Certificate of Analysis

Analysis Requested:	Asbestos by PLM
Sample Description:	3 Bulk Samples

Client Sample ID	Lab Sample ID	Sample Matrix	Fibre Type	Asbestos Content
Sample# 1- Manhole #1 (5064) 13.8 KV Cable Insulation	19-3841-1	Cable Insulation		Not Detected
Sample# 2- Manhole #6 13.8 KV Cable Insulation	19-3841-2	Cable Insulation		Not Detected
Sample# 3- Manhole #7 13.8 KV Cable Insulation	19-3841-3	Cable Insulation		Not Detected

Fisher Environmental Laboratories (Lab ID #: 2745) is accredited by CALA (Canadian Association for Laboratory Accreditation Inc.) for asbestos analysis by PLM.

ANALYTICAL METHOD:

Asbestos has been done in accordance with normal professional standard using the following Fisher Environmental Lab Method: Asbestos by PLM (Polarized Light Microscope) F-26, Rev.2.2.

Authorized by: Lin Rong

Roger Lin, Ph. D., C. Chem.
Laboratory Manager

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
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Ronggen (Roger) Lin
CHEMIST