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June 25, 2013

SANITARY SEWER SERVICING FOR NORTH KEATING AREA AND EAST BAYFRONT EAST OF LOWER SHERBOURNE STREET PRELIMINARY DESIGN REPORT - REVISED JUNE 25, 2013

Prepared for:

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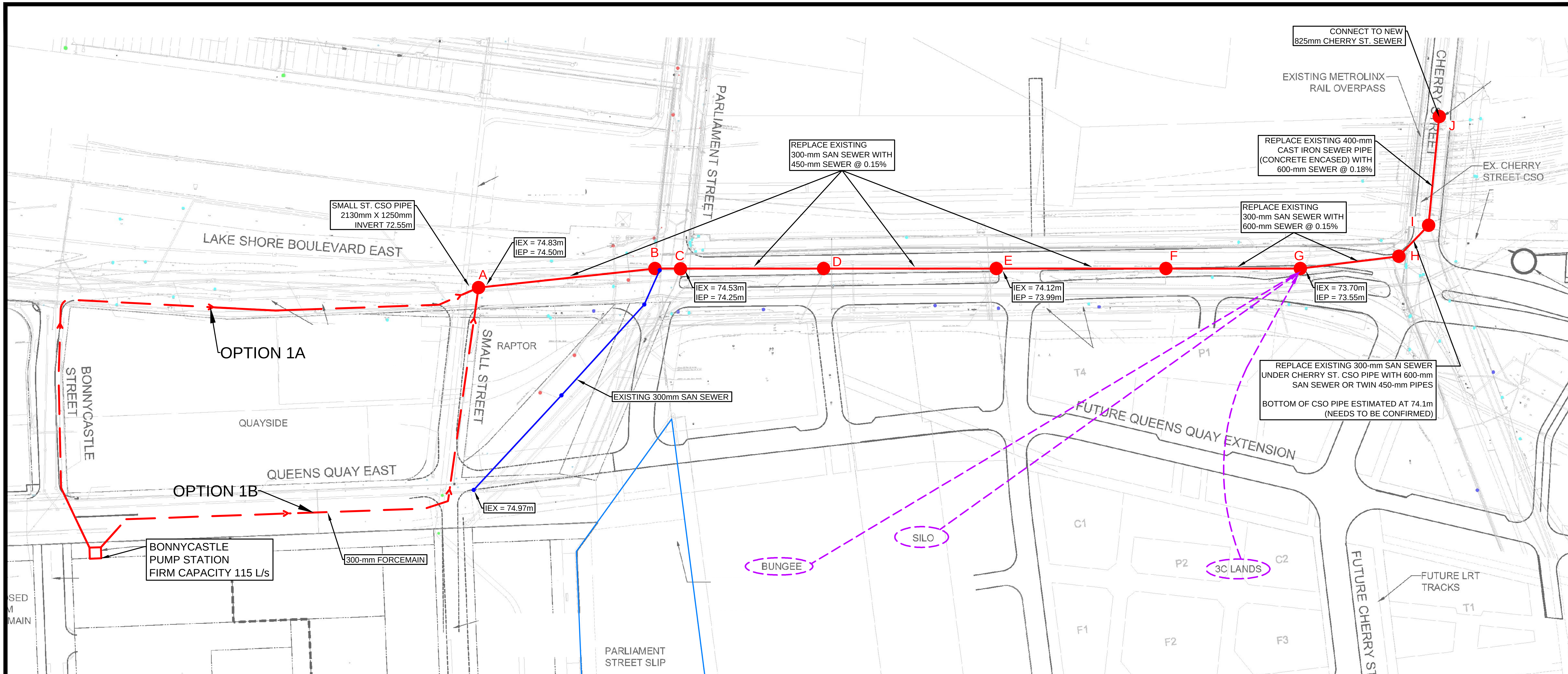
1. INTRODUCTION

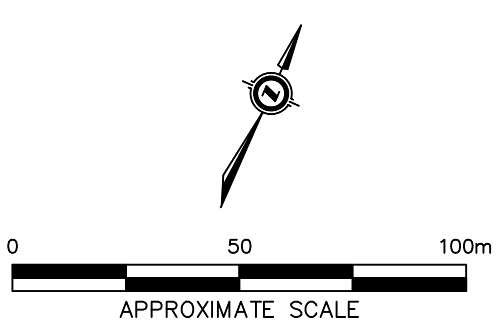
This report presents the preliminary design for proposed sanitary sewer servicing for the North Keating development area, and for the portion of the East Bayfront precinct that is east of Lower Sherbourne Street. The project area and development properties are indicated on Figures 1 and 2.

The proposed sanitary servicing strategy includes (see Figure 2):

- A new sewage pumping station (firm capacity 300 L/s) located at City-owned property at 480 Lakeshore Boulevard East, to the immediate west of the recently constructed main shaft of the West Don Lands stormwater conveyance system.
- Deep gravity sewer (450-mm and 600-mm diameter) under Lakeshore Boulevard to the south side of the right-of-way under Martin Goodman Trail westward as far as Parliament Street, and then along south side of Lakeshore Boulevard to Small Street.
- West of Small Street, the servicing would be by gravity sewer along Queens Quay East and Small Street to the Small Street/Lakeshore Boulevard intersection.

This report explains the basis for this recommended servicing approach, based on review of a number of options that have been considered.





LEGEND:

	PROPOSED FORCEMAIN
	SHALLOW GRAVITY SEWER
	PROPOSED MANHOLE (REPLACING EXISTING MANHOLE)
IEX	EXISTING PIPE INVERT
IEP	PROPOSED PIPE INVERT
	ASSUMED SANITARY SERVICE CONNECTION LOCATION

DRAWING REFERENCE: Base drawing supplied by Sanitary Servicing Analysis, East Bayfront & Lower Don Lands (MMM, Feb. 2013).
NOTE: Location of building, underground utilities, etc. are for reference only and should not be relied upon for detailed design, renovation, or construction purposes. Property boundary and building locations shown may not represent actual surveyed boundaries.

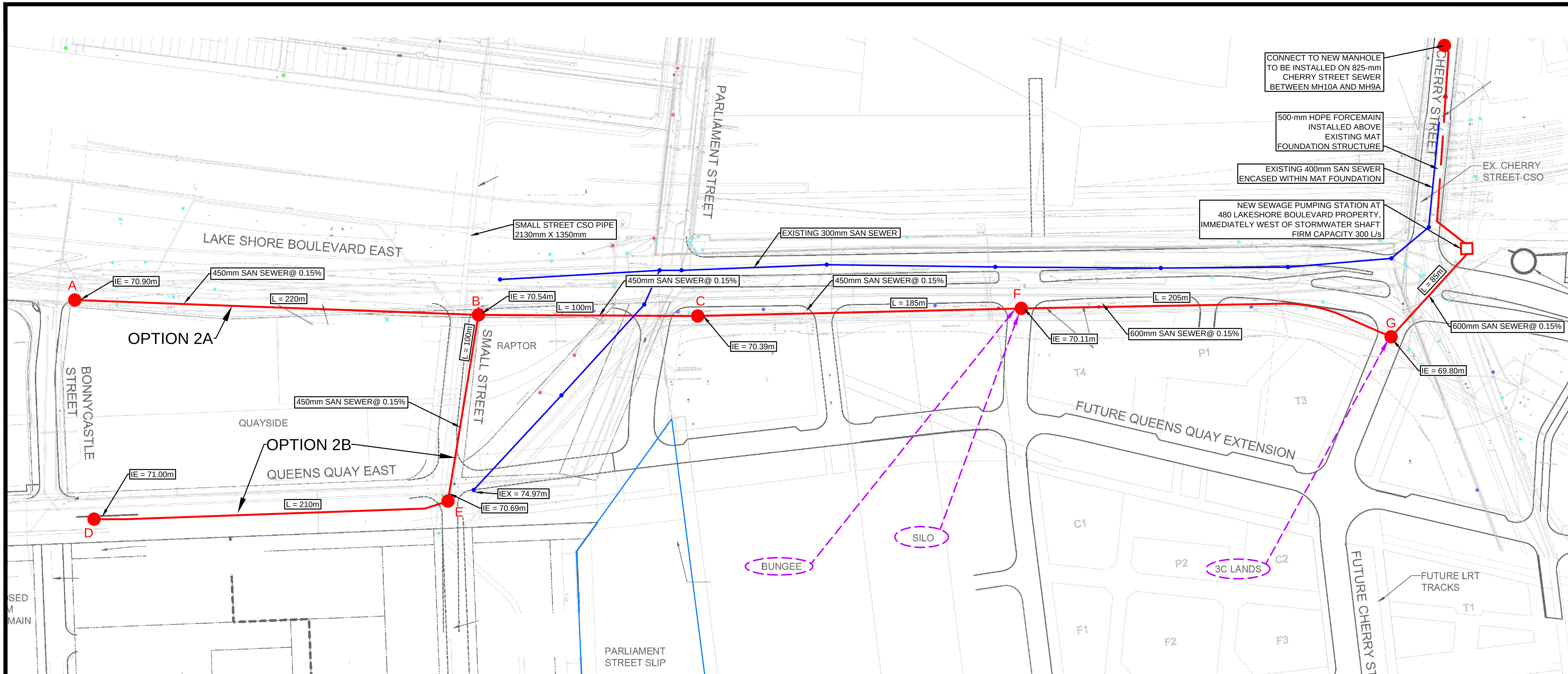
SHEET: R_3-03139525_FIG01.pdf
FILE: R_3-03139525.dwg

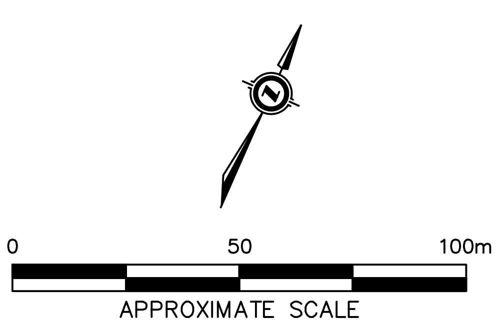
OPTION 1: BONNYCASTLE PUMPING STATION TO SHALLOW GRAVITY SEWER ALONG LAKESHORE BOULEVARD

EAST BAYFRONT AND NORTH KEATING SANITARY SERVICE
TORONTO, ONTARIO

XCG
Environmental Engineers & Scientists

DATE	JOB NO.	FIGURE NO.
APR. 2013	3-244-33-18	1





LEGEND:

(red line)	DEEP GRAVITY SEWER
(red dot)	PROPOSED MANHOLE (REPLACING EXISTING MANHOLE)
(dashed magenta line)	ASSUMED SANITARY SERVICE CONNECTION LOCATION

DRAWING REFERENCE: Base drawing supplied by Sanitary Servicing Analysis, East Bayfront & Lower Don Lands (MMM, Feb. 2013).
NOTE: Location of building, underground utilities, etc. are for reference only and should not be relied upon for detailed design, renovation, or construction purposes. Property boundary and building locations shown may not represent actual surveyed boundaries.

SHEET: R_3-03139525_FIG02.pdf
FILE: R_3-03139525_2.dwg

OPTION 2: DEEP GRAVITY SEWER ON LAKESHORE BOULEVARD

EAST BAYFRONT AND NORTH KEATING SANITARY SERVICE
TORONTO, ONTARIO

XCG Environmental Engineers & Scientists

DATE	JOB NO.	FIGURE NO.
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2. BACKGROUND

The City of Toronto (City) Waterfront Sanitary Master Servicing Study (Class EA) was completed in October 2012. The Class EA presented a recommended long-term sanitary servicing strategy for the central waterfront area including East Bayfront (EBF), West Don Lands (WDL), North Keating Area (NKA), Lower Don Lands (LDL) and Port Lands development areas.

For the WDL and NKA, the Class EA recommendations reflected the previously developed servicing studies for WDL and associated design for Cherry Street reconstruction. This previous planning and design included a new and larger sanitary sewer along Cherry Street, from immediately north of the CN Rail railway corridor northward to the Low Level Interceptor (LLI) at Eastern Avenue.

The design for this new sanitary sewer was based on accommodating future development in WDL as well as the NKA (reference West Don Lands Phase II Functional Servicing Study, Feb 2012, by R.V. Anderson Associates). Because the Cherry Street sewer can become surcharged in wet weather (due to surcharging along the LLI), servicing of WDL and NKA via the Cherry Street sewer is to be based on use of protective plumbing in connected buildings.

The Class EA recommended that due to ultimate capacity limitations at the Scott Street Sewage Pumping Station, wastewater flows from the portion of EBF that is east of Lower Sherbourne Street should ultimately be sent eastward to the Cherry Street sewer. On this basis, the final design for the new Cherry Street sewer was revised to increase its diameter from 750-mm to 825-mm.

The Class EA recommended strategy was based on Waterfront Toronto's proposed servicing approach that includes a sewage pumping station at the southeast corner of Queens Quay/Bonnycastle intersection. On this basis the Class EA's strategy was to direct flow from the Bonnycastle Sewage Pumping Station (SPS) to the new Cherry Street sewer via replacement of the existing 300-mm gravity sanitary sewer that runs from Small St/Parliament intersection and then along Lakeshore Boulevard to an existing 400-mm sanitary sewer that runs northward through the Cherry Street rail-corridor underpass into the Cherry Street sewer (Figure 1 shows alignment of these existing sewers). The Class EA strategy was based on upsizing the 300-mm sewer to 450-mm diameter; and the 400-mm pipe to a 525-mm sewer to provide conveyance through the Cherry Street underpass for EBF and NKA flows.

The Class EA strategy was based on estimated peak flow from all connected properties south of the rail corridor to the new Cherry Street sewer of 212 L/s. (75 L/s from EBF east of Lower Sherbourne Street; 112 L/s from NKA, plus additional allowance of 25 L/s).

Since completion of the Class EA, development planning for EBF and NKA properties has advanced, and projected sewage flows have increased. As well, a number of constraints have become defined that affect design options, including:

- Proposal to install stormwater forcemains along Lakeshore Boulevard from East Bayfront to the WDL stormwater treatment facility (Ballasted Flocculation Facility (BFF)) and return treated storm flow to EBF for UV treatment.
- Updated estimate of the total sludge flow that will be discharged from the BFF to the Cherry Street sanitary sewer. This flow has been increased from a previous estimate of 32 L/s, to 64 L/s.
- Presence of reinforced concrete mat foundation structure under the railway bridge at Cherry Street which affects feasibility of upsizing existing 400-mm sanitary sewer through the existing underpass.
- Design/construction requirements related to protection of Gardiner Expressway structure, particularly need to protect existing “grade beams” located underneath some portions of Lakeshore Boulevard between Bonnycastle Street and Cherry Street.

The above considerations have led to the examination of alternative design options that are reviewed in this report.

As presented in this report, a new servicing solution is now recommended. The recommended solution is now comprised of a new gravity sewer from East Bayfront via Queens Quay Boulevard and Small Street, and then through the North Keating Area along Lakeshore Boulevard, to a new pumping station that would be situated at the City-owned property at 480 Lakeshore Boulevard East (at the intersection of Cherry Street and Lakeshore Boulevard), with forcemain through the Cherry Street rail underpass northward to the newly constructed 825-mm sanitary sewer on Cherry Street.

This new solution represents a change to the Waterfront Sanitary Servicing Master Plan Class EA that was filed October 25, 2012. As discussed later in this report, to meet Class EA requirements a Revised Notice of Completion is therefore required.

3. DESIGN FLOWS

3.1 Wastewater Flows from Proposed Precinct Development

Design flows have been based on following information sources:

1. Report prepared by MMM Group for Waterfront Toronto, dated February 2013 entitled "Sanitary Servicing Analysis East Bayfront & Lower Don Lands".
2. Waterfront Toronto East Bayfront Engineering/Public Realm Technical Working Group meeting minutes, Sept 2012.

Table 2 attached presents the development population projections and wastewater flow projections have been developed using the above information sources.

3.2 Underflow from Proposed BFF

In finalizing design flows, additional allowances need to be included to allow for estimated peak discharge of sludge underflow from the proposed West Don Lands Stormwater Treatment Facility (BFF) to be located on the 480 Lakeshore Boulevard East site, immediately east of the newly constructed stormwater shaft.

Table 1 lists the potential ultimate discharge from the BFF to the sanitary collection system.

Table 1 Estimated Peak Sludge Underflow Rates from Proposed BFF to Sanitary Collection System

Development Precinct	Estimated Stormwater Service Area Draining to BFF	Estimated Peak Discharge from BFF to Sanitary System
WDL + NK2: West Don Lands plus North Keating Area east of Cherry Street	42 ha	16 L/s
EBF + NK1: East Bayfront plus North Keating Area west of Cherry Street	36 ha	16 L/s
Lower Don Lands south of Keating Channel	80 ha	32 L/s
Total of Above	158 ha	64 L/s
Notes: Above based on information supplied to XCG by R.V. Anderson Associates in March 2013. Ultimate service area for BFF not yet determined. The above is considered at this time to be the potential ultimate design condition.		

Table 2 Estimates of Ultimate Future Wastewater Flows from NKA and EBF East of Lower Sherbourne Street

PRELIMINARY DESIGN SANITARY SEWER SERVICES FOR EBF AND NKA to new Cherry Street sewer

CALCULATION OF DESIGN FLOWS

March 15, 2013

Unit rates for average sewage flow:		
Residential	300	L/cap/day
Employment	250	L/cap/day

	Land area	POPULATIONS		AVERAGE SEWAGE FLOW		PEAKING FACTORS		PEAK SEWAGE FLOW		Extraneous inflow	TOTAL =
										Unit rate =	DESIGN FLOW
	Land area	Residential	Employment	Residential	Employment	Residential	Employment	Residential	Employment	0.26 L/s/ha	
	ha	persons	jobs			Harmon PF	Harmon PF				
				L/s	L/s			L/s	L/s	L/s	L/s
EAST BAYFRONT											
Parkside	0.5	876	116	3.04	0.34	3.84	4.23	11.7	1.4	0.1	13.2
Quayside	2.4	3,844	0	13.35	0.00	3.35	4.50	44.7	0.0	0.6	45.3
Raptor	0.9	481	70	1.67	0.20	3.98	4.28	6.7	0.9	0.2	7.8
Bayside	5.1	2,870	1,237	9.97	3.58	3.46	3.74	34.5	13.4	1.3	49.2
EBF	8.9	8,071	1,423	28.02	4.12	3.05	3.70	85.4	15.2	2.3	102.9
EBF rounded pop'ns	**8.9**	**8,100**	**1,500**	**28.13**	**4.34**	**3.04**	**3.68**	**85.6**	**16.0**	**2.3**	**103.9**
NORTH KEATING AREA											
Bungee	2.2	1,698	244	5.90	0.71	3.64	4.12	21.5	2.9	0.6	24.9
Silo	2.2	1,585	228	5.50	0.66	3.66	4.13	20.2	2.7	0.6	23.4
3C	5.6	4,244	611	14.74	1.77	3.31	3.93	48.8	6.9	1.5	57.2
480 Lakeshore	9.0	4,207	2,048	14.61	5.93	3.31	3.58	48.4	21.2	2.3	71.9
NKA	19.0	11,734	3,131	40.74	9.06	2.89	3.43	117.6	31.0	4.9	153.5
NKA rounded pop'ns	**19.0**	**12,000**	**3,200**	**41.67**	**9.26**	**2.88**	**3.42**	**119.8**	**31.7**	**4.9**	**156.4**
EBF + NKA	27.9	19,805	4,554	68.77	13.18	2.66	3.28	182.7	43.3	7.3	233.2
EBF + NKA rounded pop'ns	**27.9**	**20,100**	**4,700**	**69.79**	**13.60**	**2.65**	**3.27**	**185.0**	**44.5**	**7.3**	**236.7**

NOTES:

(1) Populations for EBF (Parkside + Quayside + Raptor + Bayside) based on drawing SA1 from MMM Group's Feb 2013 report "Sanitary Servicing Analysis East Bayfront & Lower Don Lands" for Waterfront Toronto

(2) Populations for Bungee, Silo, 3C and 480 Lakeshore based on information included with WT East Bayfront Engineering/Public Realm Submission Technical Working Group Meeting 06 minutes Sept 12, 2012

(3) "rounded pop'ns" are with populations rounded up to nearest 100.

(4) Unit flow rates and peaking factor calculation method same as applied in design sheet for new Cherry Street sewer (by R.V. Anderson Associates)

4. DESIGN OPTIONS

4.1 Description of Options

Two general options have been examined for providing wastewater conveyance from EBF and NKA over to Cherry Street sewer:

- Option No. 1 (Figure 1): Bonnycastle SPS to upsized shallow sewer along Lakeshore Blvd (replaces existing sewer).
- Option No. 2 (Figure 2): Deep gravity sewer along Lakeshore Blvd to pumping station at 480 Lakeshore Blvd East (no pumping station at Bonnycastle Street).

Both options are based on conveying flows from EBF along Lakeshore Boulevard from Parliament Street over to Cherry Street.

At this point in time, options involving new sewer works along the proposed Queens Quay extension through the North Keating Area have not been considered due to the unknown timing of the proposed roadway extension and required modifications to the Parliament Street slip.

Both options have been based on the assumption that internal servicing for EBF east of Lower Sherbourne Street will bring all flows from that area to Bonnycastle Street at Queens Quay Boulevard.

In both options, there are two variations (A and B) for sewer alignment west of Parliament Street to Bonnycastle Street: Alignment A is along Lakeshore Boulevard, Alignment B is along existing Small Street/Queens Quay, per Figures 1 and 2. Plan/profile drawings for all four options are provided in Appendix D.

Option 1B is effectively the same as that proposed in the Class EA. It involves replacement and upsizing of the existing sanitary sewer.

Option 1A is a variation that involves replacing the existing sewer along Lakeshore Boulevard between Small Street and Parliament Street.

The depth of Option 2 results from the need to pass under the Small Street box culvert storm sewer pipe (CSO pipe). This option provides sewer invert at Bonnycastle/Queens Quay of 71.0 m (approx. 6 m below surface) which is assumed deep enough to service proposed development in EBF east of Lower Sherbourne Street (Option 2 therefore does not include a pumping station at Bonnycastle Street).

4.2 Sewer Construction Considerations

4.2.1 Option 1: Sewer Replacement along Lakeshore Blvd

For Option No. 1, the construction approach would be through open-cut excavation to expose, remove and replace the existing 300-mm sewer pipe that runs under the westbound lanes of Lakeshore Boulevard. A number of important considerations come into play:

1. Temporary lane closures along westbound Lakeshore Boulevard would be required. It is expected that at least two of the three westbound lanes would need to be closed, with possible need for full closure of westbound Lakeshore Boulevard; over a construction duration that is expected would be at least one month.

2. Protection of existing tie beams between Small Street and Parliament Street may significantly complicate and possibly render unacceptable Option 1A and 1B. The City's Engineering & Construction Services Division has indicated that excavation under existing grade beams will not be permitted.
3. Preliminary analysis indicates a potential conflict with elevation of the existing CSO culvert at Cherry Street.
4. There is some uncertainty on the full extent of utility relocations that might be required, including potential need to relocate local storm sewer pipes along Lakeshore Blvd. between Parliament and Cherry. Encountering unexpected conflicts could delay construction progress.
5. The construction project would take place directly under the elevated Gardiner Expressway structure. This will limit working headroom and swingroom for the contractor, increasing costs and presenting potential risks.
6. Replacing the active sewer also requires flow management (e.g. temporary pumping) that further complicates the construction process along Lakeshore Boulevard (could possibly necessitate closure of an eastbound lane).
7. Construction under the CN Railway Bridge at Cherry Street will require specialized techniques due to reduced headroom and swingroom, resulting in significantly increased costs and risks.
8. Presence of the reinforced concrete mat foundation structure under the railway bridge at Cherry Street which affects feasibility of upsizing existing 400-mm sanitary sewer through the existing underpass.
9. Open-cut construction will require some level of dewatering. Dewatering discharge and excavated soils are likely to be contaminated and therefore will require specialized disposal requirements and/or treatment.

4.2.2 Option 2: Deep sewer along Martin Goodman Trail

For Option 2, the construction approach would be through microtunnelling. Along Lakeshore Boulevard, alignment would be along the eastbound lanes between Small Street and Parliament Street. East of Parliament Street the alignment will follow the Martin Goodman Trail (MGT).

Microtunnelling is a tunnel excavation technique that employs a Microtunnel Boring Machine (MTBM) that is similar to, but smaller than, a standard Tunnel Boring Machine (TBM). The MTBMs typically range from 600-mm to 1500-mm in diameter and are controlled from the ground surface. The typical configuration could be best described as a pipe jacking set-up that allows for full directional control, and typically uses a slurry system to remove excavated material from the head of the MTBM, and to provide pipe lubrication. As thrust is provided by a jacking system the maximum distance between shafts is much shorter than a conventional TBM, but with advances in technology this seems to be constantly increasing.

Employing microtunnelling construction techniques will reduce the quantity of soil to be excavated and disposed, and will essentially eliminate dewatering for the sewer construction. Microtunnelling will also reduce disruption to traffic and the surrounding area.

The microtunnelling operation will require the construction of tunnel shafts at a number of locations. The shafts would be constructed using engineered shoring systems, and would be engineered to meet requirements for protection of existing structures including the Gardiner Expressway columns and footings. Shafts would be constructed using techniques that do not require any dewatering. Upon completion of tunnel construction, manholes will be constructed in each of the shaft locations to allow for connection of local sewers, and access points for future operations and maintenance purposes.

Construction considerations are as follows:

1. Between Cherry Street and Parliament Street, the alignment would be underneath or immediately adjacent the existing MGT paved recreational pathway. Temporary closure of this portion of MGT could be required.
2. In Option 2A, temporary lane closures would be required along Lakeshore Boulevard at Bonnycastle Street and at Small Street to allow sufficient working room around the mining shafts.
3. In Option 2B, temporary lane closures would be required along Lakeshore Boulevard at Small Street. Additional lane closures could be required along Queens Quay and Small Street to allow sufficient working room around the mining shafts.
4. Shaft construction under the Gardiner Expressway will be complicated by the reduced headroom and swing room.
5. Sewer construction under the Gardiner Expressway will require tunnelling between existing footing piles and beneath the tie beams. Feasibility and authorization from City’s Engineering & Construction Services Division will require further investigation during detailed design phase. The plan/profile drawings in Appendix D include a typical detail regarding the footing piles for the Gardiner Expressway bents, and indicate the approximate locations of tie beams associated with the bents for the portion of the Gardiner Expressway from Parliament Street west to Small Street.
6. Construction of the forcemain under the CN Railway bridge at Cherry Street will require specialized techniques due to reduced headroom and swingroom, resulting in significantly increased costs and risks.

With respect to sewer installation by tunnelling underneath the Gardiner Expressway structure, in Option 2A this is required between Parliament Street and Bonnycastle Street (approximately 330 metres); in Option 2B, from Parliament Street to Small Street (approximately 100 metres). The plan/profile drawings in Appendix D include a typical elevation section showing the footing piles for the Gardiner Expressway bents, and indicate the typical locations of tie beams associated with the bents for the portion of the Gardiner Expressway from Parliament Street west to Bonnycastle Street, per record drawings supplied by the City.

With regard to further investigations during detailed design to meet the requirements of the City's Engineering & Construction Services Division, these investigations are outlined later in this report, for the recommended option.

4.3 Sewage Pumping Stations

4.3.1 Option 1: SPS at Bonnycastle/Queens Quay

The following is a summary of the preliminary designs for Options 1A and 1B for Bonnycastle/Queens Quay Sewage Pumping Station. The proposed location for the pumping station is at the south east corner of the intersection of Bonnycastle Street and Queens Quay.

The calculations are based on the elevations and forcemain profiles shown on the preliminary plan and profile drawings for Option 1A and 1B (see Appendix D).

Based on the alignments, forcemains for Options 1A and 1B will discharge to sanitary manholes SMH 'A' and SMH 'B', respectively. For either option (1A or 1B), a single 300-mm diameter HDPE DR 11 forcemain will be used to convey sewage from the PS to their respective discharge manholes. The station design is based on the following assumptions:

1. Peak Flowrate (Firm Capacity) = 115 L/s.
2. Single forcemain designed to handle 100% Peak Flowrate.
3. Pumping Arrangement = 2 duty + 1 standby.
4. Individual Pump Capacity = Approximately 58 L/s.
5. Submersible Pump Station with a valve chamber.
6. Forcemain Chainage (Option 1A) = 373 m.
7. Forcemain Chainage (Option 1B) = 222 m.

Since the MOE does not have any specific guidelines on the general layout of a station of this size, the pumping station is proposed to consist of an underground wet well cast-in-place concrete structure equipped with three submersible pumps.

All electrical equipment, including a stand-by generator, MCCs, Lighting Panel and PLC system will be housed in an above-ground structure. An underground valve chamber will be provided next to the wet well to house the check valves, isolation valves, pressure transmitter and the flow meter. The dimensions of the wet well, valve chamber and the electrical control building are listed in Table 3.

Table 3 Bonnycastle Pumping Station Dimensions (Options 1A and 1B)

Infrastructure	Dimensions (L x W x Depth)
Wet Well	3.5m x 3.5m x 9m
Valve Chamber	8m x 3.5m x 4m
Electrical Control Building	5m x 5m x 4m high

Based on the above design criteria, listed below are the system head losses (TDH) in the station and the forcemain, for Options 1A and 1B.

Table 4 Bonnycastle Pumping Station Total System Head Summary for Options 1A and 1B

	Option 1A – Headloss (m)	Option 1B – Headloss (m)
Static Headloss	6.4	6.5
Frictional Headloss	11.7	8.4
Total System Head (TDH)	18.1	14.9

Using the TDH and the surge pressure calculations, a single 300-mm diameter HDPE DR 11 forcemain is recommended for this station. At ultimate design peak flow conditions, the velocity in the forcemain is approximately 2.14 m/s, which will be sufficient to maintain self-cleansing along the forcemain.

Based on the above control levels, individual pump cycle time (time to fill + empty the control volume) is calculated to be approximately 10 minutes. This relates to two pump starts per hour for each pump.

4.3.2 Option 2: SPS at 480 Lakeshore Boulevard East

The following is a summary of the preliminary design for Cherry Street Sewage Pumping Station; a detailed pumping station preliminary design report can be found in Appendix C.

The proposed location for the pumping station is at 480 Lakeshore Boulevard East, immediately west of the recently constructed main shaft of the West Don Lands stormwater conveyance system. Appendix C provides an arrangement plan.

The calculations are based on the elevations and forcemain profiles shown on the preliminary plan and profile drawings for Option 2 (see Appendix D). In this scenario, a single 500-mm diameter HDPE DR 11 rated forcemain will be used to convey sewage from the PS to the discharge manhole on Cherry Street immediately north of the CN Railway corridor.

The station design is based on the following assumptions:

1. Peak Flowrate (Firm Capacity) = 300 L/s.
2. Single forcemain designed to handle 100% Peak Flowrate.
3. Pumping Arrangement = 2 duty + 1 standby.
4. Individual Pump Capacity = Approximately 150 L/s.
5. Submersible Pump Station with a valve chamber.
6. Forcemain Chainage = 105m.

Since the MOE does not have any specific guidelines on the general layout of a station of this size, the pumping station is proposed to consist of an underground wet well cast-in-place concrete structure equipped with three submersible pumps. All electrical equipment, including a stand-by generator, Motor Control Centers (MCCs), Lighting Panel and Programmable Logic Controller (PLC) system will be housed in an above-ground structure. An underground valve chamber will be provided next to the wet well to house the check valves, isolation valves, pressure transmitter and the flow meter. The dimensions of the wet well, valve chamber and the electrical control building are listed in Table 5.

Table 5 Cherry Street Pumping Station Dimensions

Infrastructure	Dimensions (L x W x Depth)
Wet Well	5.5m x 3m x 12.3m
Valve Chamber	8m x 3.4m x 4m
Electrical Control Building	7.3m x 1.45m x 3.7m x 4.5m x 3.8m x 4m high Polygon with a plan area of 24.5m^2 and 4m high

Based on the above design criteria, listed below are the TDH in the station and the forcemain.

Table 6 Cherry Street Pumping Station Total System Head Summary

	Headloss (m)
Static Headloss	10.8
Frictional Headloss	4.7
Total System Head (TDH)	15.5

Using the TDH and the surge pressure calculations, a single 500-mm diameter HDPE DR 11 forcemain is recommended for this station. At ultimate design peak flow conditions, the velocity in the forcemain is approximately 2.3 m/s, which sufficient to maintain self-cleansing along the forcemain.

Based on the above control levels, individual pump cycle time (time to fill + empty the control volume) is calculated to be approximately 10 minutes. This relates to two pump starts per hour for each pump.

4.4 Site Contamination Considerations

A review of available information regarding soil and groundwater contamination within the project area was carried out by XCG, and is provided in Appendix A. The purpose of this review was to assist with comparing the design options with respect to requirements and costs for disposal of any excess excavated material, and for dewatering of excavations during construction.

Based on the information reviewed, it has been concluded that soil to be excavated during the construction of the proposed sanitary sewer can reasonably be anticipated to be contaminated along essentially the entire length, and will require off-site disposal. Similarly, the groundwater extracted during dewatering activities is expected to be contaminated along essentially the entire length of the installation, and will require treatment to reduce contaminants to acceptable levels prior to discharge to the municipal sewer system.

These findings have been incorporated in the comparison and costing of options presented in this report.

5. PREFERRED OPTION

5.1 Selection of Preferred Option

To select the preferred option, a number of factors have been considered. These are listed in Table 7. Costing details for all options are provided in Appendix F.

Options 1A and 1B are considered to be not feasible because of constructability factors. The reasons are as follows:

- Both options require the replacement of the existing 400-mm cast-iron sewer pipe that runs through (i.e. within) the mat foundation structure that lies beneath the Cherry Street rail overpass. The 400-mm pipe would need to be replaced by a 675-mm pipe to provide required future capacity for all areas south of the rail corridor, as well as up to 64 L/s of sludge underflow from the proposed BFF. The mat foundation is a reinforced concrete structure that supports the rail bridge structure. No alteration or removal of this foundation structure for purposes of sewer upsizing is considered feasible or acceptable.
- The existing 300-mm sanitary sewer along Lakeshore Boulevard between Small Street and Parliament Street runs beneath below-grade tie beam structures that are located at some of the Gardiner Expressway bents. The City's Engineering & Construction Services Division has stated that open-cut excavation under the existing tie beam structures will not be permitted.
- There may be an elevation conflict with the existing Cherry Street CSO box culvert pipe. The existing 300-mm sanitary sewer runs beneath this pipe, but the available information indicates that clearance may be minimal to none. Upsizing the sanitary sewer from 300-mm to 600-mm may not be feasible, pending confirmation of the elevation of the bottom of the existing CSO box culvert pipe.

Furthermore, Options 1A and 1B are not favourable from the point of view of facilitating sanitary servicing for development properties in North Keating Area. Since these properties would be connected by gravity sewer to the new Cherry Street sewer, these development properties would be subject to the requirement for protective plumbing measures (same requirement as applied to WDL properties north of the rail corridor that are connected to new Cherry Street sewer). As well, the relatively shallow depth of the new sewer along Lakeshore Boulevard might require private-side pumping to lift wastewater to the sewer.

From this vantage point, Option 2 is much more favourable with respect to servicing the North Keating properties (i.e. Bungee, Silo, 3C and 480 Lakeshore lands).

Given the feasibility issues and drawbacks of Options 1A and 1B, the selection process therefore becomes a matter of deciding between Option 2A and 2B. Note that Options 2A and 2B do not include a pumping station at Bonnycastle Street; instead, all flow from East Bayfront and North Keating Area is conveyed by the proposed deep gravity sewer to the proposed pumping station at 480 Lakeshore Boulevard East.

The comparison presented in Table 7 indicates that there are differences between 2A and 2B with respect to traffic impacts and potential constructability issues, as follows:

1. For the sewer installation west of Parliament Street, Option 2B minimizes the length of microtunelling required beneath the Gardiner Expressway. This is advantageous, since sewer construction under the Gardiner Expressway will require tunnelling between existing footing piles and beneath the tie beams.
2. As well, Option 2B would result in shorter duration of traffic-lane closures on Lakeshore Boulevard. Option 2A will required tunnelling access shafts at Small Street and at Bonnycastle Street, and at each location some temporary lane closures would be needed. In contrast, Option 2B requires access shaft at only Small Street (avoids Lakeshore/Bonnycastle intersection).
3. Option 2B may present the opportunity for cost savings by allowing for sewer pipe installation by open-cut trench construction along the leg on Small Street and along Queens Quay Boulevard. This is an option that some sewer contractors may wish to pursue and which may be feasible for qualified contractors.

On this basis, Option 2B is considered at this time to be the preferred option for the City to pursue.

Table 7 Comparison of Options

	Criteria	OPTION 1A With Bonnycastle SPS at 115 L/s	OPTION 1B With Bonnycastle SPS at 115 L/s	OPTION 2A With 480 Lakeshore Blvd. SPS at 300 L/s	OPTION 2B With 480 Lakeshore Blvd. SPS at 300 L/s
1	Estimated capital cost (construction cost plus allowance for engineering design, approvals and contingencies), including estimated costs for dewatering and disposal of excess excavated material (see Appendix F for costing details)				
1.1	Sewage pumping station	$ 3,670,000	$ 3,670,000	$ 4,350,000	$ 4,350,000
1.2	Gravity sewer	$ 1,870,000	$ 1,870,000	$ 9,330,000	$ 9,050,000
1.3	Forcemain	$ 610,000	$ 560,000	$ 980,000	$ 980,000
1.4	Total Capital Cost	$6,150,000	$ 6,100,000	$ 14,660,000	$ 14,380,000
2	Servicing of North Keating properties (Bungee, Silo, 3C and 480 Lakeshore Blvd lands): advantages / disadvantages	Shallow surcharged sewer (direct gravity connection to Cherry St sewer) requires protective plumbing in NKA properties, and may require private-side pumping		Deep sewer provides good service outlet for NKA properties; no protective plumbing required as system hydraulically isolated from Cherry Street sewer surcharge by pumping station.	
3	Constructability	Not feasible due to conflicts with Gardiner Expressway grade beams, Cherry Street rail underpass foundation and possibly the Cherry St CSO pipe	Not feasible due to conflicts with Gardiner Expressway grade beams, Cherry Street rail underpass foundation and possibly the Cherry St CSO pipe	Tunnelling length under Gardiner Expwy of approx. 330 m between Parliament and Bonnycastle presents increased risk of constructability issues related to need for avoidance of existing structures including Gardiner Expressway bent piles.	Tunnelling length under Gardiner Expwy of approx. 100 m between Parliament and Small Street presents less risk of constructability issues than Option 2A.
4	Excavation dewatering requirements	Sewer/Forcemain: significant Pumping Station: minimal	Sewer/Forcemain: significant Pumping Station: minimal	Sewer/Forcemain: minimal Pumping Station: minimal	Sewer/Forcemain: minimal Pumping Station: minimal
5	Disposal of excess excavated material	Will require disposal of significant quantities of possibly contaminated material	Will require disposal of significant quantities of possibly contaminated material	Minimal disposal of excavated material.	Minimal disposal of excavated material.
6	Traffic disruption	Severe - Closure of multiple lanes of Lakeshore Blvd. – Long duration	Severe - Closure of multiple lanes of Lakeshore Blvd. – Long duration.	Significant: Closure of multiple lanes of Lakeshore Blvd. medium duration. Closure likely required at two locations: Small Street and at Bonnycastle Street.	Significant: Closure of multiple lanes of Lakeshore Blvd. medium duration. Closure required at one location: Small Street.
7	Other local impacts during construction, including noise, dust, truck traffic, etc.	Moderate	Moderate	Minimal	Minimal
8	Implementation time required (construction duration)	Sewer/Forcemain: 3-4 months Pumping Station: 6-8 months	Sewer/Forcemain: 3-4 months Pumping Station: 6-8 months	Sewer/Forcemain: 3-4 months Pumping Station: 6-8 months	Sewer/Forcemain: 3-4 months Pumping Station: 6-8 months
9	Class EA requirements	None. (No significant change from Waterfront Sanitary Master Servicing Plan Class EA filed in October 2012)	None. (No significant change from Waterfront Sanitary Master Servicing Plan Class EA filed in October 2012)	Revised Notice of Completion, and 30-day review period	Revised Notice of Completion, and 30-day review period

6. RECOMMENDATIONS

6.1 Final Design

The following describes a number of factors that need to be considered in final detailed design.

6.1.1 Alignment

In general terms, the horizontal alignment of the preferred alternative is along existing City-owned property or rights-of-way; being along the south side of Queens Quay Boulevard from Bonnycastle Street to Small Street, then along the east side of Small Street to Lakeshore Boulevard, then eastward along the eastbound lanes of Lakeshore Boulevard to Parliament Street, and then along the Martin Goodman Trail (MGT) to the intersection of Cherry Street. It is understood that the MGT is on City-owned property or is a City-owned right-of-way with the southern boundary being the chain-link fence immediately south of the paved recreational pathway. The proposed alignment is detailed on Plan and Profile Drawings 2B-1 to 2B-3 found in Appendix D.

The vertical alignment of Option 2B is controlled by the crossing of the CSO culvert at Small Street. The resulting deep vertical alignment of the gravity sewer allows for the connection of local sewers along the route to provide servicing for future development.

6.1.2 Pipe Material

As the sewer will be constructed by microtunneling methods, the pipe material will have to be reinforced concrete jacking pipe. The design and outside dimensions of the pipe are dependent on the MTBM to be utilized and the jacking forces expected to be encountered during construction. Therefore, the class of pipe cannot be determined at this time.

It should be noted that MTBMs employed in recent years within Ontario vary in size from 600-mm to 1500-mm in diameter. The design has been reviewed with this in mind, and based on the information available at this time it is confirmed that the proposed sewer could be increased to 900-mm diameter.

The forcemain shall be constructed using HDPE pipe as per City standards.

6.1.3 Hydraulics

The design flows as described in Section 3 require the sanitary sewer to range from 450-mm to 600-mm in diameter. A detailed sewer design sheet can be found in Appendix E. In summary, a proposed slope of 0.15% in the proposed gravity pipe results in a velocity ranging from 0.7 m/s to 0.8 m/s which is within the MOE guidelines for sewer design.

Sewer installation for some or all of the length of the proposed sewer works will be by micro-tunnelling (micro-tunnel boring machine, MTBM). At this time, it is expected that the project would involve MTBM equipment for installation of a 900-mm reinforced concrete sewer pipe. In other words, the pipe installed would be oversized. Cost estimation for the recommended works has been based on assuming the MTBM would be installing a 900-mm pipe.

To confirm the feasibility of a larger diameter sewer, flow velocities were checked for a 900-mm diameter concrete sewer installed at 0.15%. At the design flow 115 L/s (i.e. peak flow from EBF area only) the velocity equals 0.82 m/s. At a flow rate of 201 L/s (EBF plus Bungee, Silo and 3C properties) the velocity equals 0.95 m/s. These velocities exceed the minimum requirement of 0.6 m/s; and this is the case for all flows greater than 42 L/s.

This indicates that if the project proceeds on the basis of installing by microtunnelling an over-sized concrete pipe of 900-mm diameter, self-cleaning flow velocities will be achieved. During final design this must be confirmed based on final diameter and pipe slope selection.

6.1.4 Manholes

The spacing of manholes is determined by the proposed mining shaft locations. Standard pre-cast concrete manholes are proposed, the size of which is dependent on the final outside diameter of the jacking pipe to be installed. Detailed design of the manholes should take into consideration the connection of future local sewers, internal or external drop structures may be required.

6.1.5 Existing 300-mm Sanitary Sewer on Lakeshore Boulevard

The existing sanitary sewer that runs along Lakeshore Boulevard East from Small Street to Cherry Street can remain in service during and after construction of the proposed works. This pipe converges with another existing 300-mm sanitary sewer pipe coming from east of Cherry Street, at a manhole located immediately south of the Cherry Street rail underpass, and discharges to the 400-mm cast-iron sewer pipe that runs through the mat foundation structure under the Cherry Street rail underpass; this 400-mm pipe then connects to the new 825-mm Cherry Street sanitary sewer at a manhole located immediately north of the mat foundation.

There are likely a number of lateral service connections to the 300-mm sewer along Lakeshore Boulevard between Cherry Street and Small Street, from properties south of Lakeshore Boulevard. The proposed deep sewer installed by micro-tunnelling will not affect these service connections.

6.1.6 Service for WDL Stormwater Treatment (Ballasted Flocculation Facility)

The proposed West Don Lands stormwater treatment facility (BFF) is to be located on the 480 Lakeshore Boulevard site, immediately the east of the recently constructed stormwater conveyance shaft.

The BFF will discharge its sludge flow to the sanitary sewer system. The current estimate is that the BFF will generate a peak sludge flow of 64 L/s, based on information supplied to XCG by R.V. Anderson Associates in March 2013.

As shown on the design sheet in Appendix E, this 64 L/s has been included in the calculation of the peak design flow to the proposed sewage pumping station at 480 Lakeshore East. In other words, it has been assumed that all of the BFF sludge flow will be directed into the sewage pumping station. At final design, there will need to be allowance for a service connection from the pumping station to the BFF. This could be a pipe stub directly from the wet well or other arrangement to be decided upon during final detailed design.

It is expected that operation of the BFF will be such that during dry-weather periods there will be minimal if any sludge discharged from the BFF to the pumping station; and during wet weather, the BFF will become active and begin discharge to the pumping station. The 64 L/s is understood to be the peak rate of discharge that would be generated by the BFF at any time. Details of the proposed operation of the BFF and frequency at which the BFF would discharge the peak flow of 64 L/s is unknown at this time; presumably, this information would become available during final design of the BFF.

6.1.7 Property Requirements

The alignment of the proposed gravity sewer is within the existing right-of-ways, and the proposed location for the Cherry Street Pumping Station is at 480 Lakeshore Boulevard East which is owned by the City.

However, the information provided to date is insufficient to determine the ownership of the property immediately north of the proposed 480 Lakeshore Pumping Station where the proposed forcemain is to be located. Further investigation is required to determine if property will need to be acquired at this location. The recently constructed storm sewer tunnel traverses this property, however, some documentation indicates that this property is subject to a Hydro One Easement, and other documentation indicates that a MetroLinx Easement is also located in this area.

6.2 Additional Site Investigations Required

6.2.1 Detailed Topographic Survey

To allow for final design and preparation of final contract drawings, a detailed topographic survey should be completed to pick up all surface features throughout the project area. This will provide base mapping for the final contract drawings. The survey should include the locations and dimensions of all the Gardiner Expressway structures between Cherry Street and Small Street, as well as all surface features and structures along Lakeshore Boulevard East from Cherry Street to Small Street including the Martin Goodman Trail corridor south of the roadway to the property line.

6.2.2 Geotechnical Investigation

A review of existing geotechnical information was conducted as part of the preliminary design. A copy of the assessment is included in Appendix B.

Based on this review additional information will be necessary. A detailed geotechnical investigation is required in order to complete a detailed design of the preferred option. The investigation will require drilling of a number of new boreholes to obtain more detailed information on the existing soils and the suitability for microtunnelling. The preparation of a Geotechnical Baseline Report is strongly recommended in order to provide a baseline for contract tendering purposes. Recommendations for the geotechnical investigation are detailed in Appendix B.

6.2.3 Subsurface Contamination and Dewatering

As outlined in Appendix A, previous investigations have generally provided reasonable information regarding the subsurface conditions and contaminant levels that are to be expected in the soil and groundwater encountered during the proposed construction activities (i.e. excavation and dewatering). XCG's opinion is that some further limited investigations are warranted, as described in Appendix A. The following additional site investigations should be undertaken prior to issuing the tender for the proposed construction:

- Additional boreholes along Queens Quay Boulevard and Small Street to investigate for potential areas of soil contamination outside the investigative areas of the previous Phase 2 ESA conducted by Franz.
- Install 100-mm (4") diameter test pumping wells at two locations along the proposed gravity sewer alignment to facilitate additional soil and groundwater sample collection, and provide for groundwater pumping tests.
- Collection and analysis of groundwater samples from existing monitoring wells located Queen's Quay and Small Street. Analyses will include PHC, PAH, VOC, metals, PCB and pesticide parameters.
- Collection and submission of soil samples from the proposed boreholes and pumping well installations. Analyses will include bulk PHC, PAH, VOC, metals, PCB and pesticide parameters, and TCLP analyses for VOC, PAH and metals/inorganics parameters.
- Conduct variable and constant rate pumping tests on the proposed test pumping wells with monitoring of water level drawdown response to provide additional information on the potential dewatering requirements. The proposed pumping tests would consist of limited dewatering and monitoring of drawdown response in the vicinity of the sewer construction, with the objective being to provide additional information which would assist bidders in estimating dewatering requirements.

Refer to Appendix A for further details regarding the above recommendations.

6.2.4 Subsurface Utility Engineering

Due to the numerous and congested existing utilities in the proposed construction area it is recommended that a detailed (Level 4) subsurface utility engineering investigation be completed.

Areas that require particular attention are the shaft location at the intersection of Small Street and Lakeshore Boulevard, and the forcemain alignment at the intersection of Cherry Street and Lakeshore Boulevard (immediately south of CNR rail overpass of Cherry Street).

6.2.5 Gardiner Expressway

Special consideration will need to be given to the design of the shafts and the tunnel alignment in the vicinity of the elevated Gardiner Expressway. The City has previously indicated that all excavations within the vicinity of the Expressway shall be completed in accordance with OPSS 539.

Between Parliament Street and Small Street, the proposed alignment for the tunnelled sewer passes underneath the existing Gardiner Expressway bent structures, along the eastbound lanes Lakeshore Boulevard, as shown on Drawings 2B-1 and 2B-2 in Appendix D. The proposed sewer alignment will pass under bents 277, 278 and 280E. The record drawings supplied by the City indicate that at these three bents, there are horizontal tie-beams below the Lakeshore Boulevard roadway surface, between the columns. (Refer to Section A-A on Drawing 2B-1).

Of particular importance is the crossing of the tie beams between the column footings for the Expressway. These tie beams have been constructed on top of creosoted wood piles. The exact location and elevation of the tie beams and piles must be determined during the detailed design phase. Approval from the City's Engineering & Construction Services must be obtained prior to proceeding any further with this design.

6.2.6 Summary of Additional Investigations Required

Table 8 below summarizes the additional investigations that are required as part of the final detailed design of the recommended works.

Per Table F-1 in Appendix F, the total cost of these additional site investigations has been estimated at $800,000. This project-specific cost has not been included within the total project capital cost estimates provided in Table 7 above.

Table 8 Summary of Additional Investigations Needed During Final Project Design

Item	Description
1	**Detailed Topographic Survey,** including location and dimensions of Gardiner Expressway structures.
2	**Geotechnical Investigation**: Additional boreholes along the final alignment and preparation of Geotechnical Baseline Report are strongly recommended to support detailed design (refer to Appendix B for details).
3	**Subsurface Contamination and Dewatering** (refer to Appendix A).
3a	Additional boreholes along Queens Quay Boulevard and Small Street to investigate for potential areas of soil contamination outside the investigative areas of the previous Phase 2 ESA.
3b	Install 100-mm (4") diameter test pumping wells at two locations along the proposed gravity sewer alignment to facilitate additional soil and groundwater sample collection, and provide for groundwater pumping tests.
3c	Collection and analysis of groundwater samples from existing monitoring wells located Queen’s Quay and Small Street.
3d	Collection and analysis of soil samples from the proposed boreholes and pumping well installations.
3e	Conduct variable and constant rate pumping tests on the proposed test pumping wells with monitoring of water level drawdown response to provide additional information on the potential dewatering requirements.
4	**Subsurface Utility Engineering:** A detailed (Level 4) subsurface utility engineering investigation.
5	**Gardiner Expressway Structures**
5a	Confirm locations of columns and column footings (as part of detailed topographic survey, item 1, above) for all bents between Small Street and Cherry Street (bents 277 to 298).
5b	Confirm locations of sub-grade horizontal tie beams and associated timber piles under eastbound lanes of Lakeshore Boulevard between Parliament Street and Small Street (Gardiner Expressway bents 277, 278 and 280E).
5c	Review above information and proposed design alignment and profile for micro-tunnelling sewer installation with City's Engineering & Construction Services Division, to confirm acceptability of proposed sewer installation between Parliament St and Small Street; and define technical submission requirements required by Engineering & Construction Services Division to obtain final approval for the works.

6.3 Other Design Requirements

6.3.1 Forcemain Connection to Cherry Street Sewer

The proposed design arrangement is based on the proposed sewage forcemain (500-mm HDPE) connecting to the new 825-mm Cherry Street sewer at a new manhole to be installed on the 825-mm sanitary sewer between manhole "MH 10A" and "MH 9A" (manhole numbering as shown on Sheet 14 of the Cherry Street reconstruction contract drawings set April 29, 2011). The new manhole would be located at a distance of 40 to 50 m north of MH 10A, with final position to be determined during final detailed design. Refer to Drawing 2B-3 in Appendix D.

This arrangement for the forcemain connection to the 825-mm Cherry Street sewer is proposed to avoid potential conflict with a new electrical conduit proposed by Toronto Hydro. Toronto Hydro is proposing to install a new electrical conduit along an alignment through the rail underpass that is parallel to and immediately west of the proposed sewage forcemain. Figure 3 below shows the proposed alignment and cross section prepared by Toronto Hydro (May 2013) for the south side of the rail underpass.

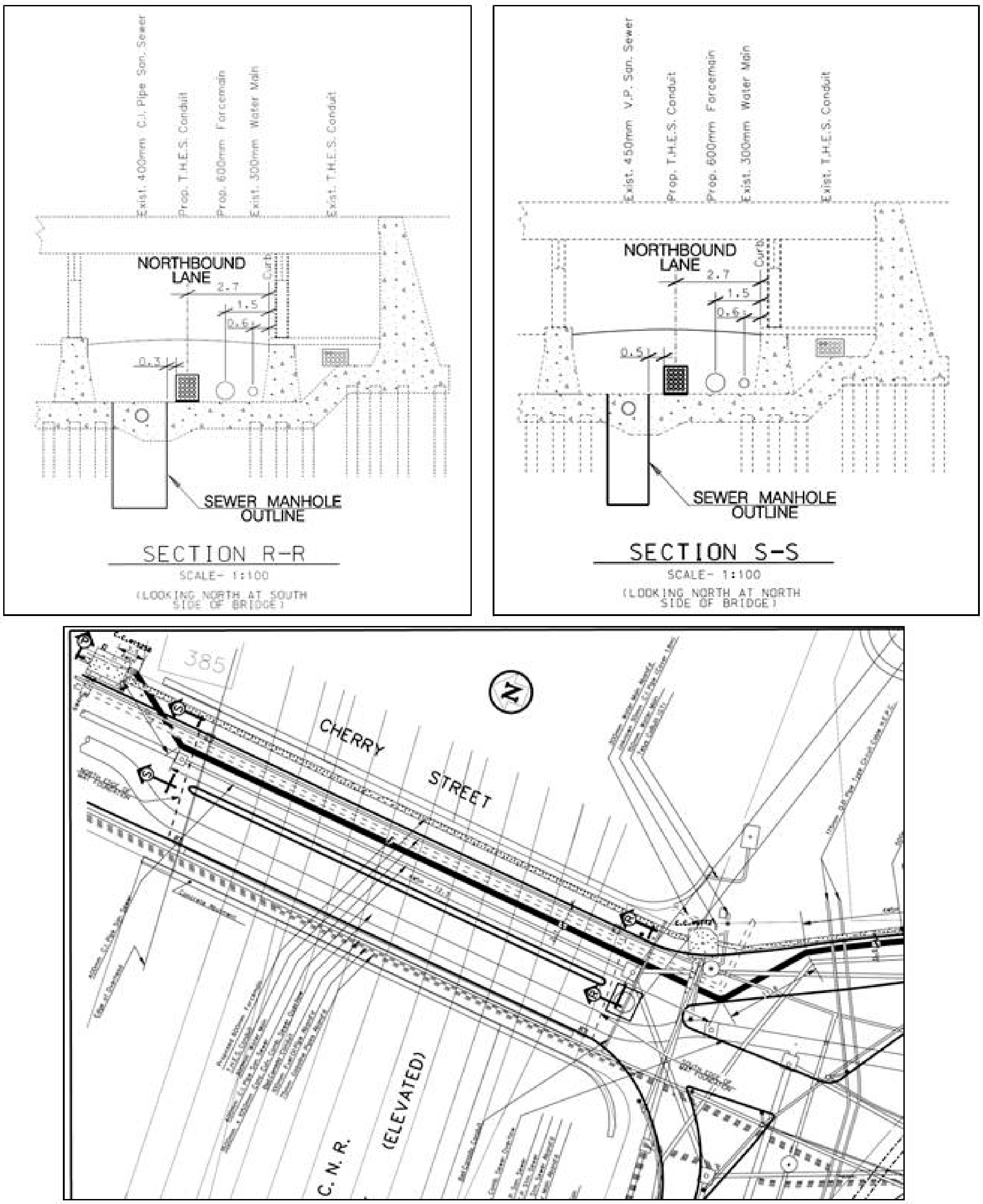


Figure 3 ***Cross-Sections and Plan provided to City by Toronto Hydro (May 2013) showing Proposed 4W5H Electrical Duct along Cherry Street***

At the north side of the rail underpass, Toronto Hydro's proposal is to connect the electrical conduit to existing works that are towards the east side of the Cherry Street right-of-way. The proposed design by Toronto Hydro is that the new electrical conduit will, immediately north of the mat foundation, drop in elevation and veer eastward to pass under the proposed sewage forcemain (indicated on the Toronto Hydro sections in Figure 3 as "Prop. 600 mm forcemain") and the existing 300-mm watermain on Cherry Street. To avoid conflict with the new electrical conduit, it likely will not be possible to turn the sewage forcemain westward to connect to MH10A on the Cherry Street sewer, so instead the forcemain will continue northward to the new manhole.

Toronto Hydro's proposed alignment and elevation profile for the new electrical conduit north of the mat foundation requires vertical and horizontal bends to allow 4W5H conduit to the pass under the proposed forcemain and existing watermain. The electrical conduit will be constructed as a cast-in-place concrete structure, and during construction it may be necessary for Toronto Hydro to make adjustments. As a result, it is possible that in a "worst case", the as-built electrical conduit could present a conflict with the proposed alignment for the sewage forcemain.

In this case, there may be a number of solution options, including:

1. Installing a series of vertical and/or horizontal bends in the forcemain immediately north of the mat foundation to work around the new electrical conduit.
2. Changing the alignment of the sewage forcemain such that it passes over top the new electrical conduit at a point south of the railway underpass, and then runs northward through the underpass on an alignment that is west of the new electrical conduit.
3. Micro-tunnelling installation below the existing mat foundation structure below the rail underpass.

The last of these three options is very likely not feasible due to space restrictions and utilities congestion at north and south ends of the mat foundation; and may not be acceptable with respect to protection of the underpass structure and rail bridge. According to the available record drawing the mat foundation is supported on a set of piles which would further complicate tunneling and likely make tunnelling unacceptable for structural protection.

It is recommended that the City meet with Toronto Hydro once Toronto Hydro awards the contract for construction of the new electrical conduit, to ensure that all reasonable efforts are made during contract supervision to avoid any conflict with the proposed forcemain. For example, a site meeting could be held at any early stage with the contractor to review the details of the critical area and ensure the contractor understands the required alignment; with subsequent site inspection once the layout for formwork in the critical area is completed, to ensure that the horizontal and vertical alignment are correct before concrete is poured.

6.3.2 Future Lakeshore Boulevard Realignment

It should be noted that the designs presented in this report were based on the future realignment of Lakeshore Boulevard as shown on the design drawings for West Don Lands stormwater conveyance system (shafts and tunnel works) as supplied to XCG by R.V. Anderson Associates in March 2013. The proposed location of the future realigned Lakeshore Boulevard should be verified during the detailed design phase.

6.3.3 Future light rapid transit (LRT) Lowering of CN Underpass.

As described in the Lower Don Lands Infrastructure Master Plan (May 2010), the Cherry Street portal (roadway underpass and rail bridge) will at some time in the future be entirely replaced with a new structure to accommodate a lowered roadway, LRT and wider pedestrian walkways under the existing rail corridor. It is proposed that the Cherry Street roadway through the underpass would be lowered by approximately 1.1 meters (from existing top of road elevation 76.20 m to 75.08 m). This is shown on Figure 15-6 from the LDL Infrastructure Master Plan report, reproduced here in Figure 4.

The proposed location of the new 500-mm sewage forcemain through the existing rail underpass does not account for the proposed future modification to the Cherry Street portal, as no design details and timing for that proposal are unknown. The final design of the Cherry Street portal will require relocation of existing underground utilities in the vicinity, and may require relocation of the proposed sewage forcemain at that time.

6.3.4 Consolidation of Electrical Control Facilities

A stormwater quality facility building (the BFF) is proposed for future construction immediately east of the recently constructed main shaft of the West Don Lands stormwater conveyance system (refer to Drawing Number 2B-3 in Appendix D). At this time, it is expected that the BFF will be constructed sometime after the new Cherry Street sewage pumping station at 480 Lakeshore East.

Due to the limited space available for the proposed Cherry Street SPS the possibility of incorporating the Electrical Control Building into the future stormwater quality facility building should be investigated during pumping station design. This would reduce visual impact to the surrounding area, and could allow for the consolidation of various resources such as back-up generators and other equipment and facilities while potentially reducing capital costs. However, this design consolidation will be possible only if the design of the BFF is sufficiently advanced at the time of the pumping station design.

6.4 Construction Contract Tendering

It is recommended that the sewer construction and the pumping station construction be tendered under separate contracts. The tendering process should be conducted in accordance with standard City requirements. As the sewer construction will require specialized microtunnelling techniques a prequalification of contractors may be warranted. Alternatively, the tender could include requirements in the document for the bidding contractors to supply information demonstrating their experience in completing similar microtunnelling projects.

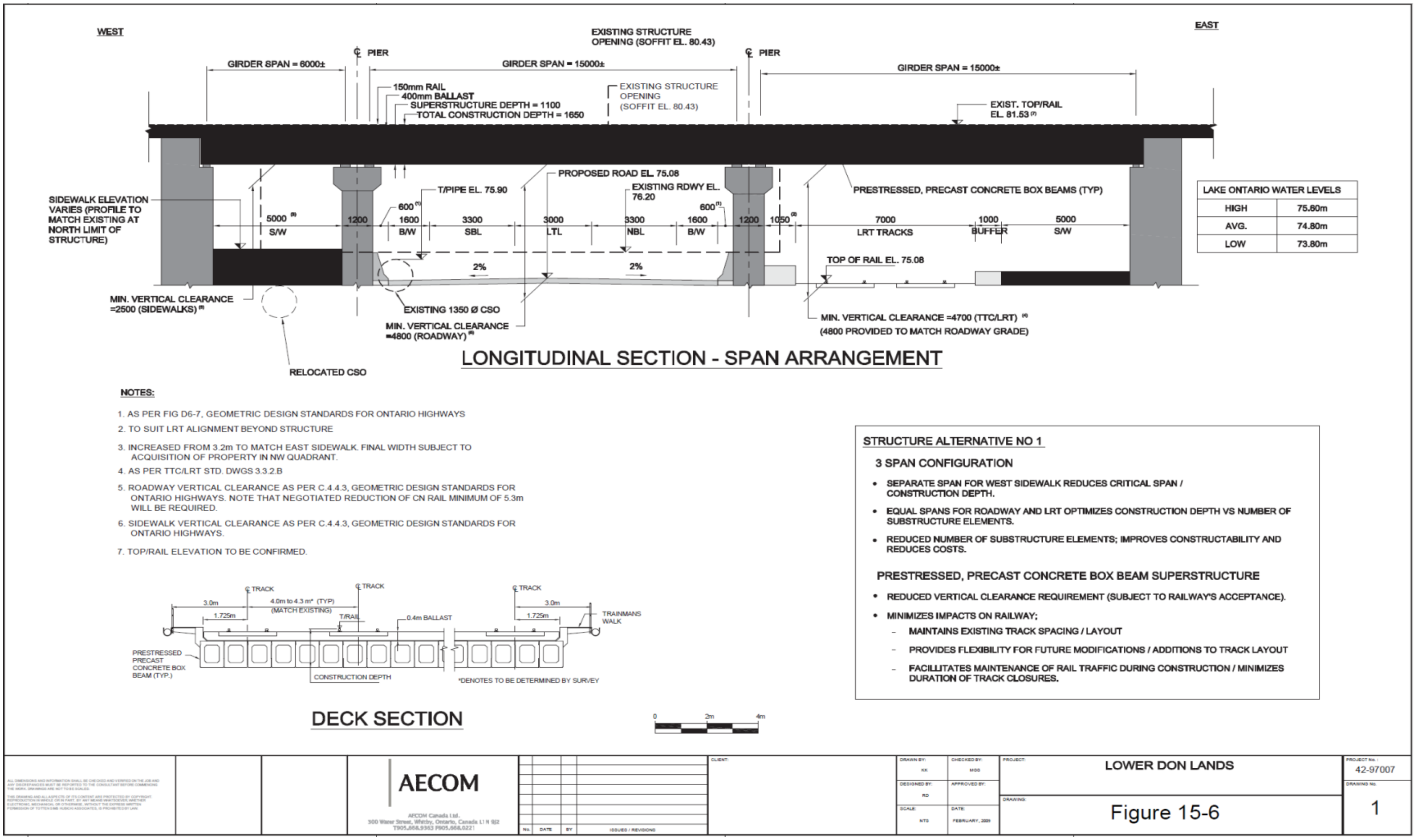


Figure 4 ***Excerpt from Lower Don Lands Infrastructure Master Plan Report (May 2010) showing Proposed Modification to the Cherry Street Portal.***

7. REFERENCES

Following is a list of information sources that have been referenced.

1. Record drawings for F.G. Gardiner Expressway as supplied by City of Toronto (electronic scans of paper record drawings).
2. Report "Sanitary Servicing Analysis East Bayfront & Lower Don Lands" prepared by MMM Group for Waterfront Toronto, dated February 2013.
3. Report "Lower Don Lands Infrastructure Master Infrastructure and Keating Channel Precinct Environmental Study Report" dated May, 2010.
4. Report "Waterfront Sanitary Master Servicing Plan Class EA - Project Report", prepared for City of Toronto, Toronto Water, Major Capital Projects Delivery; prepared by XCG., dated October 17, 2012.
5. Sewer design sheet for 825-mm Cherry Street sanitary sewer (undated) as supplied by R.V. Anderson Associates in March 2013.
6. Design drawings set entitled "Cherry Street/Sumach Street Road Reconstruction From CN Railway Corridor to King Street, Project 071529, Issued for City Approval April 29, 2011", prepared by R.V. Anderson Associates Limited, Waterfront Toronto, Moon-Matz Ltd., City of Toronto Technical Services and The Panning Partnership; comprised of 129 drawings sheets; Sheet 14 shows proposed new 750-mm Cherry Street sanitary sewer, with design invert of 73.44 m at south limit of contract. (This drawings set indicates the new sewer on Cherry Street to be 750-mm pipe, but information provided to XCG by the City of Toronto is that the new sewer has been upsized to 825-mm; and information provided to XCG by R.V. Anderson Associates confirmed that the as-built sewer invert at south limit of contract is 73.44 m)
7. Design drawings for West Don Lands storm tunnel conveyance system (shafts and tunnel works) as supplied to XCG by R.V. Anderson Associates in March 2013; comprised of Drawing Number T001, dated April 7, 2011; Drawing Number S201 dated Aug 2011; and Storm Water Quality Facility general site plan Drawing Number G01, dated Feb. 17, 2012.
8. Utilities location information (DMOG drawings) acquired March 2013 from City of Toronto Mapping Services.
9. Waterfront Toronto East Bayfront Engineering/Public Realm Technical Working Group meeting minutes, Sept 2012, as provided by City of Toronto.
10. Report "East Bayfront Lakeshore Boulevard (Bonnycastle Street to Cherry Street) Geotechnical Investigation to Support the Design of the Proposed Sanitary Sewer, Final Report", by LVM Inc. for Waterfront Toronto, dated Feb. 13, 2013.

APPENDIX A
REVIEW OF SITE CONTAMINATION INFORMATION

1. INTRODUCTION AND PURPOSE

XCG Consultants Ltd. (XCG) has conducted a review of available background information to determine the probable requirements ("data gaps") for the assessment of the disposal of the excavated soil and dewatering requirements, including cost implications, resulting from the implementation of either Option 1-Shallow Gravity Sewer on Lakeshore Boulevard East, or Option 2-Deep Gravity Sewer to New Pumping Station at 480 Lakeshore Boulevard East.

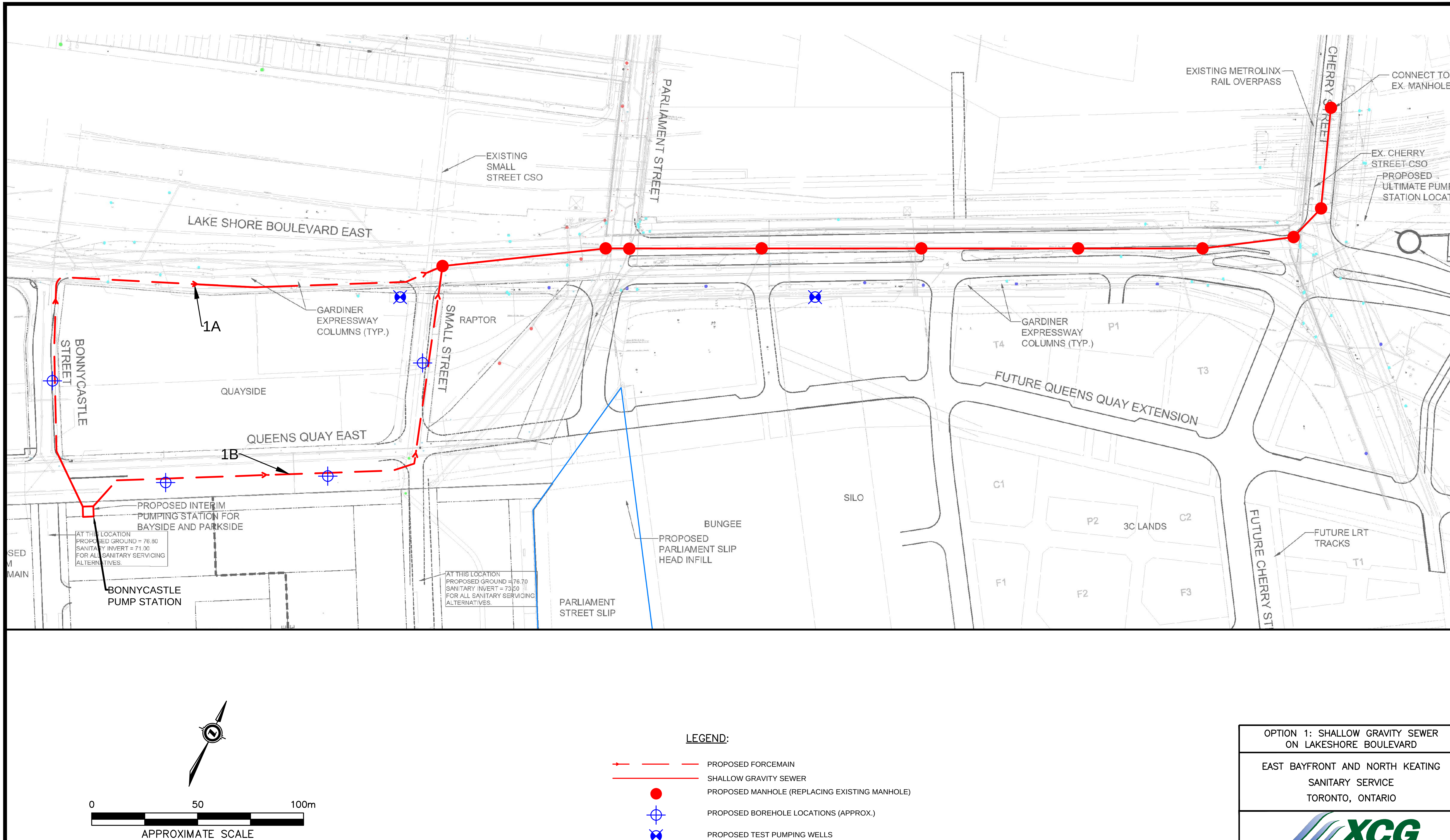
The layouts of Option 1 and Option 2 on Figure A1 and Figure A2, respectively.

2. SCOPE OF WORK

XCG's scope of work included the review of the following reports and information provided by the City of Toronto (City):

1. *Category 3 Permit to Take Water, Lakeshore Boulevard East (Bonnycastle Street to Cherry Street)*, Hydrogeology Study Final Report, prepared by LVM, dated March 11, 2013.
2. *Phase Two Environmental Site Assessment, Lake Shore Boulevard East Bonnycastle to Cherry Street, Toronto, Ontario*, prepared by Franz Environmental, dated March 5, 2013.
3. *East Bayfront Lakeshore Boulevard (Bonnycastle Street to Cherry Street), Geotechnical Investigation to Support the Design of the Proposed Sanitary Sewer*, prepared by LVM, dated February 13, 2013.
4. *Final Project Report, Waterfront Sanitary Master Servicing Plan Class EA*, prepared by XCG, dated October 17, 2012.
5. *Lower Don Lands Infrastructure Master Infrastructure and Keating Channel Precinct Environmental Study Report*, Waterfront Toronto, dated May 2010.
6. Waterfront Toronto Environmental Management Plan for Project Related Activities, Waterfront Toronto, dated March 2010.
7. *East Bayfront Functional Servicing Report*, prepared by the Municipal Infrastructure Group Ltd., dated March 2009.
8. Record drawings for F.G. Gardiner Expressway as supplied by City.
9. City of Toronto Borehole Database.
10. Ontario Geotechnical Borehole Database.

As necessary, specific details from the reports reviewed are presented and referenced in the sections below.



LEGEND:

PROPOSED FORCEMAIN

SHALLOW GRAVITY SEWER

PROPOSED MANHOLE (REPLACING EXISTING MANHOLE)

PROPOSED BOREHOLE LOCATIONS (APPROX.)

PROPOSED TEST PUMPING WELLS

DRAWING REFERENCE: Base drawing supplied by Sanitary Servicing Analysis, East Bayfront & Lower Don Lands (MMM, Feb. 2013).
NOTE: Location of building, underground utilities, etc. are for reference only and should not be relied upon for detailed design, renovation, or construction purposes. Property boundary and building locations shown may not represent actual surveyed boundaries.

SHEET: R_3-03139525_FIGA1.pdf
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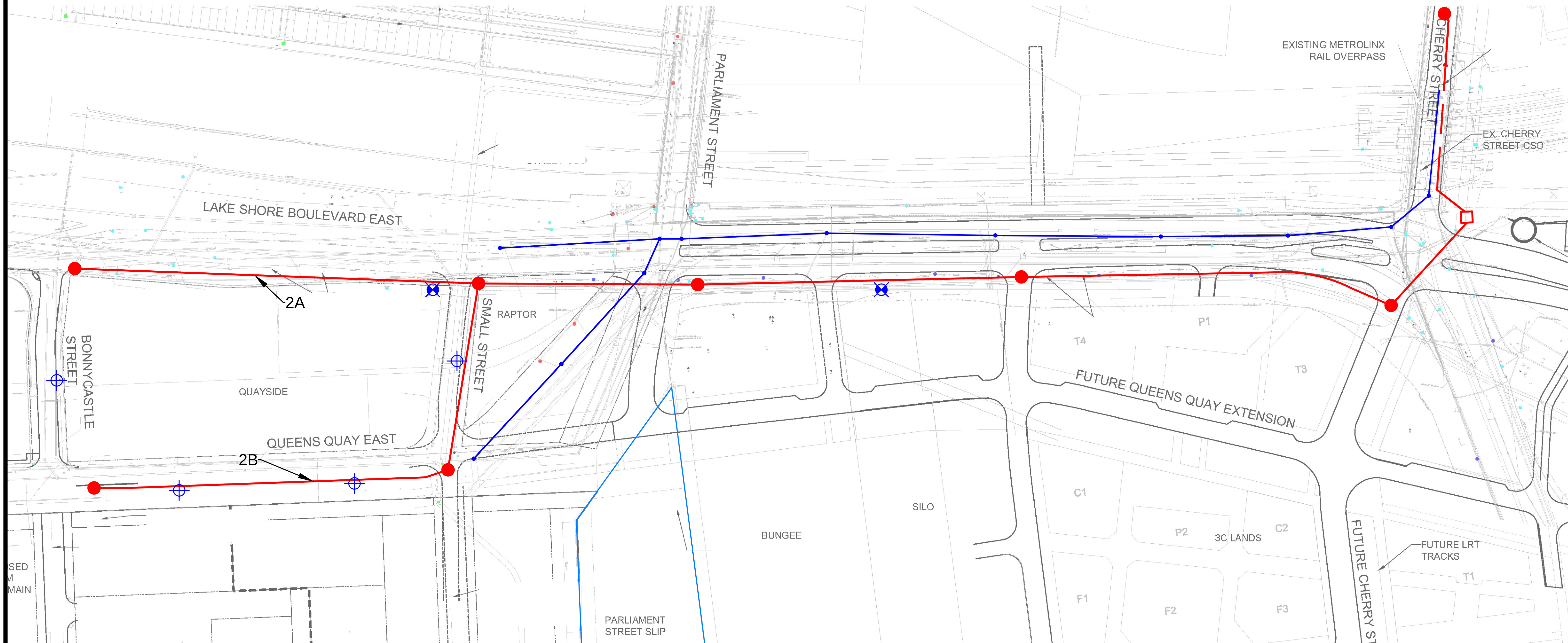
OPTION 1: SHALLOW GRAVITY SEWER ON LAKESHORE BOULEVARD

EAST BAYFRONT AND NORTH KEATING
SANITARY SERVICE
TORONTO, ONTARIO

XCG
Environmental Engineers & Scientists

DATE	JOB NO.	FIGURE NO.
MAR. 2013	3-244-33-18	A1



LEGEND:

PROPOSED FORCEMAIN

DEEP GRAVITY SEWER

PROPOSED MANHOLE

PROPOSED BOREHOLE LOCATIONS (APPROX.)

PROPOSED TEST PUMPING WELLS

DRAWING REFERENCE: Base drawing supplied by Sanitary Servicing Analysis, East Bayfront & Lower Don Lands (MMM, Feb. 2013).
NOTE: Location of building, underground utilities, etc. are for reference only and should not be relied upon for detailed design, renovation, or construction purposes. Property boundary and building locations shown may not represent actual surveyed boundaries.

SHEET: R_3-03139525_FIGA2.pdf
FILE: R_3-03139525_2.dwg

OPTION 2: DEEP GRAVITY SEWER ON LAKESHORE BOULEVARD

EAST BAYFRONT AND NORTH KEATING SANITARY SERVICE
TORONTO, ONTARIO

XCG Environmental Engineers & Scientists

DATE	JOB NO.	FIGURE NO.
JUNE 2013	3-244-33-18	A2

3. *KEY FINDINGS OF THE REVIEW OF BACKGROUND INFORMATION*

The key findings based on the review of the background reports focussed on issues relevant to the project scope and are provided below.

3.1 *Geology/Hydrogeology*

The geotechnical study (LVM, 2013) included detailed borehole logs along the alignment of the proposed sanitary sewer, from which the following generalization of site stratigraphy was made:

Fill and Native Stratigraphy

- The fill material underlying the area of the proposed sanitary sewer consists mainly of loosely compacted sand, with varying amounts of silt, gravel, clay and organics, and occasional rubble. The majority of the boreholes were advanced to approximately 6 metres below grade, and only fill material was encountered, i.e. no native soil was present with the borehole interval. At deeper borehole locations, native sand was encountered at approximately 9 metres below grade, and the surface of the weathered shale bedrock surface was encountered at approximately 11 metres below grade.

Groundwater Levels

- In monitoring wells installed by LVM near the proposed sanitary sewer, depth to groundwater was typically measured at approximately 2 metres below grade, and ranged from 1.6 to 2.7 metres below grade. The measured groundwater depths indicates that essentially the entire length of the proposed sanitary sewer will be constructed below the water table and will require some form of dewatering during construction.

3.2 *Potential to Encounter Contaminated Soil and Groundwater*

Based on the historical filling in the area, local industrial land use, numerous field observations of petroleum and/or coal tar impacts reported at the various borehole locations, and documented analytical results indicating extensive contaminated soil and groundwater conditions, the likelihood of encountering contaminated soil and groundwater during construction of the proposed sanitary sewer seems certain.

LVM submitted water samples from three monitoring wells that were analysed and compared to the City's Sanitary and Combined Sewer Discharge By-Law. One of the three samples exceeded the sewer discharge guidelines for various polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs) parameters.

As described in the Phase Two Environmental Site Assessment (ESA) report (Franz Environmental, 2013), soil and groundwater analyses identified areas of groundwater and soil contamination. Excerpts from this Phase Two ESA report are provided in Attachment 1. The identification of the areas of soil and groundwater contamination was based on the comparison of the analytical results to the criteria published by the Ministry of the Environment (MOE) in the document entitled "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act," dated April 15, 2011 for coarse-textured soils in a non-potable groundwater setting (MOE Table 3 Standards) for

Industrial/Commercial/Community (ICC) Property Use were used for evaluation of on-site soil and groundwater quality. In general the analytical results reported in the Phase Two ESA (Franz Environmental, 2013) can be summarized as follows:

- Exceedances in soil of the MOE Table 3 Standards for Petroleum Hydrocarbons (PHCs) and/or PAH and/or VOC were reported at 15 of the 18 borehole locations sampled.
- Two borehole locations also reported exceedances in soil of the MOE Table 3 Standard for Sodium Adsorption Ratio (SAR), one of which also reported exceedances for the metals parameters lead and zinc.
- Exceedances in groundwater of the MOE Table 3 Standards PHCs and/or PAHs and/or VOCs were reported at six of the 14 monitoring well locations sampled. Exceedances for free cyanide were also reported at two monitoring well locations.
- Oily free-product was reported by Franz in soil at one borehole location (BH16), at depths of 3.0 to 5.2 metres below ground surface. The extents of this free product have reportedly not been delineated. Borehole locations are shown in the reports excerpts provided in Attachment 1.
- A total of six soil samples were submitted for Toxicity Characteristic Leaching Procedure (TCLP), as per O. Reg. 558/00, and the analytical results were compared to Schedule 4 Leachate Quality Criteria. Reportedly, the samples analyzed generally represented the worst-case soil conditions encountered, and the analytical results indicated the soils in the vicinity of the borehole locations can be considered as non-hazardous waste for disposal purposes.

Based on the information reviewed and described above, the soil to be excavated during the construction of the proposed sanitary sewer can reasonably be anticipated to be contaminated along essentially the entire length, and will require off-site disposal. Similarly, the groundwater extracted during dewatering activities is expected to be contaminated along essentially the entire length of the installation, and will require treatment to reduce contaminants to acceptable levels prior to discharge to the municipal sewer system.

3.3 Disposal Requirements

Transport and Disposal of Soil

As stated above, contaminated soil and/or groundwater, and oily free product have been documented along the alignment of the proposed sanitary sewer.

Typically, remediation through off-site disposal of large quantities of contaminated soil is undertaken by excavation and direct loading onto truck and trailers, which then transport the impacted soil directly to the waste receiver (i.e. landfill, treatment facility, etc.).

Depending on the constraints of the particular project, there are sometimes opportunities to reuse excavated soils by segregating soil deemed through field screening to be ‘clean’ or marginally-impacted and conducting confirmatory sampling and analysis of the segregated material to determine if the soil meets standards for reuse as fill material. However, this requires full-time, diligent supervision by experienced personnel during the excavation activities to continually assess soil impacts, and requires flexibility in terms of the contractor's schedule to allow for excavation stoppages so that the necessary field screening can be conducted. Depending on contractual arrangements, field screening and soil segregation during excavation can result in significant extra costs due to delays in the progress of the excavation.

In certain cases, some form of grid sampling can be used to delineate 'clean' soil from impacted soil, often allowing for reasonable excavation rates while reducing unnecessary disposal costs. However, the heterogeneous nature of the fill deposits and possible multiple contaminant sources in the work area suggests that delineation through a grid sampling program would require a relatively close-spaced grid with a high number of samples to achieve a reliable delineation. In addition, re-use of fill material deemed to have questionable quality may have implications in future land use, nearby property values, property transactions, contaminated site assessments, etc.

With respect to the proposed construction; due to backfilling requirements (minimizing duration of open excavations), the nature of the excavation (linear with limited work area), potential for soil sporadic contamination, logistical issues with segregating/field screening soil, and the marginal geotechnical properties of the fill material, it is XCG's opinion that there would be limited benefit in attempting to re-use significant quantities of the excavated material. Based on the available information, direct loading and off-site disposal of excavated soil, and replacement with imported backfill approved and tested by the Geotechnical Engineer, would be recommended if open-cut excavation methods are to be used.

Landfill tipping fees for disposal of impacted soil can vary, depending on various factors such as type and degree of impact, waste classification as per O. Reg.558/00, water content, market demand, location, trucking costs, etc., but in general typical costs to excavate, load, transport and dispose of non-hazardous, petroleum-impacted soil range from $45/Tonne to $50/Tonne.

Unit rate costs for excavation and disposal of soil removed using microtunnelling methods are dependent on the methods, equipment, etc., selected by contractor and so are more difficult to estimate than open cut excavation methods, but in general microtunnelling is the more expensive option on a unit rate basis due to re-handling, dewatering, higher disposal costs, etc. For the purposes of this review, the unit rate cost for excavation and disposal of soil using microtunelling methods has been assumed to be $75/Tonne, approximately 50% higher than open-cut excavation methods.

The preliminary estimated costs for open-cut excavation and off-site disposal of contaminated soil are provided in Table A1, and the preliminary estimated costs using micro tunnelling methods and off-site disposal of contaminated soil are provided in Table A2. As shown on Tables A1 and A2, the estimates have been provided to assess respective cost estimates for Option 1 and Option 2, with each option having two variations, A and B. These options are summarized as follows:

- **Option 1A:** Bonnycastle Pumping Station to shallow gravity sewer along Lakeshore Boulevard East, routed north on Bonnycastle Street to Lakeshore Boulevard East.

- **Option 1B:** Bonnycastle Pumping Station to shallow gravity sewer along Lakeshore Boulevard East, routed east along Queens Quay and north on Small Street to Lakeshore Boulevard East.
- **Option 2A:** Deep gravity sewer along Lakeshore Boulevard East and Martin Goodman Trail to a new Pumping Station at 480 Lakeshore Boulevard East.
- **Option 2B:** Deep gravity sewer along Lakeshore Boulevard East to new Pumping Station at 480 Lakeshore Boulevard East, routed east from Bonnycastle Street/Queens Quay to Small Street, and north to Lakeshore Boulevard East. .

Refer to Figure A1 and Figure A2 showing the layouts of the options.

Dewatering

As described in the Hydrogeology Study Final Report (LVM, 2013), LVM produced simulated dewatering rates using a 3D numerical groundwater flow model. The model incorporated water levels and hydraulic conductivity values that were based on data collected during field investigations. The assumptions applied in generating the groundwater flow model and the simulated dewatering rates included the following:

- Dewatering will occur over 100-metre sections, 24 hours per days, seven days per week during construction.
- Hydraulic conductivity values were applied over a range of values based on field observations and results of in-situ hydraulic testing conducted by LVM.
- The simulated water level drawdown was 5-metres below grade, under steady state conditions.

LVM reported simulated dewatering rates that ranged from 140,000 L/day to 3,150,000 L/day. With respect to the pending Permit to Take Water (PTTW) application, LVM recommended requesting a maximum pumping rate of 6,300,000 L/day for a period of three years.

Selection of specific dewatering method(s) and estimation of full dewatering costs are outside the scope of this review. The estimated monthly costs for the treatment of extracted groundwater are provided in Table A3.

As shown on Table A3, preliminary water treatment costs have been provided for assumed system capacities of 500,000 L/ day and 1,000,000 L/day. These capacities are within the range of simulated dewatering rates predicted by the groundwater flow model developed by LVM. However, the actual construction dewatering rates will vary depending on numerous factors such as dewatering methods, excavation size, schedule, etc.; therefore, these assumed capacities are for general cost estimating purposes only, and should not viewed as estimates of the anticipated construction dewatering rates.

The estimated costs to supply, operate and manage the groundwater treatment system ranges from approximately $80,000 to $100,000 per month. These costs include daily water sampling and analyses to confirm the treated discharge water meets the City sanitary sewer discharge limits as per Municipal Code 681-Sewers, and the related engineering costs specific to the water treatment system.

4. *ADDITIONAL SITE INVESTIGATIONS*

Based on XCG's review of the available information, it is our opinion that the following additional site investigations be undertaken prior to issuing the tender for the proposed construction:

- Advance boreholes to approximately 6 metres at four locations along Bonnycastle Street and Small Street to investigate for potential areas of soil and groundwater contamination outside the investigative areas of the Phase Two ESA conducted by Franz Environmental. The proposed locations are shown on Figures A1 and A2.
- Install four-inch diameter test pumping wells at two locations along the proposed gravity sewer alignment to facilitate additional soil and groundwater sample collection, and groundwater pumping tests. The proposed locations are shown on Figures A1 and A2.
- Collection and analysis of up to 11 groundwater samples [including one quality assurance/quality control (QA/QC) sample] from eight selected existing monitoring wells located south of Lakeshore Boulevard East on Bonnycastle Street, Queens Quay, Small Street and Parliament Street and the two proposed pumping wells. Laboratory analyses of the groundwater samples for PHCs, PAHs, VOCs, metals/inorganics, polychlorinated biphenyls (PCBs) and pesticide parameters. The analytical parameters were selected based on in potential environmental concerns identified in the Phase Two ESA conducted by Franz.
- Collection and submission of soil samples from the proposed boreholes and pumping well installations. Laboratory analyses of the soil samples for PHCs, PAHs, VOCs, metals, PCBs and pesticide parameters, and TCLP analyses for VOCs, PAHs and metals/inorganics parameters.
- Conduct variable and constant rate pumping tests on the proposed test pumping wells with monitoring of water level drawdown response to provide additional information on the potential dewatering requirements. The pumping tests would be conducted over a two-day period at each test pumping well location, at pumping rates limited to less than 50,000 L/day (34.7 LPM). Water takings of less than 50,000 L/day typically do not require a PTTW.
- During the pumping tests, a mobile water treatment system will be required to treat the pumping test discharge water prior to disposal in the municipal sewer system. The treated water will be sampled for comparison to City of Toronto Sanitary Sewer discharge limits as per Municipal Code 681-Sewers, and the sampling results will provide information that may assist in developing groundwater treatment options for future construction dewatering.
- Review of field testing and analytical results and preparation of summary report.

The preliminary cost estimate to conduct the proposed Additional Site Investigations as described above is provided in Table A4, and the proposed new investigative locations are shown on Figures A1 and A2. The Additional Site Investigations as described above are intended to provide information relevant for the proposed construction, but are not intended to fully delineate existing contamination.

5. CONTRACT SPECIFICATIONS AND TENDERING

One of the main objectives of the proposed Additional Site Investigations would be to supplement the background information that would be made available to bidders as part of the tendering process.

Previous investigations have generally provided reasonable information regarding the subsurface conditions and contaminant levels that are to be expected in the soil and groundwater encountered during the proposed construction activities (i.e. excavation and dewatering), although we feel some further limited investigations are still warranted, as described above.

The approach and scope of the reviewed Hydrogeology Study Final Report (LVM, 2013) were generally consistent with industry standards, and were also consistent with requirements of background documents to be included with submittal of PTTW applications. However, the simulated dewatering flows offered in the LVM report ranged from 140,000 L/day to 3,150,000 L/day, and the recommended dewatering rate for the PTTW application was 6,300,000 L/day. This wide range in the simulated dewatering rates would likely present difficulties to bidders when preparing dewatering cost estimates, selecting dewatering methods, sizing treatment systems, etc.

The proposed pumping tests would consist of limited dewatering and monitoring of drawdown response in the vicinity of the sewer construction, with the objective being to provide additional information which would assist bidders in estimating dewatering requirements. The report to be prepared by XCG would summarize the findings of Additional Site Investigations, and would not include recommended or predicted construction dewatering rates or methods, but would provide additional background information to assist bidders in producing their own estimates of dewatering requirements.

As discussed above, the groundwater discharged during the proposed pumping test would require treatment before discharge to the municipal sewer (or other discharge location), and costs for the provision of a mobile groundwater treatment system have been included in XCG’s cost estimate to conduct the Additional Site Investigations described herein. Influent (untreated) water samples, as well as effluent (treated) water samples, would be collected and submitted for laboratory analysis of parameters identified in previous investigations (PHCs, PAHs, VOCs, metals/inorganics) as well as parameters included in the City Sanitary Sewer by-law. The performance (removal efficiency) of the treatment system used in the proposed pumping test will be documented and reported, potentially to be used to assist in assessing water treatment system requirements for the larger-scale construction dewatering. XCG has undertaken preliminary discussions with water treatment specialists, who (based on reported groundwater contaminant levels) have indicated that removal of PAH from the groundwater may require retention time within the treatment system, which would have implications for the required storage capacity of the system.

Table A1 Estimated Soil Excavation Quantities and Disposal Costs (Open-cut Excavation Methods, Off-site Disposal of All Soil as Non-Hazardous Waste)

Option No.		Length (m)	Trench Width (m)	Approx. Average Depth (m)		Volume (m^3)	Excavated Quantity (Tonne) @1.7 T/m^3	Excavation, Trucking and Disposal Cost @$50/T
1A	Bonnycastle Pumping Station to Small Street/Lakeshore Blvd (forcemain)	340	1	2	Open Cut	680	1156	$57,800
1A	Small Street/Lakeshore to Cherry Street (west side)	500	1.5	3.25	Open Cut	2438	4144	$207,200
1A	Cherry Street (west side) to Ex. Manhole	75	1.5	4	Open Cut	450	765	$38,250
							Option 1A subtotal	**$303,250**
1B	Bonnycastle Pumping Station to Small Street/Queens Quay (forcemain)	210	1	2	Open Cut	420	714	$35,600
1B	Small Street/Queens Quay to Cherry Street (west side)	600	1.5	3.25	Open Cut	2925	4973	$248,650
1B	Cherry Street (west side) to Ex. Manhole	75	1.5	4	Open Cut	450	765	$38,250
							Option 1B subtotal	**$322,500**
2A	Bonnycastle Street/Lakeshore Blvd to Cherry Street (450mm)	750	1.5	7	Open Cut	7875	13388	$669,375
2A	Cherry Street to PS at 480 Lakeshore Blvd	85	1.5	7.5	Open Cut	956	1626	$81,325
2A	PS at 480 Lakeshore Blvd to Ex.Manhole	100	1	2	Open Cut	200	340	$17,000
							Option 2A subtotal	**$767,700**

Table A1 Estimated Soil Excavation Quantities and Disposal Costs (Open-cut Excavation Methods, Off-site Disposal of All Soil as Non-Hazardous Waste)

Option No.		Length (m)	Trench Width (m)	Approx. Average Depth (m)		Volume (m^3)	Excavated Quantity (Tonne) @1.7 T/m^3	Excavation, Trucking and Disposal Cost @$50/T
2B	Bonnycastle/Queens Quay to Small Street/Queens Quay	200	1.5	6.5	Open Cut	1950	3315	$165,750
2B	Small Street/Queens Quay to Lakeshore Blvd via Small Street	100	1.5	7	Open Cut	1050	1785	$89,250
2B	Lakeshore Blvd/Small Street to Cherry Street	500	1.5	7.5	Open Cut	5625	9563	$478,125
2B	Cherry Street to PS at 480 Lakeshore Blvd	85	1	7.5	Open Cut	638	1084	$54,175
2B	PS at 480 Lakeshore Blvd to Ex.MH	100	1	2	Open Cut	200	340	$17,000
							Option 2B subtotal	**$804,300**

Table A2 Estimated Soil Excavation Quantities and Disposal Costs (Micro-tunnelling, Re-handling/Dewatering of Cuttings (Soil), Off-Site Disposal of All Soil As Non-Hazardous Waste)

Option No.		Length (m)	Diameter (m)		Volume (m^3)	Excavated Quantity (Tonne) @1.8 T/m^3	Excavation, Trucking and Disposal Cost @$75/T
2A	Bonnycastle Street/Lakeshore Blvd to Cherry Street (450mm)	750	1.1	Micro-Tunnelling	908	1634	$122,515
2A	Cherry Street to PS at 480 Lakeshore Blvd	85	1.1	Micro-Tunnelling	103	185	$13,870
2A	PS at 480 Lakeshore Blvd to Ex.MH	100	1.1	Micro Tunnelling	121	218	$16,315
					Option 2A subtotal		**$152,700**
2B	Bonnycastle/Queens Quay to Small Street/Queens Quay	200	1.1	Micro-Tunnelling	242	436	$32,670
2B	Small Street/Queens Quay to Lakeshore Blvd via Small Street	100	1.1	Micro-Tunnelling	121	218	$16,335
2B	Lakeshore Blvd/Small Street to Cherry Street	500	1.1	Micro-Tunnelling	605	1089	$81,660
2B	Cherry Street to PS at 480 Lakeshore Blvd	85	1.1	Micro-Tunnelling	103	185	$13,885
2B	PS at 480 Lakeshore Blvd to Ex.MH	100	1 m x 2 m	Open Cut	200	340	$17,000
					Option 2B subtotal		**$161,550**

Table A3 Estimated Water Treatment Cost (Discharge to Combined Sewer)

	Capacity (L/day)	Supply, Setup and Commissioning of Treatment System
Treatment System Option 1	500,000	$45,000/month
Treatment System Option 2	1,000,000	$65,000/month
Sampling of Treated Water to Confirm Toronto Sanitary Sewer Discharge Limits		***Analytical Costs***
		$27,750/month (30 samples/month, $925/sample)
		Engineering Costs
		$7,500/month Sample collection, review and reporting of analytical results

Preliminary Monthly Water Treatment Costs:

Treatment System Option 1: $ 80,250 / Month

Treatment System Option 2: $100,250 / Month

Table A4 Additional Site Investigations – East Bayfront and North Keating Sanitary Service

Item	Description	Estimated Cost
1	Drilling Subcontractor Services Allowance	$9,500
2	Analytical Subcontractor Services Allowance	$14,500
3	Traffic Control/Private Utility Locating Services Allowance	$4,500
4	Engineering Services Allowance	
	i. Project Initiation	$4,000
	ii. Drilling Oversight	$7,500
	iii. Groundwater Sampling	$5,800
	iv. Pumping Test Oversight and Coordination, Provision of Water Treatment System	$30,700
	v. Reporting and Overall Project Management	$9,500
	Estimated Subtotal (Excluding HST)	**$86,000**

ATTACHMENT 1
EXCERPTS FROM THE PHASE TWO ESA REPORT (FRANZ ENVIRONMENTAL, 2013)

6 REVIEW AND EVALUATION

6.1 GEOLOGY

Details of soil stratigraphy observed in the boreholes advanced at the site are presented in the attached logs (**Appendix B**). Elevations are presented in the borehole logs in **Appendix B**, in **Table 6** and are relative to geodetic elevations. Subsurface stratigraphy is shown in cross section on **Figure 7**.

In summary, the subsurface geology at the Site varies slightly but generally comprises three (3) units including: 1) fill overburden; 2) native lake bottom sediments; and 3) shale bedrock. A summary of each of these units is presented below:

1. The fill overburden is the uppermost unit at the Site. It is present below the asphalt, concrete and granular roadway sub-base and extends to a depth ranging from approximately 4 to 8 m. The composition of this unit is variable, it is generally sandy with varying amounts of silt, clay and gravel;
2. The native lake bottom sediments underlie the fill across most of the site and were present prior to infilling. The native lake bottom sediments were generally encountered at depths ranging from approximately 4 to 8 m where encountered. The boundary between the fill and native lake bottom sediments was somewhat difficult to distinguish due to ambiguous properties of both materials. Generally speaking the native lake bottom sediments comprise dark silty clays and clayey silts with varying amounts of sand;
3. Shale bedrock was encountered across the site in three deep boreholes (BH6, BH16 and BH23) at depths ranging from 11 to 12 m.

Wet soil conditions were encountered at approximately 1.5 to 3.5 m below the existing grade.

6.2 GROUND WATER ELEVATIONS AND FLOW DIRECTION

Ground water monitoring data are provided in **Table 6**. The depths to ground water in 13 of the monitoring wells were measured on two separate occasions, during well development on September 20-21, 2012, and during ground water sampling on September 24-26, 2012. The depth to ground water on September 20-21, 2012 ranged from 1.8 to 2.4 mbgs, which corresponds to a water table elevation of 74.15 to 75.01 masl. The depth to ground water on September 24-26, 2012 ranged from 1.73 to 2.45 mbgs which corresponds to a ground water table elevation of 74.06 masl to 74.96 masl. BH27(MW) was monitored on October 23, 2012 and a depth to ground water of 2.70 mbgs was measured. This corresponds to a water table elevation of 74.44 masl. Based on the calculated ground water elevations, the shallow water table elevation along the Lake Shore Boulevard Corridor appears to relatively flat with less than a metre variation in water elevations.

Ground water contours could not be prepared due to the near straight line orientation of the monitoring wells on the Site. Based on the local topography of the area, the interpreted shallow ground water flow direction is south-southwest toward Lake Ontario. Ground water elevations can be expected to vary seasonally with precipitation trends and the varying water levels in Lake Ontario. However, ground water flow directions are anticipated to remain relatively constant and maintain a southward flow direction towards Lake Ontario throughout all seasons. Underground utilities along Lake Shore Boulevard East can influence shallow ground water flow locally.

6.3 GROUND WATER: HYDRAULIC CONDUCTIVITY AND GRADIENTS

Single well rate of recovery hydraulic tests were performed on all 14 installed monitoring wells. Results were used to estimate hydraulic conductivity of site soils. Rate of recovery tests were performed by rapidly removing ground water from each monitoring well and then monitoring the water table recovery through short time intervals. Water was removed quickly by purging the well using Inertial (Waterra) tubing and water level recovery was measured manually at regular intervals with a battery operated electric water level tape. The hydraulic conductivity of each screened interval was determined using the Hvorslev method. The hydraulic test results are provided in the **Table 7**.

Hydraulic conductivity test reports are provided in **Appendix E**. Hydraulic conductivities for the fill ranged from 1.0×10^{-6} to 1.2×10^{-4} m/s. The geometric mean hydraulic conductivity was 1.0×10^{-5} m/s. The range in hydraulic conductivities likely reflects the variable fill materials present. Horizontal hydraulic gradients and ground water velocities could not be calculated given the near straight line orientation of the monitoring wells on the Site.

6.4 FINE-MEDIUM SOIL TEXTURE

Four soil samples representative of surface soil and 20 soil samples representative of subsurface soil at the site were submitted for grain size analysis. All four surface soil samples were identified as medium/fine textured soils while six subsurface samples were identified as coarse textured, in accordance with O.Reg. 153/04 (as amended). The remaining 14 analysed soil samples contained more than 50% by mass of soil particles less than 75 µm in mean diameter and are classified as medium-fine textured in accordance with O.Reg. 153/04 (as amended). The results of these grain size analysis tests are summarized in **Table 4** and grain size analysis reports are provided in **Appendix F**. Field observations indicate significant variability in soil type with depth and location, and as such, the more conservative coarse textured soil standards are applied to the Site.

6.5 SOIL FIELD SCREENING

Headspace vapour concentrations measured in the soil samples recovered during drilling are presented on the borehole logs in **Appendix B** and in **Table 5**. Soil headspace vapour concentrations were relatively low, generally less than 100 ppmv. Elevated headspace vapour readings were obtained from Borehole 11 (120 and >1280 ppmv), borehole 18 (120 ppmv) and borehole 25 (240 – 3750 ppmv). Soil PID readings were generally less than 25 ppmv with elevated measurements at BH11 (351 and 580 ppmv), BH18 (226, 378 and 234 ppmv) and BH25 (78.9 to 2124 ppmv).

Oily free product was identified on soils at BH16 from a depth of 3.0 to 5.2 metres below ground surface. The source of this oily product was not apparent. The lateral extent of these impacts could not be determined within the scope of this investigation.

6.6 Soil pH

Twenty-three representative soil samples from the Site were analyzed for soil pH; five of these samples were collected from surface soils (0 – 1.5 m) and 18 were collected from subsurface soils (below 1.5 m). Soil pH measured in surface soil samples ranged from 7.58 to 7.81 while soil pH measured in subsurface soil samples ranged from 7.08 to 8.03. Both surface and subsurface soil pH is within the acceptable range of 5 to 9 for surface soils and 5 to 11 for subsurface soils under O.Reg 153/04.

6.7 Soil Quality

Soil samples from all 18 boreholes were submitted to Maxxam for laboratory analysis of one or more of VOCs, F1-F4 PHC, metals and inorganics (including hot water soluble boron and mercury), PAHs, PCBs and SVOCs. The borehole soil analytical results are presented in **Tables 8 to 12.** The applicable MOE Table 3 I/C/C coarse textured SCSs are provided in **Tables 8 to 12** for comparison. Soil analytical results are also summarized on **Figure 5.** Copies of the laboratory Certificates of Analysis are provided in **Appendix D**. Key findings evident in the soil analyses are summarized below.

BH Location	Sample ID	Sample Depth (m)	Parameters Analyzed	Exceedances of Table 3 SCS
BH1	SS1A	0.3 – 0.5	Metals & Inorganics	SAR
	SS3	1.5 – 2.3	PAHs, PHCs, VOCs	None
BH2	SS3	0.8 – 1.5	Metals & Inorganics, PAHs, PHCs, VOCs	None
BH3B	SS3	1.5 – 2.3	Metals & Inorganics, PAHs, PHCs, VOCs	None
BH5	SS1	0.1 – 0.8	Metals & Inorganics	None
	SS3	1.5 – 2.3	PAHs, PHCs, VOCs	None
BH6	SS4	2.3 – 3.1	Metals & Inorganics, PAHs, PHCs, VOCs	None
	SS6	3.8 – 4.4	PAHs, PHCs, VOCs	6 PAHs
BH7	SS5 / SS55	3.1 – 3.8	Metals & Inorganics, PAHs, PHCs, VOCs	8 PAHs
	SS6B	3.8 – 4.6	PAHs, PHCs, VOCs	None

BH Location	Sample ID	Sample Depth (m)	Parameters Analyzed	Exceedances of Table 3 SCS
BH8	SS5	3.8 – 4.4	PAHs, PHCs, VOCs	PHC F2, PHC F3, 17 PAHs
	SS6	4.6 – 5.2	Metals & Inorganics	None
BH11	SS2	1.5 – 2.1	PAHs, PHCs, VOCs	PHC F2, PHC F3, ethylbenzene, 1,2-DCA, hexane, 1,1,2,2-tetrachloroethane, 1,1,2-TCA
	SS3A	2.3 – 2.9	Metals & Inorganics	SAR, EC, Pb, Zn
BH12	SS5	3.1 – 3.5	Metals & Inorganics, PAHs, PHCs, VOCs	PHC F2, 8 PAHs
	SS6	3.5 – 3.8	PAHs, PHCs, VOCs	PHC F2, PHC F3, 9 PAHs
BH14	SS2	0.8 – 1.5	Metals & Inorganics	None
	SS4	2.3 – 3.1	PAHs, PHCs, VOCs	1 PAH
BH16	SS6 / SS56	3.8 – 4.4	Metals & Inorganics, PAHs, PHCs, VOCs	PHC F1, PHC F2, PHC F3, benzene, ethylbenzene, xylene, 16 PAHs, 1,2-DCA, 1,1,2,2-tetrachloroethane, 1,1,2-TCA
BH18	SS4	3.0 – 3.7	PAHs, PHCs, VOCs	PHC F1, PHC F2, PHC F3, benzene, ethylbenzene, toluene, xylene, 16 PAHs, 14 VOCs
	SS5	3.8 – 4.4	Metals & Inorganics	None
BH21	SS5	3.0 – 3.7	Metals & Inorganics	None
	SS6	3.8 – 4.4	PAHs, PHCs, VOCs	None
BH23	SS1	0 – 0.6	Metals & Inorganics	None
	SS3	1.5 – 2.1	Metals & Inorganics	None
	SS4	2.3 – 2.9	PAHs, PHCs, VOCs	None
BH24	SS3	2.3 – 2.9	Metals & Inorganics, PAHs, PHCs, VOCs	PHC F2, benzene, 1 PAH
	SS6	4.6 – 5.2	Metals & Inorganics, PAHs, PHCs, VOCs	None
BH25	2 / 52	1.5 – 2.1	Metals & Inorganics, PAHs, PHCs, VOCs	PHC F1, PHC F2, benzene, ethylbenzene, xylene, 8 PAHs, 1,2-DCA, 1,3-dichloropropene, EDB, hexane, 1,1,2,2-tetrachloroethane, 1,1,2-TCA
	3	2.3 – 2.9	PHCs, VOCs	PHC F1, PHC F2, benzene
BH26A	4	3.0 – 3.7	Metals & Inorganics, PAHs, PHCs, VOCs	2 PAHs
	6	4.6 – 5.2	Metals & Inorganics, PAHs, PHCs, VOCs	PHC F2, 11 PAHs
BH27B	2B	0.8 – 1.4	Metals & Inorganics	None
	3	1.5 – 2.1	PAHs, PHCs, VOCs	None
	8	5.5 – 6.1	Metals & Inorganics, PAHs, PHCs, VOCs	PHC F2, 12 PAHs

Contaminants of concern in soil at the Site include metals and inorganics, PAHs, BTEX/PHCs, and VOCs. The maximum concentrations of the contaminants of concern are summarized in **Table 12**; contaminants of concern identified in soil at the Site include:

Metals and Inorganics:

Sodium Adsorption Ratio	Electrical Conductivity	Lead
Zinc		

PAHs:

Acenaphthene	Benzo(b,j)fluoranthene	Fluoranthene
Acenaphthylene	Benzo(g,h,i)perylene	Fluorene
Anthracene	Benzo(k)fluoranthene	Indeno(1,2,3-c,d)pyrene
Benzo(a)anthracene	Chrysene	Naphthalene
Benzo(a)pyrene	Dibenzo(a,h)anthracene	Phenanthrene
Pyrene		

PHCs and BTEX:

Benzene	Toluene	Ethylbenzene
Xylene	F1 PHC	F2 PHC
PHC F3		

VOCs:

Bromomethane	Carbon tetrachloride	Chloroform
Dichlorobenzene(1,4)	Dichloroethane(1,2)	Dichloroethylene (1,1)
Dichloropropane(1,2)	Dichloropropene(1,3-cis)	Dichloropropene(1,3-trans)
Dichloropropene(1,3-total)	Ethylene dibromide	Hexane
Tetrachloroethane (1,1,2,2)	Tetrachloroethane(1,1,1,2)	Trichloroethane(1,1,2)
Vinyl Chloride		

The findings of the soil analysis have identified soils impacted with metals, PAHs, petroleum hydrocarbons and volatile organic compounds. One or more PAH parameters were identified at 12 of the 18 borehole locations while metals (lead and zinc) exceeded at one location. PAH impacts have been identified to be widespread across the proposed utility corridor and the presence of PAHs is attributable to the poor quality fill materials used to infill the area. SAR and/or EC impacts were identified at two locations (BH1, BH11) and are likely a result of road salt application. PHC and VOC impacts were noted at several locations (BH8, BH11, BH12, BH16, BH18 and BH25) along the corridor and may be a result of point sources in the vicinity of these locations. BH8, BH11 and BH12 are located in the vicinity of former gasoline service stations and PHC impacts in soils at these boreholes are likely attributable to these former service stations. Sources of localized PHC impacts at BH16, BH18 and BH25 are unclear but may be due to historic industrial operations at these locations or to the north of Lake Shore Boulevard.

6.7.1 TCLP Leachate Analytical Results

Six soil samples were submitted for waste classification analyses site were submitted for toxic characteristic leaching procedure (TCLP) leachate analysis of benzo(a)pyrene, PCBs, VOCs, metals, and ignitability. Soil samples for waste classification analysis were collected via split spoon samplers; waste classification samples were generally representative of worst case soils at each of the six boreholes sampled. The results of the TCLP analysis are presented in **Table 13**. As indicated in **Table 13**, the results of waste classification analyses indicated that soils at the site may be generally classified as non-hazardous, however additional TCLP testing may need to be completed if additional soil impacts are encountered during excavation for installation of the planned sewer.

6.8 GROUND WATER QUALITY

Fourteen (14) ground water samples were submitted for laboratory analysis of metals and inorganics, F1-F4 PHC, PAHs and VOCs (including BTEX compounds). Ground water analytical results are summarized in **Tables 14 to 18** along with the applicable MOE Table 3 SCSs. Ground water analytical results are also summarized on **Figure 6**. The laboratory certificates of analysis for the ground water samples are provided in **Appendix D.** The maximum concentrations of contaminants of concern identified in ground water are summarized in **Table 18.** A summary of the ground water analytical results is presented in the table below.

Monitoring Well Location	Date Sampled	Parameters Analyzed	Exceedances of Table 3 SCS
BH1 (MW)	Sept 24, 2012	Metals and Inorganics, PAHs, PHCs, VOCs	None
BH2 (MW)	Sept 25, 2012	Metals and Inorganics, PAHs, PHCs, VOCs	None
BH3 (MW)	Sept 25, 2012	Metals and Inorganics, PAHs, PHCs, VOCs	Sodium,
BH5 (MW)	Sept 25, 2012	Metals and Inorganics, PAHs, PHCs, VOCs	PHC F2, acenaphthylene
BH7 (MW) / BH7 (MW) Dup	Sept 24, 2012	Metals and Inorganics, PAHs, PHCs, VOCs	PHC F2, anthracene
BH8 (MW)	Sept 24, 2012	Metals and Inorganics, PAHs, PHCs, VOCs	PHC F2, anthracene, chrysene
BH11 (MW)	Sept 24, 2012	Metals and Inorganics, PAHs, PHCs, VOCs	PHC F1, PHC F2, benzene, acenaphthylene, anthracene
BH12 (MW)	Sept 25, 2012	Metals and Inorganics, PAHs, PHCs, VOCs	Free cyanide

Monitoring Well Location	Date Sampled	Parameters Analyzed	Exceedances of Table 3 SCS
BH14 (MW) / BH14 (MW) Dup	Sept 26, 2012	Metals and Inorganics, PAHs, PHCs, VOCs	Free cyanide
BH16 (MW)	Sept 26, 2012	Metals and Inorganics, PAHs, PHCs, VOCs	PHC F1, PHC F2, benzene, acaphthylene, anthracene, naphthalene
BH18 (MW)	Sept 26, 2012	Metals and Inorganics, PAHs, PHCs, VOCs	PHC F2, benzene, acenaphthylene, anthracene, benzo(a)pyrene, benzo(b/j)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene
BH21 (MW)	Sept 26, 2012	Metals and Inorganics, PAHs, PHCs, VOCs	None
BH24 (MW)	Sept 26, 2012	Metals and Inorganics, PAHs, PHCs, VOCs	None
BH27 (MW)	November 9, 2012	Metals and Inorganics, PAHs, PHCs, VOCs	None

Notes:
PHC F1 – Petroleum Hydrocarbon Fraction F1
PHC F2 – Petroleum Hydrocarbon Fraction F2

Contaminants of concern in ground water at the site include metals and inorganics, PAHs and BTEX/PHCs. The maximum concentrations of the contaminants of concern are summarized in **Table 18**; contaminants of concern identified in ground water at the Site include:

Metals and Inorganics:

Free cyanide	Sodium	

PAHs:

Acenaphthylene	Anthracene	Benzo(a)pyrene
Benzo(b/j)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene
Chrysene	Indeno(1,2,3-cd)pyrene	Naphthalene

PHCs and BTEX:

PHC F1	PHC F2	Benzene

Exceedances of the applicable Table 3 SCS were identified at nine of the 14 monitoring wells sampled as part of this study. PHC Fractions F1 and/or F2 and one or more PAH parameters exceeded at six of the fourteen monitoring wells sampled (BH5, BH7, BH8, BH11, BH16, BH18). The exceedances of PHCs and PAHs at the six locations may be due to point sources of petroleum hydrocarbons along the sewer alignment. BH5 is located in the vicinity of a former machine shop while BH7 and BH8 are located in the vicinity of a former fuel station and historic

UST leak. BH11 is located in the vicinity of an additional former service station. BH16 and BH18 are located to the north of some former industrial lands containing numerous oil storage tanks. Two of the monitoring wells sampled exceeded for free cyanide (BH12, BH14) while one exceeded for sodium (BH3). Sodium in ground water is likely attributable to road salting while the source of cyanide in ground water is unclear.

6.9 QUALITY ASSURANCE AND QUALITY CONTROL RESULTS

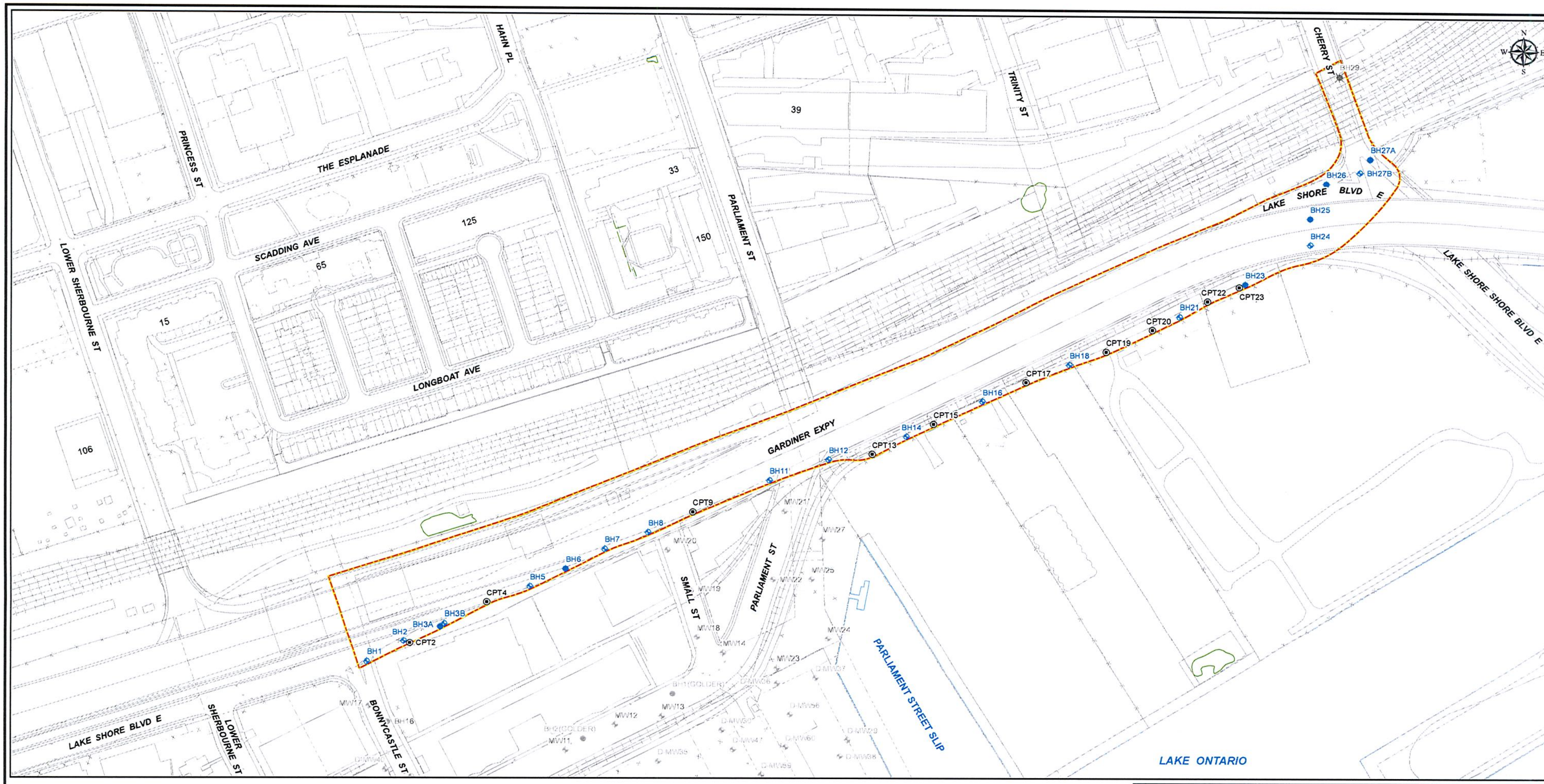
Three field duplicate soil samples were submitted for analysis of one (1) or more of PHCs, VOCs, PAHs, metals and inorganics, and sVOCs. Two field duplicate ground water samples were submitted for analysis of F1 to F4 PHCs, VOCs, PAHs, and metals and inorganics. The analytical results for field duplicate analyses were compared to their respective primary sample and the RPDs were calculated, where possible. RPDs were not calculated where the concentration in both samples were less than five (5) times the laboratory reportable detection limits (RDLs).

The results of field duplicate soil and ground water analyses and relative percent difference (RPD) calculations (where calculated) are summarized in **Tables 8 to 17**. The results of other QA/QC analyses and RPD calculations (where calculated) for laboratory duplicate analyses are provided in the Laboratory Certificates of Analysis (**Appendix D**).

The calculated between soil field duplicates were generally below the acceptable alert limit of 100%, with the exception of PHC F1-F4 in sample BH16-SS6 and duplicate BH16-SS56, and RPDs for 14 PAHs were elevated above 100% between sample BH7-SS5 and duplicate BH7SS55. The elevated RPDs in soil duplicates are attributed to heterogeneity of the fill soils and are not indicative of poor data quality. RPDs between ground water duplicate pairs were all below the 100% alert limit. In summary, the results of QA/QC analyses were generally acceptable. Where deviations were identified, they were determined to be materially insignificant to the interpretation of the data and the data were considered reliable.

All hold times were satisfied and the appropriate preservation methods were used. Samples were collected in the appropriate clean sample containers provided by Maxxam and were stored on sufficient ice to maintain the temperature between 0 and 10°C.

All certificates of analysis and analytical reports received comply with subsection 47 (3) of the regulation; a certificate of analysis has been received for each sample submitted for analysis; and all certificates of analysis received have been included in **Appendix D** to the Phase Two ESA Report.

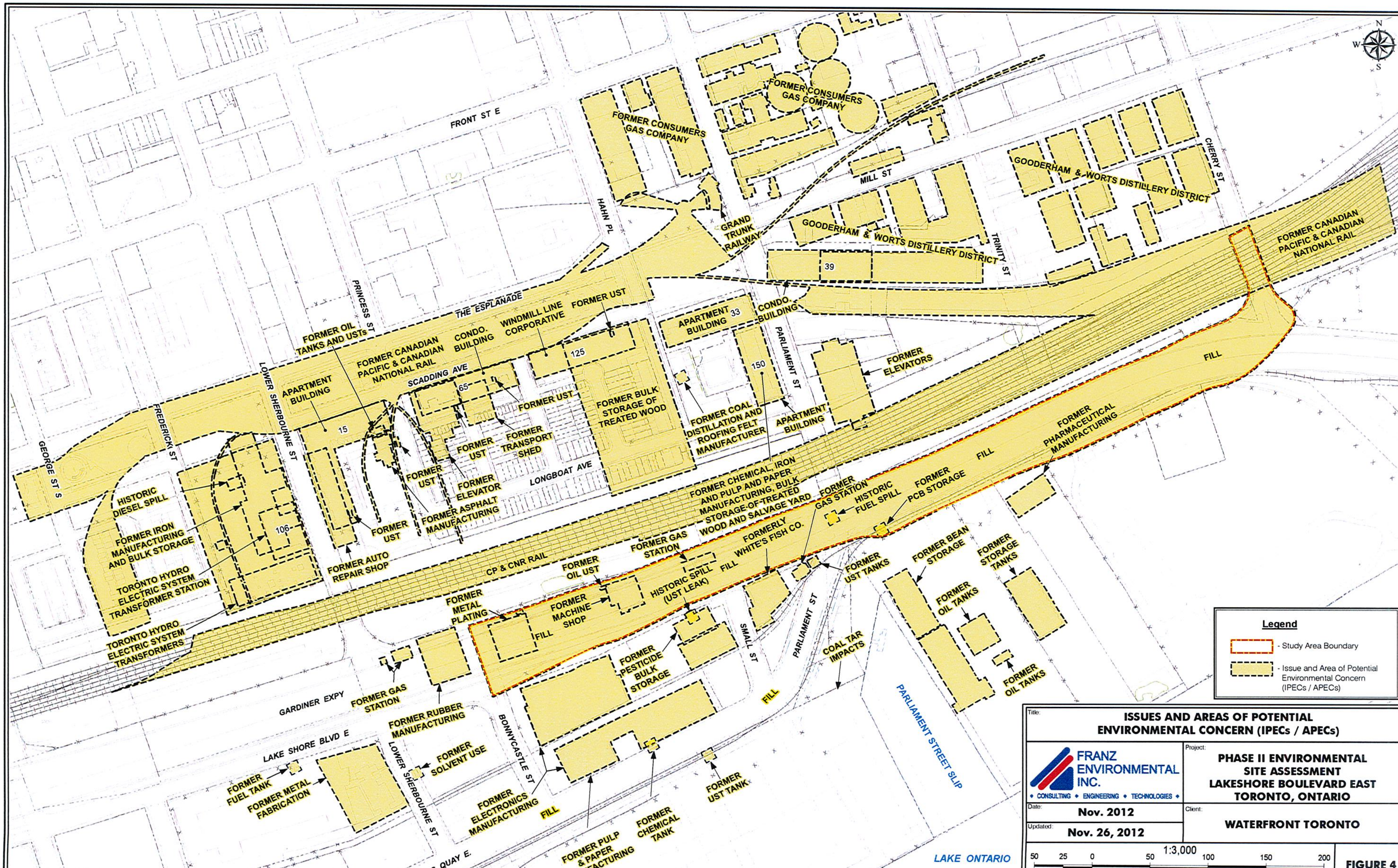


Legend

- Study Area Boundary
- Piezocone (FRANZ/LVM, Sep., 2012)
- Borehole (Dillon, Golder, LVM) [not part of the scope of this study]
- Borehole (FRANZ/LVM, Aug. & Oct., 2012)
- Monitoring Well (Dillon, Golder, LVM) [not part of the scope of this study]
- Monitoring Well (FRANZ/LVM, Aug. & Oct., 2012)

Title: **SITE PLAN SHOWING BOREHOLE/MONITORING WELL LOCATIONS**	
FRANZ ENVIRONMENTAL INC. • CONSULTING • ENGINEERING • TECHNOLOGIES •	Project: **PHASE II ENVIRONMENTAL SITE ASSESSMENT LAKESHORE BOULEVARD EAST TORONTO, ONTARIO**
Date: **Nov. 2012**	Client: **WATERFRONT TORONTO**
Updated: **Nov. 26, 2012**	
1:2,500 (50 25 0 50 100 150 Metres)	**FIGURE 3**

2286-1204-ESA_II/AD/MZ/LakeShE_BHMWs.pdf



Title: **ISSUES AND AREAS OF POTENTIAL ENVIRONMENTAL CONCERN (IPECs / APECs)**

FRANZ ENVIRONMENTAL INC.
• CONSULTING • ENGINEERING • TECHNOLOGIES •

Project: **PHASE II ENVIRONMENTAL SITE ASSESSMENT LAKESHORE BOULEVARD EAST TORONTO, ONTARIO**

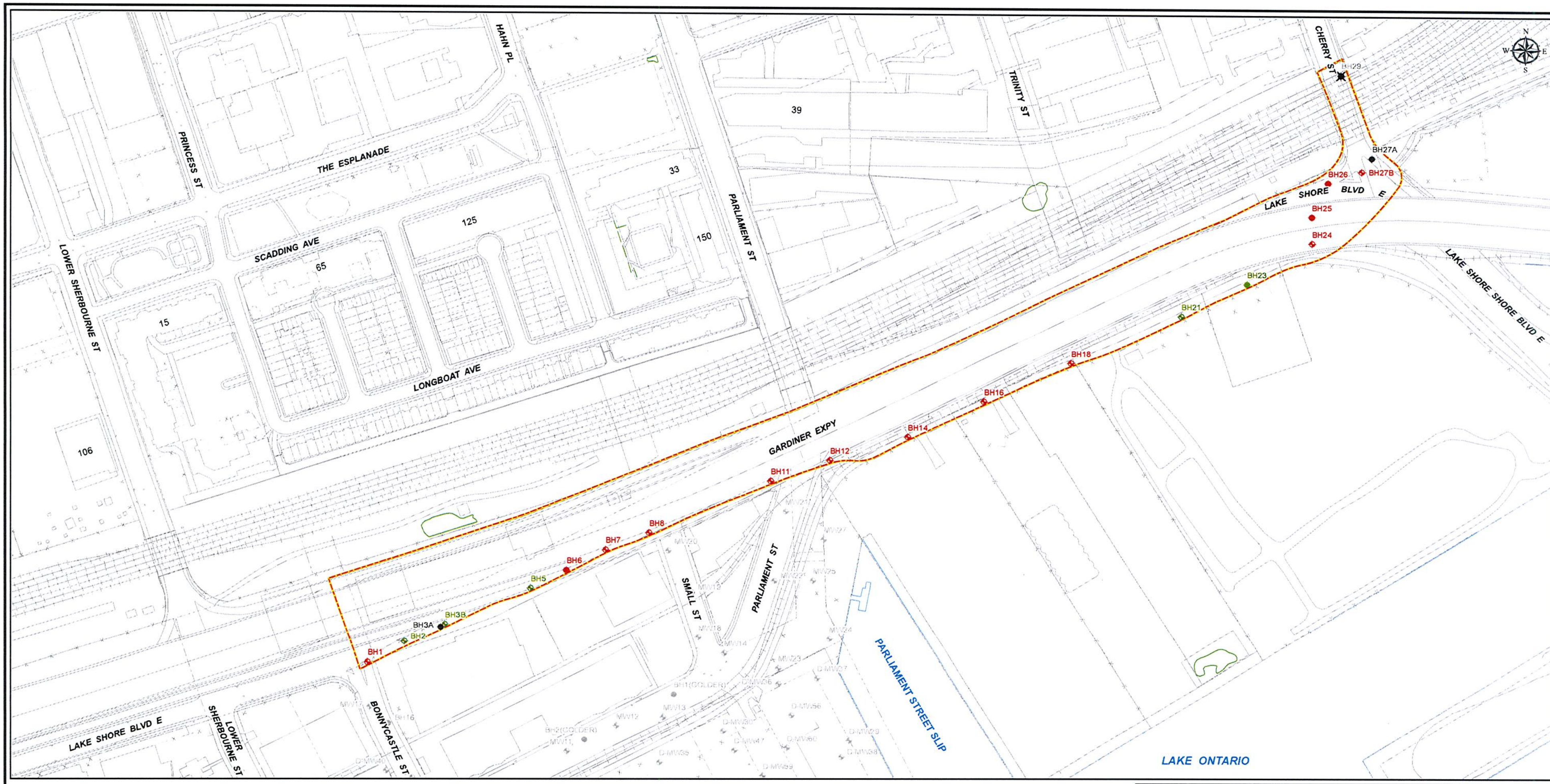
Date: **Nov. 2012**

Updated: **Nov. 26, 2012**

Client: **WATERFRONT TORONTO**

FIGURE 4

2286-1204-ESA_II/AD/MZ/LakeShE_APECs.pdf



Legend

- Study Area Boundary
- Borehole/Monitoring Well (not part of the scope of this study)
- Borehole/Monitoring Well (No Analysed Soil Sample From This Location)
- Borehole/Monitoring Well (All Analysed Parameters Satisfy the MOE Table 3 Standards)
- Borehole/Monitoring Well (At Least One Analysed Parameter Exceeds the MOE Table 3 Standards)

Title: **SOIL ANALYTICAL RESULTS SUMMARY**

FRANZ ENVIRONMENTAL INC.
♦ CONSULTING ♦ ENGINEERING ♦ TECHNOLOGIES ♦

Project: **PHASE II ENVIRONMENTAL SITE ASSESSMENT LAKESHORE BOULEVARD EAST TORONTO, ONTARIO**

Date: **Nov. 2012**

Updated: **Nov. 26, 2012**

Client: **WATERFRONT TORONTO**

1:2,500

50 25 0 50 100 150
Metres

FIGURE 5

2286-1204-ESA_II/AD/MZ/LakeShE_results_SS.mxd.pdf

APPENDIX B
REVIEW OF GEOTECHNICAL INFORMATION

GENIVAR

TECHNICAL MEMORANDUM

Date: April 22, 2013

To: Chad Stephen, P.Eng.

From: Oswin Li, P.Eng.

Project No.: 111-12480-00

Subject: Geotechnical Assessment of Preliminary Design
City of Toronto East Bay Front Sanitary Sewer Servicing

As an extension of the City of Toronto Waterfront Sanitary Servicing Master Plan Class EA, we have conducted a review of available subsurface and geotechnical information for the preliminary design of the sanitary sewer servicing for the East Bay Front development area. The purpose of the review was to comment on design and construction considerations for the preferred sewer alignment along the subject property, and construction of a proposed pumping station at 480 Lakeshore Blvd. It is understood that the proposed sanitary sewer will be installed by tunnelling methods.

1. Summary

There is a considerable amount of subsurface information (water well and borehole logs) for the Waterfront area from the Land Inventory Ontario and City of Toronto databases. From these data, an inferred cross section profile (Cross-Section ‘A-A’) indicating the predominant subsurface conditions along with the preferred deep gravity sewer alignment was prepared. Based on the available information it is noted that construction of the preferred alternative alignment for the sanitary sewer will encounter soft / loose fill and organic rich soils, clay and silt, and sand materials. Construction will occur below the groundwater table.

As limited information is available as to the density / consistency of the subsoils, a report titled “East Bayfront Lakeshore Boulevard (Bonnycastle Street to Cherry Street) Geotechnical Investigation to Support the Design of the Proposed Sanitary Sewer” dated February 13, 2013 and prepared by LVM Inc. was provided to GENIVAR Inc. by Waterfront Toronto for review and use in this current assessment.

2. Discussion and Recommendations

Borehole data was collected from the City of Toronto geotechnical borehole database and the Land Inventory Ontario borehole database and used to create a cross section in proximity to the preferred alignment to provide a conceptual understanding of the soil stratigraphy along the alignment. The proposed deep gravity sanitary sewer invert profile is also shown on the cross section. Geotechnical implications of Cross-Section A-A’ Profile are discussed in detail below.

2.1 Cross Section A-A’ Profile – Bonnycastle Street to Cheery Street

Based on the representative borehole data along Section A-A’, the subsurface profile consists of 10 m to 15 m of soil overburden overlying shale bedrock. At the west end of the cross section the thickness of the overburden is approximately 10 m. The overburden generally consists of loose sand and fill material, overlying soft organic rich soil (peat, muck, and organics), and soft clay and silt material, which in turn overlies sand of variable density (loose becoming dense below approximate elevation 67 mASL). Bedrock has been encountered in many of these boreholes, typically below 67 mASL. The groundwater level, where measured, is consistently within 2.0 m of the ground surface.

Based on the conceptual sewer alignment profile shown on Section A-A’, the proposed sanitary sewer will be constructed at a depth of between 5 m and 7 m below ground surface, in the predominantly soft and saturated organic rich material and clay and silt.

2.2 Geotechnical Investigation Report Review

As indicated above, limited soil density / consistency information is available in the two reference databases along this section. Given that the cross section was developed using available borehole data, the cross section is not exactly representative of the soil conditions at the sewer location. In view of this, the 2013 report by LVM Inc. was referenced for use in this geotechnical assessment.

The report states that sixteen (16) boreholes were advanced to approximately 6.0 m depth below ground surface (or refusal to auger penetration) and three (3) boreholes were advanced to approximately 14 m depth below ground surface, including approximately 2 m of bedrock coring. In fourteen (14) of the boreholes, 50 mm O.D. monitoring wells were installed to permit measurement of groundwater levels, groundwater chemistry sampling, and in-situ hydraulic (slug) testing. In addition, cone penetration (piezocone) testing (CPT) was completed at ten (10) locations using an integrated, 22.7 t (25-ton) CPT truck operated by Cone Tec Inc. equipped with an electronic piezocone with a 15 cm^2 tip and a 225 cm^2 friction sleeve.

The report summarizes and evaluates the subsurface conditions encountered in the boreholes based on three sections as follows:

Section 1 – Bonnycastle Street to Parliament Street

Within this section, the report states that below the pavement structure within the road right-of-way ROW, heterogeneous mixtures of fill were observed which extended from between 76.2 mASL and 75.9 mASL near the surface to below the borehole termination depth (70.6 mASL). The stabilized groundwater level was measured at approximately 74.8 mASL in each of the boreholes.

Underlying the boulevard, relatively heterogeneous mixtures of fill were observed which extended from between 76.7 mASL and 76.2 mASL near the surface, to a confirmed depth of 67.6 mASL in one borehole (BH 6). In addition, bedrock, consisting of Georgian Bay Shale, was encountered in BH 6 at approximately 66.0 mASL. Stabilized groundwater levels were measured to be between 74.2 mASL and 74.9 mASL in the boreholes.

Section 2 – Parliament Street to Cherry Street (MGT)

The LVM report indicates that heterogeneous mixtures of fill are present below the pavement structure along the northern edge of the Martin Goodman Trail bike path. The fill extends from elevation 77.1 mASL to 76.4 mASL near the surface to 68.2 mASL to 68.5 mASL in two of the boreholes (BH 16 and BH 23). In addition, bedrock, consisting of Georgian Bay Shale, was encountered in BH 16 and BH 23 between elevations 64.0 mASL and 66.8 mASL. Stabilized groundwater levels were to be between 73.8 mASL and 74.8 mASL.

Section 3 – Lakeshore Boulevard Crossing at Cherry Street

Heterogeneous mixtures of fill are reportedly present between elevations 75.6 mASL to 76.8 mASL to the borehole termination/refusal depths. Stabilized groundwater levels were measured to be between 73.7 mASL and 75.6 mASL.

Subsurface information in LVM Inc. report is generally consistent with the other two reference sources stated herein.

2.3 Sewer Design Recommendations

The sewer lines for the preliminary design of the preferred alignment are to be constructed at elevations ranging from 69.5 mASL at the east project limit to 71.0 mASL at the west project limit, and will be installed by micro-tunnelling methods. Based on the borehole data collected from the City of Toronto geotechnical borehole database, the Land Inventory Ontario borehole database and the borehole data along Lakeshore Boulevard (Bonnycastle Street to Cherry Street) obtained from the 2013 report by LVM Inc., it is apparent that the majority of the sewer alignment will likely be constructed below the groundwater level in very loose to loose heterogeneous fill and / or organic rich soils, clay and silt, and sand material. As indicated by the LVM Inc. report, the fill contains potentially compressible materials of relatively low natural unit weight. The following are our comments pertaining to challenges associated with the current method of construction under consideration.

2.3.1 Recommendations for Trenchless Installation – Microtunnel Boring (MTBM)

We are of the opinion that state of the art, slurry shield microtunnel boring (MTBM) methods will be required to successfully complete the sanitary sewer installation. Given the anticipated challenges with high groundwater heads and heterogeneous fill and / or organic rich soils, it is anticipated that slurry shield operation of the MTBM will be required.. The MTBM method involves direct jacking the product pipe in place. The MTBM head is remotely controlled from surface and the soil cuttings are removed from the face as slurry is pumped back to the launching shaft. In addition, bentonite and polymer lubrication of the product pipe will be required to reduce friction between the jacking pipe and the tunnel walls. Slurry spoils are thickened at surface using a separation plant. A very accomplished tunnelling contractor and shaft shoring contractor must be retained to undertake this installation.

2.3.2 Recommendations for Shafts Installation

Based on the preliminary deep gravity sewer design drawings and pumping station design drawings, we understand that new maintenance holes MH 'D' to MH 'G' and pumping station wet well will be constructed on the subject property at various locations along the alignment of the proposed sewer lines. The proposed manhole invert elevations range from 71.0 mASL to 70.18 mASL and the pumping station wet well has a proposed invert elevation of 63.42 mASL. At these locations, it is anticipated that the shafts will likely penetrate heterogeneous mixtures of loose fill materials that are submerged under groundwater. In view of this, sealed shafts are recommended at each MH location. The shafts must be extended into a lower impervious boundary in order to cut-off groundwater and reduce the potential for basal uplift. An alternative to this deep cut-off is to excavate in-the-wet and place a tremi-concrete base plug within the base of the shaft, an operation that is not commonly done by Ontario-based contractors. Furthermore, a basal plug could be jet-grouted within the shaft base in advance of excavation. However, based on our review of the available boreholes, the depth of a suitable low permeability soil deposit could not be identified at present time.

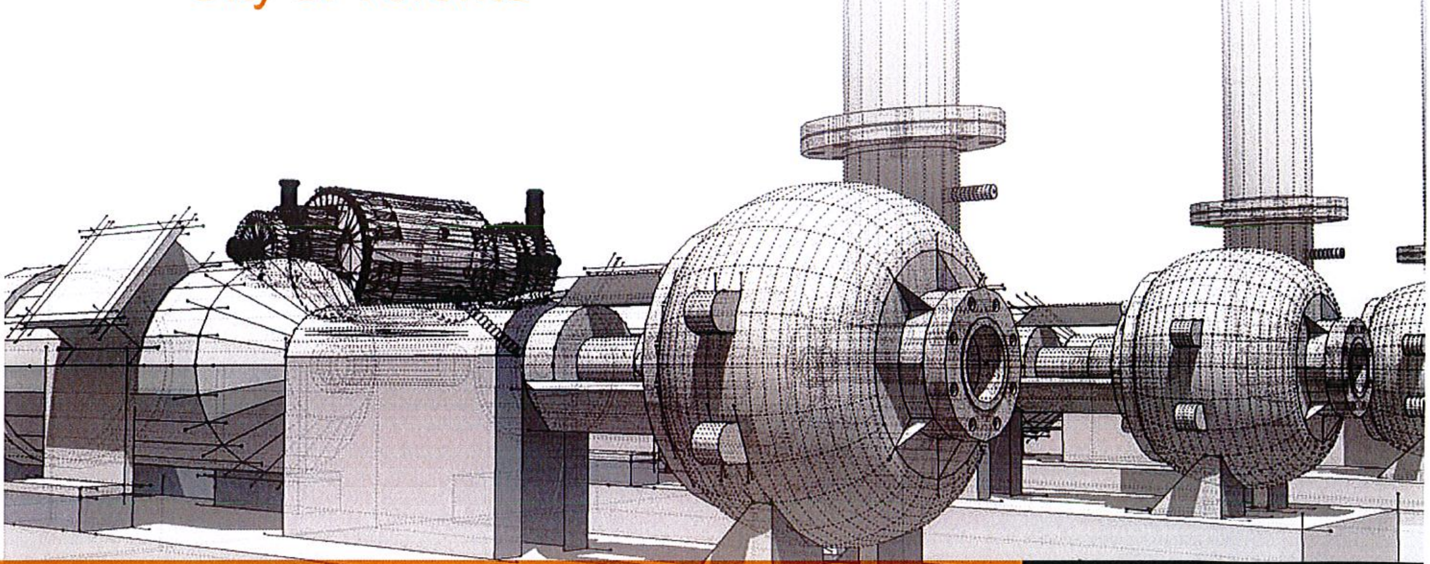
2.3.3 Recommendations for Additional Investigation

Given that the cross section was developed using limited water well records and borehole data, the inferred cross section may not be truly representative of soil conditions at the proposed sewer location. In particular, as mentioned above, a suitable low permeability soil deposit could not be identified at the proposed MH locations. Therefore, additional boreholes and deeper borings, positioned as close as possible to the final MH locations are strongly recommended for detailed design and construction considerations.

APPENDIX C
PRELIMINARY DESIGN REPORT FOR PROPOSED CHERRY STREET PUMPING STATION

TORONTO

Cherry Street Sanitary Pumping Station
City of Toronto



PREDESIGN REPORT

GENIVAR

JUNE 22, 2013

GENIVAR Inc. 600 Cochrane Drive - 5th Floor, Markham, Ontario, L3R 5K3
T 905.475.7270 F 905.475.5994 - www.genivar.com
contact: Chad Stephen, **P.Eng.** e-mail: chad.stephen@genivar.com

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Appendices

1. Introduction

GENIVAR Inc. has been retained by City of Toronto/XCG to complete the preliminary design for a new sanitary pumping station (SPS) located at the northeast corner of Cherry Street and Lake Shore Boulevard East in the City of Toronto. The pumping station is proposed to service the future Development Lands of the Easy Bay Front area. The pumping station will be designed and constructed to the Ministry of Environment (MOE) Design Guidelines for Sewage Works.

The design of the pumping station and the related equipment will comply with the Ministry of Environment's Guidelines as listed in the following manual:

- Ministry of Environment, Design Guidelines for Sewage Works, Chapter 7 – Pumping Station, dated 2008

The purpose of this report is to:

- Provide the design criteria for Cherry Street SPS;
- List specific requirements incorporated into the design;
- Outline the arrangement of and detail the site requirements;

The parameters discussed in the document include preliminary station layout, pump selection, process equipment, electrical requirements and operating philosophy. Preliminary design drawings for the project are included in the submission package.

2. Site Location and Sanitary Drainage Area

2.1 Location and Servicing Concept

The proposed site for the Cherry Street Sanitary Pumping Station is at the northeast corner of the intersection of Cherry Street and Lake Shore Boulevard East in the City of Toronto. The pumping station site measures approximately 117 m^2 in area. For further details, refer to the preliminary site plan (C001, Appendix A) included with this report.

All flows to the pumping station will be conveyed via gravity sewer system to the pumping station. The flow will enter the wet well through a single 600mm diameter sanitary sewer (if sewer is installed by microtunneling then pipe may be oversized to 900mm diameter).

The pumping station will discharge through a proposed sanitary forcemain which will exit the west side of the pumping station and run north along Cherry Street, discharging to an existing sanitary manhole on Cherry Street.

The expected maximum flow (including infiltration and inflow) to the station from the development lands is approximately 300 L/s. As such, the pumping station will be capable of conveying peak sewage flows of 300 L/s.

2.2 General Arrangement and Site Layout

The pumping station facility will consist of a wet well equipped with three submersible pumps, a valve chamber, and an electrical building. The electrical building will contain the electrical controls, the MCCs and a permanent standby diesel generator. The valve chamber will house the flow meter, check valves and isolation valves for the pump discharge lines. The building will be constructed of concrete block walls, with brick cladding and a pitched roof to match the surrounding development.

An asphalt access road will be provided at the site to allow for easy truck access to the wet well and electrical building. The property will include security fencing and the building will have locked and alarmed covers to the wet well and the electrical building.

All surface drainage from the pumping station site will be collected and directed to a storm sewer located in close proximity to the station.

3. Process Design

3.1 Wet Well

Wet Well Size and Design

The wet well will be an underground cast-in-place concrete structure equipped with three submersible pumps. The wet well dimensions will be 5.5m x 3.0m and 12.4m deep and has been sized to provide appropriate pump cycle times. The preliminary drawings provide an outline of the wet well structure, and are included in Appendix A.

Access for maintenance personnel to the wet well will be provided through hinged access covers (with locking devices). A standard manhole ladder and platform as well as confined space entry equipment will be included in accordance with applicable design standards.

The wet well will include an ultrasonic level transducer with back-up hard-wired floats for level control.

Wet Well Operating Level

The depth of the wet well is controlled by the invert elevation of the inlet sewer (69.61m), the required pump cycle time as well as the minimum level required over the pump. The wet well control elevations for the ultimate station capacity are proposed to be set as shown in Table 3-1 below.

Table 3-1 Wet Well Liquid Level Control Elevations

Wet Well Liquid Level (elevation in m)	Pump control/alarm signal	Comment
77.30	Ground Elevation	Located at 0.5m below the estimated lowest basement elevation of EL. 77.30m. Alarm will be generated.
69.61	Sewer Inlet Invert Elevation	Elevation at which the sewer enters the pumping station
69.41	High-High Level Alarm, Hard Wired (H.W.) Float, Standby pump ON	A high-high level alarm is generated, Hard wired float, standby pump starts in case of ultrasonic level sensor failure
69.21	H.W. Float Duty Pump 2 ON	Hard wired float, Duty pump 2 Starts in case of ultrasonic level sensor failure
69.01	H.W. Float Duty Pump 1 ON	Hard wired float, Duty pump 1 Starts in case of ultrasonic level sensor failure
68.81	High Level Alarm, Standby Pump ON	A high level alarm signal will be generated and the standby pump will start.
67.25	Duty Pump 2 Starts	A start signal will be sent to the duty pump 2
65.88	Duty Pump 1 Starts	A start signal will be sent to the duty pump 1
65.88	Ultrasonic Level Sensor and H.W. Float Pump OFF	A stop signal will be sent to duty pump(s) and the duty/standby pumps will alternate
65.68	Low Level alarm	Low Level Alarm will be generated
64.88	Wet Well invert	Bottom of the Wet Well (Depth)

3.2 Submersible Pumps

The wet well will be equipped with three (3) identical submersible pumps, in a two duty and one standby configuration. The capacity of the pumping station as outlined in section 2.1 will be 300 L/s. The system curve based on the preliminary station and forcemain design is included in Appendix C. Based on the peak design flow, two duty pumps will operate in parallel to pump 300.0L/s at a TDH of 13.9m.

The pump that fits this design criteria is Xylem-Flygt pump model NP3202.180 MT (33.6 kW) with an N type impeller as the recommended model for this station. Detailed specification of the pump is listed in Table 3-2 below:

Table 3-2 Individual Pump Specifications for Xylem-Flygt NT3202.180 MT

Criteria	Rating
Manufacturer	Xylem Flygt
Model	NT 3202.180 MT
Motor #	N3202.180 30-23-6AA-D 45hp
Frequency (Hz)	60
Rated Voltage (V)	600
Number of Poles	6
Phases	3
Rated Power (kW/hp)	33.6/45
Rated Speed (1/min)	1175
Impeller Diameter (mm)	354

The recommended pump curve is plotted on the system curve to show the expected operating point for the duty pump.

The pumps will be provided with an inspection port to check impeller condition or to unclog pumps. Refer to Appendix C for additional details on the pump curve and dimensional drawings of the preferred pump.

3.3 Valve Chamber

The depth of the valve chamber is approximately 4m, and will have an approximate area of 8.0mx3.4m. The valve chamber will house the check valves, isolation valves, flowmeter and pumping station by-pass line.

A level float will be included in the valve chamber, 10mm above the finished floor level, to notify staff of a leakage in the valve chamber. The valve chamber will be drained via floor drains into the wet well.

3.4 Process Piping and Valves

Station Piping and Valves

The process piping inside the wet well and dry well shall be fabricated with 350 Ductile Iron with rigid or Victaulic flanged joints. The isolation valves will be gate style and the check valves will be swing flex type with rubber flapper style or conventional swing check valve with counter weight. All process valves will be mounted horizontally. A flowmeter bypass line will be included in the design should the flowmeter need to be removed.

The pump discharge piping and the pump discharge header will be 250mm diameter, while the main discharge header will be 400mm diameter. The pipe velocities in the pump discharge header and the main discharge header at peak flow conditions will be lower than 3 m/s, which adhere to the MOE guidelines.

Recirculation piping and valves will be provided into the wet well to allow for maintenance and operations performance testing purposes. The piping and valves will provide recirculation of pumped wastewater into the wet well to stir up any solids on the bottom of the well to prevent sedimentation.

Forcemain Sizing and Operation

The pumping station will discharge sewage through a single 400mm pump header within the pumping station to a single 500 mm diameter HDPE DR-11 forcemain running approximately 140m along Cherry

Street. The forcemain will be installed at a generally continuously rising grade from the station to the outlet manhole. The forcemain will be capable of handling 100% of the design flow (i.e. 300 L/s). The pipe velocities at 300 L/s will be less than 2.5 m/s. This is in compliance with the MOE's standard design guidelines.

A combination air release air vacuum valve will be included within the valve chamber and other high points along the alignment to prevent air locking.

Station Bypass

A 250 mm diameter bypass connection will be provided to allow temporary bypass pumping of either the wet well or forcemains in the event of emergency.

4. Mechanical Building Services

4.1 General

The building services systems at this pumping station facility will include HVAC, gas detection, fire protection, and drainage. Since the site and building layouts are still at a preliminary stage, building dimensions, elevations and materials of construction are subject to further refinement. The following description outlines the major elements and basic concepts that will be considered and developed further during the detailed design stage. The features that are being considered integrate ventilation requirements for operator safety for the various classified and odorous areas with the goal of minimizing energy demands and off site release of odours.

The ventilation system will be designed to meet National Fire Protection Association (NFPA), American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE), the Ontario Building Code (OBC) and the Peel's Pumping Station Design Manual requirements.

4.2 Valve Chamber – Heating and Ventilation

The valve chamber at the pumping station will be classified as Class 1, Group D, Division 2 hazardous location as per the Ontario Electrical Safety Code. The space will remain classified and as such, all equipment selected for installation in this area will comply with NFPA requirements. The valve chamber will be serviced by a single make-up air unit (MAU) supplying air when the space is occupied and to control the space temperature. Similar to the MOE guidelines, an initial 12 ACH will be supplied to the space during the first 10 minutes of occupancy. Thereafter, the two speed fan will supply a continuous 6 ACH until the building is no longer occupied. The MAU will be constructed with thick gauge casing and protective coatings to ensure longevity. The unit will use gas heating which will be decided during detailed design. The MAU will be interlocked with a two speed exhaust fan to provide push and pull ventilation.

Gas-fired unit heaters will be installed to provide supplementary heating as required during occupied hours while the MAU is operating, and provide main heating during unoccupied hours when the MAU is off. The unit heaters will have their own thermostat and will be fabricated of corrosion resistant materials suitable for the area.

The valve chamber will be equipped with a combustible gas detection system to monitor hydrogen sulphide and methane gas concentrations. The gas detection system will be interlocked with the ventilation system to provide maximum ventilation in the event the gas concentration approaches 10 percent of the lower explosive limit.

Both the ventilation and gas detection systems will be monitored by the SCADA and have local visual alarms at all entrances. A dual-light system will be used to indicate "go" and "no-go" warnings to the operators.

4.3 Electrical Building – Heating and Ventilation

Per the Ontario Electrical Safety Code, the electrical building will be considered non-hazardous and will be serviced as an unclassified space. As such, all equipment installed in this area will meet the Class/Zone classifications as per the *Electrical Safety Code* (O. Reg. 164/99).

The room will have a ventilation system designed to comply with ASHRAE 62 requirements and to maintain space temperature during summer and winter seasons. Upon a call for cooling by the room thermostat, intake and exhaust louvers will open and a supply fan will energize to maintain the room temperature at an adjustable set point. The supply fan will be sized to offset the heat gain generated by the electrical equipment and for generator cool down. The supply fan will also provide positive pressure against the drywell to prevent infiltration of combustible gases.

A gas-fired unit heater with its own built-in thermostat will provide heating during the winter months.

4.4 Wet Well - Ventilation

The Wet Well will be classified as Class 1, Group D, Division 1 hazardous location as per the Ontario Electrical Safety Code. During normal, unoccupied operation, the wet well will be passively vented through two 200mm diameter gooseneck vent pipes. Both will extend 1500mm above the top slab of the wet well. One pipe will extend down to within 300mm of the incoming sewer; the other will terminate on the underside of the roof slab, as per MOE guidelines.

To enable safe man entry into the wet well, a ventilation system will be provided for this space. It will consist of a supply fan, which will be ducted down into the wet well above the high water level and will be sized to provide 12 ACH. The supply fan will be activated by the light switch located inside the access hatch.

A combustible gas detection system will be installed as per NFPA 820-12 requirements to detect hydrogen sulphide and methane gases. The detectors will be set at higher than 10 percent of the explosive limit to minimize spurious alarms.

Both the ventilation and gas detection systems will be monitored by the SCADA and have a local visual alarm located so that it is easily visible from the access hatch. A dual-light system will be used to indicate "go" and "no-go" warnings.

4.5 Plumbing and Drainage

Hose stations will be installed throughout the Service Building and along the wall outside for easy use in wash down and maintenance. A non-freeze hose bib will be provided for outdoor installation. Water will be supplied through the potable water system. Incoming potable water line will be equipped with a backflow preventer to ensure contamination is contained within the superstructure. Local backflow preventers will also be installed at each hose station to protect occupants inside.

A sanitary drainage system will be designed to discharge directly into the wet well. The drainage from the floor drains and the emergency eye wash station on the ground floor will be combined with the drainage from the washroom and will connect to the wet well. Trap seal primers will be installed to prevent sewer gas from entering the building through the drain connections as required by the OBC.

All surface drainage from the pumping station site will be collected and directed through a storm sewer located in close proximity to the station.

4.6 Fire Protection

Fire extinguishers will be installed to meet the Ontario Fire Code and NFPA 820 throughout the facility. Smoke alarms will be installed in the electrical control building and the valve chamber.

A fire hydrant will be constructed adjacent to the entrance road to the pumping station.

4.7 Station Security

The pumping station will be equipped with security systems and that logic defined alarms shall be generated by the PLC. These detection and alarm systems include:

- Access Security – Designed to meet the Region's Standards
- Building Temperature – High and low
- Building Smoke Alarm
- Building Flood

5. Electrical and I&C Design

5.1 Electrical Services

The electrical design for the pumping station will be based on the total load requirements of all equipment proposed within the station. The main loads are the pumps at 33.6 kW each. To provide the ultimate station capacity, two duty pumps will be required to operate and one pump will serve as stand-by. Other loads include some ancillary process loads, instrumentation, lighting and HVAC requirements. Toronto Hydro, who services the City of Toronto, will be contacted and provided with the initial electrical load list and station location in order to provide us with information such as available power and proper grid to transmit the power to the plant, Hydro terminal point, primary voltage, transformer type (pole or pad mounted) and size. A utility wall mounted metering cabinet will be provided on the wall outside the electrical room.

Power Distribution and Motor Control Centre

The pumping station distribution system will be 600 V, 3-phase, 60 Hz. Motor Control Centre (MCC), which will be fed from the utility pad mounted transformer. Motor Control Centre (MCC) will be installed in an electrical room, and will contain electrical switchgear, metering equipment, pump motor starters, transfer switch, feeder breakers and lighting panel board.

It is not expected that a bulk power factor control will be required because the pumps on the system will have individual capacitors.

One lighting panel board will be provided to supply 120/208V, 1-phase/3-phase power to ancillary loads, such as lighting, receptacles, HVAC, generator heater block and instrumentation/control equipment.

Given the pump size (33.6 kW), the motor starting technology for the main pumps selected for this application is soft starters.

General Codes and Practices

The electrical design will follow the requirements stipulated in the latest edition of the Ontario Electrical Safety Code.

Other applicable standards from the Ontario Building Code (OBC), CAN/CSA and TSSA (Technical Standards and Safety Authority) will also be used as a reference for the electrical design.

In addition, all works including the design drafting, specifications, SCADA and security systems will be completed in compliance with the City of Toronto's standards.

Electrical Controls

A programmable logic controller (PLC) will be installed for the pump station to control the pumping operation automatically. The PLC will be integrated with the City of Toronto's SCADA system for remote control.

The pump controller will contain the control schematic required to provide safe pump control (such as featuring operation and fault diagnostic and display). The operation of the pumps will be controlled by ultrasonic level control tied to the station PLC (SCADA set points) with hardwired control logic from level float switches located in the wet well for backup control. One additional level float switch shall be provided to monitor the high-high level in the wet well. In the control panel, an ultrasonic level transducer will be installed (with the sensor in the Pumping Station Wet Well). The pump control scheme also calls for the rotation of the pumps on duty service. The controller will include logic to allow for automatic duty selection and cycling the pumps from duty to standby.

The wet well will be classified as Class 1, Group D, Division 1 hazardous location as per the Ontario Electrical Safety Code. As such, all equipment selected for installation in these areas will be in compliance with this classification.

The pump control will allow all pumps to run at the same time should a high flow event occur. Two modes of operation will be available:

- MANUAL mode: Each pump can be started and stopped individually, from the pump control panel;
- AUTO mode: Duty pumps start, stop and alternate at the end of every pump cycle.

Power for the control circuits of the pumps is to be provided via a UPS, which will also power the field instruments.

Standby Power

Standby power will be required for the pumping station to keep the pumps operational during a power outage. Emergency power supply (during power outages in the main distribution grid) will be provided by a stationary-type diesel generator. The generator will operate automatically, based on available utility voltage. The control of the generator start will be through an Automatic Transfer Switch (ATS) located within the MCC. This ATS will be on the load side of the main breaker and utility metering, and allow the generator to power the complete station.

This generator will, along with all switchgear for the pumping station be housed in the pumping station building electrical room. The size of the generator will be determined during the detailed design phase. It will be complete with auto transfer switch, batteries, charger and skid mounted control panel sized for total station load.

The recommended fuel for this application is diesel. No peak shaving or load shedding shall be required. Diesel is able to handle block loading of motors more rigidly than natural gas engines. A double wall sub-base fuel tank will be installed underneath the generator, and will be supplied as part of the generator. This tank will be of sufficient capacity to operate the pumping station for at least 24 hours continuous operation.

The generator will have a prime rating and standby rating per current standards. The generator will have mechanical louvers for ventilation and combustion air.

Lighting

Lighting inside the wet well will have a fixture rated for Class 1, Group D, Division 1 classifications. The lighting within the electrical room and valve chamber will include fluorescent lights (120 V) mounted on the ceiling of the building. Receptacles (120 V) are provided inside for convenience. All interior lighting will be switch-controlled. The equipment installed in the valve chamber will comply with the *Electrical Safety Code* (O.Reg. 164/99) for Class 1, Group D, Division 2 classification.

An outdoor floodlight will be provided above the main door of the electrical building to allow for operator access during evening hours, and to provide a level of security. Switch control for this light will be inside the building. There will also be a photo-cell controlled lamp post located on the site.

5.2 Instrumentation and SCADA

Programmable Controller (PLC) and Control Panel

The operation of the pumps will be controlled by ultrasonic level control tied to the station programmable logic controller (PLC). Float switches will be provided hardwired to the pump motor starter for starting the pump(s) on High High Level in the event that the ultrasonic level control and/or PLC control fail. The PLC will be located in a control panel that will be complete with the required I/O requirements, UPS (Uninterruptible Power Supply), terminal blocks.

The design will incorporate the City's requirement for spare I/O. The method used to ensure the correct spare count will be included to clearly define the I/O requirements during the design stage and ensure there is suitable expansion available in the event that additional I/O is requested.

Instrumentation

All field instruments will be based on the approved vendors list provided by the City. The power for field instruments will be either loop powered or powered from a 120V circuit within the Control Panel – through the UPS.

Input / Output (I/O)

All analogue instruments will be based on a 4-20 mA signal. Valves that require I/O signals will have a fully opened and fully closed signal. These details will be developed during the detail design phase and presented on a P&ID drawing as well as an I/O list.

The pump starter I/O signal will be pump start/stop (DO), pump running (DI), pump alarm (DI), pump ready (DI), local/remote (DI).

There will also be I/O signals from the generator standby system, and some power monitoring reference signals. The level of these signals will be developed in the detail design phase. We will work closely with the City to ensure the correct signals are captured, and transmitted to the PLC via a suitable protocol.

Communications

A dedicated DSL or Fibre Optic Cable line will be provided to transmit the data signals to the City's SCADA system.

6. Permits and Approvals

Certificate of Approval – Municipal and Private Sewage Works

A single Environmental Compliance Approval (ECA) covers the works relating to the establishment, operation and upgrades of a municipal/private sewage systems and stormwater management systems (e.g. sewers, pumping stations and treatment plants).

The approval process takes into account the adjacent land use, effluent quality for stormwater management, Environmental Assessment Act requirements and, for upgrades to an existing system, any existing municipal/private sewage or stormwater management system information, if applicable.

In addition, the ECA will also cover any approvals required for the implementation of any equipment or process that may discharge a contaminant to the air. An emission study and a noise review will be conducted for the ECA application. These studies will take into account the surrounding properties to determine the exhaust stack height and the proper noise attenuation devices required for the standby generator.

Site Plan Approval and Building Permit

Prior to the start of construction, a separate building permit and site plan approval are required for the new pumping station electrical building.

Permit to Take Water

A Permit to Take Water (PTTW) may be required if anticipated construction dewatering rates exceed 50,000 L/d during the construction phase of the wet well, incoming manhole and valve chamber. The requirement for a PTTW will be evaluated once the geotechnical investigation has been completed.

Appendix A

Pump Station Design Calculations

GENIVAR

Project	Cherry Street WWPS		
Location	City of Toronto	Date	22-Jun-13
Subject	Raw SPS	Design By:	VM
Details	Design	Checked By	VM

Sanitary Sewage Pumping Station

Design Flows

	Interim		Ultimate		
	m^3/d	L/s	m^3/d	L/s	
Average Day Flows (ADF)	8,640	100.0	8,640	100.0	
Peak Wet Weather Flows (PWWF)	25,920	300.0	25,920	300.0	*Peak flow

Design Information

Pump Capacities (Theoretical)

Plant Pumps			
Total Pumps	3		
Duty Pumps	2		
Standby Pumps	1		
Required Individual Pump Capacity	12,960 m^3/d	150.00 L/s	540 m^3/h
TDH **(includes 15% safety factor on friction losses)**	**13.9** m	19.73 psi	
Static Head	8.62 m		

Wet Well Sizing

Spacing around pumps	0.50 m
Pump Width	0.75 m
Minimum Wet Well Length	3.75 m
Length	5.50 m
Width	3.00 m
Area	16.500 m^2

Water Level Calculations (Theoretical)

Lowest Basement Elevation	69.61 m
Sewer Inlet EL	69.61 m
Ground Elevation	77.30 m
Minimum Time between Pump Starts, T	10 min
Pump Starts Per Hour, Total	6.0
Pump Starts Per Hour, Per pump	**2.0**

GENIVAR

Project: Cherry Street WWPS
Location: City of Toronto
Subject: Raw SPS
Details: Design

Date: 22-Jun-13
Design By: VM
Checked By: VM

Sanitary Sewage Pumping Station

Description	Elevation	VFD?	Pump Flow, Q	Volume (TQ/4)	Height
	m	*YES/NO*	*m3/d*	*m3*	*m*
Sewer Inlet El	69.61				
Lowest Basement EL.	69.61				0.00
HWL Alarm and Hard-Wired Standby Pump ON	69.41				0.20
Hard-Wired Duty Float Pump 2 ON	69.21				0.20
Hard-Wired Duty Float Pump 1 ON	69.01				0.20
Wet Well High Level & Standby Pump ON	68.81				0.20
Pump 2 ON & Standby Pump Off	68.61				0.20
Pump 1 ON	67.25	NO	12,960	22.50	1.36
Pump Duty Stop	65.88	NO	12,960	22.50	1.36
Hard-Wired Duty Stop	65.88				0.00
LWL	65.68				0.20
Wet Well Floor	64.88				0.80
Total Depth	**12.42**				

Forcemain Sizing

	Pump Suction Inlet	*Pump Suction Header*	*Pump Suction*	*Pump Discharge*	*Pump Discharge Header*	*Main Discharge Header*	*Forcemain Flowmeter*	*Forcemain*	
Flow	12,960	12,960	12,960	12,960	12,960	25,920	25,920	25,920	m^3/d
Diameter	250	250	250	250	250	400	350	500	mm
Pipe Material	DI 350	DI 350	DI 350	DI 350	DI 350	DI 350	DI 350	PE DR11	
Actual Diameter	269.0	269.0	269.0	269.0	269.0	425.0	373.0	410.1	mm
Area	0.06	0.06	0.06	0.06	0.06	0.14	0.11	0.13	m^2
Max Velocity	2.64	2.64	2.64	2.64	2.64	2.11	2.75	2.27	m/s
Min Velocity	1.76	1.76	1.76	1.76	1.76	0.70	0.92	0.76	m/s

GENIVAR

Project: Cherry Street WWPS
Location: City of Toronto
Subject: Raw SPS
Details: Design

Date: 22-Jun-13
Design By: VM
Checked By: VM

Sanitary Sewage Pumping Station

Minor Loss Calculations

System Forcemain

Calculated using Hazen Williams = H = (10.74L)/D^4.86*(Q/C)^1.85 (obtained from Hydraulic Design Handbook)

Description	Number of Units	Flow m^3/s	Dia. mm	Area m^2	Velocity m/s	Sludge Factor	K Factor Increase	Length m	C	K	Loss: Minor m	Loss: Friction m	Loss: Total m
Pump Suction Inlet													
Pipe Entrance, Bellmouth	1	**0.15**	**269.0**	0.06	2.64	1.00	7.00			0.05	0.019		0.019
(empty)	0	0.15	269.0	0.06	2.64	1.00							0.000
(empty)	0	0.15	269.0	0.06	2.64	1.00							0.000
(empty)	0	0.15	269.0	0.06	2.64	1.00							0.000
(empty)	0	0.15	269.0	0.06	2.64	1.00							0.000
Pump Discharge Header													
Discharge Pipe	1	**0.15**	**269.0**	0.06	2.64	1.00		12.5	120			0.338	0.338
Forged or cast fittings, 90° elbow, standard	2	0.15	269.0	0.06	2.64	1.00	7.00			0.50	0.190		0.190
Check Valve, Swing Check	1	0.15	269.0	0.06	2.64	1.00	7.00			2.20	0.837		0.837
Knife gate Valve, Metal seat	1	0.15	269.0	0.06	2.64	1.00	7.00			0.20	0.076		0.076
Forged or cast fittings, Tee, branch flow	1	0.15	269.0	0.06	2.64	1.00	7.00			0.75	0.286		0.286
Increasers, Conical	1	0.15	269.0	0.06	2.64	1.00	7.00			0.03	0.007		0.007
(empty)	0	0.15	269.0	0.06	2.64	1.00							0.000
Main Discharge Header													
Discharge Pipe	1	**0.30**	**425.0**	0.14	2.12	1.00		12	120			0.127	0.127
Knife gate Valve, Metal seat	3	0.30	425.0	0.14	2.12	1.00	0.00			0.60	0.137		0.137
Forged or cast fittings, Tee, branch flow	2	0.30	373.0	0.11	2.75	1.00	0.00			1.50	0.577		0.577
Flowmeter	1	0.30	373.0	0.11	2.75	1.00	0.00			0.50	0.192		0.192
Increasers, Conical	1	0.30	425.0	0.14	2.12	1.00	0.00			0.03	-0.009		-0.009
Increasers, Conical	0	0.30	425.0	0.14	2.12	1.00							0.000
(empty)	0	0.30	425.0	0.14	2.12	1.00							0.000
Forcemain													
Forcemain	1	**0.30**	**410.1**	0.13	2.27	1.00		140	120			1.756	1.756
Subtotal (with 15% Safety Factor)													**5.250**

LWL in the Wet Well	65.68 m	8.62	m	13.87	m
Average WL in the Wet Well	67.65 m	6.65	m	11.90	m
HWL in the Wet Well	69.61 m	4.69	m	9.94	m

Discharge Point (Cherry St Sewer North of Rail Corridor) 74.30 m
Pump TDH **13.87** m

GENIVAR

Project	Cherry Street WWPS
Location	City of Toronto
Subject	Raw SPS
Details	Design

Date	22-Jun-13
Design By:	VM
Checked By	VM

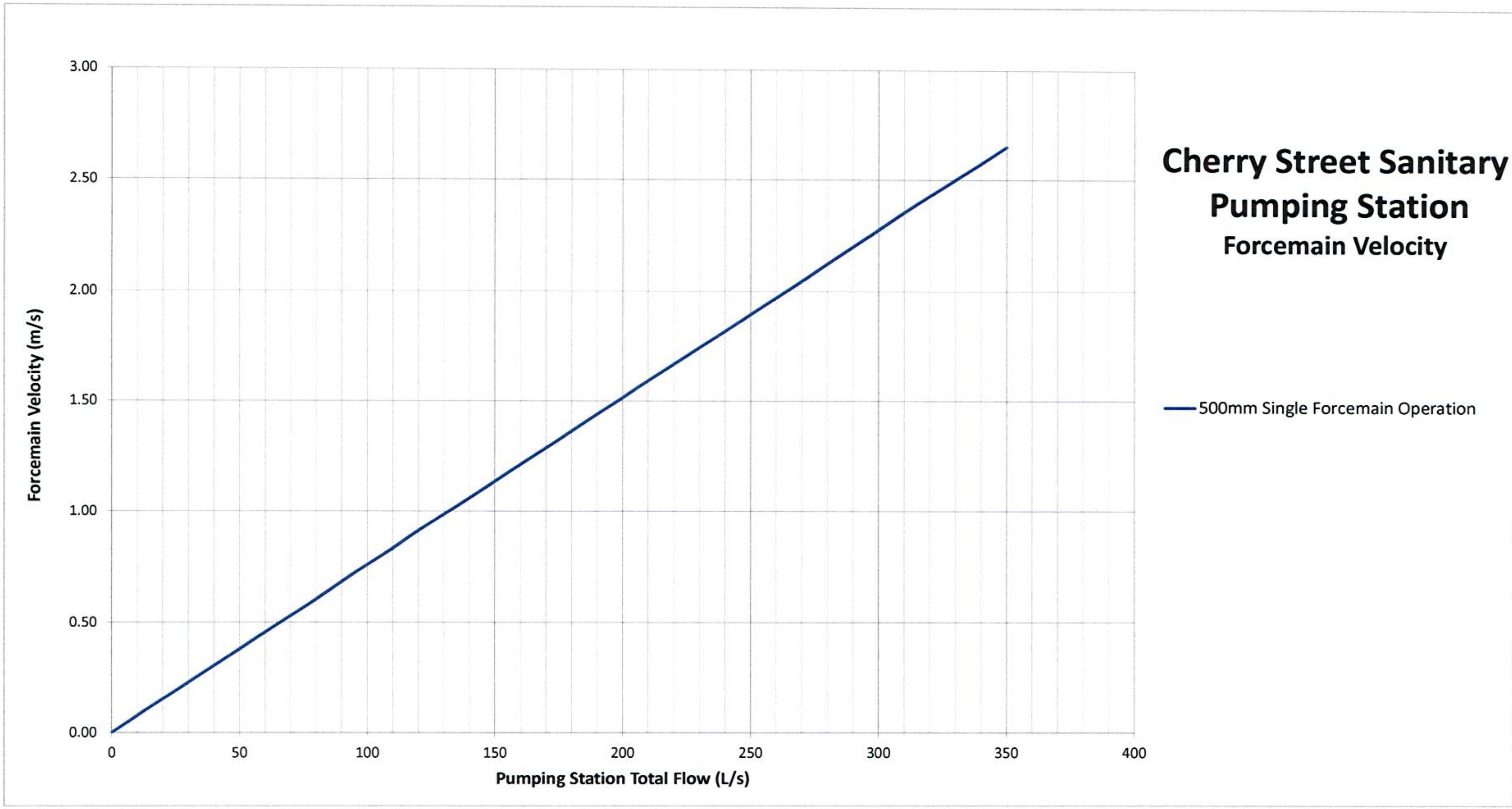
Sanitary Sewage Pumping Station

Pump Selection

Pump Type:	**Xylem**
Model:	**NP 3202.180 30-23-6AA-D 45hp**
Motor:	**33.6** kW
Pump Frequency:	60 Hz
Rated Speed:	1175 1/min
NPSHr:	7.49 m

Flow	60 Hz
L/s	Supplier
0	29.500
20	26.500
40	24.500
60	23.000
80	21.500
100	20.000
120	18.500
140	17.000
160	15.500
180	14.000

Head	Flow			
	1 Pump		2 Pumps	
m	L/s	MLD		MLD
29.500	0	0	0	0
26.500	20	1.728	40	3.456
24.500	40	3.456	80	6.912
23.000	60	5.184	120	10.368
21.500	80	6.912	160	13.824
20.000	100	8.64	200	17.28
18.500	120	10.368	240	20.736
17.000	140	12.096	280	24.192
15.500	160	13.824	320	27.648
14.000	180	15.552	360	31.104
12.000	200	17.28	400	34.56
10.000	220	19.008	440	38.016
8.000	240	20.736	480	41.472


Cherry Street Sanitary
Pumping Station
Forcemain Velocity
Forcemain Velocity (m/s)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0
50
100
150
200
250
300
350
400
Pumping Station Total Flow (L/s)
500mm Single Forcemain Operation

GENIVAR

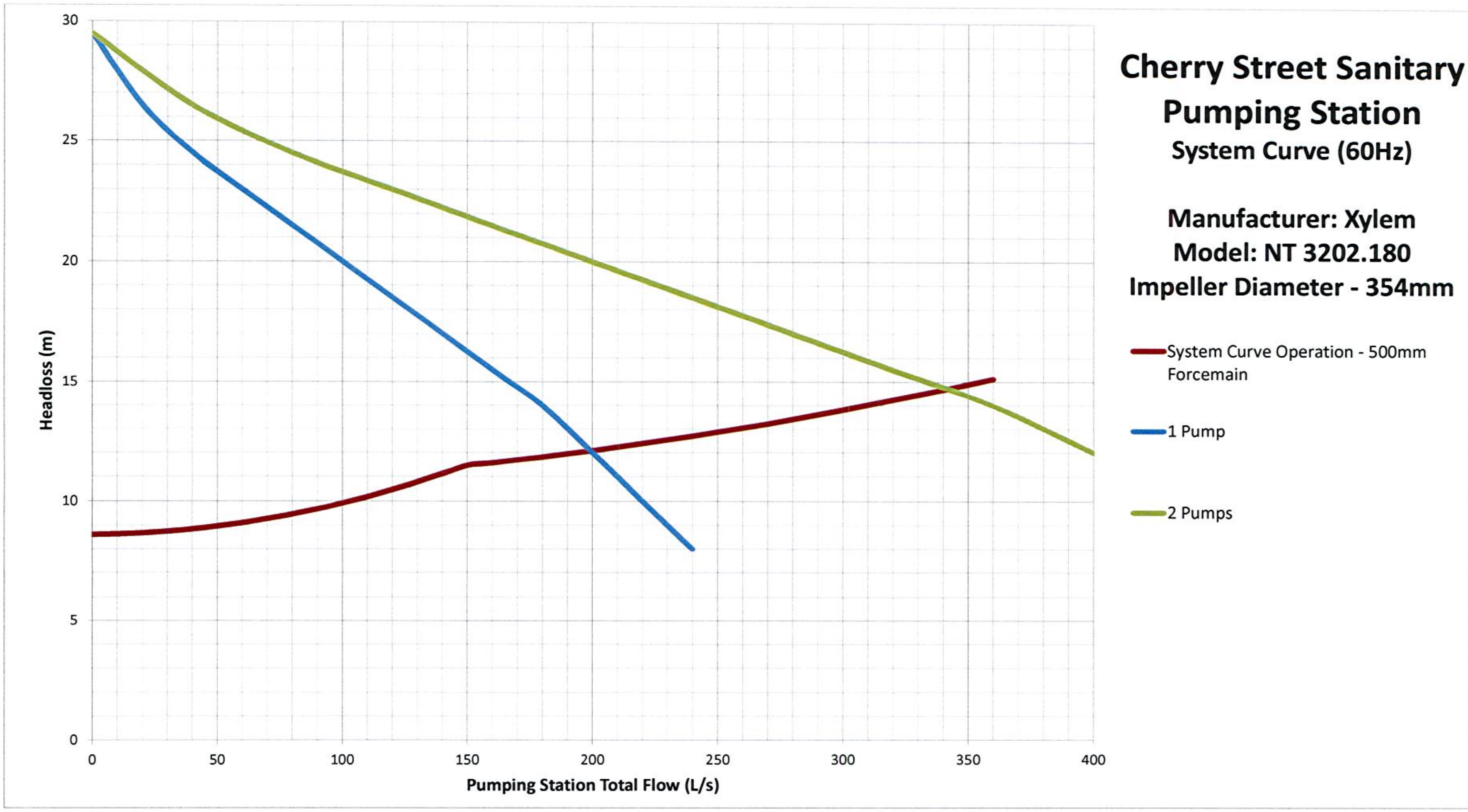
Project	Cherry Street WWPS	Date	22-Jun-13
Location	City of Toronto	Design By:	VM
Subject	Raw SPS	Checked By	
Details	Design		

NPSH Calculations

NPSH Required (NPSHr)	7.5	m	*max based on Pump Manufacturer
NPSH Available (NPSHa)	10.6	m	*NPSHa = (Patm/ρ*g) - z1 - headloss - (Pv/ρ*g)
P_{atm}	101325	Pa	
Temperature of Water	10	°C	
P_v, Vapor Press. @ Temp	1228	Pa	
ρ, Density @ Temp	999.7	kg/m^3	
z1, Height	-0.4	m	*Worst Case = LWL-Pump CL
headloss, Suction Losses	0.02	m	
Is NPSHa > NPSHr	OK		

Appendix B

Pump Curves



Cherry Street Sanitary
Pumping Station
System Curve (60Hz)
Manufacturer: Xylem
Model: NT 3202.180
Impeller Diameter - 354mm
System Curve Operation - 500mm Forcemain
1 Pump
2 Pumps
Headloss (m)
Pumping Station Total Flow (L/s)
0
5
10
15
20
25
30
50
100
150
200
250
300
350
400

Appendix C

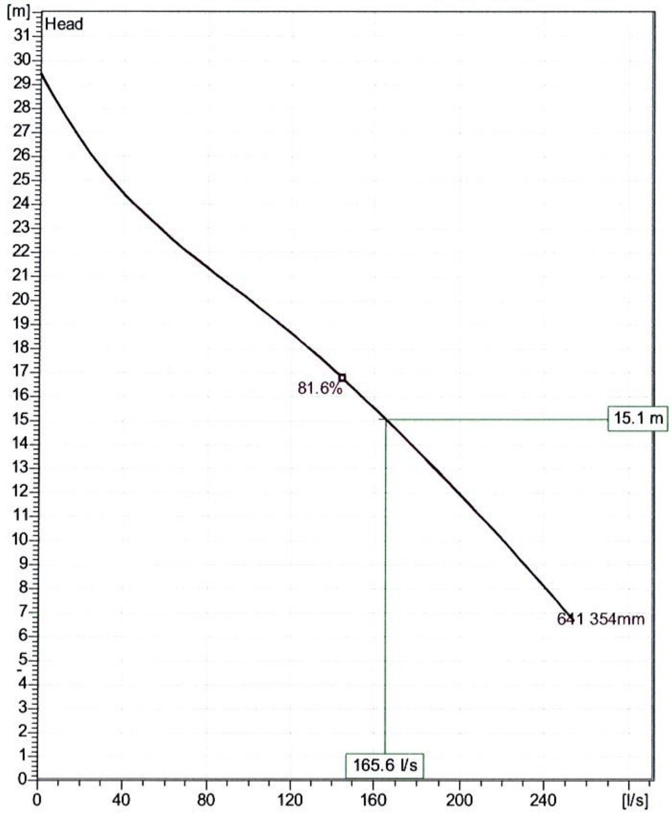
Pump Details

xylem
Let's Solve Water

NT 3202 MT 3~ 641

Technical specification

FLYGT



Curve according to: ISO 9906

Note: Picture might not correspond to the current configuration.

Installation: T - Vertical Permanent, Dry

General

Patented self cleaning semi-open channel impeller, ideal for pumping in most waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.

Impeller

Impeller material	Grey cast iron
Outlet width	200 mm
Inlet diameter	250 mm
Impeller diameter	354 mm
Number of blades	2
	0 mm

Motor

Motor #	N3202.180 30-23-6AA-D 45hp
Stator variant	3
Frequency	60 Hz
Rated voltage	600 V
Number of poles	6
Phases	3~
Rated power	33.6 kW
Rated current	43 A
Starting current	276 A
Rated speed	1175 1/min
Power factor	
1/1 Load	0.83
3/4 Load	0.78
1/2 Load	0.68
Efficiency	
1/1 Load	90.0 %
3/4 Load	90.0 %
1/2 Load	89.0 %

Configuration

Project	Project ID	Created by	Created on	Last update
			2013-06-25	

xylem
Let's Solve Water

NT 3202 MT 3~ 641

Performance curve

FLYGT

Pump

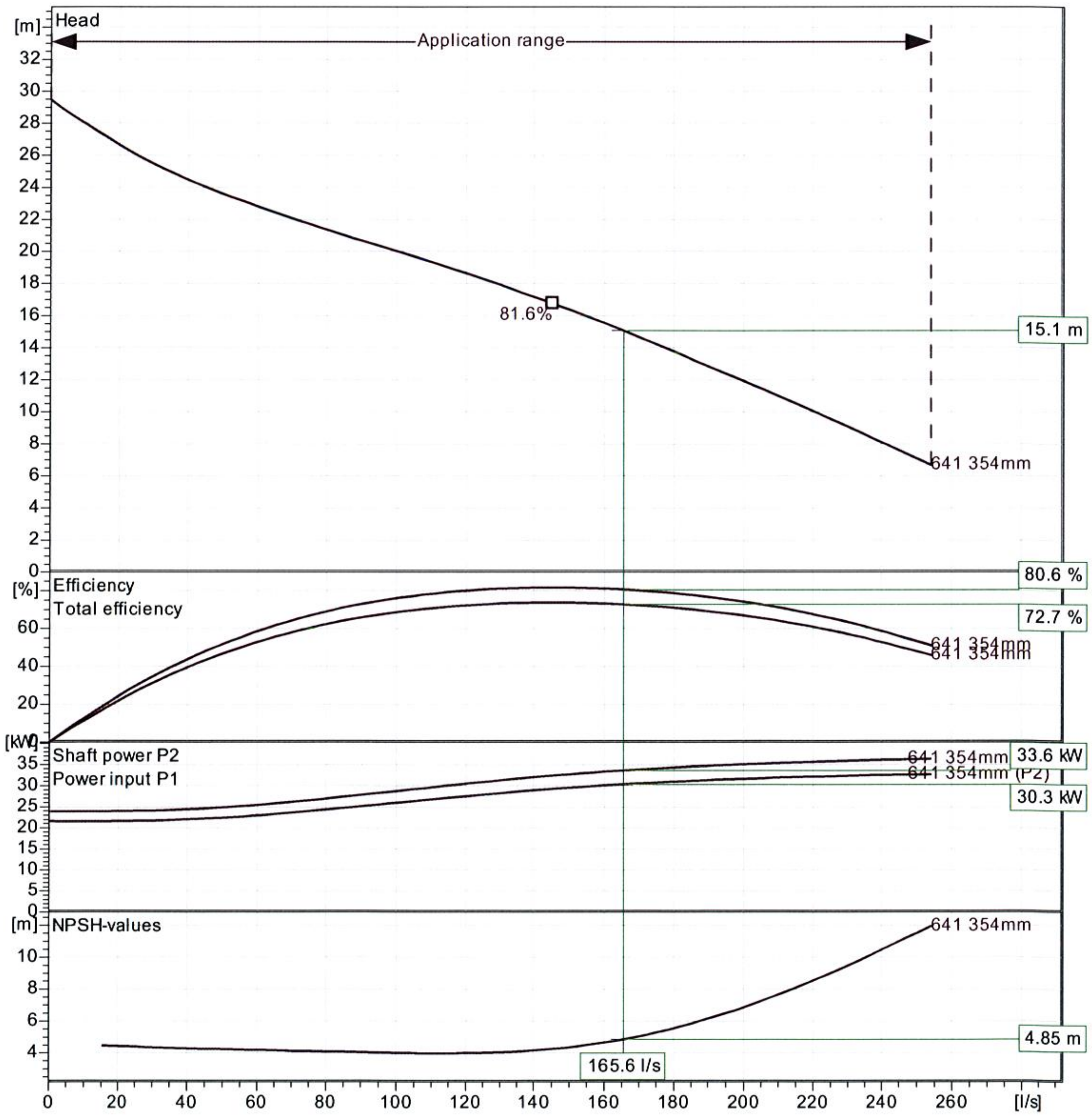
Outlet width	200 mm
Inlet diameter	250 mm
Impeller diameter	354 mm
Number of blades	2
	0 mm

Motor

Motor #	N3202.180 30-23-6AA-D 45hp
Stator variant	3
Frequency	60 Hz
Rated voltage	600 V
Number of poles	6
Phases	3~
Rated power	33.6 kW
Rated current	43 A
Starting current	276 A
Rated speed	1175 1/min

Power factor	
1/1 Load	0.83
3/4 Load	0.78
1/2 Load	0.68

Efficiency	
1/1 Load	90.0 %
3/4 Load	90.0 %
1/2 Load	89.0 %



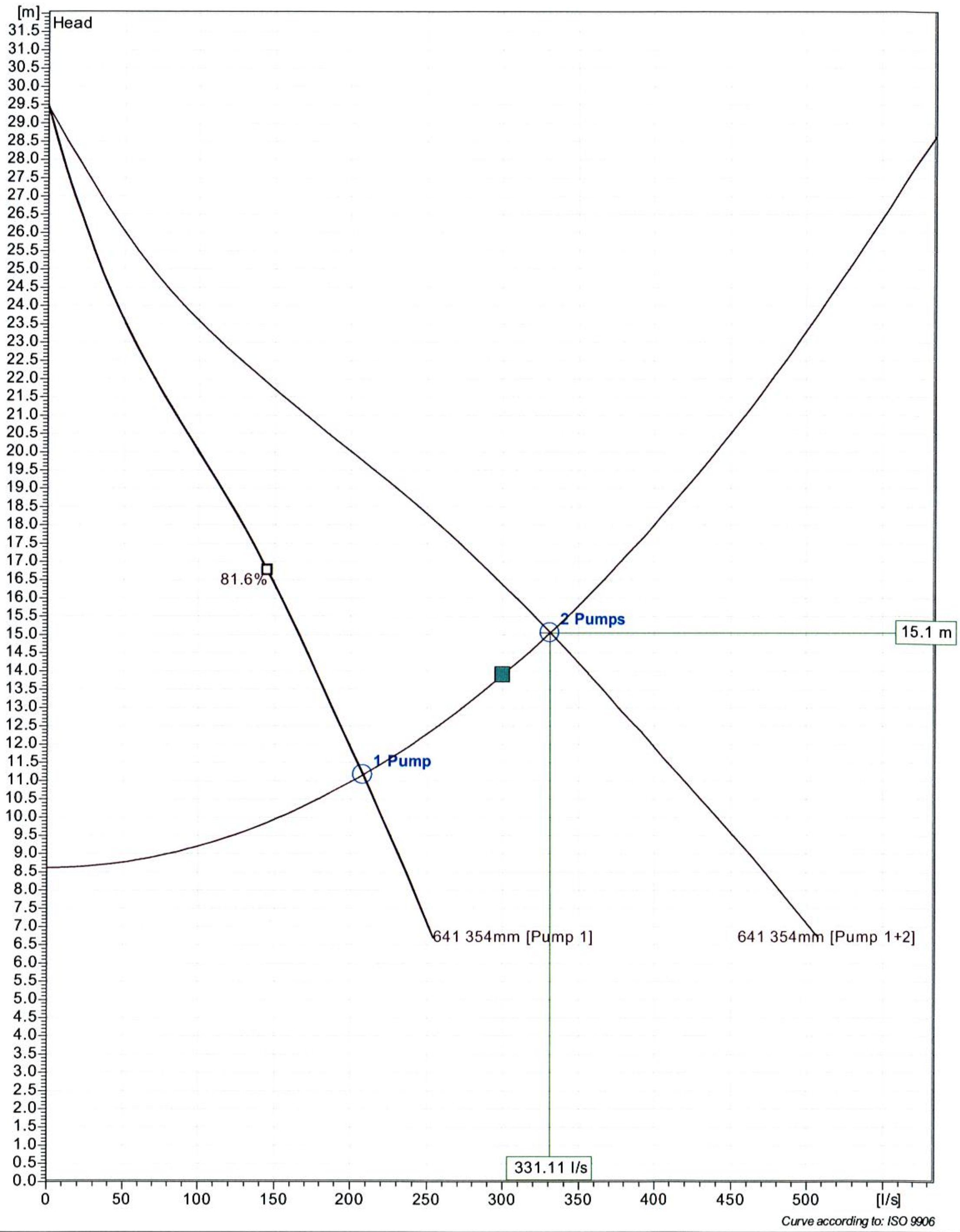
Curve according to: ISO 9906

Project	Project ID	Created by	Created on	Last update
			2013-06-25	

xylem
Let's Solve Water

NT 3202 MT 3~ 641

Duty Analysis



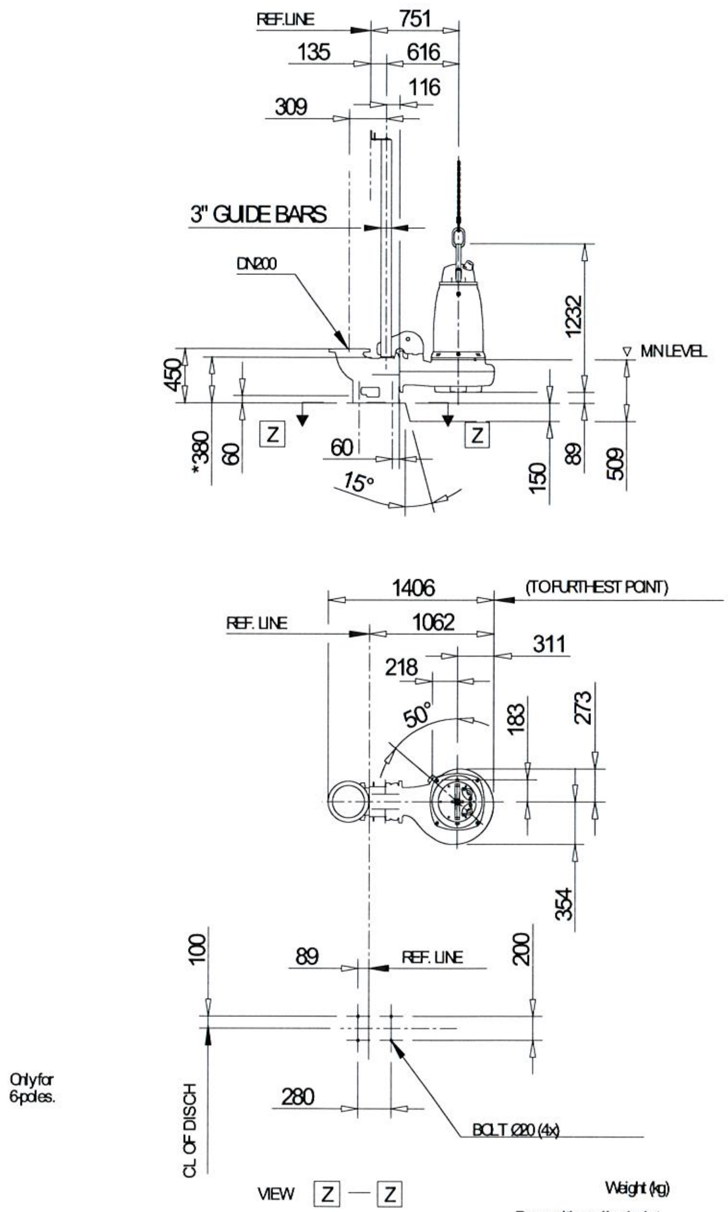
	Individual pump			Total					
Pumps running /System	Flow	Head	Shaft power	Flow	Head	Shaft power	Hyd eff.	Specific energy	NPSHre
2	166 l/s	15.1 m	30.3 kW	331 l/s	15.1 m	60.6 kW	80.6 %	0.0563 kWh/m³	4.85 m
1	208 l/s	11.2 m	31.8 kW	208 l/s	11.2 m	31.8 kW	71.8 %	0.047 kWh/m³	7.49 m

Project	Project ID	Created by	Created on	Last update
			2013-06-25	

xylem
Let's Solve Water

NP 3202 MT 3~ 641
Dimensional drawing

FLYGT



Weight (kg)	
Pump with cooling jacket	Disch
580	100
Pump without cooling jacket	
530	

* DIMENSION TO ENDS OF GUIDE BARS

FP,NP 3202.090,095,180,185,350,390 MT

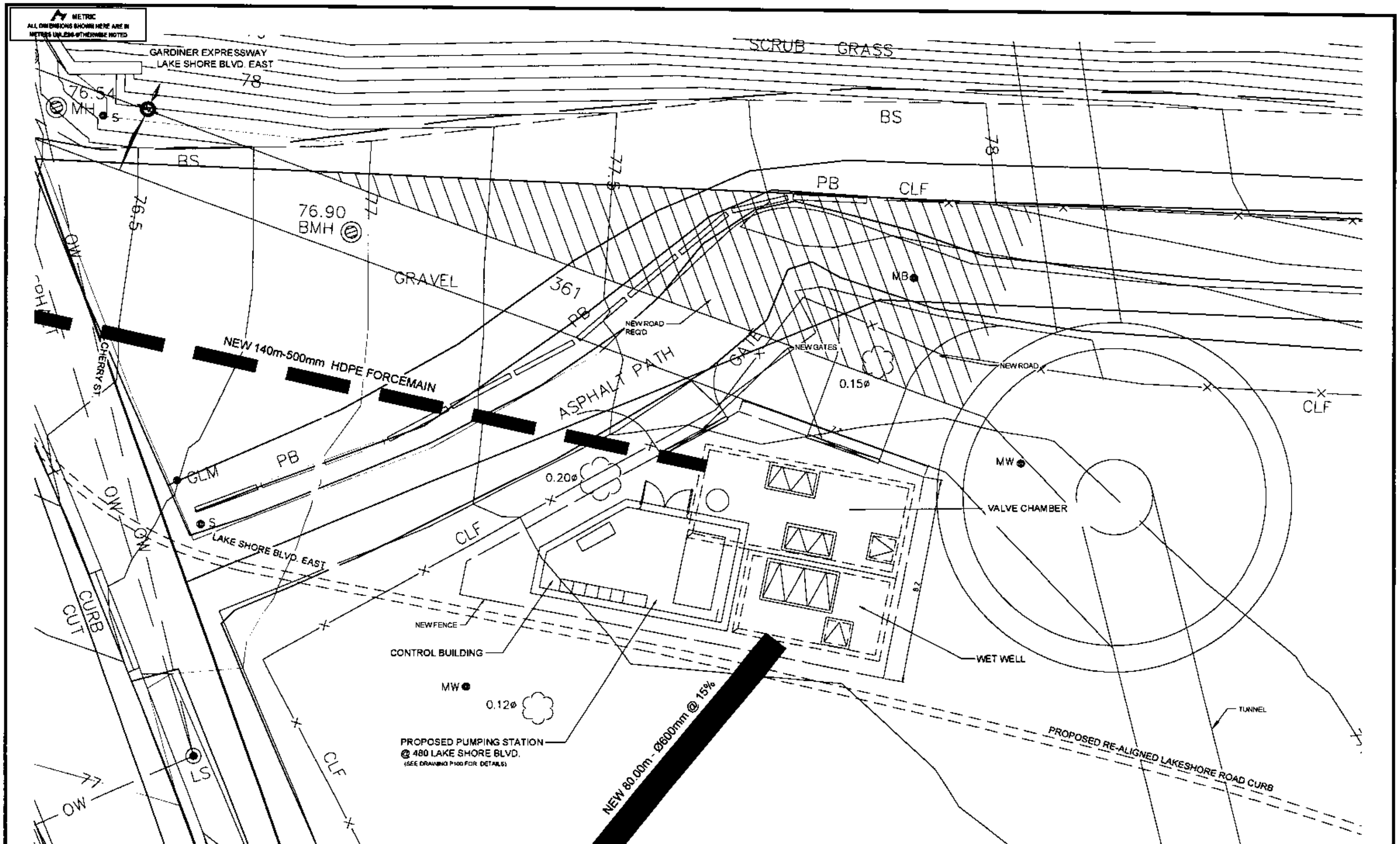
Dimensional dwg

FP,NP 3202.090,095,180,185,350,390 MT

Project	Project ID	Created by	Created on	Last update
			2013-04-18	

Appendix D

Preliminary Drawings



PROPOSED NEW PUMPING STATION
SITE PLAN

CONCEPTUAL DESIGN DRAWING

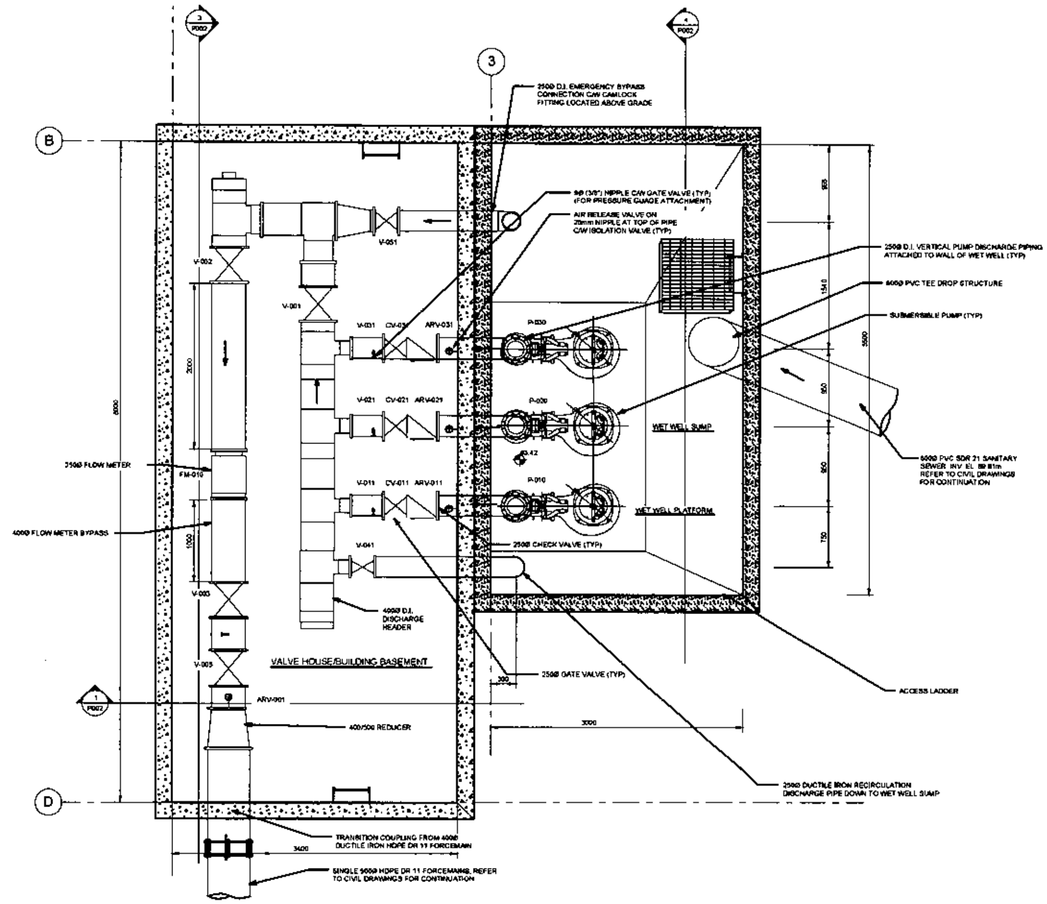
GENIVAR

No.	DATE	REVISIONS	INITIAL	SIGNED
1	APR.13	ISSUED FOR CONCEPTUAL DESIGN REVIEW		

CITY OF TORONTO
ENGINEERING & CONSTRUCTION SERVICES

TORONTO WSMP
CHERRY STREET SPS
SITE LAYOUT
PARTIAL PLAN

DESIGN:	V.M.	DRAFTING:	R.P.	CHECK:	V.M.
SCALE:	1:200	DRAWING NUMBER:	111-12480-00-C001	CONTRACT No.	
DATE:	APR.13				



① LOWER VALVE CHAMBER
1:25

② WET WELL
1:25

GENIVAR

No.	DATE	REVISIONS	INITIAL	SIGNED
1	APR. 13	ISSUED FOR CONCEPTUAL DESIGN REVIEW		

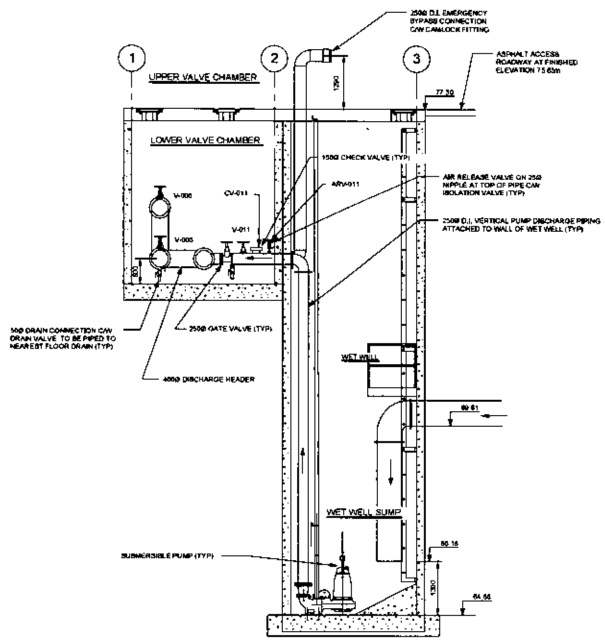
CITY OF TORONTO

ENGINEERING & CONSTRUCTION SERVICES

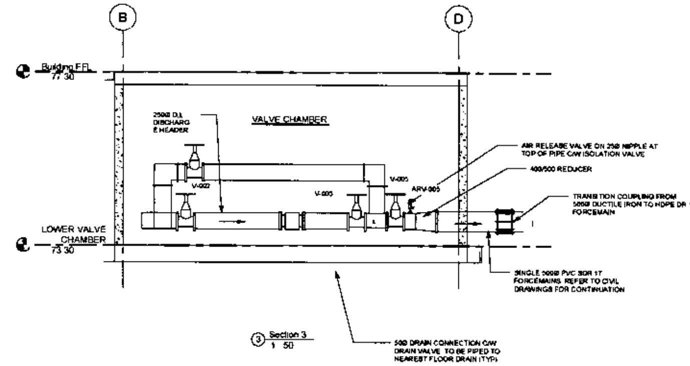
TORONTO WSMP
CHERRY STREET SPS
Process Plan View

PARTIAL PLAN

DESIGN:	V.M./T.H	DRAFTING:	S.P	CHECK:	V.M.	CONTRACT No.
SCALE:	AS SHOWN		DRAWING NUMBER:	111-12480-00-PD001		
DATE:	APR.13					



Section 1
1 : 50



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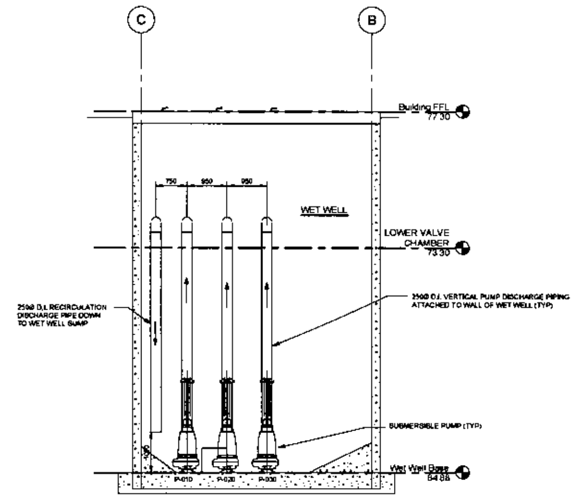

Section 4
1 : 50

GENIVAR

No.	DATE	REVISIONS	INITIAL	SIGNED
1	APR. 13	ISSUED FOR CONCEPTUAL DESIGN REVIEW		

CITY OF TORONTO

ENGINEERING & CONSTRUCTION SERVICES

TORONTO WSMP
CHERRY STREET SPS
Process Section

PARTIAL PLAN

DESIGN:	V.M./T.H	DRAFTING:	B.P	CHECK:	V.M.	CONTRACT No.	CONTRACT NO.
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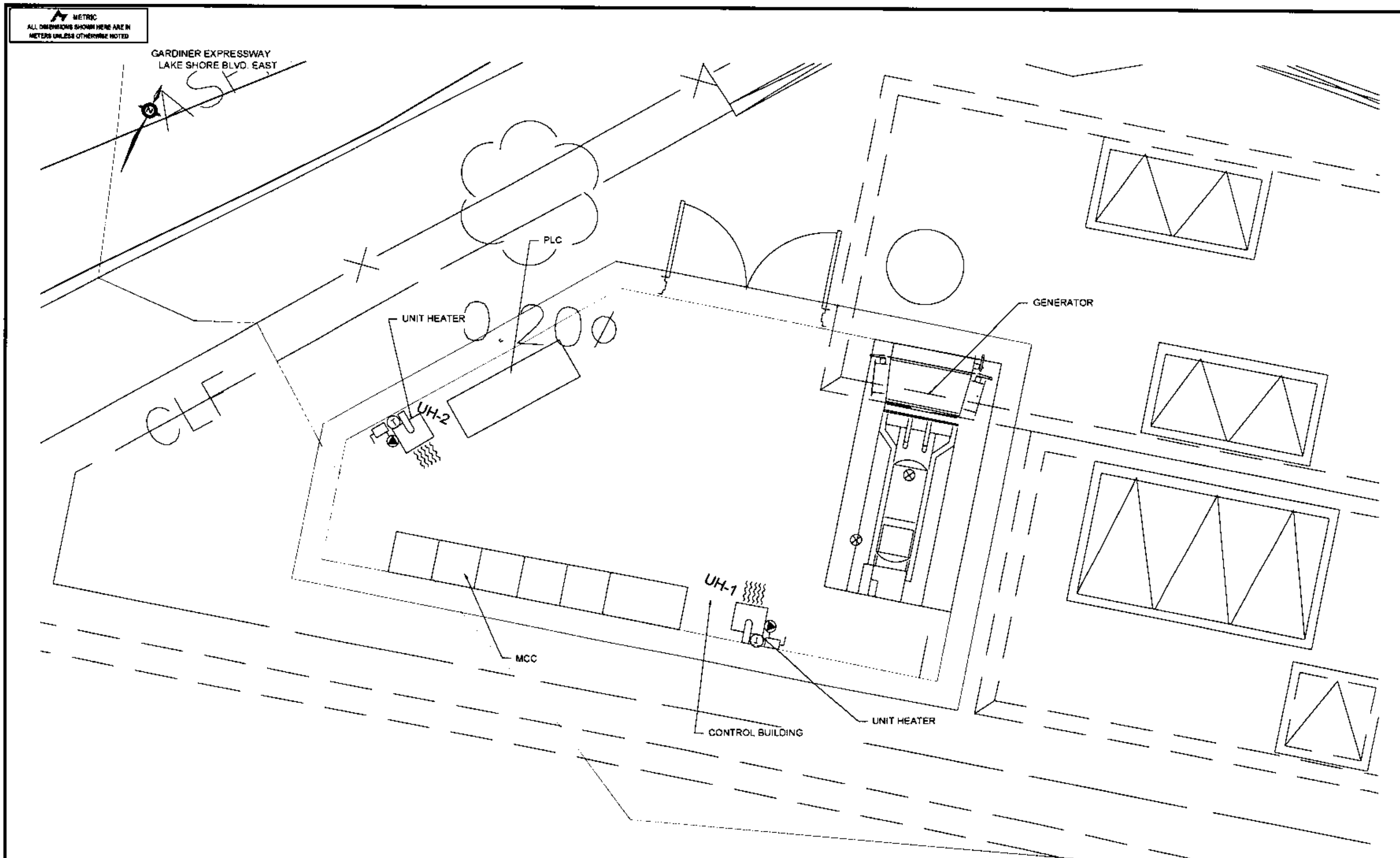
DATE:	APR.13						



PROPOSED NEW PUMPING STATION
SITE PLAN

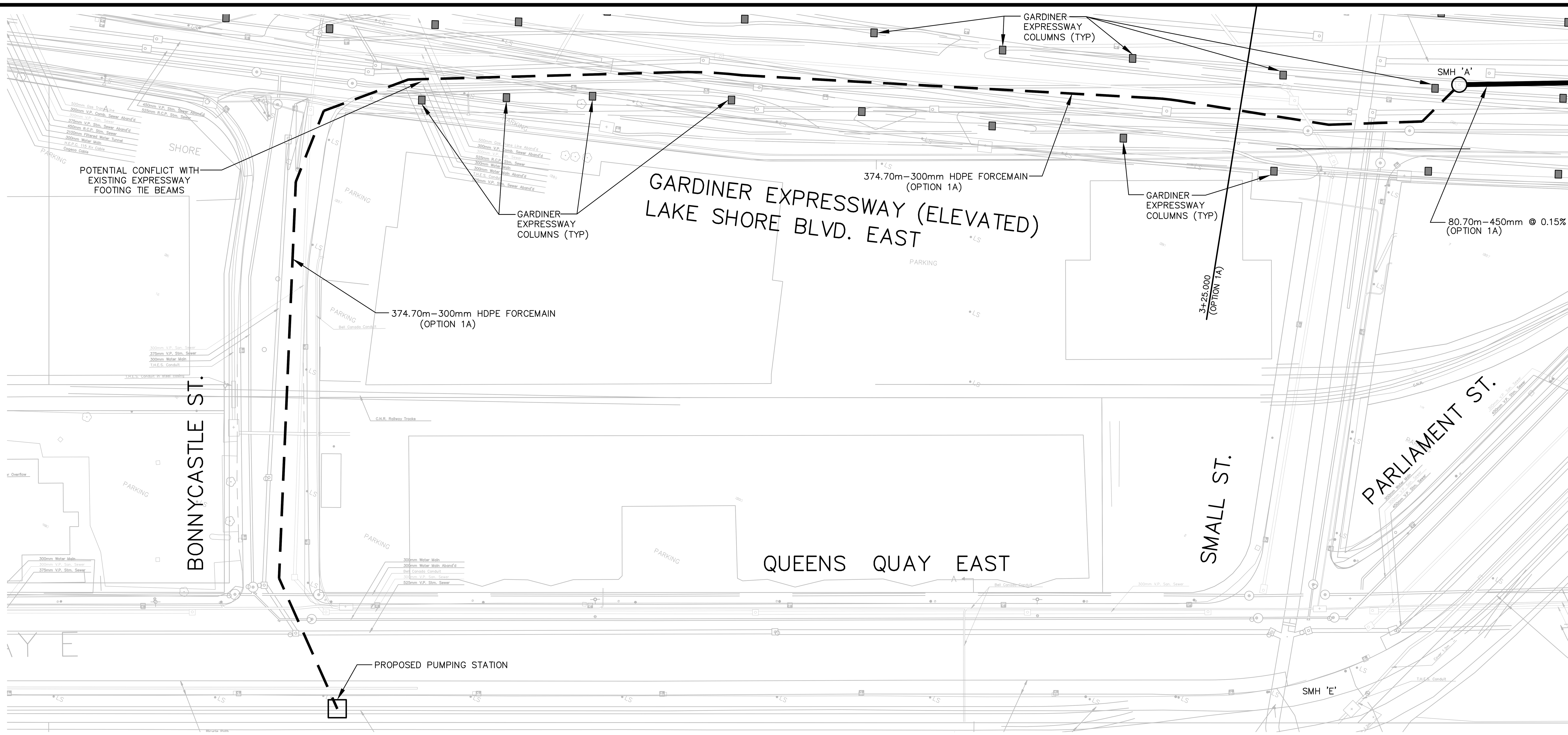
GENIVAR	
CITY OF TORONTO	ENGINEERING & CONSTRUCTION SERVICES
TORONTO WSMP	CHERRY STREET SPS CONTROL BUILDING
PARTIAL PLAN	
DESIGN: V.M.	DRAFTING: R.P
CHECK: V.M.	CONTRACT No.
SCALE: N.T.S	DRAWING NUMBER: 111-12480-00-PD003
DATE: APR.13	

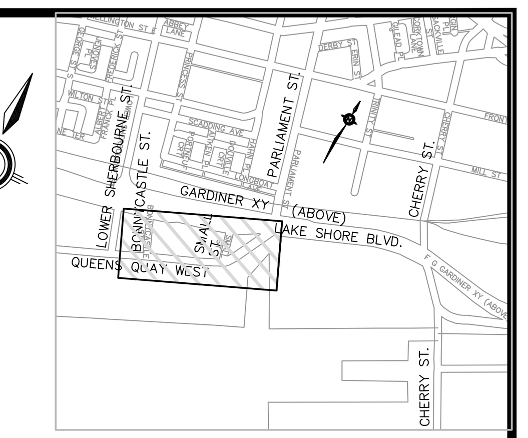
No.	DATE	REVISIONS	INITIAL	SIGNED
1	APR. 13	ISSUED FOR CONCEPTUAL DESIGN REVIEW		

APPENDIX D
SEWER PLAN/PROFILE DRAWINGS FOR OPTIONS 1A, 1B, 2A AND 2B

Appendix D provides preliminary design plan/profile drawings for each of Options 1A, 1B, 2A and 2B; three drawings sheets per option, as follows:

- Option 1A: Drawing No.'s 1A-1, 1A-2 and 1A-3
- Option 1B: Drawing No.'s 1B-1, 1B-2 and 1B-3
- Option 2A: Drawing No.'s 2A-1, 2A-2 and 2A-3
- Option 2B: Drawing No.'s 2B-1, 2B-2 and 2B-3





NOTES:

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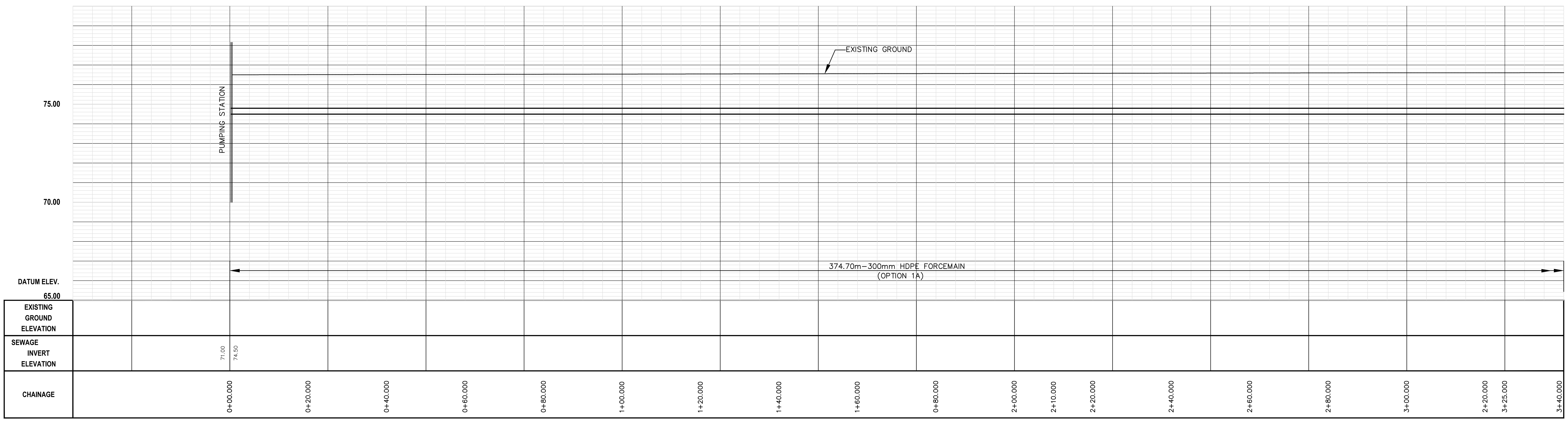

TORONTO WATER

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Engineering Services - Works Facilities & Structures

FRANK QUARISA, P. ENG.
DIRECTOR,
WASTE WATER TREATMENT

TONY PAGNANELLI, P. ENG.
DIRECTOR, ENGINEERING SERVICES
WORKS FACILITIES AND STRUCTURES

EAST BAYFRONT AND NORTH KEATING ARE
SANITARY SERVICING TO CHERRY STREET SEWER
OPTION 1A - LAKE SHORE BOULEVARD FORCEMAIN AND GRAVITY SEWER

PLAN AND PROFILE

DESIGN:	JEA	DRAFTING:	AV	CHECK:	CGS	CONTRACT No. XXXX-XXXX
SCALE:	1:500	DRAWING NUMBER:	1A-1	SHEET No.	C-1	
DATE:	MARCH 2013					

NOTES:

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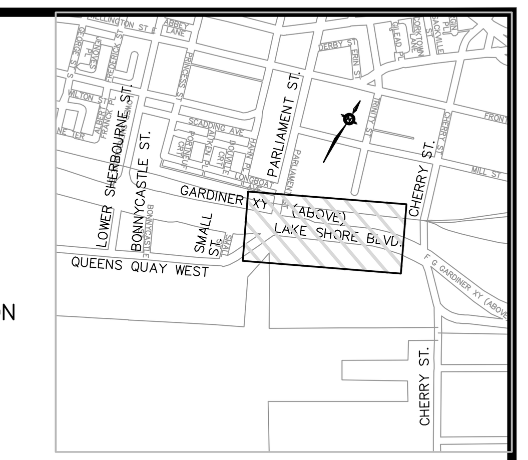

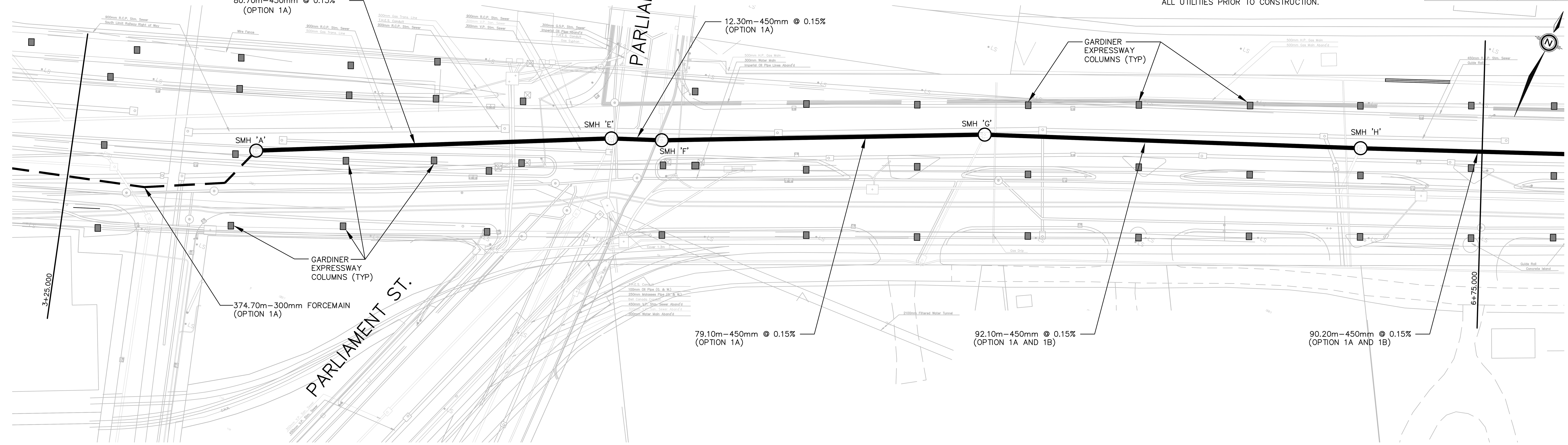

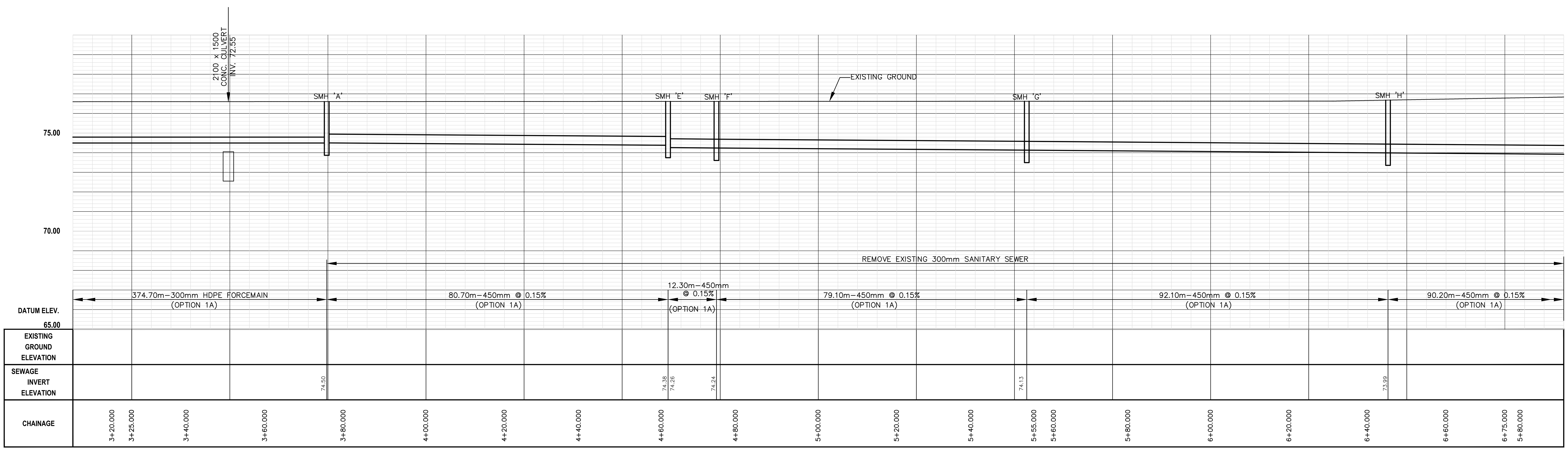

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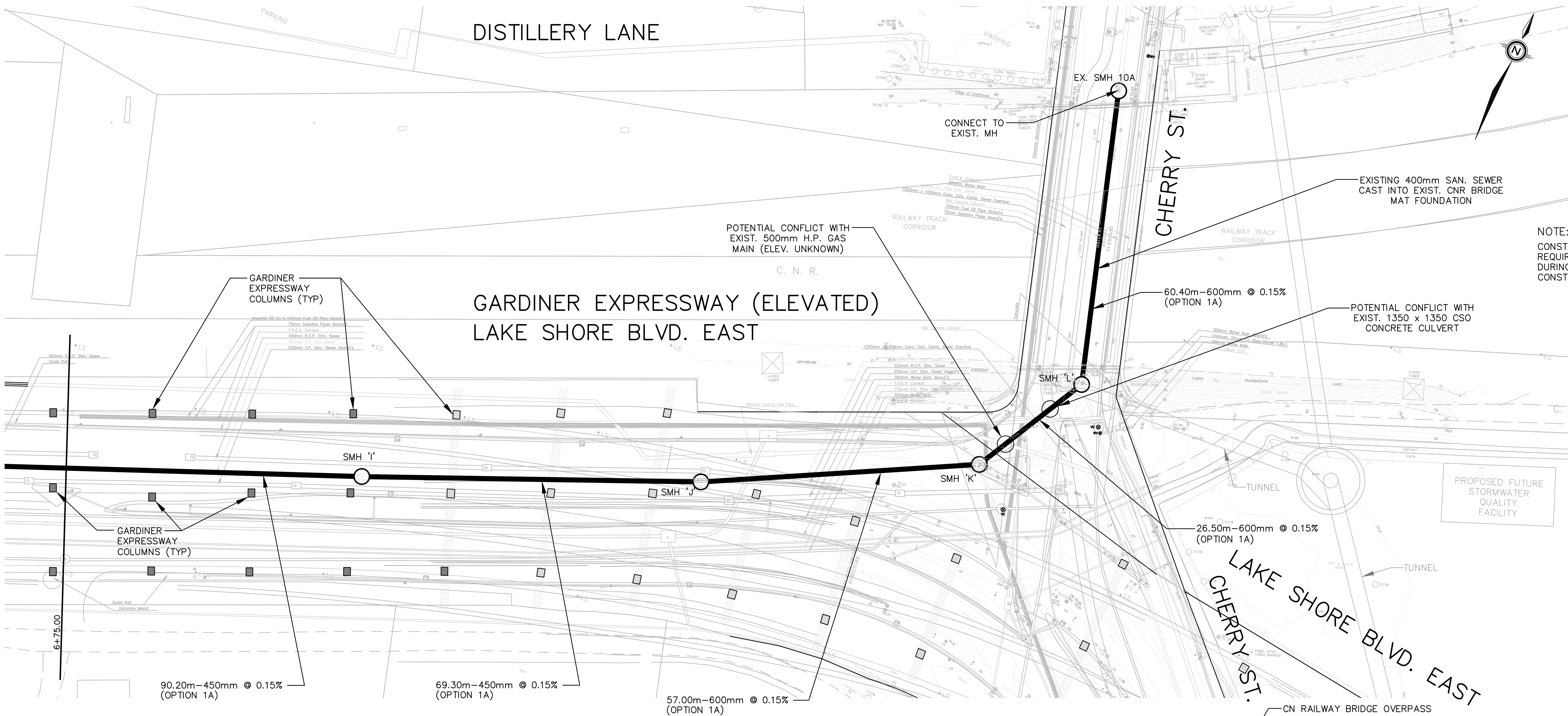
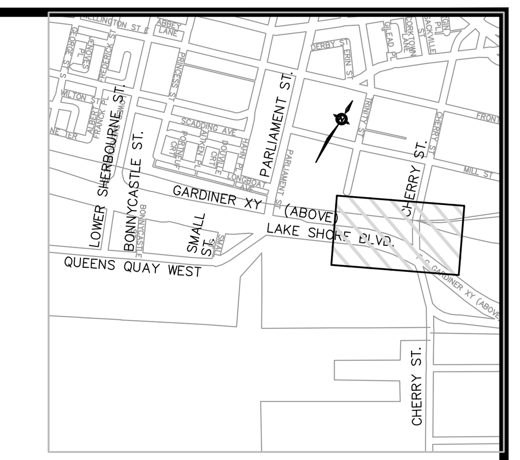
EAST BAYFRONT AND NORTH KEATING ARE
SANITARY SERVICING TO CHERRY STREET SEWER
OPTION 1A - LAKE SHORE BOULEVARD FORCEMAIN AND GRAVITY SEWER

PLAN AND PROFILE

DESIGN:	JEA	DRAFTING:	AV	CHECK:	CGS	CONTRACT No. XXXX-XXXX
SCALE:	1:500			DRAWING NUMBER:	1A-2	SHEET No. C-2
DATE:	MARCH 2013					





NOTE:
CONSTRUCTION UNDER CNR BRIDGE REQUIRES SPECIAL CONSIDERATION DURING DETAILED DESIGN AND CONSTRUCTION PHASES.

NOTES:

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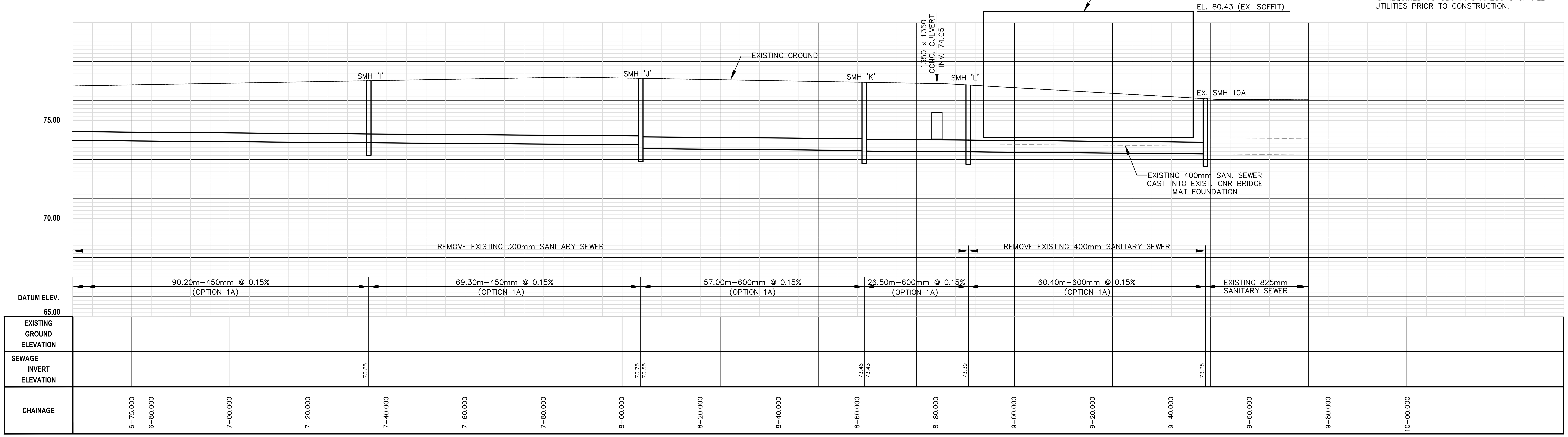

1	MAR. 2013	CONCEPTUAL DESIGN	JA		
No.	DATE	REVISIONS	INITIAL	SIGNED	

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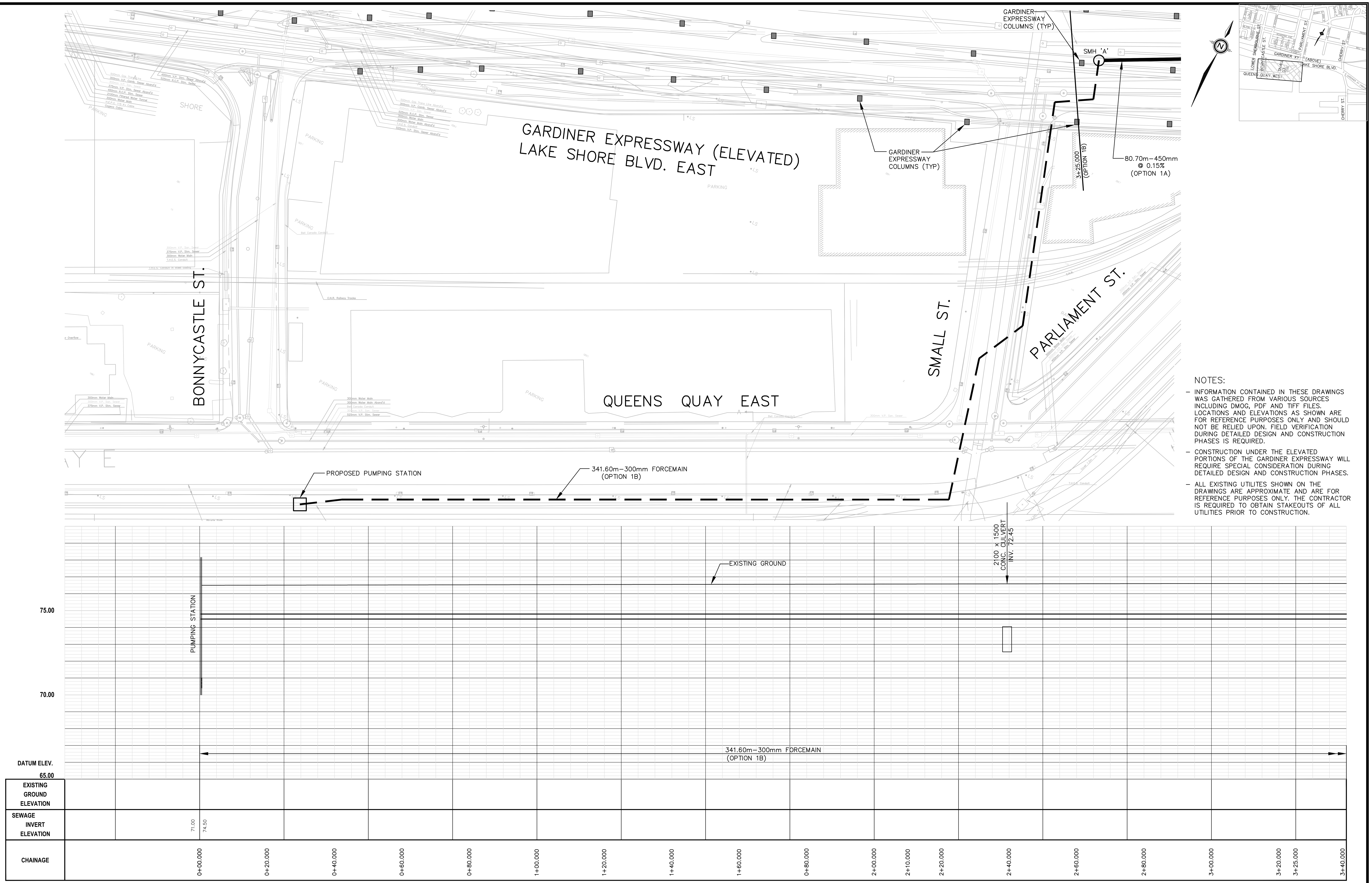
EAST BAYFRONT AND NORTH KEATING ARE

SANITARY SERVICING TO CHERRY STREET SEWER

OPTION 1A - LAKE SHORE BOULEVARD FORCEMAIN AND GRAVITY SEWER

PLAN AND PROFILE

DESIGN:	JEA	DRAFTING:	AV	CHECK:	CGS	CONTRACT No. XXXX-XXXX
SCALE:	1:500			DRAWING NUMBER:	1A-3	SHEET No. C-3
DATE:	MARCH 2013					



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WASTE WATER TREATMENT

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DIRECTOR, ENGINEERING SERVICES
WORKS FACILITIES AND STRUCTURES

EAST BAYFRONT AND NORTH KEATING ARE
SANITARY SERVICING TO CHERRY STREET SEWER
OPTION 1A - LAKE SHORE BOULEVARD FORCEMAIN AND GRAVITY SEWER

PLAN AND PROFILE

DESIGN:	JEA	DRAFTING:	AV	CHECK:	CGS	CONTRACT No. XXXX-XXXX
SCALE:	1:500			DRAWING NUMBER:	1B-1	SHEET No. C-1
DATE:	MARCH 2013					

NOTES:

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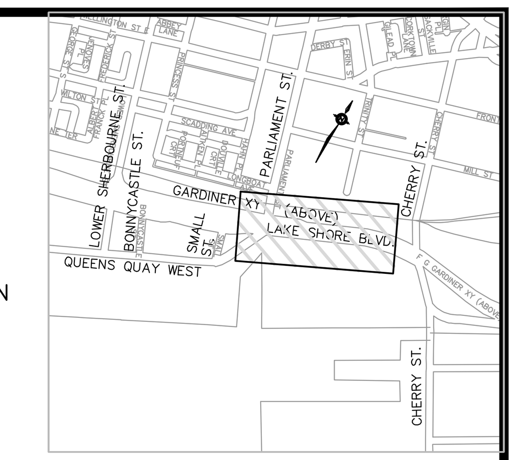

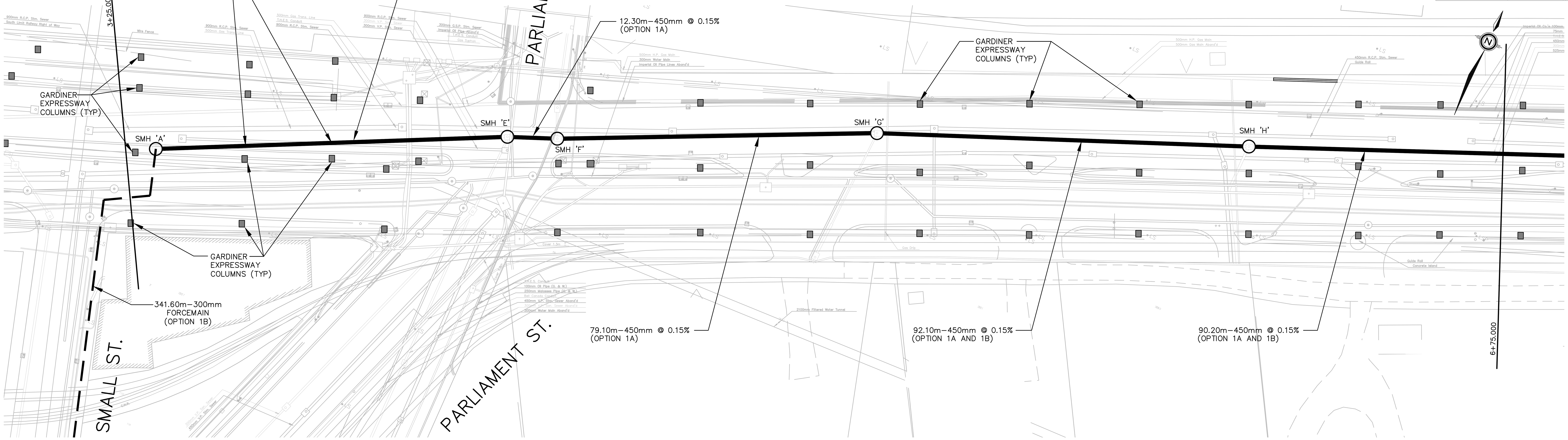

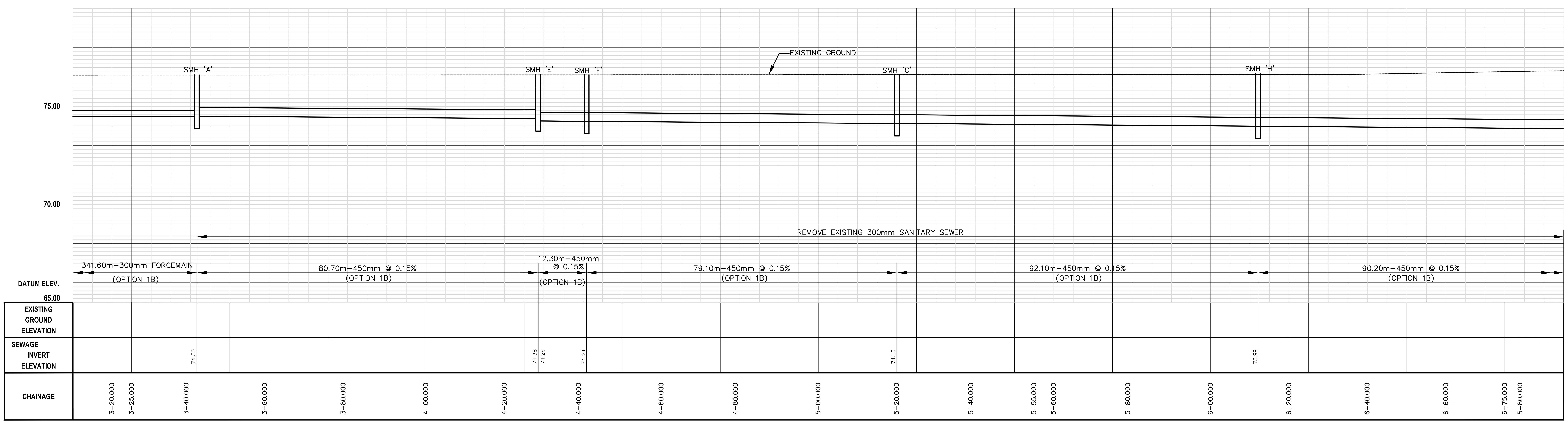

TORONTO WATER					
GENIVAR	1	MAR. 2013	CONCEPTUAL DESIGN	JA	
	No.	DATE	REVISIONS	INITIAL	SIGNED

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WORKS FACILITIES AND STRUCTURES

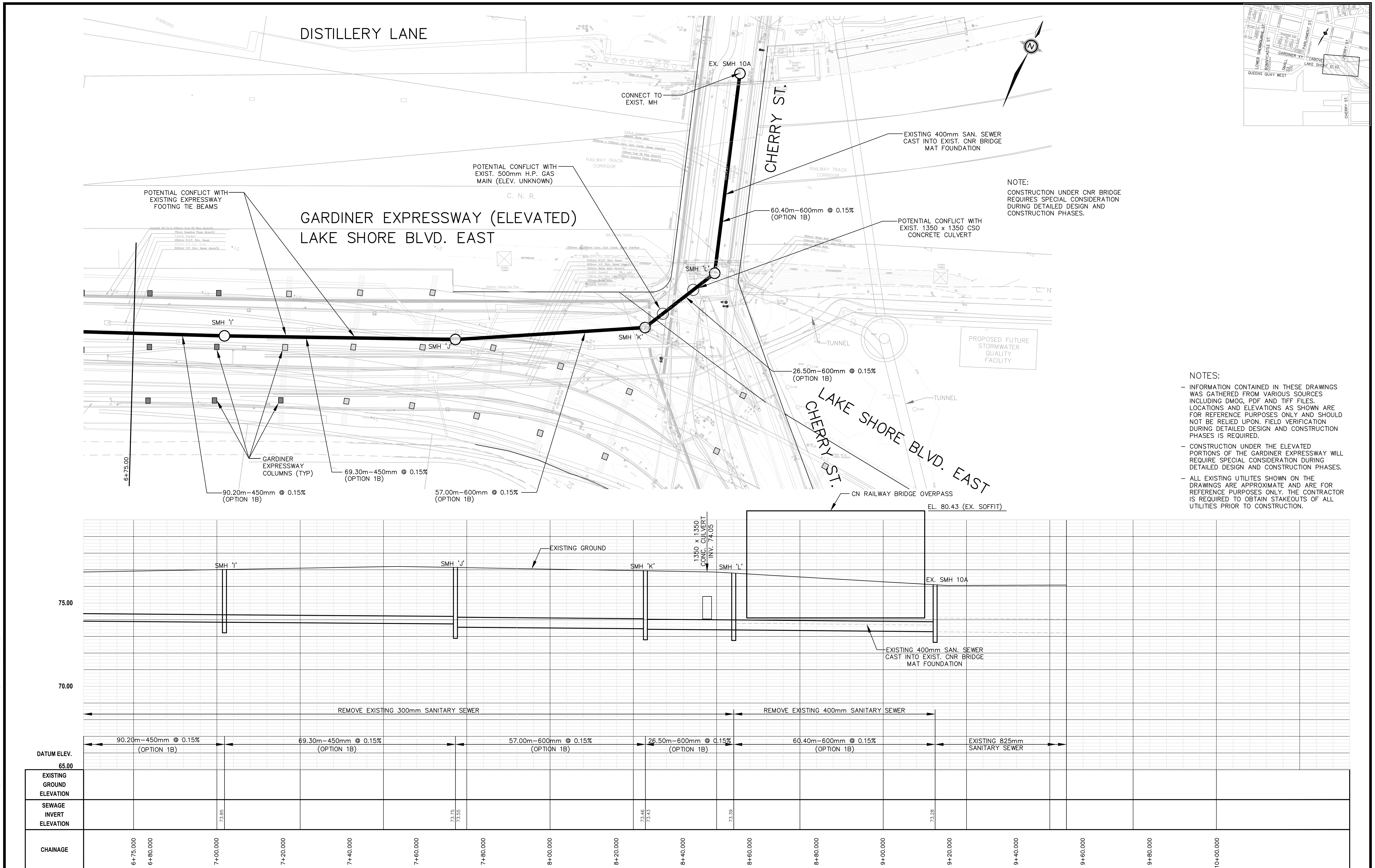
EAST BAYFRONT AND NORTH KEATING ARE

SANITARY SERVICING TO CHERRY STREET SEWER

OPTION 1A - LAKE SHORE BOULEVARD FORCEMAIN AND GRAVITY SEWER

PLAN AND PROFILE

DESIGN:	JEA	DRAFTING:	AV	CHECK:	CGS	CONTRACT No. XXXX-XXXX
SCALE:	1:500			DRAWING NUMBER:	1B-2	SHEET No. C-2
DATE:	MARCH 2013					



NOTES:

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TORONTO WATER

GENIVAR

No.	DATE	REVISIONS	INITIAL	SIGNED
1	MAR. 2013	CONCEPTUAL DESIGN	JA	

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Engineering Services - Works Facilities & Structures

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DIRECTOR,
WASTE WATER TREATMENT

TONY PAGNANELLI, P. ENG.
DIRECTOR, ENGINEERING SERVICES
WORKS FACILITIES AND STRUCTURES

EAST BAYFRONT AND NORTH KEATING ARE
SANITARY SERVICING TO CHERRY STREET SEWER
OPTION 1A - LAKE SHORE BOULEVARD FORCEMAIN AND GRAVITY SEWER

PLAN AND PROFILE

DESIGN:	JEA	DRAFTING:	AV	CHECK:	CGS	CONTRACT No. XXXX-XXXX
SCALE:	1:500	DRAWING NUMBER:	1B-3	SHEET No.	C-3	
DATE:	MARCH 2013					

NOTES:

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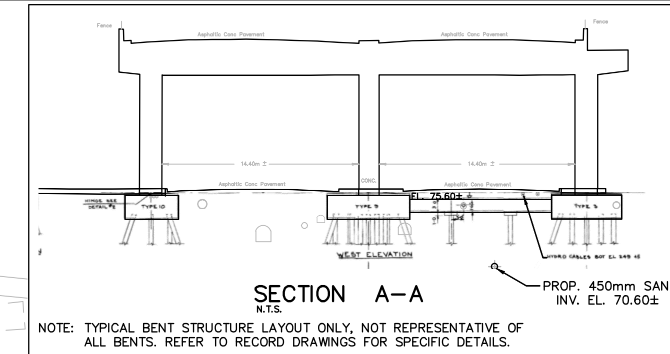

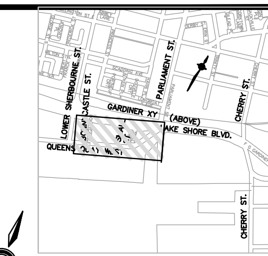

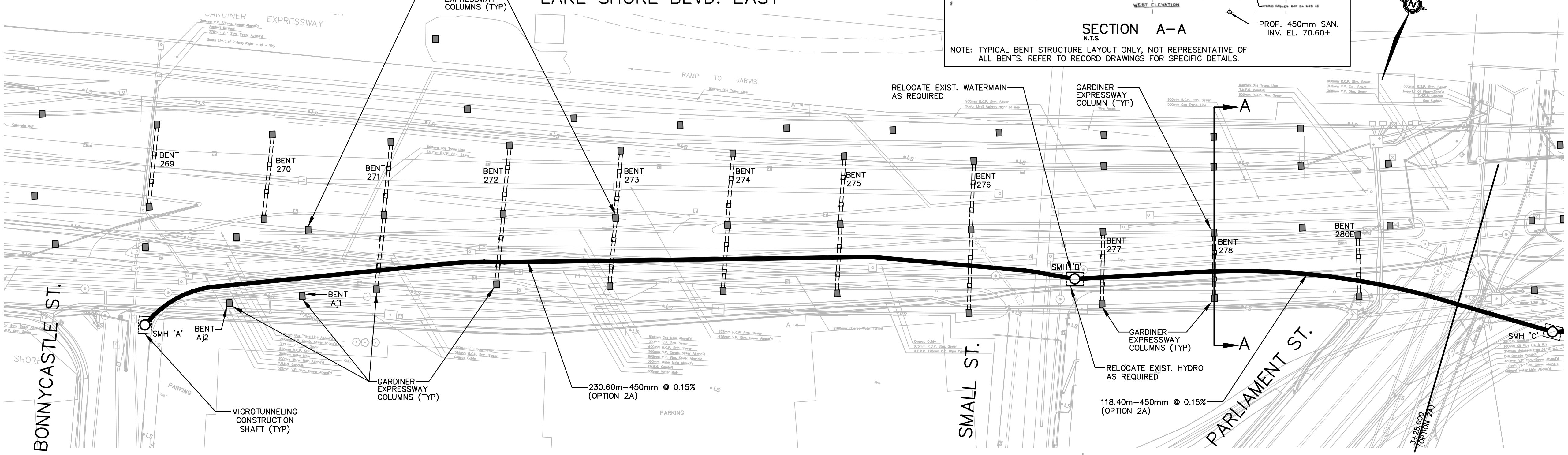

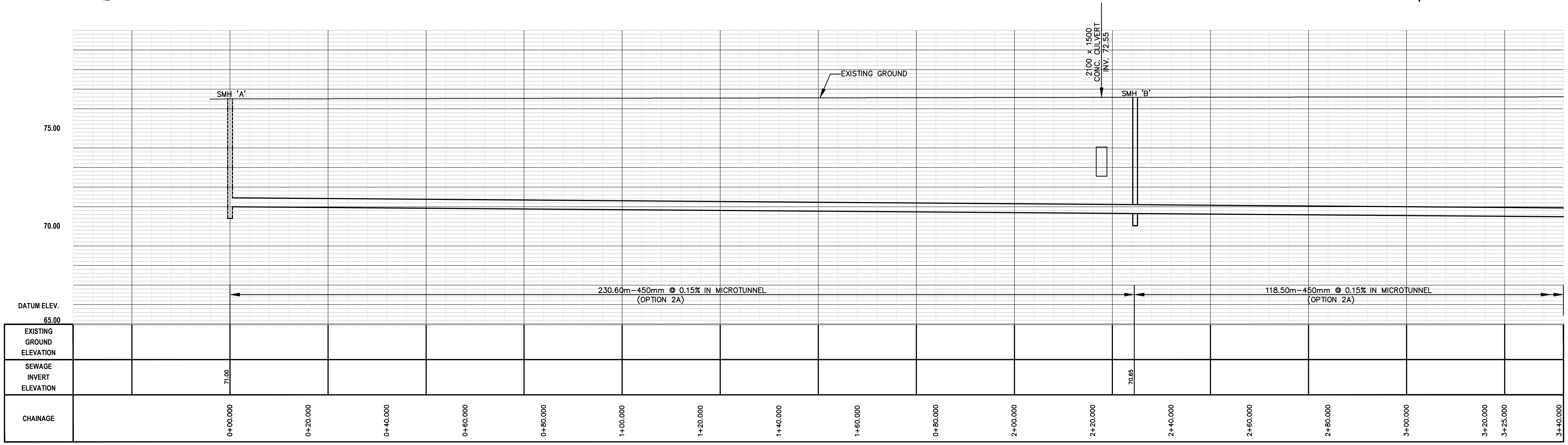

TORONTO WATER

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1	MAR. 2013	CONCEPTUAL DESIGN	JA	

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TECHNICAL SERVICES
Engineering Services - Works Facilities & Structures

FRANK QUARISA, P. ENG.
DIRECTOR, WASTE WATER TREATMENT

TONY PAGNANELLI, P. ENG.
DIRECTOR, ENGINEERING SERVICES WORKS FACILITIES AND STRUCTURES

EAST BAYFRONT AND NORTH KEATING AREA
SANITARY SERVICING TO CHERRY STREET SEWER
OPTION 2A - LAKE SHORE BOULEVARD GRAVITY SEWER

PLAN AND PROFILE

DESIGN:	JEA	DRAFTING:	AV	CHECK:	CGS	CONTRACT No.	XXXX-XXXX
SCALE:	1:500			DRAWING NUMBER:	2A-1	SHEET No.	C-1
DATE:	MARCH 2013						

NOTES:

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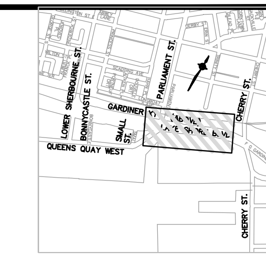

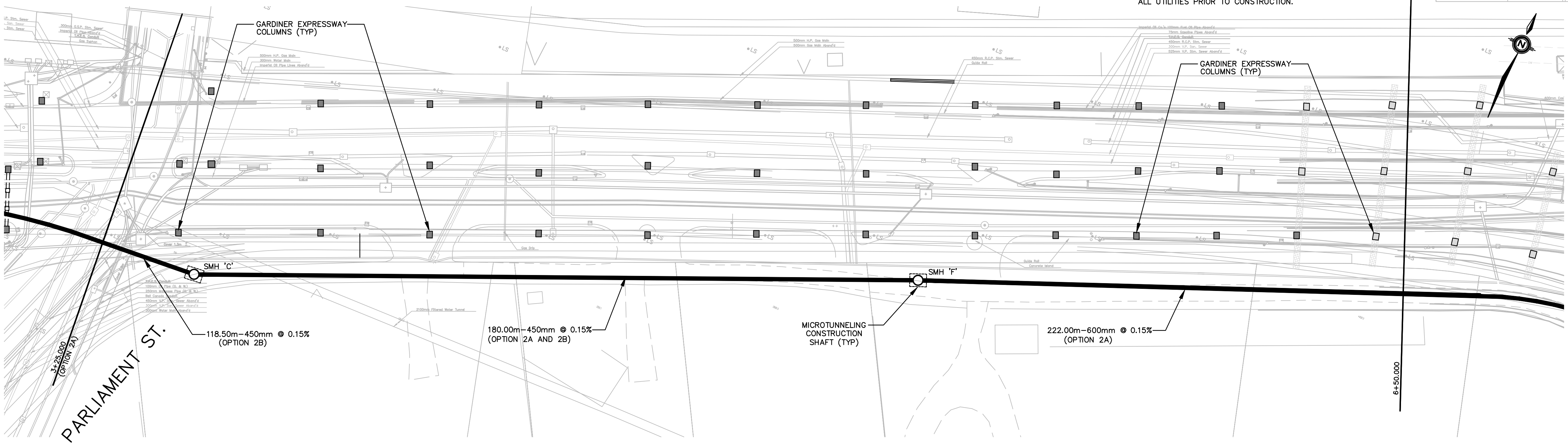

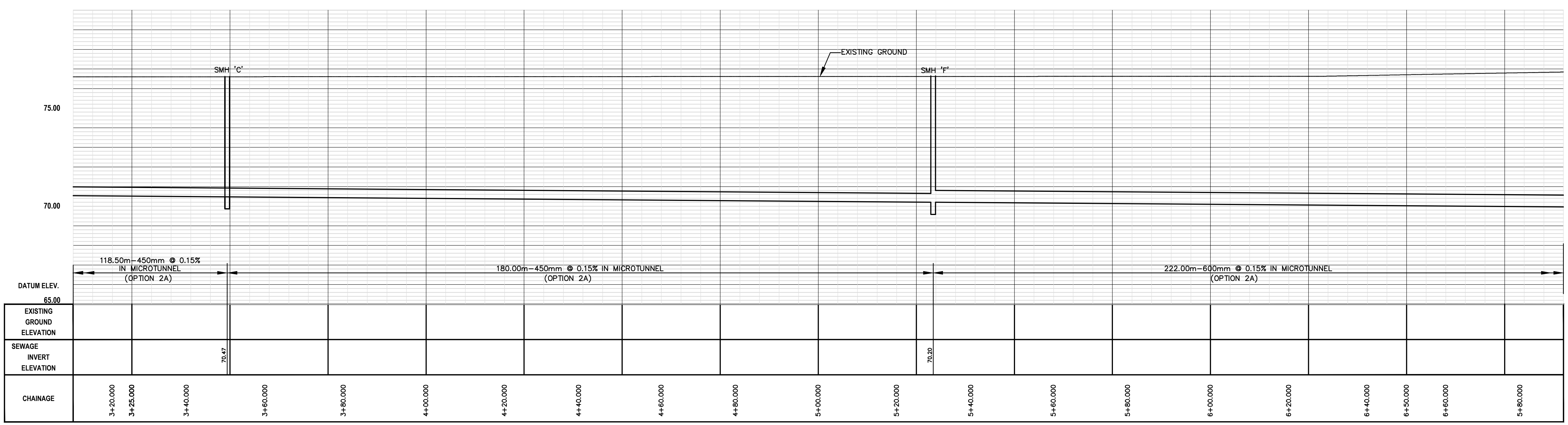

TORONTO WATER

GENIVAR

No.	DATE	REVISIONS	INITIAL	SIGNED
1	MAR. 2013	CONCEPTUAL DESIGN	JA	

TORONTO

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Engineering Services - Works Facilities & Structures

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EAST BAYFRONT AND NORTH KEATING ARE
SANITARY SERVICING TO CHERRY STREET SEWER
OPTION 2A AND 2B - LAKE SHORE BOULEVARD GRAVITY SEWER

PLAN AND PROFILE

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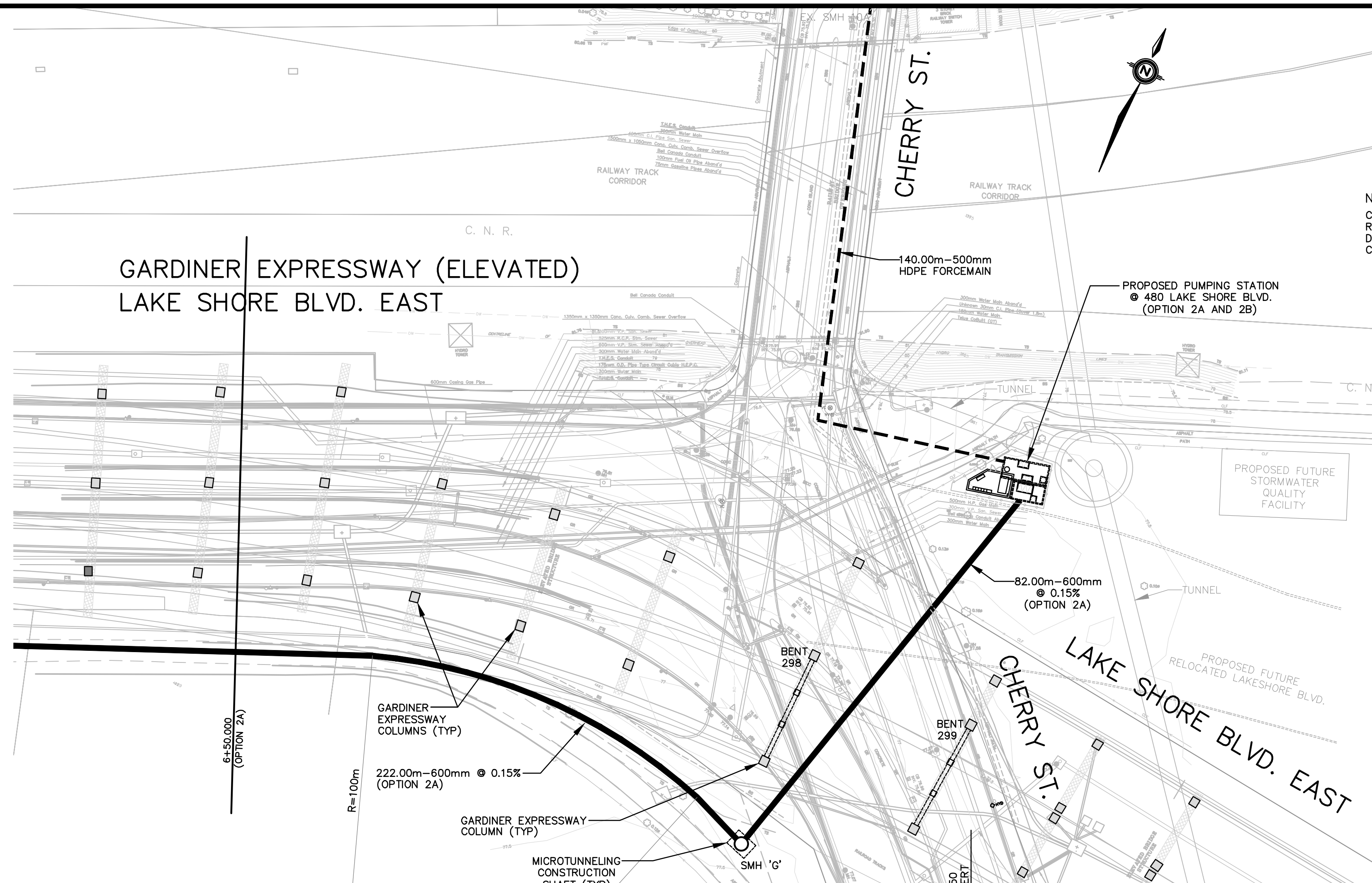
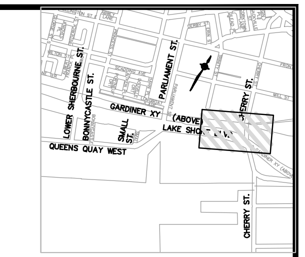
SCALE:	1:500	DRAWING NUMBER:	2A-2			SHEET No. C-2
DATE:	MARCH 2013					





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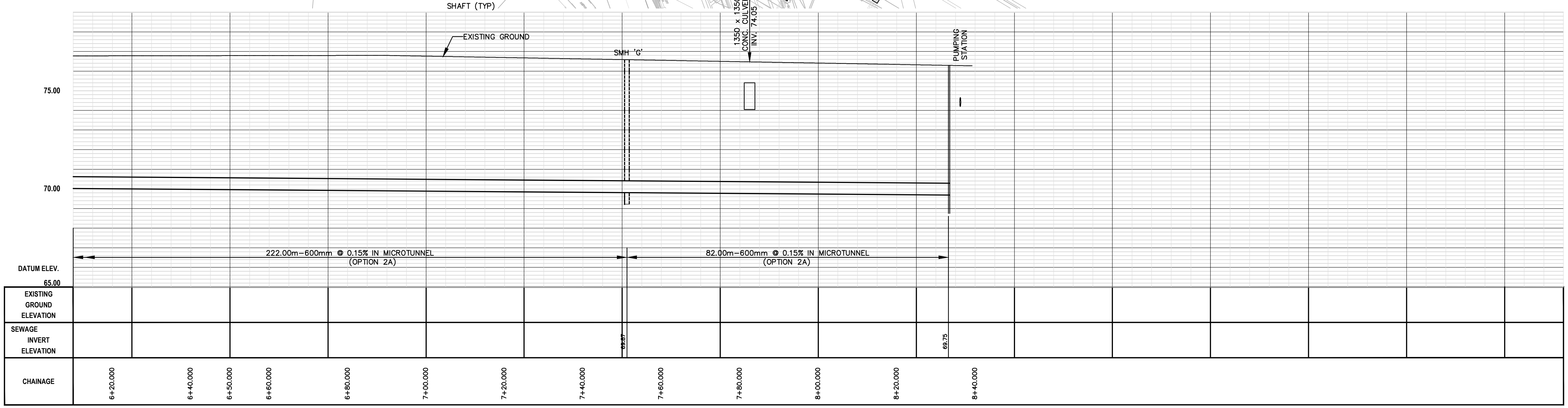

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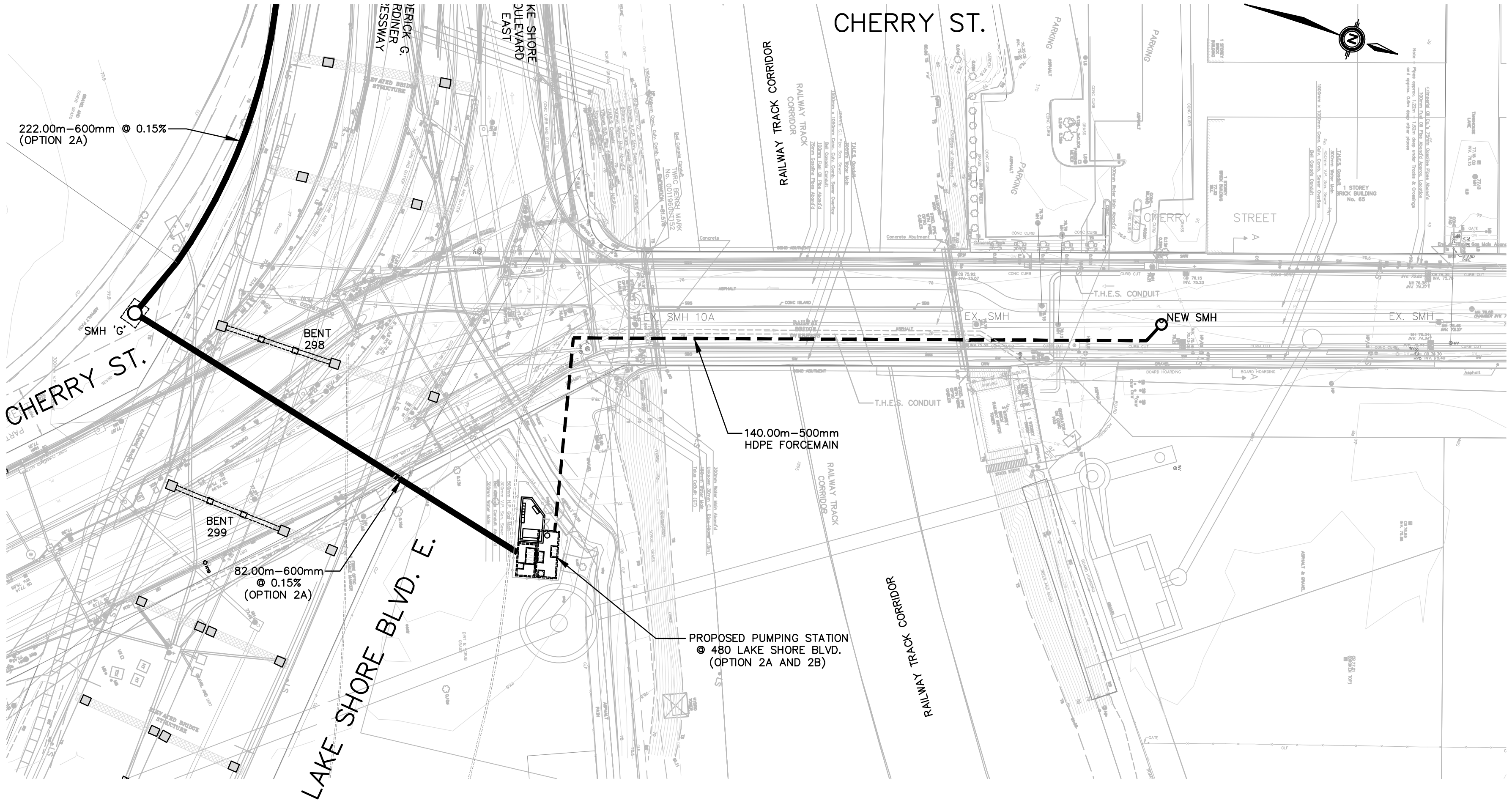
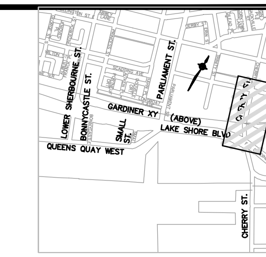
DATE:	MARCH 2013					





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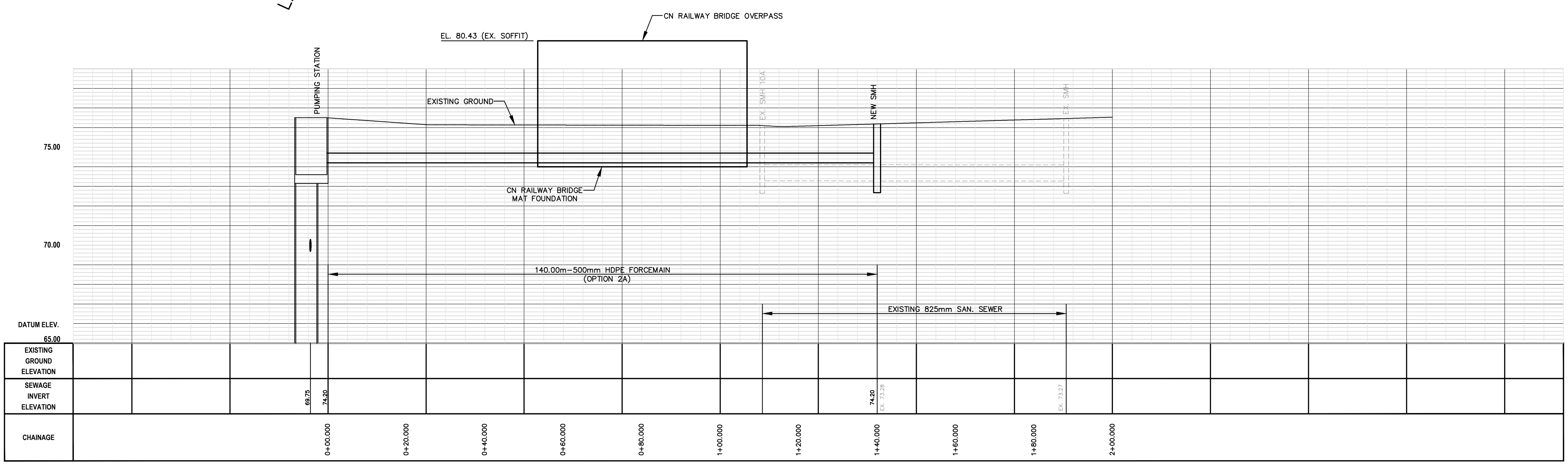

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OPTION 2A AND 2B - LAKE SHORE BOULEVARD GRAVITY SEWER

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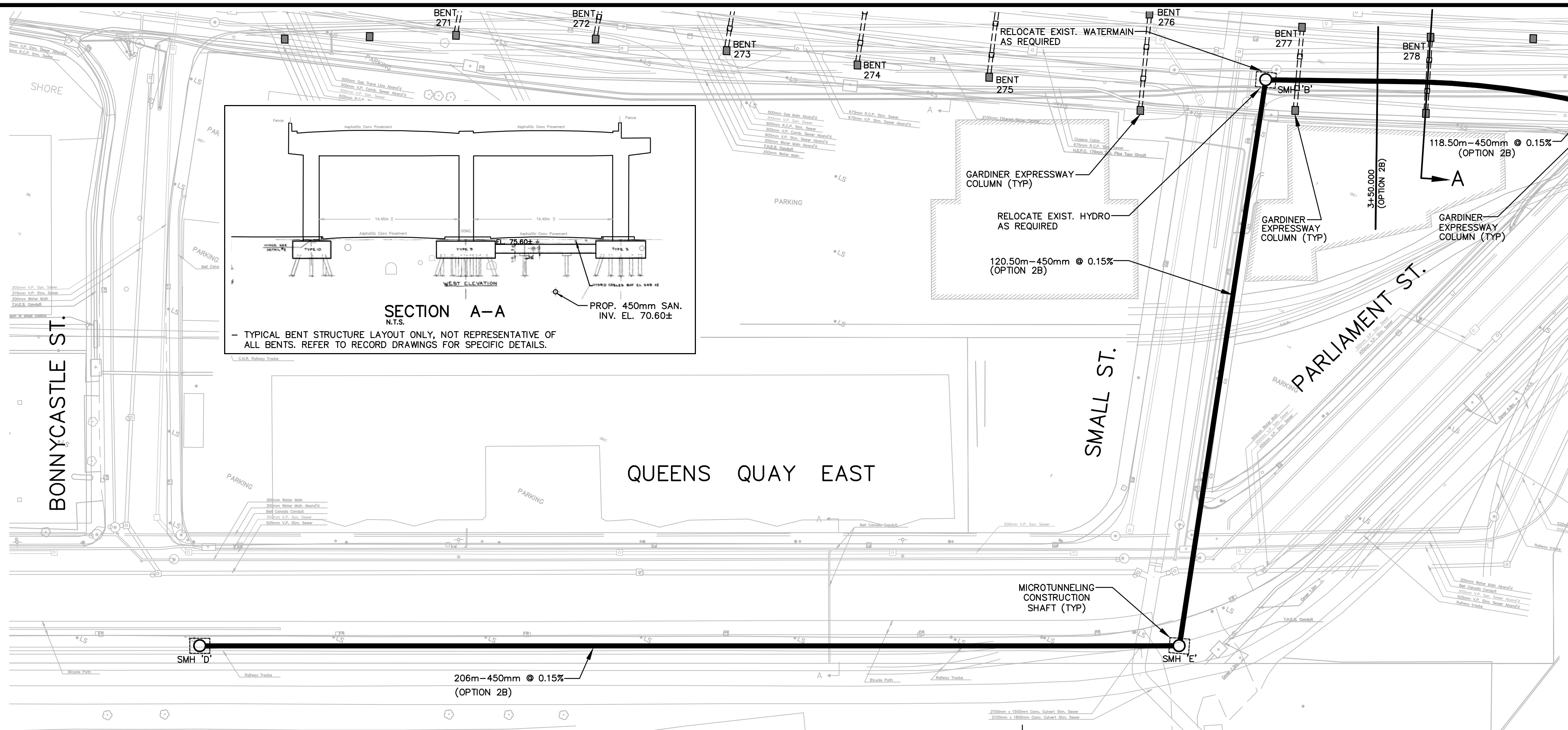
DATE:	MARCH 2013					



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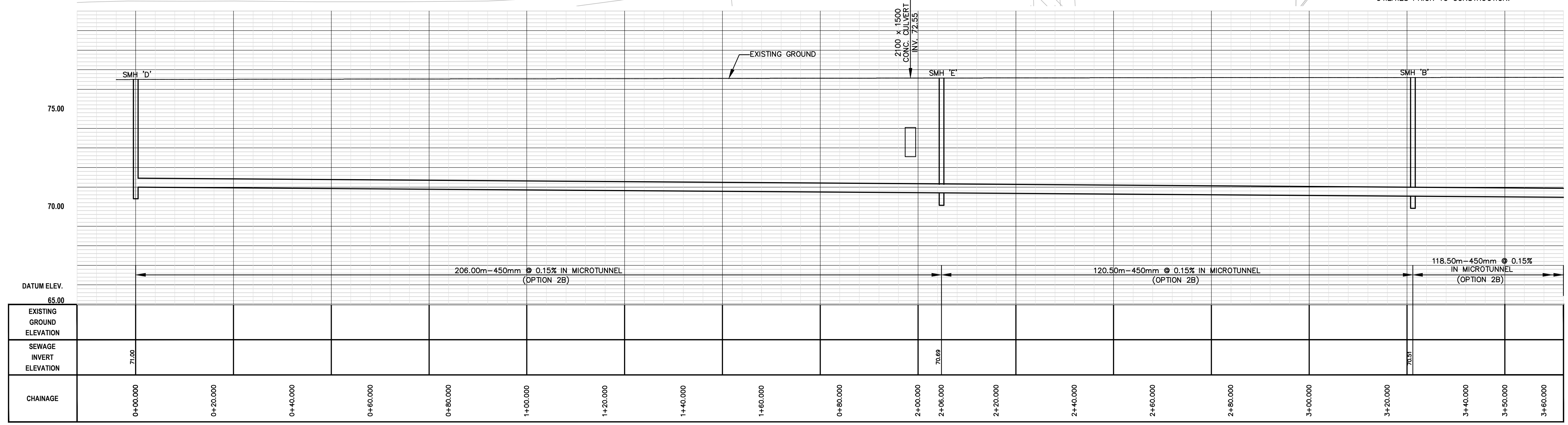

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EAST BAYFRONT AND NORTH KEATING AREA
SANITARY SERVICING TO CHERRY STREET SEWER
OPTION 2B - QUEENS QUAY GRAVITY SEWER

PLAN AND PROFILE

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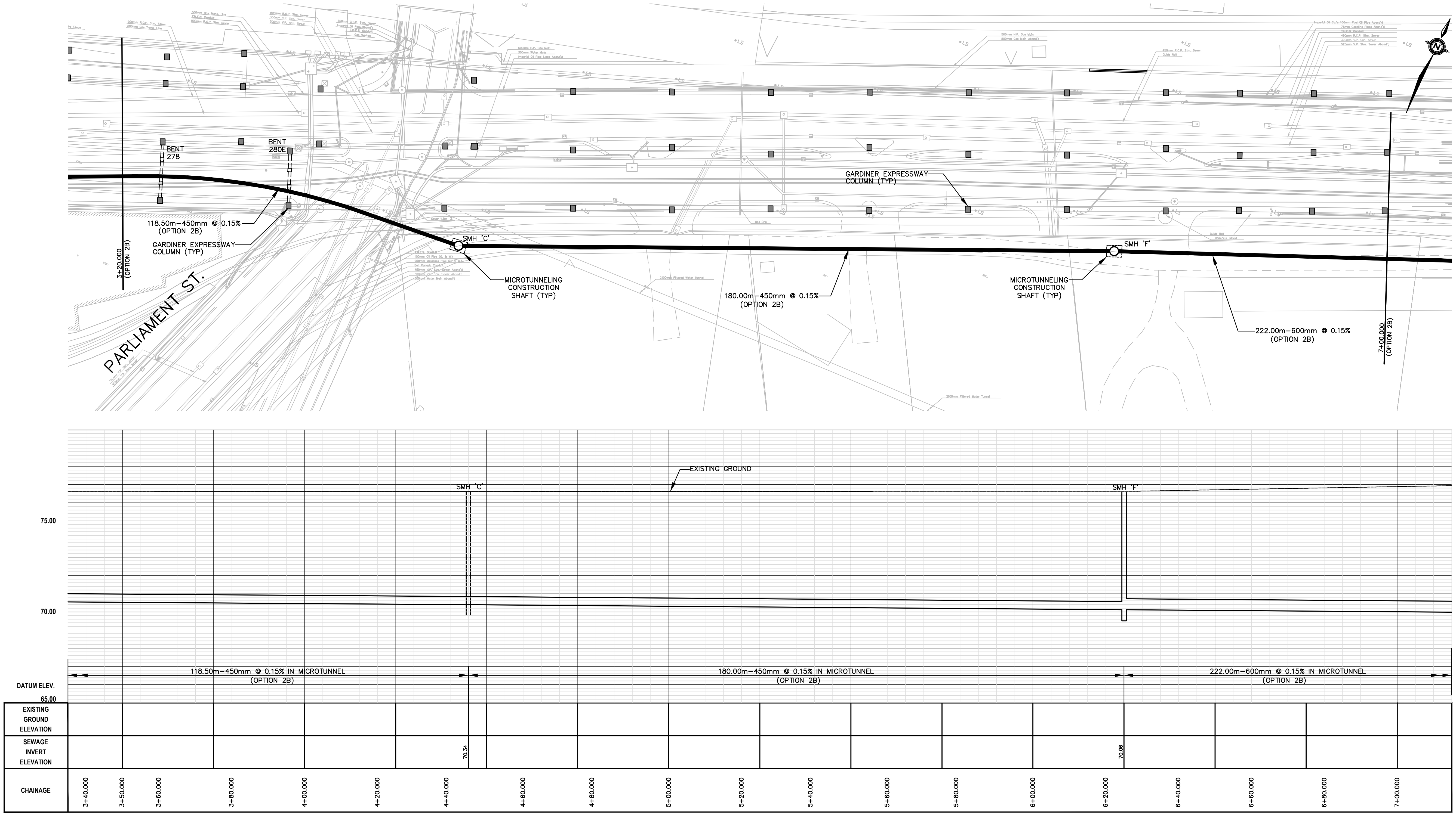

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EAST BAYFRONT AND NORTH KEATING ARE
SANITARY SERVICING TO CHERRY STREET SEWER
OPTION 2A AND 2B - LAKE SHORE BOULEVARD GRAVITY SEWER

PLAN AND PROFILE

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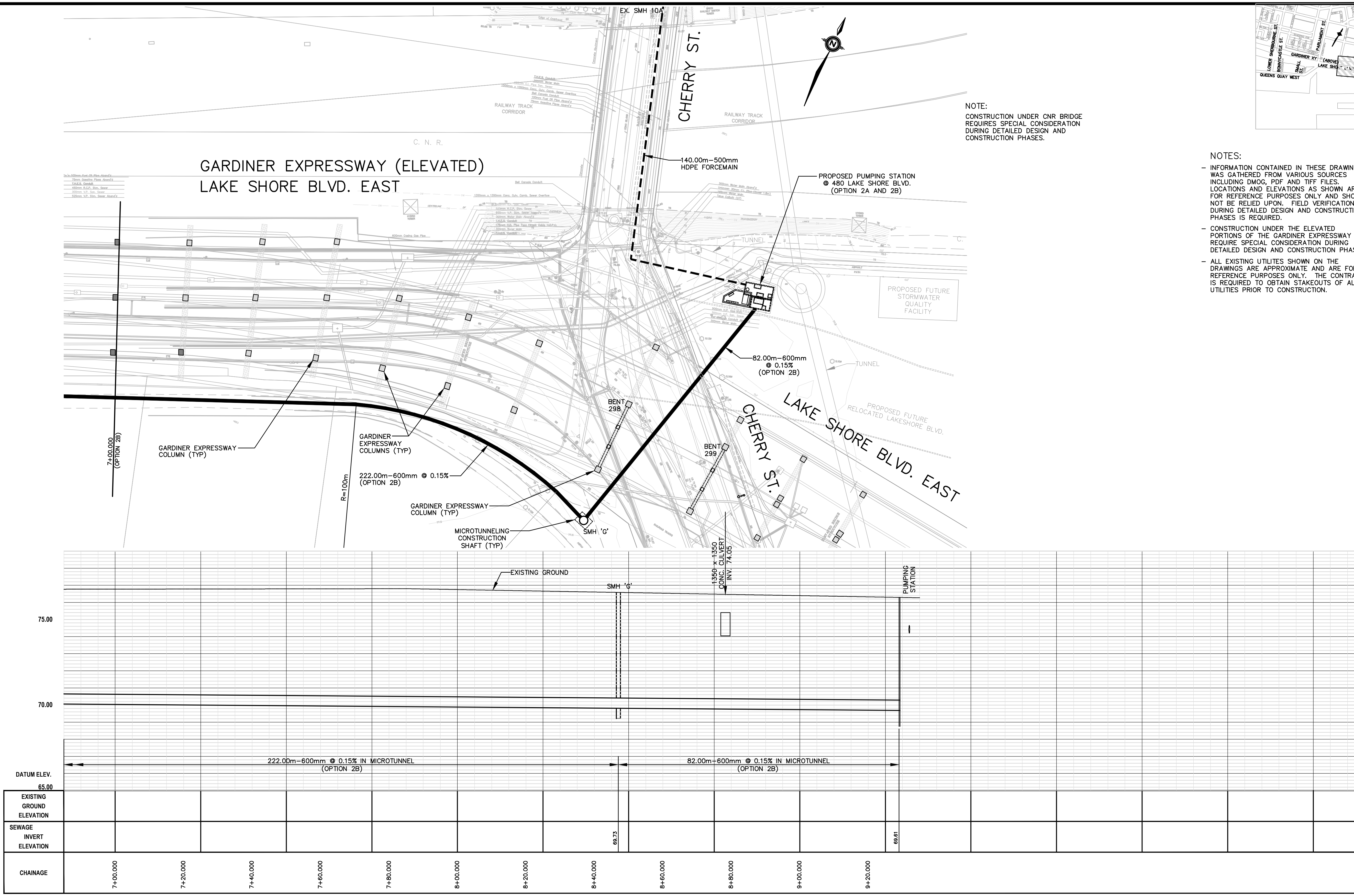

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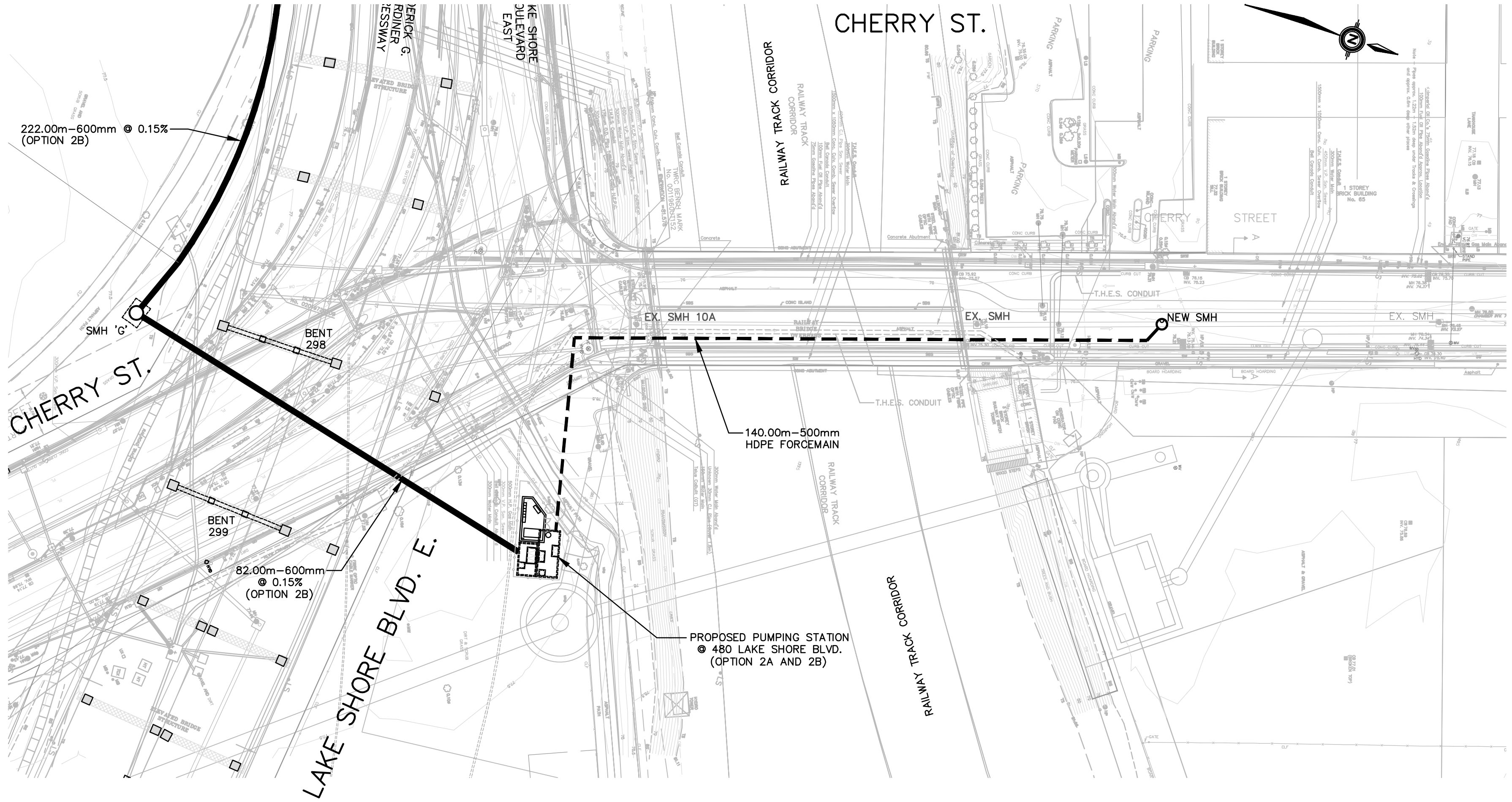

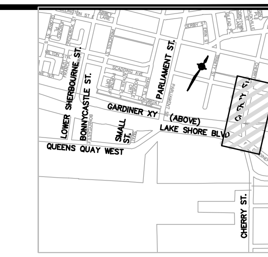

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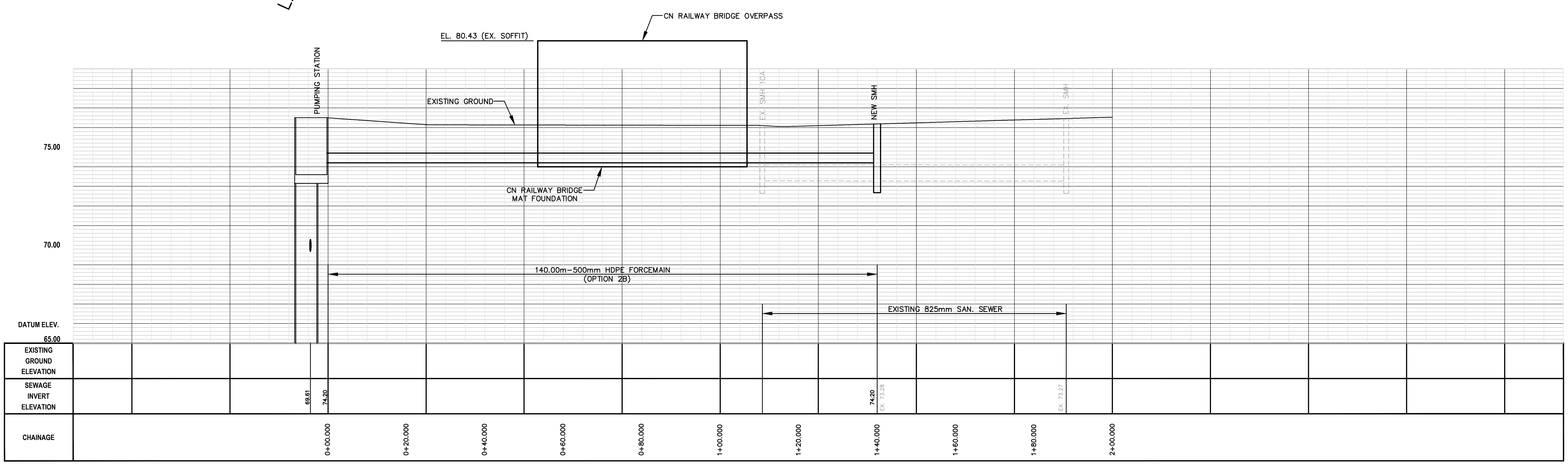

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EAST BAYFRONT AND NORTH KEATING ARE

SANITARY SERVICING TO CHERRY STREET SEWER
OPTION 2A AND 2B - LAKE SHORE BOULEVARD GRAVITY SEWER

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APPENDIX E
SEWER DESIGN SHEET FOR PREFERRED OPTION AND CHERRY STREET SEWER

EAST BAYFRONT and NORTH KEATING AREA SAN SERVICING TO CHERRY STREET SEWER

OPTION 2B: Deep gravity sewer along Lakeshore Blvd to pumping station at 480 Lakeshore Blvd East

Sewer design sheet, including new Cherry Street sewer from rail corridor north to Low Level Interceptor

24-Apr-13

UNIT RATES		
RESIDENTIAL	300	L/person/day
EMPLOYMENT	250	L/job/day
EXTRANEOUS INFLOW	0.26	L/s/ha

			POPULATIONS				**Land area**		**Peaking factors**		**Design Flow Calculation**						**PIPE SIZING / PROFILE**										
Street	**From**	**To**	**Residential to add**	**Employment to add**	**Cumul residential**	**Cumul employment**	Increm. Area	Cumul Area	Resid.	Employ.	**Peak resid. Flow**	**Peak employment flow**	**Extraneous inflow**	**BFF discharge**		**DESIGN FLOW**	Nominal diameter	Actual diameter	Slope	Length	Type of pipe	Manning n	Full-flow velocity	Pipe capacity	Unused capacity	U/S invert	D/S invert
			persons	jobs	persons	jobs	ha	ha			L/s	L/s	L/s	L/s		**L/s**	mm	mm	m/m	m			L/s	L/s	L/s	m	m
QUEENS QUAY E	D: Bonnycastle	E: Small St CSO pipe (Parliament St)	8,071	1,423	8,071	1,423	8.9	8.9	3.1	3.7	86.9	15.2	2.3			**104**	450	457	0.0015	210	RCP	0.013	0.70	**115**	11	71.00	70.69
SMALL ST	E: Queens Quay E at Small St	B: Lakeshore Blvd at Small St			8,071	1,423	0.0	8.9	3.1	3.7	86.9	15.2	2.3			**104**	450	457	0.0015	100	RCP	0.013	0.70	**115**	11	70.69	70.54
LAKESHORE BLVD	B: Lakeshore Blvd at Small St	C: Lakeshore Blvd at Parliament St			8,071	1,423	0.0	8.9	3.1	3.7	86.9	15.2	2.3			**104**	450	457	0.0015	100	RCP	0.013	0.70	**115**	11	70.54	70.39
LAKESHORE BLVD	C: Lakeshore Blvd at Parliament St	F: East limit of Silo lands			8,071	1,423	0.0	8.9	3.1	3.7	86.9	15.2	2.3			**104**	450	457	0.0015	185	RCP	0.013	0.70	**115**	11	70.39	70.11
LAKESHORE BLVD	F: East limit of Silo lands	G: Adjacent Cherry St, south side of ROW	3,283	472	11,354	1,895	4.4	13.3	2.9	3.7	114.3	20.3	3.5			**138**	600	609	0.0015	205	RCP	0.013	0.85	**247**	109	70.11	69.80
LAKESHORE BLVD	G: Adjacent Cherry St, south side of ROW	Pumping station at 480 Lakeshore Blvd E	4,244	611	15,598	2,506	5.6	18.9	2.8	3.6	151.6	26.1	4.9			**183**	600	609	0.0015	85	RCP	0.013	0.85	**247**	65	69.80	69.67
Pumping Station at 480 Lakeshore Blvd E			4,207	2,048	19,805	4,554	9.0	27.9	2.7	3.3	185.7	43.5	7.3	64.0		**300**											

CHERRY STREET SEWER NORTH OF RAIL CORRIDOR: Populations and service areas based on R.V. Anderson Associates design sheet for new Cherry Street sewer

Design flows calculated by adding peak tributary flows to peak discharge (i.e. firm capacity) of proposed pumping station at 480 Lakeshore Boulevard East.

If not all BFF underflow discharge added to 480 Lakeshore PS, then remainder of BFF discharge added at MH 10A (based on assumption of gravity discharge from BFF via existing san sewer through rail underpass)

Set new PS firm capacity = 300 L/s

Pipe size and invert elevations for new 825-mm Cherry Street sewer taken from sewer design sheet provided by R.V. Anderson Associates in March 2013

											Peak resid. Flow	**Peak employment flow**	**Extraneous inflow**	**BFF discharge**	**Distillery District**	**Peak gravity inflow**	**Peak inflow from PS**	**DESIGN FLOW**	Nominal diameter	Actual diameter	Slope	Length	Type of pipe	Manning n	Full-flow velocity	Pipe capacity	Unused capacity	U/S invert	D/S invert
											L/s	L/s	L/s	L/s	L/s	L/s	L/s	L/s	mm	mm	m/m	m			L/s	L/s	L/s	m	m
CHERRY	MH 10A	MH 9A	0	0			0.259	0.3	4.5	4.5			0.1	0.0	46.0	46.1	300.0	**346**	825	838	0.001022	93.9	RCP	0.013	0.87	**479**	132	73.44	73.344
CHERRY	MH 9A	MH 8A	0	0	0	0	0.240	0.5	4.5	4.5	0.0	0.0	0.1	0.0	46.0	46.1	300.0	**346**	825	838	0.001102	61.7	RCP	0.013	0.90	**497**	151	73.344	73.276
CHERRY	MH 8A	MH 7A	2,781	612	2,781	612	4.244	4.7	3.5	4.0	33.8	7.1	1.2	0.0	46.0	88.1	300.0	**388**	825	838	0.001106	44.3	RCP	0.013	0.90	**498**	110	73.276	73.227
CHERRY	MH 7A	MH 6A	1,020	652	3,801	1,264	1.908	6.7	3.4	3.8	44.9	13.9	1.7	0.0	46.0	106.5	300.0	**407**	825	838	0.001009	34.7	RCP	0.013	0.86	**475**	69	73.227	73.192
CHERRY	MH 6A	MH 5A	0	0	3,801	1,264	0.227	6.9	3.4	3.8	44.9	13.9	1.8	0.0	46.0	106.6	300.0	**407**	825	838	0.001004	68.7	RCP	0.013	0.86	**474**	68	73.192	73.123
CHERRY	MH 5A	MH 4A	4,079	628	7,880	1,892	7.522	14.4	3.1	3.7	84.8	20.3	3.7	0.0	46.0	154.8	300.0	**455**	825	838	0.000992	38.3	RCP	0.013	0.85	**471**	17	73.123	73.085
CHERRY	MH 4A	MH 3A	438	79	8,318	1,971	0.417	14.8	3.1	3.6	89.5	20.5	3.9	0.0	46.0	159.9	300.0	**460**	825	838	0.001004	85.7	RCP	0.013	0.86	**474**	14	73.085	72.999
CHERRY	MH 3A	MH 2A	0	0	8,318	1,971	0.061	14.9	3.1	3.6	89.5	20.5	3.9	0.0	46.0	159.9	300.0	**460**	825	838	0.000994	17.1	RCP	0.013	0.86	**472**	12	72.999	72.982
CHERRY	MH 2A	MH 1A	0	0	8,318	1,971	0.000	14.9	3.1	3.6	89.5	20.5	3.9	0.0	46.0	159.9	300.0	**460**	825	838	0.000988	16.2	RCP	0.013	0.85	**470**	10	72.982	72.966
CHERRY	MH 1A	EX MH 6	0	0	8,318	1,971	0.000	14.9	3.1	3.6	89.5	20.5	3.9	0.0	46.0	159.9	300.0	**460**	825	838	0.00284	16.2	RCP	0.013	1.45	**797**	338	72.556	72.51

NOTES

1/ See table below for populations for individual development properties and infromation sources.

2/ Unit flow rates and peaking factor calculation method same as applied in design sheet for new Cherry Street sewer (by R.V. Anderson Associates)

3/ Flow from Distillery District of 46 L/s added to Cherry Street sewer commencing at MH10 A per R.V.Anderson Associates design sheet

4/ "BFF discharge" refers to sludge underflow from the proposed Ballasted Flocculation Facility for stormwater treatment for West Don Lands, North Keating Area, East Bayfront and Lower Don Lands.

5/ Total BFF discharge to sanitary system estimated at 64 L/s, based on 16 L/s for WDL and NK2, plus 16L/s for EBF and NK1, and 32 L/s for LDL lands south of Keating Channel (per info from R.V. Anderson Assoc, March 2013)

6/ Assumed that BFF underflow discharge (64 L/s) is input to the new pumping station at 480 Lakeshore Blvd.

FUTURE POPULATION PROJECTIONS

		POPULATIONS (Full build-out)
	Land area	Residential
	ha	persons
EAST BAYFRONT		
Parkside	0.5	876
Quayside	2.4	3,844
Raptor	0.9	481
Bayside	5.1	2,870
EBF	8.9	8,071
NORTH KEATING AREA		
Bungee	2.2	1,698
Silo	2.2	1,585
3C	5.6	4,244
480 Lakeshore	9.0	4,207
NKA	19.0	11,734
EBF + NKA	27.9	19,805

NOTES:

(1) Populations for EBF (Parkside + Quayside + Raptor + Bayside) based on drawing SA1 from MMM Group's Feb 2013 report "Sanitary Servicing Analysis East Bayfront & Lower Don Lands" for Waterfront Toronto

(2) Populations for Bungee, Silo, 3C and 480 Lakeshore based on information included with WT East Bayfront Engineering/Public Realm Submission Technical Working Group Meeting 06 minutes Sept 12, 2012

EAST BAYFRONT and NORTH KEATING AREA SAN SERVICING TO CHERRY STREET SEWER

OPTION 1: Shallow sewer along Lakeshore Blvd replacing existing 300-mm pipe

Preliminary design profile for new sewer from Small Street, along Lakeshore Blvd to Cherry Street as replacement for existing 300-mm sewer pipe, including replacement of the run of 375-mm pipe up Cherry Street from Lakeshore Blvd to the south limit of the Cherry Street reconstruction contract just north of the rail corridor

Unit rates for average sewage flow:		
Residential	300	L/cap/day
Employment	250	L/cap/day
Extraneous inflow	0.26	L/s per ha

OPTION 1 SEWER along Lakeshore Blvd from Small Street to Cherry St						**EXISTING PIPE**							**Future Service Populations**			**Design Flow**				**PROPOSED REPLACEMENT PIPE**				Manning n = 0.013				
Street	**FROM**		**TO**		Notes	Length	U/S invert	D/S invert	Diam	Slope	V	Cap	Resid.	Employ't	Service Area	Peak sewage flow	Extraneous inflow	BFF underflow	**Design Flow**	Length	Pipe slope	U/S invert	D/S invert	Diam	V	Cap	U/S obvert	D/S obvert
		InfoWorks MH IDs		InfoWorks MH IDs			m	m	mm	m/m	m/s	L/s	persons	jobs	ha	L/s	L/s	L/s	**L/s**	m	m/m	m	m	mm	m/s	L/s	m	m
Lakeshore Blvd	A	3396615906 at Small Street	B	3400115979 (Parliament)	Small St storm/CSO pipe (2130x1520 conc box) has invert 72.54 and obvert 74.07, top of pipe estimated at 74.5 m	80.7	74.83	74.62	300	0.0027	0.71	50.0	8,071	1,423	8.9	102	2	0	**104**	80.7	0.0015	74.50	74.38	457	0.70	**115**	74.96	74.84
Lakeshore Blvd	B	3400115979	C	3400515990		12.3	74.59	74.53	300	0.0045	0.91	64.7	8,071	1,423	8.9	102	2	0	**104**	12.3	0.0015	74.26	74.25	457	0.70	**115**	74.72	74.70
Lakeshore Blvd	C	3400515990	D	3404016061		79.1	74.53	74.34	300	0.0024	0.67	47.6	8,071	1,423	8.9	102	2	0	**104**	79.1	0.0015	74.25	74.13	457	0.70	**115**	74.70	74.58
Lakeshore Blvd	D	3404016061	E	3407616146	Roughly mid-way between Parliament and Cherry	92.1	74.34	74.12	300	0.0023	0.66	46.6	8,071	1,423	8.9	102	2	0	**104**	92.1	0.0015	74.13	73.99	457	0.70	**115**	74.58	74.45
Lakeshore Blvd	E	3407616146	F	3411216229		90.2	74.12	73.90	300	0.0025	0.68	48.3	8,071	1,423	8.9	102	2	0	**104**	90.2	0.0015	73.99	73.85	457	0.70	**115**	74.45	74.31
Lakeshore Blvd	F	3411216229	G	3414016292		69.3	73.90	73.70	300	0.0029	0.73	51.7	8,071	1,423	8.9	102	2	0	**104**	69.3	0.0015	73.85	73.75	457	0.70	**115**	74.31	74.21
Lakeshore Blvd	G	3414016292	H	3416716342 at Lakeshore Blvd (300-mm pipe from south enters here)		57	73.70	73.60	300	0.0018	0.58	41.3	15,598	2,506	18.9	178	5	0	**183**	57.0	0.0015	73.55	73.46	610	0.85	**249**	74.16	74.07
Cherry Street	H	3416716342 at Lakeshore Blvd	I	3419116354 north side Lakeshore Blvd intersect (second 300-mm pipe from south enters here)	This pipe passes under the existing Cherry Street CSO pipe	26.5	73.60	73.35	300	0.0092	1.31	92.8	15,598	2,506	18.9	178	5	0	**183**	26.5	0.0015	73.43	73.39	610	0.85	**249**	74.04	74.00
Cherry Street	I	3419116354 north side Lakeshore Blvd intersect	J	Limit of Cherry St contract at approx STA 0+076	This pipe encased in mat foundation under Cherry Street rail overpass	60.4	73.35	73.28	375	0.0013	0.56	62.2	19,805	4,554	27.9	229	7	64	**300**	60.4	0.0015	73.39	73.30	686	0.92	**340**	74.08	73.99

APPENDIX F
COSTING DETAILS

TABLE F-1
Summary of Estimated Capital Costs

	Gravity Sewer	Forcemain	Pumping Station	Total Estimated Capital Cost
Option 1A	$ 1,867,450	$ 609,375	$ 3,666,000	**$ 6,142,825**
Option 1B	$ 1,867,450	$ 555,750	$ 3,666,000	**$ 6,089,200**
Option 2A	$ 9,330,750	$ 975,000	$ 4,349,000	**$14,654,750**
Option 2B	$ 9,048,000	$ 975,000	$ 4,349,000	**$14,372,000**

Estimated Extra Costs for Additional Site Investigations **$ 800,000**

Notes:

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TABLE F-2
Option 1A

New forcemain constructed on Bonnycastle and Lakeshore, and remove and replace existing gravity sewer on Lakeshore and connect to new Cherry St. Sewer.

Gravity Sewer

Street	From	To	Type	Diam mm	Length m	Unit price $/m	Cost	Engineering 10%	Contingency 20%	Total
Lakeshore Blvd.	MH 'A'	MH 'E'	Gravity sewer	450	81	$1,500	$121,500	$12,150	$24,300	$157,950
Lakeshore Blvd.	MH 'E'	MH 'F'	Gravity sewer	450	12	$1,500	$18,000	$1,800	$3,600	$23,400
Lakeshore Blvd.	MH 'F'	MH 'G'	Gravity sewer	450	79	$1,500	$118,500	$11,850	$23,700	$154,050
Lakeshore Blvd.	MH 'G'	MH 'H'	Gravity sewer	450	92	$1,500	$138,000	$13,800	$27,600	$179,400
Lakeshore Blvd.	MH 'H'	MH 'I'	Gravity sewer	450	90	$1,500	$135,000	$13,500	$27,000	$175,500
Lakeshore Blvd	MH 'I'	MH 'J'	Gravity sewer	450	69	$1,500	$103,500	$10,350	$20,700	$134,550
Lakeshore Blvd	MH 'J'	MH 'K'	Gravity sewer	600	57	$1,750	$99,750	$9,975	$19,950	$129,675
Cherry Street	MH 'K'	MH 'L'	Gravity sewer	600	27	$1,750	$47,250	$4,725	$9,450	$61,425
Cherry Street	MH 'L'	MH 'M'	Gravity sewer	600	60	$1,750	$105,000	$10,500	$21,000	$136,500
Premium for open cut construction under CN Rail overpass							$150,000	$15,000	$30,000	$195,000
Utility coordination, protection and relocation							$400,000	$40,000	$80,000	$520,000
						Total Cost	**$1,436,500**			**$1,867,450**

Forcemain

Forcemain from Bonnycastle PS to MH 'A'			
Design flow	115	L/s	
Design Capacity	125	L/s	
Max allow Veloc	2.5	m/s	
F/M nom. diameter (single main)	300	mm	(HDPE DR 11)

Street	From	To	Type	Length of Section	Unit price	Cost	Engineering 10%	Contingency 20%	Total
Bonnycastle/Lakeshore	Bonnycastle PS	MH 'A'	Forcemain	375	$1,250	$468,750	$46,875	$93,750	$609,375
					Total Cost	**$468,750**			**$609,375**

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TABLE F-3
Option 1B

New forcemain constructed on Queens Quay and Small St., and remove and replace existing gravity sewer on Lakeshore and connect to new Cherry St. Sewer.

Gravity Sewer

Street	From	To	Type	Diam mm	Length m	Unit price $/m	Cost	Engineering 10%	Contingency 20%	Total
Lakeshore Blvd.	MH 'A'	MH 'E'	Gravity sewer	450	81	$1,500	$121,500	$12,150	$24,300	$157,950
Lakeshore Blvd.	MH 'E'	MH 'F'	Gravity sewer	450	12	$1,500	$18,000	$1,800	$3,600	$23,400
Lakeshore Blvd.	MH 'F'	MH 'G'	Gravity sewer	450	79	$1,500	$118,500	$11,850	$23,700	$154,050
Lakeshore Blvd.	MH 'G'	MH 'H'	Gravity sewer	450	92	$1,500	$138,000	$13,800	$27,600	$179,400
Lakeshore Blvd.	MH 'H'	MH 'I'	Gravity sewer	450	90	$1,500	$135,000	$13,500	$27,000	$175,500
Lakeshore Blvd	MH 'I'	MH 'J'	Gravity sewer	450	69	$1,500	$103,500	$10,350	$20,700	$134,550
Lakeshore Blvd	MH 'J'	MH 'K'	Gravity sewer	600	57	$1,750	$99,750	$9,975	$19,950	$129,675
Cherry Street	MH 'K'	MH 'L'	Gravity sewer	600	27	$1,750	$47,250	$4,725	$9,450	$61,425
Cherry Street	MH 'L'	MH 'M'	Gravity sewer	600	60	$1,750	$105,000	$10,500	$21,000	$136,500
Premium for open cut construction under CN Rail overpass							$150,000	$15,000	$30,000	$195,000
Utility coordination, protection and relocation							$400,000	$40,000	$80,000	$520,000
						Total Cost	**$1,436,500**			**$1,867,450**

Forcemain

Forcemain from Bonnycastle PS to MH 'A'			
	Design flow	115	L/s
	Design Capacity	125	L/s
	Max allow Veloc	2.5	m/s
	F/M nom. diameter (single main)	300	mm (HDPE DR 11)

Street	From	To	Type	Length of Section	Unit price	Cost	Engineering 10%	Contingency 20%	Total
Queens Quay/Small St.	Bonnycastle PS	MH 'A'	Forcemain	342	$1,250	$427,500	$42,750	$85,500	$555,750
					Total Cost	**$427,500**			**$555,750**

Notes:
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TABLE F-4
Option 2A

New gravity sewer constructed in Microtunnel along Lakeshore Blvd. and connect to new Cherry St. P.S.

Gravity Sewer

Street	From	To	Type	Diam mm	Length m	Unit price $/m	Cost	Engineering 10%	Contingency 20%	Total
Bonnycastle St.	Queens Quay	Lakeshore Blvd.	Gravity sewer	450	124	$7,500	$930,000	$93,000	$186,000	$1,209,000
Lakeshore Blvd.	Bonnycastle St.	Small St.	Gravity sewer	450	231	$7,500	$1,732,500	$173,250	$346,500	$2,252,250
Lakeshore Blvd.	Small St.	Parliament St.	Gravity sewer	450	118	$7,500	$885,000	$88,500	$177,000	$1,150,500
Lakeshore Blvd.	Parliament St.	MH 'F'	Gravity sewer	600	180	$7,500	$1,350,000	$135,000	$270,000	$1,755,000
Lakeshore Blvd	MH 'F'	MH 'G'	Gravity sewer	600	222	$7,500	$1,665,000	$166,500	$333,000	$2,164,500
Lakeshore Blvd	MH 'G'	Cherry St. PS	Gravity sewer	600	82	$7,500	$615,000	$61,500	$123,000	$799,500
						Total Cost	**$7,177,500**			**$9,330,750**

* - Diameter shown is minimum required, unit price is based on microtunnel installation of 900mm diam.

Forcemain

Forcemain from Cherry St. PS to new Cherry St. sewer		
Design flow	300	L/s
Design Capacity	325	L/s
Max allow Veloc	2.5	m/s
F/M nom. diameter (single main)	500	mm (HDPE DR 11)

Street	From	To	Type	Length of Section	Unit price	Cost	Engineering 10%	Contingency 20%	Total
Cherry St	Lakeshore Blvd	New 1800mm MH	Forcemain	140	$1,250	$175,000	$17,500	$35,000	$227,500
New 1800mm MH						$25,000	$2,500	$5,000	$32,500
Premium for open cut construction under CN Rail overpass						$150,000	$15,000	$30,000	$195,000
Utility coordination, protection and relocation						$400,000	$40,000	$80,000	$520,000
					Total Cost	**$750,000**			**$975,000**

Notes:
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- Excluded from estimates are applicable taxes, legal fees, property requirements, geotechnical, hydrogeological, surveying, subsurface utility investigation, permits, landscaping, etc.
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TABLE F-5
Option 2B

New gravity sewer constructed in Microtunnel along Queens Quay, Small St. and Lakeshore Blvd. and connect to new Cherry St. P.S.

Gravity Sewer

Street	From	To	Type	Diam * mm	Length m	Unit price $/m	Cost	Engineering 10%	Contingency 20%	Total
Queens Quay	Bonnycastle St.	Small St.	Gravity sewer	450	206	$7,500	$1,545,000	$154,500	$309,000	$2,008,500
Small St.	Queens Quay	Lakeshore Blvd.	Gravity sewer	450	120	$7,500	$900,000	$90,000	$180,000	$1,170,000
Lakeshore Blvd.	Small St.	Parliament St.	Gravity sewer	450	118	$7,500	$885,000	$88,500	$177,000	$1,150,500
Lakeshore Blvd.	Parliament St.	MH 'F'	Gravity sewer	600	180	$7,500	$1,350,000	$135,000	$270,000	$1,755,000
Lakeshore Blvd	MH 'F'	MH 'G'	Gravity sewer	600	222	$7,500	$1,665,000	$166,500	$333,000	$2,164,500
Lakeshore Blvd	MH 'G'	Cherry St. PS	Gravity sewer	600	82	$7,500	$615,000	$61,500	$123,000	$799,500
						Total Cost	**$6,960,000**			**$9,048,000**

* - Diameter shown is minimum required, unit price is based on microtunnel installation of 900mm diam.

Forcemain

Forcemain from Cherry St. PS to new Cherry St. sewer		
Design flow	300	L/s
Design Capacity	325	L/s
Max allow Veloc	2.5	m/s
F/M nom. diameter (single main)	500	mm (HDPE DR 11)

Street	From	To	Type	Length of Section	Unit price	Cost	Engineering 10%	Contingency 20%	Total
Cherry St	Lakeshore Blvd	New 1800mm MH	Forcemain	140	$1,250	$175,000	$17,500	$35,000	$227,500
New 1800mm MH						$25,000	$2,500	$5,000	$32,500
Premium for open cut construction under CN Rail overpass						$150,000	$15,000	$30,000	$195,000
Utility coordination, protection and relocation						$400,000	$40,000	$80,000	$520,000
					Total Cost	**$750,000**			**$975,000**

Notes:
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- Unit Prices are based on unit prices in "Waterfront Sanitary Master Servicing Plan Class EA - Project Report" - Oct. 17, 2012. Some adjustments have been made to suit site conditions and new information available.
- Excluded from estimates are applicable taxes, legal fees, property requirements, geotechnical, hydrogeological, surveying, subsurface utility investigation, permits, landscaping, etc.
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Table F-6

Bonnycastle SPS - Options 1A/1B
Preliminary Cost Estimate

Component	Itemized Costs	Construction Cost Estimate
Total Architectural:		$ 80,000.00
Total Site Works (incl. shoring and excavation, etc.):		$ 800,000.00
Structural (including excavation)		
Wet Well (Wall, Roof and Base Slab)	$ 750,000.00	
Building (Wall, Roof, and Base Slab)	$ 200,000.00	
Roofing, Doors and Hatches	$ 50,000.00	
Total Structural:		$ 1,000,000.00
Building Mechanical:		
Plumbing	$ 20,000.00	
Fire Protection	$ 10,000.00	
HVAC	$ 80,000.00	
HVAC Controls	$ 20,000.00	
Installation & Testing	$ 97,500.00	
Total Mechanical:		$ 227,500.00
Total Electrical and I&C (incl. backup power)		$ 332,500.00
Process Mechanical		
3 Pumps (each pump 58 L/s @ TDH 14.9m)	$ 120,000.00	
Station Piping and Valves	$ 80,000.00	
Installation & Testing	$ 150,000.00	
Total Process Mechanical:		$ 350,000.00
Subtotal:		$ 2,790,000.00
Contingency for Disposal of Hazardous Material ($250/m^3)		$ 30,000.00
Contingency and Engineering (30%)		$ 846,000.00
Subtotal:		$ 3,666,000.00

Notes:

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- Unit Prices are based on unit prices in "Waterfront Sanitary Master Servicing Plan Class EA - Project Report" - Oct. 17, 2012. Some adjustments have been made to suit site conditions and new information available.
- Excluded from estimates are applicable taxes, legal fees, property requirements, geotechnical, hydrogeological, surveying, subsurface utility investigation, permits, landscaping, etc.
- This estimate does not include for any unforeseen conditions.
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Table F-7

Cherry Street SPS - Options 2A/2B
Preliminary Cost Estimate

Component	Itemized Costs	Construction Cost Estimate
Total Architectural:		$ 80,000.00
Total Site Works (incl. shoring and excavation, etc.):		$ 1,000,000.00
Structural (including excavation)		
Wet Well (Wall, Roof and Base Slab)	$ 900,000.00	
Building (Wall, Roof, and Base Slab)	$ 200,000.00	
Roofing, Doors and Hatches	$ 50,000.00	
Total Structural:		$ 1,150,000.00
Building Mechanical:		
Plumbing	$ 20,000.00	
Fire Protection	$ 10,000.00	
HVAC	$ 100,000.00	
HVAC Controls	$ 20,000.00	
Installation & Testing	$ 112,500.00	
Total Mechanical:		$ 262,500.00
Total Electrical and I&C (incl. backup power)		$ 367,500.00
Process Mechanical		
3 Pumps (each pump 150 L/s @ TDH 15.5m)	$ 150,000.00	
Station Piping and Valves	$ 100,000.00	
Installation & Testing	$ 187,500.00	
Total Process Mechanical:		$ 437,500.00
Subtotal:		$ 3,297,500.00
Contingency for Disposal of Hazardous Material ($250/m^3)		$ 47,500.00
Contingency and Engineering (30%)		$ 1,004,000.00
Subtotal:		$ 4,349,000.00

Notes:

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