WEST VILLAGE (PORT CREDIT)

PORT CREDIT WEST VILLAGE PARTNERS INC.

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

City of Mississauga
70 Mississauga Road South / 181 Lakeshore Road West
City File Numbers OP/OZ 17-12 and 21T-M 17004
Project Number 16-489
March 1st, 2018
Revised November 2018

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FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

This report provides functional servicing design and stormwater management information in support of proposed Official Plan and Zoning By-Law Amendment applications and Draft Plan of Subdivision for the subject lands. This report fulfils DARC 17-201 W1 submission requirements and addresses City of Mississauga comments related to grading, servicing, drainage, stormwater management and LID measures regarding City File 21T-M 170044. The servicing and development strategies presented in this report have been developed in conjunction with the greater consulting team and should be considered in conjunction with their work. The following studies are included in the appendices:

- *Final Report - Geotechnical Feasibility Study (Stantec, 2018)*
- *Watermain Hydraulic Modelling Analysis – (AECOM, 2018)*

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CONTENTS

INTRODUCTION

Urbantech Consulting has been retained by Port Credit West Village Partners Inc. to prepare a preliminary engineering design and functional servicing report for the former Imperial Oil property located at 70 Mississauga Road South and 181 Lakeshore Road West in the City of Mississauga, Region of Peel.

This report is applicable to any future revisions to the Draft Plan, assuming the revisions are in general conformance with the land use, servicing and stormwater management concepts outlined herein. The design information presented in this report considers the following guidelines:

- *City of Mississauga Engineering Standard Drawings Manual*
- *Credit Valley Conservation Authority Stormwater Management Criteria Document (August 2012)*
- *Draft Ministry of the Environment and Climate Change LID SWM Guidance Manual (2017)*
- *Regional Municipality of Peel PW Design Specifications and Procedures*
- *Stormwater Management Planning and Design Manual by the Ministry of Environment and Climate Change; (March 2003)*

The subject property is approximately 29 hectares (72.0 acres) and is located in the City of Mississauga. The site was formerly used by Imperial Oil for refinery and other industrial uses (including a brickworks facility). Currently, the site is undergoing active environmental remediation but was previously generally covered in low lying vegetation and some remnant roads, parking areas, a former service building and remnants of a gas service station. The site is bounded by:

- Lakeshore Road West to the north;
- Mississauga Road to the east;
- A strip of waterfront land to the south (not subject to this applications); and
- Existing residential lands with frontages on Pine Avenue to the west.

Figure 1 illustrates the location of the site. The legal description of the site is All of Lot 10, Part of Lots 9 and 11 and Water Lot Location in Front of Lot 9, Broken Front Range, Credit Indian Reserve (Geographic Township of Toronto), in the City of Mississauga, Regional Municipality of Peel.

The strip of waterfront lands abutting Lake Ontario are not part of this application but have been considered with respect to the related grading and servicing constraints.

The proposed development will proceed under an Official Plan Amendment, Rezoning and Plan of Subdivision processes. Subsequent site plan applications for the private blocks will be submitted once the process is further advanced.

SITE STATS

Location:
Lakeshore Road West & Mississauga Road

Existing Site / Drainage Area:
Approx. 29 ha

Subwatershed:
Credit River / Lake Ontario

Owner:
Port Credit West Village Partners Inc.

EXISTING CONDITIONS

Land Use & Topography

The majority of the site is undergoing an active environmental remediation program. Previously, the site was covered in vegetation with some areas of asphalt/concrete and remnants of the former industrial use. There is an existing shale pond located in the southern portion of the site which was the former extraction pit for the brickworks and then functioned as a stormwater management pond during oil refinery operations. Throughout the site there are multiple monitoring wells used to monitor the environmental conditions / quality of the groundwater.

A topographical survey of the subject lands was completed by JD Barnes in February of 2017. The site generally falls from Lakeshore Road to Lake Ontario with a maximum grade change of approximately 7m. Along the western boundary, an existing 3m high berm separates the rear yards of the existing residences on Pine Avenue South from the subject lands. The average slope from Lakeshore Road to the south property limit is approximately 1.5%.

Figure 3 illustrates the existing site features, topography and drainage patterns.

Shoreline

Lands adjacent to Lake Ontario are regulated by the Credit Valley Conservation Authority (CVCA). Limits of the Regulated Area are shown on **Figure 5**. The development will require new storm sewers discharging directly to Lake Ontario. All works within the regulated area will include appropriate shoreline protection, restoration and E&SC measures. Based on comments received to date, CVCA and Provincial approvals will be required for the proposed shoreline alterations and will obtained through the detailed design process. This process is currently underway.

The waterfront lands directly to the south of the site adjacent to Lake Ontario are owned by the Crown and not subject to this application. Discussions with the City related to the shoreline are ongoing.

Soil Conditions

Stantec Consulting has been retained by Port Credit West Village Partners Inc. to investigate the geotechnical conditions of the site. Stantec has provided a final report titled “Geotechnical Feasibility Study – Development of 70 Mississauga Road South, City of Mississauga, ON” (November 1st, 2018) that provides a detailed discussion of geotechnical site conditions. The report states that the site is located in the Iroquois Plain and that the soil stratigraphy in this area is generally characterized by clay till overlain by sand. Underlying bedrock comprises shale and limestone of the Georgian Bay Formation.

- The overburden consisted of sand with gravel, sandy silt, sandy clay with gravel, clay with sand or clay, underlain by native clay to clay with sand to clay with gravel
- The overburden was underlain by slightly to highly weathered shale bedrock.
- Depth of bedrock ranged from 1.2m to 11.0m below existing grade and certain areas may require rock-breaking equipment for excavation.

Stantec (on behalf of Port Credit West Village Partners Inc.) has prepared a detailed environmental remediation program to be undertaken on site. This program consists primarily of conventional excavation and disposal of impacted materials at approved facilities and the completion of Risk Assessments, as per Ontario Regulation 153/04, as amended.

Efforts will be made to re-use in-situ soil where possible. In-situ soil re-use will be finalized during the detailed earthwork design.

Groundwater was encountered in both the overburden and the bedrock:

- Median depth of 2.0 m below existing grade, with a maximum depth of 6.0 m below existing grade in the overburden.
- Median depth of 4.0 m below existing grade; maximum depth of 16.0 m below existing grade in the bedrock.

Please refer to Appendix A for further information.

Existing Drainage

Drainage from the existing site is generally north to south, towards the lake. The majority of the site drainage is intercepted by the existing Shale Pond on the subject lands.

In terms of external drainage, Lakeshore Road West is urbanized and drains via storm sewers to the existing Mississauga Road storm sewer system. A 1050mm diameter storm sewer on Mississauga Road collects drainage from Lakeshore Road West and the existing developments east of Mississauga Road (approximately 13.65 ha). This sewer extends beneath the waterfront trail and discharges to the lake via a headwall.

Refer to Figure 3 for the existing site drainage.

SOILS

Topsoil Depth:

Varies

Predominant Soils:

Clay till / sand & Bedrock (1.2m -11.0m below ground)

Groundwater depth:

0.0m – 6.0m (overburden)

0.1m – 16.0m (bedrock)

DEVELOPMENT CONCEPT

Draft Plan

As shown on **Figure 2**, the proposed 29.0 ha development consists of several public right-of-ways and private site plan blocks, including:

- Mixed use blocks including a campus
- High density residential blocks
- A commercial development block
- Park blocks / Open space
- Public ROWs

The proposed development will be advanced through both Draft Plan of Subdivision approval process and the Site Plan approval process for the individual private site plan blocks. The Subdivision components will consist of the public ROW areas, open space blocks, and services. Right of Way cross sections have been prepared and are included in **Appendix E**. These cross sections have been developed to support the proposed surface and sub surface treatment of the various right of ways. The cross sections are the result of extensive consultation with the City of Mississauga, Region of Peel, CVCA and relevant utility companies.

Refer to Figure 4 – Concept Plan

Conceptual Development Phasing

Currently the project is proposed to be developed in 4 phases. Servicing infrastructure is designed to facilitate the proposed phasing and provide flexibility should the phasing be altered. The current phasing is based on the anticipated development schedule provided by Port Credit West Village Partners Inc. and may change through the approval process.

External servicing works are required for the proposed development to proceed. These include a new sanitary sewer from the development lands to the existing Front Street Sanitary Pump Station (SPS), a new storm sewer within Mississauga Road from Lakeshore Drive to Lake Ontario and a storm outfall through the central portion of the site to Lake Ontario.

If required, the Phase 1 mixed-use block can be serviced independently in advance of the proposed subdivision through storm, sanitary and water connections to the existing municipal infrastructure within Mississauga Road and Lakeshore Road. Consequently, an interim storm servicing strategy may be pursued for the Phase 1 mixed-use block (Block 4 on the Draft Plan). This interim servicing strategy may consist of a temporary pond located on the subject lands.Any interim servicing strategies will comply with all relevant city and agency criteria.

Refer to Figure 5 – Proposed Conceptual Phasing Plan

GRADING

The proposed conceptual grading for the development will be designed in accordance with City of Mississauga standards. Grading is generally governed by the existing boundary conditions. Site grading has also been designed to ensure that adequate cover over proposed services is maintained. With the exception of the proposed Mississauga Road grading, no external grading works are proposed.

A preliminary grading concept plan has been prepared for the subject lands based on the following engineering constraints:

- Storm sewer outlet elevations;
- Major system drainage paths;
- Provision of minimum cover over services where feasible;
- Proposed road patterns and land use;
- Elevations along boundary roads, property lines and waterfront trail; and,
- Application of the City of Mississauga standards.

The grading plans are consistent with the City standards with respect to minimum / maximum slopes and cover requirements. In general, grading of all proposed roads and site plan blocks adjacent to the surrounding development and roads matches the existing grades or the ultimate anticipated grades at the property line, as appropriate.

As noted in the preceding section, a considerable amount of soil will be removed from the lands as part of an environmental remediation program. The site grading design minimizes the overall site earthworks program once impacted soils are removed and will continue to be refined to maximize the sustainable reuse of soils within the property.

Refer to Drawing GR-1 for further details.

SANITARY SERVICING

Existing & Future Infrastructure

There are two existing sanitary pump stations (SPS) in the vicinity of the subject lands.

The Ben Machree SPS is located to the south west of the subject site on Ben Machree Drive and services a relatively small drainage area representing approximately 140 residential lots. The Region of Peel identified that it has minimal excess service capacity available to increase its service area (refer to correspondence in **Appendix B)**.

The Front Street SPS is located to the east of the subject site at the southeast corner of Lakeshore Road and Front Street and services a 166 hectare drainage area representing a mixture of residential and commercial lands. The Region of Peel identified that this pump station has significant excess service capacity available to service the subject site (refer to correspondence in **Appendix B** for details).

The Region of Peel has identified the need to upgrade the wastewater infrastructure and has identified that a new large trunk sanitary sewer will be constructed along the frontage of the site. One of the outcomes is to remove the requirement for the existing SPS in the area. The proposed Lakeshore Trunk is currently in the Environmental Assessment (EA) process and is anticipated to be submitted to the MOE in 2018 with approvals expected later that year. The Region's Draft Master Plan identifies this as Project WW-ST-163 with a planned in service date of 2022.

There are existing sanitary mains surrounding the site which provide servicing to the existing drainage area, namely:

- the 350mm and 375 mm sanitary sewers on Lakeshore Road West
- a 250 mm sanitary sewer on Mississauga Road
- a 250 mm sanitary sewer on Port Street
- a 250 mm sanitary sewer on Bay Street
- the 250 mm, 300 mm and 375 mm sanitary sewers within Front Street

Refer to Drawing SAN-1 and Appendix B for further details.

Proposed Sanitary Drainage

A review of the 2013 Region of Peel Water and Wastewater Master Plan indicates that the Front Street SPS has excess/available capacity of approximately 200 L/s (i.e., the difference between the firm capacity of 276 L/s, and present-day peak wet weather flow of 76 L/s).

The existing sanitary sewers on Lakeshore Road, Mississauga Road, Port Street and Front Street do not have adequate capacity to convey the proposed sanitary flows to the Front Street SPS. It is proposed that a new 525 mm sanitary sewer be constructed along Port Street and Front Street as an outfall for the subject lands replacing the existing 250 mm sanitary sewer. Refer to **Drawing SAN-1** for the proposed sanitary sewer location. There is some available capacity in the surrounding network and the opportunity to utilize components of the existing sewer system will be further reviewed at the detailed design stage.

SANITARY DESIGN CRITERIA

Average Dry Weather Flow:

302.8 L/c/day

Infiltration / Inflow:

0.2 L/s/ha

Peaking Factor:

Harmon Formula (Section 2.2 in Region Design Criteria)

Population (people per ha):

Semi-detached – 70

Row Dwellings – 175

Apartment – 475

Commercial - 50

(people per unit):

Apartments – 2.7

Based on a review of the available as-constructed information (refer to **Appendix B**), the subject lands can be serviced entirely by gravity sewers to the Front Street SPS (although private pumping within the site plan blocks may be necessary depending on evolving site plan concepts and depths of underground parking structures).

Wastewater infrastructure will be designed in accordance with the latest Region of Peel standards and specifications.

Sanitary sewer design sheets have been prepared and used to size proposed sanitary sewers for the proposed development. The population is estimated using the population equivalent densities per the Region of Peel standards. Using a rate of 2.7 people per unit (ppu), whenever the proposed population equivalent is greater than the population equivalents based on land use, the calculated population equivalent was used for design.

Population Estimates and Sanitary Design Sheets can be found in **Appendix B.**

Based on the above criteria and the proposed external improvements it has been determined that there is sufficient capacity to service the subject lands as the proposed development generates approximately **90.3 L/s** of additional peak flow to the Front Street SPS, which would result in a total peak wet weather flow of **166.3 L/s** (90.3 L/s proposed + 76 L/s existing).

A preliminary profile of the proposed 525 mm sanitary sewer and pictures of the proposed route are included in **Appendix B**.

Refer to Drawing SAN-1 for further details.

Timing Implications

With the exception of the proposed 525 mm sanitary outfall to the Front Street SPS which will be constructed by the proponent, all necessary sanitary infrastructure is in place and available to service the subject lands. The 450 mm sanitary sewers (and larger) qualify for development credits under the Region of Peel Capital Plan. Further discussions with the Region are required.

The Region's project WW-ST-163 is scheduled to be completed in 2022. This project is not required in order for the development of the subject lands to proceed.

As requested by the Region of Peel, the sanitary design calculations included in **Appendix B** have been designed using a 40 to 50% safety factor.

WATER DISTRIBUTION

Existing & Future Infrastructure

There are existing watermains on Lakeshore Road (300 mm and 400 mm) and Mississauga Road (300 mm).

The Region of Peel has identified the need to upgrade the water servicing in Pressure Zone 1 and has identified that a new 600 mm diameter watermain is to be constructed along Lakeshore Road from the subject lands easterly to the existing Lakeview Water Treatment Plant located south of Lakeshore Road on Cawthra Road. This new 600 mm diameter watermain is identified as Regional Project 18-1119 in the Region's 2015 Capital Budget and is funded through Development Charges. This watermain is expected to be in service by 2020.

*Refer to **Drawing WM-1** for further details.*

Proposed Water Infrastructure

AECOM was retained to carry out a detailed hydraulic analysis of the proposed developments impact on both existing and proposed infrastructure. The analysis includes design years of 2021, 2026, 2027 and 2041.

The analysis was based on Region of Peel 2016 design Criteria and the following criteria

All scenarios were modelled without the proposed 600 mm watermain on Lakeshore Road.

A network of municipal watermains is proposed throughout the subject lands. In accordance with AECOM's recommendations these have been proposed as 300 mm in diameter. The findings of the report indicate that the proposed development can be serviced without the proposed 600 mm watermain on Lakeshore Road, even under the 2041 maximum day demand conditions.

The Hydraulic Analysis Report is included in **Appendix F**.

Refer to Drawing WM-1 and Appendix F for further details.

WATER DESIGN CRITERIA

Minimum Pressure:

275 kPa (40 psi)

Maximum Pressure:

700 kPA (100 psi)

Maximum Velocity:

2.0 m/s

Fire Flow:

25,020 L/minute

417 L/s

Minimum Pressure

(max. day + fire flow):

140 kPa (20 psi)

STORM DRAINAGE

Existing Storm Infrastructure

An existing storm sewer within Mississauga Road runs along the length of the eastern boundary of the subject lands and discharges through an existing headwall into Lake Ontario. The existing Mississauga Road storm sewer increases in size from a 900 mm storm sewer to a 1050 mm storm sewer and receives drainage from Port Street, Bay Street, Lake Street Peter Street, and lands to the North of Lakeshore Road.

As shown on the existing storm sewer design sheet included in **Appendix D**, the minor system storm sewers within Mississauga Road are over capacity under existing conditions during the 10-year storm. The external drainage areas were delineated in consultation with the City of Mississauga and are based on the grading and minor system network of the surrounding area. The 10-year design storm peak flows from these external areas are greater than the capacity of the connected storm sewers draining to Mississauga Road

Despite the inability of the existing minor system storm sewers to convey the flows attributed to them in the design sheet, these contributing flows have not been reduced under proposed conditions in order to account for any future works that may expand the capacity of the minor system flows.

Minor & Major System

Storm servicing for the development will conform to City of Mississauga standards. Storm sewers will be designed to convey minor system flows resulting from the 10-year storm event for ultimate discharge to Lake Ontario.

The runoff coefficients were based on the proposed land use and the City standard runoff coefficients. The 100-year flows from the subject lands were calculated using the increased runoff coefficients (1.25 x $C_{10\text{-year}}$) as per the City requirements.

The proposed storm sewers within the subject lands will be designed to intercept the minor and some of the major system flows as shown on **Drawing STM-1** and **Drawing STM-2**. All major system flows will be captured prior to discharge into Lake Ontario via the western and eastern outlets. Portions of the site plan areas will require localized 100-year capture due to grading constraints. Areas with underground garages will receive 100-year capture into underground cisterns or other storage / LID measures as described in the ***Quantity Control*** section. These quantity control measures will release controlled flows (10-year post-development flow or lower) into the minor system on the public ROW. The 100-year capture areas for Port Credit West Village are shown on **Drawing STM-2.** The storm sewers have been sized assuming that none of the proposed LID measures reduce the flow directed to the proposed storm sewers.

Two design sheets are provided in **Appendix D.** The 10-year design sheet shows the minor system pipe flows during a 10-year storm event. The associated drainage areas for the 10-year design sheet are shown on **Drawing STM-1**. The '10-year+Constant Flow' design sheet shows the minor system pipes during a 100-year storm, including 100-year capture areas as shown on **Drawing STM-2**. Two separate outfalls to Lake Ontario are proposed to service the subject lands; a western headwall within the site boundary and an eastern headwall to replace the existing headwall serving the Mississauga Road sewer. These outfalls are highlighted on the design sheets described above,

WESTERN HEADWALL DRAINAGE

The western headwall will provide an outlet for the minor system drainage from the western portions of the site. The majority of the subject lands will discharge from the site through the western outlet. As mentioned above, some isolated areas within the site will capture the major system drainage (100-year flow) into the minor system. The high-rise blocks will control the 100-year flows on site and discharge to the minor system at the 10-year post-development design rate or lower as shown on **Drawing STM-2.** The remaining 100-year discharge from the western area will be conveyed to 100-year capture points along Street A and Street F before discharging to a proposed 1200 mm x 2400 mm box culvert. The box culvert has been sized to convey the 100-year flow through Block 22 to the western headwall. The ultimate location of the proposed box culvert will be determined in collaboration with the City of Mississauga Recreation and Parks Department and Engineering Department.

Detailed grading of the western headwall is provided on **Drawing GR-2**.

EASTERN HEADWALL DRAINAGE

As shown on **Drawing STM-2**, the eastern portion of the site will drain to an outfall on Mississauga Road. Mississauga Road is low relative to the rest of the site and drainage naturally flows to the east. A storm sewer is proposed to replace / upgrade the existing storm sewer on Mississauga Road. The proposed sewer has been designed to accommodate the existing drainage and post-development drainage from the development lands. As shown on **Drawing STM-2**, the minor system within this eastern section will convey the 100-year flows from specific areas that cannot drain overland due to grading constraints. As in the western portion of the site, the high-rise areas will control the 100-year flow and release to the minor system at the 10-year post-development peak flow rate or less. The major system flows from the rest of this area will drain overland to on-site 100-year capture points to prevent overland flow from discharging to the surface of Mississauga Road, for which major system capacity is limited.

An additional 100-year capture point is proposed at the southern end of Mississauga Road to capture the external 100-year drainage before it discharges into Lake Ontario. Analysis of this drainage scenario shows that the storm sewers downstream of the proposed capture point on Mississauga Road will have to be increased in size in order to accommodate the additional minor system flows from the subject lands and the 100-year flows from the external area. Under this scenario, the final leg of the Mississauga Road storm sewer will be increased from a 1050 mm circular pipe to a 1200 mm x 3000 mm box culvert. This upgrade would account for all additional drainage from the subject lands and 100-year capture from the external areas as shown on **Drawing STM-2**.

The existing eastern outlet is protected with an existing armour stone structure. The existing structure will be modified to accommodate appropriate headwalls for the proposed storm infrastructure. The proposed invert of approximately 75.0m is expected to locate the pipes well above the existing lake bottom and will reduce the likelihood of any sediment entering the pipe. The design of the shoreline works including outfall protection will be undertaken by others and coordinated with future submissions.

Detailed grading of the eastern headwall is provided on **Drawing GR-2**.

Internal ROW Conveyance and Capacity

The capacity of the proposed ROWs within the subject lands has been evaluated and will provide conveyance capacity for the major system flows (evaluated as the 100-year less 10-year storm flows). As shown in **Table STM-1** below, the conveyance capacity for all proposed ROW's is sufficient to convey the major system flows directed to them. Capacity calculations for the proposed ROWs are included in **Appendix C**. All ROW capacity calculations are based on the cross-section with the least paved roadway surface.

Table STM-1 shows the overland flow capacity of each of the proposed ROW's and the overland peak flow directed to each ROW. The results included in **Appendix C** show that each of the proposed ROWs will have sufficient capacity to convey the proposed overland flow. Note that the site plan areas with proposed on-site quantity control (to 10-year post-development rates) will not discharge any runoff to the public ROWs. The Mississauga Road contributing drainage area is entirely from external areas. No overland flows from the subject lands will discharge to Mississauga Road.

Table STM-1: ROW Conveyance Capacity and Overland Flow

Street Name	Roadway Width	Minimum Slope	Contributing Drainage Area (ha)	ROW Capacity (based on minimum slope / minimum section) (m^3/s)	Overland Peak Flow (m^3/s)
Street A (20m ROW)	6.6	0.5	2.52	0.556	0.330
Street B (22m ROW)	6.6	0.5	2.52	0.948	0.330
Street C (20m ROW)	6.6	0.5	0.233	0.948	0.034
Street D (19m ROW)	6.6	0.5	2.13	0.842	0.264
Street E (20m ROW)	6.6	0.5	0.47	0.539	0.069
Street F (19m ROW)	6.6	0.5	3.75	0.842	0.449
Mississauga Road (22m ROW)	8.0	0.5	12.84	1.512	1.401

*Overland Peak Flow calculations included in **Appendix C**

The overland peak flow for the internal ROWs was calculated based on the maximum contributing drainage area to that ROW.

Refer to Drawing STM-1, STM-2 and Appendix D for further details.

STORMWATER MANAGEMENT

Quantity Control

Due to the subject site's close proximity to Lake Ontario, quantity control is not required according to City and CVC guidelines. However, to minimize the size of storm infrastructure in the public ROWs and to optimize the performance of the proposed LIDs in the ROW, on-site control of the 100-year post-development flow to the 10-year post-development flow is proposed on select site plan blocks. Where storage / quantity control is not proposed (i.e., on the public ROWs), major system flows in excess of the 10-year storm event will be conveyed within the site to underground cisterns or to the proposed storm sewer outfalls to Lake Ontario via right-of-way's within the subject lands. Major system flows will be captured upstream of the outfall pipes. The location and inlet capacity of the 100-year capture points are shown on **Drawing STM-2**. The outfalls beneath the Water Front Trail will be sized for the 100-year flows.

Drainage from these blocks will be directed to cisterns / storage tanks and/or LID management practices through internal conveyance systems. While quantity control is not required for this site, underground cisterns will capture the 100-year flow from selected high-rise and mid-rise site plan areas and control the discharge to the 10-year post-development flow or lower. The storage and discharge targets for these site plan areas are shown in the table below and have been rounded down from the 10-year design storm peak flow in order to provide a feasible discharge target at the detailed design stage. Drainage collected by these LID BMPs may also be re-used for irrigation and other water re-use purposes.

Quantity control mechanisms will be finalized at the detailed design stage. The volume of these facilities may vary, however the total 100-year discharge from each site plan should equal the proposed release rate requirement listed in **Table SWM-1** below. As shown in **Table SWM-1** below, quantity control is not recommended on blocks that do not have high-rises due to the relatively low cost of foundation cisterns compared with other forms of quantity control.

Table SWM-1: Cistern Storage and Discharge Targets

Block Number	Contributing Drainage Area (ha)	Rational Method Release Rate (L/s)	Proposed Release Rate Requirement(L/s)	Proposed Volume (m^3)
1	0.45	111.65	110	95
2	0.67	166.24	165	135
3	0.85	210.90	210	170
4	1.98	491.26	490	325
5	0.60	148.87	145	125
6	0.28	69.47	65	65
7	0.43	106.69	105	90
9	0.56	138.94	135	120
10	1.17	290.29	290	220
11	1.22	302.70	300	225
13	0.77	191.84	190	160
14	0.87	215.86	215	170
16	0.39	96.76	95	85
17	0.37	91.80	90	80
18	2.10	521.04	520	360
Total	12.71			2425

The proposed quantity control volume and release rate targets were determined using EPASWMM.

The proposed site plan block quantity control facilities will ensure that rooftop flows, which do not need quality control, are not directed onto roadways where they would require treatment due to mixture with road runoff. Details related to the design and capacity of the proposed quantity control systems are included in **Appendix D**.

Quality Control

The standard MOECC stormwater management quality criteria for TSS removal apply to this site. Controls will be designed to provide an Enhanced Level of water quality protection to ensure removal of 80% of suspended solids.

Low-Impact Development (LID) best management practices (BMPs) are proposed to provide water quality improvements prior to drainage entering the storm sewer system by treating the 'first flush' of runoff. This 'first flush' of rainfall conveys the vast majority of pollutants that accumulate on roadways and paved areas, and consequently LID BMP quality control mechanisms are sized for minor design storm events. Oil Grit Separators (or other mechanical separators) may also provide quality control for the site plan block areas, however the use of potential LID measures can also address the City's target erosion control volume (10mm).

Quality control will be provided separately for the ROW areas and the development blocks. Drainage from the development blocks will receive 80% TSS removal through a combination of LIDs and / or OGS units prior to discharging to the public ROWs. By providing quality control for the site plan block areas prior to their discharge onto the ROWs, the ROW quality control measures may be sized for only the drainage generated on the ROWs.

Clean water from the site plan areas will be discharged directly into the storm sewer system within the ROW, and the ROW drainage will be treated by surface LID measures prior to discharge into the storm sewer. In effect, the storm sewer will be a "clean" pipe.

More details regarding quality control are provided in the ***Site Plan Block Control*** and ***Right-of-Way Control*** sections.

Erosion Control

Erosion control will be provided for each site plan block by capturing 10mm of rainfall and retaining it in LID BMP facilities or in the proposed underground cisterns. Recommendations for the erosion control storage on each site plan block are provided in ***Table SWM-2: Proposed Site Plan Control Requirements*** . The erosion control volume will have to be re-retained on site as opportunities for infiltrating the erosion control volume will be limited on the site plan areas due to underground parking structures and on-site soil contamination.

Erosion control will also be provided for the ROW areas. As described in the ***Right of Way Control*** section, LID BMPs proposed for the ROWs will retain and control 25mm of roadway drainage for the purposes of quality control, exceeding the erosion control requirement of 10mm. These areas are shown on **Drawing LID-1**.

Site Plan Control Guidelines

In order to ensure that future detailed site plan designs comply with the overall servicing strategy described in this report, requirements for the quantity control, erosion control, and quality control for each block have been established for the subject lands. These requirements ensure that the overland flow capacity and storm sewer capacity are not exceeded under the 100-year design storm event. The requirements are listed in the ***Table SWM-2: Proposed Site Plan Control Requirements*** included below.

As described in the ***Quantity Control*** section, quantity control for the high-rise blocks is proposed due to the ease and low cost of incorporating cisterns into the foundations of high-rise buildings. Control of the 100-year peak flow reduces the overland flow that must be conveyed by the ROWs. Additionally, as all the 100-year discharge from the site is captured into the minor system before leaving the property boundary, 100-year peak flow control also reduces the peak flow sent to the minor system during the 100-year design storm event. This is represented on the storm sewer design sheets included in **Appendix D**, where the discharge from the site plan blocks has been modelled as the 10-year design storm peak flow (no 100-year capture of constant flow, as the site plan blocks will discharge the 10-year post-development flow). The target discharge rates from each block have been rounded down to the nearest 5 l/s to provide a more practical discharge target for the future site plan block designs.

The quality control recommendations are intended to provide a feasible servicing strategy for each block which can comply with the 80%TSS removal requirement. These recommendations represent only one potential servicing strategy for compliance and may change at the detailed design stage. At the site plan approval stage, Oil Grit Separators (or other mechanical separators) may be selected as an alternative to or augmentation of the proposed LID BMPs if required to provide a treatment train capable of achieving 80% TSS removal.

Erosion control can be provided in the site plan areas through a combination of cistern control and LID BMP soil retention. Each site plan block will retain 10mm of rainfall for the purposes of erosion control, above and beyond any quantity control storage requirements established for each block. The Stormwater Management Model (SWMM) developed by the U.S. Environmental Protection Agency (EPA) was used to estimate the required storage and corresponding runoff reduction of the proposed cisterns. EPA SWMM is a "dynamic rainfall-runoff simulation model used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas" (EPA, 2010).The output for the cistern sizing is included in **Appendix D**.

The %TSS removal rates shown in the table below are based on the example LID footprints allocated for each block. Calculations supporting these %TSS removal rates are described in the sections below and are included in **Appendix C**.

Table SWM-2: Proposed Site Plan Control Requirements

Block ID	Draft Plan Assumptions for Storm Sewer Sizing and Quality Control Evaluation	Detailed Recommendations for Site Plan Design based on Modelling Results
1	Quantity Control:100-year post to 10-year post Q_{10} =111.65 L/s Based on rational rethod parameters A=0.45 ha, C= 0.9, Tc=15 min Q100 based on 4 hour Chicago distribution, A = 0.45 ha, %IMP =95	Target flow = 110 L/s Storage Required to release Q100 to 110 L/s - 95 m^3
	Erosion Control: Retain 10 mm on site	10 mm x 0.45 ha = 45 m^3 of LID storage to achieve 10 mm retention/detention
	Quality Control: 80% TSS Removal	Bioretention Footprint - 0.018 ha TSS Removal - 82% Allocation of LID areas is preliminary and based on achieving minimum 80% TSS removal. Final details to be confirmed during site plan approval.
2	Quantity Control:100-year post to 10-year post Q_{10} = 166.24 L/s Based on rational rethod parameters A=0.67 ha, C= 0.9, Tc=15 min Q100 based on 4 hour Chicago distribution, A = 0.67 ha, %IMP =95	Target flow = 165 L/s Storage Required to release Q100 to 165 L/s - 135 m^3
	Erosion Control: Retain 10 mm on site	10 mm x 0.67 ha = 67 m^3 of LID storage to achieve 10 mm retention/detention
	Quality Control: 80% TSS Removal	Bioretention Footprint - 0.030 ha TSS Removal - 84% Allocation of LID areas is preliminary and based on achieving minimum 80% TSS removal. Final details to be confirmed during site plan approval.
3	Quantity Control:100-year post to 10-year post Q_{10} =210.90 L/s Based on rational rethod parameters A=0.85 ha, C= 0.9, Tc=15 min Q100 based on 4 hour Chicago distribution, A = 0.85 ha, %IMP =95	Target flow = 210 L/s Storage Required to release Q100 to 210 L/s - 170 m^3
	Erosion Control: Retain 10 mm on site	10 mm x 0.85 ha = 85 m^3 of LID storage to achieve 10 mm retention/detention
	Quality Control: 80% TSS Removal	Bioretention Footprint - 0.030 ha TSS Removal - 84% Allocation of LID areas is preliminary and based on achieving minimum 80% TSS removal. Final details to be confirmed during site plan approval.
4	Quantity Control:100-year post to 10-year post Q_{10} = 491.26 L/s Based on rational rethod parameters A=1.98 ha, C= 0.9, Tc=15 min Q100 based on 4 hour Chicago distribution, A = 1.98 ha, %IMP =95	Target flow = 490 L/s Storage Required to release Q100 to 490 L/s - 325 m^3
	Erosion Control: Retain 10 mm on site	10 mm x 1.98 ha = 198 m^3 of LID storage to achieve 10 mm retention/detention
	Quality Control: 80% TSS Removal	OGS has been sized to provide 80% TSS removal

5	Quantity Control:100-year post to 10-year post Q_{10} =148.87 L/s Based on rational rethod parameters A=0.60 ha, C= 0.9, Tc=15 min Q100 based on 4 hour Chicago distribution, A = 0.60 ha, %IMP =95	Target flow = 105 L/s Storage Required to release Q100 to 105 L/s - 90 m^3
	Erosion Control: Retain 10 mm on site	10 mm x 0.43 ha = 43 m^3 of LID storage to achieve 10 mm retention/detention
	Quality Control: 80% TSS Removal	Green Roof Area - 0.100 ha Bioretention Footprint - 0.020 ha Permeable Paver Area - 0.050 ha TSS Removal - 87% Allocation of LID areas is preliminary and based on achieving minimum 80% TSS removal. Final details to be confirmed during site plan approval.
6	Quantity Control:100-year post to 10-year post Q_{10} = 69.47 L/s Based on rational rethod parameters A=0.28 ha, C= 0.9, Tc=15 min Q100 based on 4 hour Chicago distribution, A = 0.28 ha, %IMP =95	Target flow = 65 L/s Storage Required to release Q100 to 65 L/s - 65 m^3
	Erosion Control: Retain 10 mm on site	10 mm x 0.28 ha = 28 m^3 of LID storage to achieve 10 mm retention/detention
	Quality Control: 80% TSS Removal	Bioretention Footprint - 0.0110 ha TSS Removal - 81% Allocation of LID areas is preliminary and based on achieving minimum 80% TSS removal. Final details to be confirmed during site plan approval.
7	Quantity Control:100-year post to 10-year postQ_{10} =106.69 L/s Based on rational rethod parameters A=0.43 ha, C= 0.9, Tc=15 min Q100 based on 4 hour Chicago distribution, A = 0.43 ha, %IMP =95	Target flow = 105 L/sStorage Required to release Q100 to 105 L/s - 90 m^3
	Erosion Control: Retain 10 mm on site	10 mm x 0.43 ha = 43 m^3 of LID storage to achieve 10 mm retention/detention
	Quality Control: 80% TSS Removal	Green Roof Area - 0.080 ha Bioretention Footprint - 0.015 ha Permeable Paver Area - 0.250 ha TSS Removal - 88% Allocation of LID areas is preliminary and based on achieving minimum 80% TSS removal. Final details to be confirmed during site plan approval.
9.1	Quantity Control:100-year post to 10-year post Q_{10} = 138.94 L/s Based on rational rethod parameters A=0.56 ha, C= 0.9, Tc=15 min Q100 based on 4 hour Chicago distribution, A = 0.56 ha, %IMP =95	Target flow = 135 L/s Storage Required to release Q100 to 135 L/s - 120 m^3
	Erosion Control: Retain 10 mm on site	10 mm x 0.56 ha = 56 m^3 of LID storage to achieve 10 mm retention/detention
	Quality Control: 80% TSS Removal	Green Roof Area - 0.040 ha Bioretention Footprint - 0.00.085 ha Permeable Paver Area - 0.130 ha Vegetated Swale - 0.035 ha TSS Removal - 81% Allocation of LID areas is preliminary and based on achieving

		minimum 80% TSS removal. Final details to be confirmed during site plan approval.
10	Quantity Control:100-year post to 10-year post Q_{10} =290.29 L/s Based on rational rethod parameters A=1.17 ha, C= 0.9, Tc=15 min Q100 based on 4 hour Chicago distribution, A = 1.17 ha, %IMP =95	Target flow = 290 L/s Storage Required to release Q100 to 290 L/s - 220 m^3
	Erosion Control: Retain 10 mm on site	10 mm x 1.17 ha = 117 m^3 of LID storage to achieve 10 mm retention/detention
	Quality Control: 80% TSS Removal	Green Roof Area - 0.125 ha Bioretention Footprint - 0.040 ha Permeable Paver Area - 0.076 ha TSS Removal - 86% Allocation of LID areas is preliminary and based on achieving minimum 80% TSS removal. Final details to be confirmed during site plan approval.
11	Quantity Control:100-year post to 10-year post Q_{10} = 302.70 L/s Based on rational rethod parameters A=1.22 ha, C= 0.9, Tc=15 min Q100 based on 4 hour Chicago distribution, A = 1.22 ha, %IMP =95	Target flow = 300 L/s Storage Required to release Q100 to 300 L/s - 225 m^3
	Erosion Control: Retain 10 mm on site	10 mm x 1.22 ha = 122 m^3 of LID storage to achieve 10 mm retention/detention
	Quality Control: 80% TSS Removal	Green Roof Area - 0.173 ha Bioretention Footprint - 0.035 ha Permeable Paver Area - 0.030 ha TSS Removal - 84% Allocation of LID areas is preliminary and based on achieving minimum 80% TSS removal. Final details to be confirmed during site plan approval.
13	Quantity Control:100-year post to 10-year post Q_{10} = 191.84 L/s Based on rational rethod parameters A=0.77 ha, C= 0.9, Tc=15 min Q_{100} based on 4 hour Chicago distribution, A = 0.77 ha, %IMP =95	Target flow to minor system = 190 L/s Storage required to release Q100 to 190 L/s - 160 m^3
	Erosion Control: Retain 10 mm on site	10 mm x 0.77 ha = 77 m^3 of LID storage to achieve 10 mm retention/detention
	Quality Control: 80% TSS Removal	Green Roof Area - 0.046 ha Bioretention Footprint - 0.040 ha Permeable Paver Area - 0.110 ha Vegetated Swale - 0.024 ha TSS Removal - 80% Allocation of LID areas is preliminary and based on achieving minimum 80% TSS removal. Final design details to be confirmed during site plan approval.
14	Quantity Control:100-year post to 10-year postQ_{10} = 215.86 L/s Based on rational rethod parameters A=0.87 ha, C= 0.9, Tc=15 min Q100 based on 4 hour Chicago distribution, A = 0.87 ha, %IMP =95	Target flow = 215 L/sStorage Required to release Q100 to 215 L/s - 170 m^3
	Erosion Control: Retain 10 mm on site	10 mm x 0.87 ha = 87 m^3 of LID storage to achieve 10 mm retention/detention

	Quality Control: 80% TSS Removal	Bioretention Footprint - 0.030 ha Permeable Paver Area - 0.045 ha TSS Removal - 81% Allocation of LID areas is preliminary and based on achieving minimum 80% TSS removal. Final details to be confirmed during site plan approval.
16	Quantity Control:100-year post to 10-year post Q_{10} = 96.76 L/s Based on rational rethod parameters A=0.39 ha, C= 0.9, Tc=15 min Q_{100} based on 4 hour Chicago distribution, A = 0.39 ha, %IMP =95	Target flow to minor system = 95 L/s Storage required to release Q100 to 95 L/s - 85 m^3
	Erosion Control: Retain 10 mm on site	10 mm x 0.39 ha = 39 m^3 of LID storage to achieve 10 mm retention/detention
	Quality Control: 80% TSS Removal	Bioretention Footprint - 0.018 ha TSS Removal - 88% Allocation of LID areas is preliminary and based on achieving minimum 80% TSS removal. Final design details to be confirmed during site plan approval.
17	Quantity Control:100-year post to 10-year post Q_{10} = 91.80 L/s Based on rational rethod parameters A=0.37 ha, C= 0.9, Tc=15 min Q_{100} based on 4 hour Chicago distribution, A = 0.37 ha, %IMP =95	Target flow to minor system = 90 L/s Storage required to release Q100 to 90 L/s - 120 m^3
	Erosion Control: Retain 10 mm on site	10 mm x 0.37 ha = 37 m^3 of LID storage to achieve 10 mm retention/detention
	Quality Control: 80% TSS Removal	Green Roof Area - 0.037 ha Bioretention Footprint - 0.018 ha TSS Removal - 83% Allocation of LID areas is preliminary and based on achieving minimum 80% TSS removal. Final details to be confirmed during site plan approval.
18	Quantity Control:100-year post to 10-year post Q_{10} = 521.04 L/s Based on rational rethod parameters A=2.10 ha, C= 0.9, Tc=15 min Q_{100} based on 4 hour Chicago distribution, A = 2.10 ha, %IMP =95	Target flow = 520 L/s Storage Required to release Q100 to 520 L/s - 360 m^3
	Erosion Control: Retain 10 mm on site	10 mm x 2.10 ha = 210 m^3 of LID storage to achieve 10 mm retention/detention
	Quality Control: 80% TSS Removal	Green Roof Area - 0.200 ha Bioretention Footprint - 0.055 ha Permeable Paver Area - 0.250 ha TSS Removal - 86% Allocation of LID areas is preliminary and based on achieving minimum 80% TSS removal. Final details to be confirmed during site plan approval.
All Other Site Plan Blocks	Quantity Control: None	
	Erosion Control: Retain 10 mm on site	Possible erosion control strategies include: Soil retention in LID BMPs, rain barrels, erosion control storage tanks. To be determined at the site plan approval stage.
	Quality Control: 80% TSS Removal	Allocation of LID areas is preliminary and based on achieving minimum 80% TSS removal. Final details to be confirmed during site plan approval.

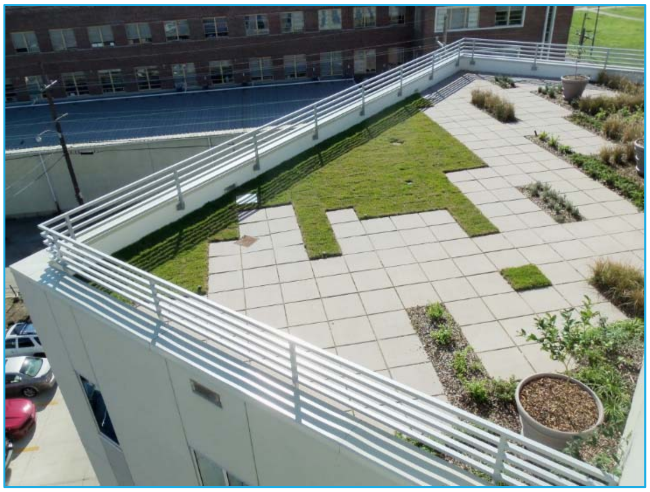
LID BMP SELECTION GUIDELINES

The LID areas described in the table above and shown on **Drawing LID-2** are provided to illustrate the feasibility of providing 80% TSS removal using LID BMPs. However, the proposed areas represent only one potential LID BMP allocation plan that could meet the requirement. The location and composition of the LID BMPs in the site plan blocks will be finalized for each site plan block during the Site Plan approval stage. Calculations supporting the LID strategy shown on **Drawing LID-2** and described in the table above are included in **Appendix C**.

LID BMPs for the site plan areas were screened for potential feasibility based on the proposed land uses, site design, grading, and budgetary constraints. In this functional servicing report, the following categories of LID BMPs have been allocated for the quality control within the Port Credit West Village site.

- Bio-Retention
- Bio-Swales
- Green Roofs
- Permeable Pavement

Each of these categories represents a range of possible technologies that fits a particular purpose. Bio-Retention facilities collect drainage in depressions and use vegetation to filter out particulates and hydrocarbons before discharging the drainage into the storm sewer system or to another LID BMP. Bio-Swales also provide vegetative filtration by conveying drainage through swales constructed from an engineered vegetative media. Permeable Pavements attenuate peak runoff flows by absorbing and infiltrating surface runoff from the overlying and surrounding areas. Green Roofs can consist of a variety of vegetative options that can provide benefits including stormwater controls, recreational spaces, heat dissipation, and air quality improvements.



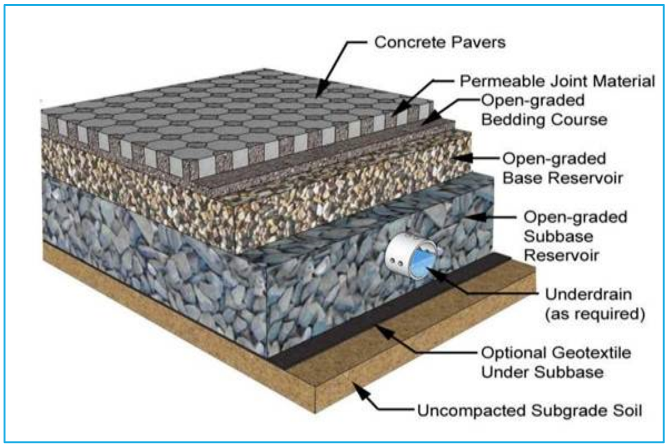
Aside from Green Roofs, each LID BMP is heavily dependent on detailed site grading, which dictates how much drainage is directed to the LID BMP. Different LID BMP categories have specific ratios of LID BMP footprint to contributing drainage area that the LID BMPs can provide full treatment for. In order to optimize the effectiveness of the LID BMPs allocated for the site, each block will have to be graded such that the correct amount of site drainage reaches each LID BMP feature. While preliminary grades have been produced, this finer level of detail will be achieved at the site plan approval stage. Care will be taken during detailed design to orient the LID BMPs such that major overland flows will bypass the LID BMP in order to mitigate erosion of the feature.

SITE PLAN LID BMP CONTROL STRATEGY

For this functional servicing report, preliminary LID BMP footprints have been determined for each site plan block based on municipal quality control criteria and the siting requirements of each LID BMP. The strategy used to determine these footprints is outlined below.

Green roof areas on high-rise and mid-rise building were sized such that only half of the available rooftop area is allocated for green roofs due to the need for rooftop utilities and servicing. The allocation of green roof areas within each block as shown in **Drawing LID-1** is preliminary and may change in future submissions, however the total green roof area throughout the site will likely remain the same. While green roofs may provide TSS removal through bio-filtration, the rooftop drainage directed to the proposed green roofs has not yet been exposed to ground-level contaminants and is therefore not considered in the TSS removal calculations. However, because rooftop and green roof drainage will be captured into proposed underground cisterns, this drainage is isolated from ground-level contaminants and will not require treatment by the proposed ground-level LID BMPs.

Permeable Pavement areas are allocated wherever they can be situated in the highest concentration to reduce installation costs and where vehicular traffic will be light to reduce compaction and future maintenance costs. According to CVC/TRCA design criteria, permeable pavements may provide 50% TSS removal if the contributing drainage area is 1.25 times the permeable pavement area. This criteria has been used in the LID BMP sizing chart included in Appendix C. As the permeable pavement areas will not provide sufficient TSS removal by themselves, they will be paired in a treatment train with additional LID BMPs at the detailed design stage.



Bio-Swales are located in areas with long and uninterrupted stretches of green space. According to CVC/TRCA design criteria and case studies, bio-swales may provide 76% TSS removal if the contributing drainage area is 10 times the bio-swale area. These swales will be used to collect and convey drainage within the residential block green space. As the bio-swales will not provide sufficient TSS removal by themselves, they will be paired in a treatment train with additional LID BMPs at the detailed design stage.

Bio-Retention cells were allocated to provide full treatment for the block area wherever possible. According to CVC/TRCA design criteria, Bio-Retention facilities can be designed to treat a contributing drainage area that is 15 times the size of the bio-retention footprint. The proposed bio-retention facilities have been sized to be 1/15th of the contributing block drainage area to maximize use of this particular BMP. While this standard ratio has been used in the site plan block analysis, it is a conservative estimate and may be increased at the detailed design stage as illustrated in the ***Bio-Retention Design Details*** section.

SITE PLAN LID PERFORMANCE ANALYSIS

On the Site Plan Block LID sizing sheet included in **Appendix C**, the contributing block drainage area is labelled C_{in}. The contributing block drainage area is not the entire area of the block. Areas such as rooftops and the LID footprint area do not require quality treatment and will therefore not be conveyed to the LID BMPs for quality control. The C_{in} area included in **Appendix C** is calculated as the total block area minus the sum of the LID area and the rooftop area which will be directed to rain barrels or cisterns for capture.

With conservative estimates of TSS removal efficiencies, 80% TSS removal is possible. However this may need to be supplemented with OGS units in certain areas. At the detailed design stage, further refinement of the LID design and simulation of TSS removal will be provided. If the treatment train efficiency can provide site-wide 80% TSS removal, it is possible that the OGS units will not be required.

All LID BMPs proposed for the site plan block areas and the municipal ROWs will be designed such that design storm flows from all paved surfaces are directed to LID features or into a nearby OGS system.

TREATMENT TRAIN ANALYSIS

LID BMP performance can be improved by incorporating each feature into a treatment train, where drainage from one feature is discharged into another feature. This configuration can compound the treatment provided. The ultimate TSS that results from a treatment train of LID BMPs can be represented by the following formula:

$$TSS_{final} = 1 - ((1 - \left(\frac{A_1}{A_t} * TSS_1\right) * (1 - \left(\frac{A_2}{A_t} * TSS_2\right) * (1 - \left(\frac{A_3}{A_t} * TSS_3\right)$$

TSS_n = % TSS removal from LID_n
A_1 = Contributing Area of First LID in the treatment train
A_t = Total contributing drainage area requiring treatment
A_2 = Area from A_1 that is also treated by LID_2
A_3 = Area from A_1 that is also treated by LID_3

This formula was used in the LID BMP tables in **Appendix C** only when drainage from one LID BMP drains directly to a second LID BMP.

Right-Of-Way Control Strategy

Bio-retention LIDs are proposed to provide quality control and erosion control for the ROW areas. Bio-retention cells were chosen for their high drainage area to cell area ratio, low maintenance requirements, and their ability to integrate into the municipal ROW. The footprint of these cell areas and their contributing drainage areas are shown on **Drawing LID-1**.

The LID BMPs proposed for the right-of-ways (ROWs) have been established in collaboration with CVC and a variety of agencies from the City of Mississauga. Fewer LID BMPs are feasible in the proposed ROWs than are available for the site plan areas due to the space and maintenance constraints inherent to municipal ROWs. The ROW bio-retention cells are designed to provide 80% TSS removal for the ROW area as per the MOECC 'Enhanced' water quality criteria. Per CVC/TRCA guidelines, 80% TSS removal will be provided by sizing the bio-retention cells such that they can store the 25mm event within the cell boundary and provide an acceptable drawdown time.

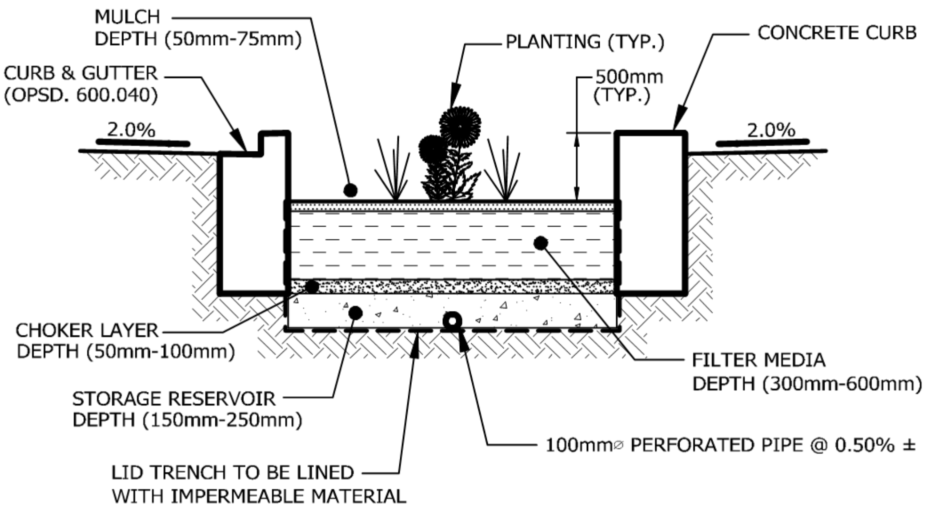
LID BMP discharge will be captured into the minor system within each block and will not drain onto the surface of the proposed right-of-ways. As mentioned above, this will prevent the treated drainage from being exposed to pollutants on the proposed right-of-ways and prevent the need to oversize quality control features intended for the treatment of right-of-way areas.

Details regarding the design of the proposed ROW bio-retention cells are provided in this submission to outline the feasibility and performance of these systems in response to City of Mississauga comments. As shown on **Drawing LID-1** and on the proposed ROW cross-sections in **Appendix C**, two varieties of bio-retention cells are proposed to accommodate municipal services, utilities, and parking areas. Both variations will be designed according to the same principles and guidelines, but vary in the orientation of their inlets and outlets. At the detailed design stage, each bio-retention cell will be designed to accommodate its contributing drainage area by controlling the depth of the filter media and the inlet capacity.

BIO-RETENTION DESIGN DETAILS

As shown in the cross-section below, the bio-retention cells will consist of four discrete layers above a perforated outlet pipe; pipe bedding, a "choker" layer, filter media, mulch, and surface ponding. The filter media will provide water quality improvement through the process of biofiltration. The "choker" layer will be composed of tight soils with a low void ratio and small particle size to prevent fine particles from the filter media from entering the pipe bedding and clogging the outlet pipe perforations. This choker layer will limit the rate of exfiltration from the system and ensure sufficient TSS removal in the filter media.

Bio-Retention Cell Cross-Section



Each bio-retention cell will be lined with an impermeable membrane to prevent infiltration per City of Mississauga recommendations. Drainage that enters the cells will be filtered as it percolates through the filter media and will discharge from the cell through a perforated pipe at the bottom of the cell.

The detailed bio-retention design sheet included in **Appendix C** illustrates that the infiltration rate through the choker layer is the controlling system exfiltration rate and not the capture capacity of the pipe perforations.

The perforated pipes at the base of the bio-retention cells will be sized for each cell at the detailed design stage, however preliminary analysis shows that a 100mm pipe will be able to convey the peak exnfiltration from the largest proposed bio-retention cells.

The mulch depth will be dictated by the optimal depth for the chosen plant species. The depth of the storage reservoir will be at minimum 150mm in order to ensure coverage of the perforated pipe.

The perforated pipe will connect to the catch-basin at the downstream end of each cell. Where possible, the downstream catch-basin will connect directly to a manhole in the municipal ROW. Otherwise the catch-basin will have a mainline connection to the municipal storm sewer. On ROWs where LIDs are present on both sides of the ROW, efforts will be made to ensure that the LID catch-basins are symmetrical on the ROW as shown on **Drawing LID-1**.

The target design criteria used for the bio-retention cells are listed below in **Table LID-1**.

Table LID-1: Bio-Retention Cell Design Targets

Parameter	Target
Required Storage Volume (m^3)	Retention of 25mm Event
Cell Depth (m)	Minimum Total Depth = 1m Minimum Filter Media Depth =0.5m
Allowable Ponding Depth (cm)	25
Surface Drawdown Time (hrs)	<4hrs
Cell Drawdown Time to Choker Layer (hrs)	<48hrs
Percolation Rate (m^3/s)	Less than the max flow through the perforated pipe.
Inlet Sizing	Inlet Capacity > 25mm Peak Flow
Perforated Pipe	Minimum 100mm Diameter
Mulch	Layer Void Ratio: 0.7 Permeability Coefficient (k)[mm/hr]: 233
Filter Media	Layer Void Ratio: 0.3 Permeability Coefficient (k)[mm/hr]: 200
Choker Layer	Layer Void Ratio: 0.2 Permeability Coefficient (k)[mm/hr]: 50
Reservoir Layer	Layer Void Ratio: 0.4 Permeability Coefficient (k)[mm/hr]: 1250

BIO-RETENTION CELL PERFORMANCE ANALYSIS

The performance of bio-retention cells can be estimated by the ratio between the contributing drainage area and the receiving bio-retention footprint area. This ratio will be referred to throughout this report as the "treatment ratio". In order to determine whether or not the proposed bio-retention areas can provide 80%TSS removal for their contributing drainage areas, two methods of analysis were used. First, the composite treatment ratio was determined for total bio-retention area on each ROW. These areas are shown on **Figure LID-1**. **Table LID-2** below lists these areas by ROW and provides the treatment ratios for each ROW. As some of the ROW areas cannot be captured due to the limited availability of ROW bio-retention areas in the proposed ROW cross-sections, the ratio between the total ROW area and the bio-retention area provided is also shown. These ratios illustrate the feasibility of providing quality control for the entirety of the proposed ROWs using only bio-retention facilities.

Table LID-2: Bio-Retention Cell – ROW Analysis

STREET-WIDE ANALYSIS	UNCONTROLLED AREA (m^2)	B-R AREA (m^2)	D.A (m^2)	Contributing Drainage Area to Bio-Retention Cell Area RATIO (Treatment Ratio 1)	Total Area to Bio-Retention Cell Area RATIO (Treatment Ratio 2)
STREET A	0	408	7892	19.3	19.3
STREET B	932	995	10660	10.7	11.7
STREET C	742	450	3571	7.9	9.6
STREET D	0	238	5496	23.1	23.1
STREET E	2154	329	3908	11.9	18.4
STREET F	0	238	5783	24.3	24.3
SITE TOTAL	3828	2658	37310	14.0	15.5

This composite analysis is representative of site-wide bio-retention performance. The depth of individual cells will be adjusted at the detailed design stage to accommodate the contributing drainage area.. As shown in the table above, the ROW with the greatest ratio of drainage area to bio-retention area is Street F. This means that Street F is the worst-case scenario based on a composite ROW analysis. A composite design of the Street F bio-retention facilities was performed to estimate the capacity of the proposed bio-retention areas to provide enhanced quality control (80% TSS removal) for the proposed ROWs. This analysis has been included in **Appendix C**. The composite Street F analysis shows that the bio-retention cells allocated for Street F can retain the 25mm event from the contributing 5783 m^2 area if the bio-retention cells have an average depth of 1.55 meters. This depth is within the range of acceptable depths outlined by CVC/TRCA and will allow for gravity discharge from the perforated pipes into the municipal ROW storm sewers.

As the treatment ratios (contributing drainage area vs. cell area) for the cells within each ROW area vary, the cell depth will need to be customized for each cell based on its contributing drainage to ensure that it can accommodate the 25mm event within the cell void space. While it was confirmed that the treatment ratio for the current bio-retention drainage area layout can provide sufficient treatment for the ROWs, a more thorough analysis will be performed at the detailed design stage as it will be dependent on final road grading.

While cell depth can be varied to accommodate more contributing drainage, a greater cell depth does not increase the cell infiltration rate. If the cumulative runoff volume directed to a cell exceeds the cells cumulative capture volume (infiltration rate x cell area x time), ponding occurs. The bio-retention design sheets included in **Appendix C** illustrate this on the drawdown time charts and performance table. The ponding depth is calculated by subtracting the cumulative captured volume from the cumulative runoff volume and dividing the result by the cell area. If the ponding depth exceeds 0.25m, the bio-retention cell will begin spilling water back onto the roadway and will not be able to capture the first 25mm of rainfall even if additional capacity is available in the cell void space.

Based on the bio-retention cell drainage areas shown on **Figure LID-1**, some bio-retention cells will exceed 0.25m of ponding and will spill into the downstream catch-basin. To determine the worst-case scenario for the proposed individual bio-retention cells, a site-wide analysis of the bio-retention areas was performed and is illustrated on **Figure LID-1**, which identifies the bio-retention cells with the worst treatment ratio on each ROW. These areas are shown in **Table LID-3** below.

Table LID-3: Controlling Catchment Analysis

CONTROLLING CATCHMENT ANALYSIS			
CONTROLLING CATCHMENT ANALYSIS	**B-R AREA (m^2)**	**D.A (m^2)**	**TREATMENT RATIO**
STREET A	48	1343	28.0
STREET B	30.5	823	27.0
STREET C	18.4	390	21.2
STREET D	14.4	468	32.5
STREET E	109	1470	13.5
STREET F	12	601	50.1
MISSISSAUGA ROAD	360	4264	11.8

The bio-retention design sheets included in **Appendix C** indicate that the maximum treatment ratio that can meet the criteria mentioned above is approximately 32.5:1. The ability of the proposed bio-retention cells to treat a contributing drainage area 32.5 times the cell area is demonstrated by the bio-retention design sheet included in **Appendix C** describing the Street D limiting catchment listed above. The ROW areas contributing to bio-retention areas that have unsuitable ratios will be outfitted with CB shields at the catchment downstream of the insufficient cell. This will ensure that each cell is providing 80% TSS removal in addition to the analysis above that shows that each total ROW area will receive sufficient treatment. Under the proposed bio-retention cell layout, only the catchments at the south end of Street F exceed the calculated 32.5:1 treatment ratio maximum. This maximum ratio is a conservative estimate and still leaves 0.08 m of additional ponding freeboard during the peak ponding of the 25mm event.

ROW Bio-Retention Cell 1: Bump-Outs

Bio-Retention cells have been proposed in the bump-outs for ROW's with on-street parking. These include Street A, Street B, Street D, and Street F. These areas will range in width from 1.45m on Street F to 2.40m on Street A. A detail of the proposed bump-out bio-retention cells is included below and is shown on **Drawing LID-1**.

The bump-out bio-retention cells will have one curb-cut inlet on the upstream end of the cell and one curb-cut inlet on the downstream end of the cell. A catch-basin will be placed immediately downstream of each of the downstream curb cut inlets to capture any overflow drainage discharging from the bio-retention cell.

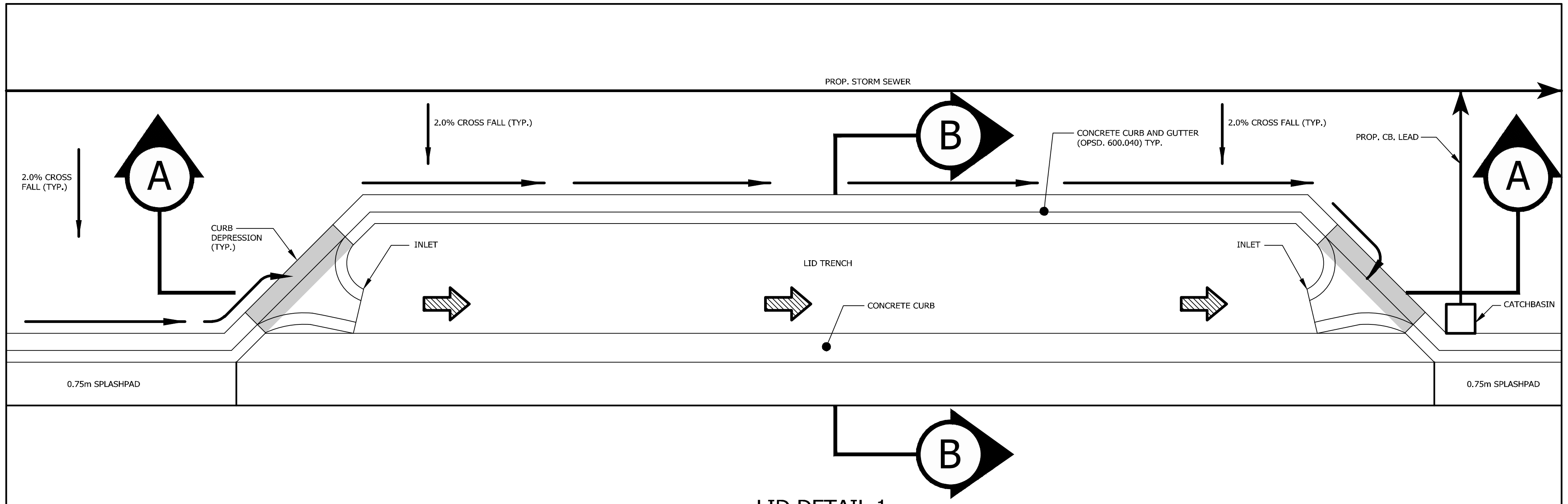
The curb-cut on the upstream end of the bump-out bio-retention cells will be sized to accommodate the 25mm peak flow. The downstream inlet will act as both an alternate inlet in case of blockages at the upstream inlet and an overflow spillway in case the cell floods beyond the allocated 25cm.

The bump-out bio-retention cells will not be designed to provide conveyance. All cell layers will be graded at 0% to ensure an even distribution of ponding and capture. Planting and soil details will be determined at the detailed design stage and in accordance with CVC, TRCA, and City of Mississauga guidelines.

Where the bump-out bio-retention area is insufficient to capture the 25mm event from the contributing drainage area, a CB shield will be installed at the downstream catchbasin to provide additional quality control through a treatment train approach.

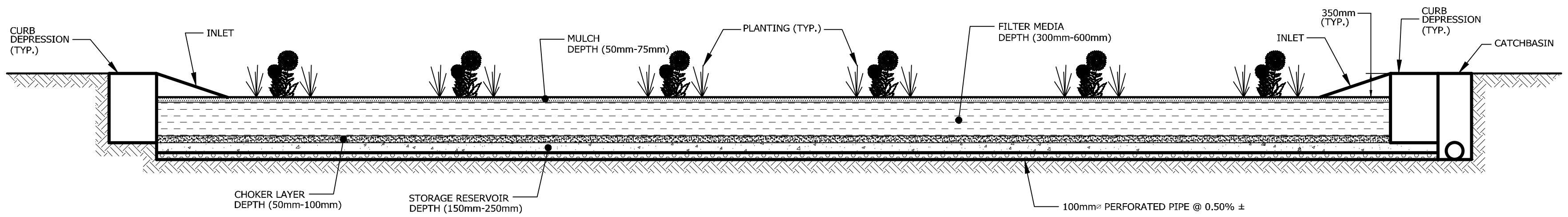
Conceptual LID Measures for Illustrative Purposes Only

Refer to Drawing LID-1, Drawing LID-2, and Appendix C for further details.



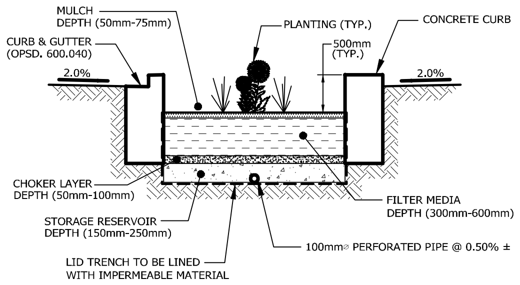
LID DETAIL 1

SCALE 1:100



SECTION A-A

SCALE 1:100



SECTION B-B

SCALE 1:100

ROW Bio-Retention Cell 2: In Series Bio-Retention LIDs

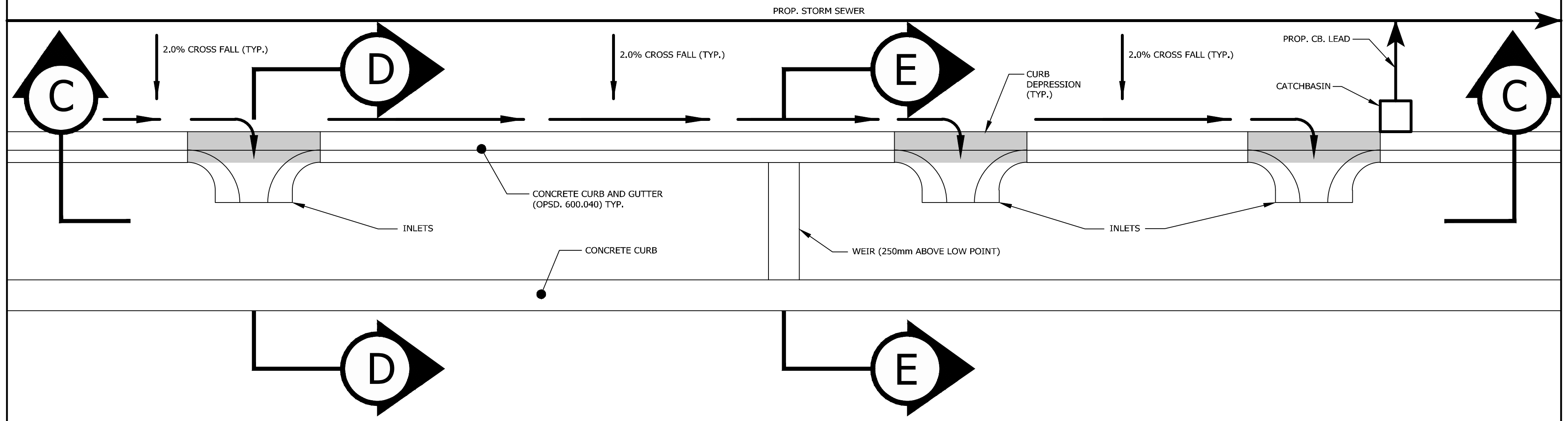
The LID shown in LID Detail 2 is illustrated conceptually in the image to the right. These bio-retention cells will be adjacent to the paved roadway and will be placed "in series" to one another. As opposed to the long distances between the bump-out right-of-ways, these LIDs will be placed consecutively along the ROW with disparate breaks to accommodate servicing and crosswalk access.

Roadway drainage will be captured into these LIDs through curb cut inlets placed at the upstream and downstream ends of each cell. These curb cuts will be sized to ensure complete capture of the 25mm event per the calculations outlined on the bio-retention design sheets in **Appendix C**.

Each cell will be no longer than 20m and will be separated from the adjacent cells by a weir which will act as the overflow point for each cell. As in the Bump-Out cells, the In Series cells will be graded at 0% to allow for an even distribution of infiltration and ponding. However instead of overflowing back onto the ROW, each cell will overflow directly to the downstream cell over the 0.25m weirs separating them. The downstream cell surface will be graded to accommodate the slope of the adjacent ROW (a ROW at 0.5% will have a 0.10m drop between adjacent 20m cells). The overflow weir in each cell will be set at 250mm above the cell surface. The invert of the roadway inlet will be 100mm above the overflow weir to ensure flow is directed to the downstream cell. The top of the surrounding curb will be 150mm above the roadway invert.

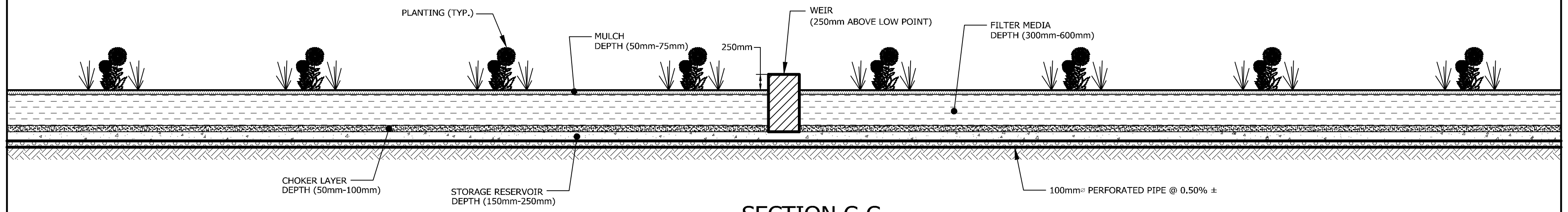
Conceptual LID Measures for Illustrative Purposes Only

Refer to Drawing LID-1, Drawing LID-2, and Appendix C for further details.



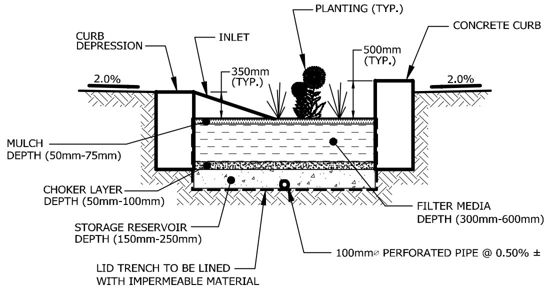
LID DETAIL 2

SCALE 1:100



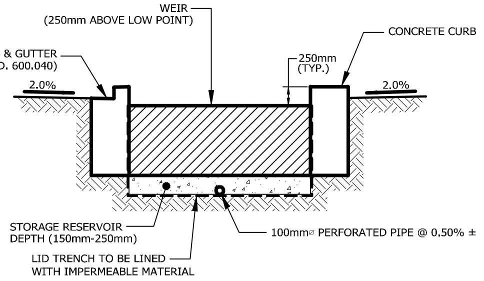
SECTION C-C

SCALE 1:100



SECTION D-D

SCALE 1:100



SECTION E-E

SCALE 1:100

EROSION AND SEDIMENT CONTROL

The erosion and sediment control plan for the site servicing program of the subject lands will be designed, approved, and implemented in conformance with the City of Mississauga, Credit Valley Conservation and MOECC recommendations.

Erosion and sediment control will be implemented for all construction activities including topsoil stripping, foundation excavation and stockpiling of materials. During construction, temporary sediment ponds may be required to treat pre-development drainage from stripped areas. The sediment control plan will be designed / coordinated with the soil remediation works.

The temporary ponds will be located at the low points of the site to detain sediment laden runoff and reduce peak flows and velocities prior to release into the receiving systems. The temporary silt ponds will maintain a permanent pool as per the MOE guidelines for temporary sediment control facilities. Forebay areas will be provided to enhance sediment removal.

The following erosion and sediment control measures will be installed and maintained during construction of the subdivision:

- A temporary sediment control fence will be placed prior to grading
- A construction plan will be implemented to limit the size of disturbed areas and to minimizing nonessential clearing
- Sediment traps will be provided
- Gravel mud mats will be provided at construction vehicle access points to minimize off-site tracking of sediments
- All temporary erosion and sediment control measures will be routinely inspected and repaired during construction. Temporary controls will not be removed until the areas they serve are restored and stable.

Recognizing that erosion and sediment control is a dynamic process, a detailed set of staging plans / construction sequencing will be required for the various stages of remediation, earthworks, servicing, site plan construction, and stabilization, coupled with the proposed development phasing.

CONCLUSIONS

The proposed Port Credit West Village Partners Inc. development can be adequately serviced through a combination of existing and proposed municipal infrastructure. In summary:

- Sanitary Servicing will be accomplished by the extension of a new municipal sanitary sewer from the existing Front Street SPS to the subject lands and the construction of local sanitary sewers.
- Water servicing for domestic potable and fire protection will be through connections to the existing system and the construction of local watermains. The Region of Peel's proposed 600mm watermain is not required to service the subject lands.
- Storm drainage will include the construction of local storm sewers designed to convey the 10 year flow. Sections of storm sewer in close proximity to Lake Ontario and along Mississauga Road will be designed for the 100-year peak flows.
- Stormwater quantity control is not required due to the closer proximity to Lake Ontario. Major system flows will be captured in sewers directly upstream of the outlet pipe. Certain development blocks will control 100 year flows to the minor system release rate to reduce the size of downstream infrastructure
- Quality control will be provided through an LID treatment train approach as described above. OGS or other mechanical separators may be used to provide additional quality control if necessary.
- Grading will be in accordance with City of Mississauga requirements and minimize on site earthworks in order to maximize reuse of soils within the property and minimize the need for retaining walls.
- Erosion and Sediment Control measures will be designed in accordance with City of Mississauga, MOECC and CVCA requirements.

REGISTERED PROFESSIONAL ENGINEER
R.B.T. MERWIN
100009772
NOV 15, 2018
PROVINCE OF ONTARIO

APPENDICES

Figures & Drawings:

APPENDIX A

Geotechnical Investigations (Stantec)

- *Final Report - Geotechnical Feasibility Study (Stantec, 2018)*

Final Report
Geotechnical Investigation - Rev. 1

Off-site Services for Development of
70 Mississauga Road South
City of Mississauga, ON

Prepared for:
Port Credit West Village Partners Inc.
C/O Fred Serrafero
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Project No. 122120255

November 1, 2018

Table of Contents

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

Port Credit West Village Partners Inc. (PCWVP) is planning the development of the property located at 70 Mississauga Road South, in the City of Mississauga. This development will require the upgrading of off-site municipal services under the public roads to the immediate east of the property.

Stantec Consulting Ltd. (Stantec) was retained by PCWVP to complete a geotechnical investigation along the alignment of the proposed off-site services.

The geotechnical investigation did not address any environmental aspects of the project such as potential environmental contamination.

The investigation consisted of two components. The initial component was completed in accordance with the proposal submitted to PCWVP dated June 28, 2017 (Proposal No. 1221-20255) and subsequent approval provided on September 6, 2017. A subsequent component, undertaken in consideration of comments provided by the Region of Peel, was completed in accordance with the proposal submitted to PCWVP dated August 7, 2018 and subsequent approval provided on August 7, 2018.

Limitations associated with this report and its contents are provided in the statement included in **Appendix A**.

2.0 PROPOSED SERVICES

2.1 OVERVIEW

The development of the property at 70 Mississauga Road will require upgrading municipal service infrastructure under the public roads to the immediate east of the property. The general location of 70 Mississauga Road and the adjacent public roads is illustrated on the Key Plan on Figure No. 1 in **Appendix B**.

The following drawings were prepared by Urbantech Consulting, A Division of Leighton-Zec Ltd. (Urbantech), the civil engineers for the project, and provided to Stantec:

- 'Conceptual Storm Drainage Plan' STM-1, dated August 2017
- 'Mississauga Rd. Plan & Profile – 1 (From Sta. -040.0 to End)' EXT-401, dated October 20, 2018
- 'Port St. Plan & Profile -1(From Sta. -030.0 to Sta. +160.0)' EXT-402, dated October 20, 2018
- 'Port St. Plan & Profile – 2 (From Sta. +160.0 to End)' EXT-403, dated October 20, 2018
- 'Front St. Plan & Profile – 1 (From Sta. 000.0 to End)' EXT-404, dated October 20, 2018

These drawings indicated that the following new services are intended:

- A new sanitary sewer service along Front Street (from Lakeshore Road south to Port Street – a distance of approximately 96 m), along Port Street (from Front Street west to Mississauga Road – a distance of approximately 307 m), and along Mississauga Road South (from Port Street to approximately 40 m northwesterly); and,
- A new storm sewer service along Mississauga Road (from Port Street south to the Lake – a distance of approximately 440 m).

It is anticipated that the services will be constructed via open-cut.

2.2 SANITARY SEWER

The Site Plan provided shows the existing sanitary sewer services and proposed sanitary sewer.

There is an existing Sanitary Pumping Station (SPS) on the southeast corner of the intersection of Lakeshore Boulevard West and Front Street South. The existing sanitary sewer originates on the east side of Mississauga Road and extends:

- Along Port Street to Front Street (a 250 mm diameter pipe); and,
- North along Front Street, terminating at the existing SPS (a 375 mm diameter pipe).

The new sanitary sewer will be parallel to the existing service (and be located on the southeast side of the existing service) under the existing roads. The new sanitary sewer will extend along Mississauga Road South from 40 m northwest of Port Street to Port Street, and from Mississauga Road east along Port Street, turning north on Front Street and connecting with the existing sanitary service at a manhole adjacent to the SPS. There will be three laterals along the portion on Mississauga Road that connect the new sewer to the site at 70 Mississauga Road South.

The new sanitary service will consist of a combination of 250 mm, 450 mm and 525 mm diameter PVC pipes.

The Site Plan and Profile drawings indicates that the invert for the new sanitary sewer will be:

- 77.24 m for the manhole 40 m northwest of Port Street on Mississauga Road South
- 74.98 m for the manhole in the intersection of Port Street and Mississauga Road South
- 74.57 m for the manhole in the intersection of Port Street and Peter Street South
- 74.19 m for the manhole in the intersection of Port Street and John Street South
- 73.78 m for the manhole in the intersection of Front Street and Port Street
- 73.43 m for the manhole under Front Street, adjacent the SPS.

2.3 STORM SEWER

The Site Plan provided shows the existing storm sewer services and proposed new storm sewer service.

There is an existing storm sewer on Mississauga Road South extending south from Lakeshore Road to an outfall into the lake. The plan indicates the existing service consists of a 900 mm diameter pipe from Lakeshore Road to Lake Street increasing to a 1050 mm diameter pipe from Lake Street to the outfall into the lake.

The plan indicates that the new service will be located on the southwest side of the existing service, in the existing grass boulevard. The new service will commence at a new manhole on the southwest side of Port Street and extend south to the lake (the service will not extend north from Port Street to Lakeshore Road).

The new storm sewer service will consist of a 900 mm by 1500 mm concrete box from Port Street to Lake Street, a 900 mm by 2400 mm concrete box sewer from Lake Street to approximately 166 m south of Lake Street, and a 900 mm by 3000 mm concrete box sewer from that point to the outfall in the lake. There will be six connections to services in the development at 70 Mississauga Road South.

The plan did not indicate the invert elevations for the box culvert but did provide the invert elevations associated with manholes along the storm sewer alignment. For reference, the initial manhole will have an invert level in the order of 76.6 m, the manhole at the approximate mid-length of the culvert will have an invert in the order of 75.8 m and the outfall will be at approximately 75 m. It is presumed that the box culvert will be founded at an elevation at or below the invert elevations referenced for the manholes.

3.0 SITE DESCRIPTION

Figure No. 1 in **Appendix B** illustrates the location of 70 Mississauga Road South and the public streets immediately east of the property.

The property at 70 Mississauga Road South is vacant excluding a small service building in the central/eastern portion of the property and a former service station (decommissioned) in the extreme northeast corner of the property. Mississauga Road is classified as a collector road. The road currently has a sidewalk on the northeast side (e.g. side with existing residential development). The southwest side of the road consists of a 2 m to 3 m wide grassy boulevard, separated from the 70 Mississauga Road South property by a chain link fence. Dense vegetation consisting of small shrubs and trees exist along the south side of the fence.

Front Street and Port Street are residential roads with sidewalks on both sides. There is a parking lot for the Port Credit Marina on the northeast side of Front Street, and a small commercial development on the southwest side of the street. There are single family residences on the southeast side of Port Street and commercial development, and single family and multiple storey residential developments on the northwest side of the street.

J.C. Saddington Park (on the shore of the lake) is located southeast of the streets discussed above and the Port Credit Harbor and Credit River are located to the northeast. There is commercial development to the north along Lakeshore Road.

In addition to the sanitary and storm sewers described above, the following utilities are present in the area:

- A 300 mm water main on Front Street from Lakeshore Road West to Port Street.
- A 200 mm water main on Port Street from Front Street to Mississauga Road South.
- A water main (no diameter indicated) on Mississauga Road South from Port Street to Lake Street.
- Overhead hydro wires on the northeast and southwest sides of Mississauga Road South from Lakeshore Road to Lake Street.
- A Rogers Cable crossing Mississauga Road South at 63 Port Street.

4.0 REGIONAL AND AREA GEOLOGY & HYDROGEOLOGY

4.1 LITERATURE REVIEW

4.1.1 Sources of Information

The following resources were reviewed in consideration of the geotechnical conditions in the vicinity of the proposed services:

- The Physiography of Southern Ontario, by Chapman and Putnam (1984);
- The Quaternary Geology of Ontario, Southern Sheet, Map 2556, by Ministry of Northern Development and Mines (1991); and,
- The Bedrock Geology of Ontario, Southern Sheet, Map 2544, by Ministry of Northern Development and Mines (1991).
- The Ontario Geological Survey (OGS) Online Database
- The Ministry of Environment and Climate Change (MOECC) Online Database

4.1.2 Overburden

The Physiography of Southern Ontario by Chapman and Putnam (1984) indicates that the site is situated in the physiographic region denoted as the Iroquois Plain. The overburden in the area is typically comprised of sand plains.

The Quaternary Geology of Ontario, Southern Sheet, Map 2556, issued by the Ministry of Northern Development and Mines, 1991, indicates that the region is comprised of glaciolacustrine deposits consisting of sand, gravelly sand and gravel, and nearshore beach deposits.

A review of the OGS online database identified several boreholes along Front Street, Port Street, and Mississauga Road South.

- Two (2) boreholes on Front Street reported encountering asphalt overlying gravel fill, overlying sand and silt and clay to a maximum termination depth of 1.2 m.
- Eight (8) boreholes on Port Street reported encountering asphalt overlying gravel fill, overlying sand and silt and clay to a maximum termination depth of 6.7 m.
- Four (4) boreholes on Mississauga Road South reported encountering asphalt overlying gravel fill in one borehole or sand and silt and clay in the other boreholes to a maximum termination depth of 1.2 m.

A review of the MOECC well records identified one (1) borehole near the intersection of Mississauga Road South and Bay Street with recorded stratigraphy. The well record reported loam overlying clayey silt till, overlying shale bedrock at a depth of 3.5 m. This well was terminated at 3.8 m below grade.

4.1.3 Bedrock

The Bedrock Geology of Ontario, Southern Sheet, Map 2544, issued by the Ministry of Northern Development and Mines, 1991, indicates that the bedrock underlying the region comprises shale and limestone of the Georgian Bay Formation.

None of the OGS boreholes reported encountering bedrock within the termination depths of the boreholes (e.g. maximum of 6.7 m).

The MOECC well record reported encountering shale bedrock at a depth of 3.5 m below grade, with a termination depth of 3. 8 m below grade.

4.1.4 Groundwater

One of the OGS boreholes located on Port Street indicated a static groundwater level of 0.7 m below existing grade.

The MOECC well record did not report a static groundwater level.

The Canadian Hydrographic Service Fisheries and Oceans Canada web site provided a mean lake level of 74.73 m for Lake Ontario for the month of September 2018. The web site also provided an average level of 74.81 m, a maximum level of 75.16 m and a minimum level of 74.51 for the period of 2008 and 2017.

4.2 SUBSURFACE INVESTIGATIONS

Environmental Site Assessments (ESAs) have been completed at 70 Mississauga Road South. The ESAs included a large number of boreholes and test pits. A limited number of the boreholes included Standard Penetration Tests. There was no coring of the underlying bedrock included in the environmental work. Additional geotechnical investigation work is ongoing at 70 Mississauga Road South.

The overburden encountered in the boreholes and test pits completed to date consisted predominantly of brown and grey sandy silt with silty clay/clayey silt layers and localized (discontinuous) sand layers.

The overburden was underlain by weathered shale bedrock. Cross sections included in one of the reports indicated the depth to the bedrock was typically in the range of 1 m to 6 m (Elevations ranging from 83.6 m above mean sea level (AMSL) in the northwest corner of the property to 68.9 m AMSL in the southeast corner of the property) though the data set was incomplete. Another report stated that bedrock was encountered at depths ranging from 0.7 m to 11 m.

Groundwater was reported in the overburden and in the underlying bedrock. The average depth to groundwater in the overburden was 1.8 m below ground surface (BGS), with a maximum observed depth of 6.8 m BGS. The average depth to groundwater in the bedrock was 3.8 m BGS with a maximum depth of 11.4 m BGS.

5.0 SCOPE OF WORK

5.1 INITIAL INVESTIGATION

The scope of work for the initial geotechnical investigation for the off-site services was as follows:

- Provide traffic control during the field drilling component of the investigation, as required, in accordance with the latest version of "Ontario Traffic Manual Book 7 Temporary Conditions".
- Advance seven (7) boreholes to maximum a depth of 6 m below the ground surface or to refusal on the underlying shale bedrock if encountered prior to achieving the stated 6 m depth. The intended depth considered an assumed depth of 5 m for the services and an additional 1 m below the anticipated invert elevation, in accordance with the City of Mississauga's Engineering Policies and Procedures document.
- Advance the seven (7) boreholes at a spacing of approximately 150 m, the maximum permissible under the City of Mississauga's Engineering Policies and Procedures document.
- Record the subsurface conditions encountered in the boreholes;
- Collect samples of the overburden soils encountered via the completion of Standard Penetration Tests (SPTs) which also provides an indication of the compactness condition (coarse grain cohesion less soils) or consistency (fine grain cohesive soils);
- Install monitoring wells in four (4) of the boreholes;
- Record groundwater levels in the open boreholes on completion of drilling and in the monitoring wells approximately two weeks following completion of drilling;
- Backfill the boreholes (without monitoring well installations) with a low permeability mixture of the auger spoils and bentonite in accordance with the intent of Regulation 903; and,
- Supplement the field information with a geotechnical laboratory testing program to provide geotechnical characterization of the soils encountered.

On completion of the field investigation and laboratory testing program, a geotechnical report was to be prepared with appropriate descriptions of the existing soil, bedrock and groundwater conditions and geotechnical recommendations for the design and construction of the proposed sanitary sewer and storm sewer.

5.2 SUPPLEMENTARY INVESTIGATION

The geotechnical report for the initial investigation was submitted to the City of Mississauga (The City) and the Region of Peel (The Region) for review. Although the scope of the original investigation complied with the City of Mississauga's Engineering Policies and Procedures Document, the Region requested that an additional two (2) boreholes be advanced with consideration for the 'tricky' conditions in the area, the presence of bedrock, and the fact that the improvements are planned for under the existing roadway.

The following scope of work was developed for the supplementary investigation to comply with the Region's request:

- Advance two (2) boreholes at the locations requested by The Region.
- Establish the coordinates (northing and eastings) and the respective ground surface elevations for the boreholes.
- Core the existing asphalt and record the thickness.
- Advance the boreholes to a depth of approximately 7.6 m (25 feet) below the existing asphalt surface. This depth is a minimum of 1 m below the invert level of the planned pipe in accordance with the City of Mississauga's Engineering Policies and Procedures Document. This depth exceeds The Region's request that the boreholes be extended to a minimum of 0.5 m below the planned sewer service.
- Conduct Standard Penetration Tests in accordance with the methods described in ASTM D 1586. The SPTs were to be conducted at regular intervals. The SPTs would permit collection of soil samples and would provide an indication of the compactness condition (cohesionless soils) or consistency (cohesive soils) of the soil strata encountered.
- Backfill the boreholes with a mixture of soil cuttings and bentonite pellets in general conformance with MOECC Regulation 903/90 as amended by 128/03. Place an asphalt plug at the finished road surface.
- Supplement the field information with a geotechnical laboratory testing program to provide geotechnical characterization of the soils encountered.

On completion of the field work program and laboratory testing programs, it was intended to update the previous geotechnical report with the additional information obtained from the supplementary investigation.

6.0 METHOD OF INVESTIGATION

6.1 FIELD INVESTIGATION

The borehole locations were established in the field with reference to the existing streets. Adjustments were made in the field in consideration of existing infrastructure, utilities and services.

Prior to commencing the field investigations, the various public utility companies were consulted to identify where public utilities were present. In addition, a private locator was contracted to clear the borehole locations of any services.

A road occupancy permit was obtained from the City of Mississauga prior to commencement of the field drilling program.

Traffic control was provided during the field drilling program as required, in accordance with the latest version of "Ontario Traffic Manual Book 7 Temporary Conditions".

The fieldwork for the initial investigation was carried out on October 4th to 6th, 2017 and for the supplementary investigation on September 6th, 2018. The seven (7) boreholes (labelled BH17-01 to BH17-07) for the initial investigation include the preface "17" to denote boreholes advanced in 2017. The two (2) boreholes (labelled BH18-01 and BH18-02) for the supplementary investigation include the preface "18" to denote boreholes advanced in 2018. The borehole locations are shown on Figure No. 1 in **Appendix B**.

Boreholes BH17-01 to BH17-07 were advanced using a track mounted drill rig equipped with 200 mm (outside diameter) hollow-stem augers. Boreholes BH18-01 and BH18-02 were advanced using a truck mounted drill rig equipped with 150 mm (outside diameter) hollow-stem augers.

Stantec personnel recorded the conditions encountered in the boreholes. Where overburden soils were present, samples were recovered at regular intervals using a 50 mm (outside diameter) split-tube sampler by conducting Standard Penetration Tests (SPTs) in accordance with the procedures outlined in ASTM specification D1586. All soil samples recovered from the boreholes were placed in moisture-proof bags and returned to our laboratory for detailed geotechnical classification and testing as required.

One borehole (BH17-07) was advanced into the underlying bedrock using HQ size (63.5 mm outside diameter) drill tube equipment.

A single monitoring well was installed in boreholes BH17-01, BH17-03, BH17-05, BH17-07. The monitoring wells were screened from 1.5 m to 4.5 m below grade in borehole BH17-01 and BH17-03, 1.1 m to 1.9 m below grade in borehole BH17-05, and 1.8 m to 3.7 m below grade in borehole BH17-07. Stantec staff recorded the static groundwater levels on October 26, 2017, September 6, 2018, and September 11, 2018.

The five (5) boreholes that did not include monitoring well installations were backfilled with a mixture of granular bentonite and auger spoils to provide a low permeability backfill in accordance with the requirements of the Ontario Ministry of the Environment Regulation 903.

6.2 SURVEY

The coordinates and ground surface elevation at the borehole locations were surveyed by J.D. Barnes Limited (Ltd.) The coordinates and elevations are shown in Table 6-1 below.

Table 6-1: Borehole Locations and Road Surface Elevations

Borehole No.	Street	Northing	Easting	Depth of Borehole (m)	Road Surface Elevation (m)
BH17-01	Front Street	4822860.87	614144.35	6.2	77.17
BH17-02	Port Street	4822817.39	614202.51	6.2	77.13
BH17-03	Port Street	4822680.73	614121.01	6.7	80.45
BH17-04	Mississauga Road South	4822552.44	614049.40	4.0	79.95
BH17-05	Mississauga Road South	4822464.44	614167.06	2.1	78.11
BH17-06	Mississauga Road South	4822396.11	614262.30	2.5	77.51
BH17-07	Mississauga Road South	4822322.95	614359.94	6.2	77.10
BH18-01	Port Street	4822615.77	614073.33	7.7	81.04
BH18-02	Port Street	4822746.02	614172.15	8.2	79.97

The road surface elevations at the borehole locations are shown on Figure No. 1 in **Appendix B** and are included on the Borehole Records Sheets provided in **Appendix C**.

6.3 LABORATORY TESTING

All soil samples returned to the laboratory were subjected to visual examination.

Representative samples of the predominant strata encountered in the boreholes were selected for laboratory analysis. The scope of testing and number of samples tested is shown in Table 6-2 below.

Table 6-2: Laboratory Testing Program

Laboratory Test	Number of Samples Proposed for Analysis	Number of Samples Tested
ASTM D2216 - Moisture Content	Estimated 64	72
ASTM D422/D - Grain Size/Hydrometer	Minimum 7	10
ASTM D4318 - Atterberg Limits	Minimum 7	8
Resistivity, pH, Redox potential, sulfides, and chlorides[1]	Minimum 3	8
Soluble Sulphates[2]	Minimum 3	8

Notes:

[1] The testing noted is intended for use in assessing the general corrosiveness of the soils and not intended for purposes of environmental characterization associated with the presence or absence of contamination.

[2] The testing noted is intended for use in assessing the potential for degradation of buried concrete in the presence of soluble sulphates and to identify the type of cement required to resist possible sulphate attack in accordance with CAN CSA A23.1/2. The testing is not intended for purposes of environmental characterization associated with the presence or absence of contamination.

The results of the laboratory tests are discussed in the text of this report and are provided on the Borehole Records in **Appendix C** and on the figures included in **Appendix D**.

The samples obtained from the initial investigation conducted in 2017 were disposed of after a period of 3 months from the date of issue of the geotechnical report. The samples from the supplementary investigation in 2018 that remain after testing will be stored for a period of three months from the date of issue of this report.

7.0 RESULTS OF INVESTIGATION

7.1 REFERENCE STANDARDS

The soils encountered in the boreholes was classified in accordance with the Unified Soil Classification System (USCS). Stantec adopts minor modifications to the USCS Standard consistent with the methods of the Ontario Ministry of Transportation (MTO) including the removal of the descriptions “lean” and “fat” with reference to clay soils and including a “Medium” category with respect to plasticity.

It should be noted that the internal diameter (I.D.) of the SPT sampler is 38 mm and hence the grain size test results and soil classifications may not reflect the entire gravel size fraction which extends to 75 mm diameter. The presence of cobbles (particles from 75 mm to 300 mm) and boulders (particles > 300 mm) were inferred to be present in particular stratums and are described separately from the gravel content.

The bedrock encountered in the boreholes was classified in accordance with the International Society for Rock Mechanics (ISRM) 2007 publication “The Complete ISRM Suggested Methods for Rock Characterization, Testing and Monitoring, 1074-2006”.

With respect to weathering of the underlying shale bedrock, The Ontario Ministry of Transportation and Communication Document RR229, Evaluation of Shale for Construction Projects, includes a typical weathering profile of low durability shale, reproduced from Skempton, Davis, and Chandler. The profile differentiates the shale into three grades of weathering and four zones as described below in Table 7-1.

Table 7-1: Typical Weathering Profile of Low Durability Shale

	Zone	Description	Notes
Fully Weathered	IVb	soil like matrix only	indistinguishable from glacial drift deposits, slightly clayey, may be fissured
Partially Weathered	IVa	soil like matrix with occasional pellets of shale less than 3 mm diameter	little or no trace of rock structure, although matrix may contain relic fissures
	III	soil like matrix with frequent angular shale particles up to 25 mm diameter	moisture content of matrix greater than the shale particles
	II	angular blocks of unweathered shale with virtually no matrix separated by weaker chemically weathered but intact shale	spheroidal chemical weathering of shale pieces emanating from relic joints and fissures, and bedding planes
Unweathered	I	Shale	regular fissuring

Reference is also made in this report to the Canadian Foundation Engineering Manual (4th Edition – 2006) [CANFEM] where used for purposes of description and classification.

7.2 OVERVIEW OF CONDITIONS

The subsurface conditions encountered in the boreholes from the initial and supplementary investigations are shown on the Borehole Records provided in **Appendix C**.

An explanation of the symbols and terms used on the Borehole Records is also provided in the appendix.

In general, the overburden stratigraphy encountered in the combined boreholes consisted of:

- Pavement structure consisting of asphalt and granular fill; underlain by,
- Fill materials (in 5 of the 9 boreholes); underlain by,
- Native silt to silt with gravel (in 6 of the 9 boreholes); underlain by,
- Native silty clay (in 1 borehole); underlain by,
- Sandy clay (in 4 boreholes) and clay with sand (in 3 boreholes).

Three (3) of the boreholes were terminated on “inferred” shale bedrock. Three (3) of the boreholes were augered/sampled into highly weathered shale. The sample at the termination depth of one (1) borehole contained shale fragments. One (1) borehole was cored into the underlying shale bedrock. One (1) borehole did not encounter the bedrock to the termination depth.

Groundwater was recorded in one (1) of the open boreholes on completion of drilling. Groundwater was recorded at depths of less than 1 m below grade in the four (4) monitoring wells installed.

A general overview of the soil, bedrock and groundwater conditions encountered in the boreholes is provided below.

7.3 PAVEMENT STRUCTURE

All the boreholes were advanced through the existing asphalt pavement. The thickness of asphalt and the underlying combined granular materials encountered in the boreholes is shown in Table 7-2 below. For reference, the table also describes the underlying sub-grade and provides an assessment of the Frost Susceptibility Factor for the sub-grade.

Table 7-2: Existing Asphalt Pavement

Borehole No.	Asphalt Thickness (mm)	Granular Thickness (mm)	Sub-grade	
			Type	Frost Susceptibility Factor[1]
BH17-01	115	385	Silt Fill	15
BH17-02	100	600	Silt Fill	15
BH17-03	100	400	Native Silt (ML)	15
BH17-04	100	900	Native Silt (ML)	15
BH17-05	100	300	Sandy Clay Fill	11
BH17-06	90	200	Sandy Clay Fill	11
BH17-07	75	325	Sandy Clay Fill	11
BH18-01	115	470	Native Silt (ML)	15
BH18-02	100	430	Native Silt (ML)	15

Notes:

[1] The frost susceptibility characterization shown is based on the Mississauga Transportation and Works Standard 2220.020.

As indicated in the table, sand and gravel fill was encountered underlying the asphalt in all the boreholes. The thickness of the sand and gravel fill materials typically ranged from 0.2 m to 0.8 m.

N-values ranging from 11 to 48 blows were obtained from the SPTs advanced in the sand and gravel fill materials, indicating a variable condition.

Based on visual and textural examination, the sand and gravel fill was assessed as dry to damp. The result of the moisture content tests conducted on samples of the sand and gravel fill ranged from 1.9% to 14.3%.

7.4 FILL MATERIALS

Sandy Clay

Fill material consisting of sandy clay was encountered underlying the pavement structure in boreholes BH17-05, BH17-06, and BH17-07. This layer typically contained some silt, trace to some gravel, and trace organics. It extended to depths of 1.4 m, 0.7 m, and 1.7 m in boreholes BH17-05, BH17-06, and BH17-07, respectively.

N-values of 6,13, and 5 blows were obtained from the SPTs advanced in the sandy clay fill materials, indicating a firm to stiff consistency.

Based on visual and textural examination, the sandy clay fill materials were assessed as moist. The results of the moisture content tests conducted on samples of the sandy clay fill ranged from 22.7% to 25.2%.

Silt

Fill material consisting of silt was encountered underlying the pavement structure in boreholes BH17-01, and BH17-02, and underlying the sandy clay fill in borehole BH17-07. This layer typically contained some clay and sand, and trace to some gravel, and extended to depths of 3.0 m, 3.0 m, and 2.4 m in BH17-01, BH17-02, and BH17-07, respectively.

N-values ranging from 0 to 24, but typically below 13, were obtained from the SPTs advanced in the silt fill materials, indicated a very loose to compact consistency.

Based on visual and textural examination, the silt fill materials were assessed as damp to moist in BH17-01 and BH17-02, and wet in BH17-07. The results of the moisture content tests conducted on samples of the silt fill materials ranged from 11.6 % to 22.0 %.

A grain size analysis test was completed on one (1) sample of the silt fill material. The results of the test are shown in Table 7-3 below.

Table 7-3: Gradation Analysis Test Results for Silt Fill Material

Borehole No.	Sample No.	Sample Median Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH17-01	SS2	1.1	6	8	67	19

The results of the test are shown on the borehole record in **Appendix C** and are illustrated on Figure 1 in **Appendix D**.

An Atterberg Limits Test was completed on a portion of the sample referenced above. The results of the test are shown in Table 7-4 below.

Table 7-4: Atterberg Limits Test Results for Silt Fill Material

Borehole	Sample	Depth (m)	Description	Liquid Limit	Plastic Limit	Plasticity Index
BH17-01	SS2	1.1	SILT (ML)	NP	NP	NP

The test indicated that the silt fill material is Non-Plastic (NP). The result is indicated on the Borehole Record sheet in **Appendix C**. The result is also indicated on the Plasticity Chart (Figure 4) in **Appendix D**.

In accordance with the Unified Soil Classification System, the sample tested can be classified as Silt (ML).

Gravel

An isolated layer of gravel fill was encountered underlying the silt fill material in borehole BH17-07. This layer was approximately 400 mm thick.

An N-value of 11 was obtained from the SPT advanced in the gravel fill material indicating a compact consistency.

Based on visual and textural examination, the gravel fill material was assessed as wet. The result of the moisture content test conducted on the sample of the gravel fill material was 11.1 %.

7.5 SILT TO SILT WITH GRAVEL

A stratum of brown to grey silt to silt with gravel was encountered underlying the fill materials in boreholes BH17-01 and BH17-02 and underlying the pavement structure in boreholes BH17-03, BH17-04, BH18-01 and BH18-02. The samples recovered typically contained some clay and sand, and trace shale fragments were present in the samples obtained at the base of the stratum in borehole BH17-01 and BH17-02. This stratum extended to depths of 5.4 m, 4.1 m, 2.2 m, 1.8 m and 5.6 m in boreholes BH17-01, BH17-03, BH17-04, BH18-01 and BH18-02, respectively. Borehole BH17-02 was terminated in this stratum at a depth of 6.2 m below grade.

N-values ranging from 11 to more than 50 were obtained from the SPTS conducted in the silt to silt with gravel soils, indicating a compact to very dense consistency.

Based on visual and textural examination, the silt to silt with gravel soils were assessed as moist. The results of the moisture content tests ranged from 7.4% to 23.7%, with one exception. One (1) test yielded a moisture content of 68.3%. It is inferred that this sample contained a quantity of fine organic material.

Grain size analyses tests were completed on five (5) samples of the silt to silt with gravel soils. The results of the tests are shown in Table 7-5 below.

Table 7-5: Gradation Analysis Test Results for Silt to Silt with Gravel Soils

Borehole No.	Sample No.	Sample Median Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH17-01	SS5	3.4	14	11	60	15
BH17-03	SS4	2.6	0	6	84	10
BH18-01	SS2	0.9	0	8	78	14
BH18-02	SS3	1.5	0	3	93	4
BH18-02	SS7	4.1	0	2	89	9

The results of the tests are shown on the borehole records in **Appendix C** and are illustrated on Figure 2 in **Appendix D**.

Atterberg Limits Tests were completed on three (3) of the samples referenced above. The results of the tests are shown in Table 7-6 below.

Table 7-6: Atterberg Limits Test Results for Silt to Silt with Gravel Soils

Borehole	Sample	Depth (m)	Description	Liquid Limit	Plastic Limit	Plasticity Index
BH17-01	SS5	3.4	SILT with GRAVEL (ML)	NP	NP	NP
BH17-03	SS4	2.6	SILT (ML)	NP	NP	NP
BH18-02	SS7	4.1	SILT (ML)	NP	NP	NP

The tests indicated the soils are Non-Plastic (NP). The test results are shown on the Borehole Record sheets in **Appendix C**. The results are also indicated on the Plasticity Chart (Figure 4) in **Appendix D**.

In accordance with the Unified Soil Classification System, the sample tested can be classified as Silt (ML) to SILT with GRAVEL (ML).

7.6 SILTY CLAY

A stratum of silty clay was encountered underlying the native silt in borehole BH18-01. This stratum extended to a depth of 4.1 m.

N-values ranging from 3 to 29 were obtained from SPTs in the silty clay soils, indicating a soft to very stiff consistency (the upper zone was very stiff and the lower zone was soft).

Based on visual and textural examination, the silty clay was assessed as moist. The results of the natural moisture content tests ranged from 13.9% to 22.5%.

Grain size analysis tests were completed on one (1) sample of the silty clay soil. The results of the test are shown in Table 7-7 below.

Table 7-7: Gradation Analysis Test Results for Silty Clay Soils

Borehole No.	Sample No.	Sample Median Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH18-01	SS6	3.4	0	0	78	22

The results of the tests are shown on the borehole record in **Appendix C** and are illustrated on Figure 3 in **Appendix D**.

An Atterberg Limits Test was completed on a portion of the sample referenced above. The results of the test are shown in Table 7-8 below.

Table 7-8: Atterberg Limits Test Results for Silty Clay Soils

Borehole	Sample	Depth (m)	Description	Liquid Limit	Plastic Limit	Plasticity Index
BH18-01	SS6	3.4	SILTY CLAY (CL-ML)	20	15	5

The results of the Atterberg Limits Test are shown on the Borehole Record sheet in **Appendix C** and are illustrated on the Plasticity Chart (Figure 4) in **Appendix D**.

In accordance with the Unified Soil Classification System, the samples tested can be classified as SILTY CLAY (CL).

7.7 CLAY WITH SAND TO SANDY CLAY

A stratum of clay with sand to sandy clay was encountered underlying the native silt in boreholes BH17-03, BH17-04 and BH18-02, underlying the fill materials in boreholes BH17-05, BH17-06, and BH17-07, and underlying the silty clay in borehole BH18-01. The samples recovered typically contained some silt, and trace to some gravel. Occasional shale fragments were noted in this stratum in borehole BH18-02. Boreholes BH17-03, BH17-04, BH17-05, and BH17-06 were terminated in this stratum at depths of 6.7 m, 4.0 m, 2.1 m, and 2. 5 m, respectively. This stratum extended to a depth of 3.4 m, 6.8 m and 7.5 m in boreholes BH17-07, BH18-01 and BH18-02, respectively.

N-values ranging from 3 to more than 50, but typically between 8 and 26, were obtained from SPTs in the clay with sand to sandy clay soils, indicating a soft to hard consistency, generally being firm to very stiff.

Based on visual and textural examination, the clay with sand to sandy clay was assessed as dry to moist. The results of the natural moisture content tests ranged from 9.3% and 27.6%.

Grain size analysis tests were completed on three (3) samples of the clay with sand to sandy clay soil. The results of the test are shown in Table 7-9 below.

Table 7-9: Gradation Analysis Test Results for Clay with Sand to Sandy Clay Soils

Borehole No.	Sample No.	Sample Median Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH17-03	SS7	4.9	1	14	40	45
BH17-06	SS3	1.8	12	19	40	29
BH18-01	SS10	6.4	10	30	34	26

The results of the tests are shown on the borehole records in **Appendix C** and are illustrated on Figure 3 in **Appendix D**.

Atterberg Limits Tests were completed on the samples referenced above. The results of the tests are shown in Table 7-10 below.

Table 7-10: Atterberg Limits Test Results for Clay with Sand to Sandy Clay Soils

Borehole	Sample	Depth (m)	Description	Liquid Limit	Plastic Limit	Plasticity Index
BH17-03	SS7	4.9	CLAY with SAND (CL)	29	15	14
BH17-06	SS3	1.8	SANDY CLAY (CL)	31	20	11
BH18-01	SS10	6.4	SANDY CLAY (CL)	24	14	10

The results of the Atterberg Limits Tests are shown on the Borehole Record sheets in **Appendix C** and are illustrated on the Plasticity Chart (Figure 4) in **Appendix D**.

In accordance with the Unified Soil Classification System, the samples tested can be classified as CLAY with SAND (CL) and SANDY CLAY(CL).

7.8 BEDROCK

Three (3) of the boreholes were terminated on “inferred” shale bedrock. Three (3) of the boreholes were augered/sampled into highly weathered shale. The sample at the termination depth of one (1) borehole contained shale fragments. Borehole BH17-07 was cored into the underlying shale bedrock.

The bedrock was encountered at depths ranging from 5.4 m to 7.6 m in boreholes BH17-01, BH17-02, BH18-01 and BH18-02 (located on Port Street and Front Street South), and at depths ranging from 2.1 m to 4. 0 m in boreholes BH17-04, BH17-05, BH17-06 and BH17-07 (located on Mississauga Road South).

The ground surface elevations at the borehole locations, depth to the contact surface with the bedrock and the corresponding elevation are summarized below in Table 7-11.

Table 7-11: Summary of Depth to Bedrock

Borehole	Ground Surface Elevation (m)	Depth to Bedrock (m)	Bedrock Elevation (m)	Comments
BH17-01	77.2	5.4	71.8	Highly weathered shale recovered in spoons from 71.8 m to 71.0 m
BH17-02	77.1	6.2	70.9	Shale fragments in last spoon;
BH17-04	80.0	4.0	76.0	Auger refusal on inferred bedrock
BH17-05	78.1	2.1	76.0	Auger refusal on inferred bedrock
BH17-06	77.5	2.5	75.0	Highly weathered shale recovered in last spoon; Borehole terminated on inferred bedrock
BH17-07	77.1	3.4	73.7	Highly weathered shale recovered in last spoon; Bedrock cored from 73.6 m to 70.8 m
BH18-01	81.0	6.8	74.3	Highly weathered shale recovered in spoons from 74.3 m to 73.4 m; Borehole terminated in inferred bedrock
BH18-02	80.0	7.5	72.4	Highly weathered shale recovered in last spoon; Borehole terminated in inferred bedrock

The highly weathered shale encountered in boreholes BH17-01, BH18-01 and BH18-02 was penetrated to depths of approximately 800 mm, 900 mm and 700 mm, respectively, via augering and SPT sampling. Boreholes BH17-02, BH17-04, BH17-05 and BH17-06 achieved sampler refusal on the inferred bedrock without any substantive penetration. The highly weathered shale would be characterized as fully weathered to partially weathered in accordance with the MTO Document previously referenced.

The bedrock encountered in Borehole BH17-07 was cored over a length of approximately 2.8 m. Table 7-12 below summarizes the bedrock conditions encountered in borehole BH17-07.

Table 7-12: Bedrock Conditions Encountered in Borehole BH17-07

Run	Depth (m)	TCR (%) / SCR (%)	RQD (%)	Fracture Index (Fractures/0.3 m)	Quality	Comments
1	3.5 – 4.8	93/77	33	8, 4, 6, 2	Poor	Moderately to intensely fractured, grey to black shale with hardness of 2 to 3.
2	4.8 – 6.3	93/74	48	6, 4, 5, 2	Poor	Moderately to intensely fractured, grey to black limestone with hardness of 2 to 3. One 64 mm grey limestone interbed at 5.4 m, with hardness of 5.5 (accounts for 2.2 % of TCR).

Borehole BH17-07 encountered a very thin layer of highly weathered shale (approximately 100 mm) at the contact surface. Consistent with the comments provided above with respect to the conditions encountered in borehole BH17-01, the highly weathered shale in borehole BH17-07 would be characterized as fully weathered to partially weathered in accordance with the MTO Document previously referenced. The underlying shale that was cored in borehole BH17-07 would be characterized as unweathered in accordance with the MTO Document.

A photograph of the core obtained from the borehole is included in **Appendix E**.

7.9 GROUNDWATER

Several of the split tubes were wet on retrieval but there was no free groundwater observed in any of the boreholes advanced for the initial geotechnical investigation in 2017. Groundwater was recorded at a depth of approximately 5.5 m below existing grade on completion of drilling in borehole BH18-02 advanced for the supplementary investigation in 2018.

The groundwater levels in the monitoring wells installed in boreholes BH17-01, BH17-03, BH17-05 and BH17-07 were measured on October 26, 2017, September 6, 2018 and September 11, 2018. It is noted that a groundwater level could not be obtained inBH17-03 in 2018 because the well could not be opened. The groundwater conditions and levels are shown in Table 7-13 below with an indication of the prevailing soil condition coincident with the well screen, where applicable.

Table 7-13: Groundwater Conditions Recorded in The Boreholes

Borehole No.	Date	Groundwater Depth (m)	Groundwater Elevation (m)	Soil Strata in which the Monitoring Well was Screened
BH17-01	October 26, 2017	1.7	75.5	Silt Fill & Native Silt with Gravel
	September 6, 2018	0.8	76.4	
BH17-03	October 26, 2017	2.7	77.8	Native Silt (CL) and Clay with Sand (CL)
BH17-05	October 26, 2017	Dry	Dry	Sandy Clay Fill and Native Clay with Sand (CL)
	September 6, 2018	0.6	77.5	
BH17-07	October 26, 2017	1.9	75.2	Silt and Gravel Fill and Native Sandy Clay (CL)
	September 11, 2018	0.9	76.2	

It is noted that a reading could not be taken in the monitoring well installed in borehole BH17-03 in 2018, because the flush mount casing cap could not be removed.

8.0 DISCUSSION AND RECOMMENDATIONS

8.1 SUBSURFACE CONDITIONS SUMMARY

The following bullets provide a general description and overview of the conditions encountered in the investigation as reported herein.

- Pavement structure consisting of asphalt and granular fill; underlain by,
- Fill materials consisting of sandy clay and/or silt materials (in 5 boreholes); underlain by,
- Native silt to silt with gravel (in 6 boreholes); underlain by,
- Native silty clay (in 1 borehole); underlain by,
- Native clay with sand to sandy clay (in 7 boreholes).

It should be noted that the depth of the fill materials varies significantly between the borehole locations. The fill materials encountered at boreholes BH17-01 and BH17-02 extended to a depth of approximately 3 m at each location and are assumed to be associated with underground utilities present in the area, whereas the fill materials encountered at boreholes BH17-03, BH17-04, BH17-05, BH17-06, BH8-01 and BH18-02 are assumed to be associated only with the pavement structure. The fill materials encountered at borehole BH17-07 extended to a depth of 2.8 m below grade and are assumed to be associated with the shoreline infill, as this location is only approximately 80 m from the shoreline.

It should also be noted that the localized stratum of soft to very stiff silty clay encountered in borehole BH18-01 from a depth of 2.8 m to 4.1 m, had very similar grain size results as the native silt soil encountered at the site. However, the Atterberg Limits test results indicated that this soil was slightly plastic, whereas, the results returned by the Atterberg Limits test on the samples of the silt soils were non-plastic.

Shale bedrock (inferred or confirmed) was encountered in eight (8) of the boreholes at depths in the order of 2 m to 7.6 m below grade (Shallower bedrock was present in two of the holes advanced at locations on Mississauga Road South).

Groundwater was recorded at depths in the order of 2 m to 3 m below grade on October 26, 2017 in the monitoring wells installed in BH17-01, BH17-03 and BH17-07. The well installed in borehole BH17-05 was dry. Groundwater was recorded at depths of less than 1 m below grade on September 6, 2018 and September 11, 2018 in the monitoring wells installed in BH17-01, BH17-05 and BH17-07. Significant rain events occurred in the weeks prior to these measurements indicating that infiltration of precipitation likely accumulates as perched groundwater in the fill materials and in the native silt soils which have higher natural moisture contents than the underlying finer grained clay with sand and sandy clay soils.

Monitoring of the wells installed in the overburden on the property at 70 Mississauga Road South indicated groundwater levels in the order of 78 m at locations approximately the same distance from the lake as Port Street. The levels recorded herein were in the order of 76.4 m to 77.8 m, only slightly to moderately lower than the levels on the adjacent property.

9.0 DESIGN & CONSTRUCTION RECOMMENDATIONS

9.1 GENERAL CONSIDERATIONS

Construction of the new services via open-cut should be feasible. Specific constraints include the following:

- Presence of existing buried utilities and services which could introduce a conflict in location and/or excavation geometry of open-cut trenches of the new services.
- Presence of shallow groundwater as recorded in the monitoring wells which may require localized dewatering or more typical unwatering of open excavations.
- Presence of bedrock at depths in the order of 2 m to 7.6 m.

9.2 CONSTRAINTS DUE TO NATURAL ENVIRONMENT

9.2.1 Frost

9.2.1.1 Frost Depth

Based on OPSD 3090.101, Foundation Frost Depths for Southern Ontario, the inferred depth of frost penetration for Mississauga is 1.2 m.

9.2.1.2 Frost Susceptibility of Soils

The City of Mississauga Standard No. 2220.020 titled Standard Frost Suitability of Soils, provides a nomograph for evaluation of the frost susceptibility factor based on the grain size of soils. A value of 1 is the lowest and a value of 15 is the highest.

An assessment of the fill materials and native soils encountered in the boreholes with respect to the nomograph yielded the following frost susceptibility factors:

• Fill - Sandy Clay – (not tested but assumed similar to the native sandy clay)	**11**
• Fill - Silt (ML)	**15**
• Native Silt to Silt with Gravel (ML)	**15**
• Native Silty Clay (CL)	**15**
• Native Clay with Sand to Sandy Clay (CL)	**11**

Given the frost susceptibility factors shown, all fill materials and native soils encountered in the investigation should be considered highly frost susceptible.

9.2.2 Seismic Conditions

9.2.2.1 Seismic Site Classification

The evaluation of the Site Classification for Seismic Site Response is addressed in the Ontario Building Code, Section 4.1.8.4. The evaluation is based on the average subsurface properties encountered in the upper 30 m of the stratigraphy.

The evaluation was completed using the weighted average N-value approach in accordance with the Building Code.

Assessing the conditions encountered in borehole BH17-01 as generally representative of the conditions encountered in the boreholes, the following applies:

- Overburden (fill and native soils) 5 m N_{avg} = 18
- Bedrock (shale) 25 m N = 100 (as prescribed in the standard)

The average N-value for the full 30 m depth was calculated as 56. Based on Table 4.1.8.4 A in the Building Code, this yields Site Class C.

9.2.2.2 Seismic Hazard Calculation Data Sheet

A copy of the National Building Code (NBC) Seismic Hazard Calculation Data sheet prepared by Natural Resources Canada (NRC) is included in **Appendix F** for reference.

It should be noted that the spectral and peak ground acceleration (PGA) values tabulated in the NRC data sheet are applicable for Site Class C. Therefore, the values must be adjusted if an alternative Site Class is used in the design. The required adjustments should be undertaken in accordance with the factors provided in the Building Code.

9.3 SITE PREPARATION

9.3.1 Decommissioning

Subject to the specific locations/alignment of the new services, there may be a requirement to remove the existing curb/gutter, sidewalk and associated concrete work. These materials should be disposed of at an approved off-site facility.

It is understood that relocation is planned for the overhead hydro wires in the grass boulevard adjacent Mississauga Road South.

9.3.2 Stripping

Stripping of the existing asphalt will be required along Front Street South and Port Street. As indicated in a previous section, it is understood that the new storm sewer service along Mississauga Road South is intended for the area of the grass boulevard. However, subject to geometry, access, and construction constraints, the limits of construction may include all or a portion of the existing roadway. As a result, stripping of the asphalt on Mississauga Road South may also be required.

All asphalt should be disposed of at an approved off-site facility.

9.4 EXCAVATIONS

9.4.1 Excavation in Soils

Excavations for the planned sanitary and storm sewer services will encounter a combination of fill materials and native soils including silt to silt with gravel, native silty clay, native clay with sand to sandy clay and shale bedrock.

Side slopes for temporary excavations should conform to the Occupational Health & Safety Act & Regulations (OH&S Act).

With respect to open-cut excavations, the soils encountered in the boreholes have been classified as follows with respect to the soil types described in the OH&S Act.

- Above the prevailing water table, all fill materials, native compact to very dense silt and silt with gravel, and native soft to very stiff clay with sand and sandy clay encountered in this investigation should be classified as Type 3 soils. The maximum excavation side slope for a Type 3 soil is 1:1 (Horizontal: Vertical) in accordance with the OH%S Act.
- Below the prevailing water table, all fill materials and the native soils must be considered Type 4 soils. The OH&S Act requires that excavations in Type 4 soils be excavated to a maximum of 3:1 (Horizontal: Vertical) slope where workers enter the trench.
- Where both Type 3 and Type 4 soils are encountered, the maximum excavation side slope should be consistent with that of a Type 4 soil, in accordance with the OH&S Act regulation.

The side slopes of the excavations in soils should be protected from exposure to precipitation and associated ground surface runoff, to prevent further softening and loss of strength of these fill materials and soils that could lead to additional sloughing and caving.

Given the typical constraints associated with excavations for services and utilities within the street it is anticipated that temporary support systems will be required. Requirements for this purpose are stipulated in the OH&S Act, Sections 235 to 238 and Section 241 which include the provisions for timbering, shoring and moveable trench boxes.

9.4.2 Excavation in Bedrock

Bedrock is expected to be encountered the excavations in the areas of boreholes BH17-04, and BH17-05, below depths of approximately 4 m, and 2 m, respectively. Based on the sanitary and storm sewer inverts shown Plan and Profile drawings provided by Urbantech, the following depths of excavation into bedrock can be expected:

- Approximately 1 m at the location of borehole BH17-04, to accommodate the proposed sanitary sewer invert. The proposed storm sewer invert is above the bedrock contact surface.
- Approximately 0.3 m at the location of borehole BH17-05, to accommodate the proposed storm sewer invert.

The excavations required in the areas of boreholes BH17-06 and BH17-07 are currently proposed to be shallower than the depth of bedrock. However, should the design change, excavation into bedrock will be required below depths of approximately 3 m and 4 m, respectively.

The bedrock is generally comprised of shale with limestone interbeds, as is typical of the Georgian Bay Foundation. The Georgian Bay Foundation is generally a rippable rock, particularly in the surficial weathered zone, and any rock removal required to a shallow depth can likely be accomplished using conventional excavation equipment. Below the weathered zone hydraulic rock breaking equipment (hoe-ramming) may be required. If layers of harder limestone in the order of 200 mm and thicker are encountered, hydraulic rock breaking can still be used but will become more difficult.

Side slopes of temporary excavations in the bedrock may be left near vertical. Consistent with the OH&S Act, the walls of an excavation in rock should be stripped of any loose rock or other material that could slide, fall, or roll upon a worker. Regular inspections by qualified geotechnical engineering personnel should be conducted for any excavation in the bedrock to confirm that conditions are safe and consistent with the requirements of the OH&S Act.

9.4.3 Groundwater & Dewatering/Unwatering Requirements

Based on the groundwater observations discussed in section 8.1, dewatering in advance is not anticipated to be required at the majority of the excavation locations. However, unwatering at the time of excavation will likely be required at all locations. A discussion of the groundwater conditions recorded and the implication for the presence of groundwater in open excavations is provided as follows.

Fill Materials

Excavations within the fill materials are likely to encounter significant groundwater seepage. However, this groundwater is generally anticipated to originate from a perched water table above the native soils. Therefore, the seepage is expected to be limited as it should drain relatively quickly.

The exception to this is the location of borehole BH17-07. As this borehole was located immediate adjacent the lake, it is inferred that the fill materials encountered represent lake infill; the groundwater level recorded in the borehole was at Elevation 75.2 m which is similar and generally consistent with the adjacent lake level.

Native Soils

Excavations within the native soils are anticipated to encounter low to moderate groundwater seepage. Where native silt (ML) soils are present, the seepage will be slightly more significant than where native clay (CL) soils are present due to the silt having a higher hydraulic conductivity.

Bedrock

A monitoring well was not installed in the bedrock penetrated in borehole BH17-07. The historic environmental investigations on the adjacent subject property at 70 Mississauga Road South reported the presence of groundwater in the bedrock at varying depths below the contact surface between the overburden and the bedrock.

Anticipated Requirements

As stated previously, it is anticipated that the bulk of the trench excavation required on Front Street South and Port Street West can be undertaken without the need for dewatering in advance of excavation. The use of sump pits and contractor pumps will be required, however, particularly where the fill materials are saturated (e.g. such as recorded in the monitoring well installed in borehole BH17-01) and/or where the slightly coarser grain native silt to silt with gravel soil is present (e.g. such as recorded in the monitoring well installed in Borehole BH17-03).

The trench excavation required along Mississauga Road South will likely encounter variable conditions with respect to the presence of groundwater. In the area of the intersection with Port Street, it may be practical to excavate without the use of dewatering in advance of construction. However, at the south end of the alignment, in proximity to the lake, the presence of lake infill materials and the shallow groundwater condition recorded in borehole BH17-07 (approximating the adjacent lake level) indicate that groundwater will be encountered at the time of construction. Localized dewatering may be required to facilitate construction in this area. Alternatively, and subject to the design grades and elevations and the lake level at the time of construction, construction in the area of the outfall may be undertaken using an earth cofferdam approach.

If dewatering is undertaken, the design of the dewatering system would need to address the extent of dewatering required, the depth of intended excavation, and the soil and groundwater conditions that prevail at the intended excavation location(s). This is beyond the scope of this geotechnical investigation.

It is noted that under the current Ministry of the Environment regulations, registration with the Environmental Sector and Activity Registry (ESAR) is required for dewatering at rates above

50,000 L/day but below 400,000 L/day. A Permit to Take Water is required for dewatering applications that require in excess of 400,000 L/day.

9.5 DESIGN OF INFRASTRUCTURE

9.5.1 Catch Basins & Manholes

The City of Mississauga Transportation and Works Department Development Requirements Manual (2016) states that all manholes and catch basins are to be in accordance with the current Ontario Provincial Standard Drawings and Specifications (OPSD and OPSS).

The Manual also states that granular material is to be placed a minimum of 1 m on all sides of the installations. Further discussion regarding backfill of the service trenches is provided in a subsequent section of this report.

9.5.2 Box Culvert

9.5.2.1 Foundation Design

It is recommended that the box culvert be designed in accordance with the Canadian Highway Bridge Design Code (CHBDC) December, 2014.

With due consideration for the approximate inverts of the manholes connected to the box culvert as outlined earlier in this report, it is anticipated that the box culvert will be founded on a combination of the native clay with sand soil, native sandy clay soil, and silt to silt with gravel fill (this last with respect to the general location of the outfall).

The presence of the fill materials will govern the design of the box culvert from a foundation perspective. Based on this, the geotechnical resistances and reactions provided in Table 9-1 below may be used in the design provided the cast-in-place concrete liner and/or box culvert segments are placed on granular bedding material placed over the undisturbed fill materials or native soils (as described further in Section 9.5.1 below).

Table 9-1: Geotechnical Resistance & Reaction for Design of Box Culvert

Foundation Element	Approximate Founding Elevation (m)	Factored Geotechnical Resistance at ULS_f (kPa) $\phi_{gu} = 0.5$	Factored Geotechnical Reaction at SLS (kPa) $\phi_{gs} = 0.8$
Box Culvert	76.6 - 75	150	100

A resistance factor of 0.5 has been applied in calculating the factored geotechnical resistance at Ultimate Limit State (ULS_f).

As the box culvert is lighter than the soil removed for installation, there will be no added load to the underlying soils. As a result, Serviceability Limit States (SLS) does not specifically apply. However, for purposes of confirming the design, a geotechnical reaction at Serviceability Limit State (SLS) has been provided in the table. For the unloading condition, settlement will be less than 10 mm and the bulk of any settlement will likely be associated with re-compression of the any fill materials or native clay soils under the box at the time of placement.

9.5.2.2 Resistance to Sliding

The unfactored horizontal resistance of the box culvert may be calculated using the following unfactored coefficient of friction:

0.55 between OPSS Granular A and concrete

9.5.2.3 Earth Pressures for Culvert Design

The parameters provided in Table 9-2 below can be used in calculating the lateral load on the box culvert.

Table 9-2: Lateral Earth Pressure Parameters

Parameter	OPSS Gran B Type I	OPSS Gran A and Gran B Type II
Bulk Unit Weight, γ (kN/m^3)	22	22
Effective Friction Angle, Φ' (°)	32	35
Coefficient of Earth Pressure at Rest, K_o	0.47	0.43
Coefficient of Active Earth Pressure, K_a	0.31	0.27
Coefficient of Passive Earth Pressure, K_p	3.25	3.69

9.5.2.4 Frost Taper

Given the intended location of the box culvert and the available space associated with the grass boulevard on the southwest side of the road, it is anticipated that the excavation for the box culvert and/or the box culvert itself will extend into the existing roadway. OPSD 803.010 includes recommendations for a frost taper to avoid differential movement between the granular backfill zone associated with the box culvert installation and the adjacent soils. The frost taper is required if the anticipated depth of frost penetration extends below the top of the box. Given the invert elevations for the new manholes as discussed herein, and assuming no change to the existing grades, it is anticipated that a frost taper will be required.

9.5.3 Outfall

Given the limited height of the box culvert (e.g. 900 mm at the outfall) it is considered unlikely that the box will include wing walls. However, it is presumed that rip rap will be placed around the opening. The rip rap should be sized for the anticipated erosion, scour and wave-runup conditions associated with the lake.

9.6 SERVICE TRENCH BEDDING AND BACKFILL

9.6.1 Bedding

Sanitary Sewer

The City of Mississauga Transportation and Works Department Development Requirements Manual includes sanitary sewers under the heading of "Regional Services" and hence defers to the Region of Peel standards with respect to the design criteria and standards. The Region of Peel Public Works Design, Specifications & Procedures Manual Standard Drawing 2-3-1 indicates that Granular 'A' compacted to 100% of its Standard Proctor Maximum Dry Density (SPMDD) should be used as bedding for sanitary sewers, when overlying "poor soil" (e.g. existing fill materials), "earth" (e.g. undisturbed native soil) or "shale/rock". The drawing indicates that the thickness of the bedding should be minimum of 100 mm where underlain by "earth" and 150 mm where underlain by "poor soil" or "shale/rock".

Consideration could be given to the use of either 19 mm stone or 6 mm stone in lieu of the OPSS Granular A, if standing water is present in the excavations. Mississauga Standard Drawings 2112.110 and 2112.140, respectively, provide grain size envelopes for these two materials. Use of either of these alternative materials would require prior approval by the City of Mississauga. In very poor conditions, a geosynthetic wrap may be required to encapsulate the stone bedding material.

Storm Sewer

The City of Mississauga Transportation and Works Department Development Requirements Manual does not provide detailed recommendations and guidance for the installation of concrete box culverts as is intended for the storm sewer on Mississauga Road South.

Box culverts are addressed on the Ontario Provincial Standard Drawings (OPSD). Drawing 803.010 titled Backfill And Cover For Concrete Culverts With Spans Less Than Or Equal To 3.0m is applicable for the size of the box proposed.

A 300 mm thick layer of OPSS Granular A should be placed as a bedding layer for the box culvert. The Granular A can be placed in a single lift and should be compacted to 100% of the material's Standard Proctor Maximum Dry Density (SPMDD). The granular bedding should be placed over the subgrade soils immediately after inspection and approval by the geotechnical consultant to protect the soils from disturbance. A 75 mm thick layer of un-compacted OPSS Granular A should be placed on the compacted Granular A bedding as a levelling course. The bedding and levelling course should extend at least 0.5 m horizontally beyond the limits of the box.

Borehole BH17-07 located at the south end of the road in proximity to the lake encountered thicker fill materials, presumed to be lake infill. Where these fill materials exist, it is recommended that a geosynthetic be placed on the sub-grade surface prior to the placement of the Granular

A bedding layer described in the preceding paragraph. The geotextile should consist of A Class I woven geosynthetic in accordance with OPSS 1860. The installation of the geosynthetic should be in accordance with OPSS 1860 and the manufacturer's instructions.

9.6.2 Backfill

Sanitary Sewer

The City of Mississauga Transportation and Works Department Development Requirements Manual states that "the use of excavated inorganic native subsoil is generally permissible for trench backfilling purposes . . . ". It is inferred that this clause is intended to apply to new development as the Manual also states that "unshrinkable fill is to be utilized as the backfill material for service trench installation within all city road allowances. The unshrinkable fill is to be placed as per City Standard 2220.030".

The second reference provided above would preclude the use of the excavated fill material or native soils as trench backfill.

Granular materials are considered geotechnically suitable for use as trench backfill, though prior consultation with and approval by the City would presumably be required. If granular backfill is used, it should consist of OPSS Granular B material. The backfill should be placed in 150 mm thick lifts and each lift compacted to 100% of the material's Standard Proctor Maximum Dry Density (SPMDD).

Storm Sewer

The requirements for backfill and cover materials and the construction of a frost taper (backfill transition) for the box culvert are outlined in OPSS 422 and OPSD 803.010.

As previously discussed in this report, OPSD 3090.101 indicates that the frost penetration depth in the area of the site is 1.2 m. The frost penetration depth should be used for the design of the culvert frost taper.

The culvert backfill material should consist of granular fill meeting the requirements of OPSS.PROV 1010 Granular A or Granular B Type II materials. The backfill should be placed and compacted in accordance with MTO's Special Provision SP105S10 (Amendment to OPSS 501).

Given that the box culvert will outfall to the lake and that it will be backfilled with granular materials, it is recommended that clay seals be provided along the length of the installation. The clay seals will act as a barrier to flow in the backfill that could lead to piping and subsequent loss of fines in the backfill. The clay seal material should meet the requirements set out in OPSS.PROV 1205.

9.6.3 Reuse of Excavated Materials

As stated above, any concrete curb, gutter, sidewalk or similar materials and any asphalt pavement stripped from the existing roads must be removed and disposed off-site. These materials are unsuitable for any form of reuse.

As also stated above, the City of Mississauga standards appear to preclude the use of any native inorganic soils as trench backfill. As a result, all excavated fill materials, native soils and excavated shale bedrock must be removed and disposed off-site.

9.7 CEMENT TYPE FOR BURIED CONCRETE AND CORROSION POTENTIAL FOR BURIED STEEL

Representative samples of the predominant soils encountered in the boreholes were submitted to AGAT Laboratories in Mississauga, Ontario for testing of pH, chlorides, concentrations of water soluble sulphates and resistivity.

The testing was completed to determine the potential for degradation of the concrete in the presence of soluble sulphates and to provide general comment with respect to the potential for corrosion of exposed buried steel. The comments provided herein are not intended to be construed as a formal corrosion assessment.

The results of the testing are provided in Table 9-3 below.

Table 9-3: Results of Chemical Analysis

Borehole No.	Sample No.	Depth (m)	pH	Chlorides (µg/g)	Sulphates (µg/g)	Resistivity (Ohm-m)
BH17-01	SS5	3.4	8.42	605	143	9.4
BH17-01	SS7	4.9	8.26	412	127	12.6
BH17-03	SS4	2.6	8.64	143	113	25.8
BH17-03	SS7	4.9	8.30	19	141	33.4
BH17-06	SS3	1.8	8.23	680	74	9.1
BH18-01	SS6	3.4	8.27	50	56	37.6
BH18-01	SS8	4.9	8.34	17	76	44.6
BH18-02	SS4	2.1	8.97	68	13	44.4

The concentration of soluble sulphates provides an indication of the degree of sulphate attack that is expected for concrete in contact with soil and groundwater at the sites. In general, soluble sulphate concentrations less than 1000 µg/g generally indicate that a low degree of sulphate attack is expected for concrete in contact with soil and groundwater. The maximum soluble sulphate concentration for all the samples tested was 143 µg/g (BH17-01/SS5). In accordance with CAN CSA A23.1 Clause 15, this represents a Low Degree of Exposure. Type GU

(General Use) Portland Cement would therefore be suitable for use in buried concrete exposed to the soil and groundwater.

The soil pH was between 8.2 and 9.0, which is within what is considered the typical or normal range for soil pH of 5.5 to 9.0. in the absence of a high organic content, the pH levels of the tested soil do not indicate a highly corrosive environment.

The AASHTO LRFD Bridge Design Specifications provides some guidance on potential corrosion of buried steel, specifically piles in the AASHTO Specifications, that can also be used for general reference and guidance.

The range in the resistivity values indicate the soils may be moderately corrosive.

The range in the chloride concentrations also indicate the soils may be moderately corrosive.

The test results provided in Table 9-3 may be used to aid in the selection of coatings and corrosion protection systems for buried steel objects, if and as required.

9.8 ESTIMATES OF HYDRAULIC CONDUCTIVITY

Supplementary Standard SB-6 of the 2006 Ontario Building Code (OBC) “Percolation Time and Soil Descriptions” provides a series of grain size curves and soil types for use in assessing the likely percolation time and coefficient of permeability that can be used in design of infiltration systems.

For reference, the results of the grain size distribution tests (and Unified Soil Classifications) completed on the predominant soil strata encountered in the boreholes has been compared to the grain size curves and soil types in the Standard to estimate the likely range in the coefficient of permeability of the soils encountered in the investigation.

It is noted that the industry typically refers to “hydraulic conductivity” rather than “coefficient of permeability” in this respect. The terms are often considered interchangeable, but for purposes of this report the values provided are in the form of “length/time” (cm/sec) and are therefore considered strictly applicable to “hydraulic conductivity”, and hence “hydraulic conductivity” is used herein.

Based on the comparison conducted, the following values are provided:

• Fill Materials (Granular)	10^{-1} cm/sec or less
• Fill Materials (Sandy Clay and Silt)	10^{-5} cm/sec or less
• Silt to Silt with Gravel (ML)	10^{-5} cm/sec or less
• Silty Clay (CL-ML)	10^{-6} cm/sec or less
• Clay with Sand to Sandy Clay (CL)	10^{-6} cm/sec or less

The fill materials have not been included in this comparison. The inherent variations in the fill materials, including compaction at the time of placement (confirmed to vary considerably based on the results of the SPTs conducted in the boreholes) does not permit a rationale for comparison. The more granular fill materials with low N-values likely have a very high hydraulic conductivity whereas the fine grain fill materials with modestly higher N-values likely have a lower hydraulic conductivity.

The OBC states, in part, that "it must be emphasized that, particularly for fine grained soils, there is no consistent relationship (between coefficient of permeability and soils of various types) due to the many factors involved". Such factors as structure, mineralogy, density (compactness or consistency), plasticity, and organic content of the soil can have a large influence on the hydraulic conductivity; variations in excess of an "order of magnitude" are common place in this respect. In addition, the OBC does not differentiate between soils of "till" or "non-till" origin.

9.9 PAVEMENT REINSTATEMENT

As discussed in previous sections of this report, the existing pavement on Front Street South and Port Street will be stripped to facilitate construction of the new sanitary sewer. A portion (or all) of the pavement on Mississauga Road South will likely be stripped to facilitate construction of the new storm sewer.

To reiterate from above, Mississauga Road South is classified as a collector road and it is inferred that Front Street South and Port Street are classified as residential roads (minor local/local). The asphalt pavement encountered in the boreholes consisted of 75 mm to 115 mm asphalt underlain by 200 mm to 900 mm granular materials. In accordance with the Mississauga Transportation and Works standards, the underlying sub-grade is considered highly frost susceptible (e.g. Frost Susceptibility Factor of 11 or 15).

The Mississauga Transportation and Works Standard Pavement and Road Base Design Requirements (Standard No. 2220.010) provides the minimum structural road depth for the various classes of road. Table 9-4 below provides the minimum structural road depth for the two classes of roads considered herein and for comparison also includes the structural road depth as recorded in the boreholes.

Table 9-4: Asphalt Pavement Design

Structural Road Component	Class of Road[1]		Existing Conditions (As Recorded in the Boreholes)
	Collector	Residential (Minor Local/Local)	
Top Course Asphalt (mm)	40	40	75 - 115
Base Course Asphalt (mm)	100	100	
Granular Base (mm)	200	200	200 - 900
Granular Sub-Base (mm)	400	250	
Total Thickness (mm)	740	590	300 – 1000

Notes:

[1] Thicknesses of structural road components consistent with presence of high frost susceptible sub-grade as outlined previously in this report

Consistent with the City of Mississauga standards, the finished sub-grade surface should have a minimum cross-fall of 3%.

City of Mississauga Standard Drawing No. 2220.010 provides additional details with respect to the materials and practices for construction of roads. This includes:

- Compaction sub-grade to a minimum of 98% Standard Proctor Density (not specifically required for this application presuming that unshrinkable fill is placed to the underside of the granular materials in the road structure); and,
- Use of HL8 base course asphalt (that may contain up to 25% RAP) and HL3 top course asphalt.

Also, as stated on Drawing No. 2220.010, sub-drains shall be installed "full-length" on all roads. Reference is made to Standard No. 2220.040 for details illustrating the sub-drain installation.

10.0 CLOSURE

Use of this report is subject to the Statement of General Conditions provided in **Appendix A**. It is the responsibility of Port Credit West Village Partners Inc. who is identified as "the Client" within the Statement of General Conditions, and its agents to review the conditions and to notify Stantec Consulting Ltd. should any of these not be satisfied. The Statement of General Conditions addresses the following:

- Use of the report;
- Basis of the report;
- Standard of care;
- Interpretation of site conditions;
- Varying or unexpected site conditions; and,
- Planning, design or construction.

Respectfully Submitted,

STANTEC CONSULTING LTD.

11.0 SIGN-OFF SHEET

Prepared by Mollie Bowness

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PROVINCE OF ONTARIO

Reviewed by

(Signature)

Ron Howieson., P. Eng.
Senior Principal, Geotechnical Engineering

APPENDIX A

Statement of General Conditions

STATEMENT OF GENERAL CONDITIONS

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Stantec Consulting Ltd. and the Client. Any use which a third party makes of this report is the responsibility of such third party.

BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Stantec Consulting Ltd.'s present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Stantec Consulting Ltd. is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Stantec Consulting Ltd. at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec Consulting Ltd. must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Stantec Consulting Ltd. will not be responsible to any party for damages incurred as a result of failing to notify Stantec Consulting Ltd. that differing site or sub-surface conditions are present upon becoming aware of such conditions.

PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Stantec Consulting Ltd., sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Stantec Consulting Ltd. cannot be responsible for site work carried out without being present.

APPENDIX B

Figure No. 1 – Off-Site Services Borehole & Monitoring Well Location Plan

Stantec

- ⬚ Site Boundary for Property at 70 Mississauga Road
- ⌖ Off-Site Monitoring Well (Stantec, 2017)
- ⊗ Off-Site Borehole (Stantec, 2017)
- ⊗ Off-Site Borehole (Stantec, 2018)
- (77.13) Ground Surface Elevation (metres above sea level)

0 50 100 metres

1:2,500 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2017.
3. Orthoimagery within Site Boundary provided by Cannington Group. Imagery date: August 31, 2018. Orthoimagery outside of Site Boundary provided by © First Base Solutions, 2018. Imagery date: 2017.

Project Location
Port Street,
Mississauga, Ontario

122120255
Prepared by PW on 2018-10-11

Client/Project
Port Credit West Village Partners Inc.
Brownfield Redevelopment
70 Mississauga Road South, Mississauga, ON

Figure No.
1

Title
Off-Site Services - Borehole and Monitoring Well Location Plan

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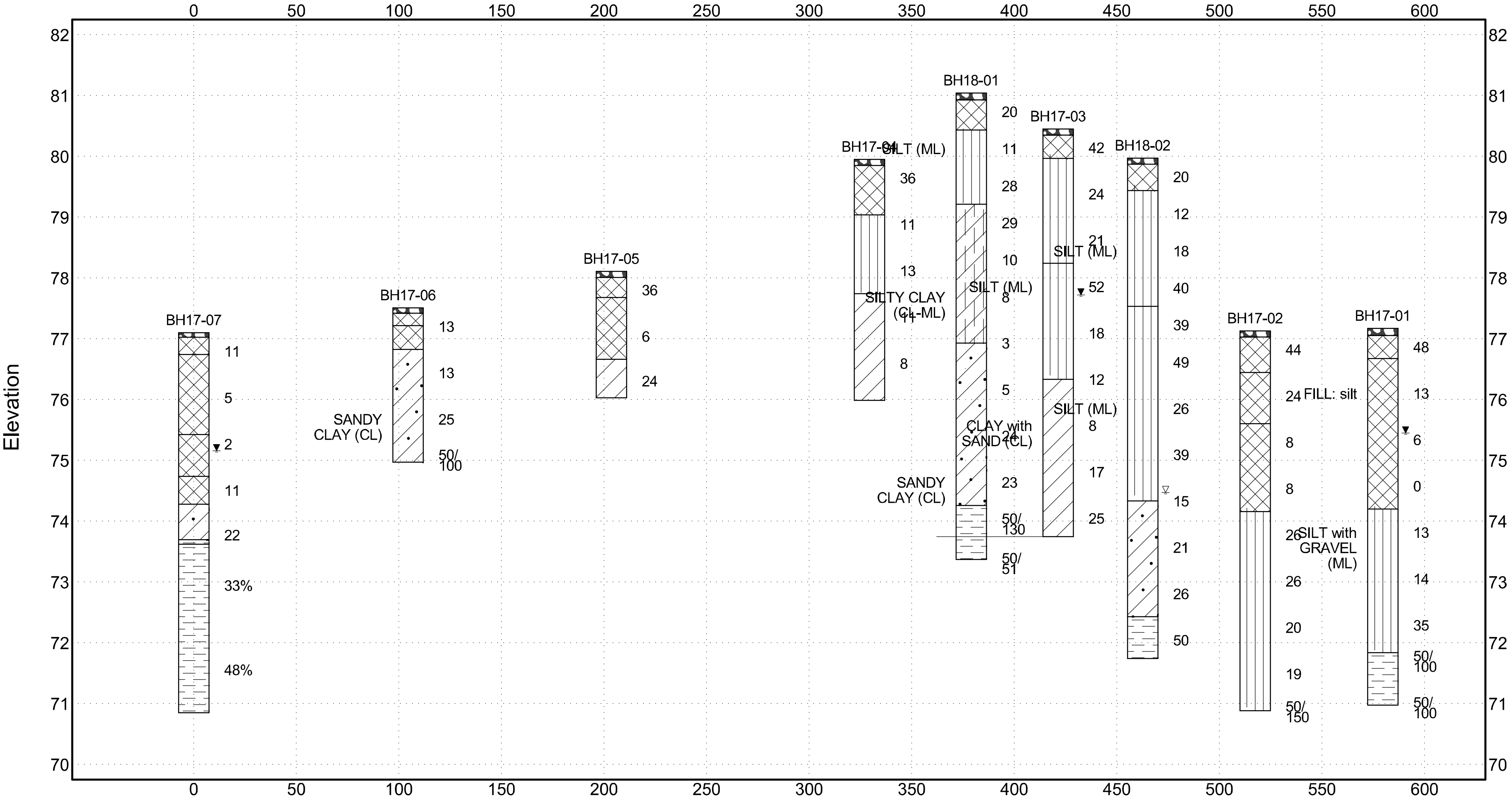


Borehole	Northing, m	Easting, m	Elevation, m	Depth, m
BH17-01	4822861	614144	77.2	6.2
BH17-02	4822817	614203	77.1	6.2
BH17-03	4822681	614121	80.5	6.7
BH17-04	4822552	614049	80.0	4.0
BH17-05	4822464	614167	78.1	2.1
BH17-06	4822396	614262	77.5	2.5
BH17-07	4822323	614360	77.1	6.3
BH18-01	4822616	614073	81.0	7.7
BH18-02	4822746	614172	80.0	8.2

SUBSURFACE FENCE DIAGRAM

PROJECT: Port Credit Off-Site Geotechnical Investigation

LOCATION: Mississauga, ON

PROJECT No.:122120255

DATE: Sep 18

FIGURE: 2

STN13-FENCE_2014-2 122120255.500.300.GPJ MM.GDT 9/25/18

APPENDIX C

Symbols & Terms Used on the Borehole Records

Borehole Records and Monitoring Well Records

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis:

Rootmat	- vegetation, roots and moss with organic matter and topsoil typically forming a mattress at the ground surface
Topsoil	- mixture of soil and humus capable of supporting vegetative growth
Peat	- mixture of visible and invisible fragments of decayed organic matter
Till	- unstratified glacial deposit which may range from clay to boulders
Fill	- material below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

Desiccated	- having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
Fissured	- having cracks, and hence a blocky structure
Varved	- composed of regular alternating layers of silt and clay
Stratified	- composed of alternating successions of different soil types, e.g. silt and sand
Layer	- > 75 mm in thickness
Seam	- 2 mm to 75 mm in thickness
Parting	- < 2 mm in thickness

Terminology describing soil types:
The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488) which excludes particles larger than 75 mm. For particles larger than 75 mm, and for defining percent clay fraction in hydrometer results, definitions proposed by Canadian Foundation Engineering Manual, 4th Edition are used. The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):
Terminology describing materials outside the USCS, (e.g. particles larger than 75 mm, visible organic matter, and construction debris) is based upon the proportion of these materials present:

Trace, or occasional	Less than 10%
Some	10-20%
Frequent	> 20%

Terminology describing compactness of cohesionless soils:
The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test (SPT) N-Value - also known as N-Index. The SPT N-Value is described further on page 3. A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
Very Loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very Dense	>50

Terminology describing consistency of cohesive soils:
The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests. Consistency may be crudely estimated from SPT N-Value based on the correlation shown in the following table (Terzaghi and Peck, 1967). The correlation to SPT N-Value is used with caution as it is only very approximate.

Consistency	Undrained Shear Strength		Approximate SPT N-Value
	kips/sq.ft.	kPa	
Very Soft	<0.25	<12.5	<2
Soft	0.25 - 0.5	12.5 - 25	2-4
Firm	0.5 - 1.0	25 - 50	4-8
Stiff	1.0 - 2.0	50 – 100	8-15
Very Stiff	2.0 - 4.0	100 - 200	15-30
Hard	>4.0	>200	>30

ROCK DESCRIPTION

Except where specified below, terminology for describing rock is as defined by the International Society for Rock Mechanics (ISRM) 2007 publication "The Complete ISRM Suggested Methods for Rock Characterization, Testing and Monitoring: 1974-2006"

Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	*Very Poor Quality*
25-50	*Poor Quality*
50-75	*Fair Quality*
75-90	*Good Quality*
90-100	*Excellent Quality*

Alternate (Colloquial) Rock Mass Quality	
Very Severely Fractured	*Crushed*
Severely Fractured	*Shattered or Very Blocky*
Fractured	*Blocky*
Moderately Jointed	*Sound*
Intact	*Very Sound*

RQD (Rock Quality Designation) denotes the percentage of intact and sound rock retrieved from a borehole of any orientation. All pieces of intact and sound rock core equal to or greater than 100 mm (4 in.) long are summed and divided by the total length of the core run. RQD is determined in accordance with ASTM D6032.

SCR (Solid Core Recovery) denotes the percentage of solid core (cylindrical) retrieved from a borehole of any orientation. All pieces of solid (cylindrical) core are summed and divided by the total length of the core run (It excludes all portions of core pieces that are not fully cylindrical as well as crushed or rubble zones).

Fracture Index (FI) is defined as the number of naturally occurring fractures within a given length of core. The Fracture Index is reported as a simple count of natural occurring fractures.

Terminology describing rock with respect to discontinuity and bedding spacing:

Spacing (mm)	Discontinuities	Bedding
>6000	*Extremely Wide*	-
2000-6000	*Very Wide*	*Very Thick*
600-2000	*Wide*	*Thick*
200-600	*Moderate*	*Medium*
60-200	*Close*	*Thin*
20-60	*Very Close*	*Very Thin*
<20	*Extremely Close*	*Laminated*
<6	-	*Thinly Laminated*

Terminology describing rock strength:

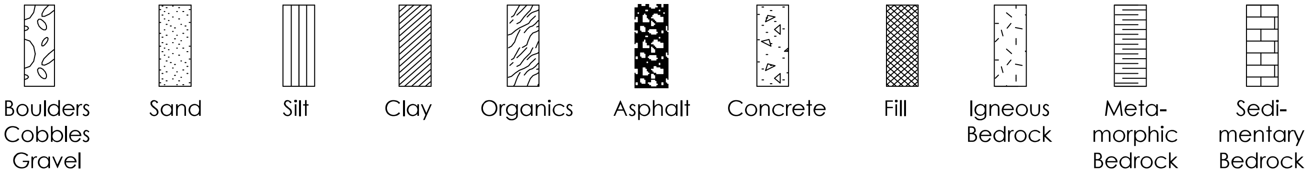
Strength Classification	Grade	Unconfined Compressive Strength (MPa)
Extremely Weak	R0	<1
Very Weak	R1	1 – 5
Weak	R2	5 – 25
Medium Strong	R3	25 – 50
Strong	R4	50 – 100
Very Strong	R5	100 – 250
Extremely Strong	R6	>250

Terminology describing rock weathering:

Term	Symbol	Description
Fresh	W1	No visible signs of rock weathering. Slight discoloration along major discontinuities
Slightly	W2	Discoloration indicates weathering of rock on discontinuity surfaces. All the rock material may be discolored.
Moderately	W3	Less than half the rock is decomposed and/or disintegrated into soil.
Highly	W4	More than half the rock is decomposed and/or disintegrated into soil.
Completely	W5	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.
Residual Soil	W6	All the rock converted to soil. Structure and fabric destroyed.

STRATA PLOT

Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
DP	Direct-Push sample (small diameter tube sampler hydraulically advanced)
PS	Piston sample
BS	Bulk sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits.

WATER LEVEL MEASUREMENT

▼	measured in standpipe, piezometer, or well
▽	inferred

RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

N-VALUE

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (63.5 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (300 mm) into the soil. In accordance with ASTM D1586, the N-Value equals the sum of the number of blows (N) required to drive the sampler over the interval of 6 to 18 in. (150 to 450 mm). However, when a 24 in. (610 mm) sampler is used, the number of blows (N) required to drive the sampler over the interval of 12 to 24 in. (300 to 610 mm) may be reported if this value is lower. For split spoon samples where insufficient penetration was achieved and N-Values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N-values corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to ‘A’ size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (300 mm) into the soil. The DCPT is used as a probe to assess soil variability.

OTHER TESTS

S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
γ	Unit weight
G_s	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
Q_U	Unconfined compression
I_p	Point Load Index (I_p on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm)

	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer

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BOREHOLE RECORD

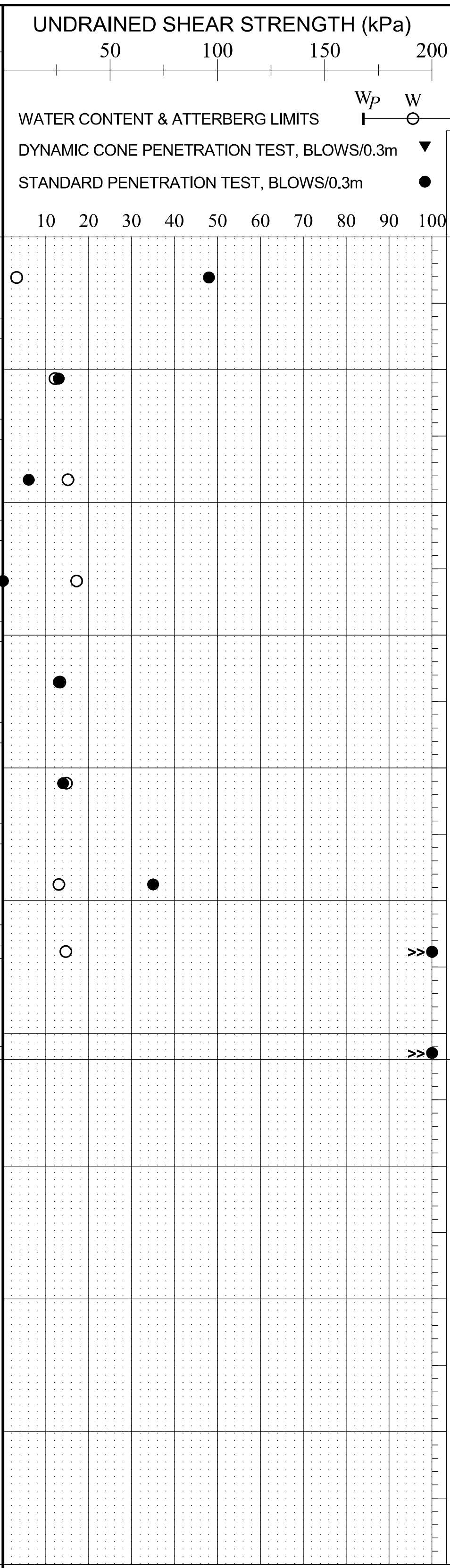
BH17-01

Sheet 1 of 1

CLIENT Port Credit West Village Partners
PROJECT No. 122120255
LOCATION Mississauga, ON, N: 4 822 861 E: 614 144
DATUM Geodetic
DATES: BORING October 6, 2017
WATER LEVEL October 26, 2017
TPC ELEV.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL
0	**77.2**	**Paved Road**		
		115 mm ASPHALT		
	76.7	FILL: brown to grey sand and gravel - dry		▼
		FILL: brown to grey silt - some clay - trace sand and gravel - moist		
3	74.2	Compact to dense, grey, SILT with GRAVEL (ML) - some clay and sand - moist - trace shale fragments		
	71.8	Highly weathered, grey, SHALE - frequent clay seams		
	71.0	END OF BOREHOLE at approximately 6.2 m below existing grade. Monitoring well installed with screen from approximately 1.5 m to 4.5 m below grade. Groundwater level measured at approximately 1.7 m below grade on October 26, 2017 and 0.8 m below grade on September 6, 2018.		

DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1	SS	1	480/610	48	
3	SS	2	380/610	13	Non Plastic 6 8 67 19
6	SS	3	410/610	6	
8	SS	4	51/610	0	
11	SS	5	410/610	13	Non Plastic 14 11 60 15
13	SS	6	430/610	14	
16	SS	7	460/610	35	
18	SS	8	100/100	50/100	
20	SS	9	100/100	50/100	



☐ Field Vane Test, kPa
▣ Remoulded Vane Test, kPa
△ Pocket Penetrometer Test, kPa

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BOREHOLE RECORD

BH17-02

Sheet 1 of 1

CLIENT Port Credit West Village Partners

PROJECT No. 122120255

LOCATION Mississauga, ON, N: 4 822 817 E: 614 203

DATUM Geodetic

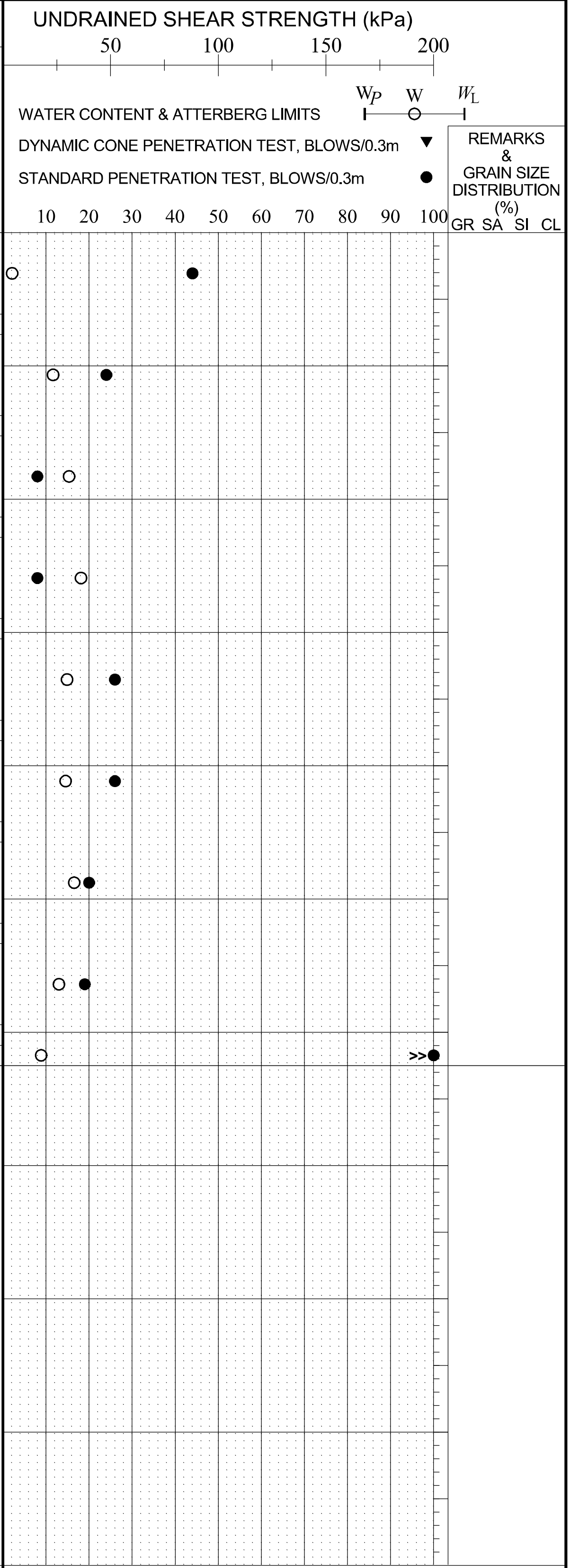
DATES: BORING October 5, 2017

WATER LEVEL

TPC ELEV.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL
0	77.1	**Paved Road**		
		100 mm ASPHALT		
	76.4	FILL: brown to grey sand and gravel - dry - 50 mm clay seam at 0.6 m		
		FILL: brown to red silt - some clay - trace sand and gravel - damp to moist - 130 mm gravel seam at 1.25 m - brown to grey		
3	74.2	Compact, grey, SILT with GRAVEL (ML) - some clay and sand - moist - shale fragments in sample SS9		
	70.9	END OF BOREHOLE at approximately 6.2 m below existing grade.		

DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
1	SS	1	530/610	44
3	SS	2	430/610	24
6	SS	3	410/610	8
8	SS	4	180/610	8
11	SS	5	510/610	26
13	SS	6	510/610	26
16	SS	7	460/610	20
18	SS	8	510/610	19
20	SS	9	100/150	50/150



☐ Field Vane Test, kPa

◘ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

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BOREHOLE RECORD

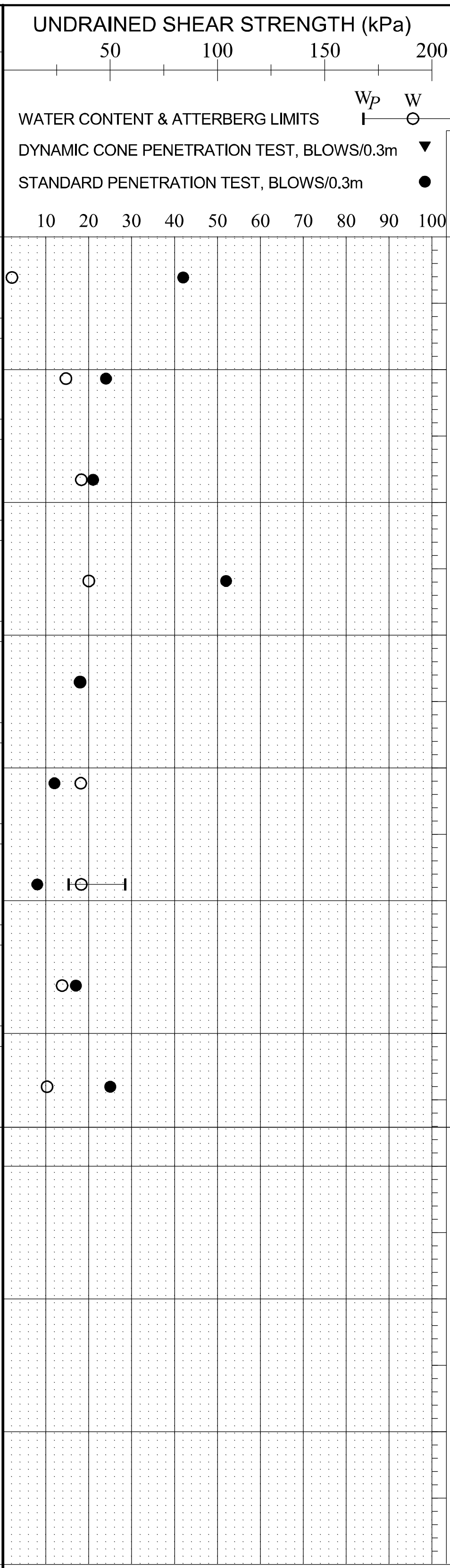
BH17-03

Sheet 1 of 1

CLIENT Port Credit West Village Partners
PROJECT No. 122120255
LOCATION Mississauga, ON, N: 4 822 681 E: 614 121
DATUM Geodetic
DATES: BORING October 5, 2017
WATER LEVEL October 26, 2017
TPC ELEV.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	WATER LEVEL
0	80.5	**Paved Road**	
		100 mm ASPHALT	
	80.0	FILL: grey sand and gravel - dry	
1		Compact to very dense, brown to grey, SILT (ML) - some clay - trace sand - moist	
2		- grey	▼
4	76.3	Firm to very stiff, grey, CLAY with SAND (CL) - trace gravel - dry to moist	
6	73.7	END OF BOREHOLE at approximately 6.7 m below existing grade. Monitoring well installed with screen from approximately 1.5 m to 4.5 m below grade. Groundwater level measured at approximately 2.7 m below grade on October 26, 2017. Monitoring well inaccessible in 2018.	

TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
SS	1	430/610	42	
SS	2	580/610	24	
SS	3	560/610	21	
SS	4	580/610	52	Non Plastic 0 6 84 10
SS	5	610/610	18	
SS	6	560/610	12	
SS	7	580/610	8	1 14 40 45
SS	8	280/610	17	
SS	9	610/610	25	



□ Field Vane Test, kPa
■ Remoulded Vane Test, kPa
△ Pocket Penetrometer Test, kPa

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BOREHOLE RECORD

BH17-04

Sheet 1 of 1

CLIENT Port Credit West Village Partners

PROJECT No. 122120255

LOCATION Mississauga, ON, N: 4 822 552 E: 614 049

DATUM Geodetic

DATES: BORING October 4, 2017

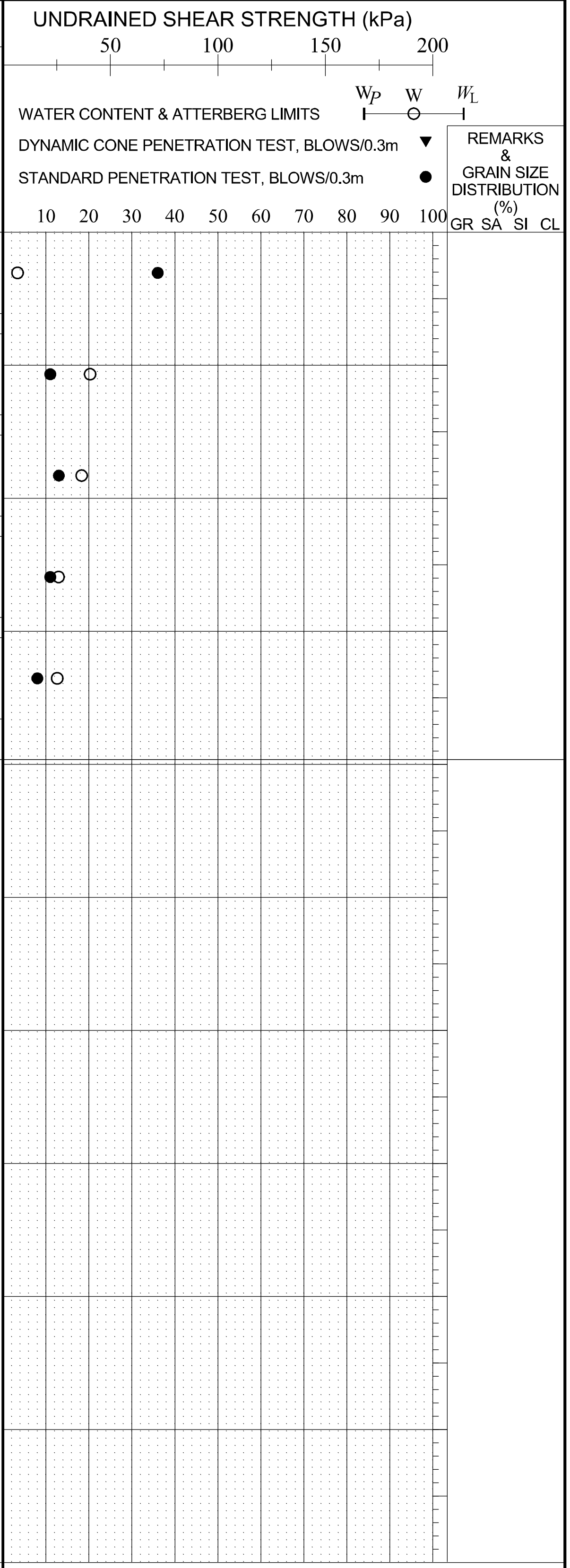
WATER LEVEL

TPC ELEV.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WATER LEVEL
	80.0	**Paved Road**		
0		100 mm ASPHALT		
	79.0	FILL: brown, sand and gravel - some silt - dry to damp		
1				
2	77.7	Compact, brown, SILT (ML) - some clay - trace sand - moist		
3		Firm to stiff, brown to grey, CLAY with SAND (CL) - moist		
4	76.0			
		END OF BOREHOLE at approximately 4.0 m below existing grade due to refusal on inferred bedrock.		
5				
6				
7				
8				
9				
10				

DEPTH (ft)	SAMPLES TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
1	SS	1	300/610	36
3–4	SS	2	610/610	11
6	SS	3	510/610	13
8–9	SS	4	580/610	11
11	SS	5	460/610	8

DEPTH (ft): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32



☐ Field Vane Test, kPa

◘ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

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BOREHOLE RECORD

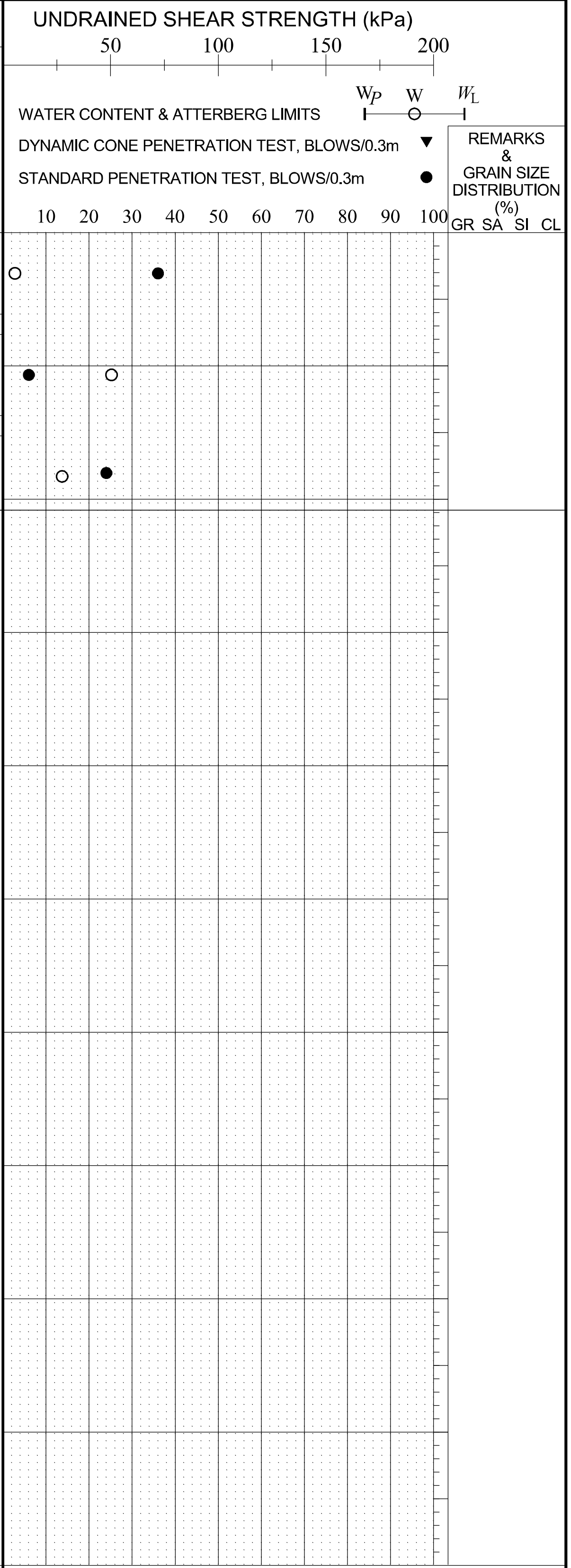
BH17-05

Sheet 1 of 1

CLIENT Port Credit West Village Partners
PROJECT No. 122120255
LOCATION Mississauga, ON, N: 4 822 464 E: 614 167
DATUM Geodetic
DATES: BORING October 5, 2017
WATER LEVEL October 26, 2017
TPC ELEV.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	WATER LEVEL	DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)
0	**78.1**	**Paved Road**		0				
		100 mm ASPHALT						
	77.7	FILL: brown, sand and gravel - dry to damp	▼	1	SS	1	430/610	36
1		FILL: dark brown, sandy clay - trace gravel - moist		3	SS	2	530/610	6
	76.7	Very stiff, dark brown, CLAY with SAND (CL) - trace gravel - moist		6	SS	3	560/560	24
2	76.0	END OF BOREHOLE at approximately 2.1 m below existing grade due to refusal on inferred bedrock.						

Monitoring well installed with screen from approximately 1.1 m to 1.9 m below grade. Monitoring well dry on October 26, 2017. Groundwater level measured at approximately 0.6 m below grade on September 6, 2018.



☐ Field Vane Test, kPa
◘ Remoulded Vane Test, kPa
△ Pocket Penetrometer Test, kPa

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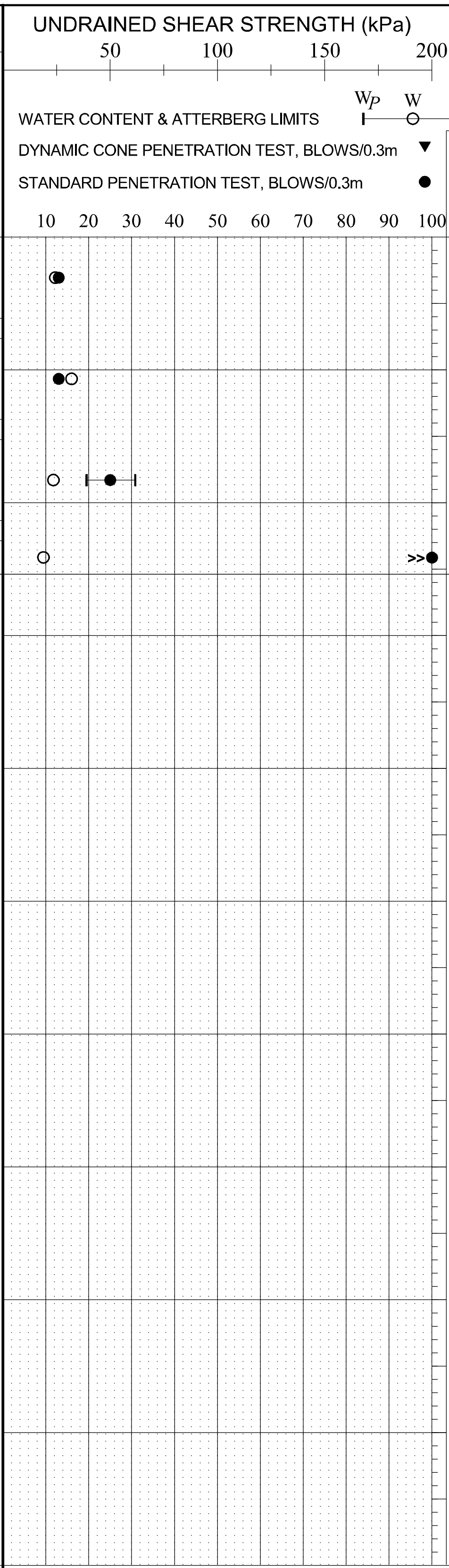
BOREHOLE RECORD

BH17-06

Sheet 1 of 1

CLIENT Port Credit West Village Partners
PROJECT No. 122120255
LOCATION Mississauga, ON, N: 4 822 396 E: 614 262
DATUM Geodetic
DATES: BORING October 4, 2017
WATER LEVEL
TPC ELEV.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	DEPTH (ft)	SAMPLES TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0	**77.5**	**Paved Road**	0					
		90 mm ASPHALT						
	77.2	FILL: brown sand and gravel - damp	1	SS	1	460/610	13	
	76.8	FILL: brown, sandy clay - trace gravel - moist	3–4	SS	2	610/610	13	
		Stiff to hard, brown, sandy CLAY (CL) - some gravel - moist - shale fragments	6	SS	3	610/610	25	12 19 40 29
	75.0		8	SS	4	250/250	50/100	
		END OF BOREHOLE at approximately 2.5 m below existing grade due to refusal on inferred bedrock.						



□ Field Vane Test, kPa
◘ Remoulded Vane Test, kPa
△ Pocket Penetrometer Test, kPa

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BOREHOLE RECORD

BH17-07

Sheet 1 of 1

CLIENT: Port Credit West Village Partners

PROJECT No.: 122120255

LOCATION: Mississauga, ON, N: 4 822 323 E: 614 360

DATUM: Geodetic

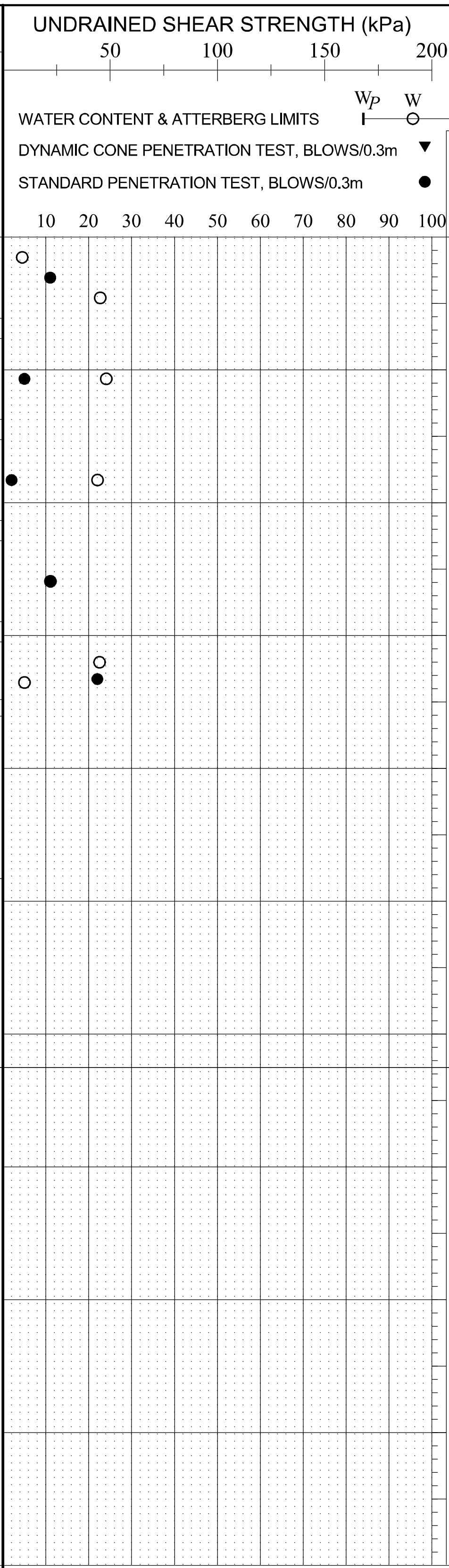
DATES: BORING October 5 and 6, 2017

WATER LEVEL: October 26, 2017

TPC ELEV.:

ELEVATION (m)	STRATA DESCRIPTION
77.1	**Paved Road**
	75 mm ASPHALT
76.7	FILL: brown sand and gravel - damp
	FILL: dark brown, sandy clay - some silt and gravel - trace organics - occasional sand and silt seams
75.4	FILL: brown, silt - some sand and gravel - wet
74.7	FILL: black gravel - wet
74.3	Very stiff, brown, sandy CLAY (CL) - some gravel - moist
73.7	Highly weathered, grey, SHALE - dry
	Slightly weathered to fresh, grey to black, SHALE BEDROCK - occasional grey limestone interbeds - poor quality - moderately to intensely fractured - 64 mm limestone interbed at 5.4 m - shale hardness 2 to 3, limestone hardness 5.5
70.8	END OF BOREHOLE at approximately 6.3 m below existing grade. Monitoring well installed with screen from approximately 1.8 m to 3.7 m below grade. Groundwater level measured at approximately 1.9 m below grade on October 26, 2017 and at approximately 0.9 m below grade on September 11, 2018.

TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
SS	1	480/610	11	
SS	2	430/610	5	
SS	3	330/610	2	
SS	4	300/610	11	
SS	5	460/560	22	
HQ	1	93%/77%	33%	FI = 8, 4, 6, 2
HQ	2	93%/74%	48%	FI = 6, 4, 5, 2



☐ Field Vane Test, kPa

◘ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

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BOREHOLE RECORD

BH18-01

Sheet 1 of 1

CLIENT Port Credit West Village Partners

PROJECT No. 122120255

LOCATION Mississauga, ON, N: 4 822 616 E: 614 073

DATUM Geodetic

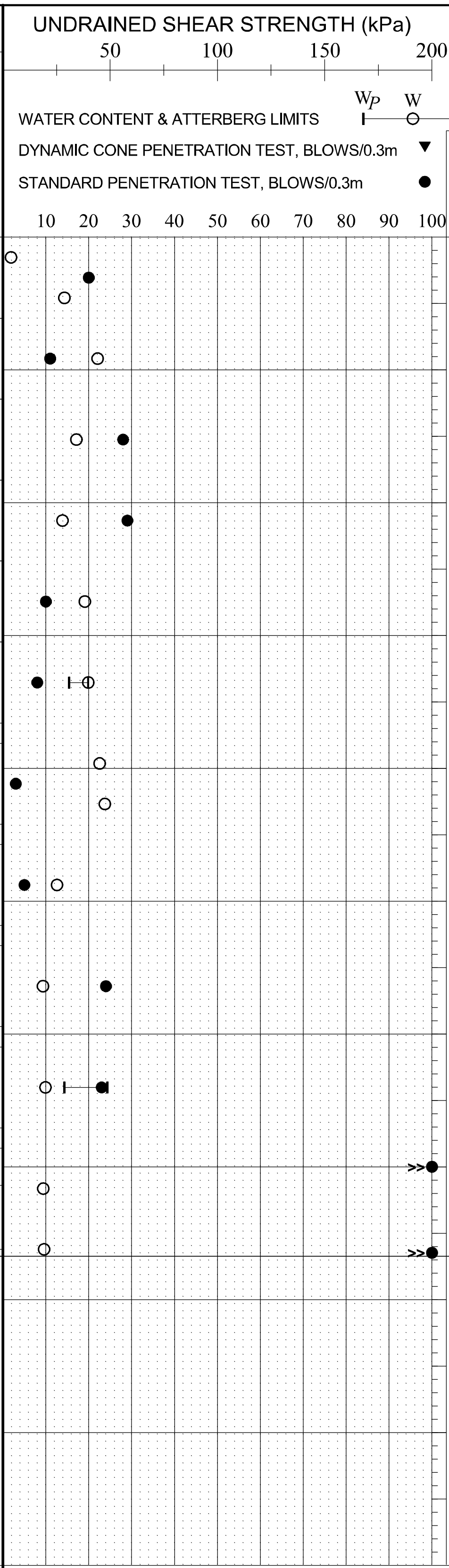
DATES: BORING September 6, 2018

WATER LEVEL

TPC ELEV.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION
0	**81.0**	**Paved Road**
		115 mm ASPHALT
		FILL: brown sand and gravel -some silt - dry
	80.4	Compact, brown, SILT (ML) - some clay - trace sand - moist
	79.2	Soft to very stiff, grey, silty CLAY (CL-ML) - moist
	76.9	Soft to very stiff, grey, sandy CLAY (CL) - some gravel - moist
	74.3	Highly weathered, grey, SHALE - moist
	73.4	END OF BOREHOLE at approximately 7.7 m below existing grade. Borehole caved at approximately 7.0 m below grade on completion of drilling.

TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
SS	1	480/610	20	
SS	2	410/610	11	0 8 78 14
SS	3	610/610	28	
SS	4	610/610	29	
SS	5	510/610	10	
SS	6	530/610	8	0 0 78 22
SS	7	610/610	3	
SS	8	410/610	5	
SS	9	610/610	24	
SS	10	610/610	23	10 30 34 26
SS	11	280/280	50/130	
SS	12	300/52	50/51	



DEPTH (ft) 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32

DEPTH (m) 0 1 2 3 4 5 6 7 8 9 10

STRATA PLOT | WATER LEVEL

☐ Field Vane Test, kPa

◘ Remoulded Vane Test, kPa

△ Pocket Penetrometer Test, kPa

Sheet 1 of 1

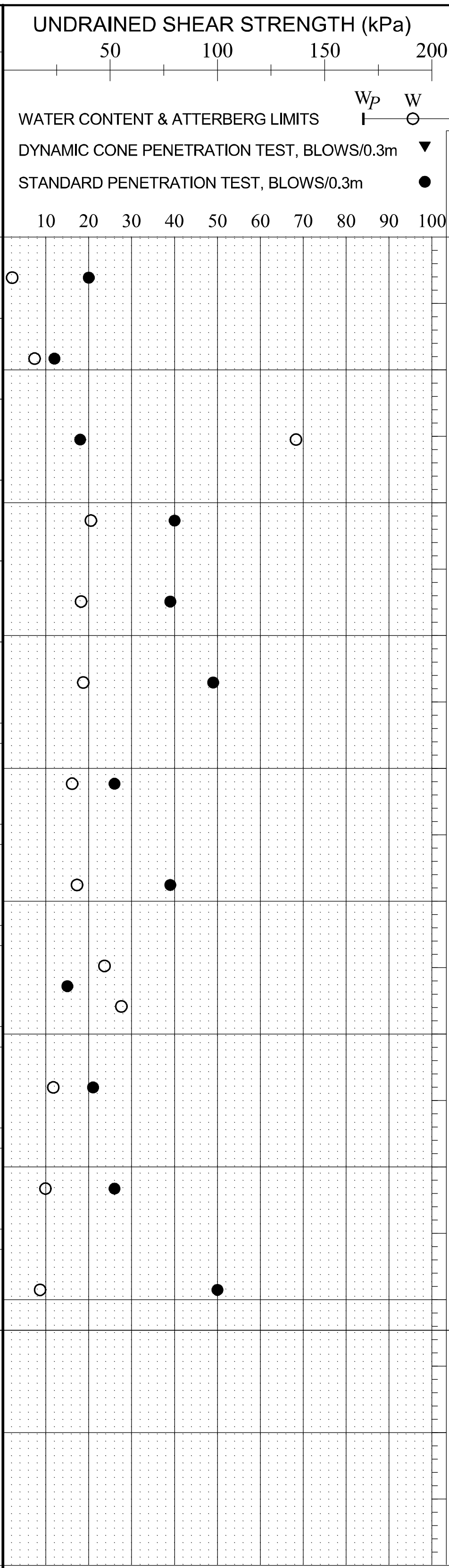
BOREHOLE RECORD

BH18-02

CLIENT Port Credit West Village Partners
PROJECT No. 122120255
LOCATION Mississauga, ON, N: 4 822 746 E: 614 172
DATUM Geodetic
DATES: BORING September 6, 2018
WATER LEVEL
TPC ELEV.

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	WATER LEVEL
0	80.0	**Paved Road**	
		100 mm ASPHALT	
	79.4	FILL: brown sand and gravel - some silt - dry	
		Compact to dense, brown to grey, SILT (ML) - trace sand and clay - moist to wet	
		- grey	▽
	74.3	Very stiff, grey, sandy CLAY (CL) - occasional shale fragments - trace gravel - moist	
	72.4	Highly weathered, grey, SHALE - dry	
	71.7	END OF BOREHOLE at approximately 8.2 m below existing grade. Groundwater level measured at approximately 5.5 m below grade on completion of drilling.	

DEPTH (ft)	TYPE	NUMBER	RECOVERY (mm) TCR(%) / SCR(%)	N-VALUE OR RQD(%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1	SS	1	330/610	20	
3	SS	2	440/610	12	
5	SS	3	530/610	18	0 3 93 4
7	SS	4	580/610	40	
9	SS	5	580/610	39	
11	SS	6	430/610	49	
13–14	SS	7	530/610	26	Non-Plastic 0 2 89 9
16	SS	8	530/610	39	
18–19	SS	9	580/610	15	
21	SS	10	610/610	21	
23–24	SS	11	610/610	26	
26	SS	12	610/610	50	

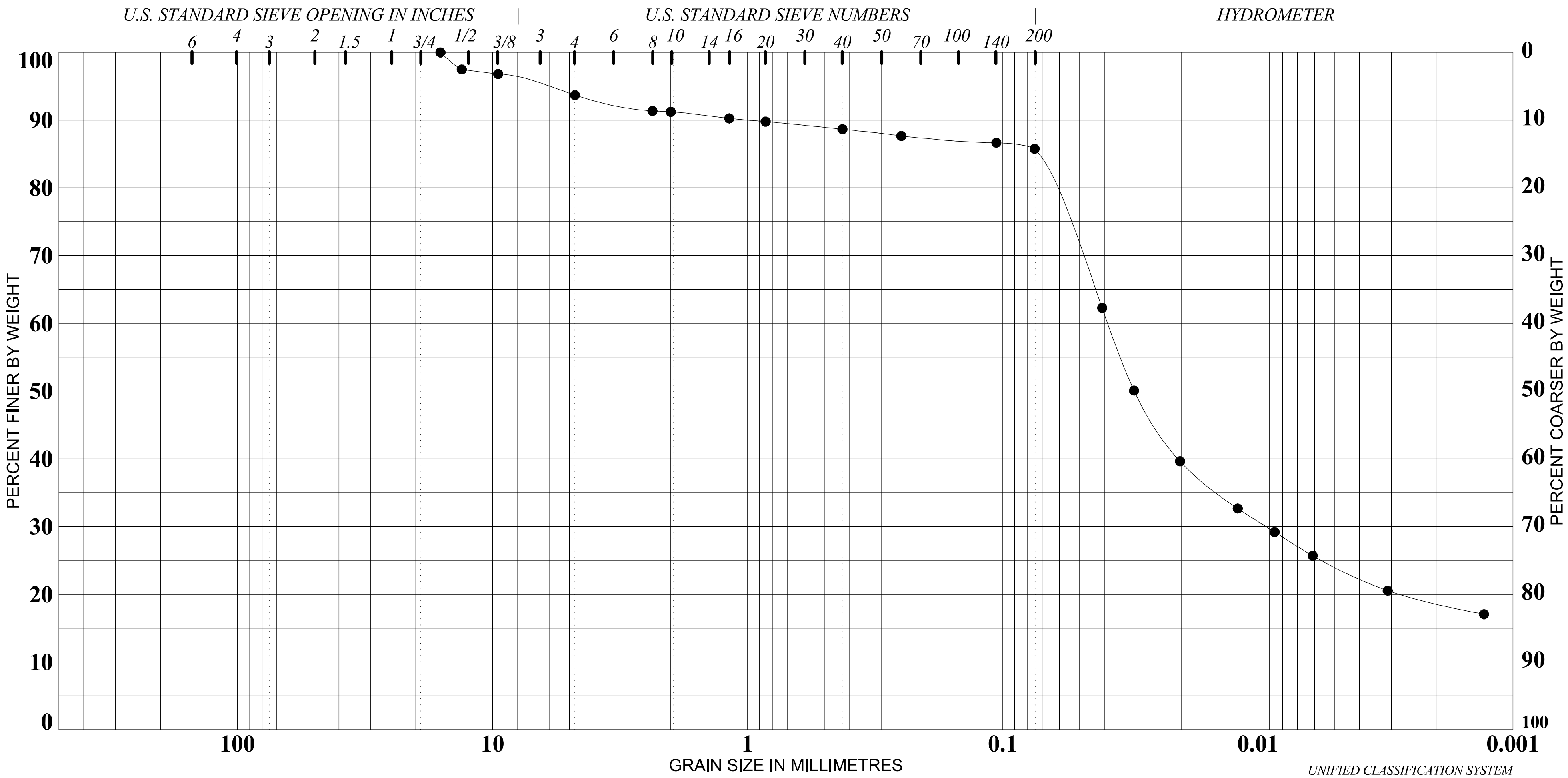


☐ Field Vane Test, kPa
◘ Remoulded Vane Test, kPa
△ Pocket Penetrometer Test, kPa

APPENDIX D

Geotechnical Laboratory Test Results

Stantec



BLDs	COBBLES	GRAVEL		SAND			SILT & CLAY	
		coarse	fine	coarse	medium	fine	SILT	CLAY

Sample	Depth (m)	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
● BH17-01	1.1	FILL: silt	12	NP	NP	NP	6	8	67	19

Stantec

Project: Port Credit Off-Site Geotechnical Investigation

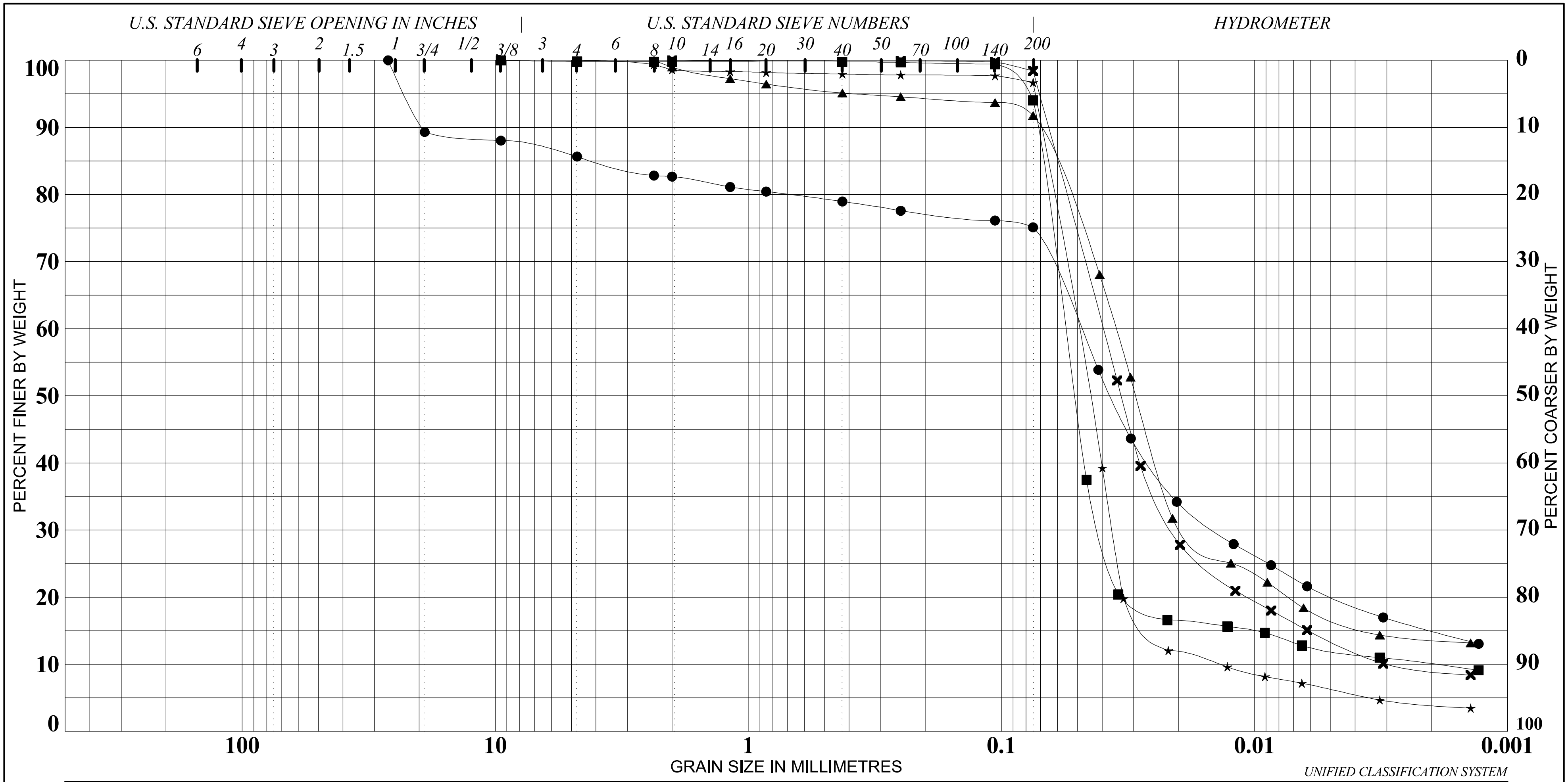
Location: Mississauga, ON

Project No.: 122120255

GRADATION CURVE (ASTM D422)

Figure: 1

Remarks:



BLDs	COBBLES	GRAVEL		SAND			SILT & CLAY	
		coarse	fine	coarse	medium	fine	SILT	CLAY

	Sample	Depth (m)	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
●	BH17-01	3.4	SILT with GRAVEL (ML)	13	NP	NP	NP	14	11	60	15
■	BH17-03	2.6	SILT (ML)	20	NP	NP	NP	0	6	84	10
▲	BH18-01	0.9	SILT (ML)	22				0	8	78	14
★	BH18-02	1.5	SILT (ML)	68				0	3	93	4
✖	BH18-02	4.1	SILT (ML)	16	NP	NP	NP	0	2	89	9

Stantec

Project: Port Credit Off-Site Geotechnical Investigation

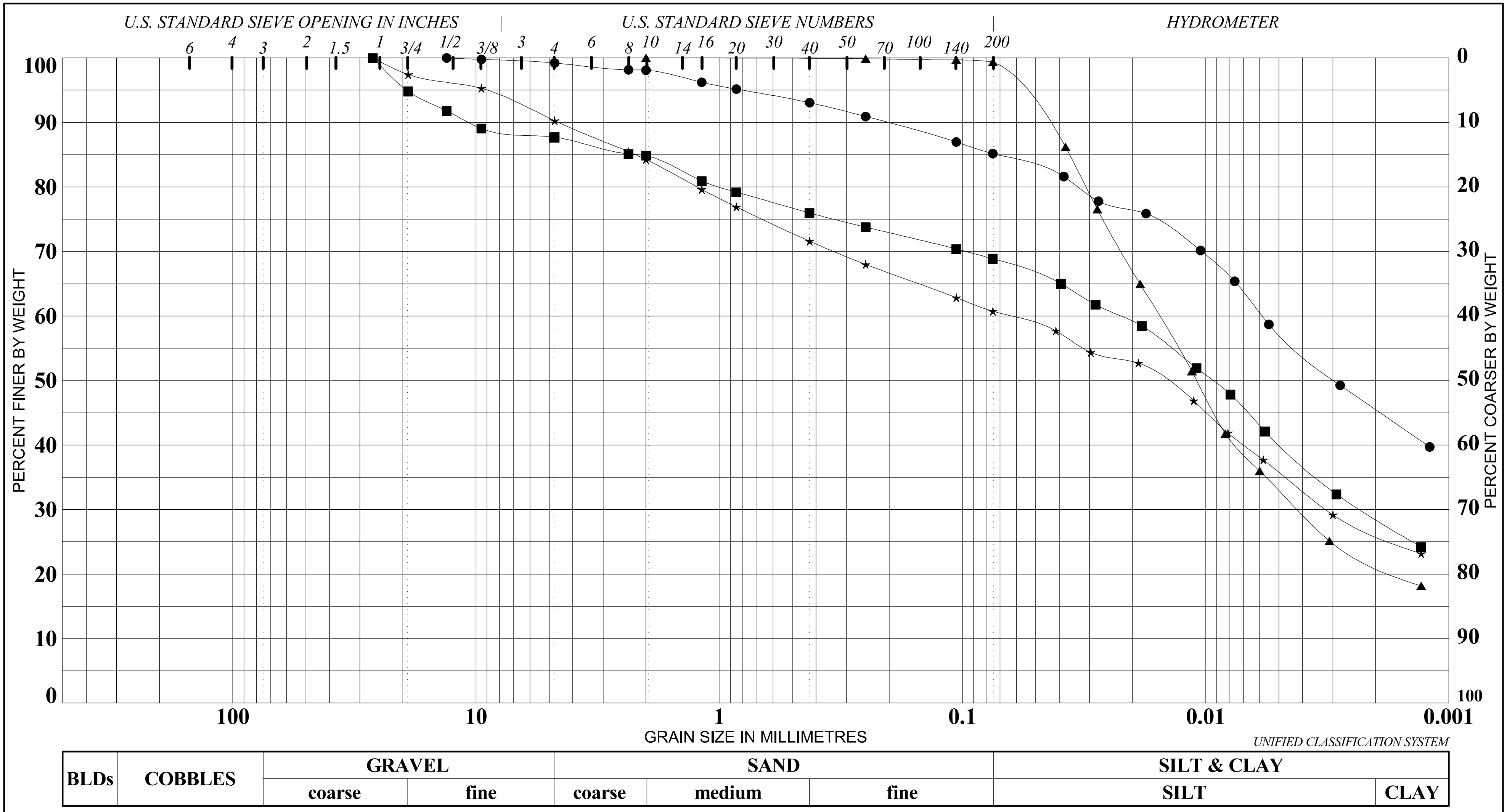
Location: Mississauga, ON

Project No.: 122120255

GRADATION CURVE (ASTM D422)

Figure: 2

Remarks:



Sample		Depth (m)	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
●	BH17-03	4.9	CLAY with SAND (CL)	18	29	15	14	1	14	40	45
■	BH17-06	1.8	SANDY CLAY (CL)	12	31	20	11	12	19	40	29
▲	BH18-01	3.4	SILTY CLAY (CL-ML)	20	20	15	5	0	0	78	22
★	BH18-01	6.4	SANDY CLAY (CL)	10	24	14	10	10	30	34	26

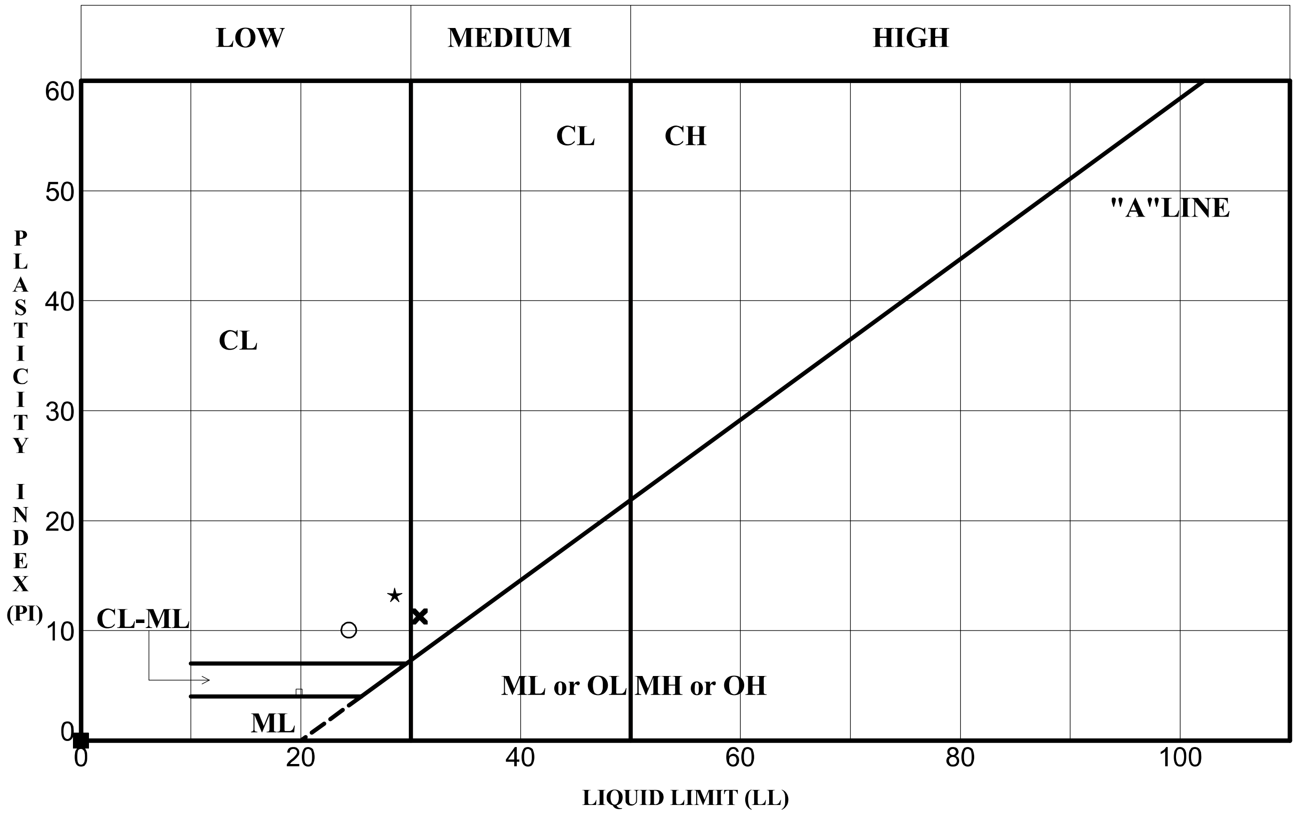
Stantec

Project: Port Credit Off-Site Geotechnical Investigation
Location: Mississauga, ON
Project No.: 122120255

GRADATION CURVE (ASTM D422)

Figure: 3
Remarks:

PLASTICITY CHART



Specimen		Depth (m)	LL	PL	PI	Fines	W%	Classification
●	BH17-01	1.1	NP	NP	NP	86	12	FILL: silt
■	BH17-01	3.4	NP	NP	NP	75	13	SILT with GRAVEL (ML)
▲	BH17-03	2.6	NP	NP	NP	94	20	SILT (ML)
★	BH17-03	4.9	29	15	14	85	18	CLAY with SAND (CL)
✖	BH17-06	1.8	31	20	11	69	12	SANDY CLAY (CL)
▫	BH18-01	3.4	20	15	5	99	20	SILTY CLAY (CL-ML)
○	BH18-01	6.4	24	14	10	61	10	SANDY CLAY (CL)
△	BH18-02	4.1	NP	NP	NP	98	16	SILT (ML)

Project: Port Credit Off-Site Geotechnical Investigation

Location: Mississauga, ON

Project No.: 122120255

ATTERBERG LIMITS

(ASTM D4318)

Figure: 4

Remarks:

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: STANTEC CONSULTING LTD.
300-675 Cochrane Drive
MARKHAM, ON L3R0B8
(905) 444-7777

ATTENTION TO: Nabeel Basheer

PROJECT: 122120255.500.300

AGAT WORK ORDER: 18T384139

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Supervisor

DATE REPORTED: Sep 18, 2018

PAGES (INCLUDING COVER): 5

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

CLIENT NAME: STANTEC CONSULTING LTD.

ATTENTION TO: Nabeel Basheer

SAMPLING SITE:

SAMPLED BY:

Corrosivity Package

DATE RECEIVED: 2018-09-12

DATE REPORTED: 2018-09-18

			SAMPLE DESCRIPTION:	BH18-01 10'-12'	BH18-01 15'-17'	BH18-02 6'-8'
			SAMPLE TYPE:	Soil	Soil	Soil
			DATE SAMPLED:	2018-09-06	2018-09-06	2018-09-06
Parameter	Unit	G / S	RDL	9539511	9539512	9539513
Sulfide (S2-)	%		0.05	0.14	0.40	<0.05
Chloride (2:1)	µg/g		2	50	17	68
Sulphate (2:1)	µg/g		2	56	76	13
pH (2:1)	pH Units		NA	8.27	8.34	8.97
Electrical Conductivity (2:1)	mS/cm		0.005	0.266	0.224	0.225
Resistivity (2:1)	ohm.cm		1	3760	4460	4440
Redox Potential (2:1)	mV		5	148	134	152

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

9539511-9539513 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).
*Sulphide analyzed at AGAT 5623 McAdam

Certified By: Amanjot Bhela

CHARTERED
AMANJOT BHELA
CHEMIST

Quality Assurance

CLIENT NAME: STANTEC CONSULTING LTD.
PROJECT: 122120255.500.300
SAMPLING SITE:

AGAT WORK ORDER: 18T384139
ATTENTION TO: Nabeel Basheer
SAMPLED BY:

Soil Analysis

RPT Date: Sep 18, 2018			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Corrosivity Package															
Sulfide (S2-)	9539511	9539511	0.14	0.12	NA	< 0.05	98%	80%	120%						
Chloride (2:1)	9539511	9539511	50	46	8.3%	< 2	91%	80%	120%	100%	80%	120%	105%	70%	130%
Sulphate (2:1)	9539511	9539511	56	53	5.5%	< 2	96%	80%	120%	100%	80%	120%	102%	70%	130%
pH (2:1)	9539511	9539511	8.27	8.20	0.9%	NA	101%	90%	110%	NA			NA		
Electrical Conductivity (2:1)	9539511	9539511	0.266	0.257	3.4%	< 0.005	96%	90%	110%	NA			NA		
Redox Potential (2:1)	9539511	9539511	148	147	0.7%	< 5	104%	70%	130%	NA			NA		

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Amanjot Bhela

CHARTERED
AMANJOT BHELA
CHEMIST

Method Summary

CLIENT NAME: STANTEC CONSULTING LTD. **AGAT WORK ORDER: 18T384139**

PROJECT: 122120255.500.300 **ATTENTION TO: Nabeel Basheer**

SAMPLING SITE: **SAMPLED BY:**

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sulfide (S2-)	MIN-200-12025	ASTM E1915-09	GRAVIMETRIC
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION
Redox Potential (2:1)		McKeague 4.12 & SM 2510 B	REDOX POTENTIAL ELECTRODE

18T384139

AGAT Laboratories

5835 Coopers Avenue
Mississauga, Ontario
L4Z 1Y2
www.agatlabs.com · webearth.agatlabs.com

Chain of Custody Record

Ph.: 905.712.5100 · Fax: 905.712.5122 · Toll Free: 800.856.6261

Laboratory Use Only

Arrival Temperature: 21^{8} 22^{6} 21^{6}
AGAT WO #:
Lab Temperature:
Notes: no ice

Client Information:

Company: Stantec Consulting Ltd.
Contact: Nabeel Basheer
Address: 300-675 Cochran Drive West Tower
Phone: 905-479-9345 Fax: 905-944-9889
Project: 122120255.500.300 PO:
AGAT Quotation #:

Please note, if quotation number is not provided, client will be billed full price for analysis.

Regulatory Requirements:

☐ Regulation 153/09 (reg. 511 Amend.)
Table ____ Indicate one
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture (check one)
☐ Coarse ☐ Fine

☐ Sewer Use
Region ____ Indicate one
☐ Sanitary
☐ Storm

☐ Regulation 558
☐ CCME
☐ Other (specify)
☐ Prov. Water Quality Objectives (PWQO)
☐ None

Turnaround Time Required (TAT) Required*

Regular TAT
☑ 5 to 7 Working Days

Rush TAT (please provide prior notification)
Rush Surcharges Apply
☐ 3 Working Days
☐ 2 Working Days
☐ 1 Working Day

OR

Date Required (Rush surcharges may apply):

*TAT is exclusive of weekends and statutory holidays

Invoice To:

Same: Yes ☑ No ☐
Company:
Contact:
Address:

Is this a drinking water sample?
(potable water intended for human consumption)
☐ Yes ☐ No
If "Yes", please use the *Drinking Water Chain of Custody Form*

Is this submission for a **Record of Site Condition?**
☐ Yes ☐ No

Legend Matrix

GW	Ground Water	**O**	Oil
SW	Surface Water	**P**	Paint
SD	Sediment	**S**	Soil

Report Information – reports to be sent to:

1. Name: Nabeel Basheer
   Email: nabeel.basheer@stantec.com
2. Name: Amanda Sheppard
   Email: amanda.sheppard@stantec.com

Sample Identification	Date Sampled	Time Sampled	Sample Matrix	# of Containers	Comments Site/Sample Information	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl- ☐ CN- ☐ EC ☐ FOC ☐ Cr+6- ☐ SAR ☐ NO_3/NO_2 ☐ N-Total ☐ Hg ☐ pH	Nutients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3/NO_2	VOC: ☐ VOC ☐ THM ☐ BTEX	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	TCLP:	Sewer Use	Corrosivity Pckg (pH, Redox Potential, sulphates and sulphides contents, chlorides contents and resistivity)
BH18-01	2018-09-06			1	10'-12'																	X
BH18-01	2018-09-06			1	15'-17'																	X
BH18-02	2018-09-06			1	6'-8'																	X

Samples Relinquished by (print name & sign): Date/Time
Samples Received by (Print name & sign): Simon Z 18/9/12 Date/Time 9 50
Samples Relinquished by (print name & sign): Date/Time
Samples Received by (Print name & sign): Date/Time

Pink Copy – Client
Yellow + Golden Copy – AGAT
White Copy – AGAT

Page ____ of ____
NO:

APPENDIX E

Rock Core Photographs

Project:	70 Mississauga Road South Off-Site Services
Project Number:	122120255
Location:	Mississauga Road South, Mississauga
Borehole:	BH17-07
Depth (m):	3.48 - 6.25

3.48m — RUN 1 → | — RUN 2 → 5.05m

5.05m — RUN 2 → | 6.25m

Page: 1 of 1

APPENDIX F

Seismic Hazard Calculation Data Sheet

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

November 17, 2017

Site: 43.5471 N, 79.5881 W User File Reference: Off-Site Services at 70 Mississauga Road South

Requested by: , Stantec Consulting Ltd.

National Building Code ground motions: 2% probability of exceedance in 50 years (0.000404 per annum)

Sa(0.05)	Sa(0.1)	**Sa(0.2)**	Sa(0.3)	**Sa(0.5)**	**Sa(1.0)**	**Sa(2.0)**	**Sa(5.0)**	**Sa(10.0)**	**PGA (g)**	**PGV (m/s)**
0.253	0.302	**0.250**	0.185	**0.126**	**0.062**	**0.029**	**0.0069**	**0.0028**	**0.161**	**0.100**

Notes. Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC 2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are specified in **bold** font. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. ***These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.***

Ground motions for other probabilities:

Probability of exceedance per annum	0.010	0.0021	0.001
Probability of exceedance in 50 years	40%	10%	5%
Sa(0.05)	0.012	0.061	0.121
Sa(0.1)	0.018	0.082	0.152
Sa(0.2)	0.020	0.073	0.129
Sa(0.3)	0.018	0.058	0.099
Sa(0.5)	0.014	0.043	0.070
Sa(1.0)	0.0067	0.024	0.037
Sa(2.0)	0.0028	0.011	0.017
Sa(5.0)	0.0006	0.0024	0.0040
Sa(10.0)	0.0004	0.0010	0.0016
PGA	0.010	0.044	0.082
PGV	0.0083	0.032	0.054

References

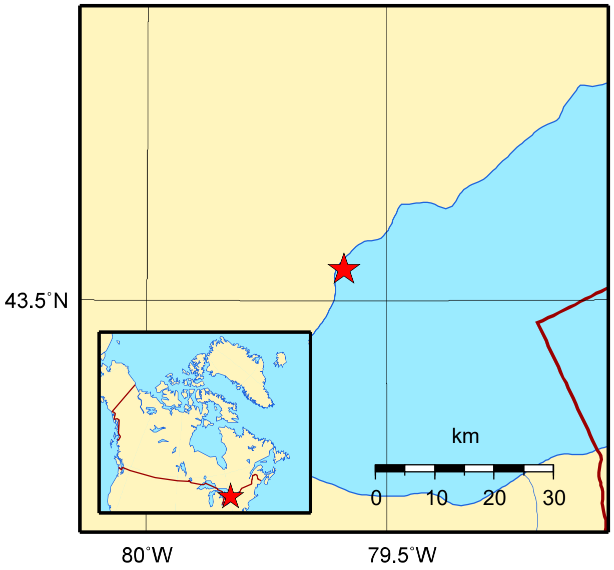
National Building Code of Canada 2015 NRCC no. 56190;
Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

User's Guide - NBC 2015, Structural Commentaries NRCC no. xxxxxx (in preparation)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites *www.EarthquakesCanada.ca* and *www.nationalcodes.ca* for more information

Aussi disponible en français



APPENDIX B

Sanitary Sewer Design Calculations

- *Sanitary Sewer Design Sheet*
- *Existing Sanitary Sewer Design Sheet*
- *Population Estimates by Block*
- *DRAFT External Sanitary Drawings*
- *External Works Population Projection*

Port Credit West Village Population Projections

By Unit Count

Block 1 15 Towns

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)				0.09	
Units	15.00				
Population	40.50		0.00	4.50	45.00

Block 3 2st+8st

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)				0.75	
Units			119.00		
Population	0.00		321.30	37.50	358.80

Block 4 Commercial

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)				1.99	
Units					
Population	0.00		0.00	99.50	99.50

Block 6 Stcks&Backs

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)					
Units	2.00	32.00			
Population	0.00	86.40	0.00	0.00	86.40

Block 19 Trail and Park

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)					
Units		0.00			
Population	0.00	0.00	0.00	0.00	0.00

Block 2 Towns

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)					
Units		69.00			
Population	0.00	186.30	0.00	0.00	186.30

Block 7 8st

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)				0.07	
Units			125.00		
Population	0.00	0.00	337.50	3.50	341.00

Block 5 8st x 2

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)				0.19	
Units			263.00		
Population	0.00	0.00	710.10	9.50	719.60

Block 8 Towns

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)					
Units	104.00				
Population	280.80	0.00	0.00	0.00	280.80

Block 20/21 - Park

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)					
Units					
Population	0.00	0.00	0.00	0.00	0.00

Port Credit West Village Population Projections

By Regional Standards

Block 1

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)	0.34			0.09	
Units					
Population	59.06		0.00	4.50	63.56

Block 3

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)			1.03	0.75	
Units		0.00			
Population	0.00		321.30	37.50	358.80

Block 4

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)				1.99	
Units					
Population	0.00		0.00	99.50	99.50

Block 6

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)		0.37		0.00	
Units					
Population	0.00	64.96	0.00	0.00	64.96

Block 19 Trail and Park

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)				0.00	
Units		0.00			
Population	0.00	0.00	0.00	0.00	0.00

Block 2 Towns

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)	0.75			0.00	
Units					
Population	130.59		0.00	0.00	130.59

Block 7 8st

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)			1.08	0.07	
Units					
Population	0.00	0.00	337.50	3.50	341.00

Block 5 8st x 2

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)			2.28	0.19	
Units					
Population	0.00	0.00	710.10	9.50	719.60

Block 8 Towns

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)	2.39			0.00	
Units					
Population	418.04	0.00	0.00	0.00	418.04

Block 20/21 - Park

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)				0.00	
Units					
Population	0.00	0.00	0.00	0.00	0.00

Population Estimate - Summary

Block #	**Population**
Block 1	64
Block 3	359
Block 4	100
Block 6	86
Block 19	
Block 2	186
Block 7	341
Block 5	720
Block 8	418
Block 20/21 - Park	
Block 10	1322
Block 12	293
Block 14	211
Block 15 - Park	
Block 9	703
Block 11	2049
Block 13	628
Block 16	78
Block 22 - Park	
Block 17	201
Block 18	1003
Total	**8763**

Block 10 18st x 2 + towns

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)					
Units	19.00		462.00		
Population	51.30	0.00	1247.40	0.00	1298.70

Block 12 Towns

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)					
Units	73.00				
Population	197.10	0.00	0.00	0.00	197.10

Block 14

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)					
Units		78.00			
Population	0.00	210.60	0.00	0.00	210.60

Block 15 - Park

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)					
Units					
Population	0.00	0.00	0.00	0.00	0.00

Block 9 Towns

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)					
Units	65.00		151.00		
Population	175.50	0.00	407.70	0.00	583.20

Block 11 22st, 22st, 26st

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)					
Units			759.00		
Population	0.00	0.00	2049.30	0.00	2049.30

Block 13 22st, towns

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)					
Units	51.00		159.00		
Population	137.70	0.00	429.30	0.00	567.00

Block 16

	Towns	Semis	Apartments	Commercial/Retail	Total
Area (ha)					
Units		29.00			
Population	0.00	78.30	0.00	0.00	78.30

Block 22 - Park

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)					
Units					
Population	0.00	0.00	0.00	0.00	0.00

Block 17 Campus 12st

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)				0.03	
Units			74.00		
Population	0.00	0.00	199.80	1.50	201.30

Block 18 12st, 15st, 12st, YMCA

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)				1.38	
Units			346.00		
Population	0.00		934.20	69.14	1003.34

Total 8306.24

Block 10 18st x 2

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)	0.42		4.41	0.00	
Units					
Population	74.15	0.00	1247.40	0.00	1321.55

Block 12

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)	1.68			0.00	
Units					
Population	293.42	0.00	0.00	0.00	293.42

Block 14

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)		1.04		0.00	
Units					
Population	0.00	182.77	0.00	0.00	182.77

Block 15 - Park

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)					
Units					
Population	0.00	0.00	0.00	0.00	0.00

Block 9 Towns

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)	1.69		1.93	0.00	
Units					
Population	295.75	0.00	407.70	0.00	703.45

Block 11 22st, 22st, 26st

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)			9.30	0.00	
Units					
Population	0.00	0.00	2049.30	0.00	2049.30

Block 13 22st, towns

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)	1.14		2.06	0.00	
Units					
Population	199.03	0.00	429.30	0.00	628.33

Block 16

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)		0.39		0.00	
Units					
Population	0.00	67.95	0.00	0.00	67.95

Block 22 - Park

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)				0.00	
Units					
Population	0.00	0.00	0.00	0.00	0.00

Block 17 Campus 12st

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)			0.97	0.03	
Units					
Population	0.00	0.00	199.80	1.50	201.30

Block 18 12st, 15st, 12st, YMCA

	Towns	Stks &Backs	Apartments	Commercial/Retail	Total
Area (ha)			4.43	1.38	5.82
Units					
Population	0.00		775.95	69.14	845.09

Total 8489.21

Port Credit West Village Population Projections

According to PUBLIC WORKS DESIGN, SPECIFICATION & PROCEDURES MANUAL

(REVISED JULY 2009)

Drainage Area 1

	Single Family	Apartments	High-Rise	Row dwelling	Institutional	Industrial	Commercial	Park/Open	Total
Area (ha)							1.99		1.99
Population/Hectare							50		50.0
Population							100		100

Drainage Area 2

	Single Family	Apartments	High-Rise	Row dwelling	Institutional	Industrial		Park/Open	Total
Area (ha)								0.07	0.07
Population/Hectare								0.00	0.0
Population								0.00	0

Drainage Area 3

	Single Family	Apartments	High-Rise	Row dwelling	Institutional	Industrial		Park/Open	Total
Area (ha)	0.17					0.28		0.25	0.70
Population/Hectare	70					70		0.00	45.7
Population	12					20		0.00	32

Drainage Area 4

	Single Family	Apartments	High-Rise	Row dwelling	Institutional*	Industrial		Park/Open	Total
Area (ha)	0.17				0.36			0.33	0.86
Population/Hectare	70				556			0.00	246.5
Population	12				200			0.00	212

*School in drainage area is daycare, equivalent population is (1/3)*600

Drainage Area 5

	Single Family	Apartments	High-Rise	Row dwelling	Institutional	Industrial		Park/Open	Total
Area (ha)	0.31	0.20						0.28	0.79
Population/Hectare	70	475.00						0.00	148.1
Population	22	95.00						0.00	117

Drainage Area 6

	Single Family	Apartments	High-Rise	Row dwelling	Institutional	Industrial		Park/Open	Total
Area (ha)	0.39							0.18	0.57
Population/Hectare	70							0.00	49.1
Population	28							0.00	28

External Area 1

	Single Family	Apartments	High-Rise	Row dwelling	Institutional	Industrial		Park/Open	Total
Area (ha)	3.49	0.32	0.85	0.20				5.64	10.50
Population/Hectare	70	475.00	635.29	175				0.00	92.6
Population	245	152.00	540.00	35				0.00	972

urbantech

SANITARY SEWER DESIGN SHEET

PORT CREDIT WEST VILLAGE PARTNERS INC.

EXISTING SANITARY CONTRIBUTION

Region of Peel

PROJECT DETAILS

Project No: 16-489W
Date: 12-Nov-18
Designed by: R.N.
Checked by: R.M.

DESIGN CRITERIA

Min. Flow = 13 l/s
Min Diameter = 250 mm
Mannings 'n'= 0.013
Min. Velocity = 0.75 m/s
Max. Velocity = 3.50 m/s
Factor of Safety = 15 %

Avg. Domestic Flow = 302.8 l/c/d
Infiltration = 0.200 l/s/ha
Max. Peaking Factor = 4.00
Min. Peaking Factor= 1.50
Domestic Sewage flow for < 1000 ppl = 0.013m^3/s
(Region of Peel Std. 2-5-2)

			RESIDENTIAL							COMMERCIAL/INDUSTRIAL/INSTITUTIONAL						FLOW CALCULATIONS								PIPE DATA					
STREET	FROM MH	TO MH	AREA (ha)	ACC. AREA (ha)	UNITS (#)	DENSITY (P/ha)	DENSITY (P/unit)	POP	ACCUM. RES. POP.	AREA (ha)	ACC. AREA (ha)	EQUIV. POP. (p/ha)	FLOW RATE (l/s/ha)	EQUIV. POP.	ACCUM. EQUIV. POP.	INFILTRATION (l/s)	TOTAL ACCUM. POP.	PEAKING FACTOR	RES. FLOW (l/s)	MIN. RES. FLOW (l/s)	COMM. FLOW (l/s)	ACCUM. COMM. FLOW (l/s)	TOTAL FLOW (l/s)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (l/s)	FULL FLOW VELOCITY (m/s)	ACTUAL VELOCITY (m/s)	PERCENT FULL (%)
PORT STREET	EX.MH13A	EX. MH14A	0.70	0.70		45.7		32	32							0.1	32	4.00	0.4	13.0			13.1	0.49	375	122.7	1.11	0.73	11%
PORT STREET	EX. MH14A	EX. MH15A	0.86	1.56		246.5		212	244							0.3	244	4.00	3.4	13.0			13.3	0.50	375	124.0	1.12	0.74	11%
PORT STREET	EX. MH15A	EX. MH17A	0.79	2.35		148.1		117	361							0.5	361	4.00	5.1	13.0			13.5	3.12	375	309.7	2.80	1.37	4%
EXISTING (SOUTH)	EX. 1	EX. MH17A	10.50	10.50		92.6		972	972							2.1	972	3.81	13.0	13.0			15.1	0.39	375	109.5	0.99	0.69	14%
FRONT STREET	EX. MH17A	EX. MH18A	0.57	13.42		49.1		28	1361							2.7	1361	3.71	17.7	17.7			20.4	0.14	375	65.6	0.59	0.52	31%
FRONT STREET	EX. MH18A	EX. MH20A		13.42					1361							2.7	1361	3.71	17.7	17.7			20.4	0.20	375	78.4	0.71	0.59	26%

REGISTERED PROFESSIONAL ENGINEER
R.B.T. MERWIN
100009772
NOV 15, 2018
PROVINCE OF ONTARIO

SANITARY SEWER DESIGN SHEET

Port Credit

CITY OF MISSISSAUGA, REGION OF PEEL

PROJECT DETAILS

Project No: 16-489
Date: 9-Nov-18
Designed by: RAM/SR
Checked by: R.B.T.M.

DESIGN CRITERIA

Min. Flow = 13 l/s
Min Diameter = 250 mm
Mannings 'n'= 0.013
Min. Velocity = 0.75 m/s
Max. Velocity = 3.50 m/s
Factor of Safety = 40 %

Avg. Domestic Flow = 302.8 l/c/d
Infiltration = 0.200 l/s/ha
Max. Peaking Factor = 4.00
Min. Peaking Factor= 1.50
Domestic Sewage flow for < 1000 ppl = $0.013m^3/s$
(Region of Peel Std. 2-5-2)

NOMINAL PIPE SIZE USED

			RESIDENTIAL							COMMERCIAL/INDUSTRIAL/INSTITUTIONAL						FLOW CALCULATIONS								PIPE DATA					
STREET	FROM MH	TO MH	AREA (ha)	ACC. AREA (ha)	UNITS (#)	DENISTY (P/ha)	DENSITY (P/unit)	POP	ACCUM. RES. POP.	AREA (ha)	ACC. AREA (ha)	EQUIV. POP. (p/ha)	FLOW RATE (l/s/ha)	EQUIV. POP.	ACCUM. EQUIV. POP.	INFILTRATION (l/s)	TOTAL ACCUM. POP.	PEAKING FACTOR	RES. FLOW (l/s)	MIN. RES. FLOW (l/s)	COMM. FLOW (l/s)	ACCUM. COMM. FLOW (l/s)	TOTAL FLOW (l/s)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (l/s)	FULL FLOW VELOCITY (m/s)	ACTUAL VELOCITY (m/s)	PERCENT FULL (%)
BLOCK 1	BLK 1A	MH13A	0.45	0.45		175		64	64							0.1	64	4.00	0.9	13.0			13.1	1.00	250	59.5	1.21	0.96	22%
STREET E	MH13A	MH12A	0.12	0.57					64							0.1	64	4.00	0.9	13.0			13.1	0.50	250	42.0	0.86	0.75	31%
STREET E	MH12A	MH11A	0.05	0.62					64							0.1	64	4.00	0.9	13.0			13.1	0.50	250	42.0	0.86	0.75	31%
STREET E	MH11A	MH10A	0.06	0.68					64							0.1	64	4.00	0.9	13.0			13.1	0.50	250	42.0	0.86	0.75	31%
STREET E	MH10A	MH9A	0.06	0.74					64							0.1	64	4.00	0.9	13.0			13.1	0.50	250	42.0	0.86	0.75	31%
STREET E	MH9A	MH8A	0.16	0.90					64							0.2	64	4.00	0.9	13.0			13.2	0.50	250	42.0	0.86	0.75	31%
BLOCK 2	BLK 2A	MH8A	0.67	0.67		175		186	186							0.1	186	4.00	2.6	13.0			13.1	1.00	250	59.5	1.21	0.96	22%
STREET F	MH8A	MH7A	0.13	1.70					250							0.3	250	4.00	3.5	13.0			13.3	0.50	250	42.0	0.86	0.75	32%
BLOCK 9	BLK 9A	MH15A	2.28	2.28		175		703	703							0.5	703	3.89	9.6	13.0			13.5	1.00	250	59.5	1.21	0.96	23%
STREET F	MH15A	MH14A	0.13	2.41					703							0.5	703	3.89	9.6	13.0			13.5	0.50	250	42.0	0.86	0.75	32%
STREET F	MH14A	MH7A	0.13	2.54					703							0.5	703	3.89	9.6	13.0			13.5	0.50	250	42.0	0.86	0.75	32%
BLOCK 8	BLK 8A	MH7A	2.50	2.50		175		418	418							0.5	418	4.00	5.9	13.0			13.5	1.00	250	59.5	1.21	0.96	23%
STREET C	MH7A	MH6A	0.11	6.85					1371							1.4	1371	3.71	17.8	17.8			19.2	0.40	250	37.6	0.77	0.76	51%
BLOCK 7	BLK 7A	MH6A	0.43	0.43		475		341	341							0.1	341	4.00	4.8	13.0			13.1	1.00	250	59.5	1.21	0.96	22%
BLOCK 10	BLK 10A	MH6A	1.17	1.17		475		1322	1322							0.2	1322	3.72	17.2	17.2			17.5	1.00	250	59.5	1.21	1.03	29%
STREET C	MH6A	MH5A	0.08	8.53					3034							1.7	3034	3.44	36.6	36.6			38.3	0.35	300	57.2	0.81	0.85	67%
STREET B	MH17A	MH16A	0.27	0.27												0.1							0.1	1.00	250	59.5	1.21	0.31	0%
BLOCK 3	BLK 3A	MH18A	0.84	0.84		475		359	359							0.2	359	4.00	5.0	13.0			13.2	1.00	250	59.5	1.21	0.96	22%
STREET E	MH18A	MH16A	0.19	1.03					359							0.2	359	4.00	5.0	13.0			13.2	0.50	250	42.0	0.86	0.75	31%
STREET B	MH16A	MH5.1A	0.11	1.41					359							0.3	359	4.00	5.0	13.0			13.3	0.50	250	42.0	0.86	0.75	32%
STREET B	MH5.1A	MH5A	0.02	1.43					359							0.3	359	4.00	5.0	13.0			13.3	0.50	250	42.0	0.86	0.75	32%
BLOCK 18	BLK 18A	MH24A	2.11	2.11		475		1003	1003							0.4	1003	3.80	13.4	13.4			13.8	1.00	250	59.5	1.21	0.96	23%
STREET A	MH24A	MH23A	0.08	2.19					1003							0.4	1003	3.80	13.4	13.4			13.8	0.50	250	42.0	0.86	0.75	33%
BLOCK 17	BLK 17A	MH23A	0.37	0.37		475		201	201							0.1	201	4.00	2.8	13.0			13.1	1.00	250	59.5	1.21	0.96	22%
STREET B	MH23A	MH22A	0.14	2.70					1204							0.5	1204	3.75	15.8	15.8			16.3	0.50	250	42.0	0.86	0.77	39%
BLOCK 11	BLK 11A	MH22A	1.22	1.22		475		2049	2049							0.2	2049	3.58	25.7	25.7			25.9	1.00	250	59.5	1.21	1.13	44%
STREET B	MH22A	MH21A	0.14	4.06					3253							0.8	3253	3.41	38.9	38.9			39.7	0.50	300	68.4	0.97	0.98	58%
STREET B	MH21A	MH20A	0.13	4.19					3253							0.8	3253	3.41	38.9	38.9			39.7	0.50	300	68.4	0.97	0.98	58%
STREET B	MH20A	MH19A	0.08	4.27					3253							0.9	3253	3.41	38.9	38.9			39.8	0.50	300	68.4	0.97	0.98	58%
STREET B	MH19A	MH5.2A	0.07	4.34					3253							0.9	3253	3.41	38.9	38.9			39.8	0.50	300	68.4	0.97	0.98	58%
STREET B	MH5.2A	MH5A	0.01	4.35					3253							0.9	3253	3.41	38.9	38.9			39.8	0.50	300	68.4	0.97	0.98	58%
STREET C	MH5A	MH4A	0.15	14.46					6646							2.9	6646	3.13	72.9	72.9			75.8	0.35	450	168.7	1.06	1.02	45%
BLOCK 5	BLK 5A	MH4A	0.60	0.60		475		720	720							0.1	720	3.89	9.8	13.0			13.1	1.00	250	59.5	1.21	0.96	22%
BLOCK 12	BLK 12A	MH4A	1.48	1.48		175		293	293							0.3	293	4.00	4.1	13.0			13.3	1.00	250	59.5	1.21	0.96	22%
STREET C	MH4A	MH3A	0.14	16.68					7659							3.3	7659	3.07	82.4	82.4			85.7	0.35	450	168.7	1.06	1.05	51%
BLOCK 16	BLK 16A	MH27A	0.39	0.39		70		78	78							0.1	78	4.00	1.1	13.0			13.1	1.00	250	59.5	1.21	0.96	22%

			RESIDENTIAL							COMMERCIAL/INDUSTRIAL/INSTITUTIONAL						FLOW CALCULATIONS								PIPE DATA					
STREET	FROM MH	TO MH	AREA (ha)	ACC. AREA (ha)	UNITS (#)	DENISTY (P/ha)	DENSITY (P/unit)	POP	ACCUM. RES. POP.	AREA (ha)	ACC. AREA (ha)	EQUIV. POP. (p/ha)	FLOW RATE (l/s/ha)	EQUIV. POP.	ACCUM. EQUIV. POP.	INFILTRATION (l/s)	TOTAL ACCUM. POP.	PEAKING FACTOR	RES. FLOW (l/s)	MIN. RES. FLOW (l/s)	COMM. FLOW (l/s)	ACCUM. COMM. FLOW (l/s)	TOTAL FLOW (l/s)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (l/s)	FULL FLOW VELOCITY (m/s)	ACTUAL VELOCITY (m/s)	PERCENT FULL (%)
STREET D	MH27A	MH26A	0.09	0.48					78							0.1	78	4.00	1.1	13.0			13.1	0.50	250	42.0	0.86	0.75	31%
BLOCK 13	**BLK 13A**	**MH26A**	**1.38**	**1.38**		**175**		**628**	**628**							**0.3**	**628**	**3.92**	**8.6**	**13.0**			**13.3**	**1.00**	**250**	**59.5**	**1.21**	**0.96**	**22%**
STREET D	MH26A	MH25A	0.12	1.98					706							0.4	706	3.89	9.6	13.0			13.4	0.50	250	42.0	0.86	0.75	32%
STREET D	MH25A	MH3A	0.12	2.10					706							0.4	706	3.89	9.6	13.0			13.4	0.50	250	42.0	0.86	0.75	32%
STREET C	MH3A	MH2A	0.04	18.82					8365							3.8	8365	3.03	88.9	88.9			92.6	0.35	450	168.7	1.06	1.07	55%
STREET C	MH2A	MH1A	0.17	18.99					8365							3.8	8365	3.03	88.9	88.9			92.7	0.35	450	168.7	1.06	1.07	55%
BLOCK 6	**BLK 6A**	**MH1A**	**0.28**	**0.28**		**175**		**86**	**86**							**0.1**	**86**	**4.00**	**1.2**	**13.0**			**13.1**	**1.00**	**250**	**59.5**	**1.21**	**0.96**	**22%**
BLOCK 14	**BLK 14A**	**MH1A**	**0.87**	**0.87**		**175**		**211**	**211**							**0.2**	**211**	**4.00**	**3.0**	**13.0**			**13.2**	**1.00**	**250**	**59.5**	**1.21**	**0.96**	**22%**
BLOCK 4	**BLK 4A**	**MH8A-E**								**1.99**	**1.99**	**50**		**100**	**100**	**0.4**	**100**	**4.00**	**1.4**	**13.0**			**13.4**	**1.00**	**250**	**59.5**	**1.21**	**0.96**	**23%**
MISSISSAUGA ROAD	MH8A-E	MH7A-E	0.80	0.80		70		56	56		1.99				100	0.6	156	4.00	2.2	13.0			13.6	1.00	250	59.5	1.21	0.96	23%
STREET C	MH1A	MH7A-E		20.14					8662							4.0	8662	3.02	91.6	91.6			95.6	0.35	450	168.7	1.06	1.07	57%
PORT STREET	MH7A-E	MH5A-E		20.94					8718		1.99				100	4.6	8818	3.01	93.0	93.0			97.6	0.35	525	254.4	1.18	1.06	38%
PORT STREET	MH5A-E	MH4A-E	0.86	21.80		266		229	8947		1.99				100	4.8	9047	3.00	95.0	95.0			99.8	0.35	525	254.4	1.18	1.06	39%
PORT STREET	MH4A-E	MH3A-E	0.80	22.60		203		162	9109		1.99				100	4.9	9209	2.99	96.5	96.5			101.4	0.35	525	254.4	1.18	1.09	40%
FRONT STREET	EX. 1	MH3A-E	10.44	10.44		72.7		759	759							2.1	759	3.87	10.3	13.0			15.1	0.39	375	109.5	0.99	0.69	14%
FRONT STREET	MH3A-E	MH2A-E	0.57	33.61		70		40	9908		1.99				100	7.1	10008	2.95	103.6	103.6			110.7	0.31	525	239.4	1.11	1.06	46%
FRONT STREET	MH2A-E	EX.MH19A		33.61					9908		1.99				100	7.1	10008	2.95	103.6	103.6			110.7	0.35	525	254.4	1.18	1.09	44%

REGISTERED PROFESSIONAL ENGINEER
R.B.T. MERWIN
100009772
NOV 15, 2018
PROVINCE OF ONTARIO

SECOND ENGINEERING SUBMISSION, NOVEMBER 15, 2018

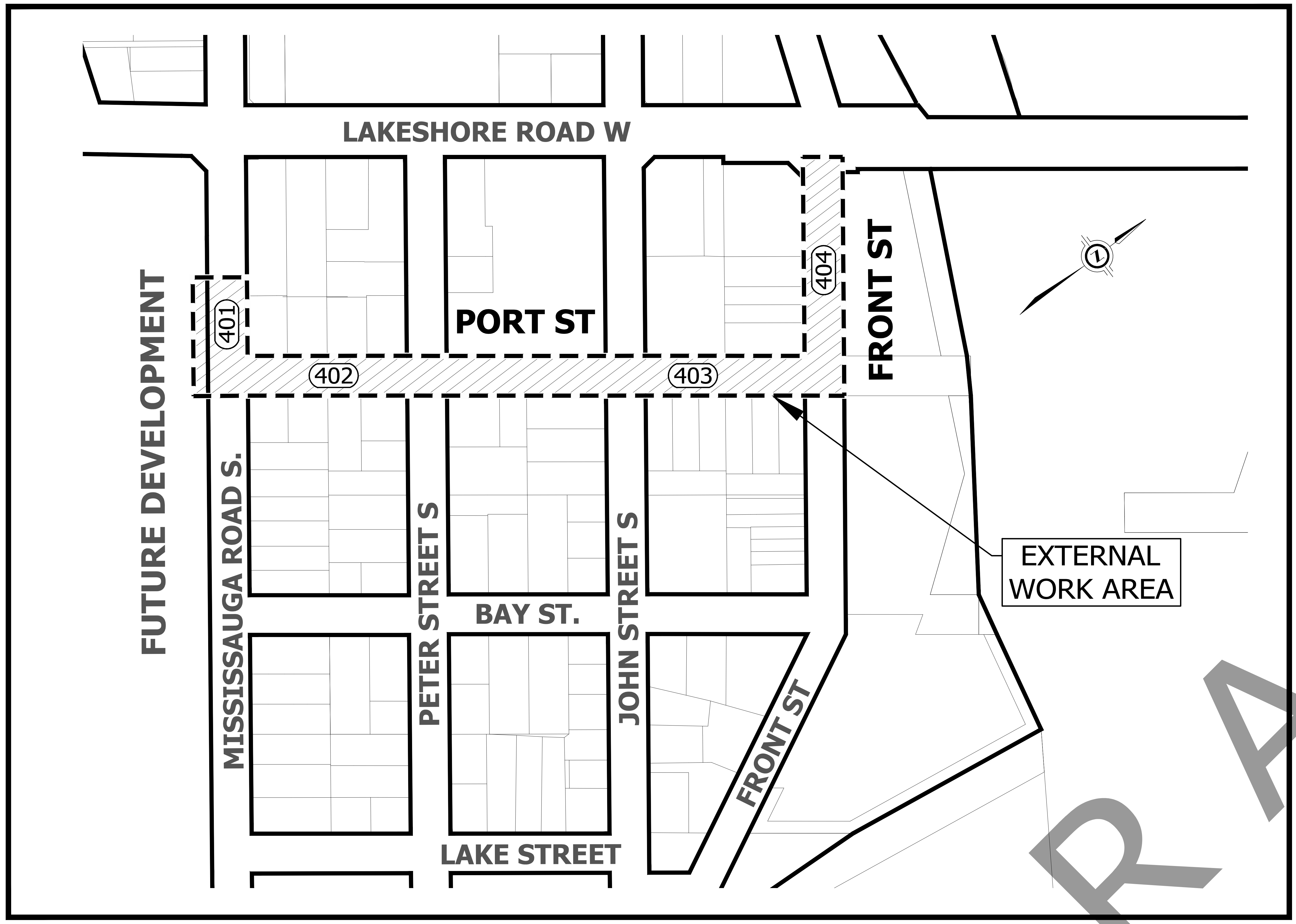
PORT CREDIT (WEST VILLAGE PARTNERS)

CITY OF MISSISSAUGA, REGIONAL MUNICIPALITY OF PEEL

EXTERNAL SANITARY SEWER CONSTRUCTION

LIST OF DRAWINGS:

EXT-100	GENERAL NOTES - 1
EXT-101	GENERAL SERVICING PLAN - 1
EXT-301	SANITARY DRAINAGE AREA PLAN - 1
EXT-401	MISSISSAUGA RD. PLAN & PROFILE - 1 (FROM STA. -040.0 TO END)
EXT-402	PORT ST. PLAN & PROFILE - 1 (FROM STA. -030.0 TO STA. +160.0)
EXT-403	PORT ST. PLAN & PROFILE - 2 (FROM STA. +160.0 TO END)
EXT-404	FRONT ST. PLAN & PROFILE - 1 (FROM STA. 000.0 TO END)
EXT-701	STANDARD DETAILS - 1
EXT-702	STANDARD DETAILS - 2
EXT-703	STANDARD DETAILS - 3



LEGEND

- - - -	LIMIT OF WORK
(402)	PLAN & PROFILE

REGION OF PEEL
FILE No. Z-08.306

NOVEMBER 15, 2018

OWNER :
PORT CREDIT WEST VILLAGE PARTNERS INC.
141 LAKESHORE ROAD EAST
MISSISSAUGA, ON L5G 1E8

Region of Peel
Working for you

MISSISSAUGA

urbantech west
Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle, Suite 201 Oakville, Ontario L6H 0H2
tel: 905.829.8818 fax: 905.829.4804
www.urbantech.com

PLOT DATE:Wednesday, November 14, 2018 4:06:38 PM

File: \\URBANWEST-NAS\ALSAL DATA\PROJECTS\16-489W (WEST VILLAGE PARTNERS - PORT CREDIT)\DRAWINGS\02_OFF-SITE WORKS (SAN EXTENSION)\02_DD_PRODUCTION DWGS\16-489W - EXT WORKS - COVER.DWG

GENERAL NOTES

1. INFORMATION ON UNDERGROUND SERVICES AND INVERT ELEVATIONS WERE TAKEN FROM OTHER SOURCES AND ITS CORRECTNESS CANNOT BE GUARANTEED.
2. ALL WORK TO BE DONE IN ACCORDANCE WITH THE LATEST CITY, REGION AND ONTARIO PROVINCIAL STANDARDS AND SPECIFICATIONS.
3. BLASTING WILL NOT BE PERMITTED WITHOUT THE PRIOR WRITTEN AUTHORIZATION OF THE CITY OF MISSISSAUGA.
4. THE APPLICANT WILL BE REQUIRED TO CONTACT ALL UTILITY COMPANIES TO OBTAIN ALL REQUIRED LOCATES PRIOR TO THE INSTALLATION OF HOARDING WITHIN THE MUNICIPAL RIGHT OF WAY. THE APPLICANT WILL BE RESPONSIBLE FOR THE COST OF ANY UTILITY RELOCATIONS NECESSITATED BY THE SITE PLAN.
5. A UTILITY INSTALLATION COORDINATION MEETING IS REQUIRED PRIOR TO THE STAKE OUT AND INSTALLATION OF ANY UTILITIES WITHIN THE MUNICIPAL BOULEVARD.
6. PRIOR TO CONSTRUCTION TAKING PLACE, ALL REQUIRED HOARDING IN ACCORDANCE WITH THE ONTARIO OCCUPATIONAL HEALTH & SAFETY ACT AND REGULATIONS FOR CONSTRUCTION PROJECTS MUST BE ERECTED AND THEN MAINTAINED THROUGHOUT ALL PHASES OF CONSTRUCTION. A CONFIRMATION MUST BE RECEIVED FROM THE DEVELOPMENT CONSTRUCTION SECTION THAT THEY HAVE MADE ARRANGEMENTS FOR A PRE-CONSTRUCTION MEETING. A NOTICE TO BE PROVIDED TO INSPECTION STAFF 48 HOURS PRIOR TO COMMENCEMENT OF ANY ROAD CONSTRUCTION.
7. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR LOCATES, EXPOSING, SUPPORTING AND PROTECTING OF ALL UNDERGROUND AND OVERHEAD UTILITIES AND STRUCTURES EXISTING AT THE TIME OF CONSTRUCTION IN THE AREA OF HIS WORK. WHETHER SHOWN ON THE PLANS OR NOT, AND FOR ALL REPAIRS AND CONSEQUENCES RESULTING FROM DAMAGE TO SAME.
8. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE TO GIVE 72 HOURS WRITTEN NOTICE TO UTILITIES PRIOR TO CROSSING SUCH UTILITIES, FOR THE PURPOSE OF INSPECTION BY THE CONCERNED UTILITY. THIS INSPECTION WILL BE FOR THE DURATION OF THE CONSTRUCTION, WITH THE CONTRACTOR RESPONSIBLE FOR ALL COSTS ARISING FROM SUCH INSPECTION.
9. ALL WORKS SHALL BE COMPLETED IN ACCORDANCE WITH THE "OCCUPATIONAL HEALTH AND SAFETY ACT". THE GENERAL CONTRACTOR SHALL BE DEEMED THE CONSTRUCTOR AS DEFINED IN THE ACT.
10. THE CONTRACTOR AT THEIR EXPENSE SHALL VERIFY THE LOCATION, DIMENSION AND ELEVATION OF ALL EXISTING SERVICES AND UTILITIES IN THE FIELD.
11. PRIOR TO EXCAVATION OR BORING CONTRACTOR AT THEIR EXPENSE SHALL EXPOSE AND VERIFY THE LOCATION AND ELEVATION OF ALL EXISTING UTILITIES AND SERVICES TO BE CROSSED AND MUST NOTIFY THE DESIGN ENGINEER AND THE AGENCY FIELD INSPECTOR AND/OR PROJECT MANAGER IMMEDIATELY, IN WRITING, OF ANY CONFLICTS OR DISCREPANCIES. CONTRACTOR SHALL BE RESPONSIBLE FOR EXPOSING THE EXISTING UTILITIES FAR ENOUGH IN ADVANCE OF CONSTRUCTION TO MAKE NECESSARY DESIGN MODIFICATIONS FOR REVIEW AND APPROVAL, IF REQUIRED, WITHOUT DELAYING THE WORK.
12. THE CONTRACTOR, AT THEIR EXPENSE AND TO THE SATISFACTION OF THE REGION OF PEEL, SHALL BE RESPONSIBLE FOR THE RESTORATION AND THE REPAIR OF THE EXISTING UTILITIES AND ALL AREAS WITHIN DISTURBED AREA DURING CONSTRUCTION.
13. THE SUPPORT OF ALL UTILITIES SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION.
14. ALL BACKFILL FOR SEWERS, WATERMAINS AND UTILITIES ON THE ROAD ALLOWANCE MUST BE MECHANICALLY COMPACTED.
15. ALL BOREHOLES SHOWN ON DRAWING ARE FOR INFORMATION ONLY. REFER TO GEOTECHNICAL REPORT.
16. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED.
17. MANHOLES, CATCHBASINS, VALVE CHAMBERS AND SIMILAR STRUCTURES SHALL BE BACKFILLED WITH GRANULAR MATERIAL TO SUBGRADE ELEVATION.
18. ALL AREAS BEYOND THE SITE PLAN LIMIT WHICH ARE DISTURBED DURING CONSTRUCTION SHALL BE RESTORED TO THE SATISFACTION OF THE COMMISSIONER OF WORKS AT THE CONTRACTORS EXPENSE.
19. CONTRACTOR TO REFER TO GEOTECHNICAL REPORT BY SOIL ENGINEERS LTD. DATED MAY 2017 FOR ALL ELEVATIONS, BEDDING AND BACKFILL REQUIREMENTS.

REGIONAL ROADS

1. CONSTRUCTION AND DETOUR SIGNAGE MUST CONFORM TO "MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES" AND LATEST REVISION OF THE ONTARIO MINISTRY OF TRANSPORTATION "TRAFFIC CONTROL MANUAL FOR ROADWAY WORK OPERATIONS".
2. ALL TEMPORARY SIGNAGE AND TRAFFIC CONTROL MEASURES SHALL BE IN ACCORDANCE WITH REQUIREMENTS OF ONTARIO TRAFFIC MANUAL, BOOK 7 "TEMPORARY CONDITIONS" AND OPS SPECIFICATIONS AND STANDARD DRAWINGS.
3. PAVEMENT MARKINGS MUST BE IN ACCORDANCE WITH THE ONTARIO TRAFFIC MANUAL, BOOK 11 "PAVEMENT HAZARD AND DELINEATION MARKINGS".
4. THE CONTRACTOR SHALL NOTIFY IN ADVANCE, AS REQUIRED, THE APPROPRIATE AUTHORITY HAVING JURISDICTION FOR THE ROAD PRIOR TO COMMENCING ANY WORK AND SHALL ACQUIRE AND SATISFY THE REQUIREMENTS OF APPROPRIATE PERMITS (FEES, INSPECTIONS, SIGNAGE, TRAFFIC, MAINTENANCE, DIVERSION, ETC...)
5. REGIONAL ROAD CLOSURE IS NOT PERMITTED AT ANY TIME UNLESS APPROVAL FROM REGIONAL COUNCIL WAS OBTAINED FOR THE WORKS, WHERE A MINIMUM TWO MONTH LEAD TIME IS REQUIRED, AS PER REGIONAL POLICY W30-12.
6. WORK OPERATIONS THAT REQUIRE DIVERTING TRAFFIC TO ONE LANE ARE SUBJECT TO TIME RESTRICTIONS AND/OR NIGHT TIME OPERATIONS AS SPECIFIED IN ROAD OCCUPANCY PERMIT. THROUGH LANES MUST BE MINIMUM 3.5m, UNLESS OTHERWISE APPROVED.
7. FOR TEMPORARY DELINEATION OF TRAFFIC IN OPPOSITE DIRECTIONS A YELLOW CENTRE LINE ON PAVEMENT MUST BE PAINTED. TRAFFIC CONTROL BARRELS (CONES) ARE NOT PERMITTED FOR THIS USE ON REGIONAL ROADS.
8. NEW JERSEY BARRIERS (NJB) WITH CRASH ATTENUATION DEVICES MUST BE USED ON LONG TERM PROJECTS AS OPPOSED TO TRAFFIC CONTROL DELINEATORS (BARRELS).
9. ACCESS TO EXISTING ENTRANCES AND SIDE STREETS, INCLUDING PEDESTRIAN ACCESS, SHALL BE MAINTAINED. ACCESS REQUIREMENTS MUST COMPLY WITH REGION OF PEEL CONTROLLED ACCESS BY-LAW.
10. LOCATION OF EXISTING UTILITIES TO BE ESTABLISHED BY THE CONTRACTOR. ALL EXISTING UTILITY ELEVATIONS (SANITARY AND WATERMAIN) INCLUDING CENTRE LINE OF THE ROAD ELEVATIONS HAVE TO BE VERIFIED BY CONTRACTOR PRIOR TO COMMENCING ANY WORK ON SITE. ANY DISCREPANCIES SHALL BE REPORTED TO THE REGION IMMEDIATELY.
11. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR LOCATING, SUPPORTING AND PROTECTING ALL UNDERGROUND AND OVERHEAD UTILITIES AND STRUCTURES EXISTING AT THE TIME OF CONSTRUCTION IN THE AREA OF HIS WORK, WHETHER SHOWN ON THE PLANS OR NOT, AND FOR ALL REPAIRS AND CONSEQUENCES RESULTING FROM DAMAGE TO SAME.
12. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE TO GIVE 72 HOURS WRITTEN NOTICE TO UTILITY AUTHORITY PRIOR TO CROSSING SUCH UTILITIES FOR THE PURPOSE OF INSPECTION. THIS INSPECTION WILL BE FOR THE DURATION OF CONSTRUCTION WITH THE CONTRACTOR RESPONSIBLE FOR ALL COSTS ARISING FROM SUCH INSPECTIONS.
13. ALL ROAD BASE SHALL BE AS PER REGION OF PEEL STD. DWG. 5-1-1 AND 5-1-2.
14. ASPHALT PRESERVATIVE SEALER SUCH AS RE-CLIMATE OR APPROVED EQUIVALENT SHALL BE APPLIED AFTER THE ONE-YEAR MAINTENANCE PERIOD FOR THE TOP COURSE ASPHALT.
15. ALL EXISTING PAVEMENTS, CURBS, SIDEWALKS AND BOULEVARDS, AND OTHER AREAS DISTURBED BY THE WORK, TO BE REINSTATED EQUAL TO EXISTING AND TO THE SATISFACTION OF APPLICABLE AUTHORITY HAVING JURISDICTION OVER THE ROAD ALLOWANCE. EXISTING PAVEMENT AND CURBS TO BE SAW- CUT TO PROVIDE A SMOOTH JOINT.
16. EROSION CONTROL MEASURES TO BE IMPLEMENTED AS REQUIRED.
17. FOR ROAD PROJECTS THAT WILL NOT BE COMPETED PRIOR TO THE END OF THE CONSTRUCTION SEASON, THE FOLLOWING WILL NEED TO BE CONSIDERED IN ORDER TO WINTERIZE THE CONSTRUCTION PROJECT TO ENSURE SAFE CONDITIONS DURING WINTER:
    a. WHERE APPLICABLE, CURB AND GUTTER SECTIONS ARE TO BE COMPETED, THE BASE COURSE ASPHALT SHALL BE IN PLACE.
    b. CATCH BASINS AND MAINTENANCE HOLES SET TO EXISTING BASE GRADE.
    c. STEEL PLATING NOT PERMITTED.
    d. HOT MIX ASPHALT (HMA) ONLY.
    e. LANE DELINEATION AND PAVEMENT MARKING COMPLETED.
    f. WHERE NEW JERSEY BARRIERS USED, OFFSET NO LESS THAN 4.25m FROM EDGE OF TRAVELLED LANE.
    g. ROAD AND BOULEVARD MUST BE FREE OF OBSTRUCTIONS AND ACCOMMODATE SAFE SNOW PLOW OPERATION CONSIDERING THAT A WING AND PLOW IS 6m WIDE AND 1.52m SNOW STORAGE MINIMUM REQUIRED.
    h. ALL CATCH BASIN GRATES SHALL BE SIDE INLET, OPSD 400.081 (LATEST VERSION) UNLESS OTHERWISE NOTED.
    i. WINTER SHUT-DOWN MEETINGS WITH THE REGION OF PEEL ROAD MAINTENANCE STAFF ARE REQUIRED PRIOR TO SEASONAL SHUT-DOWN AND SHALL BE ORGANIZED BY THE CONSULTANT OR PROJECT MANAGER OR DESIGNATE.

EROSION AND SEDIMENT CONTROL

1. SEDIMENTATION CONTROL WORKS IN ACCORDANCE WITH CITY STANDARDS ARE TO BE IMPLEMENTED DURING CONSTRUCTION.
2. SEDIMENT CONTROLS ARE REQUIRED IN ACCORDANCE WITH CITY OF MISSISSAUGA BY-LAW No. 512-91, AS AMENDED, AND THE REQUIRED PERMIT SHALL HAVE BEEN OBTAINED BY THE OWNER PRIOR TO THE START OF ANY CONSTRUCTION OPERATIONS. SEDIMENT CONTROLS SHALL BE INSTALLED IMMEDIATELY AFTER CATCHBAIN CONSTRUCTION AND SHALL REMAIN IN PLACE UNTIL BUILDING OPERATIONS ARE COMPLETED.
3. REFER TO SHEET EXT-1001 FOR SEDIMENT CONTROL REQUIREMENTS FOR THIS PROJECT
4. ALL REQUIRED SEDIMENT CONTROLS SHALL BE REGULARLY MAINTAINED UNTIL ALL CONSTRUCTION OPERATIONS ARE COMPLETED AND DISTURBED AREAS REVEGETATED.
5. SEDIMENT CONTROLS AS NOTED ON SHEET EXT-1001 ARE REQUIRED AT ALL CATCHBASINS.
6. ALL ROADSIDE CATCHBASINS TO HAVE SEDIMENT PROTECTION AS PER CITY OF MISSISSAUGA STD No. 2930.050 INSTALLED IMMEDIATELY AFTER CATCHBASIN INSTALLATION. SEDIMENT PROTECTION BARRIER TO BE MAINTAINED ON A REGULAR BASIS OR TO THE SATISFACTION OF THE CITY OF MISSISSAUGA.
7. IF SITE CONSTRUCTION ACTIVITIES ARE INTERRUPTED AND/OR INACTIVITY EXCEEDS 30 DAYS ALL STRIPPED AND/'OR BARE SOIL AREAS ARE TO BE STABILIZED BY SODDING/SEEDING/MULCHING OR OTHER APPROVED METHOD TO THE SATISFACTION OF THE CITY OF MISSISSAUGA.
8. DURING ALL CONSTRUCTION PHASES, MUD-TRACKING CONTROL WILL CONSIST OF MAINTAINING THE STONE PAD CONSTRUCTION ENTRANCE AND/OR FLUSHING OR SWEEPING ROADS AS WARRANTED, IN ACCORDANCE WITH THE CITY OF MISSISSAUGA MUD TRACKING CONTROL POLICY.
9. ALL CATCHBASINS WITHIN LANDSCAPED ARES TO HAVE SEDIMENT BARRIER, CITY OF MISSISSAUGA STD. NO. 2930.020 ERECTED IMMEDIATELY AFTER CATCHBASIN INSTALLATION. SEDIMENT PROTECTION BARRIER TO BE MAINTAINED ON A REGULAR BASIS OR TO THE SATISFACTION OF THE CITY OF MISSISSAUGA.

ENVIRONMENTAL PROTECTION

1. FIRES AND BURNINGS OF RUBBISH AT THE PLACE OF WORK WILL NOT BE PERMITTED.
2. DISPOSAL OF WASTES:
    a. DO NOT BURY RUBBISH AND WASTE MATERIALS ON SITE.
    b. DO NOT DISPOSE OF WASTE OR VOLATILE MATERIALS, SUCH AS MINERAL SPIRITS, OIL OR PAINT THINNER INTO WATERWAYS, STORM OR SANITARY SEWERS.
    c. UNLESS INDICATED OTHERWISE, SURPLUS MATERIALS SHALL BECOME THE PROPERTY OF THE CONTRACTOR AND SHALL BE REMOVED FROM THE PREMISES PROMPTLY AS THEY BECOME SURPLUS, AT THE CONTRACTOR.
3. DRAINAGE:
    a. DIVERT SURFACE DRAINAGE WATER AWAY FROM EXCAVATION.
    b. PROVIDE TEMPORARY DRAINAGE AND PUMPING AS NECESSARY TO KEEP EXCAVATION AND SITE FREE FROM WATER FROM WHATEVER SOURCE UNTIL BACKFILL OPERATIONS ARE COMPLETED.
    c. DO NOT PUMP WATER CONTAINING SUSPENDED MATERIALS INTO WATERWAYS, SEWER OR DRAINAGE SYSTEMS.
    d. PROVIDE PUMPING UNITS OF SUFFICIENT NUMBER TO COMPLY WITH THE ABOVE REQUIREMENTS AND KEEP A MINIMUM OF ONE (1) UNIT IN OPERATION CONDITION AS A SPARE ON SITE.
4. POLLUTION CONTROL:
    a. OPERATIONS GENERATING SMOKE, FUMES, GASES, DUSTS, VAPOURS AND ODURS SHALL BE EXHAUSTED AT SOURCE IN MANNER APPROVED BY THE CONSULTANT.
    b. TAKE PRECAUTIONS NECESSARY TO KEEP DUST, SMOKE, FUMES, DIRT AND VIBRATION TO AN ACCEPTABLE LEVEL AS DETERMINED BY THE CONSULTANT.
    c. PREVENT EXTRANEOUS MATERIALS FROM CONTAMINATING THE ENVIRONMENT IMMEDIATELY OR OTHER APPROPRIATE PREVENTATIVE MEASURES, INCLUDING A CONSTRUCTION MAT AT THE VEHICULAR EXIT FROM THE SITE.
5. NOISE:
    a. PREVENT EXCESSIVE NOISE WHICH WILL BE DISTURBING TO THE OCCUPANT OF BUILDING. MACHINE TOOLS WHICH ARE SET UP IN FIXED LOCATIONS SHALL BE SO LOCATED TO MINIMIZE NOISE AND SUITABLE SOUND DEFLECTORS SHALL BE USED IF DIRECTED BY THE CONSULTANT.
    b. USE AIR COMPRESSORS AND PNEUMATIC HAMMERS ONLY WITH THE EXPRESSED AUTHORIZATION OF THE CONSULTANT.
6. SPILLS:
    a. THE CONTRACTOR SHALL PROVIDE GO TRANSIT WITH A WRITTEN PROGRAM FOR SPILLS RESPONSE AND REPORTING. COPIES OF TRAINING RECORDS SHALL ALSO BE PROVIDED.
    b. ALL SPILLS SHALL IMMEDIATELY BE REPORTED TO THE RAIL OPERATIONS CONTROL CENTRE, (416) 601-2174, OR AS DIRECTED BY THE CONSULTANT.
7. DUST CONTROL:
    a. THE CONTRACTOR SHALL TAKE ANY AND ALL STEPS NECESSARY TO PREVENT A DUST NUISARICE OCCURING AS RESULT OF HIS PERFORMANCE OF THE WORK.
    b. WHERE WORK REQUIRES THE SAWING Or GRINDING OF CONCRETE, WET TYPE BLADES AND GRIDNERS SHALL BE USED TOGETHER WITH SUFFICIENT WATER TO PREVENT THE OCCURRENCE OF DUST. COST OF ALL SUCH PREVENTATIVE MEASURES SHALL BE BORNE BY THE CONTRACTOR.

LOCAL ROADS / DRIVEWAYS

1. ALL FILL MATERIAL WITHIN ROAD ALLOWANCES AND EASEMENTS SHALL BE COMPACTED TO A MINIMUM OF 95% STANDARD PROCTOR DENSITY. ALL FILLS GREATER THAN 1.0m IN DEPTH, WHETHER ON ROADS OR LOTS, SHALL BE CLASSED AS ENGINEERED FILL AND SHALL BE PLACED UNDER THE DIRECT SUPERVISION OF THE GEOTECHNICAL ENGINEER AND SHALL BE COMPACTED TO A MINIMUM OF 98% STANDARD PROCTOR DENSITY.
2. THE SUITABILITY AND COMPACTION OF ALL FILL MATERIALS SHALL BE CONFIRMED TO THE CITY ENGINEER BY A RECOGNIZED SOILS CONSULTANT AND THE SUBGRADE OF ALL ROADWAYS SHALL BE PROOF ROLLED UNDER THE SUPERVISION OF THE SOILS CONSULTANT PRIOR TO THE INSTALLATION OF ANY ROAD BASE MATERIALS.
3. CURB AND GUTTER IN FRONT OF RESIDENTIAL LOTS AND STREET TOWN HOUSE BLOCKS TO BE TWO-STAGE CONSTRUCTION AS PER OPSD 600.07 MODIFIED TO WIDEN KEY AND ELIMINATE STIRRUPS AS PER CITY OF MISSISSAUGA REQUIREMENTS.
4. CURB AND GUTTER IN ALL OTHER AREAS TO BE SINGLE STAGE AS PER OPSD 600.04, UNLESS OTHERWISE NOTED ON THE DRAWINGS.
5. CURB RETURN RADII TO BE 8.0m UNLESS OTHERWISE NOTED ON THE DRAWINGS.
6. SUBDRAINS AS PER CITY OF MISSISSAUGA STDS. 2220.040 & 2220.050 SHALL BE INSTALLED FOR THE FULL LENGTH OF ALL CURB AND GUTTER INCLUDING REGIONAL ROADS.
7. SIDEWALKS TO BE AS PER CITY OF MISSISSAUGA STDS. 2240.01 & 2240.04. PEDESTRIAN RAMPS TO BE PROVIDED AT ALL INTERSECTIONS IN ACCORDANCE WITH CITY OF MISSISSAUGA STDS. 2240.02 & 2240.03.
8. PAVEMENT THICKNESSES AND COMPOSITION TO BE AS SHOWN ON INDIVIDUAL PLAN/PROFILE DWGS.
9. THE TOP 100mm OF THE SUB-GRADE IS TO BE COMPACTED TO A MINIMUM 98% STANDARD PROCTOR DENSITY WITHIN 2% OF OPTIMUM MOISTURE CONTENT.
10. AT ARTERIAL ROAD INTERSECTIONS, AND ADDITIONAL 150mm DEPTH OF 50mm CRUSHER RUN LIMESTONE IS REQUIRED. THIS ADDITIONAL DEPTH SHALL EXTEND FOR A MINIMUM DISTANCE OF 15m FROM THE PROPERTY LINE OF THE INTERSECTING ROAD.
11. ALL BACKFILL FOR SEWERS, WATERMAINS AND UTILITIES ON THE ROAD ALLOWANCE MUST BE COMPACTED TO MINIMUM 95% STANDARD PROCTOR DENSITY EXCEPT FOR THE TOP 300mm WHICH MUST BE COMPACTED TO 98% S.P.D.

SANITARY SEWERS

1. MAINLINE SANITARY SEWER PIPE SIZE SHALL BE MINIMUM 250mm DIAMETER. MATERIALS SHALL BE AS PER REGION'S SPECIFICATIONS.
2. SANITARY SERVICE LATERALS SHALL BE MINIMUM 125mm DIAMETER.
3. CONNECTIONS TO SEWERS SHALL BE MADE WITH MANUFACTURED TEES OR WYES WHERE APPLICABLE AND SHALL BE COLOUR CODED AS NON-WHITE, AS PER STD 2-4-1, 2-4-2, AND 2-4-3.
3. SANITARY SERVICE SHALL BE LOWER THAN AND TO THE RIGHT OF THE STORM SERVICE AT THE PROPERTY LINE WHEN FACING THE LOT FROM THE STREET.
4. ALL SEWERS CONSTRUCTED WITH GRADES 0.5% OR LESS, SHALL BE INSTALLED WITH LASER AND CHECKED PRIOR TO BACKFILL.
5. MINIMUM SANITARY SEWER PIPE SLOPE FOR LAST LEG SHALL BE 1% AND DESIRABLE SLOPE 2%.
6. ALL SANITARY SEWER BEDDING AS PER STD 2-3-1.
7. ALL MANHOLES SHALL BE AS PER REGION STD 2-5-3 AND 2-5-4 WITH BENCHING AS PER STD 2-5-20, WALL CONNECTIONS AS PER STD 2-5-15, FROST STRAPS AS PER STD 2-5-23 AND WATERPROOF MEMBRANES AS PER STD 2-5-25.
8. MANHOLE LADDERS TO BE AS PER REGION STD 2-6-9 & 2-6-10.
9. FRAME AND COVERS SHALL BE AS PER REGION STD 2-5-13, 2-6-1 AND 2-6-4.

GENERAL REFERENCES FOR DRAWINGS:

REGION OF PEEL STANDARD DRAWINGS DELETED - APRIL 2011 REVISION:

DRAWING NUMBER	DRAWING TITLE	ORIGINAL DATE	REPLACED WITH NEW REGION OF PEEL STANDARD DRAWING APRIL 2011	REPLACED WITH OPSD
1-1-1	CIRCULAR PRECAST CHAMBER	MAY 2009	1-1-5, 1-1-7	
1-1-2	SMALL CAST-IN-PLACE CHAMBER	MAY 2009	1-1-6	
1-1-3	750/900 DIA. WM. VALVE AND CHAMBER (CAST-IN-PLACE)	MAY 2009	1-1-6, 1-3-27 TO 1-3-40	
1-1-4	RECTANGULAR PRECAST CHAMBER	MAY 2009	1-1-6	
1-2-2	STANDARD HEAVY DUTY FRAME AND COVER	MAY 2009		401.030
1-2-5	STANDARD CHAMBER STEPS ALUMINUM	MAY 2009		405.020
1-3-5	AIR VALVE AND CHAMBER	APRIL 2009	1-1-5, 1-3-12, 1-3-13, 1-3-14	
1-3-6	DRAIN VALVE AND CHAMBER	MAY 2009	1-1-6, 1-3-15	
1-3-7	VALVE SETTING FOR 400mm TO 600mm PIPE	MAY 2009	1-1-6, 1-3-18 TO 1-3-24	
1-3-10	PRESSURE ZONE BOUNDARY VALVE	MAY 2009	1-1-5, 1-3-16	
1-5-1	WATERMAIN BEDDING	MAY 2009	N/A - As Per Contract Design	
1-5-2	WATERMAIN SUPPORT BRIDGING DISTURBED GROUND	MAY 2009	N/A - As Per Contract Design	
1-5-3	CONCRETE THRUST COLLAR	MAY 2009	N/A - As Per Contract Design	
1-7-5	SWABBING OUTLET 100mm AND LARGER	MAY 2009	1-7-9	

ONTARIO PROVINCIAL STANDARD DRAWING REFERENCES TO BE READ IN CONJUNCTION WITH REGION OF PEEL STANDARD DRAWINGS - APRIL 2011 REVISION

DRAWING NUMBER	DRAWING TITLE
401.030	CAST IRON, SQUARE FRAME WITH CIRCULAR WATERTIGHT COVER FOR MAINTENANCE HOLES
402.030	CAST IRON, RECTANGULAR FRAME WITH TWO PIECE COVER FOR METER AN VALVE CHAMBERS
404.020	ALUMINUM SAFETY PLATFORM FOR CIRCULAR MAINTENANCE HOLES
404.022	ALUMINUM SAFETY PLATFORM FOR 1800mm CIRCULAR MAINTENANCE HOLES WITH DROP PIPE
405.020	MAINTENANCE HOLE STEPS SOLID
406.010	ALUMINUM LADDER FOR MAINTENANCE HOLES
1101.019	PRECAST CONCRETE VALVE CHAMBER WITH POURED-IN-PLACE THRUST BLOCKS 2400 x 3000mm CHIMNEY AND CAP
1101.020	VALVE OPERATOR
1109.010	CATHODIC PROTECTION FOR METALLIC WATERMAIN SYSTEMS

NOTE: THIS LIST INCLUDES OPSD REFERENCES THAT APPLY DIRECTLY TO THE NEW AND REVISED REGION OF PEEL STANDARD DRAWINGS, BUT IT DOES NOT PRECLUDE THE APPROVED USE OF ANY APPLICABLE OPSD REFERENCES NOT LISTED ABOVE.

GENERAL NOTES FOR PRECAST CONCRETE CHAMBERS:

1. HAVE ALL WORK CARRIED OUT BY A MANUFACTURER CERTIFIED BY THE CANADIAN STANDARD ASSOCIATION ACCORDING TO CSA A251, 'QUALIFICATION CODE FOR MANUFACTURERS OF ARCHITECTURAL AND STRUCTURAL PRECAST CONCRETE".
2. SUBMIT SHOP DRAWINGS TO THE CONTRACT ADMINISTRATOR FOR INFORMATION. ALL DRAWINGS SHALL BEAR THE SIGNATURE AND SEAL OF A PROFESSIONAL ENGINEER LICENSED TO PRACTISE IN ONTARIO.
3. PROVIDE LETTERS SIGNED BY THE PROFESSIONAL ENGINEER CERTIFYING THE FOLLOWING:
    i) THAT THE DESIGN OF THE PRECAST UNITS MEETS THE REQUIRMENTS OF THE SPECIFICATIONS
    ii) THAT THE PRECAST UNITS HAVE BEEN INSPECTED AND MANUFACTURED IN ACCORDANCE WITH THE DESIGN
    iii) THAT THE PRECAST UNITS HAVE BEEN ERECTED AND THE FINISHED INSTALLATION IS IN ACCORDANCE WITHTHE DESIGN.
4. PROVIDE CONCRETE WITH MINIMUM STRENGTH OF 35 MPa UNLESS A HIGHER STRENGTH IS REQUIRED BY THE MANUFACTURER OR DESIGNER.
5. REINFORCING STEEL SHALL BE IN ACCORDANCE WITH CSA G30.18 WITH A MINIMUM YIELD STRENGTH OF Fy=400 MPa.
6. MINIMUM CONCRETE WALL THICKNESS SHALL BE 250mm.
7. REFER TO STANDARD DRAWINGS 1-1-5, 1-1-6, 1-1-7, 1-1-8, 1-2-1, 1-2-4, 1-2-6 AND 1-2-7 AND ONTARIO PROVINCIAL STANDARD DRAWINGS FOR CHAMBER DETAILS PERTAINING TO WATERPROOFING, JOINT SEALING, ADJUSTMENT UNITS, FRAME & COVERS, CHAMBER STEPS AND LADDERS, INSULATION, FROST STRAPS, VALVE STEM EXTENSION AND BRACKETS, SUMPS, VALVE AND PIPE SUPPORTS.
8. ALL INTERNAL AND EXTERNAL VALVES, FITTINGS, THROUGH WALL METAL PIPING AND MECHANICAL RESTRAINTS TO BE c/w DENSO PASTE AND DENSO TAPE OR APPROVED EQUAL APPLIED TO MANUFACTURER'S RECOMMENDATIONS.

Region of Peel
Working for you

PUBLIC WORKS
STANDARD DRAWING

GENERAL NOTES AND REFERENCES

REV. DATE: APRIL 2011

APPROVED BY	DRAWN BY
A.P.	AINLEY GROUP
STD. DWG. NUMBER	SCALE
1-1-0	N.T.S.

BENCHMARK NOTE

ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE DERIVED FROM THE CITY OF MISSISSAUGA BENCHMARK NO. 731
ELEVATION = 81.58m

No.	REVISION	DATE	
2	SECOND SUBMISSION TO REGION OF PEEL	AUGUST 17, 2018	R.M.
1	FIRST SUBMISSION TO REGION OF PEEL	MAY 8, 2018	R.M.

SUBMISSIONS:
FIRST: ____________
SECOND: ____________
INTERIM: ____________
PRE–SERVICING: ____________
FINAL: ____________

PORT CREDIT WEST VILLAGE PARTNERS INC.
141 LAKESHORE ROAD EAST, MISSISSAUGA, ON L5G 1E8

70 MISSISSAUGA RD SOUTH
181 LAKESHORE RD WEST

CITY FILE No. TBD
REGION FILE No. Z-08.306

MISSISSAUGA

Region of Peel
Working for you

urbantech west
Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle, Suite 201 Oakville, Ontario L6H 0H2
tel: 905.829.8818 fax: 905.829.4804
www.urbantech.com

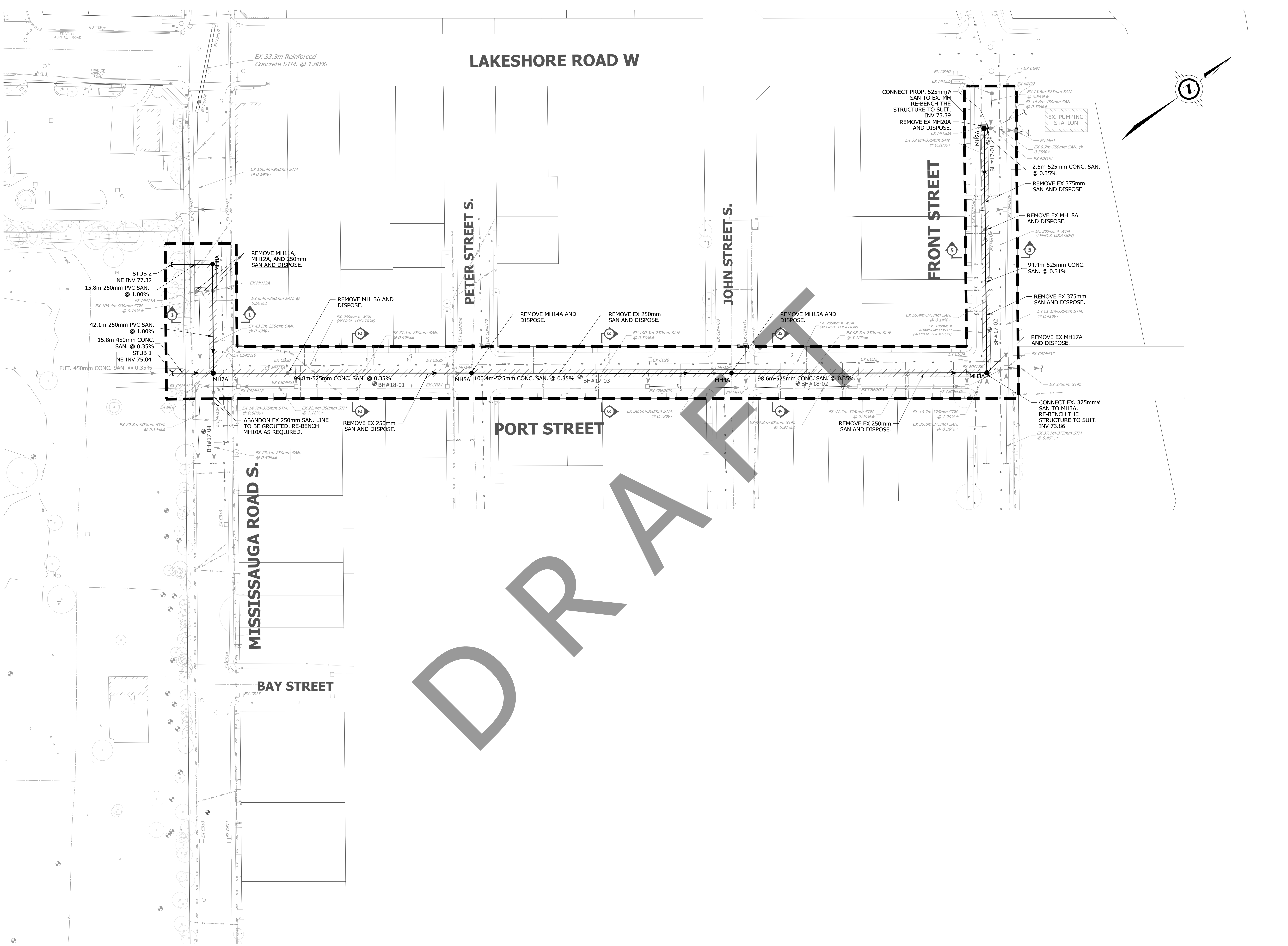
GENERAL NOTES - 1

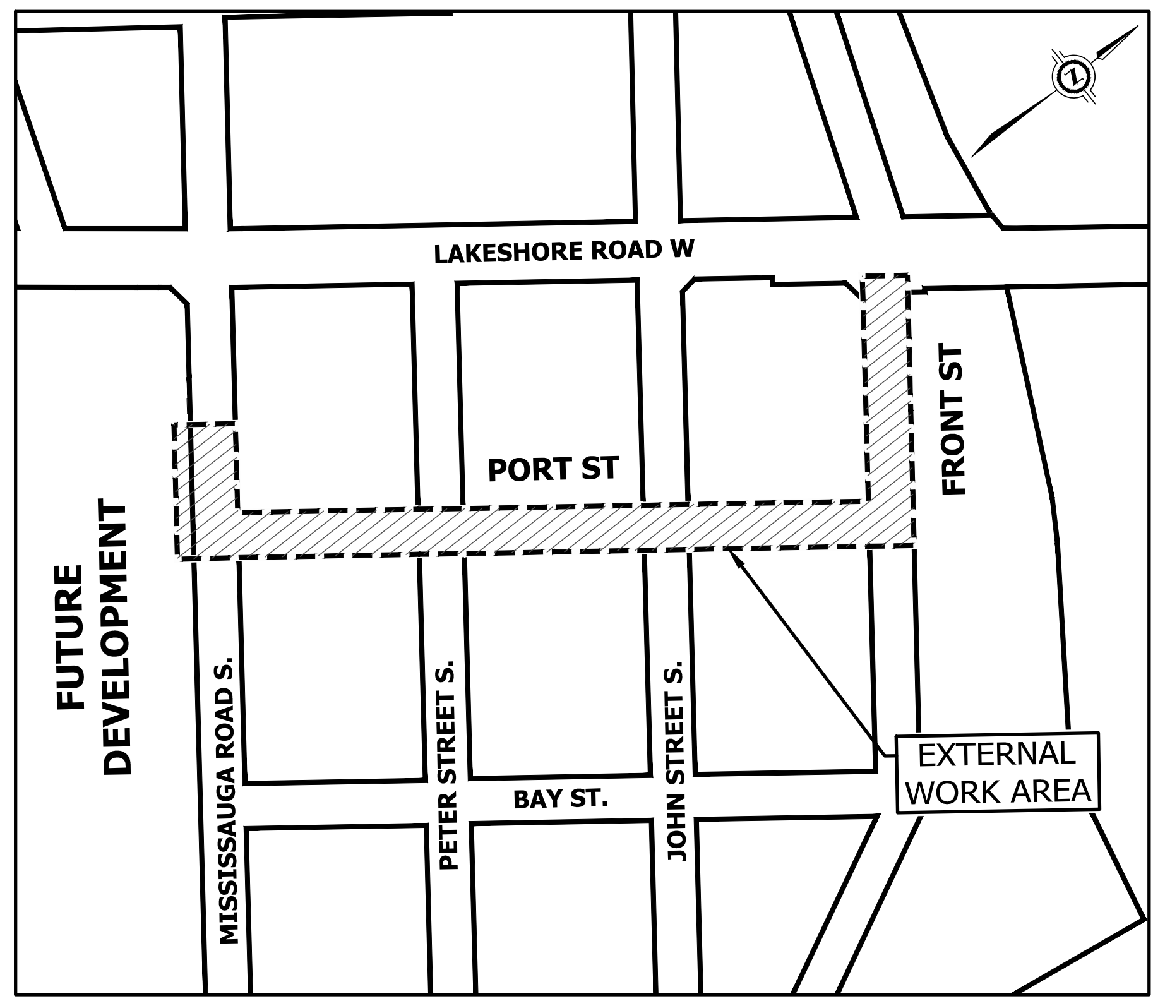
DESIGNED: R.M.	CHECKED: R.M.	PROJECT No.:	16-489W
DRAWN: R.N.	DATE: APRIL 2018	SHEET No.:	
SCALE: N/A		DRAWING No.:	EXT-100

SECOND ENGINEERING SUBMISSION, NOVEMBER 15, 2018

PLOT DATE:Wednesday, November 14, 2018 4:06:50 PM

File: \\URBANWEST-NAS\ALSAL DATA\PROJECTS\16-489W (WEST VILLAGE PARTNERS - PORT CREDIT)\DRAWINGS\02_OFF-SITE WORKS (SAN EXTENSION)\02_DD_PRODUCTION DWGS\16-489W - EXT WORKS - NT1 - GENRAL NOTES.DWG





KEY PLAN
N.T.S.

LEGEND

- LIMIT OF WORK
- SANITARY SEWER/MANHOLE
- EXISTING STORM SEWER/MANHOLE
- EXISTING SANITARY SEWER/MANHOLE
- EXISTING CATCH BASIN
- BOREHOLE LOCATION
- EXISTING WATER MAIN
- EXISTING SANITARY SERVICE CONNECTION
- EXISTING WATER SERVICE CONNECTION
- EXISTING OVERHEAD WIRE
- EXISTING WATERMAIN VALVE
- EXISTING HYDRANT
- EXISTING SIGN
- EXISTING TREE
- ▨ 3-METER WIDE SAW CUT AND TRENCH EXCAVATION. RESTORE PER CITY STANDARDS, AND COMPLETE WITH LAP JOINT. REFER TO DWG EXT-703 FOR DETAILS.
- TRENCH CROSS SECTION REFER TO DWG EXT-102 AND EXT-103 FOR DETAILS.

CONTRACTOR IS TO NOTIFY THE CITY, REGION AND AFFECTED RESIDENTS A MINIMUM OF TWO WEEKS PRIOR TO CONSTRUCTION. THE CONTRACTOR IS TO MAKE PROVISIONS TO MAINTAIN SANITARY FLOWS FROM EXISTING SERVICES AT ALL TIMES.

BENCHMARK NOTE

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ELEVATION = 81.58m

No.	REVISION	DATE	
2	SECOND SUBMISSION TO REGION OF PEEL	AUGUST 17, 2018	R.M.
1	FIRST SUBMISSION TO REGION OF PEEL	MAY 8, 2018	R.M.

SUBMISSIONS:
FIRST: ____
SECOND: ____
INTERIM: ____
PRE–SERVICING: ____
FINAL: ____

PORT CREDIT WEST VILLAGE PARTNERS INC.
141 LAKESHORE ROAD EAST, MISSISSAUGA, ON L5G 1E8

70 MISSISSAUGA RD SOUTH
181 LAKESHORE RD WEST

CITY FILE No. TBD
REGION FILE No. Z-08.306

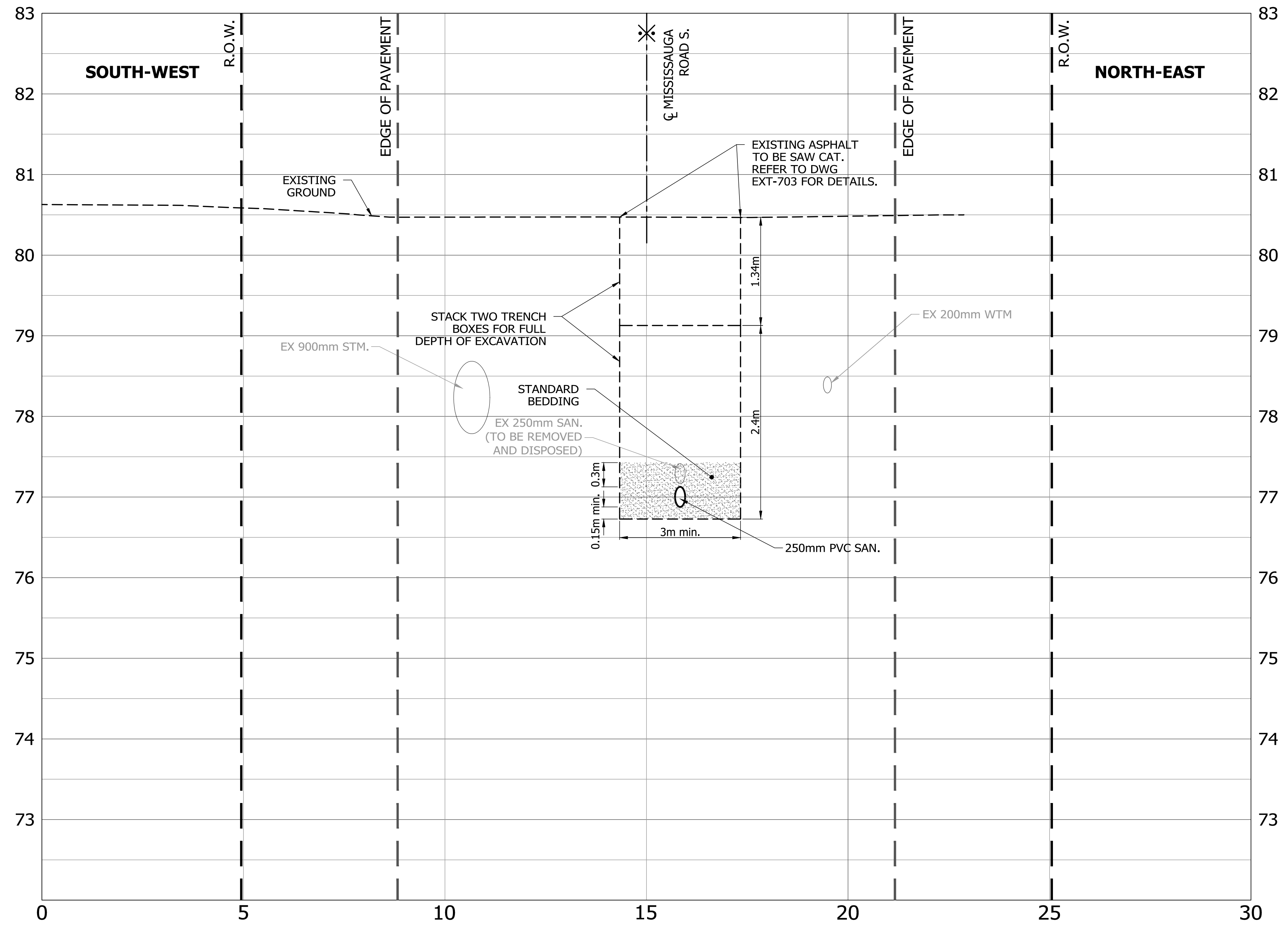
MISSISSAUGA

Region of Peel
Working for you

urbantech
west
Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle, Suite 201 Oakville, Ontario L6H 0H2
tel: 905.829.8818 fax: 905.829.4804
www.urbantech.com

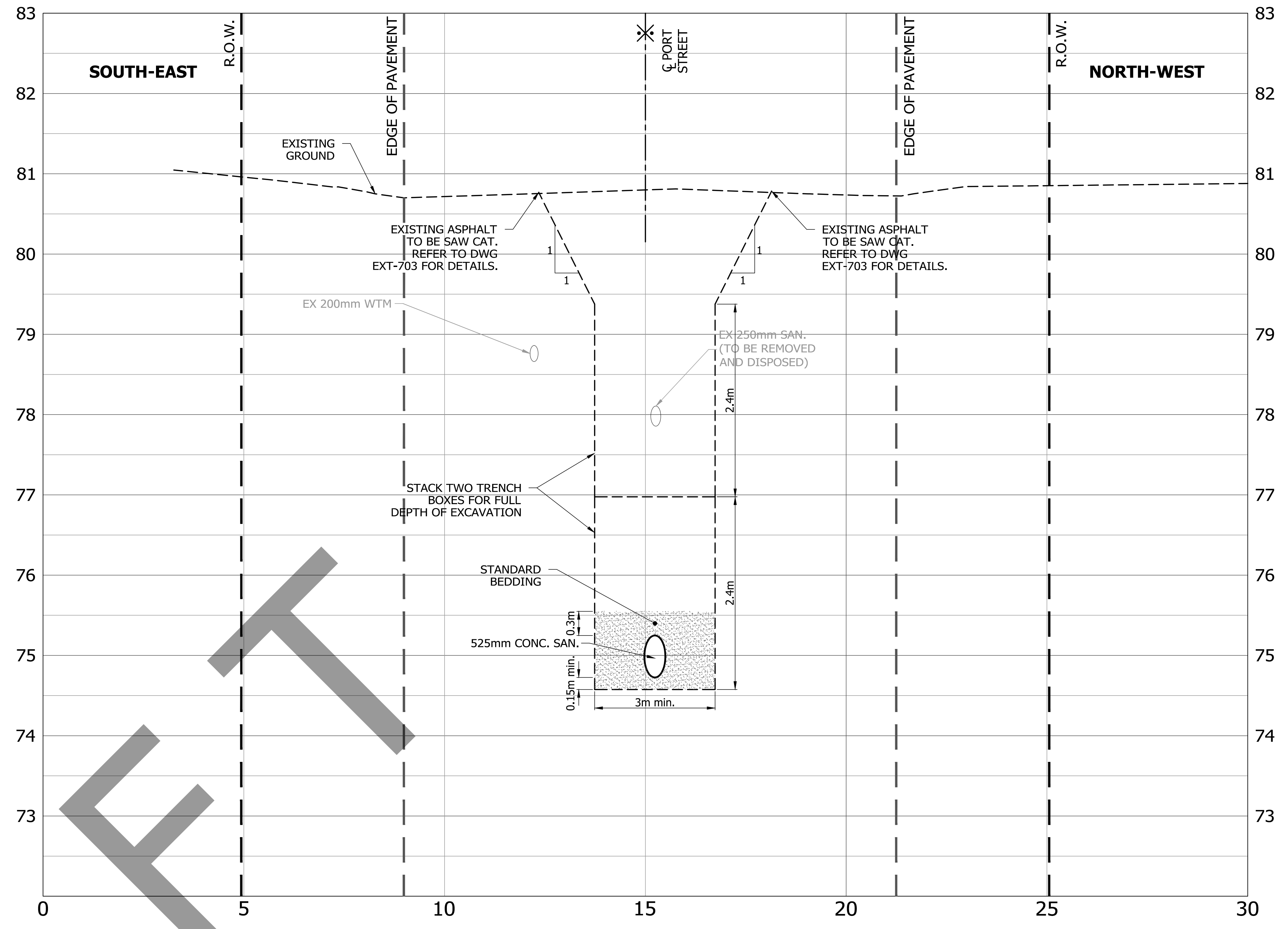
GENERAL SERVICING PLAN - 1

DESIGNED:	R.M.	CHECKED:	R.M.	PROJECT No.:	16-489W
DRAWN:	R.N.	DATE:	APRIL 2018	SHEET No.:	
SCALE:	1:750 (7.5m 0m 7.5m 15m 30m 45m)			DRAWING No.:	EXT-101



SECTION 1-1

SCALE: H-1:100 V-1:50



SECTION 2-2

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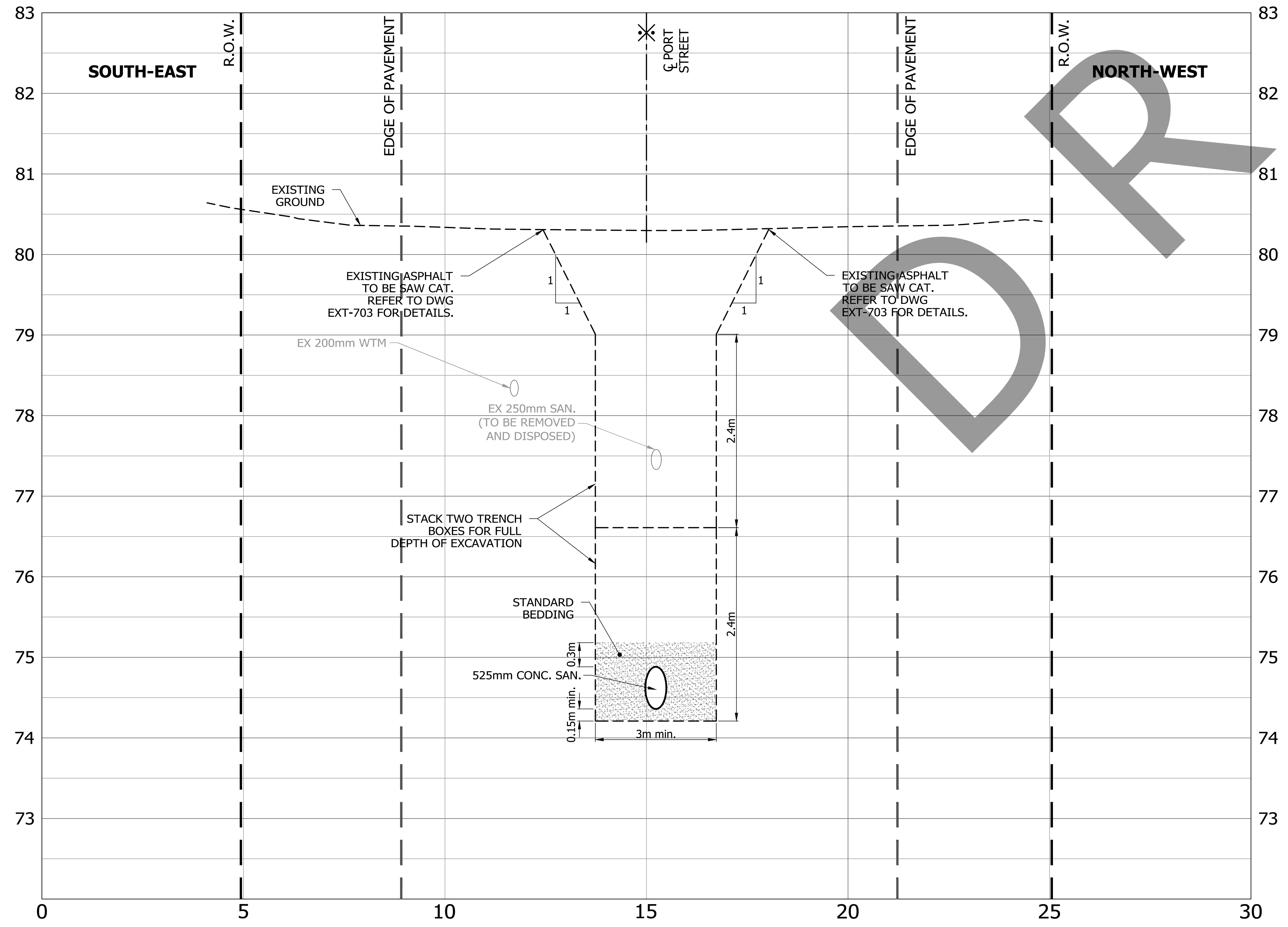
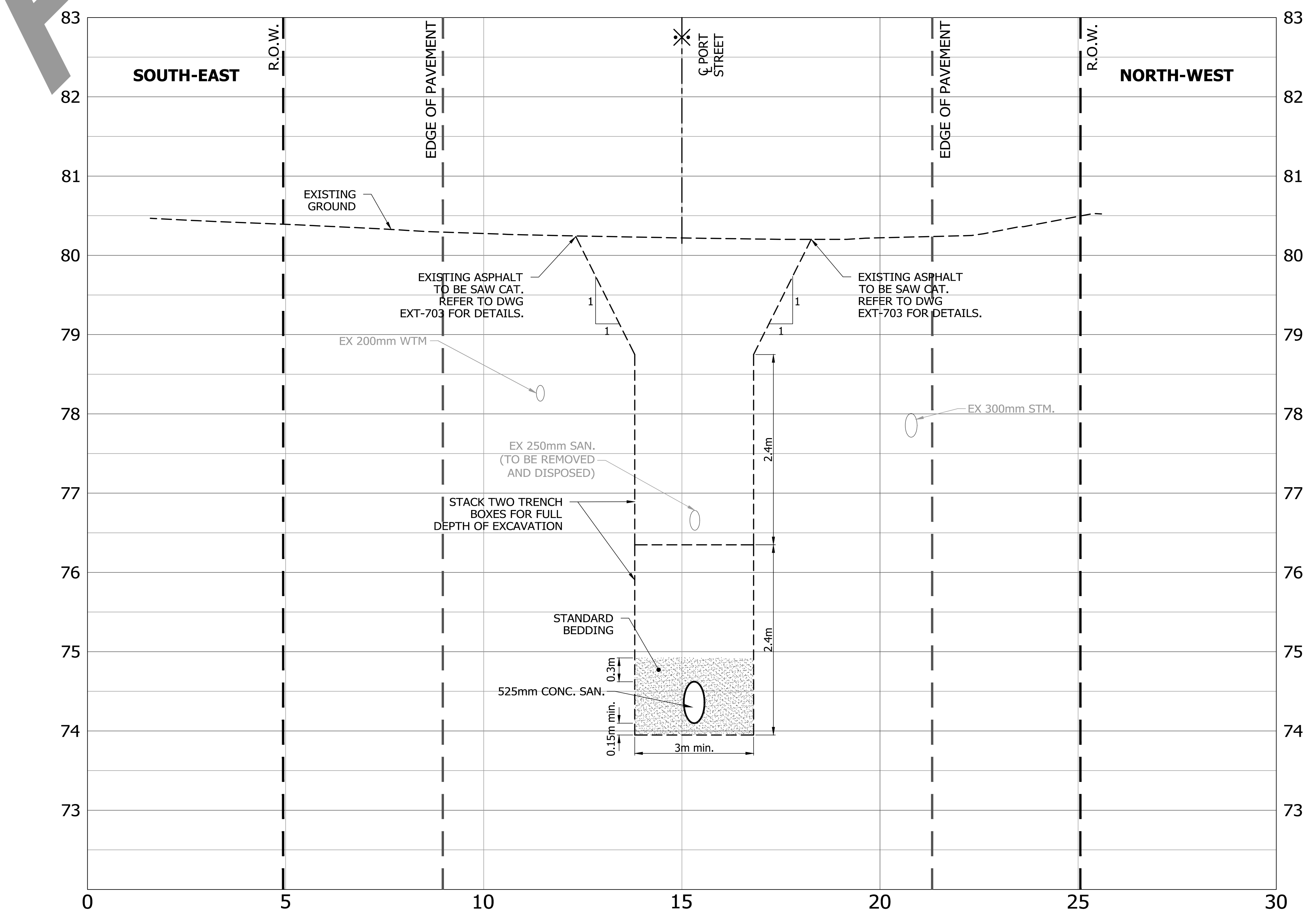


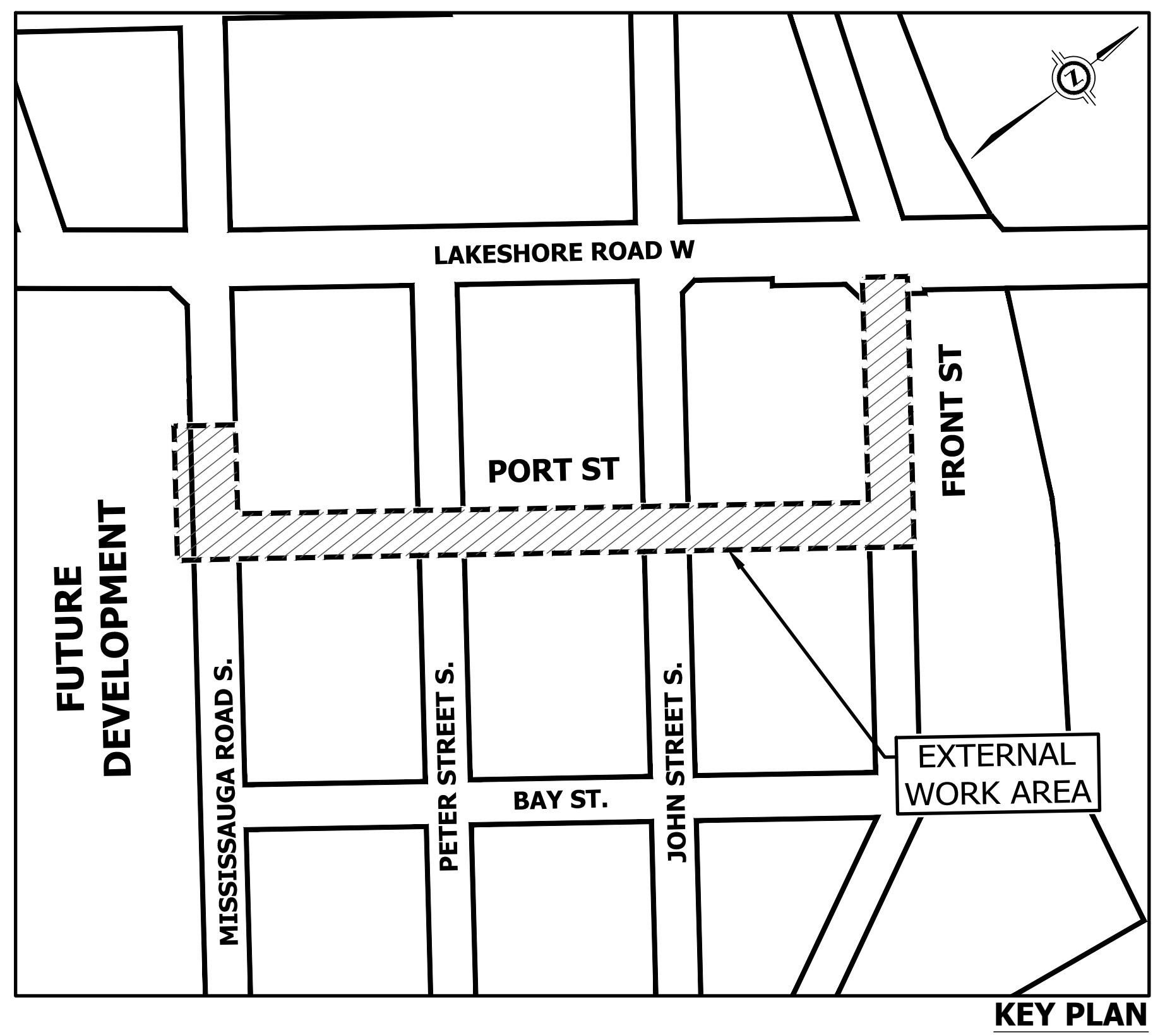
SECTION 3-3

SCALE: H-1:100 V-1:50



SECTION 4-4

SCALE: H-1:100 V-1:50



KEY PLAN
N.T.S.

CONTRACTOR IS TO NOTIFY THE CITY, REGION AND AFFECTED RESIDENTS A MINIMUM OF TWO WEEKS PRIOR TO CONSTRUCTION. THE CONTRACTOR IS TO MAKE PROVISIONS TO MAINTAIN SANITARY FLOWS FROM EXISTING SERVICES AT ALL TIMES.

BENCHMARK NOTE

ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE DERIVED FROM THE CITY OF MISSISSAUGA BENCHMARK NO. 731
ELEVATION = 81.58m

No.	REVISION	DATE	
2	SECOND SUBMISSION TO REGION OF PEEL	AUGUST 17, 2018	R.M.
1	FIRST SUBMISSION TO REGION OF PEEL	MAY 8, 2018	R.M.

SUBMISSIONS:
FIRST:
SECOND:
INTERIM:
PRE-SERVICING:
FINAL:

PORT CREDIT WEST VILLAGE PARTNERS INC.
141 LAKESHORE ROAD EAST, MISSISSAUGA, ON L5G 1E8

70 MISSISSAUGA RD SOUTH
181 LAKESHORE RD WEST

CITY FILE No. TBD
REGION FILE No. Z-08.306

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TRENCH DETAILS - 1

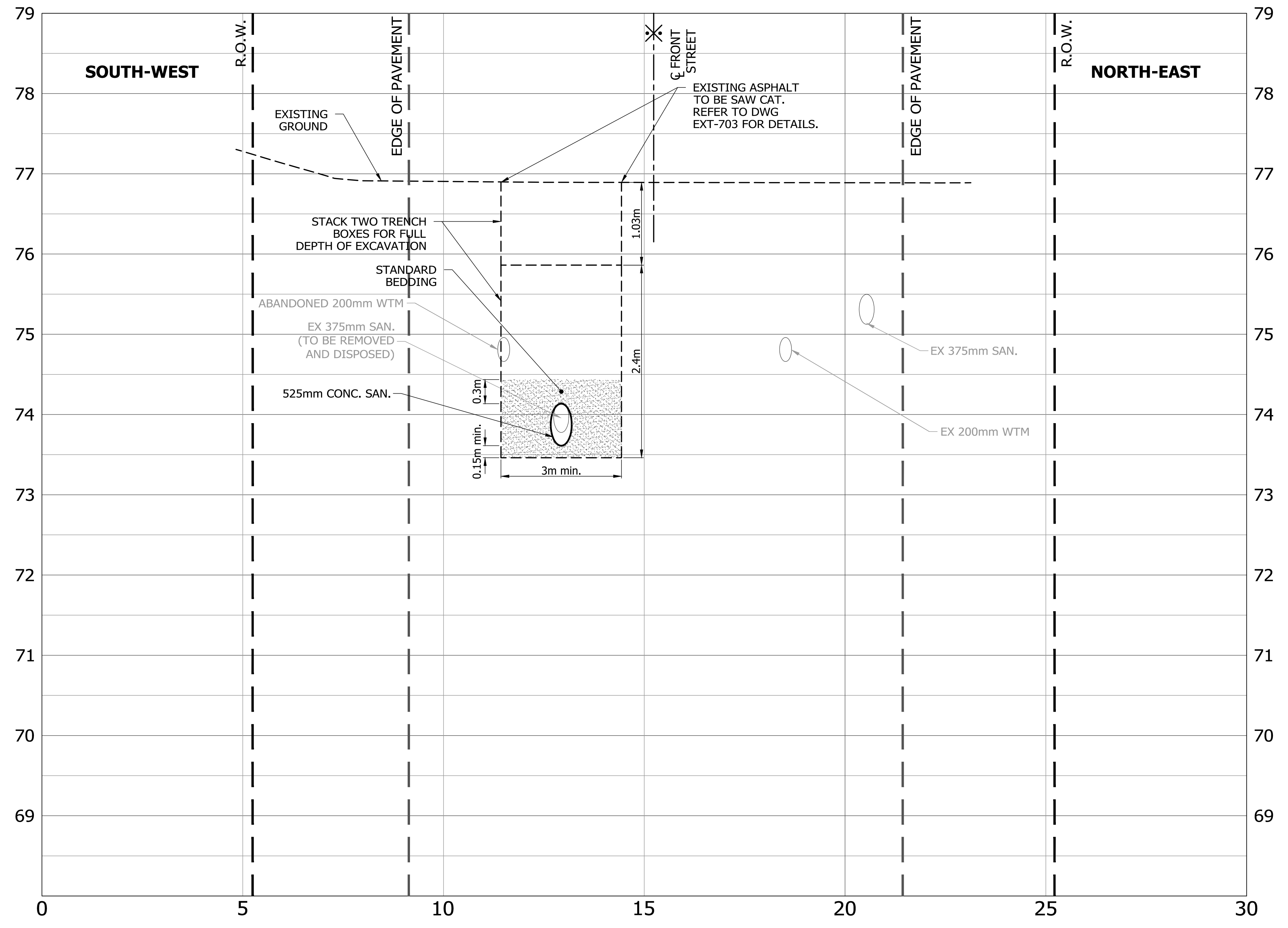
DESIGNED: R.M.	CHECKED: R.M.	PROJECT No.: 16-489W	
DRAWN: R.N.	DATE: APRIL 2018	SHEET No.:	
SCALE: V 1:50 H 1:100 (2.5m 0m 2.5m 5m 4m 6m)		DRAWING No.: EXT-102	

SECOND ENGINEERING SUBMISSION, NOVEMBER 15, 2018

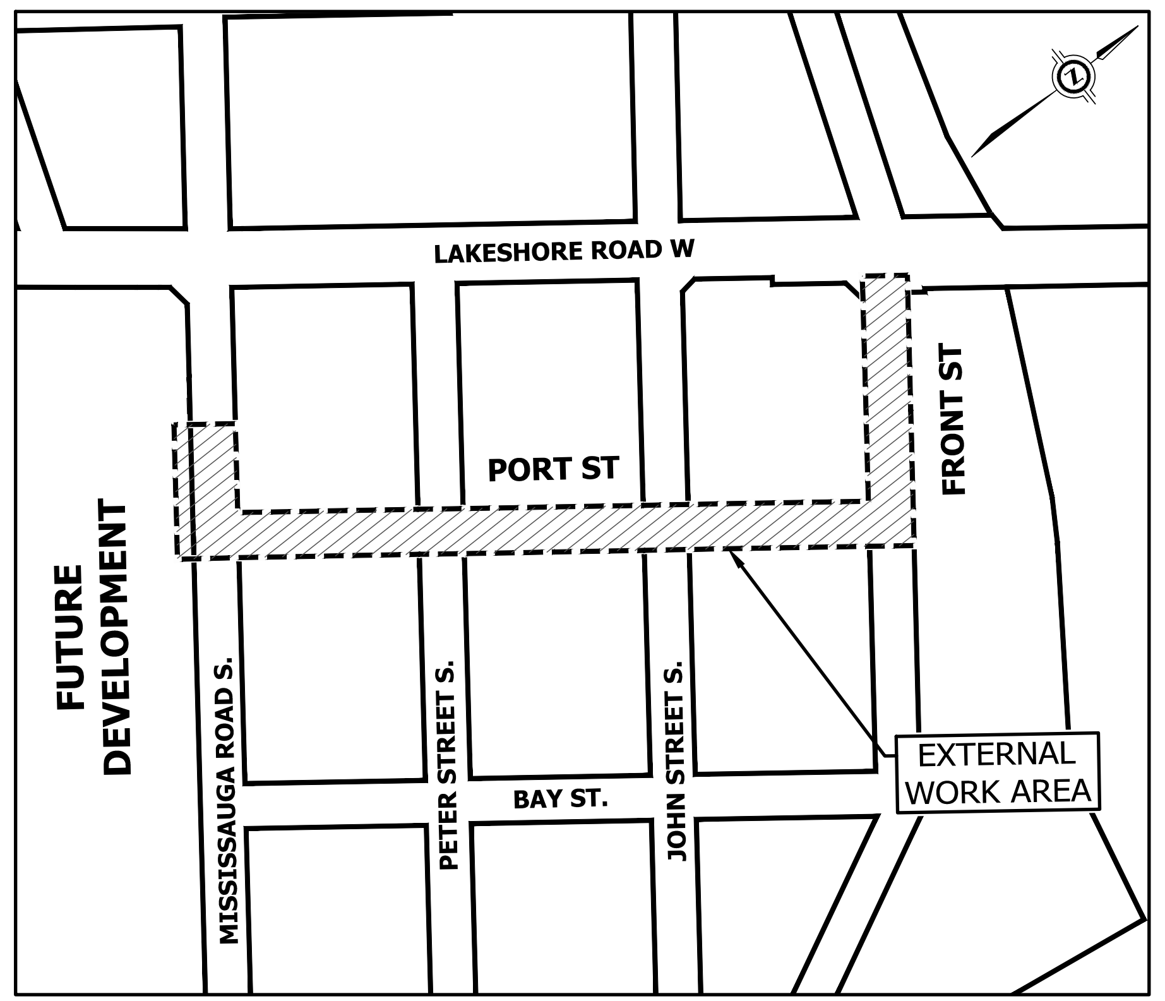
PLOT DATE:Wednesday, November 14, 2018 4:07:11 PM

File: \\URBANWEST-NAS\ALSAL DATA\PROJECTS\16-489W (WEST VILLAGE PARTNERS - PORT CREDIT)\DRAWINGS\02_OFF-SITE WORKS (SAN EXTENSION)\02_DD_PRODUCTION DWGS\16-489W - EXT WORKS - GP1 - GENRAL PLAN.DWG

SECOND ENGINEERING SUBMISSION, NOVEMBER 15, 2018



SECTION 5-5 SCALE: H-1:100 V-1:50



KEY PLAN
N.T.S.

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1	FIRST SUBMISSION TO REGION OF PEEL	MAY 8, 2018	R.M.
No.	REVISION	DATE	

SUBMISSIONS:
INTERIM: ____________
FIRST: ____________
PRE–SERVICING: ____________
SECOND: ____________
FINAL: ____________

PORT CREDIT WEST VILLAGE PARTNERS INC.
141 LAKESHORE ROAD EAST, MISSISSAUGA, ON L5G 1E8

70 MISSISSAUGA RD SOUTH
181 LAKESHORE RD WEST

CITY FILE No. TBD
REGION FILE No. Z-08.306

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TRENCH DETAILS - 2

DESIGNED: R.M.
CHECKED: R.M.
PROJECT No.: 16-489W
DRAWN: R.N.
DATE: APRIL 2018
SHEET No.:
SCALE: V 1:50 H 1:100 2.5m 0m 2.5m 5m 4m 6m
DRAWING No.: EXT - 103

PLOT DATE:Wednesday, November 14, 2018 4:07:16 PM

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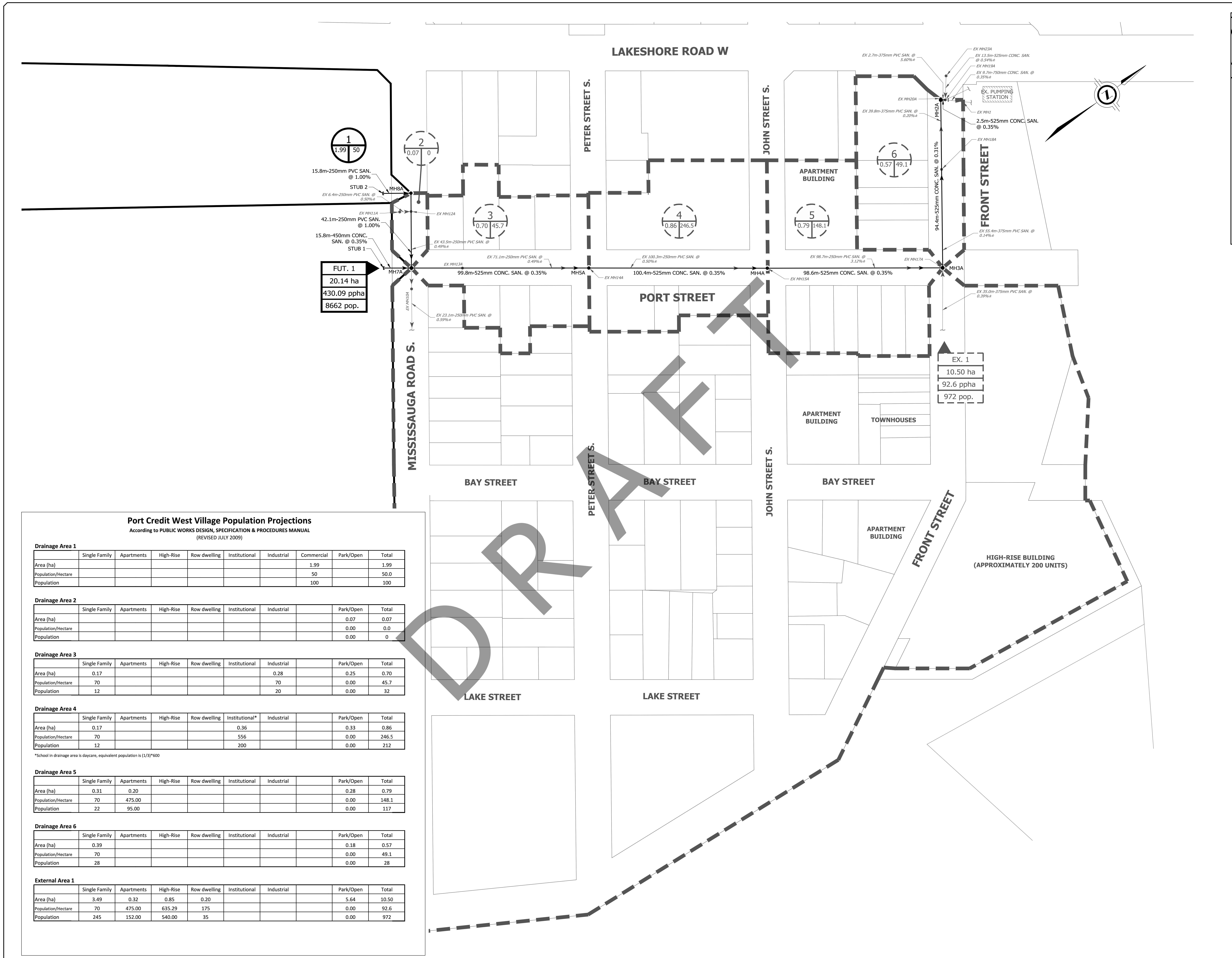
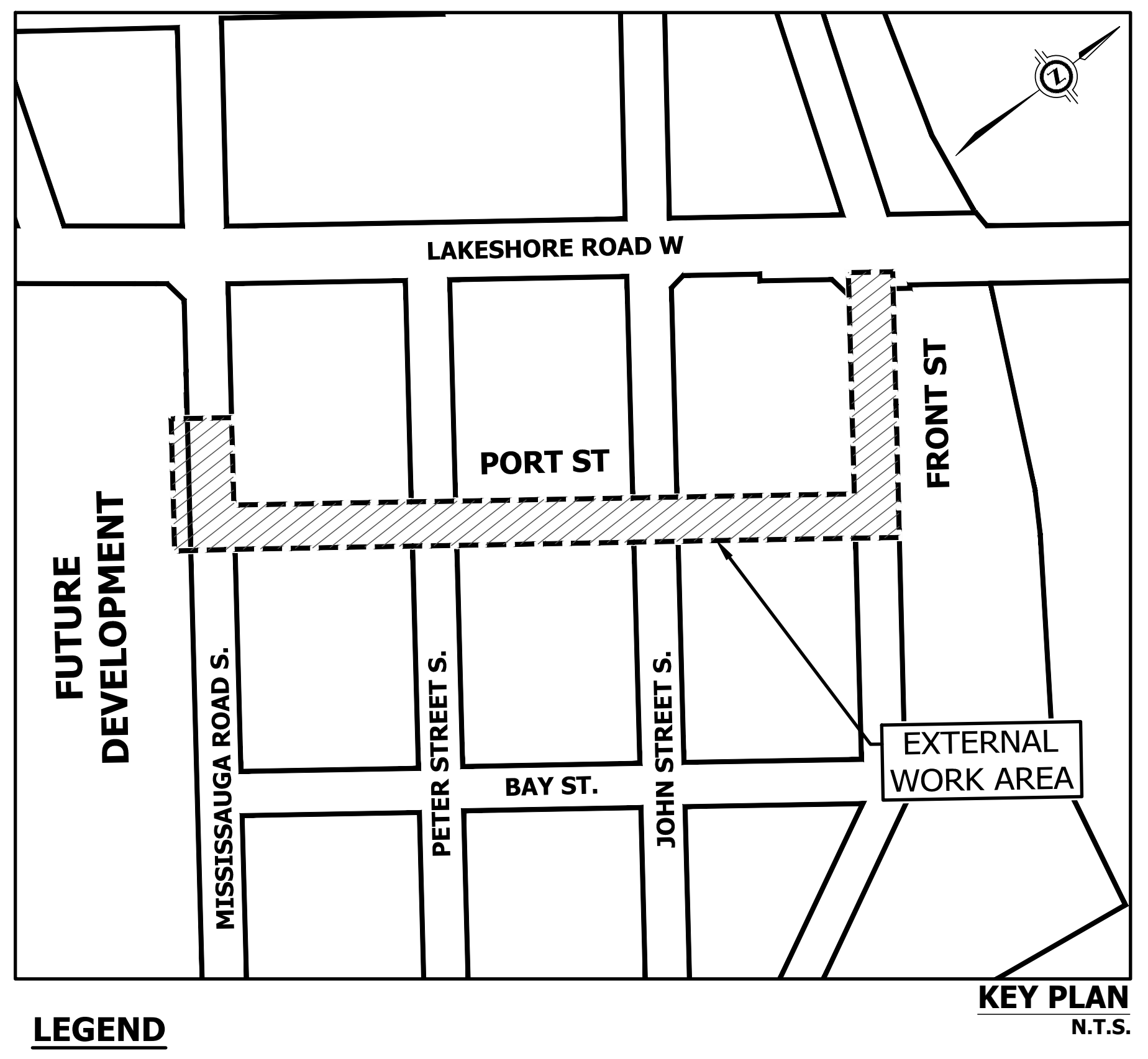
SECOND ENGINEERING SUBMISSION, NOVEMBER 15, 2018





KEY PLAN
N.T.S.

LEGEND

- EXISTING SANITARY DRAINAGE AREA
- FUTURE SANITARY DRAINAGE AREA
- SANITARY SEWER/MANHOLE
- EXISTING SANITARY SEWER/MANHOLE
- 1 — PROPOSED DRAINAGE AREA I.D.; 50 — POPULATION PER HECTARE (ppha); 0.96 — PROPOSED DRAINAGE AREA (ha)
- 5 — EXISITING DRAINAGE AREA I.D.; 50 — POPULATION PER HECTARE (ppha); 0.90 — EXISITNG DRAINAGE AREA (ha)
- FUT. 1 — PROPOSED DRAINAGE AREA I.D.; 22.74 ha — DRAINAGE AREA (ha); 356.51 ppha — POPULATION PER HECTARE; 8107 pop. — TOTAL POPULATION
- EX. 1 — EXISTING DRAINAGE AREA I.D.; 10.44 ha — DRAINAGE AREA (ha); 71.55 ppha — POPULATION PER HECTARE; 747 pop. — TOTAL POPULATION

Port Credit West Village Population Projections

According to PUBLIC WORKS DESIGN, SPECIFICATION & PROCEDURES MANUAL
(REVISED JULY 2009)

Drainage Area 1

	Single Family	Apartments	High-Rise	Row dwelling	Institutional	Industrial	Commercial	Park/Open	Total
Area (ha)							1.99		1.99
Population/Hectare							50		50.0
Population							100		100

Drainage Area 2

	Single Family	Apartments	High-Rise	Row dwelling	Institutional	Industrial		Park/Open	Total
Area (ha)								0.07	0.07
Population/Hectare								0.00	0.0
Population								0.00	0

Drainage Area 3

	Single Family	Apartments	High-Rise	Row dwelling	Institutional	Industrial		Park/Open	Total
Area (ha)	0.17					0.28		0.25	0.70
Population/Hectare	70					70		0.00	45.7
Population	12					20		0.00	32

Drainage Area 4

	Single Family	Apartments	High-Rise	Row dwelling	Institutional*	Industrial		Park/Open	Total
Area (ha)	0.17				0.36			0.33	0.86
Population/Hectare	70				556			0.00	246.5
Population	12				200			0.00	212

*School in drainage area is daycare, equivalent population is (1/3)*600

Drainage Area 5

	Single Family	Apartments	High-Rise	Row dwelling	Institutional	Industrial		Park/Open	Total
Area (ha)	0.31	0.20						0.28	0.79
Population/Hectare	70	475.00						0.00	148.1
Population	22	95.00						0.00	117

Drainage Area 6

	Single Family	Apartments	High-Rise	Row dwelling	Institutional	Industrial		Park/Open	Total
Area (ha)	0.39							0.18	0.57
Population/Hectare	70							0.00	49.1
Population	28							0.00	28

External Area 1

	Single Family	Apartments	High-Rise	Row dwelling	Institutional	Industrial		Park/Open	Total
Area (ha)	3.49	0.32	0.85	0.20				5.64	10.50
Population/Hectare	70	475.00	635.29	175				0.00	92.6
Population	245	152.00	540.00	35				0.00	972

BENCHMARK NOTE

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ELEVATION = 81.58m

No.	REVISION	DATE	
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SUBMISSIONS:
FIRST: ______
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PRE-SERVICING: ______
FINAL: ______

PORT CREDIT WEST VILLAGE PARTNERS INC.
141 LAKESHORE ROAD EAST, MISSISSAUGA, ON L5G 1E8

70 MISSISSAUGA RD SOUTH
181 LAKESHORE RD WEST

CITY FILE No. TBD
REGION FILE No. Z-08.306

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SANITARY DRAINAGE AREA PLAN - 1

DESIGNED: R.M.	CHECKED: R.M.	PROJECT No.: 16-489W
DRAWN: R.N.	DATE: APRIL 2018	SHEET No.:
SCALE: 1:1000 10m 0m 10m 20m 40m 60m		DRAWING No.: EXT-301

PLOT DATE:Wednesday, November 14, 2018 4:07:26 PM

File: \\URBANWEST-NAS\ALSAL DATA\PROJECTS\16-489W (WEST VILLAGE PARTNERS - PORT CREDIT)\DRAWINGS\02_OFF-SITE WORKS (SAN EXTENSION)\02_DD_PRODUCTION DWGS\16-489W - EXT WORKS - SAN1 - SANITARY DRAINAGE AREA PLAN.DWG

CROSSING TABLE

CROSSING ID	TOP PIPE	BOTTOM PIPE	CLEARANCE
1	STM INV. 77.82	SAN OBV. 77.50	0.32m
2	WTM INV. 78.15	SAN OBV. 75.42	2.73m
3	WTM INV. 78.57	SAN OBV. 75.04	3.53m
4	WTM INV. 78.16	SAN OBV. 74.72	3.44m
5	WTM INV. 75.05	SAN OBV. 74.34	0.71m
6	WTM INV. 74.78	SAN OBV. 74.26	0.52m

NOTE:

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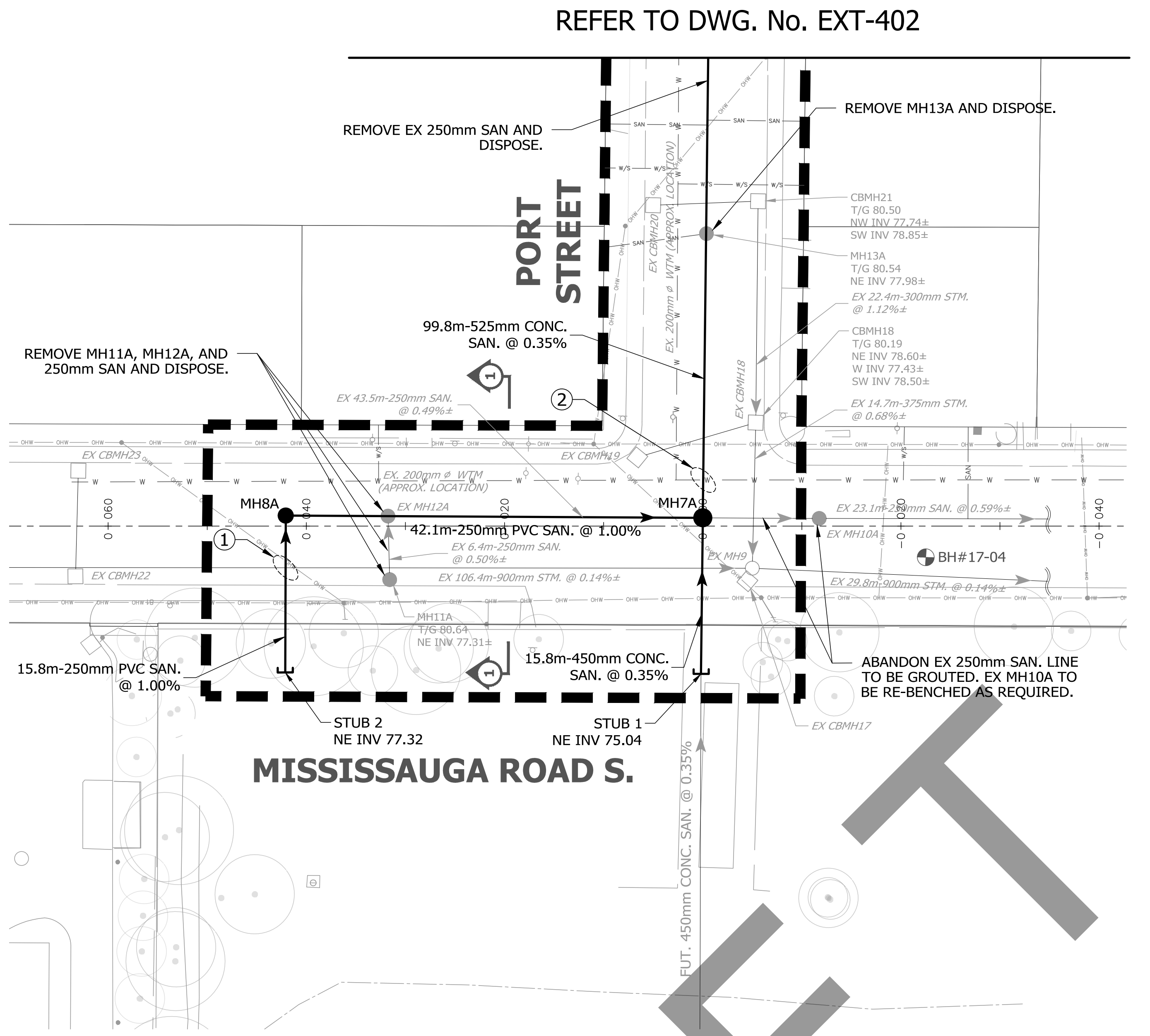
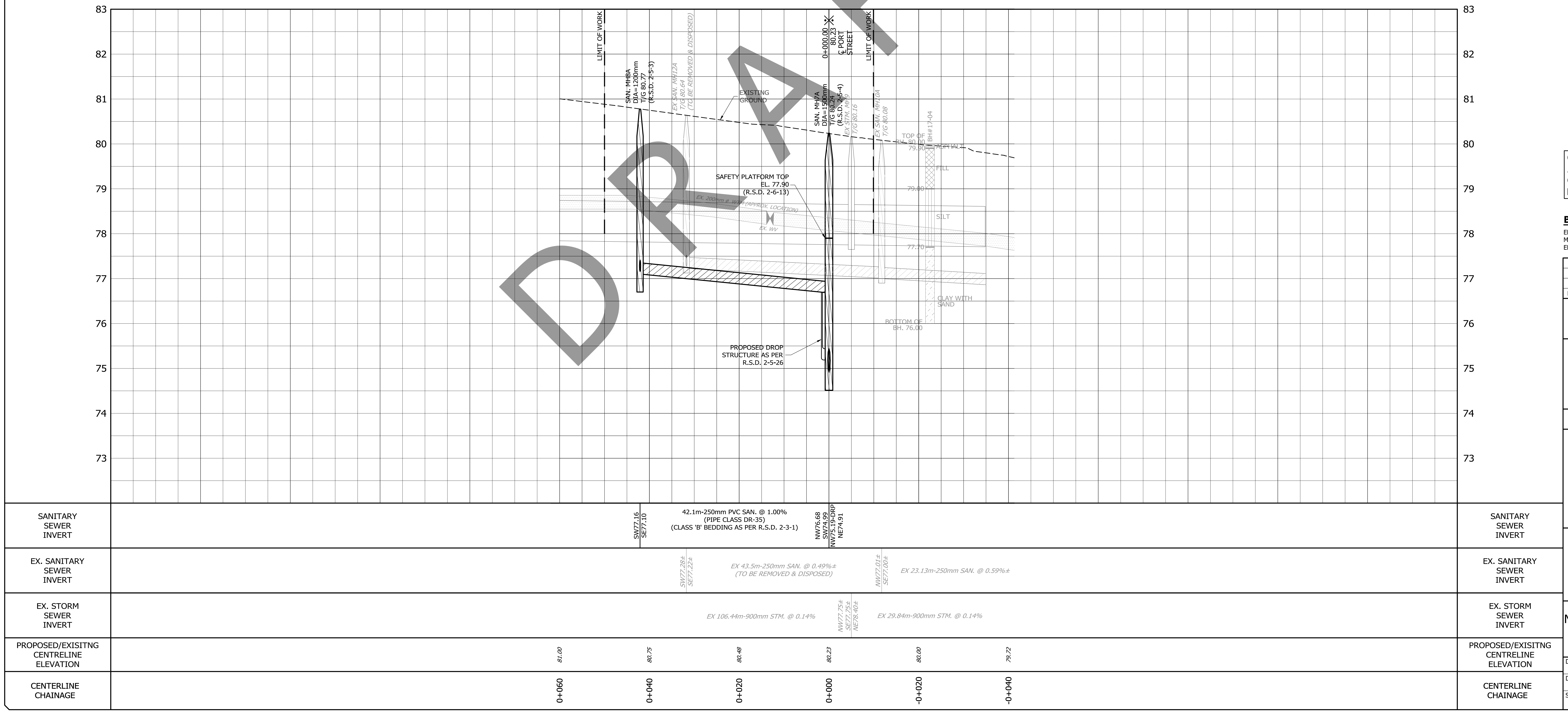
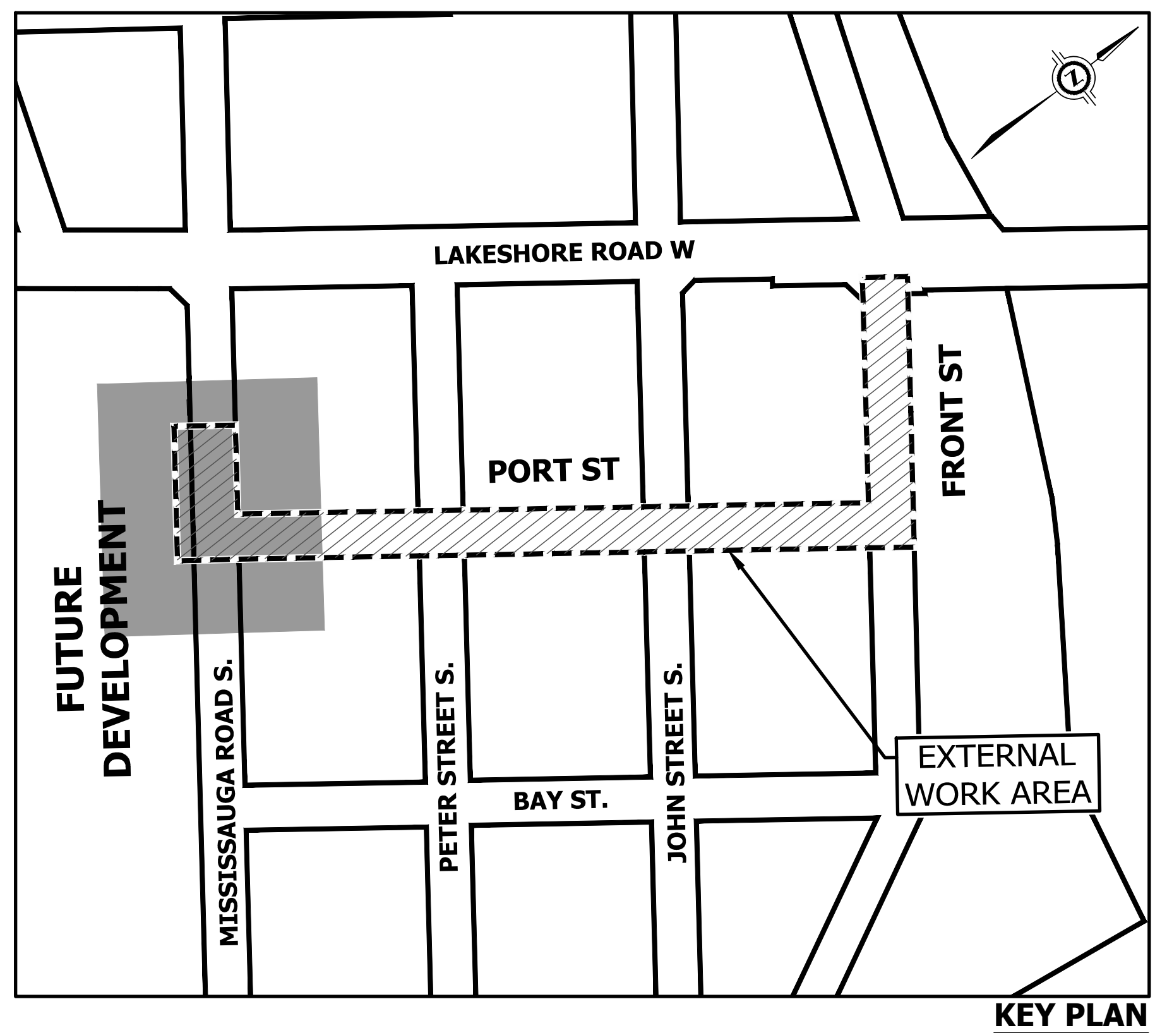
THE CONTRACTOR TO PROVIDE THEIR DETAIL OF SUPPORT SYSTEM FOR THE CROSSING OF WATERMAIN.







KEY PLAN
N.T.S.

LEGEND

▬ ▬ ▬	LIMIT OF WORK
●◄—	SANITARY SEWER/MANHOLE
○◄—	EXISTING STORM SEWER/MANHOLE
●◄—	EXISTING SANITARY SEWER/MANHOLE
□	EXISTING CATCH BASIN
◐	BOREHOLE LOCATION
—·—·—	EXISTING WATER MAIN
——	EXISTING SANITARY SERVICE CONNECTION
——	EXISTING WATER SERVICE CONNECTION
—·—·—	EXISTING OVERHEAD WIRE
⊕	EXISTING WATERMAIN VALVE
+	EXISTING HYDRANT
▫	EXISTING SIGN
○	EXISTING TREE
①	SERVICING CROSSING (SEE CROSSING TABLE ON THIS DRAWING FOR DETAILS)
①	TRENCH CROSS SECTION REFER TO DWG EXT-102 AND EXT-103 FOR DETAILS.

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ELEVATION = 81.58m

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SUBMISSIONS:
FIRST: ______
SECOND: ______
INTERIM: ______
PRE–SERVICING: ______
FINAL: ______

PORT CREDIT WEST VILLAGE PARTNERS INC.
141 LAKESHORE ROAD EAST, MISSISSAUGA, ON L5G 1E8

70 MISSISSAUGA RD SOUTH
181 LAKESHORE RD WEST

CITY FILE No. TBD
REGION FILE No. Z-08.306

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MISSISSAUGA RD. PLAN & PROFILE - 1
(FROM STA. -040.0 TO END)

DESIGNED: R.M.	CHECKED: R.M.	PROJECT No.: 16-489W
DRAWN: R.N.	DATE: APRIL 2018	SHEET No.:
SCALE: V 1:50 H 1:500 (5m 0m 5m 10m 20m 30m)		DRAWING No.: EXT-401

SECOND ENGINEERING SUBMISSION, NOVEMBER 15, 2018

PLOT DATE:Wednesday, November 14, 2018 4:07:41 PM

File: \\URBANWEST-NAS\ALSAL DATA\PROJECTS\16-489W (WEST VILLAGE PARTNERS - PORT CREDIT)\DRAWINGS\02_OFF-SITE WORKS (SAN EXTENSION)\02_DD_PRODUCTION DWGS\16-489W - EXT WORKS - PP1 - PLAN & PROFILE MISSISSAUGA RD.DWG

SECOND ENGINEERING SUBMISSION, NOVEMBER 15, 2018

CROSSING TABLE

CROSSING ID	TOP PIPE	BOTTOM PIPE	CLEARANCE
1	STM INV. 77.82	SAN OBV. 77.50	0.32m
2	WTM INV. 78.15	SAN OBV. 75.42	2.73m
3	WTM INV. 78.57	SAN OBV. 75.04	3.53m
4	WTM INV. 78.16	SAN OBV. 74.72	3.44m
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6	WTM INV. 74.78	SAN OBV. 74.26	0.52m

NOTE:

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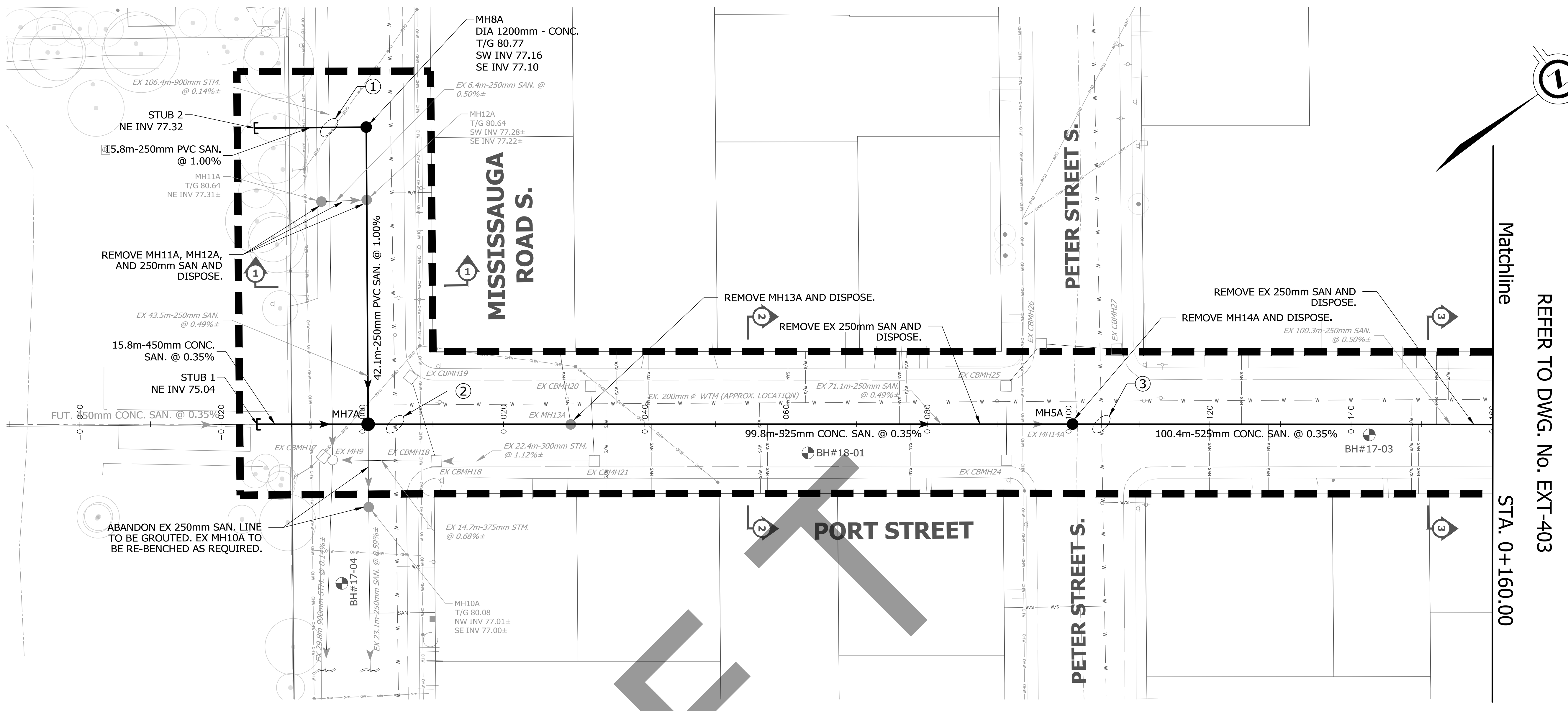
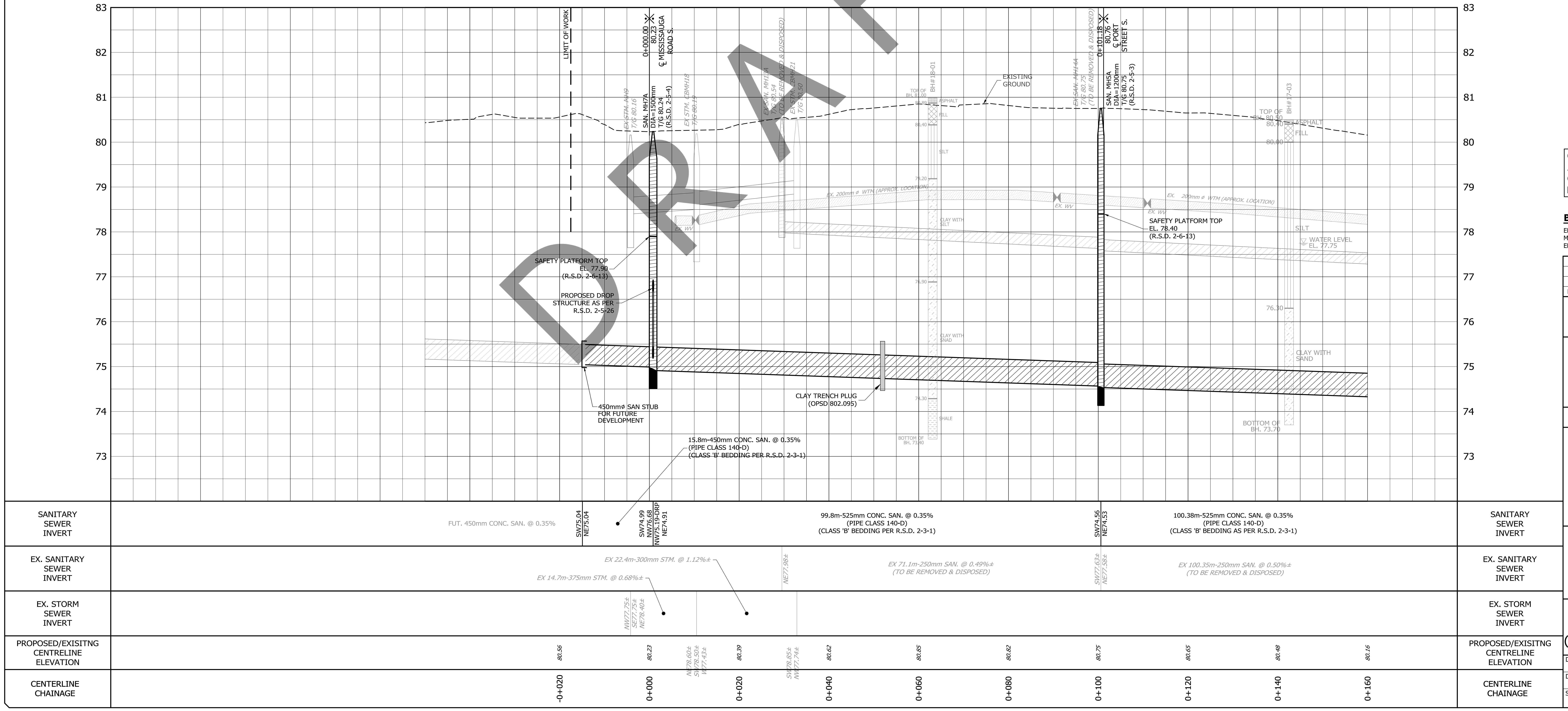
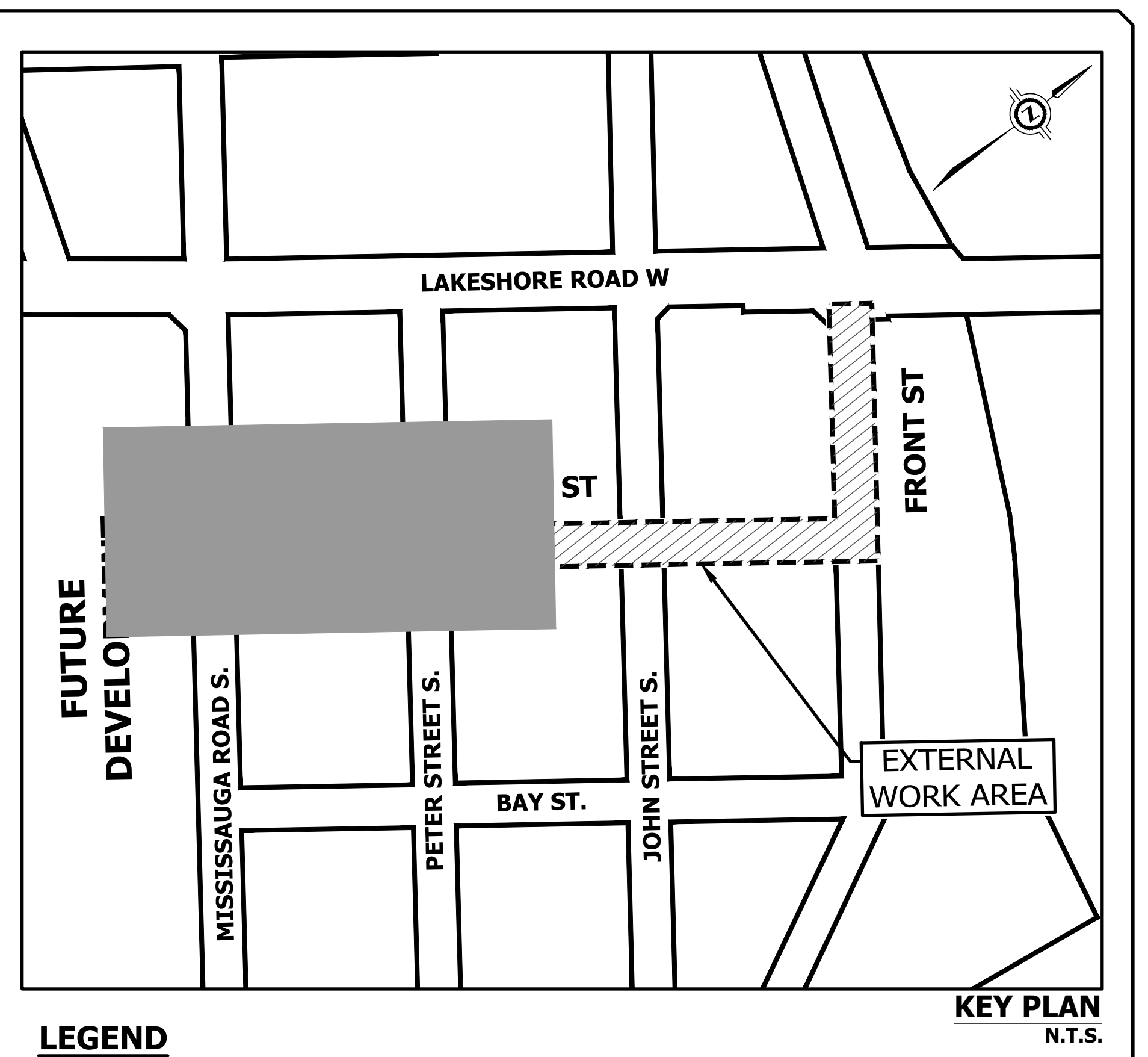
THE CONTRACTOR TO PROVIDE THEIR DETAIL OF SUPPORT SYSTEM FOR THE CROSSING OF WATERMAIN.







KEY PLAN
N.T.S.

LEGEND

▬ ▬ ▬	LIMIT OF WORK
●←	SANITARY SEWER/MANHOLE
○←	EXISTING STORM SEWER/MANHOLE
●←	EXISTING SANITARY SEWER/MANHOLE
□	EXISTING CATCH BASIN
◕	BOREHOLE LOCATION
— W — W — W — W	EXISTING WATER MAIN
— SAN — SAN —	EXISTING SANITARY SERVICE CONNECTION
— W/S — W/S —	EXISTING WATER SERVICE CONNECTION
— OHW — OHW — OHW — OHW — OHW	EXISTING OVERHEAD WIRE
-○-	EXISTING WATERMAIN VALVE
-♀-	EXISTING HYDRANT
ᑫ	EXISTING SIGN
○	EXISTING TREE
①	SERVICING CROSSING (SEE CROSSING TABLE ON THIS DRAWING FOR DETAILS)
1	TRENCH CROSS SECTION REFER TO DWG EXT-102 AND EXT-103 FOR DETAILS.

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SECOND: ______
INTERIM: ______
PRE–SERVICING: ______
FINAL: ______

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70 MISSISSAUGA RD SOUTH
181 LAKESHORE RD WEST

CITY FILE No. TBD
REGION FILE No. Z-08.306

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PORT ST. PLAN & PROFILE - 1
(FROM STA. -030.0 TO STA. +160.0)

DESIGNED: R.M.	CHECKED: R.M.	PROJECT No.: 16-489W
DRAWN: R.N.	DATE: APRIL 2018	SHEET No.:
SCALE: V 1:50 H 1:500 (5m 0m 5m 10m 20m 30m)		DRAWING No.: EXT-402

PLOT DATE:Wednesday, November 14, 2018 4:07:58 PM

File: \\URBANWEST-NAS\ALSAL DATA\PROJECTS\16-489W (WEST VILLAGE PARTNERS - PORT CREDIT)\DRAWINGS\02_OFF-SITE WORKS (SAN EXTENSION)\02_DD_PRODUCTION DWGS\16-489W - EXT WORKS - PP2-3 - PLAN & PROFILE PORT ST.DWG

CROSSING TABLE

CROSSING ID	TOP PIPE	BOTTOM PIPE	CLEARANCE
1	STM INV. 77.82	SAN OBV. 77.50	0.32m
2	WTM INV. 78.15	SAN OBV. 75.42	2.73m
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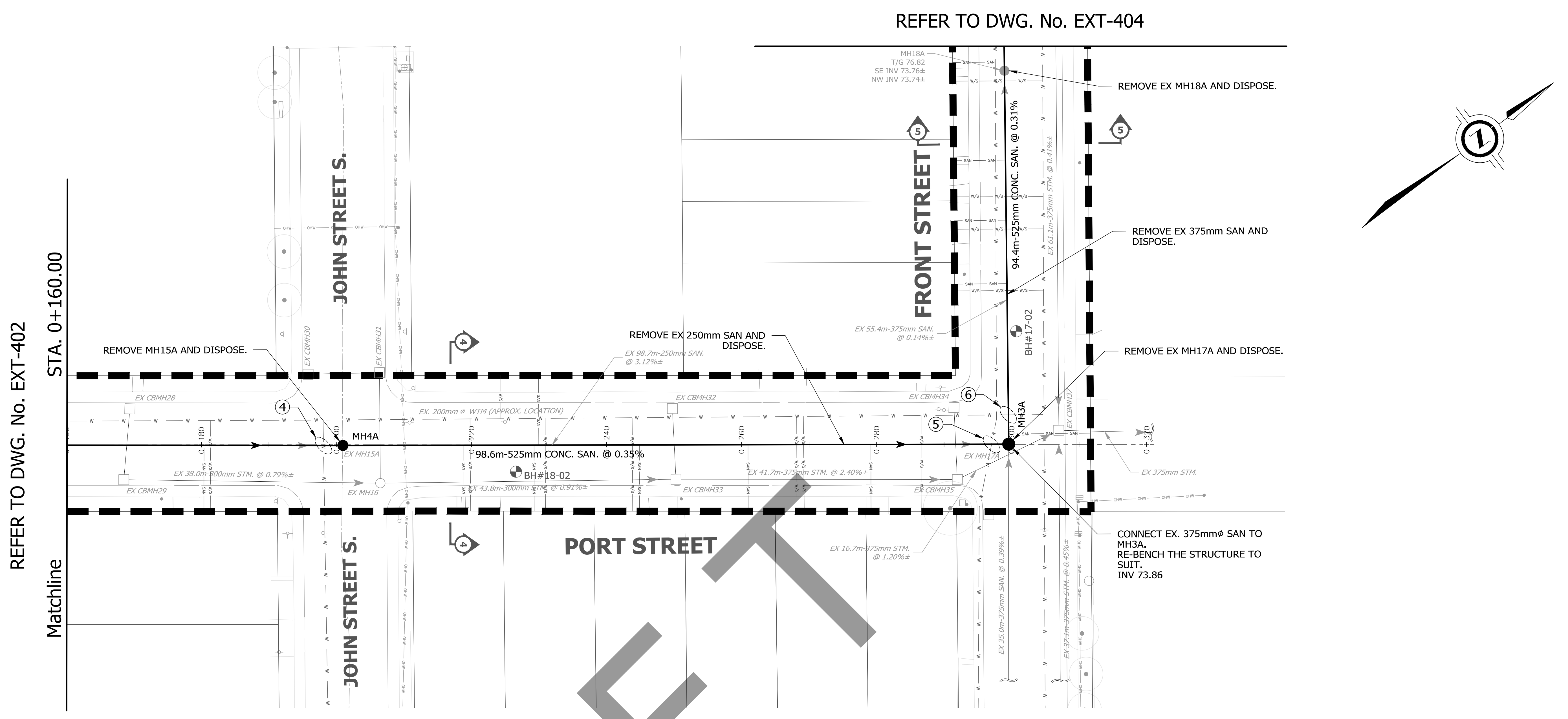
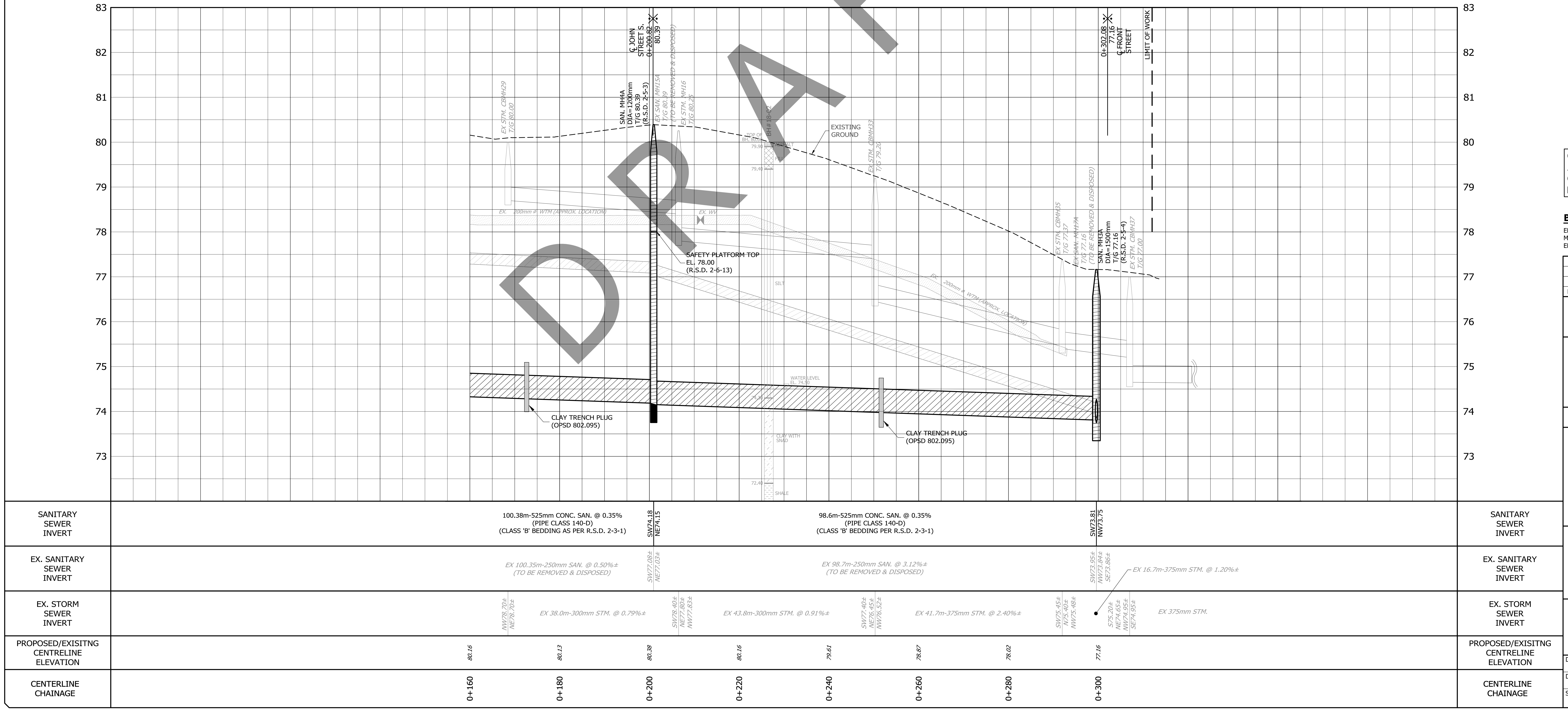
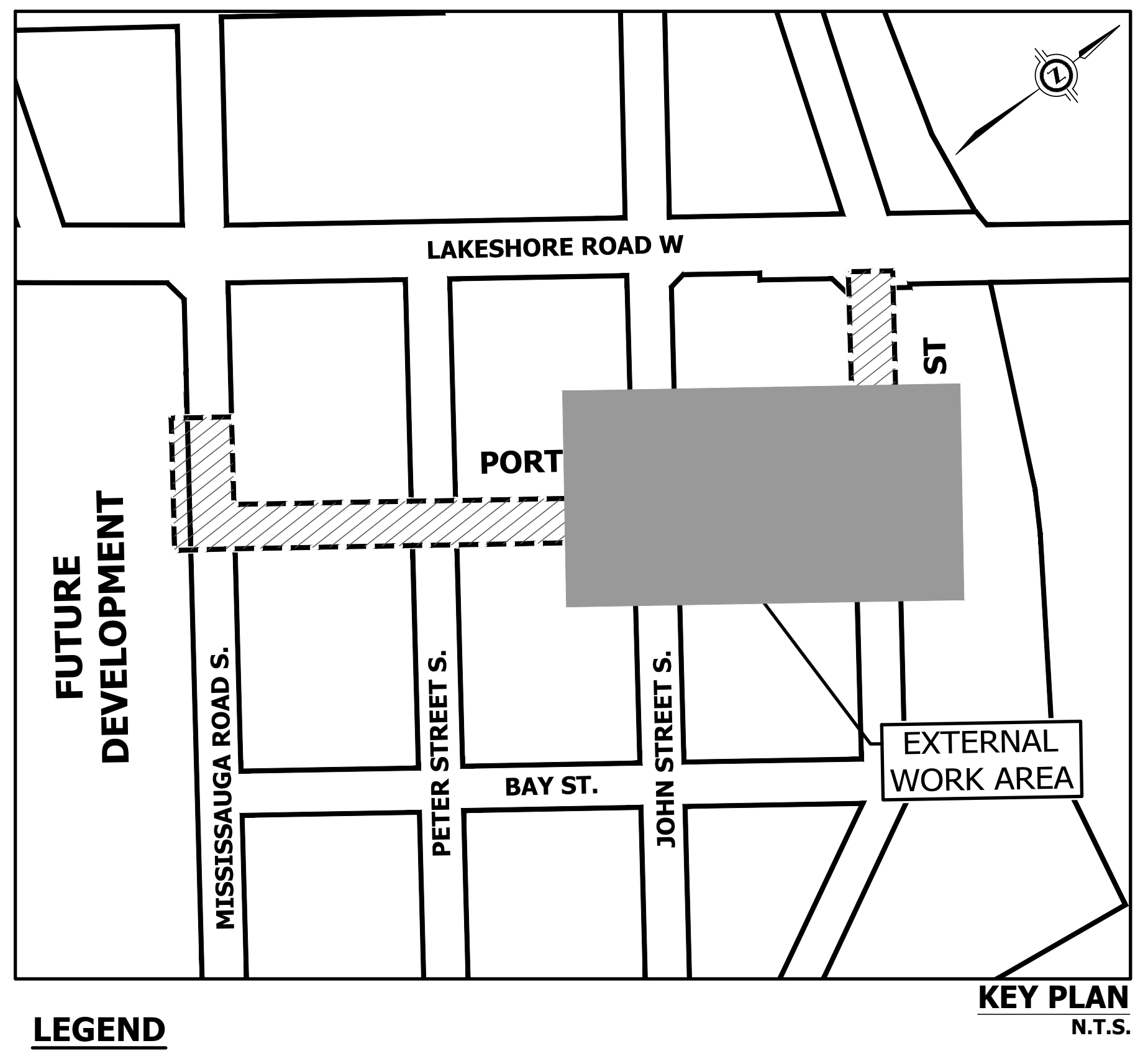
THE CONTRACTOR TO PROVIDE THEIR DETAIL OF SUPPORT SYSTEM FOR THE CROSSING OF WATERMAIN.







KEY PLAN
N.T.S.

LEGEND

▬ ▬ ▬	LIMIT OF WORK
●◀	SANITARY SEWER/MANHOLE
○◀	EXISTING STORM SEWER/MANHOLE
●◀	EXISTING SANITARY SEWER/MANHOLE
□	EXISTING CATCH BASIN
◕	BOREHOLE LOCATION
	EXISTING WATER MAIN
	EXISTING SANITARY SERVICE CONNECTION
	EXISTING WATER SERVICE CONNECTION
	EXISTING OVERHEAD WIRE
	EXISTING WATERMAIN VALVE
	EXISTING HYDRANT
	EXISTING SIGN
	EXISTING TREE
①	SERVICING CROSSING (SEE CROSSING TABLE ON THIS DRAWING FOR DETAILS)
①	TRENCH CROSS SECTION REFER TO DWG EXT-102 AND EXT-103 FOR DETAILS.

CONTRACTOR IS TO NOTIFY THE CITY, REGION AND AFFECTED RESIDENTS A MINIMUM OF TWO WEEKS PRIOR TO CONSTRUCTION. THE CONTRACTOR IS TO MAKE PROVISIONS TO MAINTAIN SANITARY FLOWS FROM EXISTING SERVICES AT ALL TIMES.

BENCHMARK NOTE

ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE DERIVED FROM THE CITY OF MISSISSAUGA BENCHMARK NO. 731
ELEVATION = 81.58m

No.	REVISION	DATE	
2	SECOND SUBMISSION TO REGION OF PEEL	AUGUST 17, 2018	R.M.
1	FIRST SUBMISSION TO REGION OF PEEL	MAY 8, 2018	R.M.

SUBMISSIONS:
FIRST: ______
SECOND: ______
INTERIM: ______
PRE–SERVICING: ______
FINAL: ______

PORT CREDIT WEST VILLAGE PARTNERS INC.
141 LAKESHORE ROAD EAST, MISSISSAUGA, ON L5G 1E8

70 MISSISSAUGA RD SOUTH
181 LAKESHORE RD WEST

CITY FILE No. TBD
REGION FILE No. Z-08.306

MISSISSAUGA

Region of Peel
Working for you

urbantech west
Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle, Suite 201 Oakville, Ontario L6H 0H2
tel: 905.829.8818 fax: 905.829.4804
www.urbantech.com

PORT ST. PLAN & PROFILE - 2
(FROM STA. +160.0 TO END)

DESIGNED: R.M.	CHECKED: R.M.	PROJECT No.: 16-489W
DRAWN: R.N.	DATE: APRIL 2018	SHEET No.:
SCALE: V 1:50 H 1:500 (5m 0m 5m 10m 20m 30m)		DRAWING No.: EXT-403

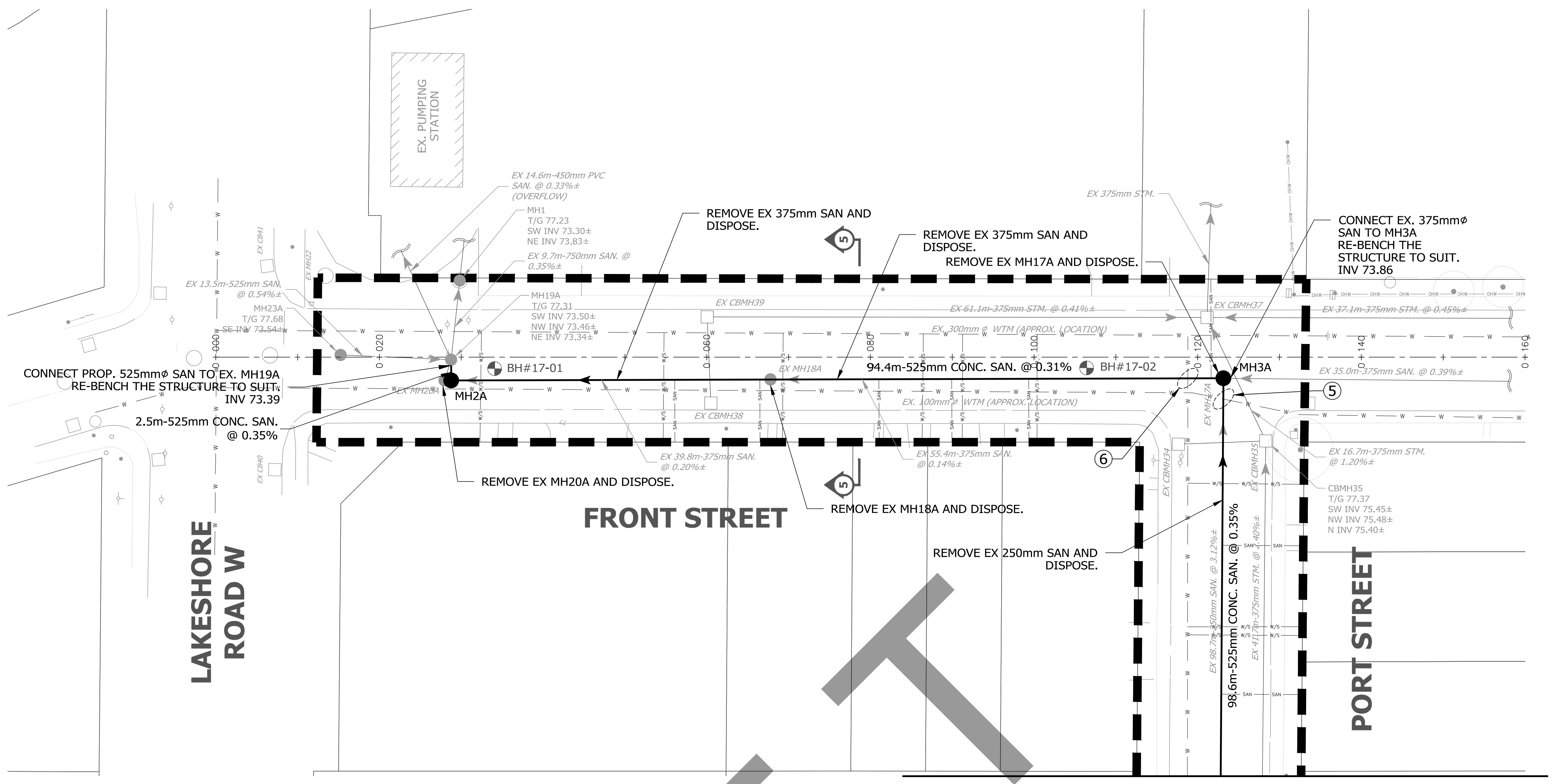
PLOT DATE:Wednesday, November 14, 2018 4:08:10 PM

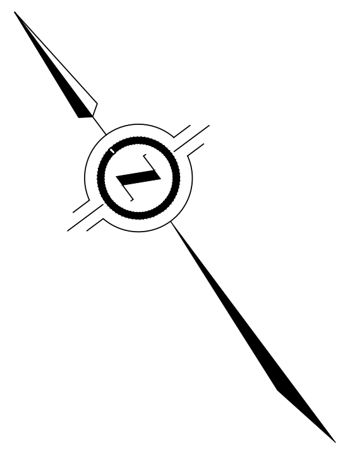
CROSSING TABLE

CROSSING ID	TOP PIPE	BOTTOM PIPE	CLEARANCE
1	STM INV. 77.82	SAN OBV. 77.50	0.32m
2	WTM INV. 78.15	SAN OBV. 75.42	2.73m
3	WTM INV. 78.57	SAN OBV. 75.04	3.53m
4	WTM INV. 78.16	SAN OBV. 74.72	3.44m
5	WTM INV. 75.05	SAN OBV. 74.34	0.71m
6	WTM INV. 74.78	SAN OBV. 74.26	0.52m

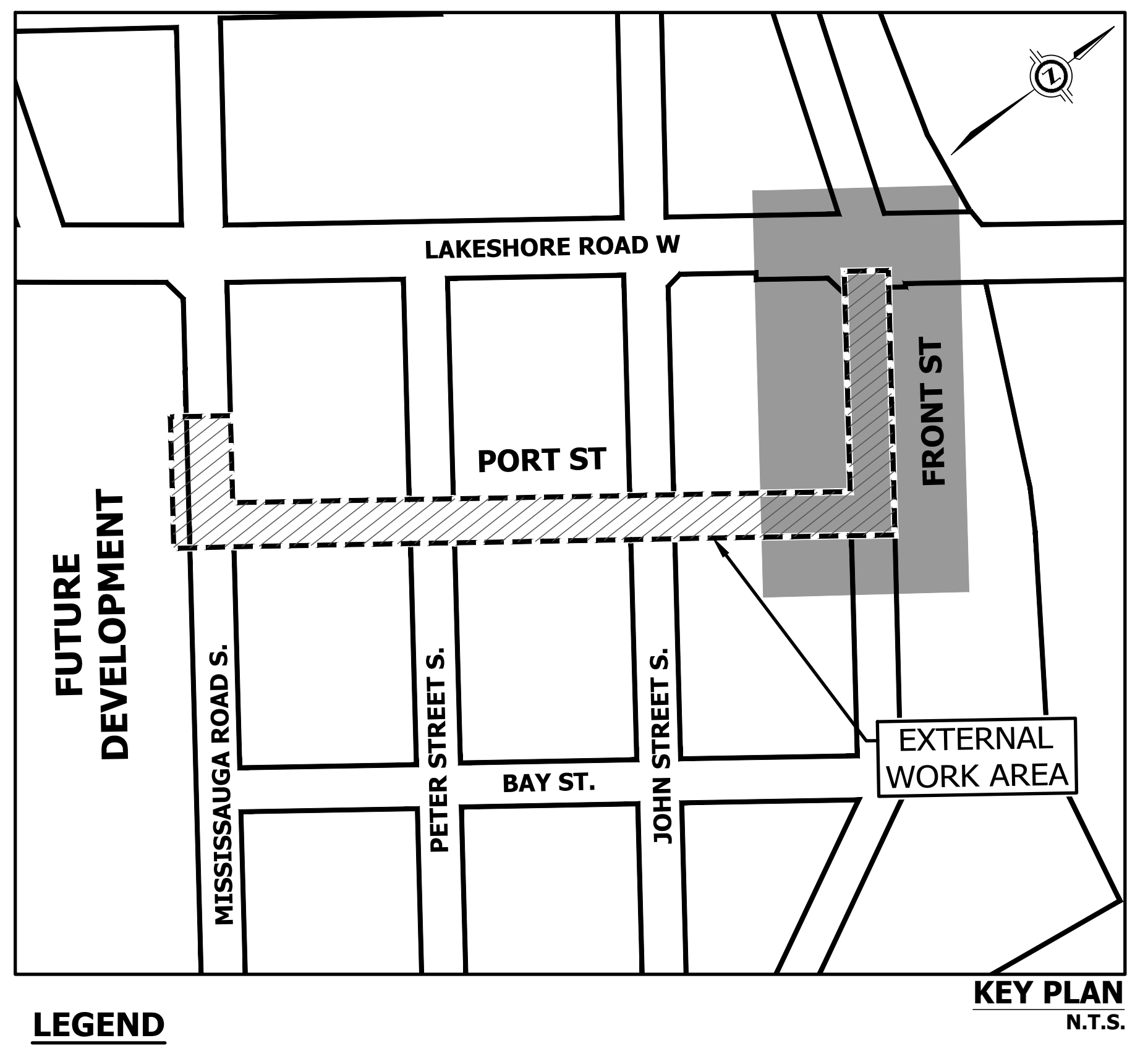
NOTE:

PRIOR TO EXCAVATION CONTRACTOR SHALL EXPOSE AND VERIFY THE LOCATION AND ELEVATION OF THE EXISTING WATER MAINS AND MUST NOTIFY THE DESIGN ENGINEER AND THE PROJECT MANAGER IMMEDIATELY IN WRITING OF ANY CONFLICT AND DISCREPANCIES.
THE CONTRACTOR TO PROVIDE THEIR DETAIL OF SUPPORT SYSTEM FOR THE CROSSING OF WATERMAIN.





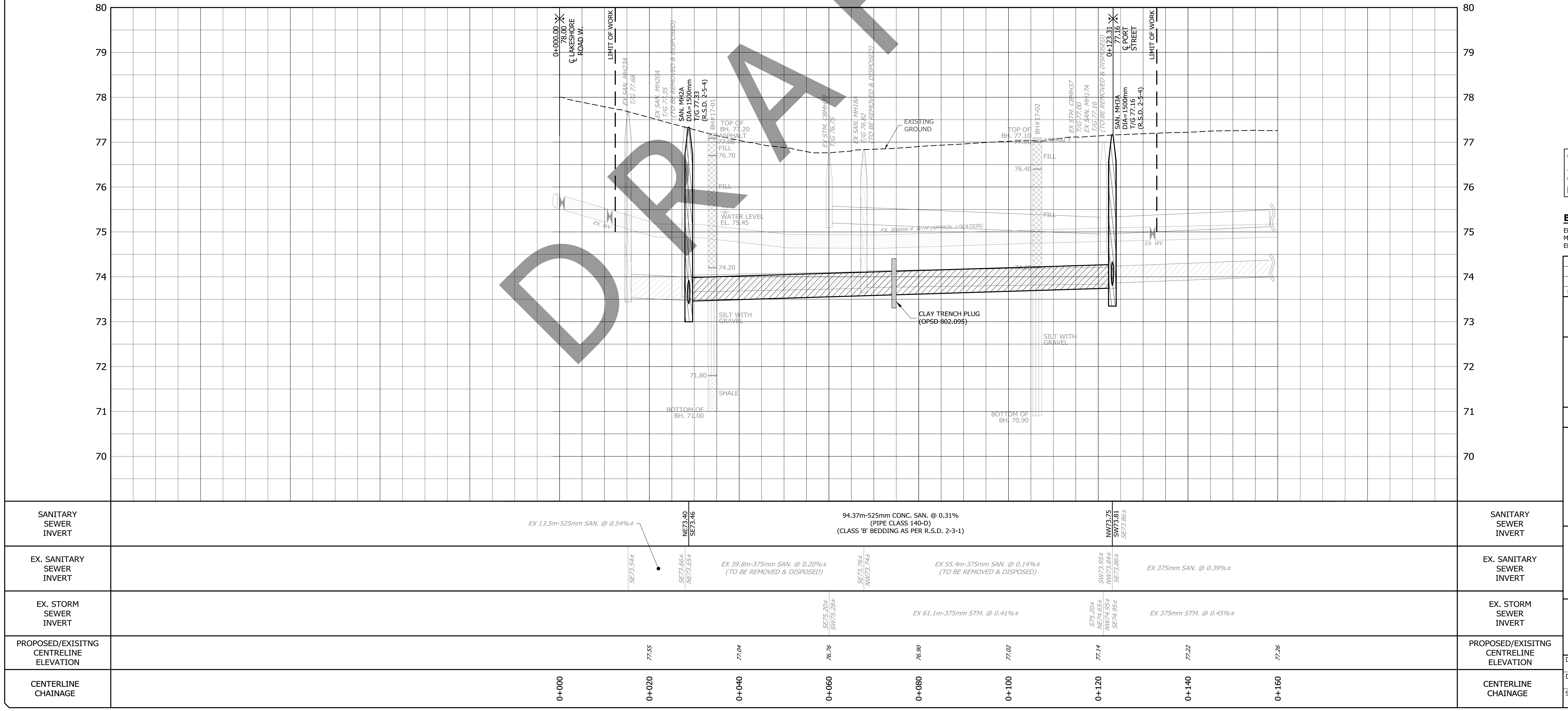
REFER TO DWG. No. EXT-403



KEY PLAN
N.T.S.

LEGEND

▬ ▬ ▬	LIMIT OF WORK
●◄──	SANITARY SEWER/MANHOLE
○◄──	EXISTING STORM SEWER/MANHOLE
●◄──	EXISTING SANITARY SEWER/MANHOLE
□	EXISTING CATCH BASIN
◐	BOREHOLE LOCATION
— W — W — W — W	EXISTING WATER MAIN
— SAN — SAN —	EXISTING SANITARY SERVICE CONNECTION
— W/S — W/S —	EXISTING WATER SERVICE CONNECTION
— OHW — OHW — OHW — OHW — OHW	EXISTING OVERHEAD WIRE
-○-	EXISTING WATERMAIN VALVE
-ϙ-	EXISTING HYDRANT
ϙ	EXISTING SIGN
◯	EXISTING TREE
①	SERVICING CROSSING (SEE CROSSING TABLE ON THIS DRAWING FOR DETAILS)
⟨1⟩	TRENCH CROSS SECTION REFER TO DWG EXT-102 AND EXT-103 FOR DETAILS.



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BENCHMARK NOTE

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ELEVATION = 81.58m

No.	REVISION	DATE	
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SUBMISSIONS:
FIRST: ____
SECOND: ____
INTERIM: ____
PRE–SERVICING: ____
FINAL: ____

PORT CREDIT WEST VILLAGE PARTNERS INC.
141 LAKESHORE ROAD EAST, MISSISSAUGA, ON L5G 1E8

70 MISSISSAUGA RD SOUTH
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CITY FILE No. TBD
REGION FILE No. Z-08.306

MISSISSAUGA

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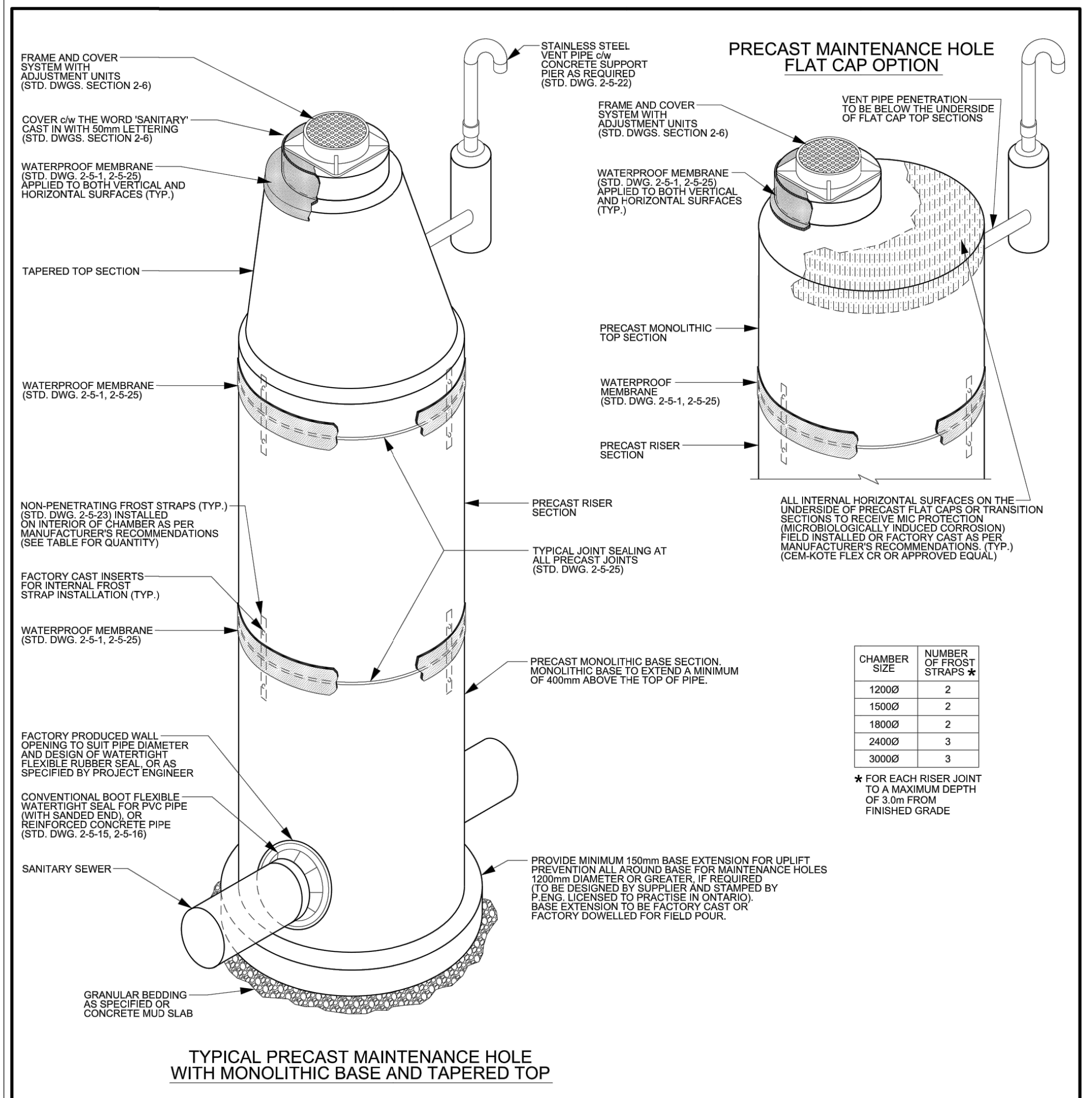
FRONT ST. PLAN & PROFILE - 1
(FROM STA. 000.0 TO END)

DESIGNED: R.M.	CHECKED: R.M.	PROJECT No.: 16-489W
DRAWN: R.N.	DATE: APRIL 2018	SHEET No.:
SCALE: V 1:50 H 1:500 (5m 0m 5m 10m 20m 30m)		DRAWING No.: EXT-404



CHAMBER SIZE	NUMBER OF FROST STRAPS *
1200Ø	2
1500Ø	2
1800Ø	2
2400Ø	3
3000Ø	3

* FOR EACH RISER JOINT TO A MAXIMUM DEPTH OF 3.0m FROM FINISHED GRADE

TYPICAL PRECAST MAINTENANCE HOLE
WITH MONOLITHIC BASE AND TAPERED TOP

NOTE

1. REFER TO STANDARD DRAWING 2-5-1 FOR GENERAL NOTES PERTAINING TO PRECAST MAINTENANCE HOLES.

Region of Peel
Working for you

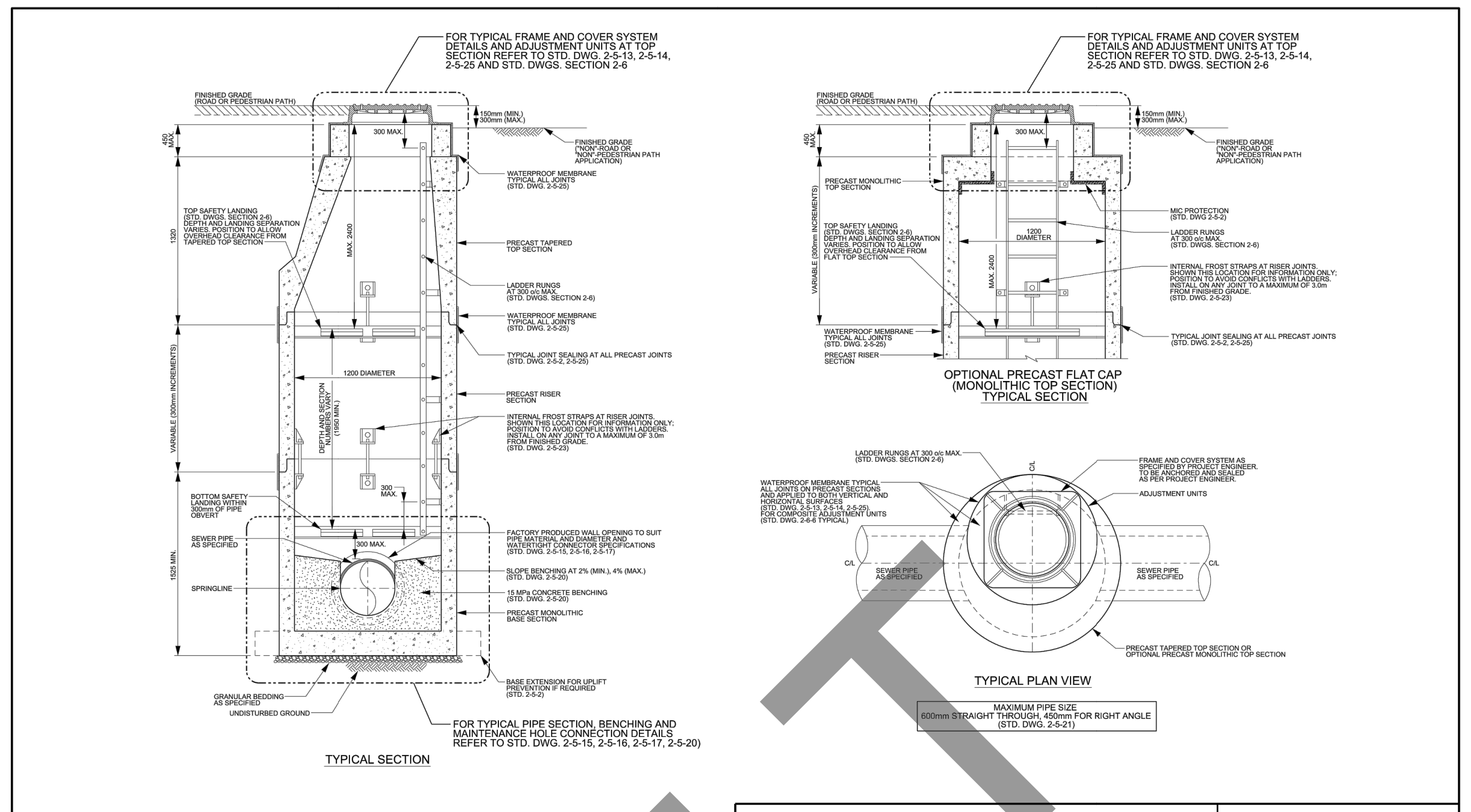
PUBLIC WORKS
STANDARD DRAWING

REV. DATE: MARCH 2017

APPROVED BY: A.P.
DRAWN BY: AINLEY GROUP

NEW SANITARY SEWER CONSTRUCTION
TYPICAL PRECAST CIRCULAR MAINTENANCE HOLE DETAILS (1200mm - 3000mm)

STD. DWG. NUMBER: 2-5-2
SCALE: N.T.S.



TYPICAL SECTION

OPTIONAL PRECAST FLAT CAP (MONOLITHIC TOP SECTION) TYPICAL SECTION

TYPICAL PLAN VIEW

MAXIMUM PIPE SIZE
600mm STRAIGHT THROUGH, 450mm FOR RIGHT ANGLE
(STD. DWG. 2-5-21)

FOR TYPICAL PIPE SECTION, BENCHING AND MAINTENANCE HOLE CONNECTION DETAILS REFER TO STD. DWG. 2-5-15, 2-5-16, 2-5-17, 2-5-20)

NOTE

1. REFER TO STANDARD DRAWING 2-5-1 FOR GENERAL NOTES PERTAINING TO PRECAST MAINTENANCE HOLES.
2. REFER TO STANDARD DRAWING 2-5-2 FOR TYPICAL INSTALLATION OPTIONS AND REQUIREMENTS.

Region of Peel
Working for you

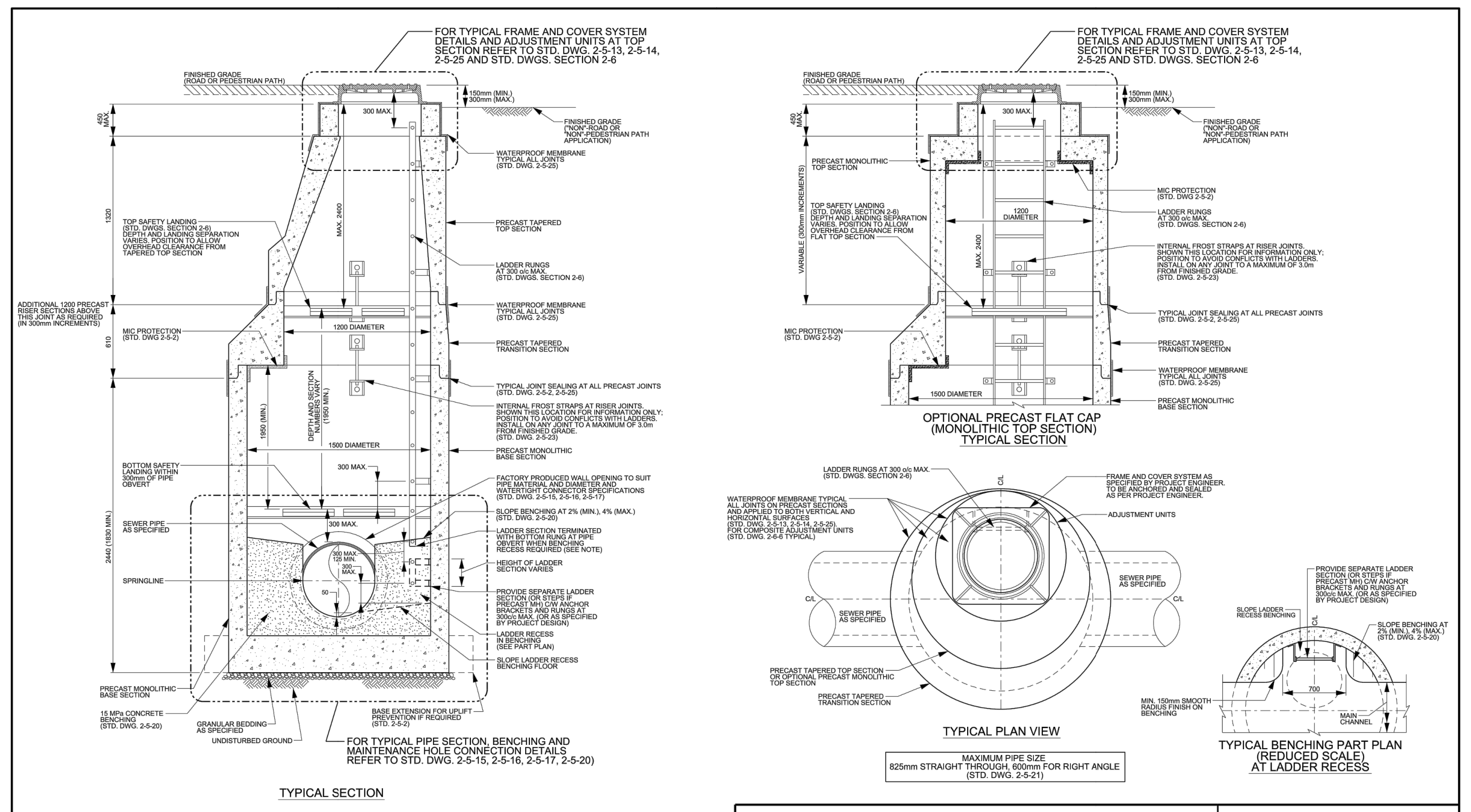
PUBLIC WORKS
STANDARD DRAWING

REV. DATE: MARCH 2017

APPROVED BY: A.P.
DRAWN BY: AINLEY GROUP

NEW SANITARY SEWER CONSTRUCTION
TYPICAL 1200mm DIAMETER PRECAST CIRCULAR MAINTENANCE HOLE DETAILS

STD. DWG. NUMBER: 2-5-3
SCALE: N.T.S.



TYPICAL SECTION

OPTIONAL PRECAST FLAT CAP (MONOLITHIC TOP SECTION) TYPICAL SECTION

TYPICAL PLAN VIEW

TYPICAL BENCHING PART PLAN (REDUCED SCALE) AT LADDER RECESS

MAXIMUM PIPE SIZE
825mm STRAIGHT THROUGH, 600mm FOR RIGHT ANGLE
(STD. DWG. 2-5-21)

FOR TYPICAL PIPE SECTION, BENCHING AND MAINTENANCE HOLE CONNECTION DETAILS REFER TO STD. DWG. 2-5-15, 2-5-16, 2-5-17, 2-5-20)

PROVIDE LADDER RECESS IN BENCHING FOR MAINTENANCE HOLES WITH PIPE GREATER THAN 600mm DIAMETER

NOTE

1. REFER TO STANDARD DRAWING 2-5-1 FOR GENERAL NOTES PERTAINING TO PRECAST MAINTENANCE HOLES.
2. REFER TO STANDARD DRAWING 2-5-2 FOR TYPICAL INSTALLATION OPTIONS AND REQUIREMENTS.
3. FOR PIPES GREATER THAN 600mm DIAMETER LADDER RECESS SHALL BE PROVIDED (STD. DWG. 2-5-10, 2-5-11)

Region of Peel
Working for you

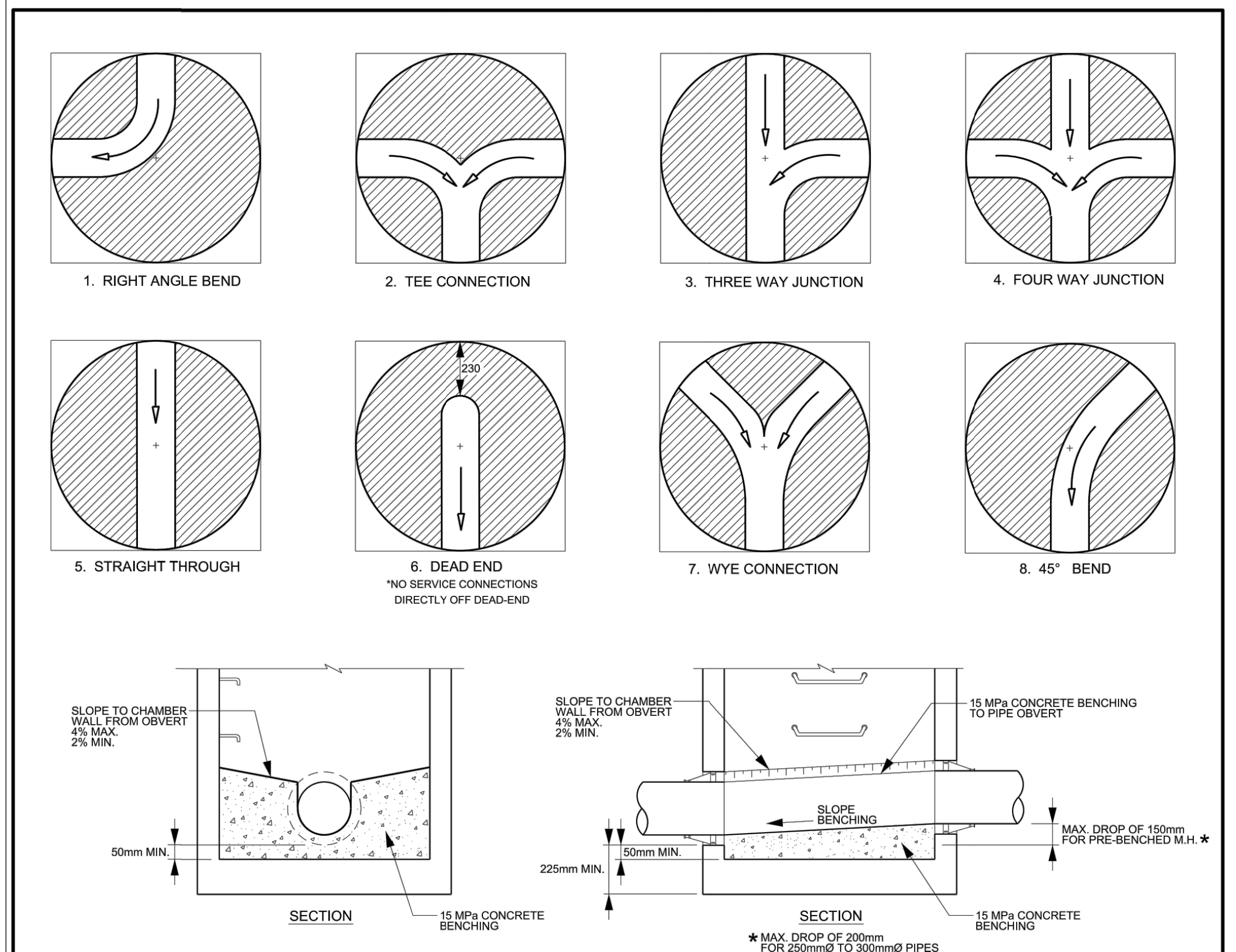
PUBLIC WORKS
STANDARD DRAWING

REV. DATE: MARCH 2017

APPROVED BY: A.P.
DRAWN BY: AINLEY GROUP

NEW SANITARY SEWER CONSTRUCTION
TYPICAL 1500mm DIAMETER PRECAST CIRCULAR MAINTENANCE HOLE DETAILS

STD. DWG. NUMBER: 2-5-4
SCALE: N.T.S.



SECTION

SECTION

* MAX. DROP OF 200mm FOR 250mmØ TO 300mmØ PIPES (REFER TO REGION DESIGN CRITERIA)

REFER TO STANDARD DRAWING 2-5-21 FOR MAXIMUM PIPE SIZES FOR MAINTENANCE HOLES

NOTE

1. CONCRETE TO BE 15 MPa COMPRESSIVE STRENGTH.
2. BENCHING TO BE GIVEN WOOD FLOAT FINISH, CHANNEL TO BE GIVEN STEEL TROWEL FINISH.
3. ALL CHANNELS MUST EXTEND 300 mm STRAIGHT OUT FROM MAINTENANCE HOLE WALL BEFORE CURVATURE BEGINS.
4. BENCHING TO BE CONSTRUCTED TO THE OBVERT OF THE PIPE.
5. FACTORY CAST PRE-BENCHING MAY BE USED WITHIN MONOLITHIC BASE SECTIONS.
6. REFER TO STANDARD DRAWING 2-5-1 FOR GENERAL NOTES PERTAINING TO PRECAST MAINTENANCE HOLES.
7. REFER TO STANDARD DRAWING 2-5-2 FOR TYPICAL INSTALLATION OPTIONS AND REQUIREMENTS.

Region of Peel
Working for you

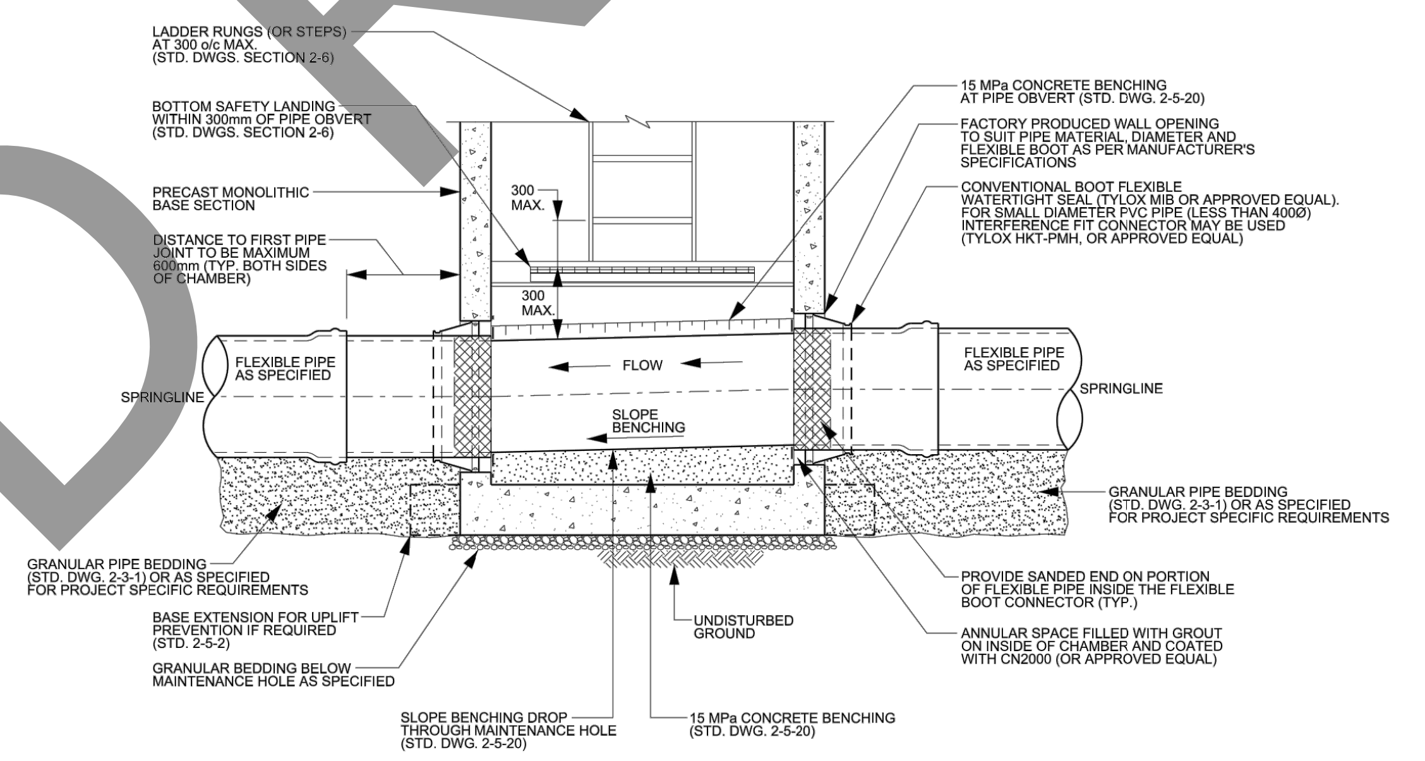
PUBLIC WORKS
STANDARD DRAWING

REV. DATE: MARCH 2017

APPROVED BY: A.P.
DRAWN BY: AINLEY GROUP

NEW SANITARY SEWER CONSTRUCTION
MAINTENANCE HOLE BENCHING DETAILS

STD. DWG. NUMBER: 2-5-20
SCALE: N.T.S.



TYPICAL SMALL DIAMETER FLEXIBLE
SEWER PIPE CONNECTION

NOTE

1. REFER TO STANDARD DRAWING 2-3-1 FOR BEDDING AND BACKFILL DETAILS.
2. REFER TO STANDARD DRAWING 2-5-1 FOR GENERAL NOTES PERTAINING TO PRECAST MAINTENANCE HOLES.
3. REFER TO STANDARD DRAWING 2-5-2, 2-5-9 FOR TYPICAL INSTALLATION OPTIONS AND REQUIREMENTS.

Region of Peel
Working for you

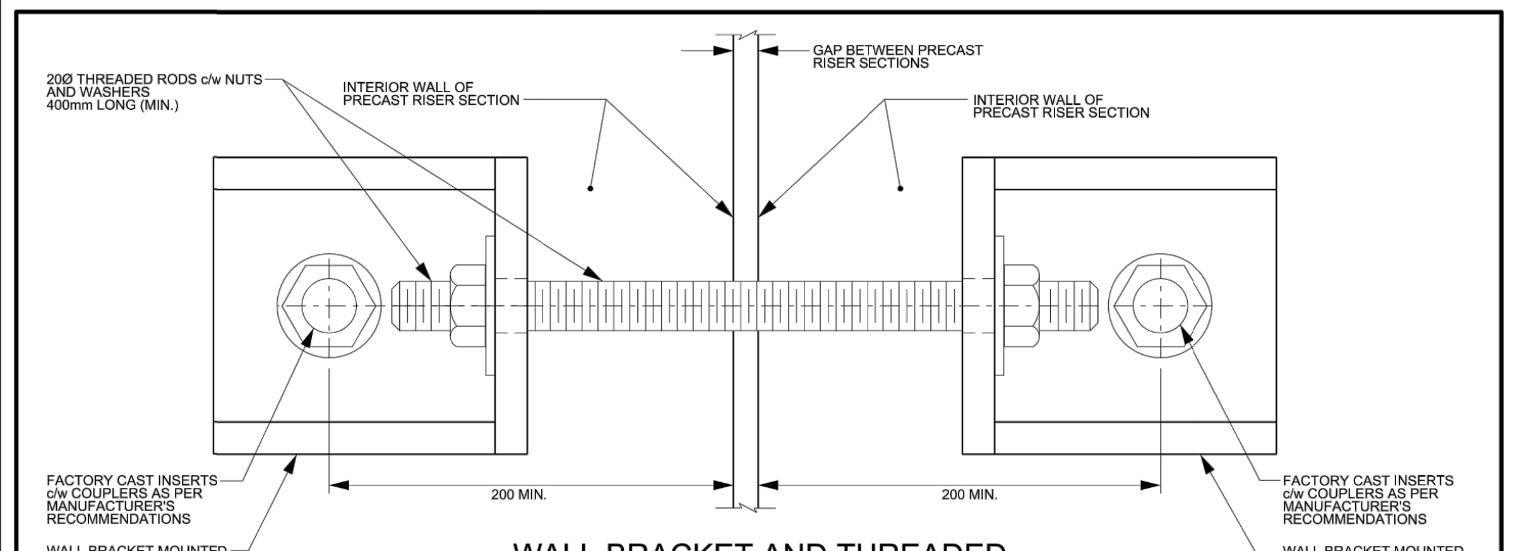
PUBLIC WORKS
STANDARD DRAWING

REV. DATE: MARCH 2017

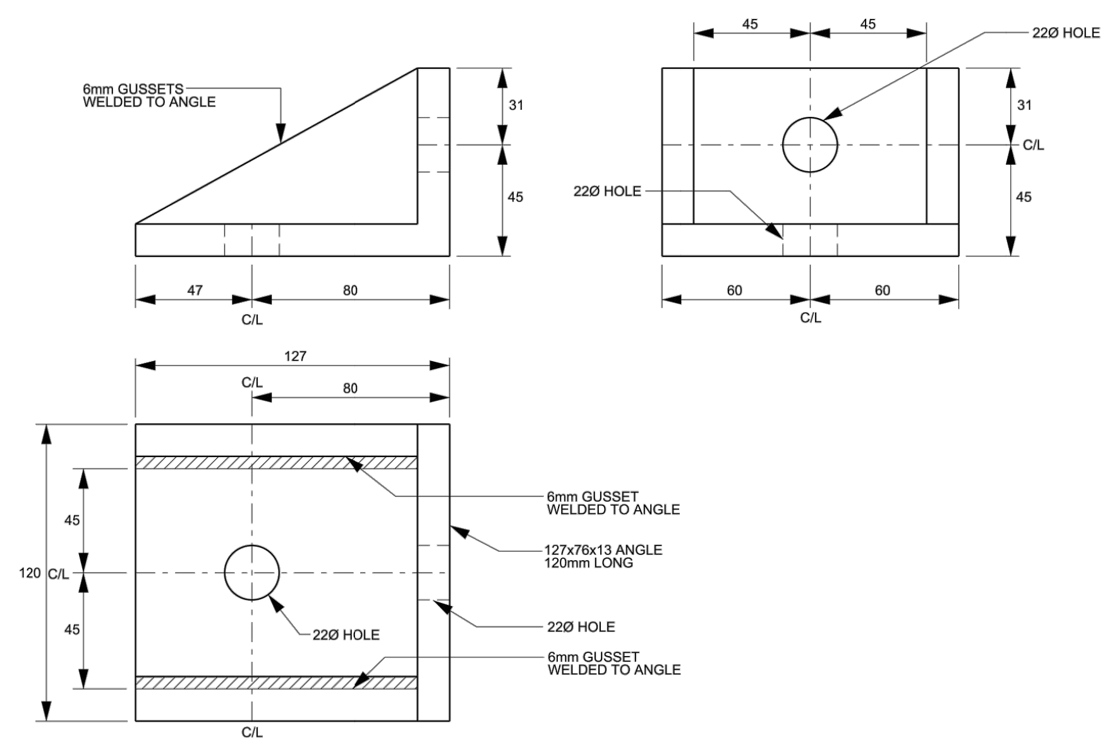
APPROVED BY: A.P.
DRAWN BY: AINLEY GROUP

NEW SANITARY SEWER CONSTRUCTION
TYPICAL FLEXIBLE PIPE
WALL CONNECTION DETAILS

STD. DWG. NUMBER: 2-5-15
SCALE: N.T.S.



WALL BRACKET AND THREADED
ROD FROST STRAP DETAIL



WALL BRACKET ANGLE DETAILS

NOTE

1. ALL MATERIALS TO BE 304 STAINLESS STEEL.
2. CONTINUOUS WELDS AT ALL INTERSECTING JOINTS TO BE 6mm.
3. REFER TO STANDARD DRAWING 2-5-1 FOR GENERAL NOTES PERTAINING TO PRECAST MAINTENANCE HOLES.
4. REFER TO STANDARD DRAWING 2-5-2 FOR TYPICAL INSTALLATION OPTIONS AND REQUIREMENTS.
5. FOR REHABILITATION APPLICATION ONLY, INSERTS CAN BE FIELD INSTALLED AS PER MANUFACTURER'S SPECIFICATIONS.

NEW CONSTRUCTION		REHABILITATION
FULL EXCAVATION	PARTIAL EXCAVATION	NO EXCAVATION
INTERNAL		EXTERNAL
ROW	FLOOD PLAIN	EASEMENT
I/I	H2S	SECURITY

Region of Peel
Working for you

PUBLIC WORKS
STANDARD DRAWING

REV. DATE: MARCH 2017

APPROVED BY: A.P.
DRAWN BY: AINLEY GROUP

NEW SANITARY SEWER CONSTRUCTION
TYPICAL FROST STRAP DETAILS

STD. DWG. NUMBER: 2-5-23
SCALE: N.T.S.

BENCHMARK NOTE

ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE DERIVED FROM THE CITY OF MISSISSAUGA BENCHMARK NO. 731
ELEVATION = 81.58m

No.	REVISION	DATE	
2	SECOND SUBMISSION TO REGION OF PEEL	AUGUST 17, 2018	R.M.
1	FIRST SUBMISSION TO REGION OF PEEL	MAY 8, 2018	R.M.

SUBMISSIONS:
FIRST: ______
SECOND: ______
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PRE–SERVICING: ______
FINAL: ______

PORT CREDIT WEST VILLAGE PARTNERS INC.
141 LAKESHORE ROAD EAST, MISSISSAUGA, ON L5G 1E8

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CITY FILE No. TBD
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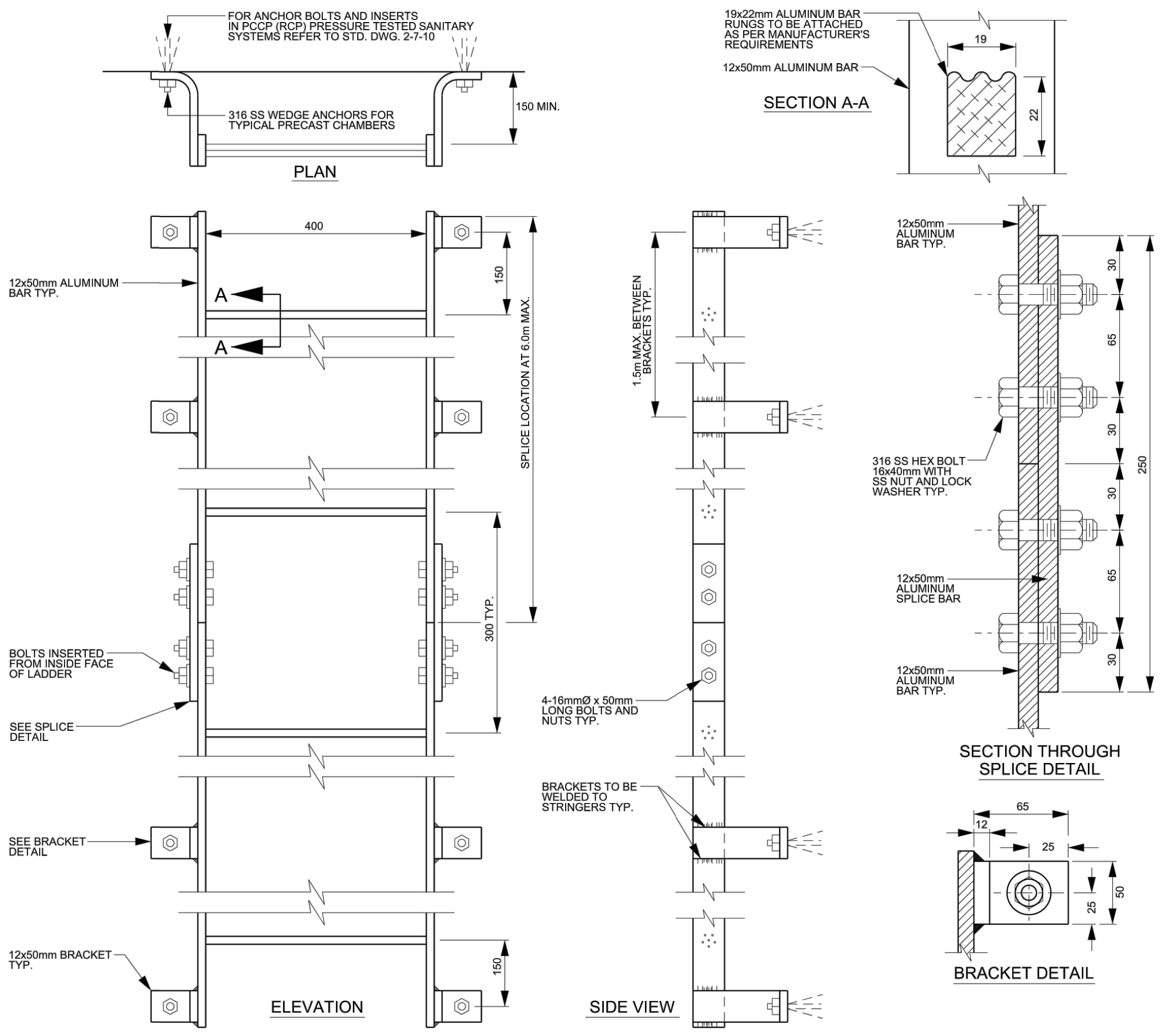
STANDARD DETAILS - 1

DESIGNED: R.M.
CHECKED: R.M.
PROJECT No.: 16-489W
DRAWN: R.N.
DATE: APRIL 2018
SHEET No.:
SCALE: N/A
DRAWING No.: EXT-701

SECOND ENGINEERING SUBMISSION, NOVEMBER 15, 2018

PLOT DATE:Wednesday, November 14, 2018 4:08:34 PM

File: \\URBANWEST-NAS\ALSAL DATA\PROJECTS\16-489W (WEST VILLAGE PARTNERS - PORT CREDIT)\DRAWINGS\02_OFF-SITE WORKS (SAN EXTENSION)\02_DD_PRODUCTION DWGS\16-489W - EXT WORKS - DET1 - STANDARD DETAILS.DWG



NOTE

1. REFER TO STANDARD DRAWING 2-5-1, 2-7-1 AND 2-8-1 FOR GENERAL NOTES PERTAINING TO PRECAST MAINTENANCE HOLES.
2. ALL BOLTS, NUTS AND WASHERS SHALL BE 316 STAINLESS STEEL UNLESS OTHERWISE NOTED IN PROJECT DESIGN.
3. ALL BRACKETS, BARS, RUNGS AND STRINGERS SHALL BE FABRICATED FROM 6000 SERIES STRUCTURAL ALUMINUM.
4. ALL WELDING SHALL BE ACCORDING TO CSA W47.2 AND W59.2.
5. ALL ALUMINUM IN CONTACT WITH CONCRETE SHALL RECEIVE TWO COATS OF BITUMINOUS PAINT.
6. SUBMIT SHOP DRAWINGS TO THE CONTRACT ADMINISTRATOR FOR INFORMATION. ALL DRAWINGS SHALL BEAR THE SIGNATURE AND SEAL OF A PROFESSIONAL ENGINEER LICENSED TO PRACTISE IN ONTARIO.
7. ALL LADDER RUNGS TO BE PROVIDED WITH NON-SLIP FINISH.
8. LADDERS TO BE USED IN NEW CONSTRUCTION. FOR REHABILITATION, IF 25% OF EXISTING STEPS NEED TO BE REPLACED, THEN REMAINING STEPS SHALL BE PROPERLY REMOVED AND REPLACED WITH LADDER.

NOTE: THIS DRAWING IS BASED ON OPSD 406.010 AND SHOULD BE READ IN CONJUNCTION WITH ALL APPLICABLE ASSOCIATED OPSD DRAWINGS AND REVISIONS.

NEW CONSTRUCTION		REHABILITATION
FULL EXCAVATION	PARTIAL EXCAVATION	NO EXCAVATION
INTERNAL		EXTERNAL
ROW	FLOOD PLAIN	EASEMENT
I/I	H2S	SECURITY

Region of Peel
Working for you

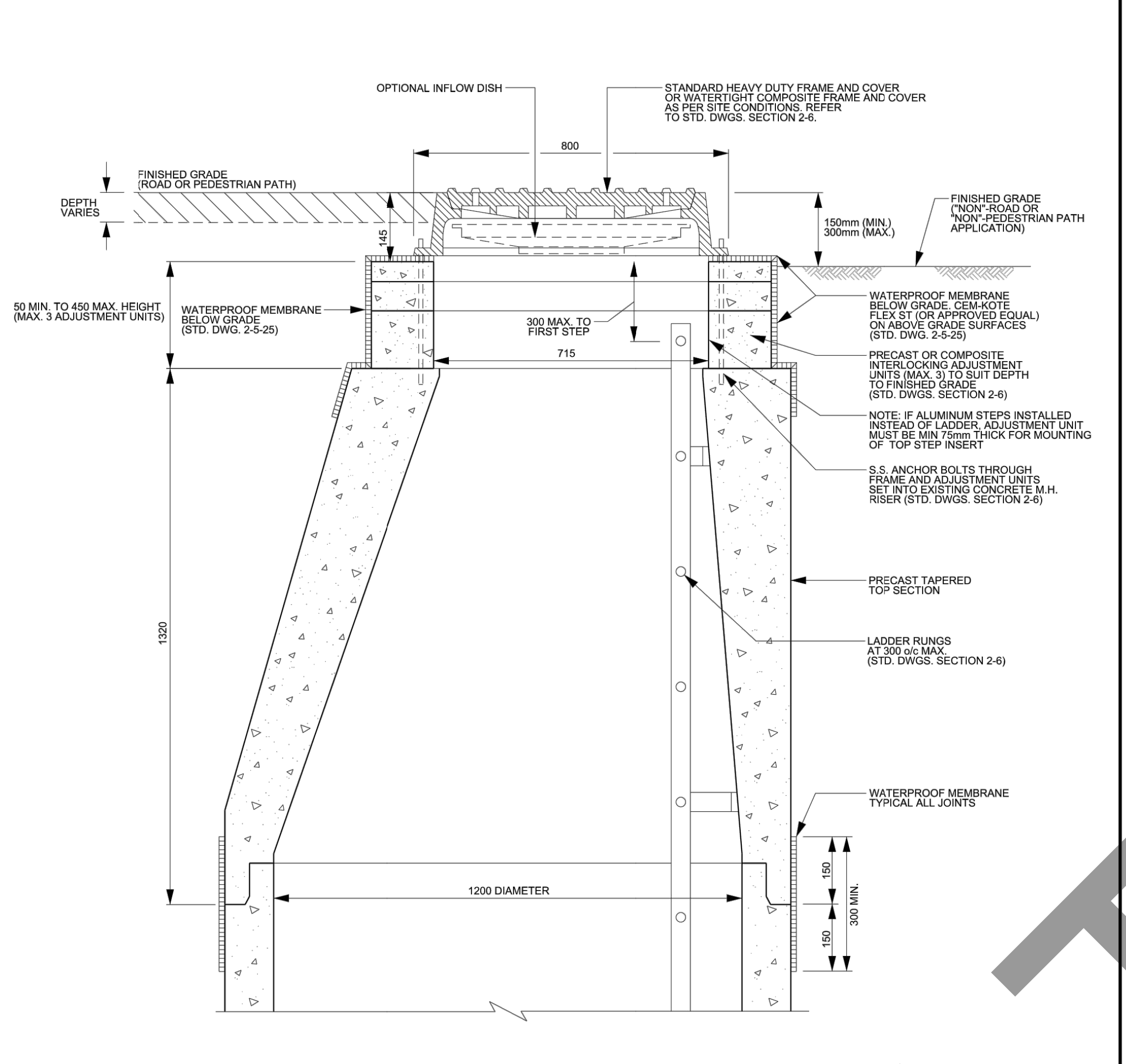
PUBLIC WORKS
STANDARD DRAWING

REV. DATE: MARCH 2017

APPROVED BY: A.P.
DRAWN BY: AINLEY GROUP

MAINTENANCE HOLE APPURTENANCES
TYPICAL ALUMINUM LADDER DETAILS

STD. DWG. NUMBER: **2-6-10**
SCALE: N.T.S.



NOTE

1. REFER TO STANDARD DRAWING 2-5-1 FOR GENERAL NOTES PERTAINING TO PRECAST MAINTENANCE HOLES.
2. REFER TO STANDARD DRAWING 2-5-2, 2-5-9 FOR TYPICAL INSTALLATION OPTIONS AND REQUIREMENTS.

NEW CONSTRUCTION		REHABILITATION
FULL EXCAVATION	PARTIAL EXCAVATION	NO EXCAVATION
INTERNAL		EXTERNAL
ROW	FLOOD PLAIN	EASEMENT
I/I	H2S	SECURITY

Region of Peel
Working for you

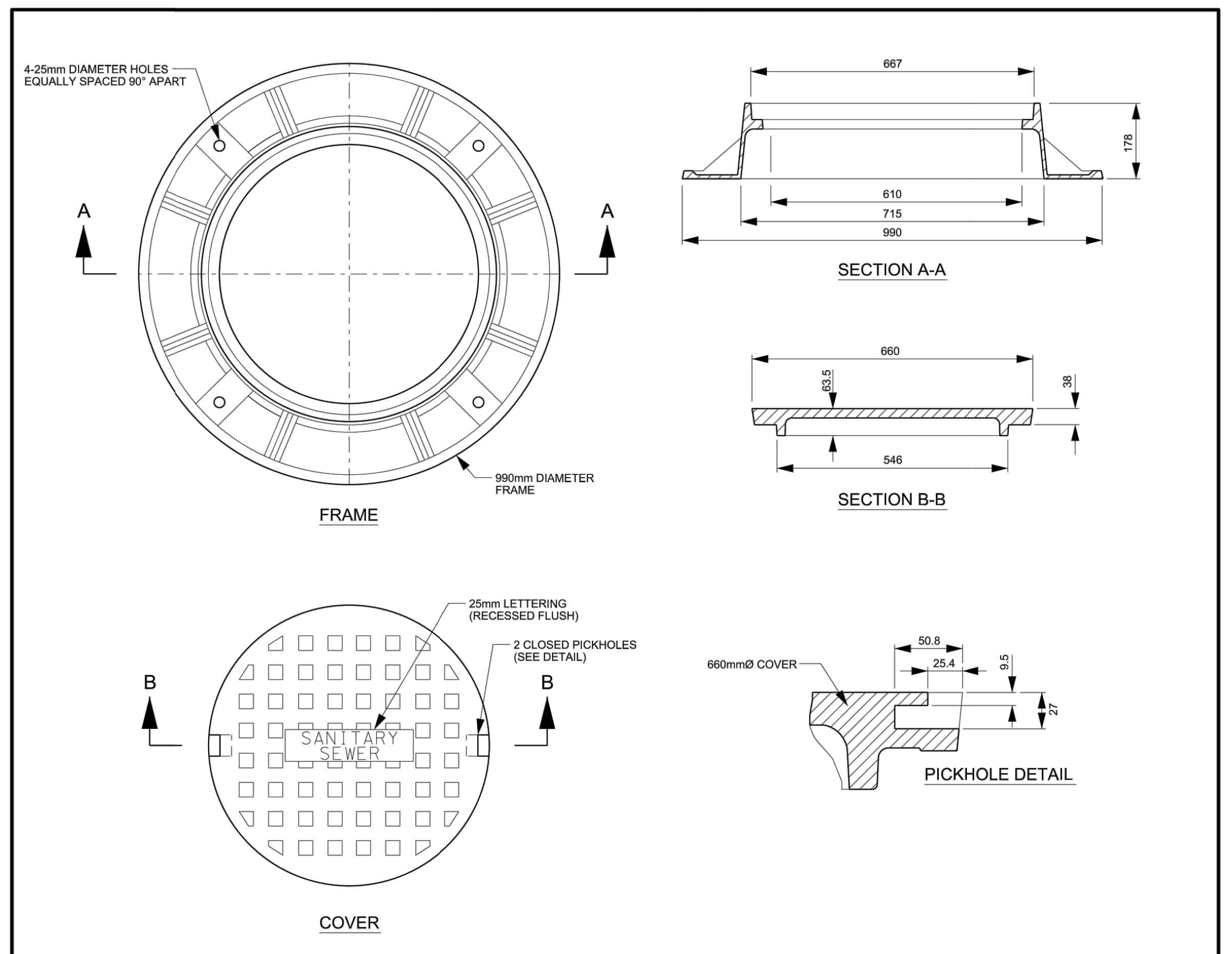
PUBLIC WORKS
STANDARD DRAWING

REV. DATE: MARCH 2017

APPROVED BY: A.P.
DRAWN BY: AINLEY GROUP

NEW SANITARY SEWER CONSTRUCTION
STANDARD FRAME AND COVER SYSTEM DETAILS

STD. DWG. NUMBER: **2-5-13**
SCALE: N.T.S.



FRAME AND COVER IS BASED ON EJ CASTING MODEL 1040 FRAME AND MODEL 1040A COVER. ALTERNATE CIRCULAR FRAME AND COVER PRODUCT MAY BE PROVIDED WITH ENGINEER APPROVED EQUAL. REFER TO OPSD 401.020 OR STANDARD DRAWING 2-6-2.

NOTE:
ALL SANITARY MAINTENANCE HOLE FRAME AND COVERS WITH NON-PENETRATING LIFT HOLES MUST HAVE COVER GASKETS. NO INFLOW REDUCTION DISHES ARE REQUIRED.

NOTE

1. REFER TO STANDARD DRAWING 2-5-1, 2-7-1 AND 2-8-1 FOR GENERAL NOTES PERTAINING TO PRECAST MAINTENANCE HOLES.
2. FRAME TO BE ATTACHED DIRECTLY TO PRECAST MAINTENANCE HOLE TOP. REFER TO STANDARD DRAWINGS 2-6-7 AND 2-6-8.

NEW CONSTRUCTION		REHABILITATION
FULL EXCAVATION	PARTIAL EXCAVATION	NO EXCAVATION
INTERNAL		EXTERNAL
ROW	FLOOD PLAIN	EASEMENT
I/I	H2S	SECURITY

Region of Peel
Working for you

PUBLIC WORKS
STANDARD DRAWING

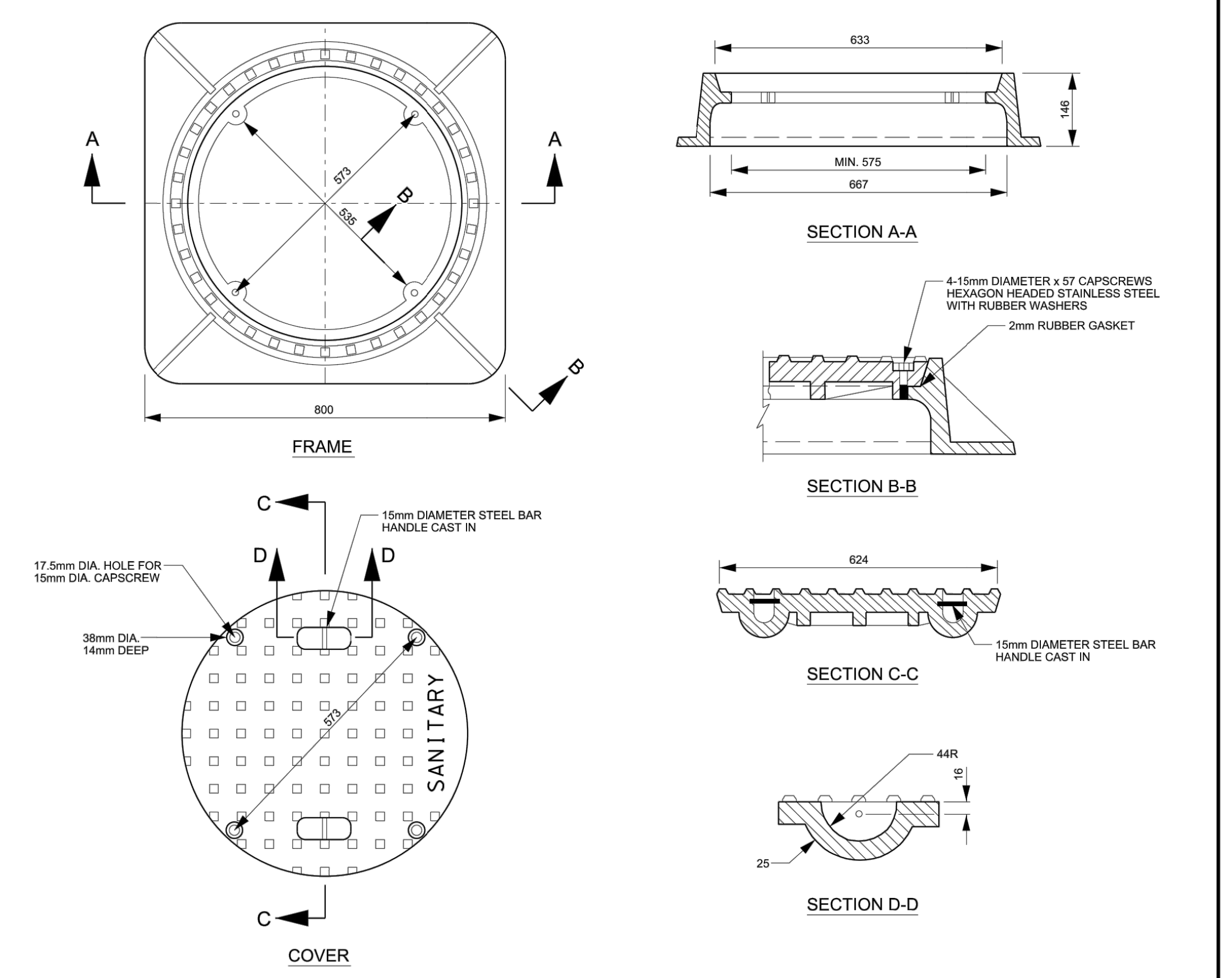
REV. DATE: MARCH 2017

APPROVED BY: A.P.
DRAWN BY: AINLEY GROUP

MAINTENANCE HOLE APPURTENANCES
HEAVY DUTY 660mm CIRCULAR
FRAME AND COVER

STD. DWG. NUMBER: **2-6-1**
SCALE: N.T.S.

THIS FRAME AND COVER SYSTEM IS NOT FOR INSTALLATION WITHIN FLOODPLAIN UNLESS SPECIFIED BY PROJECT ENGINEER



NOTE

1. REFER TO STANDARD DRAWING 2-5-1, 2-7-1 AND 2-8-1 FOR GENERAL NOTES PERTAINING TO PRECAST MAINTENANCE HOLES.
2. FRAME TO BE ATTACHED DIRECTLY TO PRECAST MAINTENANCE HOLE TOP. REFER TO STANDARD DRAWINGS 2-6-7 AND 2-6-8.
3. THE WORD "SANITARY" TO BE CAST INTO COVER WITH 50mm LETTERS.
4. FOR USE IN EASEMENT WHERE UNAUTHORIZED ACCESS NEEDS TO BE LIMITED.
5. NOT FOR USE IN AREAS WHERE SURFACE WATER OR FLOODING COULD CAUSE INFILTRATION OR INFLOW. USE FRAME AND COVER AS PER STANDARD DRAWING 2-6-6.
6. NOT FOR USE IN PAVED PORTION OF ROW.
7. IF COVER IS PRESENT ON AN EXISTING ASSET, REPLACE GASKET AND MISSING BOLTS, UNLESS SUBJECT TO NOTE 5. REPLACE FRAME AND COVER AS PER STANDARD DRAWING 2-6-6.

NEW CONSTRUCTION		REHABILITATION
FULL EXCAVATION	PARTIAL EXCAVATION	NO EXCAVATION
INTERNAL		EXTERNAL
ROW	FLOOD PLAIN	EASEMENT
I/I	H2S	SECURITY

Region of Peel
Working for you

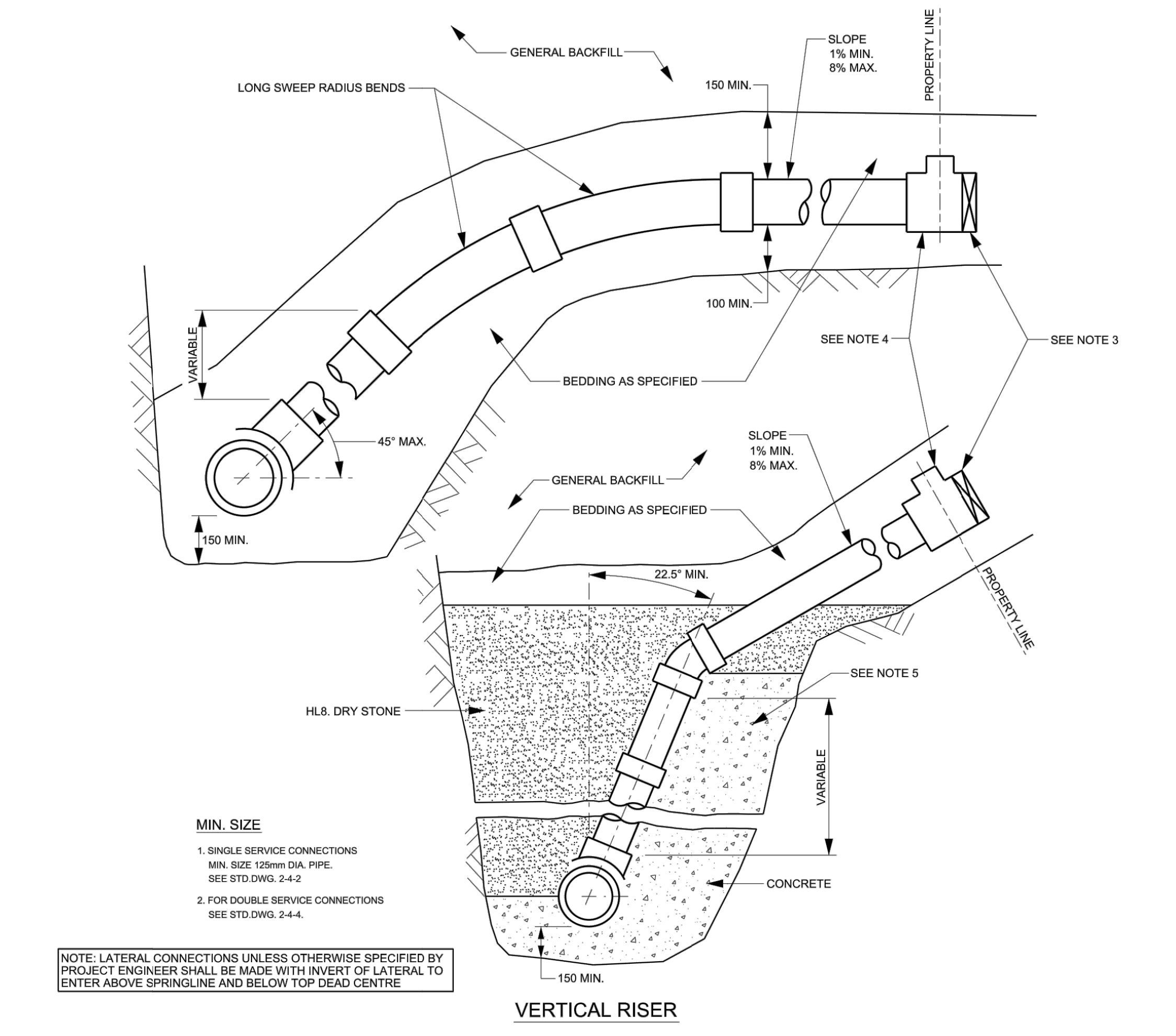
PUBLIC WORKS
STANDARD DRAWING

REV. DATE: MARCH 2017

APPROVED BY: A.P.
DRAWN BY: AINLEY GROUP

MAINTENANCE HOLE APPURTENANCES
HEAVY DUTY WATER TIGHT
FRAME AND COVER

STD. DWG. NUMBER: **2-6-4**
SCALE: N.T.S.



MIN. SIZE

1. SINGLE SERVICE CONNECTIONS MIN. SIZE 125mm DIA. PIPE. SEE STD.DWG. 2-4-2
2. FOR DOUBLE SERVICE CONNECTIONS SEE STD.DWG. 2-4-4.

NOTE: LATERAL CONNECTIONS UNLESS OTHERWISE SPECIFIED BY PROJECT ENGINEER SHALL BE MADE WITH INVERT OF LATERAL TO ENTER ABOVE SPRINGLINE AND BELOW TOP DEAD CENTRE

NOTE

1. FOR SEWERS 375mm AND SMALLER, SERVICE LATERAL CONNECTIONS MUST BE MADE USING FACTORY MADE TEES AT MAIN; FOR ALL OTHER SIZES, EITHER FACTORY MADE TEES OR APPROVED STRAP-ON SADDLE MAY BE USED.
2. STRAP-ON SADDLES MUST BE INSTALLED ON THE MAIN PIPE BEFORE THAT PIPE IS LAID.
3. SERVICE CONNECTION MUST BE SECURELY PLUGGED AT PROPERTY LINE WITH A WATERTIGHT, FACTORY MANUFACTURED PLUG/CAP THAT WAS DESIGNED FOR USE ON SPECIFIED LATERAL MATERIAL AND DIAMETER.
4. AN APPROVED TEST FITTING TO BE INSTALLED AT PROPERTY LINE TO BE EQUIPPED WITH WATERTIGHT RUBBER GASKETS AT ALL CONNECTION AND INSPECTION POINTS.
5. FOR RISER DETAIL, CONCRETE BEDDING TO HAVE A MINIMUM WIDTH OF 600mm.
6. ALTERNATE TO VERTICAL RISER SHOWN, IS ON STD. 2-4-2.
7. SANITARY LATERALS TO BE PROPERLY ABANDONED AT THE MAIN WITH WATERTIGHT SEAL.

Region of Peel
Working for you

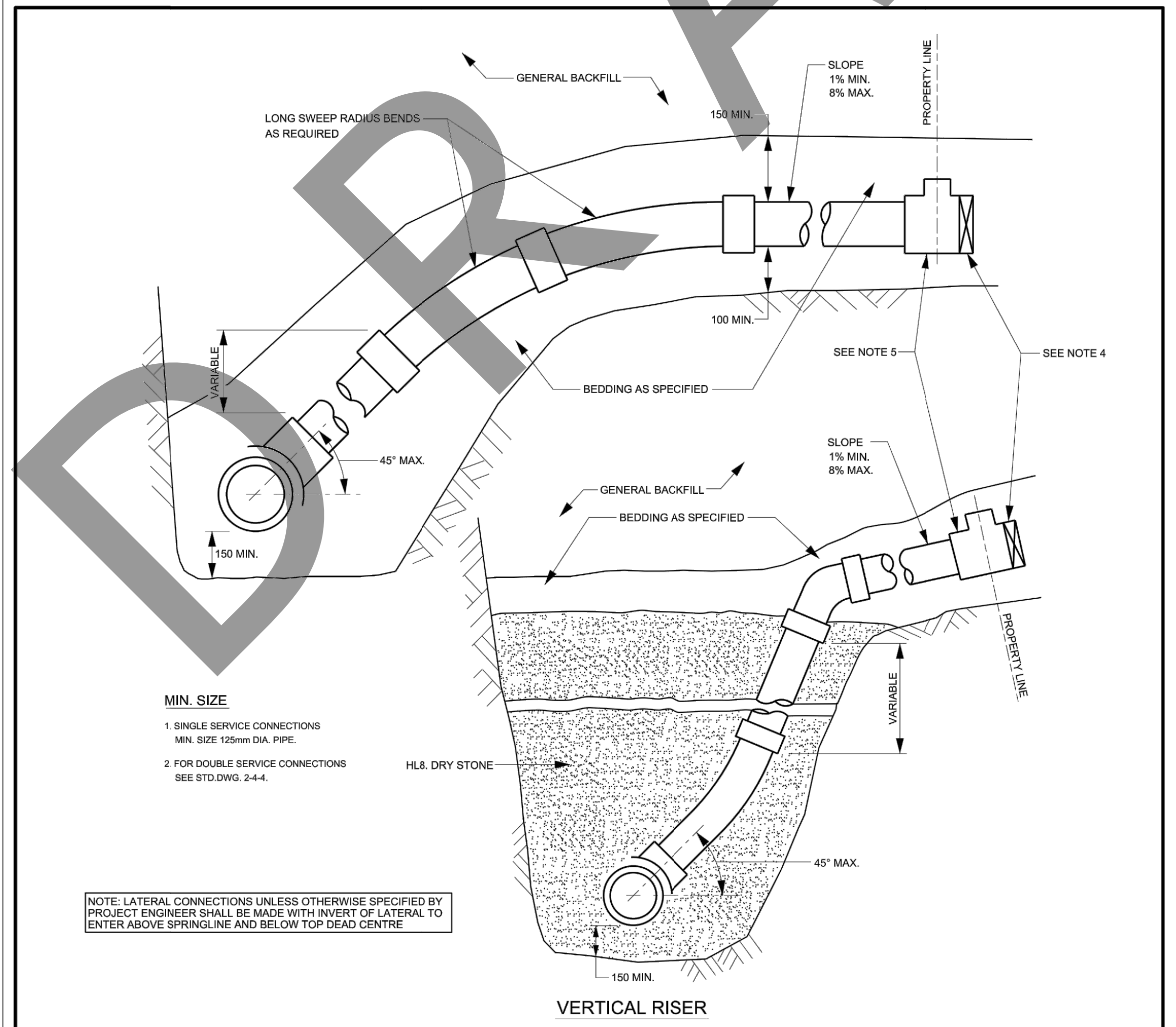
PUBLIC WORKS
STANDARD DRAWING

REV. DATE: MARCH 2017

APPROVED BY: D.L.
DRAWN BY: I.F.

SERVICE CONNECTIONS FOR RIGID PIPE
RESIDENTIAL LOW TO MEDIUM DENSITY

STD. DWG. NUMBER: **2-4-1**
SCALE: N.T.S.



MIN. SIZE

1. SINGLE SERVICE CONNECTIONS MIN. SIZE 125mm DIA. PIPE.
2. FOR DOUBLE SERVICE CONNECTIONS SEE STD.DWG. 2-4-4.

NOTE: LATERAL CONNECTIONS UNLESS OTHERWISE SPECIFIED BY PROJECT ENGINEER SHALL BE MADE WITH INVERT OF LATERAL TO ENTER ABOVE SPRINGLINE AND BELOW TOP DEAD CENTRE

NOTE

1. FOR SEWERS 375mm AND SMALLER, SERVICE LATERAL CONNECTIONS MUST BE MADE USING FACTORY MADE TEES AT MAIN; FOR ALL OTHER SIZES, EITHER FACTORY MADE TEES OR APPROVED STRAP-ON SADDLE MAY BE USED.
2. STRAP-ON SADDLES MUST BE INSTALLED ON THE MAIN PIPE BEFORE THAT PIPE IS LAID.
3. APPROVED CUT-IN TOOL MUST BE USED FOR THE FIELD MADE TEES.
4. SERVICE CONNECTION MUST BE SECURELY PLUGGED AT PROPERTY LINE WITH A WATERTIGHT, FACTORY MANUFACTURED PLUG/CAP THAT WAS DESIGNED FOR USE ON SPECIFIED LATERAL MATERIAL AND DIAMETER.
5. AN APPROVED TEST FITTING TO BE INSTALLED AT PROPERTY LINE TO BE EQUIPPED WITH WATERTIGHT RUBBER GASKETS AT ALL CONNECTION AND INSPECTION POINTS.
6. ALTERNATE TO VERTICAL RISER SHOWN, IS ON STD. 2-4-1.
7. SANITARY LATERALS TO BE PROPERLY ABANDONED AT THE MAIN WITH WATERTIGHT SEAL.

Region of Peel
Working for you

PUBLIC WORKS
STANDARD DRAWING

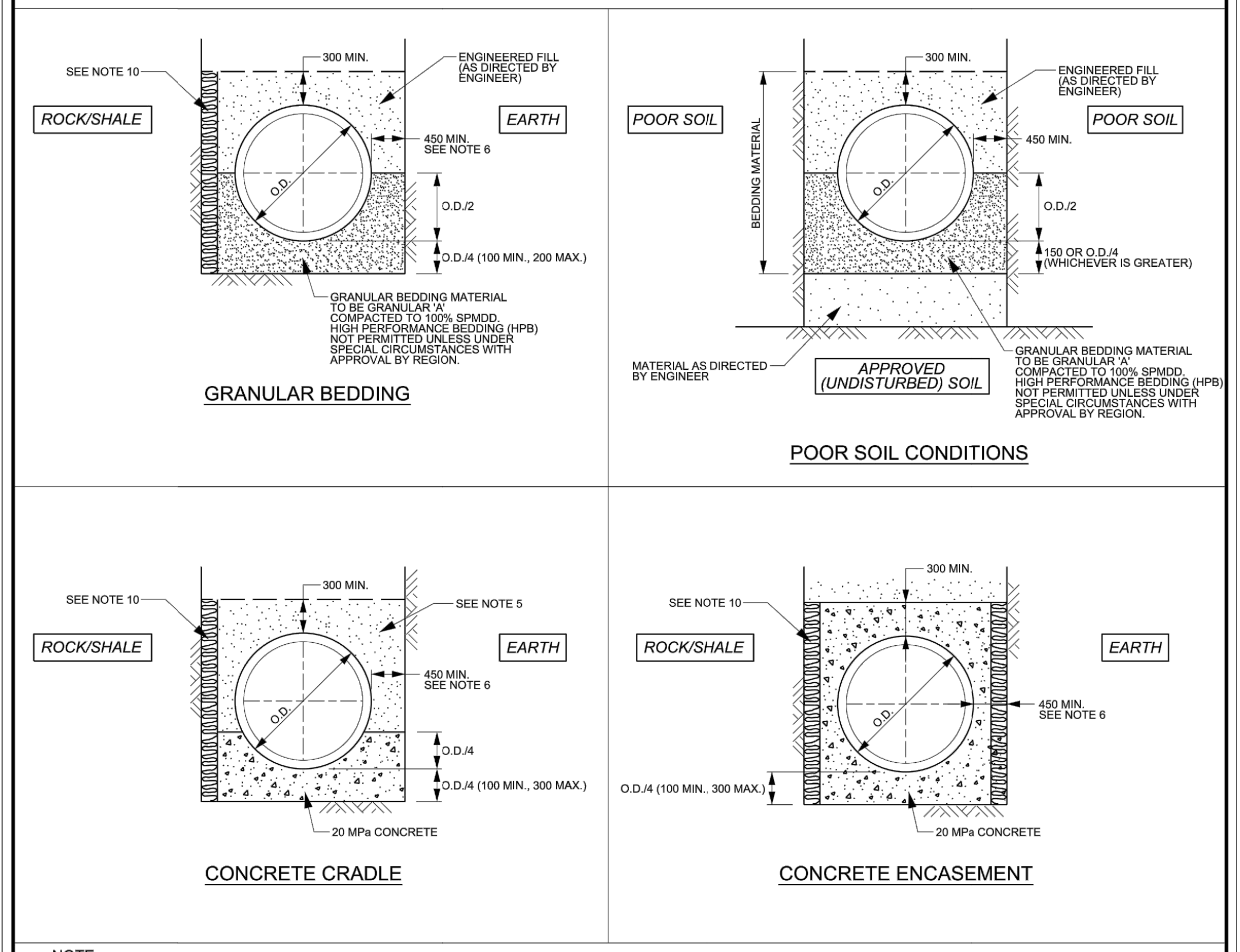
REV. DATE: MARCH 2017

APPROVED BY: D.L.
DRAWN BY: I.F.

SERVICE CONNECTIONS FOR FLEXIBLE PIPE
RESIDENTIAL LOW TO MEDIUM DENSITY

STD. DWG. NUMBER: **2-4-2**
SCALE: N.T.S.

BEDDING DETAILS ARE INTENDED FOR GENERAL INFORMATION. REFER TO CONTRACT SPECIFICATIONS AND GEOTECHNICAL REPORT FOR PROJECT SPECIFIC REQUIREMENTS.



NOTE

1. MATERIAL TO BE PLACED IN TRENCH IN 150mm LAYERS AND COMPACTED TO 100% STANDARD PROCTOR MAXIMUM DRY DENSITY (SPMDD).
2. IN CASE OF OVER-EXCAVATION TRENCH TO BE FILLED TO BOTTOM OF PIPE WITH APPROVED MATERIALS IN 150mm LAYERS AND COMPACTED TO 100% STANDARD PROCTOR DENSITY.
3. IN POOR SOILS PIPE FOUNDATION TO BE PROVIDED AS PER DESIGN. ADDITIONAL BEDDING MODIFICATIONS MAY BE REQUIRED AS PER DESIGN.
4. BACKFILL ABOVE BEDDING AS REQUIRED PER DESIGN. NATIVE BACKFILL NOT PERMITTED UNDER PAVED PORTIONS.
5. COVER MATERIAL, NO STONES GREATER THAN 25mm WILL BE PERMITTED.
6. MIN. TRENCH WIDTH TO BE O.D. PLUS 450mm, MAX. TRENCH WIDTH TO BE O.D. PLUS 750mm, UNLESS PROJECT SPECIFIC BEDDING STATES OTHERWISE.
7. APPROVED SOIL AS PER GEOTECHNICAL REPORT RECOMMENDATIONS.
8. THE CONSULTANT SHALL RECOMMEND THE APPROPRIATE BEDDING REQUIREMENTS BASED ON THE FINDINGS OF THE GEOTECHNICAL INVESTIGATION AND PROVIDE A CROSS-SECTION ILLUSTRATION ON THE FIRST PLAN & PROFILE DRAWING OR GENERAL DETAIL PAGE.
9. IN ROCK EXCAVATION, A MINIMUM OF 150mm GRANULAR MATERIAL BEDDING IS REQUIRED UNDERNEATH THE PIPE (FOR PVC), AND UP TO SPRING LINE FOR CONCRETE PIPE.
10. IN ROCK OR SHALE TRENCH CONDITIONS, INSTALL 100mm THICK POLYETHYLENE FOAM FOR ALL CONCRETE ENCASED SEWER INSTALLATIONS. REFER TO PROJECT SPECIFIC REQUIREMENTS. POLYETHYLENE FOAM TO BE EITHER DOW ETHAFOAMT 400 OR NORDIC VOID 400 OR APPROVED EQUAL.

Region of Peel
Working for you

PUBLIC WORKS
STANDARD DRAWING

REV. DATE: MARCH 2017

APPROVED BY: A.P.
DRAWN BY: AINLEY GROUP

BEDDING DETAILS FOR SEWERS

STD. DWG. NUMBER: **2-3-1**
SCALE: N.T.S.

BENCHMARK NOTE

ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE DERIVED FROM THE CITY OF MISSISSAUGA BENCHMARK NO. 731
ELEVATION = 81.58m

2	SECOND SUBMISSION TO REGION OF PEEL	AUGUST 17, 2018	R.M.
1	FIRST SUBMISSION TO REGION OF PEEL	MAY 8, 2018	R.M.
No.	REVISION	DATE	

SUBMISSIONS:
FIRST: ____________
SECOND: ____________
INTERIM: ____________
PRE–SERVICING: ____________
FINAL: ____________

PORT CREDIT WEST VILLAGE PARTNERS INC.
141 LAKESHORE ROAD EAST, MISSISSAUGA, ON L5G 1E8

70 MISSISSAUGA RD SOUTH
181 LAKESHORE RD WEST

CITY FILE No. TBD
REGION FILE No. Z-08.306

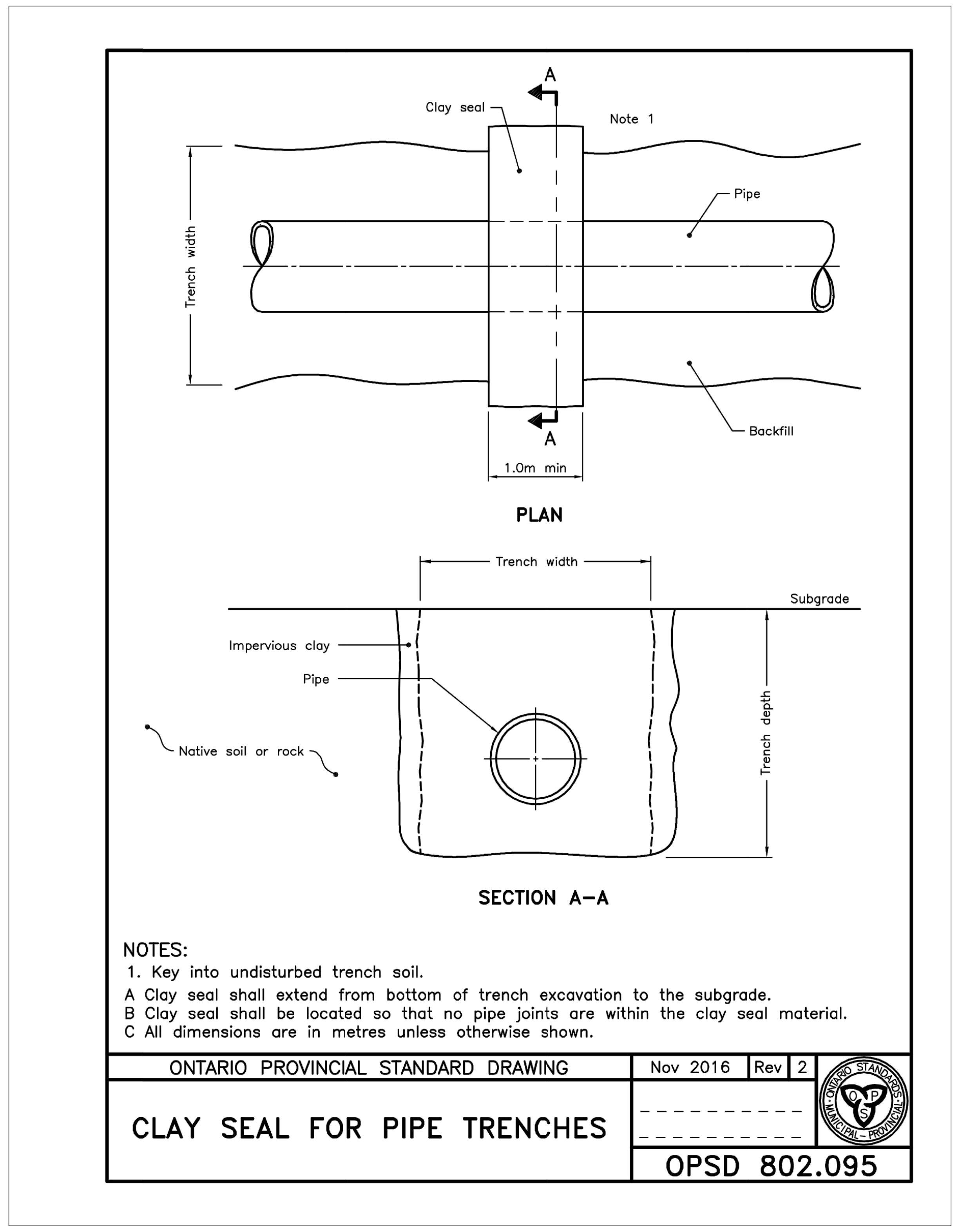
MISSISSAUGA

Region of Peel
Working for you

urbantech west
Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle, Suite 201 Oakville, Ontario L6H 0H2
tel: 905.829.8818 fax: 905.829.4804
www.urbantech.com

STANDARD DETAILS - 2

DESIGNED:	R.M.	CHECKED:	R.M.	PROJECT No.:	16-489W
DRAWN:	R.N.	DATE:	APRIL 2018	SHEET No.:	
SCALE:	N/A			DRAWING No.:	EXT-702



NOTES:

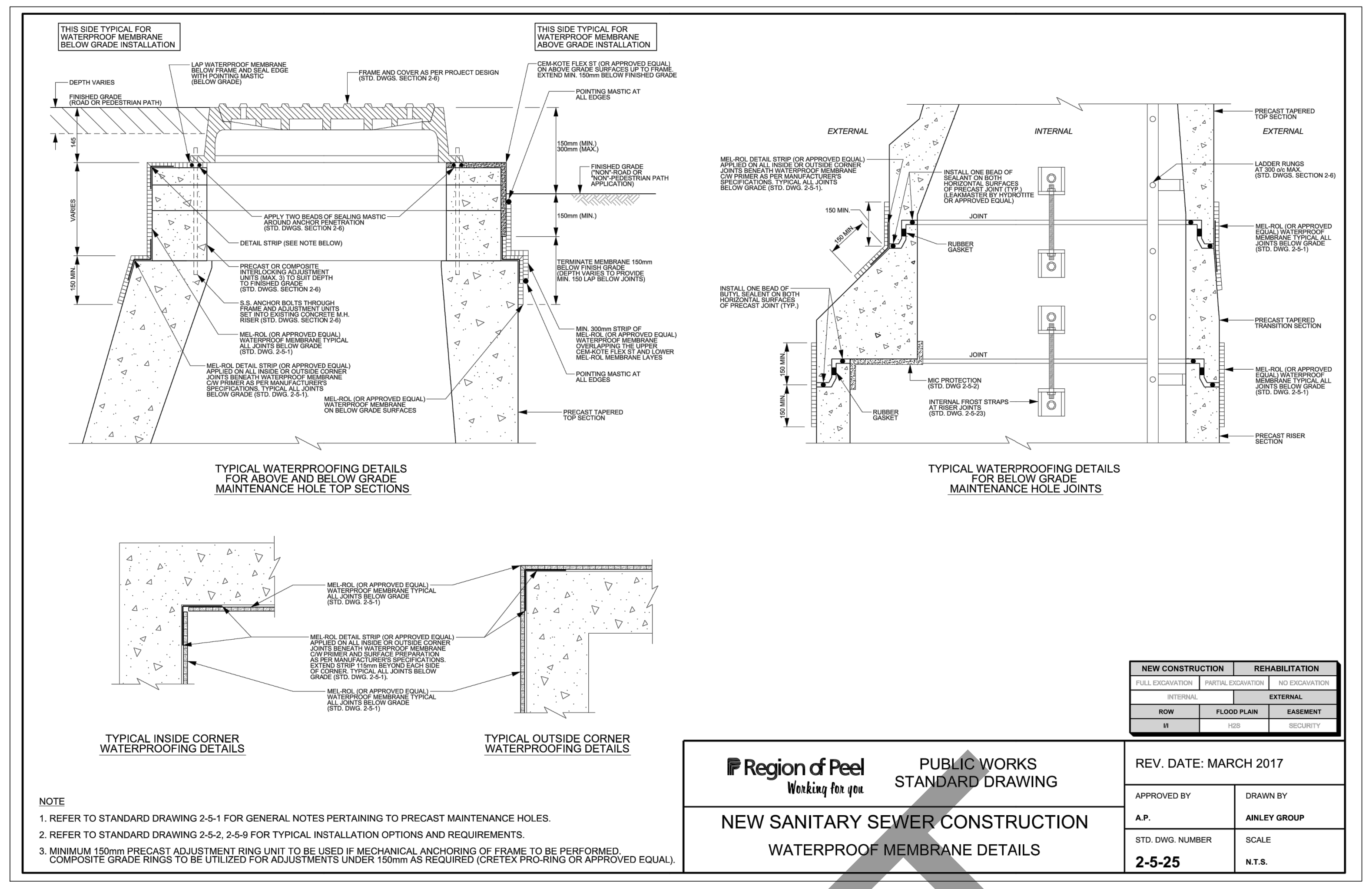
1. Key into undisturbed trench soil.

A Clay seal shall extend from bottom of trench excavation to the subgrade.
B Clay seal shall be located so that no pipe joints are within the clay seal material.
C All dimensions are in metres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING | Nov 2016 | Rev 2

CLAY SEAL FOR PIPE TRENCHES

OPSD 802.095



NOTE

1. REFER TO STANDARD DRAWING 2-5-1 FOR GENERAL NOTES PERTAINING TO PRECAST MAINTENANCE HOLES.
2. REFER TO STANDARD DRAWING 2-5-2, 2-5-9 FOR TYPICAL INSTALLATION OPTIONS AND REQUIREMENTS.
3. MINIMUM 150mm PRECAST ADJUSTMENT RING UNIT TO BE USED IF MECHANICAL ANCHORING OF FRAME TO BE PERFORMED. COMPOSITE GRADE RINGS TO BE UTILIZED FOR ADJUSTMENTS UNDER 150mm AS REQUIRED (CRETEX PRO-RING OR APPROVED EQUAL).

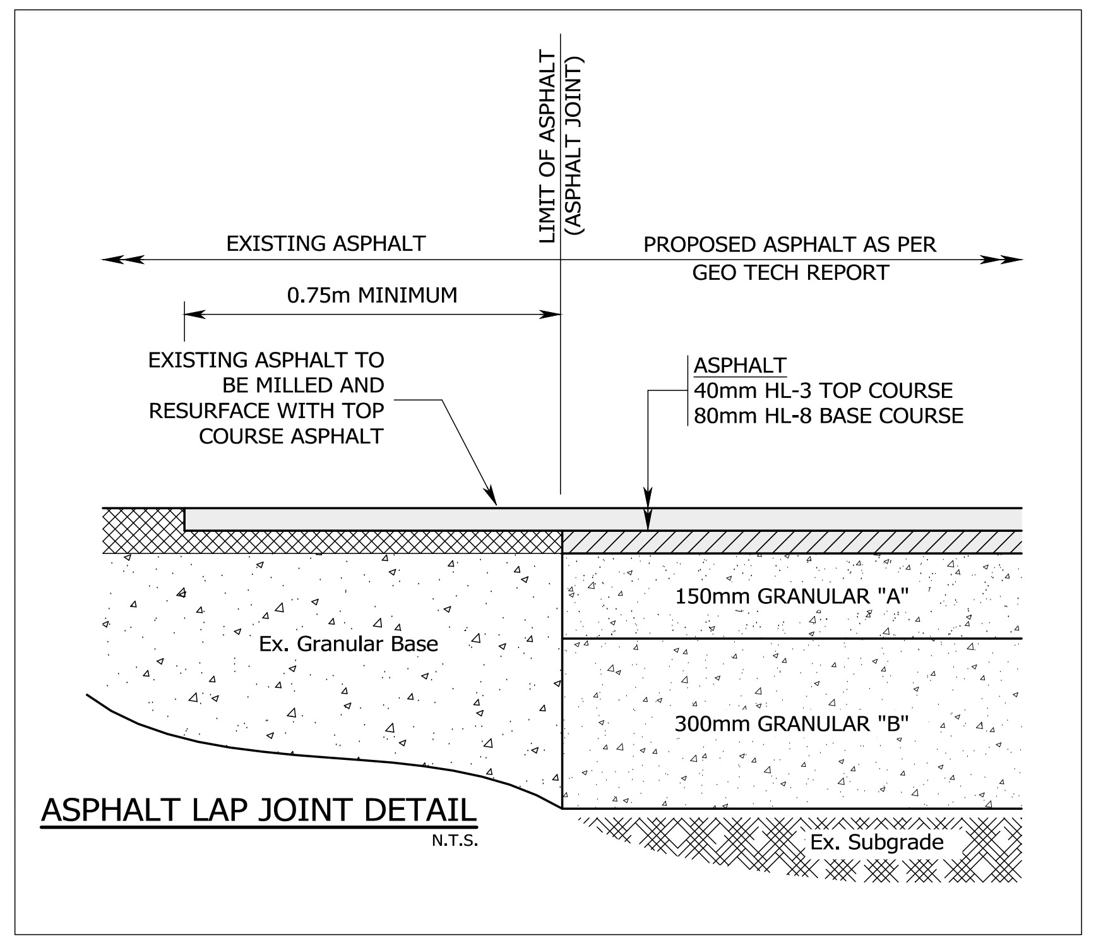
Region of Peel
Working for you

PUBLIC WORKS
STANDARD DRAWING

NEW SANITARY SEWER CONSTRUCTION
WATERPROOF MEMBRANE DETAILS

REV. DATE: MARCH 2017

APPROVED BY: A.P.
DRAWN BY: AINLEY GROUP
STD. DWG. NUMBER: 2-5-25
SCALE: N.T.S.



ASPHALT LAP JOINT DETAIL
N.T.S.

BENCHMARK NOTE

ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE DERIVED FROM THE CITY OF
MISSISSAUGA BENCHMARK NO. 731
ELEVATION = 81.58m

No.	REVISION	DATE	
2	SECOND SUBMISSION TO REGION OF PEEL	AUGUST 17, 2018	R.M.
1	FIRST SUBMISSION TO REGION OF PEEL	MAY 8, 2018	R.M.

SUBMISSIONS:
FIRST: ______________
SECOND: ______________
INTERIM: ______________
PRE–SERVICING: ______________
FINAL: ______________

PORT CREDIT WEST VILLAGE PARTNERS INC.
141 LAKESHORE ROAD EAST, MISSISSAUGA, ON L5G 1E8

70 MISSISSAUGA RD SOUTH
181 LAKESHORE RD WEST

CITY FILE No. TBD
REGION FILE No. Z-08.306

MISSISSAUGA

Region of Peel
Working for you

urbantech west
Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle, Suite 201 Oakville, Ontario L6H 0H2
tel: 905.829.8818 fax: 905.829.4804
www.urbantech.com

STANDARD DETAILS - 3

DESIGNED: R.M.
CHECKED: R.M.
PROJECT No.: 16-489W
DRAWN: R.N.
DATE: APRIL 2018
SHEET No.:
SCALE: N/A
DRAWING No.: EXT-703

SECOND ENGINEERING SUBMISSION, NOVEMBER 15, 2018

PLOT DATE:Wednesday, November 14, 2018 4:08:47 PM

File: \\URBANWEST-NAS\ALSAL DATA\PROJECTS\16-489W (WEST VILLAGE PARTNERS - PORT CREDIT)\DRAWINGS\02_OFF-SITE WORKS (SAN EXTENSION)\02_DD_PRODUCTION DWGS\16-489W - EXT WORKS - DET1 - STANDARD DETAILS.DWG

APPENDIX C

Stormwater Management

- *Proposed ROW Overland Flow Capacity Calculations*
    - *Street A (6.6m road on 20m ROW)*
    - *Street A (9.0m road on 20m ROW)*
    - *Street B (6.6m road on 20m ROW)*
    - *Street B (9.0m road on 20m ROW)*
    - *Street C (6.6m road on 20m ROW)*
    - *Street D & F (6.6m road on 20m ROW)*
    - *Street F (6m road on 20m ROW)*
    - *Street E (6.6m road on 20m ROW)*
    - *Street E (9.0m road on 20m ROW)*
    - *Mississauga Road*
- *ROW Bio-retention Calculations*
    - *Street F Bio-Retention Calculation*
    - *Street D - Controlling Catchment Calculation*
- *Site Plan LID Sizing Spreadsheet*
- *LID Design and O&M Resources (From Others)*
- *Block 19 Swale Sizing Calculation*

Channel Report

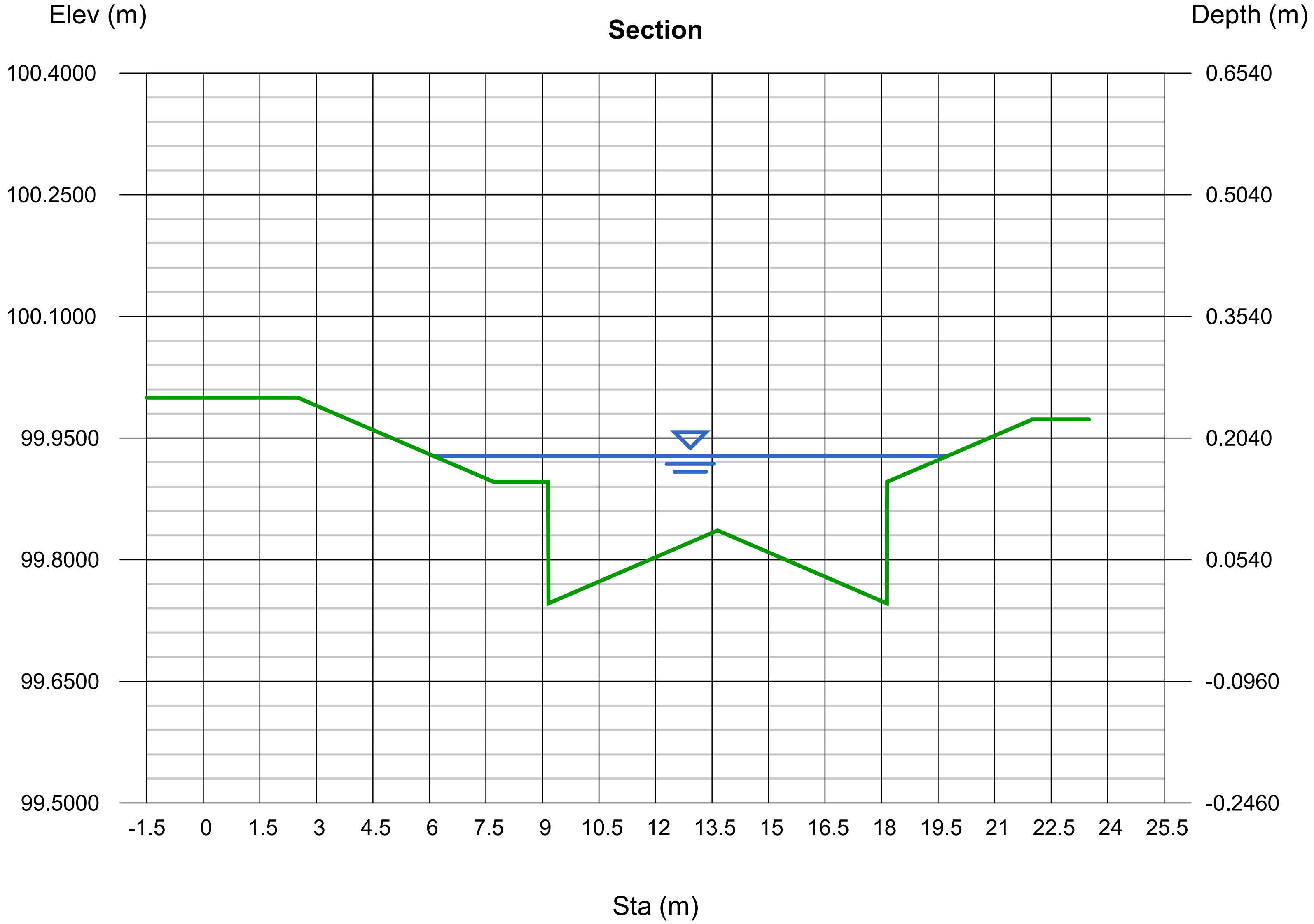
Mississauga Road - 8m Road on 22m ROW - Slope (0.5%) & Depth (max 0.182m) & n (0.

User-defined
Invert Elev (m) = 99.7460
Slope (%) = 0.5000
N-Value = 0.013

Calculations
Compute by: Known Depth
Known Depth (m) = 0.1820

Highlighted
Depth (m) = 0.1820
Q (cms) = 1.5123
Area (sqm) = 1.3292
Velocity (m/s) = 1.1377
Wetted Perim (m) = 13.9331
Crit Depth, Yc (m) = 0.1981
Top Width (m) = 13.6500
EGL (m) = 0.2480

(Sta, El, n)-(Sta, El, n)...
(0.0000, 100.0000)-(2.5000, 100.0000, 0.050)-(4.7000, 99.9560, 0.013)-(7.7000, 99.8960, 0.013)-(9.1500, 99.8960, 0.013)-(9.1600, 99.7460, 0.013)-(9.6500, 99.75
-(13.6500, 99.8360, 0.013)-(17.6500, 99.7560, 0.013)-(18.1400, 99.7460, 0.013)-(18.1500, 99.8960, 0.013)-(19.7500, 99.9280, 0.013)-(22.0000, 99.9730, 0.050)



Channel Report

Street A - 6.6m Road on 20m ROW - Slope (0.5%) & Depth (0.15m) & n (0.013, 0.05) with

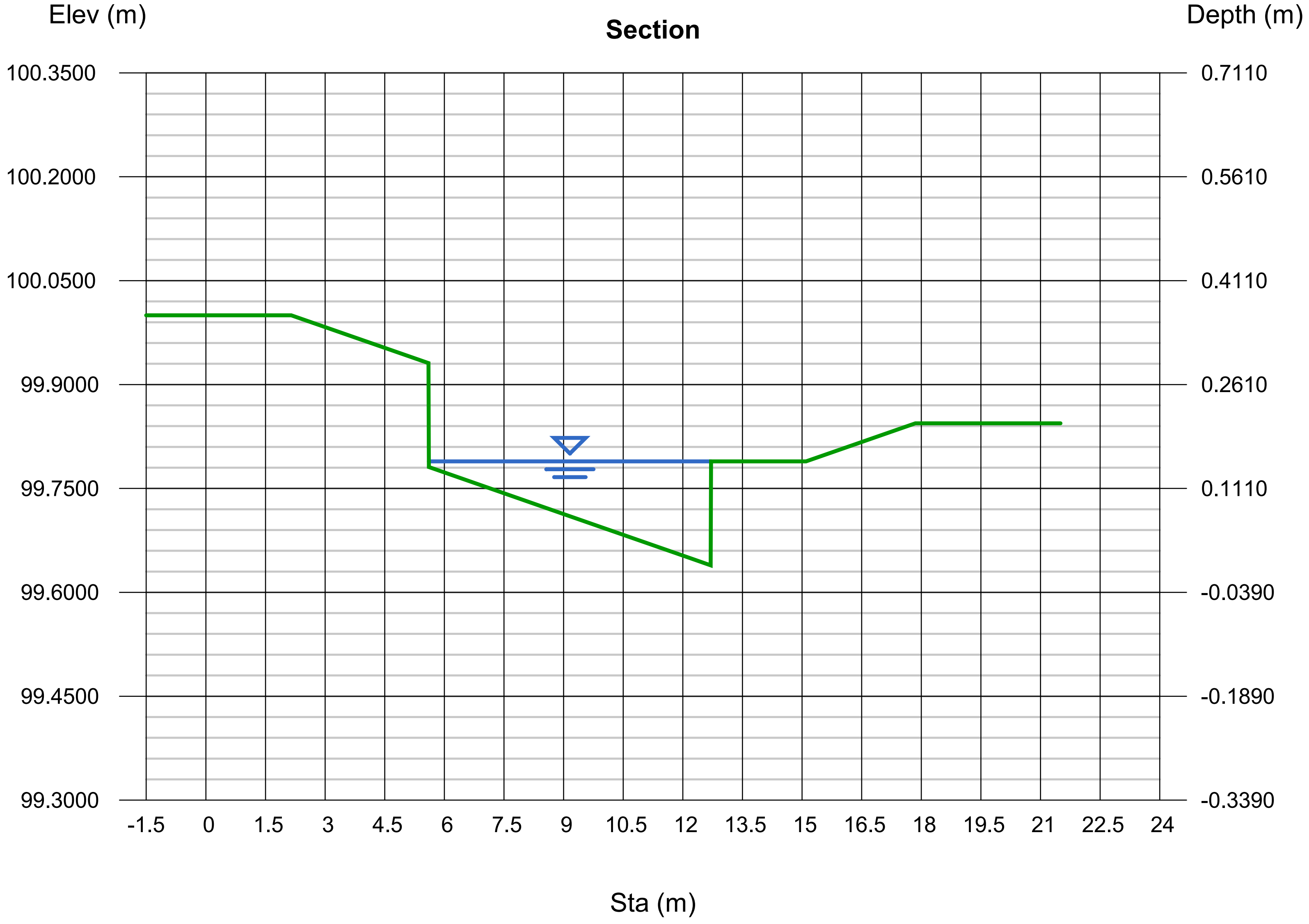
User-defined
Invert Elev (m) = 99.6390
Slope (%) = 0.5000
N-Value = 0.013

Calculations
Compute by: Known Depth
Known Depth (m) = 0.1500

Highlighted
Depth (m) = 0.1500
Q (cms) = 0.5555
Area (sqm) = 0.5613
Velocity (m/s) = 0.9898
Wetted Perim (m) = 7.2498
Crit Depth, Yc (m) = 0.1646
Top Width (m) = 7.1005
EGL (m) = 0.2000

(Sta, El, n)-(Sta, El, n)...

(0.0000, 100.0000)-(2.1500, 100.0000, 0.050)-(4.3500, 99.9560, 0.013)-(5.1000, 99.9410, 0.013)-(5.6000, 99.9310, 0.013)-(5.6100, 99.7810, 0.013)-(8.9000, 99.715
-(12.2000, 99.6490, 0.013)-(12.7000, 99.6390, 0.013)-(12.7100, 99.7890, 0.013)-(15.1000, 99.7890, 0.013)-(15.8500, 99.8040, 0.013)-(17.8500, 99.8440, 0.013)-(20



Channel Report

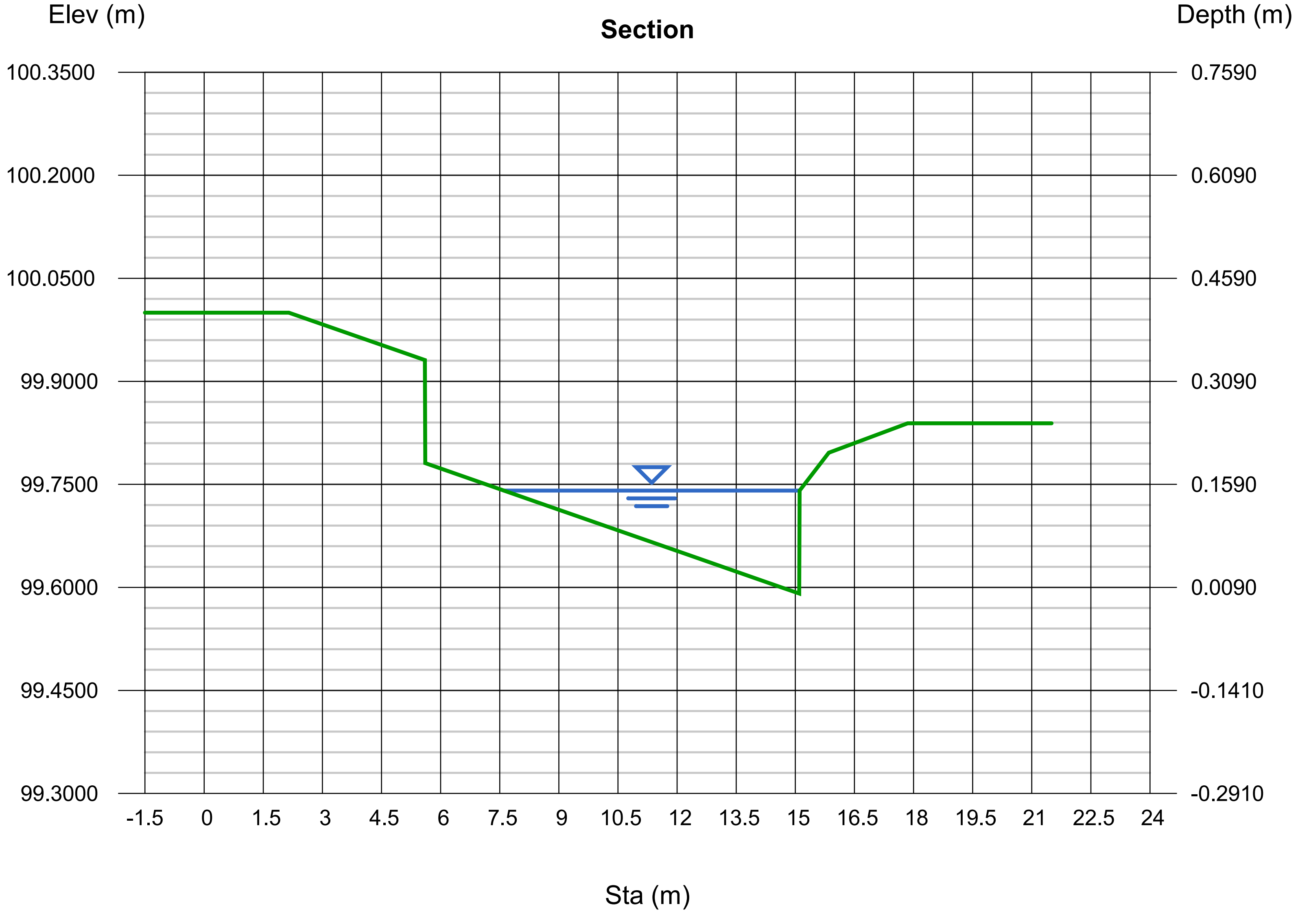
Street A - 9.0m Road on 20m ROW - Slope (0.5%) & Depth (0.15m) & n (0.013, 0.05) with

User-defined
Invert Elev (m) = 99.5910
Slope (%) = 0.5000
N-Value = 0.013

Calculations
Compute by: Known Depth
Known Depth (m) = 0.1500

Highlighted
Depth (m) = 0.1500
Q (cms) = 0.5392
Area (sqm) = 0.5633
Velocity (m/s) = 0.9573
Wetted Perim (m) = 7.6482
Crit Depth, Yc (m) = 0.1585
Top Width (m) = 7.5063
EGL (m) = 0.1967

(Sta, El, n)-(Sta, El, n)...
(0.0000, 100.0000)-(2.1500, 100.0000, 0.050)-(4.3500, 99.9560, 0.013)-(5.1000, 99.9410, 0.013)-(5.6000, 99.9310, 0.013)-(5.6100, 99.7810, 0.013)-(8.9000, 99.715
-(12.2000, 99.6490, 0.013)-(14.6000, 99.6010, 0.013)-(15.1000, 99.5910, 0.013)-(15.1100, 99.7410, 0.013)-(15.8500, 99.7960, 0.013)-(17.8500, 99.8390, 0.013)-(20



Channel Report

Street B - 6.6m Road on 22m ROW - Slope (0.5%) & Depth (0.15m) & n (0.013, 0.05) with

User-defined
Invert Elev (m) = 99.7410
Slope (%) = 0.5000
N-Value = 0.013

Calculations
Compute by: Known Depth
Known Depth (m) = 0.1500

Highlighted
Depth (m) = 0.1500
Q (cms) = 0.9481
Area (sqm) = 0.7791
Velocity (m/s) = 1.2170
Wetted Perim (m) = 7.3821
Crit Depth, Yc (m) = 0.1798
Top Width (m) = 7.1093
EGL (m) = 0.2255

(Sta, El, n)-(Sta, El, n)...
(0.0000, 100.0000)-(2.2000, 99.9560, 0.013)-(4.7000, 99.9560, 0.050)-(6.2000, 99.9260, 0.013)-(6.9500, 99.9110, 0.013)-(9.3500, 99.9110, 0.013)-(9.8500, 99.9010
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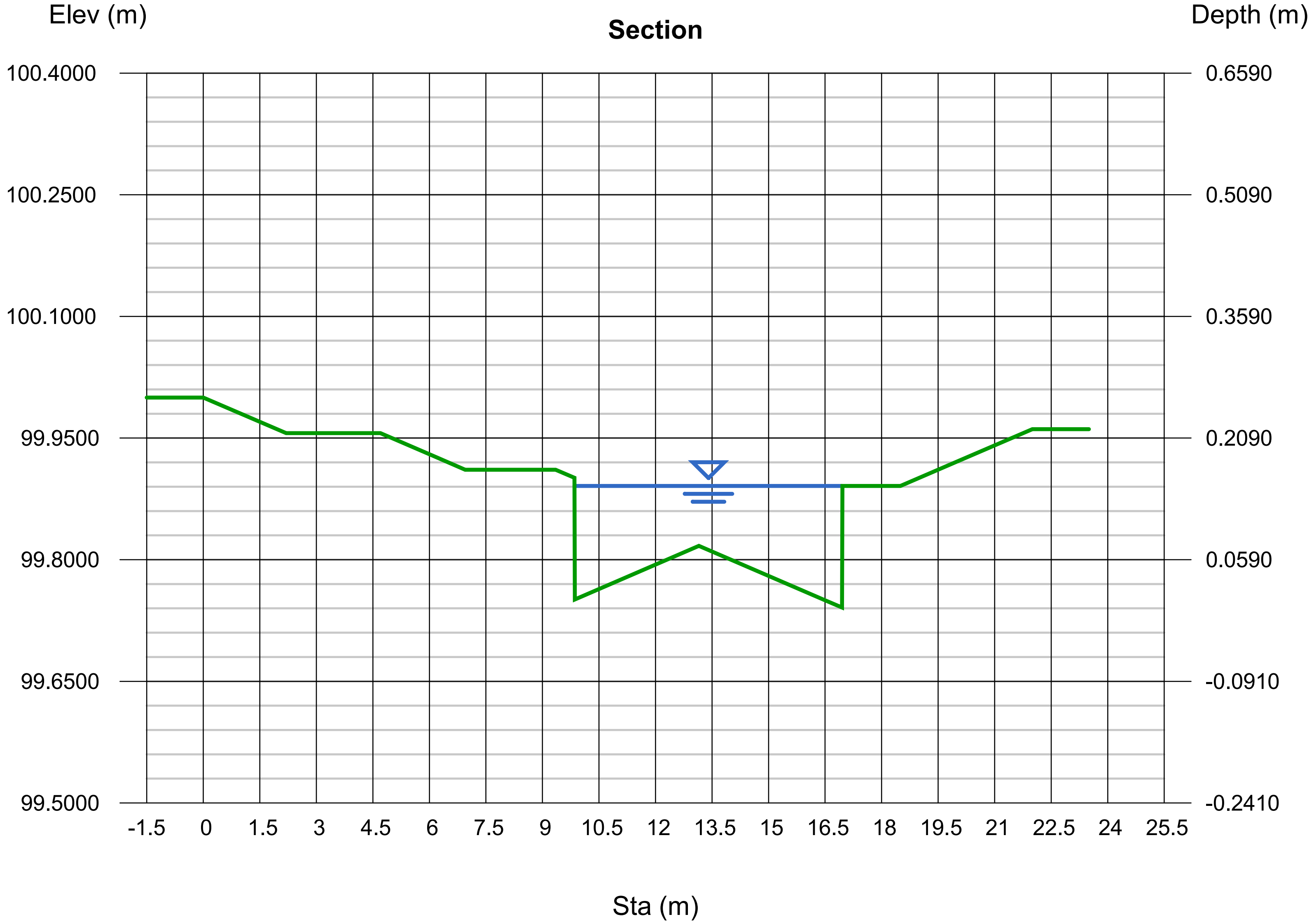
-(22.0000, 99.9610, 0.013)



Channel Report

Street B - 9.0m Road on 22m ROW - Slope (0.5%) & Depth (0.15m) & n (0.013, 0.05) with

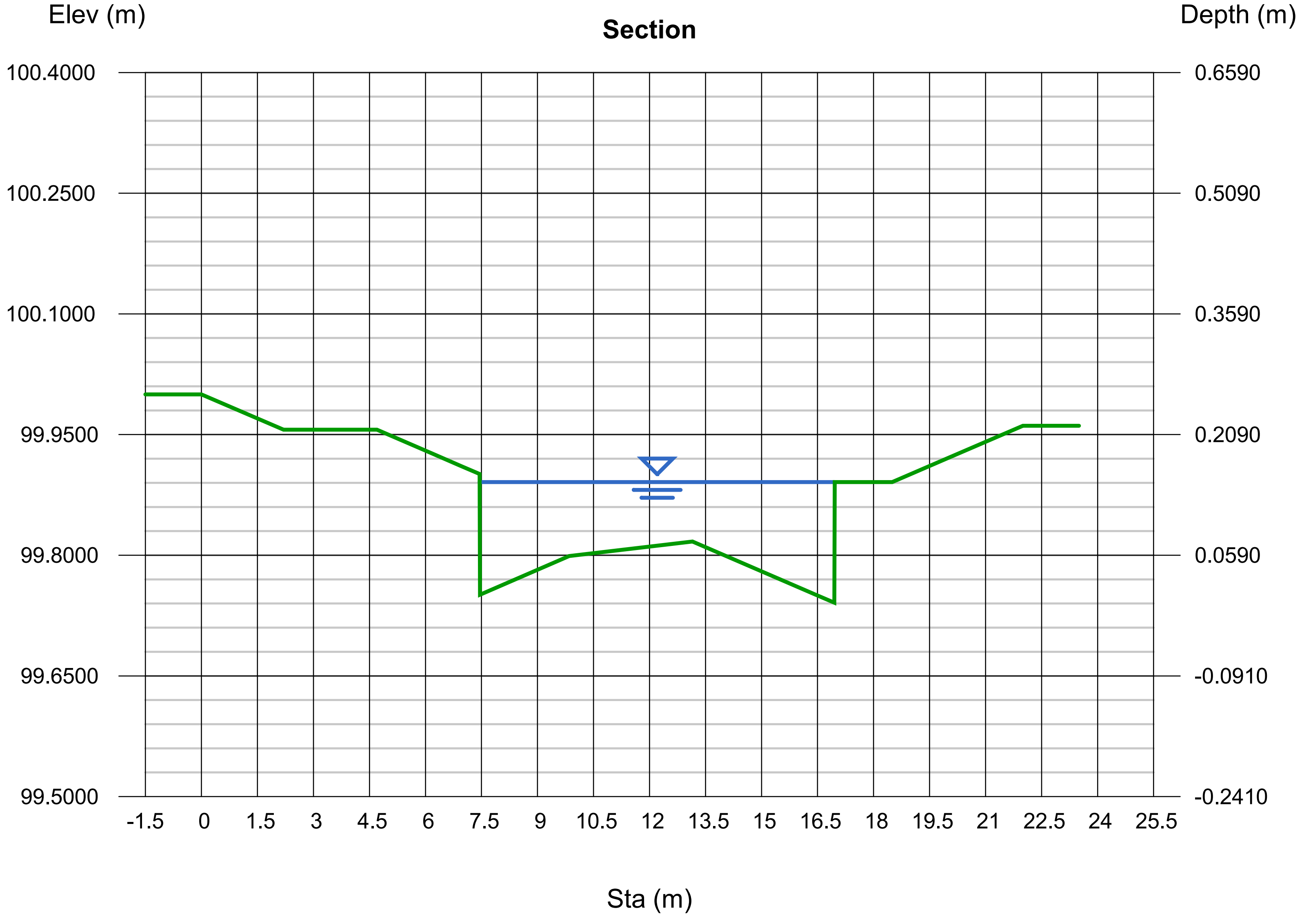
User-defined
Invert Elev (m) = 99.7410
Slope (%) = 0.5000
N-Value = 0.013

Calculations
Compute by: Known Depth
Known Depth (m) = 0.1500

Highlighted
Depth (m) = 0.1500
Q (cms) = 1.1483
Area (sqm) = 0.9781
Velocity (m/s) = 1.1740
Wetted Perim (m) = 9.7819
Crit Depth, Yc (m) = 0.1707
Top Width (m) = 9.5093
EGL (m) = 0.2203

(Sta, El, n)-(Sta, El, n)...

(0.0000, 100.0000)-(2.2000, 99.9560, 0.013)-(4.7000, 99.9560, 0.050)-(6.2000, 99.9260, 0.013)-(6.9500, 99.9110, 0.013)-(7.4500, 99.9010, 0.013)-(7.4600, 99.7510
-(9.8500, 99.7990, 0.013)-(13.1500, 99.8170, 0.013)-(16.4500, 99.7510, 0.013)-(16.9500, 99.7410, 0.013)-(16.9600, 99.8910, 0.013)-(18.5000, 99.8910, 0.013)-(20.0
-(22.0000, 99.9610, 0.013)



Channel Report

Street C - 6.6m Road on 20m ROW - Slope (0.5%) & Depth (0.15m) & n (0.013, 0.05) with

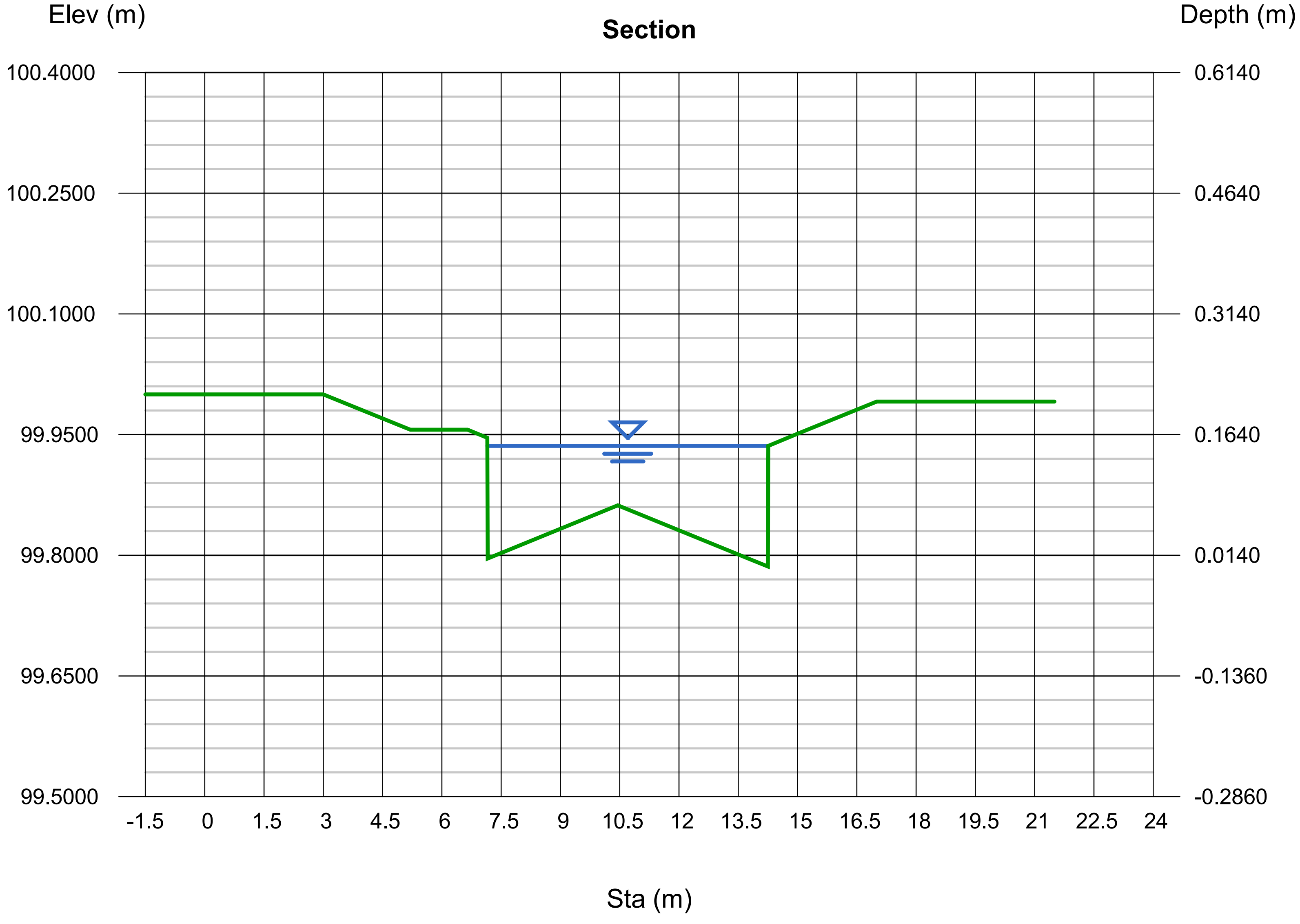
User-defined
Invert Elev (m) = 99.7860
Slope (%) = 0.5000
N-Value = 0.013

Calculations
Compute by: Known Depth
Known Depth (m) = 0.1500

Highlighted
Depth (m) = 0.1500
Q (cms) = 0.9481
Area (sqm) = 0.7791
Velocity (m/s) = 1.2170
Wetted Perim (m) = 7.3825
Crit Depth, Yc (m) = 0.1768
Top Width (m) = 7.1098
EGL (m) = 0.2255

(Sta, El, n)-(Sta, El, n)...

(0.0000, 100.0000)-(3.0000, 100.0000, 0.050)-(5.2000, 99.9560, 0.013)-(6.6500, 99.9560, 0.013)-(7.1500, 99.9460, 0.013)-(7.1600, 99.7960, 0.013)-(10.4500, 99.8
-(13.7500, 99.7960, 0.013)-(14.2500, 99.7860, 0.013)-(14.2600, 99.9360, 0.013)-(15.0000, 99.9510, 0.013)-(17.0000, 99.9910, 0.013)-(20.0000, 99.9910, 0.050)



Channel Report

Street D & F - 6.6m Road on 19.0m ROW - Slope (0.5%) & Depth (0.15m) & n (0.013, 0.05)

User-defined
Invert Elev (m) = 99.7860
Slope (%) = 0.5000
N-Value = 0.013

Calculations
Compute by: Known Depth
Known Depth (m) = 0.1500

Highlighted
Depth (m) = 0.1500
Q (cms) = 0.8419
Area (sqm) = 0.7791
Velocity (m/s) = 1.0806
Wetted Perim (m) = 8.8225
Crit Depth, Yc (m) = 0.1615
Top Width (m) = 8.5498
EGL (m) = 0.2096

(Sta, El, n)-(Sta, El, n)...
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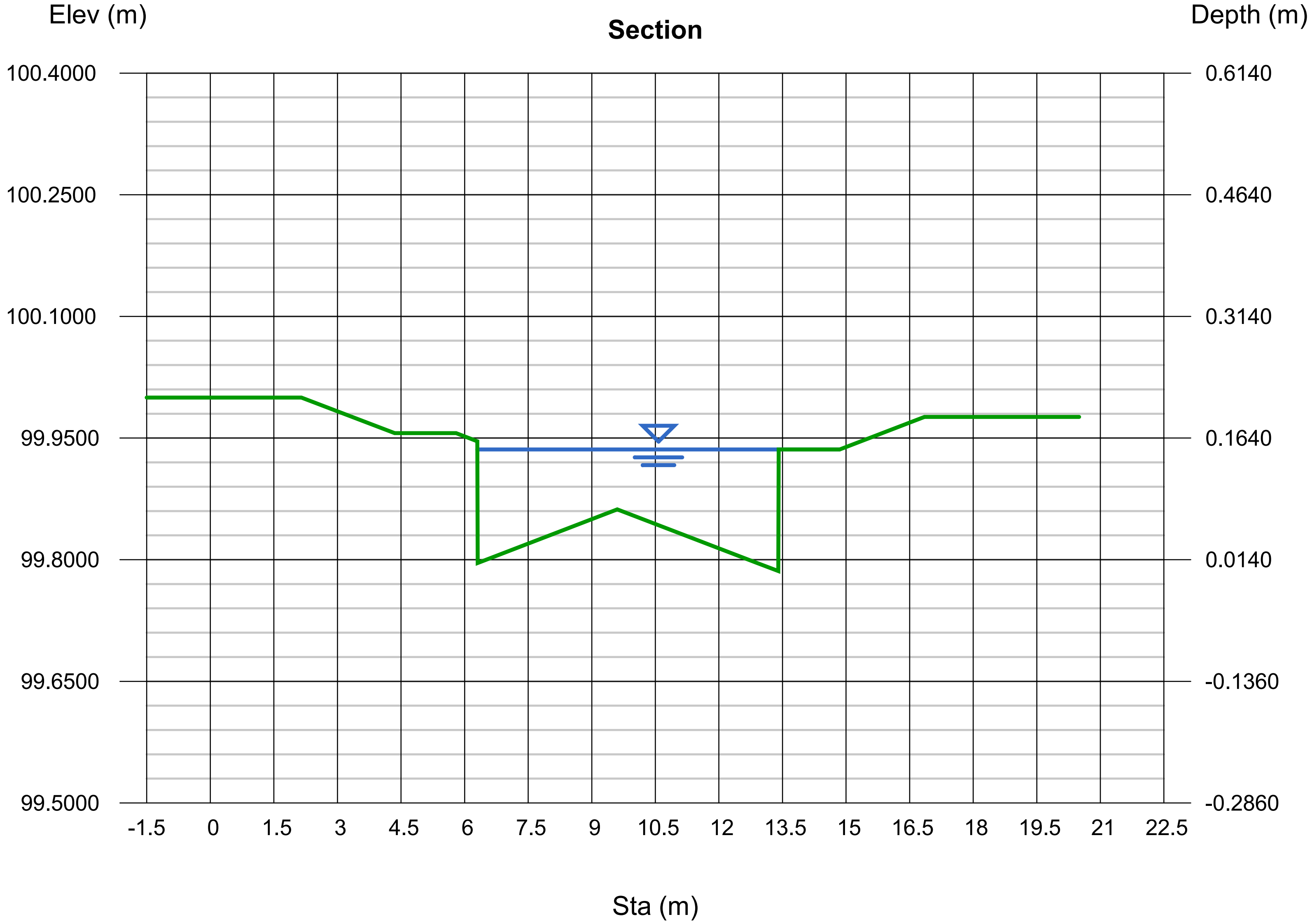

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Nov 13 2018

Street D & F - 8.0m Road on 19.0m ROW - Slope (0.5%) & Depth (0.15m) & n (0.013, 0.05)

User-defined
Invert Elev (m) = 99.7710
Slope (%) = 0.5000
N-Value = 0.013

Calculations
Compute by: Known Depth
Known Depth (m) = 0.1500

Highlighted
Depth (m) = 0.1500
Q (cms) = 1.0206
Area (sqm) = 0.8729
Velocity (m/s) = 1.1693
Wetted Perim (m) = 8.7823
Crit Depth, Yc (m) = 0.1646
Top Width (m) = 8.5093
EGL (m) = 0.2197

(Sta, El, n)-(Sta, El, n)...

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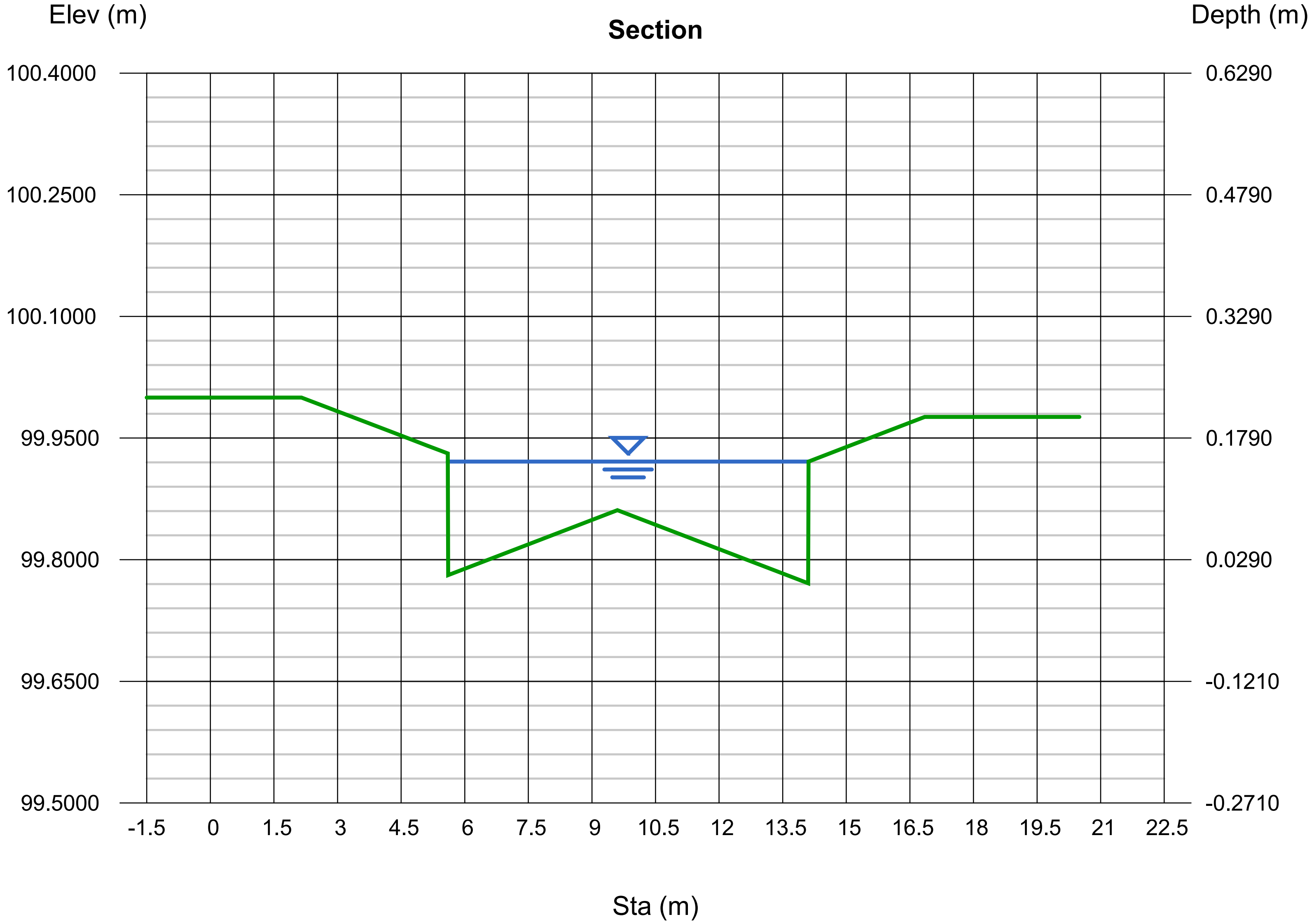
-(13.6000, 99.7810, 0.013)-(14.1000, 99.7710, 0.013)-(14.1100, 99.9210, 0.013)-(14.8500, 99.9360, 0.013)-(16.8500, 99.9760, 0.013)-(19.0000, 99.9760, 0.050)



Channel Report

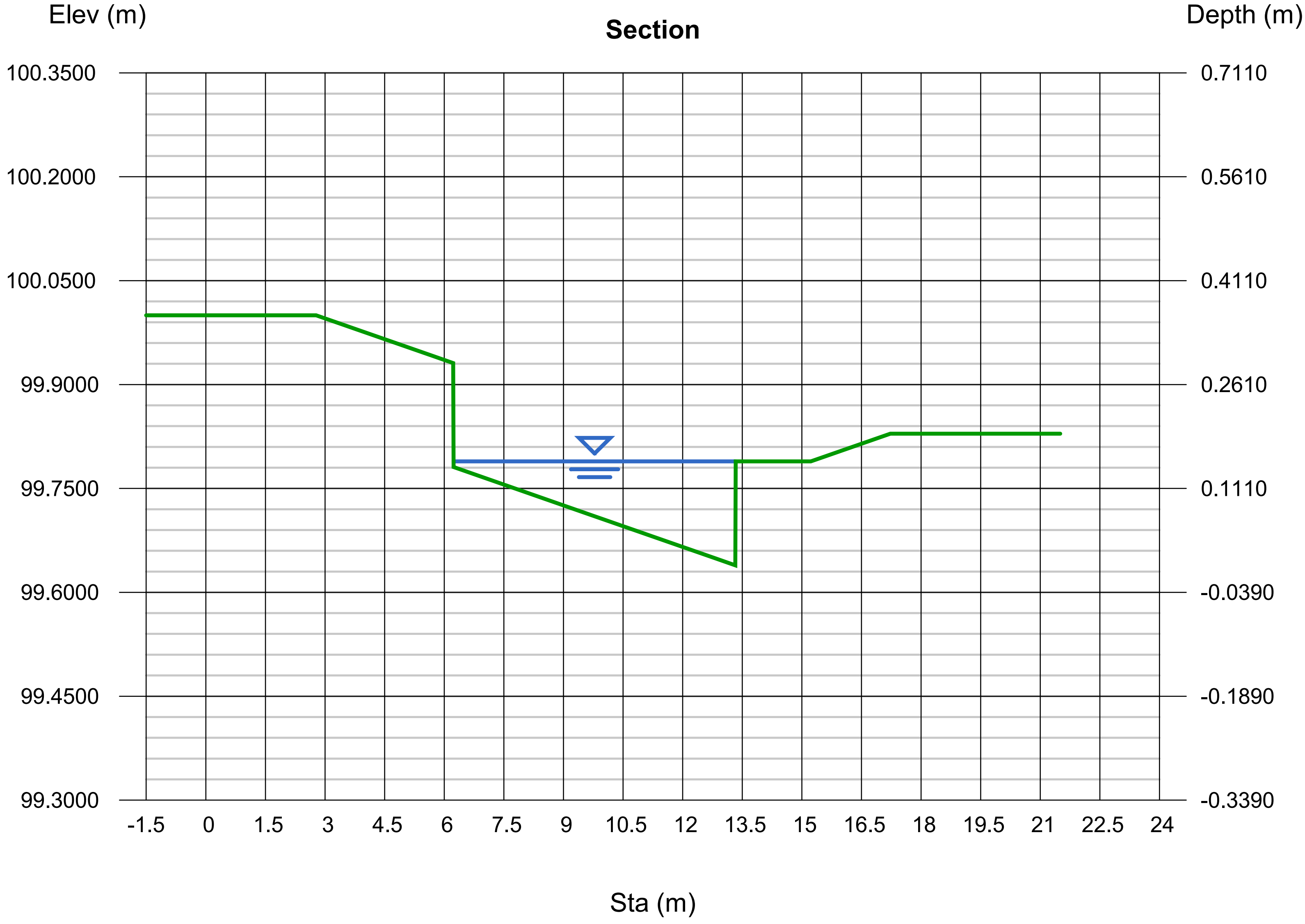
Street E - 6.6m Road on 20.0m ROW - Slope (0.5%) & Depth (0.15m) & n (0.013, 0.05) with

User-defined
Invert Elev (m) = 99.6390
Slope (%) = 0.5000
N-Value = 0.013

Calculations
Compute by: Known Depth
Known Depth (m) = 0.1500

Highlighted
Depth (m) = 0.1500
Q (cms) = 0.5555
Area (sqm) = 0.5613
Velocity (m/s) = 0.9898
Wetted Perim (m) = 7.2498
Crit Depth, Yc (m) = 0.1646
Top Width (m) = 7.1005
EGL (m) = 0.2000

(Sta, El, n)-(Sta, El, n)...
(0.0000, 100.0000)-(2.7750, 100.0000, 0.050)-(4.9750, 99.9560, 0.013)-(5.7250, 99.9410, 0.013)-(6.2250, 99.9310, 0.013)-(6.2350, 99.7810, 0.013)-(9.5250, 99.715
-(12.8250, 99.6490, 0.013)-(13.3250, 99.6390, 0.013)-(13.3350, 99.7890, 0.013)-(15.2250, 99.7890, 0.013)-(17.2250, 99.8290, 0.013)-(20.0000, 99.8290, 0.050)



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Nov 6 2018

Street E - 9.6m Road on 20.0m ROW - Slope (0.5%) & Depth (0.15m) & n (0.013, 0.05) with

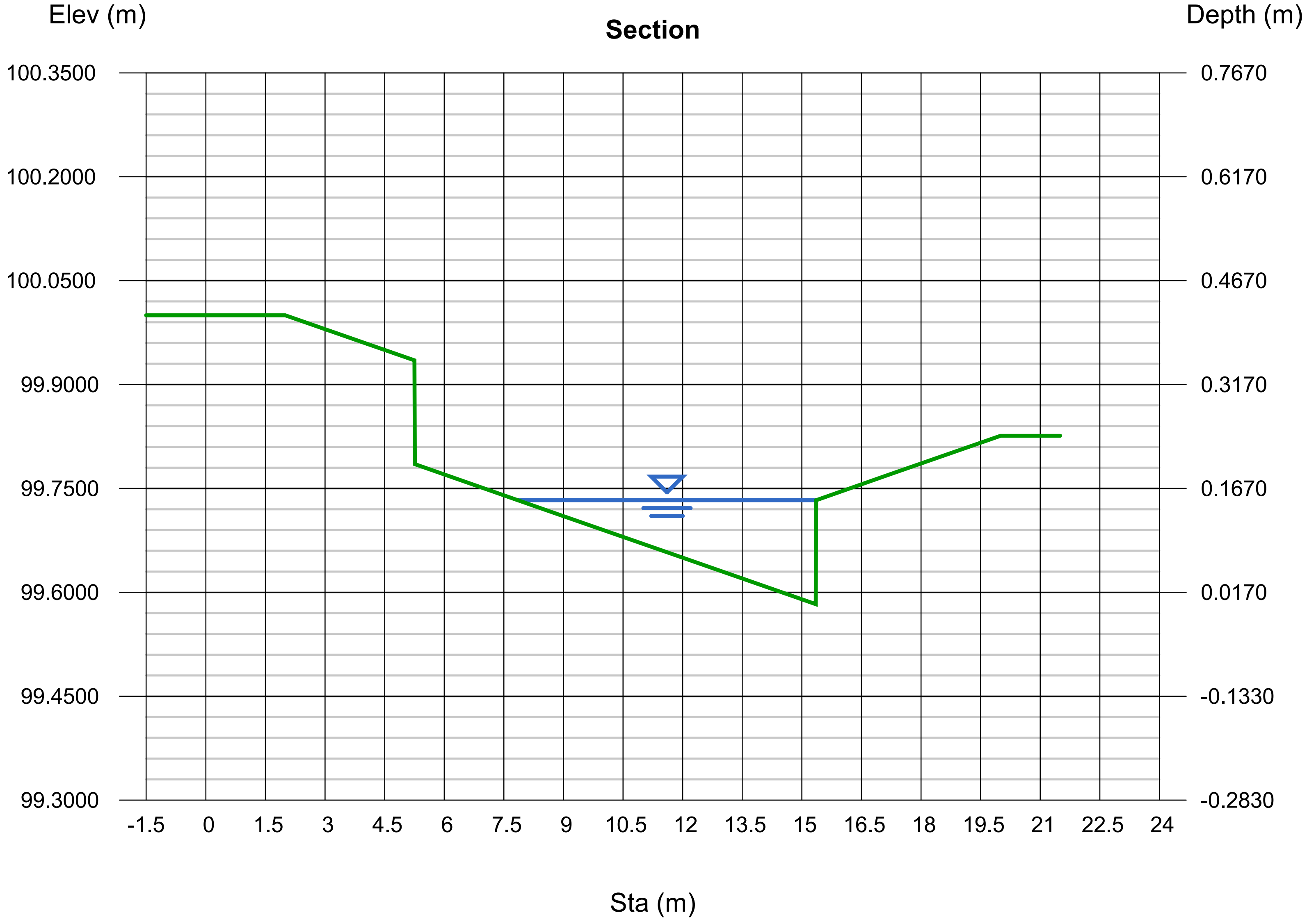
User-defined
Invert Elev (m) = 99.5830
Slope (%) = 0.5000
N-Value = 0.013

Calculations
Compute by: Known Depth
Known Depth (m) = 0.1500

Highlighted
Depth (m) = 0.1500
Q (cms) = 0.5392
Area (sqm) = 0.5632
Velocity (m/s) = 0.9572
Wetted Perim (m) = 7.6496
Crit Depth, Yc (m) = 0.1585
Top Width (m) = 7.5078
EGL (m) = 0.1967

(Sta, El, n)-(Sta, El, n)...

(0.0000, 100.0000)-(2.0000, 100.0000, 0.050)-(4.0000, 99.9600, 0.013)-(4.7500, 99.9450, 0.013)-(5.2500, 99.9350, 0.013)-(5.2600, 99.7850, 0.013)-(8.5500, 99.71
-(11.8500, 99.6530, 0.013)-(14.8500, 99.5930, 0.013)-(15.3500, 99.5830, 0.013)-(15.3600, 99.7330, 0.013)-(17.2500, 99.7710, 0.013)-(18.0000, 99.7860, 0.013)-(20



urbantech
west

BioRetention Design Sheet - Street D Limiting Catchment

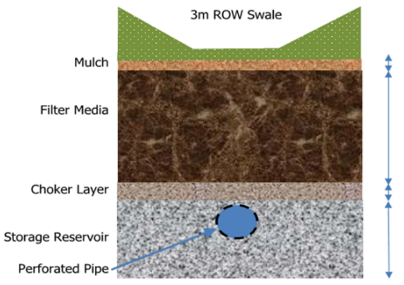
Project Name: Port Credit West Village
Municipality: City of Mississauga
Project No.: 16-489
Date: 14-Nov-18

Prepared by: N.M
Checked by: A.F.
Submission #: 2nd FSR Submission

Legend
🟪 **= Inactive Cells**
🟦 **= Inputs**
🟧 **= Storage Targets**
🟩 **= Outputs**

Inputs

2-D Bio-Retention Cell Schematic



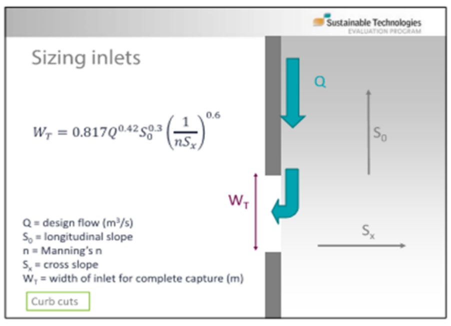
Layer	Layer Depth (m)	Layer Void Ratio	K (mm/hr)
Ponding	0.25	1	
Mulch	0.2	0.7	233
Filter Media	0.8	0.3	200
Choker Layer	0.1	0.2	50
Storage Reservoir	0.2	0.4	1250
Total Depth	1.55		
Composite Void Ratio		0.47	

Site Variables

Contributing ROW Length	62.6	m
Contributing ROW "Width"	9.5	m
Permeability of "Tightest" Soil Layer (choker layer?)	50	mm/hr
Evapotranspiration Rate (in which month? Ranges from 0.4 to 3.8 mm/day)	0.04	mm/hr
Catchment Peak Flow (from Rational Method)	0.006	m^3/s
Contributing Drainage Area	0.0468	ha

Inlet Sizing

Longitudinal Slope	2.00%	%
Mannings (n)	0.032	
Sx (Cross Slope)	2.00%	%
Q (Design Flow)	0.006	m^3/s


Sizing inlets

$$W_T = 0.817 Q^{0.42} S_0^{0.3} \left(\frac{1}{nS_x}\right)^{0.6}$$

Q = design flow (m^3/s)
S_0 = longitudinal slope
n = Manning's n
S_x = cross slope
W_T = width of inlet for complete capture (m)

Curb cuts

Bioretention Cell Variables

Length of B-R Swale	8.6	m
Design Infiltration Rate	50	mm/hr
Allowable Ponding Depth	0.25	m
Bottom width of Swale	1	m
Side Slopes of Swale	3:1, 3:1	
Depth of Medium (m)	0.3	m
Area of BioRetention Cell:	14.4	m^2
Perimeter of BioRetention Cell:	20.2	m
Total Reservoir Depth	1.55	m
Max flow through Media	0.0002	m^3/s

Perforated Pipe Details

Diameter	100	mm
Length (m)	10.66667	m
B (Clogging Factor)	0.5	(typical)
Cd (Discharge Coefficient)	0.61	(sharp edge)
Open Area per meter (m^2/m)	0.0037	(from manufacturer)
H_{max} (ponding over top of pipe)	0.20	m
Q_{max}	0.024	m^3/s

Targets

Maximum Storage Volume (no cell discharge):	24.8	m^3
Bioretention Cell Depth Required (no cell discharge):	4.31	m
Required Storage Volume (From Swale Drawdown Sheet)	6.5	m^3
Bioretention Cell Depth Required:	0.96	m
Rainfall to Capture:	25	mm
Time required to infiltrate RVCt volume	35	hrs

Outputs

Green: Target is met
Red: Not enough area or depth

Calculated Storage and Depth

Retention Volume Provided	10.5	m^3
Cell Depth Provided	1.550	m

System Exfiltration Rate

Outlet Pipe? (Y/N)	**Yes**	
$Q_{max,p}$ (flow into perforated pipe)	0.024	m^3/s
Q_s (Percolation Rate through Tightest Soil Layer)	0.0002	m^3/s
Controlling Rate	0.0002	m^3/s

Drawdown Time

Calculated Ponding Depth	0.17	m
Calculated Surface Drawdown Time	0.0	hrs
Calculated Cell Drawdown Time	14.5	hrs

Required Inlet Width

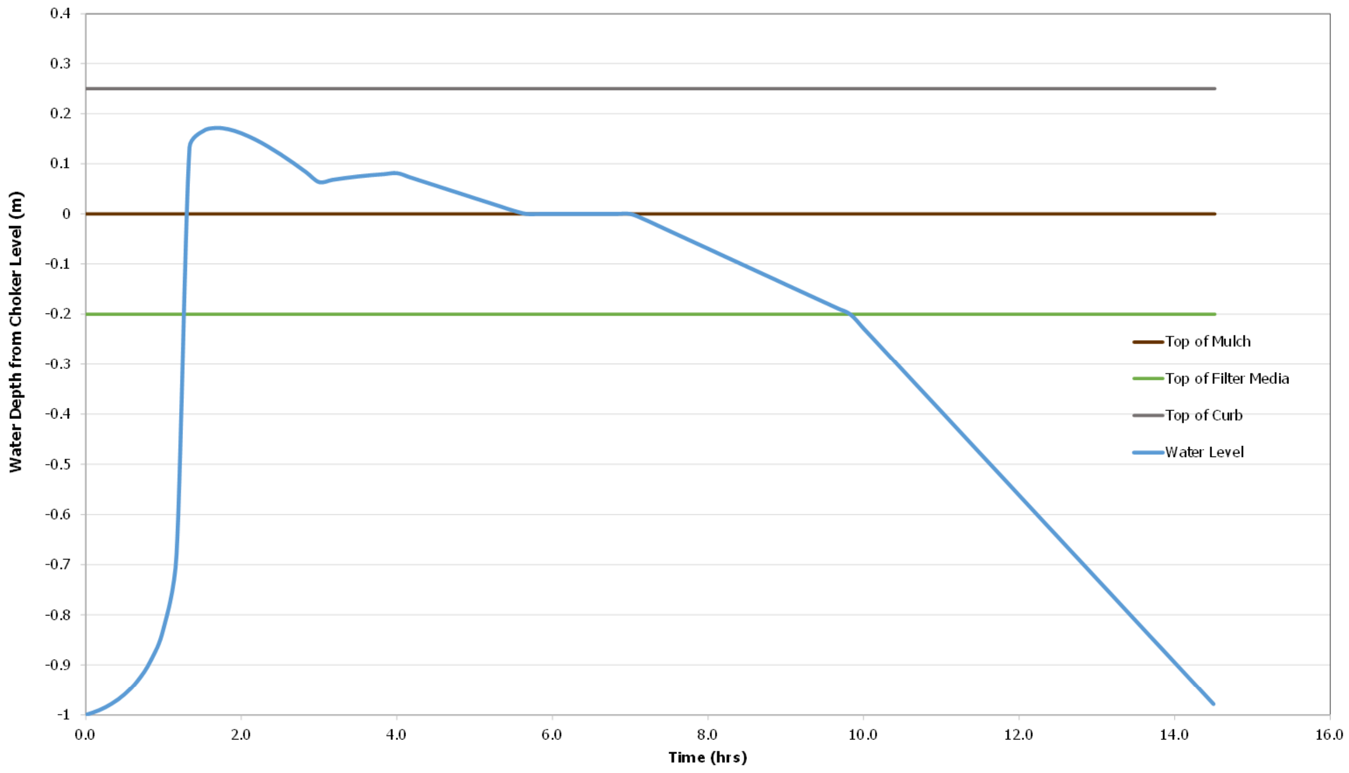
W_T (inlet width for complete capture)	2.41	m

Advanced Bio-Retention Design Output

Project Name: Port Credit West Village
Municipality: City of Mississauga
Project No.: 16-489
Date: 14-Nov-18

Prepared by: N.M
Checked by: A.F.
Submission #: 2nd FSR Submission

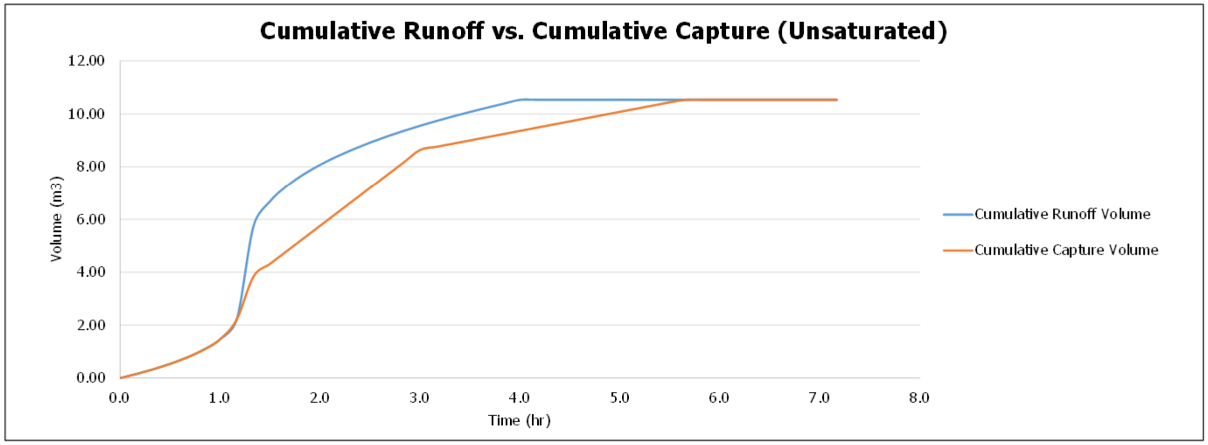
Bio-Retention Cell Drawdown Time

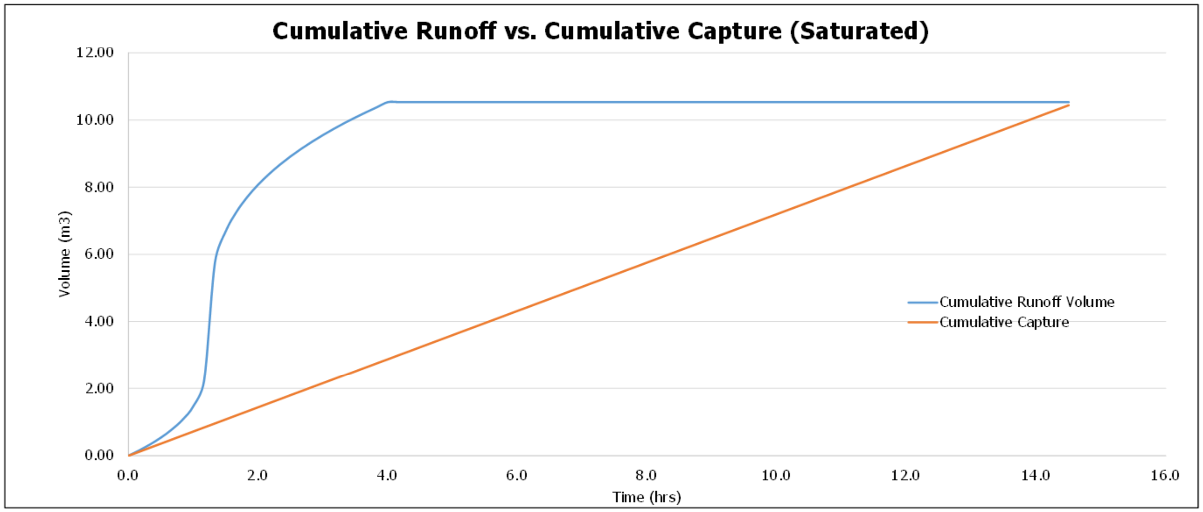


Advanced Bio-Retention Design Output

Project Name: Port Credit West Village
Municipality: City of Mississauga
Project No.: 16-489
Date: 14-Nov-18

Prepared by: N.M
Checked by: A.F.
Submission #: 2nd FSR Submission





Advanced Bio-Retention Drawdown Calculation

Project Name: Port Credit West Village
Municipality: City of Mississauga
Project No.: 16-489
Date: 14-Nov-18

Prepared by: N.M
Checked by: A.F.
Submission #: 2nd FSR Submission

Contributing Drainage Area =	0.0468	ha
Bioretention Surface Area =	14.4	m^2
"C" =	0.90	
AC=	0.04212	ha
Tc =	10.0	min
Time Increment =	10.0	min
Total Infiltration Rate =	0.20	l/s
Max.Storage =	6	m^3
Max.Runoff =	6	l/s

Time Delay Calculation

Layer	Layer Depth (m)	Layer Void Ratio	Wet Hydraulic Conductivity [K_{sat}] (m/s)	Infiltration Rate (m^3/min)	Layer Void Volume (m^3)	Cumulative Void Volume (m^3)	Wet "Travel" time (hr)
Ponding	0.25	1			3.6	3.6	
Mulch	0.2	0.7	6.481E-05	5.60E-02	2.016	5.616	0.86
Filter Media	0.8	0.3	5.556E-05	4.80E-02	3.456	9.072	4.00
Choker Layer	0.1	0.2	1.389E-05	1.20E-02	0.288	9.36	2.00
Storage Reservoir	0.2	0.4	3.472E-04	3.00E-01	1.152	10.512	0.16
Total/Cumulative	**1.55**	**0.47**					**7.02**

Time (hr)	Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Minimum Captured Volume (m^3/min)	Cumulative Runoff Volume (m^3)	Cumulative Captured Volume (m^3)	Cumulative Released Volume (m^3)	Volume in B-R Cell (m^3)	Ponding Depth m	Release Volume l/s
0.0	0	2.071	0.24	0.00	0.00	0.00	0.00	0.00	0.00	
0.2	10	2.266	0.27	0.12	0.16	0.16	0.12	0.04	0.00	0.20
0.3	20	2.524	0.30	0.18	0.34	0.34	0.24	0.10	0.00	0.20
0.5	30	2.88	0.34	0.20	0.54	0.54	0.36	0.18	0.00	0.20
0.7	40	3.382	0.40	0.24	0.78	0.78	0.48	0.30	0.00	0.20
0.8	50	4.175	0.49	0.29	1.07	1.07	0.60	0.47	0.00	0.20
1.0	60	5.696	0.67	0.40	1.47	1.47	0.72	0.75	0.00	0.20
1.2	70	10.777	1.26	0.76	2.23	2.23	0.84	1.39	0.00	0.20
1.3	80	50.214	5.88	0.96	5.75	3.84	0.96	2.88	0.13	0.20
1.5	90	13.366	1.57	0.94	6.69	4.32	1.08	3.24	0.16	0.20
1.7	100	8.286	0.97	0.58	7.27	4.80	1.20	3.60	0.17	0.20
1.8	110	6.295	0.74	0.44	7.71	5.28	1.32	3.96	0.17	0.20
2.0	120	5.194	0.61	0.36	8.08	5.76	1.44	4.32	0.16	0.20
2.2	130	4.466	0.52	0.31	8.39	6.24	1.56	4.68	0.15	0.20
2.3	140	3.949	0.46	0.28	8.67	6.72	1.68	5.04	0.14	0.20
2.5	150	3.56	0.42	0.25	8.92	7.20	1.80	5.40	0.12	0.20
2.7	160	3.252	0.38	0.23	9.15	7.68	1.92	5.76	0.10	0.20
2.8	170	3.01	0.35	0.21	9.36	8.16	2.04	6.12	0.08	0.20
3.0	180	2.799	0.33	0.20	9.55	8.64	2.16	6.48	0.06	0.20
3.2	190	2.622	0.31	0.18	9.74	8.76	2.28	6.48	0.07	0.20
3.3	200	2.476	0.29	0.17	9.91	8.88	2.40	6.48	0.07	0.20
3.5	210	2.346	0.27	0.16	10.08	9.00	2.52	6.48	0.07	0.20
3.7	220	2.233	0.26	0.16	10.23	9.12	2.64	6.48	0.08	0.20
3.8	230	2.136	0.25	0.15	10.38	9.24	2.76	6.48	0.08	0.20
4.0	240	2.136	0.25	0.15	10.53	9.36	2.88	6.48	0.08	0.20
4.2	250			0.00	10.53	9.48	3.00	6.48	0.07	0.20
4.3	260			0.00	10.53	9.60	3.12	6.48	0.06	0.20
4.5	270			0.00	10.53	9.72	3.24	6.48	0.06	0.20
4.7	280			0.00	10.53	9.84	3.36	6.48	0.05	0.20
4.8	290			0.00	10.53	9.96	3.48	6.48	0.04	0.20
5.0	300			0.00	10.53	10.08	3.60	6.48	0.03	0.20
5.2	310			0.00	10.53	10.20	3.72	6.48	0.02	0.20
5.3	320			0.00	10.53	10.32	3.84	6.48	0.01	0.20
5.5	330			0.00	10.53	10.44	3.96	6.48	0.01	0.20
5.7	340			0.00	10.53	10.53	4.08	6.45	0.00	0.20
5.8	350			0.00	10.53	10.53	4.20	6.33	0.00	0.20
6.0	360			0.00	10.53	10.53	4.32	6.21	0.00	0.20
6.2	370			0.00	10.53	10.53	4.44	6.09	0.00	0.20
6.3	380			0.00	10.53	10.53	4.56	5.97	0.00	0.20
6.5	390			0.00	10.53	10.53	4.68	5.85	0.00	0.20
6.7	400			0.00	10.53	10.53	4.80	5.73	0.00	0.20
6.8	410			0.00	10.53	10.53	4.92	5.61	0.00	0.20
7.0	420			0.00	10.53	10.53	5.04	5.49	0.00	0.20
7.2	430			0.00	10.53	10.53	5.16	5.37	0.00	0.20
7.3	440			0.00	10.53	10.53	5.28	5.25	0.00	0.20

Time (hr)	Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Minimum Captured Volume (m^3/min)	Cumulative Runoff Volume (m^3)	Cumulative Captured Volume (m^3)	Cumulative Released Volume (m^3)	Volume in B-R Cell (m^3)	Ponding Depth m	Release Volume l/s
7.5	450			0.00	10.53	10.53	5.40	5.13	0.00	0.20
7.7	460			0.00	10.53	10.53	5.52	5.01	0.00	0.20
7.8	470			0.00	10.53	10.53	5.64	4.89	0.00	0.20
8.0	480			0.00	10.53	10.53	5.76	4.77	0.00	0.20
8.2	490			0.00	10.53	10.53	5.88	4.65	0.00	0.20
8.3	500			0.00	10.53	10.53	6.00	4.53	0.00	0.20
8.5	510			0.00	10.53	10.53	6.12	4.41	0.00	0.20
8.7	520			0.00	10.53	10.53	6.24	4.29	0.00	0.20
8.8	530			0.00	10.53	10.53	6.36	4.17	0.00	0.20
9.0	540			0.00	10.53	10.53	6.48	4.05	0.00	0.20
9.2	550			0.00	10.53	10.53	6.60	3.93	0.00	0.20
9.3	560			0.00	10.53	10.53	6.72	3.81	0.00	0.20
9.5	570			0.00	10.53	10.53	6.84	3.69	0.00	0.20
9.7	580			0.00	10.53	10.53	6.96	3.57	0.00	0.20
9.8	590			0.00	10.53	10.53	7.08	3.45	0.00	0.20
10.0	600			0.00	10.53	10.53	7.20	3.33	0.00	0.20
10.2	610			0.00	10.53	10.53	7.32	3.21	0.00	0.20
10.3	620			0.00	10.53	10.53	7.44	3.09	0.00	0.20
10.5	630			0.00	10.53	10.53	7.56	2.97	0.00	0.20
10.7	640			0.00	10.53	10.53	7.68	2.85	0.00	0.20
10.8	650			0.00	10.53	10.53	7.80	2.73	0.00	0.20
11.0	660			0.00	10.53	10.53	7.92	2.61	0.00	0.20
11.2	670			0.00	10.53	10.53	8.04	2.49	0.00	0.20
11.3	680			0.00	10.53	10.53	8.16	2.37	0.00	0.20
11.5	690			0.00	10.53	10.53	8.28	2.25	0.00	0.20
11.7	700			0.00	10.53	10.53	8.40	2.13	0.00	0.20
11.8	710			0.00	10.53	10.53	8.52	2.01	0.00	0.20
12.0	720			0.00	10.53	10.53	8.64	1.89	0.00	0.20
12.2	730			0.00	10.53	10.53	8.76	1.77	0.00	0.20
12.3	740			0.00	10.53	10.53	8.88	1.65	0.00	0.20
12.5	750			0.00	10.53	10.53	9.00	1.53	0.00	0.20
12.7	760			0.00	10.53	10.53	9.12	1.41	0.00	0.20
12.8	770			0.00	10.53	10.53	9.24	1.29	0.00	0.20
13.0	780			0.00	10.53	10.53	9.36	1.17	0.00	0.20
13.2	790			0.00	10.53	10.53	9.48	1.05	0.00	0.20
13.3	800			0.00	10.53	10.53	9.60	0.93	0.00	0.20
13.5	810			0.00	10.53	10.53	9.72	0.81	0.00	0.20
13.7	820			0.00	10.53	10.53	9.84	0.69	0.00	0.20
13.8	830			0.00	10.53	10.53	9.96	0.57	0.00	0.20
14.0	840			0.00	10.53	10.53	10.08	0.45	0.00	0.20
14.2	850			0.00	10.53	10.53	10.20	0.33	0.00	0.20
14.3	860			0.00	10.53	10.53	10.32	0.21	0.00	0.20
14.5	870			0.00	10.53	10.53	10.44	0.09	0.00	0.20
0.0	880			0.00	10.53	10.53	10.53	0.00	0.00	0.20

BioRetention Design Sheet - Street F Composite

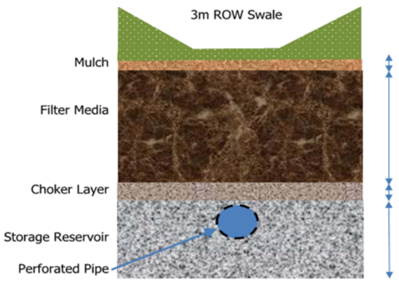
Project Name: Port Credit West Village
Municipality: City of Mississauga
Project No.: 16-489
Date: 8-Nov-18

Prepared by: N.M
Checked by: A.F.
Submission #: 2nd FSR Submission

Legend	
🟪	= Inactive Cells
🟦	= Inputs
🟧	= Storage Targets
🟩	= Outputs

Inputs

2-D Bio-Retention Cell Schematic



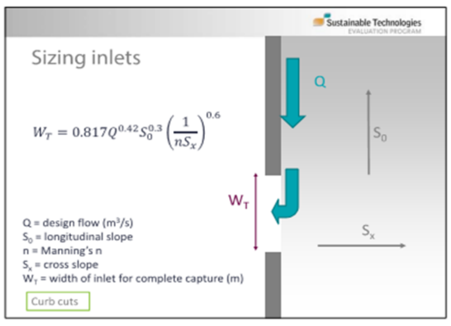
Layer	Layer Depth (m)	Layer Void Ratio	K (mm/hr)
Ponding	0.25	1	
Mulch	0.2	0.7	233
Filter Media	0.8	0.3	200
Choker Layer	0.1	0.2	50
Storage Reservoir	0.2	0.4	1250
Total Depth	1.55		
Composite Void Ratio		0.47	

Site Variables

Contributing ROW Length	62.6	m
Contributing ROW "Width"	9.5	m
Permeability of "Tightest" Soil Layer (choker layer?)	50	mm/hr
Evapotranspiration Rate (in which month? Ranges from 0.4 to 3.8 mm/day)	0.04	mm/hr
Catchment Peak Flow (from Rational Method)	0.073	m^3/s
Contributing Drainage Area	0.5783	ha

Inlet Sizing

Longitudinal Slope	2.00%	%
Mannings (n)	0.032	
Sx (Cross Slope)	2.00%	%
Q (Design Flow)	0.073	m^3/s



Sizing inlets

$$W_T = 0.817 Q^{0.42} S_0^{0.3} \left(\frac{1}{nS_x}\right)^{0.6}$$

Q = design flow (m^3/s)
S_0 = longitudinal slope
n = Manning's n
S_x = cross slope
W_T = width of inlet for complete capture (m)

Bioretention Cell Variables

Length of B-R Swale	8.6	m
Design Infiltration Rate	50	mm/hr
Allowable Ponding Depth	0.25	m
Bottom width of Swale	1	m
Side Slopes of Swale	3:1, 3:1	
Depth of Medium (m)	0.3	m
Area of BioRetention Cell:	238	m^2
Perimeter of BioRetention Cell:	20.2	m
Total Reservoir Depth	1.55	m
Max flow through Media	0.0033	m^3/s

Perforated Pipe Details

Diameter	100	mm
Length (m)	10.66667	m
B (Clogging Factor)	0.5	(typical)
Cd (Discharge Coefficient)	0.61	(sharp edge)
Open Area per meter (m^2/m)	0.0037	(from manufacturer)
H_{max} (ponding over top of pipe)	0.20	m
Q_{max}	0.024	m^3/s

Targets

Maximum Storage Volume (no cell discharge):	307.0	m^3
Bioretention Cell Depth Required (no cell discharge):	3.22	m
Required Storage Volume (From Swale Drawdown Sheet)	82.4	m^3
Bioretention Cell Depth Required:	0.73	m
Rainfall to Capture:	25	mm
Time required to infiltrate RVCt volume	26	hrs

Outputs

Green: Target is met
Red: Not enough area or depth

Calculated Storage and Depth

Retention Volume Provided	173.7	m^3
Cell Depth Provided	1.550	m

System Exfiltration Rate

Outlet Pipe? (Y/N)	**Yes**	
$Q_{max,p}$ (flow into perforated pipe)	0.024	m^3/s
Q_s (Percolation Rate through Tightest Soil Layer)	0.0033	m^3/s
Controlling Rate	0.0033	m^3/s

Drawdown Time

Calculated Ponding Depth	0.05	m
Calculated Surface Drawdown Time	0.0	hrs
Calculated Cell Drawdown Time	10.8	hrs

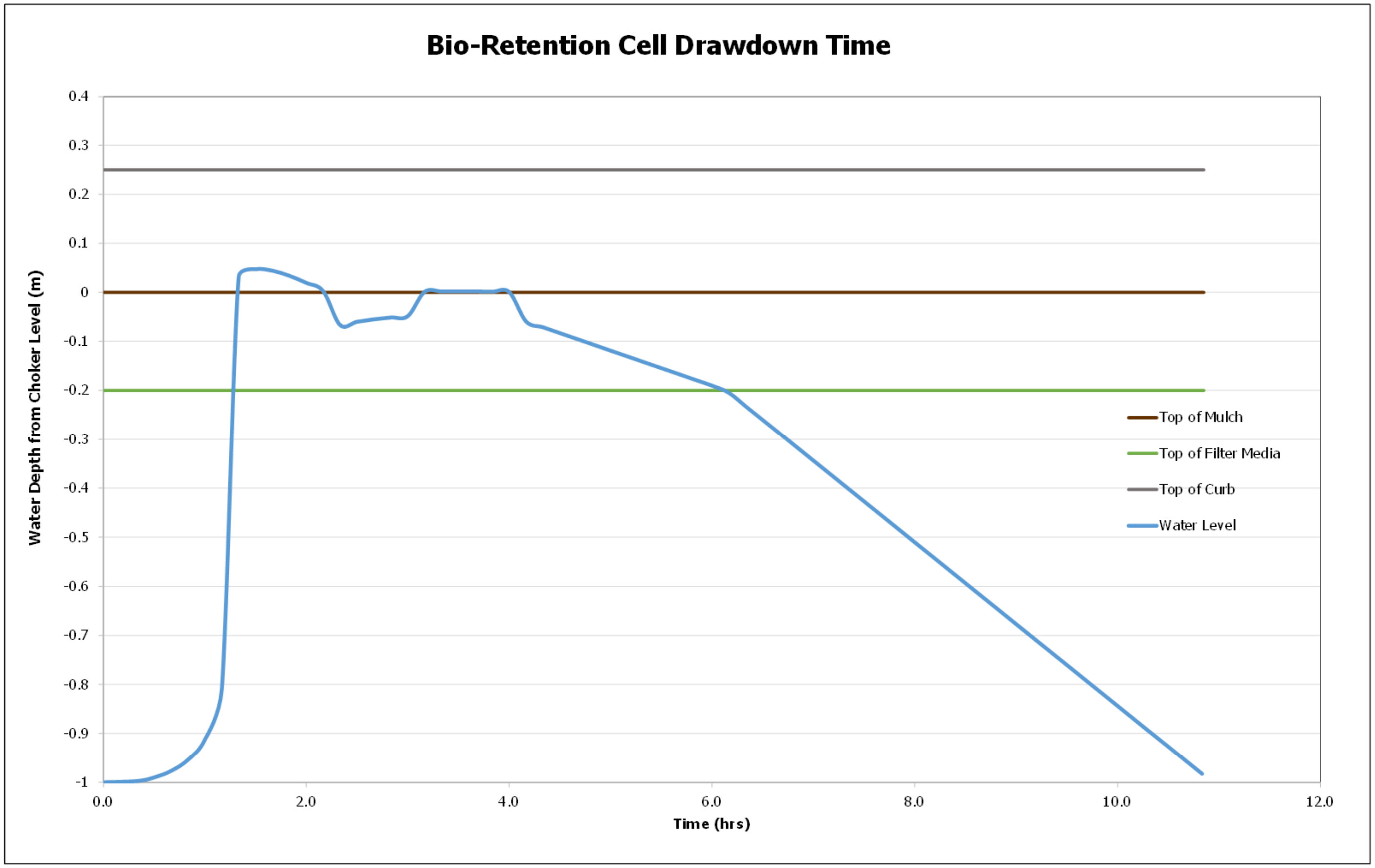
Required Inlet Width

W_T (inlet width for complete capture)	6.93	m

Advanced Bio-Retention Design Output

Project Name: Port Credit West Village
Municipality: City of Mississauga
Project No.: 16-489
Date: 8-Nov-18

Prepared by: N.M
Checked by: A.F.
Submission #: 2nd FSR Submission



Advanced Bio-Retention Design Output

Project Name: Port Credit West Village
Municipality: City of Mississauga
Project No.: 16-489
Date: 8-Nov-18

Prepared by: N.M
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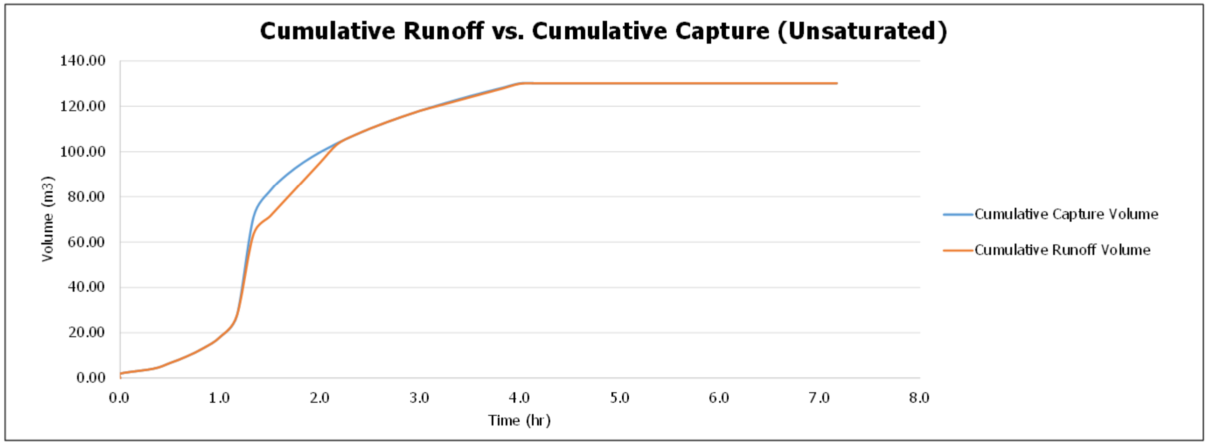

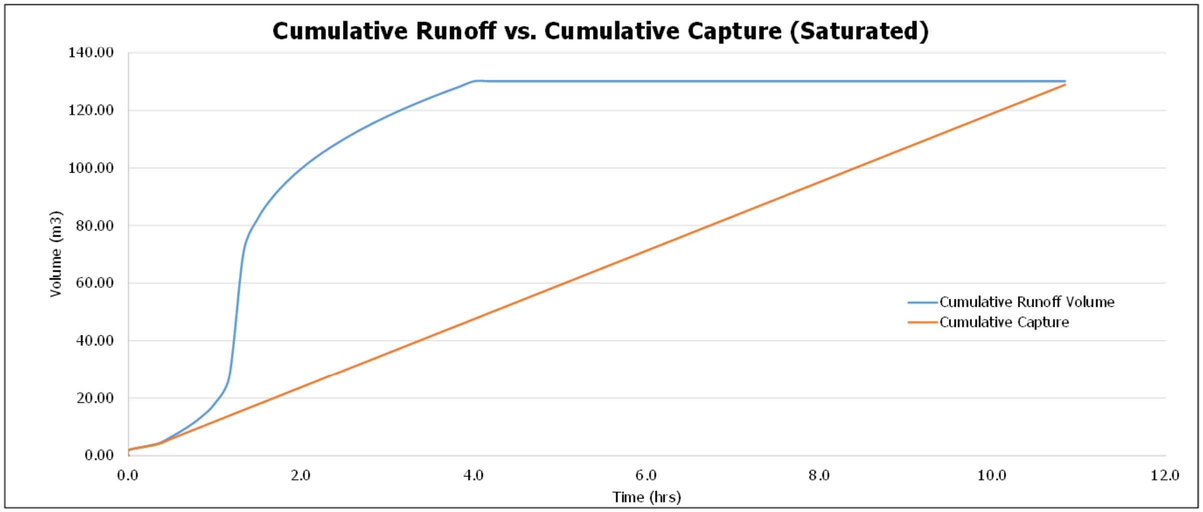

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Advanced Bio-Retention Drawdown Calculation

Project Name: Port Credit West Village
Municipality: City of Mississauga
Project No.: 16-489
Date: 8-Nov-18

Prepared by: N.M
Checked by: A.F.
Submission #: 2nd FSR Submission

Contributing Drainage Area =	0.5783	ha
Bioretention Surface Area =	238	m^2
"C" =	0.90	
AC=	0.52047	ha
Tc =	10.0	min
Time Increment =	10.0	min
Total Infiltration Rate =	3.31	l/s
Max.Storage =	82	m^3
Max.Runoff =	73	l/s

Time Delay Calculation

Layer	Layer Depth (m)	Layer Void Ratio	Wet Hydraulic Conductivity [K_{sat}] (m/s)	Infiltration Rate (m^3/min)	Layer Void Volume (m^3)	Cumulative Void Volume (m^3)	Wet "Travel" time (hr)
Ponding	0.25	1			59.5	59.5	
Mulch	0.2	0.7	6.481E-05	9.26E-01	33.32	92.82	0.86
Filter Media	0.8	0.3	5.556E-05	7.93E-01	57.12	149.94	4.00
Choker Layer	0.1	0.2	1.389E-05	1.98E-01	4.76	154.7	2.00
Storage Reservoir	0.2	0.4	3.472E-04	4.96E+00	19.04	173.74	0.16
Total/Cumulative	1.55	0.47					7.02

Time (hr)	Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Minimum Captured Volume (m^3/min)	Cumulative Runoff Volume (m^3)	Cumulative Captured Volume (m^3)	Cumulative Released Volume (m^3)	Volume in B-R Cell (m^3)	Ponding Depth m	Release Volume l/s
0.0	0	2.071	3.00	0.00	0.00	0.00	0.00	0.00	0.00	
0.0	10	2.266	3.28	1.97	1.97	1.97	1.97	0.00	0.00	3.31
0.3	20	2.524	3.65	2.19	4.16	4.16	3.97	0.19	0.00	3.31
0.5	30	2.88	4.17	2.50	6.65	6.65	5.95	0.70	0.00	3.31
0.7	40	3.382	4.89	2.94	9.59	9.59	7.93	1.65	0.00	3.31
0.8	50	4.175	6.04	3.62	13.21	13.21	9.92	3.29	0.00	3.31
1.0	60	5.696	8.24	4.94	18.15	18.15	11.90	6.25	0.00	3.31
1.2	70	10.777	15.59	9.36	27.50	27.50	13.88	13.61	0.00	3.31
1.3	80	50.214	72.65	15.87	71.06	63.47	15.87	47.60	0.03	3.31
1.5	90	13.366	19.34	11.60	82.65	71.40	17.85	53.55	0.05	3.31
1.7	100	8.286	11.99	7.19	89.84	79.33	19.83	59.50	0.04	3.31
1.8	110	6.295	9.11	5.46	95.30	87.27	21.82	65.45	0.03	3.31
2.0	120	5.194	7.52	4.51	99.80	95.20	23.80	71.40	0.02	3.31
2.2	130	4.466	6.46	3.88	103.68	103.13	25.78	77.35	0.00	3.31
2.3	140	3.949	5.71	3.43	107.10	107.10	27.77	79.34	0.00	3.31
2.5	150	3.56	5.15	3.09	110.19	110.19	29.75	80.44	0.00	3.31
2.7	160	3.252	4.71	2.82	113.01	113.01	31.73	81.28	0.00	3.31
2.8	170	3.01	4.36	2.61	115.62	115.62	33.72	81.91	0.00	3.31
3.0	180	2.799	4.05	2.43	118.05	118.05	35.70	82.35	0.00	3.31
3.2	190	2.622	3.79	2.28	120.33	120.04	37.68	82.35	0.00	3.31
3.3	200	2.476	3.58	2.15	122.47	122.02	39.67	82.35	0.00	3.31
3.5	210	2.346	3.39	2.04	124.51	124.00	41.65	82.35	0.00	3.31
3.7	220	2.233	3.23	1.94	126.45	125.99	43.63	82.35	0.00	3.31
3.8	230	2.136	3.09	1.85	128.30	127.97	45.62	82.35	0.00	3.31
4.0	240	2.136	3.09	1.85	130.15	129.95	47.60	82.35	0.00	3.31
4.2	250			0.00	130.15	130.15	49.58	80.57	0.00	3.31
4.3	260			0.00	130.15	130.15	51.57	78.59	0.00	3.31
4.5	270			0.00	130.15	130.15	53.55	76.60	0.00	3.31
4.7	280			0.00	130.15	130.15	55.53	74.62	0.00	3.31
4.8	290			0.00	130.15	130.15	57.52	72.64	0.00	3.31
5.0	300			0.00	130.15	130.15	59.50	70.65	0.00	3.31
5.2	310			0.00	130.15	130.15	61.48	68.67	0.00	3.31
5.3	320			0.00	130.15	130.15	63.47	66.69	0.00	3.31
5.5	330			0.00	130.15	130.15	65.45	64.70	0.00	3.31
5.7	340			0.00	130.15	130.15	67.43	62.72	0.00	3.31
5.8	350			0.00	130.15	130.15	69.42	60.74	0.00	3.31
6.0	360			0.00	130.15	130.15	71.40	58.75	0.00	3.31
6.2	370			0.00	130.15	130.15	73.38	56.77	0.00	3.31
6.3	380			0.00	130.15	130.15	75.37	54.79	0.00	3.31
6.5	390			0.00	130.15	130.15	77.35	52.80	0.00	3.31
6.7	400			0.00	130.15	130.15	79.33	50.82	0.00	3.31
6.8	410			0.00	130.15	130.15	81.32	48.84	0.00	3.31
7.0	420			0.00	130.15	130.15	83.30	46.85	0.00	3.31
7.2	430			0.00	130.15	130.15	85.28	44.87	0.00	3.31
7.3	440			0.00	130.15	130.15	87.27	42.89	0.00	3.31

Time (hr)	Time (min)	Rainfall Intensity (mm/hr)	Storm Runoff (l/s)	Minimum Captured Volume (m^3/min)	Cumulative Runoff Volume (m^3)	Cumulative Captured Volume (m^3)	Cumulative Released Volume (m^3)	Volume in B-R Cell (m^3)	Ponding Depth m	Release Volume l/s
7.5	450			0.00	130.15	130.15	89.25	40.90	0.00	3.31
7.7	460			0.00	130.15	130.15	91.23	38.92	0.00	3.31
7.8	470			0.00	130.15	130.15	93.22	36.94	0.00	3.31
8.0	480			0.00	130.15	130.15	95.20	34.95	0.00	3.31
8.2	490			0.00	130.15	130.15	97.18	32.97	0.00	3.31
8.3	500			0.00	130.15	130.15	99.17	30.99	0.00	3.31
8.5	510			0.00	130.15	130.15	101.15	29.00	0.00	3.31
8.7	520			0.00	130.15	130.15	103.13	27.02	0.00	3.31
8.8	530			0.00	130.15	130.15	105.12	25.04	0.00	3.31
9.0	540			0.00	130.15	130.15	107.10	23.05	0.00	3.31
9.2	550			0.00	130.15	130.15	109.08	21.07	0.00	3.31
9.3	560			0.00	130.15	130.15	111.07	19.09	0.00	3.31
9.5	570			0.00	130.15	130.15	113.05	17.10	0.00	3.31
9.7	580			0.00	130.15	130.15	115.03	15.12	0.00	3.31
9.8	590			0.00	130.15	130.15	117.02	13.14	0.00	3.31
10.0	600			0.00	130.15	130.15	119.00	11.15	0.00	3.31
10.2	610			0.00	130.15	130.15	120.98	9.17	0.00	3.31
10.3	620			0.00	130.15	130.15	122.97	7.19	0.00	3.31
10.5	630			0.00	130.15	130.15	124.95	5.20	0.00	3.31
10.7	640			0.00	130.15	130.15	126.93	3.22	0.00	3.31
10.8	650			0.00	130.15	130.15	128.92	1.24	0.00	3.31
0.0	660			0.00	130.15	130.15	130.15	0.00	0.00	3.31

Preliminary Site Plan LID Sizing

Project Name: Port Credit West Village
Municipality: City of Mississauga
Project No.: 16-489
Date: 8-Nov-18

Prepared by: J.L.
Checked by: A.F.
Submission #: 2nd FSR Submission

Drainage Block	Land Use	Total Area	Green Roofs			Landscaping Area									Paved Areas			Volume Reduction			Cin Area to be treated (with rooftop capture) (ha)	Total TSS Removal (with TH and Green Roof Capture)
			Area			Bioretention (Rain Gardens)			Vegetated Swales			Tree Pits			Permeable Paver			Rain Barrels	Cisterns			
			High-Rise Rooftop (ha)	Building Footprint (ha)	Green Roof Area (ha)	Bioretention Footprint (ha)	Bioretention Treatment Area (ha)	TSS Removal	Vegetated Swales Footprint (ha)	Vegetated Swales Treatment Area (ha)	TSS Removal	# of Trees	Treatment Area (ha)	Tss Removal	Permeable Paver Area (ha)	Treated Area (ha)	TSS Removal	# of Rain Barrels	Cistern Volume (L)	Cistern Treatment Area (ha)		
1	Townhouses	0.451		0.196		0.018	0.263	74%										12		0.000	0.238	82%
2	Townhouses	0.667		0.238		0.030	0.450	74%										8		0.000	0.399	84%
3	Mixed	0.842	0.348	0.405	0.075	0.030	0.450	74%												0.348	0.408	82%
5	High-Rise	0.601	0.270	0.270	0.100	0.020	0.300	74%							0.050	0.063	12%		5000	0.270	0.261	87%
6	Townhouses	0.280		0.118		0.011	0.165	74%										4		0.000	0.151	81%
8	Townhouses	2.499		0.844		0.100	1.500	74%	0.035	0.350	20%				0.210	0.263	10%	24		0.000	1.346	87%
21	Park	0.323																		0.000	0.323	N/A
20	Park	0.576																		0.000	0.576	N/A
9	Mixed	2.287	0.236	0.795	0.040	0.085	1.275	74%	0.035	0.350	21%				0.130	0.163	6%	16	5000	0.236	1.277	81%
7	High-Rise	0.427	0.157	0.222	0.080	0.015	0.225	74%											5000	0.157	0.189	88%
10	Mixed	1.171	0.382	0.532	0.125	0.040	0.600	74%							0.076	0.095	9%	4	10000	0.382	0.523	86%
11	High-Rise	1.224	0.691	0.691	0.173	0.035	0.525	74%							0.030	0.038	4%		10000	0.691	0.468	84%
12	Townhouses	1.477		0.572		0.050	0.750	74%	0.018	0.180	18%				0.110	0.138	9%	16		0.000	0.745	81%
13	Mixed	1.373	0.153	0.576	0.046	0.040	0.600	69%	0.024	0.240	28%				0.110	0.138	11%	12	5000	0.153	0.647	80%
14	Townhouses	0.874		0.381		0.030	0.450	74%							0.045	0.056	7%	16		0.000	0.418	81%
15	Park	0.264																		0.000	0.264	N/A
22	Park	3.961																		0.000	3.961	N/A
16	Townhouses	0.385		0.139		0.018	0.270	74%										8		0.000	0.228	88%
18	High-Rise	2.106	1.055	1.055	0.200	0.055	0.825	74%							0.250	0.313	21%		10000	1.055	0.746	86%
17	High-Rise	0.375	0.116	0.116	0.037	0.018	0.270	74%											10000	0.116	0.241	83%
		22.2	**3.41**	**7.15**	**0.88**	**0.59**	**8.92**		**0.11**	**1.12**					**1.01**	**1.26**		**120**		**3.41**		**84%**

🟥 =High-Rise Blocks
🟨 =Townhouse Blocks
⬜ =Mixed Blocks

7.0 BMP SPECIFIC INSPECTION, TESTING AND MAINTENANCE

7.1 Bioretention and Dry Swales

7.1.1 BMP Overview

Bioretention is a general term that refers to stormwater treatment practices that temporarily store runoff in shallow, depressed planting beds or other structures (e.g., concrete planters) and treat it by sedimentation, filtration through highly permeable soil (i.e., filter media) and the root zones of plants, infiltration into underlying sub-soil and evaporation back to the atmosphere. Runoff water is delivered to the practice through inlets such as curb-cuts or other concrete structures, sheet flow from paved areas, or pipes connected to other stormwater conveyances (e.g., catchbasins, roof downspouts). The planting bed and side slopes are typically covered with a mixture of vegetation, mulch and stone. Water that is in excess of the surface ponding or storage capacity overflows to an adjacent drainage system (e.g., municipal storm sewer or other BMP). Bioretention is typically designed to capture runoff from small to medium-sized storm events. An overflow outlet or bypass is necessary to safely convey flows from major storm events. Filtered water is either infiltrated into the underlying native sub-soil or collected by a sub-drain and discharged to the municipal storm sewer system. Key components of bioretention practices for inspection and maintenance are described in Table 7.1 and Figure 7.1.

Properly functioning bioretention practices reduce the quantity of runoff and pollutants being discharged to municipal storm sewers and receiving waters (i.e., rivers, lakes and wetlands) and can help replenish groundwater resources. In addition to their SWM benefits, bioretention areas provide aesthetic value as attractive landscaped features.

A variety of terms can be used to describe design variations for the practice of bioretention. Rain gardens or bioretention cells are depressed planting beds located on individual lots that receive drainage from small to medium-sized areas. Depending on the permeability of the underlying native sub-soil and other constraints, bioretention practices may be designed without a sub-drain for full infiltration, with a sub-drain for partial infiltration, or with an impermeable liner and sub-drain for filtration only. The sub-drain pipe may feature a flow restrictor (e.g., orificed cap, ball valve) in BMPs designed to control peak flow rate. Bio-filters are another name for lined, filtration only bioretention practices. A linearly oriented bioretention practice may be referred to as a bioretention swale (i.e., bio-swale) or dry swale. When contained within engineered structures they may be referred to as stormwater planters or soil cells. Bioretention practices can be adapted to fit into many different contexts and provide a convenient area for snow storage and treatment.

Table 7.1: *Key Components of Bioretention and Dry Swales for Inspection and Maintenance.*

Component	Description
Contributing Drainage Area	The area from which runoff directed to the BMP originates. CDAs include impervious and pervious areas draining to the BMP and the BMP itself. CDAs should be free of point sources of pollutants (e.g., leaking waste containers, spills, failing ESCs). Trash, sediment and debris should be removed regularly from pavements and other conveyances (e.g., gutters, catchbasins, eavestroughs) draining to the BMP.
Inlets	Inlets can be pavement edges (for BMPs receiving sheet flow), curb-cuts, pipes or other engineered structures. Inlets must remain unobstructed to ensure that stormwater enters the BMP as designed. Scour protection features (e.g., stone cover, flow spreader) may also be needed for curb-cut or pipe inlets to prevent erosion of the filter bed from concentrated flow.
Pretreatment	Pretreatment refers to techniques or devices used to slow down and spread out concentrated stormwater flow and retain coarse materials suspended in runoff through filtration or settling, before it enters the BMP. Proper pretreatment extends the operating life cycle of the BMP by reducing the rate of accumulation of coarse sediment in the BMP. Common pretreatment devices include vegetated filter strips, geotextile-lined stone inlets, gravel diaphragms, forebays, check dams, eavestrough screens or filters, oil and grit separators (i.e., hydrodynamic separators) and manholes containing baffles or filters and sumps. Pretreatment devices require frequent (e.g., annual or bi-annual) trash, sediment and debris removal.
Perimeter	Side slopes of the BMP, covered by a mixture of vegetation, mulch and stone with slopes of 2:1 (H:V) or less that surround the filter bed and allow for surface ponding. For stormwater planters the perimeter may be a concrete or masonry structure with vertical walls. Inspection of the perimeter is done to confirm the dimensions of the BMP are acceptable, ensure the structural integrity of side slopes or vertical walls is maintained and confirm that the BMP continues to provide the designed surface ponding water storage capacity. Periodic maintenance of side slopes may be needed to repair erosion rills or damage from vehicle or foot traffic.
Filter bed	Flat or gently sloping area composed of a 0.5 to 1 metre deep layer of filter media soil covered by a mixture of vegetation, mulch and stone where surface ponding and infiltration of runoff occurs. Bioretention practices are designed to infiltrate all water ponded on the surface within 24 hours of the end of a storm to prevent conditions supportive of mosquito breeding. Filter beds should be checked for presence of standing water. Trash should be removed from the filter bed regularly. Mulch or stone cover should be maintained on non-vegetated areas to prevent weed growth and soil erosion. Accumulated sediment should be periodically removed to maintain infiltration function. Repair of animal burrows, sunken areas, erosion rills or damage from vehicle or foot traffic may also be needed to prevent short circuiting of flow through the filter media soil. Maximum ponding depth should be checked to ensure designed water storage capacity is maintained.
Vegetation	Bioretention practices rely on vegetation to intercept, uptake and evapotranspire stormwater and provide habitat for soil organisms that break down pollutants. Plant roots also help to maintain soil structure and permeability. Routine maintenance of vegetation is the same as a conventional planting bed (i.e., weeding, mowing, pruning, irrigation during droughts). In the first 2 months of

	establishment, plantings need to be irrigated frequently (e.g., bi-weekly). As bioretention practices are intended to retain nutrients from inflowing stormwater, applying fertilizer to the filter bed should not be a part of routine maintenance.
Overflow Outlets	Flows exceeding the storage capacity of the BMP are conveyed to an adjacent drainage system via an overflow outlet structure (e.g., pipe, standpipe, curb-cut, swale, catchbasin). Overflow outlet structures must be kept free of obstructions to ensure stormwater is safely conveyed during major storm events.
Sub-drain	Sub-drains are optional components that may be included where the permeabililty of the underlying native sub-soil is low or, due to other constraints, an impermeable liner is required. They are installed below the filter media soil layer to collect and convey treated water to an adjacent drainage system. Sub-drains are comprised of perforated pipes wrapped in a gravel blanket and in some cases geotextile filter fabric. The perforated pipe must be kept free of obstructions to ensure that the subsurface water storage capacity of the BMP drains within a specified time period. A maintenance port standpipe may be connected to the perforated pipe to provide a means of flushing and inspecting it. Perforated pipes should be routinely flushed with water to remove sediment. Trimming of plant roots that have penetrated the perforated pipes may be warranted periodically. If the sub-drain is equipped with a flow-restrictor (e.g., orificed cap, ball valve) to attenuate flow rates, the flow restrictor must be inspected and cleaned regularly.
Monitoring well	Standpipes that extend from above the surface of the filter bed to the bottom of the excavation and contain perforations or slots to allow observation and measurement of subsurface water level in the BMP. Monitoring wells are needed to determine if the BMP drains within an acceptable time period and to track drainage performance over its operating lifespan. Standpipes should be securely capped on both ends and remain undamaged and free of sediment which may require periodic flushing.

7.1.2 Inspection and Testing Framework

Table 7.2 describes what visual and testing indicators should be used for bioretention practices during each type of inspection and provides a basis for planning field work. Numbers in the first column refer to the part of Section 8.0 and Appendix C that provides detailed guidance on standard protocols and test methods for assessing the respective indicator.

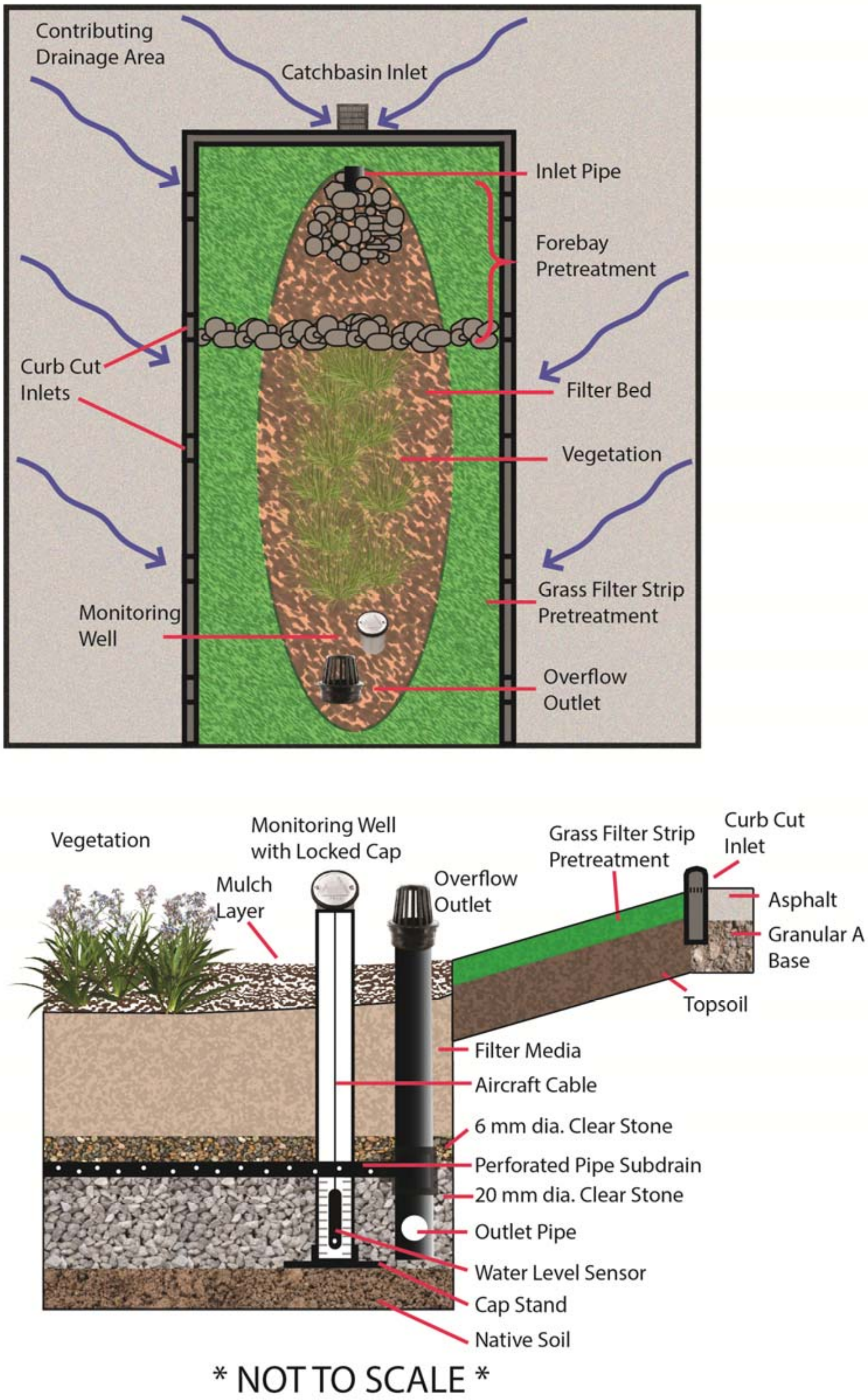


***Figure 7.1:** Generalized plan and cross-section views of a bioretention cell showing key components.*

Table 7.2: *Inspection and testing indicators framework for bioretention and dry swales.*

INSPECTION AND TESTING FRAMEWORK					
BIORETENTION & DRY SWALES		**Inspection Type**			
Section	**Indicator**	**Construction**	**Assumption**	**Routine Operation**	**Verification**
Visual indicators					
C.1	CDA condition	x	x	x	x
C.2	Inlet/Flow spreader structural integrity		x	x	x
C.3	Inlet/Flow spreader obstruction	x	x	x	x
C.4	Pretreatment sediment accumulation	x	x	x	
C.5	Inlet erosion		x	x	
C.6	BMP dimensions	x	x		x
C.7	Side slope erosion		x	x	
C.8	Surface ponding area	x	x		x
C.9	Standing water		x	x	x
C.10	Trash		x	x	
C.11	Filter bed erosion		x	x	
C.12	Mulch depth	x	x	x	x
C.13	Filter bed sediment accumulation		x	x	x
C.14	Surface ponding depth	x	x		x
C.15	Filter bed surface sinking		x	x	x
C.16	Check dams	x	x	x	x
C.17	Vegetation cover	x	x	x	x
C.18	Vegetation condition		x	x	
C.19	Vegetation composition	x	x	x	
C.20	Monitoring well condition	x	x	x	x
C.21	Sub-drain/Perforated pipe obstruction		x		x
C.22	Overflow outlet obstruction	x	x	x	x
Testing Indicators					
8.2	Soil characterization testing	x	x		(x)
8.3	Sediment accumulation testing	x	x	x	x
8.4	Surface infiltration rate testing		x		(x)
8.5	Natural or simulated storm event testing		x		(x)
8.6	Continuous monitoring		x		(x)

(x) denotes indicators to be used for Performance Verification inspections only (i.e., not for Maintenance Verification inspections)

7.1.3 Critical Timing of Construction Inspections

Construction inspections take place during several points in the construction sequence, specific to the type of LID BMP, but at a minimum should be done weekly and include the following:

1. During site preparation, prior to BMP excavation and grading to ensure the CDA is stabilized or that adequate ESCs or flow diversion devices are in place and confirm that construction materials meet design specifications;
2. At completion of excavation and grading, prior to installation of pipes/sewers and backfilling to ensure depths, slopes and elevations are acceptable;
3. At completion of installation of pipes/sewers, prior to backfilling to ensure slopes and elevations are acceptable;
4. After final grading, prior to planting to ensure depths, slopes and elevations are acceptable;
5. Prior to hand-off points in the construction sequence when the contractor responsible for the work changes (i.e., hand-offs between the storm sewer servicing, paving, building and landscaping contractors);
6. After every large storm event (e.g., 15 mm rainfall depth or greater) to ensure ESCs and pretreatment or flow diversion devices are functioning and adequately maintained.

Table 7.3 describes critical points during the construction sequence when inspections should be performed prior to proceeding further. Table 7.3 can also be used as a checklist during Construction inspections, in addition to the Inspection Field Data Forms provided in Appendix C.

7.1.4 Inspection Field Data Forms

Template forms for recording inspection observations, measurements, sampling location details and follow-up actions have been prepared for each LID BMP type and can be found in Appendix C.

Table 7.3: *Critical timing of construction inspections - bioretention and dry swales.*

Construction Sequence Step and Timing	Inspection Item	Observations [1]
Site Preparation – after site clearing and grading, prior to BMP excavation and grading	Natural heritage system and tree protection areas remain fenced off	
	ESCs protecting BMP layout area are installed properly	
	CDA is stabilized or runoff is diverted around BMP layout area	
	BMP layout area has been cleared and is staked/delineated	
	Benchmark elevation(s) are established nearby	
	Construction materials have been confirmed to meet design specifications	
BMP Excavation and Grading - prior to installation of pipes/sewers and backfilling	Excavation location, footprint, depth and slopes are acceptable	
	Excavated soil is stockpiled outside the CDA	
	Embankments/berms (elevations, slopes, compaction) are acceptable	
	Excavation bottom and sides roughened to reduce smearing and compaction	
BMP Installation – after installation of pipes/sewers, prior to backfilling	Structural components (e.g., foundation, walls) installed according to plans, if applicable	
	Impermeable liner installed correctly, if applicable	
	Installations of sub-drain pipes (e.g., locations, elevations, slopes), standpipes/monitoring wells are acceptable	
	Sub-drain trench dams installed correctly (location, elevation)	
Landscaping – after final grading, prior to planting	Filter bed depth and surface elevations at inlets are acceptable	
	Maximum surface ponding depth is acceptable	
	Filter bed is free of ruts, local depressions and not overly compacted	
	Planting material meets approved planting plan specifications (plant types and quantities)	

Notes:

1. S = Satisfactory; U= Unsatisfactory; NA = Not Applicable

7.1.5 Routine Maintenance

Table 7.4 describes routine maintenance tasks for bioretention practices, organized by BMP component, along with recommended minimum frequencies. It also suggests higher frequencies for certain tasks that may be warranted for BMPs located in highly visible locations or those receiving flow from high traffic areas (vehicle or pedestrian). Tasks involving removal of trash, debris and sediment and weeding/trimming of vegetation for BMPs in such contexts may need to be done more frequently (i.e., higher standards may be warranted).

Individuals conducting vegetation maintenance and in particular, weeding (i.e., removal of undesirable vegetation), should be familiar with the species of plants specified in the planting plan and experienced in plant identification and methods of removing/controlling noxious weeds. Key resources on these topics are provided below:

- Agriculture and Agri-food Canada's WeedInfo database, http://www.weedinfo.ca/en/
- Ontario Ministry of Agriculture, Food and Rural Affairs' Ontario Weed Gallery, http://www.omafra.gov.on.ca/english/crops/facts/ontweeds/weedgal.htm
- Ontario Ministry of Agriculture, Food and Rural Affairs' Noxious Weeds In Ontario list, http://www.omafra.gov.on.ca/english/crops/facts/noxious_weeds.htm
- Ontario Invasive Plant Council's Quick Reference Guide to Invasive Plant Species, http://www.ontarioinvasiveplants.ca/files/Invasives_booklet_2.pdf
- Oregon State University Stormwater Solutions, 2013, Field Guide: Maintaining Rain Gardens, Swales and Stormwater Planters, Corvallis, OR.
- Plants of Southern Ontario (book), 2014, by Richard Dickinson and France Royer, Lone Pine Publishing, 528 pgs.
- Weeds of North America (book), 2014, by Richard Dickinson and France Royer, University of Chicago Press, 656 pgs.

Table 7.4: *Routine Maintenance Tasks for Bioretention and Dry Swales.*

Component	Routine Maintenance Task	Frequency[1]	
		Minimum[2]	**High[3]**
Contributing Drainage Area	◖ Remove trash, natural debris, clippings and sediment	BA	Q
	◖ Remove accumulated sediment. ◖ Re-plant or seed bare soil areas	A	BA
Inlets and Outlets	◖ Remove trash, natural debris and clippings	BA	Q
	◖ Remove accumulated sediment ◖ Remove woody vegetation at inflow points	A	BA
Pretreatment & Flow spreaders	◖ Remove trash, natural debris, clippings	BA	Q
	◖ Remove accumulated sediment	A	BA
	◖ Re-grade and re-plant eroded areas when ≥30 cm in length	AN	AN
Perimeter	◖ Add stone or mulch to maintain 5 to 10 cm depth on non-vegetated areas	Every 2 years	Every 2 years
	◖ Re-grade and re-plant eroded areas when ≥30 cm in length	AN	AN
Filter bed	◖ Remove trash ◖ Re-distribute mulch or stone cover to maintain 5 to 10 cm depth on non-vegetated areas	BA	Q
	◖ Remove accumulated sediment when ≥ 5 cm depth ◖ Re-grade and restore cover over any animal burrows, sunken areas when ≥ 10 cm in depth and erosion rills when ≥ 30 cm in length	AN	AN
	◖ Add mulch or stone cover to maintain 5 to 10 cm depth where specified in the planting plan	Every 2 years	Every 2 years
Vegetation	◖ Watering during first two months after planting	BW	BW
	◖ Watering for the remainder of the first two (2) growing seasons (i.e., May to September) after planting or until vegetation is established	AN	AN
	◖ Watering for the remainder of the BMP lifespan	D	AN
	◖ Mow grass to maintain height between 10 to 15 cm.	M	BM
	◖ Remove undesirable vegetation (e.g., tree seedlings, invasives/weeds)	BA	Q
	◖ Replace dead/diseased plants to maintain a minimum of 80% vegetation cover[4]	A	BA
	◖ Prune shrubs and trees ◖ Cut back spent plants ◖ Divide or thin out overcrowded plants	A	A
Sub-drain & Monitoring well	◖ Flush out accumulated sediment with hose or pressure washer	A	A

Notes:

1. A = Annually; AN = As needed based on Routine Operation inspections; BA = Bi-annually or twice per year, ideally in the spring and late fall/early winter; BM = Bi-monthly; BW = Bi-weekly or twice per week; M = Monthly; D = During drought conditions classified by Agriculture and Agri-Food Canada's Canadian Drought Monitor as severe (D2) or higher (AAC, 2015); Q = Quarterly or four times per year, ideally in the spring, summer, early fall and late fall/early winter; W = Weekly.
2. These frequencies are recommended as the minimum necessary to ensure the BMP functions adequately over its expected lifespan.
3. High priority BMPs such as or those draining to a sensitive receiving waterbody, those receiving drainage from high traffic areas, or those designed with larger than recommended impervious drainage area to pervious BMP footprint area ratios (i.e., I:P ratios), may warrant a higher frequency of routine maintenance tasks involving removal of trash/debris/sediment and mowing/weeding/trimming of vegetation.
4. More frequent inspections may be warranted for highly visible BMPs, those receiving drainage from high traffic areas (vehicle or pedestrian), or those designed with larger than recommended impervious drainage area to pervious BMP footprint area ratio (i.e., I:P ratio), which will be more prone to accumulation of trash and sediment.
5. Aim to achieve 80% vegetation cover in planting areas by the end of the establishment/warranty period for the original plantings (e.g., two years after planting).

Tips to help preserve BMP function

- Because the risk of compaction is higher when filter media soil is saturated, any maintenance tasks involving vehicle (e.g., ride mower) or foot traffic on the filter bed should not be performed during wet weather;
- Use push mower to maintain bioretention practices with grass as vegetation cover or the lightest ride mower equipment available to minimize compaction of the filter bed;
- Use a mulching mower to maintain bioretention practices with grass as vegetation cover or leave clippings on the surface to help maintain organic matter and nutrients in the filter media;
- Pruning of mature trees should be performed under the guidance of a Certified Arborist;
- Woody vegetation should not be planted or allowed to become established where snow will be piled/stored during winter; and
- Removal of sediment accumulated on the filter bed surface should be performed by hand with rake and shovel, or vacuum equipment where feasible. If a small excavator is the chosen method, keep the excavator off the BMP footprint to avoid damage to side slopes/embankments and compaction of the filter media.

7.1.6 Rehabilitation and Repair

Table 7.5 provides guidance on rehabilitation and repair work specific to bioretention and dry swales organized according to BMP component.

Table 7.5: *Rehabilitation and repair guidance for bioretention and dry swales.*

BMP Component	Problem	Tasks
Inlets	Inlet or flow spreading device is producing concentrated flow and causing filter bed erosion	Add flow spreading device or re-grade existing device back to level to promote sheet flow to the filter bed. Regrade damaged portion of the filter bed and replant or restore mulch/stone cover. If problem persists, replace filter bed vegetation/mulch cover with stone at inlets.
Filter bed	Filter media is overly compacted	Core aerate; or remove stone, mulch and vegetation cover and till filter media to a depth of 20 cm; or remove and replace with uncompacted material that meets design specifications. Replace stone, mulch and vegetation cover (re-use/transplant where possible).
	Filter media texture is too fine (i.e., % silt and clay-sized particles too high)	Remove stone, mulch and vegetation cover and till filter media to a depth of 20 cm; or remove and replace all or the uppermost 15 cm of material with filter media that meets design specifications. Replace stone, mulch and vegetation cover (re-use/transplant where possible).
	Filter media organic matter or phosphorus content too low AND vegetation not thriving	Remove stone, mulch and vegetation cover and uppermost 5 cm of filter media, spread 5 cm compost, incorporate into filter media to 20 cm depth by tilling. Replace stone, mulch and vegetation cover (re-use/transplant where possible).
	Filter media pH is out of specification range (6.0 to 7.8) AND vegetation not thriving	If soil pH is lower than 6.0, amend with ground limestone to raise the pH back to neutrality. If soil pH is higher than 7.8, amend with compost or sulphur to lower the pH back to neutrality.
	Filter media cationic exchange capacity is <10 meq/100 g	Remove stone, mulch and vegetation cover and uppermost 5 cm of filter media, spread 5 cm compost, incorporate into filter media to 20 cm depth by tilling; or replace all or the uppermost 15 cm of material with filter media that meets design specifications. Replace stone, mulch and vegetation cover (re-use/transplant where possible).
	Filter media soluble salts content exceeds 2.0 mS/cm	Flush the affected area thoroughly with fresh water.
Filter bed	Local or average sediment accumulation ≥ 5 cm in depth	For local accumulation areas (e.g., at inlets) remove stone and use vacuum equipment to remove accumulated sediment/mulch, or to minimize disturbance of vegetation cover. Sediment from local areas can be removed with hand tools (e.g., rake and shovel). For large BMPs, use of a small excavator may be preferable. Restore grades with filter media that meets design specifications. Replace stone, mulch and vegetation cover (re-use/transplant where possible).

	Surface ponding remains for > 24 hours or surface infiltration rate is out of acceptable range	Remove stone, accumulated sediment/mulch, and vegetation cover. Till the exposed filter media to a depth of 20 cm to eliminate surface crusting or macropores and reduce compaction, or remove and replace the uppermost 15 cm of material with filter media that meets design specifications. Replace stone, mulch and vegetation cover (re-use/transplant where possible).
	Damage to filter bed or slide slope is present (e.g., erosion rills, animal burrows, local sinking, ruts)	Regrade damaged portion by shovel and replant or restore mulch/stone cover. Animal burrows, local sinking and compacted areas should be tilled to 20 cm depth prior to re-grading.
Sub-drain	Sub-drain perforated pipe is obstructed by sediment or roots	Schedule hydro-vac truck or drain-snaking service to remove the obstruction.

7.1.7 Life Cycle Costs of Inspection and Maintenance

Estimates of the life cycle costs of inspection and maintenance have been produced using the latest version of the LID Life Cycle Costing Tool (STEP, 2016; TRCA & U of T, 2013b) for three design variations (full infiltration, partial infiltration and no infiltration) to assist stormwater infrastructure planners, designers and asset managers with planning and preparing budgets. For each design variation, life cycle cost estimates have been calculated for two level-of-service scenarios: the minimum recommended frequency of inspection and maintenance tasks (i.e., Table 7.2 and Table 7.4 "Minimum Frequency" column), and a high frequency scenario (i.e., Table 7.2 and Table 7.4 "High Frequency" column) to provide an indication of the potential range.

The general assumptions used in developing version 1.1 of the LID Life Cycle Costing Tool (TRCA & U of T, 2013b) are outlined in detail in the report titled "Assessment of the Life Cycle Costs of Low Impact Development Stormwater Management Practices" (TRCA and U of T, 2013a). Assumptions for the Minimum Maintenance Frequency scenario can be viewed in the latest version of the spreadsheet tool (STEP, 2016) using the default values and a CDA of 2,000 m^2, and are briefly summarized here. Assumptions regarding design and material specifications are based on guidance provided in the LID SWM Planning and Design Guide (CVC & TRCA, 2010).

Capital costs included within the category of construction include those related to site assessment, and conceptual and detailed design related tasks such as borehole analysis and soil testing. All material, delivery, labour, equipment (rental, operation, operator), hauling and disposal costs are accounted for within the construction costs of the facility. Standard union costs were derived from the RSMeans database in 2010 and have been adjusted for 5 year inflation of 8.79% (2010 to June, 2015). Costs include overhead and inflation to represent contractor pricing. It was assumed the practice is part of a new development (i.e., not a retrofit), thereby excluding (de)mobilization costs unless a particular piece of equipment would not normally have been present at the site. Additionally, it was assumed that excavated soil associated with construction of the BMP would be reused elsewhere on site. Overhead costs were presumed to consist of construction management (4.5%), design (2.5%), small tools (0.5%), clean up (0.3%) and other (2.2%).

Assumptions regarding maintenance frequencies and requirements and the life span of each practice are based on both literature and practical experience. Life cycle and associated maintenance costs are evaluated over a 50 year timeframe, which is the typical period over which infrastructure decisions are made.

For bioretention it is assumed that some rehabilitation (e.g., rehabilitative maintenance) work will be needed on the filter bed surface once the BMP reaches 25 and 50 years of age in order to maintain functional drainage performance at an acceptable level. Included in the rehabilitation costs are (de)mobilization costs, as equipment would not have been present on site. Design costs were not included in the rehabilitation as it was assumed that the original LID practice design would be used to inform this work. The annual average maintenance cost does not include rehabilitation costs and therefore represents an average of routine maintenance tasks, as outlined in Table 7.4. All cost value estimates represent the net present value (NPV) as the calculation takes into account average annual interest (2%) and discount (3%) rates over the evaluation time periods.

For all bioretention design variations, the CDA has been defined as a 2,000 m^2 impervious pavement area plus the footprint area of a bioretention cell that is 133 m^2 in size, as per design recommendations. The impervious area to pervious area ratio (I:P ratio) used to size the BMP footprint is 15:1, which is the maximum ratio recommended in the LID SWM Planning and Design Guide (CVC & TRCA, 2010). It is assumed that water drains to the cell through curb inlets spaced 6 m apart with stone cover on the filter bed at the inlets to dissipate the energy of the flowing water.

While orientation (i.e., cell versus swale) and choice of components (e.g., inlet/outlet structures etc.) can vary widely, design variations for bioretention practices can be broken down into three main categories. They can be designed to drain through infiltration into the underlying subsoil alone (i.e., Full Infiltration design, no sub-drain), through the combination of a sub-drain and infiltration into the underlying subsoil (i.e., Partial Infiltration design, with a sub-drain), or through a sub-drain alone (i.e., No Infiltration or “filtration only” design, with a sub-drain and impermeable liner). For Full Infiltration systems, an overflow is provided for storms up to 37 mm based on a subsoil infiltration rate of 20 mm/hour. Two standpipe wells are part of the design (one subdrain inspection/flushing port at the upstream end and one sub-surface water storage reservoir monitoring well at the downstream end). Partial Infiltration systems have a sub-surface water storage reservoir with a perforated pipe sub-drain within it. The depth of the reservoir is sized to store flow from a 25 mm rain event over the CDA based on native soil infiltration rate of 10 mm/hour. The No Infiltration system includes an impermeable liner between the base and sides of the BMP and surrounding native sub-soil, to prevent infiltration.

Estimates of the life cycle costs of bioretention and dry swales in Canadian dollars per unit CDA (\$/m^2) are presented in Table 7.6. The LID Life Cycle Costing Tool allows users to select what BMP type and design variation applies, and to use the default assumptions to generate planning level cost estimates.

Users can also input their own values relating to a site or area, design, unit costs, and inspection and maintenance task frequencies to generate customized cost estimates, specific to a certain project, context or stormwater infrastructure program.

For all BMP design variations and maintenance scenarios, it is assumed that rehabilitation of part or all of the filter bed surface will be necessary once the BMP reaches 25 and 50 years of age to maintain acceptable surface drainage performance (e.g., surface ponding drainage time). Filter bed rehabilitation for bioretention and dry swales is assumed to typically involve the following tasks and associated costs:

- Remove mulch, stone and vegetation cover, separating and re-using existing materials and plants to greatest extent feasible (all stone is re-used, 2/3 of vegetation is transplanted);
- Remove uppermost 15 cm of soil from the filter bed surface;
- Spread 15 cm of filter media that meets design specifications, thoroughly wet the material, allow time to settle, and rake to restore grade;
- Construction and Assumption inspection and testing work, including soil characterization testing to confirm that filter media meets design specifications;
- Surface infiltration rate testing, to confirm that acceptable drainage performance has been restored;
- Restore mulch or stone cover and transplant/plant vegetation;
- Perform routine vegetation maintenance tasks (i.e., watering, weeding, trimming) at recommended frequencies over the two (2) year establishment period for the plantings; and
- Replace plants that don't survive the initial establishment period (assumes 10% and 20% of plant material does not survive the first year for Minimum Recommended and High Frequency maintenance scenarios, respectively).

Table 7.6: *Life cycle cost estimates for bioretention and dry swales.*

Bioretention & Dry Swales	**Minimum Frequency**			**High Frequency**		
Design Variation	**Full Infiltr.**	**Partial Infiltr.**	**No Infiltr.**	**Full Infiltr.**	**Partial Infiltr.**	**No Infiltr.**
Construction Costs	$17.02	$22.17	$21.80	$17.02	$22.17	$21.80
Rehabilitation Costs	$4.83	$4.78	$4.78	$4.50	$4.41	$4.41
Rehabilitation Period (years in service)	25	25	25	25	25	25
50 YEAR EVALUATION PERIOD						
Average Annual Maintenance	$0.66	$0.70	$0.70	$0.94	$0.98	$0.98
Maintenance and Rehabilitation	$37.59	$39.09	$39.09	$51.75	$53.25	$53.25
25 YEAR EVALUATION PERIOD						
Average Annual Maintenance	$0.70	$0.75	$0.75	$1.03	$1.08	$1.08
Maintenance and Rehabilitation	$20.53	$21.33	$21.33	$28.36	$29.16	$29.16

Notes:

1. Estimated life cycle costs represent NPV of associated costs in Canadian dollars per square metre of CDA ($/m^2).
2. Average annual maintenance cost estimates represent NPV of all costs incurred over the time period and do not include rehabilitation costs.
3. Rehabilitation cost estimates represent NPV of all costs related to repair work assumed to occur every 25 years, including those associated with inspection and maintenance over a two (2) year establishment period for the plantings.
4. Full Infiltration design life cycle costs are lower than Partial and No Infiltration designs due to the absence of a sub-drain to construct, inspect and routinely flush.
5. Rehabilitation costs for Full Infiltration designs are estimated to be 26.4 to 28.4% of the original construction costs for High and Minimum Recommended Frequency maintenance program scenarios, respectively.
6. Rehabilitation costs for Partial Infiltration designs are estimated to be 19.9 to 21.6% of the original construction costs for High and Minimum Recommended Frequency maintenance program scenarios, respectively.
7. Rehabilitation costs for No Infiltration designs are estimated to be 20.2 to 21.9% of the original construction costs for High and Minimum Recommended Frequency maintenance program scenarios, respectively.
8. Maintenance and rehabilitation costs over a 25 year time period for the Minimum Recommended maintenance scenario are estimated to be roughly equivalent to the original construction cost for Partial Infiltration and No Infiltration designs (96.2% and 97.8%, respectively), and 1.21 times the original construction cost for Full Infiltration design.

9. Maintenance and rehabilitation costs over a 25 year time period for the High Frequency maintenance scenario are estimated to be 1.32 times the original construction costs for Partial Infiltration, 1.34 times for No Infiltration designs, and 1.67 times for Full Infiltration designs.
10. Maintenance and rehabilitation costs over a 50 year time period for the Minimum Recommended Frequency maintenance scenario are estimated to be approximately 1.76 times the original construction cost for Partial Infiltration designs, 1.79 times the original construction cost for No Infiltration designs, and 2.21 times the original construction cost for Full Infiltration designs.
11. Maintenance and rehabilitation costs over a 50 year time period for the High Frequency maintenance scenario are estimated to be approximately 2.40 times the original construction cost for Partial Infiltration designs, 2.44 times the original construction cost for No Infiltration designs, and 3.04 times the original construction cost for Full Infiltration designs.

APPENDIX D

INSPECTION FIELD DATA FORMS

INSPECTION FIELD DATA FORMS: Bioretention and Dry Swales

GENERAL INFORMATION:

BMP Identifier:	**Inspection type:**
Address :	**Location:**
BMP construction date:	**BMP assumption date:**

VISUAL INDICATORS:

Inspection date and time:	**Weather (24 hours prior to inspection):**
Inspected by:	**Inspection duration (minutes):**

ZONE	INDICATOR & TRIGGER FOR FOLLOW-UP	CONDITION		FOLLOW-UP
CDA	**Contributing drainage area condition:** Area differs by >10% from design or as-built drawing; Excessive trash, debris, sediment or other pollutant load is present or impairing function of the BMP; Land cover has changed	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
INLET	**Inlet structural integrity:** Damage to inlet or flow spreader structure is impairing function of the BMP	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
	Inlet obstruction: Sediment/trash/debris/vegetation ≥5 cm deep or blocking inflow over one third (33%) of the width	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
	Pretreatment sediment accumulation: Device is ≥50% full of sediment/trash/debris or inflow of water to the BMP is impaired	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
	Inlet erosion: Gullies or bare soil areas ≥ 30 cm in length are visible	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**

PERIMETER	**BMP dimensions:** Differ from design or as-built drawing by >10%	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
	Side slope erosion: Gullies, ruts or bare soil areas ≥30 cm in length are visible	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
	Surface ponding area: Maximum surface ponding area differs from design by >25%	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
FILTER BED	**Standing water:** Standing water ponded on filter bed surface >24 hours after the end of a storm event	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
	Trash: Trash is visible and impairing aesthetics or function of the BMP	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
	Filter bed erosion: Gullies, ruts or bare soil areas ≥30 cm in length are visible	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
	Mulch depth: Average depth is less than 5 cm or greater than 15 cm or bare soil areas are visible	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
	Filter bed sediment accumulation: Mean or local accumulation of sediment is ≥5 cm in depth	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
	Surface ponding depth: Maximum differs from design or as-built drawing by >10%	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**

FILTER BED	**Filter bed surface sinking:** Local surface depressions are ≥10 cm in depth or animal burrows are visible	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
	Check dams: Structures are missing or buried in sediment	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
PLANTING AREA	**Vegetation cover:** Less than 80% of planting area is covered by living vegetation	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
	Vegetation condition: Vegetation is over-grown or over-crowded and is impairing aesthetics or obstructing sight lines needed for safety	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
	Vegetation composition: More than 50% of the vegetation is undesirable (e.g. weeds, invasive) or not the species specified in the planting plan	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
OUTLET	**Monitoring well condition:** Structural damage or sediment clog is visible and impairing its function or cap is missing	**Comments/Measurements:** **Water level (cm):**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
	Sub-drain obstruction: Structural damage, sediment clog or vegetation roots are visible and reducing conveyance capacity of the pipe by ≥ 33%	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**
	Overflow outlet obstruction: Structural damage, sediment/trash/debris is obstructing outflow, structure is full of water or grate is missing	**Comments/Measurements:**		**Action:**
		Pass:	**Fail:**	**Timeframe:**

Codes

Inspection type: C = Construction; A = Assumption; RO = Routine Operation; MV = Maintenance Verification; PV = Performance Verification

Comments: NA = not applicable; NI = not inspected.

Actions: 0 = no action necessary; 1 = routine maintenance needed; 2 = structural repair needed; 3 = further investigation needed.

Photographs:

Notes and Sketches:

SOIL CHARACTERIZATION TESTING:

BMP Identifier	**Inspection Type:**
Sampling date and time:	**Weather (24 hours prior to sampling):**
Sampled by:	**Sampling duration (minutes):**

Sampling Location	**Sample Collected? (Y/N)**	**Filter Media Depth (cm)**	**Maximum Penetrometer Reading (PSI, kg/cm^2 or kPa)**	**Sample Location**	**Sample Collected? (Y/N)**	**Filter Media Depth (cm)**	**Maximum Penetrometer Reading (PSI, kg/cm^2 or kPa)**

Notes and Sketches:

NATURAL OR SIMULATED STORM EVENT TESTING:

BMP Identifier:	**Inspection Type:**
Testing date and time:	**Sub-surface water storage reservoir depth (mm):**
Tested by:	**Test duration (hours):**

Term	Parameter	Test 1	Test 2	Test 3	Mean
A	**Volume of water directed to the BMP (L or m^3, estimated from CDA and rainfall depth for natural storm events, measured by magnetic flow meter for simulated storm events):**				
B	Maximum post-storm filter bed surface water level (mm, at end of rainfall or delivery of water to the BMP):				
C	Date/time (mm/dd/yyyy hh:mm:ss) of maximum post-storm filter bed surface water level:				
D	Date/time (mm/dd/yyyy hh:mm:ss) when filter bed surface water level reaches 50 mm:				
E	Minimum post-storm filter bed surface water level (mm, zero or static reading or level just prior to onset of next rain storm):				
F	Date/time (mm/dd/yyyy hh:mm:ss) of minimum post-storm filter bed surface water level (zero or static reading or level just prior to onset of next rain storm):				
G	Date/time (mm/dd/yyyy hh:mm:ss) when filter bed surface is fully drained (zero or static water level reading):				
H	**Filter bed surface ponding event duration (h, (G-C)*24):**				
I	**Filter bed surface infiltration rate estimate (mm/h, (F-D)*24):**				
J	Maximum post-storm sub-surface storage reservoir water level (mm, at end of rainfall or delivery of water to the BMP):				
K	Date/time (mm/dd/yyyy hh:mm:ss) of maximum post-storm sub-surface storage reservoir water level:				
L	Sub-surface storage reservoir starting water level (mm, half full water level):				
M	Date/time (mm/dd/yyyy hh:mm:ss) of sub-surface storage reservoir starting water level (half full):				

N	Sub-surface storage reservoir ending water level (mm, one quarter full water level):				
O	Date/time (mm/dd/yyyy hh:mm:ss) of sub-surface storage reservoir ending water level (one quarter full):				
P	Date/time (mm/dd/yyyy hh:mm:ss) when sub-surface storage reservoir is fully drained (zero or static water level reading):				
Q	**Sub-surface water storage reservoir drainage period duration (h, (P-K)*24):**				
R	**Sub-surface water storage reservoir drainage rate (mm/h, (L-N)/(M-O)*24):**				

Acceptance Criteria:	
Water flows into BMP as intended; Filter bed surface infiltration rate ≥25 mm/h and ≤203 mm/h, or consult manufacturer or vendor for an acceptable range specific to the product; Surface water storage reservoir (i.e., surface ponding) fully drains within 24 hours of the end of the storm;	Sub-drain peak flow rate is within +/- 15% of design specification; Active sub-surface water storage reservoir volume drains within 48 to 72 hours of the end of the storm for newly constructed BMPs, and within 48 to 96 hours for in-service BMPs.

Notes and Sketches:

FACT SHEET

Sustainable Technologies
EVALUATION PROGRAM

Bioretention

Inspection and Maintenance of Stormwater Best Management Practices

Bioretention is a general term that refers to vegetated stormwater best management practices (BMPs) that temporarily store rainwater or snowmelt from roofs or pavements (i.e., stormwater runoff) in depressed planting beds or other structures (e.g., concrete planters). Bioretention treats stormwater by slowing it down, filtering it through soil and plant roots, soaking it into the ground and evaporating it back to the atmosphere. Runoff water is delivered to the practice through inlets such as curb-cuts, spillways or other concrete structures, sheet flow from pavement edges, or pipes connected to catchbasins or roof downspouts. The planting bed and side slopes are typically covered with a mixture of plants, mulch and stone. Water in excess of its storage capacity overflows to another BMP or the municipal storm sewer. Filtered water is either infiltrated into the underlying soil to replenish groundwater, or collected by a sub-drain (i.e., underground perforated pipe) and discharged to the storm sewer system or another BMP. Depending on the permeability of the underlying soil or other constraints, it may be designed with no sub-drain for full infiltration, with a sub-drain for partial infiltration, or with an impermeable liner and sub-drain for a no infiltration practice. The sub-drain pipe may feature a flow restrictor (e.g., orifice cap or valve) for gradually releasing detained water and optimizing the amount drained by infiltration. Key components of bioretention practices for inspection and maintenance are described in Table 1 and Figure 2.

Key components of bioretention to pay close attention to are the inlets, filter bed surface and overflow outlets. Trash, debris and sediment builds up at these locations and can prevent water from flowing into or out of the practice.

RELATED TERMS

Bioretention cell: A flat-bottomed, depressed planting bed containing filter media soil, a gravel water storage layer and optional sub-drain pipe(s); Also known as a **rain garden**.

Stormwater planter: A bioretention cell contained within an engineered (e.g., concrete) structure.

Biofilter: Bioretention cell or swale with an impermeable liner or containment structure and sub-drain.

Bioretention swale: A gently sloping, linear oriented bioretention practice designed to be capable of conveying water across an elevation gradient. Also known as a **bioswale** or **dry swale**.

BENEFITS

- Reduce the quantity of runoff and pollutants being discharged to municipal storm sewers and receiving waters (i.e., rivers, lakes and wetlands);

- Replenish groundwater resources and keep the flow of water to our rivers and lakes cool for temperature-sensitive fish like trout and salmon;

- Can be adapted to fit into many contexts (e.g., roadways, parking lots, plazas, parks and yards);

- Can provide a convenient area for snow storage and snowmelt treatment; and

- Can provide aesthetic value as attractive landscaped features.

Figure 1. Bioretention in residential area

TIPS TO HELP PRESERVE BMP FUNCTION

- Maintain grading of the filter bed (or grass filter strip if present) at curb-cut inlets so at least 5 cm of the back of the curb is visible through regular sediment removal and regrading;

- To avoid over-compaction of the filter media soil, any maintenance tasks involving vehicle or foot traffic on the filter bed should not be performed during wet weather;

- For bioretention with sod (i.e., turf grass) as vegetation cover, maintain with a push mower or the lightest mulching ride mower available and core aerate and dethatch annually in the spring to help maintain permeability;

- Pruning of mature trees should be performed under the guidance of a Certified Arborist;

- Woody vegetation should not be planted or allowed to become established where snow will be piled/stored during winter; and

- Removal of sediment from the filter bed surface should be done with rake and shovel, or vacuum equipment to minimize plant disturbance. If a small excavator is to be used, keep it off the BMP footprint to avoid damage to side slopes/embankments and over-compaction of the filter media.

KEY COMPONENTS AND INSPECTION AND MAINTENANCE TASKS

Figure 2. Generalized plan and cross-section view of a bioretention cell showing key components

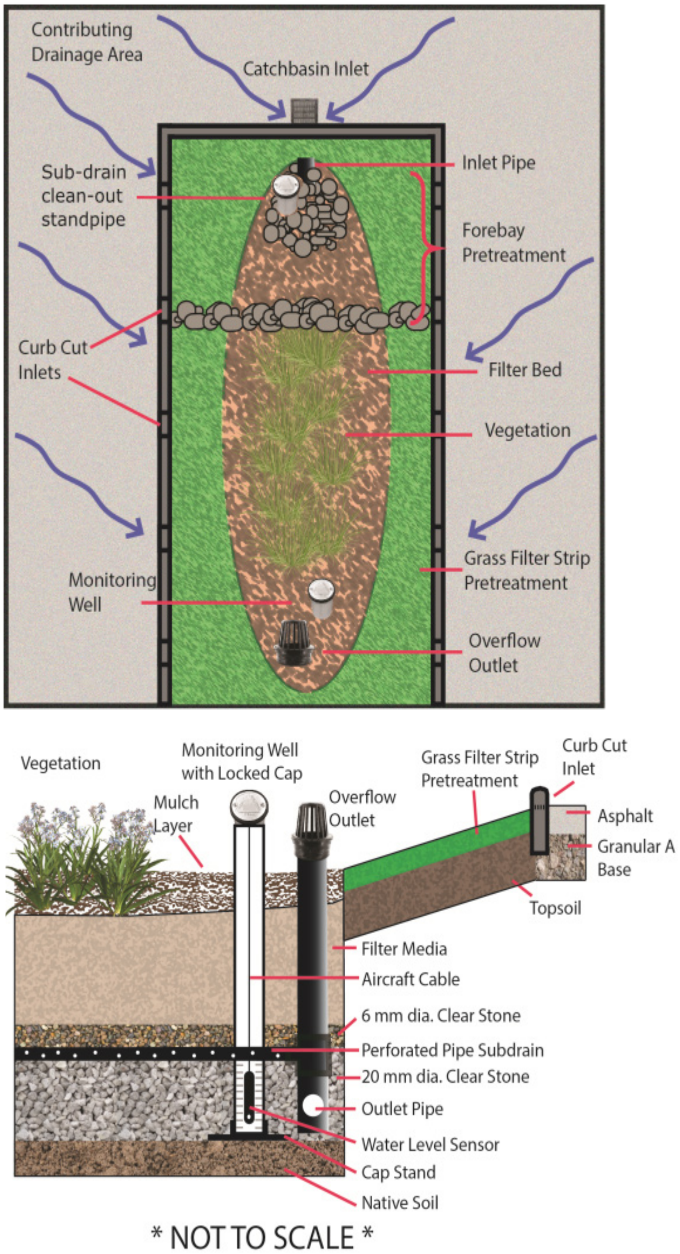


Figure 3. Biofilter swale retrofit within the road right-of-way

Table 1. Key components, descriptions and routine inspection and maintenance tasks.

Component	Description	Inspection and Maintenance Tasks
Contributing drainage area (CDA)	Area(s) from which runoff directed to the BMP originates; includes both impervious and pervious areas.	• Remove trash, debris and sediment from pavements (biannually to quarterly) and eavestroughs (annually); • Replant or seed bare soil areas as needed.
Pretreatment	Devices or features that retain trash, debris and sediment; help to extend the operating life cycle; examples are eavestrough screens, catchbasin inserts and sumps, oil and grit separators, geotextile-lined inlets, gravel trenches, grass filter strips, forebays.	• Remove trash, debris and sediment annually to biannually or when the device sump is half full; • Measure sediment depth or volume during each cleaning, or annually to estimate accumulation rate and optimize frequency of maintenance.
Inlets	Structures that deliver water to the BMP (e.g., curb-cuts, spillways, pavement edges, catchbasins, pipes).	• Keep free of obstructions; • Remove trash, debris and sediment biannually to quarterly; • Measure sediment depth or volume during each cleaning or annually to estimate accumulation rate and optimize frequency of maintenance; • Remove woody vegetation from filter bed at inlets annually.
Perimeter	Side slopes or structures that define the BMP footprint; may be covered by a mixture of vegetation, mulch and stone with slopes up to 2:1 (H:V), or concrete or masonry structures with vertical walls.	• Confirm the surface ponding footprint area dimensions are within ±10% of the design and that maximum surface ponding depth meets design specifications; • Check for side slope erosion or damage that compromises water storage capacity.
Filter bed	Flat or gently sloping area composed of a 0.5 to 1 m deep layer of filter media soil covered by a mixture of vegetation, mulch and stone where surface ponding and filtration of runoff occurs.	• Check for standing water, barren/eroded areas, sinkholes or animal burrows; • Remove trash biannually to quarterly; • Rake regularly to redistribute mulch and prevent sediment crusts; • Maintain 5 to 10 cm of mulch or stone cover to prevent weed growth and soil erosion; • Repair sunken areas when ≥ 10 cm deep and barren/eroded areas when ≥ 30 cm long; • Remove sediment when > 5 cm deep or time to drain water ponded on the surface exceeds 48 hours.
Vegetation	A mixture of deep rooting perennial plants, tolerant to both wet and dry conditions and salt (if receiving pavement runoff); can include grasses, flowers, shrubs and trees; roots uptake water and return it to the atmosphere; provide habitat for organisms that break down trapped pollutants and help maintain soil structure and permeability.	• Routine maintenance is the same as a conventional perennial garden bed; • In the first 2 months water plantings frequently (biweekly in the absence or rain) and as needed (e.g., bimonthly) over the remainder of the first growing season; • Remove weeds and undesirable plants biannually to quarterly; • Replace dead plantings annually to achieve 80% cover by the third growing season; • Do not apply chemical fertilizers.
Overflow Outlet	Structures that convey overflows to another BMP or municipal storm sewer.	• Keep free of obstructions; • Remove trash, debris and sediment biannually to quarterly.
Sub-drain	Optional component; perforated pipe(s) surrounded by gravel and may be wrapped in geotextile filter fabric; installed below the filter media soil layer to collect and convey treated water to an adjacent drainage system; may also include a flow restrictor.	• Include standpipes or access points to provide means of flushing the perforated pipe; • Keep pipe and flow restrictor free of obstructions by flushing annually; • Inspect flow restrictor frequently (e.g., biannually to quarterly).
Monitoring well	Perforated standpipe that extends from the bottom of the BMP to above the invert of the overflow outlet. Allows measurement of subsurface water level to track drainage performance over time.	• Standpipes should be securely capped on both ends and remain undamaged.

Figure 4. Urban bioretentions

REHABILITATION

Table 2. Key components, typical problems and rehabilitation tasks.

Component	**Problem**	**Rehabilitation Tasks**
Inlets	Inlet is producing concentrated flow and causing filter bed erosion	Add flow spreading device or re-grade existing device back to level. Rake to regrade damaged portion of the filter bed and replant or restore mulch/stone cover. If problem persists, replace some mulch cover with stone.
Filter bed	Local or average sediment accumulation ≥ 5 cm in depth	At inlets remove stone and use vacuum equipment or rake and shovel to remove sediment. For large areas or BMPs, use of a small excavator may be preferable. Restore grades with filter media that meets design specifications. Test surface infiltration rate (one test for every 25 m^2 of filter bed area) to confirm it is > 25 mm/h. Replace stone, mulch and plant cover (re-use/transplant where possible). If problem persists, add pretreatment device(s) or investigate the source(s).
	Surface ponding remains for > 48 hours or surface infiltration rate is <25 mm/h.	Remove sediment as described above. Core aerate (for sodded bioretention); or remove stone, sediment, mulch, and plant cover and till the exposed filter media to a depth of 20 cm; or remove and replace the uppermost 15 cm of material with filter media that meets specifications. Test surface infiltration rate (one test for every 25 m^2 of filter bed area) to confirm it is > 25 mm/h. Replace stone, mulch and plants (re-use/transplant where possible).
	Damage to filter bed or slide slope is present (e.g., erosion rills, animal burrows, sink holes, ruts)	Regrade damaged portion by raking and replant or restore mulch/stone cover. Animal burrows, sink holes and compacted areas should be tilled to 20 cm depth prior to re-grading. If problems persist, consider adding flow spreading device to prevent erosion or barriers to discourage foot or vehicular traffic.
Vegetation	Vegetation is not thriving AND filter media is low in organic matter (<3%) or extractable phosphorus (<10 mg/kg)	Remove stone, mulch and plant cover and uppermost 5 cm of filter media, spread 5 cm of yard waste compost, incorporate into filter media to 20 cm depth by tilling. Replace stone, mulch and plants (re-use/transplant where possible).
Sub-drain	Sub-drain perforated pipe is obstructed by sediment or roots	Schedule hydro-vac truck or drain-snaking service to clear the obstruction.

TYPES OF INSPECTIONS

Routine Operation: Regular inspections (twice annually, at a minimum) done as part of routine maintenance tasks over the operating phase of the BMP life cycle to determine if maintenance task frequencies are adequate and determine when rehabilitation or further investigations into BMP function are warranted.

Maintenance and Performance Verification: Periodic inspections done every 5 years (Maintenance Verifications) and every 15 years (Performance Verifications) post-construction over the operating phase of the BMP life cycle to ensure compliance with maintenance agreement (e.g., Environmental Compliance Approval permit) conditions, evaluate functional performance and determine when rehabilitation or replacement is warranted.

INSPECTION TIME COMMITMENTS AND COSTS

Estimates are based on a typical partial infiltration bioretention design (i.e., includes a sub-drain); estimates for other designs (i.e., full infiltration and no-infiltration) are described in the Low Impact Development (LID) Stormwater Management Practice Inspection and Maintenance Guide available at https://sustainabletechnologies.ca.

Table 3. Time commitments and costs for inspection

Bioretention	Routine Operation	Maintenance Verification	Performance Verification
Tasks to complete	18	15	15
Visits (per year)	2	1 every 5 years	1 every 15 years
Time (hours per m^2 BMP area)	0.012	0.010	0.010
Cost	$1.33	$0.66	$2.31
Performance Verification Options ($ per m^2 BMP area)			
Surface infiltration rate testing: $5.48, 5 tests			
Simulated storm event testing: $15.70			
Natural storm event testing: $15.00, 2 months monitoring			

Figure 5. Sediment removal in Spring

Table 4. Task cost estimates for maintenance and rehabilitation of a partial infiltration bioretention

Bioretention	Costs per m^2 of BMP area	
Tasks	**Min.**	**High**
Watering - first year only	$3.67	$3.67
Watering - second year only	$1.24	$1.51
Annual watering - Starts in year 3	$0.37	$0.73
Drought watering	$0.19	$0.19
Remove litter and debris	$0.33	$0.63
Prune shrubs or trees	$0.45	$0.45
Weeding	$0.31	$0.61
Sediment removal - starts year 2	$1.36	$2.71
Add mulch to maintain 5 to 10 cm - starts year 2	$3.77	$3.77
Replace dead plantings - starts year 2	$3.35	$6.69
Flush sub-drain - starts year 2	$0.59	$0.59
Rehabilitation (every 25 years)	$59.46	$59.46

Figure 5. Leaves clogging inlet to bioretention

For a detailed description of construction, inspection, maintenance and rehabilitation cost assumptions see section 7.1.7 of the LID Stormwater Management Practice Inspection and Maintenance Guide. To generate BMP-specific cost estimates use the LID Life Cycle Costing Tool available at https://sustainabletechnologies.ca.

Table 2. Construction and life cycle cost estimates

Bioretention	**Costs per m^2 of BMP area + CDA**	
	Minimum	**High**
Construction	$17.02	
LIFE CYCLE COSTS		
25 year evaluation period		
Average annual maintenance	$0.75	$1.08
Maintenance and rehabilitation	$21.33	$28.36
50 year evaluation period		
Average annual maintenance	$0.70	$0.98
Maintenance and rehabilitation	$39.09	$53.25

Figure 6. Continuous water level monitoring in a bioretention

Figure 7. Overflow pipe in bioretention

This communication has been prepared by the Sustainable Technologies Evaluation Program (STEP) with funding support from the Toronto and Region Remedial Action Plan (RAP), Region of Peel, York Region and City of Toronto. The contents of this fact sheet do not necessarily represent the policies of the supporting agencies and the funding does not indicate an endorsement of the contents.

For more detailed information on inspection, testing and maintenance of bioretention and a field data form (checklist) to use for collecting and recording inspection results, please refer to Appendix D of the Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide, available at **https://sustainabletechologies.ca.**

For more information about STEP and other resources and studies related to stormwater management, visit our website or email us at **STEP@trca.on.ca.**

Toronto and Region
Conservation
for The Living City

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Nov 14 2018

BLOCK 19 SWALE

Trapezoidal

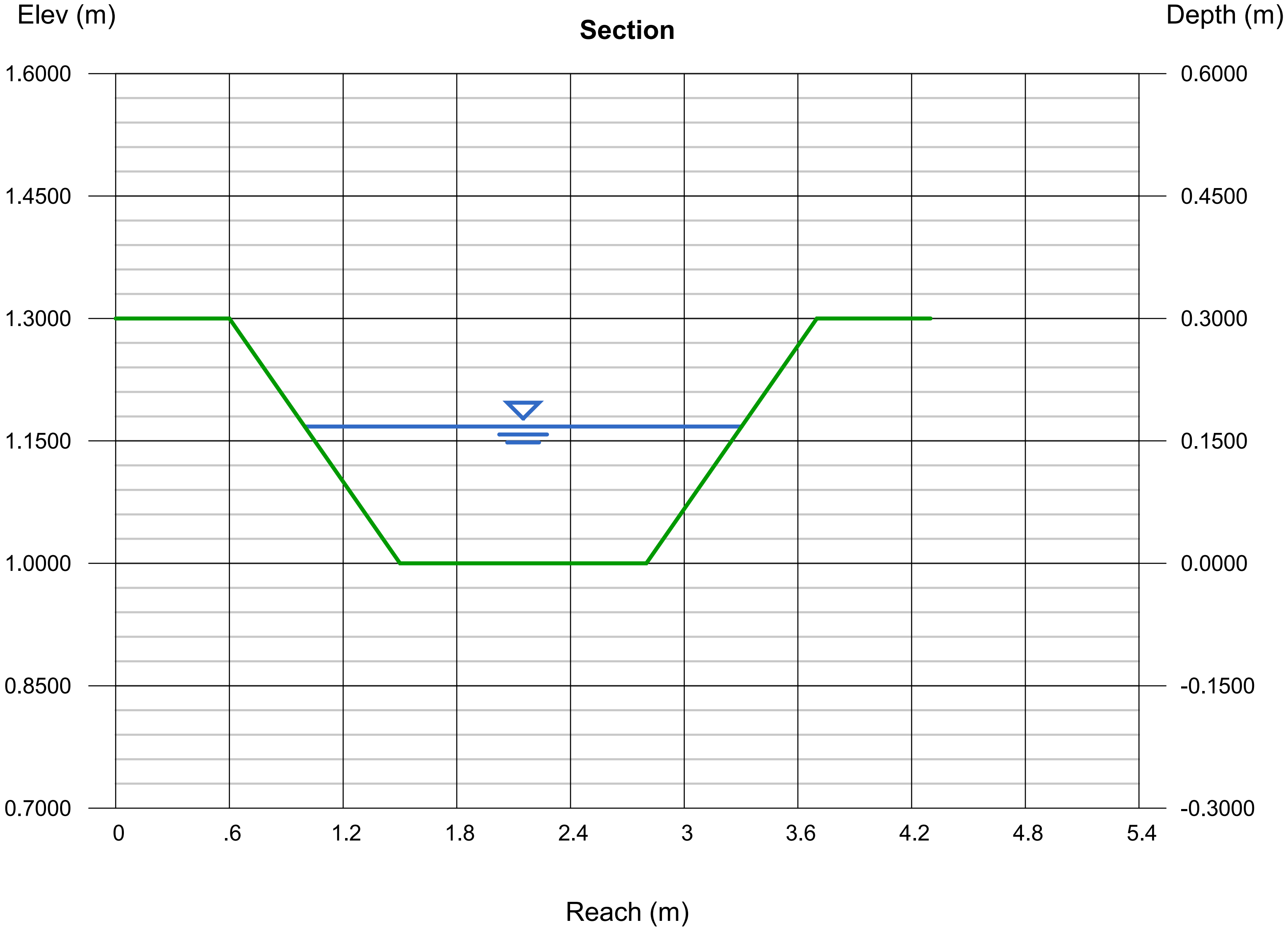
Bottom Width (m)	= 1.3000
Side Slopes (z:1)	= 3.0000, 3.0000
Total Depth (m)	= 0.3000
Invert Elev (m)	= 1.0000
Slope (%)	= 0.7000
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cms)	= 0.1830

Highlighted

Depth (m)	= 0.1676
Q (cms)	= 0.183
Area (sqm)	= 0.3022
Velocity (m/s)	= 0.6055
Wetted Perim (m)	= 2.3602
Crit Depth, Yc (m)	= 0.1158
Top Width (m)	= 2.3058
EGL (m)	= 0.1863



Depth	Q	Area	Veloc
(m)	(cms)	(sqm)	(m/s)
0.0300	0.009	0.042	0.2202
0.0600	0.030	0.089	0.3366
0.0900	0.060	0.141	0.4272
0.1200	0.100	0.199	0.5036
0.1500	0.150	0.262	0.5708
0.1800	0.209	0.331	0.6315
0.2100	0.279	0.405	0.6873
0.2400	0.358	0.485	0.7393
0.2700	0.449	0.570	0.7883
0.3000	0.551	0.660	0.8349

Wp	Yc	TopWidth	Energy
(m)	(m)	(m)	(m)
1.4897	0.0183	1.4800	0.0325
1.6795	0.0396	1.6600	0.0658
1.8692	0.0579	1.8400	0.0993
2.0589	0.0823	2.0200	0.1329
2.2487	0.1036	2.2000	0.1666
2.4384	0.1250	2.3800	0.2003
2.6282	0.1494	2.5600	0.2341
2.8179	0.1737	2.7400	0.2679
3.0076	0.1981	2.9200	0.3017
3.1974	0.2225	3.1000	0.3356

APPENDIX D

Storm Sewer Design

- *Existing Storm Sewer Design Sheet*
- *Proposed 10-year Storm Sewer Design Sheet*
- *Proposed 10-year+Constant Flow*
- *100-year capture (Constant Flow) Calculations*
- *EPA SWMM Cistern Sizing Output*

STORM SEWER DESIGN SHEET

10 Year Storm - Existing Conditions

West Village Partners

City of Mississauga

PROJECT DETAILS

Project No: 16-489
Date: 8-Nov-18
Designed by: NM
Checked by: RM

JAN 6/16

DESIGN CRITERIA

Min. Diameter = 300 mm
Mannings 'n'= 0.013
Starting Tc = 15 min
Factor of Safety = 10 %

Rainfall Intensity = $\frac{A}{(Tc+B)^c}$
A = 1010
B = 4.6
c = 0.78

NOMINAL PIPE SIZE USED

STREET	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
Lakeshore Rd	1L	2L	0.26	0.90	0.23	0.23	99.2	0.064			0.064	50.4	0.50	375	0.124	1.12	15.00	0.75	15.75	52%
Lakeshore Rd	2L	3L	0.29	0.90	0.26	0.50	96.3	0.132			0.132	9.5	0.50	450	0.202	1.27	15.75	0.12	15.87	66%
Lakeshore Rd	3L	4L	0.17	0.90	0.15	0.65	95.9	0.173			0.173	75.6	0.50	525	0.304	1.40	15.87	0.90	16.77	57%
Lakeshore Rd	4L	5L	0.24	0.90	0.22	0.86	92.7	0.222			0.222	9.7	0.50	600	0.434	1.54	16.77	0.11	16.88	51%
Lakeshore Rd	Ext. 1	5L	3.79	0.60	2.27	2.27	99.2	0.626			0.626	8.8	0.50	675	0.594	1.66	15.00	0.09	15.09	105%
Lakeshore Rd	5L	6L	0.20	0.90	0.18	3.32	92.3	0.851			0.851	80.4	0.50	675	0.594	1.66	16.88	0.81	17.68	143%
Lakeshore Rd	Ext. 2	6L	2.41	0.60	1.45	1.45	99.2	0.398			0.398	32.2	0.50	675	0.594	1.66	15.00	0.32	15.32	67%
Mississauga Road	6L	7L	0.30	0.90	0.27	5.03	89.7	1.255			1.255	32.2	0.50	675	0.594	1.66	17.68	0.32	18.01	211%
Mississauga Road	7L	1M	0.97	0.90	0.87	5.91	88.7	1.456			1.456	50.4	0.50	750x1345 (E)	1.625	2.05	18.01	0.41	18.41	90%
Mississauga Road	1M	2M	0.27	0.90	0.24	6.15	87.5	1.495			1.495	75.6	0.50	900	1.280	2.01	18.41	0.63	19.04	117%
Port Street	Ext. 3	2M	0.97	0.60	0.58	0.58	99.2	0.160			0.160	9.5	0.50	375	0.124	1.12	15.00	0.14	15.14	129%
Mississauga Road	2M	3M	0.27	0.90	0.24	6.98	85.7	1.660			1.660	80.4	0.50	900	1.280	2.01	19.04	0.67	19.71	130%
Bay Street	Ext. 4	3M	0.97	0.90	0.87	0.87	99.2	0.240			0.240	9.5	0.50	375	0.124	1.12	15.00	0.14	15.14	194%
Mississauga Road	3M	4M	0.26	0.90	0.23	8.08	83.8	1.882			1.882	80.4	0.50	900	1.280	2.01	19.71	0.67	20.37	147%
Lake Street	Ext. 5	5M	0.97	0.90	0.87	0.87	99.2	0.240			0.240	9.5	0.50	375	0.124	1.12	15.00	0.14	15.14	194%
Mississauga Road	4M	5M	0.20	0.90	0.18	8.26	82.1	1.884			1.884	32.2	0.50	900	1.280	2.01	20.37	0.27	20.64	147%
Peter Street	Ext. 6	5M	1.16	0.65	0.75	0.75	99.2	0.208			0.208	109.0	0.50	450	0.202	1.27	15.00	1.43	16.43	103%
Mississauga Road	5M	6M	0.31	0.90	0.28	10.17	81.4	2.299			2.299	39.0	0.50	1050	1.931	2.23	20.64	0.29	20.93	119%
Mississauga Road	6M	HW	0.31	0.90	0.28	10.45	80.7	2.342			2.342	122.0	0.50	1050	1.931	2.23	20.93	0.91	21.84	121%

REGISTERED PROFESSIONAL ENGINEER
R.B.T. MERWIN
100009772
NOV 15, 2018
PROVINCE OF ONTARIO

STORM SEWER DESIGN SHEET

10 Year Storm

Port Credit West Village Partners

City of Mississauga

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BLK 1	**0**	**BLOCK 1**	**112**	**0.45**	**0.90**	**0.41**	**0.41**	**99.2**	**0.112**	**0.000**	**0.000**	**0.112**	**11.0**	**0.50**	**375**	**0.124**	**1.12**	**15.00**	**0.16**	**15.16**	**90%**
110	STREET E	112	111	0.14	0.90	0.13	0.53	98.5	0.145			0.145	52.0	0.50	450	0.202	1.27	15.16	0.68	15.85	72%
109	STREET E	111	110	0.05	0.90	0.05	0.58	95.9	0.154			0.154	26.0	0.50	525	0.304	1.40	15.85	0.31	16.16	50%
108	STREET E	110	109	0.06	0.90	0.05	0.63	94.8	0.166			0.166	25.0	0.50	525	0.304	1.40	16.16	0.30	16.45	55%
107	STREET E	109	108	0.06	0.90	0.05	0.68	93.8	0.178			0.178	28.0	0.50	525	0.304	1.40	16.45	0.33	16.78	59%
106	STREET E	108	107	0.16	0.90	0.14	0.83	92.7	0.213			0.213	80.0	0.50	525	0.304	1.40	16.78	0.95	17.73	70%
BLK 2		**BLOCK 2**	**107**	**0.67**	**0.90**	**0.60**	**0.60**	**99.2**	**0.166**	**0.000**	**0.000**	**0.166**	**11.0**	**0.50**	**450**	**0.202**	**1.27**	**15.00**	**0.14**	**15.14**	**82%**
105	STREET F	107	106	0.13	0.90	0.12	1.55	89.6	0.385			0.385	74.0	0.50	675	0.594	1.66	17.73	0.74	18.48	65%
115	STREET B	117	115	0.30	0.90	0.27	0.27	99.2	0.074			0.074	98.0	0.50	375	0.124	1.12	15.00	1.46	16.46	60%
BLK 3	**0**	**BLOCK 3**	**116**	**0.85**	**0.90**	**0.77**	**0.77**	**99.2**	**0.211**	**0.000**	**0.000**	**0.211**	**11.0**	**0.50**	**525**	**0.304**	**1.40**	**15.00**	**0.13**	**15.13**	**69%**
116	STREET A	116	115	0.19	0.90	0.17	0.94	98.7	0.256			0.256	56.0	0.50	525	0.304	1.40	15.13	0.66	15.79	84%
114	STREET B	115	114	0.13	0.90	0.12	1.32	93.8	0.345			0.345	65.0	0.50	600	0.434	1.54	16.46	0.71	17.16	79%
113	STREET C	118	114	0.15	0.90	0.14	0.14	99.2	0.037			0.037	77.0	0.50	300	0.068	0.97	15.00	1.33	16.33	54%
112	STREET C	114	113	0.08	0.90	0.07	1.53	91.4	0.388			0.388	36.0	0.50	675	0.594	1.66	17.16	0.36	17.52	65%
BLK 7	**0**	**BLOCK 7**	**113**	**0.43**	**0.90**	**0.39**	**0.39**	**99.2**	**0.107**	**0.000**	**0.000**	**0.107**	**12.0**	**0.50**	**375**	**0.124**	**1.12**	**15.00**	**0.18**	**15.18**	**86%**
111	STREET C	113	106	0.11	0.90	0.10	2.02	90.2	0.505			0.505	59.0	0.50	750	0.787	1.78	17.52	0.55	18.07	64%
104	STREET F	106	105	0.13	0.90	0.12	3.68	87.3	0.893			0.893	70.0	0.50	975	1.585	2.12	18.48	0.55	19.03	56%
	STREET F	105	104	0.13	0.90	0.12	3.80	85.7	0.904			0.904	66.0	0.50	975	1.585	2.12	19.03	0.52	19.54	57%
BLK 8		**BLOCK 8**	**104**	**2.50**	**0.60**	**1.50**	**1.50**	**99.2**	**0.413**			**0.413**	**10.0**	**0.50**	**750**	**0.787**	**1.78**	**15.00**	**0.09**	**15.09**	**52%**
BLK 10		BLOCK 10	104	1.17	0.90	1.05	1.05	99.2	0.290			0.290	11.0	0.50	600	0.434	1.54	15.00	0.12	15.12	67%
102	STREET F	104	103	0.22	0.90	0.20	6.55	84.3	1.533			1.533	115.0	0.50	1050	1.931	2.23	19.54	0.86	20.40	79%
101	STREET F	103	102	0.03	0.90	0.03	6.58	82.0	1.498			1.498	20.0	0.50	1200	2.757	2.44	20.40	0.14	20.54	54%
BLK 9	**0**	**BLOCK 9**	**102**	**0.17**	**0.60**	**0.10**	**0.10**	**99.2**	**0.028**	**0.000**	**0.000**	**0.028**	**5.0**	**0.50**	**450**	**0.202**	**1.27**	**15.00**	**0.07**	**15.07**	**14%**

F:\Projects\16-489W (West Village Partners - Port Credit)\Design\Storm\16-489 STM (10 yr+Capture):STM (10yr)

STORM SEWER DESIGN SHEET

10 Year Storm

Port Credit West Village Partners

City of Mississauga

PROJECT DETAILS

Project No: 16-489
Date: 9-Nov-18
Designed by: RAM/NM
Checked by: R.B.T.M

JAN 6/16

DESIGN CRITERIA

Min. Diameter = 300 mm
Mannings 'n'= 0.013
Starting Tc = 15 min
Factor of Safety = 10 %

Rainfall Intensity = $\frac{A}{(Tc+B)^c}$
A = 1010
B = 4.6
c = 0.78

NOMINAL PIPE SIZE USED

CATCHMENT ID	STREET	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
125	STREET B	127	126	0.08	0.90	0.07	0.07	99.2	0.020			0.020	27.0	0.50	300	0.068	0.97	15.00	0.47	15.47	29%
124	STREET B	126	125	0.08	0.90	0.07	0.14	97.4	0.039			0.039	35.0	0.50	300	0.068	0.97	15.47	0.60	16.07	57%
123	STREET B	125	124	0.12	0.90	0.11	0.25	95.1	0.067			0.067	56.0	0.50	375	0.124	1.12	16.07	0.83	16.90	54%
122	STREET B	124	123	0.13	0.90	0.12	0.37	92.3	0.095			0.095	59.0	0.50	375	0.124	1.12	16.90	0.88	17.78	76%
121	STREET B	123	121	0.15	0.90	0.14	0.50	89.4	0.125			0.125	74.0	0.50	450	0.202	1.27	17.78	0.97	18.75	62%
BLK 20	**(PARK)**	**BLOCK 20**	**122**	**0.58**	**0.30**	**0.17**	**0.17**	**99.2**	**0.048**			**0.048**	**10.0**	**0.50**	**300**	**0.068**	**0.97**	**15.00**	**0.17**	**15.17**	**70%**
120	STREET A	122	121	0.09	0.90	0.08	0.26	98.5	0.070			0.070	29.0	0.50	375	0.124	1.12	15.17	0.43	15.60	56%
BLK 17	**0**	**BLOCK 17**	**121**	**0.37**	**0.90**	**0.33**	**0.33**	**99.2**	**0.092**	**0.000**	**0.000**	**0.092**	**11.0**	**0.50**	**375**	**0.124**	**1.12**	**15.00**	**0.16**	**15.16**	**74%**
119	STREET A	121	120	0.13	0.90	0.12	1.21	86.5	0.291			0.291	66.0	0.50	750	0.787	1.78	18.75	0.62	19.37	37%
BLK 11		BLOCK 11	120	0.15	0.90	0.14	0.14	99.2	0.037			0.037	10.0	0.50	300	0.068	0.97	15.00	0.17	15.17	54%
118	STREET A	120	119	0.18	0.90	0.16	1.51	84.8	0.355			0.355	91.0	0.50	750	0.787	1.78	19.37	0.85	20.22	45%
BLK 21	**(PARK)**	**BLOCK 21**	**119**	**0.32**	**0.30**	**0.10**	**0.10**	**99.2**	**0.026**			**0.026**	**10.0**	**0.50**	**300**	**0.068**	**0.97**	**15.00**	**0.17**	**15.17**	**39%**
117	STREET A	119	102	0.02	0.90	0.02	1.62	82.5	0.371			0.371	19.0	0.50	750	0.787	1.78	20.22	0.18	20.39	47%
BLK 22	(PARK)	102	101				8.30	81.7	1.882			1.882	99.0	0.25	1200x2400 (BOX)	6.013	2.09	20.54	0.79	21.33	31%
BLK 22	(PARK)	101	WEST HEADWALL				8.30	79.7	1.837			1.837	35.0	0.25	1200x2400 (BOX)	6.013	2.09	21.33	0.28	21.61	31%

STORM SEWER DESIGN SHEET

10 Year Storm

Port Credit West Village Partners

City of Mississauga

PROJECT DETAILS

Project No: 16-489
Date: 9-Nov-18
Designed by: RAM/NM
Checked by: R.B.T.M *JAN 6/16*

DESIGN CRITERIA

Min. Diameter = 300 mm
Mannings 'n'= 0.013
Starting Tc = 15 min
Factor of Safety = 10 %

Rainfall Intensity = A / (Tc+B)^c
A = 1010
B = 4.6
c = 0.78

NOMINAL PIPE SIZE USED

CATCHMENT ID	STREET	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
EXT. 7	*LAKESHORE ROAD*	*1L*	*2L*	*0.26*	*0.90*	*0.23*	*0.23*	*99.2*	*0.064*			*0.064*	*50.4*	*0.50*	*375*	*0.124*	*1.12*	*15.00*	*0.75*	*15.75*	*52%*
EXT. 8	*LAKESHORE ROAD*	*2L*	*3L*	*0.29*	*0.90*	*0.26*	*0.50*	*96.3*	*0.132*			*0.132*	*9.5*	*0.50*	*450*	*0.202*	*1.27*	*15.75*	*0.12*	*15.87*	*66%*
EXT. 9	*LAKESHORE ROAD*	*3L*	*4L*	*0.17*	*0.90*	*0.15*	*0.65*	*95.9*	*0.173*			*0.173*	*75.6*	*0.50*	*525*	*0.304*	*1.40*	*15.87*	*0.90*	*16.77*	*57%*
EXT. 10	*LAKESHORE ROAD*	*4L*	*5L*	*0.24*	*0.90*	*0.22*	*0.86*	*92.7*	*0.222*			*0.222*	*9.7*	*0.50*	*600*	*0.434*	*1.54*	*16.77*	*0.11*	*16.88*	*51%*
EXT. 1	*LAKESHORE ROAD*	*EXT. 1*	*5L*	*3.79*	*0.60*	*2.27*	*2.27*	*99.2*	*0.626*			*0.626*	*304.0*	*0.50*	*450*	*0.202*	*1.27*	*15.00*	*4.00*	*19.00*	*311%*
EXT. 11	*LAKESHORE ROAD*	*5L*	*6L*	*0.30*	*0.90*	*0.27*	*3.41*	*85.8*	*0.812*			*0.812*	*80.4*	*0.50*	*675*	*0.594*	*1.66*	*19.00*	*0.81*	*19.80*	*137%*
	MISSISSAUGA ROAD	*6L*	*7L*				*3.41*	*83.6*	*0.791*			*0.791*	*33.0*	*0.50*	*675*	*0.594*	*1.66*	*19.80*	*0.33*	*20.13*	*133%*
EXT. 2	*LAKESHORE ROAD*	*EXT. 2*	*7L*	*2.41*	*0.60*	*1.45*	*1.45*	*99.2*	*0.398*			*0.398*	*220.0*	*0.50*	*375*	*0.124*	*1.12*	*15.00*	*3.27*	*18.27*	*321%*
	MISSISSUAGA ROAD	7L	217	0.15	0.90	0.14	4.99	82.7	1.146			1.146	88.0	0.50	730x1150 (E)	1.299	1.97	20.13	0.74	20.88	88%
206	MISSISSUAGA ROAD	217	216	0.18	0.90	0.16	5.15	99.2	1.419			1.419	62.0	0.30	900x1800 (BOX)	3.059	1.89	15.00	0.55	15.55	46%
BLK 4	**0**	**BLOCK 4**	**216**	**1.96**	**0.90**	**1.76**	**1.76**	**99.2**	**0.486**	**0.000**	**0.000**	**0.486**	**20.0**	**0.50**	**675**	**0.594**	**1.66**	**15.00**	**0.20**	**15.20**	**82%**
205	MISSISSUAGA ROAD	216	215	0.09	0.90	0.08	7.00	97.1	1.886			1.886	42.0	0.30	900x1800 (BOX)	3.059	1.89	15.55	0.37	15.92	62%
BLK 15		**BLOCK 5**	**210**	**0.60**	**0.90**	**0.54**	**0.54**	**99.2**	**0.149**			**0.149**	**12.0**	**0.50**	**450**	**0.202**	**1.27**	**15.00**	**0.16**	**15.16**	**74%**
217	STREET C	210	211	0.16	0.90	0.14	0.68	98.5	0.187			0.187	65.0	0.50	525	0.304	1.40	15.16	0.77	15.93	62%
216	STREET C	211	212	0.24	0.90	0.22	0.90	95.6	0.239			0.239	25.0	0.50	525	0.304	1.40	15.93	0.30	16.23	79%
215	STREET C	212	213	0.33	0.60	0.20	1.10	94.6	0.288			0.288	84.0	0.50	600	0.434	1.54	16.23	0.91	17.14	66%
BLK 6	**0**	**BLOCK 6**	**213**	**0.28**	**0.90**	**0.25**	**0.25**	**99.2**	**0.069**	**0.000**	**0.000**	**0.069**	**12.0**	**0.50**	**375**	**0.124**	**1.12**	**15.00**	**0.18**	**15.18**	**56%**
BLK 14	**0**	**BLOCK 14**	**213**	**0.87**	**0.90**	**0.78**	**0.78**	**99.2**	**0.216**	**0.000**	**0.000**	**0.216**	**8.0**	**0.50**	**525**	**0.304**	**1.40**	**15.00**	**0.09**	**15.09**	**71%**
214	STREET C	213	215	0.24	0.90	0.22	2.35	91.5	0.597			0.597	14.0	0.50	750	0.787	1.78	17.14	0.13	17.27	76%
EXT.3	*PORT STREET*	*EXT. 3*	*215*	*0.97*	*0.60*	*0.58*	*0.58*	*99.2*	*0.160*			*0.160*	*15.0*	*0.50*	*375*	*0.124*	*1.12*	*15.00*	*0.22*	*15.22*	*129%*
204	MISSISSAUGA ROAD	215	214	0.27	0.90	0.24	10.17	91.0	2.572			2.572	123.0	0.30	900x1800 (BOX)	3.059	1.89	17.27	1.09	18.35	84%
BLK 15	**PARK**	**BLOCK 15**	**214**	**0.26**	**0.30**	**0.08**	**0.08**	**99.2**	**0.021**			**0.021**	**7.0**	**0.50**	**300**	**0.068**	**0.97**	**15.00**	**0.12**	**15.12**	**31%**
EXT.4	*BAY STREET*	*EXT.4*	*214*	*0.97*	*0.60*	*0.58*	*0.58*	*99.2*	*0.160*			*0.160*	*15.0*	*0.50*	*375*	*0.124*	*1.12*	*15.00*	*0.22*	*15.22*	*129%*
203	MISSISSUAGA ROAD	214	202	0.26	0.90	0.23	11.06	87.7	2.694			2.694	116.0	0.30	900x1800 (BOX)	3.059	1.89	18.35	1.02	19.38	88%
213	STREET D	209	208	0.23	0.90	0.21	0.21	99.2	0.057			0.057	108.0	0.50	300	0.068	0.97	15.00	1.86	16.86	83%
BLK 12		**BLOCK 12**	**208**	**1.48**	**0.60**	**0.89**	**0.89**	**99.2**	**0.245**			**0.245**	**8.0**	**0.50**	**600**	**0.434**	**1.54**	**15.00**	**0.09**	**15.09**	**56%**
212	STREET D	208	207	0.19	0.90	0.17	1.27	92.4	0.325			0.325	102.0	0.50	675	0.594	1.66	16.86	1.02	17.88	55%
BLK 16	**0**	**BLOCK 16**	**207**	**0.39**	**0.90**	**0.35**	**0.35**	**99.2**	**0.097**	**0.000**	**0.000**	**0.097**	**11.0**	**0.50**	**375**	**0.124**	**1.12**	**15.00**	**0.16**	**15.16**	**78%**
211	STREET D	207	203	0.04	0.90	0.04	1.65	89.1	0.409			0.409	23.0	0.50	675	0.594	1.66	17.88	0.23	18.12	69%
210	STREET A	206	205	0.10	0.90	0.09	0.09	99.2	0.025			0.025	50.0	0.50	300	0.068	0.97	15.00	0.86	15.86	36%

STORM SEWER DESIGN SHEET

10 Year Storm

Port Credit West Village Partners

City of Mississauga

PROJECT DETAILS

Project No: 16-489
Date: 9-Nov-18
Designed by: RAM/NM
Checked by: R.B.T.M
JAN 6/16

DESIGN CRITERIA

Min. Diameter = 300 mm
Mannings 'n'= 0.013
Starting Tc = 15 min
Factor of Safety = 10 %

Rainfall Intensity = $\frac{A}{(Tc+B)^c}$

A = 1010
B = 4.6
c = 0.78

NOMINAL PIPE SIZE USED

CATCHMENT ID	STREET	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
BLK 13	**0**	**BLOCK 13**	**205**	**1.37**	**0.75**	**1.03**	**1.03**	**99.2**	**0.283**	**0.000**	**0.000**	**0.283**	**10.0**	**0.50**	**600**	**0.434**	**1.54**	**15.00**	**0.11**	**15.11**	**65%**
209	STREET A	205	204	0.07	0.90	0.06	1.18	95.9	0.314			0.314	33.0	0.50	600	0.434	1.54	15.86	0.36	16.22	72%
208	STREET A	204	203	0.06	0.90	0.05	1.23	94.6	0.324			0.324	32.0	0.50	600	0.434	1.54	16.22	0.35	16.57	75%
207	STREET A	203	202	0.09	0.90	0.08	2.97	88.4	0.729			0.729	51.0	0.20	1200	1.744	1.54	18.12	0.55	18.67	42%
EXT. 5	*LAKE STREET*	*EXT. 5*	*202*	*0.97*	*0.60*	*0.58*	*0.58*	*99.2*	*0.160*			*0.160*	*15.0*	*0.50*	*375*	*0.124*	*1.12*	*15.00*	*0.22*	*15.22*	*129%*
202	MISSISSAUGA ROAD	202	201	0.20	0.90	0.18	14.79	84.7	3.482			3.482	90.0	0.20	1200x3000 (BOX)	7.040	1.96	19.38	0.77	20.14	49%
EXT. 6	*PARKING LOT/PETER ST*	*EXT. 6*	*201*	*1.98*	*0.90*	*1.78*	*1.78*	*99.2*	*0.491*			*0.491*	*110.0*	*0.50*	*450*	*0.202*	*1.27*	*15.00*	*1.45*	*16.45*	*243%*
BLK 18	**0**	**BLOCK 18**	**201**	**2.10**	**0.90**	**1.89**	**1.89**	**99.2**	**0.521**	**0.000**	**0.000**	**0.521**	**8.0**	**0.50**	**675**	**0.594**	**1.66**	**15.00**	**0.08**	**15.08**	**88%**
201	LAKE	201	EAST HEADWALL	0.30	0.90	0.27	18.74	82.7	4.303			4.303	154.0	0.20	1200x3000 (BOX)	7.040	1.96	20.14	1.31	21.46	61%

▨ = Q_{100} IS CONTROLLED TO Q_{10} WITHIN HIGHLIGHTED BLOCKS.

REGISTERED PROFESSIONAL ENGINEER
R.B.T. MERWIN
100009772
NOV 15, 2018
PROVINCE OF ONTARIO

STORM SEWER DESIGN SHEET

10+100 Year Capture

Port Credit West Village Partners

City of Mississauga

PROJECT DETAILS

Project No: 16-489
Date: 9-Nov-18
Designed by: RAM/NM
Checked by: R.B.T.M

JAN 6/16

DESIGN CRITERIA

Min. Diameter = 300 mm
Mannings 'n'= 0.013
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Factor of Safety = 10 %

$$\text{Rainfall Intensity} = \frac{A}{(Tc+B)^c}$$

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NOMINAL PIPE SIZE USED

CATCHMENT ID	STREET	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
BLK 1	0	**BLOCK 1**	**112**	**0.45**	**0.90**	**0.41**	**0.41**	**99.2**	**0.112**	0.000	0.000	**0.112**	**11.0**	**0.50**	**375**	**0.124**	**1.12**	**15.00**	**0.16**	**15.16**	**90%**
110	STREET E	112	111	0.14	0.90	0.13	0.53	98.5	0.145	0.036	0.036	0.181	52.0	0.50	450	0.202	1.27	15.16	0.68	15.85	90%
109	STREET E	111	110	0.05	0.90	0.05	0.58	95.9	0.154		0.036	0.189	26.0	0.50	525	0.304	1.40	15.85	0.31	16.16	62%
108	STREET E	110	109	0.06	0.90	0.05	0.63	94.8	0.166		0.036	0.202	25.0	0.50	525	0.304	1.40	16.16	0.30	16.45	66%
107	STREET E	109	108	0.06	0.90	0.05	0.68	93.8	0.178		0.036	0.214	28.0	0.50	525	0.304	1.40	16.45	0.33	16.78	70%
106	STREET E	108	107	0.16	0.90	0.14	0.83	92.7	0.213		0.036	0.249	80.0	0.50	525	0.304	1.40	16.78	0.95	17.73	82%
BLK 2		**BLOCK 2**	**107**	**0.67**	**0.90**	**0.60**	**0.60**	**99.2**	**0.166**	0.000	0.000	**0.166**	**11.0**	**0.50**	**450**	**0.202**	**1.27**	**15.00**	**0.14**	**15.14**	**82%**
105	STREET F	107	106	0.13	0.90	0.12	1.55	89.6	0.385		0.036	0.421	74.0	0.50	675	0.594	1.66	17.73	0.74	18.48	71%
115	**STREET B**	**117**	**115**	**0.30**	**0.90**	**0.27**	**0.27**	**99.2**	**0.074**	**0.035**	**0.035**	**0.110**	**98.0**	**0.50**	**375**	**0.124**	**1.12**	**15.00**	**1.46**	**16.46**	**89%**
BLK 3	0	**BLOCK 3**	**116**	**0.85**	**0.90**	**0.77**	**0.77**	**99.2**	**0.211**	0.000	0.000	**0.211**	**11.0**	**0.50**	**525**	**0.304**	**1.40**	**15.00**	**0.13**	**15.13**	**69%**
116	STREET A	116	115	0.19	0.90	0.17	0.94	98.7	0.256			0.256	56.0	0.50	525	0.304	1.40	15.13	0.66	15.79	84%
114	STREET B	115	114	0.13	0.90	0.12	1.32	93.8	0.345		0.035	0.380	65.0	0.50	600	0.434	1.54	16.46	0.71	17.16	88%
113	STREET C	118	114	0.15	0.90	0.14	0.14	99.2	0.037			0.037	77.0	0.50	300	0.068	0.97	15.00	1.33	16.33	54%
112	STREET C	114	113	0.08	0.90	0.07	1.53	91.4	0.388		0.035	0.424	36.0	0.50	675	0.594	1.66	17.16	0.36	17.52	71%
BLK 7	0	**BLOCK 7**	**113**	**0.43**	**0.90**	**0.39**	**0.39**	**99.2**	**0.107**	0.000	0.000	**0.107**	**12.0**	**0.50**	**375**	**0.124**	**1.12**	**15.00**	**0.18**	**15.18**	**86%**
111	STREET C	113	106	0.11	0.90	0.10	2.02	90.2	0.505		0.035	0.541	59.0	0.50	750	0.787	1.78	17.52	0.55	18.07	69%
104	STREET F	106	105	0.13	0.90	0.12	3.68	87.3	0.893		0.071	0.964	70.0	0.50	975	1.585	2.12	18.48	0.55	19.03	61%
	STREET F	105	104	0.13	0.90	0.12	3.80	85.7	0.904		0.071	0.976	66.0	0.50	975	1.585	2.12	19.03	0.52	19.54	62%
BLK 8	0	**BLOCK 8**	**104**	**2.50**	**0.60**	**1.50**	**1.50**	**99.2**	**0.413**	**0.137**	**0.137**	**0.550**	**10.0**	**0.50**	**750**	**0.787**	**1.78**	**15.00**	**0.09**	**15.09**	**70%**
BLK 10		**BLOCK 10**	**104**	**1.17**	**0.90**	**1.05**	**1.05**	**99.2**	**0.290**			**0.290**	**11.0**	**0.50**	**600**	**0.434**	**1.54**	**15.00**	**0.12**	**15.12**	**67%**
102	STREET F	104	103	0.22	0.90	0.20	6.55	84.3	1.533		0.208	1.741	115.0	0.50	1050	1.931	2.23	19.54	0.86	20.40	90%
101	STREET F	103	102	0.03	0.90	0.03	6.58	82.0	1.498	0.449	0.658	2.156	20.0	0.50	1200	2.757	2.44	20.40	0.14	20.54	78%
BLK 9	0	**BLOCK 9**	**102**	**0.17**	**0.60**	**0.10**	**0.10**	**99.2**	**0.028**	**0.085**	**0.085**	**0.114**	**5.0**	**0.50**	**450**	**0.202**	**1.27**	**15.00**	**0.07**	**15.07**	**56%**
125	STREET B	127	126	0.08	0.90	0.07	0.07	99.2	0.020			0.020	27.0	0.50	300	0.068	0.97	15.00	0.47	15.47	29%
124	STREET B	126	125	0.08	0.90	0.07	0.14	97.4	0.039			0.039	35.0	0.50	300	0.068	0.97	15.47	0.60	16.07	57%
123	STREET B	125	124	0.12	0.90	0.11	0.25	95.1	0.067			0.067	56.0	0.50	375	0.124	1.12	16.07	0.83	16.90	54%
122	STREET B	124	123	0.13	0.90	0.12	0.37	92.3	0.095			0.095	59.0	0.50	375	0.124	1.12	16.90	0.88	17.78	76%
121	STREET B	123	121	0.15	0.90	0.14	0.50	89.4	0.125			0.125	74.0	0.50	450	0.202	1.27	17.78	0.97	18.75	62%
BLK 20	**(PARK)**	**BLOCK 20**	**122**	**0.58**	**0.30**	**0.17**	**0.17**	**99.2**	**0.048**			**0.048**	**10.0**	**0.50**	**300**	**0.068**	**0.97**	**15.00**	**0.17**	**15.17**	**70%**
120	STREET A	122	121	0.09	0.90	0.08	0.26	98.5	0.070			0.070	29.0	0.50	375	0.124	1.12	15.17	0.43	15.60	56%
BLK 17	0	**BLOCK 17**	**121**	**0.37**	**0.90**	**0.33**	**0.33**	**99.2**	**0.092**	0.000	0.000	**0.092**	**11.0**	**0.50**	**375**	**0.124**	**1.12**	**15.00**	**0.16**	**15.16**	**74%**
119	STREET A	121	120	0.13	0.90	0.12	1.21	86.5	0.291	0.330	0.330	0.621	66.0	0.50	750	0.787	1.78	18.75	0.62	19.37	79%
BLK 11		**BLOCK 11**	**120**	**0.15**	**0.90**	**0.14**	**0.14**	**99.2**	**0.037**			**0.037**	**10.0**	**0.50**	**300**	**0.068**	**0.97**	**15.00**	**0.17**	**15.17**	**54%**
118	STREET A	120	119	0.18	0.90	0.16	1.51	84.8	0.355		0.330	0.685	91.0	0.50	750	0.787	1.78	19.37	0.85	20.22	87%
BLK 21	**(PARK)**	**BLOCK 21**	**119**	**0.32**	**0.30**	**0.10**	**0.10**	**99.2**	**0.026**			**0.026**	**10.0**	**0.50**	**300**	**0.068**	**0.97**	**15.00**	**0.17**	**15.17**	**39%**
117	STREET A	119	102	0.02	0.90	0.02	1.62	82.5	0.371		0.330	0.702	19.0	0.50	750	0.787	1.78	20.22	0.18	20.39	89%

STORM SEWER DESIGN SHEET

10+100 Year Capture

Port Credit West Village Partners

City of Mississauga

PROJECT DETAILS

Project No: 16-489
Date: 9-Nov-18
Designed by: RAM/NM
Checked by: R.B.T.M

JAN 6/16

DESIGN CRITERIA

Min. Diameter = 300 mm
Mannings 'n'= 0.013
Starting Tc = 15 min
Factor of Safety = 10 %

Rainfall Intensity = $\frac{A}{(Tc+B)^c}$
A = 1010
B = 4.6
c = 0.78

NOMINAL PIPE SIZE USED

CATCHMENT ID	STREET	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
BLK 22	(PARK)	102	101				8.30	81.7	1.882		1.074	2.956	99.0	0.25	1200x2400 (BOX)	6.013	2.09	20.54	0.79	21.33	49%
BLK 22	(PARK)	101	WEST HEADWALL				8.30	79.7	1.837		1.074	2.911	35.0	0.25	1200x2400 (BOX)	6.013	2.09	21.33	0.28	21.61	48%

F:\Projects\16-489W (West Village Partners - Port Credit)\Design\Storm\16-489 STM (10 yr+Capture):STM (10yr+100yr)

urbantech
west

STORM SEWER DESIGN SHEET

10+100 Year Capture

Port Credit West Village Partners

City of Mississauga

PROJECT DETAILS

Project No: 16-489
Date: 9-Nov-18
Designed by: RAM/NM
Checked by: R.B.T.M
JAN 6/16

DESIGN CRITERIA

Min. Diameter = 300 mm
Mannings 'n'= 0.013
Starting Tc = 15 min
Factor of Safety = 10 %

Rainfall Intensity = $\frac{A}{(Tc+B)^c}$
A = 1010
B = 4.6
c = 0.78

NOMINAL PIPE SIZE USED

CATCHMENT ID	STREET	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
EXT. 7	LAKESHORE ROAD	1L	2L	0.26	0.90	0.23	0.23	99.2	0.064			0.064	50.4	0.50	375	0.124	1.12	15.00	0.75	15.75	52%
EXT. 8	LAKESHORE ROAD	2L	3L	0.29	0.90	0.26	0.50	96.3	0.132			0.132	9.5	0.50	450	0.202	1.27	15.75	0.12	15.87	66%
EXT. 9	LAKESHORE ROAD	3L	4L	0.17	0.90	0.15	0.65	95.9	0.173			0.173	75.6	0.50	525	0.304	1.40	15.87	0.90	16.77	57%
EXT. 10	LAKESHORE ROAD	4L	5L	0.24	0.90	0.22	0.86	92.7	0.222			0.222	9.7	0.50	600	0.434	1.54	16.77	0.11	16.88	51%
EXT. 1	LAKESHORE ROAD	EXT. 1	5L	3.79	0.60	2.27	2.27	99.2	0.626			0.626	304.0	0.50	450	0.202	1.27	15.00	4.00	19.00	311%
EXT. 11	LAKESHORE ROAD	5L	6L	0.30	0.90	0.27	3.41	85.8	0.812			0.812	80.4	0.50	675	0.594	1.66	19.00	0.81	19.80	137%
	MISSISSAUGA ROAD	6L	7L				3.41	83.6	0.791			0.791	33.0	0.50	675	0.594	1.66	19.80	0.33	20.13	133%
EXT. 2	LAKESHORE ROAD	EXT. 2	7L	2.41	0.60	1.45	1.45	99.2	0.398			0.398	220.0	0.50	375	0.124	1.12	15.00	3.27	18.27	321%
	MISSISSUAGA ROAD	7L	217	0.15	0.90	0.14	4.99	82.7	1.146			1.146	88.0	0.50	730x1150 (E)	1.299	1.97	20.13	0.74	20.88	88%
206	MISSISSUAGA ROAD	217	216	0.18	0.90	0.16	5.15	99.2	1.419			1.419	62.0	0.30	900x1800 (BOX)	3.059	1.89	15.00	0.55	15.55	46%
BLK 4	0	BLOCK 4	216	1.96	0.90	1.76	1.76	99.2	0.486	0.000	0.000	0.486	20.0	0.50	675	0.594	1.66	15.00	0.20	15.20	82%
205	MISSISSUAGA ROAD	216	215	0.09	0.90	0.08	7.00	97.1	1.886			1.886	42.0	0.30	900x1800 (BOX)	3.059	1.89	15.55	0.37	15.92	62%
BLK 15		BLOCK 5	210	0.60	0.90	0.54	0.54	99.2	0.149			0.149	12.0	0.50	450	0.202	1.27	15.00	0.16	15.16	74%
217	STREET C	210	211	0.16	0.90	0.14	0.68	98.5	0.187			0.187	65.0	0.50	525	0.304	1.40	15.16	0.77	15.93	62%
216	STREET C	211	212	0.24	0.90	0.22	0.90	95.6	0.239			0.239	25.0	0.50	525	0.304	1.40	15.93	0.30	16.23	79%
215	STREET C	212	213	0.33	0.60	0.20	1.10	94.6	0.288			0.288	84.0	0.50	600	0.434	1.54	16.23	0.91	17.14	66%
BLK 6	0	BLOCK 6	213	0.28	0.90	0.25	0.25	99.2	0.069	0.000	0.000	0.069	12.0	0.50	375	0.124	1.12	15.00	0.18	15.18	56%
BLK 14	0	BLOCK 14	213	0.87	0.90	0.78	0.78	99.2	0.216	0.000	0.000	0.216	8.0	0.50	525	0.304	1.40	15.00	0.09	15.09	71%
214	STREET C	213	215	0.24	0.90	0.22	2.35	91.5	0.597	0.034	0.034	0.631	14.0	0.50	750	0.787	1.78	17.14	0.13	17.27	80%
EXT.3	PORT STREET	EXT. 3	215	0.97	0.60	0.58	0.58	99.2	0.160			0.160	15.0	0.50	375	0.124	1.12	15.00	0.22	15.22	129%
204	MISSISSAUGA ROAD	215	214	0.27	0.90	0.24	10.17	91.0	2.572		0.034	2.606	123.0	0.30	900x1800 (BOX)	3.059	1.89	17.27	1.09	18.35	85%
BLK 15	PARK	BLOCK 15	214	0.26	0.30	0.08	0.08	99.2	0.021			0.021	7.0	0.50	300	0.068	0.97	15.00	0.12	15.12	31%
EXT.4	BAY STREET	EXT.4	214	0.97	0.60	0.58	0.58	99.2	0.160			0.160	15.0	0.50	375	0.124	1.12	15.00	0.22	15.22	129%
203	MISSISSUAGA ROAD	214	202	0.26	0.90	0.23	11.06	87.7	2.694		0.034	2.728	116.0	0.30	900x1800 (BOX)	3.059	1.89	18.35	1.02	19.38	89%
213	STREET D	209	208	0.23	0.90	0.21	0.21	99.2	0.057			0.057	108.0	0.50	300	0.068	0.97	15.00	1.86	16.86	83%
BLK 12	0	BLOCK 12	208	1.48	0.60	0.89	0.89	99.2	0.245	0.083	0.083	0.328	8.0	0.50	600	0.434	1.54	15.00	0.09	15.09	75%
212	STREET D	208	207	0.19	0.90	0.17	1.27	92.4	0.325		0.083	0.408	102.0	0.50	675	0.594	1.66	16.86	1.02	17.88	69%
BLK 16	0	BLOCK 16	207	0.39	0.90	0.35	0.35	99.2	0.097	0.000	0.000	0.097	11.0	0.50	375	0.124	1.12	15.00	0.16	15.16	78%
211	STREET D	207	203	0.04	0.90	0.04	1.65	89.1	0.409		0.083	0.492	23.0	0.50	675	0.594	1.66	17.88	0.23	18.12	83%
210	STREET A	206	205	0.10	0.90	0.09	0.09	99.2	0.025			0.025	50.0	0.50	300	0.068	0.97	15.00	0.86	15.86	36%
BLK 13	0	BLOCK 13	205	1.37	0.75	1.03	1.03	99.2	0.283	0.040	0.040	0.323	10.0	0.50	600	0.434	1.54	15.00	0.11	15.11	74%
209	STREET A	205	204	0.07	0.90	0.06	1.18	95.9	0.314		0.040	0.355	33.0	0.50	600	0.434	1.54	15.86	0.36	16.22	82%
208	STREET A	204	203	0.06	0.90	0.05	1.23	94.6	0.324		0.040	0.365	32.0	0.50	600	0.434	1.54	16.22	0.35	16.57	84%
207	STREET A	203	202	0.09	0.90	0.08	2.97	88.4	0.729	0.264	0.387	1.116	51.0	0.20	1200	1.744	1.54	18.12	0.55	18.67	64%

Urbantech West, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle, Suite 105 Oakville, Ontario L6H 0H2
TEL: 905.829.8818 FAX: 905.829.4804
www.urbantech.com

F:\Projects\16-489W (West Village Partners - Port Credit)\Design\Storm\16-489 STM (10 yr+Capture):STM (10yr+100yr) urbantech west

STORM SEWER DESIGN SHEET

10+100 Year Capture

Port Credit West Village Partners

City of Mississauga

PROJECT DETAILS

Project No: 16-489
Date: 9-Nov-18
Designed by: RAM/NM
Checked by: R.B.T.M

JAN 6/16

DESIGN CRITERIA

Min. Diameter = 300 mm
Mannings 'n'= 0.013
Starting Tc = 15 min
Factor of Safety = 10 %

Rainfall Intensity = $\frac{A}{(Tc+B)^c}$

A = 1010
B = 4.6
c = 0.78

NOMINAL PIPE SIZE USED

CATCHMENT ID	STREET	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
EXT. 5	*LAKE STREET*	*EXT. 5*	*202*	*0.97*	*0.60*	*0.58*	*0.58*	*99.2*	*0.160*			*0.160*	*15.0*	*0.50*	*375*	*0.124*	*1.12*	*15.00*	*0.22*	*15.22*	*129%*
202	MISSISSAUGA ROAD	202	201	0.20	0.90	0.18	14.79	84.7	3.482	1.401	1.822	5.305	90.0	0.20	1200x3000 (BOX)	7.040	1.96	19.38	0.77	20.14	75%
EXT. 6	*PARKING LOT/PETER ST*	*EXT. 6*	*201*	*1.98*	*0.90*	*1.78*	*1.78*	*99.2*	*0.491*			*0.491*	*110.0*	*0.50*	*450*	*0.202*	*1.27*	*15.00*	*1.45*	*16.45*	*243%*
BLK 18	**0**	**BLOCK 18**	**201**	**2.10**	**0.90**	**1.89**	**1.89**	**99.2**	**0.521**	**0.000**	**0.000**	**0.521**	**8.0**	**0.50**	**675**	**0.594**	**1.66**	**15.00**	**0.08**	**15.08**	**88%**
201	LAKE	201	EAST HEADWALL	0.30	0.90	0.27	18.74	82.7	4.303		1.822	6.125	154.0	0.20	1200x3000 (BOX)	7.040	1.96	20.14	1.31	21.46	87%

BOLD	= SITE PLAN BLOCK FLOW
0 🟨	= 100-YR CAPTURE PIPE LENGTHS
🟦	= Q_{100} IS CONTROLLED TO Q_{10} WITHIN HIGHLIGHTED BLOCKS

R.B.T. MERWIN
100009772
NOV 15, 2018

F:\Projects\16-489W (West Village Partners - Port Credit)\Design\Storm\16-489 STM (10 yr+Capture):STM (10yr+100yr)

PROJECT DETAILS	
Title1:	**STORM SEWER DESIGN SHEET**
Title2:	**Constant Flow (100yr Minor System Capture)**
Project Name:	**Port Credit West Village Partners**
Municipality:	**City of Mississauga**
Project No:	**16-489**
Date:	**9-Nov-18**
Designed by:	**RAM/NM**
Checked by:	**R.B.T.M**

IDF Parameters			
		10-yr	100-yr
$I=A/(T+b)^c$	A	1010	1450
	B	4.6	4.9
	C	0.78	0.78

CAPTURE LOCATION	AREA ID	CAPTURE POINT	Area ha	R 100-year	R 10-year	AR 100-year	AR 10-year	Flow Length m	Velocity m/s	Tc* min	I10 mm/hr	I100 mm/hr	Q10 m3/s	Q100 m3/s	Q100-Q10 m3/s	Const. flow m3/s
STREET E	100YR-1	MH112	0.19	1.13	0.90	0.21	0.17	34.00	1.50	15.38	97.7	138.6	0.046	0.082	0.036	0.036
BLOCK 8	100YR-2	BLOCK 8	0.24	0.75	0.60	0.18	0.14	40.00	1.50	15.44	97.4	138.3	0.039	0.069	0.030	0.030
BLOCK 8	100YR-3	BLOCK 8	0.17	0.75	0.60	0.13	0.10	40.00	1.50	15.44	97.4	138.3	0.028	0.049	0.021	0.021
BLOCK 8	100YR-4	BLOCK 8	0.17	0.75	0.60	0.13	0.10	40.00	1.50	15.44	97.4	138.3	0.028	0.049	0.021	0.021
BLOCK 8	100YR-5	BLOCK 8	0.17	0.75	0.60	0.13	0.10	40.00	1.50	15.44	97.4	138.3	0.028	0.049	0.021	0.021
BLOCK 8	100YR-6	BLOCK 8	0.35	0.75	0.60	0.26	0.21	110.00	1.50	16.22	94.6	134.3	0.055	0.098	0.043	0.043
BLOCK 9	100YR-7	BLOCK 9	0.17	0.75	0.60	0.13	0.10	40.00	1.50	15.44	97.4	138.3	0.028	0.049	0.021	0.021
BLOCK 9	100YR-8	BLOCK 9	0.17	0.75	0.60	0.13	0.10	40.00	1.50	15.44	97.4	138.3	0.028	0.049	0.021	0.021
BLOCK 9	100YR-9	BLOCK 9	0.35	0.75	0.60	0.26	0.21	110.00	1.50	16.22	94.6	134.3	0.055	0.098	0.043	0.043
STREET B	100YR-10	MH117	0.19	1.13	0.90	0.21	0.17	63.00	1.50	15.70	96.5	136.9	0.046	0.081	0.035	0.035
STREET A	100YR-11	MH103	3.75	0.91	0.73	3.42	2.74	725.00	1.50	23.06	75.8	107.9	0.576	1.026	0.449	0.449
STREET A	100YR-12	MH121	2.52	0.81	0.64	2.03	1.62	110.00	1.50	16.22	94.6	134.3	0.426	0.757	0.330	0.330
BLOCK 12	100YR-13	BLOCK 12	0.34	0.75	0.60	0.26	0.20	110.00	1.50	16.22	94.6	134.3	0.054	0.095	0.042	0.042
BLOCK 12	100YR-14	BLOCK 12	0.34	0.75	0.60	0.26	0.20	110.00	1.50	16.22	94.6	134.3	0.054	0.095	0.042	0.042
BLOCK 13	100YR-15	BLOCK 13	0.33	0.75	0.60	0.25	0.20	110.00	1.50	16.22	94.6	134.3	0.052	0.092	0.040	0.040
STREET C	100YR-16	MH213	0.23	0.90	0.72	0.21	0.17	115.00	1.50	16.28	94.4	134.0	0.044	0.078	0.034	0.034
STREET A	100YR-17	MH202	2.13	0.84	0.67	1.78	1.43	365.00	1.50	19.06	85.6	121.7	0.339	0.603	0.264	0.264
MISSISSAUGA ROAD	100YR-18	MH201	12.84	0.86	0.69	11.07	8.86	850.00	1.50	24.44	73.0	103.9	1.796	3.197	1.401	1.401

*Where available, Tc is calculated from design sheet or overland flow calculation

Tc calcs *where Tc = starting Tc + flow length/velocity*
(starting Tc = 15min)

Assumed Velocities for Calculation of time of Concentration	
Pipe Flow Velocity=	2.0 m/s
OLF Velocity=	1.5 m/s
External Flow Velocity=	0.25 m/s

REGISTERED PROFESSIONAL ENGINEER
R.B.T. MERWIN
100009772
NOV 15, 2018
PROVINCE OF ONTARIO

Composite Runoff Coefficients

Project Name: West Village
Municipality: City of Mississauga
Project No.: 16-489
Date: 8-Nov-18

Prepared by: NM
Checked by: RM
Date Modified: 14-Nov-18

To HW West			
Land Use	Area		C
ROW	0.9282	ha	0.9
Towns	2.50	ha	0.6
Park	0.32	ha	0.25
Total Hatch Area	3.75	ha	
Composite C			0.644389

To HW West			
Land Use	Area		C
ROW	1.77	ha	0.9
Towns	0.17	ha	0.6
Park	0.58	ha	0.25
Total Hatch Area	2.52	ha	
Composite C			0.730373

To Mississauga Road MH 202 (HW East)			
	Area		C
ROW	0.22	ha	0.90
Towns	0.28	ha	0.60
Park	0.00	ha	0.25
Total Hatch Area	0.51	ha	
Composite C			0.72

To Mississauga Road MH 215 (HW East)			
	Area		C
ROW	0.78	ha	0.90
Towns	1.09	ha	0.60
Park	0.26	ha	0.25
Total Hatch Area	2.13	ha	
Composite C			0.67

External To Mississauga Road MH 215 (HW East)			
	Area		C
ROW	3.73	ha	0.90
Towns	9.11	ha	0.60
Park	0.00	ha	0.25
Total Area	12.84	ha	
Composite C			0.69

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.013)
--------------------------------------------------------------


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... LPS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... CURVE_NUMBER
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 11/01/2018 00:00:00
Ending Date .............. 11/02/2018 23:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:01:00
Dry Time Step ............ 00:01:00
Routing Time Step ........ 1.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.001500 m


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         1.009        79.409
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.021         1.690
Surface Runoff ...........         0.970        76.280
Final Storage ............         0.019         1.489
Continuity Error (%) .....        -0.063


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.970         9.695
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.970         9.695
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....        -0.001


***************************
Time-Step Critical Elements
***************************
```

```
  None


  ********************************
  Highest Flow Instability Indexes
  ********************************
  All links are stable.


  *************************
  Routing Time Step Summary
  *************************
  Minimum Time Step           :     0.50 sec
  Average Time Step           :     1.00 sec
  Maximum Time Step           :     1.00 sec
  Percent in Steady State     :     0.00
  Average Iterations per Step :     2.00
  Percent Not Converging      :     0.00


  ***************************
  Subcatchment Runoff Summary
  ***************************


----------------------------------------------------------------------------------------------------------------------
--------
                            Total      Total      Total      Total     Imperv       Perv      Total       Total
Peak  Runoff
                           Precip      Runon       Evap      Infil     Runoff     Runoff     Runoff      Runoff
Runoff   Coeff
  Subcatchment                 mm         mm         mm         mm         mm         mm         mm    10^6 ltr
LPS

----------------------------------------------------------------------------------------------------------------------
--------
  1_Block9.1                79.41       0.00       0.00       1.63      74.07       2.28      76.35        0.43
270.29   0.961
  2a_Block17                79.41       0.00       0.00       1.63      74.09       2.28      76.37        0.28
178.75   0.962
  2b_Block18                79.41       0.00       0.00       1.65      74.04       2.26      76.30        1.60
974.65   0.961
  3_Block11                 79.41       0.00       0.00       2.14      74.05       1.77      75.82        0.93
574.84   0.955
  4_Block13                 79.41       0.00       0.00       1.64      74.07       2.27      76.34        0.59
370.92   0.961
  5_Block16                 79.41       0.00       0.00       1.63      74.09       2.28      76.37        0.30
188.40   0.962
  6_Block10                 79.41       0.00       0.00       1.64      74.05       2.27      76.32        0.89
559.65   0.961
  7_Block14                 79.41       0.00       0.00       1.64      74.06       2.27      76.33        0.66
418.53   0.961
  8_Block7                  79.41       0.00       0.00       1.63      74.08       2.28      76.36        0.33
207.69   0.962
  9_Block5                  79.41       0.00       0.00       1.63      74.07       2.28      76.35        0.46
289.51   0.961
  10a_Block1                79.41       0.00       0.00       1.63      74.08       2.28      76.36        0.34
217.33   0.962
  10b_Block2                79.41       0.00       0.00       1.64      74.07       2.27      76.34        0.51
323.09   0.961
  10c_Block3                79.41       0.00       0.00       1.64      74.06       2.27      76.33        0.65
409.02   0.961
  11b-Block6                79.41       0.00       0.00       1.63      74.10       2.28      76.38        0.21
135.30   0.962
  11a_Block4                79.41       0.00       0.00       1.65      74.04       2.26      76.30        1.51
923.27   0.961

  ******************
  Node Depth Summary
  ******************
```

```
---------------------------------------------------------------------------------
                              Average  Maximum  Maximum  Time of Max    Reported
                                Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type      Meters   Meters   Meters  days hr:min      Meters
---------------------------------------------------------------------------------
MH(B11)              OUTFALL     0.00     0.00    -1.00     0  00:00        0.00
MH(B13)              OUTFALL     0.00     0.00    -1.00     0  00:00        0.00
MH(B9.1)             OUTFALL     0.00     0.00    -1.00     0  00:00        0.00
MH(B17)              OUTFALL     0.00     0.00    -1.00     0  00:00        0.00
MH(B16)              OUTFALL     0.00     0.00    -1.00     0  00:00        0.00
MH(B10)              OUTFALL     0.00     0.00    -1.00     0  00:00        0.00
MH(B14)              OUTFALL     0.00     0.00    -1.00     0  00:00        0.00
MH(B7)               OUTFALL     0.00     0.00    -1.00     0  00:00        0.00
MH(B5)               OUTFALL     0.00     0.00    -1.00     0  00:00        0.00
MH(B2)               OUTFALL     0.00     0.00    -1.00     0  00:00        0.00
MH(B4)               OUTFALL     0.00     0.00    -1.00     0  00:00        0.00
MH(B18)              OUTFALL     0.00     0.00    -1.00     0  00:00        0.00
MH(B1)               OUTFALL     0.00     0.00    -1.00     0  00:00        0.00
MH(B3)               OUTFALL     0.00     0.00    -1.00     0  00:00        0.00
MH(B6)               OUTFALL     0.00     0.00    -1.00     0  00:00        0.00
1_Cistern(B9.1)      STORAGE     0.03     1.96     1.96     0  01:21        1.96
2a_Cistern(B17)      STORAGE     0.03     1.98     1.98     0  01:21        1.97
2b_Cistern(B18)      STORAGE     0.03     1.98     1.98     0  01:23        1.98
3_Cistern(B11)       STORAGE     0.03     1.98     1.98     0  01:22        1.98
4_Cistern(B13)       STORAGE     0.03     1.94     1.94     0  01:22        1.94
5_Cistern(B16)       STORAGE     0.03     1.96     1.96     0  01:21        1.96
6_Cistern(B10)       STORAGE     0.03     2.00     2.00     0  01:22        1.99
7_Cistern(B14)       STORAGE     0.03     1.99     1.99     0  01:22        1.99
8_Cistern(B7)        STORAGE     0.03     2.00     2.00     0  01:21        2.00
9_Cistern(B5)        STORAGE     0.03     1.99     1.99     0  01:21        1.99
10b_Cistern(B2)      STORAGE     0.03     2.00     2.00     0  01:21        2.00
11a_Cistern(B4)      STORAGE     0.03     2.04     2.04     0  01:23        2.04
10a_Cistern(B1)      STORAGE     0.03     1.99     1.99     0  01:21        1.99
10c_Cistern(B3)      STORAGE     0.03     1.97     1.97     0  01:22        1.97
11b_Cistern(B6)      STORAGE     0.03     1.95     1.95     0  01:21        1.95


*******************
Node Inflow Summary
*******************


-------------------------------------------------------------------------------------------------
                               Maximum  Maximum                  Lateral       Total        Flow
                               Lateral    Total  Time of Max      Inflow      Inflow     Balance
                                Inflow   Inflow   Occurrence      Volume      Volume       Error
Node                 Type          LPS      LPS  days hr:min    10^6 ltr    10^6 ltr     Percent
-------------------------------------------------------------------------------------------------
MH(B11)              OUTFALL      0.00   298.63     0  01:22           0       0.925       0.000
MH(B13)              OUTFALL      0.00   186.79     0  01:22           0       0.588       0.000
MH(B9.1)             OUTFALL      0.00   133.60     0  01:21           0       0.428       0.000
MH(B17)              OUTFALL      0.00    89.44     0  01:21           0       0.283       0.000
MH(B16)              OUTFALL      0.00    93.97     0  01:21           0       0.298       0.000
MH(B10)              OUTFALL      0.00   289.87     0  01:22           0       0.893       0.000
MH(B14)              OUTFALL      0.00   215.54     0  01:22           0       0.664       0.000
MH(B7)               OUTFALL      0.00   105.00     0  01:21           0       0.328       0.000
MH(B5)               OUTFALL      0.00   144.60     0  01:21           0       0.458       0.000
MH(B2)               OUTFALL      0.00   164.96     0  01:21           0       0.512       0.000
MH(B4)               OUTFALL      0.00   490.00     0  01:21           0        1.51       0.000
MH(B18)              OUTFALL      0.00   516.36     0  01:23           0         1.6       0.000
MH(B1)               OUTFALL      0.00   109.63     0  01:21           0       0.344       0.000
MH(B3)               OUTFALL      0.00   208.44     0  01:22           0       0.649       0.000
MH(B6)               OUTFALL      0.00    64.10     0  01:21           0       0.214       0.000

1_Cistern(B9.1)      STORAGE    270.29   270.29     0  01:20       0.428       0.428      -0.001
2a_Cistern(B17)      STORAGE    178.75   178.75     0  01:20       0.283       0.283      -0.001
2b_Cistern(B18)      STORAGE    974.65   974.65     0  01:20         1.6         1.6      -0.002
3_Cistern(B11)       STORAGE    574.84   574.84     0  01:20       0.925       0.925      -0.001
4_Cistern(B13)       STORAGE    370.92   370.92     0  01:20       0.588       0.588      -0.001
5_Cistern(B16)       STORAGE    188.40   188.40     0  01:20       0.298       0.298      -0.001
```

```
6_Cistern(B10)       STORAGE     559.65   559.65     0  01:20       0.893       0.893      -0.001
7_Cistern(B14)       STORAGE     418.53   418.53     0  01:20       0.664       0.664      -0.001
8_Cistern(B7)        STORAGE     207.69   207.69     0  01:20       0.328       0.328      -0.001
9_Cistern(B5)        STORAGE     289.51   289.51     0  01:20       0.458       0.458      -0.001
11a_Cistern(B4)      STORAGE     923.27   923.27     0  01:20        1.51        1.51      -0.001
10a_Cistern(B1)      STORAGE     217.33   217.33     0  01:20       0.344       0.344      -0.001
10b_Cistern(B2)      STORAGE     323.09   323.09     0  01:20       0.512       0.512      -0.001
10c_Cistern(B3)      STORAGE     409.02   409.02     0  01:20       0.649       0.649      -0.001
11b_Cistern(B6)      STORAGE     135.30   135.30     0  01:20       0.214       0.214      -0.001


*********************
Node Flooding Summary
*********************

No nodes were flooded.


**********************
Storage Volume Summary
**********************

--------------------------------------------------------------------------------------------------
                       Average     Avg  Evap Exfil       Maximum     Max    Time of Max    Maximum
                        Volume    Pcnt  Pcnt  Pcnt        Volume    Pcnt     Occurrence    Outflow
Storage Unit           1000 m3    Full  Loss  Loss       1000 m3    Full    days hr:min        LPS
--------------------------------------------------------------------------------------------------
1_Cistern(B9.1)          0.002       1     0     0         0.118      98       0  01:21     133.60
2a_Cistern(B17)          0.001       1     0     0         0.079      98       0  01:21      89.44
2b_Cistern(B18)          0.005       1     0     0         0.356      98       0  01:23     516.36
3_Cistern(B11)           0.003       1     0     0         0.223      99       0  01:22     298.63
4_Cistern(B13)           0.002       1     0     0         0.155      97       0  01:22     186.79
5_Cistern(B16)           0.001       1     0     0         0.083      98       0  01:21      93.97
6_Cistern(B10)           0.003       1     0     0         0.219      99       0  01:22     289.87
7_Cistern(B14)           0.002       1     0     0         0.170      99       0  01:22     215.54
8_Cistern(B7)            0.001       1     0     0         0.090     100       0  01:21     105.00
9_Cistern(B5)            0.002       1     0     0         0.124      99       0  01:21     144.60
11a_Cistern(B4)          0.005       1     0     0         0.332      97       0  01:23     490.00
10a_Cistern(B1)          0.001       1     0     0         0.094      99       0  01:21     109.63
10b_Cistern(B2)          0.002       1     0     0         0.135      99       0  01:21     164.96
10c_Cistern(B3)          0.002       1     0     0         0.168      98       0  01:22     208.44
11b_Cistern(B6)          0.001       2     0     0         0.063      97       0  01:21      64.10


***********************
Outfall Loading Summary
***********************

-----------------------------------------------------------
                       Flow       Avg       Max       Total
                       Freq      Flow      Flow      Volume
Outfall Node           Pcnt       LPS       LPS    10^6 ltr
-----------------------------------------------------------
MH(B11)               16.63     32.86    298.63       0.925
MH(B13)               13.50     25.73    186.79       0.588
MH(B9.1)              12.09     20.90    133.60       0.428
MH(B17)               10.91     15.30     89.44       0.283
MH(B16)               11.03     15.95     93.97       0.298
MH(B10)               16.28     32.41    289.87       0.893
MH(B14)               14.17     27.69    215.54       0.664
MH(B7)                11.23     17.28    105.00       0.328
MH(B5)                12.34     21.93    144.60       0.458
MH(B2)                12.79     23.63    164.96       0.512
MH(B4)                22.03     40.51    490.00       1.511
MH(B18)               22.91     41.32    516.36       1.602
MH(B1)                11.36     17.88    109.63       0.344
MH(B3)                14.04     27.30    208.44       0.649
MH(B6)                10.60     11.92     64.10       0.214
-----------------------------------------------------------
System                14.13    372.61     64.10       9.695
```

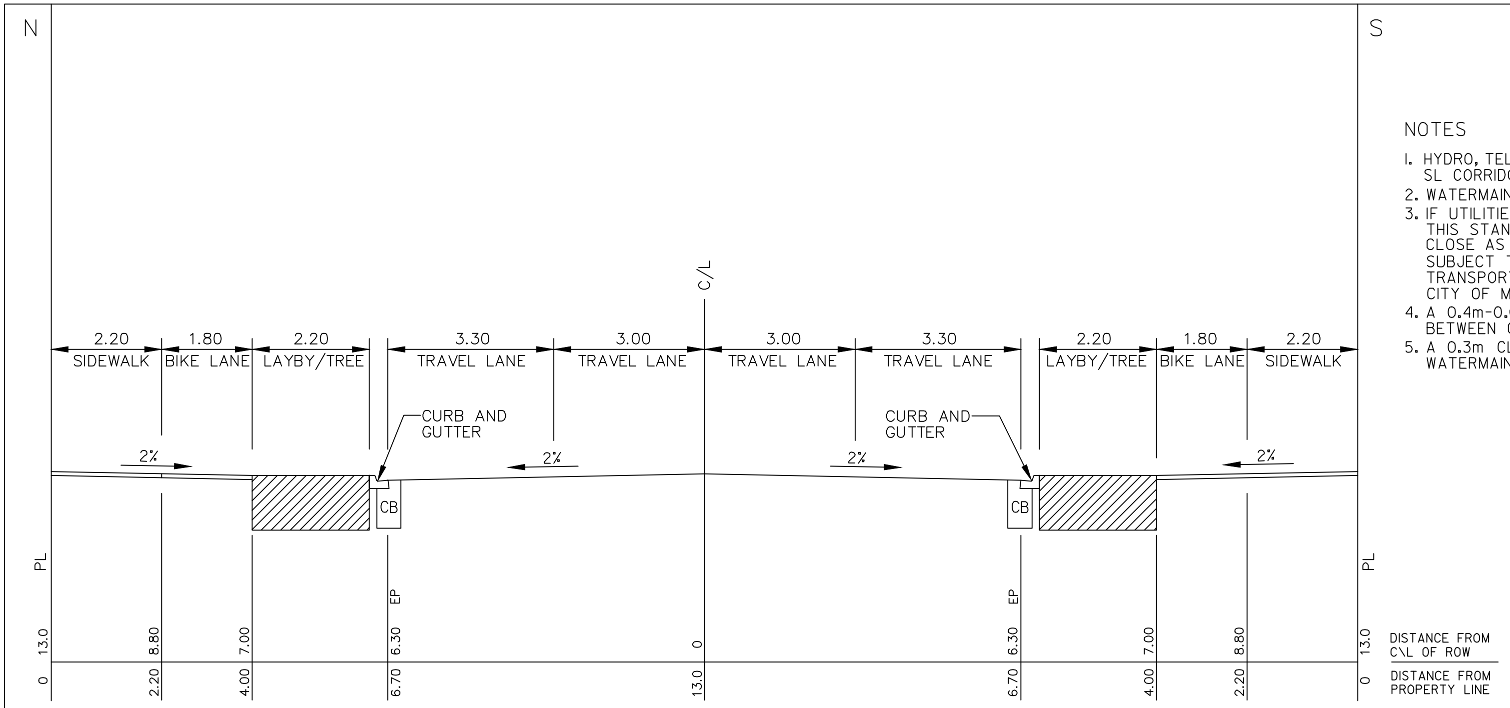
```
********************
Link Flow Summary
********************

-----------------------------------------------------------------------------
                               Maximum  Time of Max   Maximum    Max/    Max/
                                |Flow|   Occurrence   |Veloc|    Full    Full
Link                 Type          LPS  days hr:min     m/sec    Flow   Depth
-----------------------------------------------------------------------------
Outet(B10)           DUMMY      289.87     0  01:22
Outlet(B2)           DUMMY      164.96     0  01:21
Outlet(B11)          DUMMY      298.63     0  01:22
Outlet(B13)          DUMMY      186.79     0  01:22
Outlet(B14)          DUMMY      215.54     0  01:22
Outlet(B16)          DUMMY       93.97     0  01:21
Outlet(B17)          DUMMY       89.44     0  01:21
Outlet(B4)           DUMMY      490.00     0  01:21
Outlet(B5)           DUMMY      144.60     0  01:21
Outlet(B7)           DUMMY      105.00     0  01:21
Outlet(B9.1)         DUMMY      133.60     0  01:21
Outlet(B18)          DUMMY      516.36     0  01:23
Outlet(B1)           DUMMY      109.63     0  01:21
Outlet(B3)           DUMMY      208.44     0  01:22
Outlet(B6)           DUMMY       64.10     0  01:21


***************************
Flow Classification Summary
***************************

-------------------------------------------------------------------------------------
                    Adjusted    ---------- Fraction of Time in Flow Class ----------
                    /Actual         Up    Down  Sub   Sup   Up    Down  Norm  Inlet
Conduit              Length    Dry  Dry   Dry   Crit  Crit  Crit  Crit  Ltd   Ctrl
-------------------------------------------------------------------------------------


*************************
Conduit Surcharge Summary
*************************

No conduits were surcharged.


Analysis begun on:  Fri Nov  9 15:31:19 2018
Analysis ended on:  Fri Nov  9 15:31:20 2018
Total elapsed time: 00:00:01
```

APPENDIX E

Proposed Right-of-Way Cross-sections

- *Mississauga Road*
- *Street A (LID)*
- *Street A (Parking Layby)*
- *Street B (LID)*
- *Street B (Parking Layby)*
- *Street C*
- *Street D & F*
- *Street D & F (Mid Block)*
- *Street E (Mid Block)*
- *Street E (Bus Bay)*

LAKESHORE BOULEVARD



METRIC
ALL DIMENSIONS IN METRES

NOTES

1. HYDRO, TELECOMMUNICATION PROVIDER, GAS AND SL CORRIDOR TO HAVE A MINIMUM COVER OF 0.965m.
2. WATERMAIN TO HAVE A MINIMUM COVER OF 1.7m.
3. IF UTILITIES CANNOT BE INSTALLED ACCORDING TO THIS STANDARD THEY ARE TO BE INSTALLED AS CLOSE AS POSSIBLE TO THE PRESCRIBED LOCATION SUBJECT TO THE APPROVAL OF THE TRANSPORTATION AND WORKS DEPARTMENT OF THE CITY OF MISSISSAUGA.
4. A 0.4m-0.6m CLEARANCE MUST BE MAINTAINED BETWEEN CABLES AND HYDRANTS.
5. A 0.3m CLEARANCE MUST BE MAINTAINED BETWEEN WATERMAINS AND UTILITY POLES.

LEGEND

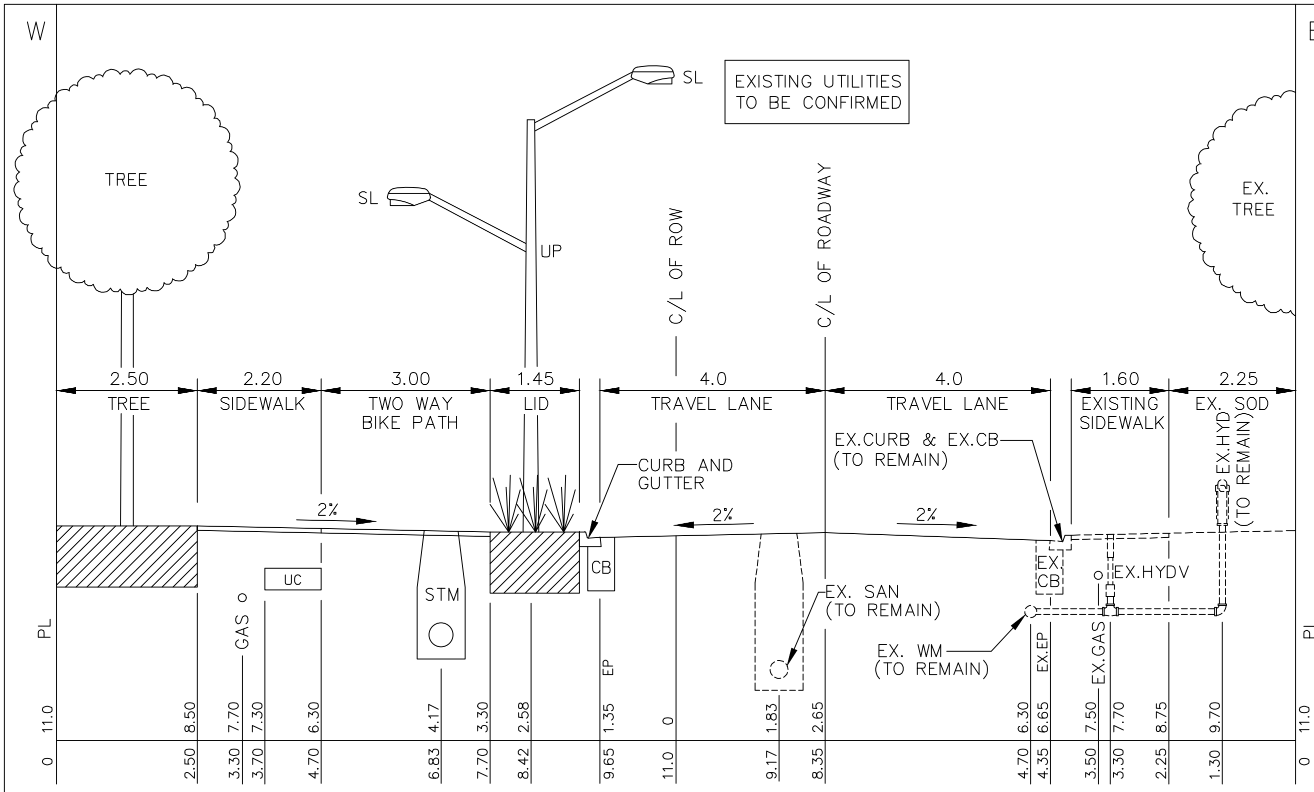
EP - EDGE OF PAVEMENT
CB - CATCH BASIN
CURB - CURB OR CURB AND GUTTER
C/L - CENTRELINE
HYD - FIRE HYDRANT
HYDV - FIRE HYDRANT VALVE
LID - LOW IMPACT DEVELOPMENT MEASURE
PWV - PRIVATE WATER VALVE
PL - PROPERTY LINE
SL - STREETLIGHT
SW - SIDEWALK
SAN - SANITARY SEWER
STM - STORM SEWER
UB - UTIITY BOX (HYDRO,TELECOMMUNICATIONS)
UC - UTILITY CORRIDOR (HYDRO,TELECOMMUNICATIONS,GAS,SL)
UP - UTILITY POLE
WM - WATERMAIN

LAKESHORE BOULEVARD
12.60m ROAD ON 26.0m ROW

EFF. DATE	SCALE N.T.S.
REV.	STANDARD No.

FIGURE IS CONCEPTUAL ONLY. FINAL DESIGN DETAILS TO BE CONFIRMED THROUGH DISCUSSIONS WITH STAFF.

MISSISSAUGA ROAD



METRIC
ALL DIMENSIONS IN METRES

NOTES

1. HYDRO, TELECOMMUNICATION PROVIDER, GAS AND SL CORRIDOR TO HAVE A MINIMUM COVER OF 0.965m.
2. WATERMAIN TO HAVE A MINIMUM COVER OF 1.7m.
3. IF UTILITIES CANNOT BE INSTALLED ACCORDING TO THIS STANDARD THEY ARE TO BE INSTALLED AS CLOSE AS POSSIBLE TO THE PRESCRIBED LOCATION SUBJECT TO THE APPROVAL OF THE TRANSPORTATION AND WORKS DEPARTMENT OF THE CITY OF MISSISSAUGA.
4. A 0.4m-0.6m CLEARANCE MUST BE MAINTAINED BETWEEN CABLES AND HYDRANTS.
5. A 0.3m CLEARANCE MUST BE MAINTAINED BETWEEN WATERMAINS AND UTILITY POLES.

LEGEND

EP - EDGE OF PAVEMENT
CB - CATCH BASIN
CURB - CURB OR CURB AND GUTTER
C/L - CENTRELINE
HYD - FIRE HYDRANT
HYDV - FIRE HYDRANT VALVE
LID - LOW IMPACT DEVELOPMENT MEASURE
PWV - PRIVATE WATER VALVE
PL - PROPERTY LINE
SL - STREETLIGHT
SW - SIDEWALK
SAN - SANITARY SEWER
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UC - UTILITY CORRIDOR (HYDRO,TELECOMMUNICATIONS,GAS,SL)
UP - UTILITY POLE
WM - WATERMAIN

MISSISSAUGA ROAD
8.0m ROAD ON 22.0m ROW

EFF. DATE
SCALE N.T.S.
REV.
STANDARD No.

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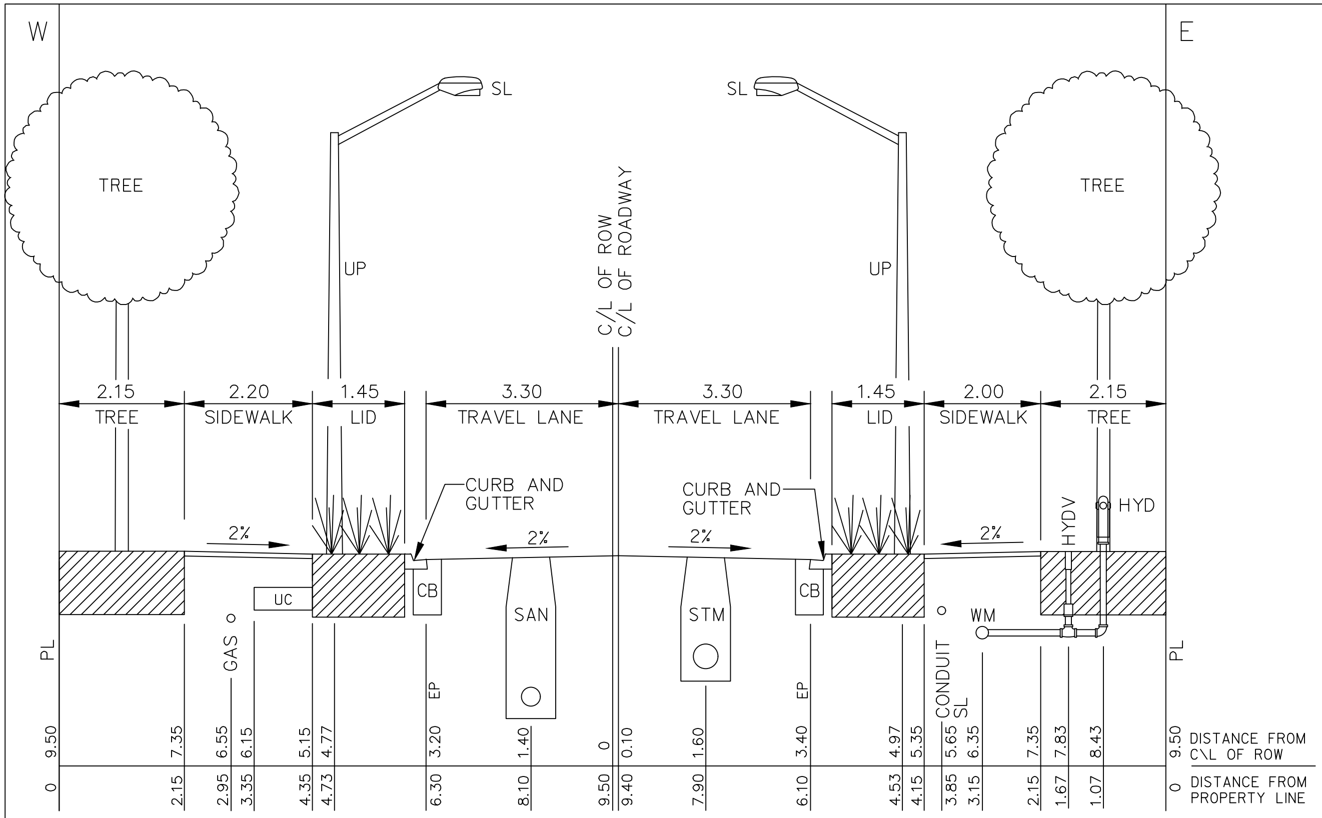
STREETS D & F



METRIC
ALL DIMENSIONS IN METRES

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9. SPECIFICATIONS RELATED TO ENVIRONMENTAL CONDITION OF THE PROPERTY ARE NOTED IN THE STANTEC REMEDIAL ACTION PLAN.
10. NO TRANSFORMERS TO BE PLACED IN ROW
11. ALL CURBS TO BE CONCRETE BARRIER CURB, 600.110.

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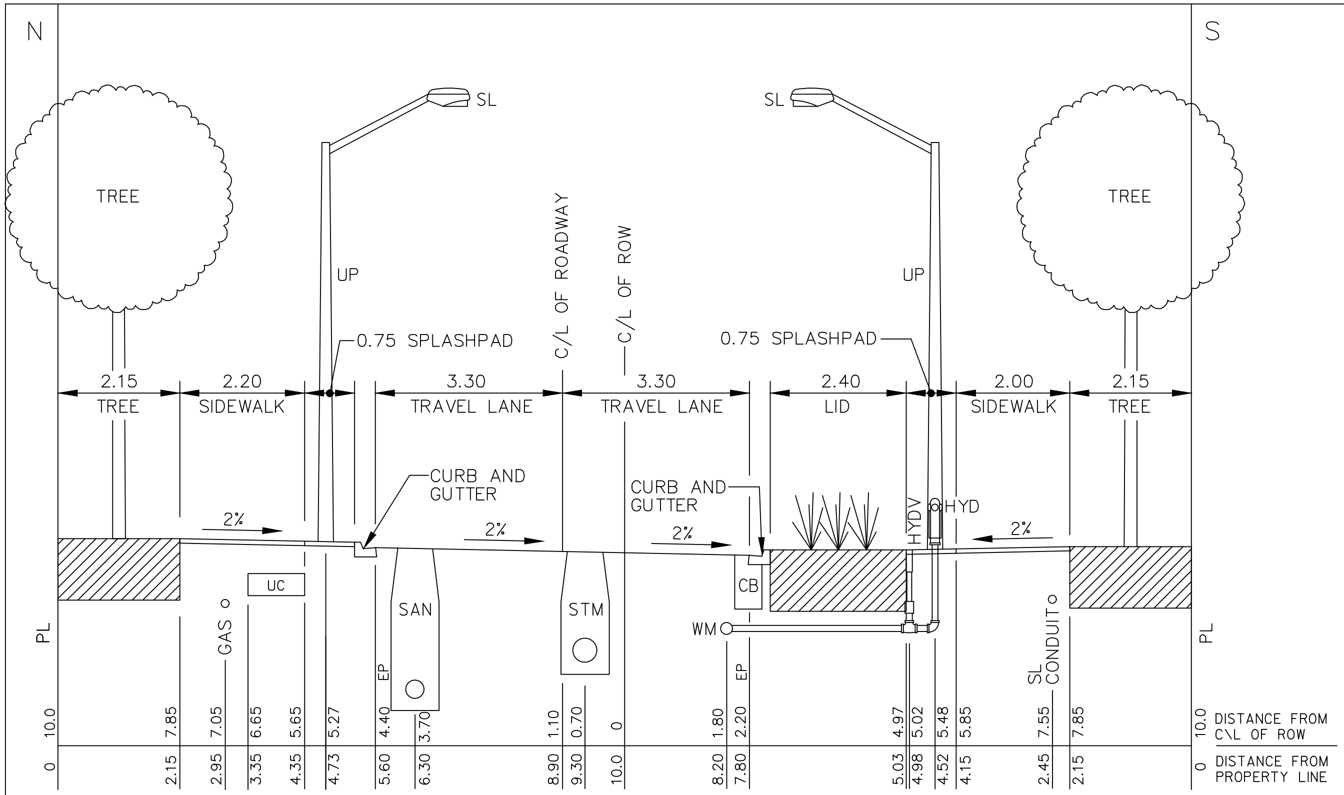
UC - UTILITY CORRIDOR (HYDRO,TELECOMMUNICATIONS,GAS,SL)
UP - UTILITY POLE
WM - WATERMAIN

STREETS D & F
6.60m ROAD ON 19.0m ROW

EFF. DATE
SCALE N.T.S.
REV.
STANDARD No.

FIGURE IS CONCEPTUAL ONLY. FINAL DESIGN DETAILS TO BE CONFIRMED THROUGH DISCUSSIONS WITH STAFF.

STREET A (LID)



METRIC
ALL DIMENSIONS IN METRES

NOTES

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11. ALL CURBS TO BE CONCRETE BARRIER CURB, 600.110.

LEGE

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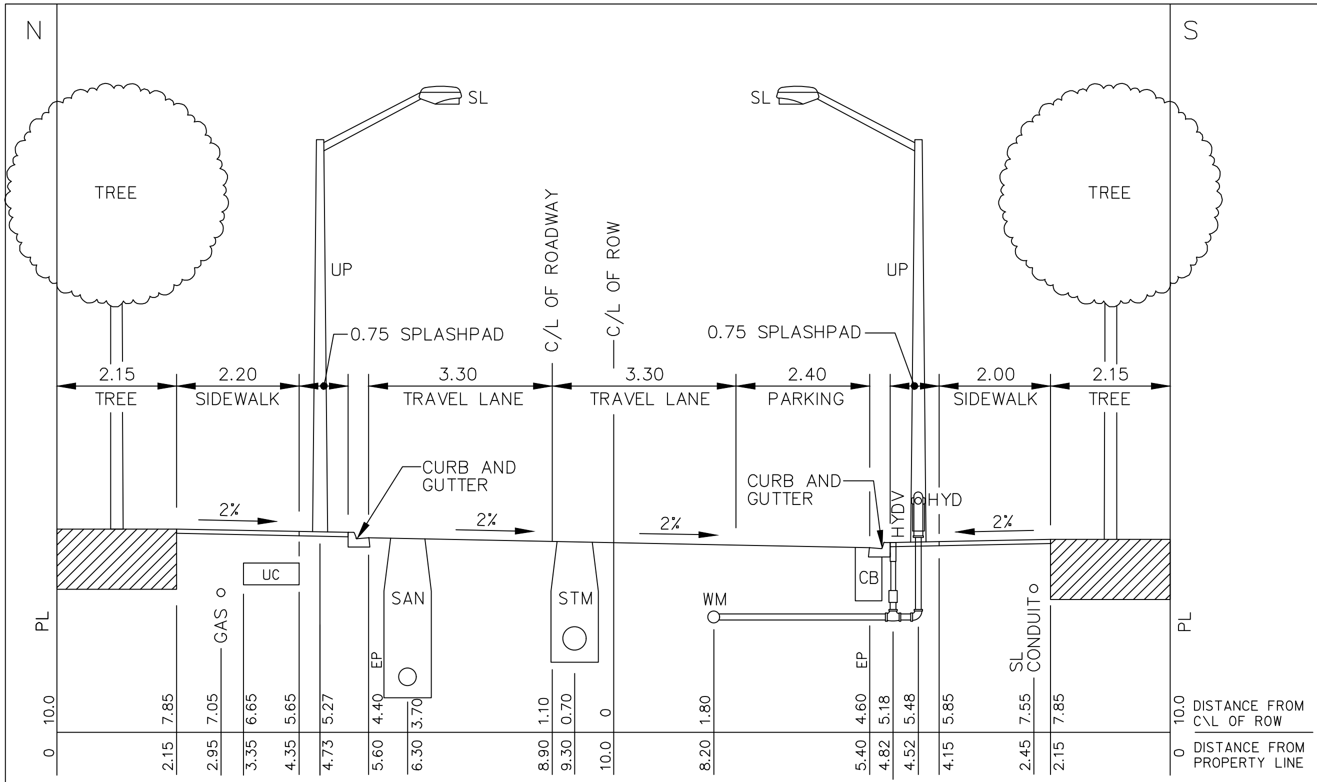
UP - UTILITY POLE
WM - WATERMAIN

STREET A (LID)
6.60m ROAD ON 20.0m ROW

EFF. DATE
SCALE N.T.S.
REV.
STANDARD No.

FIGURE IS CONCEPTUAL ONLY. FINAL DESIGN DETAILS TO BE CONFIRMED THROUGH DISCUSSIONS WITH STAFF.

STREET A (PARKING LAYBY)



METRIC
ALL DIMENSIONS IN METRES

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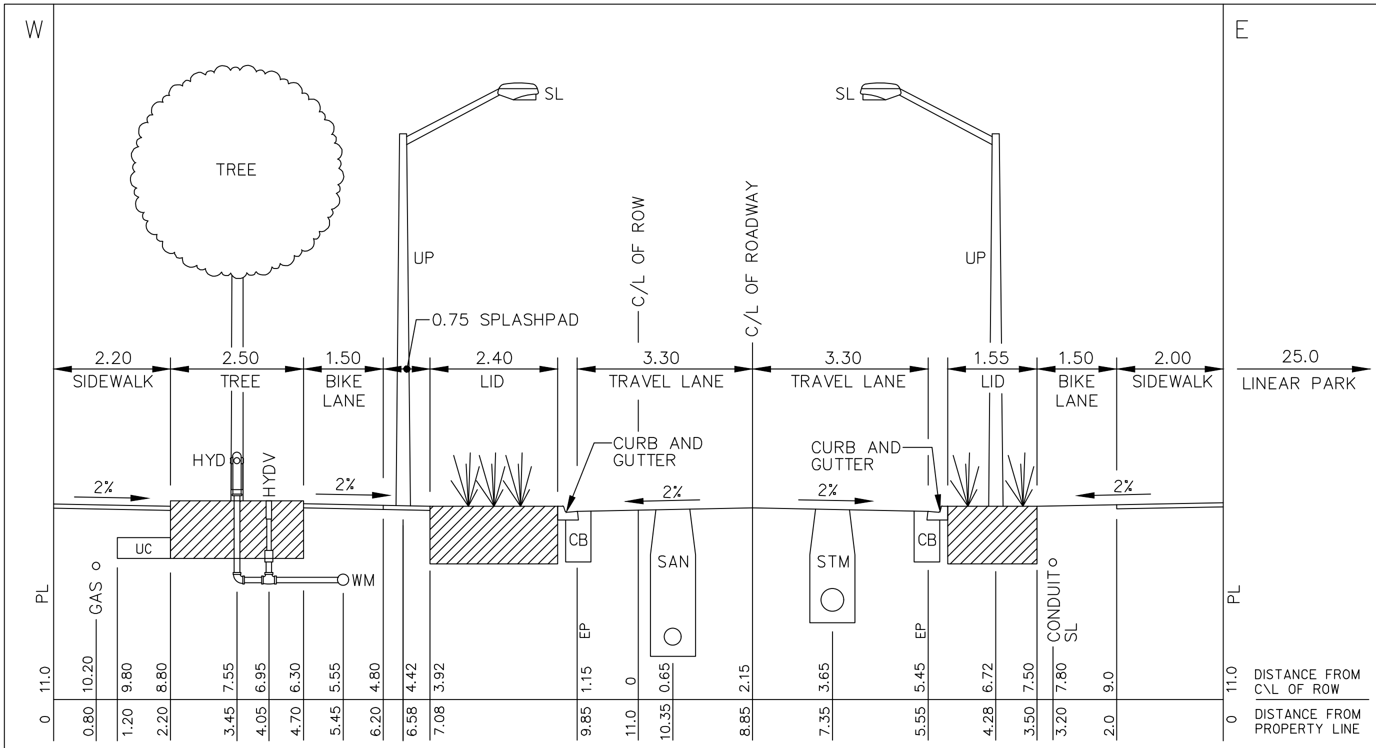
WM - WATERMAIN

STREET A (PARKING LAYBY)
9.0m ROAD ON 20.0m ROW

EFF. DATE		SCALE	N.T.S.
REV.		STANDARD No.	

FIGURE IS CONCEPTUAL ONLY. FINAL DESIGN DETAILS TO BE CONFIRMED THROUGH DISCUSSIONS WITH STAFF.

STREET B (LID)



METRIC

ALL DIMENSIONS IN METRES

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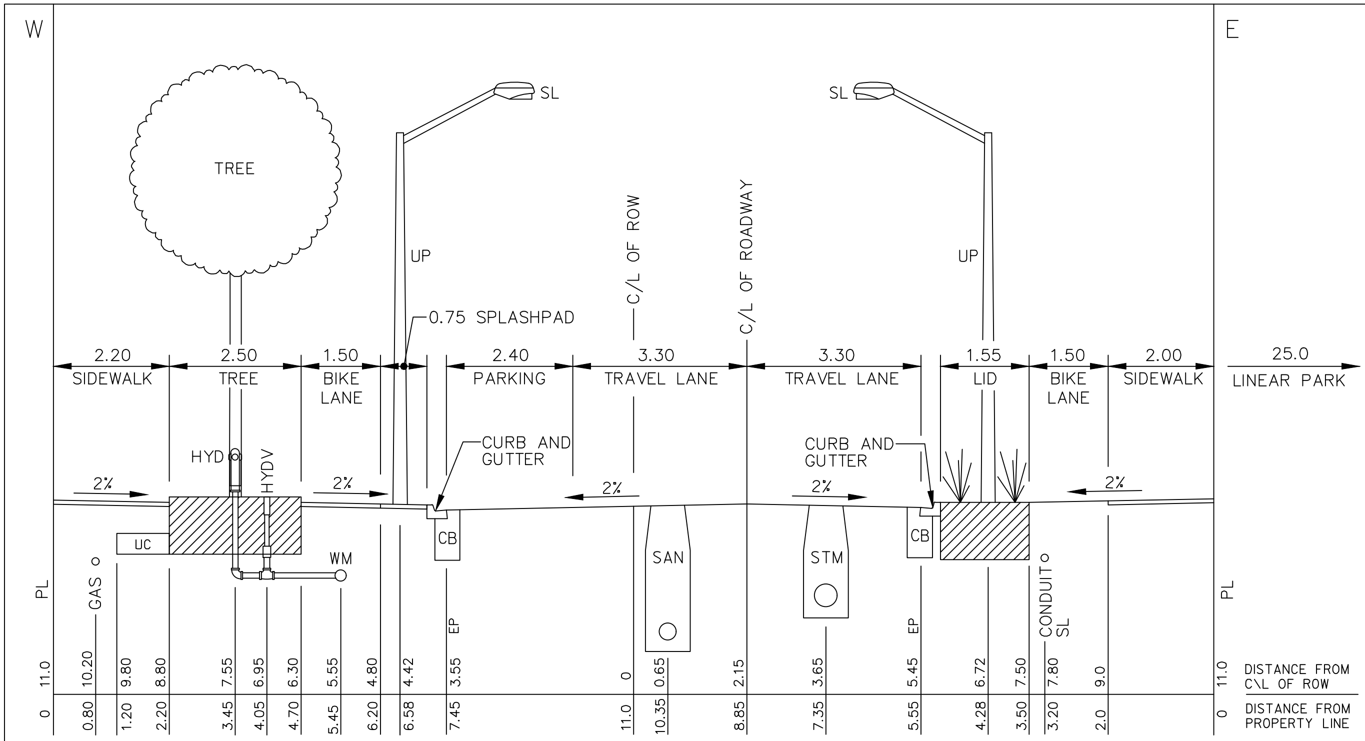
STREET B (LID)
6.60m ROAD ON 22.0m ROW

EFF. DATE	SCALE N.T.S.
REV.	STANDARD No.

FIGURE IS CONCEPTUAL ONLY. FINAL DESIGN DETAILS TO BE CONFIRMED THROUGH DISCUSSIONS WITH STAFF.

STREET B (PARKING LAYBY)



METRIC
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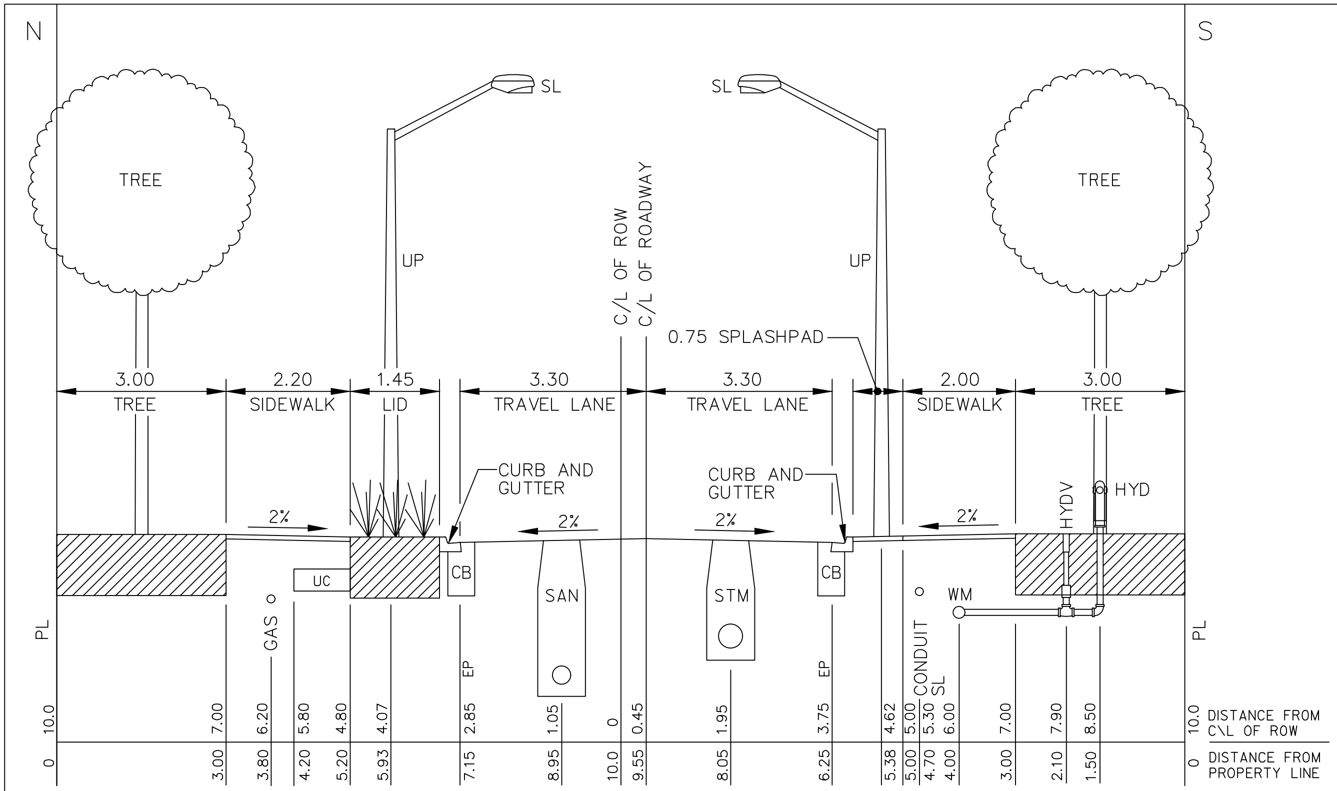
STREET B (PARKING LAYBY)
9.0m ROAD ON 22.0m ROW

EFF. DATE
SCALE N.T.S.
REV.
STANDARD No.

FIGURE IS CONCEPTUAL ONLY. FINAL DESIGN DETAILS TO BE CONFIRMED THROUGH DISCUSSIONS WITH STAFF.

STREET C



METRIC
ALL DIMENSIONS IN METRES

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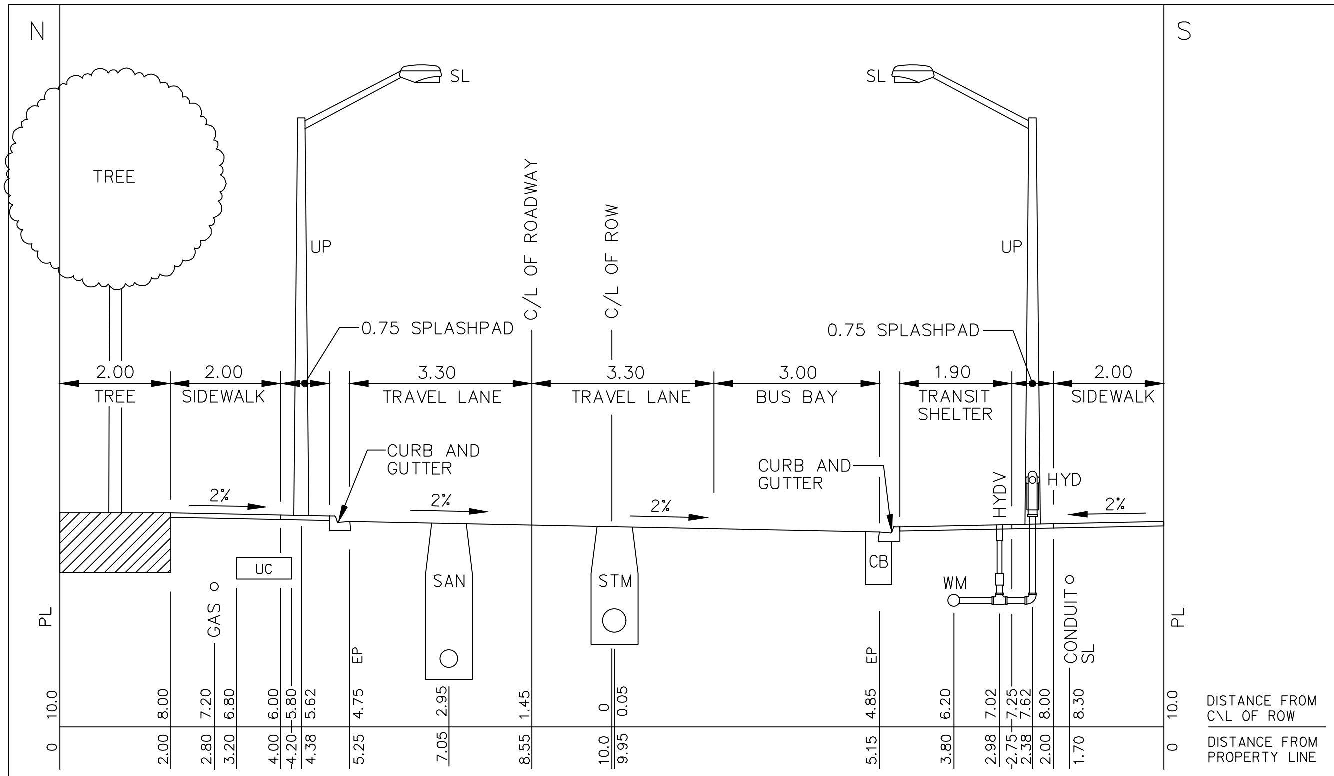
STREET C
6.60m ROAD ON 20.0m ROW

EFF. DATE
SCALE N.T.S.
REV.
STANDARD No.

FIGURE IS CONCEPTUAL ONLY. FINAL DESIGN DETAILS TO BE CONFIRMED THROUGH DISCUSSIONS WITH STAFF.

STREET E (BUS BAY)



METRIC

ALL DIMENSIONS IN METRES

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STREET E (BUS BAY)
9.60m ROAD ON 20.0m ROW

EFF. DATE		SCALE	N.T.S.
REV.		STANDARD No.	

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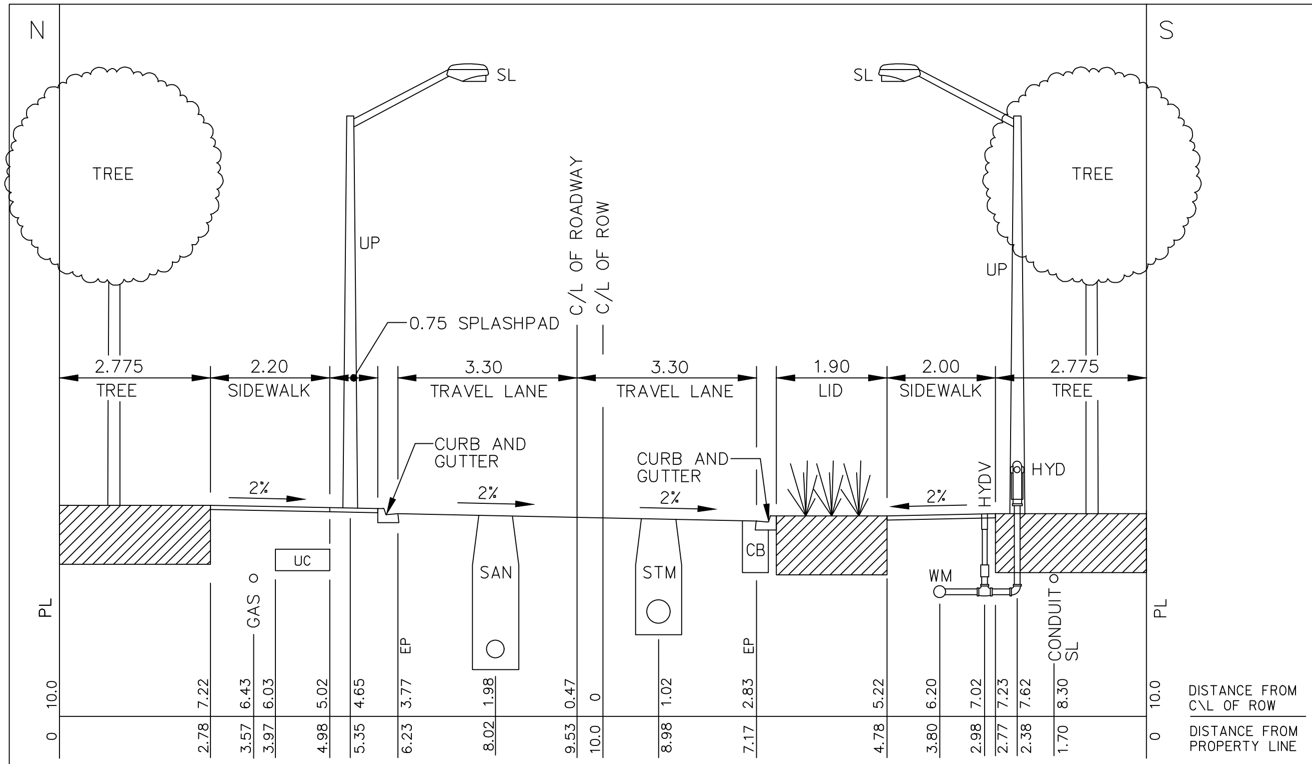
STREET E (MID BLOCK)



METRIC

NOTES

ALL DIMENSIONS IN METRES

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7. SOIL CAP RISK MANAGEMENT MEASURE: LANDSCAPE SURFACE TREATMENT AND UNDERLAYING UNIMPACTED SOIL SHALL BE A MINIMUM OF 1.50m THICK.
   "SUBJECT TO APPROVAL OF THE CITY OF MISSISSAUGA"
8. NEW OR REPLACED UTILITIES REQUIRED BENEATH THE 1.50m SOIL/HARDCAP MUST INCLUDE:
   "SUBJECT TO APPROVAL OF THE CITY OF MISSISSAUGA"
   - UNIMPACTED SOIL FROM TOP OF UTILITY TO BOTTOM OF 1.50m HARD/SOIL CAP.
   - 300mm (MINIMUM) UNIMPACTED SOIL/BEDDING ON EITHER SIDE & BELOW INSTALLED UTILITY.
9. SPECIFICATIONS RELATED TO ENVIRONMENTAL CONDITION OF THE PROPERTY ARE NOTED IN THE STANTEC REMEDIAL ACTION PLAN.
10. NO TRANSFORMERS TO BE PLACED IN ROW
11. ALL CURBS TO BE CONCRETE BARRIER CURB, 600.110.

LEGEND

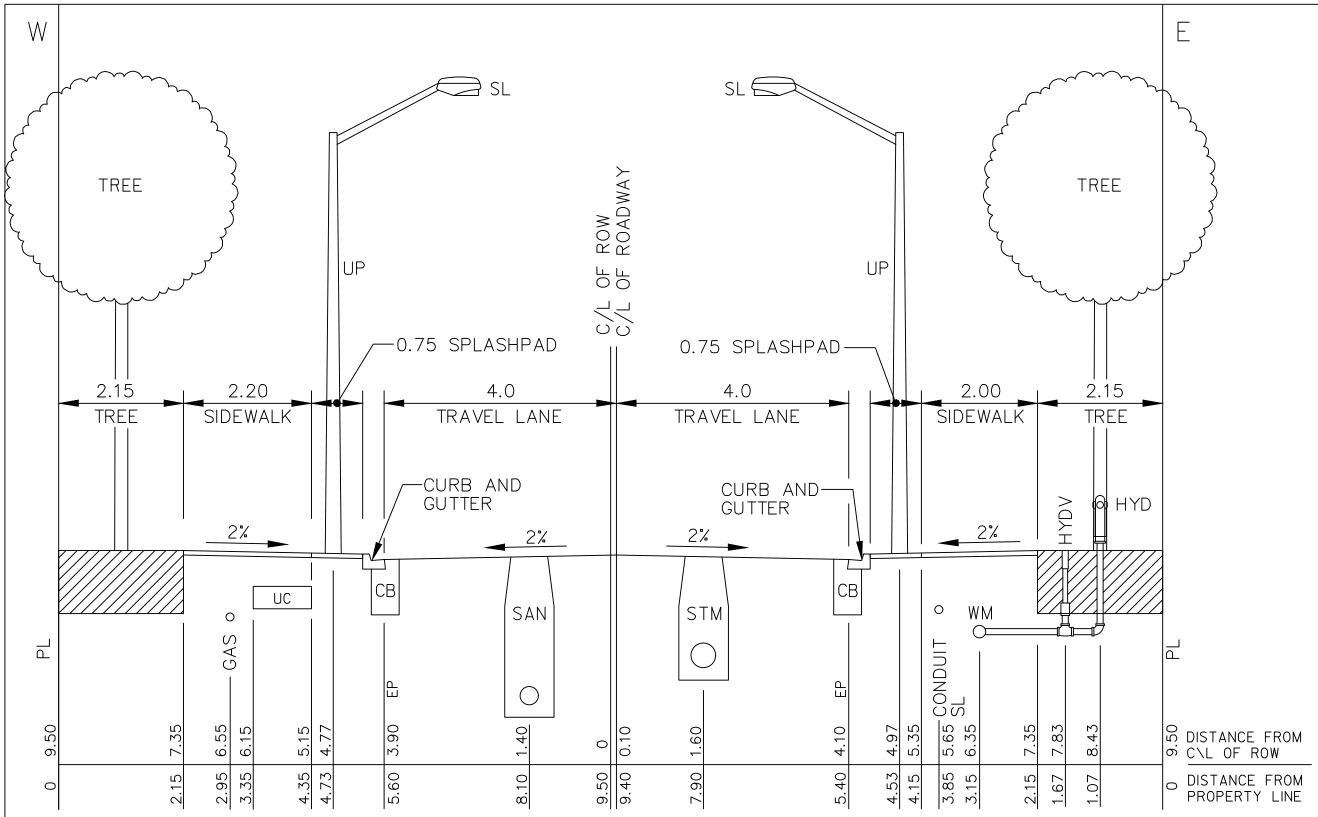
EP - EDGE OF PAVEMENT
CB - CATCH BASIN
CURB - CURB OR CURB AND GUTTER
C/L - CENTRELINE
HYD - FIRE HYDRANT
HYDV - FIRE HYDRANT VALVE
LID - LOW IMPACT DEVELOPMENT MEASURE
PWV - PRIVATE WATER VALVE
PL - PROPERTY LINE
SL - STREETLIGHT
SW - SIDEWALK
SAN - SANITARY SEWER
STM - STORM SEWER
UB - UTIITY BOX (HYDRO,TELECOMMUNICATIONS)
UC - UTILITY CORRIDOR (HYDRO,TELECOMMUNICATIONS,GAS,SL)
UP - UTILITY POLE
WM - WATERMAIN

STREET E (MID BLOCK)
6.60m ROAD ON 20.0m ROW

EFF. DATE			SCALE	N.T.S.
REV.			STANDARD No.	

FIGURE IS CONCEPTUAL ONLY. FINAL DESIGN DETAILS TO BE CONFIRMED THROUGH DISCUSSIONS WITH STAFF.

STREETS D & F (MID BLOCK)



METRIC

ALL DIMENSIONS IN METRES

NOTES

1. HYDRO, TELECOMMUNICATION PROVIDER, GAS AND SL CORRIDOR TO HAVE A MINIMUM COVER OF 0.965m.
2. WATERMAIN TO HAVE A MINIMUM COVER OF 1.7m.
3. IF UTILITIES CANNOT BE INSTALLED ACCORDING TO THIS STANDARD THEY ARE TO BE INSTALLED AS CLOSE AS POSSIBLE TO THE PRESCRIBED LOCATION SUBJECT TO THE APPROVAL OF THE TRANSPORTATION AND WORKS DEPARTMENT OF THE CITY OF MISSISSAUGA.
4. A 0.4m-0.6m CLEARANCE MUST BE MAINTAINED BETWEEN CABLES AND HYDRANTS.
5. A 0.3m CLEARANCE MUST BE MAINTAINED BETWEEN WATERMAINS AND UTILITY POLES.
6. HARDCAP RISK MANAGEMENT MEASURE: SURFACE TREATMENT (ASPHALT OR CONCRETE), REQUIRED BEDDING, AND UNDERLAYING UNIMPACTED SOIL SHALL BE A MINIMUM OF 1.50m THICK. "SUBJECT TO APPROVAL OF THE CITY OF MISSISSAUGA"
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   - UNIMPACTED SOIL FROM TOP OF UTILITY TO BOTTOM OF 1.50m HARD/SOIL CAP.
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9. SPECIFICATIONS RELATED TO ENVIRONMENTAL CONDITION OF THE PROPERTY ARE NOTED IN THE STANTEC REMEDIAL ACTION PLAN.
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UC - UTILITY CORRIDOR (HYDRO,TELECOMMUNICATIONS,GAS,SL)
UP - UTILITY POLE
WM - WATERMAIN

STREETS D & F (MID. BLOCK)
8.0m ROAD ON 19.0m ROW

EFF. DATE
SCALE N.T.S.
REV.
STANDARD No.

FIGURE IS CONCEPTUAL ONLY. FINAL DESIGN DETAILS TO BE CONFIRMED THROUGH DISCUSSIONS WITH STAFF.

APPENDIX F

Watermain Report

(AECOM)

- *Hydraulic Modelling Analysis – Imperial Oil, Region of Peel (March 7th, 2018)*

NOTE: THIS HYDRAULIC MODELLING REPORT CONTAINS POPULATION AND PEAK FLOW INFORMATION FROM THE MARCH 2018 FSR SUBMISSION AND HAS NOT BEEN UPDATED TO REFLECT THE INFORMATION CONTAINED WITHIN THIS REPORT. THE UPDATED HYDRAULIC MODELLING REPORT FROM AECOM WILL BE SUBMITTED AS AN ADDENDUM AS SOON AS IT IS AVAILABLE.

AECOM
105 Commerce Valley Drive West, Floor 7 905 886 7022 tel
Markham, ON, Canada L3T 7W3 905 886 9494 fax
www.aecom.com

Urbantech

CC

Subject Hydraulic Modelling Analysis – Imperial Oil, Region of Peel

From Benny Wan, P.Eng., Sogol Bandehali (EIT)

Date March 7, 2018

Project Number 60538792

INTRODUCTION

AECOM was retained to perform hydraulic analysis for determining the water infrastructure requirements for providing sustainable water service to the development located at the southwest corner of Mississauga Road and Lakeshore Drive West under the desired growth conditions. The purpose of this report is to summarize the findings of this analysis and confirm that the planning area may be serviced through the existing and future watermains, the sizing of the proposed watermains within the development and there are no significant off-site constraints, which may prohibit development.

Imperial Oil development includes 2,969 residential units and net site area of about 193,149 m^2 (19 ha) located at the southwest corner of Mississauga Road and Lakeshore Drive West, Region of Peel. Figure 1 shows the location of the study area.

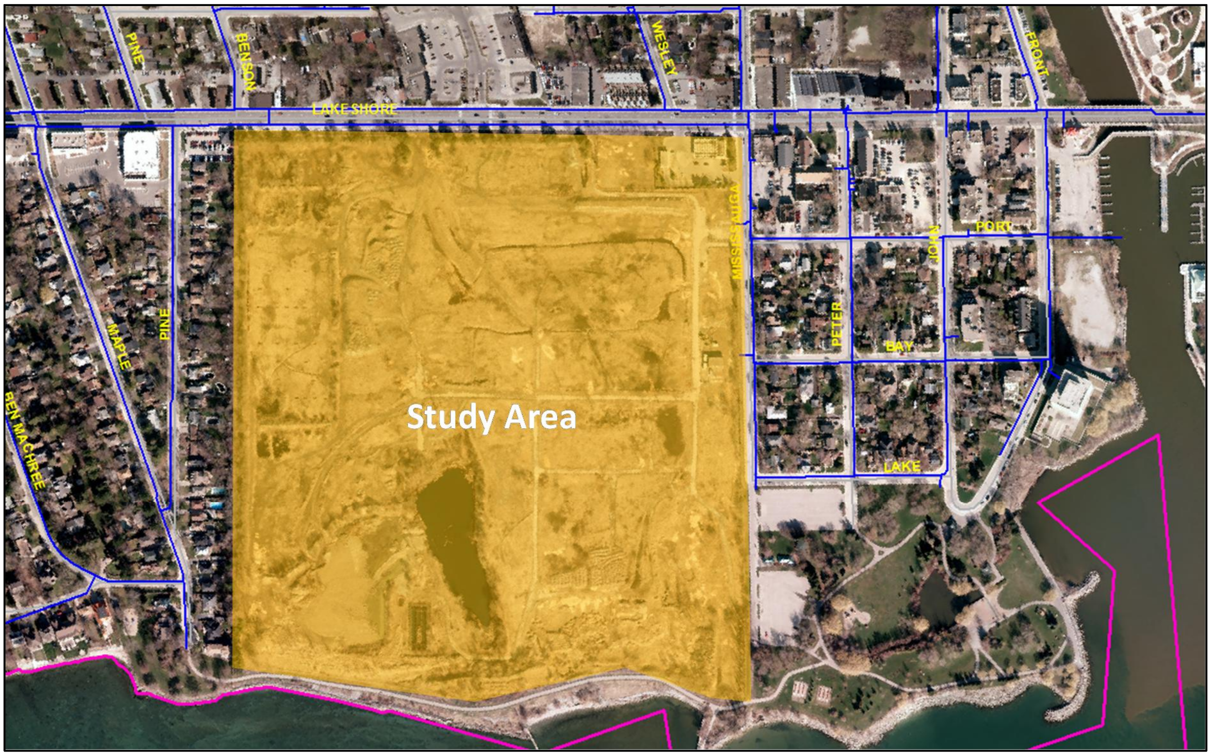


Figure 1 - Study Area

MODELLING PARAMETERS, CRITERIA, AND ASSUMPTIONS

AECOM received the necessary information provided by Urbantech on July 31, 2017. After a thorough review of the Peel water model and the information provided by Urbantech, the following subsections detailed the design criteria and the modelling methodology used for this analysis for requested design year of 2021, 2026, 2027 and 2041.

Connection to Existing Network

Based on the information provided, it was identified that the subdivision will obtain water service from the existing 300 mm watermain connecting to 150 mm watermain on Mississauga Road and Lake from east side of the development and to 300 mm watermain on Lakeshore Drive West from north side of the development. 300 mm watermain is used to simulate this development and the adequacy of this size can be confirmed under different condition such as fireflow.

The layout within the development is shown in Figure **2** based on topographical drawings provided by Urbantech. The modelling junctions that represented the Imperial Oil development are also shown in Figure **2**. The elevation for these junctions was updated in the hydraulic model based on the topology drawing.

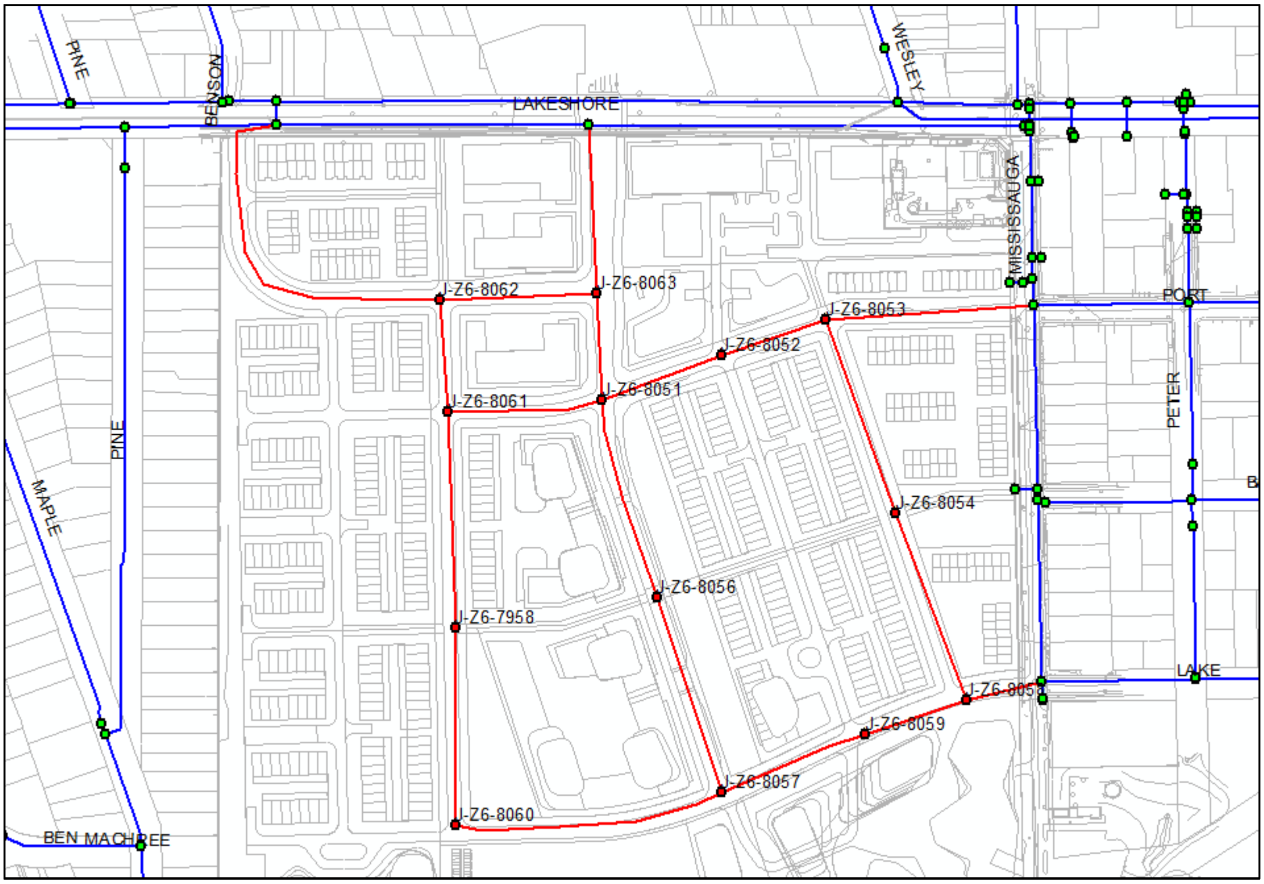


Figure 2 - Pipe Network in the study area

Design Criteria

The following design criteria and population information were used for the analysis.

Table 1 Region of Peel Masterplan Design Criteria

Criteria	Residential Population	Employment Force
Average Day Demand (ADD)(L/cap.day)	270	250
Maximum Day Factor (MDF)	1.8	1.4
Peak Hour Factor (PHF)	3	3

Table 2 Imperial Oil Population based on phasing

Design Year	Total Population
2021	2204
2026	8753
2027	9248

Water Demand

The total area of development is 19 ha; this is divided in 77% residential and 23% employment according to the master site plan drawing. The demand was calculated based on the population, which varied for each design year, and residential vs employment ratio. Subsequently, the demand was allocated to the assumed modelling junctions. Table 3 summarizes the estimated population growth for the proposed development and Tables 4 to 7 present the calculated water demands for each development phasing.

Table 3 Population Summary

Design Year	Residential Population	Employment Population	Total Equivalent Population
2021	1692	512	2204
2026	6720	2033	8753
2027	7100	2148	9248
2041	7100	2148	9248

Table 4 Demand Allocation for 2021

2021			
	Residential Demand(L/s)	Employment Demand(L/s)	Total Demand(L/s)
Average Day Demand (ADD) (L/s)	5.3	1.5	6.8
Maximum Day Demand (MDD) (L/s)	9.5	2.1	11.6
Peak Hour Demand (PHD) (L/s)	15.9	4.4	20.3

Table 5 Demand Allocation for 2026

2026			
	Residential Demand(L/s)	Employment Demand(L/s)	Total Demand(L/s)
Average Day Demand (ADD) (L/s)	21.0	5.9	26.9
Maximum Day Demand (MDD) (L/s)	37.8	8.2	46.0
Peak Hour Demand (PHD) (L/s)	63.0	17.6	80.6

Table 6 Demand Allocation for 2027

2027			
	Residential Demand(L/s)	Employment Demand(L/s)	Total Demand(L/s)
Average Day Demand (ADD) (L/s)	22.2	6.2	28.4
Maximum Day Demand (MDD) (L/s)	39.9	8.7	48.6
Peak Hour Demand (PHD) (L/s)	66.6	18.6	85.2

Table 7 Demand Allocation for 2041

2041			
	Residential Demand(L/s)	Employment Demand(L/s)	Total Demand(L/s)
Average Day Demand (ADD) (L/s)	22.2	6.2	28.4
Maximum Day Demand (MDD) (L/s)	39.9	8.7	48.6
Peak Hour Demand (PHD) (L/s)	66.6	18.6	85.2

*The same demands calculated for 2027MDD within the development area was added to 2041MDD scenario which included the Region of Peel demands for the rest of the Region and it was assumed that there was no additional growth to the Imperial Oil lands Port Credit (West Village) area between 2027 and 2041.

The modelling results were analyzed based on the following criteria:

- Minimum acceptable pressure - 275 kPa (40 psi) (*Ministry of the Environment Design Guidelines for Drinking-Water Systems and Region of Peel Water System Design Criteria*)
- Maximum acceptable pressure - 700 kPa (100 psi) (*Ministry of the Environment Design Guidelines for Drinking-Water Systems and Region of Peel Water System Design Criteria)*
- Maximum acceptable velocity – 2 m/s (*Ministry of the Environment Design Guidelines for Drinking-Water Systems)*
- Fire demands – 25,020 L/min (417 L/s) (Region of Peel Public Works Watermain Design Criteria)
- Minimum pressure under maximum day demand plus fire flow - 140 kPa (20 psi) (*Ministry of the Environment Design Guidelines for Drinking-Water Systems and Region of Peel Water System Design Criteria*)

Scenarios

The following scenarios were used for the analysis

- **2021**
  - 2021 ADD/ MDD/ PHD / MDD + Fire Flow without the proposed 600 mm main on Lakeshore Road
- **2026**
  - 2026 ADD/ MDD/ PHD / MDD + Fire Flow without the proposed 600 mm main on Lakeshore Road
- **2027**
  - 2027 ADD/ MDD/ PHD / MDD + Fire Flow without the proposed 600 mm main on Lakeshore Road
- **2041**
  - 2041 MDD/ MDD + Fire Flow without the proposed 600 mm main on Lakeshore Road

The modelling analysis was completed based on the Region's all pipe water model. For each scenario, the minimum pressure for the areas that are within the vicinity of the development was reviewed under extended period simulation (EPS).

ANALYSIS OF MODELLING RESULTS

The following sections detail the results of the analysis completed for evaluating the impact of the Imperial Oil development on the Region's water system. According to the hydraulic modelling results, no serviceability issue within the development was indicated and there appeared to be no negative impact to the surrounding system after the growth. Under all scenarios, the development shows acceptable pressure and velocity using the 300 mm watermains within the development.

Serviceability to the Proposed Development

Table 8 demonstrates the average pressure at the junction representing the growth under all scenarios. Pressure within the development ranges between 74 psi and 87 psi; which is well within the 40 psi – 100 psi allowable range indicated that the development gets service using the 300mm main connecting to existing system and there will be no complication in velocity and pressure in this area.

Table 8 - Minimum Pressure Comparison in Different Scenarios within the Imperial Oil Development

Without 600 mm watermain on Lakeshore Drive West		
Scenarios		Minimum Pressure (psi)
2021	**ADD**	83.1
	MDD	80.5
	PHD	85.8
2026	**ADD**	81.1
	MDD	83.9
	PHD	80.4
2027	**ADD**	80.7
	MDD	83.8
	PHD	80.1
2041	**MDD**	84.4

Hydraulic Implications to the Region’s Water System

The following section summarizes the hydraulic implications in Zone 1 with the inclusion of the proposed development. Figure 3 displays modelling junctions in Zone 1, which the pressure was assessed during the analysis:

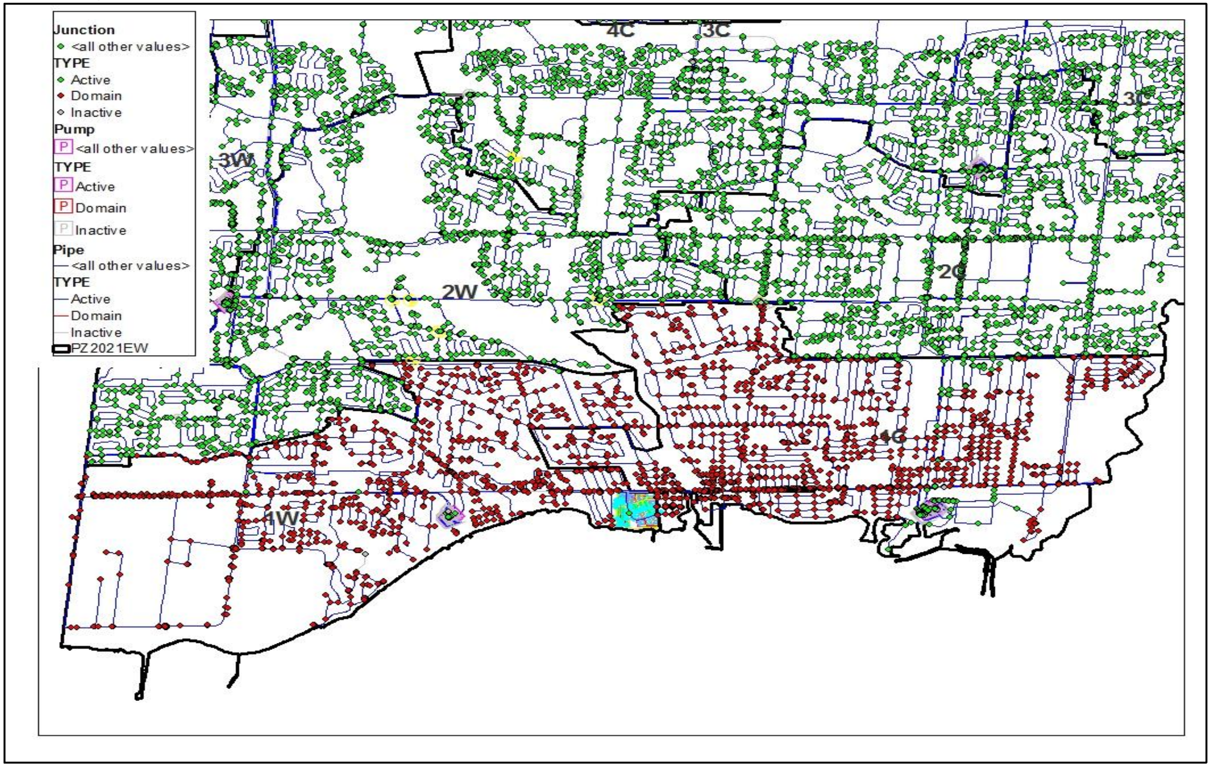


Figure 3 - Region of Peel Zone 1 Junctions

Table 9 - Minimum Pressure comparison in Different Scenarios for zone 1 Junctions

		BASE Scenario Minimum Pressure without Proposed Development & without proposed 600 mm on Lakeshore Road (psi)	Minimum Pressure with Proposed Development (psi) (without 600 watermain on Lakeshore)
2021	ADD	42.7	42.3
	MDD	37.9	37.8
	PHD	44.1	44.1
2026	ADD	39.8	39.5
	MDD	41.7	41.4
	PHD	39.6	39.1
2027	ADD	39.8	39.3
	MDD	41.7	41.4
	PHD	39.6	39.0
2041	MDD	44.9	43.1

According to the results stated in the above table, the growth has minimal effect on the minimum pressure (+/- 0.5 psi) in all of the scenarios in zone 1.

Fire Flow Analysis

Fire Flow analysis was completed to ensure the surrounding area of the development meets sufficient pressure and velocity during a fire event with the assumed size of 300 mm watermain within the development. The modelling results show that the assumed sizing of the watermains within the proposed development is sufficient to provide adequate supply during fire in this area. Table 10 summarizes the fire flow analysis results for the proposed development.

According to the fire flow analysis summary results, the Region’s water system would provide adequate fire flow to proposed development while maintaining the minimum pressure at above 20 psi. In addition, the velocity in 300 mm watermains within the proposed development did not exceed the Region’s design criteria of 2.0m/s.

Table 10 – Summary of Fireflow Results

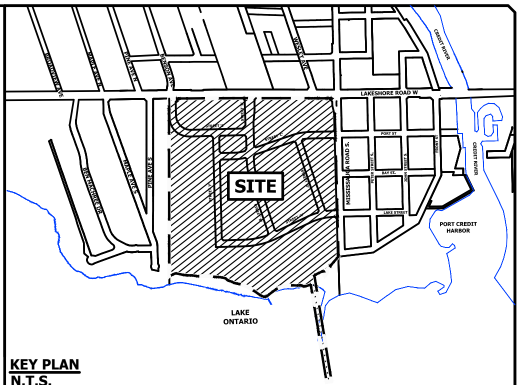
Junction Within the Development	2021 MDD		2026 MDD		2027 MDD		2041 MDD	
	Residual Pressure (psi)	Available Flow at Hydrant (L/s)	Residual Pressure (psi)	Available Flow at Hydrant (L/s)	Residual Pressure (psi)	Available Flow at Hydrant (L/s)	Residual Pressure (psi)	Available Flow at Hydrant (L/s)
J-Z6-7958	81.9	677.5	85.9	698.2	85.9	695.2	88.1	717.6
J-Z6-8051	84.4	890.8	88.4	920.3	88.4	916.4	90.5	940.7
J-Z6-8052	86.7	848.4	90.8	874.3	90.7	870.6	92.9	895.5
J-Z6-8053	87.1	892.2	91.1	916.8	91.1	913.1	93.3	937.5
J-Z6-8054	88.3	794.7	92.3	823.0	92.3	819.6	94.5	844.6
J-Z6-8056	84.7	743.7	88.8	768.5	88.7	765.1	90.9	787.8
J-Z6-8057	86.9	804.2	91.0	826.4	90.9	822.7	93.1	847.3
J-Z6-8058	88.3	881.1	92.4	910.9	92.3	907.1	94.5	931.3
J-Z6-8059	87.7	809.5	91.8	833.0	91.7	829.3	93.9	854.1
J-Z6-8060	86.1	696.7	90.1	710.5	90.1	707.0	92.3	727.6
J-Z6-8061	83.0	823.4	87.0	855.9	87.0	851.5	89.2	872.3
J-Z6-8062	82.0	833.2	86.1	864.8	86.0	860.6	88.2	880.7
J-Z6-8063	84.1	882.3	88.2	916.0	88.1	911.7	90.3	933.3

CONCLUSIONS

The hydraulic modelling results lead to the following conclusions:

- The hydraulic modelling results show that the Imperial Oil development can receive sufficient water service without 600 mm main on Lakeshore Drive West even under 2041 maximum day demand conditions.
- This development has minimal effect on the pressure in Zone 1 of the Region of Peel system and the Imperial Oil Development does not cause any negative impacts to the existing system.
- The assumed size for the watermains within the development is adequate to maintain the same level of service in Zone 1 area and the development can get adequate supply with a 300 mm watermain connecting to the existing system.
- Although the model used for this analysis was calibrated within the Region’s acceptable accuracy, AECOM recommends hydrant flow test to be undertaken in order to further validate the hydraulic modelling results presented herein.

FIGURES & DRAWINGS



KEY PLAN
N.T.S.

LEGEND

▬	PROPERTY BOUNDARY

BENCHMARK

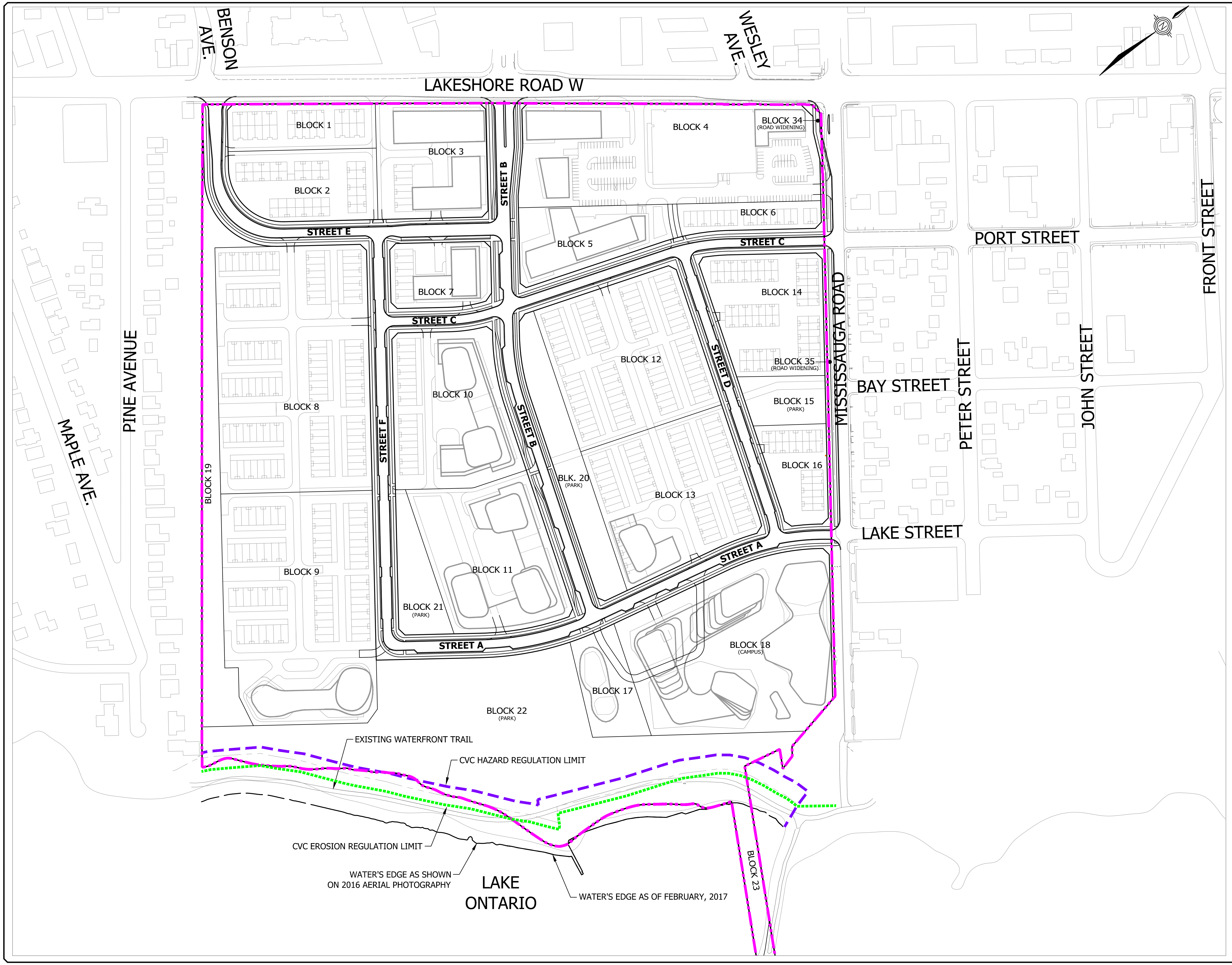
ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE DERIVED FROM THE CITY OF MISSISSAUGA BENCHMARK No. 731.
ELEVATION = 81.58

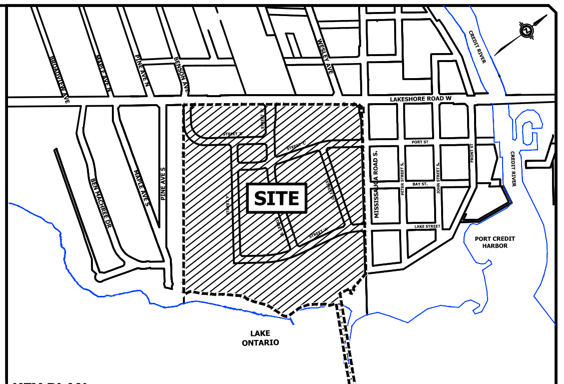
WEST VILLAGE PARTNERS INC.
CITY OF MISSISSAUGA

urbantech
west
Urbantech Consulting, A Division of Leighton-Zec West Ltd.
2030 Bristol Circle, Suite 105 Oakville, Ontario L6H 0H2
tel: 905.829.8818 fax: 905.829.4804
www.urbantech.com

SITE LOCATION PLAN

PROJECT No.: 16-489
DATE: AUGUST 2017
DRAWING No.: FIGURE 1
SCALE: H 1:5000 40.0m 20.0m 0m 20.0m 40.0m





KEY PLAN
N.T.S.

LEGEND

▬ · ▬ · ▬	PROERTY BOUNDARY
·······	CVC EROSION REGULATION LIMIT
▬ ▬ ▬	CVC HAZARD REGULATION LIMIT
● ● ●	PROPOSED TREES
▨	PROPOSED PAVING
▬	PROPOSED GRASS

BENCHMARK

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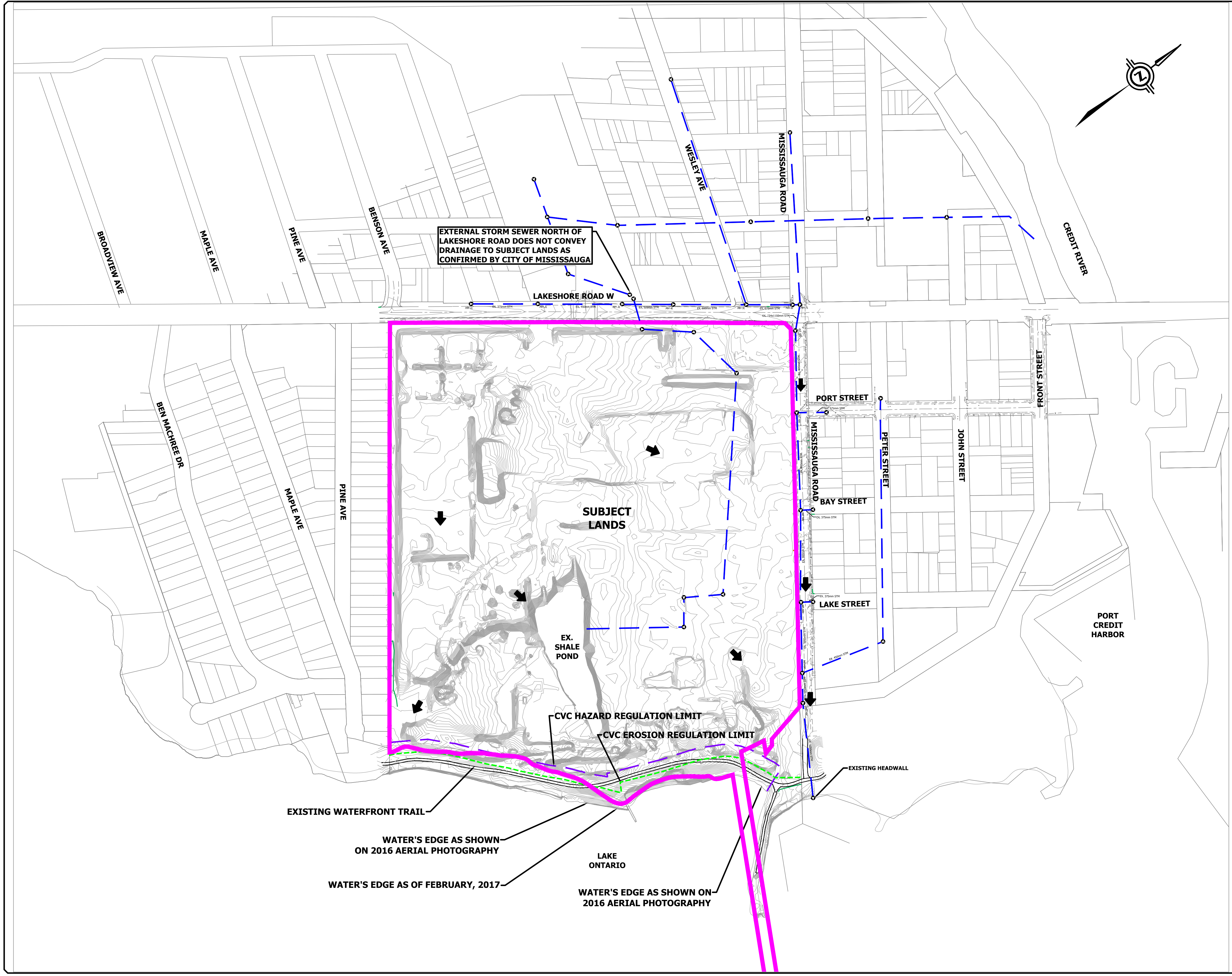
CONCEPT PLAN

PROJECT No.: 16-489	DATE: AUGUST 2017	DRAWING No.: FIGURE 2
SCALE: H 1:3000	40m 20m 0m 20m 40m	

File: F:\PROJECTS\16-489W (WEST VILLAGE PARTNERS - PORT CREDIT)\DRAWINGS\00_FUNCTIONAL\05_FD_FIGURES\16-489_FIGURE 2-CONCEPT PLAN.DWG



EXTERNAL STORM SEWER NORTH OF LAKESHORE ROAD DOES NOT CONVEY DRAINAGE TO SUBJECT LANDS AS CONFIRMED BY CITY OF MISSISSAUGA

CVC HAZARD REGULATION LIMIT

CVC EROSION REGULATION LIMIT

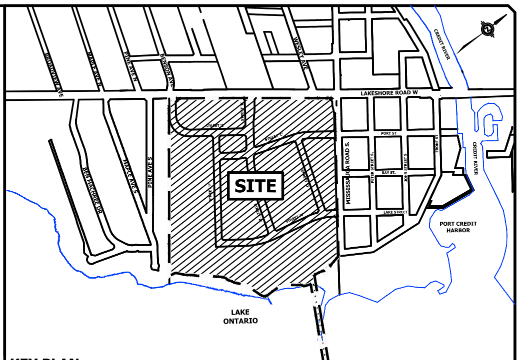
EXISTING HEADWALL

EXISTING WATERFRONT TRAIL

WATER'S EDGE AS SHOWN ON 2016 AERIAL PHOTOGRAPHY

WATER'S EDGE AS OF FEBRUARY, 2017

WATER'S EDGE AS SHOWN ON 2016 AERIAL PHOTOGRAPHY



KEY PLAN
N.T.S.

LEGEND

🟪	PROPERTY BOUNDARY
🟩	CVC EROSION REGULATION LIMIT
🟪	CVC HAZARD REGULATION LIMIT
🟦	EXISTING STORM SEWER
➡	EXISTING OVERLAND FLOW

BENCHMARK

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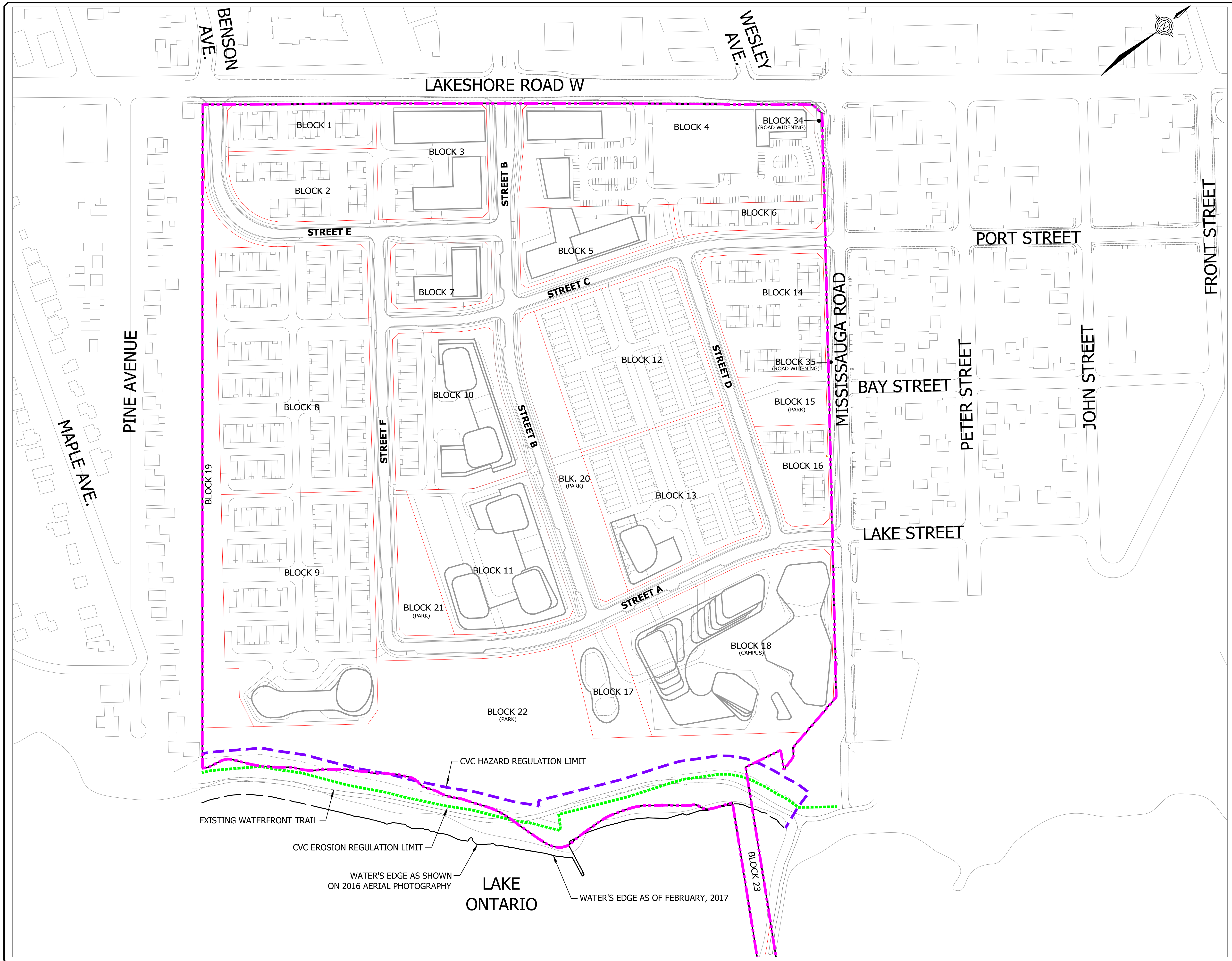
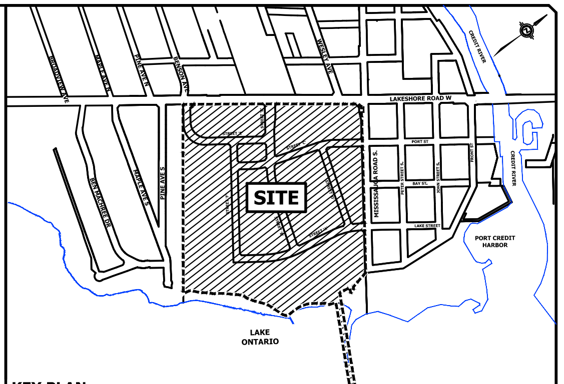
www.urbantech.com

EXISTING CONDITIONS PLAN

PROJECT No.:	16-489	DATE:	AUGUST 2017	DRAWING No.:
SCALE: H 1:5000	40.0m 20.0m 0m 20.0m 40.0m			FIGURE 3





KEY PLAN
N.T.S.

LEGEND

▬ · · ▬	PROERTY BOUNDARY
──	PROPOSED LOT BOUNDARIES
········	CVC EROSION REGULATION LIMIT
▬ ▬ ▬	CVC HAZARD REGULATION LIMIT

BENCHMARK

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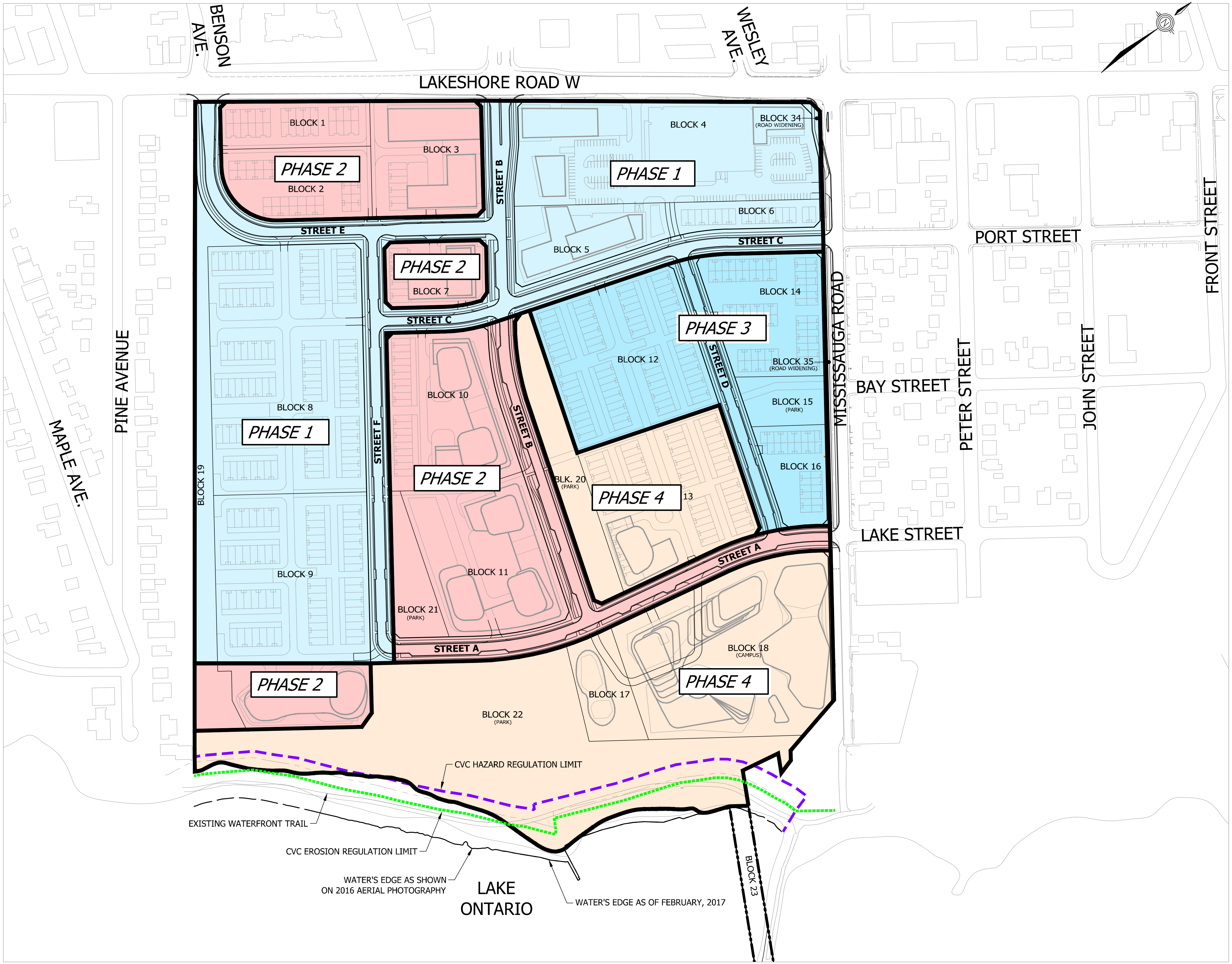
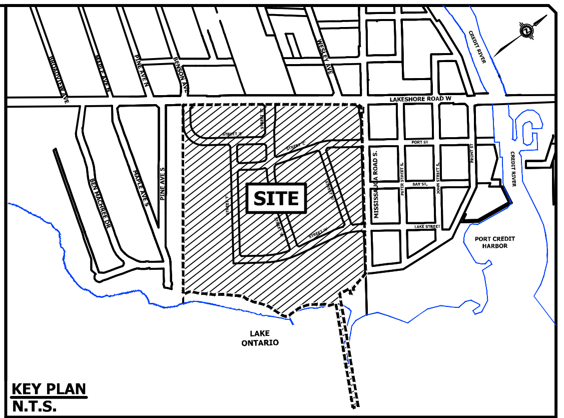
www.urbantech.com

PROPOSED DRAFT PLAN

PROJECT No.: 16-489
DATE: AUGUST 2017
DRAWING No.: FIGURE 4
SCALE: H 1:3000
40m 20m 0m 20m 40m





KEY PLAN
N.T.S.

LEGEND

━ · · ━	PROERTY BOUNDARY
━━━	PROPOSED PHASING BOUNDARY
········	CVC EROSION REGULATION LIMIT
━ ━ ━	CVC HAZARD REGULATION LIMIT
■	PHASE 1
■	PHASE 2
■	PHASE 3
■	PHASE 4

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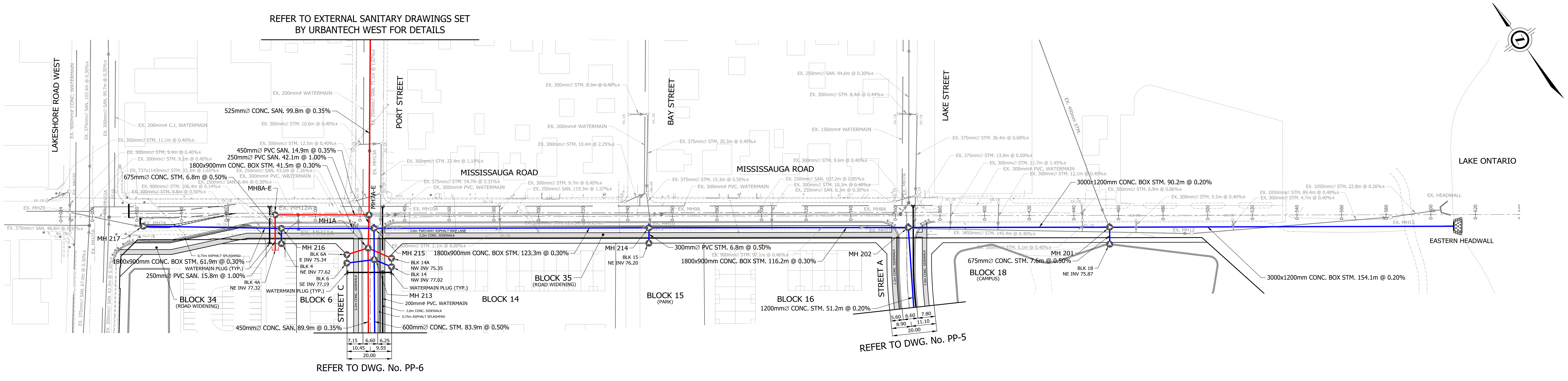
CONCEPTUAL PHASING PLAN

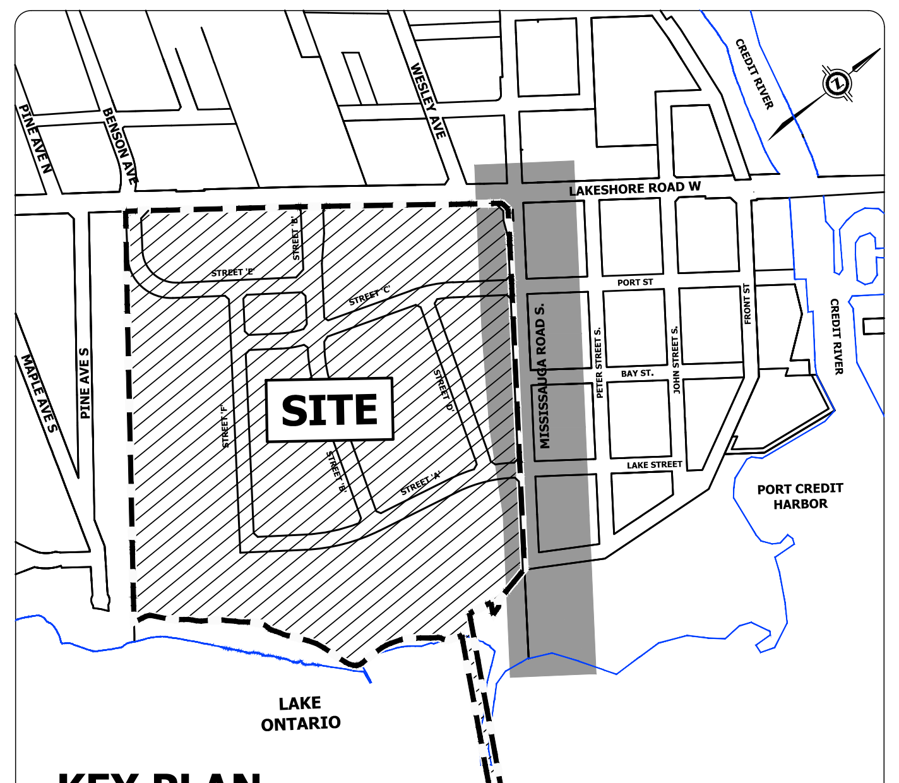
PROJECT No.: 16-489
DATE: AUGUST 2017
DRAWING No.: FIGURE 5
SCALE: H 1:3000
40m 20m 0m 20m 40m

REFER TO EXTERNAL SANITARY DRAWINGS SET
BY URBANTECH WEST FOR DETAILS



REFER TO DWG. No. PP-6

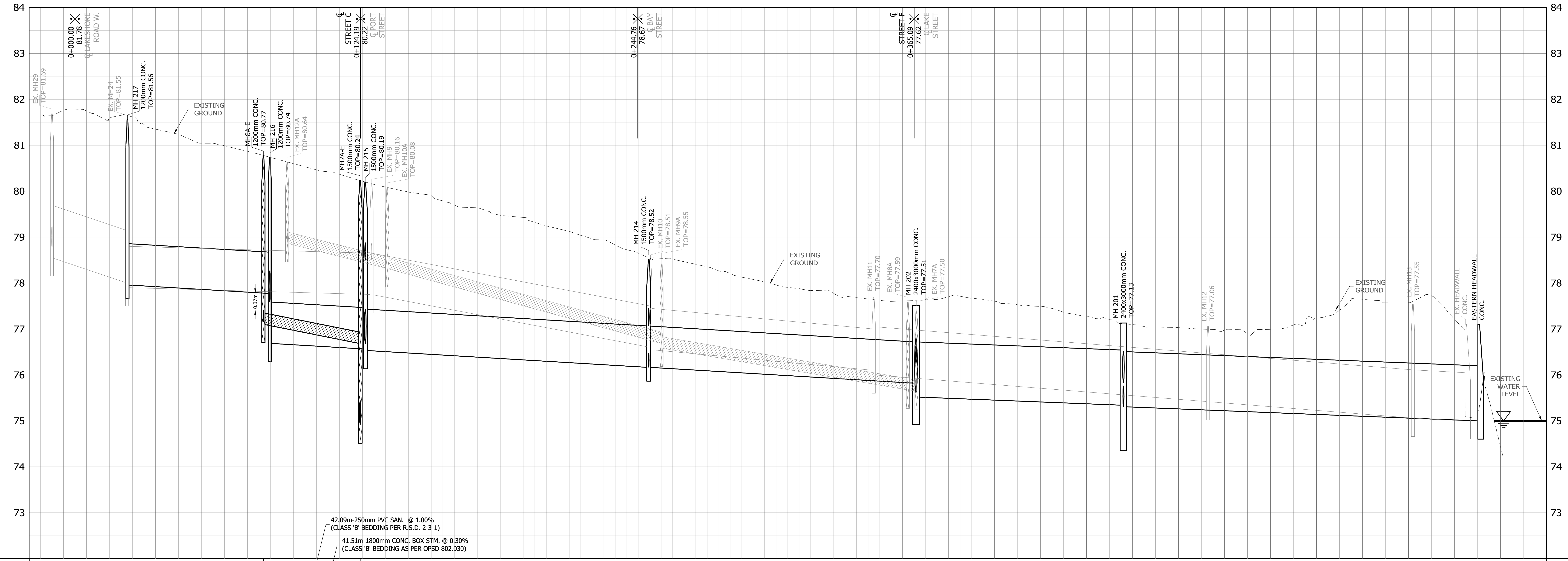
REFER TO DWG. No. PP-5



KEY PLAN
N.T.S.

LEGEND

- PROPERTY BOUNDARY
- PROPOSED SANITARY SEWER
- PROPOSED PUBLIC STORM SEWER
- PROPOSED WATERMAIN
- EX SANITARY SEWER
- EX PUBLIC STORM SEWER
- EX WATERMAIN
- PROPOSED SIDEWALK / PATHWAY



42.09m-250mm PVC SAN. @ 1.00%
(CLASS 'B' BEDDING PER R.S.D. 2-3-1)

41.51m-1800mm CONC. BOX STM. @ 0.30%
(CLASS 'B' BEDDING AS PER OPSD 802.030)

SANITARY SEWER INVERT
SE77.10 SW77.16
NW76.68 SW74.99 NE74.91

STORM SEWER INVERT
SE77.96
61.94m-1800mm CONC. BOX STM. @ 0.30% (CLASS 'B' BEDDING AS PER OPSD 802.030)
NW77.77 SE76.69 SW77.59
SW76.68 SE76.53 NW76.56 NE78.50
123.28m-1800mm CONC. BOX STM. @ 0.30% (CLASS 'B' BEDDING AS PER OPSD 802.030)
NW76.16 SE76.17 SW76.17 NE77.08
116.24m-1800x900mm CONC. BOX STM. @ 0.30% (CLASS 'B' BEDDING AS PER OPSD 802.030)
SE75.52 NW75.82 SW75.61 NE76.25
90.25m-3000x1200mm CONC. BOX STM. @ 0.20% (CLASS 'B' BEDDING AS PER OPSD 802.030)
SE75.31 NW75.34 SW75.83 NE75.31
154.15m-3000x1200mm CONC. BOX STM. @ 0.20% (CLASS 'B' BEDDING AS PER OPSD 802.030)
NW75.00

EX. SANITARY SEWER INVERT
33.31m-737x1143mm STM. @ 1.65%
SW78.86± SE78.86±
EX 43.52m-250mm SAN. @ 1.26%±
NW78.32± SE78.32±
EX 119.35m-250mm SAN. @ 1.37%±
SE76.58± NW76.68±
EX 107.16m-250mm SAN. @ 0.85%±
NW75.67± E75.67±
W75.65± NE75.65±
EX 6.30m-250mm SAN. @ 0.30%±

EX. STORM SEWER INVERT
SE78.55± NE78.96± SW78.76±
NW78.00± SE77.90±
106.44m-900mm STM. @ 0.14%±
NW77.75± SE77.75± NE78.50±
121.28m-900mm STM. @ 0.95%±
SE76.55± NW76.60± NE77.08±
97.10m-900mm STM. @ 0.46%±
NW76.10± SE76.00±
145.43m-1050mm STM. @ 0.40%±
SE75.42± NW75.42±
89.43m-1050mm STM. @ 0.40%±
NW75.06± SE75.06±
NW75.00±
22.76m-1050mm STM. @ 0.26%±

CENTERLINE CHAINAGE	PROPOSED/EXISTING CENTERLINE ELEVATION
0+000	81.78 81.78
0+020	81.65 81.65
0+040	81.30 81.30
0+060	81.04 81.04
0+080	80.80 80.80
0+100	80.53 80.53
0+120	80.29 80.29
0+140	80.03 80.03
0+160	79.79 79.79
0+180	79.56 79.56
0+200	79.32 79.32
0+220	79.04 79.04
0+240	78.73 78.73
0+260	78.52 78.52
0+280	78.27 78.27
0+300	78.01 78.01
0+320	77.84 77.84
0+340	77.68 77.68
0+360	77.61 77.61
0+380	77.70 77.70
0+400	77.61 77.61
0+420	77.49 77.49
0+440	77.28 77.28
0+460	77.10 77.10
0+480	77.03 77.03
0+500	76.98 76.98
0+520	76.99 76.99
0+540	77.24 77.24
0+560	77.65 77.65
0+580	77.58 77.58
0+600	77.22 77.22
0+620	74.45 74.45

BENCHMARK
ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE DERIVED FROM THE CITY OF MISSISSAUGA BENCHMARK No. 731. ELEVATION = 81.58

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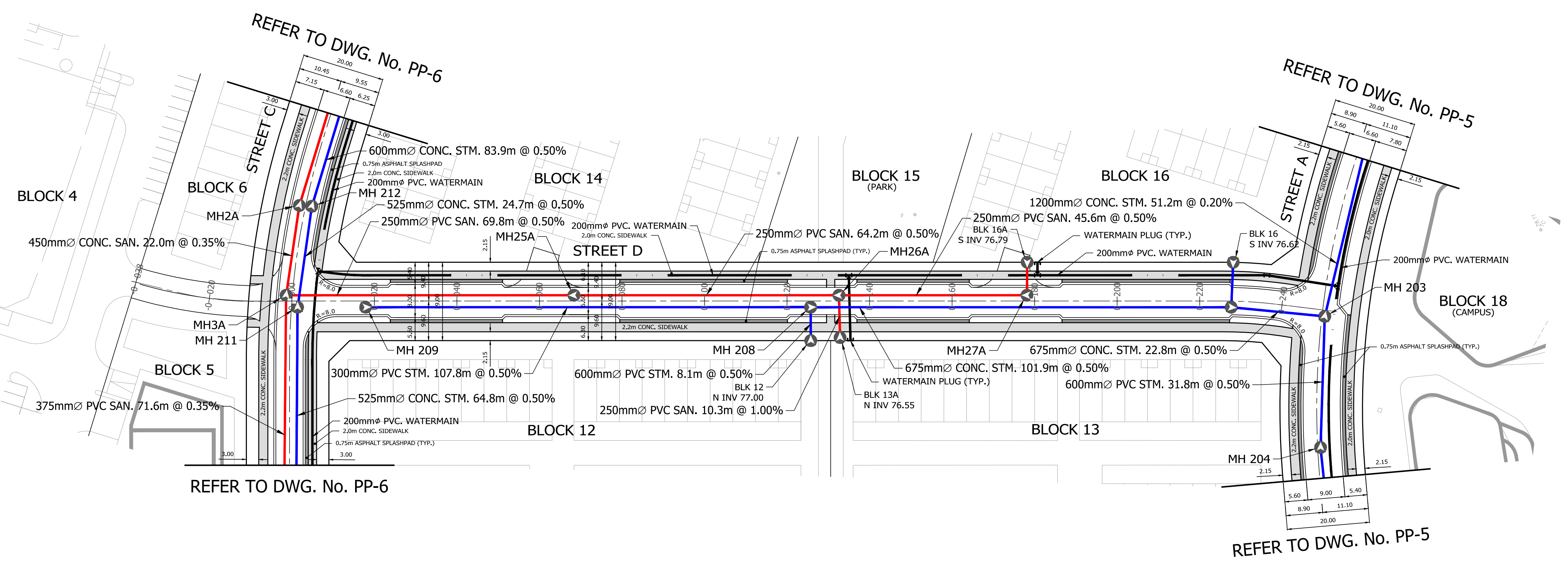
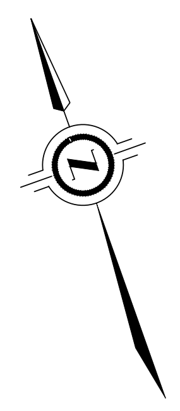
WEST VILLAGE PARTNERS
CITY OF MISSISSAUGA

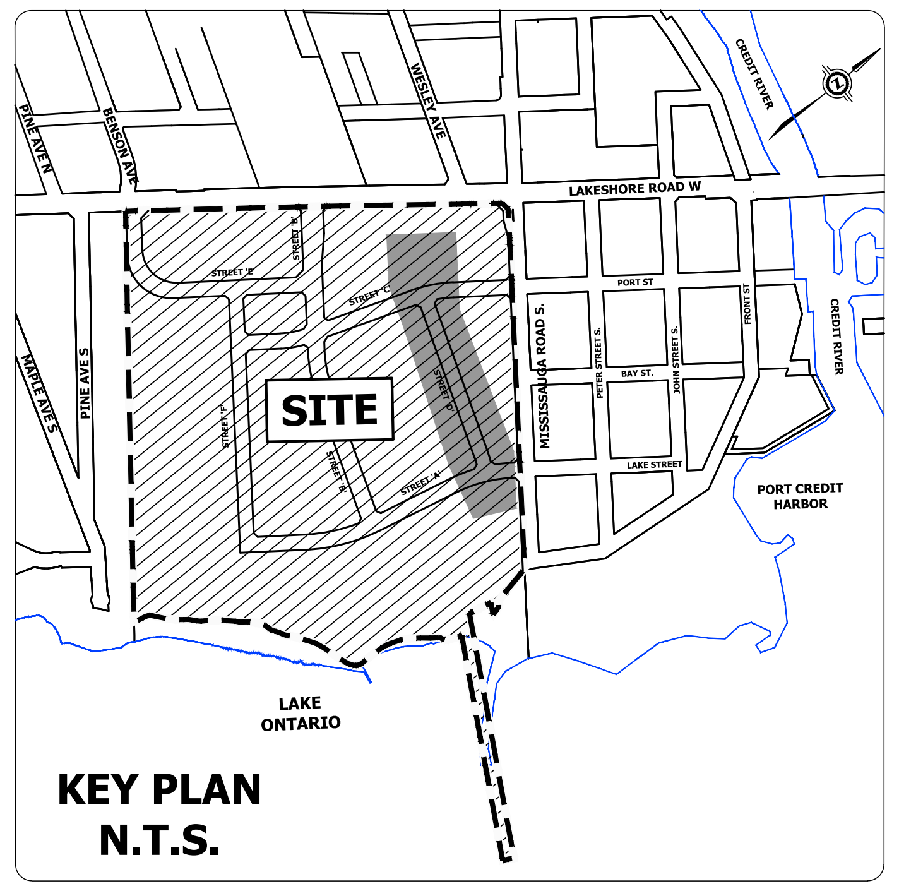
MISSISSAUGA RD PLAN & PROFILE
FROM ST. 0.000m TO END

PROJECT No.	DATE	SCALE	DWG No.
16-489	MAR 2017	V 1:50 H 1:1000	PP-1

11/9/2018

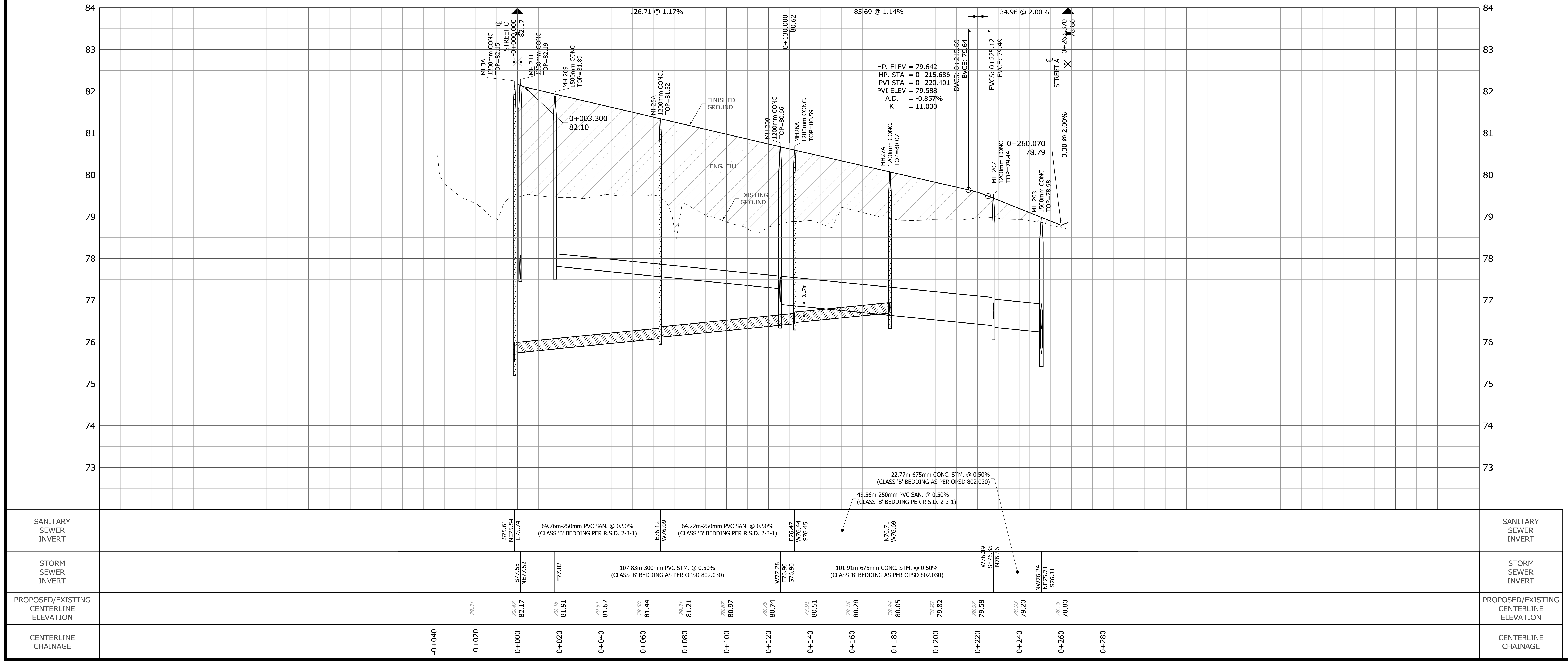






LEGEND

— · — · —	PROPERTY BOUNDARY
—●—	PROPOSED SANITARY SEWER
—●—	PROPOSED PUBLIC STORM SEWER
— — —	PROPOSED WATERMAIN
—●—	EX SANITARY SEWER
—○—	EX PUBLIC STORM SEWER
—— ——	EX WATERMAIN
▨	PROPOSED SIDEWALK / PATHWAY



BENCHMARK

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WEST VILLAGE PARTNERS
CITY OF MISSISSAUGA

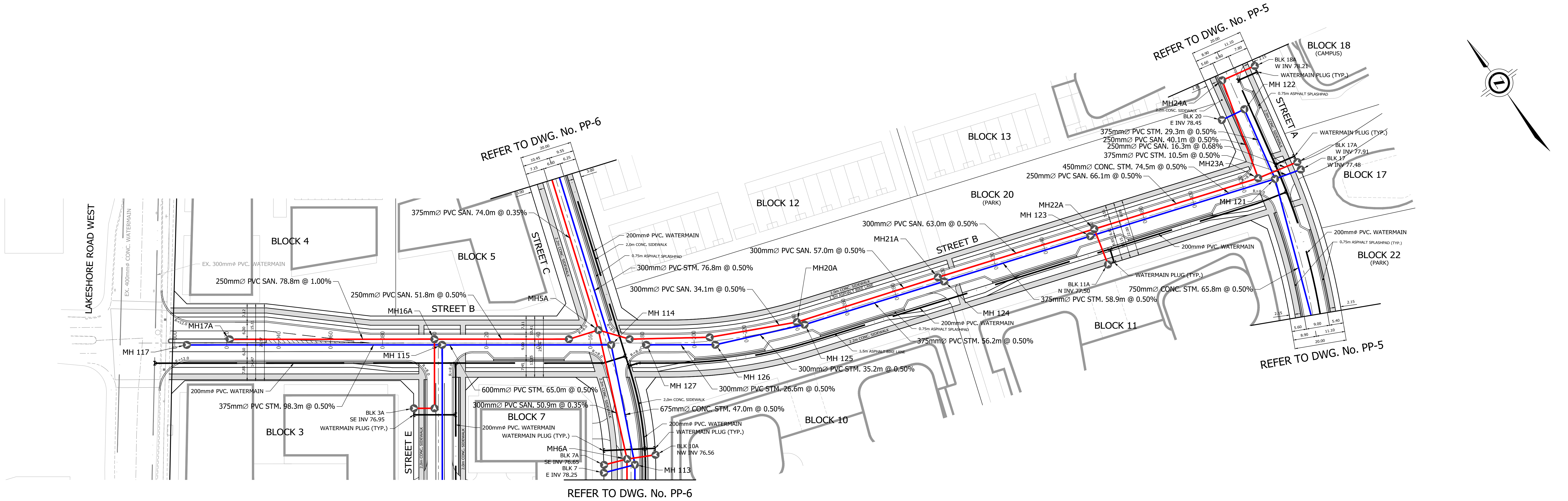
STREET 'D'
PLAN & PROFILE

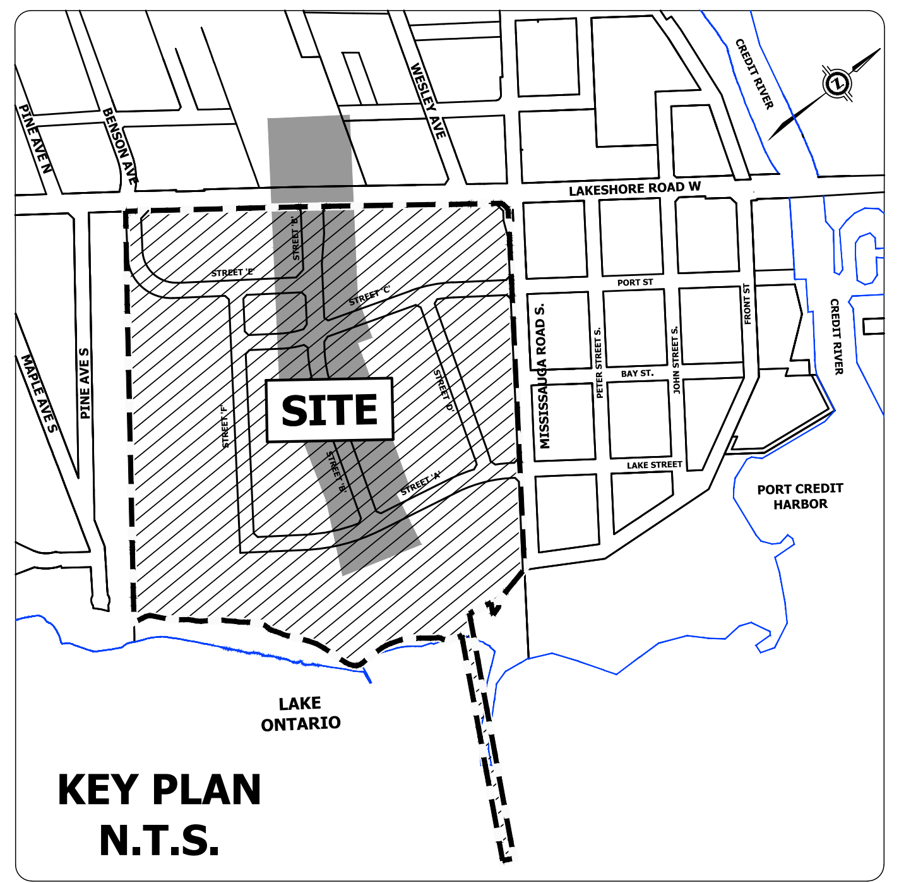
FROM ST. 0.000m TO END

PROJECT No.	DATE	SCALE	DWG No.
16-489	MAR 2017	V 1:50 H 1:1000	PP-2

11/8/2018

File: \\URBANWEST-NAS\ALSAL DATA\PROJECTS\16-489W (WEST VILLAGE PARTNERS - PORT CREDIT)\DRAWINGS\00_FUNCTIONAL\05_FD_FIGURES\16-489-FSR-PP-2-STREET 'D' PLAN AND PROFILE.DWG

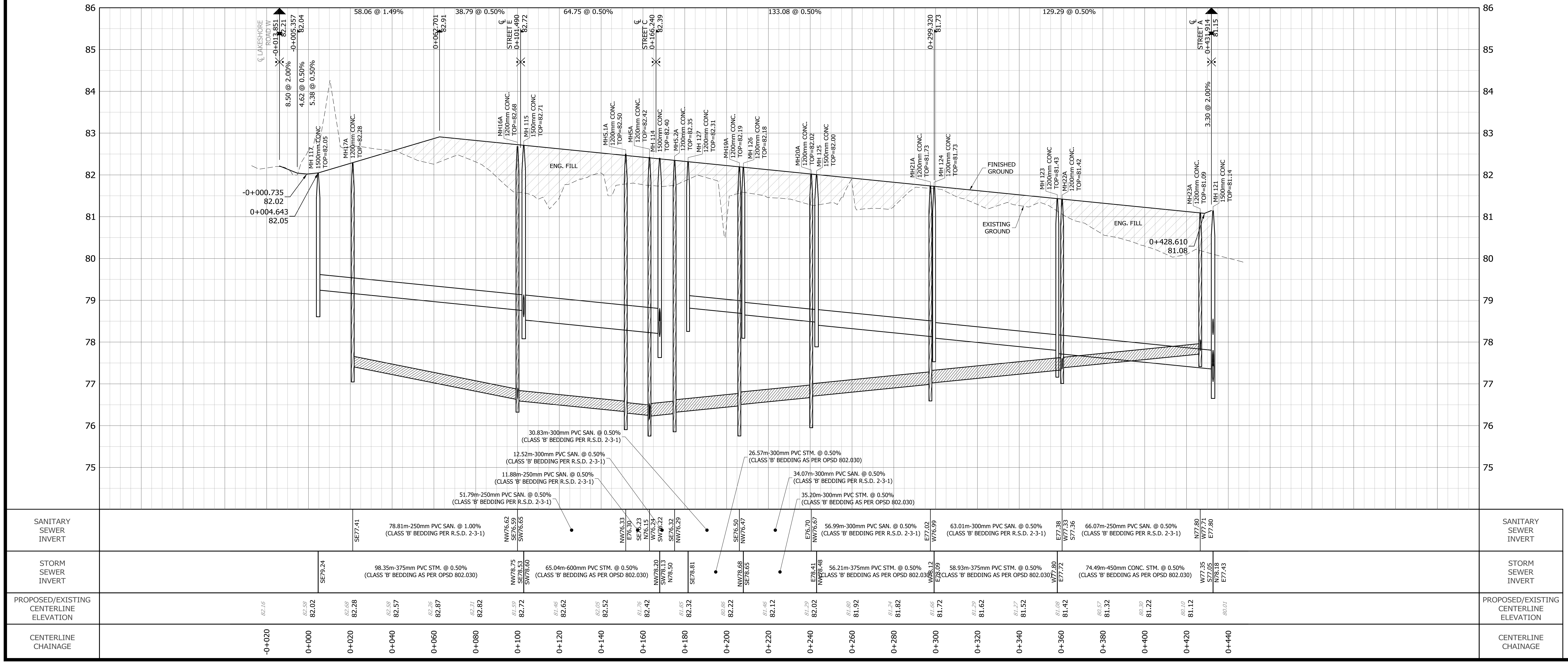




KEY PLAN
N.T.S.

LEGEND

‒ · ‒	PROPERTY BOUNDARY
─●─	PROPOSED SANITARY SEWER
─●─	PROPOSED PUBLIC STORM SEWER
━ ━	PROPOSED WATERMAIN
─●─	EX SANITARY SEWER
─○─	EX PUBLIC STORM SEWER
─ ─	EX WATERMAIN
▨	PROPOSED SIDEWALK / PATHWAY



CENTERLINE CHAINAGE	PROPOSED/EXISTING CENTERLINE ELEVATION	
-0+020	82.16	
0+000	82.58	82.02
0+020	82.68	82.28
0+040	82.58	82.57
0+060	82.26	82.87
0+080	82.31	82.82
0+100	81.59	82.72
0+120	81.46	82.62
0+140	82.05	82.52
0+160	81.76	82.42
0+180	81.85	82.32
0+200	80.86	82.22
0+220	81.46	82.12
0+240	81.29	82.02
0+260	81.80	81.92
0+280	81.24	81.82
0+300	81.66	81.72
0+320	81.29	81.62
0+340	81.27	81.52
0+360	81.08	81.42
0+380	80.57	81.32
0+400	80.30	81.22
0+420	80.10	81.12
0+440	80.01	

BENCHMARK

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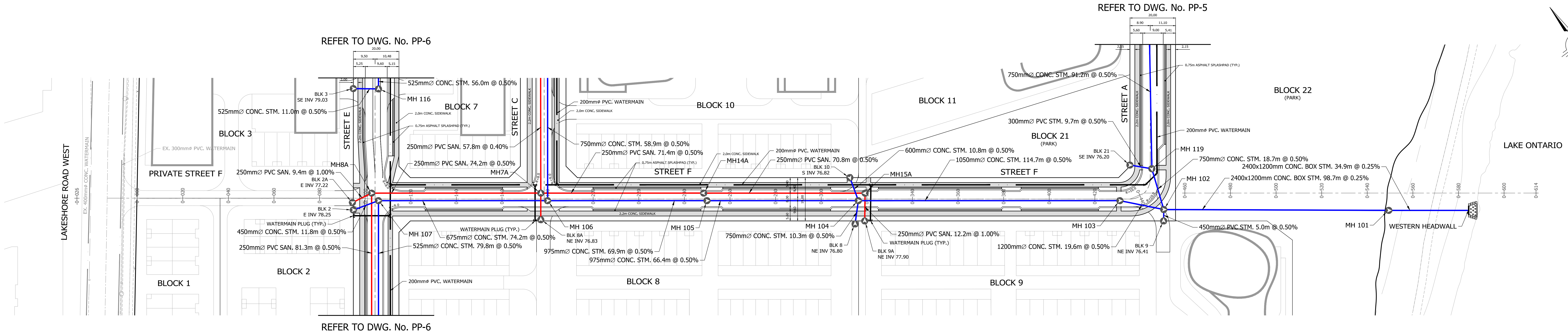
WEST VILLAGE PARTNERS
CITY OF MISSISSAUGA

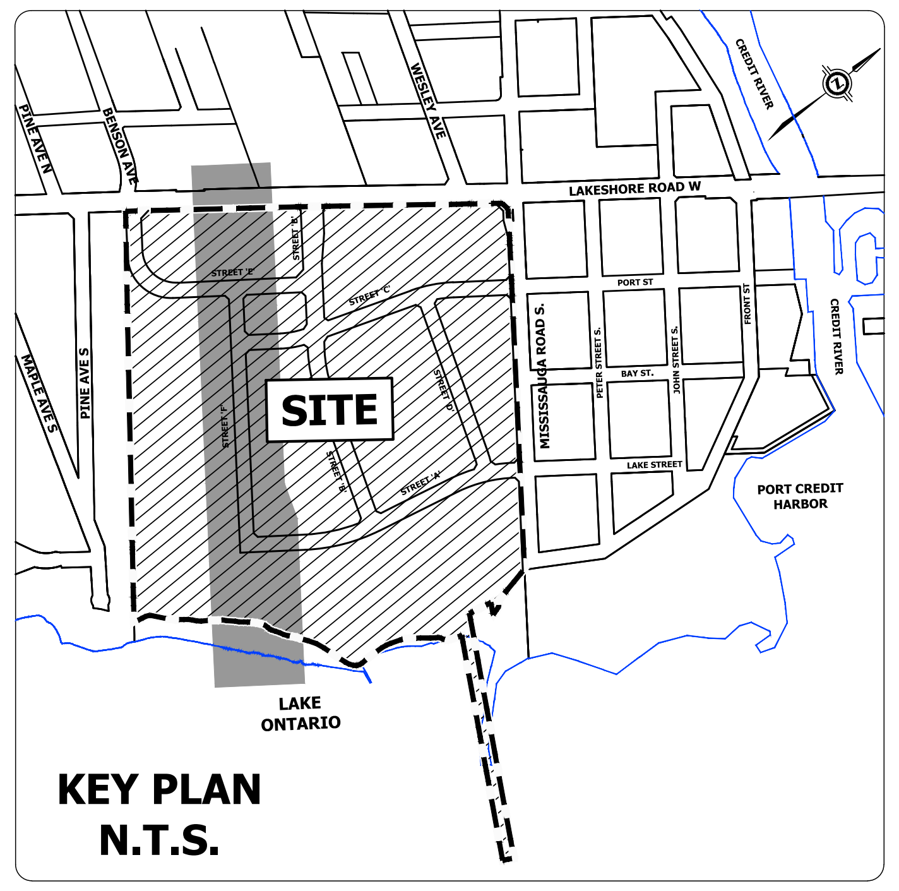
STREET 'B'
PLAN & PROFILE
FROM ST. 0.000m TO END

PROJECT No.	DATE	SCALE	DWG No.
16-489	MAR 2017	V 1:50 H 1:1000	PP-3

11/9/2018

File: \\URBANWEST-NAS\ALSAL DATA\PROJECTS\16-489W (WEST VILLAGE PARTNERS - PORT CREDIT)\DRAWINGS\00_FUNCTIONAL\05_FD_FIGURES\16-489-FSR-PP-3-STREET 'B' PLAN AND PROFILE.DWG

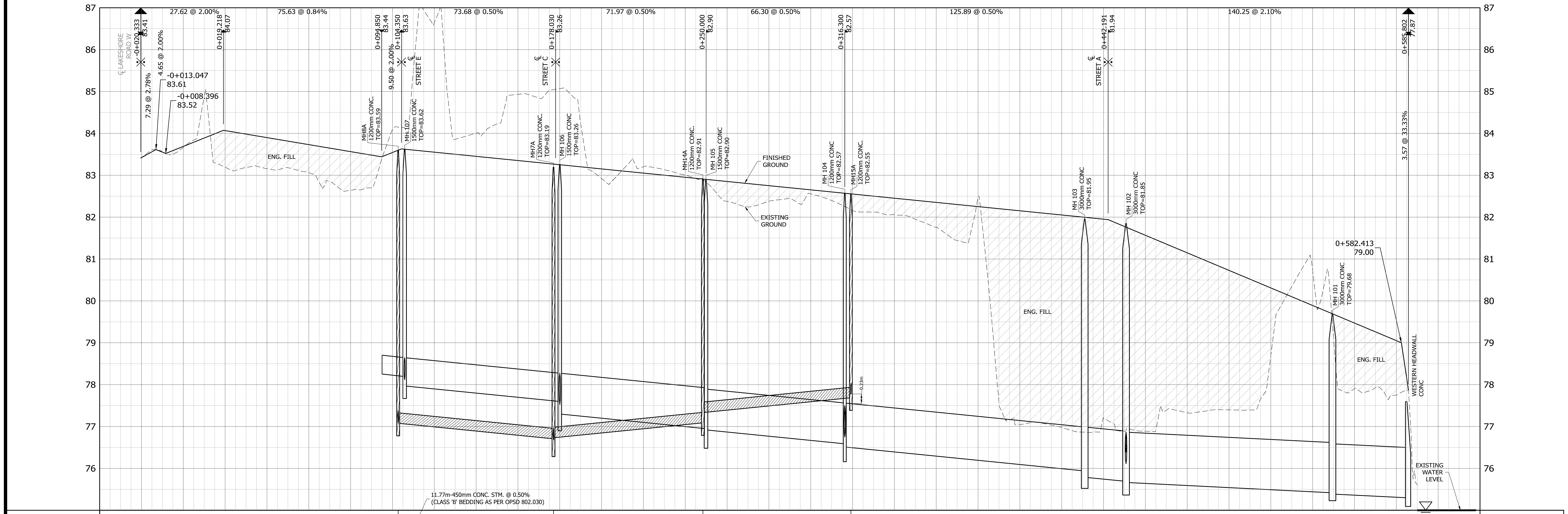




KEY PLAN
N.T.S.

LEGEND

- PROPERTY BOUNDARY
- PROPOSED SANITARY SEWER
- PROPOSED PUBLIC STORM SEWER
- PROPOSED WATERMAIN
- EX SANITARY SEWER
- EX PUBLIC STORM SEWER
- EX WATERMAIN
- ▨ PROPOSED SIDEWALK / PATHWAY



11.77m-450mm CONC. STM. @ 0.50%
(CLASS 'B' BEDDING AS PER OPSD 802.030)

SANITARY SEWER INVERT

W77.13 SW77.08 SE77.08

74.17m-250mm PVC SAN. @ 0.50%
(CLASS 'B' BEDDING PER R.S.D. 2-3-1)

SE76.73 NW76.71 NE76.68

71.44m-250mm PVC SAN. @ 0.50%
(CLASS 'B' BEDDING PER R.S.D. 2-3-1)

SE77.33 NW77.09

70.78m-250mm PVC SAN. @ 0.50%
(CLASS 'B' BEDDING PER R.S.D. 2-3-1)

NW77.69 SW77.78

19.63m-1200mm CONC. STM. @ 0.50%
(CLASS 'B' BEDDING AS PER OPSD 802.030)

34.90m-2400x1200mm CONC. BOX STM. @ 0.25%
(CLASS 'B' BEDDING AS PER OPSD 802.030)

STORM SEWER INVERT

SW78.12 SE77.97 W78.19

74.17m-675mm CONC. STM. @ 0.50%
(CLASS 'B' BEDDING AS PER OPSD 802.030)

NW77.60 SE77.30 NE77.52

69.91m-975mm CONC. STM. @ 0.50%
(CLASS 'B' BEDDING AS PER OPSD 802.030)

NW76.95 SE76.92

66.38m-975mm CONC. STM. @ 0.50%
(CLASS 'B' BEDDING AS PER OPSD 802.030)

NW76.59 SE76.51 SW76.75 N76.77

114.70m-1050mm CONC. STM. @ 0.50%
(CLASS 'B' BEDDING AS PER OPSD 802.030)

NW75.94 SE75.79

SE75.66 NW75.69 N76.11 SW76.39

98.70m-2400x1200mm CONC. BOX STM. @ 0.25%
(CLASS 'B' BEDDING AS PER OPSD 802.030)

SE75.39 NW75.42

NW75.30

CENTERLINE CHAINAGE	PROPOSED/EXISTING CENTERLINE ELEVATION
-0+020	83.42 83.42
0+000	83.66 83.69
0+020	83.19 84.07
0+040	83.16 83.90
0+060	83.06 83.73
0+080	82.64 83.56
0+100	84.08 83.54
0+120	86.64 83.55
0+140	84.00 83.45
0+160	84.93 83.35
0+180	85.07 83.25
0+200	82.92 83.15
0+220	83.20 83.05
0+240	83.00 82.95
0+260	82.37 82.85
0+280	82.38 82.75
0+300	82.55 82.65
0+320	82.16 82.55
0+340	82.06 82.45
0+360	81.75 82.35
0+380	82.49 82.25
0+400	77.04 82.15
0+420	76.97 82.05
0+440	77.20 81.95
0+460	76.89 81.57
0+480	77.33 81.15
0+500	77.40 80.73
0+520	78.70 80.31
0+540	80.71 79.89
0+560	77.90 79.47
0+580	77.75 79.05
0+600	

BENCHMARK

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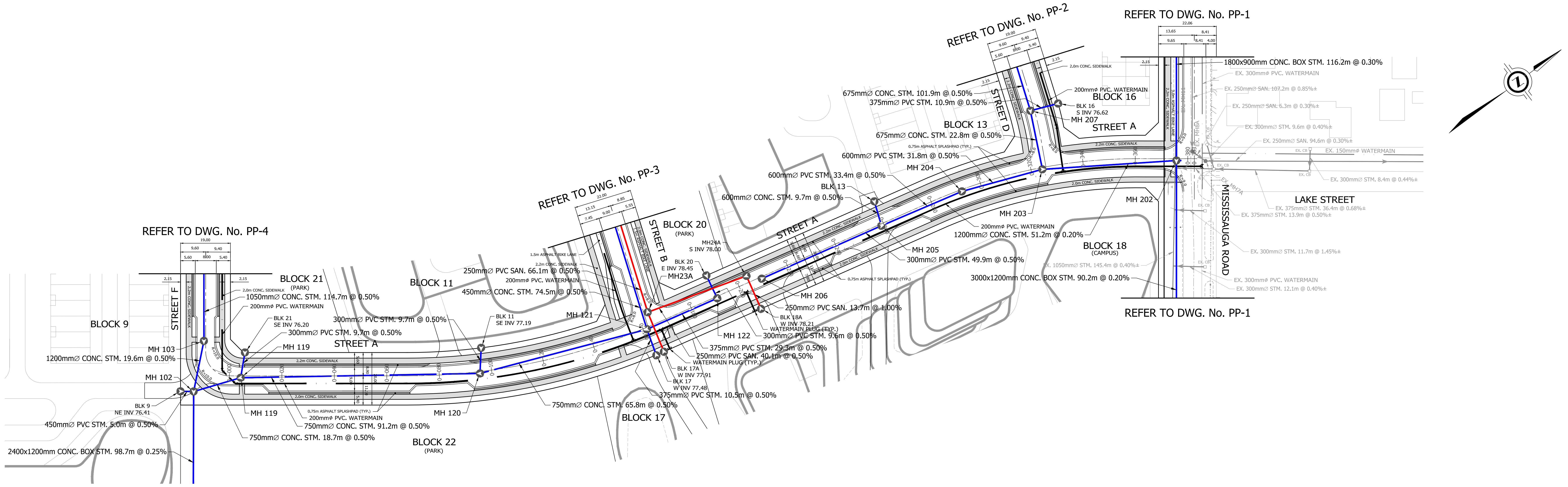
WEST VILLAGE PARTNERS
CITY OF MISSISSAUGA

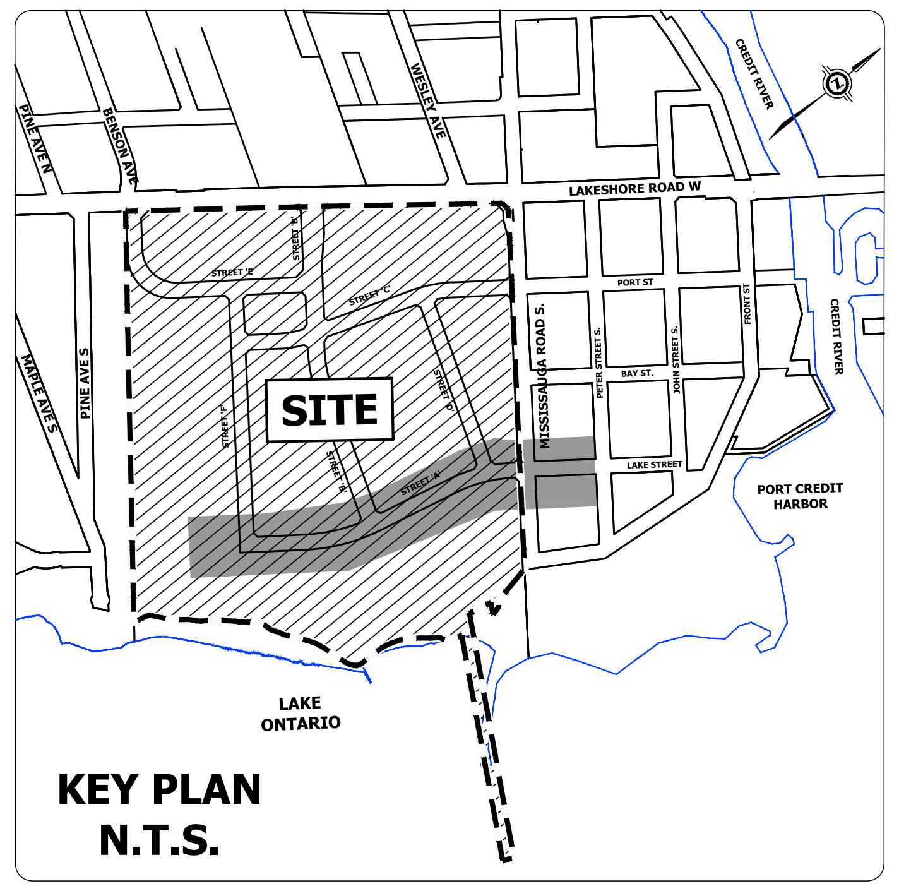
STREET 'F'
PLAN & PROFILE
FROM ST. 0.000m TO END

PROJECT No.	DATE	SCALE	DWG No.
16-489	MAR 2017	V 1:50 H 1:1000	PP-4

11/9/2018

File: \\URBANWEST-NAS\ALSAL DATA\PROJECTS\16-489W (WEST VILLAGE PARTNERS - PORT CREDIT)\DRAWINGS\00_FUNCTIONAL\05_FD_FIGURES\16-489-FSR-PP-4-STREET 'F' PLAN AND PROFILE.DWG

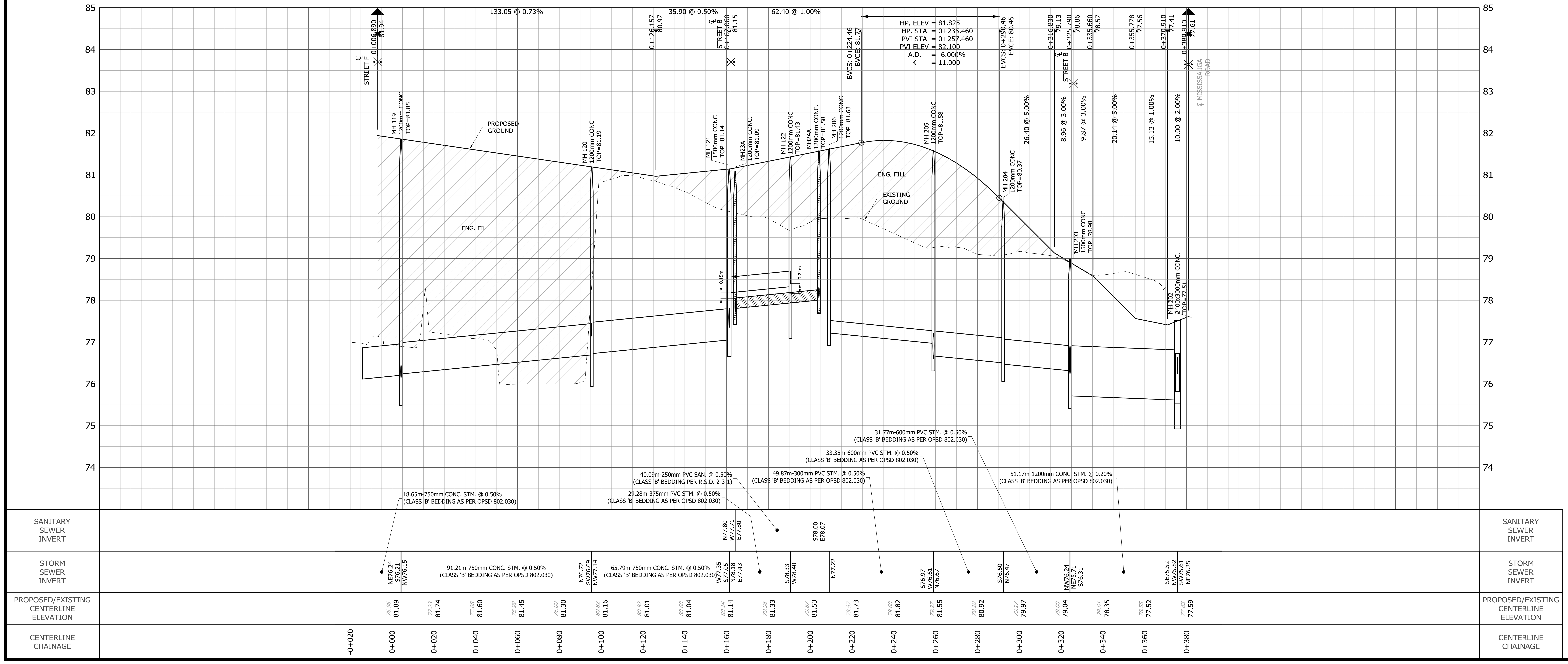




KEY PLAN
N.T.S.

LEGEND

— · — · —	PROPERTY BOUNDARY
—⊳—	PROPOSED SANITARY SEWER
—⊳—	PROPOSED PUBLIC STORM SEWER
— — —	PROPOSED WATERMAIN
—●—	EX SANITARY SEWER
—○—	EX PUBLIC STORM SEWER
— — —	EX WATERMAIN
▨	PROPOSED SIDEWALK / PATHWAY



11/9/2018

BENCHMARK

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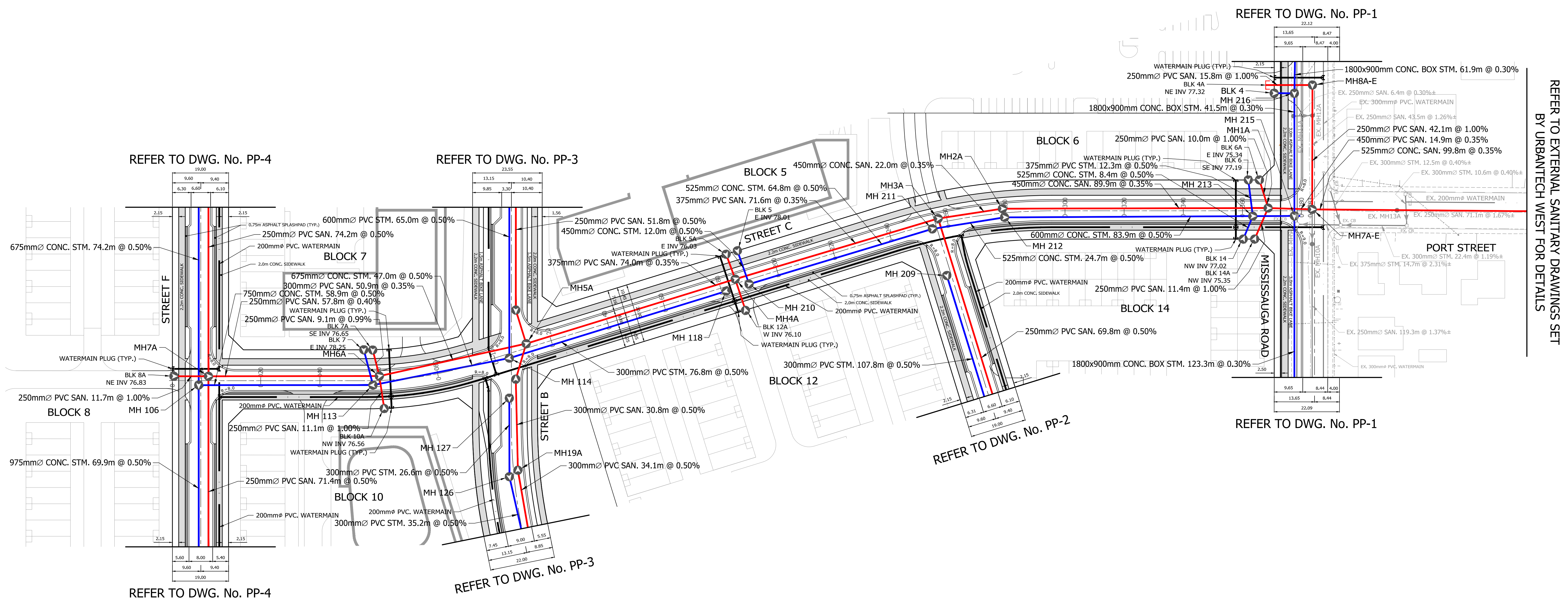
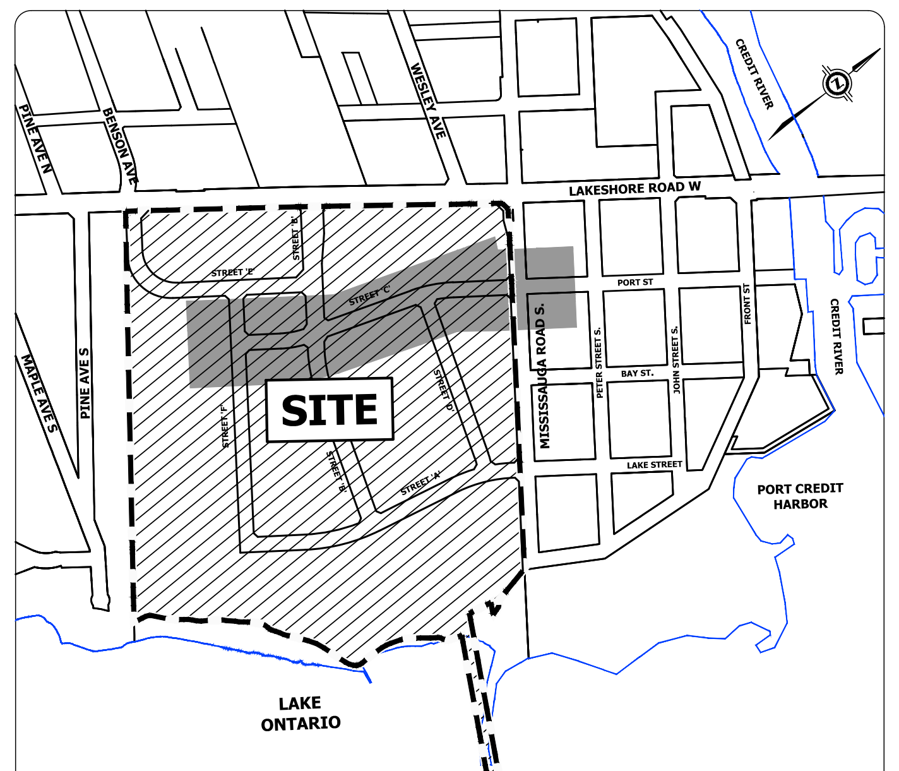
WEST VILLAGE PARTNERS
CITY OF MISSISSAUGA

STREET 'A'
PLAN & PROFILE
FROM ST. 0.000m TO END

PROJECT No.	DATE	SCALE	DWG No.
16-489	MAR 2017	V 1:50 H 1:1000	PP-5

File: \\URBANWEST-NAS\ALSAL DATA\PROJECTS\16-489W (WEST VILLAGE PARTNERS - PORT CREDIT)\DRAWINGS\00_FUNCTIONAL\05_FD_FIGURES\16-489-FSR-PP-5-STREET 'A' PLAN AND PROFILE.DWG

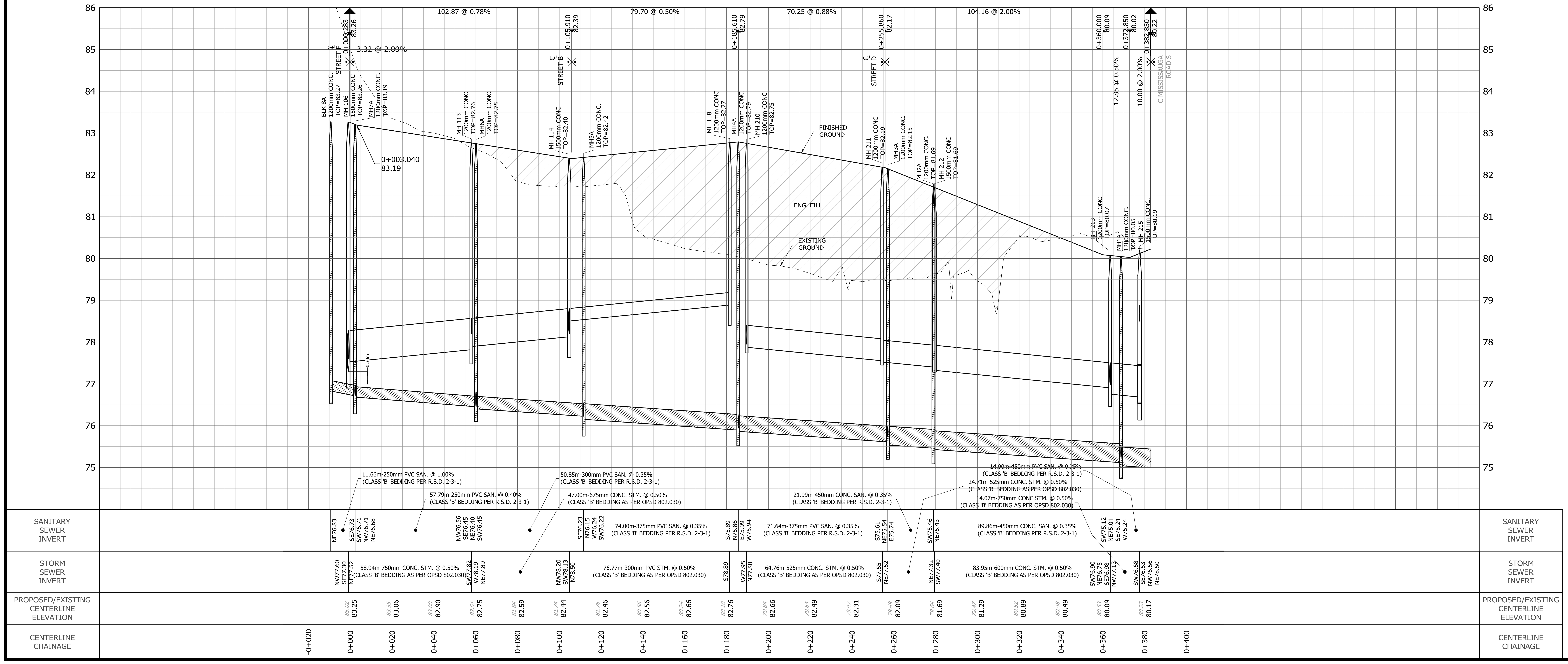




KEY PLAN
N.T.S.

LEGEND

— · —	PROPERTY BOUNDARY
—●—	PROPOSED SANITARY SEWER
—●—	PROPOSED PUBLIC STORM SEWER
— —	PROPOSED WATERMAIN
—●—	EX SANITARY SEWER
—○—	EX PUBLIC STORM SEWER
— —	EX WATERMAIN
▨	PROPOSED SIDEWALK / PATHWAY



BENCHMARK

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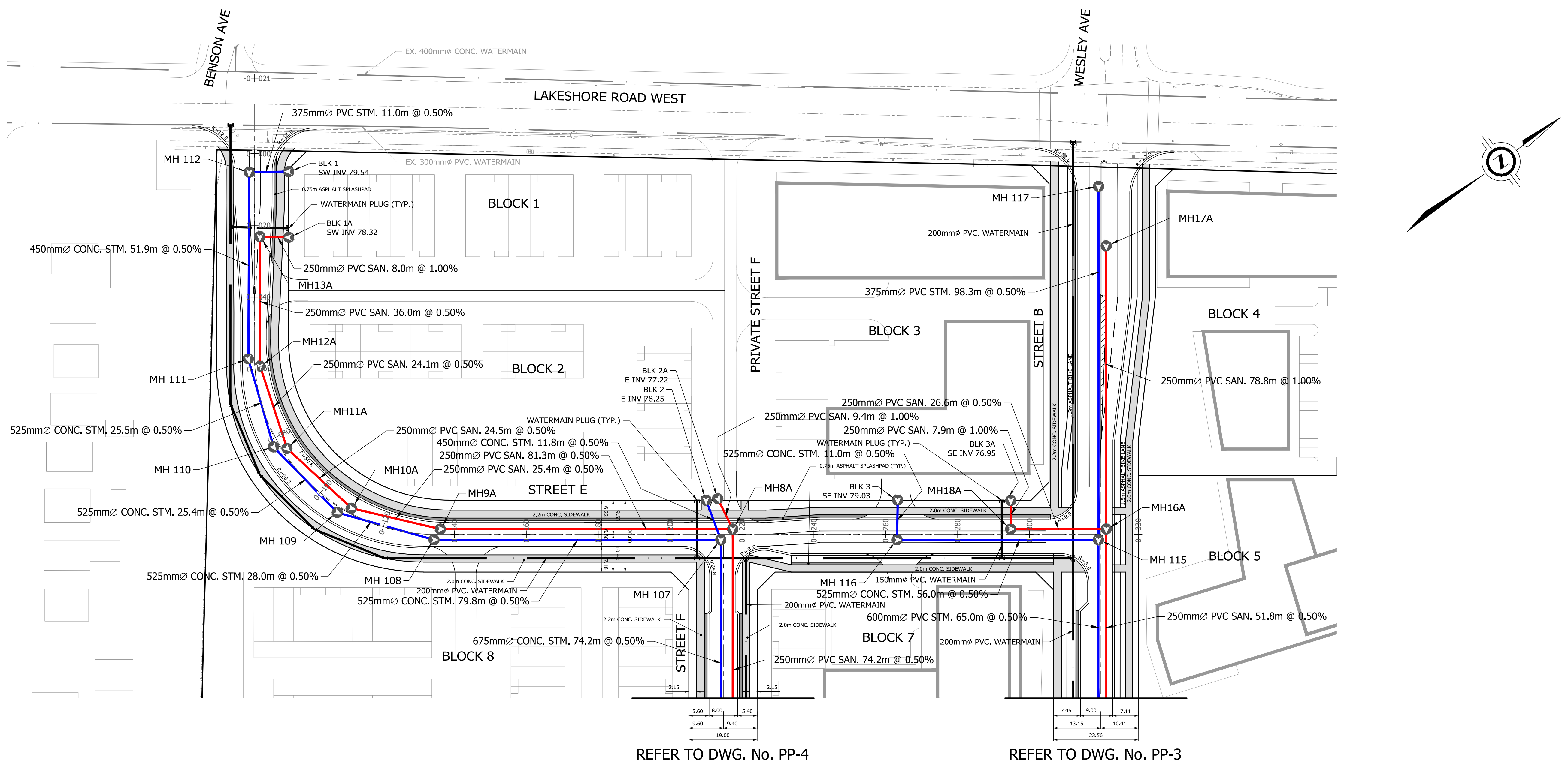
WEST VILLAGE PARTNERS
CITY OF MISSISSAUGA

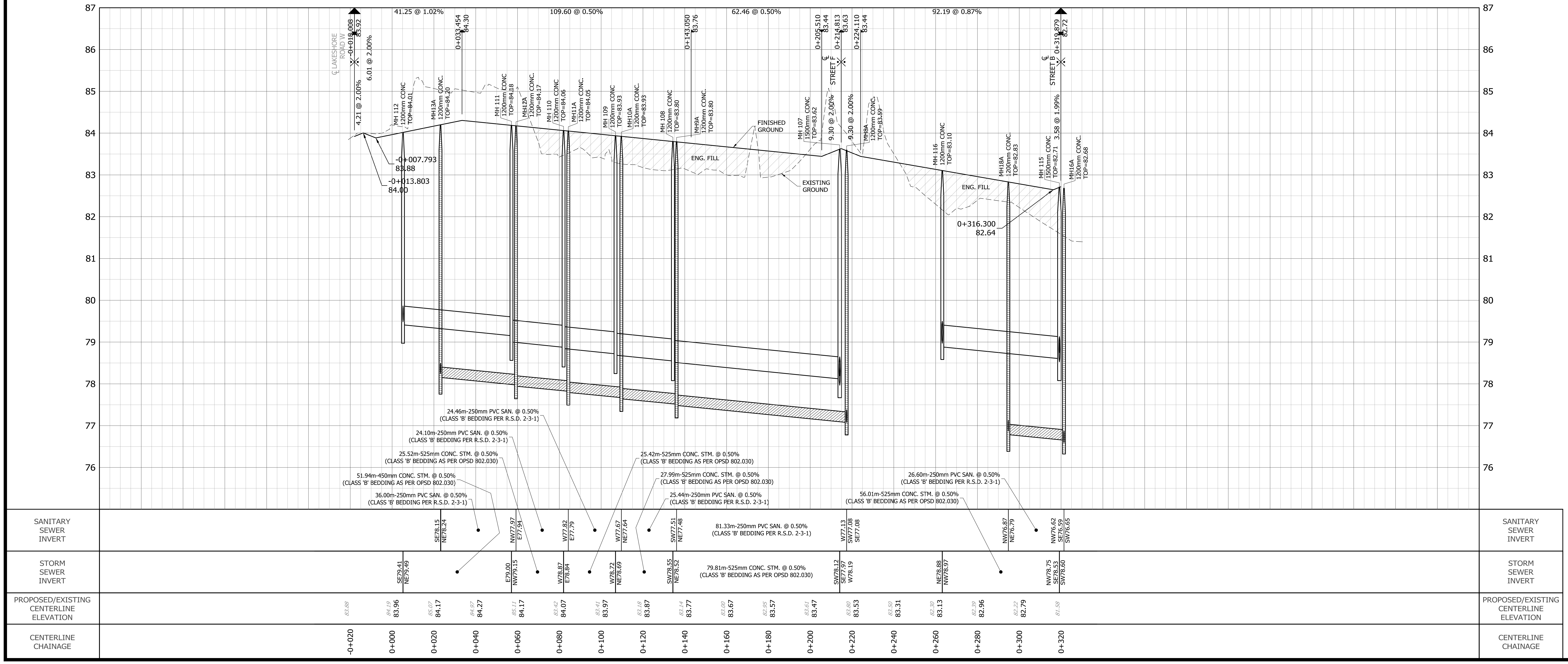
STREET 'C' PLAN & PROFILE

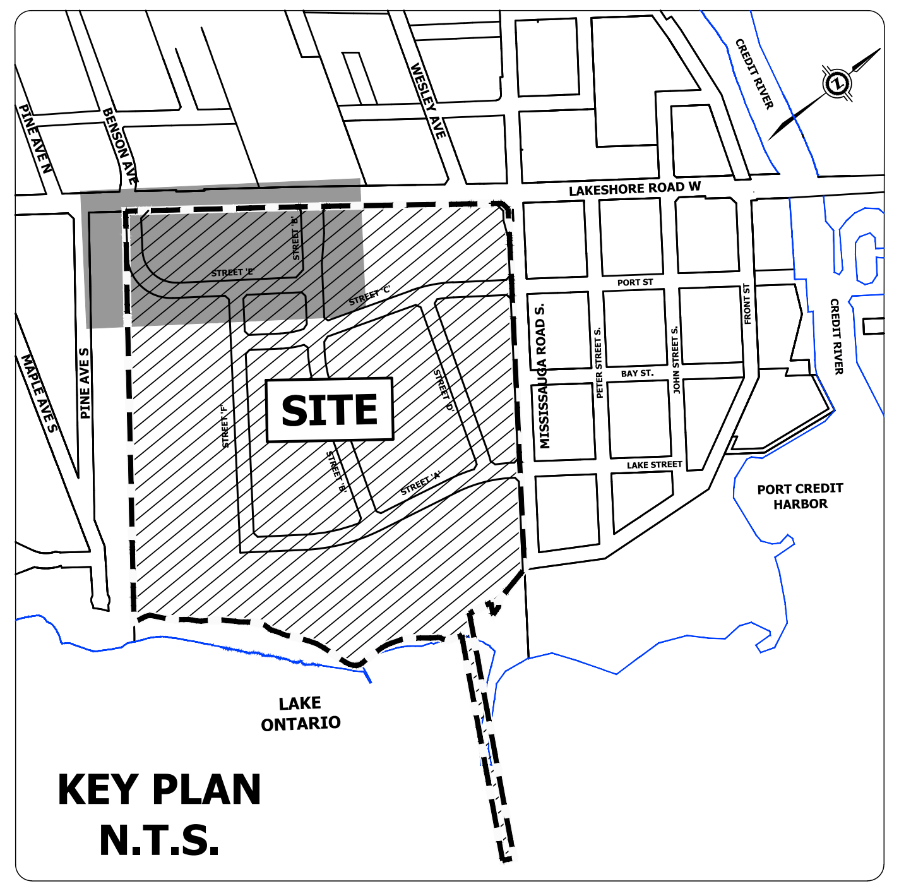
FROM ST. 0.000m TO END

PROJECT No.	DATE	SCALE	DWG No.
16-489	MAR 2017	V 1:50 H 1:1000	PP-6

File: \\URBANWEST-NAS\ALSAL DATA\PROJECTS\16-489W (WEST VILLAGE PARTNERS - PORT CREDIT)\DRAWINGS\00_FUNCTIONAL\05_FD_FIGURES\16-489-FSR-PP-6-STREET 'C' PLAN AND PROFILE.DWG







KEY PLAN
N.T.S.

LEGEND

- PROPERTY BOUNDARY
- PROPOSED SANITARY SEWER
- PROPOSED PUBLIC STORM SEWER
- PROPOSED WATERMAIN
- EX SANITARY SEWER
- EX PUBLIC STORM SEWER
- EX WATERMAIN
- PROPOSED SIDEWALK / PATHWAY

BENCHMARK

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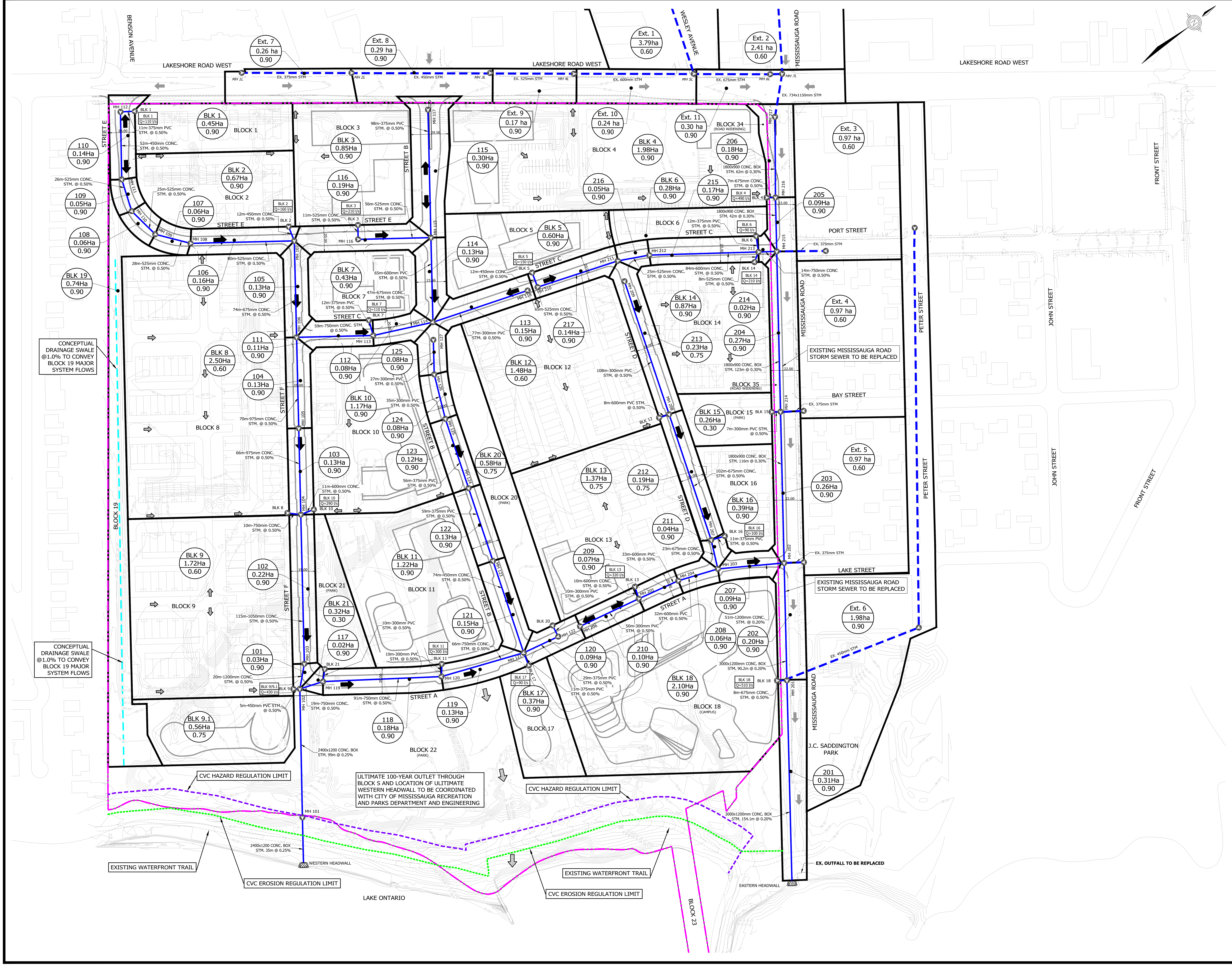
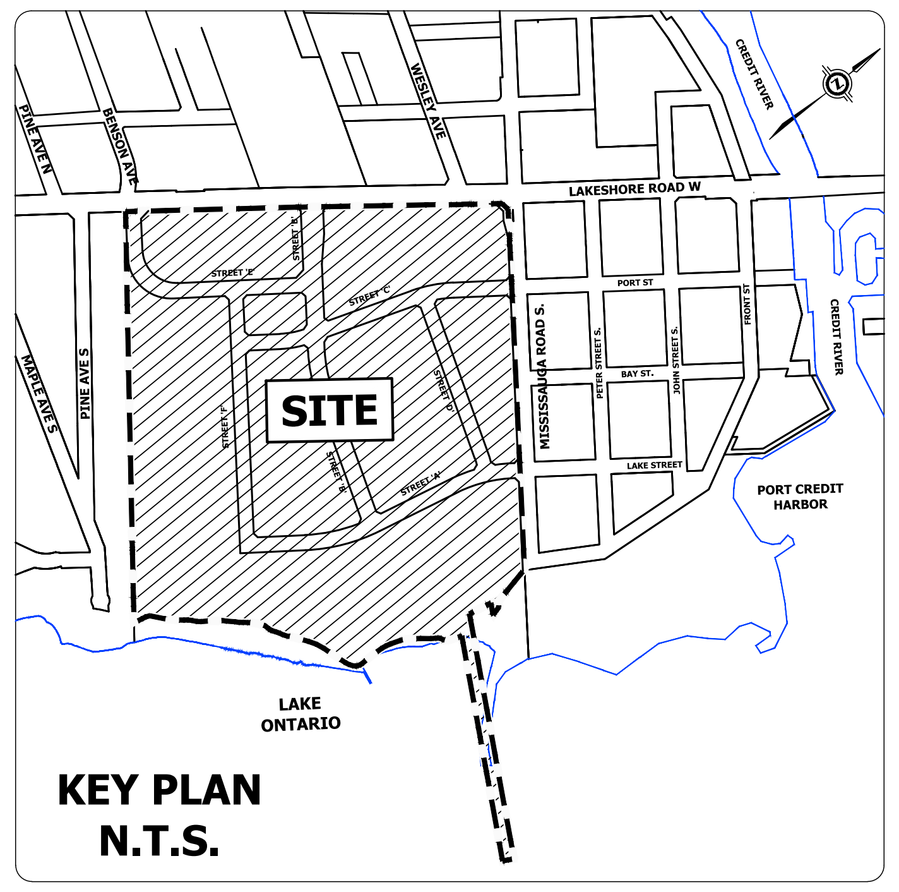
WEST VILLAGE PARTNERS
CITY OF MISSISSAUGA

STREET 'E' PLAN & PROFILE

FROM ST. 0.000m TO END

PROJECT No.	DATE	SCALE	DWG No.
16-489	MAR 2017	V 1:50 H 1:1000	PP-7





KEY PLAN
N.T.S.

LEGEND

━ ▪ ━	PROPERTY BOUNDARY
━━━	STORM DRAINAGE AREA BOUNDARY
━●━	PROPOSED PUBLIC STORM SEWER
···●···	EXISTING STORM SEWER
- - -	PROPOSED SWALE
➡	MAJOR OVERLAND FLOW
➡	EXISTING MAJOR OVERLAND FLOW
⇨	EMERGENCY OVERLAND FLOW
79.50	EXISTING CONTOUR & ELEVATION
1	CATCHMENT I.D.
0.97 ha	CATCHMENT AREA
0.60	RUNOFF COEFFICIENT
BLK 18	CATCHMENT I.D.
Q=100 l/s	ALLOWABLE RELEASE RATE

* APPLIES TO BLOCKS WHERE THE 100Yr FLOWS ARE CONTROLLED TO THE MINOR STORM CAPACITY.

BENCHMARK

ELEVATIONS ARE OF GEODETIC ORIGIN AND ARE DERIVED FROM THE CITY OF MISSISSAUGA BENCHMARK No. 731. ELEVATION = 81.58

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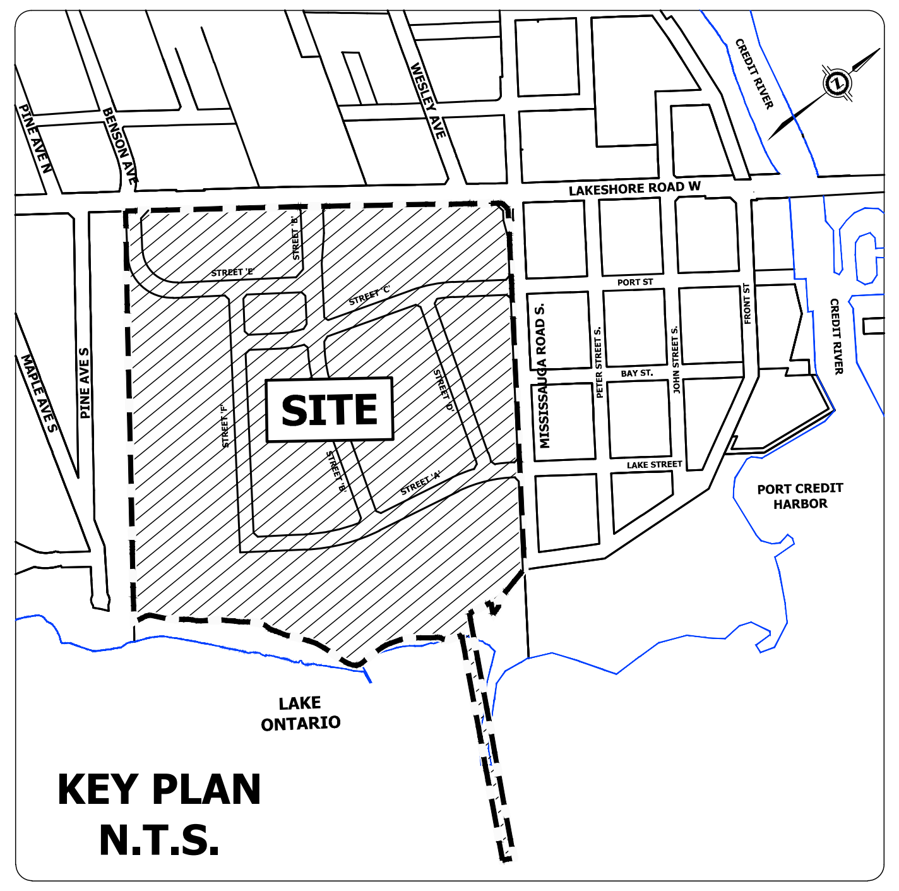
WEST VILLAGE PARTNERS
CITY OF MISSISSAUGA

PRELIMINARY MINOR SYSTEM STORM SERVICING PLAN

PROJECT No.	DATE	SCALE	DWG No.
16-489	MAR 2017	1:1250	STM-1



KEY PLAN
N.T.S.

LEGEND

─·─·─	PROPERTY BOUNDARY
───	100-YEAR CAPTURE STORM DRAINAGE AREA BOUNDARY
──○──	PROPOSED PUBLIC STORM SEWER
┄┄○┄┄	EXISTING STORM SEWER
┄┄	PROPOSED SWALE
➡	MAJOR OVERLAND FLOW
➡	EXISTING MAJOR OVERLAND FLOW
⇨	EMERGENCY OVERLAND FLOW
79.50	EXISTING CONTOUR & ELEVATION
Ext. 5	EXTERNAL CATCHMENT I.D.
0.97ha	EXTERNAL CATCHMENT AREA
0.60	EXTERNAL RUNOFF COEFFICIENT
100YR-15	PRIVATE CAPTURE POINT
0.33 ha	PRIVATE AREA (ha)
0.040 cms	PRIVATE 100-YEAR CAPTURE FLOW
100YR-17	PUBLIC CAPTURE POINT
2.13 ha	PUBLIC AREA (ha)
0.817 cms	PUBLIC 100-YEAR CAPTURE FLOW
M-203	MISSISSAUGA CATCHMENT I.D.
0.26ha	MISSISSAUGA CATCHMENT AREA
0.90	RUNOFF COEFFICIENT

DRAINAGE TO MISSISSAUGA ROAD (HW EAST)

🟦	100-YEAR DRAINAGE OVERLAND (100-YEAR CAPTURE AT MH202)
🟦	100-YEAR DRAINAGE TO MINOR SYSTEM
▨	100-YEAR DRAINAGE TO CISTERNS 10-YEAR PEAK FLOW DISCHARGE

DRAINAGE TO HW WEST

🟩	100-YEAR DRAINAGE OVERLAND (100-YEAR CAPTURE AT MH202)
🟩	100-YEAR DRAINAGE TO MINOR SYSTEM
▨	100-YEAR DRAINAGE TO CISTERNS 10-YEAR PEAK FLOW DISCHARGE

BENCHMARK

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WEST VILLAGE PARTNERS
CITY OF MISSISSAUGA

PRELIMINARY MAJOR SYSTEM STORM SERVICING PLAN

PROJECT No.	DATE	SCALE	DWG No.
16-489	MAR 2017	1:1250	STM-2

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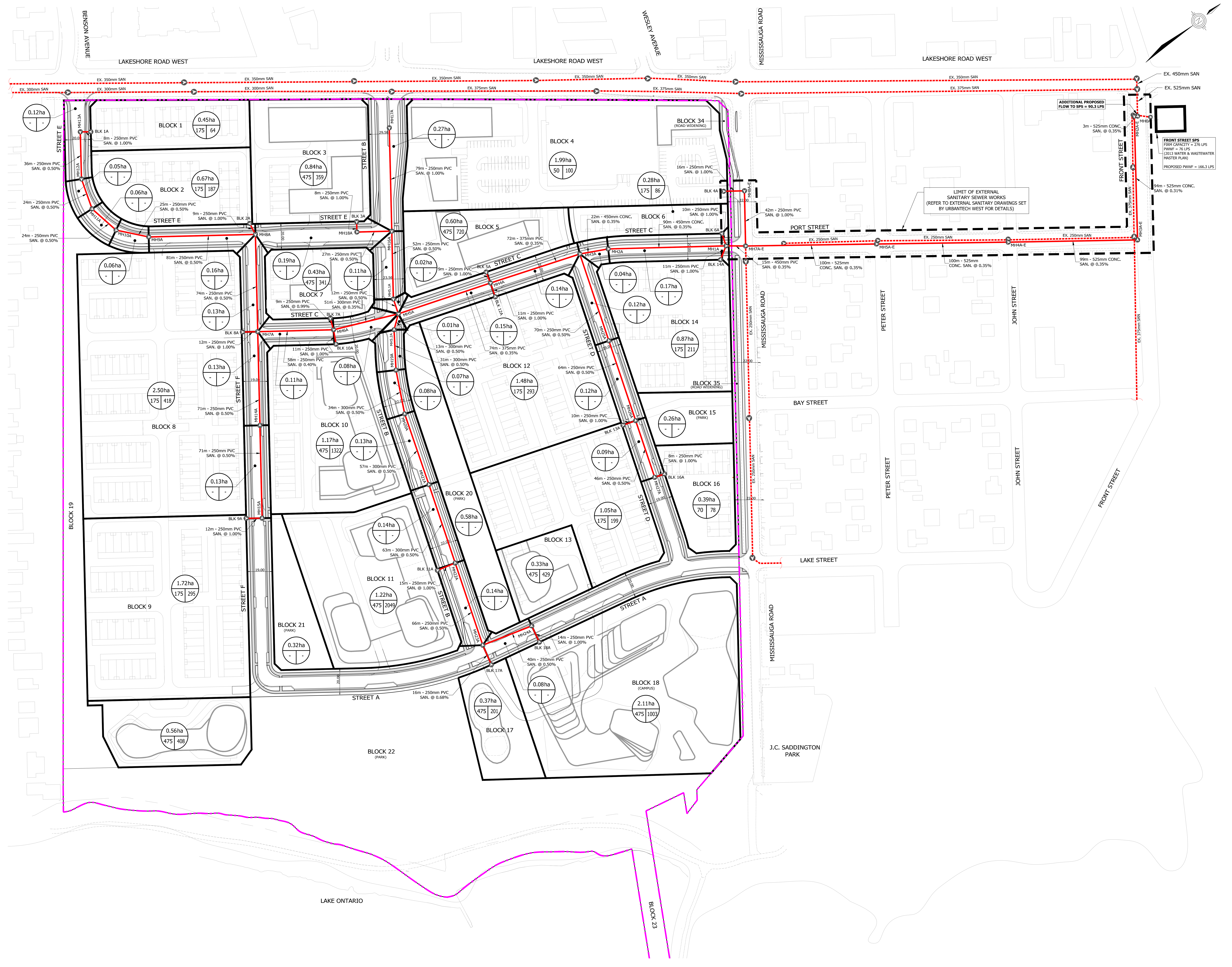

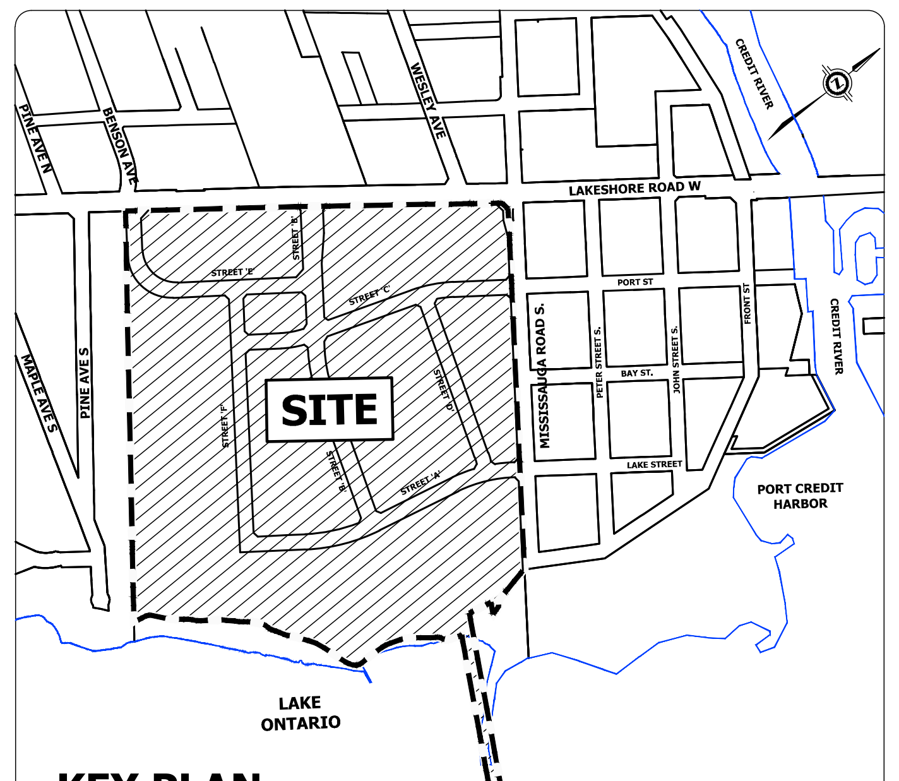

KEY PLAN
N.T.S.

LEGEND

━ ▪ ▪ ━	PROPERTY BOUNDARY
━━━	SANITARY DRAINAGE AREA BOUNDARY
━➤━	PROPOSED SANITARY SEWER
┅➤┅	EXISTING SANITARY SEWER
0.10ha	DRAINAGE AREA (ha)
7	POPULATION
70	DENSITY (P/Ha) (WHERE NOT SHOWN, POPULATION IS BASED ON 2.7 PEOPLE PER UNIT FOR HIGH RISES AND 175 P/Ha FOR TOWNHOMES)

BENCHMARK

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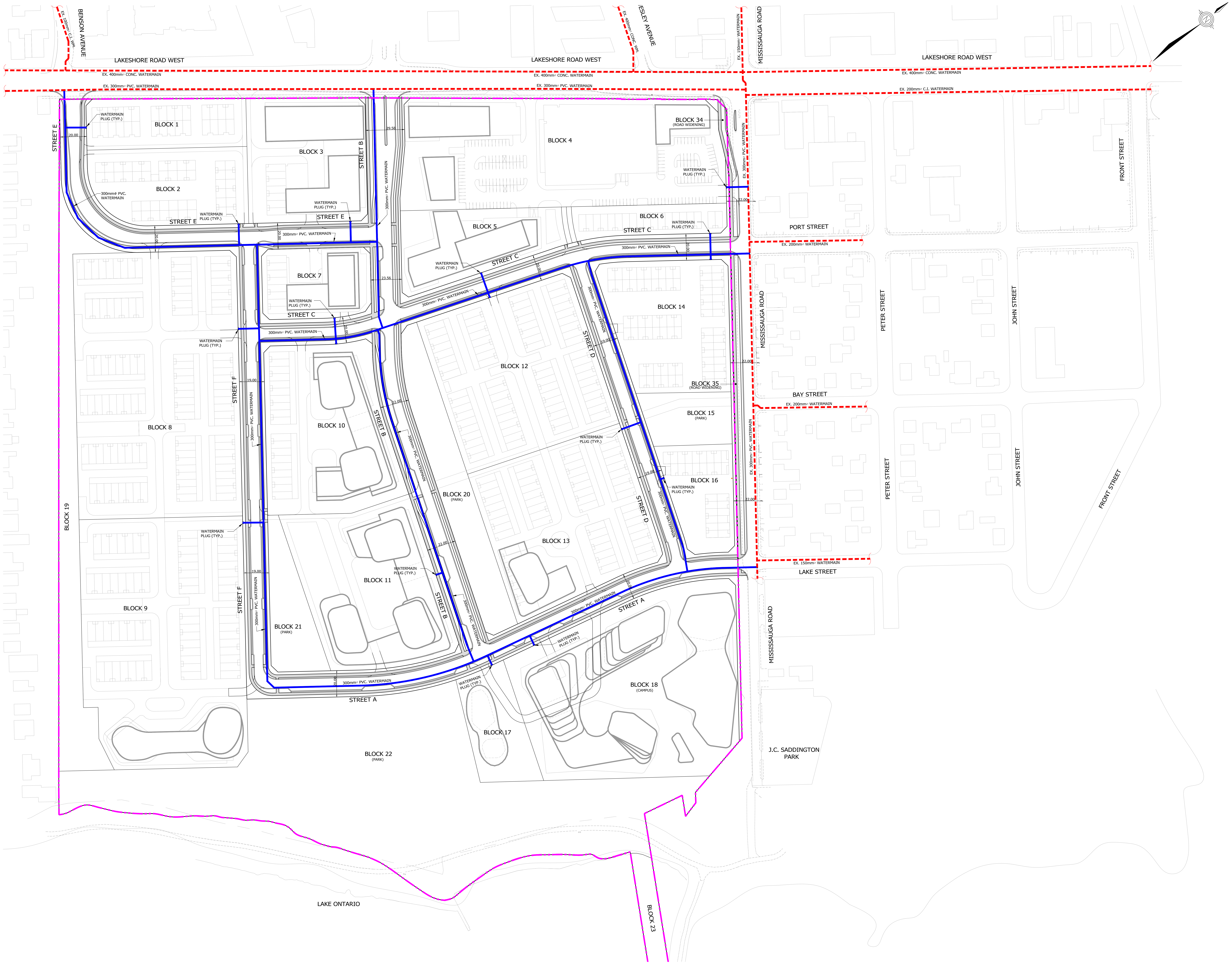
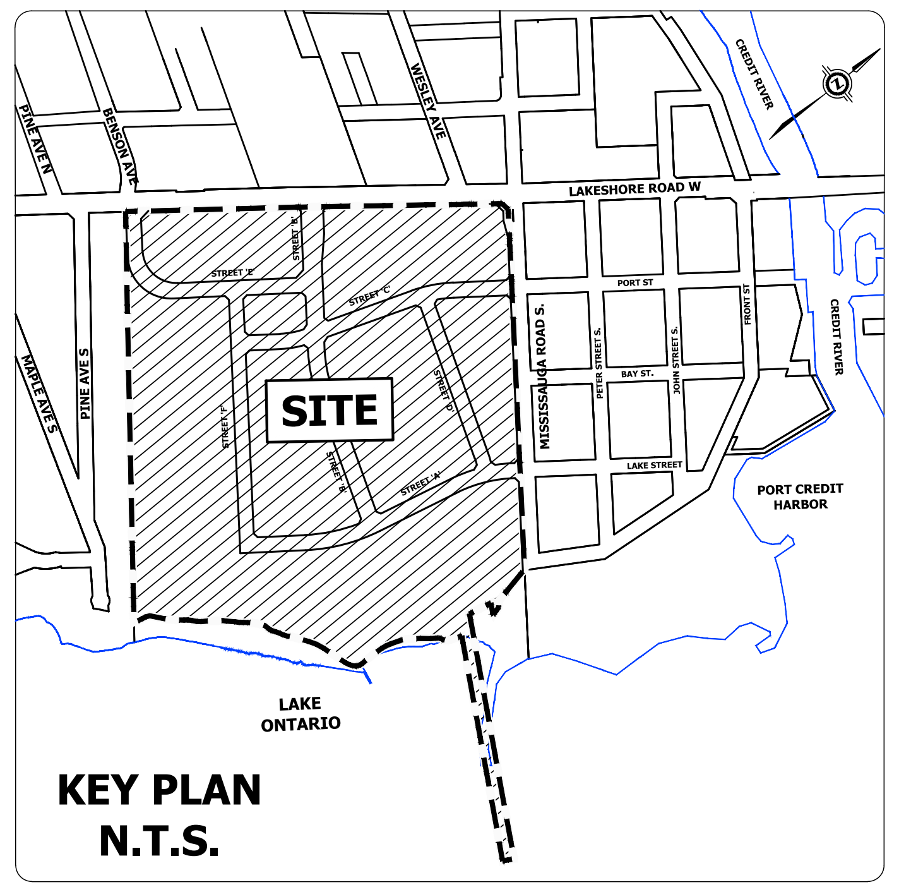
WEST VILLAGE PARTNERS
CITY OF MISSISSAUGA

PRELIMINARY SANITARY SERVICING PLAN

PROJECT No.	DATE	SCALE	DWG No.
16-489	MAR 2017	1:1250	**SAN-1**

File: F:\PROJECTS\16-489W (WEST VILLAGE PARTNERS - PORT CREDIT)\DRAWINGS\00_FUNCTIONAL\05_FD_FIGURES\16-489-FSR-SAN-1.DWG





KEY PLAN
N.T.S.

LEGEND

‐·‐·‐	PROPERTY BOUNDARY
▬	PROPOSED 300mm∅ WATERMAIN
‐ ‐ ‐	EXISTING WATERMAIN

BENCHMARK

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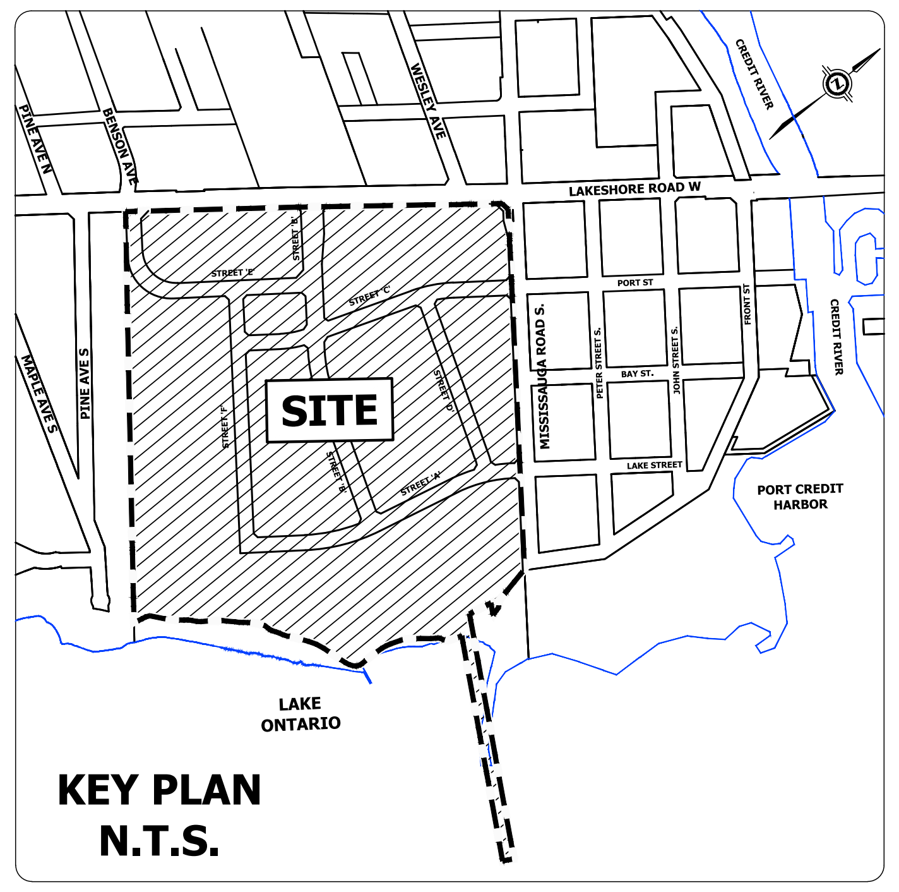
WEST VILLAGE PARTNERS
CITY OF MISSISSAUGA

PRELIMINARY WATER DISTRIBUTION PLAN

PROJECT No.	DATE	SCALE	DWG No.
16-489	MAR 2017	1:1250	**WM-1**

File: F:\PROJECTS\16-489W (WEST VILLAGE PARTNERS - PORT CREDIT)\DRAWINGS\00_FUNCTIONAL\05_FD_FIGURES\16-489-FSR-WM-1.DWG

11/9/2018



KEY PLAN
N.T.S.

LEGEND

‐ · ‐ · ‐	PROPERTY BOUNDARY
242.00	EXISTING CONTOUR AND ELEVATION
+240.71	PROPOSED ELEVATION
+ 189.99 EX	EXISTING ELEVATION
‐ ‐ ‐ ‐	UNDERGROUND PARKING
⬅	MAJOR OVERLAND FLOW
⬅	EXISTING OVERLAND FLOW
⇦	EMERGENCY OVERLAND FLOW
▬	RETAINING WALL
▨	PROPOSED SIDEWALK / PATHWAY

BENCHMARK

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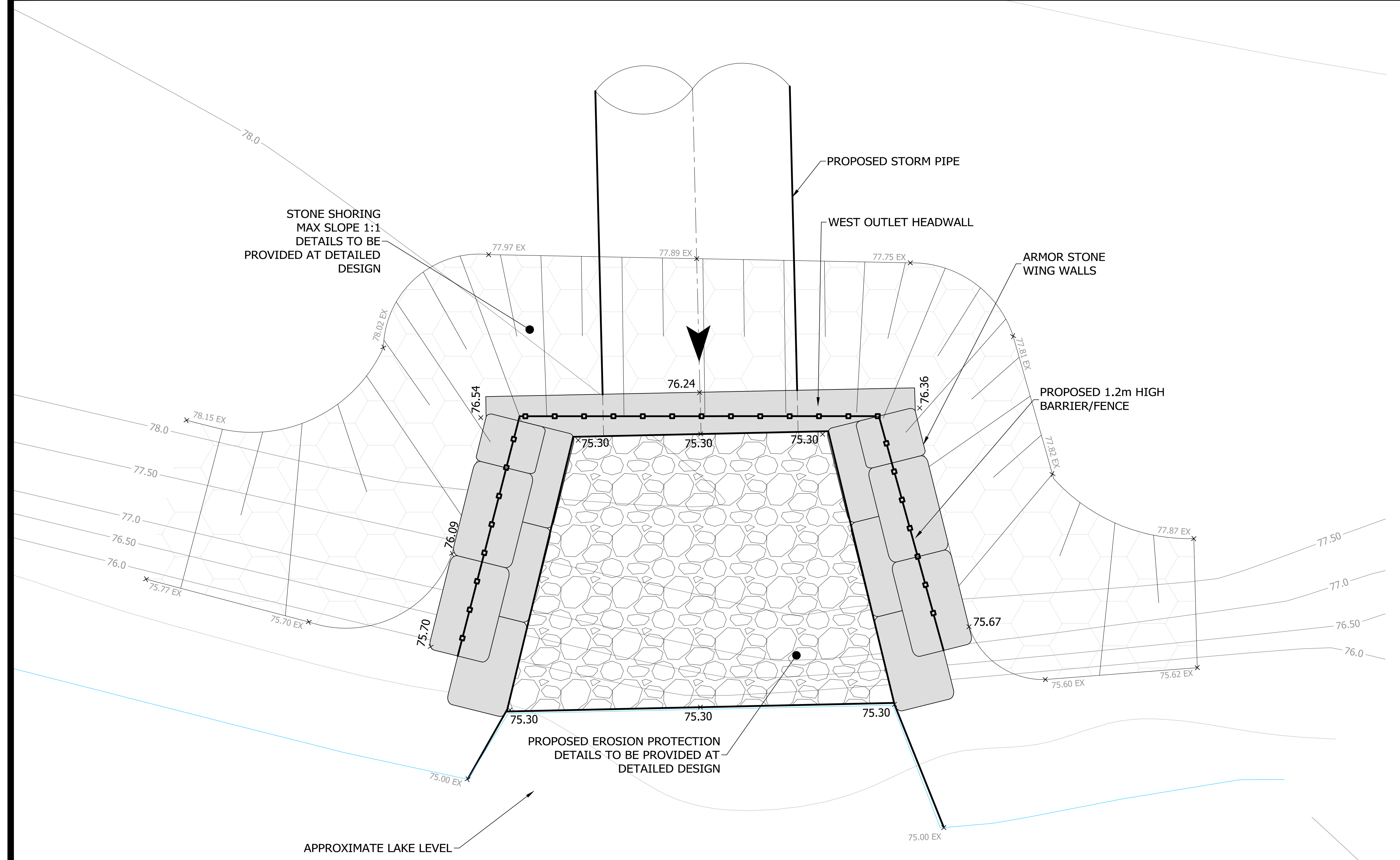
WEST VILLAGE PARTNERS
CITY OF MISSISSAUGA

PRELIMINARY GRADING PLAN

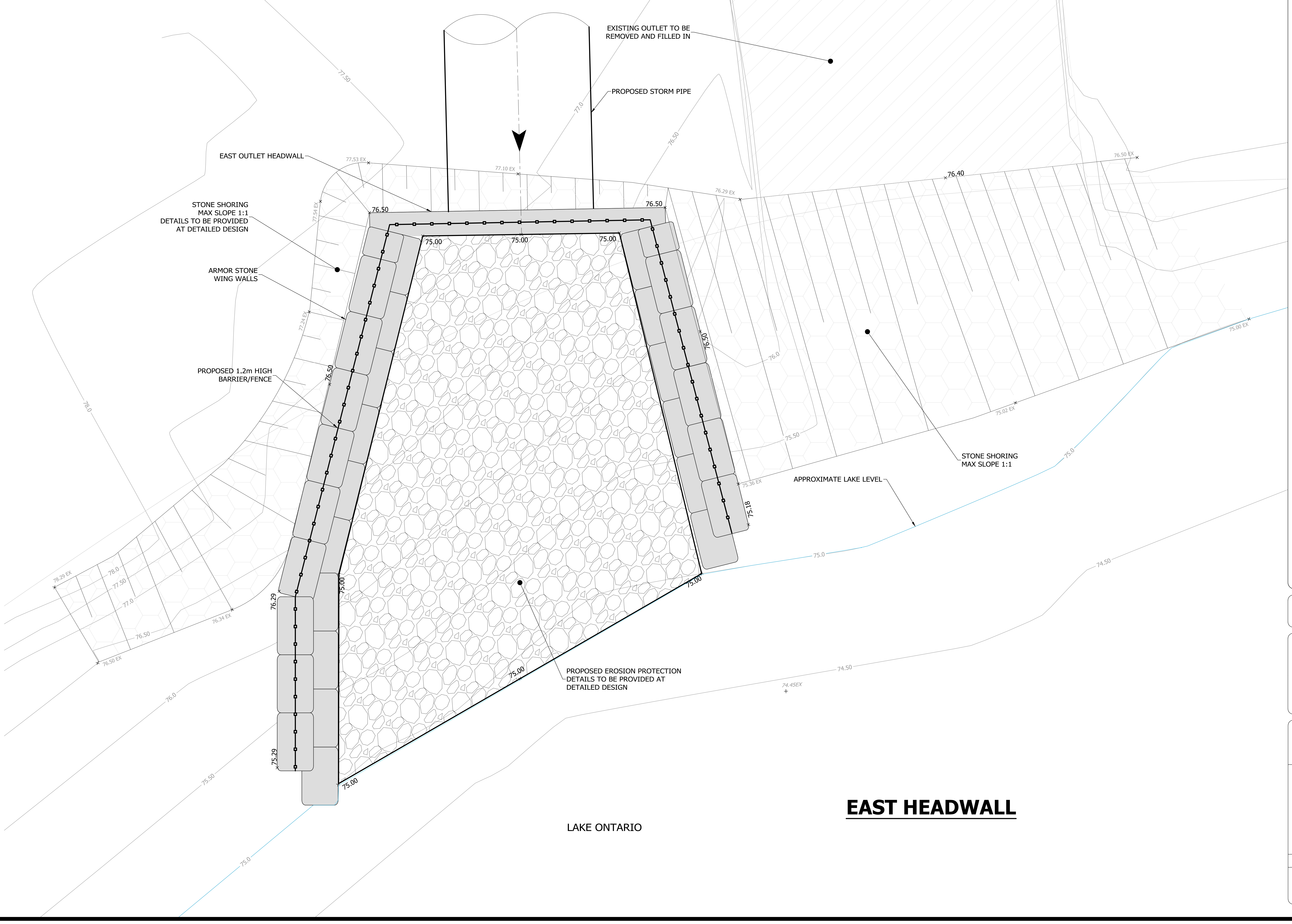
PROJECT No.	DATE	SCALE	DWG No.
16-489	MAR 2017	1:1250	**GR-1**

File: F:\PROJECTS\16-489W (WEST VILLAGE PARTNERS - PORT CREDIT)\DRAWINGS\00_FUNCTIONAL\05_FD_FIGURES\16-489-FSR-GR-1.DWG



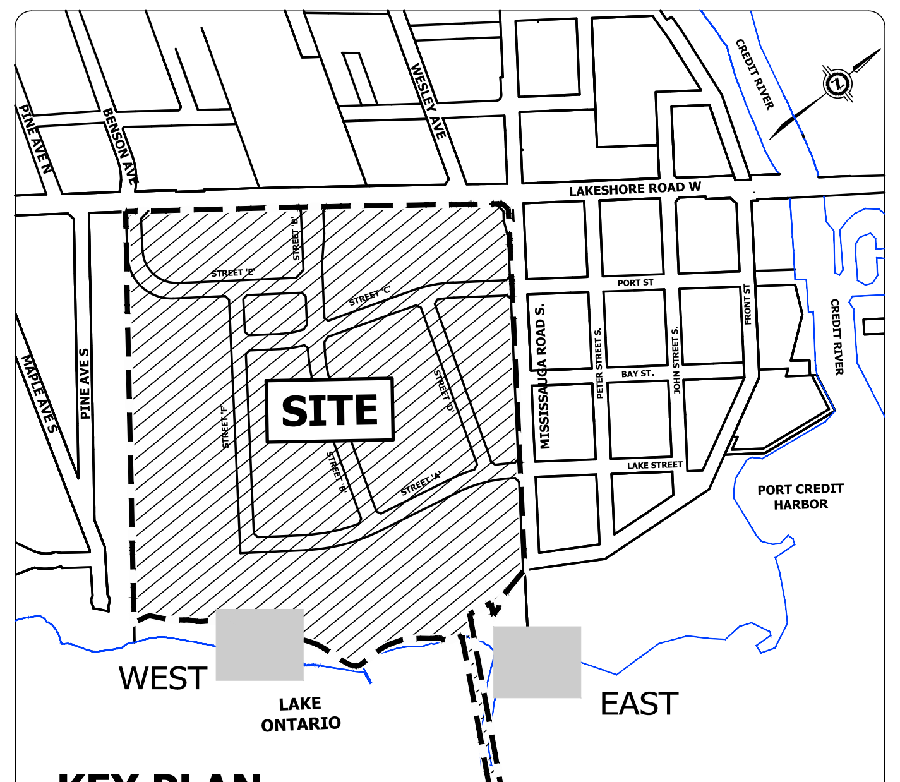
WEST HEADWALL

LAKE ONTARIO



EAST HEADWALL

LAKE ONTARIO



KEY PLAN
N.T.S.

LEGEND

247.00	EXISTING CONTOUR AND ELEVATION
+240.71	PROPOSED ELEVATION
+169.99 EX	EXISTING ELEVATION

BENCHMARK

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WEST VILLAGE PARTNERS
CITY OF MISSISSAUGA

PRELIMINARY
HEADWALL GRADING PLAN

PROJECT No.	DATE	SCALE	DWG No.
16-489	MAR 2017	1:50	**GR-2**

11/9/2018

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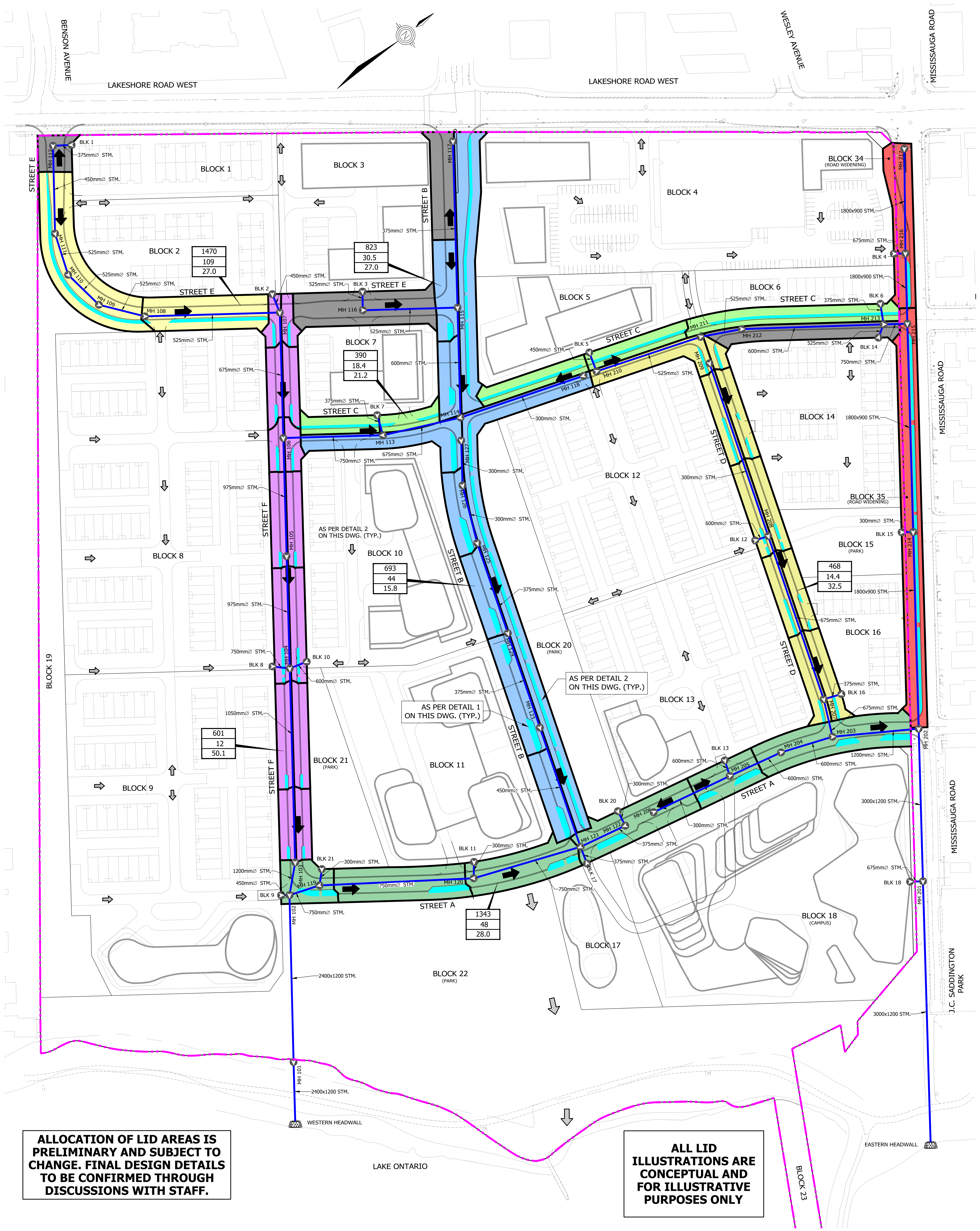


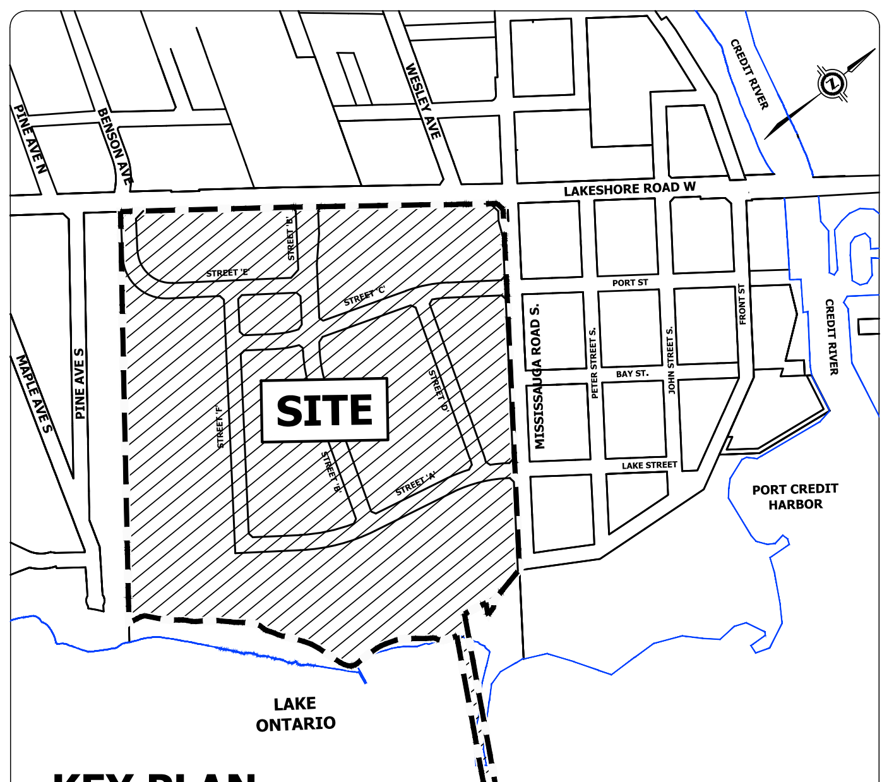
ALLOCATION OF LID AREAS IS PRELIMINARY AND SUBJECT TO CHANGE. FINAL DESIGN DETAILS TO BE CONFIRMED THROUGH DISCUSSIONS WITH STAFF.

ALL LID ILLUSTRATIONS ARE CONCEPTUAL AND FOR ILLUSTRATIVE PURPOSES ONLY

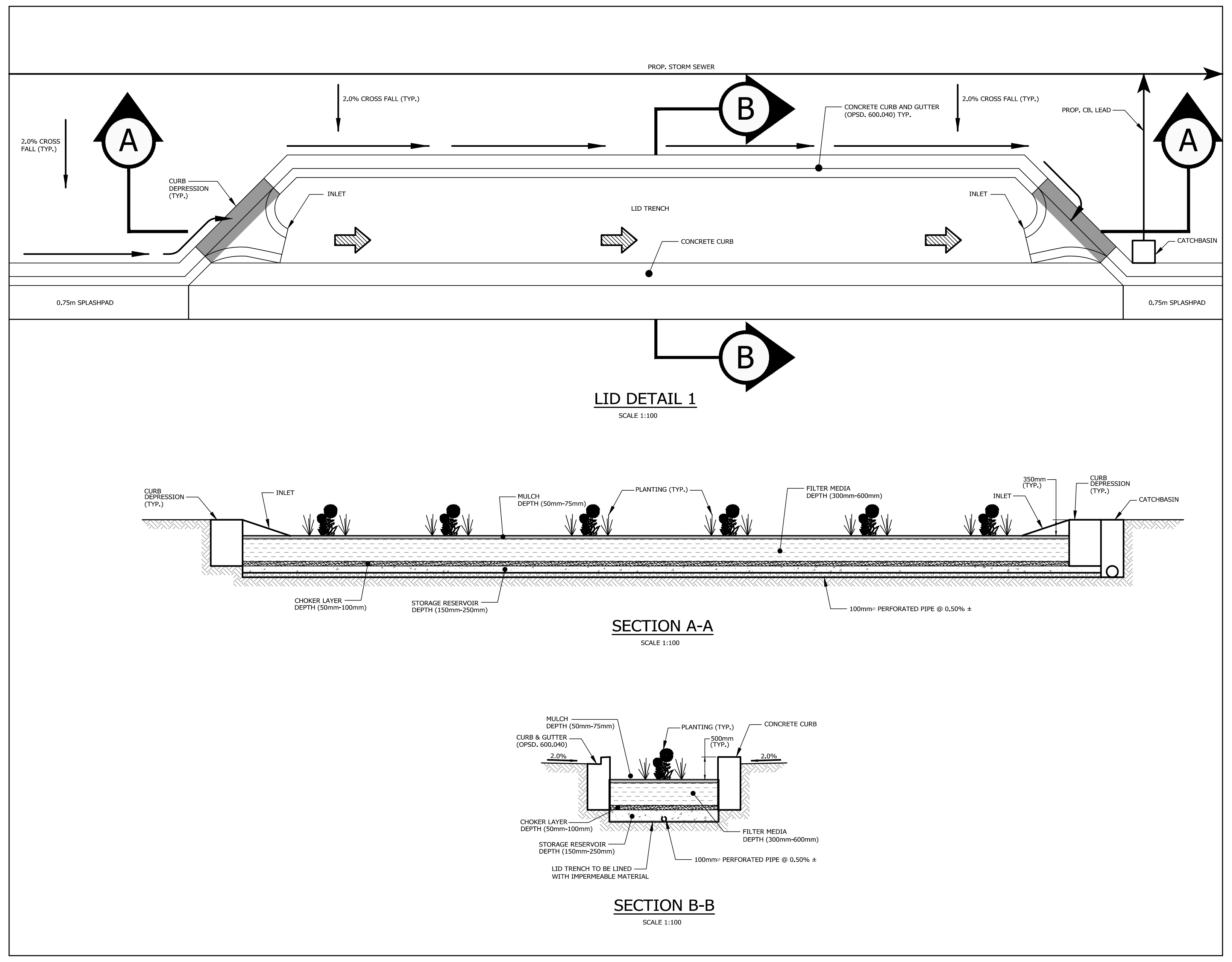
STREET-WIDE ANALYSIS	UNCONTROLLED AREA (m2)	BIO-RETENTION CELL AREA (m2)	CONTRIBUTING DRAINAGE AREA (m2)	BIO-RETENTION CELL AREA TO CONTRIBUTING DRAINAGE AREA RATIO	BIO-RETENTION CELL AREA TO TOTAL AREA RATIO
STREET A	0	408	7892	19.3	19.3
STREET B	932	995	10660	10.7	11.7
STREET C	742	450	3571	7.9	9.6
STREET D	0	238	5496	23.1	23.1
STREET E	2154	329	3908	11.9	18.4
STREET F	0	238	5783	24.3	24.3
SITE TOTAL	3828	2658.0	37310.0	14.0	15.5

STREET SIDE BIO-RETENTION SAMPLE IMAGE

BIO-RETENTION BUMP-OUT SAMPLE IMAGE



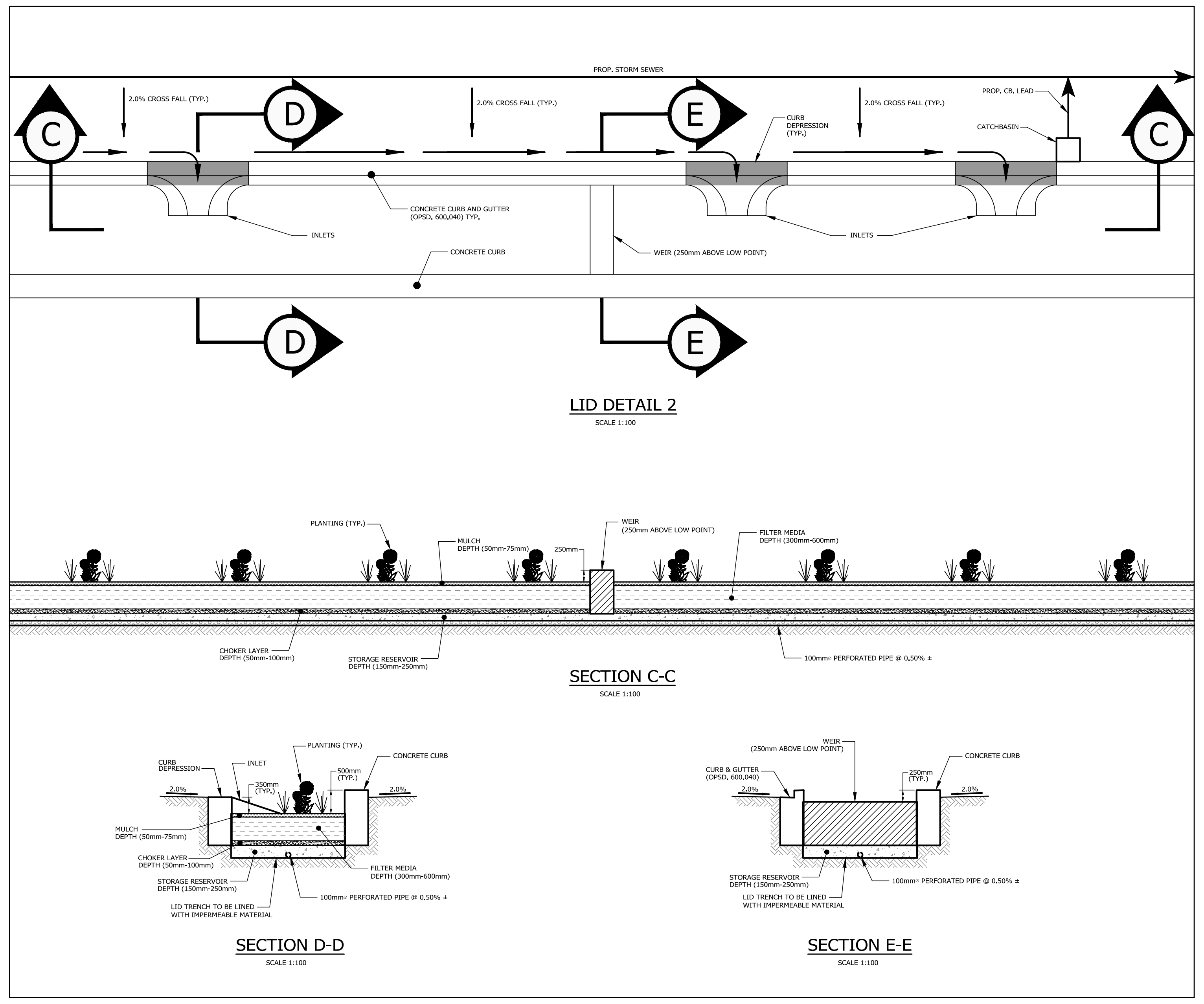
KEY PLAN
N.T.S.



LID DETAIL 1

SECTION A-A

SECTION B-B



LID DETAIL 2

SECTION C-C

SECTION D-D

SECTION E-E

LEGEND

- ─·─·─ PROPERTY BOUNDARY
- 🟦 BIO-RETENTION AREAS
- 🟩 STREET A BIO-RETENTION DRAINAGE AREAS
- 🟦 STREET B BIO-RETENTION DRAINAGE AREAS
- 🟩 STREET C BIO-RETENTION DRAINAGE AREAS
- 🟨 STREET D BIO-RETENTION DRAINAGE AREAS
- 🟨 STREET E BIO-RETENTION DRAINAGE AREAS
- 🟪 STREET F BIO-RETENTION DRAINAGE AREAS
- 🟥 MISSISSAUGA ROAD BIO-RETENTION DRAINAGE AREAS
- ⬛ NO BIO-RETENTION COVERAGE

654	CONTRIBUTING DRAINAGE AREA
27	BIO-RETENTION CELL AREA
24.22	DRAINAGE AREA TO CELL AREA RATIO

*CATCHMENTS SHOWN REPRESENT CELLS WITH THE HIGHEST DRAINAGE AREA TO CELL AREA RATIO FOR EACH ROW

- ➡ MAJOR OVERLAND FLOW
- ⇨ EMERGENCY OVERLAND FLOW

BENCHMARK

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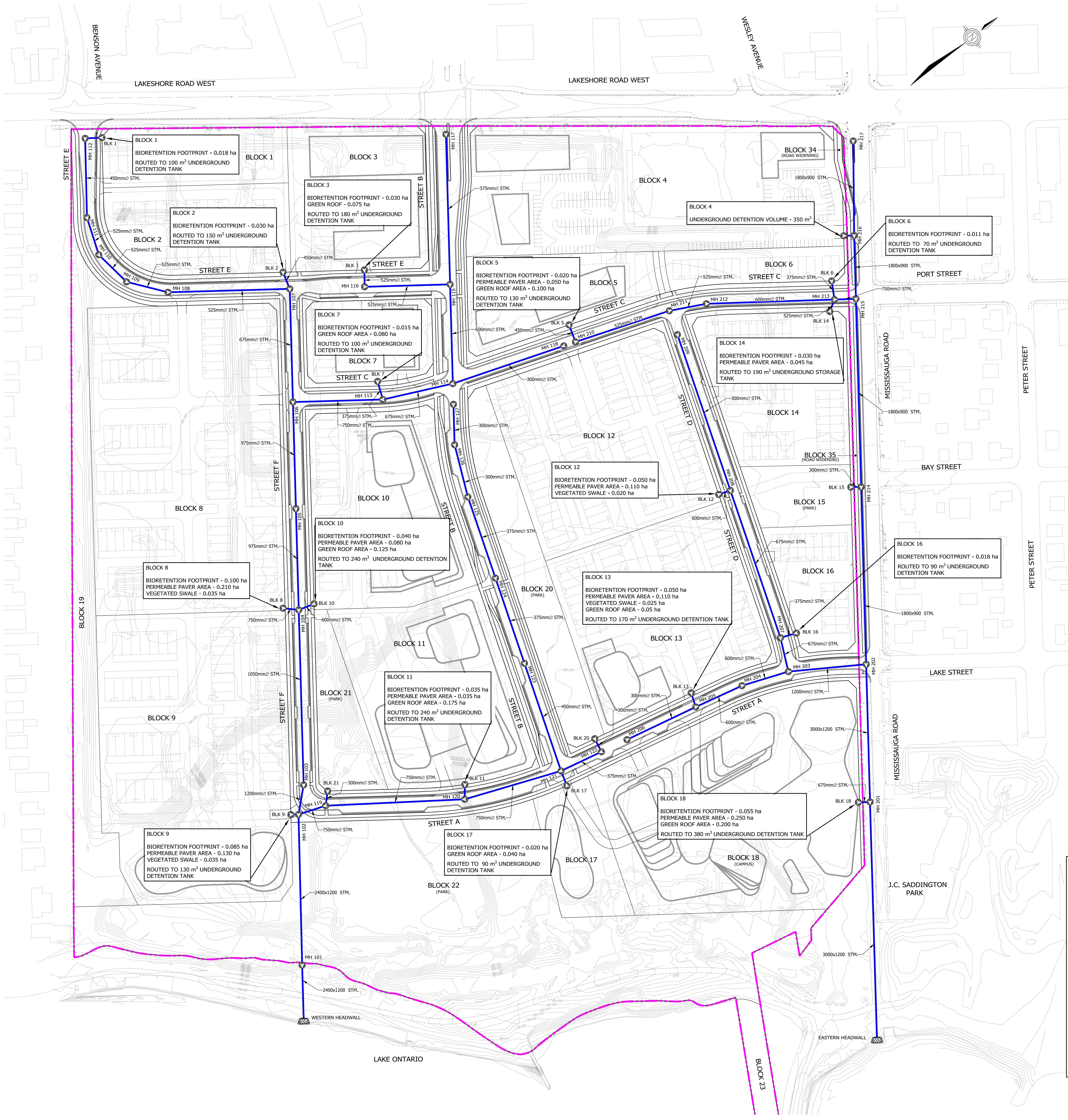
WEST VILLAGE PARTNERS
CITY OF MISSISSAUGA

PRELIMINARY LOW IMPACT DEVELOPMENT PLAN (R.O.W.'S)

PROJECT No.	DATE	SCALE	DWG No.
16-489	MAR 2017	1:1250	**LID-1**

File: F:\PROJECTS\16-489W (WEST VILLAGE PARTNERS - PORT CREDIT)\DRAWINGS\00_FUNCTIONAL\05_FD_FIGURES\16-489-FSR-LID-1.DWG

1/5/2018



LID GREEN ROOF

LID RAIN GARDENS

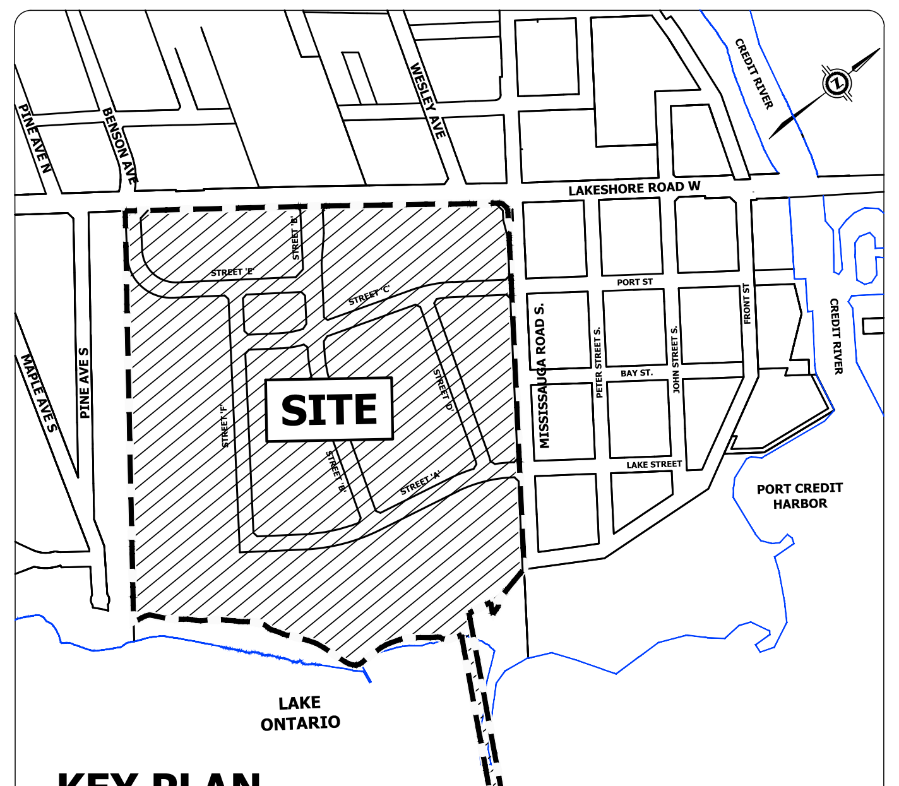
LID PERMEABLE PAVEMENT

LID SWALE ALONG PEDESTRIAN PATH

LID RAIN BARREL

PROPOSED BLOCK LID STRATEGIES ARE CONCEPTUAL AND ARE INTENDED TO DEMONSTRATE THAT REQUIRED QUALITY CONTROL CAN BE ACHIEVED. FINAL DESIGN WILL BE DETERMINED AT THE SITE PLAN APPROVAL FOR EACH INDIVIDUAL BLOCK. EACH BLOCK IS REQUIRED TO ACHIEVE 80% TSS REMOVAL AND 10 mm RETENTION IN ACCORDANCE WITH CVCA AND CITY OF MISSISSAUGA STANDARDS.

ALL LID ILLUSTRATIONS ARE CONCEPTUAL AND FOR ILLUSTRATIVE PURPOSES ONLY



KEY PLAN
N.T.S.

LEGEND

▬ · ▬ · ▬	PROPERTY BOUNDARY
▬●▬	PROPOSED PUBLIC STORM SEWER
79.50	EXISTING CONTOUR & ELEVATION

FOR DISCUSSION ONLY

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WEST VILLAGE PARTNERS
CITY OF MISSISSAUGA

PRELIMINARY LOW IMPACT DEVELOPMENT PLAN - BLOCK

PROJECT No.	DATE	SCALE	DWG No.
16-489	MAR 2017	1:1250	**LID-2**

11/9/2018

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