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FUNCTIONAL SERVICING REPORT

FOR THE

BRONTE GREEN PROPERTY

TOWN OF OAKVILLE

REGION OF HALTON

PROJECT NO. 12-601

FEBRUARY 2014
REVISED APRIL 2015

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1.0 INTRODUCTION

The proposed development was the subject of a report prepared by David Schaeffer Engineering dated February 2014. This updated report is based on the updated draft plan, dated April 14, 2015, and addresses the proposed changes to the draft plan layout. The Bronte Green Property in the Town of Oakville consists of approximately 55 hectares and is bounded by Fourteen Mile Creek to the east, Bronte Road to the west, Halton Regional Centre and Deerfield Golf Course to the south, and Upper Middle Road to the north, as illustrated in ***Figure 1***.

The subject lands are proposed to be developed for residential and related purposes. The plan includes single residential, townhouses, a medium-high density block, a retail-mixed use block, residential condo blocks, park blocks, two stormwater management ponds and municipal rights-of-way. The proposed draft plan is shown in ***Figure 2***.

The following report outlines the water, wastewater and stormwater servicing requirements for the project and confirms that adequate services are available to support the proposed development in accordance with the standards of the Region of Halton, the Area Servicing Plan for the Merton Tertiary Plan Area and general industry practice.

2.0 PREVIOUS STUDIES AND REPORTS

The following material has been reviewed in order to identify the constraints, which govern development within the subject site:

- **2012 Development Charges Update Technical Report**

  Region of Halton, August 2011

(Development Charges)

- **Sustainable Halton Water & Wastewater Master Plan**

  (Master Plan Update)

  Region of Halton, February 2001 (updated 2007)

- **Water and Wastewater Linear Design Manual**

  (Linear Design Manual)

  Region of Halton, February 2014

- **Development Engineering Procedures and Guidelines Manual**

  Development Engineering Department, Town of Oakville, January 2011

- **Design Guidelines for Drinking-Water Systems 2008**

  Ministry of the Environment

- **Design Guidelines for Sewage Works 2008**

  Ministry of the Environment

- **Stormwater Management Planning and Design Manual**

  Ministry of the Environment, March 2003

  (SWMP Design Manual)

- **Geomorphic Assessment of Fourteen Mile Creek and Associated Tributaries**

  Parish Geomorphic, December 2013

- **Fourteen Mile Creek / McCarney Creek Flood Management Alternative Assessment & PCSWMM Model**

  AMEC, July 17, 2013

  (AMEC Flood Management Assessment)

- **Water Balance Assessment, Saw Whet (Bronte Green) Property, Oakville, Ontario**
  R.J. Burnside & Associates Limited, April 2015

  (Water Balance)

- **Erosion and Sediment Control Guidelines for Urban Construction,** Conservation Halton et al, December 2006

- **Ministry of Natural Resources Draft Guidance for Development Activities in Redside Dace Protected Habitat**

  Ministry of Natural Resources, February 2011

  (MNRF Guidelines)

- **Phase 2 Environmental Impact Study, Merton (QEW / Bronte Rd), Tertiary Planning Study**

  Beacon Environmental, December 2013, updated April 2015

- **Area Servicing Plan for Merton Tertiary Plan Area**

  David Schaeffer Engineering Ltd., December 2013, Revised October 2014

  (Area Servicing Plan)

3.0 WATER SUPPLY SERVICING

3.1 Water Supply Servicing Design Criteria

The water supply servicing the Bronte Green lands will be designed according to the ***Master Plan Update, Linear Design Manual*** and the ***Development Charges Update***, by taking into consideration watermain sizing, depth, crossings, valves, hydrants, and service connections such that adequate pressures and fire flows can be achieved. Water design flows will be designed with the following criteria:

Water Design Factors

Average Daily Demand – Residential	➢	314 L/person/day
Average Daily Demand - Employment	➢	213 L/person/day
Maximum Daily Demand Peaking Factor	➢	1.9 times average day
Peak Hour Demand Peaking Factor	➢	3.0 times average day

Population Criteria

Single family	3.472 persons / unit
Single family (condo)	55 persons / hectare
Townhouse	2.555 persons / unit
Apartments	1.742 persons / unit
Light Commercial (mixed used)	90 persons / hectare

3.2 Existing Water Services

Existing watermains are currently available in the vicinity of the Bronte Green Property as follows:

Table 3-1 Summary of Existing Watermains

Street	Size	Location
Zone O3		
Upper Middle Road	600 mm	Kitchen Reservoir to Reeves Gate
Zone O2		
Bronte Road	300 mm	Approx. 440m south of Upper Middle Road to North Service Road
Zone O1		
Bronte Road	1050 mm	Kitchen Reservoir to North Service Road

The existing watermains are illustrated in ***Figure 3***.

3.3 External Water Supply Requirements

In accordance with the ***Master Plan Update***, the Region is planning future water infrastructure to service lands throughout Oakville. This will be achieved through comprehensively planned infrastructure including transmission mains, pump stations, storage facilities, and distribution mains.

A summary of projects related to the study area are listed in Table 3-1 below:

Table 3-1 Summary of Proposed Regional Water Infrastructure

Project Description	Regional Project No.	Zone	Year
Kitchen Zone 3 Pumping Station expansion by 80ML/d	6701	3	2026/2027

The preferred servicing figure from the ***Master Plan Update*** illustrating the above projects is included in ***Appendix A***.

3.4 Proposed Water Supply

The subject site is located within an area that spans both the existing Zone O2 and Zone O3 limits. The residential area north of the Fourteen Mile Creek tributary is proposed to be serviced by Zone O3 watermains, supplied by the 600mm Zone O3 watermain on Upper Middle Road, with the balance of the site to be serviced through Zone O2

The water distribution system within the Bronte Green Property will be sized to meet the pressures and flows in accordance with the Region of Halton criteria under both interim and ultimate servicing scenarios.

The timing of the Zone O2 future Burloak Pumping Station is anticipated to occur after 2016, which will augment fire flows to sections south of Fourteen Mile Creek. To meet the fire flows on an interim basis, a watermain with a pressure reducing valve between Zone O2 and O3 has been proposed to satisfy interim conditions. This valve would be set to only operate under emergency situations to supplement the fire flow. When the pumping station is constructed, the PRV may be decommissioned. Fire flows are adequate under ultimate conditions with the additional supply points from the south. Details are provided in the preliminary watermain analysis in ***Appendix B***.

The proposed watermain network is illustrated in ***Figure 4***.

4.0 WASTEWATER SERVICING

4.1 Region of Halton Wastewater Design Criteria

The wastewater supply servicing the Bronte Green lands will be designed according to the ***Linear Design Manual*** and the ***Development Charges Update***. Wastewater design flows will be designed with the following criteria:

Sewer Design Criteria

Average dry weather flow	➢	275 litres per capita per day
Infiltration	➢	0.286 litres per second per hectare
Peaking Factor (Residential)	➢	Peak Flow Factor – Harmon Formula
Peaking Factor (Commercial and Industrial)	➢	Peak Flow Factor – Modified Harmon Formula

Population Criteria

Single family	➢	3.472 persons / unit
Single family (condo)	➢	55 persons / hectare
Townhouse	➢	2.555 persons / unit
Apartments	➢	1.742 persons / unit
Light Commercial (mixed used)	➢	90 persons / hectare

4.2 Existing Wastewater Services

Existing sanitary sewers are currently available in the vicinity of the Bronte Green Property as follows:

Table 4-1 Summary of Existing Wastewater Mains

Street	Size	Location
To Mid-Halton Wastewater Treatment Plant		
Upper Middle Road	2400 mm	Bronte Road to Grand Oak Trail
Bronte Road	1200 mm	Westoak Trails Boulevard to Upper Middle Road
Bronte Road	2400 mm	Upper Middle Road diagonally across the subject lands to the Mid-Halton WWTP

4.3 Proposed Wastewater Servicing

The subject site will be serviced by a network of local gravity sewers designed in accordance with Region of Halton design criteria. The 2400mm gravity sewer that crosses the subject lands diagonally to the Mid Halton North Pumping Station will function as the outlet for local sewers in the subject lands. The profile of the 2400mm sewer is provided in ***Figure 6***. The total flow (including peaking factor and infiltration) produced by the subject lands is 36.97 L/s. Sanitary flow calculations are provided in ***Appendix D***. As per the Genivar ***Sanitary Capacity Analysis*** from the ***Area Servicing Plan***, the 2400mm trunk sewer has sufficient capacity to convey the sanitary flows from this development, which are the same as the anticipated flows in the *Area Servicing Plan*, to the Mid Halton North Pumping Station. The Genivar analysis also indicates the loading be directed towards the Mid-Halton Plant where there are no capacity restrictions. The analysis can be found in ***Appendix E.*** Sanitary flows will be collected in local sewers and will drain into the trunk sewers Trunk 1A, Trunk 1B and Trunk 1C. The trunk sewer flows drain into the 2400 mm trunk sewer on Street A as illustrated in ***Figure 6***.

Background information on the design of the trunk sewer is included in ***Appendix C***.

The wastewater servicing concept is illustrated in ***Figure 7***.

5.0 STORM DRAINAGE

5.1 Existing Drainage Patterns

The majority of the runoff from the subject lands currently drains overland to Fourteen Mile Creek. A small portion to the east of the Region of Halton works facilities drains to Bronte Creek via a culvert underneath the QEW. There are no storm sewers within the subject lands. The existing storm drainage areas are illustrated in ***Figure 8***.

5.2 Minor System Design

It should be noted that the Town of Oakville Engineering Standards require the post-development peak runoff to be maintained at pre-development levels for all events up to the 100-year level. As per the Town's standards and the Area Servicing Plan, the subject lands will be serviced by a conventional storm sewer system discharging to the proposed stormwater management facilities. Storm sewers will be sized using a 5 year return frequency and Town IDF curves.

Inlet control devices (ICD) or equivalent may be required to prevent surcharging of downstream system. The location, size, and number of ICD's or equivalent measures will be determined at the detailed design stage. Gravity storm connections will be provided throughout the site.

The development areas north of the Fourteen Mile Creek tributaries will be treated on-site for quality, quantity and erosion control before being released into Fourteen Mile Creek, as described in ***Section 9.0***.

The development areas south of the Fourteen Mile Creek tributaries and south of the sanitary trunk sewer easement will flow through local sewers to the South SWM Pond, south of the sanitary trunk easement. The development areas south of the Fourteen Mile Creek tributaries and north of the sanitary trunk sewer easement will flow through local sewers to the North SWM Pond, north of sanitary trunk easement.

The lands west of Bronte Road have been accounted for in the subject lands' stormwater management strategy in the form of full treatment within the end of pipe stormwater management pond. . The lands west of Bronte Road would also have the opportunity for local stormwater management controls. The cost and technical effectiveness of each option are highly dependent on the proposed development plan for those lands. During the detailed design stage of those lands, the appropriate solution will be determined and advanced at that time.

The proposed storm sewer concept is illustrated in ***Figure 9*****.**

5.3 Major System Design

In accordance with the Town of Oakville Engineering Standards, an overland flow route must be established through all areas and shall be contained within either the road right-of-way or by other lands.

Major system runoff in excess of the minor system and up and including the 100 year event will be conveyed within the road allowances via continuous overland flow routes to the proposed stormwater management ponds. The major system flow up to and including the 100 year event will not exceed the width of the road allowance. The ponds will treat the major system flows for quantity, quality and erosion control before ultimately discharging to Fourteen Mile Creek.

The following Oakville standards will be carried through to detailed design:

- For all classes of roads, the product of depth of water (m) at the gutter times the velocity of flow (ms^{-1}) shall not exceed 0.65 m^2/s. In addition, during detailed design, design parameters from MNR's *Technical Guide River and Stream Systems: Flooding Hazard Limit,* such as a recommended depth velocity product of 0.4 m^2/s for the low risk zone for combined personal and vehicular access may be applied where required.
- For arterial roads, the depth of water at the crown shall not exceed 0.15 m.
- Flow across road intersections shall not be permitted for minor storms (generally 1:10 year). To meet criteria for major storm run-off, low points in roads must have adequate provision for the safe overland flow.

The conceptual major system is illustrated in ***Figure 9***.

6.0 STORMWATER MANAGEMENT STRATEGY

6.1 Stormwater Management Requirements

In accordance with the Area Servicing Plan & the EIS, stormwater management must be practiced as follows:

Water Balance	➢ Infiltrate runoff on-site to meet the infiltration targets, to the extent feasible as set out in the *Hydrogeological Study* (***Appendix F***, R.J. Burnside & Associates, January 2015). Maintain surface and groundwater inputs at a level similar to the pre-development condition for all tributaries within the subject lands.
Base Flows	➢ Maintain monitored base flow of 20 L/s in the West Branch of Fourteen Mile Creek. ➢ Maintain calculated potential groundwater discharge at 2.5×10^{-4} m^3/s (0.25 L/s) as detailed in the ***Area Servicing Plan.***
Water Quality Control	➢ Provide enhanced level of protection for receiving watercourses. The enhanced level of control provides for the average long-term removal of 80% of suspended solids, which is recommended when sensitive aquatic habitat will be affected by end-of-pipe discharge. This is the case for Fourteen Mile Creek and its tributaries that supports fish communities. ➢ To maintain the existing thermal regime in the tributaries (14W-W1, 14W-W1-2, and 14W-W1-3) a maximum discharge temperature of 22°C is required for outflows directed to these specific reaches.
Erosion Control	➢ Provide extended detention storage to minimize post-development exceedance of distinct bed and bank erosion thresholds for select reaches of Fourteen Mile Creek and its tributaries, as outlined in the *Geomorphic Assessment* (Parish Geomorphic Ltd., December 2013): o SW-2: Bed Threshold 0.43 m^3/s / Bank Threshold 0.07 m^3/s o R-75a: Bed Threshold 4.02 m^3/s / Bank

Threshold 0.27 m^3/s

- R-73: Bed Threshold 4.26 m^3/s / Bank Threshold 0.63 m^3/s

Quantity Control

- Provide storage for stormwater runoff so as to not exceed pre-development flow rates and flood levels within Fourteen Mile Creek and its tributaries in the 1:2, 1:5, 1:10, 1:25, 1:50 and 1:100, and the Regional Hurricane Hazel design storm events, as per the pre-development flow rates defined in the Fourteen Mile Creek/ McCraney Creek Flood Management Alternative Assessment (AMEC, July 2013) and associated calibrated PCSWMM model.

- It has been determined that regional storage will be provided for this development. When considering the proposed development of the entire TPA, the detailed analysis provided in ***Appendix G*** shows that without regional controls, the regional Hurricane Hazel event flows at Queen Elizabeth Way would increase insignificantly (e.g. by 200 L/s, or 0.1% of total flows), notwithstanding this very small increase, post development flows will be controlled for all events up to and including the Regional event, with Regional storage provided above the 100 year depth in the ponds.

6.2 Water Balance

Detailed water balance calculations can be found in ***Appendix F*.**

The water balance assessment, prepared by R. J. Burnside, has noted that with no mitigation measures, the development of the property contributing to Tributary 14W-W1 could be reduced by approximately 42%. To promote infiltration, it is recommended that the use of ‘low impact development’ (LID) measures be implemented in pervious areas.

As design of the development progresses, surficial LID techniques should be applied – such as increasing topsoil thickness by about 1.5 times the normal thickness, reducing lot grading, directing roof runoff from low and medium density residential areas to pervious areas such as lawns, side and rear yard swales and other open areas, and disconnecting roof leaders. These measures would result in the pre-treatment of the runoff water as it passes through the vegetative medium, would reduce the volume of runoff through initial abstraction and evaporation, would reduce peak flows by reducing the flow velocity, and would increase infiltration to the maximum extent possible. The calculations suggest that the use of such LID measures will maintain approximately 90% of the pre-development infiltration volume. The overall groundwater contribution to the watercourses is very small in relation to the surface water contributions, and as such the overall impact of the small remaining deficit in the infiltration volume would not be anticipated to have a significant impact on the tributary flows.

Within the subject lands, the actual amount of water that infiltrates and moves through the subsurface to recharge groundwater is limited: the clayey silt till soils and shale bedrock within the subject lands have relatively low hydraulic conductivities that limit infiltration rates. As such, the use of large-scale engineered subsurface infiltration facilities is generally not considered to be suitable for use as part of the overall stormwater management strategy for the Bronte Green property for the purposes of controlling the quantity of stormwater runoff.

Specific LID measures, in keeping with the recommendations noted above, will be determined at the detailed design stage of the Bronte Green lands.

6.3 Thermal Mitigation

To protect the Redside Dace and other fish populations in Fourteen Mile Creek, a maximum discharge temperature 24^{0}C should be achieved in the implementation of the proposed stormwater management plan. Conservation Halton has suggested that it would be beneficial if a lower maximum discharge temperature of 22^{0}C were to be met, if possible.

Furthermore, to maintain the existing thermal regime in the Saw Whet tributaries (14W-W1, 14W-W1-2, and 14W-W1-3) a maximum discharge temperature of 22°C is required for outflows directed to these specific reaches.

The following thermal mitigation measures are to be provided in the detailed design of the proposed stormwater management ponds, to provide temperature protection for the fish populations in Fourteen Mile Creek.

- A reverse-grade pipe in a deep pool will be provided to draw the cooler water from the deepest portions of the ponds. Permanent pool depths of 2 metres are proposed (see ***Section 8***), as per ***Oakville Engineering Guidelines***. At detailed design, increased permanent pool depth for of 3 metres could be considered as per Conservation Halton’s recommendation, to promote more significant thermal stratification and to better reduce temperatures for the reverse-grade bottom-draw outlet. The increased depth would be implemented for a portion of the main cell of the permanent pool. Permanent pool depths beyond 3m are not recommended because the outflows can become anoxic (***SWMP Design Manual***), and there is a potential for metals and nutrients to be remobilized, thus causing negative impacts to fish habitat in the receiving watercourses.

- The facilities will be designed with regard for a high length to width ratio to allow for effective shading with landscape material.

- The landscape plans should have regard for best management practices, such as the planting recommendations in the *Study Report: Thermal Impacts of*

Urbanization Including Preventative and Mitigation Techniques (Credit Valley Conservation, 2011).

- Shading is to be provided by perimeter plantings and in-pond plantings, for example by way of peninsulas, etc. where practical and feasible.

6.4 Sanitary Trunk Sewer Constraint

The existing 2400 mm dia. sanitary trunk sewer and associated easement is a constraint to storm servicing for lands tributary to Fourteen Mile Creek. The large diameter and shallow depth of the sewer requires distinct drainage areas on each side of the trunk in some locations.

The majority of lands west of the trunk sewer will drain to a stormwater management facility west of the trunk sewer. It has been determined that the south stormwater management facility can drain through a storm sewer crossing underneath the sewer trunk to outlet into Fourteen Mile Creek. The facilities will not be located within the working easement of the trunk sanitary sewer.

7.0 STORMWATER MANAGEMENT POND OPERATING CHARACTERISTICS

Two stormwater management ponds are proposed within the subject lands to treat minor and major system flows for quality and quantity prior to being discharged to Fourteen Mile Creek. The location and conceptual design of both ponds is illustrated in ***Figure 10***. The following sections provide storage requirements for both ponds. The SWM ponds have been designed in accordance with directions of the *Oakville Engineering Guidelines* and the *MOE SWM Design Manual*, and include the following features:

Sediment Forebay	➢ To improve sediment removal prior to entering the pond
Permanent Pool	➢ To buffer storm flows and trap pollutants
Extended Detention Storage	➢ To provide water quality and erosion control
Quantity Control Storage	➢ To attenuate post development flows to the allowable release rates

Sizing calculations for the ponds are provided in ***Appendix G*** (SWMHYMO Modeling files are available on CD)**.**

Table 7-1 Summary of Stormwater Management Facility Characteristics

Pond I.D.	Pond Type	Drainage Area (ha)	Imp. Coverage (%)[1]	Permanent Pool Volume (m^3)	Water Quality Volume (m^3)[2]	100 Year Flood Volume (m^3)	Regional Flood Volume (m^3)	SWM Pond Block Area (ha)
North Pond	Wet	6.0	64	1231	240	3217	5667	0.71
South Pond[3]	Wet	52.7	58	11099	2108	26350	43580	2.42

[1] Average impervious cover based on anticipated development density
[2] Quality control volume based on 40 m^3/ha, based on the minimum MOE quality controls and the downstream erosion analysis
[3] Including unattenuated flows from 8.8 ha west of Bronte Road

Table 7-2 Summary of SWM Facility Discharge Characteristics

Pond I.D.	Imp. Area	Drainage Area (ha)	Unit Release Rates[1] (m^3/s/ha)			Target Release Rates[2] (m^3/s)		
			Extended Detention*	100 Year	Regional	Extended Detention[3]	100 Year	Regional
North Pond	384	6.0	N/A	0.037	0.085	N/A	0.186	0.426
South Pond	3082.1	52.7	N/A	0.037	0.085	N/A	1.630	3.744

[1] Unit release rates on 14 Mile Creek at Lakeshore, as per "*Fourteen Mile Creek / McCarney Creek Flood Management Alternative Assessment"* (AMEC, July 17, 2013).
[2] Target release rates reduced by a factor of 0.4[Return Period]$^{0.16}$ (where Regional = 100) to match existing conditions flows upstream of Queen Elizabeth Way, as simulated using AMEC's July 17, 2013 PCSWMM model.
[3] Extended detention based on the runoff from the 25 mm design storm with a drawdown time of 48 hours.

The impervious coverage has been estimated based on the various land uses and their respective sizes in land use concept. The final impervious coverage will be refined at the detail design stage, at which time the calculations will be updated, and, if necessary, the pond sizing adjusted accordingly.

8.0 STORMWATER MANAGEMENT POND DESIGN ELEMENTS

8.1 Sediment Forebay

All SWM ponds include a sediment forebay in order to improve the pollutant removal by trapping larger particles near the inlet of the pond. The forebays have been designed with a length to width ratio of approximately 4:1 and do not exceed one third of the permanent pool surface area for wet ponds, as required in the ***SWMP Design Manual***. Furthermore, the forebays have a minimum depth of 1.2m to minimize the potential for re-suspension.

8.2 Permanent Pool

The permanent pools have been sized to provide 'Enhanced Protection' in accordance with the ***SWMP Design Manual***.

- The permanent pool will be approximately 2.0 metres deep, which falls within the one to two metre deep range recommended in the ***SWMP Design Manual*** and the 1.2 to 2.0 metre deep range prescribed by the ***Oakville Engineering Guidelines***. Consideration will be given to increasing a portion of permanent pool depth to 3 metres to augment thermal mitigation.

- The slopes within the 3m horizontal zone above and below the normal water level will include minimum slopes of 7:1, as per the ***Oakville Engineering Guidelines.***

- Below this zone, to the pond bottom, the slopes in the permanent pools will be graded with side slopes of 5:1 (max 4:1), with minor localized variations, as per the ***Oakville Engineering Guidelines.***

8.3 Extended Detention Storage

Storage for each extended detention pond component will be provided in accordance with the release rates set out in ***Section 6.4.***

- The extended detention storage together with the quantity control component (up to the 100 year event) will not exceed 2.0 metre depth in accordance with ***Oakville Engineering Guidelines.*** Volumes required for the Regional event will be provided above the 100 year depth, in accordance with the guidelines.

- The extended detention component will be provided with side slopes of 5:1 with minor localized variations in accordance with ***Oakville Engineering Guidelines.***

- The details of the outlet structures for each pond will be determined at the detailed design stage. It is expected that the extended detention volume will outlet through a reverse graded pipe, with an orifice provided to discharge the extended detention volume at the allowable release rate for erosion control. The primary outlet control pipe shall be bottom draw with perforated end.

8.4 Quality Control

The ***SWMP Design Manual*** requires an enhanced protection level of 80% TSS removal for all runoff from the development to Fourteen Mile Creek. Quality control may be provided locally by oil-and-grit separators for some areas of the development. The required active quality control volumes were based on the ***SWMP Design Manual*** and are contained within the erosion control volume.

8.5 Erosion Control

The extended detention of runoff from the 25mm storm will be retained for 48 hours in order to meet the Fourteen Mile Creek erosion control requirements, as detailed in ***Appendix H***. The current development area of 72.7ha at 60% imperviousness would produce similar or less critical erosion analysis results as undertaken for the ***Area Servicing Plan***. The 2-year unit release rate, for this development, of 10 L/s/ha is reduced by half to 5 L/s/ha to provide additional erosion control.

8.6 Quantity (Flood) Control

Flood control is to be provided based on the release rates described in ***Table 7.2***.

- Each pond will be provided with an outlet pipe, controlling the outflows to the allowable release rates. Preliminary details for the outfalls have been provided in ***Figure 12***, further consideration will be made at detailed design stage according to the orifice requirements set out in the ***Oakville Engineering Guidelines.***
- The quantity control component will be provided with side slopes of minimum 3:1.
- The quantity control component together with the extended detention storage will not exceed 5.0 metre depth in accordance with ***Oakville Engineering Guidelines.***

8.7 Access Road

In accordance with the Town’s standards, 3.0m wide access roads are provided above the active storage elevation. Access roads are provided in order to facilitate routine inspection and maintenance activities. The maximum slope of access roads is 10:1 (H:V).

8.8 Emergency Overflows

In the event of a blockage or a storm greater than the design horizon, an emergency overflow weir will be provided.

9.0 ON-SITE CONTROLS

On-site quality, quantity and erosion controls will be provided for the development areas north of the Fourteen Mile Creek tributary prior to flows discharging into the tributary. Quality control will be provided up to 80% TSS removal with an oil / grit separator.

As noted in section 8.5, extended detention runoff from the 25mm storm will be retained for 48 hours in order to meet erosion control requirements for Fourteen Mile Creek.

The Upper Middle Road at Bronte Road development area of 4.3 ha will be controlled at target release rates of 0.0037 m^3/s and 0.159 m^3/s under the 5-year and 100-year storm events, respectively, as per the analysis in ***Appendix G***. Underground and surface storage will be provided for the required storage volumes detailed in ***Appendix G***.

The northwest confluence development area of 1.2 ha will be controlled at target release rates of 0.0010 m^3/s and 0.044 m^3/s under the 5-year and 100-year storm events, respectively, as per the analysis in ***Appendix G.*** Release rates and required storage volumes have been provided in Table 9-1.

Small drainage areas with local/on-site treatment measures are not traditionally able to completely meet the erosion control requirements, due to very small orifice sizes required to meet control rates. Other measures, such as Hydrovex flow regulators, are available for small drainage areas where small orifice sizes would result. In this particular application, the erosion control release rate for the 1.2 ha parcel is 1 L/s based on retention of the runoff from the 25 mm storm (176 cu.m.) for a 48 hour drawdown time. A release rate of 1 L/s may be achieved with a 25 SVHV-1 flow regulator, even at a head of 6.0 m. The depth of the 176 cu.m. erosion control storage will be far less than 6.0 m for the 1.2 ha parcel, and for all other proposed parcels with local on-site controls. Therefore, the proposed erosion control measures are feasible with the use of on-site storage and Hydrovex flow regulators, or other equivalent measures. The Hydrovex catalogue is included in ***Appendix H.***

Table 9-1 Summary of On-site Stormwater Management Facility Characteristics

Pond I.D.	Drainage Area (ha)	Imp. Coverage (%)[1]	Unit Release Rates (m^3/s/ha)			Target Release Rates (m^3/s)			Required storage (m^3)
			Extended Detention	100 Year	Regional	Extended Detention	100 Year	Regional	
Upper Middle Road at Bronte Road	4.0	64	N/A	0.037	0.085	0.0034	0.148	0.340	2826
Northwest Confluence	1.2	64	N/A	0.037	0.085	0.0010	0.044	0.102	857

[1] Average impervious cover based on anticipated development density

The 2.0 ha of external drainage adjacent to the 4.0 ha development area at Upper Middle Road and Bronte will be collected in a DICB and outlet directly into Fourteen Mile Creek via an optional clean water diversion pipe as shown on ***Figure 9***. On-site controls are shown in ***Figure 13***.

10.0 EXISTING FOURTEEN MILE CREEK FLOODPLAIN

The existing conditions floodplain for Fourteen Mile Creek has been provided by the Conservation Halton for the main valley system.. As per Conservation Halton’s policies, the regulated limit includes both the regulatory floodplain and erosion hazard plus a regulated 7.5m, for Fourteen Mile Creek and its tributaries, setback from the greater of the flooding or erosion hazard. There will be no anticipated impact to the existing floodplain as this development is designed to control post development flows to pre-development conditions for all storm events up to and including the regional event.

In addition to the existing floodplain for the main valley system, existing floodplain model information was extended for Tributary 14W-W1, up to the confluence of 14W-W1-2 and 14W-W1-3 (the HEC-RAS model is included on a CD). The regional floodplain is well contained within the tributary valley, and is not a governing development constraint.

Using the HEC-RAS model of the main branch of Fourteen Mile Creek provided by Conservation Halton Tributary 14-W-W1 was added to the model based on topographic information; the tributary connects between Main Branch cross-sections 7322.142 and 7232.906. The Manning's roughness coefficients for Tributary 14-W-W1 were set to

0.035 for the low flow channel and 0.08 for the banks. Flows for Tributary 14-W-W1 are set using existing conditions 2- to 100-year and Regional flows from the EPASWMM models provided in the ***AMEC Flood Management Assessment***, for subcatchments 187 and 194. The existing floodplain for Fourteen Mile Creek and Tributary 14W-W1 are illustrated in the figures.

11.0 ROADS

11.1 Municipal Roads

Access to the subject lands is from Bronte Road. A series of municipal roads will include 16m, 18m, 19m and 22m rights of way, as per Town of Oakville standard cross-sections as seen in ***Figure 2***. The Town of Oakville standard cross-sections are illustrated in ***Appendix I***.

11.2 Infrastructure Crossing

One infrastructure crossing at tributary 14W-W1 and Street V is proposed in the northwest section of the site, located southeast of Upper Middle Road and Bronte Road. Preliminary investigations suggests that the location is appropriate from a geomorphologic perspective. The upstream crossing at Bronte Road is 3.66 m x 2.44 m, however, to ensure channel stability, the road crossing has been sized as 3 times the bankfull width, approximately 5.0m. The crossing is proposed to be 28m in length with dimensions 5.0 x 2.44m with a proposed slope of 1.6%. As referenced in the *Response to the Conservation Halton comments on Area Servicing Plan, by Parish Geomorphix,* included in ***Appendix J***, this will provide adequate space for any future planform migration so that the channel does not become constrained by the crossing which would lead to erosion. This will also allow for the channel to adequately convey bankfull flows through the crossing. The conceptual crossing is illustrated in ***Figure 14***.

11.3 Sidewalks

A sidewalk will be provided as per the Town of Oakville design standards.

12.0 GRADING

A conceptual grading plan has been prepared, and is illustrated in ***Drawing 1.*** Typical cross sections are included in ***Figure 15.***

13.0 EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION

An Erosion and Sediment Control (ESC) strategy will be prepared and implemented in accordance with the Town and CH's *Erosion and Sediment Control Guideline for Urban Construction* (Greater Golden Horseshoe Conservation Authorities, 2006) prior to any earthworks or grading activities on the Subject Lands. The ESC strategy will include the following:

- methods for constructing SWM and environmental features in the dry;
- methods to stabilize disturbed areas to minimize transfer of sediment;
- special measures for works in or adjacent to stream corridors, such as culvert crossings, wetland construction, etc.;
- environment fencing;
- stone mud mat at all construction entrances;
- use of the permanent ponds as temporary silt basins during site construction activities;
- regular inspection of the ESC devices; and,
- removal and disposal of the ESC devices after the site has been stabilized.

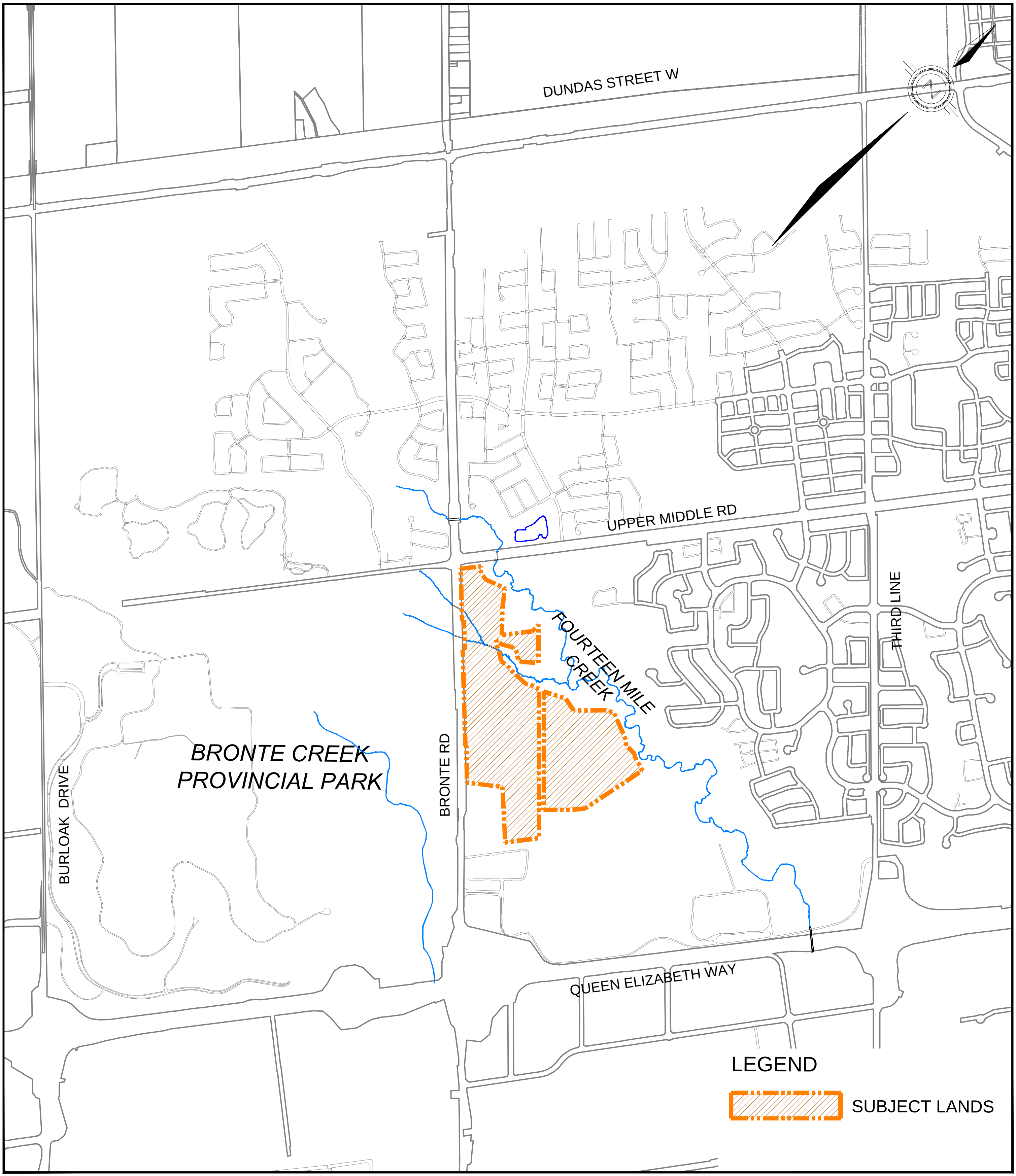
14.0 CONCLUSIONS

The Functional Servicing Report provides an overview of the servicing plan for the Bronte Green Property located within the Region of Halton. This report demonstrates the availability of water, wastewater and stormwater management services for the proposed subdivision in accordance with Regional criteria.

We trust you will find the contents of this report satisfactory.

Prepared by	Reviewed by,
David Schaeffer Engineering Ltd	**David Schaeffer Engineering Ltd**
Mathu Kamalakaran, P.Eng.	Mike Baldesarra, P.Eng.

FIGURES & DRAWINGS



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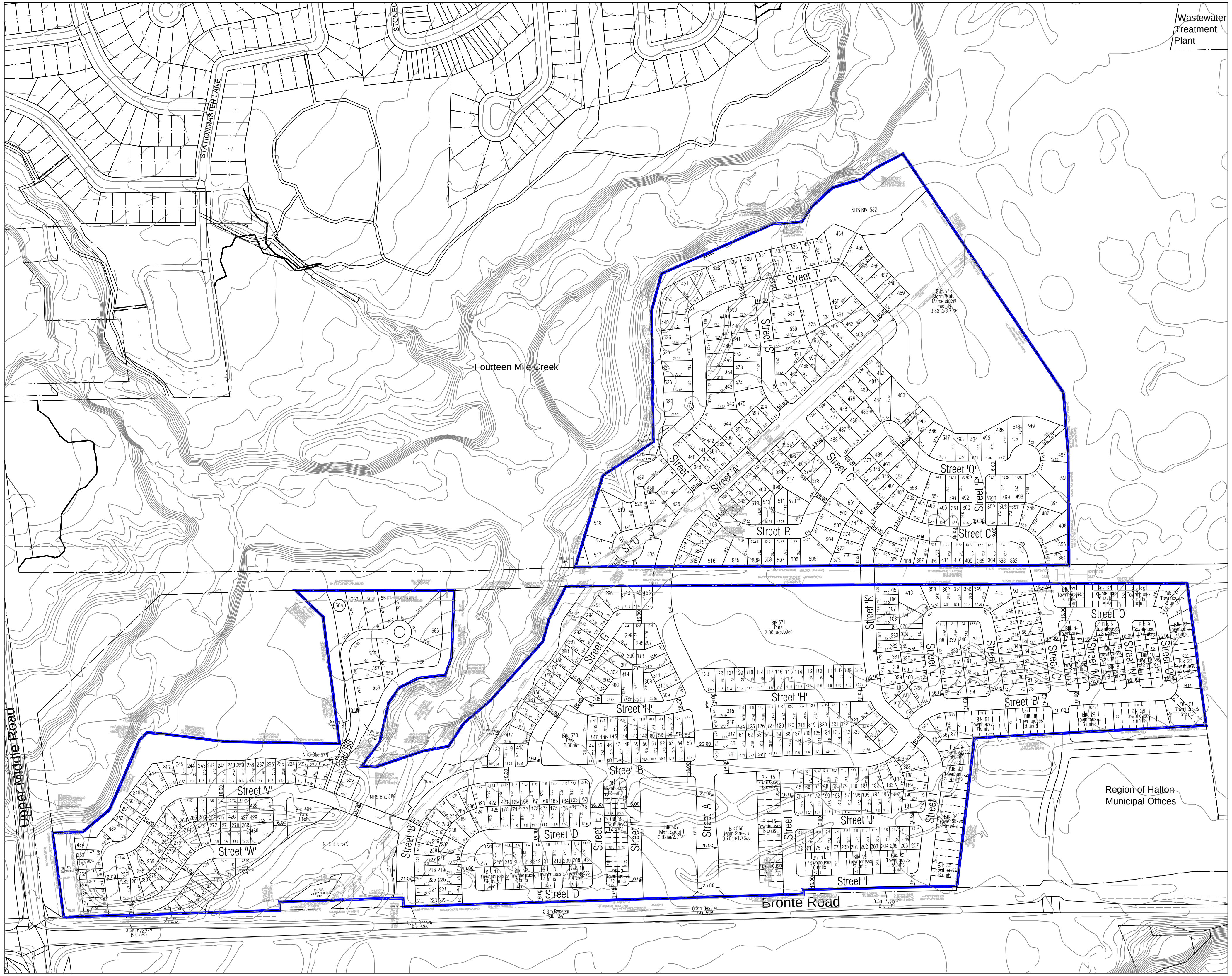
BRONTE GREEN PROPERTY

SITE LOCATION

DATE:	APRIL 2015
SCALE:	1:25000
PROJECT No.:	12-601
FIGURE:	1



DRAFT PLAN OF SUBDIVISION

PART OF LOTS 28, 29 AND 30
CONCESSION 2, SOUTH OF DUNDAS STREET
(GEOGRAPHIC TOWNSHIP OF TRAFALGAR)
TOWN OF OAKVILLE
REGIONAL MUNICIPALITY OF HALTON

SCALE 1: 2,000 METRIC
10 0 20 40 60 80 100metres

N

Owner's Certificate

I hereby authorize Sorenson Gravely Lowes Planning Associates Inc. to submit this plan for approval.

Saw Whet Golf Course Ltd.
April 14, 2015
DATE

Surveyor's Certificate

I hereby certify that the boundaries of the land to be subdivided as shown on this plan, and their relationship to the adjacent land are accurately and correctly shown.

J.D. Barnes Limited
April 14, 2015
DATE

Schedule of Land Use

	DESCRIPTION	LOTS / BLOCKS	AREA (ha.)	UNITS
1.	Residential (back-to-back)	1-10	0.99	104
2.	Residential (townhouse 7.5m)	11-27	2.06	80
3.	Residential (townhouse 8.1m)	28-35	1.31	45
4.	Residential (single - 10.4m)	36-78	1.32	43
5.	Residential (single - 11.60m)	79-282	7.08	204
6.	Residential (single - 12.80m)	283-389	4.35	107
7.	Residential (single - 13.72m)	390-434	2.10	45
8.	Residential (single - 15.24m)	435-513	4.70	79
9.	Residential (single - 18.30m)	514-555	3.30	42
10.	Residential Condo (single - 18.30m)	556-564	0.83	9
11.	Residential Condo (single - 20.0m)	565-566	0.32	2
12.	Main Street 1	567-568	1.62	
13.	Park	569-571	2.51	
14.	Storm Water Management Facility	572	3.53	
15.	Walkway/Servicing Access	573-576	0.09	
16.	Easement	577	0.24	
17.	Road Right-of-way	NA	12.12	
18.	Private Road Right-of-way & Common Element Areas	NA	0.32	
19.	Natural Heritage System	578-582	5.66	
20.	Open Space	583-584	0.06	
21.	Enhancement Area	585-594	0.58	
22.	0.3m Reserve	595-599	0.01	
TOTAL			55.10	760

TOTAL NUMBER OF UNITS: 760

Additional Information Required Under Section 51(17) of the Planning Act R.S.O. 1990,C.P.13

A. AS SHOWN
B. AS SHOWN
C. AS SHOWN
D. RESIDENTIAL, MIXED USE, PARK, STORMWATER MANAGEMENT, OPEN SPACE
E. AS SHOWN
F. AS SHOWN
G. AS SHOWN
H. MUNICIPAL WATER SUPPLY.
I. LOAM
J. AS SHOWN
K. ALL SERVICES AS REQUIRED
L. AS SHOWN

Revisions	DATE	INITIAL
Internal Draft Plan Revisions	October 27, 2014	UMG
Internal Draft Plan Revisions	December 5, 2014	UMG
Internal Draft Plan Revisions	December 15, 2014	UMG
Internal Draft Plan Revisions	April 3, 2015	UMG

Date: April 14, 2015
File Name: 150414 Bronte Green SGL Draft Plan.dwg

\Volumes\SGL-Data\4-CVs_Overview-Logos\SGL Logos\1 - Full Name Logo\2015 For Print\150408 logo NEW NAME.jpg

BRONTE GREEN DRAFT PLAN, April 14, 2015

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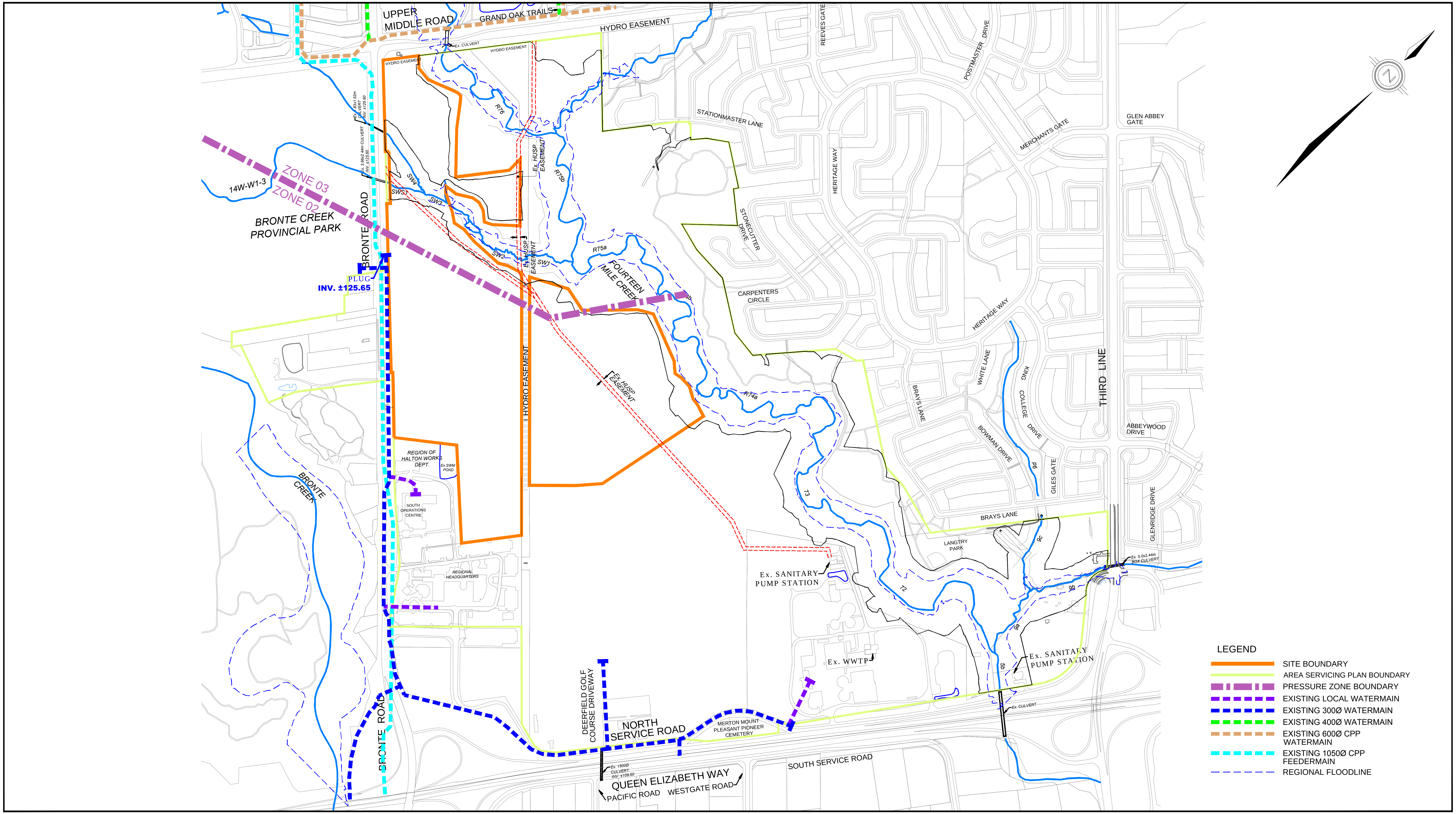
BRONTE GREEN PROPERTY

DRAFT PLAN

DATE: APRIL 2015
SCALE: N.T.S.
PROJECT No.: 12-601
FIGURE 2



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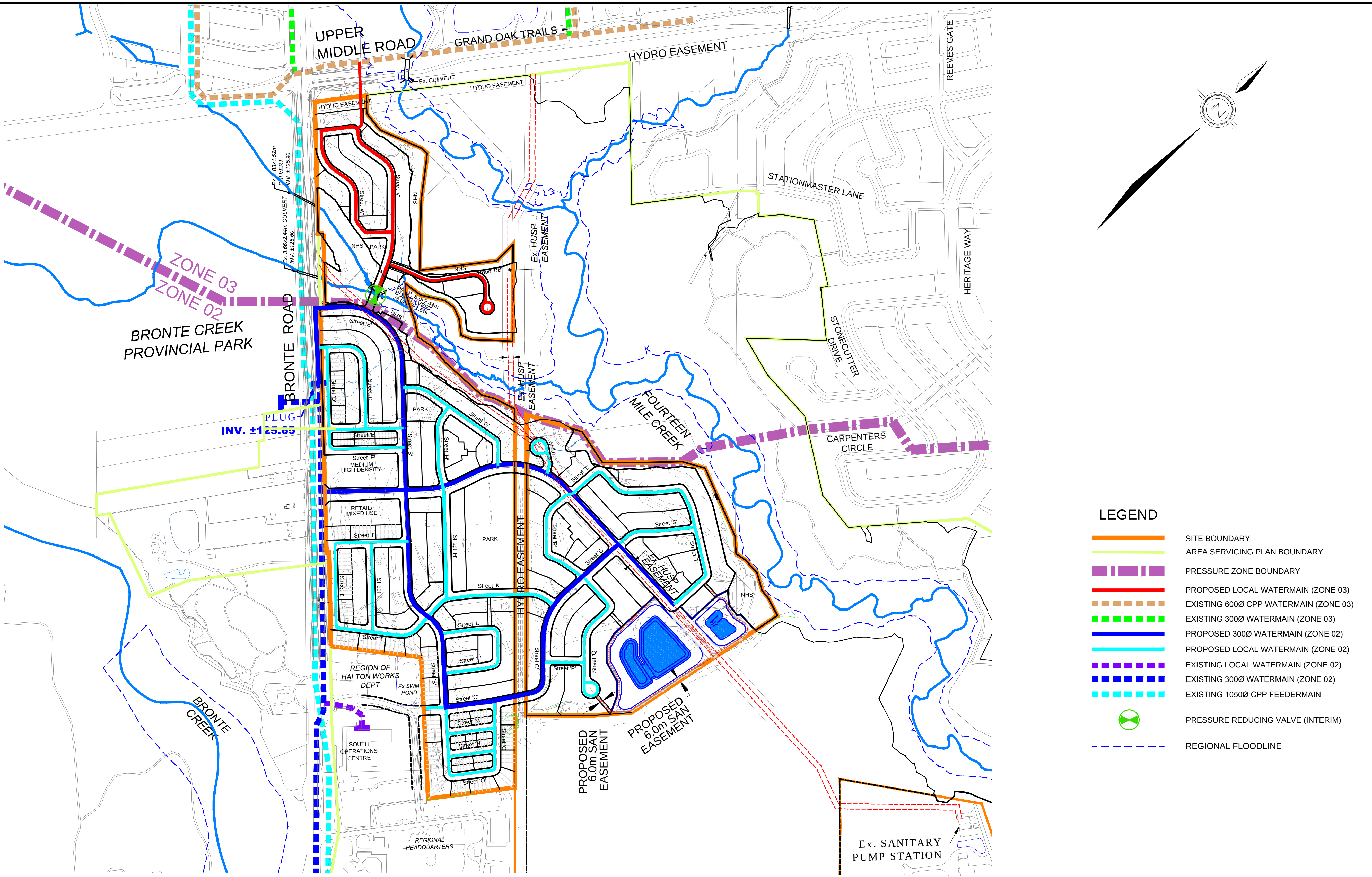
BRONTE GREEN PROPERTY

EXISTING WATER SERVICING

DATE:	APRIL 2015
SCALE:	1:10000
PROJECT No.:	12-601
FIGURE	3



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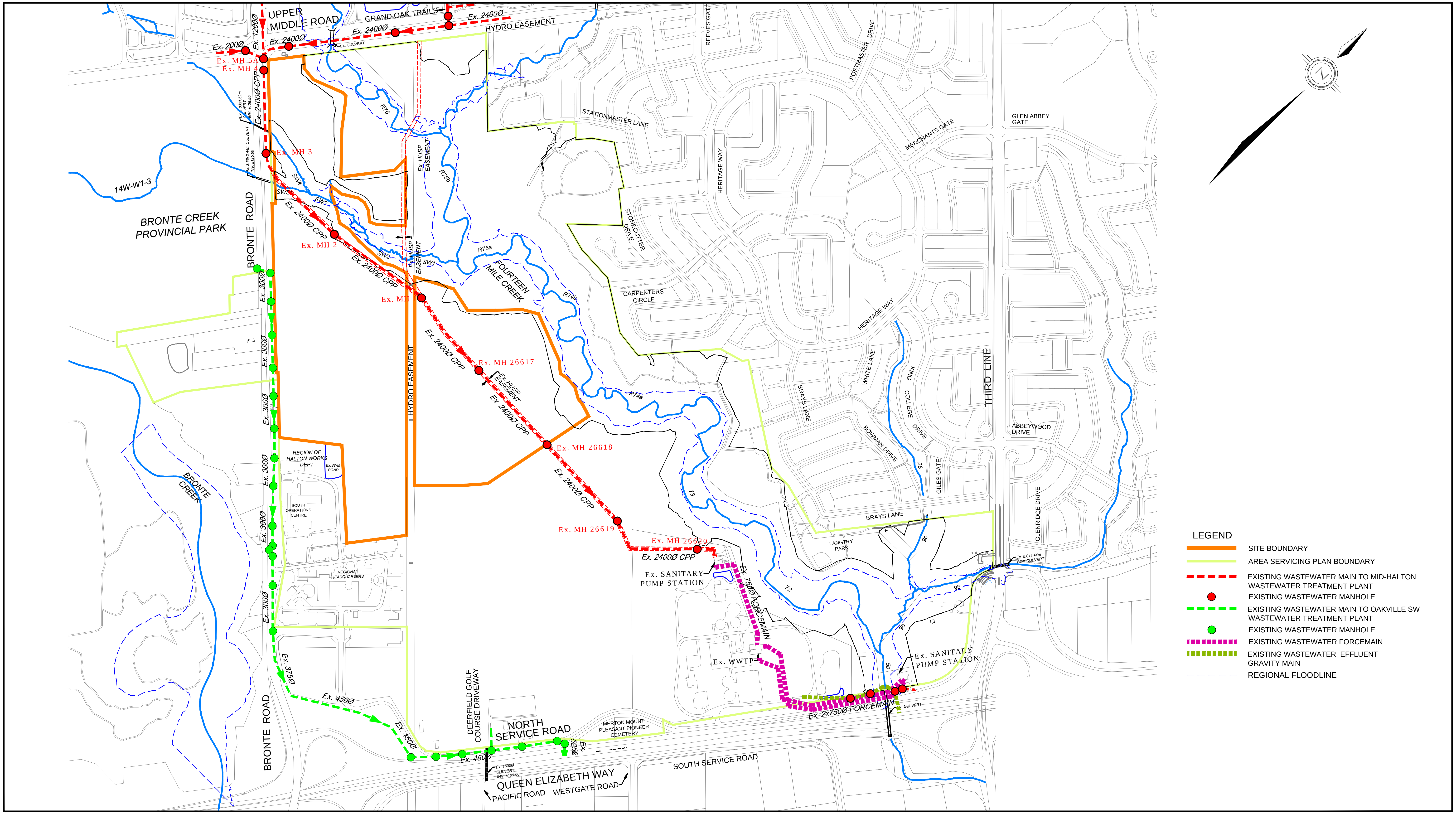
BRONTE GREEN PROPERTY

CONCEPTUAL WATERMAIN

DATE:	APRIL 2015
SCALE:	1:7500
PROJECT No.:	12-601
FIGURE	4



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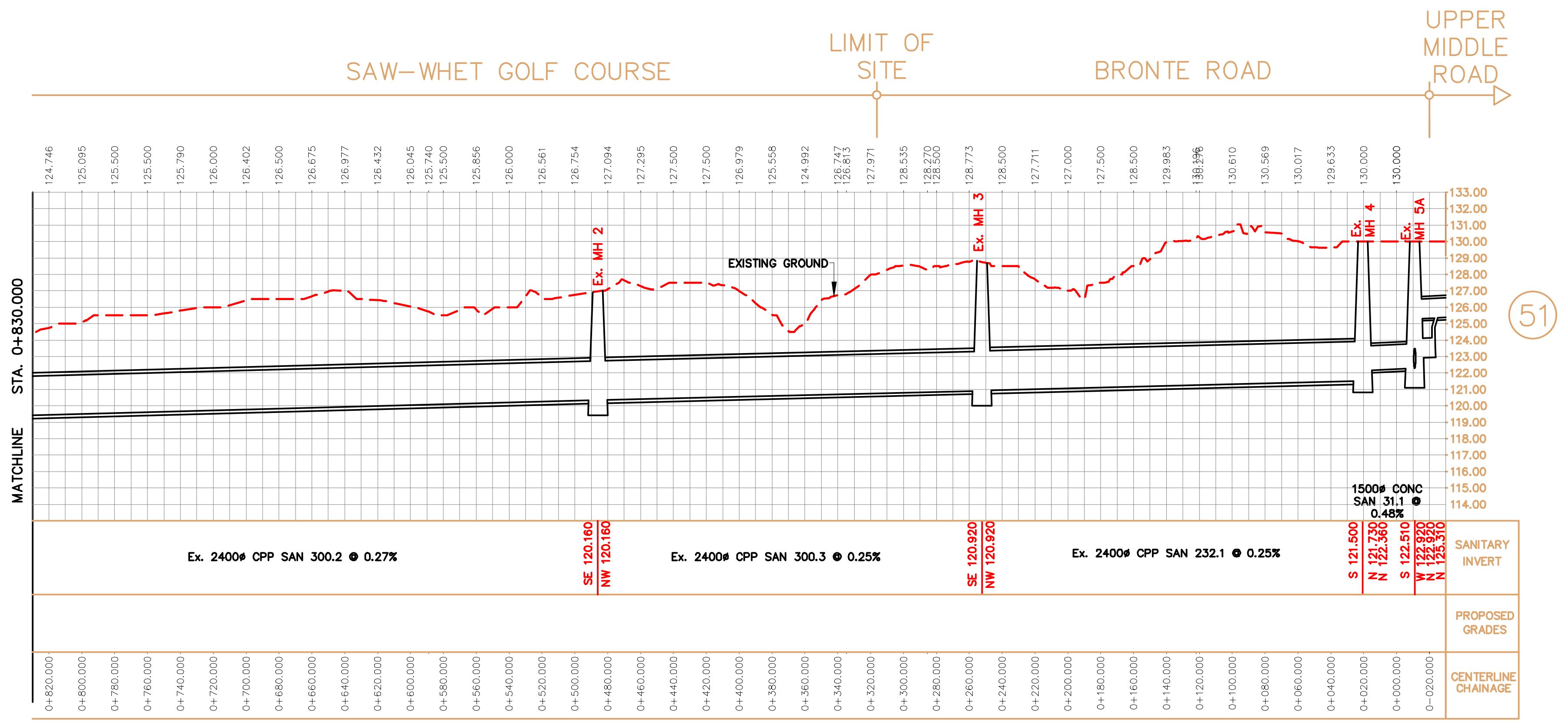
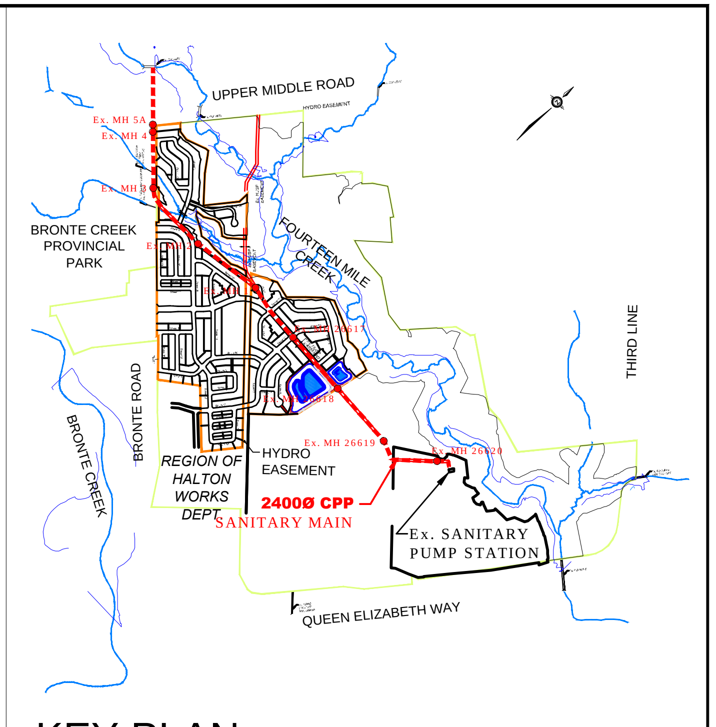
BRONTE GREEN PROPERTY

EXISTING WASTEWATER SERVICING

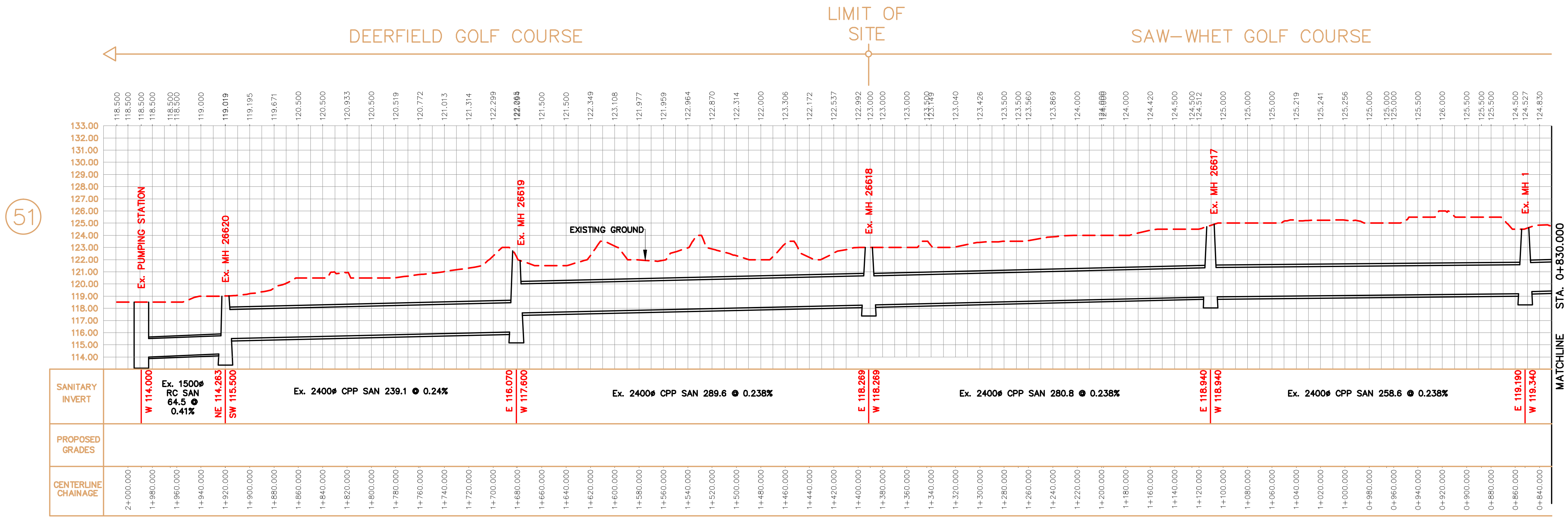
DATE:	APRIL 2015
SCALE:	1:10000
PROJECT No.:	12-601
FIGURE	5





KEY PLAN

N.T.S



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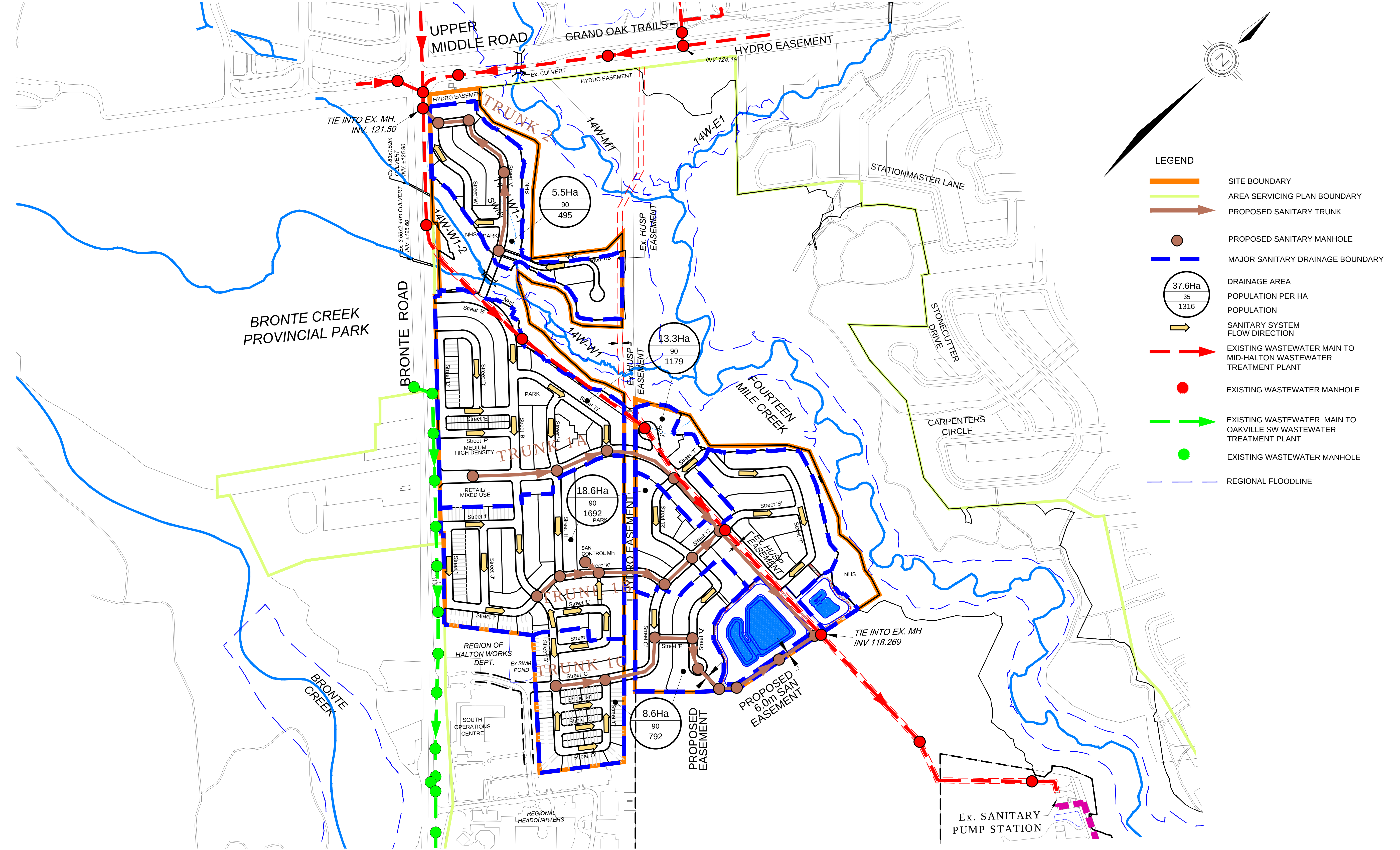
BRONTE GREEN PROPERTY

Ex. 2400Ø SANITARY TRUNK

DATE:	APRIL 2015
SCALE:	1:4000
PROJECT No.:	12-601
FIGURE	6



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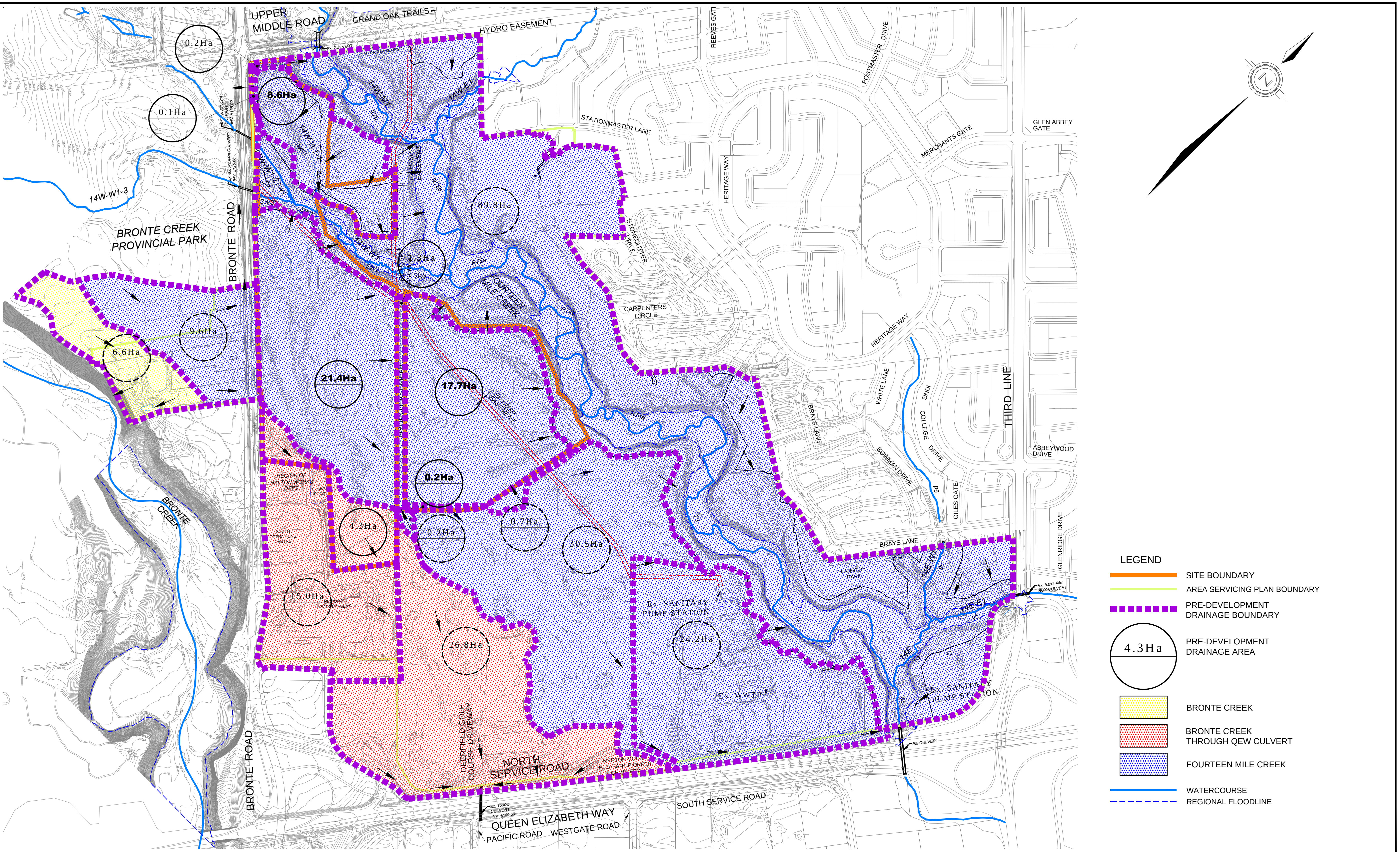
BRONTE GREEN PROPERTY

CONCEPTUAL SANITARY SERVICING

DATE:	APRIL 2015
SCALE:	1:7500
PROJECT No.:	12-601
FIGURE	7



LEGEND

▬	SITE BOUNDARY
▬	AREA SERVICING PLAN BOUNDARY
▪▪▪▪	PRE-DEVELOPMENT DRAINAGE BOUNDARY
4.3Ha	PRE-DEVELOPMENT DRAINAGE AREA
▨	BRONTE CREEK
▨	BRONTE CREEK THROUGH QEW CULVERT
▨	FOURTEEN MILE CREEK
▬	WATERCOURSE
- - -	REGIONAL FLOODLINE

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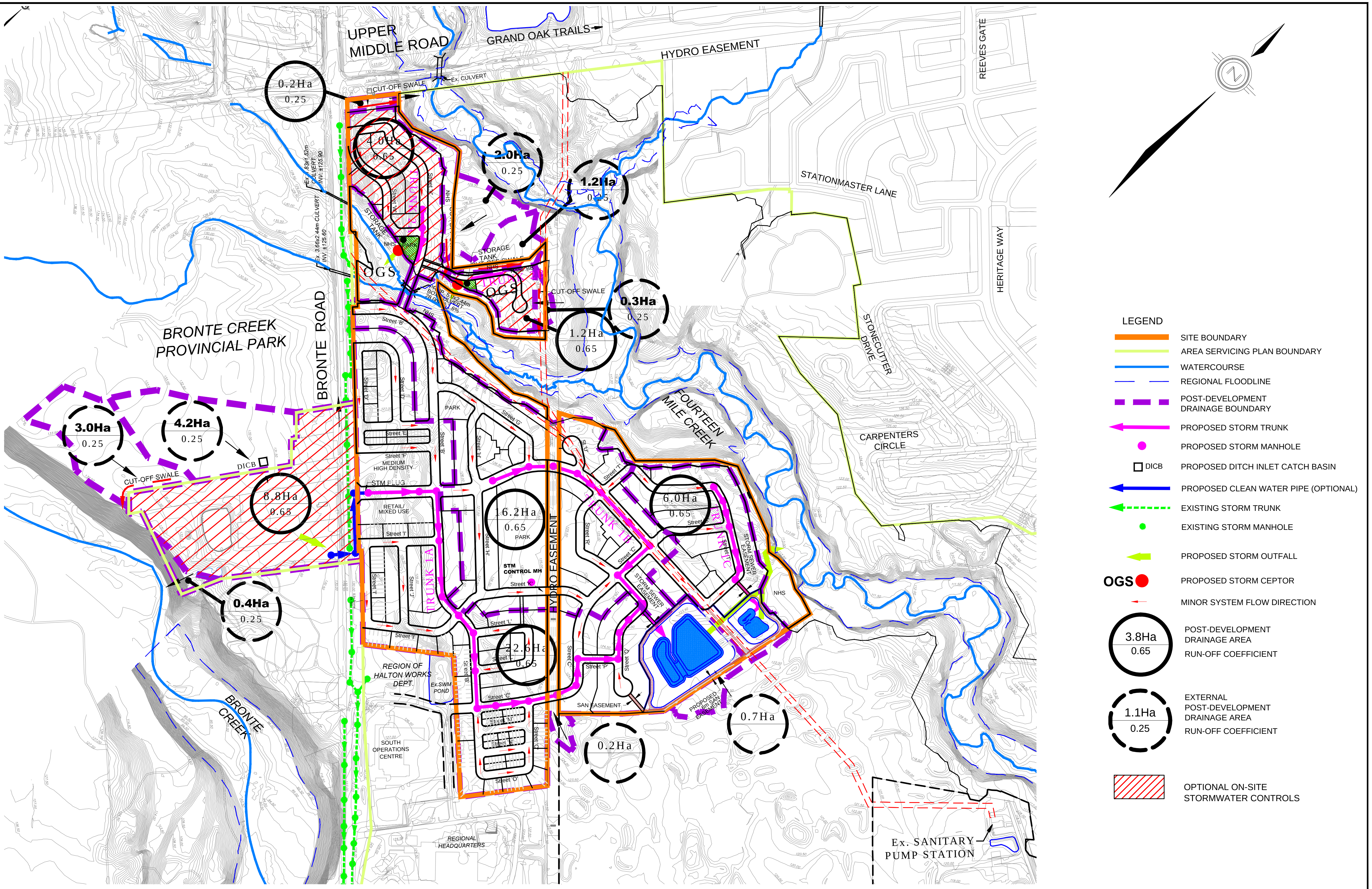
BRONTE GREEN PROPERTY

PRE-DEVELOPMENT DRAINAGE AREAS

DATE:	APRIL 2015
SCALE:	1:10000
PROJECT No.:	12-601
FIGURE	8



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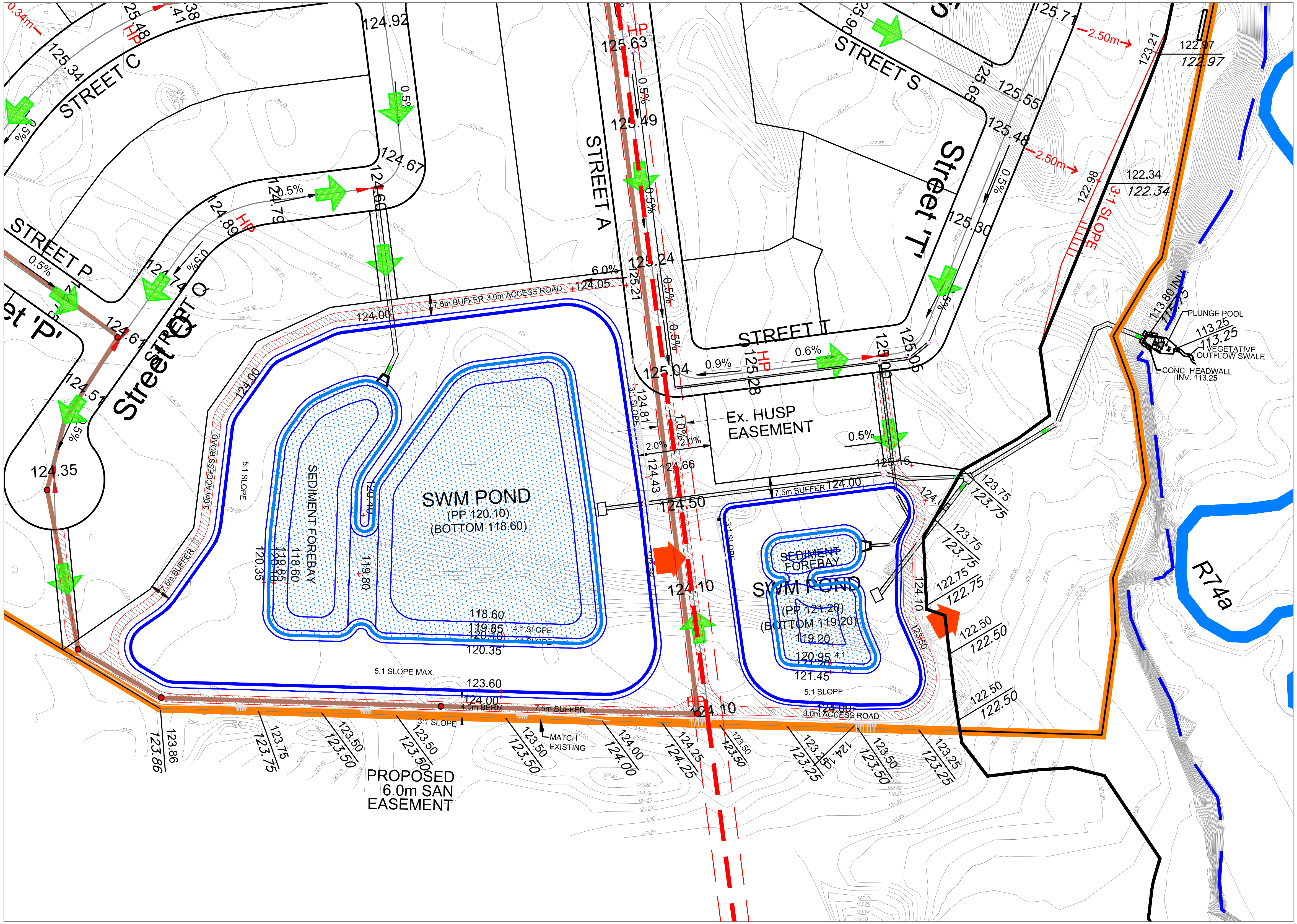
POST-DEVELOPMENT DRAINAGE AREA

DATE:	APRIL 2015
SCALE:	1:7500
PROJECT No.:	12-601
FIGURE	9



NOTE:
FINAL OUTFALL LOCATION
TO BE DETERMINED WITH
AGENCY CONSULTATION

LEGEND

▨	ACCESS ROAD
▦	PERMANENT POOL
259.50 / 263.00	PROPOSED GRADE EXISTING GRADE
🟩	OVERLAND FLOW DIRECTION
🟥	EMERGENCY OVERFLOW DIRECTION
━	WATERCOURSE
‒ ‒	REGIONAL FLOODLINE
━	SITE BOUNDARY
	POND INLET
	POND OUTLET
‒ ‒	EXISTING WASTEWATER MAIN TO MID-HALTON WASTEWATER TREATMENT PLANT
━	PROPOSED SANITARY TRUNK
○	PROPSED STORM MANHOLE
●	PROPSED SANITARY MANHOLE

NORTH POND CHARACTERISTICS

POND COMPONENT	VOLUME REQUIRED (m^3)	VOLUME PROVIDED (m^3)	ELEVATION (m)
PERMANENT POOL	1,026	1,231	121.20
100 YR	3,217	4,847	123.20
REGIONAL	5,667	6,818	123.70

SOUTH POND CHARACTERISTICS

POND COMPONENT	VOLUME REQUIRED (m^3)	VOLUME PROVIDED (m^3)	ELEVATION (m)
PERMANENT POOL	8,274	11,099	120.10
100 YR	26,350	26,359	122.10
REGIONAL	43,580	50,481	123.60

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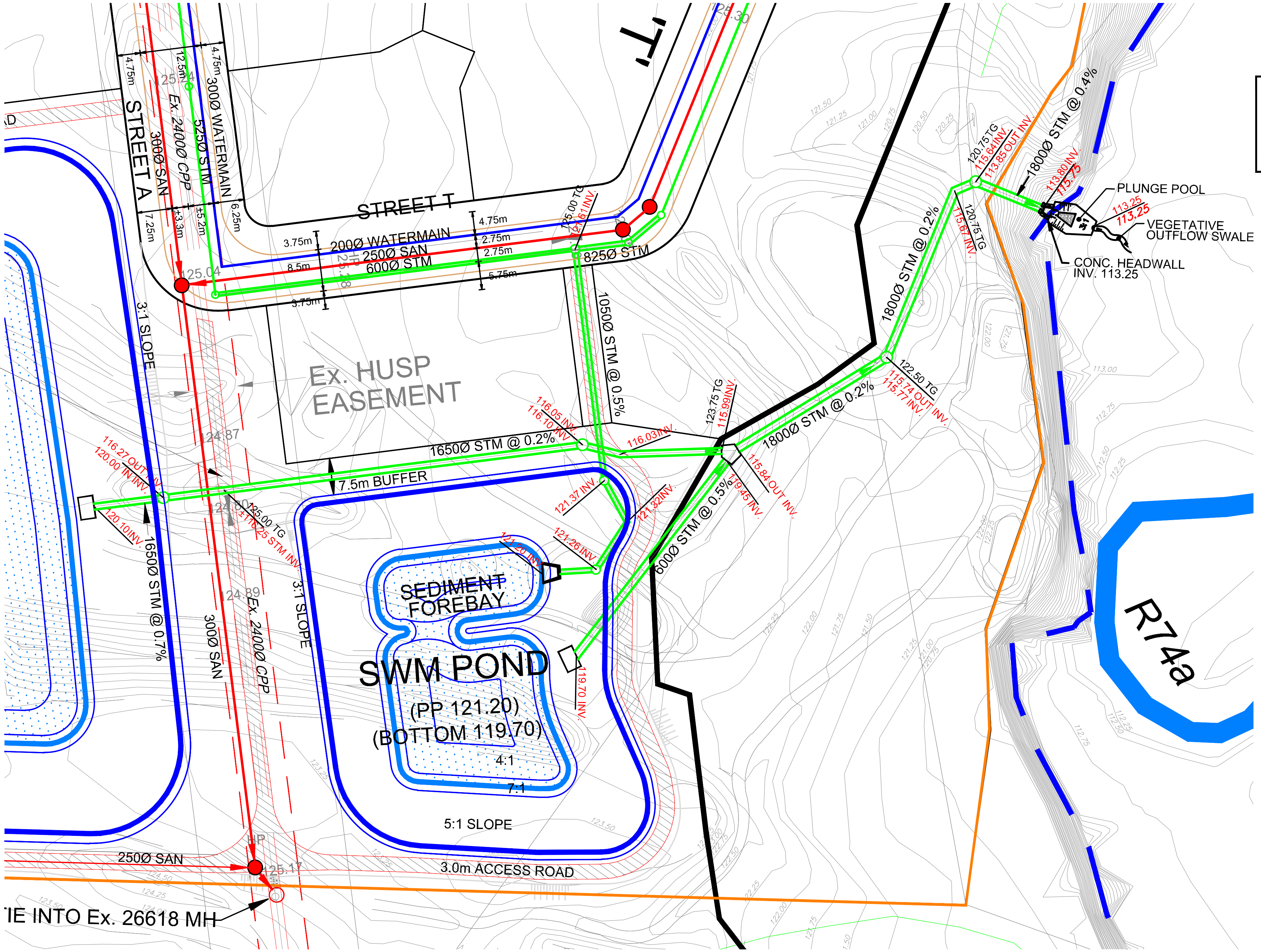
BRONTE GREEN PROPERTY

SWM POND

DATE:	APRIL 2015
SCALE:	1:1500
PROJECT No.:	12-601
FIGURE	10

EX. SANITARY AT CROSSING
EX. SAN INV. ±118.48
EX. SAN OBV. ±120.88



NOTE:
FINAL OUTFALL LOCATION
TO BE DETERMINED WITH
AGENCY CONSULTATION

LEGEND

▨	ACCESS ROAD
⬚	PERMANENT POOL
125.00 TG 116.17 INV.	PROPOSED GRADE PROPOSED INVERT
⇩	OVERLAND FLOW DIRECTION
⬇	EMERGENCY OVERFLOW DIRECTION
—	SITE BOUNDARY
▷═	POND INLET
╤	POND OUTLET
—	STORM SEWER
—	SANITARY SEWER
—	WATERMAIN
▬	WATERCOURSE
— —	REGIONAL FLOODLINE

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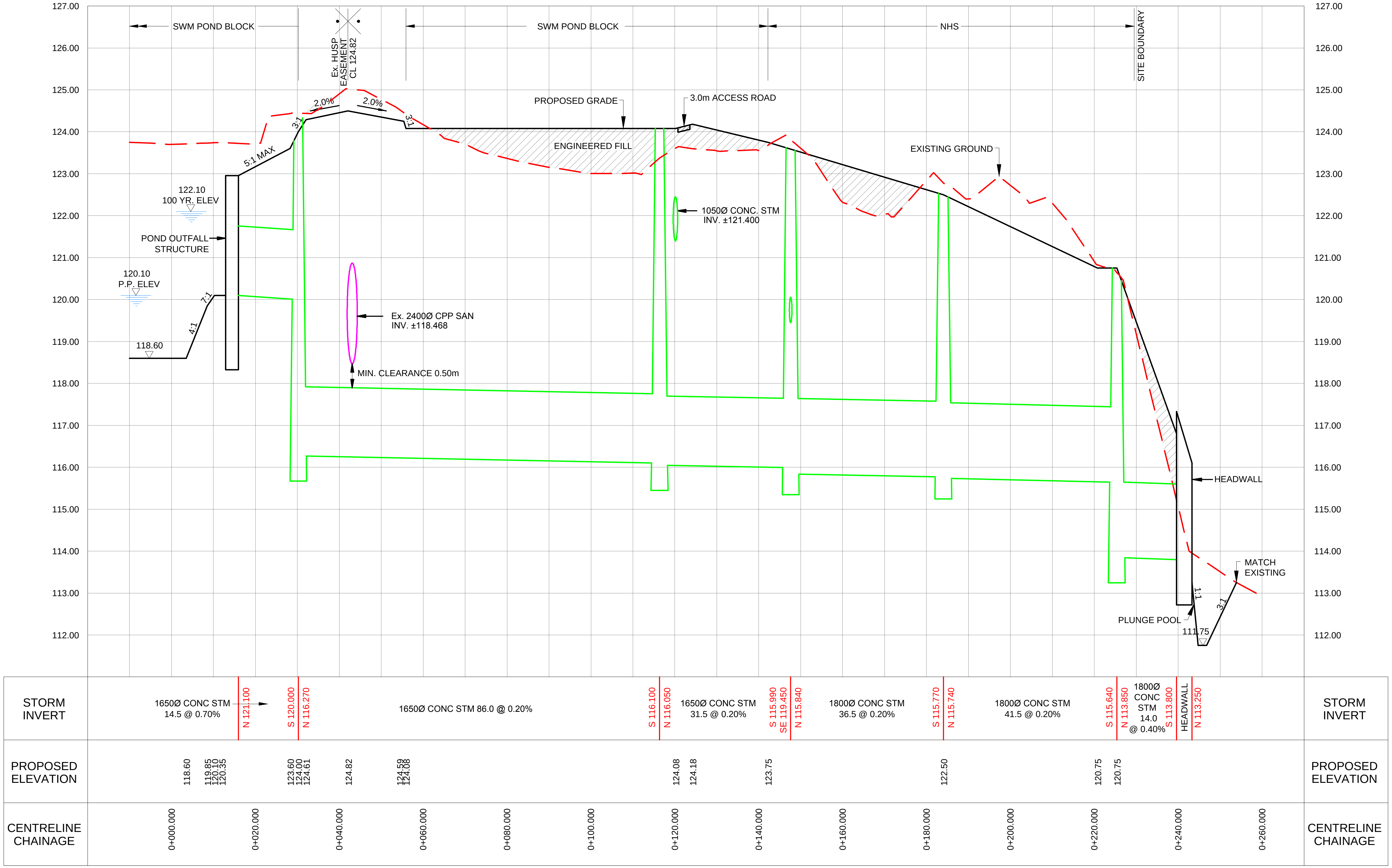
BRONTE GREEN PROPERTY

SWM POND DETAILS

DATE:	APRIL 2015
SCALE:	1:1000
PROJECT No.:	12-601
FIGURE	11



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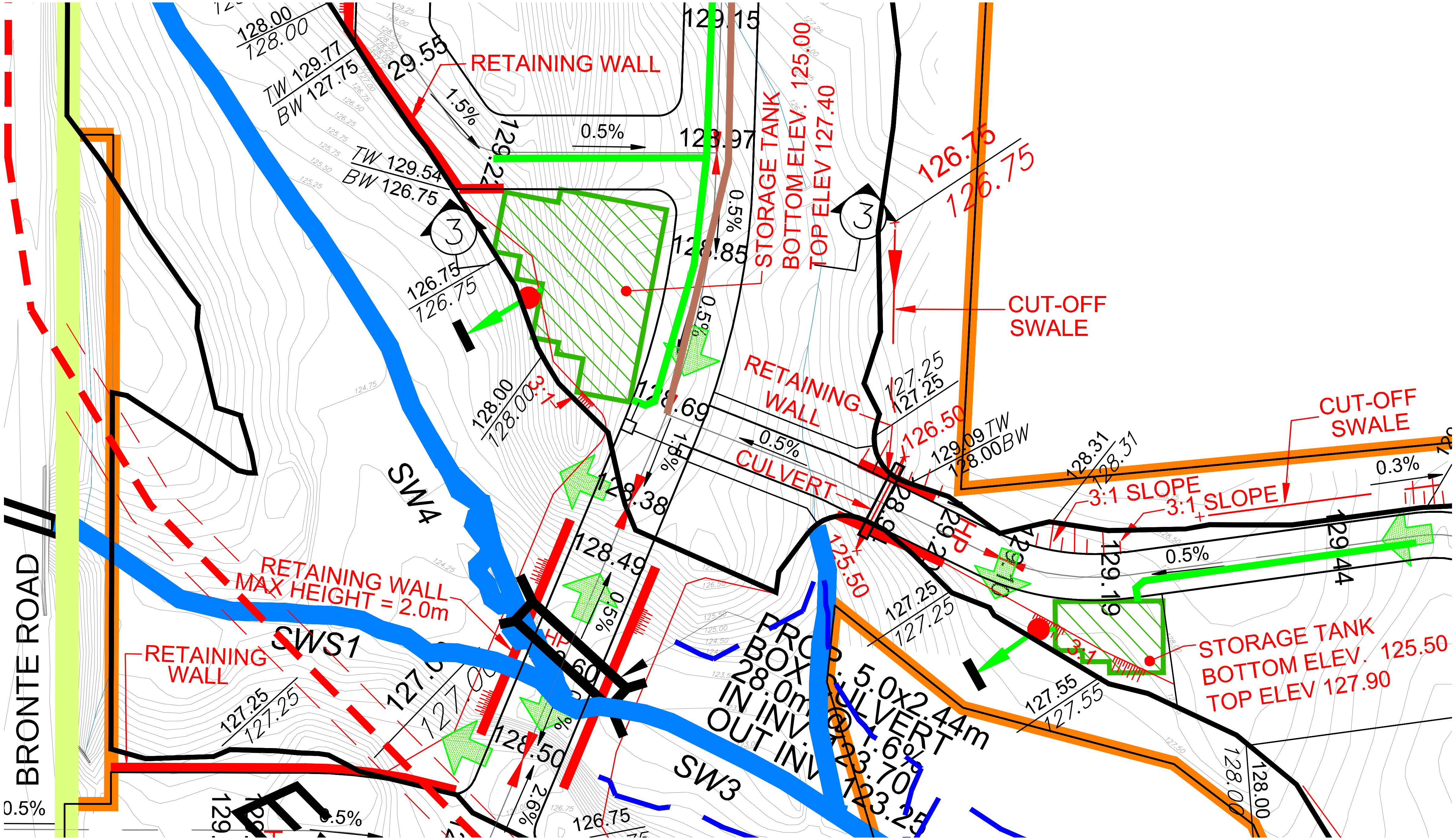
BRONTE GREEN PROPERTY

SWM POND OUTFALL DETAILS

DATE:	APRIL 2015
SCALE:	AS SHOWN
PROJECT No.:	12-601
FIGURE	12

NOTE:
FOR CROSS-SECTION 3-3,
REFER TO FIGURE No. 15

NOTE:
TOTAL VOLUME REQUIRED
AS PER APPENDIX G



LEGEND

259.50	PROPOSED GRADE
263.00	EXISTING GRADE
⇩	OVERLAND FLOW DIRECTION
🟦	WATERCOURSE
— —	REGIONAL FLOODLINE
🟧	SITE BOUNDARY
🟫	PROPOSED SANITARY TRUNK
🟩	PROPOSED STORAGE PIPES

NORTH WEST STORAGE CHARACTERISTICS

STORAGE COMPONENT	VOLUME REQUIRED (m^3)	VOLUME PROVIDED (m^3)
TANK		2,440
PIPES		420
TOTAL VOLUME	2,826	2,860

NORTH EAST STORAGE CHARACTERISTICS

STORAGE COMPONENT	VOLUME REQUIRED (m^3)	VOLUME PROVIDED (m^3)
TANK		647
PIPES		211
TOTAL VOLUME	857	858

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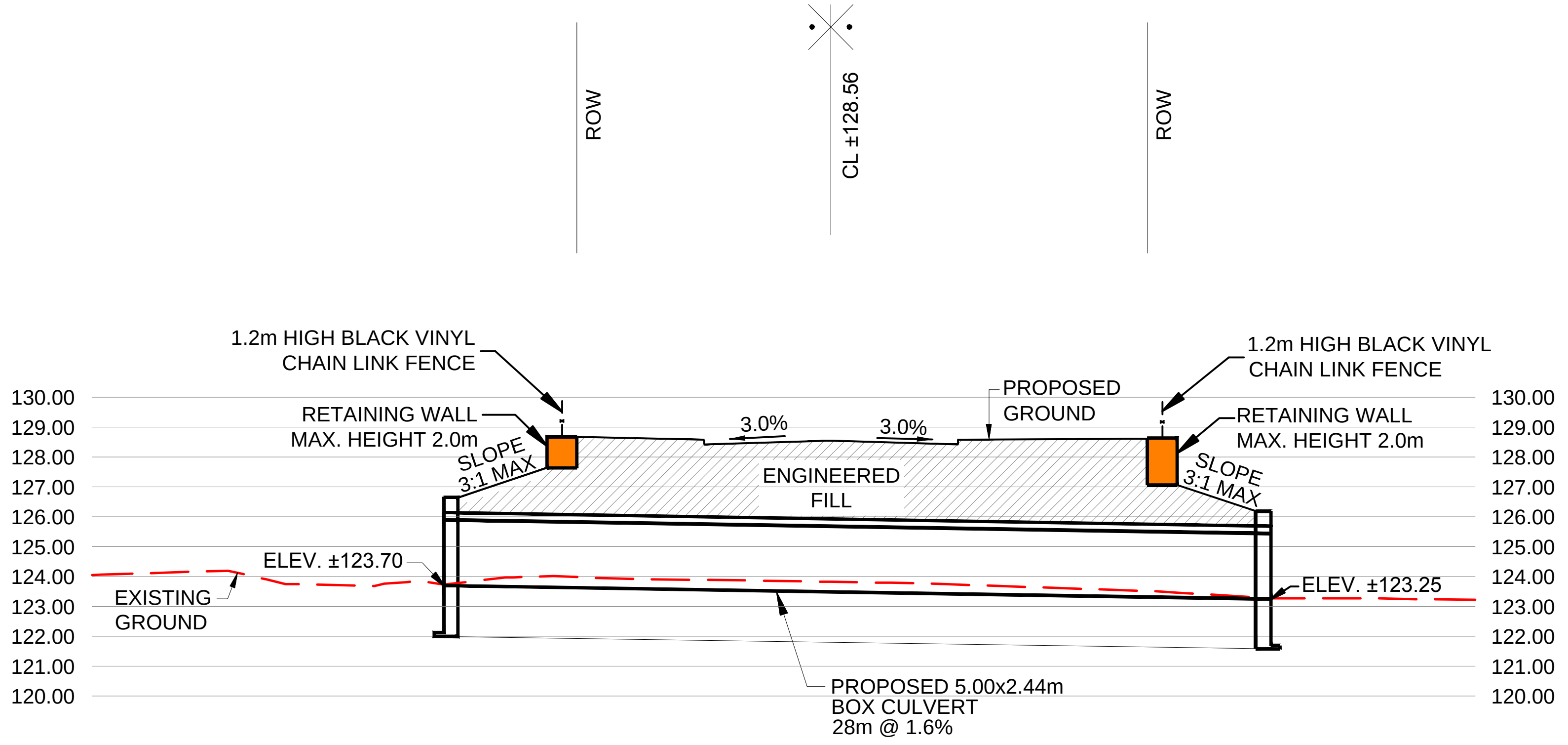
BRONTE GREEN PROPERTY

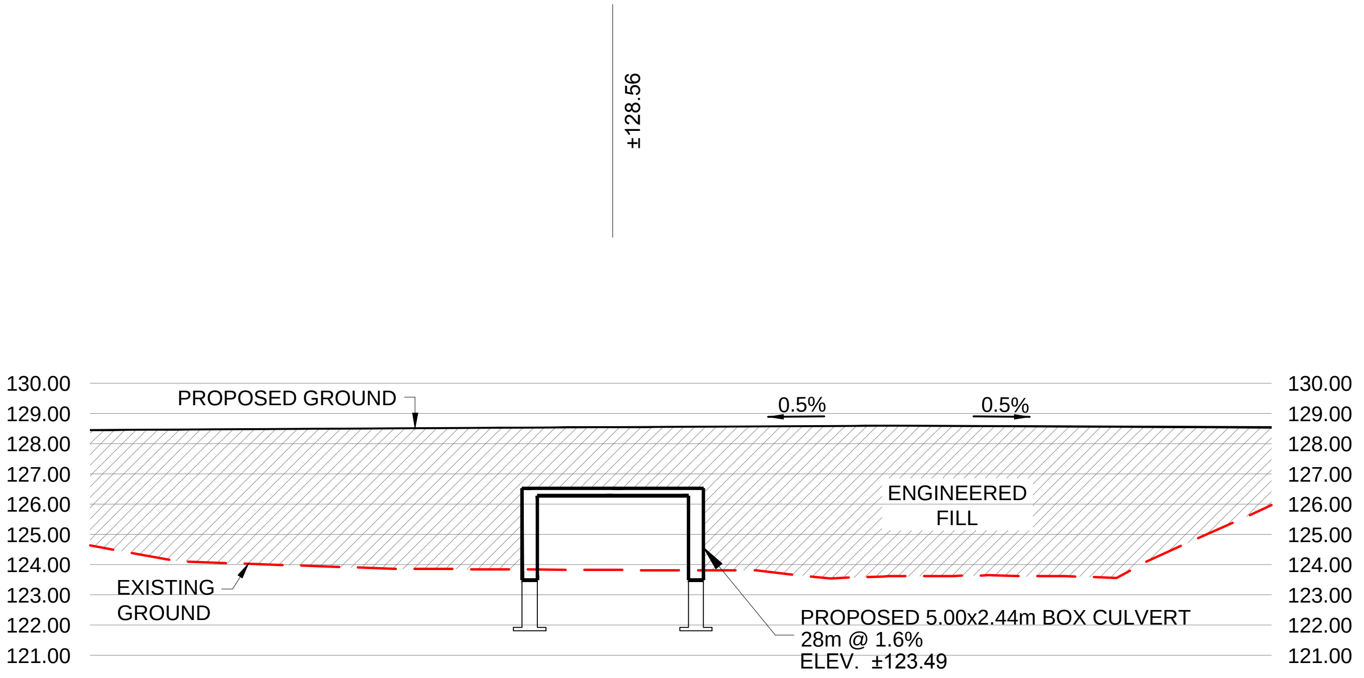
ON-SITE STORAGE CONTROL

DATE:	APRIL 2015
SCALE:	1:1000
PROJECT No.:	12-601
FIGURE	13



SECTION 1-1

SCALE HOR. 1:250
VER. 1:250



SECTION 2-2

SCALE HOR. 1:250
VER. 1:250

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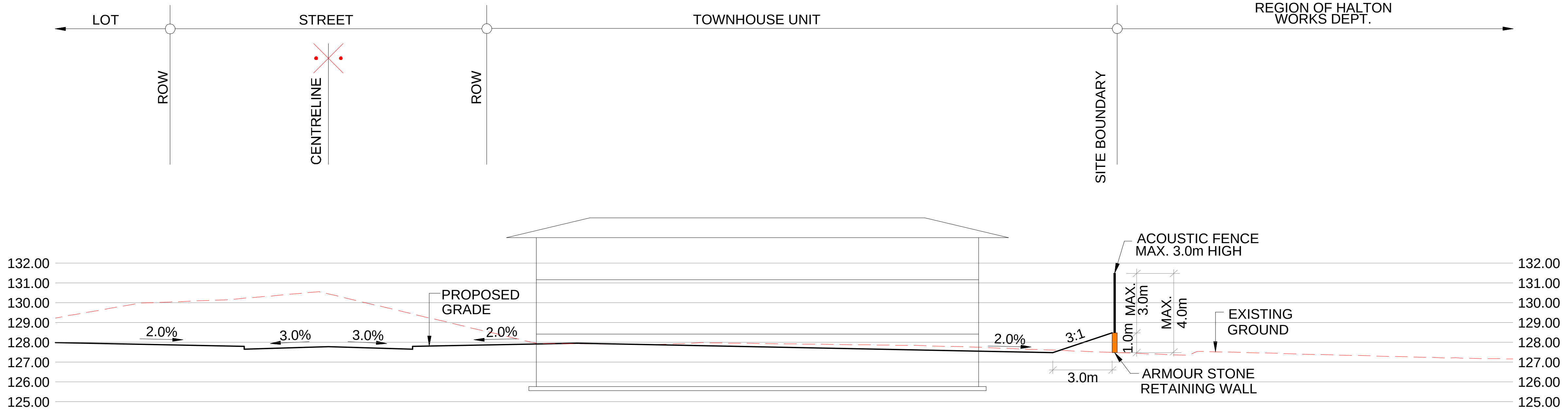
BRONTE GREEN PROPERTY

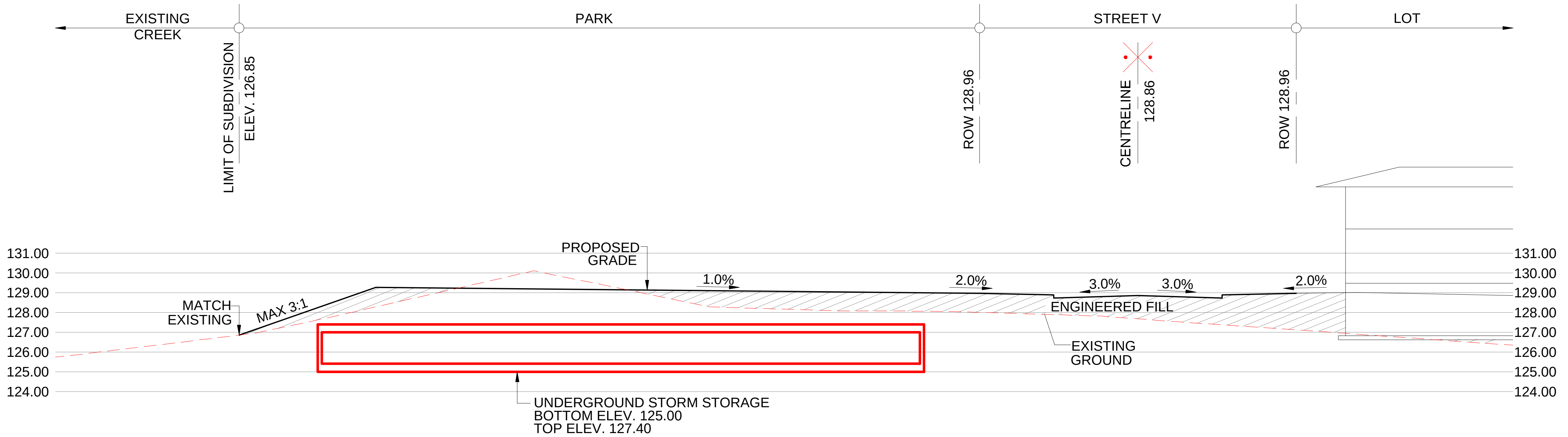
CONCEPTUAL CROSSING

DATE:	APRIL 2015
SCALE:	AS SHOWN
PROJECT No.:	12-601
FIGURE	14



TYPICAL SOUND BARRIER SECTION

SCALE HOR. 1:250
VER. 1:250



SECTION 3-3

SCALE HOR. 1:250
VER. 1:250

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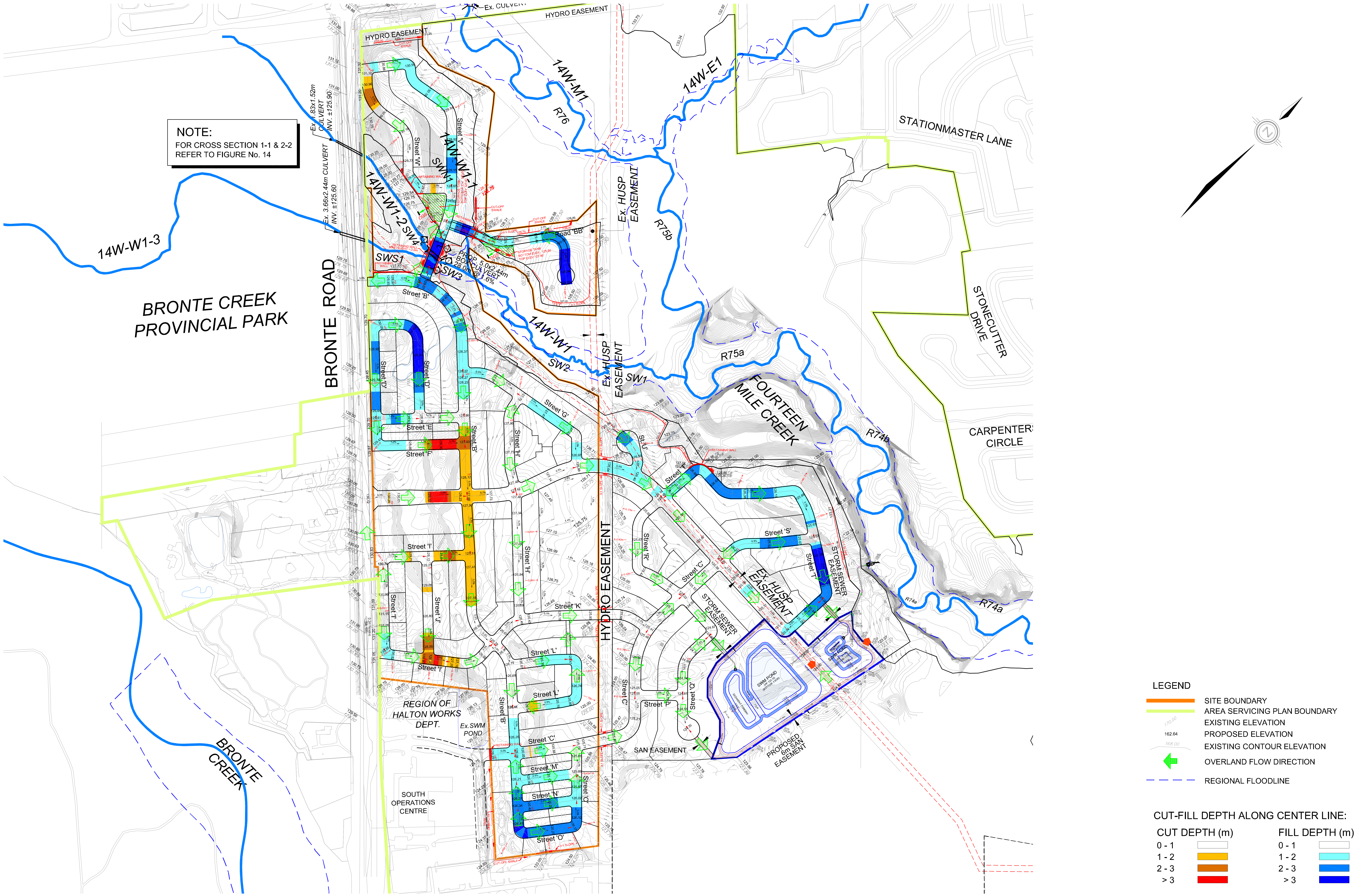
BRONTE GREEN PROPERTY

SECTIONS

DATE:	APRIL 2015
SCALE:	AS SHOWN
PROJECT No.:	12-601
FIGURE	15



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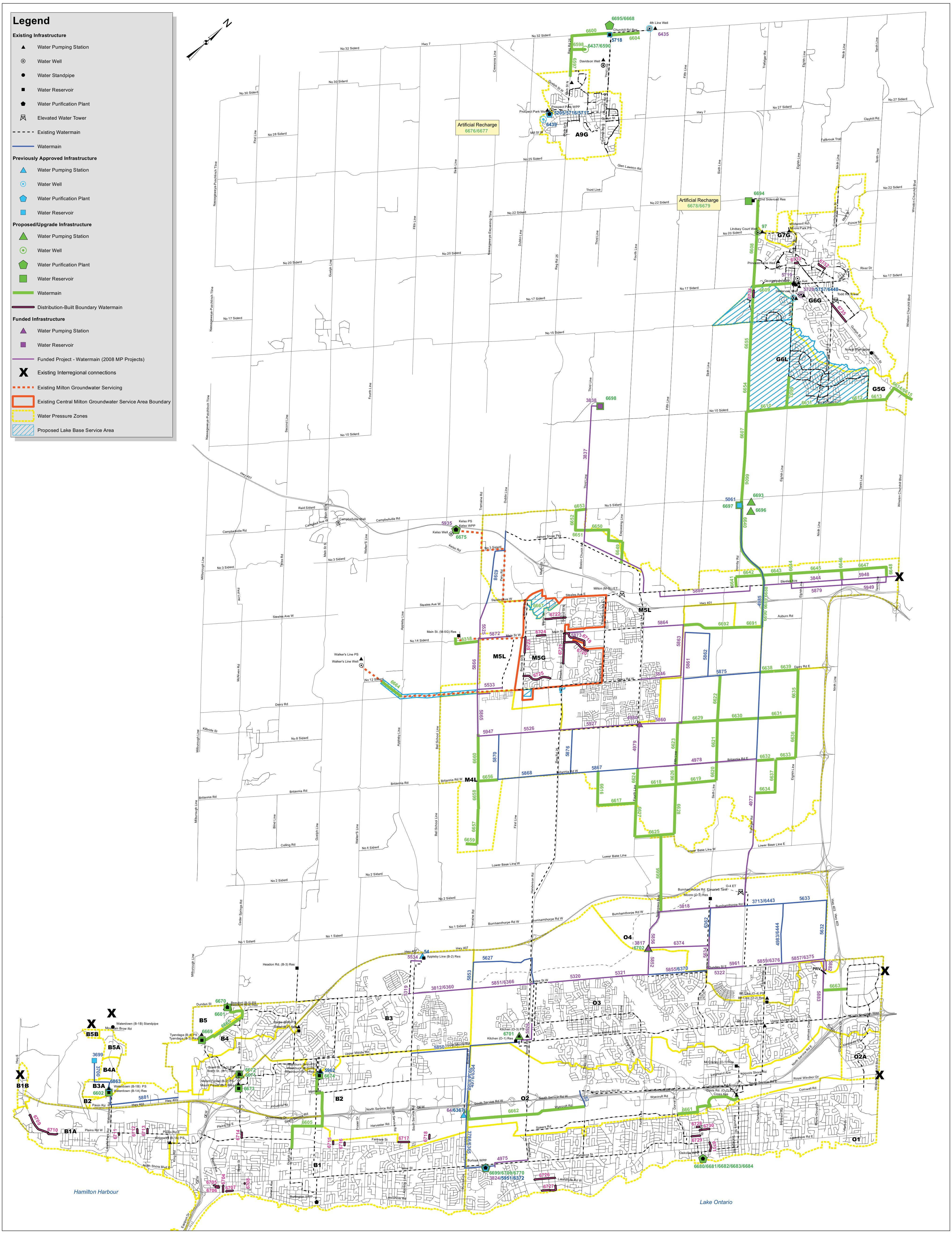
BRONTE GREEN PROPERTY

CONCEPTUAL GRADING PLAN

DATE:	APRIL 2015
SCALE:	1:3000
PROJECT No.:	12-601
DRAWING:	1

APPENDIX A

MASTER PLAN UPDATE, SEPTEMBER 2011
- Preferred water servicing
- Preferred wastewater servicing



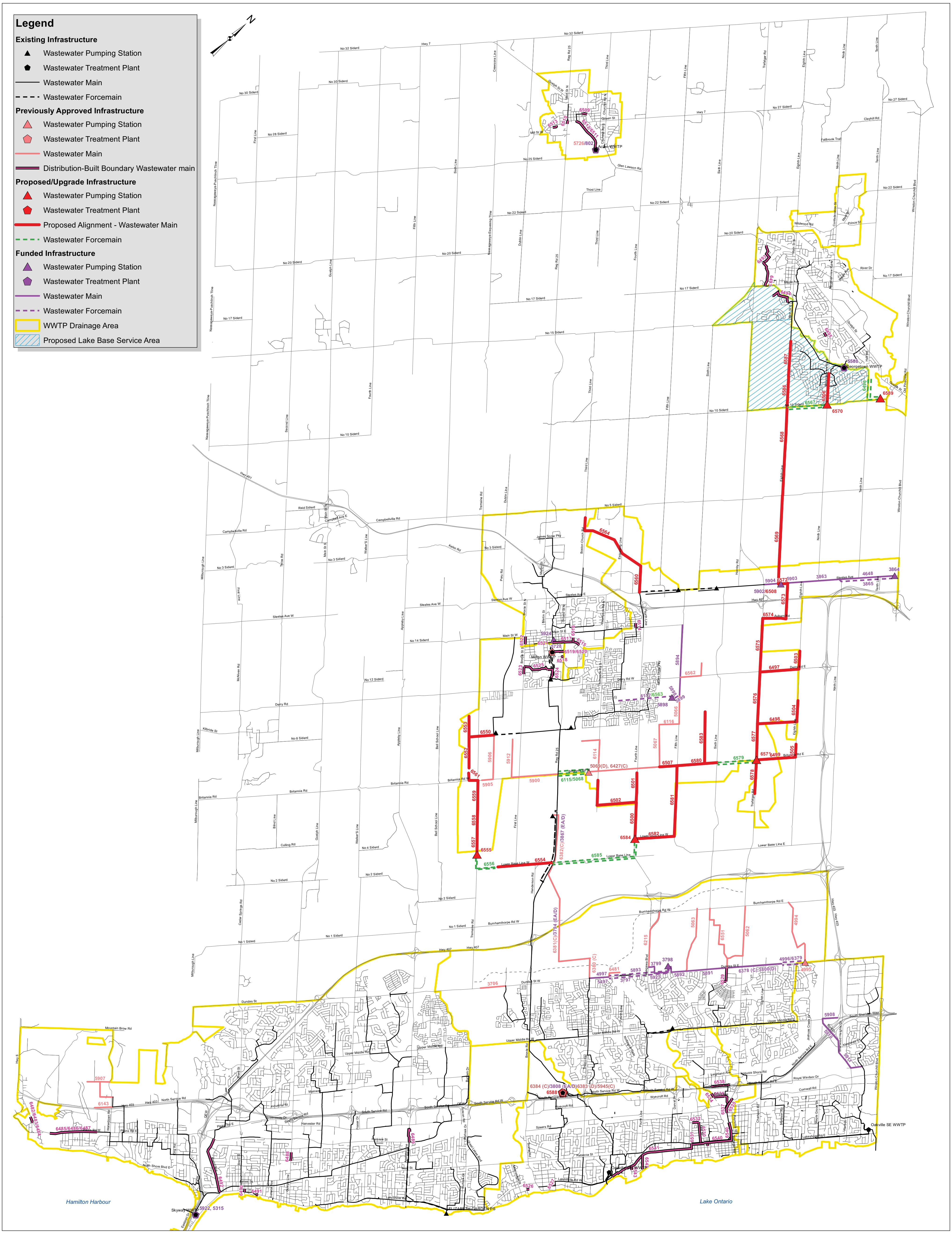
Halton REGION

Sustainable Halton
Water and Wastewater Master Plan

Preferred Water
Servicing Strategy
Figure 28

AECOM

Oct 07, 2011
1:40,000
601140562-363-W



Halton REGION

Sustainable Halton
Water and Wastewater Master Plan

Preferred Wastewater
Servicing Strategy
Figure 29

AECOM

October, 2011
1:40,000
60114062-362-WW

APPENDIX B

PRELIMINARY WATERMAIN ANALYSIS

Genivar

Project No. 141-13094-00

April 16, 2015

Mr. M. Baldesarra, P. Eng.
David Schaeffer Engineering Ltd.
600 Alden Road, Suite 500
Markham, Ontario L3R 0E7

Subject: Bronte Green Subdivision - Water Distribution Modeling

Dear Mr. Baldesarra,

We are pleased to present the results of our revised water distribution analysis for the Bronte Green Subdivision in the Town of Oakville, Region of Halton. The development was updated to suit new road layout and incorporated into the Region's 2014 Infowater model of their water system.

If you have any questions, please do not hesitate to call.

Yours truly,

WSP Canada Inc.

Stan C. Holden, P.Eng.
Director , Municipal Infrastructure

WSP Canada Inc.
600 Cochrane Drive, Suite 500
Markham, ON L3R

Phone: +1 905-475-7270
Fax: +1 905-475-5994
www.wspgroup.com

TABLE OF CONTENTS

TABLES

IMAGES

APPENDICES

1 INTRODUCTION

WSP Canada Inc. was retained by DSEL to conduct a hydraulic analysis for the proposed Bronte Green development in Oakville.

The proposed residential development is made up of single family homes and townhouses with blocks of high density units and mixed use. The site is located near Bronte Road and Upper Middle Road in Oakville, Ontario. To complete this analysis, the subdivision's water demands were estimated and incorporated into the existing Region of Halton InfoWater model (Sept 2014) developed for the South Halton Water & Wastewater Master Plan Update forwarded by the Region in May 2013. Bronte Green is part of the Merton development area that was analysed previously in our draft report dated November 16 2013. At that time, the area build out was still in the preliminary stages of design. This report covers the updates of our January 28, 2014 report.

A diagram of the development is shown in Figure 1.

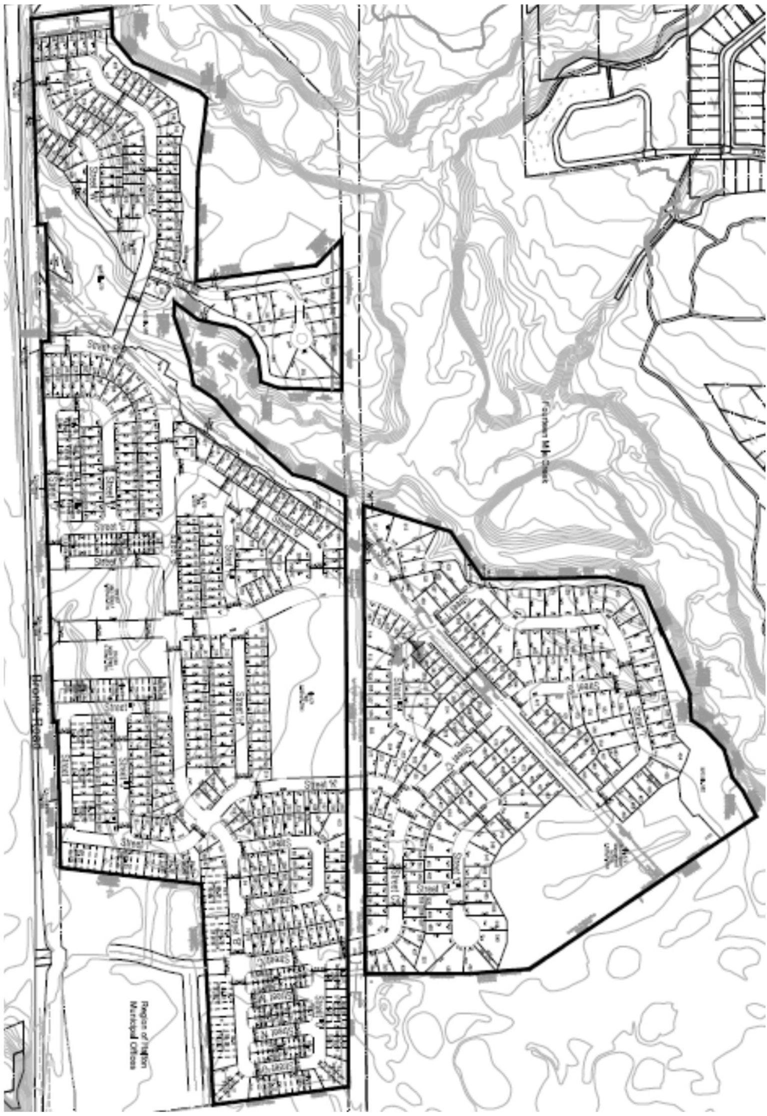


Figure 1 - Proposed Bronte Green Subdivision

2 DESIGN CRITERIA AND DEMANDS

2.1 DEVELOPMENT DEMANDS

The design criteria to determine water demands was based on Region of Halton's 2014 Water and Wastewater Linear Design Manual, the Ministry of the Environment (MOE) Watermain Design Criteria and the Fire Underwriters Survey, as appropriate.

The population calculation guidelines for various types of developments are shown in Table 1.

Table 1 - Development Density
(Source: Region of Halton Water and Wastewater Linear Design Manual, May 2014)

DEVELOPMENT TYPE	EQUIVALENT POPULATION DENSITY (PERSONS/UNIT)
Single Family or Semi-Detached	3.472
Townhouse	2.555
Apartment	1.742

After determining the equivalent population, the corresponding Average Day, Maximum Day and Peak Hour demands were calculated based on water design factors as stated in Table 2. The calculated demands for the subdivision are summarized in Table 3. Details on the development demands and assigned nodes in the water model are provided in Appendix A.

Table 2 - Water Design Criteria
(Source: Region of Halton Water and Wastewater Linear Design Manual, May 2014)

DEMAND TYPE	CRITERIA
Average Daily Demand (m^3/capita)	0.275
Maximum Daily Demand P.F.	2.25
Maximum Hourly Demand P.F.	
Residential	4
I/C/I	2.25

Table 3 – Total Calculated Demand for Bronte Green Subdivision

	AVERAGE DAY DEMAND (L/S)	MAXIMUM DAY DEMAND (L/S)	PEAK HOUR DEMAND (L/S)
Bronte Green Subdivision	8.19	18.44	31.97

2.2 EXTERNAL DEMANDS

The model received from the Region of Halton included demands for existing developments and known future developments in the Region.

2.3 FIRE DEMANDS

Fire demands were based on the Region of Halton's suggested fire flows for medium density developments as shown in Table 4. Details on the fire flow demands for each node in the model are provided in Appendix A.

Table 4 - Typical Fire Flow Requirements
(Source: Region of Halton Development Co-ordinator, 2003)

DEVELOPMENT TYPE	FIRE FLOWS (L/S)
Residential Low-Density	91
Residential Medium-Density	136
Residential High-Density	212
Commercial	273
Institutional	273
Industrial	273

2.4 SYSTEM PRESSURE REQUIREMENTS

In addition to meeting fire flows, the development must be within operating pressure requirements. The Region of Halton pressure criterion stipulates a minimum of 40 psi (275 kPa) and maximum pressure of 100 psi (690 kPa). Under fire flow conditions, pressures above 20 psi (140 kPa) must be maintained.

It is important to note that the Ontario Building Code requires individual pressure regulating valves if pressures are above 80 psi (550 kPa).

2.5 WATERMAIN SIZING

Watermains are to be sized appropriately to maintain adequate flows without causing excessive energy loss or result in water quality decay. It should therefore be sized to carry the maximum of:

- Maximum day plus fire demand
- Peak hour demand

According to the Ministry of the Environment (MOE), the minimum pipe size in a distribution system providing fire protection should be at least 150 mm. Also, pipes should be looped wherever possible to improve supply security and water quality. Friction factors were assigned according to the pipe diameter as suggested by the MOE and as shown in Table 5.

Table 5 - Hazen-Williams Roughness Factors
(Source: Region of Halton Water and Wastewater Linear Design Manual, May 2014)

DIAMETER – NOMINAL	C-FACTOR
150 mm and smaller	100
200 mm to 250 mm	110
300 mm to 600 mm	120
Over 600 mm	130

3 ANALYSIS

3.1 MODEL SETUP

The Bronte Green lands lie across the boundary between pressure zones O-2 and O-3. Elevations range from 124.3 m to 131.2 m. The development was modeled under two planning scenarios (interim, 2016, and ultimate, 2031) to confirm that the development could be serviced adequately under existing and future conditions.

In our previous report, it was found that the development south of Fourteen Mile Creek could be serviced by Zone O-2. The condominium homes north of Fourteen Mile Creek will be serviced by Zone O-3. Under the interim conditions, the area south of Fourteen Mile Creek will be supplied from the existing watermain along Bronte Road. Additional supply points from the North Service Road will be available under the ultimate scenario. The proposed watermains south of Bronte Green will need to be confirmed when that portion of the Merton/Bronte Green development is designed.

It should be noted that the Region does not consider minimum hour conditions so pressures experienced in the condominium block supplied by Zone O-3 area may be above 100 psi (690 kPa) during low demand periods. With the building code requirement of 80 psi (550 kPa), homes supplied by Zone O-3 will require individual PRVs.

The results of the analysis shows that the development can be adequately serviced by the proposed system and pressure zone under interim and ultimate conditions as shown on the attached schematics.

The development was added to an existing Infowater hydraulic model of the Region of Halton's water distribution system. This model was received by WSP from the Region in September 2014.

Elevations and demands were inputted into new nodes created for the development. Friction factor for the pipes were assigned according to Table 5.

3.2 WATERMAIN SIZING AND SYSTEM PRESSURES

The analysis was conducted under interim (2016) and future servicing conditions (2031) for Average Day, Maximum Day, Maximum Hour and Maximum day plus Fire demands to size the watermains and meet the pressure requirements. The pipe size and layout are shown in Appendix B.

The timing of the Zone O-2 future Burloak Pumping Station was changed in the updated Region model. Without the pumping station, it was not possible to achieve adequate fire flows to the townhomes. To meet the fire flows, a watermain with a pressure reducing valve will be constructed between the two zones across the creek. This valve would be set to only operate under emergency situations to supplement the fire flow. When the pumping station is constructed, hydrant tests should be performed to confirm the systems adequacy before the PRV is decommissioned. Fire flows are adequate under ultimate conditions with the additional supply points from the south.

Under interim conditions, the fire flow achieved near the high density/mixed use blocks is below the required (2016 - 238 L/s). The fire flow requirements for these blocks should be calculated when the building designs are underway and a fire pump may be required.

The watermains were sized between 150 mm to 300 mm according to the results of average day, maximum day, maximum day plus fire, and peak hour scenarios.

Modeled service pressures for the development are summarized in Table 6. All pressures lie within the required operating range under average day, maximum day, maximum day plus fire flow and peak hour demands. It should be noted that the Ontario Building Code suggests a maximum pressure of 80 psi (550 kPa). Pressure reduction may be required for the homes north of Fourteen Mile Creek.

Detailed pipe and node tables for the various scenarios modelled are attached to this report in Appendix B.

Table 6 - Modeled Service Pressures

SCENARIO	AVERAGE DAY	MAXIMUM DAY	PEAK HOUR	MAX DAY & FIRE
Interim (2016) Zone 2	64 to 74 psi (441 to 508 kPa)	55 to 64 psi (379 to 441 kPa)	53 to 63 psi (368 to 434 kPa)	116 to 267 L/s Flow available @ 20 psi
Interim (2016) Zone 3	121 to 124 psi (834 to 853 kPa)	96 to 99 psi (660 to 680 kPa)	105 to 108 psi (722 to 741 kPa)	121 to 235 L/s Flow available @ 20 psi
Ultimate (2031) Zone 2	64 to 74 psi (441 to 510 kPa)	60 to 70 psi (416 to 483 kPa)	57 to 67 psi (394 to 461 kPa)	125 to 325 L/s Flow available @ 20 psi
Ultimate (2031) Zone 3	106 to 109 psi (733 to 753 kPa)	101 to 104 psi (698 to 717 kPa)	97 to 100 psi (670 to 690 kPa)	121 to 276 L/s Flow available @ 20 psi

4 CONCLUSIONS

The proposed watermain report for the Bronte Green Subdivision can achieve hydraulic requirements as prescribed by the Region of Halton watermain design criteria as summarized below.

- The service pressures off of the watermain are expected to range between 53 psi to 124 psi (368 kPa to 853 kPa under interim conditions and between 57 psi to 109 psi (394 kPa to 753 kPa) under ultimate conditions. Pressures may be above 100 psi (690 kPa) during low demand periods under interim conditions and above 80 psi (550 kPa). The homes will require individual PRVs to meet the OBC requirements. .
- The available fire flow meets or exceeds the required fire flow demands at the minimum pressure of 140 kPa based on the proposed watermain configuration except for the mixed use blocks under interim conditions. Those blocks should have the fire flow calculated when more information is available about the buildings and fire pumps may be required.

Appendix A

DEMANDS

Halton Design Criteria
Source (unless stated): Water & Wastewater Linear Design Manual, May 2014

Equivalent Population by Unit
(Source: 2012 Development Charges Background Study)

Type of Development	Equivalent Population Density
	(Person/Unit)
Single Family or Semi-Detached	3.472
Townhouse	2.555
Apartment	1.742

Equivalent Population by Area

Type of Development	Equivalent Population Density	Average Day Demands
	(Person/Hectare)	*(m3/ha/day)*
Single Family	55	15.125
Semi-detached duplex and 4-plex	100	27.5
Townhouse, Maisonette (<6 stories)	135	37.125
Apartments (>6 stories)	285	78.375
Light Commercial Areas	90	24.75
Community Services	40	11
Light Industrial Areas	125	34.375
Hospitals (persons/bed)	4	

Water Design Factors

Average Daily Demand (m3/capita)	0.275
Maximum Daily Demand P.F.	2.25
Maximum Hourly Demand P.F.	
Residential	*4*
I/C/I	*2.25*

Cofficient of Roughness

Size of Pipe (mm Dia.)	Coefficient of Roughness (C)
150	100
200-250	110
300-600	120
Over 600	130

Minimum Pipe Size

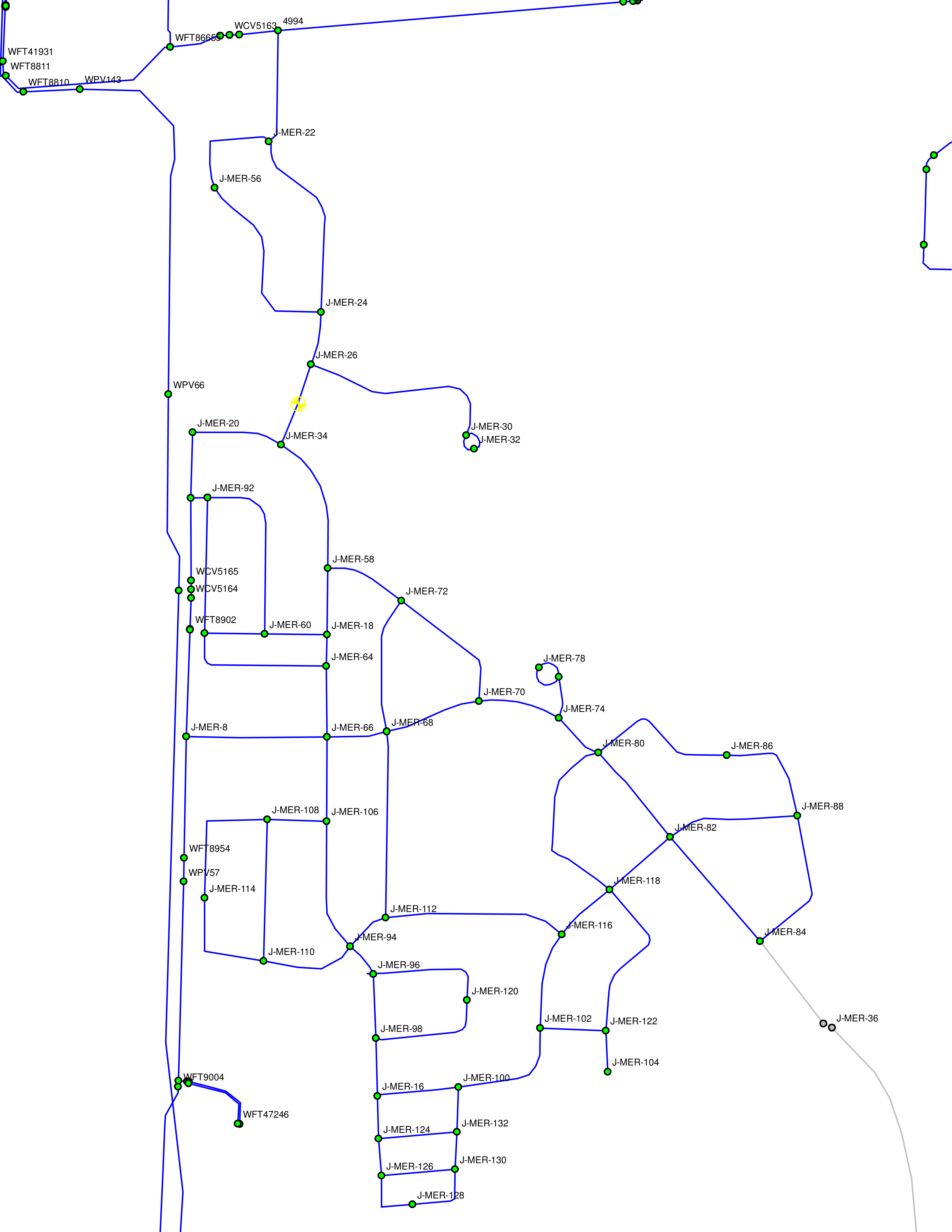
Type of Development	Size of Pipe (mm Dia.)
Residential	100
Commercial/Industrial/Community	300

Working Pressures

Parameter	Pressure
Normal Condition	
Minimum Pressure	275 kPa (40 psi)
Target Pressure	310 kPa (45 psi)
Maximum (Building Code)	550 kPa (80 psi)
Maximum (Halton)	690 kPa (100 psi)
Fire Flow Conditions	
Minimum Pressure	140 kPa (20 psi)

Hydraulic Analysis - Water Demand Calculations
Bronte Green Development (Oakville, ON)
Revision Date: April 16, 2015

Node #	Phase	Elevation	Area by Type of Development							Equivalent Population		Water Demands		
			Single Family	Semi-Detached	Townhouse	Apartment	Commercial	Community	Industrial	Total Population	Total Population	ADF	MDD	MHD
		(m)	*(units)*	*(units)*	*(units)*	*(units)*	*(ha)*	*(ha)*	*(ha)*	*(Residential)*	*(ICI)*	*(L/s)*	*(L/s)*	*(L/s)*
J-MER-16	1	126.13	4		11					42	0	0.13	0.30	0.53
J-MER-18	1	127.96	6		4					31	0	0.10	0.22	0.40
J-MER-20	1	129.68								0	0	0.00	0.00	0.00
J-MER-22	1	130.54	23							80	0	0.25	0.57	1.02
J-MER-24	1	128.97	28							97	0	0.31	0.70	1.24
J-MER-26	1	128.69	3							10	0	0.03	0.07	0.13
J-MER-30	1	129.94	11							38	0	0.12	0.27	0.49
J-MER-32	1									0	0	0.00	0.00	0.00
J-MER-34	1	129.07	18							62	0	0.20	0.45	0.80
J-MER-56	1	130.56	15							52	0	0.17	0.37	0.66
J-MER-58	1	128.22	5							17	0	0.06	0.12	0.22
J-MER-60	1	128.79	20		10					95	0	0.30	0.68	1.21
J-MER-62	1	129.61			21					54	0	0.17	0.38	0.68
J-MER-64	1	127.83	6		9					44	0	0.14	0.31	0.56
J-MER-66	1	127.98	7				*1.62*			24	146	0.54	1.22	1.35
J-MER-68	1	127.42	21							73	0	0.23	0.52	0.93
J-MER-70	1	126.88	16							56	0	0.18	0.40	0.71
J-MER-72	1	127.70	27							94	0	0.30	0.67	1.19
J-MER-74	1	126.40	5							17	0	0.06	0.12	0.22
J-MER-76	1	126.65	4							14	0	0.04	0.10	0.18
J-MER-78	1	126.65								0	0	0.00	0.00	0.00
J-MER-8	1	130.09								0	0	0.00	0.00	0.00
J-MER-80	1	126.10	16							56	0	0.18	0.40	0.71
J-MER-82	1	125.42	20							69	0	0.22	0.50	0.88
J-MER-84	1	125.04	21							73	0	0.23	0.52	0.93
J-MER-86	1	126.21	22							76	0	0.24	0.55	0.97
J-MER-88	1	125.55	19							66	0	0.21	0.47	0.84
J-MER-92	1	130.05	10		8					55	0	0.18	0.40	0.70
J-MER-94	1	126.84	20		7					87	0	0.28	0.63	1.11
J-MER-96	1	126.87	9		2					36	0	0.12	0.26	0.46
J-MER-98	1	126.50	6		8					41	0	0.13	0.30	0.53
J-MER-100	1	125.70	7		8					45	0	0.14	0.32	0.57
J-MER-102	1	125.00	19							66	0	0.21	0.47	0.84
J-MER-104	1	124.35	8							28	0	0.09	0.20	0.35
J-MER-106	1	127.51	12		3					49	0	0.16	0.35	0.63
J-MER-108	1	129.12	14		9					72	0	0.23	0.51	0.91
J-MER-110	1	129.23	12		8					62	0	0.20	0.44	0.79
J-MER-112	1	126.49	25							87	0	0.28	0.62	1.11
J-MER-114	1	131.14			26					66	0	0.21	0.48	0.85
J-MER-116	1	125.39	15							52	0	0.17	0.37	0.66
J-MER-118	1	125.01	19							66	0	0.21	0.47	0.84
J-MER-120	1	126.61	23							80	0	0.25	0.57	1.02
J-MER-122	1	124.61	15							52	0	0.17	0.37	0.66
J-MER-124	1	126.27			16					41	0	0.13	0.29	0.52
J-MER-126	1	126.40			19					49	0	0.15	0.35	0.62
J-MER-128	1	126.37			27					69	0	0.22	0.49	0.88
J-MER-130	1	126.02			17					43	0	0.14	0.31	0.55
J-MER-132	1	125.89			16					41	0	0.13	0.29	0.52
TOTAL			**531**	**0**	**229**	**0**	**2**	**0**	**0**	**2429**	**146**	**8.19**	**18.44**	**31.97**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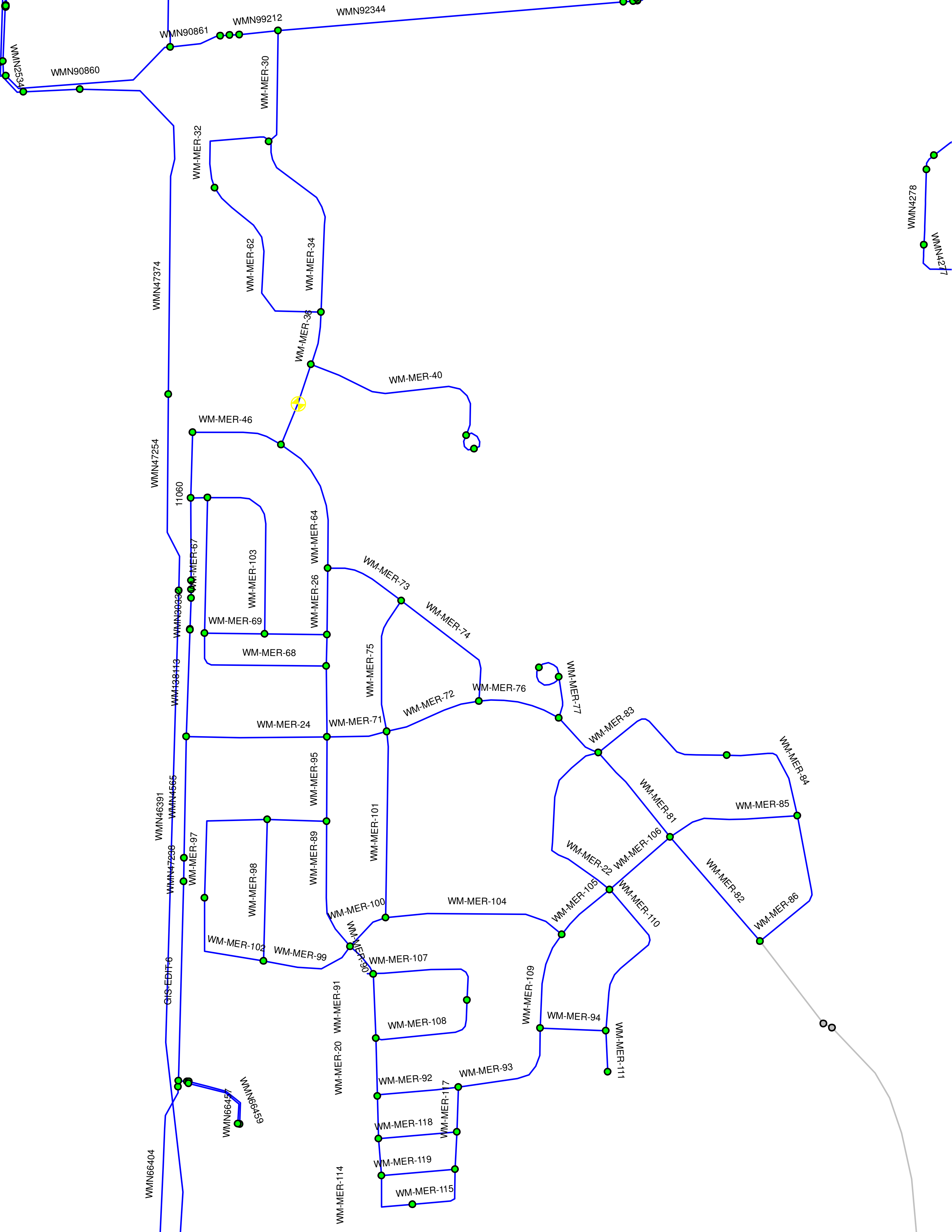
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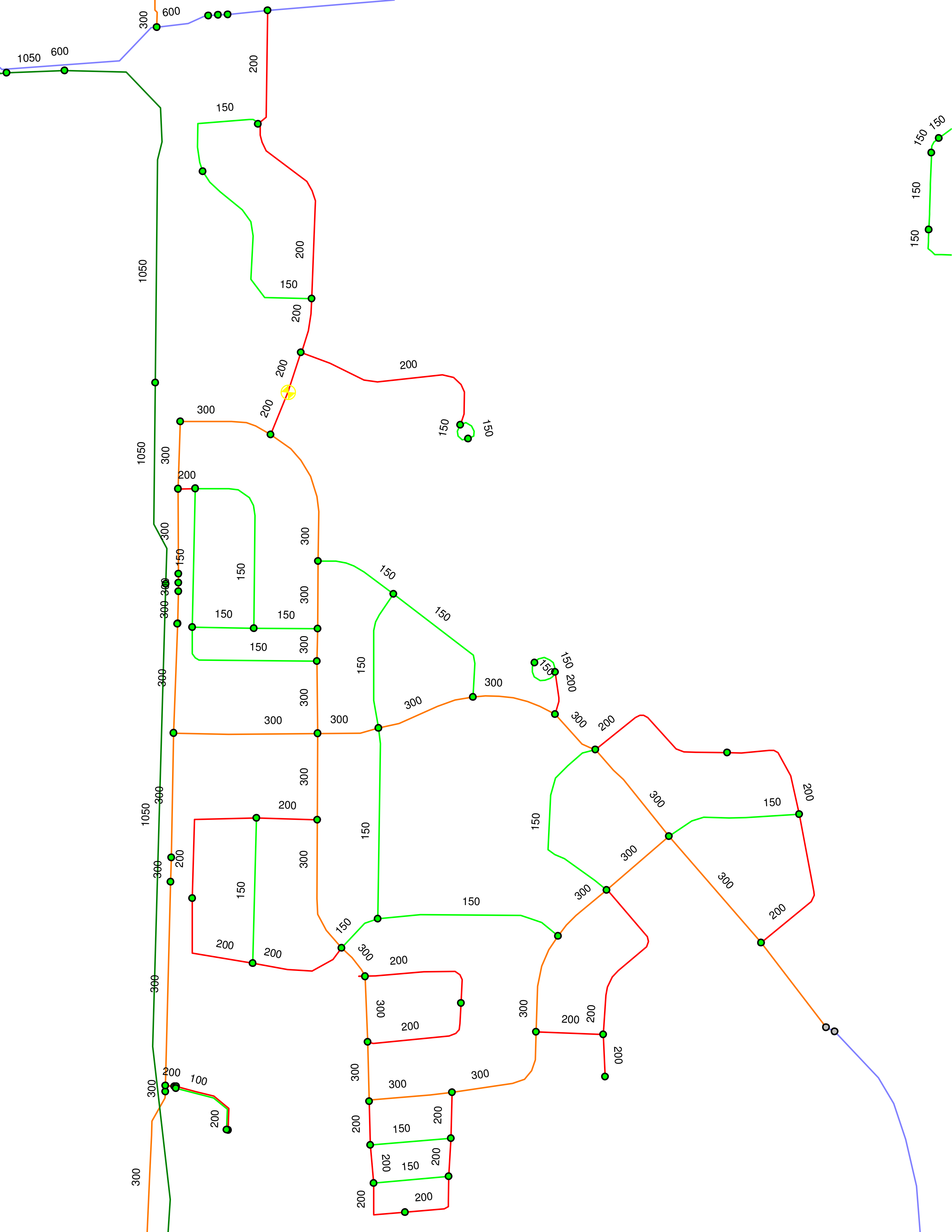

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Appendix B

MODEL RESULTS

Hydraulic Analysis - 2016 Conditions
Bronte Green Development (Oakville, ON)
Revision Date: April 16, 2015

Average Day

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	(m)	(m)	(psi)
4994	0	130.7	215.78	120.95
J-MER-22	0.25	130.54	215.78	121.17
J-MER-24	0.31	128.97	215.78	123.4
J-MER-26	0.03	128.69	215.78	123.8
J-MER-30	0.12	129.94	215.78	122.03
J-MER-32	0	130.03	215.78	121.9
J-MER-56	0.17	130.56	215.78	121.14
WFT17729	0.02	127.48	176.18	69.24
J-MER-98	0.13	126.5	176.18	70.63
J-MER-96	0.12	126.87	176.18	70.1
J-MER-94	0.28	126.84	176.18	70.14
J-MER-92	0.18	130.05	176.18	65.58
J-MER-88	0.21	125.55	176.18	71.98
J-MER-86	0.24	126.21	176.18	71.04
J-MER-84	0.23	125.04	176.18	72.7
J-MER-82	0.22	125.42	176.18	72.16
J-MER-80	0.18	126.1	176.18	71.19
J-MER-8	0	130.09	176.19	65.53
J-MER-78	0	126.65	176.18	70.41
J-MER-76	0.04	126.65	176.18	70.41
J-MER-74	0.06	126.4	176.18	70.77
J-MER-72	0.3	127.7	176.18	68.92
J-MER-70	0.18	126.88	176.18	70.09
J-MER-68	0.23	127.42	176.18	69.32
J-MER-66	0.54	127.98	176.18	68.52
J-MER-64	0.14	127.83	176.18	68.74
J-MER-62	0.17	129.61	176.18	66.21
J-MER-60	0.3	128.79	176.18	67.37
J-MER-58	0.06	128.22	176.18	68.18
J-MER-34	0.2	129.07	176.18	66.98
J-MER-20	0	129.68	176.18	66.11
J-MER-18	0.1	127.96	176.18	68.55
J-MER-16	0.13	126.13	176.18	71.15
J-MER-132	0.13	125.89	176.18	71.49
J-MER-130	0.14	126.02	176.18	71.31
J-MER-128	0.22	126.37	176.18	70.81
J-MER-126	0.15	126.4	176.18	70.77
J-MER-124	0.13	126.27	176.18	70.95
J-MER-122	0.17	124.61	176.18	73.31
J-MER-120	0.25	126.61	176.18	70.47
J-MER-118	0.21	125.01	176.18	72.74
J-MER-116	0.17	125.39	176.18	72.2
J-MER-114	0.21	131.14	176.18	64.03
J-MER-112	0.28	126.49	176.18	70.64
J-MER-110	0.2	129.23	176.18	66.75
J-MER-108	0.23	129.12	176.18	66.9
J-MER-106	0.16	127.51	176.18	69.19
J-MER-104	0.09	124.35	176.18	73.68
J-MER-102	0.21	125	176.18	72.76
J-MER-100	0.14	125.7	176.18	71.76

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)	(C)	(MLD)	(m/s)
WM-MER-30	4994	J-MER-22	131.59	200	110	0.08	0.03
WM-MER-32	J-MER-22	J-MER-56	338.30	150	100	0.01	0.01
WM-MER-34	J-MER-22	J-MER-24	228.52	200	110	0.04	0.01
WM-MER-36	J-MER-24	J-MER-26	63.19	200	110	0.01	0
WM-MER-40	J-MER-26	J-MER-30	243.16	200	110	0.01	0
WM-MER-42	J-MER-30	J-MER-32	26.97	150	100	0	0
WM-MER-44	J-MER-30	J-MER-32	33.77	150	100	0	0
WM-MER-62	J-MER-56	J-MER-24	227.23	150	100	0	0
11060	J-MER-20	WFT17729	77.11	300	120	-0.15	0.02
WM-MER-100	J-MER-94	J-MER-112	54.79	150	100	0.01	0.01
WM-MER-101	J-MER-112	J-MER-68	219.02	150	100	-0.02	0.02
WM-MER-102	J-MER-114	J-MER-110	133.53	200	110	0.01	0
WM-MER-103	J-MER-92	J-MER-60	216.67	150	100	0.02	0.02
WM-MER-104	J-MER-112	J-MER-116	214.67	150	100	0.01	0.01
WM-MER-105	J-MER-116	J-MER-118	77.26	300	120	-0.03	0.01
WM-MER-106	J-MER-118	J-MER-82	94.56	300	120	-0.05	0.01
WM-MER-107	J-MER-96	J-MER-120	157.67	200	110	0.02	0.01
WM-MER-108	J-MER-98	J-MER-120	138.67	200	110	0	0
WM-MER-109	J-MER-102	J-MER-116	115.17	300	120	-0.03	0
WM-MER-110	J-MER-118	J-MER-122	202.99	200	110	0.01	0
WM-MER-111	J-MER-122	J-MER-104	48.33	200	110	0.01	0
WM-MER-112	J-MER-16	J-MER-124	50.17	200	110	0.04	0.01
WM-MER-113	J-MER-124	J-MER-126	43.66	200	110	0.02	0.01
WM-MER-114	J-MER-126	J-MER-128	73.25	200	110	0.01	0
WM-MER-115	J-MER-128	J-MER-130	85.57	200	110	-0.01	0
WM-MER-116	J-MER-130	J-MER-132	43.72	200	110	-0.02	0.01
WM-MER-117	J-MER-132	J-MER-100	52.81	200	110	-0.03	0.01
WM-MER-118	J-MER-124	J-MER-132	92.73	150	100	0	0
WM-MER-119	J-MER-126	J-MER-130	86.73	150	100	0	0
WM-MER-120	J-MER-64	J-MER-66	83.02	300	120	0.09	0.01
WM-MER-20	J-MER-16	J-MER-98	68.31	300	120	-0.09	0.01
WM-MER-22	J-MER-118	J-MER-80	223.31	150	100	-0.01	0.01
WM-MER-24	J-MER-8	J-MER-66	165.59	300	120	0.41	0.07
WM-MER-26	J-MER-58	J-MER-18	77.89	300	120	0.1	0.02
WM-MER-46	J-MER-20	J-MER-34	107.27	300	120	0.15	0.02
WM-MER-48	WFT17729	J-MER-92	19.54	200	110	0.07	0.03
WM-MER-64	J-MER-34	J-MER-58	165.86	300	120	0.13	0.02
WM-MER-66	J-MER-60	J-MER-18	73.43	150	100	0	0
WM-MER-67	J-MER-62	J-MER-92	159.36	150	100	-0.03	0.02
WM-MER-68	J-MER-64	J-MER-62	176.84	150	100	-0.01	0
WM-MER-69	J-MER-60	J-MER-62	70.78	150	100	-0.01	0
WM-MER-70	J-MER-64	J-MER-18	37.05	300	120	-0.09	0.01
WM-MER-71	J-MER-66	J-MER-68	70.77	300	120	0.21	0.04
WM-MER-72	J-MER-68	J-MER-70	114.86	300	120	0.16	0.03
WM-MER-73	J-MER-58	J-MER-72	97.78	150	100	0.03	0.02
WM-MER-74	J-MER-72	J-MER-70	163.84	150	100	0.02	0.01
WM-MER-75	J-MER-72	J-MER-68	161.1	150	100	-0.01	0.01
WM-MER-76	J-MER-70	J-MER-74	98.05	300	120	0.16	0.03
WM-MER-77	J-MER-76	J-MER-74	49.46	200	110	0	0
WM-MER-78	J-MER-78	J-MER-76	35.57	150	100	0	0
WM-MER-79	J-MER-78	J-MER-76	46.87	150	100	0	0
WM-MER-80	J-MER-80	J-MER-74	62.63	300	120	-0.15	0.03
WM-MER-81	J-MER-82	J-MER-80	130.89	300	120	-0.1	0.02
WM-MER-82	J-MER-82	J-MER-84	161.73	300	120	0.03	0
WM-MER-83	J-MER-80	J-MER-86	181.81	200	110	0.03	0.01

Average Day

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	(m)	(m)	(psi)
O2				
MIN		**124.35**		**64.03**
MAX		**131.14**		**73.68**
O3				
MIN		**128.69**		**120.95**
MAX		**130.7**		**123.8**

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)	(C)	(MLD)	(m/s)
WM-MER-84	J-MER-86	J-MER-88	134.95	200	110	0.01	0
WM-MER-85	J-MER-88	J-MER-82	155.83	150	100	0	0
WM-MER-86	J-MER-88	J-MER-84	177.39	200	110	-0.01	0
WM-MER-89	J-MER-106	J-MER-94	156.2	300	120	0.16	0.03
WM-MER-90	J-MER-94	J-MER-96	42.83	300	120	0.13	0.02
WM-MER-91	J-MER-98	J-MER-96	75	300	120	-0.1	0.02
WM-MER-92	J-MER-16	J-MER-100	100.86	300	120	0.04	0.01
WM-MER-93	J-MER-100	J-MER-102	143.17	300	120	0	0
WM-MER-94	J-MER-102	J-MER-122	77.46	200	110	0.01	0
WM-MER-95	J-MER-66	J-MER-106	99.18	300	120	0.24	0.04
WM-MER-96	J-MER-106	J-MER-108	69.88	200	110	0.06	0.02
WM-MER-97	J-MER-108	J-MER-114	161.74	200	110	0.03	0.01
WM-MER-98	J-MER-110	J-MER-108	166.74	150	100	-0.01	0.01
WM-MER-99	J-MER-110	J-MER-94	113	200	110	0.01	0

Hydraulic Analysis - 2016 Conditions
Bronte Green Development (Oakville, ON)
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Maximum Day

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	*(m)*	*(m)*	*(psi)*
4994	0	130.7	198.12	95.85
J-MER-22	0.57	130.54	198.12	96.07
J-MER-24	0.7	128.97	198.11	98.3
J-MER-26	0.07	128.69	198.11	98.69
J-MER-30	0.27	129.94	198.11	96.92
J-MER-32	0	130.03	198.11	96.79
J-MER-56	0.37	130.56	198.11	96.03
J-MER-100	0.32	125.7	169.56	62.35
J-MER-102	0.47	125	169.56	63.34
J-MER-104	0.2	124.35	169.56	64.26
J-MER-106	0.35	127.51	169.56	59.78
J-MER-108	0.51	129.12	169.56	57.49
J-MER-110	0.44	129.23	169.56	57.33
J-MER-112	0.62	126.49	169.56	61.22
J-MER-114	0.48	131.14	169.56	54.61
J-MER-116	0.37	125.39	169.56	62.79
J-MER-118	0.47	125.01	169.56	63.33
J-MER-120	0.57	126.61	169.56	61.05
J-MER-122	0.37	124.61	169.56	63.89
J-MER-124	0.29	126.27	169.56	61.53
J-MER-126	0.35	126.4	169.56	61.35
J-MER-128	0.49	126.37	169.56	61.39
J-MER-130	0.31	126.02	169.56	61.89
J-MER-132	0.29	125.89	169.56	62.07
J-MER-16	0.3	126.13	169.56	61.73
J-MER-18	0.22	127.96	169.57	59.15
J-MER-20	0	129.68	169.57	56.71
J-MER-34	0.45	129.07	169.57	57.57
J-MER-58	0.12	128.22	169.57	58.78
J-MER-60	0.68	128.79	169.57	57.97
J-MER-62	0.38	129.61	169.57	56.8
J-MER-64	0.31	127.83	169.57	59.33
J-MER-66	1.22	127.98	169.57	59.12
J-MER-68	0.52	127.42	169.56	59.91
J-MER-70	0.4	126.88	169.56	60.67
J-MER-72	0.67	127.7	169.56	59.51
J-MER-74	0.12	126.4	169.56	61.35
J-MER-76	0.1	126.65	169.56	61
J-MER-78	0	126.65	169.56	61
J-MER-8	0	130.09	169.59	56.15
J-MER-80	0.4	126.1	169.56	61.78
J-MER-82	0.5	125.42	169.56	62.74
J-MER-84	0.52	125.04	169.56	63.28
J-MER-86	0.55	126.21	169.56	61.62
J-MER-88	0.47	125.55	169.56	62.56
J-MER-92	0.4	130.05	169.57	56.18
J-MER-94	0.63	126.84	169.56	60.73
J-MER-96	0.26	126.87	169.56	60.68
J-MER-98	0.3	126.5	169.56	61.21
WFT17729	0.03	127.48	169.57	59.84

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	*(mm)*	*(C)*	*(MLD)*	*(m/s)*
WM-MER-30	4994	J-MER-22	131.59	200	110	0.17	*0.06*
WM-MER-32	J-MER-22	J-MER-56	338.30	150	100	0.03	*0.02*
WM-MER-34	J-MER-22	J-MER-24	228.52	200	110	0.09	*0.03*
WM-MER-36	J-MER-24	J-MER-26	63.19	200	110	0.03	*0.01*
WM-MER-40	J-MER-26	J-MER-30	243.16	200	110	0.02	*0.01*
WM-MER-42	J-MER-30	J-MER-32	26.97	150	100	0	*0*
WM-MER-44	J-MER-30	J-MER-32	33.77	150	100	0	*0*
WM-MER-62	J-MER-56	J-MER-24	227.23	150	100	0	*0*
11060	J-MER-20	WFT17729	77.11	300	120	-0.34	*0.06*
WM-MER-100	J-MER-94	J-MER-112	54.79	150	100	0.03	*0.02*
WM-MER-101	J-MER-112	J-MER-68	219.02	150	100	-0.05	*0.04*
WM-MER-102	J-MER-114	J-MER-110	133.53	200	110	0.02	*0.01*
WM-MER-103	J-MER-92	J-MER-60	216.67	150	100	0.06	*0.04*
WM-MER-104	J-MER-112	J-MER-116	214.67	150	100	0.03	*0.02*
WM-MER-105	J-MER-116	J-MER-118	77.26	300	120	-0.07	*0.01*
WM-MER-106	J-MER-118	J-MER-82	94.56	300	120	-0.11	*0.02*
WM-MER-107	J-MER-96	J-MER-120	157.67	200	110	0.05	*0.02*
WM-MER-108	J-MER-98	J-MER-120	138.67	200	110	0	*0*
WM-MER-109	J-MER-102	J-MER-116	115.17	300	120	-0.06	*0.01*
WM-MER-110	J-MER-118	J-MER-122	202.99	200	110	0.03	*0.01*
WM-MER-111	J-MER-122	J-MER-104	48.33	200	110	0.02	*0.01*
WM-MER-112	J-MER-16	J-MER-124	50.17	200	110	0.08	*0.03*
WM-MER-113	J-MER-124	J-MER-126	43.66	200	110	0.05	*0.02*
WM-MER-114	J-MER-126	J-MER-128	73.25	200	110	0.02	*0.01*
WM-MER-115	J-MER-128	J-MER-130	85.57	200	110	-0.02	*0.01*
WM-MER-116	J-MER-130	J-MER-132	43.72	200	110	-0.05	*0.02*
WM-MER-117	J-MER-132	J-MER-100	52.81	200	110	-0.07	*0.02*
WM-MER-118	J-MER-124	J-MER-132	92.73	150	100	0.01	0
WM-MER-119	J-MER-126	J-MER-130	86.73	150	100	0	0
WM-MER-120	J-MER-64	J-MER-66	83.02	300	120	0.2	0.03
WM-MER-20	J-MER-16	J-MER-98	68.31	300	120	-0.2	0.03
WM-MER-22	J-MER-118	J-MER-80	223.31	150	100	-0.02	0.02
WM-MER-24	J-MER-8	J-MER-66	165.59	300	120	0.93	0.15
WM-MER-26	J-MER-58	J-MER-18	77.89	300	120	0.21	0.04
WM-MER-46	J-MER-20	J-MER-34	107.27	300	120	0.34	0.06
WM-MER-48	WFT17729	J-MER-92	19.54	200	110	0.15	0.06
WM-MER-64	J-MER-34	J-MER-58	165.86	300	120	0.3	0.05
WM-MER-66	J-MER-60	J-MER-18	73.43	150	100	0.01	0.01
WM-MER-67	J-MER-62	J-MER-92	159.36	150	100	-0.06	0.04
WM-MER-68	J-MER-64	J-MER-62	176.84	150	100	-0.02	0.01
WM-MER-69	J-MER-60	J-MER-62	70.78	150	100	-0.01	0.01
WM-MER-70	J-MER-64	J-MER-18	37.05	300	120	-0.21	0.03
WM-MER-71	J-MER-66	J-MER-68	70.77	300	120	0.48	0.08
WM-MER-72	J-MER-68	J-MER-70	114.86	300	120	0.36	0.06
WM-MER-73	J-MER-58	J-MER-72	97.78	150	100	0.07	0.05
WM-MER-74	J-MER-72	J-MER-70	163.84	150	100	0.04	0.02
WM-MER-75	J-MER-72	J-MER-68	161.1	150	100	-0.02	0.01
WM-MER-76	J-MER-70	J-MER-74	98.05	300	120	0.36	0.06
WM-MER-77	J-MER-76	J-MER-74	49.46	200	110	-0.01	0
WM-MER-78	J-MER-78	J-MER-76	35.57	150	100	0	0
WM-MER-79	J-MER-78	J-MER-76	46.87	150	100	0	0
WM-MER-80	J-MER-80	J-MER-74	62.63	300	120	-0.34	0.06
WM-MER-81	J-MER-82	J-MER-80	130.89	300	120	-0.22	0.04
WM-MER-82	J-MER-82	J-MER-84	161.73	300	120	0.06	0.01
WM-MER-83	J-MER-80	J-MER-86	181.81	200	110	0.06	0.02

Hydraulic Analysis - 2016 Conditions
Bronte Green Development (Oakville, ON)
Revision Date: April 16, 2015

Maximum Day

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	(m)	(m)	(psi)
O2				
MIN		**124.35**		**54.61**
MAX		**131.14**		**64.26**
O3				
MIN		**128.69**		**95.85**
MAX		**130.7**		**98.69**

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)	(C)	(MLD)	(m/s)
WM-MER-84	J-MER-86	J-MER-88	134.95	200	110	0.02	0.01
WM-MER-85	J-MER-88	J-MER-82	155.83	150	100	-0.01	0.01
WM-MER-86	J-MER-88	J-MER-84	177.39	200	110	-0.01	0.01
WM-MER-89	J-MER-106	J-MER-94	156.2	300	120	0.37	0.06
WM-MER-90	J-MER-94	J-MER-96	42.83	300	120	0.3	0.05
WM-MER-91	J-MER-98	J-MER-96	75	300	120	-0.23	0.04
WM-MER-92	J-MER-16	J-MER-100	100.86	300	120	0.1	0.02
WM-MER-93	J-MER-100	J-MER-102	143.17	300	120	0	0
WM-MER-94	J-MER-102	J-MER-122	77.46	200	110	0.02	0.01
WM-MER-95	J-MER-66	J-MER-106	99.18	300	120	0.54	0.09
WM-MER-96	J-MER-106	J-MER-108	69.88	200	110	0.14	0.05
WM-MER-97	J-MER-108	J-MER-114	161.74	200	110	0.06	0.02
WM-MER-98	J-MER-110	J-MER-108	166.74	150	100	-0.03	0.02
WM-MER-99	J-MER-110	J-MER-94	113	200	110	0.01	0

Hydraulic Analysis - 2016 Conditions
Bronte Green Development (Oakville, ON)
Revision Date: April 16, 2015

Maximum Hour

Node Table

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
4994	0	130.7	204.33	104.67
J-MER-22	1.02	130.54	204.31	104.87
J-MER-24	1.24	128.97	204.3	107.09
J-MER-26	0.13	128.69	204.3	107.49
J-MER-30	0.49	129.94	204.3	105.71
J-MER-32	0	130.03	204.3	105.58
J-MER-56	0.66	130.56	204.3	104.83
J-MER-100	0.57	125.7	168.78	61.24
J-MER-102	0.84	125	168.78	62.24
J-MER-104	0.35	124.35	168.78	63.16
J-MER-106	0.63	127.51	168.79	58.69
J-MER-108	0.91	129.12	168.79	56.39
J-MER-110	0.79	129.23	168.78	56.23
J-MER-112	1.11	126.49	168.78	60.12
J-MER-114	0.85	131.14	168.79	53.52
J-MER-116	0.66	125.39	168.78	61.68
J-MER-118	0.84	125.01	168.78	62.22
J-MER-120	1.02	126.61	168.78	59.95
J-MER-122	0.66	124.61	168.78	62.79
J-MER-124	0.52	126.27	168.78	60.43
J-MER-126	0.62	126.4	168.78	60.24
J-MER-128	0.88	126.37	168.78	60.29
J-MER-130	0.55	126.02	168.78	60.78
J-MER-132	0.52	125.89	168.78	60.97
J-MER-16	0.53	126.13	168.78	60.63
J-MER-18	0.4	127.96	168.81	58.07
J-MER-20	0	129.68	168.82	55.65
J-MER-34	0.8	129.07	168.82	56.5
J-MER-58	0.22	128.22	168.81	57.7
J-MER-60	1.21	128.79	168.81	56.89
J-MER-62	0.68	129.61	168.81	55.73
J-MER-64	0.56	127.83	168.81	58.25
J-MER-66	1.35	127.98	168.81	58.04
J-MER-68	0.93	127.42	168.8	58.82
J-MER-70	0.71	126.88	168.79	59.58
J-MER-72	1.19	127.7	168.8	58.42
J-MER-74	0.22	126.4	168.79	60.26

Pipe Table

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness (C)	Flow (MLD)	Velocity (m/s)
WM-MER-30	4994	J-MER-22	131.59	200	110	0.31	0.11
WM-MER-32	J-MER-22	J-MER-56	338.30	150	100	0.06	0.04
WM-MER-34	J-MER-22	J-MER-24	228.52	200	110	0.16	0.06
WM-MER-36	J-MER-24	J-MER-26	63.19	200	110	0.05	0.02
WM-MER-40	J-MER-26	J-MER-30	243.16	200	110	0.04	0.02
WM-MER-42	J-MER-30	J-MER-32	26.97	150	100	0	0
WM-MER-44	J-MER-30	J-MER-32	33.77	150	100	0	0
WM-MER-62	J-MER-56	J-MER-24	227.23	150	100	0	0
11060	J-MER-20	WFT17729	77.11	300	120	-0.59	0.1
WM-MER-100	J-MER-94	J-MER-112	54.79	150	100	0.05	0.03
WM-MER-101	J-MER-112	J-MER-68	219.02	150	100	-0.1	0.06
WM-MER-102	J-MER-114	J-MER-110	133.53	200	110	0.04	0.02
WM-MER-103	J-MER-92	J-MER-60	216.67	150	100	0.1	0.06
WM-MER-104	J-MER-112	J-MER-116	214.67	150	100	0.05	0.03
WM-MER-105	J-MER-116	J-MER-118	77.26	300	120	-0.12	0.02
WM-MER-106	J-MER-118	J-MER-82	94.56	300	120	-0.2	0.03
WM-MER-107	J-MER-96	J-MER-120	157.67	200	110	0.09	0.03
WM-MER-108	J-MER-98	J-MER-120	138.67	200	110	0	0
WM-MER-109	J-MER-102	J-MER-116	115.17	300	120	-0.11	0.02
WM-MER-110	J-MER-118	J-MER-122	202.99	200	110	0.04	0.02
WM-MER-111	J-MER-122	J-MER-104	48.33	200	110	0.03	0.01
WM-MER-112	J-MER-16	J-MER-124	50.17	200	110	0.15	0.05
WM-MER-113	J-MER-124	J-MER-126	43.66	200	110	0.09	0.03
WM-MER-114	J-MER-126	J-MER-128	73.25	200	110	0.04	0.01
WM-MER-115	J-MER-128	J-MER-130	85.57	200	110	-0.04	0.01
WM-MER-116	J-MER-130	J-MER-132	43.72	200	110	-0.08	0.03
WM-MER-117	J-MER-132	J-MER-100	52.81	200	110	-0.12	0.04
WM-MER-118	J-MER-124	J-MER-132	92.73	150	100	0.01	0.01
WM-MER-119	J-MER-126	J-MER-130	86.73	150	100	0	0
WM-MER-120	J-MER-64	J-MER-66	83.02	300	120	0.33	0.05
WM-MER-20	J-MER-16	J-MER-98	68.31	300	120	-0.36	0.06
WM-MER-22	J-MER-118	J-MER-80	223.31	150	100	-0.04	0.03
WM-MER-24	J-MER-8	J-MER-66	165.59	300	120	1.6	0.26
WM-MER-26	J-MER-58	J-MER-18	77.89	300	120	0.37	0.06
WM-MER-46	J-MER-20	J-MER-34	107.27	300	120	0.59	0.1
WM-MER-48	WFT17729	J-MER-92	19.54	200	110	0.27	0.1
WM-MER-64	J-MER-34	J-MER-58	165.86	300	120	0.52	0.08

Maximum Hour

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	(m)	(m)	(psi)
J-MER-76	0.18	126.65	168.79	59.9
J-MER-78	0	126.65	168.79	59.9
J-MER-8	0	130.09	168.86	55.12
J-MER-80	0.71	126.1	168.78	60.68
J-MER-82	0.88	125.42	168.78	61.64
J-MER-84	0.93	125.04	168.78	62.18
J-MER-86	0.97	126.21	168.78	60.52
J-MER-88	0.84	125.55	168.78	61.45
J-MER-92	0.7	130.05	168.83	55.12
J-MER-94	1.11	126.84	168.78	59.63
J-MER-96	0.46	126.87	168.78	59.58
J-MER-98	0.53	126.5	168.78	60.11
WFT17729	0.05	127.48	168.83	58.78
O2				
MIN		**124.35**		**53.52**
MAX		**131.14**		**63.16**
O3				
MIN		**128.69**		**104.67**
MAX		**130.7**		**107.49**

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)	(C)	(MLD)	(m/s)
WM-MER-66	J-MER-60	J-MER-18	73.43	150	100	0.02	0.01
WM-MER-67	J-MER-62	J-MER-92	159.36	150	100	-0.11	0.07
WM-MER-68	J-MER-64	J-MER-62	176.84	150	100	-0.03	0.02
WM-MER-69	J-MER-60	J-MER-62	70.78	150	100	-0.02	0.02
WM-MER-70	J-MER-64	J-MER-18	37.05	300	120	-0.35	0.06
WM-MER-71	J-MER-66	J-MER-68	70.77	300	120	0.86	0.14
WM-MER-72	J-MER-68	J-MER-70	114.86	300	120	0.65	0.11
WM-MER-73	J-MER-58	J-MER-72	97.78	150	100	0.13	0.09
WM-MER-74	J-MER-72	J-MER-70	163.84	150	100	0.06	0.04
WM-MER-75	J-MER-72	J-MER-68	161.1	150	100	-0.03	0.02
WM-MER-76	J-MER-70	J-MER-74	98.05	300	120	0.65	0.11
WM-MER-77	J-MER-76	J-MER-74	49.46	200	110	-0.02	0.01
WM-MER-78	J-MER-78	J-MER-76	35.57	150	100	0	0
WM-MER-79	J-MER-78	J-MER-76	46.87	150	100	0	0
WM-MER-80	J-MER-80	J-MER-74	62.63	300	120	-0.61	0.1
WM-MER-81	J-MER-82	J-MER-80	130.89	300	120	-0.4	0.06
WM-MER-82	J-MER-82	J-MER-84	161.73	300	120	0.11	0.02
WM-MER-83	J-MER-80	J-MER-86	181.81	200	110	0.11	0.04
WM-MER-84	J-MER-86	J-MER-88	134.95	200	110	0.03	0.01
WM-MER-85	J-MER-88	J-MER-82	155.83	150	100	-0.02	0.01
WM-MER-86	J-MER-88	J-MER-84	177.39	200	110	-0.03	0.01
WM-MER-89	J-MER-106	J-MER-94	156.2	300	120	0.66	0.11
WM-MER-90	J-MER-94	J-MER-96	42.83	300	120	0.54	0.09
WM-MER-91	J-MER-98	J-MER-96	75	300	120	-0.41	0.07
WM-MER-92	J-MER-16	J-MER-100	100.86	300	120	0.17	0.03
WM-MER-93	J-MER-100	J-MER-102	143.17	300	120	0	0
WM-MER-94	J-MER-102	J-MER-122	77.46	200	110	0.04	0.02
WM-MER-95	J-MER-66	J-MER-106	99.18	300	120	0.96	0.16
WM-MER-96	J-MER-106	J-MER-108	69.88	200	110	0.24	0.09
WM-MER-97	J-MER-108	J-MER-114	161.74	200	110	0.11	0.04
WM-MER-98	J-MER-110	J-MER-108	166.74	150	100	-0.05	0.03
WM-MER-99	J-MER-110	J-MER-94	113	200	110	0.02	0.01

Fire Flow Table

ID	Total Demand (L/s)	Available Flow (L/s)	Fire Flow Met?
J-MER-100	136.32	224	TRUE
J-MER-102	91.47	226.17	TRUE
J-MER-104	91.2	177.25	TRUE
J-MER-106	136.35	228.28	TRUE
J-MER-108	136.51	196.23	TRUE
J-MER-110	136.44	190.15	TRUE
J-MER-112	91.62	178.82	TRUE
J-MER-114	136.48	170.83	TRUE
J-MER-116	91.37	224.8	TRUE
J-MER-118	91.47	226.95	TRUE
J-MER-120	91.57	194.22	TRUE
J-MER-122	91.37	203.33	TRUE
J-MER-124	136.29	206.6	TRUE
J-MER-126	136.35	197.63	TRUE
J-MER-128	136.49	188.46	TRUE
J-MER-130	136.31	198.6	TRUE
J-MER-132	136.29	207.34	TRUE
J-MER-16	136.3	223.47	TRUE
J-MER-18	136.22	233.7	TRUE
J-MER-20	91	229.28	TRUE
J-MER-22	91.57	267.19	TRUE
J-MER-24	91.7	181.92	TRUE
J-MER-26	91.07	163.18	TRUE
J-MER-30	91.27	121.34	TRUE
J-MER-32	91	116.75	TRUE
J-MER-34	91.45	235.95	TRUE
J-MER-56	91.37	126.28	TRUE
J-MER-58	91.12	233.4	TRUE
J-MER-60	136.68	178.6	TRUE
J-MER-62	136.38	168.68	TRUE
J-MER-64	136.31	234.1	TRUE
J-MER-66	274.22	234.98	FALSE
J-MER-68	91.52	231.38	TRUE
J-MER-70	91.4	227.77	TRUE
J-MER-72	91.67	174.61	TRUE
J-MER-74	91.12	225.49	TRUE
J-MER-76	91.1	188.42	TRUE
J-MER-78	91	162.94	TRUE
J-MER-8	91	231.69	TRUE
J-MER-80	91.4	225.21	TRUE
J-MER-82	91.5	225.71	TRUE
J-MER-84	91.52	216.17	TRUE
J-MER-86	91.55	185.42	TRUE
J-MER-88	91.47	194.3	TRUE
J-MER-92	136.4	215.41	TRUE
J-MER-94	136.63	226.62	TRUE
J-MER-96	136.26	224.34	TRUE
J-MER-98	136.3	223.76	TRUE

Hydraulic Analysis - 2031 Conditions
Bronte Green Development (Oakville, ON)
Revision Date: April 16, 2015

Average Day

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	(m)	(m)	(psi)
4994	0	130.7	205.51	106.35
J-MER-22	0.25	130.54	205.51	106.58
J-MER-24	0.31	128.97	205.51	108.81
J-MER-26	0.03	128.69	205.51	109.21
J-MER-30	0.12	129.94	205.51	107.43
J-MER-32	0	130.03	205.51	107.3
J-MER-56	0.17	130.56	205.51	106.55
J-MER-100	0.14	125.7	176.24	71.84
J-MER-102	0.21	125	176.24	72.84
J-MER-104	0.09	124.35	176.24	73.76
J-MER-106	0.16	127.51	176.24	69.27
J-MER-108	0.23	129.12	176.24	66.98
J-MER-110	0.2	129.23	176.24	66.82
J-MER-112	0.28	126.49	176.24	70.72
J-MER-114	0.21	131.14	176.24	64.11
J-MER-116	0.17	125.39	176.24	72.28
J-MER-118	0.21	125.01	176.24	72.82
J-MER-120	0.25	126.61	176.24	70.55
J-MER-122	0.17	124.61	176.24	73.39
J-MER-124	0.13	126.27	176.24	71.03
J-MER-126	0.15	126.4	176.24	70.84
J-MER-128	0.22	126.37	176.24	70.89
J-MER-130	0.14	126.02	176.24	71.39
J-MER-132	0.13	125.89	176.24	71.57
J-MER-16	0.13	126.13	176.24	71.23
J-MER-18	0.1	127.96	176.24	68.63
J-MER-20	0	129.68	176.24	66.18
J-MER-34	0.2	129.07	176.24	67.05
J-MER-58	0.06	128.22	176.24	68.26
J-MER-60	0.3	128.79	176.24	67.45
J-MER-62	0.17	129.61	176.24	66.28
J-MER-64	0.14	127.83	176.24	68.81
J-MER-66	0.54	127.98	176.24	68.6
J-MER-68	0.23	127.42	176.24	69.4
J-MER-70	0.18	126.88	176.24	70.16
J-MER-72	0.3	127.7	176.24	69
J-MER-74	0.06	126.4	176.24	70.85
J-MER-76	0.04	126.65	176.24	70.49
J-MER-78	0	126.65	176.24	70.49
J-MER-8	0	130.09	176.24	65.6
J-MER-80	0.18	126.1	176.24	71.27
J-MER-82	0.22	125.42	176.24	72.24
J-MER-84	0.23	125.04	176.24	72.78
J-MER-86	0.24	126.21	176.24	71.12
J-MER-88	0.21	125.55	176.24	72.06
J-MER-92	0.18	130.05	176.24	65.66
J-MER-94	0.28	126.84	176.24	70.22
J-MER-96	0.12	126.87	176.24	70.18
J-MER-98	0.13	126.5	176.24	70.7
WFT17729	0.02	127.48	176.24	69.31

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)	(C)	(MLD)	(m/s)
WM-MER-30	4994	J-MER-22	131.59	200	110	0.08	0.03
WM-MER-32	J-MER-22	J-MER-56	338.30	150	100	0.01	0.01
WM-MER-34	J-MER-22	J-MER-24	228.52	200	110	0.04	0.01
WM-MER-36	J-MER-24	J-MER-26	63.19	200	110	0.01	0
WM-MER-40	J-MER-26	J-MER-30	243.16	200	110	0.01	0
WM-MER-42	J-MER-30	J-MER-32	26.97	150	100	0	0
WM-MER-44	J-MER-30	J-MER-32	33.77	150	100	0	0
WM-MER-62	J-MER-56	J-MER-24	227.23	150	100	0	0
11060	J-MER-20	WFT17729	77.11	300	120	-0.06	0.01
WM-MER-100	J-MER-94	J-MER-112	54.79	150	100	0	0
WM-MER-101	J-MER-112	J-MER-68	219.02	150	100	-0.01	0.01
WM-MER-102	J-MER-114	J-MER-110	133.53	200	110	0	0
WM-MER-103	J-MER-92	J-MER-60	216.67	150	100	0.01	0.01
WM-MER-104	J-MER-112	J-MER-116	214.67	150	100	-0.01	0.01
WM-MER-105	J-MER-116	J-MER-118	77.26	300	120	-0.13	0.02
WM-MER-106	J-MER-118	J-MER-82	94.56	300	120	-0.17	0.03
WM-MER-107	J-MER-96	J-MER-120	157.67	200	110	0.01	0
WM-MER-108	J-MER-98	J-MER-120	138.67	200	110	0.01	0
WM-MER-109	J-MER-102	J-MER-116	115.17	300	120	-0.1	0.02
WM-MER-110	J-MER-118	J-MER-122	202.99	200	110	0.03	0.01
WM-MER-111	J-MER-122	J-MER-104	48.33	200	110	0.01	0
WM-MER-112	J-MER-16	J-MER-124	50.17	200	110	0.03	0.01
WM-MER-113	J-MER-124	J-MER-126	43.66	200	110	0.02	0.01
WM-MER-114	J-MER-126	J-MER-128	73.25	200	110	0.01	0
WM-MER-115	J-MER-128	J-MER-130	85.57	200	110	-0.01	0
WM-MER-116	J-MER-130	J-MER-132	43.72	200	110	-0.02	0.01
WM-MER-117	J-MER-132	J-MER-100	52.81	200	110	-0.04	0.01
WM-MER-118	J-MER-124	J-MER-132	92.73	150	100	0	0
WM-MER-119	J-MER-126	J-MER-130	86.73	150	100	0	0
WM-MER-120	J-MER-64	J-MER-66	83.02	300	120	-0.02	0
WM-MER-20	J-MER-16	J-MER-98	68.31	300	120	0	0
WM-MER-22	J-MER-118	J-MER-80	223.31	150	100	-0.01	0.01
WM-MER-24	J-MER-8	J-MER-66	165.59	300	120	0.16	0.03
WM-MER-26	J-MER-58	J-MER-18	77.89	300	120	0.02	0
WM-MER-46	J-MER-20	J-MER-34	107.27	300	120	0.06	0.01
WM-MER-48	WFT17729	J-MER-92	19.54	200	110	0.04	0.01
WM-MER-64	J-MER-34	J-MER-58	165.86	300	120	0.04	0.01
WM-MER-66	J-MER-60	J-MER-18	73.43	150	100	-0.01	0.01
WM-MER-67	J-MER-62	J-MER-92	159.36	150	100	-0.01	0.01
WM-MER-68	J-MER-64	J-MER-62	176.84	150	100	0.01	0
WM-MER-69	J-MER-60	J-MER-62	70.78	150	100	0	0
WM-MER-70	J-MER-64	J-MER-18	37.05	300	120	0	0
WM-MER-71	J-MER-66	J-MER-68	70.77	300	120	-0.03	0
WM-MER-72	J-MER-68	J-MER-70	114.86	300	120	-0.07	0.01
WM-MER-73	J-MER-58	J-MER-72	97.78	150	100	0.01	0.01
WM-MER-74	J-MER-72	J-MER-70	163.84	150	100	-0.01	0.01
WM-MER-75	J-MER-72	J-MER-68	161.1	150	100	-0.01	0
WM-MER-76	J-MER-70	J-MER-74	98.05	300	120	-0.09	0.02
WM-MER-77	J-MER-76	J-MER-74	49.46	200	110	0	0
WM-MER-78	J-MER-78	J-MER-76	35.57	150	100	0	0
WM-MER-79	J-MER-78	J-MER-76	46.87	150	100	0	0
WM-MER-80	J-MER-80	J-MER-74	62.63	300	120	0.1	0.02
WM-MER-81	J-MER-82	J-MER-80	130.89	300	120	0.11	0.02
WM-MER-82	J-MER-82	J-MER-84	161.73	300	120	-0.28	0.05
WM-MER-83	J-MER-80	J-MER-86	181.81	200	110	-0.02	0.01

Average Day

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	*(m)*	*(m)*	*(psi)*
O2				
MIN		**124.35**		**64.11**
MAX		**131.14**		**73.76**
O3				
MIN		**128.69**		**106.35**
MAX		**130.7**		**109.21**

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	*(mm)*	*(C)*	*(MLD)*	*(m/s)*
WM-MER-84	J-MER-86	J-MER-88	134.95	200	110	-0.04	0.02
WM-MER-85	J-MER-88	J-MER-82	155.83	150	100	0.01	0.01
WM-MER-86	J-MER-88	J-MER-84	177.39	200	110	-0.08	0.03
WM-MER-89	J-MER-106	J-MER-94	156.2	300	120	0.08	0.01
WM-MER-90	J-MER-94	J-MER-96	42.83	300	120	0.04	0.01
WM-MER-91	J-MER-98	J-MER-96	75	300	120	-0.02	0
WM-MER-92	J-MER-16	J-MER-100	100.86	300	120	-0.04	0.01
WM-MER-93	J-MER-100	J-MER-102	143.17	300	120	-0.09	0.02
WM-MER-94	J-MER-102	J-MER-122	77.46	200	110	-0.01	0
WM-MER-95	J-MER-66	J-MER-106	99.18	300	120	0.13	0.02
WM-MER-96	J-MER-106	J-MER-108	69.88	200	110	0.04	0.01
WM-MER-97	J-MER-108	J-MER-114	161.74	200	110	0.01	0
WM-MER-98	J-MER-110	J-MER-108	166.74	150	100	-0.01	0
WM-MER-99	J-MER-110	J-MER-94	113	200	110	-0.02	0.01

Hydraulic Analysis - 2031 Conditions
Bronte Green Development (Oakville, ON)
Revision Date: April 16, 2015

Maximum Day

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	(m)	(m)	(psi)
4994	0	130.7	201.9	101.22
J-MER-22	0.57	130.54	201.9	101.44
J-MER-24	0.7	128.97	201.89	103.67
J-MER-26	0.07	128.69	201.89	104.06
J-MER-30	0.45	129.94	201.89	102.29
J-MER-32	0	130.03	201.89	102.16
J-MER-56	0.37	130.56	201.89	101.41
J-MER-100	0.32	125.7	173.62	68.12
J-MER-102	0.47	125	173.62	69.11
J-MER-104	0.2	124.35	173.62	70.04
J-MER-106	0.35	127.51	173.62	65.54
J-MER-108	0.51	129.12	173.62	63.25
J-MER-110	0.44	129.23	173.62	63.1
J-MER-112	0.62	126.49	173.62	66.99
J-MER-114	0.48	131.14	173.62	60.38
J-MER-116	0.37	125.39	173.62	68.56
J-MER-118	0.47	125.01	173.62	69.1
J-MER-120	0.57	126.61	173.62	66.82
J-MER-122	0.37	124.61	173.62	69.67
J-MER-124	0.29	126.27	173.62	67.31
J-MER-126	0.35	126.4	173.62	67.12
J-MER-128	0.49	126.37	173.62	67.16
J-MER-130	0.31	126.02	173.62	67.66
J-MER-132	0.29	125.89	173.62	67.85
J-MER-16	0.3	126.13	173.62	67.51
J-MER-18	0.22	127.96	173.62	64.91
J-MER-20	0	129.68	173.62	62.46
J-MER-34	0.45	129.07	173.62	63.33
J-MER-58	0.12	128.22	173.62	64.54
J-MER-60	0.68	128.79	173.62	63.73
J-MER-62	0.38	129.61	173.62	62.56
J-MER-64	0.31	127.83	173.62	65.09
J-MER-66	1.22	127.98	173.62	64.88
J-MER-68	0.52	127.42	173.62	65.67
J-MER-70	0.4	126.88	173.62	66.44
J-MER-72	0.67	127.7	173.62	65.28
J-MER-74	0.12	126.4	173.62	67.13
J-MER-76	0.1	126.65	173.62	66.77
J-MER-78	0	126.65	173.62	66.77
J-MER-8	0	130.09	173.62	61.88
J-MER-80	0.4	126.1	173.62	67.55
J-MER-82	0.5	125.42	173.62	68.52
J-MER-84	0.52	125.04	173.63	69.08
J-MER-86	0.55	126.21	173.62	67.4
J-MER-88	0.47	125.55	173.62	68.34
J-MER-92	0.4	130.05	173.62	61.94
J-MER-94	0.63	126.84	173.62	66.5
J-MER-96	0.26	126.87	173.62	66.45
J-MER-98	0.3	126.5	173.62	66.98
WFT17729	0.04	127.48	173.62	65.59

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)	(C)	(MLD)	(m/s)
WM-MER-30	4994	J-MER-22	131.59	200	110	0.19	0.07
WM-MER-32	J-MER-22	J-MER-56	338.30	150	100	0.04	0.02
WM-MER-34	J-MER-22	J-MER-24	228.52	200	110	0.1	0.04
WM-MER-36	J-MER-24	J-MER-26	63.19	200	110	0.04	0.02
WM-MER-40	J-MER-26	J-MER-30	243.16	200	110	0.04	0.01
WM-MER-42	J-MER-30	J-MER-32	26.97	150	100	0	0
WM-MER-44	J-MER-30	J-MER-32	33.77	150	100	0	0
WM-MER-62	J-MER-56	J-MER-24	227.23	150	100	0	0
11060	J-MER-20	WFT17729	77.11	300	120	-0.11	0.02
WM-MER-100	J-MER-94	J-MER-112	54.79	150	100	-0.01	0.01
WM-MER-101	J-MER-112	J-MER-68	219.02	150	100	-0.03	0.02
WM-MER-102	J-MER-114	J-MER-110	133.53	200	110	-0.01	0
WM-MER-103	J-MER-92	J-MER-60	216.67	150	100	0.02	0.01
WM-MER-104	J-MER-112	J-MER-116	214.67	150	100	-0.03	0.02
WM-MER-105	J-MER-116	J-MER-118	77.26	300	120	-0.3	0.05
WM-MER-106	J-MER-118	J-MER-82	94.56	300	120	-0.4	0.06
WM-MER-107	J-MER-96	J-MER-120	157.67	200	110	0.02	0.01
WM-MER-108	J-MER-98	J-MER-120	138.67	200	110	0.02	0.01
WM-MER-109	J-MER-102	J-MER-116	115.17	300	120	-0.23	0.04
WM-MER-110	J-MER-118	J-MER-122	202.99	200	110	0.08	0.03
WM-MER-111	J-MER-122	J-MER-104	48.33	200	110	0.02	0.01
WM-MER-112	J-MER-16	J-MER-124	50.17	200	110	0.07	0.02
WM-MER-113	J-MER-124	J-MER-126	43.66	200	110	0.05	0.02
WM-MER-114	J-MER-126	J-MER-128	73.25	200	110	0.02	0.01
WM-MER-115	J-MER-128	J-MER-130	85.57	200	110	-0.02	0.01
WM-MER-116	J-MER-130	J-MER-132	43.72	200	110	-0.05	0.02
WM-MER-117	J-MER-132	J-MER-100	52.81	200	110	-0.08	0.03
WM-MER-118	J-MER-124	J-MER-132	92.73	150	100	-0.01	0
WM-MER-119	J-MER-126	J-MER-130	86.73	150	100	0	0
WM-MER-120	J-MER-64	J-MER-66	83.02	300	120	-0.04	0.01
WM-MER-20	J-MER-16	J-MER-98	68.31	300	120	0.02	0
WM-MER-22	J-MER-118	J-MER-80	223.31	150	100	-0.02	0.01
WM-MER-24	J-MER-8	J-MER-66	165.59	300	120	0.34	0.06
WM-MER-26	J-MER-58	J-MER-18	77.89	300	120	0.05	0.01
WM-MER-46	J-MER-20	J-MER-34	107.27	300	120	0.11	0.02
WM-MER-48	WFT17729	J-MER-92	19.54	200	110	0.08	0.03
WM-MER-64	J-MER-34	J-MER-58	165.86	300	120	0.07	0.01
WM-MER-66	J-MER-60	J-MER-18	73.43	150	100	-0.03	0.02
WM-MER-67	J-MER-62	J-MER-92	159.36	150	100	-0.02	0.02
WM-MER-68	J-MER-64	J-MER-62	176.84	150	100	0.02	0.01
WM-MER-69	J-MER-60	J-MER-62	70.78	150	100	-0.01	0.01
WM-MER-70	J-MER-64	J-MER-18	37.05	300	120	0	0
WM-MER-71	J-MER-66	J-MER-68	70.77	300	120	-0.09	0.01
WM-MER-72	J-MER-68	J-MER-70	114.86	300	120	-0.18	0.03
WM-MER-73	J-MER-58	J-MER-72	97.78	150	100	0.02	0.01
WM-MER-74	J-MER-72	J-MER-70	163.84	150	100	-0.03	0.02
WM-MER-75	J-MER-72	J-MER-68	161.1	150	100	-0.02	0.01
WM-MER-76	J-MER-70	J-MER-74	98.05	300	120	-0.24	0.04
WM-MER-77	J-MER-76	J-MER-74	49.46	200	110	-0.01	0
WM-MER-78	J-MER-78	J-MER-76	35.57	150	100	0	0
WM-MER-79	J-MER-78	J-MER-76	46.87	150	100	0	0
WM-MER-80	J-MER-80	J-MER-74	62.63	300	120	0.26	0.04
WM-MER-81	J-MER-82	J-MER-80	130.89	300	120	0.26	0.04
WM-MER-82	J-MER-82	J-MER-84	161.73	300	120	-0.66	0.11
WM-MER-83	J-MER-80	J-MER-86	181.81	200	110	-0.05	0.02

Maximum Day

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	(m)	(m)	(psi)
O2				
MIN		**124.35**		**60.38**
MAX		**131.14**		**70.04**
O3				
MIN		**128.69**		**101.22**
MAX		**130.7**		**104.06**

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)	(C)	(MLD)	(m/s)
WM-MER-84	J-MER-86	J-MER-88	134.95	200	110	-0.1	0.04
WM-MER-85	J-MER-88	J-MER-82	155.83	150	100	0.04	0.02
WM-MER-86	J-MER-88	J-MER-84	177.39	200	110	-0.18	0.07
WM-MER-89	J-MER-106	J-MER-94	156.2	300	120	0.16	0.03
WM-MER-90	J-MER-94	J-MER-96	42.83	300	120	0.08	0.01
WM-MER-91	J-MER-98	J-MER-96	75	300	120	-0.03	0.01
WM-MER-92	J-MER-16	J-MER-100	100.86	300	120	-0.11	0.02
WM-MER-93	J-MER-100	J-MER-102	143.17	300	120	-0.22	0.04
WM-MER-94	J-MER-102	J-MER-122	77.46	200	110	-0.03	0.01
WM-MER-95	J-MER-66	J-MER-106	99.18	300	120	0.28	0.05
WM-MER-96	J-MER-106	J-MER-108	69.88	200	110	0.08	0.03
WM-MER-97	J-MER-108	J-MER-114	161.74	200	110	0.03	0.01
WM-MER-98	J-MER-110	J-MER-108	166.74	150	100	-0.01	0.01
WM-MER-99	J-MER-110	J-MER-94	113	200	110	-0.04	0.01

Hydraulic Analysis - 2031 Conditions
Bronte Green Development (Oakville, ON)
Revision Date: April 16, 2015

Maximum Hour

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	(m)	(m)	(psi)
4994	0	130.7	199.16	97.33
J-MER-22	1.02	130.54	199.15	97.53
J-MER-24	1.24	128.97	199.14	99.75
J-MER-26	0.13	128.69	199.14	100.15
J-MER-30	0.49	129.94	199.14	98.37
J-MER-32	0	130.03	199.14	98.24
J-MER-56	0.66	130.56	199.14	97.49
J-MER-100	0.57	125.7	171.43	65.02
J-MER-102	0.84	125	171.44	66.02
J-MER-104	0.35	124.35	171.44	66.94
J-MER-106	0.63	127.51	171.44	62.45
J-MER-108	0.91	129.12	171.43	60.15
J-MER-110	0.79	129.23	171.43	60
J-MER-112	1.11	126.49	171.43	63.89
J-MER-114	0.85	131.14	171.43	57.28
J-MER-116	0.66	125.39	171.44	65.47
J-MER-118	0.84	125.01	171.44	66.01
J-MER-120	1.02	126.61	171.43	63.72
J-MER-122	0.66	124.61	171.44	66.57
J-MER-124	0.52	126.27	171.43	64.2
J-MER-126	0.62	126.4	171.43	64.02
J-MER-128	0.88	126.37	171.43	64.06
J-MER-130	0.55	126.02	171.43	64.56
J-MER-132	0.52	125.89	171.43	64.74
J-MER-16	0.53	126.13	171.43	64.4
J-MER-18	0.4	127.96	171.44	61.81
J-MER-20	0	129.68	171.44	59.37
J-MER-34	0.8	129.07	171.44	60.23
J-MER-58	0.22	128.22	171.44	61.44
J-MER-60	1.21	128.79	171.44	60.63
J-MER-62	0.68	129.61	171.44	59.46
J-MER-64	0.56	127.83	171.44	62
J-MER-66	1.35	127.98	171.44	61.78
J-MER-68	0.93	127.42	171.44	62.58
J-MER-70	0.71	126.88	171.44	63.35
J-MER-72	1.19	127.7	171.44	62.18
J-MER-74	0.22	126.4	171.45	64.04

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)	(C)	(MLD)	(m/s)
WM-MER-30	4994	J-MER-22	131.59	200	110	0.31	0.11
WM-MER-32	J-MER-22	J-MER-56	338.30	150	100	0.06	0.04
WM-MER-34	J-MER-22	J-MER-24	228.52	200	110	0.16	0.06
WM-MER-36	J-MER-24	J-MER-26	63.19	200	110	0.05	0.02
WM-MER-40	J-MER-26	J-MER-30	243.16	200	110	0.04	0.02
WM-MER-42	J-MER-30	J-MER-32	26.97	150	100	0	0
WM-MER-44	J-MER-30	J-MER-32	33.77	150	100	0	0
WM-MER-62	J-MER-56	J-MER-24	227.23	150	100	0	0
11060	J-MER-20	WFT17729	77.11	300	120	-0.19	0.03
WM-MER-100	J-MER-94	J-MER-112	54.79	150	100	-0.02	0.01
WM-MER-101	J-MER-112	J-MER-68	219.02	150	100	-0.06	0.04
WM-MER-102	J-MER-114	J-MER-110	133.53	200	110	-0.02	0.01
WM-MER-103	J-MER-92	J-MER-60	216.67	150	100	0.04	0.02
WM-MER-104	J-MER-112	J-MER-116	214.67	150	100	-0.06	0.04
WM-MER-105	J-MER-116	J-MER-118	77.26	300	120	-0.53	0.09
WM-MER-106	J-MER-118	J-MER-82	94.56	300	120	-0.7	0.11
WM-MER-107	J-MER-96	J-MER-120	157.67	200	110	0.04	0.02
WM-MER-108	J-MER-98	J-MER-120	138.67	200	110	0.04	0.02
WM-MER-109	J-MER-102	J-MER-116	115.17	300	120	-0.41	0.07
WM-MER-110	J-MER-118	J-MER-122	202.99	200	110	0.14	0.05
WM-MER-111	J-MER-122	J-MER-104	48.33	200	110	0.03	0.01
WM-MER-112	J-MER-16	J-MER-124	50.17	200	110	0.12	0.04
WM-MER-113	J-MER-124	J-MER-126	43.66	200	110	0.09	0.03
WM-MER-114	J-MER-126	J-MER-128	73.25	200	110	0.04	0.01
WM-MER-115	J-MER-128	J-MER-130	85.57	200	110	-0.04	0.01
WM-MER-116	J-MER-130	J-MER-132	43.72	200	110	-0.09	0.03
WM-MER-117	J-MER-132	J-MER-100	52.81	200	110	-0.15	0.05
WM-MER-118	J-MER-124	J-MER-132	92.73	150	100	-0.01	0.01
WM-MER-119	J-MER-126	J-MER-130	86.73	150	100	-0.01	0
WM-MER-120	J-MER-64	J-MER-66	83.02	300	120	-0.09	0.02
WM-MER-20	J-MER-16	J-MER-98	68.31	300	120	0.02	0
WM-MER-22	J-MER-118	J-MER-80	223.31	150	100	-0.04	0.02
WM-MER-24	J-MER-8	J-MER-66	165.59	300	120	0.57	0.09
WM-MER-26	J-MER-58	J-MER-18	77.89	300	120	0.07	0.01
WM-MER-46	J-MER-20	J-MER-34	107.27	300	120	0.19	0.03
WM-MER-48	WFT17729	J-MER-92	19.54	200	110	0.14	0.05
WM-MER-64	J-MER-34	J-MER-58	165.86	300	120	0.12	0.02

Maximum Hour

Node Table

ID	Demand	Elevation	Head	Pressure
	(L/s)	(m)	(m)	(psi)
J-MER-76	0.18	126.65	171.45	63.68
J-MER-78	0	126.65	171.45	63.68
J-MER-8	0	130.09	171.45	58.79
J-MER-80	0.71	126.1	171.45	64.46
J-MER-82	0.88	125.42	171.45	65.44
J-MER-84	0.93	125.04	171.48	66.02
J-MER-86	0.97	126.21	171.45	64.31
J-MER-88	0.84	125.55	171.46	65.26
J-MER-92	0.7	130.05	171.44	58.84
J-MER-94	1.11	126.84	171.43	63.39
J-MER-96	0.46	126.87	171.43	63.35
J-MER-98	0.53	126.5	171.43	63.88
WFT17729	0.07	127.48	171.44	62.5
O2				
MIN		**124.35**		**57.28**
MAX		**131.14**		**66.94**
O3				
MIN		**128.69**		**97.33**
MAX		**130.7**		**100.15**

Pipe Table

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)	(C)	(MLD)	(m/s)
WM-MER-66	J-MER-60	J-MER-18	73.43	150	100	-0.05	0.03
WM-MER-67	J-MER-62	J-MER-92	159.36	150	100	-0.04	0.03
WM-MER-68	J-MER-64	J-MER-62	176.84	150	100	0.03	0.02
WM-MER-69	J-MER-60	J-MER-62	70.78	150	100	-0.01	0.01
WM-MER-70	J-MER-64	J-MER-18	37.05	300	120	0.02	0
WM-MER-71	J-MER-66	J-MER-68	70.77	300	120	-0.14	0.02
WM-MER-72	J-MER-68	J-MER-70	114.86	300	120	-0.31	0.05
WM-MER-73	J-MER-58	J-MER-72	97.78	150	100	0.03	0.02
WM-MER-74	J-MER-72	J-MER-70	163.84	150	100	-0.04	0.03
WM-MER-75	J-MER-72	J-MER-68	161.1	150	100	-0.03	0.02
WM-MER-76	J-MER-70	J-MER-74	98.05	300	120	-0.41	0.07
WM-MER-77	J-MER-76	J-MER-74	49.46	200	110	-0.02	0.01
WM-MER-78	J-MER-78	J-MER-76	35.57	150	100	0	0
WM-MER-79	J-MER-78	J-MER-76	46.87	150	100	0	0
WM-MER-80	J-MER-80	J-MER-74	62.63	300	120	0.45	0.07
WM-MER-81	J-MER-82	J-MER-80	130.89	300	120	0.45	0.07
WM-MER-82	J-MER-82	J-MER-84	161.73	300	120	-1.16	0.19
WM-MER-83	J-MER-80	J-MER-86	181.81	200	110	-0.1	0.04
WM-MER-84	J-MER-86	J-MER-88	134.95	200	110	-0.18	0.07
WM-MER-85	J-MER-88	J-MER-82	155.83	150	100	0.06	0.04
WM-MER-86	J-MER-88	J-MER-84	177.39	200	110	-0.31	0.12
WM-MER-89	J-MER-106	J-MER-94	156.2	300	120	0.29	0.05
WM-MER-90	J-MER-94	J-MER-96	42.83	300	120	0.15	0.02
WM-MER-91	J-MER-98	J-MER-96	75	300	120	-0.07	0.01
WM-MER-92	J-MER-16	J-MER-100	100.86	300	120	-0.19	0.03
WM-MER-93	J-MER-100	J-MER-102	143.17	300	120	-0.39	0.06
WM-MER-94	J-MER-102	J-MER-122	77.46	200	110	-0.05	0.02
WM-MER-95	J-MER-66	J-MER-106	99.18	300	120	0.5	0.08
WM-MER-96	J-MER-106	J-MER-108	69.88	200	110	0.15	0.06
WM-MER-97	J-MER-108	J-MER-114	161.74	200	110	0.05	0.02
WM-MER-98	J-MER-110	J-MER-108	166.74	150	100	-0.02	0.01
WM-MER-99	J-MER-110	J-MER-94	113	200	110	-0.07	0.03

Fire Flow Table

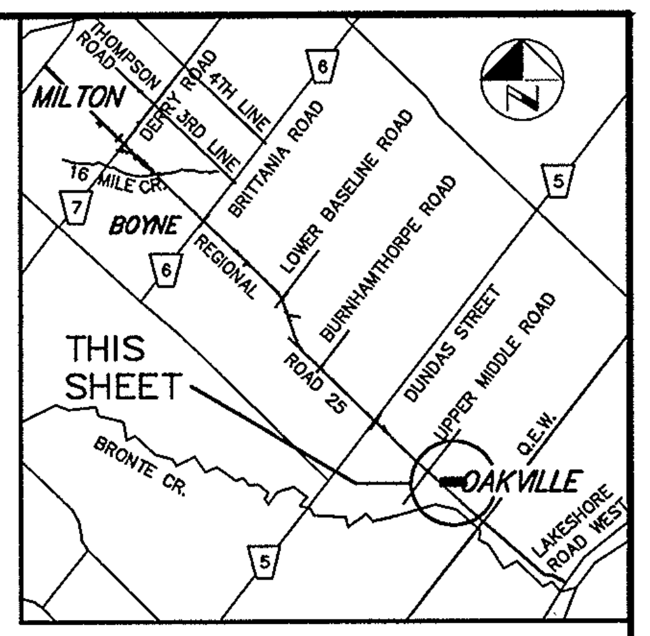
ID	Total Demand *(L/s)*	Available Flow *(L/s)*	Fire Flow Met?
J-MER-100	136.32	280.29	TRUE
J-MER-102	91.47	289.18	TRUE
J-MER-104	91.2	195.83	TRUE
J-MER-106	136.35	281.39	TRUE
J-MER-108	136.51	221.62	TRUE
J-MER-110	136.44	211.95	TRUE
J-MER-112	91.62	194.02	TRUE
J-MER-114	136.48	182.81	TRUE
J-MER-116	91.37	291.62	TRUE
J-MER-118	91.47	300.44	TRUE
J-MER-120	91.57	218.82	TRUE
J-MER-122	91.37	241.42	TRUE
J-MER-124	136.29	243.53	TRUE
J-MER-126	136.35	226.98	TRUE
J-MER-128	136.49	211.09	TRUE
J-MER-130	136.31	228.32	TRUE
J-MER-132	136.29	244.52	TRUE
J-MER-16	136.3	278.06	TRUE
J-MER-18	136.22	275.08	TRUE
J-MER-20	91	255.02	TRUE
J-MER-22	91.57	276.16	TRUE
J-MER-24	91.7	187.6	TRUE
J-MER-26	91.07	168.26	TRUE
J-MER-30	91.45	125.4	TRUE
J-MER-32	91	120.51	TRUE
J-MER-34	91.45	258.17	TRUE
J-MER-56	91.37	130.47	TRUE
J-MER-58	91.12	268.93	TRUE
J-MER-60	136.68	183.96	TRUE
J-MER-62	136.38	171.44	TRUE
J-MER-64	136.31	278.74	TRUE
J-MER-66	274.22	288.97	TRUE
J-MER-68	91.52	288.15	TRUE
J-MER-70	91.4	288.84	TRUE
J-MER-72	91.67	183.98	TRUE
J-MER-74	91.12	292.46	TRUE
J-MER-76	91.1	214.77	TRUE
J-MER-78	91	174.72	TRUE
J-MER-8	91	273.6	TRUE
J-MER-80	91.4	298.1	TRUE
J-MER-82	91.5	310.46	TRUE
J-MER-84	91.52	324.71	TRUE
J-MER-86	91.55	218.34	TRUE
J-MER-88	91.47	238.49	TRUE
J-MER-92	136.4	236.23	TRUE
J-MER-94	136.63	280.76	TRUE
J-MER-96	136.26	277.84	TRUE
J-MER-98	136.3	277.54	TRUE

APPENDIX C

2400Ø SANITARY TRUNK SEWER DRAWINGS

PR–1823–XX 37 of 43

O–11211

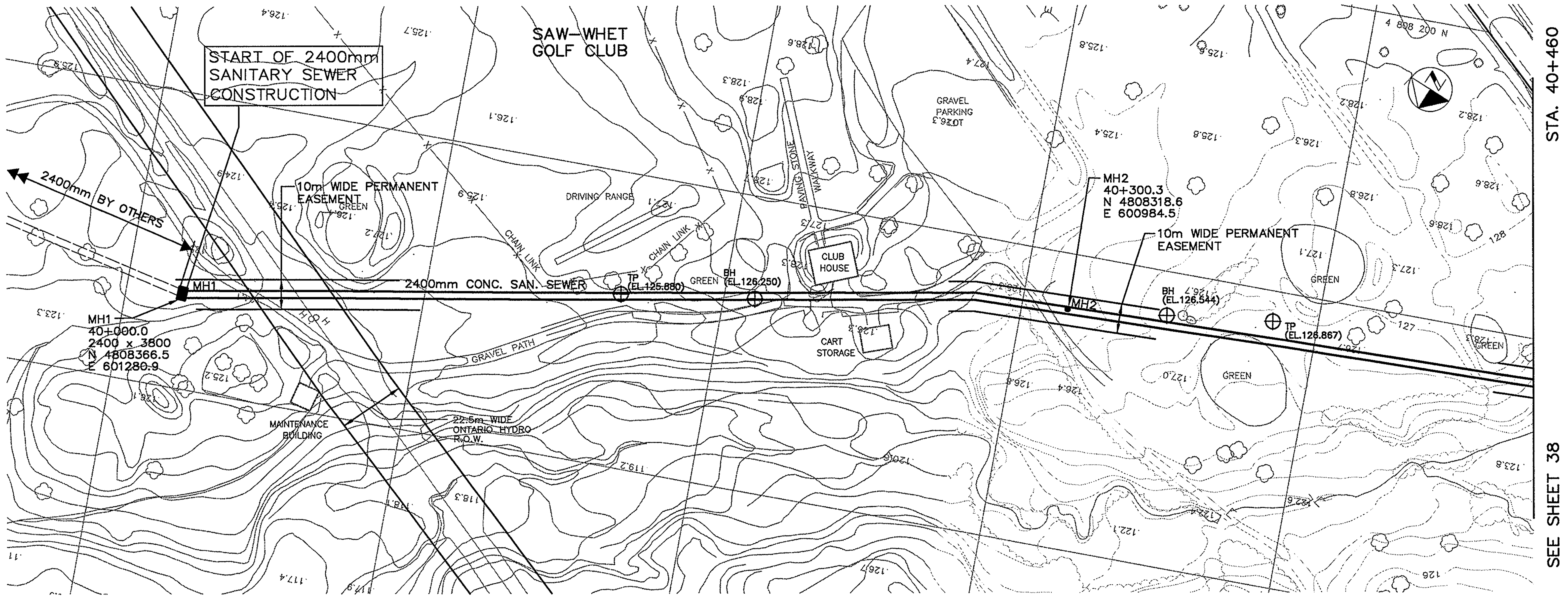


KEY PLAN

GENERAL NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SPECIFIED.
2. STATIONS ARE ALONG THE 2400mm SEWER CENTRELINE.
3. THE LOCATIONS OF ALL EXISTING UTILITIES ENCOUNTERED DURING CONSTRUCTION ARE APPROXIMATE. CONTACT THE APPLICABLE UTILITY OWNER FOR EXACT LOCATIONS.

REGIONAL MUNICIPALITY OF HALTON,
ITS EMPLOYEES, OFFICERS AND AGENTS
ARE NOT RESPONSIBLE FOR ANY ERRORS,
OMISSIONS OR INACCURACIES, WHETHER
DUE TO THEIR NEGLIGENCE OR OTHERWISE.
ALL INFORMATION SHOULD BE VERIFIED



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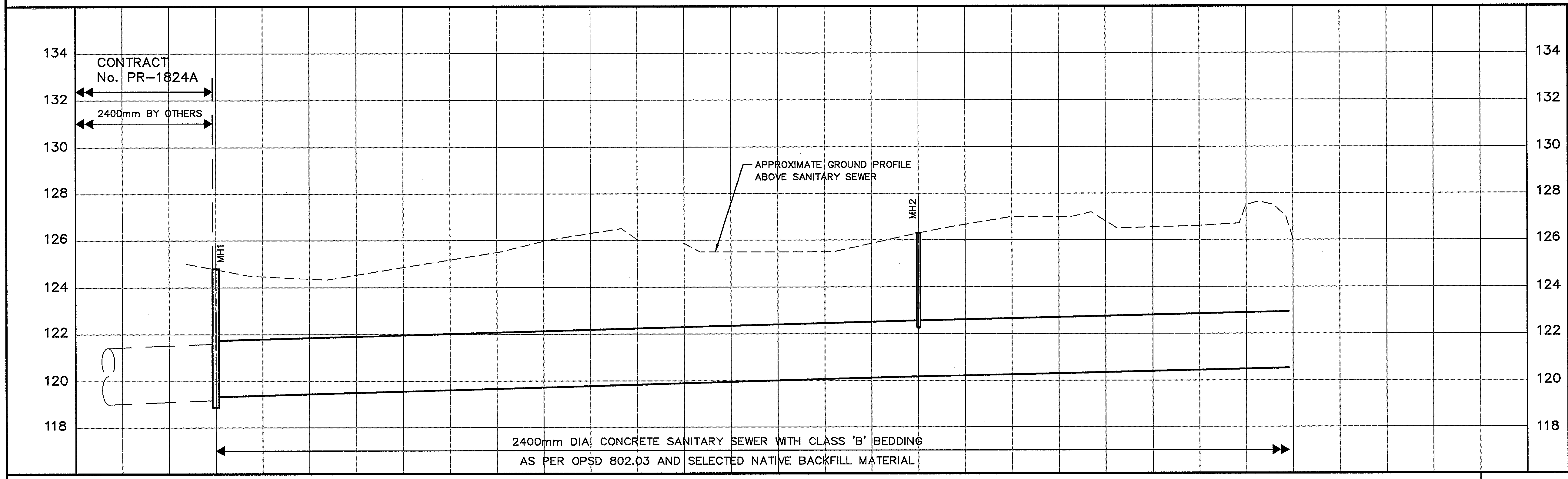
EASEMENT



CENTRELINE ELEVATIONS

WATERMAIN INVERTS

SANITARY SEWER INVERTS
E119.19 W119.34 — 300.2 @ +0.27% 65–D ASTM C76 — 120.16 — 300.3 @ +0.25% 65–D ASTM C76

CHAINAGE
40+000 40+100 40+200 40+300 40+400 40+460

Nº	Date	By	REVISIONS	MANU	CAD
5	09/12/01	GOH	RECORD DRAWING		
4	03/30/00	GOH	ISSUED FOR CONSTRUCTION		
3	02/21/00	GOH	REVISED ALIGNMENT		
2	02/11/00	GOH	ISSUED FOR COMMENT		
1	01/19/00	GOH	REVISED PER REGION COMMENTS		
0	11/04/99	GOH	ISSUED FOR DESIGN BASIS REPORT		

Design	HJG	Ch'kd	WAB
Drawn	CLC/JC	Ch'kd	HJG

Date
NOVEMBER 1999

Scale Horiz. 20 10 0 20
Vert. 2 1 0 2

References
APPENDIX VI

APPROVALS

Municipal

Regional

Director, Engineering Services

Manager, Design Services

Field Notes

Stamp

D'ORAZIO / WALTER JOINT VENTURE

Halton

TITLE
WASTEWATER TRUNK MAIN
EASEMENT & REGIONAL ROAD 25
FROM STA. 40+000 TO STA. 40+460
IN THE TOWN OF OAKVILLE

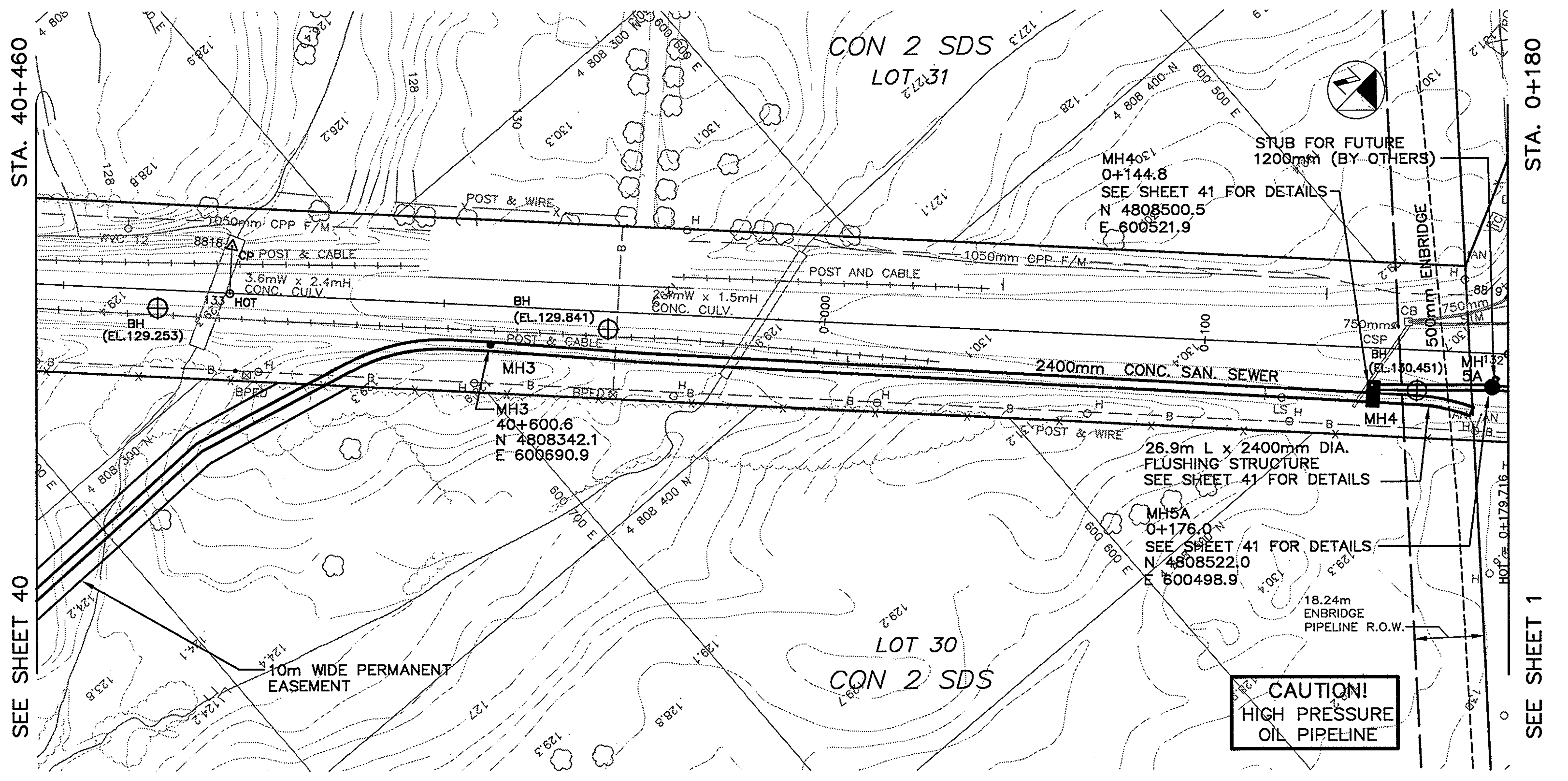
Consultant File Nº
99–6749–06

Regional Drawing Nº
O–11211

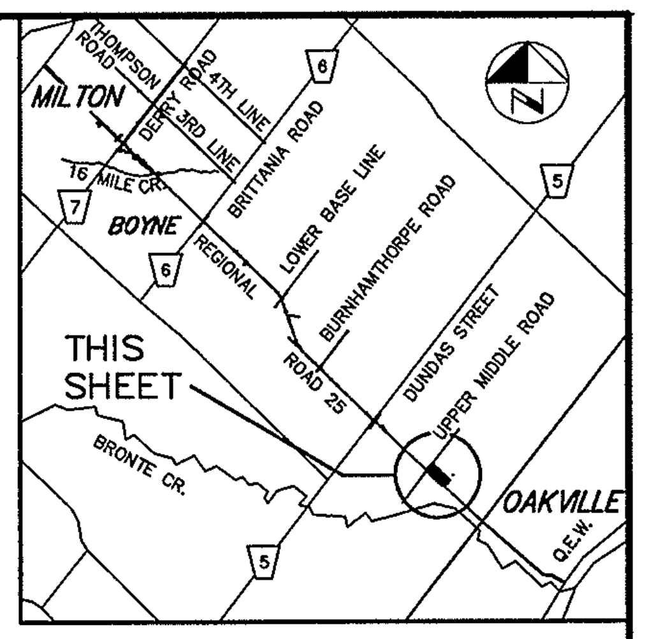
CONTRACT Nº
PR–1824B

Drawing Nº
SHEET 37 OF 43

PR-1823-XX 38 of 43 0-11212



REGIONAL ROAD 25



KEY PLAN

GENERAL NOTES:

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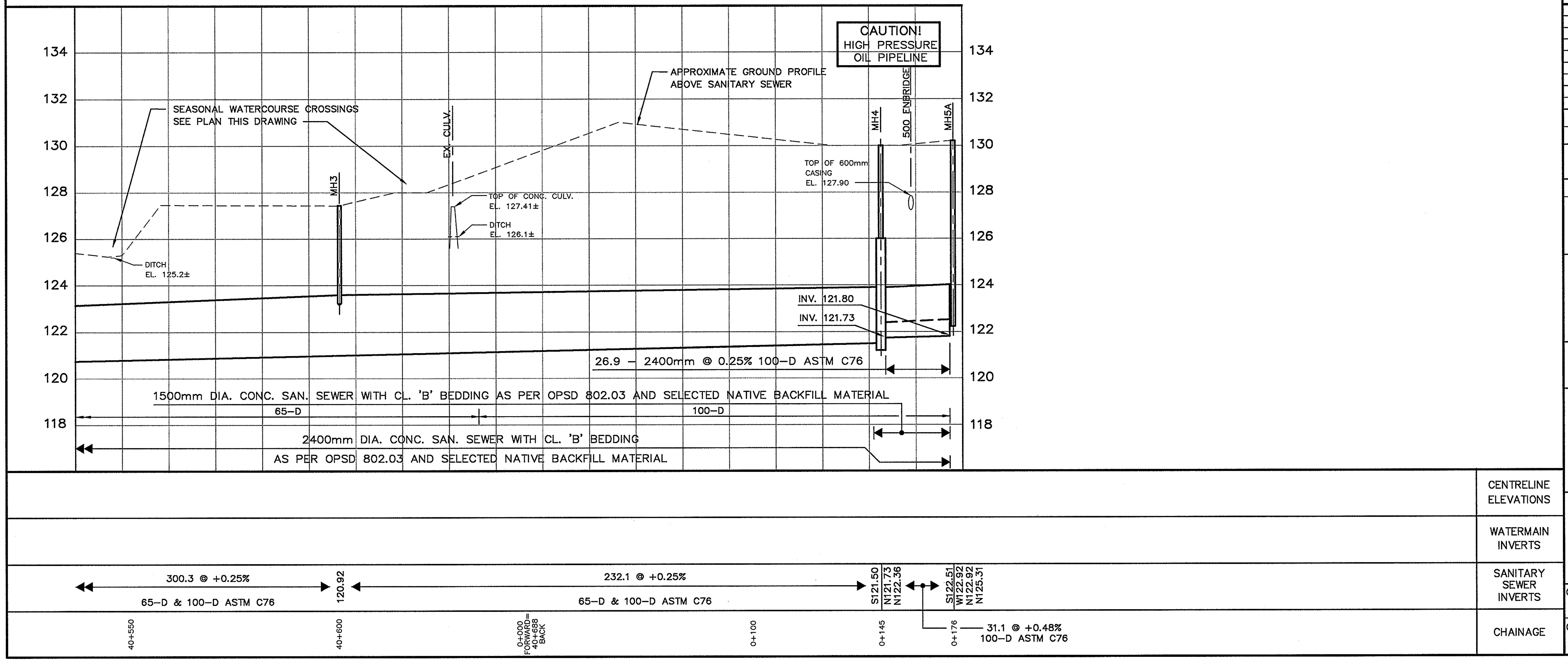

9	09/12/01	GOH	RECORD DRAWING		
8	06/05/00	GOH	INTERIM AS CONSTRUCTED		
7	03/30/00	GOH	ISSUED FOR CONSTRUCTION		
6	02/21/00	GOH	REVISED ALIGNMENT		
5	02/18/00	GOH	REVISED CROSSING		
4	02/11/00	GOH	ISSUED FOR COMMENT		
3	02/01/00	GOH	ISSUED FOR CROSSING APPROVALS		
2	01/25/00	GOH	ISSUED FOR MOE C of A APPL'N		
1	01/19/00	GOH	REVISED PER REGION COMMENTS		
0	11/04/99	GOH	ISSUED FOR DESIGN BASIS REPORT		
NՉ	Date	By	REVISIONS	MANU	CAD

Design	HJG	Ch'kd	WAB	Date NOVEMBER 1999
Drawn	CLC/JC	Ch'kd	HJG	

Scale Horiz. 20 10 0 20 Vert. 2 1 0 2

References
APPENDIX VI

APPROVALS

Municipal

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Stamp

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Director, Engineering Services

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D'ORAZIO / WALTER JOINT VENTURE

Halton

TITLE

WASTEWATER TRUNK MAIN
REGIONAL ROAD 25
FROM STATION 40+460 TO STA. 0+180
IN THE TOWN OF OAKVILLE

Consultant File NՉ 99–6749–06

Regional Drawing NՉ 0–11212

CONTRACT NՉ PR–1824B

Drawing NՉ SHEET 38 OF 43

APPENDIX D

SANITARY FLOW CALCULATIONS
DSEL

Sanitary Flow Calculation

Total developable area = 48.91 ha

Residential area = 29.98 ha

- Single family homes = 22.85 ha @ 55 p/ha
- Condo single family homes = 1.15 ha @ 55 p/ha
- Townhouses = 4.36 ha @ 135 p/ha
- High density = 0.92 ha @ 135 p/ha
- Mixed use = 0.70 ha @ 135 p/ha

Area for infiltration = 45.38 ha

Population estimate

- Single family homes = 1256.75 persons
- Condo single family homes = 63.25 persons
- Townhouses = 588.60 persons
- High density = 124.20 persons
- Mixed use = 94.50 persons
- **Total = 2127 persons**

Average Day Dry Weather Flow = 275 L/cap/day x 2127 persons = 6.77 L/s

Peak Factor = $1 + 14/(4 + \sqrt{(2127/1000)}) = 3.56$

Infiltration and inflow = 0.286 L/s/ha x 45.38 ha = 12.98 L/s

Total sanitary flow = 6.77 L/s x 3.56 + 12.98 L/s = **37.08 L/s**

APPENDIX E

SANITARY CAPACITY ANALYSIS
Genivar

141-13094-00

April 20, 2015

Mr. M. Baldesarra
David Schaeffer Engineering Ltd.
600 Alden Road
Suite 500
Markham, Ontario
L3R 0E7

Re: Merton Development Wastewater Analysis

Dear Mr. Baldesarra:

We are pleased to present the results of our updated wastewater analysis of the Merton development located near Bronte Road and Upper Middle Road in Oakville, Ontario.

WASTEWATER MODELING

Sanitary modeling was conducted on the Merton development. The analysis consisted of using the Region of Halton's (ROH) all-pipe sanitary model and adding to it the flows generated from the proposed development. The flows were added to the closest sanitary trunks that could provide a gravity outlet to the development area as shown in Figure 1.

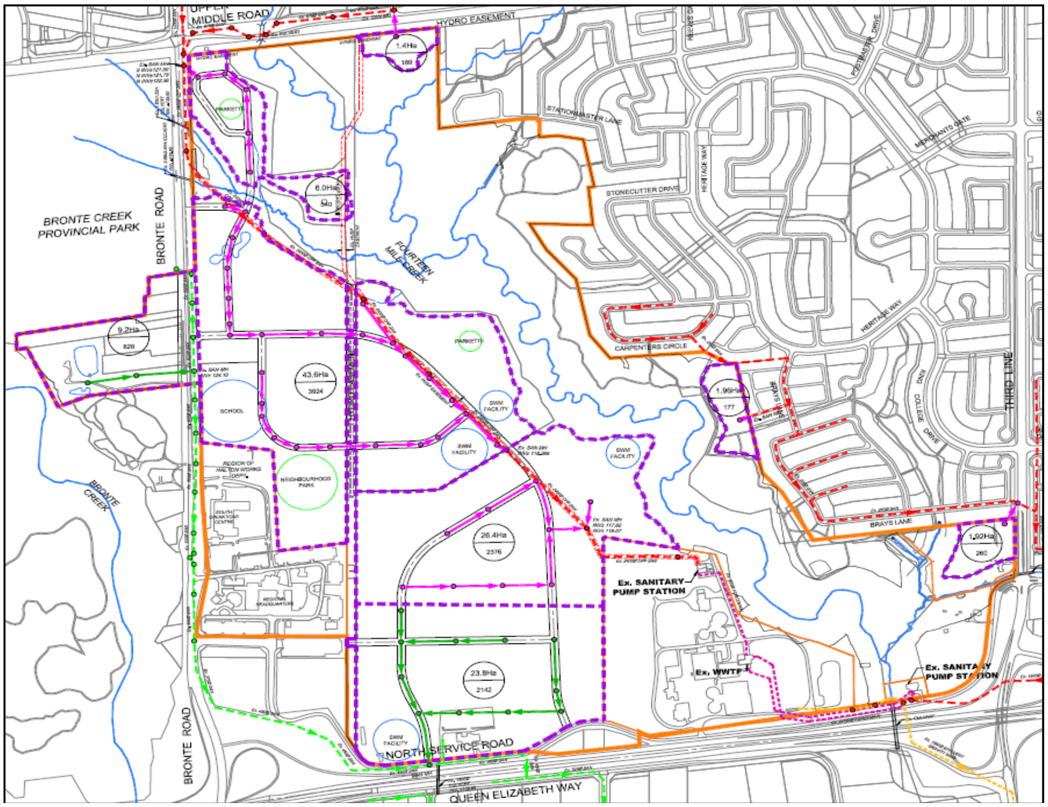


Figure 1: Proposed Sanitary Servicing of the development

The majority of the area will connect to the 2400 mm sanitary trunk leading to Mid-Halton. The Southern parts of the development fall within the drainage area for Oakville Southwest Plant and its load was added to a trunk leading to the Southwest Plant.

Region's Sanitary Model

The Region's sanitary model is built in MWH Soft's InfoSewer software. The model consists of 2011, 2016, and 2021, and 2031 scenarios. Loading in the model consist of peakable (peaked using the Harmon formula) and non-peakable (Infiltration and Inflow) loads applied to the Manholes.

Design Criteria and Load Data

In order to assess the impact of the development on the existing and proposed future infrastructure, the load from the development was added to the 2031 scenario in the model. The ROH's design criteria was used in calculating the loads from the development. The load was added to the trunk sanitary sewers in the area as shown in Figure 1. A total of 3 different scenarios were examined namely Options A, B, and C. Options A, B, C are the conceptual development plans that consist of differing population numbers and distribution. The model input for each of the development options is summarized in Tables 1-3.
A fourth option, Option D was also evaluated that consists of Option C population numbers but with all the sanitary flows directed to Mid-Halton WWTP. This would be accomplished by a sewage pumping station at the southern end of the development that would direct flows to the Mid-Halton Plant. The modeling results are summarized next.

Table 1 – Sanitary Design Criteria and Model Loadings for Option A

Region's Design Criteria			
Average Day Dry Weather Flow (L/cap/day)	275		
Infiltration and Inflow (L/s/Ha)	0.286		
Model Loading			
Loading MH	# of Persons	Serviced Area (ha)	Total Flow (L/s)
SMH5447	607	8.8	4.45
SMH4893	2,925	23.4	16.00
SMH5472	180	2	1.14
SMH5021	238	1.92	1.31
MH-13-AB	126	1.4	0.80
SMH17864	219	5.5	2.27
SMH26617	2,356	41.93	19.49
SMH26619	3,288	26.3	17.99
SMH5547	149	2.7	1.25

Table 2: Sanitary Design Criteria and Model Loadings for Option B

Region's Design Criteria			
Average Day Dry Weather Flow (L/cap/day)	275		
Infiltration and Inflow (L/s/Ha)	0.286		
Model Loading			
Loading MH	# of Persons	Serviced Area (ha)	Total Flow (L/s)
SMH5447	582	8.8	4.37
SMH4893	2,925	23.4	16.00
SMH5472	0	0	0.00
SMH5021	171	1.92	1.09
MH-13-AB	126	1.4	0.80
SMH17864	219	5.5	2.27
SMH26617	2,356	41.93	19.49
SMH26619	2,944	24.6	16.41
SMH5547	149	2.7	1.25

Table 3 – Sanitary Design Criteria and Model Loadings for Options C

Region's Design Criteria			
Average Day Dry Weather Flow (L/cap/day)	275		
Infiltration and Inflow (L/s/Ha)	0.286		
Model Loading			
Loading MH	# of Persons	Serviced Area (ha)	Total Flow (L/s)
SMH5447	490	8.9	4.11
SMH4893	2925	23.4	16.00
SMH5472	189	1.4	1.00
SMH5021	171	1.9	1.09
MH-13-AB	126	1.4	0.80
SMH17864	219	5.5	2.27
SMH26617	2,356	41.93	19.49
SMH26619	2680	24.3	15.48
SMH5547	338	2.7	1.85

Modeling Results

The model was run under the 2031 peak wet weather flow for the various scenarios. The scenarios consisted of the 3 main development options A, B,C. Other Scenarios modeled were Option D which consisted of all loads directed to the Mid-Halton Plant and a 2031 run without Merton loading. The results are summarized in Appendix A in the form of trunk profiles showing water level and hydraulic grade conditions and detailed pipe output tables.

The results show that there are no capacity restrictions in the 2400 mm sewer leading to Mid-Halton Plant under any of the development scenarios modeled. The addition of Merton loading to the trunk increases its flow however, there is significant capacity remaining. The flows going south to Oakville Southwest show the there are some constrictions in the lower parts of the trunk near the lakeshore under all scenarios including the scenario without any Merton development. There are approximately 300 m of 750 mm pipe that are surcharged under the 2031 peak flow condition. From the surcharged sections, a 108 m section is severely surcharged with proposed flows greater than twice the pipe capacity. The rest are slightly surcharged by 10 – 20 %. A scenario was simulated with the surcharged sections upgraded to 900 mm and 1200 mm depending on the severity of surcharge. The results of this scenario are included in Appendix B.

Given that servicing of Merton is still at a conceptual level, it is recommended that all of Merton loading be directed towards the Mid-Halton Plant where there are no capacity restrictions.

The results are subject to the data inputs of the model provided, particularly pipe inverts and drainage area population numbers. It is recommended that survey of inverts and flow monitoring be conducted on the surcharged sections to field-verify the model outputs before any upgrades are planned.

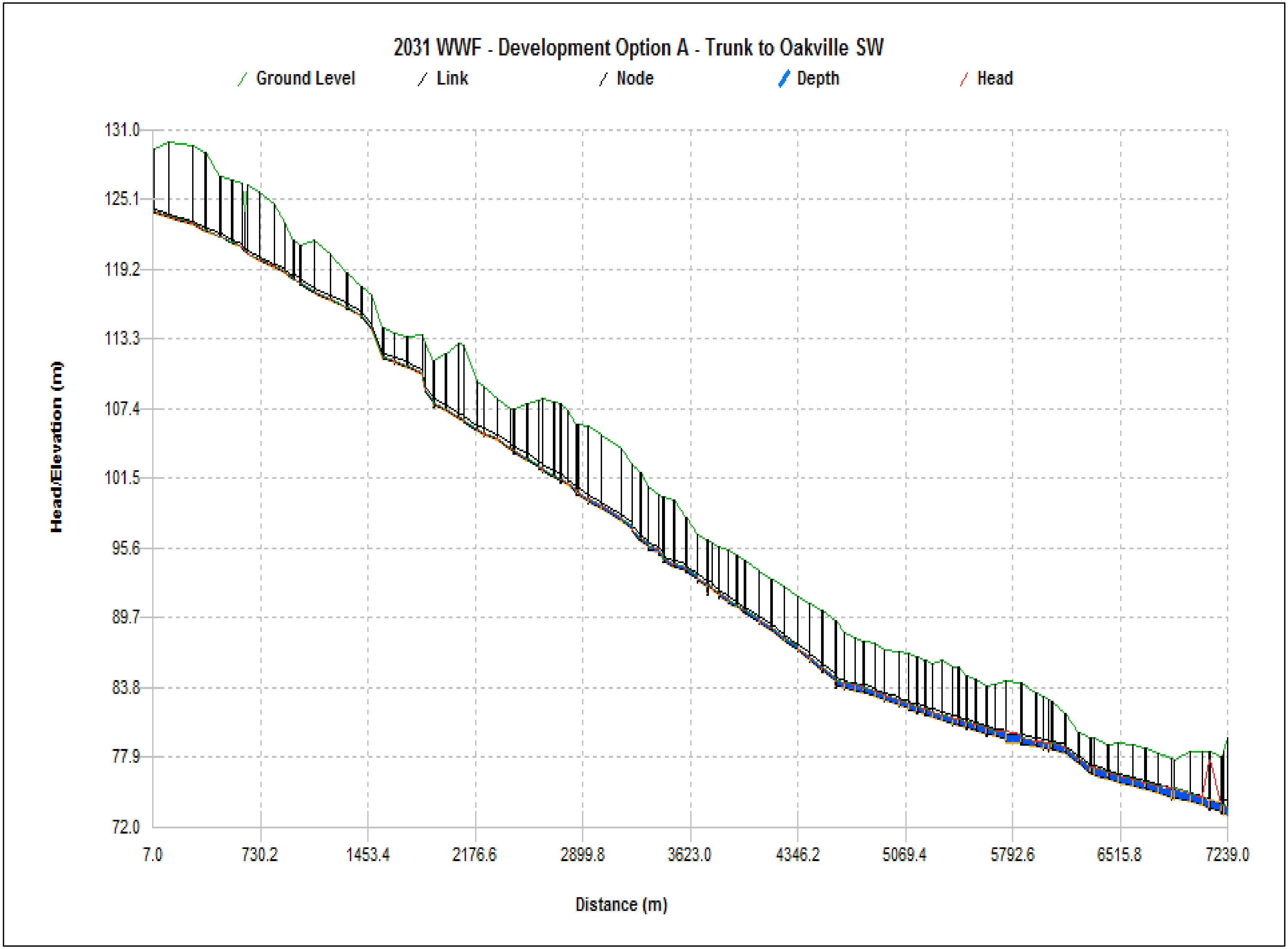
Yours truly,
WSP Canada Inc.

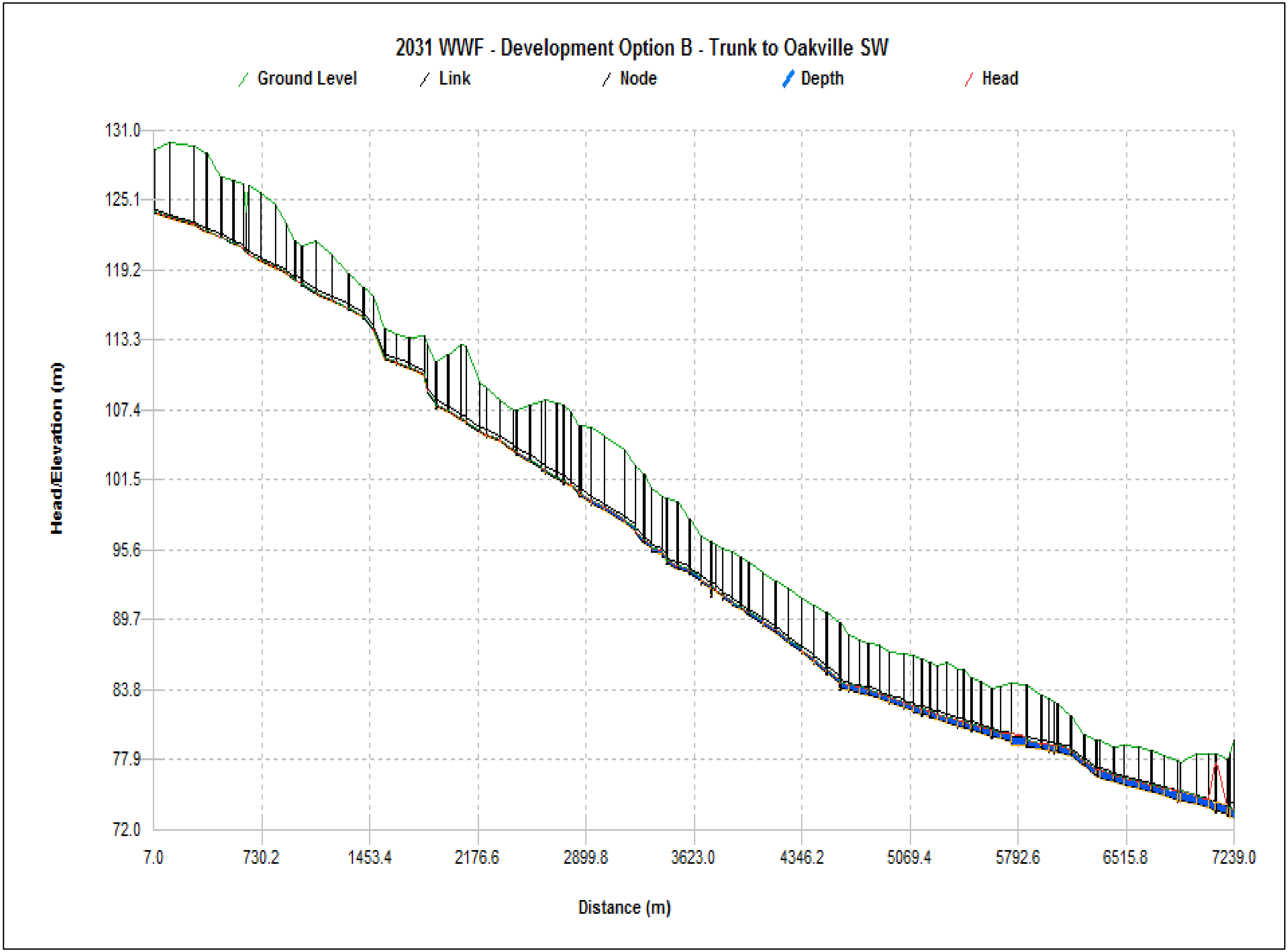
Stan Holden, P.Eng
Project Manager

Hubail Ajward, P.Eng
Senior Engineer

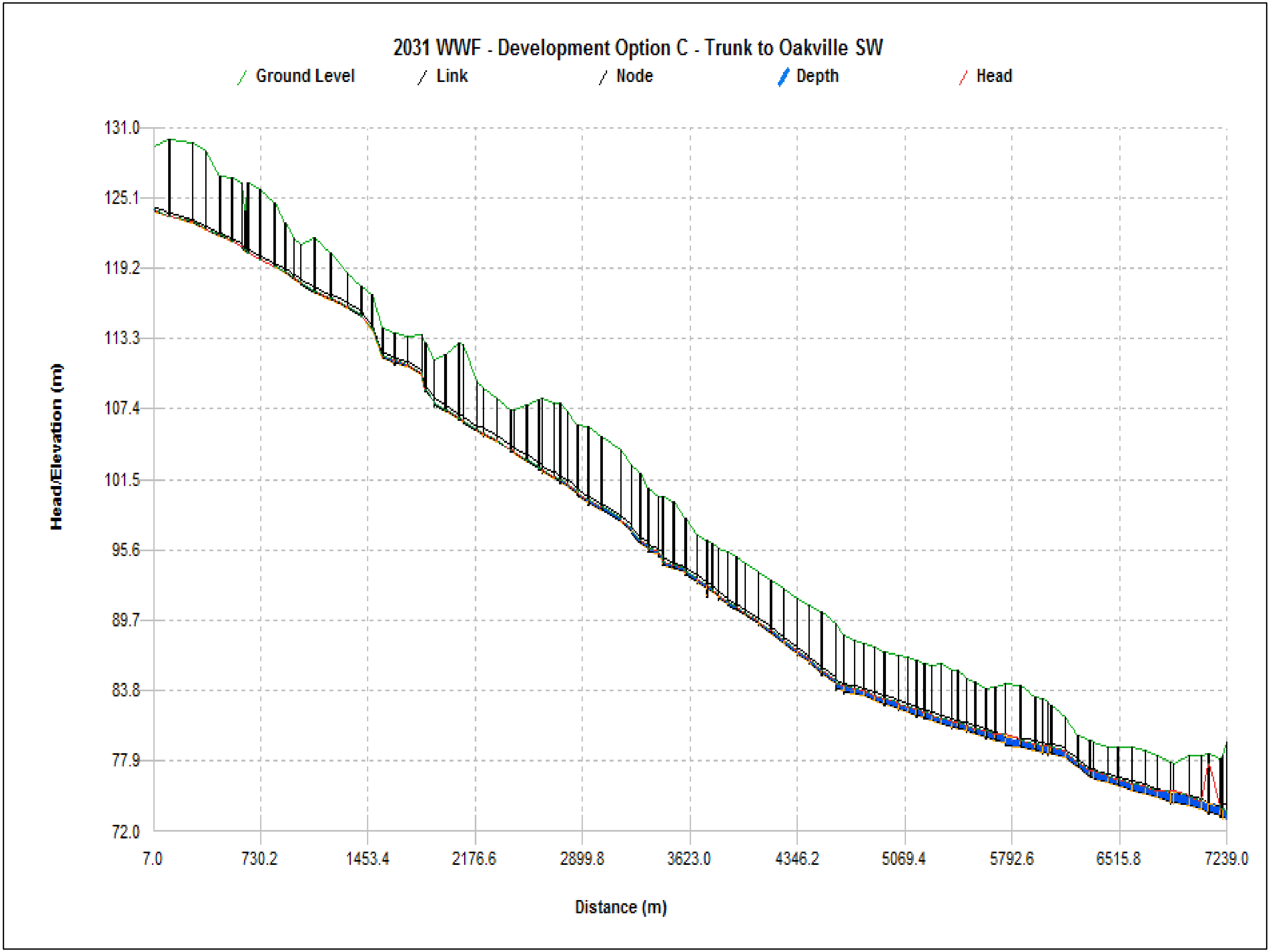
Appendix A

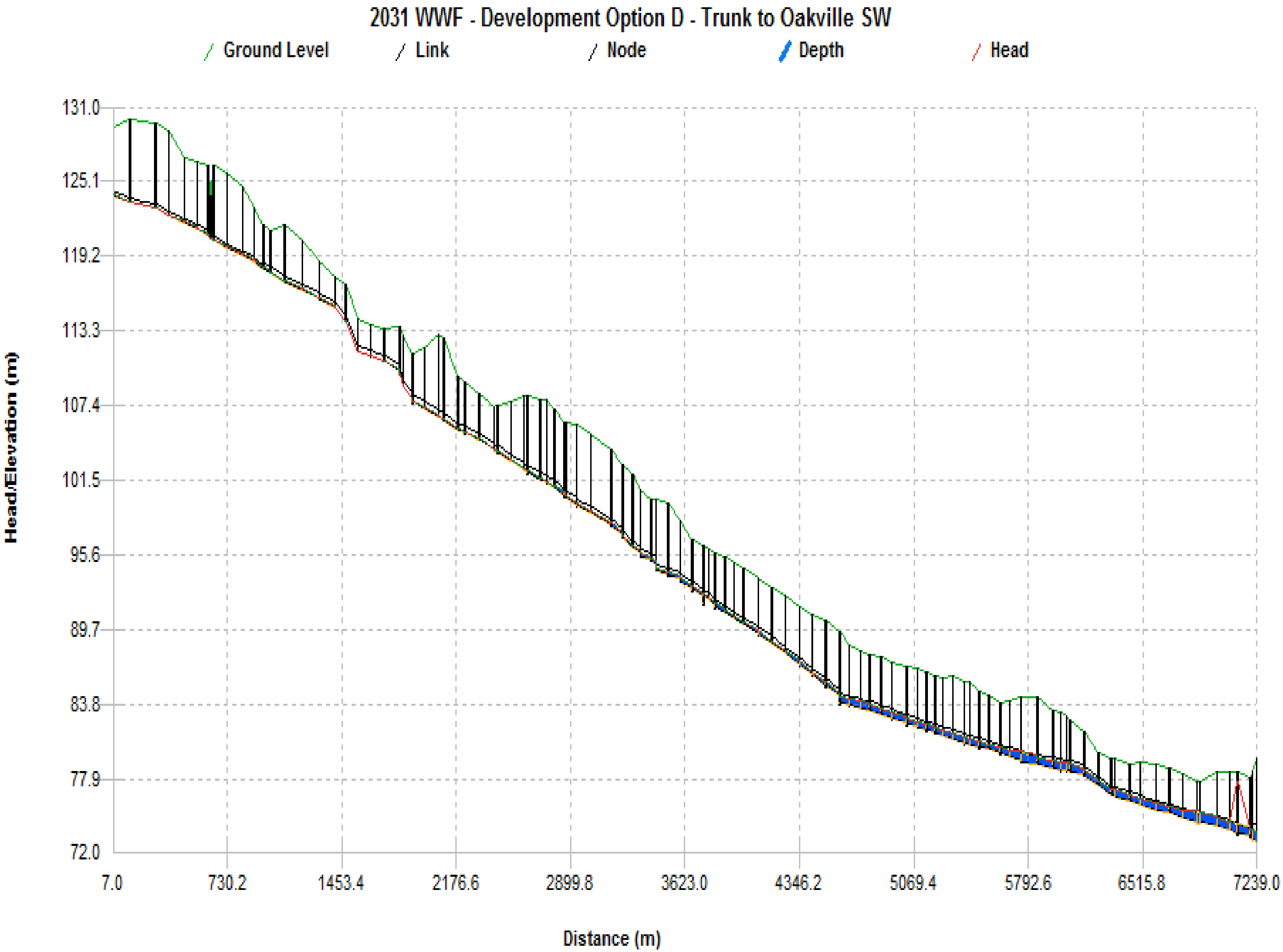
Sanitary Modeling Results

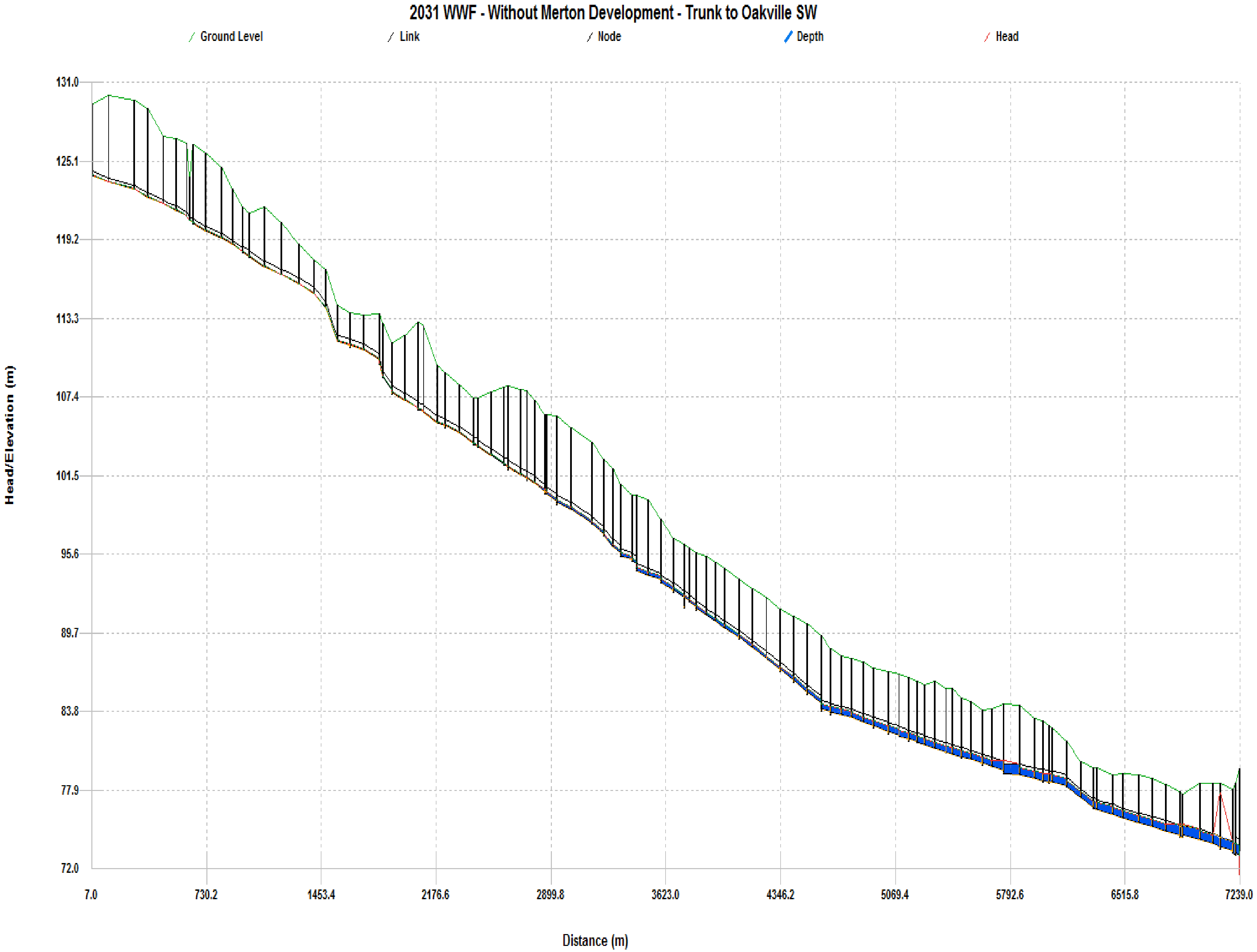

2031 WWF - Development Option A - Trunk to Oakville SW
Ground Level
Link
Node
Depth
Head
Head/Elevation (m)
131.0
125.1
119.2
113.3
107.4
101.5
95.6
89.7
83.8
77.9
72.0
7.0
730.2
1453.4
2176.6
2899.8
3623.0
4346.2
5069.4
5792.6
6515.8
7239.0
Distance (m)

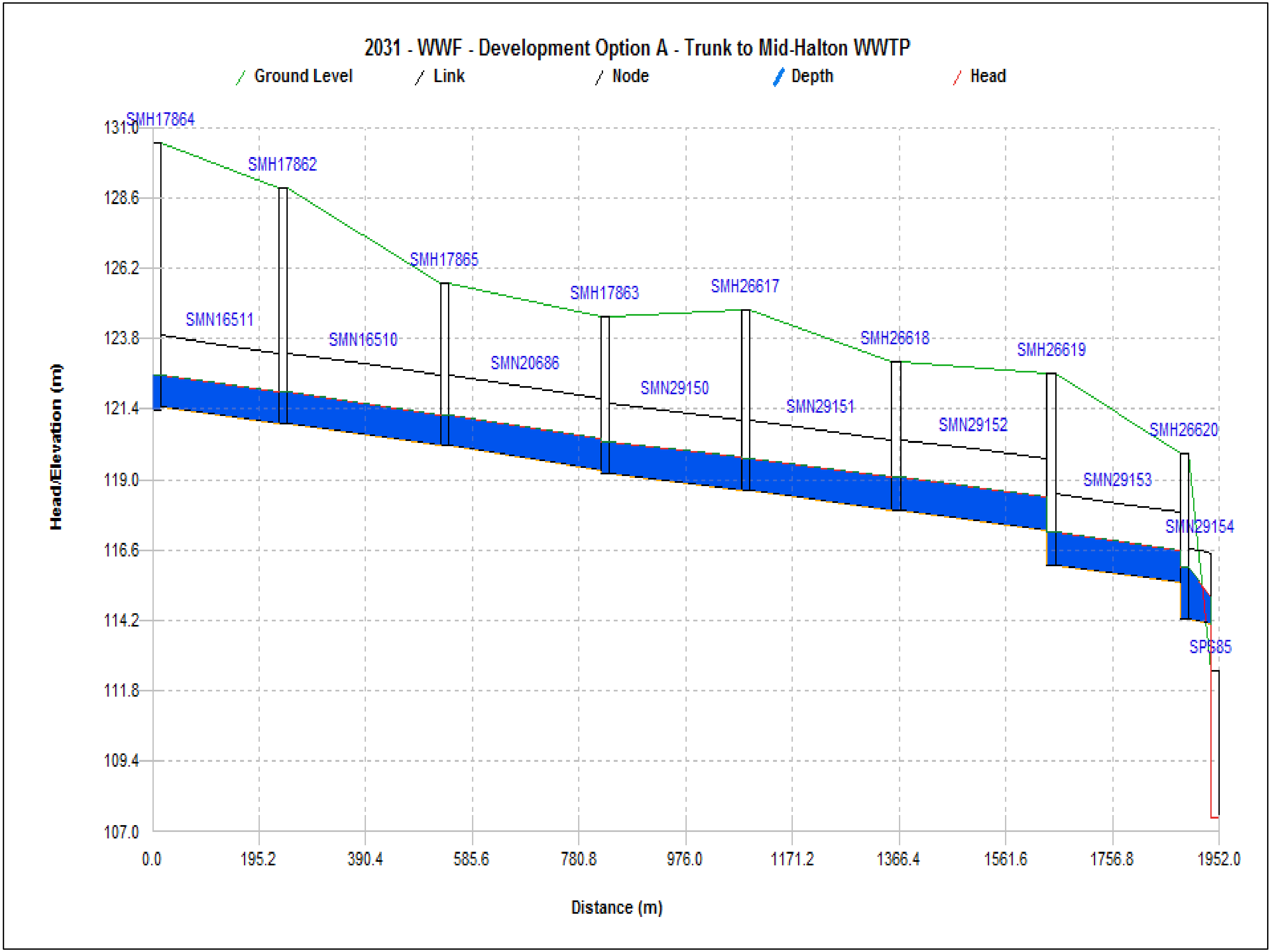


2031 WWF - Development Option B - Trunk to Oakville SW

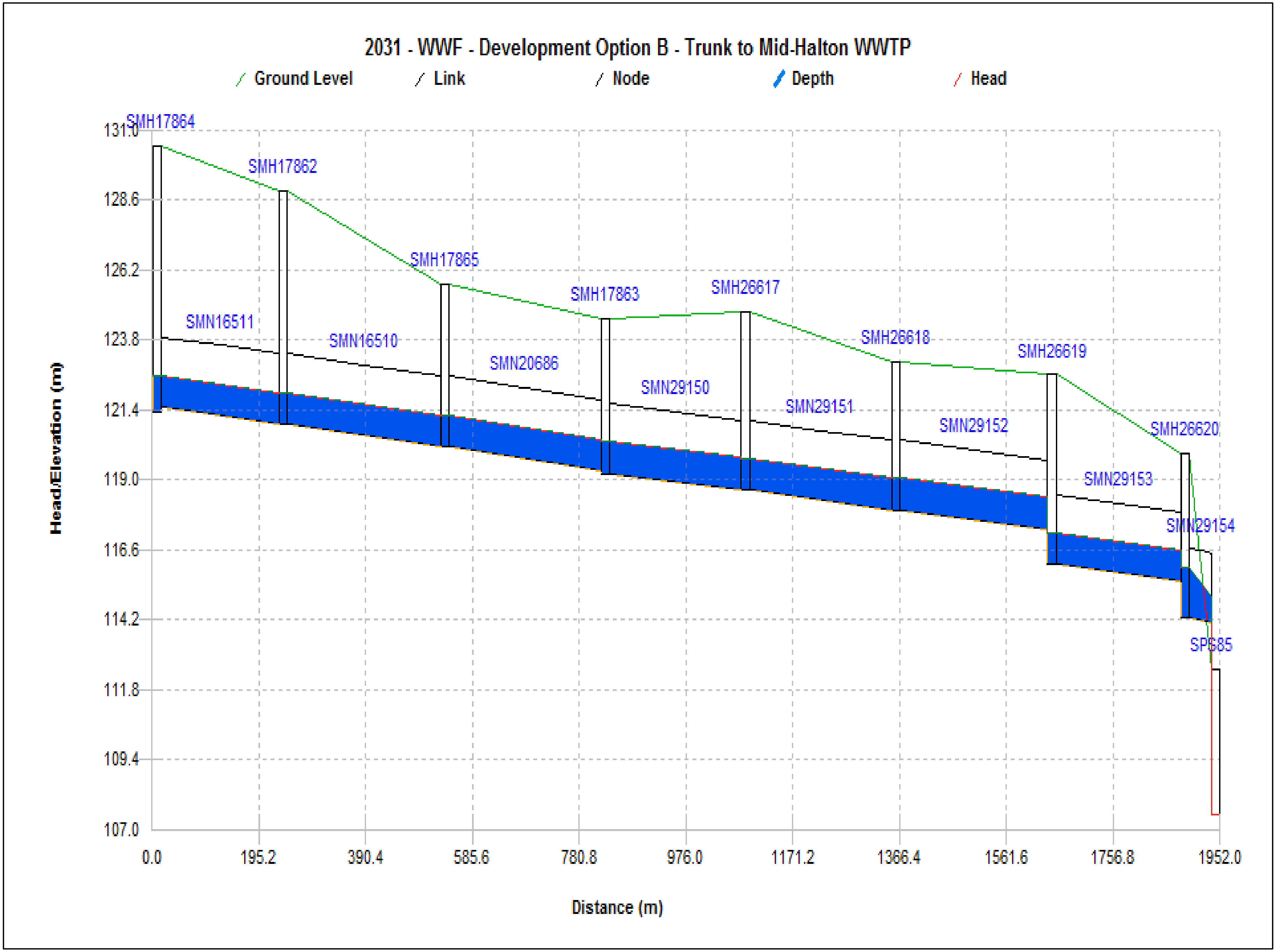

2031 WWF - Development Option C - Trunk to Oakville SW
Ground Level
Link
Node
Depth
Head
Head/Elevation (m)
131.0
125.1
119.2
113.3
107.4
101.5
95.6
89.7
83.8
77.9
72.0
7.0
730.2
1453.4
2176.6
2899.8
3623.0
4346.2
5069.4
5792.6
6515.8
7239.0
Distance (m)


2031 WWF - Development Option D - Trunk to Oakville SW
Ground Level
Link
Node
Depth
Head
Head/Elevation (m)
131.0
125.1
119.2
113.3
107.4
101.5
95.6
89.7
83.8
77.9
72.0
7.0
730.2
1453.4
2176.6
2899.8
3623.0
4346.2
5069.4
5792.6
6515.8
7239.0
Distance (m)

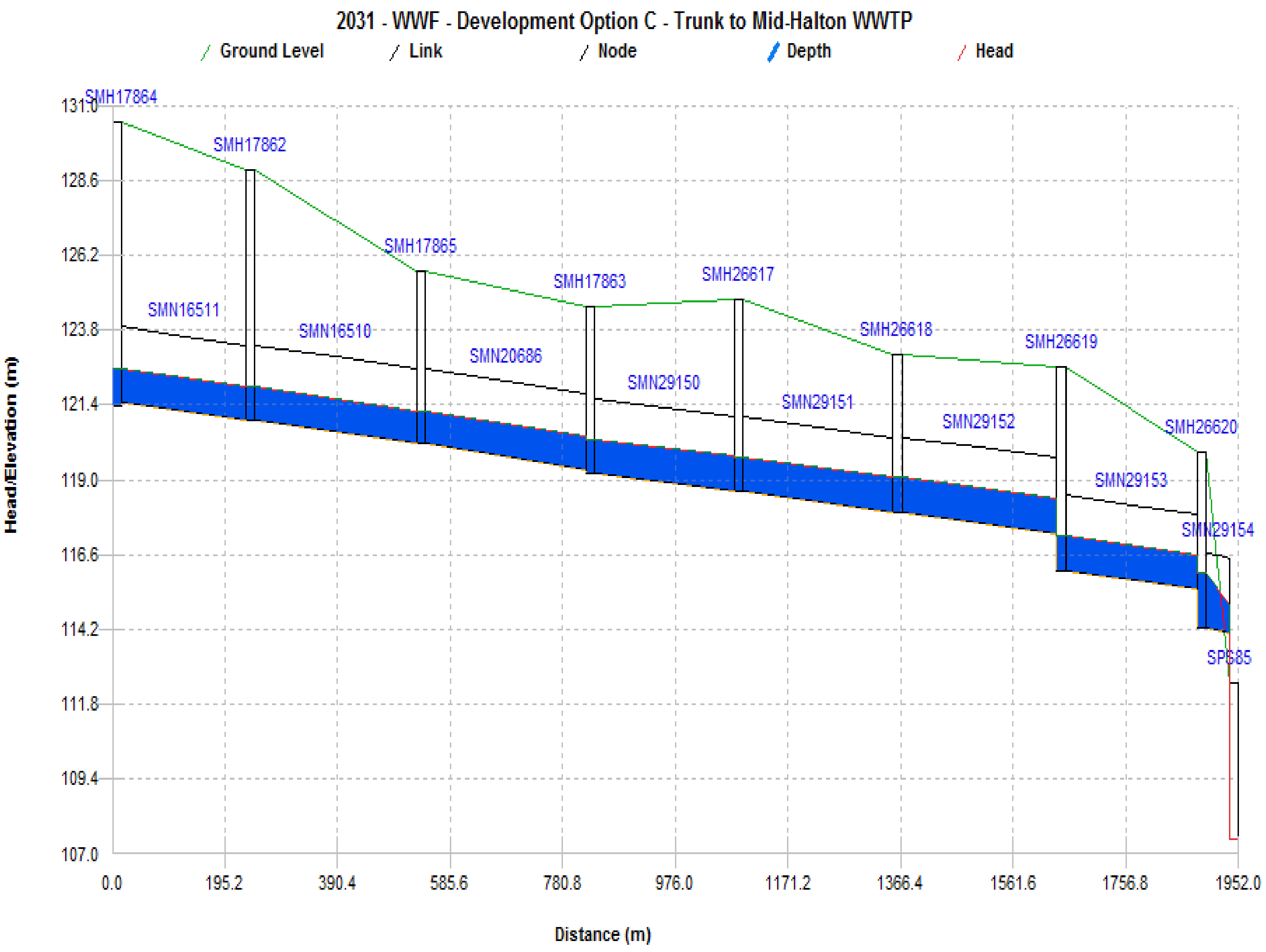

2031 WWF - Without Merton Development - Trunk to Oakville SW
Ground Level
Link
Node
Depth
Head
131.0
125.1
119.2
113.3
107.4
101.5
95.6
89.7
83.8
77.9
72.0
Head/Elevation (m)
7.0
730.2
1453.4
2176.6
2899.8
3623.0
4346.2
5069.4
5792.6
6515.8
7239.0
Distance (m)

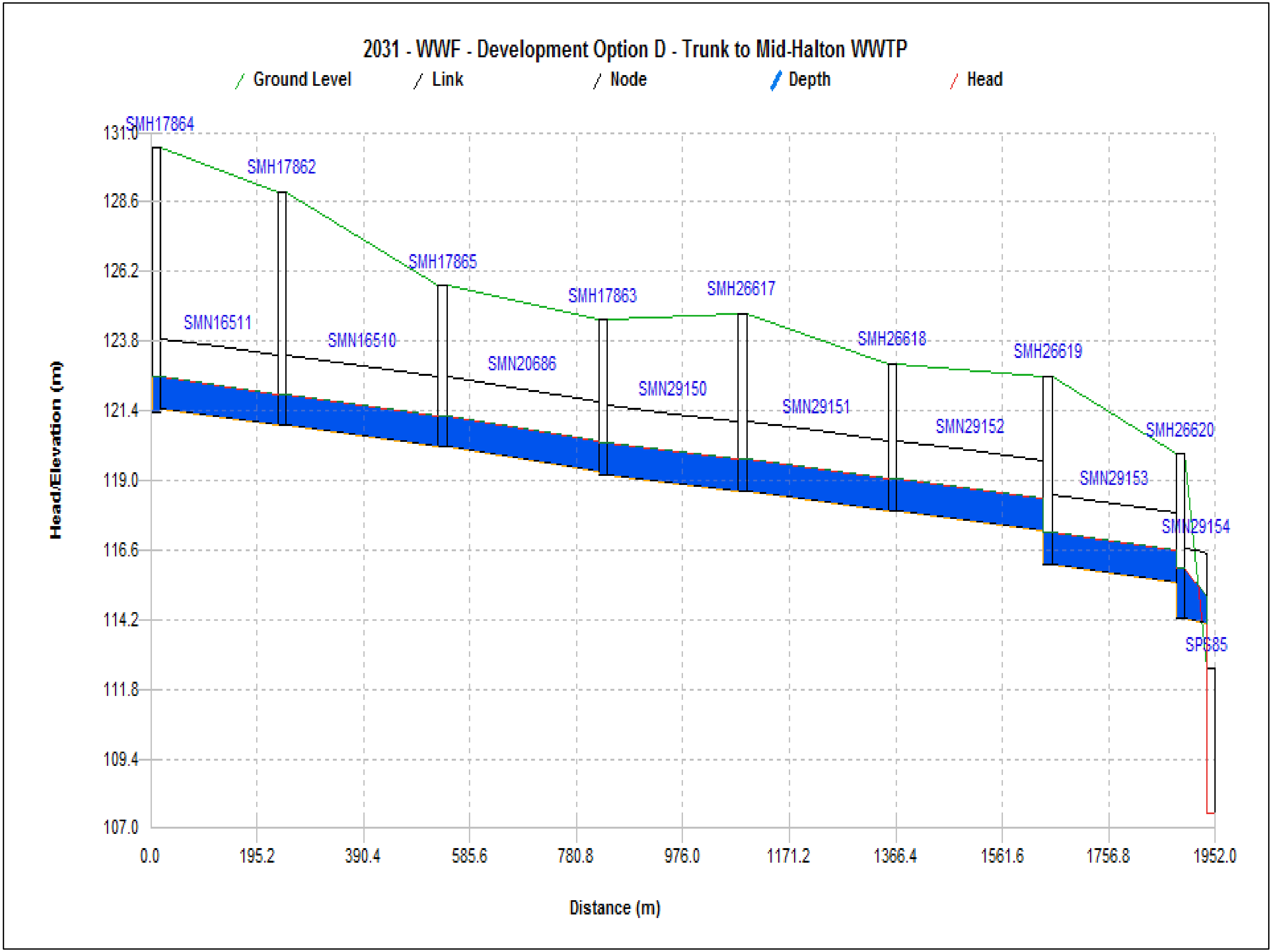


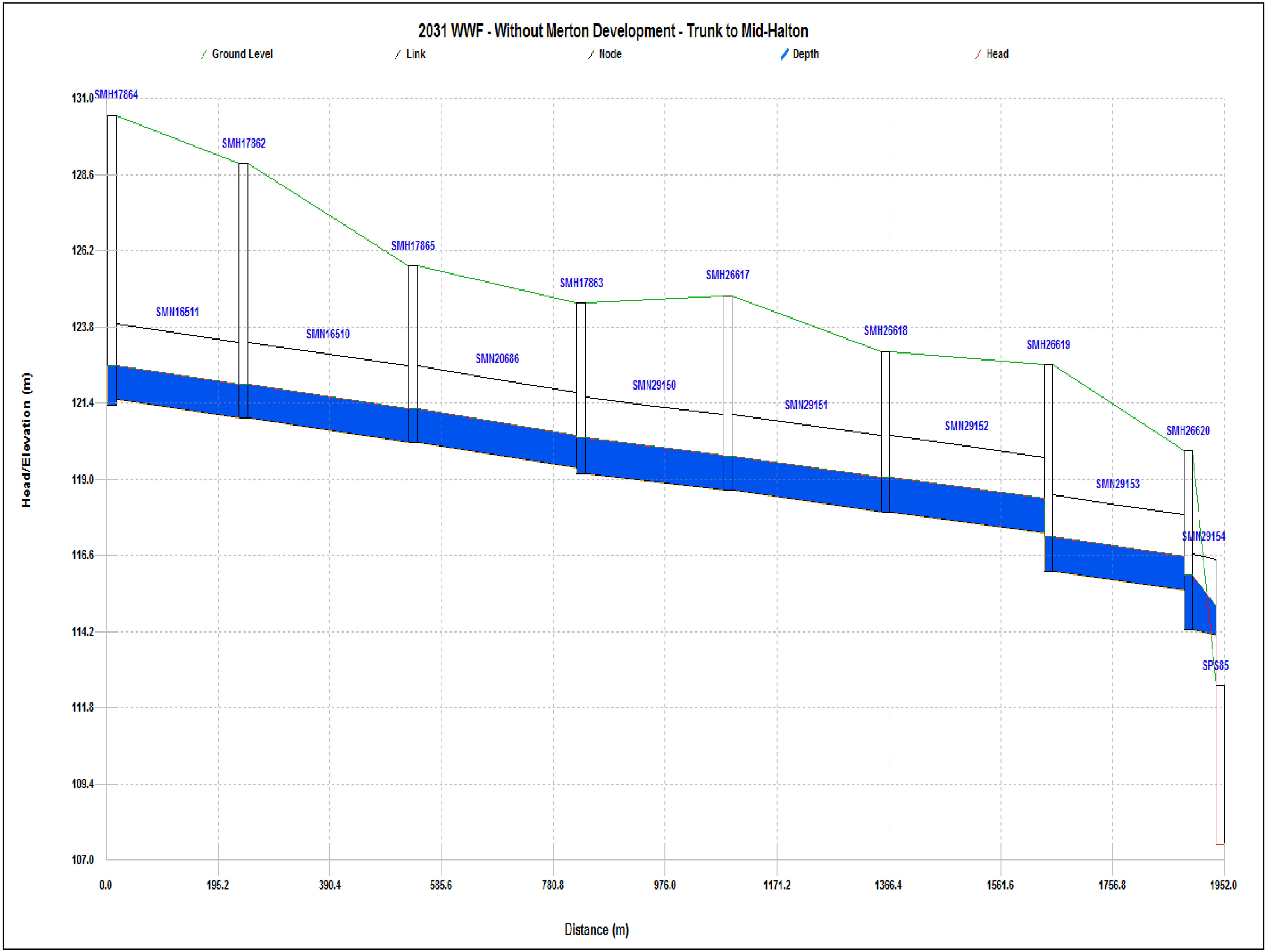
2031 - WWF - Development Option A - Trunk to Mid-Halton WWTP



2031 - WWF - Development Option B - Trunk to Mid-Halton WWTP


2031 - WWF - Development Option C - Trunk to Mid-Halton WWTP
Ground Level
Link
Node
Depth
Head
Head/Elevation (m)
Distance (m)
131.0
128.6
126.2
123.8
121.4
119.0
116.6
114.2
111.8
109.4
107.0
0.0
195.2
390.4
585.6
780.8
976.0
1171.2
1366.4
1561.6
1756.8
1952.0
SMH17864
SMH17862
SMH17865
SMH17863
SMH26617
SMH26618
SMH26619
SMH26620
SP685
SMN16511
SMN16510
SMN20686
SMN29150
SMN29151
SMN29152
SMN29153
SMN29154


2031 - WWF - Development Option D - Trunk to Mid-Halton WWTP
Ground Level
Link
Node
Depth
Head
Head/Elevation (m)
131.0
128.6
126.2
123.8
121.4
119.0
116.6
114.2
111.8
109.4
107.0
0.0
195.2
390.4
585.6
780.8
976.0
1171.2
1366.4
1561.6
1756.8
1952.0
Distance (m)
SMH17864
SMH17862
SMH17865
SMH17863
SMH26617
SMH26618
SMH26619
SMH26620
SPS85
SMN16511
SMN16510
SMN20686
SMN29150
SMN29151
SMN29152
SMN29153
SMN29154



2031 WWF - Without Merton Development - Trunk to Mid-Halton

Option A

Trunk to Oakville Southwest

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN18246	SMH6547	SMH6548	300	67	0.008	0.89	0.85	0.01	Free Surface	0.39	0.07	0.01
SMN5299	SMH5447	SMH5448	300	107	0.005	13.20	5.61	1.93	Free Surface	0.72	0.31	0.20
SMN5298	SMH5448	SMH5449	300	167	0.003	13.31	5.73	1.93	Free Surface	0.63	0.34	0.25
SMN5297	SMH5449	SMH5451	300	88	0.007	13.69	6.11	1.93	Free Surface	0.84	0.28	0.17
SMN5296	SMH5451	SMH5450	300	100	0.005	14.21	6.63	1.93	Free Surface	0.76	0.31	0.21
SMN5295	SMH5450	SMH5452	300	81	0.006	14.53	6.95	1.93	Free Surface	0.81	0.30	0.20
SMN5294	SMH5452	SMH5459	300	68	0.006	14.58	6.99	1.93	Free Surface	0.83	0.30	0.19
SMN5293	SMH5459	SMH5458	300	16	0.017	14.59	7.01	1.93	Free Surface	1.18	0.23	0.12
SMN5292	SMH5458	SMH5457	300	14	0.009	14.60	7.02	1.93	Free Surface	0.95	0.27	0.16
SMN5291	SMH5457	SMH5453	300	84	0.006	20.14	12.55	1.93	Free Surface	0.92	0.35	0.26
SMN5290	SMH5453	SMH5454	300	101	0.005	21.24	13.66	1.93	Free Surface	0.88	0.37	0.30
SMN5289	SMH5454	SMH5455	300	71	0.007	21.29	13.71	1.93	Free Surface	0.95	0.35	0.27
SMN5288	SMH5455	SMH5456	300	60	0.01	21.33	13.75	1.93	Free Surface	1.08	0.32	0.23
SMN5351	SMH5456	SMH5556	450	42	0.007	21.38	13.79	1.93	Free Surface	0.93	0.20	0.09
SMN5352	SMH5556	SMH5553	450	96	0.007	23.17	15.59	1.93	Free Surface	0.95	0.21	0.10
SMN5353	SMH5553	SMH5555	450	112	0.006	23.36	15.77	1.93	Free Surface	0.88	0.22	0.11
SMN4818	SMH5555	SMH5554	450	114	0.006	23.55	15.97	1.93	Free Surface	0.90	0.22	0.11
SMN5350	SMH5554	SMH5557	450	99	0.006	24.37	16.78	1.93	Free Surface	0.94	0.22	0.11
SMN5349	SMH5557	SMH5558	450	70	0.015	24.74	17.16	1.93	Free Surface	1.27	0.18	0.07
SMN5348	SMH5558	SMH4893	450	74	0.034	24.82	17.23	1.93	Free Surface	1.69	0.15	0.05
SMN5347	SMH4893	SMH4890	450	82	0.004	62.02	24.01	11.24	Free Surface	1.01	0.41	0.35
SMN5287	SMH4890	SMH4892	450	86	0.005	62.14	24.14	11.24	Free Surface	1.08	0.39	0.32
SMN12641	SMH4892	SMH14447	450	105	0.007	62.25	24.25	11.24	Free Surface	1.24	0.35	0.27
SMN12643	SMH14447	SMH14448	450	17	0.055	62.27	24.27	11.24	Free Surface	2.63	0.21	0.09
SMN12642	SMH14448	SMH6550	450	57	0.016	62.33	24.33	11.24	Free Surface	1.70	0.28	0.17
SMN5726	SMH6550	SMH6552	525	78	0.007	64.40	26.45	11.26	Free Surface	1.25	0.29	0.18
SMN5720	SMH6552	SMH6551	525	89	0.007	64.76	26.83	11.26	Free Surface	1.25	0.29	0.18
SMN5713	SMH6551	SMH6553	525	31	0.004	64.79	26.87	11.26	Free Surface	1.03	0.33	0.24
SMN5717	SMH6553	SMH6555	525	91	0.009	65.45	27.56	11.27	Free Surface	1.37	0.27	0.16
SMN5723	SMH6555	SMH6554	525	44	0.005	65.91	28.04	11.27	Free Surface	1.11	0.32	0.22
SMN5729	SMH6554	SMH6558	525	93	0.006	69.41	31.66	11.30	Free Surface	1.20	0.31	0.21
SMN5734	SMH6558	SMH6559	525	91	0.009	69.97	32.25	11.31	Free Surface	1.39	0.28	0.18
SMN5733	SMH6559	SMH6560	525	19	0.004	69.97	32.27	11.31	Free Surface	1.04	0.35	0.26

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN5732	SMH6560	SMH6561	525	90	0.007	70.66	32.98	11.32	Free Surface	1.30	0.30	0.19
SMN5727	SMH6561	SMH6562	525	79	0.008	71.33	33.67	11.32	Free Surface	1.35	0.29	0.19
SMN5721	SMH6562	SMH6527	525	21	0.006	71.35	33.70	11.32	Free Surface	1.25	0.31	0.21
SMN5725	SMH6527	SMH6526	525	80	0.007	74.97	37.41	11.34	Free Surface	1.30	0.31	0.21
SMN5728	SMH6526	SMH6525	525	40	0.007	75.00	37.46	11.35	Free Surface	1.32	0.31	0.21
SMN5731	SMH6525	SMH6730	525	48	0.007	79.38	41.89	11.36	Free Surface	1.34	0.32	0.22
SMN5736	SMH6730	SMH6524	525	61	0.01	79.45	41.96	11.36	Free Surface	1.54	0.29	0.18
SMN15824	SMH6524	SMH6523	525	8	0.002	127.10	90.11	11.55	Free Surface	0.99	0.57	0.63
SMN15823	SMH6523	SMH6522	525	63	0.009	127.20	90.22	11.56	Free Surface	1.64	0.39	0.32
SMN15825	SMH6522	SMH6521	525	92	0.006	143.95	107.34	11.69	Free Surface	1.49	0.46	0.43
SMN15851	SMH6521	SMH17031	525	138	0.007	150.68	114.09	11.70	Free Surface	1.59	0.45	0.42
SMN15852	SMH17031	SMH17032	525	72	0.01	151.32	114.75	11.71	Free Surface	1.82	0.41	0.35
SMN38577	SMH17032	SMH34418	525	59	0.014	151.57	115.01	11.72	Free Surface	2.07	0.37	0.30
SMN38578	SMH34418	SMH17030	525	49	0.009	151.57	115.01	11.72	Free Surface	1.73	0.43	0.38
SMN15849	SMH17030	SMH25910	525	70	0.004	151.66	115.11	11.72	Free Surface	1.24	0.55	0.59
SMN27402	SMH25910	SMH17024	525	27	0.007	151.69	115.14	11.73	Free Surface	1.63	0.45	0.41
SMN15850	SMH17024	SMH17018	525	74	0.005	170.47	134.09	11.84	Free Surface	1.43	0.54	0.57
SMN5755	SMH17018	SMH6520	525	81	0.004	172.28	135.91	11.84	Free Surface	1.27	0.60	0.67
SMN6101	SMH6520	SMH6873	525	76	0.007	172.69	136.33	11.84	Free Surface	1.68	0.48	0.47
SMN6106	SMH6873	SMH6871	525	71	0.008	173.51	137.18	11.85	Free Surface	1.71	0.48	0.46
SMN6104	SMH6871	SMH6870	525	29	0.009	174.01	137.70	11.84	Free Surface	1.79	0.46	0.43
SMN6194	SMH6870	SMH6996	525	40	0.01	174.17	137.86	11.84	Free Surface	1.90	0.44	0.40
SMN6196	SMH6996	SMH6997	525	62	0.008	176.72	140.57	11.83	Free Surface	1.75	0.47	0.46
SMN6195	SMH6997	SMH6868	525	58	0.007	176.97	140.83	11.83	Free Surface	1.69	0.49	0.48
SMN6100	SMH6868	SMH6376	525	56	0.009	177.32	141.18	11.82	Free Surface	1.82	0.46	0.44
SMN5774	SMH6376	SMH6375	525	95	0.007	177.86	141.73	11.82	Free Surface	1.68	0.49	0.49
SMN14294	SMH6375	SMH16351	525	85	0.009	187.09	151.29	11.81	Free Surface	1.85	0.48	0.46
SMN14293	SMH16351	SMH16350	525	88	0.009	187.66	151.87	11.81	Free Surface	1.88	0.47	0.45
SMN14292	SMH16350	SMH16348	525	91	0.009	188.23	152.45	11.81	Free Surface	1.85	0.48	0.46
SMN14291	SMH16348	SMH16349	525	82	0.01	193.98	158.33	11.81	Free Surface	1.93	0.47	0.45
SMN14290	SMH16349	SMH6369	525	85	0.01	231.98	197.18	11.82	Free Surface	2.05	0.52	0.53
SMN5870	SMH6369	SMH6231	525	94	0.009	233.14	198.38	11.82	Free Surface	1.94	0.54	0.57
SMN5880	SMH6231	SMH6227	675	56	0.003	412.13	378.29	12.05	Free Surface	1.53	0.71	0.85
SMN5879	SMH6227	SMH6228	675	71	0.003	413.82	380.02	12.05	Free Surface	1.42	0.76	0.92
SMN5877	SMH6228	SMH6230	675	60	0.003	414.16	380.36	12.05	Free Surface	1.40	0.77	0.94
SMN5872	SMH6230	SMH6229	675	73	0.005	414.76	380.97	12.05	Free Surface	1.76	0.63	0.72
SMN5882	SMH6229	SMH6151	675	65	0.004	415.16	381.38	12.04	Free Surface	1.69	0.65	0.75

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN5899	SMH6151	SMH6149	675	98	0.004	417.76	384.04	12.04	Free Surface	1.60	0.69	0.81
SMN5898	SMH6149	SMH6157	675	65	0.004	420.93	387.30	12.03	Free Surface	1.63	0.68	0.81
SMN5875	SMH6157	SMH6156	675	59	0.004	421.37	387.76	12.03	Free Surface	1.62	0.68	0.81
SMN5853	SMH6156	SMH6158	675	52	0.004	425.75	392.25	12.02	Free Surface	1.59	0.70	0.84
SMN5845	SMH6158	SMH6159	675	49	0.004	427.09	393.60	12.02	Free Surface	1.60	0.70	0.83
SMN5849	SMH6159	SMH6161	675	63	0.004	427.39	393.91	12.02	Free Surface	1.66	0.68	0.80
SMN5861	SMH6161	SMH6160	675	71	0.004	427.86	394.39	12.02	Free Surface	1.61	0.69	0.83
SMN5873	SMH6160	SMH6208	675	36	0.005	429.41	395.97	12.01	Free Surface	1.74	0.65	0.76
SMN5886	SMH6208	SMH6207	675	58	0.003	429.77	396.34	12.01	Free Surface	1.51	0.74	0.90
SMN5904	SMH6207	SMH6210	675	59	0.004	431.30	397.90	12.01	Free Surface	1.68	0.68	0.80
SMN5923	SMH6210	SMH6209	675	72	0.004	431.67	398.28	12.01	Free Surface	1.61	0.70	0.84
SMN5938	SMH6209	SMH6498	675	61	0.004	435.66	402.35	12.00	Free Surface	1.65	0.69	0.83
SMN5950	SMH6498	SMH6123	675	71	0.004	436.07	402.76	12.00	Free Surface	1.59	0.72	0.86
SMN5949	SMH6123	SMH6126	750	106	0.001	611.12	547.60	25.19	Pressurized	1.38	1.00	2.28
SMN36879	SMH6126	SMH33844	825	98	0.003	611.54	548.03	25.19	Free Surface	1.52	0.71	0.85
SMN36880	SMH33844	SMH7041	825	49	0.002	611.75	548.25	25.19	Free Surface	1.49	0.72	0.86
SMN6234	SMH7041	SMH6125	825	37	0.003	615.72	552.31	25.18	Free Surface	1.59	0.68	0.81
SMN36877	SMH6125	SMH33843	825	16	0.002	618.38	555.06	25.17	Free Surface	1.38	0.78	0.95
SMN36878	SMH33843	SMH6127	825	95	0.003	618.92	555.62	25.17	Free Surface	1.56	0.70	0.83
SMN5884	SMH6127	SMH6128	675	90	0.009	619.73	556.45	25.17	Free Surface	2.51	0.65	0.76
SMN5862	SMH6128	SMH6069	675	83	0.009	620.17	556.92	25.16	Free Surface	2.46	0.67	0.78
SMN5846	SMH6069	SMH6070	750	17	0.009	620.20	556.95	25.16	Free Surface	2.45	0.56	0.60
SMN5844	SMH6070	SMH6073	750	100	0.003	620.37	557.12	25.16	Free Surface	1.61	0.81	0.99
SMN6187	SMH6073	SMH6991	750	67	0.005	620.49	557.24	25.16	Free Surface	1.97	0.67	0.79
SMN6188	SMH6991	SMH6992	750	99	0.003	620.67	557.41	25.17	Free Surface	1.66	0.79	0.97
SMN6189	SMH6992	SMH6075	750	89	0.003	621.12	557.87	25.17	Free Surface	1.63	0.81	0.99
SMN6545	SMH6075	SMH6078	750	85	0.004	621.71	558.46	25.17	Free Surface	1.78	0.74	0.89
SMN6524	SMH6078	SMH6079	750	92	0.004	621.88	558.62	25.17	Free Surface	1.72	0.76	0.93
SMN6509	SMH6079	SFT114	750	13	0.003	651.46	588.66	25.21	Pressurized	1.70	0.81	0.99
SMN6502	SFT114	SMH6082	750	113	0.003	651.66	588.86	25.21	Pressurized	1.48	1.00	1.14
SMN6480	SMH6082	SMH6083	750	80	0.004	651.82	589.02	25.21	Free Surface	1.75	0.79	0.96
SMN6623	SMH6083	SMH6086	750	48	0.006	651.92	589.13	25.21	Free Surface	2.22	0.63	0.72
SMN6624	SMH6086	SMH6087	750	80	0.003	729.26	667.51	25.31	Pressurized	1.65	1.00	1.16
SMN20762	SMH6087	SMH26611	750	10	0.016	729.39	667.63	25.31	Free Surface	3.20	0.51	0.52
SMN28950	SMH26611	SPS25	1,200	24	0.007	2,001.36	1,799.31	103.50	Free Surface	3.01	0.57	0.62

Option B

Trunk to Oakville Southwest

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN18246	SMH6547	SMH6548	300	67	0.008	0.89	0.85	0.01	Free Surface	0.39	0.07	0.01
SMN5299	SMH5447	SMH5448	300	107	0.005	12.90	5.61	1.85	Free Surface	0.72	0.30	0.20
SMN5298	SMH5448	SMH5449	300	167	0.003	13.02	5.73	1.85	Free Surface	0.63	0.34	0.24
SMN5297	SMH5449	SMH5451	300	88	0.007	13.39	6.11	1.85	Free Surface	0.83	0.28	0.17
SMN5296	SMH5451	SMH5450	300	100	0.005	13.92	6.63	1.85	Free Surface	0.76	0.31	0.20
SMN5295	SMH5450	SMH5452	300	81	0.006	14.23	6.95	1.85	Free Surface	0.80	0.30	0.20
SMN5294	SMH5452	SMH5459	300	68	0.006	14.28	6.99	1.85	Free Surface	0.83	0.29	0.19
SMN5293	SMH5459	SMH5458	300	16	0.017	14.29	7.01	1.85	Free Surface	1.18	0.23	0.11
SMN5292	SMH5458	SMH5457	300	14	0.009	14.30	7.02	1.85	Free Surface	0.94	0.27	0.16
SMN5291	SMH5457	SMH5453	300	84	0.006	19.84	12.55	1.85	Free Surface	0.92	0.35	0.26
SMN5290	SMH5453	SMH5454	300	101	0.005	20.95	13.66	1.85	Free Surface	0.88	0.37	0.29
SMN5289	SMH5454	SMH5455	300	71	0.007	21.00	13.71	1.85	Free Surface	0.95	0.35	0.26
SMN5288	SMH5455	SMH5456	300	60	0.01	21.04	13.75	1.85	Free Surface	1.08	0.32	0.22
SMN5351	SMH5456	SMH5556	450	42	0.007	21.08	13.79	1.85	Free Surface	0.93	0.20	0.09
SMN5352	SMH5556	SMH5553	450	96	0.007	22.87	15.59	1.85	Free Surface	0.95	0.21	0.10
SMN5353	SMH5553	SMH5555	450	112	0.006	23.06	15.77	1.85	Free Surface	0.88	0.22	0.11
SMN4818	SMH5555	SMH5554	450	114	0.006	23.26	15.97	1.85	Free Surface	0.89	0.22	0.11
SMN5350	SMH5554	SMH5557	450	99	0.006	24.07	16.78	1.85	Free Surface	0.94	0.22	0.11
SMN5349	SMH5557	SMH5558	450	70	0.015	24.44	17.16	1.85	Free Surface	1.27	0.18	0.07
SMN5348	SMH5558	SMH4893	450	74	0.034	24.52	17.23	1.85	Free Surface	1.69	0.15	0.05
SMN5347	SMH4893	SMH4890	450	82	0.004	61.77	24.01	11.16	Free Surface	1.01	0.41	0.35
SMN5287	SMH4890	SMH4892	450	86	0.005	61.90	24.14	11.16	Free Surface	1.08	0.39	0.32
SMN12641	SMH4892	SMH14447	450	105	0.007	62.01	24.25	11.16	Free Surface	1.24	0.35	0.27
SMN12643	SMH14447	SMH14448	450	17	0.055	62.03	24.27	11.16	Free Surface	2.63	0.21	0.09
SMN12642	SMH14448	SMH6550	450	57	0.016	62.09	24.33	11.16	Free Surface	1.70	0.28	0.17
SMN5726	SMH6550	SMH6552	525	78	0.007	64.16	26.45	11.18	Free Surface	1.25	0.29	0.18
SMN5720	SMH6552	SMH6551	525	89	0.007	64.52	26.83	11.18	Free Surface	1.25	0.29	0.18
SMN5713	SMH6551	SMH6553	525	31	0.004	64.55	26.87	11.18	Free Surface	1.03	0.33	0.24
SMN5717	SMH6553	SMH6555	525	91	0.009	65.21	27.56	11.19	Free Surface	1.37	0.27	0.16
SMN5723	SMH6555	SMH6554	525	44	0.005	65.67	28.04	11.19	Free Surface	1.11	0.32	0.22
SMN5729	SMH6554	SMH6558	525	93	0.006	69.17	31.66	11.22	Free Surface	1.20	0.31	0.21
SMN5734	SMH6558	SMH6559	525	91	0.009	69.73	32.25	11.23	Free Surface	1.39	0.28	0.17
SMN5733	SMH6559	SMH6560	525	19	0.004	69.73	32.27	11.23	Free Surface	1.03	0.35	0.26
SMN5732	SMH6560	SMH6561	525	90	0.007	70.42	32.98	11.24	Free Surface	1.30	0.30	0.19
SMN5727	SMH6561	SMH6562	525	79	0.008	71.09	33.67	11.24	Free Surface	1.35	0.29	0.19

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN5721	SMH6562	SMH6527	525	21	0.006	71.11	33.70	11.24	Free Surface	1.25	0.31	0.21
SMN5725	SMH6527	SMH6526	525	80	0.007	74.73	37.41	11.26	Free Surface	1.30	0.31	0.21
SMN5728	SMH6526	SMH6525	525	40	0.007	74.76	37.46	11.27	Free Surface	1.32	0.31	0.21
SMN5731	SMH6525	SMH6730	525	48	0.007	79.15	41.89	11.28	Free Surface	1.34	0.32	0.22
SMN5736	SMH6730	SMH6524	525	61	0.01	79.21	41.96	11.28	Free Surface	1.54	0.29	0.18
SMN15824	SMH6524	SMH6523	525	8	0.002	126.87	90.11	11.47	Free Surface	0.99	0.57	0.62
SMN15823	SMH6523	SMH6522	525	63	0.009	126.97	90.22	11.48	Free Surface	1.64	0.39	0.32
SMN15825	SMH6522	SMH6521	525	92	0.006	143.72	107.34	11.61	Free Surface	1.49	0.46	0.43
SMN15851	SMH6521	SMH17031	525	138	0.007	150.45	114.09	11.62	Free Surface	1.59	0.45	0.42
SMN15852	SMH17031	SMH17032	525	72	0.01	151.09	114.75	11.63	Free Surface	1.82	0.41	0.35
SMN38577	SMH17032	SMH34418	525	59	0.014	151.34	115.01	11.64	Free Surface	2.07	0.37	0.30
SMN38578	SMH34418	SMH17030	525	49	0.009	151.34	115.01	11.64	Free Surface	1.73	0.43	0.38
SMN15849	SMH17030	SMH25910	525	70	0.004	151.43	115.11	11.64	Free Surface	1.24	0.55	0.59
SMN27402	SMH25910	SMH17024	525	27	0.007	151.46	115.14	11.65	Free Surface	1.63	0.45	0.41
SMN15850	SMH17024	SMH17018	525	74	0.005	170.24	134.09	11.76	Free Surface	1.43	0.54	0.57
SMN5755	SMH17018	SMH6520	525	81	0.004	172.05	135.91	11.76	Free Surface	1.27	0.60	0.67
SMN6101	SMH6520	SMH6873	525	76	0.007	172.46	136.33	11.76	Free Surface	1.68	0.48	0.47
SMN6106	SMH6873	SMH6871	525	71	0.008	173.28	137.18	11.77	Free Surface	1.70	0.48	0.46
SMN6104	SMH6871	SMH6870	525	29	0.009	173.78	137.70	11.76	Free Surface	1.79	0.46	0.43
SMN6194	SMH6870	SMH6996	525	40	0.01	173.94	137.86	11.76	Free Surface	1.90	0.44	0.40
SMN6196	SMH6996	SMH6997	525	62	0.008	176.49	140.57	11.75	Free Surface	1.75	0.47	0.45
SMN6195	SMH6997	SMH6868	525	58	0.007	176.74	140.83	11.75	Free Surface	1.69	0.49	0.48
SMN6100	SMH6868	SMH6376	525	56	0.009	177.09	141.18	11.74	Free Surface	1.81	0.46	0.44
SMN5774	SMH6376	SMH6375	525	95	0.007	177.63	141.73	11.74	Free Surface	1.68	0.49	0.49
SMN14294	SMH6375	SMH16351	525	85	0.009	186.86	151.29	11.73	Free Surface	1.85	0.48	0.46
SMN14293	SMH16351	SMH16350	525	88	0.009	187.44	151.87	11.73	Free Surface	1.88	0.47	0.45
SMN14292	SMH16350	SMH16348	525	91	0.009	188.00	152.45	11.73	Free Surface	1.85	0.48	0.46
SMN14291	SMH16348	SMH16349	525	82	0.01	193.76	158.33	11.73	Free Surface	1.93	0.47	0.45
SMN14290	SMH16349	SMH6369	525	85	0.01	231.75	197.18	11.74	Free Surface	2.05	0.52	0.53
SMN5870	SMH6369	SMH6231	525	94	0.009	232.91	198.38	11.74	Free Surface	1.94	0.54	0.57
SMN5880	SMH6231	SMH6227	675	56	0.003	411.92	378.29	11.97	Free Surface	1.53	0.71	0.84
SMN5879	SMH6227	SMH6228	675	71	0.003	413.61	380.02	11.97	Free Surface	1.42	0.76	0.92
SMN5877	SMH6228	SMH6230	675	60	0.003	413.94	380.36	11.97	Free Surface	1.40	0.77	0.94
SMN5872	SMH6230	SMH6229	675	73	0.005	414.54	380.97	11.97	Free Surface	1.76	0.63	0.72
SMN5882	SMH6229	SMH6151	675	65	0.004	414.94	381.38	11.96	Free Surface	1.69	0.65	0.75
SMN5899	SMH6151	SMH6149	675	98	0.004	417.55	384.04	11.96	Free Surface	1.60	0.68	0.81
SMN5898	SMH6149	SMH6157	675	65	0.004	420.71	387.30	11.95	Free Surface	1.62	0.68	0.81

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN5875	SMH6157	SMH6156	675	59	0.004	421.16	387.76	11.95	Free Surface	1.62	0.68	0.81
SMN5853	SMH6156	SMH6158	675	52	0.004	425.54	392.25	11.94	Free Surface	1.59	0.70	0.84
SMN5845	SMH6158	SMH6159	675	49	0.004	426.88	393.60	11.94	Free Surface	1.60	0.70	0.83
SMN5849	SMH6159	SMH6161	675	63	0.004	427.18	393.91	11.94	Free Surface	1.66	0.68	0.80
SMN5861	SMH6161	SMH6160	675	71	0.004	427.65	394.39	11.94	Free Surface	1.61	0.69	0.83
SMN5873	SMH6160	SMH6208	675	36	0.005	429.19	395.97	11.93	Free Surface	1.74	0.65	0.76
SMN5886	SMH6208	SMH6207	675	58	0.003	429.55	396.34	11.93	Free Surface	1.51	0.74	0.90
SMN5904	SMH6207	SMH6210	675	59	0.004	431.08	397.90	11.93	Free Surface	1.68	0.68	0.80
SMN5923	SMH6210	SMH6209	675	72	0.004	431.46	398.28	11.93	Free Surface	1.61	0.70	0.84
SMN5938	SMH6209	SMH6498	675	61	0.004	435.44	402.35	11.92	Free Surface	1.65	0.69	0.83
SMN5950	SMH6498	SMH6123	675	71	0.004	435.86	402.76	11.92	Free Surface	1.59	0.72	0.86
SMN5949	SMH6123	SMH6126	750	106	0.001	610.93	547.60	25.11	Pressurized	1.38	1.00	2.28
SMN36879	SMH6126	SMH33844	825	98	0.003	611.35	548.03	25.11	Free Surface	1.51	0.71	0.85
SMN36880	SMH33844	SMH7041	825	49	0.002	611.56	548.25	25.11	Free Surface	1.49	0.72	0.86
SMN6234	SMH7041	SMH6125	825	37	0.003	615.52	552.31	25.10	Free Surface	1.59	0.68	0.81
SMN36877	SMH6125	SMH33843	825	16	0.002	618.18	555.06	25.09	Free Surface	1.38	0.78	0.95
SMN36878	SMH33843	SMH6127	825	95	0.003	618.73	555.62	25.09	Free Surface	1.56	0.70	0.83
SMN5884	SMH6127	SMH6128	675	90	0.009	619.53	556.45	25.09	Free Surface	2.51	0.65	0.76
SMN5862	SMH6128	SMH6069	675	83	0.009	619.98	556.92	25.08	Free Surface	2.46	0.67	0.78
SMN5846	SMH6069	SMH6070	750	17	0.009	620.01	556.95	25.08	Free Surface	2.45	0.56	0.60
SMN5844	SMH6070	SMH6073	750	100	0.003	620.18	557.12	25.08	Free Surface	1.61	0.81	0.99
SMN6187	SMH6073	SMH6991	750	67	0.005	620.30	557.24	25.08	Free Surface	1.97	0.67	0.79
SMN6188	SMH6991	SMH6992	750	99	0.003	620.47	557.41	25.09	Free Surface	1.66	0.79	0.97
SMN6189	SMH6992	SMH6075	750	89	0.003	620.93	557.87	25.09	Free Surface	1.63	0.81	0.99
SMN6545	SMH6075	SMH6078	750	85	0.004	621.52	558.46	25.09	Free Surface	1.78	0.74	0.89
SMN6524	SMH6078	SMH6079	750	92	0.004	621.69	558.62	25.09	Free Surface	1.72	0.76	0.93
SMN6509	SMH6079	SFT114	750	13	0.003	651.27	588.66	25.13	Pressurized	1.70	0.81	0.99
SMN6502	SFT114	SMH6082	750	113	0.003	651.47	588.86	25.13	Pressurized	1.48	1.00	1.14
SMN6480	SMH6082	SMH6083	750	80	0.004	651.63	589.02	25.13	Free Surface	1.75	0.79	0.96
SMN6623	SMH6083	SMH6086	750	48	0.006	651.73	589.13	25.13	Free Surface	2.22	0.63	0.72
SMN6624	SMH6086	SMH6087	750	80	0.003	729.08	667.51	25.23	Pressurized	1.65	1.00	1.16
SMN20762	SMH6087	SMH26611	750	10	0.016	729.20	667.63	25.23	Free Surface	3.20	0.51	0.52
SMN28950	SMH26611	SPS25	1,200	24	0.007	2,001.21	1,799.31	103.42	Free Surface	3.01	0.57	0.62

Option C

Trunk to Oakville Southwest

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN18246	SMH6547	SMH6548	300	67	0.008	0.89	0.85	0.01	Free Surface	0.39	0.07	0.01
SMN5299	SMH5447	SMH5448	300	107	0.005	11.85	5.64	1.56	Free Surface	0.70	0.29	0.18
SMN5298	SMH5448	SMH5449	300	167	0.003	11.97	5.76	1.56	Free Surface	0.61	0.32	0.22
SMN5297	SMH5449	SMH5451	300	88	0.007	12.34	6.14	1.56	Free Surface	0.82	0.27	0.16
SMN5296	SMH5451	SMH5450	300	100	0.005	12.87	6.66	1.56	Free Surface	0.74	0.29	0.19
SMN5295	SMH5450	SMH5452	300	81	0.006	13.18	6.98	1.56	Free Surface	0.78	0.29	0.18
SMN5294	SMH5452	SMH5459	300	68	0.006	13.23	7.02	1.56	Free Surface	0.81	0.28	0.17
SMN5293	SMH5459	SMH5458	300	16	0.017	13.24	7.04	1.56	Free Surface	1.15	0.22	0.11
SMN5292	SMH5458	SMH5457	300	14	0.009	13.25	7.05	1.56	Free Surface	0.92	0.26	0.14
SMN5291	SMH5457	SMH5453	300	84	0.006	18.79	12.58	1.56	Free Surface	0.91	0.34	0.24
SMN5290	SMH5453	SMH5454	300	101	0.005	19.90	13.69	1.56	Free Surface	0.87	0.36	0.28
SMN5289	SMH5454	SMH5455	300	71	0.007	19.95	13.74	1.56	Free Surface	0.94	0.34	0.25
SMN5288	SMH5455	SMH5456	300	60	0.01	19.99	13.78	1.56	Free Surface	1.06	0.31	0.21
SMN5351	SMH5456	SMH5556	450	42	0.007	20.03	13.82	1.56	Free Surface	0.92	0.20	0.08
SMN5352	SMH5556	SMH5553	450	96	0.007	21.82	15.62	1.56	Free Surface	0.94	0.20	0.09
SMN5353	SMH5553	SMH5555	450	112	0.006	22.01	15.80	1.56	Free Surface	0.86	0.22	0.10
SMN4818	SMH5555	SMH5554	450	114	0.006	22.20	16.00	1.56	Free Surface	0.88	0.22	0.10
SMN5350	SMH5554	SMH5557	450	99	0.006	23.02	16.81	1.56	Free Surface	0.93	0.21	0.10
SMN5349	SMH5557	SMH5558	450	70	0.015	23.39	17.19	1.56	Free Surface	1.25	0.18	0.07
SMN5348	SMH5558	SMH4893	450	74	0.034	23.47	17.26	1.56	Free Surface	1.66	0.14	0.05
SMN5347	SMH4893	SMH4890	450	82	0.004	60.93	24.04	10.87	Free Surface	1.00	0.41	0.35
SMN5287	SMH4890	SMH4892	450	86	0.005	61.06	24.17	10.87	Free Surface	1.08	0.39	0.32
SMN12641	SMH4892	SMH14447	450	105	0.007	61.17	24.28	10.87	Free Surface	1.23	0.35	0.26
SMN12643	SMH14447	SMH14448	450	17	0.055	61.19	24.30	10.87	Free Surface	2.62	0.20	0.09
SMN12642	SMH14448	SMH6550	450	57	0.016	61.25	24.36	10.87	Free Surface	1.70	0.28	0.17
SMN5726	SMH6550	SMH6552	525	78	0.007	63.32	26.48	10.885	Free Surface	1.25	0.29	0.18
SMN5720	SMH6552	SMH6551	525	89	0.007	63.68	26.86	10.889	Free Surface	1.25	0.29	0.18
SMN5713	SMH6551	SMH6553	525	31	0.004	63.71	26.90	10.891	Free Surface	1.03	0.33	0.23
SMN5717	SMH6553	SMH6555	525	91	0.009	64.37	27.59	10.898	Free Surface	1.36	0.27	0.16
SMN5723	SMH6555	SMH6554	525	44	0.005	64.83	28.07	10.902	Free Surface	1.11	0.32	0.22
SMN5729	SMH6554	SMH6558	525	93	0.006	68.33	31.69	10.929	Free Surface	1.20	0.31	0.21
SMN5734	SMH6558	SMH6559	525	91	0.009	68.89	32.28	10.937	Free Surface	1.38	0.28	0.17
SMN5733	SMH6559	SMH6560	525	19	0.004	68.89	32.30	10.943	Free Surface	1.03	0.35	0.26
SMN5732	SMH6560	SMH6561	525	90	0.007	69.59	33.01	10.946	Free Surface	1.30	0.30	0.19
SMN5727	SMH6561	SMH6562	525	79	0.008	70.26	33.70	10.951	Free Surface	1.35	0.29	0.18

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN5721	SMH6562	SMH6527	525	21	0.006	70.27	33.73	10.952	Free Surface	1.25	0.31	0.20
SMN5725	SMH6527	SMH6526	525	80	0.007	73.89	37.44	10.974	Free Surface	1.29	0.31	0.21
SMN5728	SMH6526	SMH6525	525	40	0.007	73.93	37.49	10.978	Free Surface	1.32	0.31	0.20
SMN5731	SMH6525	SMH6730	525	48	0.007	78.31	41.92	10.989	Free Surface	1.34	0.32	0.22
SMN5736	SMH6730	SMH6524	525	61	0.01	78.38	41.99	10.991	Free Surface	1.53	0.29	0.18
SMN15824	SMH6524	SMH6523	525	8	0.002	126.05	90.14	11.184	Free Surface	0.99	0.57	0.62
SMN15823	SMH6523	SMH6522	525	63	0.009	126.14	90.25	11.186	Free Surface	1.64	0.39	0.32
SMN15825	SMH6522	SMH6521	525	92	0.006	142.90	107.37	11.321	Free Surface	1.48	0.46	0.43
SMN15851	SMH6521	SMH17031	525	138	0.007	149.63	114.12	11.331	Free Surface	1.59	0.45	0.41
SMN15852	SMH17031	SMH17032	525	72	0.01	150.28	114.78	11.34	Free Surface	1.82	0.41	0.35
SMN38577	SMH17032	SMH34418	525	59	0.014	150.53	115.04	11.347	Free Surface	2.06	0.37	0.29
SMN38578	SMH34418	SMH17030	525	49	0.009	150.53	115.04	11.347	Free Surface	1.72	0.42	0.37
SMN15849	SMH17030	SMH25910	525	70	0.004	150.62	115.14	11.354	Free Surface	1.23	0.55	0.59
SMN27402	SMH25910	SMH17024	525	27	0.007	150.65	115.17	11.358	Free Surface	1.63	0.44	0.41
SMN15850	SMH17024	SMH17018	525	74	0.005	169.44	134.12	11.468	Free Surface	1.43	0.54	0.57
SMN5755	SMH17018	SMH6520	525	81	0.004	171.25	135.94	11.473	Free Surface	1.27	0.60	0.67
SMN6101	SMH6520	SMH6873	525	76	0.007	171.66	136.36	11.474	Free Surface	1.67	0.48	0.47
SMN6106	SMH6873	SMH6871	525	71	0.008	172.48	137.21	11.475	Free Surface	1.70	0.48	0.46
SMN6104	SMH6871	SMH6870	525	29	0.009	172.98	137.73	11.474	Free Surface	1.79	0.46	0.43
SMN6194	SMH6870	SMH6996	525	40	0.01	173.14	137.89	11.474	Free Surface	1.90	0.44	0.40
SMN6196	SMH6996	SMH6997	525	62	0.008	175.69	140.60	11.455	Free Surface	1.75	0.47	0.45
SMN6195	SMH6997	SMH6868	525	58	0.007	175.94	140.86	11.455	Free Surface	1.69	0.49	0.47
SMN6100	SMH6868	SMH6376	525	56	0.009	176.29	141.21	11.454	Free Surface	1.81	0.46	0.43
SMN5774	SMH6376	SMH6375	525	95	0.007	176.83	141.76	11.454	Free Surface	1.68	0.49	0.48
SMN14294	SMH6375	SMH16351	525	85	0.009	186.06	151.32	11.442	Free Surface	1.84	0.47	0.46
SMN14293	SMH16351	SMH16350	525	88	0.009	186.64	151.90	11.442	Free Surface	1.87	0.47	0.45
SMN14292	SMH16350	SMH16348	525	91	0.009	187.21	152.48	11.441	Free Surface	1.85	0.48	0.46
SMN14291	SMH16348	SMH16349	525	82	0.01	192.96	158.36	11.435	Free Surface	1.92	0.47	0.45
SMN14290	SMH16349	SMH6369	525	85	0.01	230.97	197.21	11.453	Free Surface	2.05	0.52	0.53
SMN5870	SMH6369	SMH6231	525	94	0.009	232.14	198.41	11.451	Free Surface	1.94	0.54	0.57
SMN5880	SMH6231	SMH6227	675	56	0.003	411.16	378.32	11.68	Free Surface	1.53	0.70	0.84
SMN5879	SMH6227	SMH6228	675	71	0.003	412.86	380.05	11.677	Free Surface	1.42	0.76	0.92
SMN5877	SMH6228	SMH6230	675	60	0.003	413.19	380.39	11.676	Free Surface	1.40	0.77	0.94
SMN5872	SMH6230	SMH6229	675	73	0.005	413.79	381.00	11.675	Free Surface	1.76	0.63	0.71
SMN5882	SMH6229	SMH6151	675	65	0.004	414.19	381.41	11.674	Free Surface	1.69	0.65	0.75
SMN5899	SMH6151	SMH6149	675	98	0.004	416.80	384.07	11.669	Free Surface	1.60	0.68	0.81
SMN5898	SMH6149	SMH6157	675	65	0.004	419.96	387.33	11.658	Free Surface	1.62	0.68	0.80

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN5875	SMH6157	SMH6156	675	59	0.004	420.41	387.79	11.658	Free Surface	1.62	0.68	0.81
SMN5853	SMH6156	SMH6158	675	52	0.004	424.79	392.28	11.648	Free Surface	1.58	0.70	0.84
SMN5845	SMH6158	SMH6159	675	49	0.004	426.13	393.63	11.648	Free Surface	1.60	0.70	0.83
SMN5849	SMH6159	SMH6161	675	63	0.004	426.43	393.94	11.647	Free Surface	1.66	0.67	0.80
SMN5861	SMH6161	SMH6160	675	71	0.004	426.90	394.42	11.646	Free Surface	1.61	0.69	0.83
SMN5873	SMH6160	SMH6208	675	36	0.005	428.45	396.00	11.643	Free Surface	1.74	0.65	0.76
SMN5886	SMH6208	SMH6207	675	58	0.003	428.81	396.37	11.643	Free Surface	1.51	0.74	0.90
SMN5904	SMH6207	SMH6210	675	59	0.004	430.34	397.93	11.64	Free Surface	1.68	0.67	0.80
SMN5923	SMH6210	SMH6209	675	72	0.004	430.72	398.31	11.639	Free Surface	1.61	0.70	0.84
SMN5938	SMH6209	SMH6498	675	61	0.004	434.70	402.38	11.633	Free Surface	1.65	0.69	0.82
SMN5950	SMH6498	SMH6123	675	71	0.004	435.11	402.79	11.632	Free Surface	1.59	0.72	0.86
SMN5949	SMH6123	SMH6126	750	106	0.001	610.26	547.63	24.818	Pressurized	1.38	1.00	2.28
SMN36879	SMH6126	SMH33844	825	98	0.003	610.69	548.06	24.817	Free Surface	1.51	0.71	0.85
SMN36880	SMH33844	SMH7041	825	49	0.002	610.89	548.28	24.816	Free Surface	1.49	0.72	0.86
SMN6234	SMH7041	SMH6125	825	37	0.003	614.86	552.34	24.808	Free Surface	1.59	0.68	0.81
SMN36877	SMH6125	SMH33843	825	16	0.002	617.52	555.09	24.799	Free Surface	1.38	0.78	0.95
SMN36878	SMH33843	SMH6127	825	95	0.003	618.07	555.65	24.798	Free Surface	1.56	0.70	0.83
SMN5884	SMH6127	SMH6128	675	90	0.009	618.87	556.48	24.795	Free Surface	2.51	0.65	0.76
SMN5862	SMH6128	SMH6069	675	83	0.009	619.32	556.95	24.793	Free Surface	2.45	0.66	0.78
SMN5846	SMH6069	SMH6070	750	17	0.009	619.34	556.98	24.793	Free Surface	2.45	0.56	0.60
SMN5844	SMH6070	SMH6073	750	100	0.003	619.52	557.15	24.793	Free Surface	1.61	0.81	0.99
SMN6187	SMH6073	SMH6991	750	67	0.005	619.64	557.27	24.794	Free Surface	1.97	0.67	0.79
SMN6188	SMH6991	SMH6992	750	99	0.003	619.81	557.44	24.796	Free Surface	1.66	0.79	0.96
SMN6189	SMH6992	SMH6075	750	89	0.003	620.27	557.90	24.797	Free Surface	1.63	0.81	0.99
SMN6545	SMH6075	SMH6078	750	85	0.004	620.86	558.49	24.801	Free Surface	1.78	0.74	0.89
SMN6524	SMH6078	SMH6079	750	92	0.004	621.02	558.65	24.802	Free Surface	1.72	0.76	0.93
SMN6509	SMH6079	SFT114	750	13	0.003	650.61	588.69	24.838	Pressurized	1.70	0.81	0.99
SMN6502	SFT114	SMH6082	750	113	0.003	650.81	588.89	24.838	Pressurized	1.47	1.00	1.14
SMN6480	SMH6082	SMH6083	750	80	0.004	650.97	589.05	24.839	Free Surface	1.75	0.79	0.96
SMN6623	SMH6083	SMH6086	750	48	0.006	651.08	589.16	24.839	Free Surface	2.22	0.63	0.72
SMN6624	SMH6086	SMH6087	750	80	0.003	728.43	667.54	24.94	Pressurized	1.65	1.00	1.15
SMN20762	SMH6087	SMH26611	750	10	0.016	728.55	667.66	24.943	Free Surface	3.20	0.51	0.52
SMN28950	SMH26611	SPS25	1,200	24	0.007	2000.70	1799.34	103.133	Free Surface	3.01	0.57	0.62

Option D

Trunk to Oakville Southwest

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN18246	SMH6547	SMH6548	300	67	0.008	0.89	0.85	0.01	Free Surface	0.39	0.07	0.01
SMN5299	SMH5447	SMH5448	300	107	0.005	3.09	3.09	0.00	Free Surface	0.47	0.15	0.05
SMN5298	SMH5448	SMH5449	300	167	0.003	3.21	3.21	0.00	Free Surface	0.42	0.17	0.06
SMN5297	SMH5449	SMH5451	300	88	0.007	3.59	3.59	0.00	Free Surface	0.57	0.15	0.05
SMN5296	SMH5451	SMH5450	300	100	0.005	4.11	4.11	0.00	Free Surface	0.53	0.17	0.06
SMN5295	SMH5450	SMH5452	300	81	0.006	4.43	4.43	0.00	Free Surface	0.57	0.17	0.06
SMN5294	SMH5452	SMH5459	300	68	0.006	4.47	4.47	0.00	Free Surface	0.59	0.16	0.06
SMN5293	SMH5459	SMH5458	300	16	0.017	4.49	4.49	0.00	Free Surface	0.84	0.13	0.04
SMN5292	SMH5458	SMH5457	300	14	0.009	4.50	4.50	0.00	Free Surface	0.67	0.15	0.05
SMN5291	SMH5457	SMH5453	300	84	0.006	10.03	10.03	0.00	Free Surface	0.76	0.24	0.13
SMN5290	SMH5453	SMH5454	300	101	0.005	11.14	11.14	0.00	Free Surface	0.74	0.27	0.16
SMN5289	SMH5454	SMH5455	300	71	0.007	11.19	11.19	0.00	Free Surface	0.79	0.25	0.14
SMN5288	SMH5455	SMH5456	300	60	0.01	11.23	11.23	0.00	Free Surface	0.90	0.23	0.12
SMN5351	SMH5456	SMH5556	450	42	0.007	11.27	11.27	0.00	Free Surface	0.77	0.15	0.05
SMN5352	SMH5556	SMH5553	450	96	0.007	13.07	13.07	0.00	Free Surface	0.80	0.16	0.06
SMN5353	SMH5553	SMH5555	450	112	0.006	13.25	13.25	0.00	Free Surface	0.74	0.17	0.06
SMN4818	SMH5555	SMH5554	450	114	0.006	13.45	13.45	0.00	Free Surface	0.76	0.17	0.06
SMN5350	SMH5554	SMH5557	450	99	0.006	14.26	14.26	0.00	Free Surface	0.80	0.17	0.06
SMN5349	SMH5557	SMH5558	450	70	0.015	14.64	14.64	0.00	Free Surface	1.09	0.14	0.04
SMN5348	SMH5558	SMH4893	450	74	0.034	14.71	14.71	0.00	Free Surface	1.45	0.12	0.03
SMN5347	SMH4893	SMH4890	450	82	0.004	14.80	14.80	0.00	Free Surface	0.67	0.20	0.08
SMN5287	SMH4890	SMH4892	450	86	0.005	14.93	14.93	0.00	Free Surface	0.72	0.19	0.08
SMN12641	SMH4892	SMH14447	450	105	0.007	15.04	15.04	0.00	Free Surface	0.82	0.17	0.07
SMN12643	SMH14447	SMH14448	450	17	0.055	15.06	15.06	0.00	Free Surface	1.72	0.10	0.02
SMN12642	SMH14448	SMH6550	450	57	0.016	15.12	15.12	0.00	Free Surface	1.13	0.14	0.04
SMN5726	SMH6550	SMH6552	525	78	0.007	17.30	17.24	0.02	Free Surface	0.85	0.15	0.05
SMN5720	SMH6552	SMH6551	525	89	0.007	17.70	17.62	0.02	Free Surface	0.86	0.15	0.05
SMN5713	SMH6551	SMH6553	525	31	0.004	17.74	17.66	0.02	Free Surface	0.71	0.17	0.07
SMN5717	SMH6553	SMH6555	525	91	0.009	18.47	18.35	0.03	Free Surface	0.94	0.15	0.05
SMN5723	SMH6555	SMH6554	525	44	0.005	18.96	18.83	0.03	Free Surface	0.78	0.17	0.06
SMN5729	SMH6554	SMH6558	525	93	0.006	22.69	22.45	0.06	Free Surface	0.87	0.18	0.07
SMN5734	SMH6558	SMH6559	525	91	0.009	23.31	23.04	0.07	Free Surface	1.01	0.16	0.06
SMN5733	SMH6559	SMH6560	525	19	0.004	23.35	23.06	0.07	Free Surface	0.76	0.20	0.09
SMN5732	SMH6560	SMH6561	525	90	0.007	24.07	23.77	0.08	Free Surface	0.95	0.17	0.07
SMN5727	SMH6561	SMH6562	525	79	0.008	24.78	24.46	0.08	Free Surface	0.99	0.17	0.07

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN5721	SMH6562	SMH6527	525	21	0.006	24.81	24.49	0.08	Free Surface	0.92	0.18	0.07
SMN5725	SMH6527	SMH6526	525	80	0.007	28.61	28.20	0.10	Free Surface	0.98	0.19	0.08
SMN5728	SMH6526	SMH6525	525	40	0.007	28.67	28.25	0.11	Free Surface	1.00	0.19	0.08
SMN5731	SMH6525	SMH6730	525	48	0.007	33.14	32.68	0.12	Free Surface	1.04	0.20	0.09
SMN5736	SMH6730	SMH6524	525	61	0.01	33.22	32.75	0.12	Free Surface	1.20	0.19	0.08
SMN15824	SMH6524	SMH6523	525	8	0.002	82.03	80.90	0.31	Free Surface	0.89	0.44	0.40
SMN15823	SMH6523	SMH6522	525	63	0.009	82.14	81.01	0.32	Free Surface	1.45	0.31	0.21
SMN15825	SMH6522	SMH6521	525	92	0.006	99.68	98.13	0.45	Free Surface	1.35	0.37	0.30
SMN15851	SMH6521	SMH17031	525	138	0.007	106.46	104.88	0.46	Free Surface	1.45	0.37	0.30
SMN15852	SMH17031	SMH17032	525	72	0.01	107.15	105.54	0.47	Free Surface	1.66	0.34	0.25
SMN38577	SMH17032	SMH34418	525	59	0.014	107.43	105.80	0.48	Free Surface	1.88	0.31	0.21
SMN38578	SMH34418	SMH17030	525	49	0.009	107.43	105.80	0.48	Free Surface	1.57	0.35	0.27
SMN15849	SMH17030	SMH25910	525	70	0.004	107.55	105.90	0.48	Free Surface	1.13	0.45	0.42
SMN27402	SMH25910	SMH17024	525	27	0.007	107.60	105.93	0.49	Free Surface	1.49	0.37	0.29
SMN15850	SMH17024	SMH17018	525	74	0.005	126.87	124.88	0.60	Free Surface	1.33	0.45	0.42
SMN5755	SMH17018	SMH6520	525	81	0.004	128.71	126.70	0.60	Free Surface	1.19	0.50	0.50
SMN6101	SMH6520	SMH6873	525	76	0.007	129.13	127.12	0.60	Free Surface	1.55	0.41	0.35
SMN6106	SMH6873	SMH6871	525	71	0.008	129.98	127.97	0.61	Free Surface	1.58	0.41	0.35
SMN6104	SMH6871	SMH6870	525	29	0.009	130.49	128.49	0.60	Free Surface	1.66	0.39	0.32
SMN6194	SMH6870	SMH6996	525	40	0.01	130.66	128.65	0.60	Free Surface	1.76	0.38	0.30
SMN6196	SMH6996	SMH6997	525	62	0.008	133.29	131.36	0.59	Free Surface	1.63	0.40	0.34
SMN6195	SMH6997	SMH6868	525	58	0.007	133.55	131.62	0.59	Free Surface	1.57	0.42	0.36
SMN6100	SMH6868	SMH6376	525	56	0.009	133.90	131.97	0.58	Free Surface	1.69	0.40	0.33
SMN5774	SMH6376	SMH6375	525	95	0.007	134.45	132.52	0.58	Free Surface	1.56	0.42	0.37
SMN14294	SMH6375	SMH16351	525	85	0.009	143.94	142.08	0.57	Free Surface	1.72	0.41	0.35
SMN14293	SMH16351	SMH16350	525	88	0.009	144.53	142.66	0.57	Free Surface	1.75	0.41	0.35
SMN14292	SMH16350	SMH16348	525	91	0.009	145.10	143.24	0.57	Free Surface	1.73	0.41	0.36
SMN14291	SMH16348	SMH16349	525	82	0.01	150.95	149.12	0.57	Free Surface	1.80	0.41	0.35
SMN14290	SMH16349	SMH6369	525	85	0.01	189.80	187.97	0.58	Free Surface	1.95	0.46	0.43
SMN5870	SMH6369	SMH6231	525	94	0.009	190.98	189.17	0.58	Free Surface	1.85	0.48	0.47
SMN5880	SMH6231	SMH6227	675	56	0.003	371.46	369.08	0.81	Free Surface	1.50	0.65	0.76
SMN5879	SMH6227	SMH6228	675	71	0.003	373.17	370.81	0.81	Free Surface	1.40	0.70	0.83
SMN5877	SMH6228	SMH6230	675	60	0.003	373.51	371.15	0.81	Free Surface	1.38	0.71	0.85
SMN5872	SMH6230	SMH6229	675	73	0.005	374.12	371.76	0.81	Free Surface	1.72	0.59	0.65
SMN5882	SMH6229	SMH6151	675	65	0.004	374.53	372.17	0.80	Free Surface	1.65	0.61	0.68
SMN5899	SMH6151	SMH6149	675	98	0.004	377.17	374.83	0.80	Free Surface	1.57	0.64	0.73
SMN5898	SMH6149	SMH6157	675	65	0.004	380.39	378.09	0.79	Free Surface	1.59	0.63	0.73

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN5875	SMH6157	SMH6156	675	59	0.004	380.85	378.55	0.79	Free Surface	1.59	0.64	0.73
SMN5853	SMH6156	SMH6158	675	52	0.004	385.31	383.04	0.78	Free Surface	1.56	0.65	0.76
SMN5845	SMH6158	SMH6159	675	49	0.004	386.65	384.39	0.78	Free Surface	1.57	0.65	0.76
SMN5849	SMH6159	SMH6161	675	63	0.004	386.96	384.70	0.78	Free Surface	1.63	0.63	0.72
SMN5861	SMH6161	SMH6160	675	71	0.004	387.43	385.18	0.78	Free Surface	1.58	0.65	0.75
SMN5873	SMH6160	SMH6208	675	36	0.005	389.01	386.76	0.77	Free Surface	1.71	0.61	0.69
SMN5886	SMH6208	SMH6207	675	58	0.003	389.37	387.13	0.77	Free Surface	1.49	0.69	0.81
SMN5904	SMH6207	SMH6210	675	59	0.004	390.92	388.69	0.77	Free Surface	1.65	0.63	0.72
SMN5923	SMH6210	SMH6209	675	72	0.004	391.30	389.07	0.77	Free Surface	1.58	0.65	0.76
SMN5938	SMH6209	SMH6498	675	61	0.004	395.34	393.14	0.76	Free Surface	1.62	0.65	0.75
SMN5950	SMH6498	SMH6123	675	71	0.004	395.76	393.55	0.76	Free Surface	1.56	0.67	0.78
SMN5949	SMH6123	SMH6126	750	106	0.001	574.41	538.39	13.95	Pressurized	1.30	1.00	2.15
SMN36879	SMH6126	SMH33844	825	98	0.003	574.83	538.82	13.95	Free Surface	1.50	0.67	0.80
SMN36880	SMH33844	SMH7041	825	49	0.002	575.04	539.04	13.95	Free Surface	1.48	0.68	0.81
SMN6234	SMH7041	SMH6125	825	37	0.003	579.03	543.10	13.94	Free Surface	1.57	0.65	0.76
SMN36877	SMH6125	SMH33843	825	16	0.002	581.72	545.85	13.93	Free Surface	1.37	0.74	0.90
SMN36878	SMH33843	SMH6127	825	95	0.00	582.27	546.41	13.93	Free Surface	1.54	0.67	0.78
SMN5884	SMH6127	SMH6128	675	90	0.009	583.08	547.24	13.93	Free Surface	2.48	0.63	0.72
SMN5862	SMH6128	SMH6069	675	83	0.009	583.53	547.71	13.92	Free Surface	2.43	0.64	0.74
SMN5846	SMH6069	SMH6070	750	17	0.009	583.56	547.74	13.92	Free Surface	2.42	0.54	0.56
SMN5844	SMH6070	SMH6073	750	100	0.003	583.73	547.91	13.92	Free Surface	1.61	0.77	0.94
SMN6187	SMH6073	SMH6991	750	67	0.005	583.85	548.03	13.92	Free Surface	1.95	0.64	0.74
SMN6188	SMH6991	SMH6992	750	99	0.003	584.03	548.20	13.93	Free Surface	1.65	0.75	0.91
SMN6189	SMH6992	SMH6075	750	89	0.003	584.49	548.66	13.93	Free Surface	1.62	0.76	0.93
SMN6545	SMH6075	SMH6078	750	85	0.004	585.08	549.25	13.93	Free Surface	1.77	0.70	0.84
SMN6524	SMH6078	SMH6079	750	92	0.004	585.24	549.41	13.93	Free Surface	1.71	0.72	0.87
SMN6509	SMH6079	SFT114	750	13	0.003	615.03	579.45	13.97	Pressurized	1.70	0.77	0.93
SMN6502	SFT114	SMH6082	750	113	0.003	615.23	579.65	13.97	Pressurized	1.39	1.00	1.08
SMN6480	SMH6082	SMH6083	750	80	0.004	615.39	579.81	13.97	Free Surface	1.74	0.75	0.91
SMN6623	SMH6083	SMH6086	750	48	0.006	615.50	579.92	13.97	Free Surface	2.19	0.61	0.68
SMN6624	SMH6086	SMH6087	750	80	0.003	693.31	658.30	14.07	Pressurized	1.57	1.00	1.10
SMN20762	SMH6087	SMH26611	750	10	0.016	693.44	658.42	14.07	Free Surface	3.16	0.50	0.50
SMN28950	SMH26611	SPS25	1,200	24	0.007	1971.21	1790.10	92.26	Free Surface	2.99	0.57	0.61

2031 WWF - Without Merton Development

Trunk to Oakville Southwest

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN18246	SMH6547	SMH6548	300	67	0.008	0.9	0.8	0.0	Free Surface	0.39	0.07	0.01
SMN5299	SMH5447	SMH5448	300	107	0.005	3.1	3.1	0.0	Free Surface	0.47	0.15	0.05
SMN5298	SMH5448	SMH5449	300	167	0.003	3.2	3.2	0.0	Free Surface	0.42	0.17	0.06
SMN5297	SMH5449	SMH5451	300	88	0.007	3.6	3.6	0.0	Free Surface	0.57	0.15	0.05
SMN5296	SMH5451	SMH5450	300	100	0.005	4.1	4.1	0.0	Free Surface	0.53	0.17	0.06
SMN5295	SMH5450	SMH5452	300	81	0.006	4.4	4.4	0.0	Free Surface	0.57	0.17	0.06
SMN5294	SMH5452	SMH5459	300	68	0.006	4.5	4.5	0.0	Free Surface	0.59	0.16	0.06
SMN5293	SMH5459	SMH5458	300	16	0.017	4.5	4.5	0.0	Free Surface	0.84	0.13	0.04
SMN5292	SMH5458	SMH5457	300	14	0.009	4.5	4.5	0.0	Free Surface	0.67	0.15	0.05
SMN5291	SMH5457	SMH5453	300	84	0.006	10.0	10.0	0.0	Free Surface	0.76	0.24	0.13
SMN5290	SMH5453	SMH5454	300	101	0.005	11.1	11.1	0.0	Free Surface	0.74	0.27	0.16
SMN5289	SMH5454	SMH5455	300	71	0.007	11.2	11.2	0.0	Free Surface	0.79	0.25	0.14
SMN5288	SMH5455	SMH5456	300	60	0.01	11.2	11.2	0.0	Free Surface	0.90	0.23	0.12
SMN5351	SMH5456	SMH5556	450	42	0.007	11.3	11.3	0.0	Free Surface	0.77	0.15	0.05
SMN5352	SMH5556	SMH5553	450	96	0.007	13.1	13.1	0.0	Free Surface	0.80	0.16	0.06
SMN5353	SMH5553	SMH5555	450	112	0.006	13.3	13.3	0.0	Free Surface	0.74	0.17	0.06
SMN4818	SMH5555	SMH5554	450	114	0.006	13.4	13.4	0.0	Free Surface	0.76	0.17	0.06
SMN5350	SMH5554	SMH5557	450	99	0.006	14.3	14.3	0.0	Free Surface	0.80	0.17	0.06
SMN5349	SMH5557	SMH5558	450	70	0.015	14.6	14.6	0.0	Free Surface	1.09	0.14	0.04
SMN5348	SMH5558	SMH4893	450	74	0.034	14.7	14.7	0.0	Free Surface	1.45	0.12	0.03
SMN5347	SMH4893	SMH4890	450	82	0.004	14.8	14.8	0.0	Free Surface	0.67	0.20	0.08
SMN5287	SMH4890	SMH4892	450	86	0.005	14.9	14.9	0.0	Free Surface	0.72	0.19	0.08
SMN12641	SMH4892	SMH14447	450	105	0.007	15.0	15.0	0.0	Free Surface	0.82	0.17	0.07
SMN12643	SMH14447	SMH14448	450	17	0.055	15.1	15.1	0.0	Free Surface	1.72	0.10	0.02
SMN12642	SMH14448	SMH6550	450	57	0.016	15.1	15.1	0.0	Free Surface	1.13	0.14	0.04
SMN5726	SMH6550	SMH6552	525	78	0.007	17.3	17.2	0.0	Free Surface	0.85	0.15	0.05
SMN5720	SMH6552	SMH6551	525	89	0.007	17.7	17.6	0.0	Free Surface	0.86	0.15	0.05
SMN5713	SMH6551	SMH6553	525	31	0.004	17.7	17.7	0.0	Free Surface	0.71	0.17	0.07
SMN5717	SMH6553	SMH6555	525	91	0.009	18.5	18.4	0.0	Free Surface	0.94	0.15	0.05
SMN5723	SMH6555	SMH6554	525	44	0.005	19.0	18.8	0.0	Free Surface	0.78	0.17	0.06
SMN5729	SMH6554	SMH6558	525	93	0.006	22.7	22.5	0.1	Free Surface	0.87	0.18	0.07
SMN5734	SMH6558	SMH6559	525	91	0.009	23.3	23.0	0.1	Free Surface	1.01	0.16	0.06
SMN5733	SMH6559	SMH6560	525	19	0.004	23.4	23.1	0.1	Free Surface	0.76	0.20	0.09
SMN5732	SMH6560	SMH6561	525	90	0.007	24.1	23.8	0.1	Free Surface	0.95	0.17	0.07
SMN5727	SMH6561	SMH6562	525	79	0.008	24.8	24.5	0.1	Free Surface	0.99	0.17	0.07

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN5721	SMH6562	SMH6527	525	21	0.006	24.8	24.5	0.1	Free Surface	0.92	0.18	0.07
SMN5725	SMH6527	SMH6526	525	80	0.007	28.6	28.2	0.1	Free Surface	0.98	0.19	0.08
SMN5728	SMH6526	SMH6525	525	40	0.007	28.7	28.3	0.1	Free Surface	1.00	0.19	0.08
SMN5731	SMH6525	SMH6730	525	48	0.007	33.1	32.7	0.1	Free Surface	1.04	0.20	0.09
SMN5736	SMH6730	SMH6524	525	61	0.01	33.2	32.8	0.1	Free Surface	1.20	0.19	0.08
SMN15824	SMH6524	SMH6523	525	8	0.002	82.0	80.9	0.3	Free Surface	0.89	0.44	0.40
SMN15823	SMH6523	SMH6522	525	63	0.009	82.1	81.0	0.3	Free Surface	1.45	0.31	0.21
SMN15825	SMH6522	SMH6521	525	92	0.006	99.7	98.1	0.5	Free Surface	1.35	0.37	0.30
SMN15851	SMH6521	SMH17031	525	138	0.007	106.5	104.9	0.5	Free Surface	1.45	0.37	0.30
SMN15852	SMH17031	SMH17032	525	72	0.01	107.1	105.5	0.5	Free Surface	1.66	0.34	0.25
SMN38577	SMH17032	SMH34418	525	59	0.014	107.4	105.8	0.5	Free Surface	1.88	0.31	0.21
SMN38578	SMH34418	SMH17030	525	49	0.009	107.4	105.8	0.5	Free Surface	1.57	0.35	0.27
SMN15849	SMH17030	SMH25910	525	70	0.004	107.6	105.9	0.5	Free Surface	1.13	0.45	0.42
SMN27402	SMH25910	SMH17024	525	27	0.007	107.6	105.9	0.5	Free Surface	1.49	0.37	0.29
SMN15850	SMH17024	SMH17018	525	74	0.005	126.9	124.9	0.6	Free Surface	1.33	0.45	0.42
SMN5755	SMH17018	SMH6520	525	81	0.004	128.7	126.7	0.6	Free Surface	1.19	0.50	0.50
SMN6101	SMH6520	SMH6873	525	76	0.007	129.1	127.1	0.6	Free Surface	1.55	0.41	0.35
SMN6106	SMH6873	SMH6871	525	71	0.008	130.0	128.0	0.6	Free Surface	1.58	0.41	0.35
SMN6104	SMH6871	SMH6870	525	29	0.009	130.5	128.5	0.6	Free Surface	1.66	0.39	0.32
SMN6194	SMH6870	SMH6996	525	40	0.01	130.7	128.7	0.6	Free Surface	1.76	0.38	0.30
SMN6196	SMH6996	SMH6997	525	62	0.008	133.3	131.4	0.6	Free Surface	1.63	0.40	0.34
SMN6195	SMH6997	SMH6868	525	58	0.007	133.5	131.6	0.6	Free Surface	1.57	0.42	0.36
SMN6100	SMH6868	SMH6376	525	56	0.009	133.9	132.0	0.6	Free Surface	1.69	0.40	0.33
SMN5774	SMH6376	SMH6375	525	95	0.007	134.4	132.5	0.6	Free Surface	1.56	0.42	0.37
SMN14294	SMH6375	SMH16351	525	85	0.009	143.9	142.1	0.6	Free Surface	1.72	0.41	0.35
SMN14293	SMH16351	SMH16350	525	88	0.009	144.5	142.7	0.6	Free Surface	1.75	0.41	0.35
SMN14292	SMH16350	SMH16348	525	91	0.009	145.1	143.2	0.6	Free Surface	1.73	0.41	0.36
SMN14291	SMH16348	SMH16349	525	82	0.01	150.9	149.1	0.6	Free Surface	1.80	0.41	0.35
SMN14290	SMH16349	SMH6369	525	85	0.01	189.8	188.0	0.6	Free Surface	1.95	0.46	0.43
SMN5870	SMH6369	SMH6231	525	94	0.009	191.0	189.2	0.6	Free Surface	1.85	0.48	0.47
SMN5880	SMH6231	SMH6227	675	56	0.003	371.5	369.1	0.8	Free Surface	1.50	0.65	0.76
SMN5879	SMH6227	SMH6228	675	71	0.003	373.2	370.8	0.8	Free Surface	1.40	0.70	0.83
SMN5877	SMH6228	SMH6230	675	60	0.003	373.5	371.1	0.8	Free Surface	1.38	0.71	0.85
SMN5872	SMH6230	SMH6229	675	73	0.005	374.1	371.8	0.8	Free Surface	1.72	0.59	0.65
SMN5882	SMH6229	SMH6151	675	65	0.004	374.5	372.2	0.8	Free Surface	1.65	0.61	0.68
SMN5899	SMH6151	SMH6149	675	98	0.004	377.2	374.8	0.8	Free Surface	1.57	0.64	0.73
SMN5898	SMH6149	SMH6157	675	65	0.004	380.4	378.1	0.8	Free Surface	1.59	0.63	0.73

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN5875	SMH6157	SMH6156	675	59	0.004	380.8	378.5	0.8	Free Surface	1.59	0.64	0.73
SMN5853	SMH6156	SMH6158	675	52	0.004	385.3	383.0	0.8	Free Surface	1.56	0.65	0.76
SMN5845	SMH6158	SMH6159	675	49	0.004	386.7	384.4	0.8	Free Surface	1.57	0.65	0.76
SMN5849	SMH6159	SMH6161	675	63	0.004	387.0	384.7	0.8	Free Surface	1.63	0.63	0.72
SMN5861	SMH6161	SMH6160	675	71	0.004	387.4	385.2	0.8	Free Surface	1.58	0.65	0.75
SMN5873	SMH6160	SMH6208	675	36	0.005	389.0	386.8	0.8	Free Surface	1.71	0.61	0.69
SMN5886	SMH6208	SMH6207	675	58	0.003	389.4	387.1	0.8	Free Surface	1.49	0.69	0.81
SMN5904	SMH6207	SMH6210	675	59	0.004	390.9	388.7	0.8	Free Surface	1.65	0.63	0.72
SMN5923	SMH6210	SMH6209	675	72	0.004	391.3	389.1	0.8	Free Surface	1.58	0.65	0.76
SMN5938	SMH6209	SMH6498	675	61	0.004	395.3	393.1	0.8	Free Surface	1.62	0.65	0.75
SMN5950	SMH6498	SMH6123	675	71	0.004	395.8	393.6	0.8	Free Surface	1.56	0.67	0.78
SMN5949	SMH6123	SMH6126	750	106	0.001	574.4	538.4	13.9	Pressurized	1.30	1.00	2.15
SMN36879	SMH6126	SMH33844	825	98	0.003	574.8	538.8	13.9	Free Surface	1.50	0.67	0.80
SMN36880	SMH33844	SMH7041	825	49	0.002	575.0	539.0	13.9	Free Surface	1.48	0.68	0.81
SMN6234	SMH7041	SMH6125	825	37	0.003	579.0	543.1	13.9	Free Surface	1.57	0.65	0.76
SMN36877	SMH6125	SMH33843	825	16	0.002	581.7	545.8	13.9	Free Surface	1.37	0.74	0.90
SMN36878	SMH33843	SMH6127	825	95	0.003	582.3	546.4	13.9	Free Surface	1.54	0.67	0.78
SMN5884	SMH6127	SMH6128	675	90	0.009	583.1	547.2	13.9	Free Surface	2.48	0.63	0.72
SMN5862	SMH6128	SMH6069	675	83	0.009	583.5	547.7	13.9	Free Surface	2.43	0.64	0.74
SMN5846	SMH6069	SMH6070	750	17	0.009	583.6	547.7	13.9	Free Surface	2.42	0.54	0.56
SMN5844	SMH6070	SMH6073	750	100	0.003	583.7	547.9	13.9	Free Surface	1.61	0.77	0.94
SMN6187	SMH6073	SMH6991	750	67	0.005	583.9	548.0	13.9	Free Surface	1.95	0.64	0.74
SMN6188	SMH6991	SMH6992	750	99	0.003	584.0	548.2	13.9	Free Surface	1.65	0.75	0.91
SMN6189	SMH6992	SMH6075	750	89	0.003	584.5	548.7	13.9	Free Surface	1.62	0.76	0.93
SMN6545	SMH6075	SMH6078	750	85	0.004	585.1	549.3	13.9	Free Surface	1.77	0.70	0.84
SMN6524	SMH6078	SMH6079	750	92	0.004	585.2	549.4	13.9	Free Surface	1.71	0.72	0.87
SMN6509	SMH6079	SFT114	750	13	0.003	615.0	579.5	14.0	Pressurized	1.70	0.77	0.93
SMN6502	SFT114	SMH6082	750	113	0.003	615.2	579.7	14.0	Pressurized	1.39	1.00	1.08
SMN6480	SMH6082	SMH6083	750	80	0.004	615.4	579.8	14.0	Free Surface	1.74	0.75	0.91
SMN6623	SMH6083	SMH6086	750	48	0.006	615.5	579.9	14.0	Free Surface	2.19	0.61	0.68
SMN6624	SMH6086	SMH6087	750	80	0.003	693.3	658.3	14.1	Pressurized	1.57	1.00	1.10
SMN20762	SMH6087	SMH26611	750	10	0.016	693.4	658.4	14.1	Free Surface	3.16	0.50	0.50
SMN28950	SMH26611	SPS25	1200	24	0.007	1971.2	1790.1	92.3	Free Surface	2.99	0.57	0.61

Option A

2400 mm Trunk to Mid-Halton WWTP

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN16511	SMH17864	SMH17862	2,400	232	0.003	5,070.63	3,594.53	926.45	Free Surface	2.61	0.45	0.41
SMN16510	SMH17862	SMH17865	2,400	301	0.003	5,070.83	3,594.73	926.45	Free Surface	2.61	0.44	0.41
SMN20686	SMH17865	SMH17863	2,400	300	0.003	5,094.49	3,618.39	926.45	Free Surface	2.70	0.44	0.39
SMN29150	SMH17863	SMH26617	2,400	259	0.002	5,094.66	3,618.56	926.45	Free Surface	2.46	0.47	0.45
SMN29151	SMH26617	SMH26618	2,400	281	0.002	5,126.56	3,639.92	933.95	Free Surface	2.57	0.45	0.42
SMN29152	SMH26618	SMH26619	2,400	290	0.002	5,189.22	3,702.58	933.95	Free Surface	2.55	0.46	0.44
SMN29153	SMH26619	SMH26620	2,400	246	0.002	5,211.61	3,710.26	944.42	Free Surface	2.60	0.46	0.43
SMN29154	SMH26620	SPS85	2,400	44	0.004	5,211.60	3,710.27	944.41	Free Surface	3.19	0.39	0.32

Option B

2400 mm Trunk to Mid-Halton WWTP

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN16511	SMH17864	SMH17862	2,400	232	0.003	5,070.63	3,594.53	926.45	Free Surface	2.61	0.45	0.41
SMN16510	SMH17862	SMH17865	2,400	301	0.003	5,070.83	3,594.73	926.45	Free Surface	2.61	0.44	0.41
SMN20686	SMH17865	SMH17863	2,400	300	0.003	5,094.49	3,618.39	926.45	Free Surface	2.70	0.44	0.39
SMN29150	SMH17863	SMH26617	2,400	259	0.002	5,094.66	3,618.56	926.45	Free Surface	2.46	0.47	0.45
SMN29151	SMH26617	SMH26618	2,400	281	0.002	5,126.56	3,639.92	933.95	Free Surface	2.57	0.45	0.42
SMN29152	SMH26618	SMH26619	2,400	290	0.002	5,189.22	3,702.58	933.95	Free Surface	2.55	0.46	0.44
SMN29153	SMH26619	SMH26620	2,400	246	0.002	5,209.58	3,709.78	943.32	Free Surface	2.60	0.46	0.43
SMN29154	SMH26620	SPS85	2,400	44	0.004	5,209.57	3,709.79	943.31	Free Surface	3.19	0.39	0.32

Option C

2400 mm Trunk to Mid-Halton WWTP

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN16511	SMH17864	SMH17862	2,400	232	0.003	5,070.63	3,594.53	926.45	Free Surface	2.61	0.45	0.41
SMN16510	SMH17862	SMH17865	2,400	301	0.003	5,070.83	3,594.73	926.45	Free Surface	2.61	0.44	0.41
SMN20686	SMH17865	SMH17863	2,400	300	0.003	5,094.49	3,618.39	926.45	Free Surface	2.70	0.44	0.39
SMN29150	SMH17863	SMH26617	2,400	259	0.002	5,094.66	3,618.56	926.45	Free Surface	2.46	0.47	0.45
SMN29151	SMH26617	SMH26618	2,400	281	0.002	5,126.56	3,639.92	933.95	Free Surface	2.57	0.45	0.42
SMN29152	SMH26618	SMH26619	2,400	290	0.002	5,189.22	3,702.58	933.95	Free Surface	2.55	0.46	0.44
SMN29153	SMH26619	SMH26620	2,400	246	0.002	5,208.31	3,709.69	942.48	Free Surface	2.60	0.46	0.43
SMN29154	SMH26620	SPS85	2,400	44	0.004	5,208.30	3,709.70	942.47	Free Surface	3.19	0.39	0.32

Option D

2400 mm Trunk to Mid-Halton WWTP

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN16511	SMH17864	SMH17862	2,400	232	0.003	5,070.63	3,594.53	926.45	Free Surface	2.61	0.45	0.41
SMN16510	SMH17862	SMH17865	2,400	301	0.003	5,070.83	3,594.73	926.45	Free Surface	2.61	0.44	0.41
SMN20686	SMH17865	SMH17863	2,400	300	0.003	5,094.49	3,618.39	926.45	Free Surface	2.70	0.44	0.39
SMN29150	SMH17863	SMH26617	2,400	259	0.002	5,094.66	3,618.56	926.45	Free Surface	2.46	0.47	0.45
SMN29151	SMH26617	SMH26618	2,400	281	0.002	5,126.56	3,639.92	933.95	Free Surface	2.57	0.45	0.42
SMN29152	SMH26618	SMH26619	2,400	290	0.002	5,189.22	3,702.58	933.95	Free Surface	2.55	0.46	0.44
SMN29153	SMH26619	SMH26620	2,400	246	0.002	5,232.48	3,718.61	953.35	Free Surface	2.60	0.46	0.43
SMN29154	SMH26620	SPS85	2,400	44	0.004	5,232.47	3,718.62	953.34	Free Surface	3.19	0.39	0.32

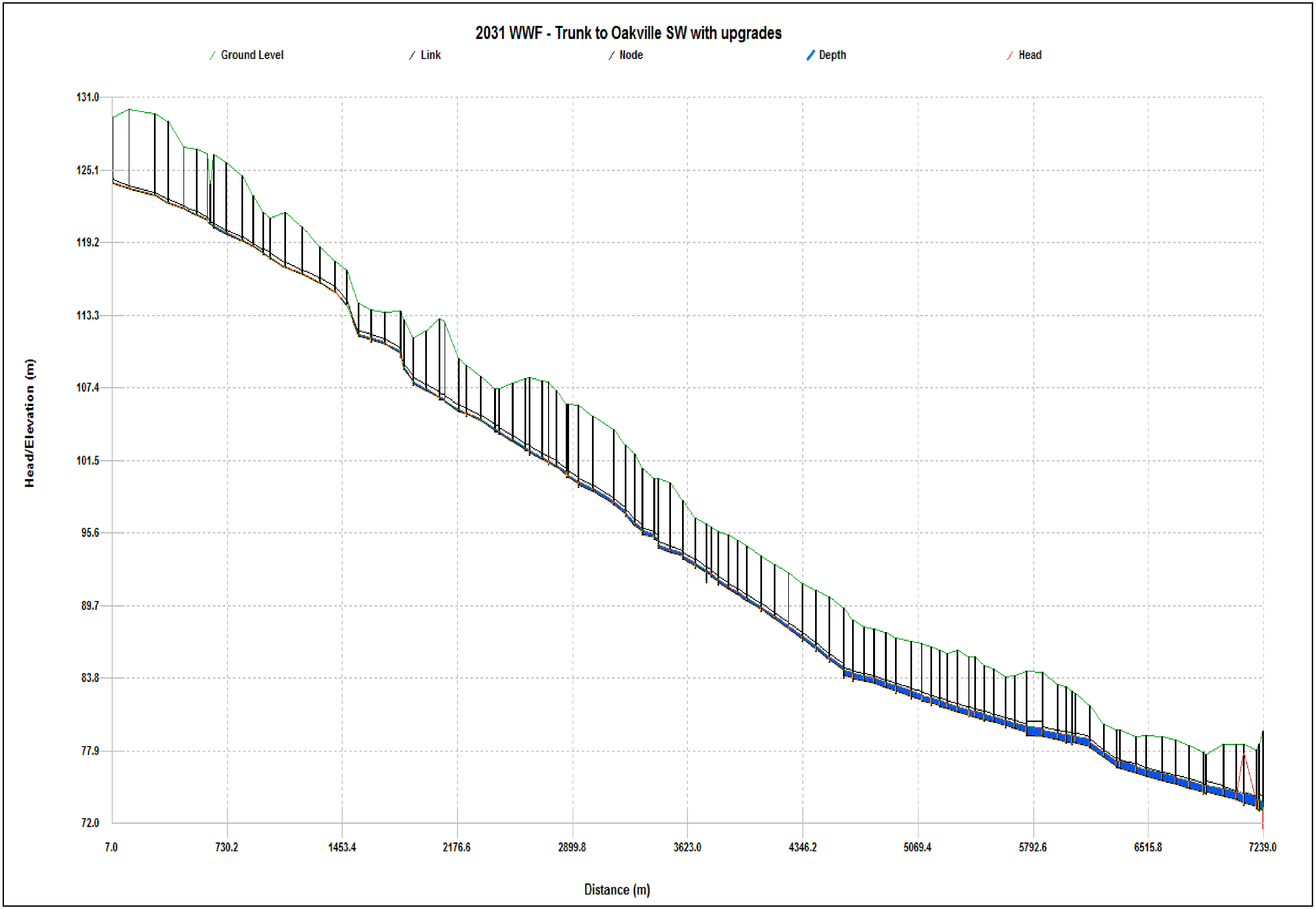
2031 WWF - Without Merton Development

2400 mm Trunk to Mid-Halton WWTP

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN16511	SMH17864	SMH17862	2,400	232	0.003	5,067.1	3,592.6	925.3	Free Surface	2.61	0.45	0.41
SMN16510	SMH17862	SMH17865	2,400	301	0.003	5,067.3	3,592.8	925.3	Free Surface	2.61	0.44	0.41
SMN20686	SMH17865	SMH17863	2,400	300	0.003	5,091.0	3,616.4	925.3	Free Surface	2.69	0.44	0.39
SMN29150	SMH17863	SMH26617	2,400	259	0.002	5,091.1	3,616.6	925.3	Free Surface	2.46	0.47	0.45
SMN29151	SMH26617	SMH26618	2,400	281	0.002	5,100.5	3,626.0	925.3	Free Surface	2.57	0.45	0.42
SMN29152	SMH26618	SMH26619	2,400	290	0.002	5,163.2	3,688.6	925.3	Free Surface	2.54	0.46	0.43
SMN29153	SMH26619	SMH26620	2,400	246	0.002	5,163.3	3,688.8	925.3	Free Surface	2.59	0.45	0.42
SMN29154	SMH26620	SPS85	2,400	44	0.004	5,163.3	3,688.8	925.3	Free Surface	3.18	0.39	0.32

Appendix B

Upgrades to surcharges sections along the trunk of Oakville SW


2031 WWF - Trunk to Oakville SW with upgrades
Ground Level
Link
Node
Depth
Head
Head/Elevation (m)
131.0
125.1
119.2
113.3
107.4
101.5
95.6
89.7
83.8
77.9
72.0
7.0
730.2
1453.4
2176.6
2899.8
3623.0
4346.2
5069.4
5792.6
6515.8
7239.0
Distance (m)

With Upgrades to Surcharged sections along the lakeshore trunk

Trunk to Oakville Southwest

ID	From ID	To ID	Diameter (mm)	Length (m)	Slope	Total Flow (L/s)	Unpeakable Flow (L/s)	Coverage Flow (L/s)	Flow Type	Velocity (m/s)	d/D	q/Q
SMN18246	SMH6547	SMH6548	300	67	0.008	0.9	0.8	0.0	Free Surface	0.39	0.07	0.01
SMN5299	SMH5447	SMH5448	300	107	0.005	11.8	5.6	1.6	Free Surface	0.70	0.29	0.18
SMN5298	SMH5448	SMH5449	300	167	0.003	12.0	5.8	1.6	Free Surface	0.61	0.32	0.22
SMN5297	SMH5449	SMH5451	300	88	0.007	12.3	6.1	1.6	Free Surface	0.82	0.27	0.16
SMN5296	SMH5451	SMH5450	300	100	0.005	12.9	6.7	1.6	Free Surface	0.74	0.29	0.19
SMN5295	SMH5450	SMH5452	300	81	0.006	13.2	7.0	1.6	Free Surface	0.78	0.29	0.18
SMN5294	SMH5452	SMH5459	300	68	0.006	13.2	7.0	1.6	Free Surface	0.81	0.28	0.17
SMN5293	SMH5459	SMH5458	300	16	0.017	13.2	7.0	1.6	Free Surface	1.15	0.22	0.11
SMN5292	SMH5458	SMH5457	300	14	0.009	13.3	7.0	1.6	Free Surface	0.92	0.26	0.14
SMN5291	SMH5457	SMH5453	300	84	0.006	18.8	12.6	1.6	Free Surface	0.91	0.34	0.24
SMN5290	SMH5453	SMH5454	300	101	0.005	19.9	13.7	1.6	Free Surface	0.87	0.36	0.28
SMN5289	SMH5454	SMH5455	300	71	0.007	19.9	13.7	1.6	Free Surface	0.94	0.34	0.25
SMN5288	SMH5455	SMH5456	300	60	0.01	20.0	13.8	1.6	Free Surface	1.06	0.31	0.21
SMN5351	SMH5456	SMH5556	450	42	0.007	20.0	13.8	1.6	Free Surface	0.92	0.20	0.08
SMN5352	SMH5556	SMH5553	450	96	0.007	21.8	15.6	1.6	Free Surface	0.94	0.20	0.09
SMN5353	SMH5553	SMH5555	450	112	0.006	22.0	15.8	1.6	Free Surface	0.86	0.22	0.10
SMN4818	SMH5555	SMH5554	450	114	0.006	22.2	16.0	1.6	Free Surface	0.88	0.22	0.10
SMN5350	SMH5554	SMH5557	450	99	0.006	23.0	16.8	1.6	Free Surface	0.93	0.21	0.10
SMN5349	SMH5557	SMH5558	450	70	0.015	23.4	17.2	1.6	Free Surface	1.25	0.18	0.07
SMN5348	SMH5558	SMH4893	450	74	0.034	23.5	17.3	1.6	Free Surface	1.66	0.14	0.05
SMN5347	SMH4893	SMH4890	450	82	0.004	60.9	24.0	10.9	Free Surface	1.00	0.41	0.35
SMN5287	SMH4890	SMH4892	450	86	0.005	61.1	24.2	10.9	Free Surface	1.08	0.39	0.32
SMN12641	SMH4892	SMH14447	450	105	0.007	61.2	24.3	10.9	Free Surface	1.23	0.35	0.26
SMN12643	SMH14447	SMH14448	450	17	0.055	61.2	24.3	10.9	Free Surface	2.62	0.20	0.09
SMN12642	SMH14448	SMH6550	450	57	0.016	61.2	24.4	10.9	Free Surface	1.70	0.28	0.17
SMN5726	SMH6550	SMH6552	525	78	0.007	63.3	26.5	10.9	Free Surface	1.25	0.29	0.18
SMN5720	SMH6552	SMH6551	525	89	0.007	63.7	26.9	10.9	Free Surface	1.25	0.29	0.18
SMN5713	SMH6551	SMH6553	525	31	0.004	63.7	26.9	10.9	Free Surface	1.03	0.33	0.23
SMN5717	SMH6553	SMH6555	525	91	0.009	64.4	27.6	10.9	Free Surface	1.36	0.27	0.16
SMN5723	SMH6555	SMH6554	525	44	0.005	64.8	28.1	10.9	Free Surface	1.11	0.32	0.22
SMN5729	SMH6554	SMH6558	525	93	0.006	68.3	31.7	10.9	Free Surface	1.20	0.31	0.21
SMN5734	SMH6558	SMH6559	525	91	0.009	68.9	32.3	10.9	Free Surface	1.38	0.28	0.17
SMN5733	SMH6559	SMH6560	525	19	0.004	68.9	32.3	10.9	Free Surface	1.03	0.35	0.26
SMN5732	SMH6560	SMH6561	525	90	0.007	69.6	33.0	10.9	Free Surface	1.30	0.30	0.19
SMN5727	SMH6561	SMH6562	525	79	0.008	70.3	33.7	11.0	Free Surface	1.35	0.29	0.18
SMN5721	SMH6562	SMH6527	525	21	0.006	70.3	33.7	11.0	Free Surface	1.25	0.31	0.20
SMN5725	SMH6527	SMH6526	525	80	0.007	73.9	37.4	11.0	Free Surface	1.29	0.31	0.21
SMN5728	SMH6526	SMH6525	525	40	0.007	73.9	37.5	11.0	Free Surface	1.32	0.31	0.20
SMN5731	SMH6525	SMH6730	525	48	0.007	78.3	41.9	11.0	Free Surface	1.34	0.32	0.22
SMN5736	SMH6730	SMH6524	525	61	0.01	78.4	42.0	11.0	Free Surface	1.53	0.29	0.18
SMN15824	SMH6524	SMH6523	525	8	0.002	126.0	90.1	11.2	Free Surface	0.99	0.57	0.62
SMN15823	SMH6523	SMH6522	525	63	0.009	126.1	90.2	11.2	Free Surface	1.64	0.39	0.32
SMN15825	SMH6522	SMH6521	525	92	0.006	142.9	107.4	11.3	Free Surface	1.48	0.46	0.43
SMN15851	SMH6521	SMH17031	525	138	0.007	149.6	114.1	11.3	Free Surface	1.59	0.45	0.41
SMN15852	SMH17031	SMH17032	525	72	0.01	150.3	114.8	11.3	Free Surface	1.82	0.41	0.35
SMN38577	SMH17032	SMH34418	525	59	0.014	150.5	115.0	11.3	Free Surface	2.06	0.37	0.29
SMN38578	SMH34418	SMH17030	525	49	0.009	150.5	115.0	11.3	Free Surface	1.72	0.42	0.37
SMN15849	SMH17030	SMH25910	525	70	0.004	150.6	115.1	11.4	Free Surface	1.23	0.55	0.59
SMN27402	SMH25910	SMH17024	525	27	0.007	150.6	115.2	11.4	Free Surface	1.63	0.44	0.41
SMN15850	SMH17024	SMH17018	525	74	0.005	169.4	134.1	11.5	Free Surface	1.43	0.54	0.57
SMN5755	SMH17018	SMH6520	525	81	0.004	171.3	135.9	11.5	Free Surface	1.27	0.60	0.67
SMN6101	SMH6520	SMH6873	525	76	0.007	171.7	136.4	11.5	Free Surface	1.67	0.48	0.47
SMN6106	SMH6873	SMH6871	525	71	0.008	172.5	137.2	11.5	Free Surface	1.70	0.48	0.46
SMN6104	SMH6871	SMH6870	525	29	0.009	173.0	137.7	11.5	Free Surface	1.79	0.46	0.43
SMN6194	SMH6870	SMH6996	525	40	0.01	173.1	137.9	11.5	Free Surface	1.90	0.44	0.40
SMN6196	SMH6996	SMH6997	525	62	0.008	175.7	140.6	11.5	Free Surface	1.75	0.47	0.45
SMN6195	SMH6997	SMH6868	525	58	0.007	175.9	140.9	11.5	Free Surface	1.69	0.49	0.47
SMN6100	SMH6868	SMH6376	525	56	0.009	176.3	141.2	11.5	Free Surface	1.81	0.46	0.43
SMN5774	SMH6376	SMH6375	525	95	0.007	176.8	141.8	11.5	Free Surface	1.68	0.49	0.48
SMN14294	SMH6375	SMH16351	525	85	0.009	186.1	151.3	11.4	Free Surface	1.84	0.47	0.46
SMN14293	SMH16351	SMH16350	525	88	0.009	186.6	151.9	11.4	Free Surface	1.87	0.47	0.45
SMN14292	SMH16350	SMH16348	525	91	0.009	187.2	152.5	11.4	Free Surface	1.85	0.48	0.46

SMN14291	SMH16348	SMH16349	525	82	0.01	193.0	158.4	11.4	Free Surface	1.92	0.47	0.45
SMN14290	SMH16349	SMH6369	525	85	0.01	231.0	197.2	11.5	Free Surface	2.05	0.52	0.53
SMN5870	SMH6369	SMH6231	525	94	0.009	232.1	198.4	11.5	Free Surface	1.94	0.54	0.57
SMN5880	SMH6231	SMH6227	675	56	0.003	411.2	378.3	11.7	Free Surface	1.53	0.70	0.84
SMN5879	SMH6227	SMH6228	675	71	0.003	412.9	380.0	11.7	Free Surface	1.42	0.76	0.92
SMN5877	SMH6228	SMH6230	675	60	0.003	413.2	380.4	11.7	Free Surface	1.40	0.77	0.94
SMN5872	SMH6230	SMH6229	675	73	0.005	413.8	381.0	11.7	Free Surface	1.76	0.63	0.71
SMN5882	SMH6229	SMH6151	675	65	0.004	414.2	381.4	11.7	Free Surface	1.69	0.65	0.75
SMN5899	SMH6151	SMH6149	675	98	0.004	416.8	384.1	11.7	Free Surface	1.60	0.68	0.81
SMN5898	SMH6149	SMH6157	675	65	0.004	420.0	387.3	11.7	Free Surface	1.62	0.68	0.80
SMN5875	SMH6157	SMH6156	675	59	0.004	420.4	387.8	11.7	Free Surface	1.62	0.68	0.81
SMN5853	SMH6156	SMH6158	675	52	0.004	424.8	392.3	11.6	Free Surface	1.58	0.70	0.84
SMN5845	SMH6158	SMH6159	675	49	0.004	426.1	393.6	11.6	Free Surface	1.60	0.70	0.83
SMN5849	SMH6159	SMH6161	675	63	0.004	426.4	393.9	11.6	Free Surface	1.66	0.67	0.80
SMN5861	SMH6161	SMH6160	675	71	0.004	426.9	394.4	11.6	Free Surface	1.61	0.69	0.83
SMN5873	SMH6160	SMH6208	675	36	0.005	428.4	396.0	11.6	Free Surface	1.74	0.65	0.76
SMN5886	SMH6208	SMH6207	675	58	0.003	428.8	396.4	11.6	Free Surface	1.51	0.74	0.90
SMN5904	SMH6207	SMH6210	675	59	0.004	430.3	397.9	11.6	Free Surface	1.68	0.67	0.80
SMN5923	SMH6210	SMH6209	675	72	0.004	430.7	398.3	11.6	Free Surface	1.61	0.70	0.84
SMN5938	SMH6209	SMH6498	675	61	0.004	434.7	402.4	11.6	Free Surface	1.65	0.69	0.82
SMN5950	SMH6498	SMH6123	675	71	0.004	435.1	402.8	11.6	Free Surface	1.59	0.72	0.86
SMN5949	SMH6123	SMH6126	1,200	106	0.001	610.3	547.6	24.8	Free Surface	0.88	0.59	0.65
SMN36879	SMH6126	SMH33844	825	98	0.003	610.7	548.1	24.8	Free Surface	1.51	0.71	0.85
SMN36880	SMH33844	SMH7041	825	49	0.002	610.9	548.3	24.8	Free Surface	1.49	0.72	0.86
SMN6234	SMH7041	SMH6125	825	37	0.003	614.9	552.3	24.8	Free Surface	1.59	0.68	0.81
SMN36877	SMH6125	SMH33843	825	16	0.002	617.5	555.1	24.8	Free Surface	1.38	0.78	0.95
SMN36878	SMH33843	SMH6127	825	95	0.003	618.1	555.6	24.8	Free Surface	1.56	0.70	0.83
SMN5884	SMH6127	SMH6128	675	90	0.009	618.9	556.5	24.8	Free Surface	2.51	0.65	0.76
SMN5862	SMH6128	SMH6069	675	83	0.009	619.3	556.9	24.8	Free Surface	2.45	0.66	0.78
SMN5846	SMH6069	SMH6070	750	17	0.009	619.3	557.0	24.8	Free Surface	2.45	0.56	0.60
SMN5844	SMH6070	SMH6073	750	100	0.003	619.5	557.2	24.8	Free Surface	1.61	0.81	0.99
SMN6187	SMH6073	SMH6991	750	67	0.005	619.6	557.3	24.8	Free Surface	1.97	0.67	0.79
SMN6188	SMH6991	SMH6992	750	99	0.003	619.8	557.4	24.8	Free Surface	1.66	0.79	0.96
SMN6189	SMH6992	SMH6075	750	89	0.003	620.3	557.9	24.8	Free Surface	1.63	0.81	0.99
SMN6545	SMH6075	SMH6078	750	85	0.004	620.9	558.5	24.8	Free Surface	1.78	0.74	0.89
SMN6524	SMH6078	SMH6079	750	92	0.004	621.0	558.7	24.8	Free Surface	1.72	0.76	0.93
SMN6509	SMH6079	SFT114	750	13	0.003	650.6	588.7	24.8	Free Surface	1.70	0.81	0.99
SMN6502	SFT114	SMH6082	900	113	0.003	650.8	588.9	24.8	Free Surface	1.58	0.62	0.70
SMN6480	SMH6082	SMH6083	750	80	0.004	651.0	589.1	24.8	Free Surface	1.75	0.79	0.96
SMN6623	SMH6083	SMH6086	750	48	0.006	651.1	589.2	24.8	Free Surface	2.22	0.63	0.72
SMN6624	SMH6086	SMH6087	900	80	0.003	728.4	667.5	24.9	Free Surface	1.75	0.62	0.71
SMN20762	SMH6087	SMH26611	750	10	0.016	728.6	667.7	24.9	Free Surface	3.20	0.51	0.52
SMN28950	SMH26611	SPS25	1,200	24	0.007	2000.7	1799.3	103.1	Free Surface	3.01	0.57	0.62

APPENDIX F

WATER BALANCE ASSESSMENT
R.J. Burnside & Associates Limited

R.J. Burnside & Associates Limited 6990 Creditview Road, Unit 2 Mississauga ON L5N 8R9 CANADA
telephone (905) 821-1800 **fax** (905) 821-1809 **web** www.rjburnside.com

BURNSIDE
[THE DIFFERENCE IS OUR PEOPLE]

April 15, 2015

Via: Email

Mr. Mike Baldesarra
David Schaeffer Engineering Limited
600 Alden Road, Suite 500
Markham, ON L3R 0E7

Dear Mr. Baldesarra:

Re: Water Balance Assessment
Saw Whet (Bronte Green) Property, Oakville, Ontario
Project No.: 300031495.0000

R.J. Burnside & Associates Limited (Burnside) completed a hydrogeological assessment of the Merton Tertiary Planning Area (TPA) in the Town of Oakville. The findings of this hydrogeological assessment are presented in the Burnside report entitled “Hydrogeological Study, Merton Tertiary Planning Area, Town of Oakville, Ontario” dated December 2013 (Revised October 2014). The report included detailed water balance calculations for the entire TPA based on three proposed land use options.

The Saw Whet property (also referred to as the Bronte Green property and referred to herein as the Subject Property) is located within the TPA at the southeast corner of Bronte Road and Upper Middle Road. Burnside completed a detailed hydrogeological assessment and water balance calculations for the Subject Property. The results were included in the FSR completed by David Schaeffer Engineering Limited (DSEL) in 2014.

As the Subject Property proceeds to Draft Plan submission, a preferred land use concept has now been chosen. DSEL is completing an assessment of the surface water conditions and stormwater management for the Subject Property. As per DSEL’s request, Burnside has refined the groundwater balance calculations for the Subject Property based on the selected land use concept to provide DSEL with target infiltration volumes for the design of Low Impact Development (LID) measures for stormwater management to promote infiltration. In addition, feature-based groundwater balance calculations have been completed for the Tributary 14W-W1 catchment area. These calculations provide a specific infiltration target for the catchment such that groundwater recharge and subsequent discharge conditions along the watercourse can be maintained. The water balance calculations are provided in the attached Tables 1 to 7, and are discussed below.

1.0 Water Balance – Existing Conditions

Water balance calculations were completed for the Subject Property using a soil-moisture balance approach, which assumes that soils do not release water as potential infiltration while a soil moisture deficit exists. During wetter periods, any excess of precipitation over evapotranspiration first goes to restore soil moisture. Once the soil moisture deficit is overcome, any further excess water can then pass through the soil as infiltration.

A soil moisture storage capacity of 100 mm was selected for golf course and landscaped areas with short-rooted vegetation and 400 mm was selected for the wooded areas which have deeper-rooted vegetation. The attached Tables 1 and 2 detail the monthly potential evapotranspiration calculations accounting for latitude and climate, and then calculate the actual evapotranspiration and water surplus components of the water balance based on the monthly precipitation and soil moisture conditions for each of these vegetation types. Climate data from the Hamilton RBG climate station were used.

The MOE SWM Planning and Design Manual (2003) methodology for calculating total infiltration based on topography, soil type and land cover was used and a corresponding runoff component was calculated for the soil moisture storage conditions. The calculated water balance components from Tables 1 and 2 were then used to assess the pre-development infiltration volume as presented on Table 3.

The monthly water balance calculations show that a water surplus is generally available from November to May for the short-rooted vegetation (Table 1) and from December to May for the deeper-rooted vegetation (Table 2). Infiltration occurs during periods when there is sufficient water available to overcome the soil moisture storage requirements. In winter climates, frozen conditions affect when the actual infiltration will occur, however, the monthly balance calculations show the potential volumes available for this water balance component. The monthly calculations are summed to provide estimates of the annual water balance component values (Tables 1 and 2). The average annual infiltration is estimated to be 126 mm/year in the landscaped areas and 120 mm/year in the wooded areas.

The total area of the Subject Property is approximately 55 ha. Based on the component values calculated in Tables 1 and 2, the total pre-development infiltration volume for the Subject Property is calculated to be about 68,000 m^3/year (Table 3).

It is acknowledged that the infiltration and runoff values presented in Table 1 and Table 2 are estimates. Single values are used for the water balance calculations, but it is important to understand that infiltration rates are dependent upon the hydraulic conductivity of the surficial soils which may vary over several orders of magnitude. As such, the margins of error for the calculated infiltration and runoff component values are potentially quite large. These margins of error are recognized, but for the purposes of this assessment, the numbers used in the water balance calculations are considered reasonable estimates based on the site-specific conditions and useful for comparison of pre- to post-development conditions.

2.0 Potential Development Impacts to Water Balance

Urban development of an area affects the natural water balance. The most significant difference is the addition of impervious surfaces as a type of surface cover (i.e., roads, parking lots, driveways, and rooftops). Impervious surfaces prevent infiltration of water into the soils and the removal of the vegetation removes the evapotranspiration component of the natural water balance. The evaporation component from impervious surfaces is relatively minor (estimated to be 10% to 20% of precipitation) compared to the evapotranspiration component that occurs with vegetation in this area (65% to 70% of precipitation). So the net effect of the construction of impervious surfaces is that most of the precipitation that falls onto impervious surfaces becomes surplus water and direct runoff. The natural infiltration component is reduced.

The increases in surface water runoff that will occur with urban development are typically addressed through the use of appropriate stormwater management techniques to control flows to the watercourses. Details of the stormwater management strategies for the property are provided in the Functional Servicing Report (including the Stormwater Management Report) prepared by David Schaeffer Engineering Limited (December, 2014).

3.0 Post-Development Water Balance with No Stormwater Management Mitigation Measures

3.1 Overall Property Water Balance

The proposed development concept for the Subject Property has been broken down into various land use areas and DSEL has assigned each land use an average percentage of imperviousness. These data have been used to calculate the potential post-development infiltration volume assuming no mitigation measures are in place (Table 3). These calculations are presented as a ‘worst-case scenario’ of potential development impacts and allow the quantification of an infiltration target for LID and mitigation strategy design to maintain the natural recharge conditions.

Based on the proposed land use analysis, the total post-development infiltration for the site is estimated to be about 29,000 m^3/year (Table 3). These calculated volumes show that without mitigation, there is potential for a decrease in infiltration across the Subject Property of about 39,000 m^3/year (57%). Therefore, this volume becomes the target for post-development stormwater management and infiltration techniques to try to maintain the natural recharge conditions (Table 3).

3.2 Feature-Based Water Balance

It is important to ensure that the infiltration volume in the catchment area to Tributary 14W-W1 can be maintained as close as possible to the pre-development infiltration volume, such that the groundwater contributions to baseflow are maintained. A large portion of the catchment area to Tributary 14W-W1 is proposed for residential development. A feature-based water balance was completed to determine the potential change in infiltration volumes that may occur specifically within the surface-water catchment area to this watercourse. The same methodology and water balance components described above were used to calculate the pre-development infiltration volume.

The portion of the Saw Whet property within the catchment area to Tributary 14W-W1, including the portion of the Natural Heritage System adjacent to the property is approximately 22 ha, and the area of the wooded area was estimated from aerial photography to be approximately 7 ha. The water balance component values from Tables 1 and 2 were used to calculate the average annual volume of infiltration across this catchment. Based on these component values, the average pre-development infiltration volume is estimated to be approximately 27,000 m^3/year (Table 6).

Post-development water balance calculations were completed based on the proposed land use concept, as shown in Table 6. These calculations assume no mitigation measures are in place, and show a potential decrease in infiltration volume of 11,000 m^3/year (42%).

4.0 Proposed Water Balance Mitigation Strategies

The water balance calculations discussed above in Section 3.0 suggest that, without mitigation, the Subject Property will receive about 43% of the current amount of average annual groundwater infiltration, and the infiltration volume in the specific portion of the Subject Property contributing to Tributary 14W-W1 could be reduced by about 42%. As recommended in the Merton TPA report, LID measures for stormwater management will be used to promote infiltration. The goal is to ensure the post-development groundwater infiltration volume is maintained as close to the pre-development infiltration volume as possible. This is particularly important to maintain the discharge of shallow groundwater that occurs along Fourteen Mile Creek and supports baseflow in this watercourse.

As outlined in the MOE SWMP Design Manual (2003) and Low Impact Development Stormwater Management Planning and Design Guide published by the CVC and TRCA (2010), a suite of techniques may be considered to promote infiltration. These include such measures as permeable pavements, rain gardens, bioswales, subsurface infiltration trenches, galleries and pervious pipe systems. It is noted, however, that subsurface infiltration methods should only be considered in areas where there is sufficient depth to water table to accommodate the system within the unsaturated zone.

DSEL has advised that LID measures designed to promote infiltration will be employed in the proposed development. These measures will include directing roof runoff from low and medium density residential areas to pervious areas such as lawns, side and rear yard swales and other open space areas throughout the development where possible and increasing the topsoil thickness by about 1.5 times the normal thickness (i.e., from 20 cm to about 30 cm). These types of LID measures promote infiltration by providing additional water volumes in the pervious areas. This may be particularly effective in the summer months, when natural infiltration would not generally occur because the additional water overcomes the soil moisture deficit. An assessment of the potential effectiveness of these LID measures for the Subject Property is discussed below.

Quantification of surficial LID techniques is challenging and there are no widely accepted quantification standards. However, as an example to demonstrate the effectiveness of these types of mitigation measures, the water balance components were recalculated for areas where the roof runoff is directed to grass (Table 4). These areas would receive precipitation (893 mm/year) as well as extra water from roof runoff (759 mm/year). Over the available lawn areas, this would be equivalent to providing a total annual water supply of 1,462 mm/year in the low density residential areas and 1,976 mm/year in the medium density residential areas. Under these conditions of increased water supply, evapotranspiration can occur at the maximum potential rate, leaving a water surplus of 836 mm/year and 1,351 mm/year in the low and medium density residential areas, respectively (Table 4). Again using the MOE SWM Planning and Design Manual (2003) methodology, the potential infiltration that could occur in pervious areas under these conditions of increased water supply is 418 mm/year and 675 mm/year, respectively. The remainder of the surplus water becomes runoff (Table 4). The pre-development infiltration in the proposed development area was calculated to be about

126 mm/year; therefore, these calculations show that the potential infiltration in areas receiving extra water supply can be much higher than natural conditions.

To assess the potential effectiveness of the LID measures for the proposed development, water balance calculations have been completed assuming that half of the runoff from the roofs in the low density and medium density residential areas is directed to pervious areas and that the average topsoil depth is increased to assist with water retention. These calculations are provided in Table 5 for the overall Subject Property and in Table 7 for the Tributary 14W-W1 catchment. The calculations suggest that the use of such LID measures will maintain approximately 90% of the pre-development infiltration volume. The overall groundwater contribution to the watercourses is very small in relation to the surface water contributions, and as such the overall impact of the small remaining deficit in the infiltration volume would not be anticipated to have a significant impact on the tributary flows. It is noted, however, that other LID measures may be considered by DSEL at the detailed design phase.

Yours truly,

R.J. Burnside & Associates Limited

J Shaw

Jackie Shaw, P.Eng.
Geological Engineer
JS/JT:cl

MJ Thompson

Joanne Thompson, M.Sc., P.Geo.
Senior Group Leader, Development Hydrogeology

Enclosure(s)

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WATER BALANCE CALCULATIONS
Saw Whet Property (Bronte Green)
Oakville, Ontario

PROJECT No.300031495

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TABLE 1

Pre- and Post-Development Monthly Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 100 mm (urban lawns in clayey soils)

Precipitation data from Hamilton RBG Climate Station (1971 - 1997)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Average Temperature (Degree C)	-5	-4.4	0.5	6.9	13.3	18.8	22	20.9	16.4	10	4.2	-1.6	**8.5**	<--From Environment Canada
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.03	1.63	4.40	7.43	9.42	8.72	6.04	2.86	0.77	0.00	**41.3**	
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	1.43	28.80	61.05	90.73	108.62	102.43	77.60	44.05	16.32	0.00	**531**	
Adjusting Factor for U (Latitude 43° 17' N)	0.81	0.82	1.02	1.12	1.26	1.28	1.29	1.2	1.04	0.95	0.81	0.77		<--From J. M. Lorente (1961). pp. 206
Adjusted Potential Evapotranspiration PET (mm)	0	0	1	32	77	116	140	123	81	42	13	0	**626**	
PRE-DEVELOPMENT WATER BALANCE	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Precipitation (P)	60	55	76	74	82	72	75	85	85	73	82	77	**893**	<--From Environment Canada
Potential Evapotranspiration (PET)	0	0	1	32	77	116	140	123	81	42	13	0	**626**	
P - PET	60	55	74	41	5	-45	-65	-38	4	31	68	77	**267**	
Change in Soil Moisture Storage	0	0	0	0	0	-45	-55	0	4	31	65	0	**0**	
Soil Moisture Storage max 100 mm	100	100	100	100	100	55	0	0	4	35	100	100		
Actual Evapotranspiration (AET)	0	0	1	32	77	116	130	85	81	42	13	0	**577**	
Soil Moisture Deficit max 100 mm	0	0	0	0	0	45	100	100	96	65	0	0		
Water Surplus - available for infiltration or runoff	60	55	74	41	5	0	0	0	0	0	3	77	**315**	
Potential Infiltration (based on MOE metholodogy*; independent of temperature)	24	22	30	16	2	0	0	0	0	0	1	31	**126**	
Potential Surface Water Runoff (independent of temperature)	36	33	45	25	3	0	0	0	0	0	2	46	**189**	
POST-DEVELOPMENT WATER BALANCE	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Precipitation (P)	60	55	76	74	82	72	75	85	85	73	82	77	**893**	
Potential Evaporation (PE) from impervious areas (assume 15%)	9	8	11	11	12	11	11	13	13	11	12	12	**134**	
P-PE (surplus available for runoff from impervious areas)	51	47	64	62	70	61	64	72	72	62	69	66	**759**	
Water surplus change compared to pre-condition (for areas that change from vegetated open areas to impervious areas)	-9	-8	-10	21	65	61	64	72	72	62	66	-12	**444**	

Assume January storage is 100% of Soil Moisture Storage

Soil Moisture Storage	100 mm	<-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003

*MOE SWM infiltration calculations

topography - rolling to hilly land	0.15	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - relatively tight silty clay materials	0.15	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - golf course fairways and greens	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor	**0.4**	

Latitude of site (or climate station) 43 °N.

WATER BALANCE CALCULATIONS
Saw Whet Property (Bronte Green)
Oakville, Ontario

PROJECT No.300031495

TABLE 2

Pre- and Post-Development Monthly Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 400 mm (wooded areas in clayey soils)

Precipitation data from Hamilton RBG Climate Station (1971 - 1997)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Average Temperature (Degree C)	-5	-4.4	0.5	6.9	13.3	18.8	22	20.9	16.4	10	4.2	-1.6	**8.5**	<--From Environment Canada
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.03	1.63	4.40	7.43	9.42	8.72	6.04	2.86	0.77	0.00	**41.3**	
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	1.43	28.80	61.05	90.73	108.62	102.43	77.60	44.05	16.32	0.00	**531**	
Adjusting Factor for U (Latitude 43° 17' N)	0.81	0.82	1.02	1.12	1.26	1.28	1.29	1.2	1.04	0.95	0.81	0.77		<--From J. M. Lorente (1961). pp. 206
Adjusted Potential Evapotranspiration PET (mm)	0	0	1	32	77	116	140	123	81	42	13	0	**626**	
PRE-DEVELOPMENT WATER BALANCE	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Precipitation (P)	60	55	76	74	82	72	75	85	85	73	82	77	**893**	<--From Environment Canada
Potential Evapotranspiration (PET)	0	0	1	32	77	116	140	123	81	42	13	0	**626**	
P - PET	60	55	74	41	5	-45	-65	-38	4	31	68	77	**267**	
Change in Soil Moisture Storage	0	0	0	0	0	-45	-65	-38	4	31	68	45	**0**	
Soil Moisture Storage max 400 mm	400	400	400	400	400	355	290	252	256	287	355	400		
Actual Evapotranspiration (AET)	0	0	1	32	77	116	140	123	81	42	13	0	**626**	
Soil Moisture Deficit max 400 mm	0	0	0	0	0	45	110	148	144	113	45	0		
Water Surplus - available for infiltration or runoff	60	55	74	41	5	0	0	0	0	0	0	32	**267**	
Potential Infiltration (based on MOE metholodogy*; independent of temperature)	27	25	33	19	2	0	0	0	0	0	0	14	**120**	
Potential Surface Water Runoff (independent of temperature)	33	30	41	23	3	0	0	0	0	0	0	18	**147**	
POST-DEVELOPMENT WATER BALANCE	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Precipitation (P)	60	55	76	74	82	72	75	85	85	73	82	77	**893**	
Potential Evaporation (PE) from impervious areas (assume 15%)	9	8	11	11	12	11	11	13	13	11	12	12	**134**	
P-PE (surplus available for runoff from impervious areas)	51	47	64	62	70	61	64	72	72	62	69	66	**759**	
Water surplus change compared to pre-condition (for areas that change from vegetated open areas to impervious areas)	-9	-8	-10	21	65	61	64	72	72	62	69	33	**492**	

Assume January storage is 100% of Soil Moisture Storage

Soil Moisture Storage	400 mm	<-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003
*MOE SWM infiltration calculations		
topography - rolling to hilly land	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - relatively tight silty clay materials	0.15	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - wooded lands	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor	**0.45**	
Latitude of site (or climate station)	43 ° N.	

WATER BALANCE CALCULATIONS
Saw Whet Property (Bronte Green)
Oakville, Ontario

PROJECT No.300031495

TABLE 3

Water Balance - Existing Conditions and Post-development (With No LID Mitigation Measures for Stormwater Management)

Land Use Description	Approx. Land Area (m^2)	Estimated Impervious Fraction for Land Use	Estimated Impervious Area (m^2)	Runoff from Impervious Area** (m/a)	Runoff Volume from Impervious Area (m^3/a)	Estimated Pervious Area (m^2)	Runoff from Pervious Area** (m/a)	Runoff Volume from Pervious Area (m^3/a)	Infiltration in Pervious Area** (m/a)	Infiltration Volume in Pervious Area (m^3/a)	Total Runoff Volume (m^3/a)	Total Infiltration Volume (m^3/a)
Exising Land Use												
Golf Course/Landscaped areas	496,900	0.02	9,938	0.759	7,540	486,962	0.189	92,065	0.126	61,377	99,605	61,377
Wooded Area	54,100	0	0	0.759	0	54,100	0.147	7,946	0.120	6,501	7,946	6,501
TOTAL PRE-DEVELOPMENT	**551,000**		**9,938**		**7,540**	**541,062**		**100,011**		**67,878**	**107,551**	**67,878**
Post-Development Land Use												
Low Density Residential	249,900	0.64	159,936	0.759	121,331	89,964	0.189	17,009	0.126	11,339	138,340	11,339
Medium Density Residential	33,700	0.79	26,623	0.759	20,197	7,077	0.189	1,338	0.126	892	21,535	892
High Density Residential	9,200	0.86	7,912	0.759	6,002	1,288	0.189	244	0.126	162	6,246	162
Mixed Use	7,000	1.00	7,000	0.759	5,310	0	0.189	0	0.126	0	5,310	0
Road/ROW	125,400	0.79	99,066	0.759	75,154	26,334	0.189	4,979	0.126	3,319	80,133	3,319
SWM Facility	35,300	0.50	17,650	0.759	13,390	17,650	0.189	3,337	0.126	2,225	16,727	2,225
Open Space, Buffer, Easement, Enhancement Area	8,800	0.00	0	0.759	0	8,800	0.189	1,664	0.126	1,109	1,664	1,109
Parks	25,100	0.00	0	0.759	0	25,100	0.189	4,745	0.126	3,164	4,745	3,164
NHS	56,600	0.00	0	0.759	0	56,600	0.147	8,313	0.120	6,801	8,313	6,801
TOTAL POST-DEVELOPMENT	**551,000**		**318,187**		**241,385**	**232,813**		**41,628**		**29,011**	**283,012**	**29,011**
% Change from Pre to Post											263	57
Effect of development (with no mitigation)											2.6 times increase in runoff	57% reduction of infiltration

** figures from Table 1 and 2

To balance pre- to post-,
the infiltration target (m^3/a)= **38,867**

WATER BALANCE CALCULATIONS
Saw Whet Property (Bronte Green)
Oakville, Ontario

PROJECT No.300031495

TABLE 4

Post-Development Monthly Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 100 mm (urban lawns in clayey soils)

Precipitation data from Hamilton RBG Climate Station (1971 - 1997)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Average Temperature (Degree C)	-5	-4.4	0.5	6.9	13.3	18.8	22	20.9	16.4	10	4.2	-1.6	**8.5**	<--From Environment Canada
Heat index: i = $(t/5)^{1.514}$	0.00	0.00	0.03	1.63	4.40	7.43	9.42	8.72	6.04	2.86	0.77	0.00	**41.3**	
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	1.43	28.80	61.05	90.73	108.62	102.43	77.60	44.05	16.32	0.00	**531**	
Adjusting Factor for U (Latitude 44° 79' N)	0.81	0.82	1.02	1.12	1.26	1.28	1.29	1.2	1.04	0.95	0.81	0.77		<--From J. M. Lorente (1961). pp. 206
Adjusted Potential Evapotranspiration PET (mm)	0	0	1	32	77	116	140	123	81	42	13	0	**626**	
Post-Development Water Balance - Pervious Areas in Low Density Residential Areas with Mitigation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Precipitation (P)	60	55	76	74	82	72	75	85	85	73	82	77	**893**	<--From Environment Canada
Potential Evaporation (PE) from impervious areas (assume up to 15% of P)	9	8	11	11	12	11	11	13	13	11	12	12	**134**	
P-PE (surplus water from impervious areas, e.g., roof runoff capture)	51	47	64	62	70	61	64	72	72	62	69	66	**759**	
Roof runoff directed over pervious area (see Note 1)	38	35	48	47	52	46	48	54	54	46	52	49	**569**	
Total water supply directed to pervious areas (rain plus total roof runoff)	97	90	124	120	134	117	123	139	139	119	133	126	**1462**	
Potential Evapotranspiration from pervious areas (PET)	0	0	1	32	77	116	140	123	81	42	13	0	**626**	
Total water available to pervious areas - PET = total potential surplus on pervious areas	97	90	123	88	57	1	-17	16	58	77	120	126	**836**	
Change in Soil Moisture Storage	0	0	0	0	0	0	-17	16	2	0	0	0	**0**	
Soil Moisture Storage (max 100 mm)	100	100	100	100	100	100	83	98	100	100	100	100		
Actual Evapotranspiration (AET) = PET	0	0	1	32	77	116	140	123	81	42	13	0	**626**	
Soil Moisture Deficit (max 100 mm)	0	0	0	0	0	0	17	2	0	0	0	0		
Total water surplus available for infiltration or runoff on pervious areas	97	90	123	88	57	1	-17	16	58	77	120	126	**836**	
Potential Infiltration (based on MOE metholodogy*; independent of temperature)	49	45	61	44	29	1	-9	8	29	38	60	63	**418**	
Potential Surface Water Runoff (independent of temperature)	49	45	61	44	29	1	-9	8	29	38	60	63	**418**	
Post-Development Water Balance - Pervious Areas in Medium Density Residential Areas with Mitigation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**	
Precipitation (P)	60	55	76	74	82	72	75	85	85	73	82	77	**893**	<--From Environment Canada
Potential Evaporation (PE) from impervious areas (assume up to 15% of P)	9	8	11	11	12	11	11	13	13	11	12	12	**134**	
P-PE (surplus water from impervious areas, e.g., roof runoff capture)	51	47	64	62	70	61	64	72	72	62	69	66	**759**	
Roof runoff directed over pervious area (see Note 1)	72	67	92	89	99	87	91	103	103	88	99	94	**1084**	
Total water supply directed to pervious areas (rain plus total roof runoff)	132	122	168	163	181	159	166	187	188	161	180	171	**1976**	
Potential Evapotranspiration from pervious areas (PET)	0	0	1	32	77	116	140	123	81	42	13	0	**626**	
Total water available to pervious areas - PET = total potential surplus on pervious areas	132	122	166	130	104	42	26	64	107	119	167	171	**1351**	
Change in Soil Moisture Storage	0	0	0	0	0	0	0	0	0	0	0	0	**0**	
Soil Moisture Storage (max 100 mm)	100	100	100	100	100	100	100	100	100	100	100	100		
Actual Evapotranspiration (AET) = PET	0	0	1	32	77	116	140	123	81	42	13	0	**626**	
Soil Moisture Deficit (max 100 mm)	0	0	0	0	0	0	0	0	0	0	0	0		
Total water surplus available for infiltration or runoff on pervious areas	132	122	166	130	104	42	26	64	107	119	167	171	**1351**	
Potential Infiltration (based on MOE metholodogy*; independent of temperature)	66	61	83	65	52	21	13	32	54	59	84	85	**675**	
Potential Surface Water Runoff (independent of temperature)	66	61	83	65	52	21	13	32	54	59	84	85	**675**	

Post-Development Water Balance Inputs:

Assume January storage is 100% of Soil Moisture Storage		
Soil Moisture Storage -Urban Lawns - Silt Loam	100 mm	<-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003
*MOE SWM infiltration calculations		
topography - rolling land	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - relatively tight silty clay materials + additional topsoil depth	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - urban lawns	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration Factor	**0.50**	
Latitude of site (or climate station)	43 ° N.	

Note 1: Roof Runoff Capture x Ratio
Ratio of Roof Areas to Receiving Pervious Areas

Low Density Residenital - assume 27% of area consists of roofs and 36% consists of pervious receiving roof runoff	0.75
Medium Density Residential - assume 30% of area consists of roofs and 21% consists of pervious receiving roof runoff	1.43

WATER BALANCE CALCULATIONS
Saw Whet Property (Bronte Green)
Oakville, Ontario

PROJECT No.300031495

TABLE 5

Water Balance
With Direction of Roof Runoff to Pervious Areas in Low and Medium Density Residential Areas and Increased Topsoil Depth

Land Use Description	Approx. Land Area (m^2)	Estimated Impervious Fraction for Land Use	Estimated Impervious Area (m^2)	Runoff from Impervious Area** (m/a)	Runoff Volume from Impervious Area (m^3/a)	Estimated Pervious Area (m^2)	Runoff from Pervious Area** (m/a)	Runoff Volume from Pervious Area (m^3/a)	Infiltration in Pervious Area** (m/a)	Infiltration Volume in Pervious Area (m^3/a)	Total Runoff Volume (m^3/a)	Total Infiltration Volume (m^3/a)
Exising Land Use												
Golf Course/Landscaped areas	496,900	0.02	9,938	0.759	7,540	486,962	0.189	92,065	0.126	61,377	99,605	61,377
Wooded Area	54,100	0	0	0.759	0	54,100	0.147	7,946	0.120	6,501	7,946	6,501
TOTAL PRE-DEVELOPMENT	**551,000**		**9,938**		**7,540**	**541,062**		**100,011**		**67,878**	**107,551**	**67,878**
Post-Development Land Use												
Low Density Residential	249,900	0.64	159,936	0.759	121,331	89,964	0.418	37,608	0.418	37,608	158,939	37,608
Medium Density Residential	33,700	0.79	26,623	0.759	20,197	7,077	0.675	4,780	0.675	4,780	24,977	4,780
High Density Residential	9,200	0.86	7,912	0.759	6,002	1,288	0.189	244	0.126	162	6,246	162
Mixed Use	7,000	1.00	7,000	0.759	5,310	0	0.189	0	0.126	0	5,310	0
Road/ROW	125,400	0.79	99,066	0.759	75,154	26,334	0.189	4,979	0.126	3,319	80,133	3,319
SWM Facility	35,300	0.50	17,650	0.759	13,390	17,650	0.189	3,337	0.126	2,225	16,727	2,225
Buffer, Easement	8,800	0.00	0	0.759	0	8,800	0.189	1,664	0.126	1,109	1,664	1,109
Parks	25,100	0.00	0	0.759	0	25,100	0.189	4,745	0.126	3,164	4,745	3,164
NHS	56,600	0.00	0	0.759	0	56,600	0.189	10,701	0.126	7,134	10,701	7,134
TOTAL POST-DEVELOPMENT	**551,000**		**318,187**		**241,385**	**232,813**		**68,057**		**59,501**	**309,442**	**59,501**
% Change from Pre to Post											288	12
Effect of development											2.9 times increase in runoff	12% decrease in infiltration

** figures from Table 1, 2 and 4

To balance pre- to post-,
the infitlration target (m^3/a)= **8,377**

WATER BALANCE CALCULATIONS
Saw Whet Property (Bronte Green)
Oakville, Ontario

PROJECT No.300031495

TABLE 6

Feature-based Water Balance for Tributary 14W-W1
With No LID Mitigation Measures for Stormwater Management

Land Use Description	Approx. Land Area (m^2)	Estimated Impervious Fraction for Land Use	Estimated Impervious Area (m^2)	Runoff from Impervious Area** (m/a)	Runoff Volume from Impervious Area (m^3/a)	Estimated Pervious Area (m^2)	Runoff from Pervious Area** (m/a)	Runoff Volume from Pervious Area (m^3/a)	Infiltration in Pervious Area** (m/a)	Infiltration Volume in Pervious Area (m^3/a)	Total Runoff Volume (m^3/a)	Total Infiltration Volume (m^3/a)
Exising Land Use												
Golf Course/Landscaped areas	150,000	0.00	0	0.759	0	150,000	0.189	28,359	0.126	18,906	28,359	18,906
Wooded Area	68,900	0	0	0.759	0	68,900	0.147	10,119	0.120	8,279	10,119	8,279
TOTAL PRE-DEVELOPMENT	**218,900**		**0**		**0**	**218,900**		**38,478**		**27,185**	**38,478**	**27,185**
Post-Development Land Use												
Low Density Residential	60,500	0.64	38,720	0.759	29,377	21,780	0.189	4,118	0.126	2,745	33,495	2,745
Medium Density Residential	10,200	0.79	8,058	0.759	6,114	2,142	0.189	405	0.126	270	6,519	270
High Density Residential	8,500	0.86	7,310	0.759	5,546	1,190	0.189	225	0.126	150	5,771	150
Mixed Use	3,600	1.00	3,600	0.759	2,731	0	0.189	0	0.126	0	2,731	0
Road/ROW	40,000	0.79	31,600	0.759	23,975	8,400	0.189	1,588	0.126	1,059	25,563	1,059
SWM Facility	0	0.50	0	0.759	0	0	0.189	0	0.126	0	0	0
Open Space, Buffer, Easement	5,400	0.00	0	0.759	0	5,400	0.189	1,021	0.126	681	1,021	681
Parks	4,500	0.00	0	0.759	0	4,500	0.189	851	0.126	567	851	567
NHS	86,200	0.00	0	0.759	0	86,200	0.147	12,660	0.120	10,358	12,660	10,358
TOTAL POST-DEVELOPMENT	**218,900**		**89,288**		**67,744**	**129,612**		**20,867**		**15,830**	**88,611**	**15,830**
% Change from Pre to Post											230	42
Effect of development (with no mitigation)											2.3 times increase in runoff	42% reduction of infiltration

** figures from Table 1 and 2

To balance pre- to post-,
the infiltration target (m^3/a)= **11,356**

WATER BALANCE CALCULATIONS
Saw Whet Property (Bronte Green)
Oakville, Ontario

PROJECT No.300031495

TABLE 7

Feature-based Water Balance for Tributary 14W-W1
With Direction of Roof Runoff to Pervious Areas in Low and Medium Density Residential Areas and Increased Topsoil Depth

Land Use Description	Approx. Land Area (m^2)	Estimated Impervious Fraction for Land Use	Estimated Impervious Area (m^2)	Runoff from Impervious Area** (m/a)	Runoff Volume from Impervious Area (m^3/a)	Estimated Pervious Area (m^2)	Runoff from Pervious Area** (m/a)	Runoff Volume from Pervious Area (m^3/a)	Infiltration in Pervious Area** (m/a)	Infiltration Volume in Pervious Area (m^3/a)	Total Runoff Volume (m^3/a)	Total Infiltration Volume (m^3/a)
Exising Land Use												
Golf Course/Landscaped areas	150,000	0.00	0	0.759	0	150,000	0.189	28,359	0.126	18,906	28,359	18,906
Wooded Area	68,900	0	0	0.759	0	68,900	0.147	10,119	0.120	8,279	10,119	8,279
TOTAL PRE-DEVELOPMENT	**218,900**		**0**		**0**	**218,900**		**38,478**		**27,185**	**38,478**	**27,185**
Post-Development Land Use												
Low Density Residential	60,500	0.64	38,720	0.759	29,377	21,780	0.418	9,105	0.418	9,105	38,482	9,105
Medium Density Residential	10,200	0.79	8,058	0.759	6,114	2,142	0.675	1,447	0.675	1,447	7,561	1,447
High Density Residential	8,500	0.86	7,310	0.759	5,546	1,190	0.189	225	0.126	150	5,771	150
Mixed Use	3,600	1.00	3,600	0.759	2,731	0	0.189	0	0.126	0	2,731	0
Road/ROW	40,000	0.79	31,600	0.759	23,975	8,400	0.189	1,588	0.126	1,059	25,563	1,059
SWM Facility	0	0.50	0	0.759	0	0	0.189	0	0.126	0	0	0
Open Space, Buffer, Easement	5,400	0.00	0	0.759	0	5,400	0.189	1,021	0.126	681	1,021	681
Parks	4,500	0.00	0	0.759	0	4,500	0.189	851	0.126	567	851	567
NHS	86,200	0.00	0	0.759	0	86,200	0.189	16,297	0.126	10,865	16,297	10,865
TOTAL POST-DEVELOPMENT	**218,900**		**89,288**		**67,744**	**129,612**		**30,533**		**23,873**	**98,277**	**23,873**
										% Change from Pre to Post	255	12
										Effect of development	2.6 times increase in runoff	12% decrease in infiltration

** figures from Tables 1 ,2 and 4

To balance pre- to post-,
the infiltration target (m^3/a)= **3,313**

APPENDIX G

PRELIMINARY POND SIZING RESULTS (FOURTEEN MILE CREEK) & PRELIMINARY POND SIZING RESULTS (BRONTE CREEK)

JFSA

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WATER RESOURCES AND ENVIRONMENTAL
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November 28, 2013

David Schaeffer Engineering Ltd.
120 Iber Road, Unit 203
Ottawa, Ontario K2S 1E9

Attention: **Laura Maxwell, P.Eng.**

Subject: **Merton Tertiary Plan Area / Preliminary Stormwater Management Pond Sizing (Fourteen Mile Creek)** *our file: 1051-12*

As requested by your office, we have evaluated, based on the provided information as described below, the minimum required volumes for the proposed stormwater management (SWM) facilities based on quality, erosion and quantity control requirements.

A development of between 91.4 ha and 92.8 ha (at 75-79% average imperviousness) is proposed in the Merton Tertiary Plan Area in the Town of Oakville, as per Conceptual Storm Servicing Options A, B and C presented in Attachment A. Runoff from the development will be treated either locally or by SWM facilities before discharging to Fourteen Mile Creek.

QUALITY CONTROL

An enhanced protection level (80% long-term suspended solids removal) according to Ministry of the Environment standards is required for all runoff from the development to Fourteen Mile Creek. Quality control may be provided locally by oil-and-grit separators for some areas of the development; however, for the purposes of this analysis, wet ponds were assumed in all locations and required permanent pool volumes were estimated as presented in Attachment B. Active storage volumes of 40 m^3/ha minimum would also be provided for quality control in any wet ponds and detained for approximately 24 hours.

QUANTITY CONTROL

Quantity control for the SWM facilities is to be provided by controlling post-development outflows to the unit release rates in Fourteen Mile Creek at Lakeshore, as calculated from the *Fourteen Mile Creek / McCarney Creek Flood Management Alternative Assessment* (AMEC, July 17, 2013). A PCSWMM model of Fourteen Mile Creek under existing conditions was provided by AMEC with the July 17, 2013 *Flood Management Alternative Assessment*, and used by JFSA to verify these unit release rates. Preliminary pond sizing results for servicing options A, B and C are presented in Attachment B.

The AMEC July 17, 2013 PCSWMM model was modified to include only the west branch of Fourteen Mile Creek draining through the Merton Tertiary Area (to Queen Elizabeth Way) and upstream tributaries in order to reduce computing time. Note that the 213.6 ha area (S107) draining to the main branch of Fourteen Mile Creek upstream of Queen Elizabeth Way, just downstream of the confluence of the east and west branches, was still included in the model. The existing conditions model was then modified to prepare a proposed conditions model based on the drainage areas and SWM facilities for the most critical servicing option (A). The existing drainage areas to the creek were reduced based on a comparison of existing and proposed boundaries in CAD to avoid double-counting the proposed development area. The proposed development areas were modelled in accordance with the standard parameters established in AMEC's July 17, 2013 PCSWMM model. The existing and proposed conditions models were then run in EPASWMM (equivalent to PCSWMM) to simulate 2- to 100-year 12-hour Chicago storm (provided by AMEC) and Regional flows in the west branch at Queen Elizabeth Way.

The initial unit release rates used the size proposed SWM facilities resulted in proposed conditions flows higher existing conditions flows in the creek. In order to reduce proposed conditions flows, target release rates in the two largest SWM facilities (east and west of HUSP easement) were reduced by a factor of 0.4[Return Period]$^{0.16}$ (where the Regional event return period was treated as 100 years). Erosion control measures, as discussed below, are also incorporated into the model. The existing and proposed conditions flows in the west branch of Fourteen Mile Creek at Queen Elizabeth Way with these quantity control measures in place are presented in Table 1.

Table 1: Flows in the West Branch of Fourteen Mile Creek at Queen Elizabeth Way (1)

Storm	Flow (m^3/s)		
	Existing	Proposed	Difference
2-Year 12-Hour Chicago	20.29	20.05	-0.23
5-Year 12-Hour Chicago	38.45	38.34	-0.10
10-Year 12-Hour Chicago	51.86	51.78	-0.08
25-Year 12-Hour Chicago	70.53	70.40	-0.13
50-Year 12-Hour Chicago	84.24	84.06	-0.18
100-Year 12-Hour Chicago	97.94	97.79	-0.15
Regional	187.33	187.28	-0.05

(1) Simulated using AMEC July 17, 2013 PCSWMM model, modified as described above.

Therefore, the proposed quantity control measures are sufficient to maintain proposed conditions flows equal to or less than existing conditions flows in Fourteen Mile Creek at Queen Elizabeth Way.

EROSION CONTROL

Given the complexity of the EPASWMM existing and proposed conditions models, and the computation time required by the models for hydrologic / hydraulic simulation, it is prohibitively time-consuming to perform a full erosion analysis of Fourteen Mile Creek based on continuous hourly rainfall data from the Toronto airport for 1960 to 2003, as is generally our practice. Instead, six years were selected from the rainfall record as representative of the overall range of conditions: 1963 and 1997 as particularly dry years, 1979 and 1993 as average years, and 1980 and 1995 as particularly wet years. A summary of rainfall statistics supporting this assessment is provided in Attachment C.

Bed and bank erosion thresholds for three locations in Fourteen Mile Creek in the Merton Tertiary Area (Tributary SW-2, Reach 75A, and Reach 73) were provided by Parish Geomorphic in their October 2013 *Merton Tertiary Planning Study: Geomorphic Assessment, Fourteen Mile Creek and Associated Tributaries Draft Report*. Given the difference in scale between the higher bed erosion threshold and lower bank erosion thresholds, it was not possible to prevent any change in erosion hours at these sites. Several erosion control measures were considered, and the best results were produced by the extended detention of runoff from the 25 mm storm for 48 hours. Additionally, the 2-year unit release rate of 10 L/s/ha was reduced by half to 5 L/s/ha to provide additional erosion control. These measures are reflected in the pond sizing presented in Attachment B.

Simulated bed and bank erosion hours at the three erosion sites in Fourteen Mile Creek for the selected years, between April 1st and October 31st, are presented in Attachment C. As may be seen in the attached, bed erosion hours change by a maximum of 3% between existing and proposed conditions. Given the relative infrequency of bed erosion at these locations (less than 18 hours over a 5136 hour simulation period), this represents a reasonable change in erosive time of less than half an hour. Bank erosion is more frequent (between 42 hours and 156 hours over a 5136 hour simulation period), and changes more significantly between existing and proposed conditions (between 4% and 13% increase in erosion hours). However, I understand that Parish Geomorphic has undertaken a cumulative erosion assessment that demonstrates that this change will not have a detrimental effect on erosive conditions in the creek.

ANNUAL FLOWS

To further demonstrate that the existing conditions flow characteristics will be maintained in Fourteen Mile Creek under proposed conditions, a comparison of annual existing and proposed conditions peak flows, average flows and total volumes are presented in Attachment D for the six selected years (1963, 1979, 1980, 1993, 1995 and 1997) at the three erosion sites and in the west branch at Queen Elizabeth Way. Sample hydrographs at these locations are also presented in Attachment D for April 1st to October 31st, 1993. As may be seen in Attachment D, runoff volumes in Fourteen Mile Creek increase between existing and proposed conditions as expected due to the imperviousness of the proposed development. Average and peak flows in the creek remain generally similar under existing and proposed conditions.

Yours truly,
J.F. Sabourin and Associates Inc.
L. Pipkins
Laura Pipkins, P.Eng.

LICENSED PROFESSIONAL ENGINEER
L. E. PIPKINS
100173786
PROVINCE OF ONTARIO

cc: J.F. Sabourin, M.Eng, P.Eng.
Director of Water Resources Projects

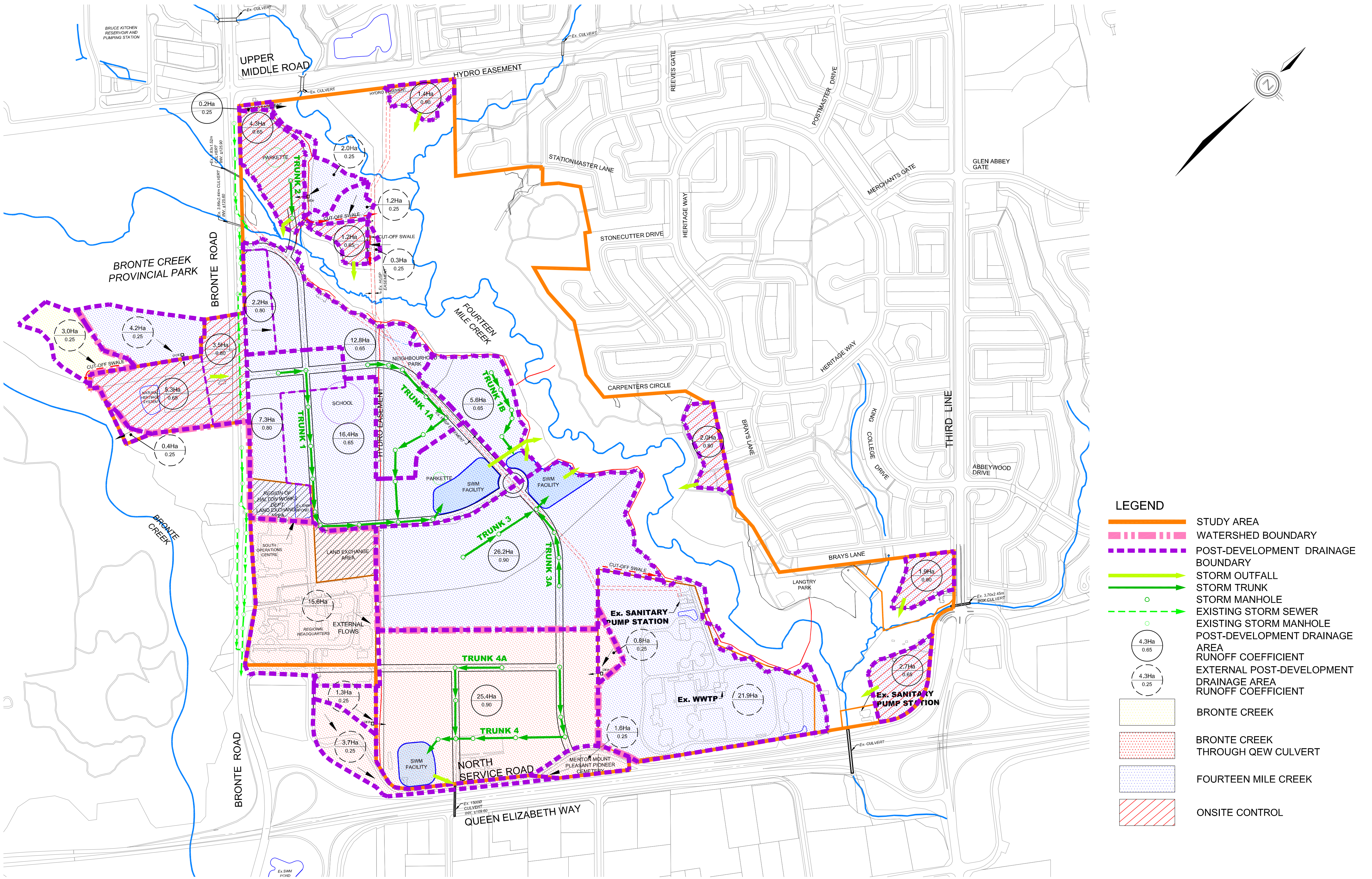
Attachment A: Conceptual Storm Servicing Options A, B and C
Attachment B: Preliminary Pond Sizing Results (Options A, B and C)
Attachment C: Rainfall Statistics for Toronto Airport Hourly Data
Simulated Annual Bed and Bank Erosion Hours in Fourteen Mile Creek (Option A)
Attachment D: Simulated Annual Flows in Fourteen Mile Creek (Option A)
Sample Hydrographs in Fourteen Mile Creek (Option A)

ATTACHMENT

A

Conceptual Storm Servicing Options A, B and C

JFSA Water Resources and Environmental Consultants



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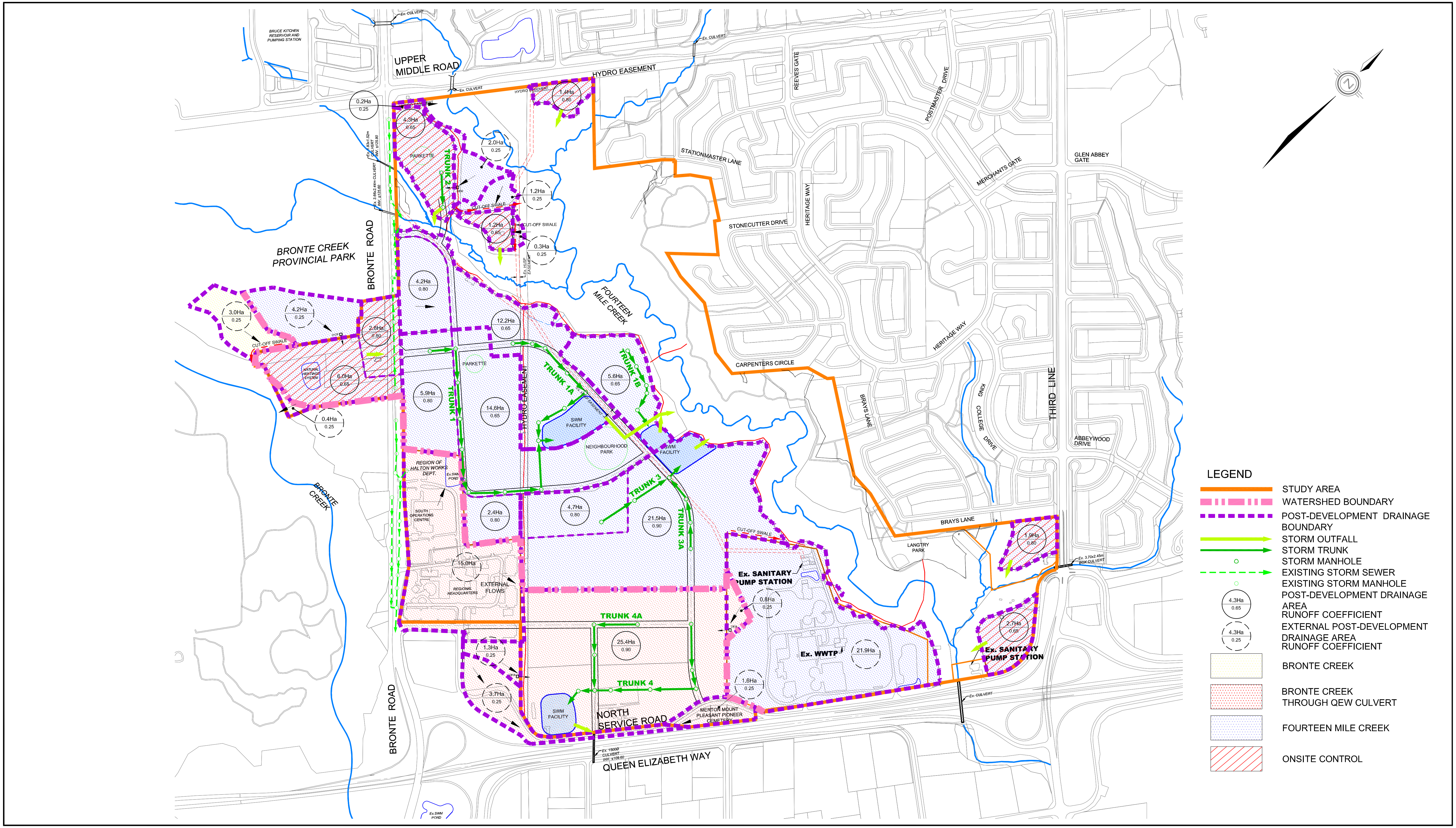
MERTON (QEW / BRONTE ROAD) TERTIARY PLANNING STUDY

CONCEPTUAL STORM SERVICING
OPTION A

DATE:	JUNE 2013
SCALE:	1:5000
PROJECT No.:	12-601
FIGURE	15



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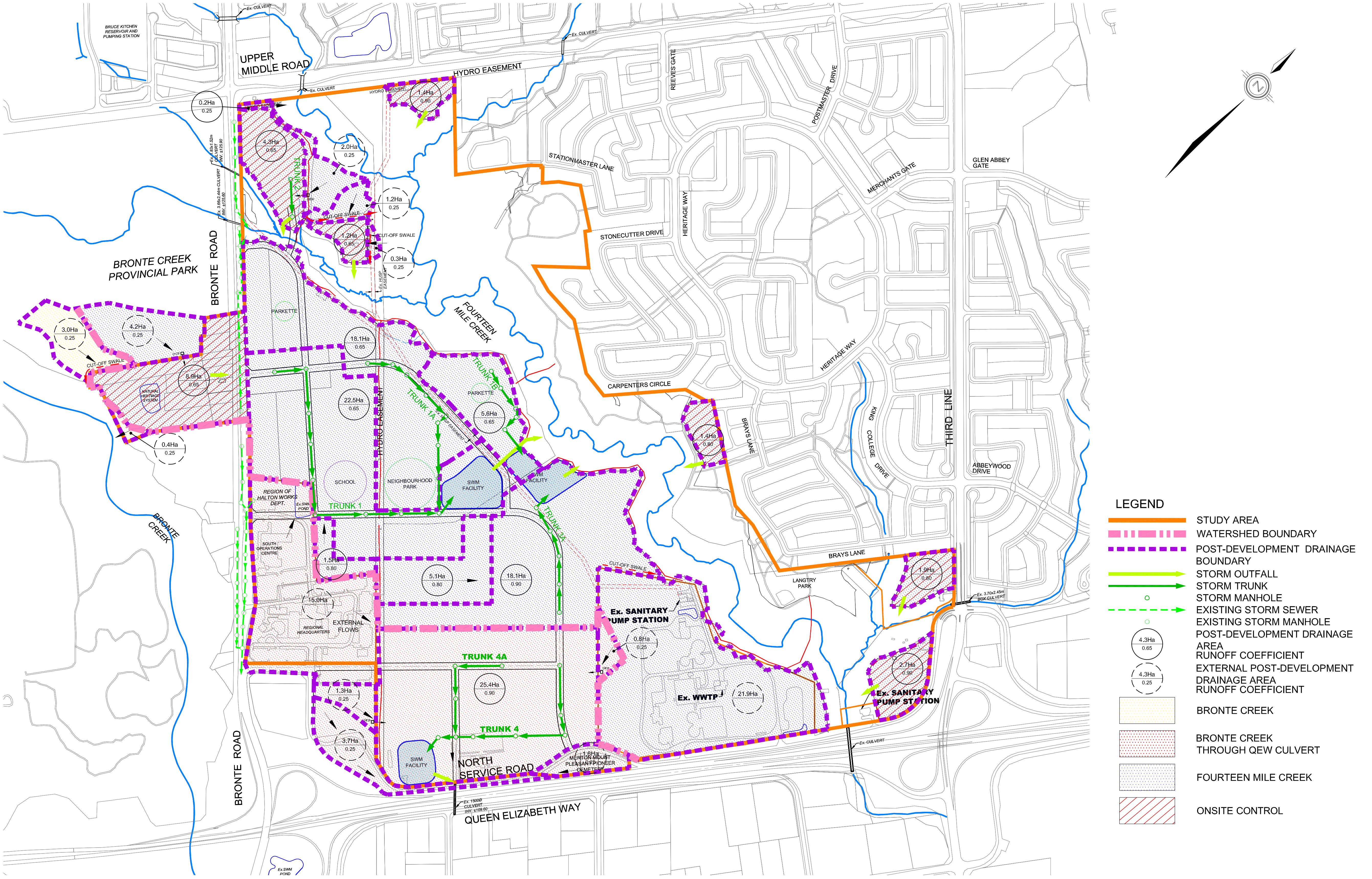
MERTON (QEW / BRONTE ROAD) TERTIARY PLANNING STUDY

CONCEPTUAL STORM SERVICING
OPTION B

DATE:	JUNE 2013
SCALE:	1:5000
PROJECT No.:	12-601
FIGURE	16



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MERTON (QEW / BRONTE ROAD) TERTIARY PLANNING STUDY

CONCEPTUAL STORM SERVICING
OPTION C

DATE:	JUNE 2013
SCALE:	1:5000
PROJECT No.:	12-601
FIGURE	17

ATTACHMENT

B

Preliminary Pond Sizing Results (Options A, B and C)

JFSA Water Resources and Environmental Consultants

PRELIMINARY POND SIZING RESULTS (CONCEPTUAL STORM SERVICING OPTION A)

Table B-1: Summary of Total Proposed Drainage Area

SWM Facility Location	Area (ha)	Imperviousness (%)	Area x Imp.
West of HUSP Easement	38.7	70	2709.0
East of HUSP Easement	31.8	93	2957.4
East of Bronte Road	8.8	73	642.4
At Northwest Confluence	1.2	64	76.8
Upper Middle Road at Bronte Road	4.3	64	275.2
East of Creek at Upper Middle Road	1.4	99	138.6
East of Creek at Bray's Lane	2.0	86	172.0
East of Creek at Third Line	1.9	99	188.1
East of Creek at QEW	2.7	64	172.8
Total	92.8	79	7332.3

Table B-2A: Allowable Release Rates and Required Volumes for Proposed SWM Facilities

Pond Component	Unit Release Rate (4) (m^3/s/ha)	West of HUSP Easement (38.7 ha)		East of HUSP Easement (31.8 ha)		East of Bronte Road (8.8 ha)	
		Target Release Rate (5) (m^3/s)	Required Storage (m^3)	Target Release Rate (5) (m^3/s)	Required Storage (m^3)	Target Release Rate (m^3/s)	Required Storage (m^3)
Permanent Pool (1)	N/A	N/A	7160	N/A	7102	N/A	1672
Quality Control (1)	N/A	N/A	1548	N/A	1272	N/A	352
Ext. Detention (2)	N/A	0.0360	6221	0.0405	6992	0.0085	1475
2yr/24hr Chicago (3)	0.005	0.086	9917	0.071	10830	0.044	2156
5yr/24hr Chicago	0.017	0.340	12490	0.280	12760	0.150	2716
10yr/24hr Chicago	0.022	0.492	14580	0.404	14470	0.194	3173
25yr/24hr Chicago	0.028	0.725	17270	0.596	16750	0.246	3793
50yr/24hr Chicago	0.033	0.955	19020	0.785	18180	0.290	4217
100yr/24hr Chicago	0.037	1.197	20800	0.983	19680	0.326	4653
Regional	0.085	2.749	34770	2.259	35880	0.748	6837

(1) Quality control and permanent pool requirements based on MOE guidelines for enhanced quality control for wet ponds;

(2) Extended detention based on the runoff from the 25 mm design storm with a drawdown time of 48 hours.

(3) 2-year unit release rate of 10 L/s/ha reduced by half to 5 L/s/ha to provide additional erosion control.

(4) Unit release rates on 14 Mile Creek at Lakeshore, as per "*Fourteen Mile Creek / McCarney Creek Flood Management Alternative Assessment* " (AMEC, July 17, 2013).

(5) Target release rates reduced by a factor of 0.4[Return Period]$^{0.16}$ (where Regional = 100) to match existing conditions flows upstream of Queen Elizabeth Way, as simulated using AMEC's July 17, 2013 PCSWMM model.

PRELIMINARY POND SIZING RESULTS (CONCEPTUAL STORM SERVICING OPTION A)

Table B-2B: Allowable Release Rates and Required Volumes for Proposed SWM Facilities

Pond Component	Unit Release Rate (4) (m^3/s/ha)	At Northwest Confluence (1.2 ha)		Upper Middle Road at Bronte Road (4.3 ha)		East of Creek at Upper Middle Road (1.4 ha)	
		Target Release Rate	Required Storage	Target Release Rate	Required Storage	Target Release Rate	Required Storage
Permanent Pool (1)	N/A	N/A	205	N/A	735	N/A	327
Quality Control (1)	N/A	N/A	48	N/A	172	N/A	56
Ext. Detention (2)	N/A	0.0010	176	0.0037	631	0.0019	336
2yr/24hr Chicago (3)	0.005	0.006	266	0.022	946	0.007	468
5yr/24hr Chicago	0.017	0.020	342	0.073	1220	0.024	550
10yr/24hr Chicago	0.022	0.026	403	0.095	1433	0.031	623
25yr/24hr Chicago	0.028	0.034	488	0.120	1739	0.039	728
50yr/24hr Chicago	0.033	0.040	546	0.142	1943	0.046	797
100yr/24hr Chicago	0.037	0.044	606	0.159	2158	0.052	870
Regional	0.085	0.102	857	0.366	3029	0.119	1444

(1) Quality control and permanent pool requirements based on MOE guidelines for enhanced quality control for wet ponds;

(2) Extended detention based on the runoff from the 25 mm design storm with a drawdown time of 48 hours.

(3) 2-year unit release rate of 10 L/s/ha reduced by half to 5 L/s/ha to provide additional erosion control.

(4) Unit release rates on 14 Mile Creek at Lakeshore, as per "*Fourteen Mile Creek / McCarney Creek Flood Management Alternative Assessment* " (AMEC, July 17, 2013).

Table B-2C: Allowable Release Rates and Required Volumes for Proposed SWM Facilities

Pond Component	Unit Release Rate (4) (m^3/s/ha)	East of Creek at Bray's Lane (2 ha)		East of Creek at Third Line (1.9 ha)		East of Creek at QEW (2.7 ha)	
		Target Release Rate (m^3/s)	Required Storage (m^3)	Target Release Rate (m^3/s)	Required Storage (m^3)	Target Release Rate (m^3/s)	Required Storage (m^3)
Permanent Pool (1)	N/A	N/A	423	N/A	443	N/A	462
Quality Control (1)	N/A	N/A	80	N/A	76	N/A	108
Ext. Detention (2)	N/A	0.0024	407	0.0026	455	0.0023	396
2yr/24hr Chicago (3)	0.005	0.010	577	0.010	630	0.014	592
5yr/24hr Chicago	0.017	0.034	702	0.032	747	0.046	767
10yr/24hr Chicago	0.022	0.044	808	0.042	848	0.059	902
25yr/24hr Chicago	0.028	0.056	952	0.053	988	0.076	1093
50yr/24hr Chicago	0.033	0.066	1050	0.063	1080	0.089	1223
100yr/24hr Chicago	0.037	0.074	1152	0.070	1181	0.100	1357
Regional	0.085	0.170	1806	0.162	1956	0.230	1906

(1) Quality control and permanent pool requirements based on MOE guidelines for enhanced quality control for wet ponds;

(2) Extended detention based on the runoff from the 25 mm design storm with a drawdown time of 48 hours.

(3) 2-year unit release rate of 10 L/s/ha reduced by half to 5 L/s/ha to provide additional erosion control.

(4) Unit release rates on 14 Mile Creek at Lakeshore, as per "*Fourteen Mile Creek / McCarney Creek Flood Management Alternative Assessment* " (AMEC, July 17, 2013).

PRELIMINARY POND SIZING RESULTS (CONCEPTUAL STORM SERVICING OPTION B)

Table B-3: Summary of Total Proposed Drainage Area

SWM Facility Location	Area (ha)	Imperviousness (%)	Area x Imp.
West of HUSP Easement	39.3	71	2790.3
East of HUSP Easement	31.8	91	2893.8
East of Bronte Road	8.8	71	624.8
At Northwest Confluence	1.2	64	76.8
Upper Middle Road at Bronte Road	4.3	64	275.2
East of Creek at Upper Middle Road	1.4	86	120.4
East of Creek at Bray's Lane	N/A	N/A	N/A
East of Creek at Third Line	1.9	86	163.4
East of Creek at QEW	2.7	64	172.8
Total	91.4	78	7117.5

Table B-4A: Allowable Release Rates and Required Volumes for Proposed SWM Facilities

Pond Component	Unit Release Rate (4) (m^3/s/ha)	West of HUSP Easement (39.3 ha)		East of HUSP Easement (31.8 ha)		East of Bronte Road (8.8 ha)	
		Target Release Rate (5) (m^3/s)	Required Storage (m^3)	Target Release Rate (5) (m^3/s)	Required Storage (m^3)	Target Release Rate (m^3/s)	Required Storage (m^3)
Permanent Pool (1)	N/A	N/A	7336	N/A	6996	N/A	1643
Quality Control (1)	N/A	N/A	1572	N/A	1272	N/A	352
Ext. Detention (2)	N/A	0.0371	6406	0.0396	6840	0.0083	1434
2yr/24hr Chicago (3)	0.005	0.088	10190	0.071	10600	0.044	2107
5yr/24hr Chicago	0.017	0.346	12790	0.280	12550	0.150	2666
10yr/24hr Chicago	0.022	0.500	14920	0.404	14270	0.194	3122
25yr/24hr Chicago	0.028	0.737	17660	0.596	16540	0.246	3740
50yr/24hr Chicago	0.033	0.970	19450	0.785	17970	0.290	4159
100yr/24hr Chicago	0.037	1.215	21250	0.983	19470	0.326	4592
Regional	0.085	2.792	35650	2.259	35210	0.748	6687

(1) Quality control and permanent pool requirements based on MOE guidelines for enhanced quality control for wet ponds;

(2) Extended detention based on the runoff from the 25 mm design storm with a drawdown time of 48 hours.

(3) 2-year unit release rate of 10 L/s/ha reduced by half to 5 L/s/ha to provide additional erosion control.

(4) Unit release rates on 14 Mile Creek at Lakeshore, as per "*Fourteen Mile Creek / McCarney Creek Flood Management Alternative Assessment* " (AMEC, July 17, 2013).

(5) Target release rates reduced by a factor of $0.4[\text{Return Period}]^{0.16}$ (where Regional = 100) to match existing conditions flows upstream of Queen Elizabeth Way, as simulated using AMEC's July 17, 2013 PCSWMM model.

PRELIMINARY POND SIZING RESULTS (CONCEPTUAL STORM SERVICING OPTION B)

Table B-4B: Allowable Release Rates and Required Volumes for Proposed SWM Facilities

Pond Component	Unit Release Rate (4) (m^3/s/ha)	At Northwest Confluence (1.2 ha)		Upper Middle Road at Bronte Road (4.3 ha)		East of Creek at Upper Middle Road (1.4 ha)	
		Target Release Rate	Required Storage	Target Release Rate	Required Storage	Target Release Rate	Required Storage
Permanent Pool (1)	N/A	N/A	205	N/A	735	N/A	296
Quality Control (1)	N/A	N/A	48	N/A	172	N/A	56
Ext. Detention (2)	N/A	0.0010	176	0.0037	631	0.0016	285
2yr/24hr Chicago (3)	0.005	0.006	266	0.022	946	0.007	405
5yr/24hr Chicago	0.017	0.020	342	0.073	1220	0.024	491
10yr/24hr Chicago	0.022	0.026	403	0.095	1433	0.031	566
25yr/24hr Chicago	0.028	0.034	488	0.120	1739	0.039	668
50yr/24hr Chicago	0.033	0.040	546	0.142	1943	0.046	737
100yr/24hr Chicago	0.037	0.044	606	0.159	2158	0.052	808
Regional	0.085	0.102	857	0.366	3029	0.119	1269

(1) Quality control and permanent pool requirements based on MOE guidelines for enhanced quality control for wet ponds;

(2) Extended detention based on the runoff from the 25 mm design storm with a drawdown time of 48 hours.

(3) 2-year unit release rate of 10 L/s/ha reduced by half to 5 L/s/ha to provide additional erosion control.

(4) Unit release rates on 14 Mile Creek at Lakeshore, as per "*Fourteen Mile Creek / McCarney Creek Flood Management Alternative Assessment* " (AMEC, July 17, 2013).

Table B-4C: Allowable Release Rates and Required Volumes for Proposed SWM Facilities

Pond Component	Unit Release Rate (4) (m^3/s/ha)	East of Creek at Third Line (1.9 ha)		East of Creek at QEW (2.7 ha)	
		Target Release Rate (m^3/s)	Required Storage (m^3)	Target Release Rate (m^3/s)	Required Storage (m^3)
Permanent Pool (1)	N/A	N/A	402	N/A	462
Quality Control (1)	N/A	N/A	76	N/A	108
Ext. Detention (2)	N/A	0.0022	387	0.0023	396
2yr/24hr Chicago (3)	0.005	0.010	546	0.014	592
5yr/24hr Chicago	0.017	0.032	668	0.046	767
10yr/24hr Chicago	0.022	0.042	768	0.059	902
25yr/24hr Chicago	0.028	0.053	906	0.076	1093
50yr/24hr Chicago	0.033	0.063	998	0.089	1223
100yr/24hr Chicago	0.037	0.070	1096	0.100	1357
Regional	0.085	0.162	1718	0.230	1906

(1) Quality control and permanent pool requirements based on MOE guidelines for enhanced quality control for wet ponds;

(2) Extended detention based on the runoff from the 25 mm design storm with a drawdown time of 48 hours.

(3) 2-year unit release rate of 10 L/s/ha reduced by half to 5 L/s/ha to provide additional erosion control.

(4) Unit release rates on 14 Mile Creek at Lakeshore, as per "*Fourteen Mile Creek / McCarney Creek Flood Management Alternative Assessment* " (AMEC, July 17, 2013).

PRELIMINARY POND SIZING RESULTS (CONCEPTUAL STORM SERVICING OPTION C)

Table B-5: Summary of Total Proposed Drainage Area

SWM Facility Location	Area (ha)	Imperviousness (%)	Area x Imp.
West of HUSP Easement	42.1	65	2736.5
East of HUSP Easement	28.8	90	2592.0
East of Bronte Road	8.9	64	569.6
At Northwest Confluence	1.2	64	76.8
Upper Middle Road at Bronte Road	4.3	64	275.2
East of Creek at Upper Middle Road	1.4	99	138.6
East of Creek at Bray's Lane	1.4	86	120.4
East of Creek at Third Line	1.9	86	163.4
East of Creek at QEW	2.7	99	267.3
Total	92.7	75	6939.8

Table B-6A: Allowable Release Rates and Required Volumes for Proposed SWM Facilities

Pond Component	Unit Release Rate (4) (m^3/s/ha)	West of HUSP Easement (42.1 ha)		East of HUSP Easement (28.8 ha)		East of Bronte Road (8.9 ha)	
		Target Release Rate (5) (m^3/s)	Required Storage (m^3)	Target Release Rate (5) (m^3/s)	Required Storage (m^3)	Target Release Rate (m^3/s)	Required Storage (m^3)
Permanent Pool (1)	N/A	N/A	7297	N/A	6288	N/A	1522
Quality Control (1)	N/A	N/A	1684	N/A	1152	N/A	356
Ext. Detention (2)	N/A	0.0363	6276	0.0355	6129	0.0076	1307
2yr/24hr Chicago (3)	0.005	0.094	10140	0.064	9513	0.045	1958
5yr/24hr Chicago	0.017	0.370	12950	0.253	11280	0.151	2518
10yr/24hr Chicago	0.022	0.536	15140	0.366	12820	0.196	2957
25yr/24hr Chicago	0.028	0.789	18070	0.540	14880	0.249	3581
50yr/24hr Chicago	0.033	1.039	19990	0.711	16190	0.294	4006
100yr/24hr Chicago	0.037	1.302	21930	0.891	17550	0.329	4449
Regional	0.085	2.991	35950	2.046	31620	0.757	6236

(1) Quality control and permanent pool requirements based on MOE guidelines for enhanced quality control for wet ponds;

(2) Extended detention based on the runoff from the 25 mm design storm with a drawdown time of 48 hours.

(3) 2-year unit release rate of 10 L/s/ha reduced by half to 5 L/s/ha to provide additional erosion control.

(4) Unit release rates on 14 Mile Creek at Lakeshore, as per "*Fourteen Mile Creek / McCarney Creek Flood Management Alternative Assessment* " (AMEC, July 17, 2013).

(5) Target release rates reduced by a factor of 0.4[Return Period]$^{0.16}$ (where Regional = 100) to match existing conditions flows upstream of Queen Elizabeth Way, as simulated using AMEC's July 17, 2013 PCSWMM model.

PRELIMINARY POND SIZING RESULTS (CONCEPTUAL STORM SERVICING OPTION C)

Table B-6B: Allowable Release Rates and Required Volumes for Proposed SWM Facilities

Pond Component	Unit Release Rate (4) (m^3/s/ha)	At Northwest Confluence (1.2 ha)		Upper Middle Road at Bronte Road (4.3 ha)		East of Creek at Upper Middle Road (1.4 ha)	
		Target Release Rate	Required Storage	Target Release Rate	Required Storage	Target Release Rate	Required Storage
Permanent Pool (1)	N/A	N/A	205	N/A	735	N/A	327
Quality Control (1)	N/A	N/A	48	N/A	172	N/A	56
Ext. Detention (2)	N/A	0.0010	176	0.0037	631	0.0019	336
2yr/24hr Chicago (3)	0.005	0.006	266	0.022	946	0.007	468
5yr/24hr Chicago	0.017	0.020	342	0.073	1220	0.024	550
10yr/24hr Chicago	0.022	0.026	403	0.095	1433	0.031	623
25yr/24hr Chicago	0.028	0.034	488	0.120	1739	0.039	728
50yr/24hr Chicago	0.033	0.040	546	0.142	1943	0.046	797
100yr/24hr Chicago	0.037	0.044	606	0.159	2158	0.052	870
Regional	0.085	0.102	857	0.366	3029	0.119	1449

(1) Quality control and permanent pool requirements based on MOE guidelines for enhanced quality control for wet ponds;

(2) Extended detention based on the runoff from the 25 mm design storm with a drawdown time of 48 hours.

(3) 2-year unit release rate of 10 L/s/ha reduced by half to 5 L/s/ha to provide additional erosion control.

(4) Unit release rates on 14 Mile Creek at Lakeshore, as per "*Fourteen Mile Creek / McCarney Creek Flood Management Alternative Assessment* " (AMEC, July 17, 2013).

Table B-6C: Allowable Release Rates and Required Volumes for Proposed SWM Facilities

Pond Component	Unit Release Rate (4) (m^3/s/ha)	East of Creek at Bray's Lane (1.4 ha)		East of Creek at Third Line (1.9 ha)		East of Creek at QEW (2.7 ha)	
		Target Release Rate (m^3/s)	Required Storage (m^3)	Target Release Rate (m^3/s)	Required Storage (m^3)	Target Release Rate (m^3/s)	Required Storage (m^3)
Permanent Pool (1)	N/A	N/A	296	N/A	402	N/A	630
Quality Control (1)	N/A	N/A	56	N/A	76	N/A	108
Ext. Detention (2)	N/A	0.0016	285	0.0022	387	0.0037	647
2yr/24hr Chicago (3)	0.005	0.007	405	0.010	546	0.014	895
5yr/24hr Chicago	0.017	0.024	491	0.032	668	0.046	1059
10yr/24hr Chicago	0.022	0.031	566	0.042	768	0.059	1203
25yr/24hr Chicago	0.028	0.039	668	0.053	906	0.076	1402
50yr/24hr Chicago	0.033	0.046	737	0.063	998	0.089	1534
100yr/24hr Chicago	0.037	0.052	808	0.070	1096	0.100	1677
Regional	0.085	0.119	1269	0.162	1718	0.230	2775

(1) Quality control and permanent pool requirements based on MOE guidelines for enhanced quality control for wet ponds;

(2) Extended detention based on the runoff from the 25 mm design storm with a drawdown time of 48 hours.

(3) 2-year unit release rate of 10 L/s/ha reduced by half to 5 L/s/ha to provide additional erosion control.

(4) Unit release rates on 14 Mile Creek at Lakeshore, as per "*Fourteen Mile Creek / McCarney Creek Flood Management Alternative Assessment* " (AMEC, July 17, 2013).

ATTACHMENT

C

Rainfall Statistics for Toronto Airport Hourly Data

Simulated Annual Bed and Bank Erosion Hours In Fourteen Mile Creek (Option A)

JFSA Water Resources and Environmental Consultants

Table C-1: Rainfall Statistics Based on Hourly Rainfall Data from the Toronto Airport

Year	Total Duration (h)	Wet Hours (h)	Dry Hours (h)	Total Precipitation (mm)	Peak Flow [2] (m^3/s)	Runoff Volume [2] (mm)
1960	5160	245	4915	377.7	1.872	41.75
1961	5160	297	4863	422.8	0.907	35.20
1962	5160	248	4912	433.0	1.854	73.60
1963	5160	206	4954	344.4	1.129	43.62
1964	5160	232	4928	447.8	1.423	96.63
1965	5160	278	4882	452.6	0.626	31.08
1966	5160	253	4907	307.8	0.767	20.36
1967	5160	297	4863	480.5	0.851	67.18
1968	5160	269	4891	521.5	4.733	106.86
1969	5160	272	4888	431.8	2.448	78.80
1970	5160	217	4943	428.1	4.442	100.88
1971	5160	209	4951	401.6	2.028	58.43
1972	5160	328	4832	488.3	0.654	70.93
1973	5160	327	4833	483.8	1.077	84.34
1974	5160	284	4876	488.4	1.922	82.03
1975	4440	217	4223	408.6	0.850	47.82
1976	5160	315	4845	483.7	0.810	64.30
1977	5160	269	4891	562.7	1.658	91.35
1978	5160	294	4866	441.9	0.880	53.56
1979	5160	292	4868	459.6	2.900	62.61
1980	5160	345	4815	606.5	4.972	144.18
1981	5160	375	4785	568.1	1.620	83.97
1982	5160	362	4798	521.0	2.663	88.34
1983	5160	306	4854	459.1	1.517	63.37
1984	5160	312	4848	434.4	0.606	43.69
1985	5160	294	4866	492.5	1.501	69.36
1986	5160	377	4783	727.0	2.750	189.28
1987	5160	297	4863	450.4	2.295	61.30
1988	5160	276	4884	404.1	1.600	40.93
1989	5160	302	4858	417.0	1.268	42.93
1990	5160	390	4770	516.0	1.083	57.30
1991	5160	262	4898	504.0	1.295	76.06
1992	5160	360	4800	680.9	2.131	143.40
1993	5160	306	4854	461.9	1.468	59.84
1994	5160	303	4857	437.4	1.237	48.32
1995	5160	271	4889	561.6	2.820	132.03
1996	5160	398	4762	601.2	0.899	111.07
1997	5160	277	4883	343.1	0.415	28.15
1998	5160	208	4952	262.4	0.771	35.47
1999	5160	253	4907	377.6	1.319	59.59
2000	5160	314	4846	524.2	1.819	105.66
2001	5160	307	4853	416.1	0.547	53.53
2002	5136	304	4832	400.9	0.387	27.89
2003	5160	338	4822	518.1	0.752	86.20
Average	**5143**	**293**	**4850**	**467.1**	**1.627**	**71.89**
Max	**5160**	**398**	**4954**	**727.0**	**4.972**	**189.28**
Min	**4440**	**206**	**4223**	**262.4**	**0.387**	**20.36**

[1] Based on a simulation period from April 1st to October 31st (5160 hours).

[2] Existing runoff to Provincially Significant Wetland 6 in the Preserve development (Oakville) for comparison purposes.

🟩 Dry Year
🟨 Average Year
🟪 Wet Year

SIMULATED ANNUAL BED EROSION HOURS IN FOURTEEN MILE CREEK (CONCEPTUAL STORM SERVICING OPTION A)

Table C-2A: Existing Conditions in Tributary SW-2

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Erosion Hours (h)	Total Exceedance (%)
1963	336	1.915	0.004	10.3	0.20
1979	453	6.754	0.006	9.5	0.18
1980	607	7.378	0.012	18.5	0.36
1993	462	2.123	0.005	12.0	0.23
1995	554	5.335	0.008	27.5	0.54
1997	322	0.864	0.002	3.8	0.07
Average	455	4.062	0.006	13.6	2.99

Table C-2B: Proposed Conditions in Tributary SW-2

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Erosion Hours (h)	Total Exceedance (%)
1963	336	1.767	0.005	9.3	0.18
1979	453	6.388	0.008	9.3	0.18
1980	607	6.799	0.014	18.5	0.36
1993	462	1.954	0.007	11.5	0.22
1995	554	5.097	0.010	27.0	0.53
1997	322	0.797	0.004	3.5	0.07
Average	455	3.801	0.008	13.2	2.90

(1) Based on a simulation period from April 1st to October 31st (5136 hours), and an erosion threshold of 430 L/s.

Avg. Change in Erosion Threshold Exceedance: -3.0%

Table C-3A: Existing Conditions in Reach 75A

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Erosion Hours (h)	Total Exceedance (%)
1963	336	17.260	0.059	11.0	0.21
1979	453	41.430	0.092	12.3	0.24
1980	607	108.337	0.183	22.0	0.43
1993	462	21.449	0.083	16.0	0.31
1995	554	34.395	0.130	34.3	0.67
1997	322	8.052	0.040	5.3	0.10
Average	455	38.487	0.098	16.8	3.69

Table C-3B: Proposed Conditions in Reach 75A

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Erosion Hours (h)	Total Exceedance (%)
1963	336	17.203	0.061	10.8	0.21
1979	453	41.327	0.095	12.3	0.24
1980	607	108.036	0.185	22.0	0.43
1993	462	21.391	0.085	16.0	0.31
1995	554	34.332	0.132	34.8	0.68
1997	322	8.012	0.041	5.3	0.10
Average	455	38.384	0.100	16.8	3.69

(1) Based on a simulation period from April 1st to October 31st (5136 hours), and an erosion threshold of 4020 L/s.

Avg. Change in Erosion Threshold Exceedance: 0.0%

Table C-4A: Existing Conditions in Reach 73

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Erosion Hours (h)	Total Exceedance (%)
1963	336	16.932	0.063	10.5	0.20
1979	453	39.601	0.098	12.5	0.24
1980	607	107.706	0.191	21.8	0.42
1993	462	21.339	0.089	15.8	0.31
1995	554	32.980	0.137	35.0	0.68
1997	322	7.738	0.043	5.3	0.10
Average	455	37.716	0.103	16.8	3.69

Table C-4B: Proposed Conditions in Reach 73

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Erosion Hours (h)	Total Exceedance (%)
1963	336	17.024	0.077	10.8	0.21
1979	453	39.888	0.116	12.5	0.24
1980	607	110.479	0.213	22.3	0.43
1993	462	21.498	0.106	16.8	0.33
1995	554	33.371	0.156	35.8	0.70
1997	322	7.782	0.054	5.5	0.11
Average	455	38.340	0.120	17.3	3.80

(1) Based on a simulation period from April 1st to October 31st (5136 hours), and an erosion threshold of 4260 L/s.

Avg. Change in Erosion Threshold Exceedance: 3.0%

Note: Erosion thresholds as per the *Merton Tertiary Planning Study: Geomorphic Assessment Fourteen Mile Creek and Associated Tributaries - Draft Report V-5* (Parish Geomorphic, October 2013).

SIMULATED ANNUAL BANK EROSION HOURS IN FOURTEEN MILE CREEK (CONCEPTUAL STORM SERVICING OPTION A)

Table C-5A: Existing Conditions in Tributary SW-2

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Erosion Hours (h)	Total Exceedance (%)
1963	336	1.915	0.004	34.8	0.68
1979	453	6.754	0.006	36.5	0.71
1980	607	7.378	0.012	60.8	1.18
1993	462	2.123	0.005	34.0	0.66
1995	554	5.335	0.008	66.3	1.29
1997	322	0.864	0.002	17.3	0.34
Average	455	4.062	0.006	41.6	9.13

Table C-5B: Proposed Conditions in Tributary SW-2

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Erosion Hours (h)	Total Exceedance (%)
1963	336	1.767	0.005	36.3	0.71
1979	453	6.388	0.008	38.5	0.75
1980	607	6.799	0.014	63.5	1.24
1993	462	1.954	0.007	37.8	0.74
1995	554	5.097	0.010	72.0	1.40
1997	322	0.797	0.004	19.3	0.37
Average	455	3.801	0.008	44.5	9.77

(1) Based on a simulation period from April 1st to October 31st (5136 hours), and an erosion threshold of 70 L/s.

Avg. Change in Erosion Threshold Exceedance: 7.0%

Table C-6A: Existing Conditions in Reach 75A

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Erosion Hours (h)	Total Exceedance (%)
1963	336	17.260	0.059	119.8	2.33
1979	453	41.430	0.092	157.8	3.07
1980	607	108.337	0.183	200.3	3.90
1993	462	21.449	0.083	139.5	2.72
1995	554	34.395	0.130	215.0	4.19
1997	322	8.052	0.040	67.5	1.31
Average	455	38.487	0.098	150.0	32.93

Table C-6B: Proposed Conditions in Reach 75A

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Erosion Hours (h)	Total Exceedance (%)
1963	336	17.203	0.061	124.3	2.42
1979	453	41.327	0.095	166.0	3.23
1980	607	108.036	0.185	207.8	4.04
1993	462	21.391	0.085	145.3	2.83
1995	554	34.332	0.132	223.3	4.35
1997	322	8.012	0.041	69.8	1.36
Average	455	38.384	0.100	156.0	34.25

(1) Based on a simulation period from April 1st to October 31st (5136 hours), and an erosion threshold of 270 L/s.

Avg. Change in Erosion Threshold Exceedance: 4.0%

Table C-7A: Existing Conditions in Reach 73

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Erosion Hours (h)	Total Exceedance (%)
1963	336	16.932	0.063	59.8	1.16
1979	453	39.601	0.098	67.5	1.31
1980	607	107.706	0.191	99.3	1.93
1993	462	21.339	0.089	59.0	1.15
1995	554	32.980	0.137	124.0	2.41
1997	322	7.738	0.043	37.5	0.73
Average	455	37.716	0.103	74.5	16.36

Table C-7B: Proposed Conditions in Reach 73

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Erosion Hours (h)	Total Exceedance (%)
1963	336	17.024	0.077	68.8	1.34
1979	453	39.888	0.116	74.5	1.45
1980	607	110.479	0.213	112.0	2.18
1993	462	21.498	0.106	65.8	1.28
1995	554	33.371	0.156	139.5	2.72
1997	322	7.782	0.054	44.0	0.86
Average	455	38.340	0.120	84.1	18.47

(1) Based on a simulation period from April 1st to October 31st (5136 hours), and an erosion threshold of 630 L/s.

Avg. Change in Erosion Threshold Exceedance: 12.9%

Note: Erosion thresholds as per the *Merton Tertiary Planning Study: Geomorphic Assessment Fourteen Mile Creek and Associated Tributaries - Draft Report V-5* (Parish Geomorphic, October 2013).

ATTACHMENT

D

Simulated Annual Flows in Fourteen Mile Creek (Option A)

Sample Hydrographs in Fourteen Mile Creek (Option A)

JFSA Water Resources and Environmental Consultants

SIMULATED ANNUAL FLOWS IN FOURTEEN MILE CREEK (CONCEPTUAL STORM SERVICING OPTION A)

Table D-1A: Existing Conditions in Tributary SW-2

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Total Volume (1000 m^3)
1963	336	1.915	0.004	54.8
1979	453	6.754	0.006	85.3
1980	607	7.378	0.012	189.5
1993	462	2.123	0.005	76.7
1995	554	5.335	0.008	186.0
1997	322	0.864	0.002	36.1
Average	455	4.062	0.006	104.7

(1) Based on a simulation period from April 1st to October 31st.

Table D-1B: Proposed Conditions in Tributary SW-2

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Total Volume (1000 m^3)
1963	336	1.767	0.005	79.9
1979	453	6.388	0.008	118.8
1980	607	6.799	0.014	226.1
1993	462	1.954	0.007	110.6
1995	554	5.097	0.010	220.0
1997	322	0.797	0.004	59.7
Average	455	3.801	0.008	135.8

Avg. Change in Total Volume: 29.7%

Table D-2A: Existing Conditions in Reach 75A

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Total Volume (1000 m^3)
1963	336	17.260	0.059	927.6
1979	453	41.430	0.092	1380.0
1980	607	108.337	0.183	2833.2
1993	462	21.449	0.083	1267.1
1995	554	34.395	0.130	2780.0
1997	322	8.052	0.040	640.5
Average	455	38.487	0.098	1638.1

(1) Based on a simulation period from April 1st to October 31st.

Table D-2B: Proposed Conditions in Reach 75A

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Total Volume (1000 m^3)
1963	336	17.203	0.061	957.6
1979	453	41.327	0.095	1419.8
1980	607	108.036	0.185	2877.1
1993	462	21.391	0.085	1307.7
1995	554	34.332	0.132	2820.2
1997	322	8.012	0.041	669.6
Average	455	38.384	0.100	1675.3

Avg. Change in Total Volume: 2.3%

Table D-3A: Existing Conditions in Reach 73

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Total Volume (1000 m^3)
1963	336	16.932	0.063	991.9
1979	453	39.601	0.098	1471.8
1980	607	107.706	0.191	2976.0
1993	462	21.339	0.089	1356.4
1995	554	32.980	0.137	2917.1
1997	322	7.738	0.043	696.0
Average	455	37.716	0.103	1734.9

(1) Based on a simulation period from April 1st to October 31st.

Table D-3B: Proposed Conditions in Reach 73

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Total Volume (1000 m^3)
1963	336	17.024	0.077	1208.3
1979	453	39.888	0.116	1769.1
1980	607	110.479	0.213	3375.6
1993	462	21.498	0.106	1656.8
1995	554	33.371	0.156	3285.0
1997	322	7.782	0.054	898.6
Average	455	38.340	0.120	2032.2

Avg. Change in Total Volume: 17.1%

Table D-4A: Existing Conditions in West Branch at QEW

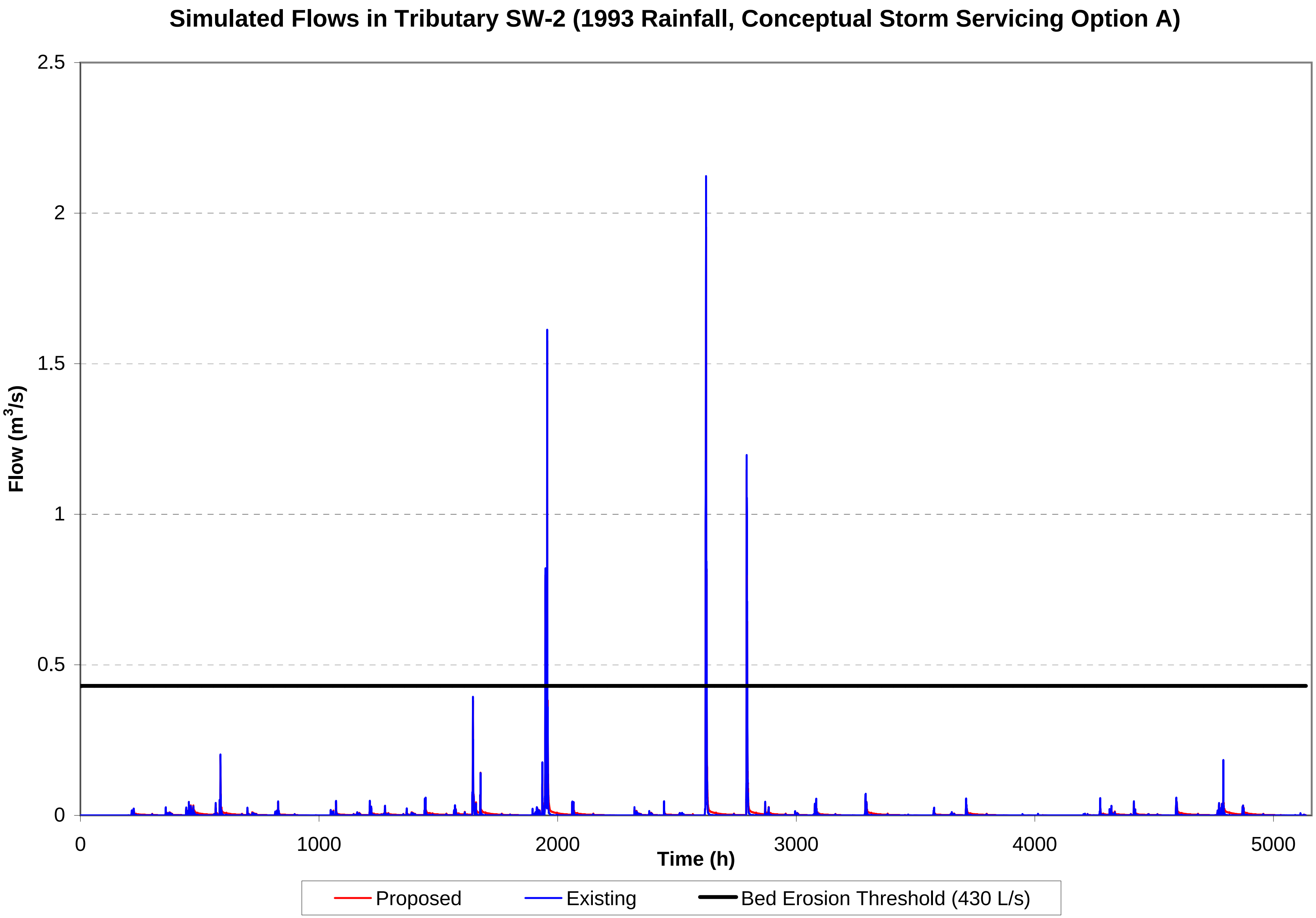
Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Total Volume (1000 m^3)
1963	336	17.190	0.070	1100.9
1979	453	39.932	0.109	1637.6
1980	607	112.231	0.214	3324.4
1993	462	21.881	0.099	1511.0
1995	554	33.287	0.152	3252.8
1997	322	7.842	0.048	773.9
Average	455	38.727	0.115	1933.4

(1) Based on a simulation period from April 1st to October 31st.

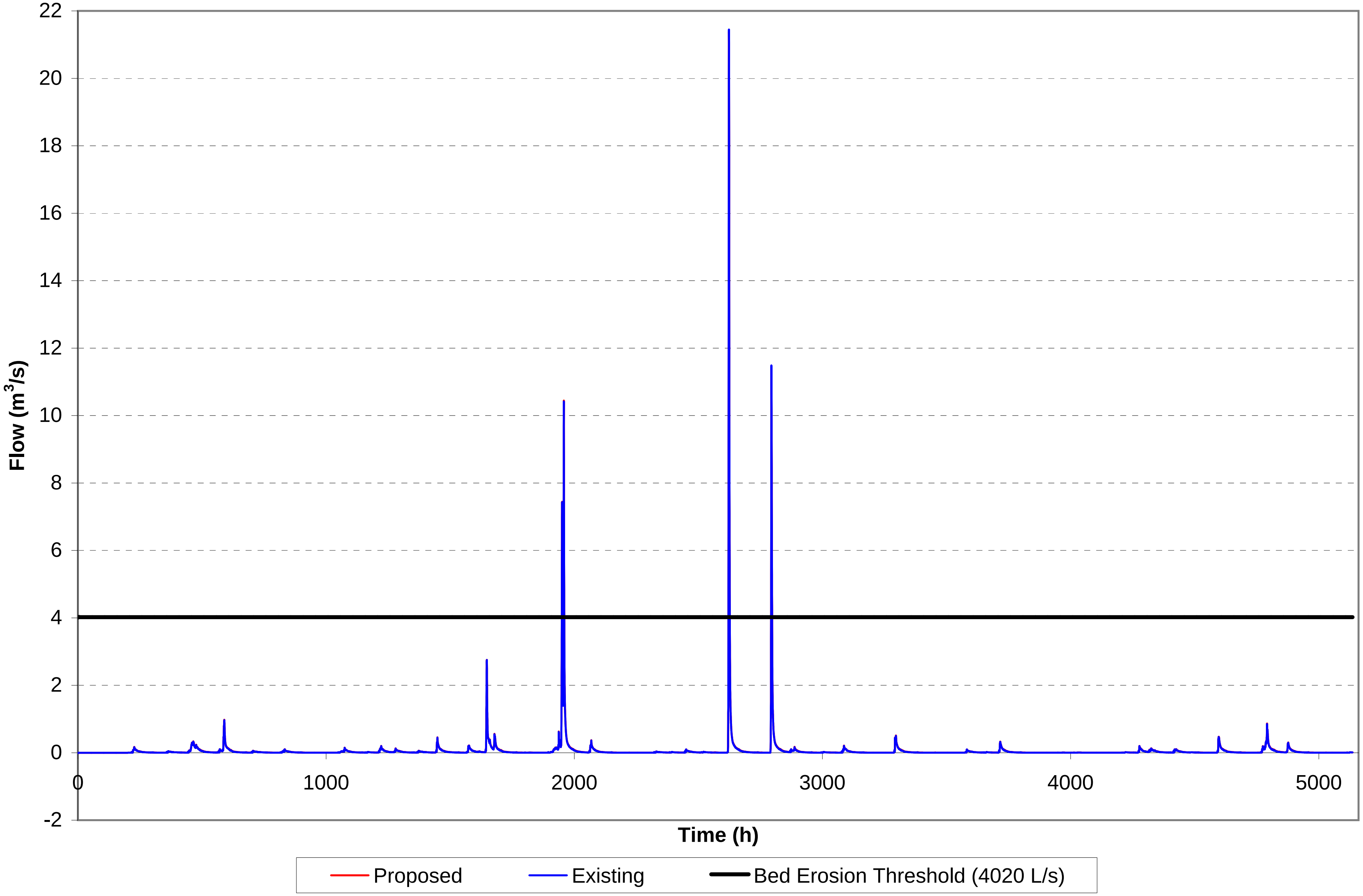
Table D-4B: Proposed Conditions in West Branch at QEW

Year (1)	Total Precipitation (mm)	Peak Flow (m^3/s)	Average Flow (m^3/s)	Total Volume (1000 m^3)
1963	336	17.107	0.082	1299.2
1979	453	39.793	0.125	1904.5
1980	607	112.763	0.231	3643.1
1993	462	21.733	0.114	1783.2
1995	554	33.263	0.168	3545.2
1997	322	7.812	0.058	964.7
Average	455	38.745	0.130	2190.0

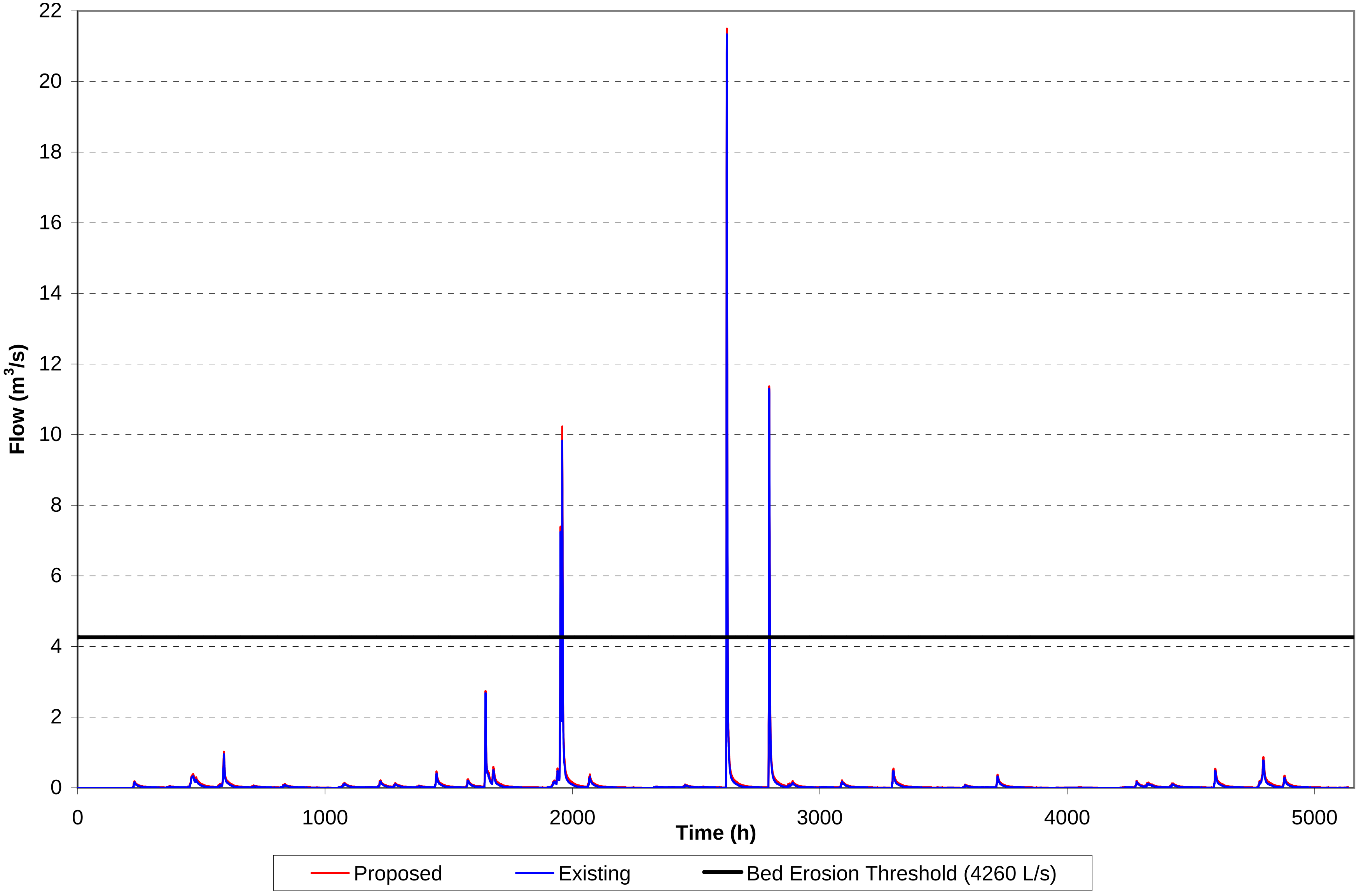
Avg. Change in Total Volume: 13.3%


Simulated Flows in Tributary SW-2 (1993 Rainfall, Conceptual Storm Servicing Option A)
Flow (m^3/s)
2.5
2
1.5
1
0.5
0
0
1000
2000
3000
4000
5000
Time (h)
Proposed
Existing
Bed Erosion Threshold (430 L/s)

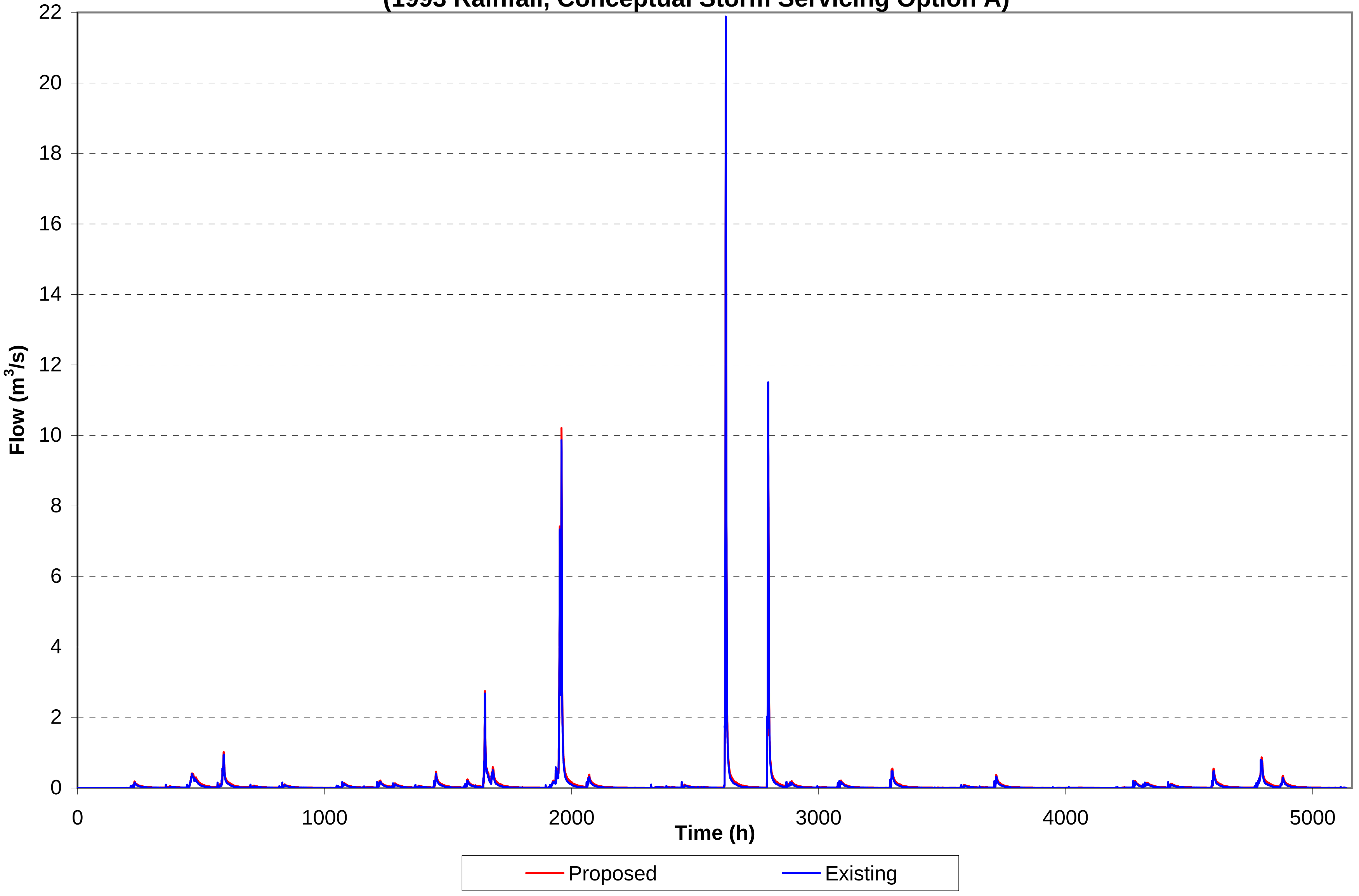
Simulated Flows in Reach 75A (1993 Rainfall, Conceptual Storm Servicing Option A)



Simulated Flows in Reach 73 (1993 Rainfall, Conceptual Storm Servicing Option A)



Simulated Flows in West Branch Upstream of Queen Elizabeth Way
(1993 Rainfall, Conceptual Storm Servicing Option A)



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April 16, 2015

David Schaeffer Engineering Ltd.
500 Alden Road, Suite 500
Markham, Ontario L3R 0E7

Attention: **Mathu Kamalakaran, P.Eng.**

Subject: **Saw-Whet Development / Preliminary Stormwater Management Pond Sizing (Fourteen Mile Creek)** *our file: 1051-12*

As requested by your office, we have evaluated, based on the provided information as described below, the minimum required volumes for the proposed stormwater management (SWM) facilities based on the quality, erosion and quantity control requirements established in the November 28, 2013 *Merton Tertiary Plan Area / Preliminary Stormwater Management Pond Sizing (Fourteen Mile Creek)* memo. Note that this memo is an update of the December 18, 2014 *Saw-Whet Development / Preliminary Stormwater Management Pond Sizing (Fourteen Mile Creek* memo. The previous version of this memo was updated in order to include detailed designs for the proposed SWM Facilities north and south of the sanitary easement.

A 72.7 ha development at 60% average imperviousness is proposed on and adjacent to the existing Saw-Whet Golf Course in the Merton Tertiary Plan Area in the Town of Oakville. Post-development drainage areas are presented in Attachment A.

Runoff from the development will be treated either locally or by the wet ponds north and south of Street A before discharging to Fourteen Mile Creek. Two treatment options were considered for the 8.8 ha site located west of Bronte Road; (i) local treatment with controlled outflows subsequently draining through the south SWM facility; or (ii) treatment in the south SWM facility. Preliminary pond sizing results are presented in Attachment B.

QUALITY CONTROL

An enhanced protection level (80% long-term suspended solids removal) according to Ministry of the Environment standards is required for all runoff from the development to Fourteen Mile Creek. Quality control may be provided locally by oil-and-grit separators for some areas of the development; however, as in the November 2013 memo, required permanent pool and active quality control volumes were estimated for all areas based on MOE wet pond standards. Active quality control volumes are contained within the erosion control volume.

EROSION CONTROL

Given that the bed and bank erosion analysis undertaken in the November 2013 memo for Fourteen Mile Creek was based on a development of between 91.4 ha and 92.8 ha at 75-79% average imperviousness, the current proposed development plan of 72.7 ha at 60% average imperviousness would produce similar or less critical erosion analysis results based on the same erosion control measures.

Therefore, as proposed in the November 2013 memo, extended detention of runoff from the 25 mm storm will be retained for 48 hours in order to meet erosion control requirements for Fourteen Mile Creek. Additionally, the 2-year unit release rate of 10 L/s/ha is reduced by half to 5 L/s/ha to provide additional erosion control in the north and south wet ponds.

QUANTITY CONTROL

Quantity control for the development is to be provided by controlling 2- to 100-year and Regional post-development outflows to the unit release rates calculated in the November 2013 memo. The 2- to 100-year and Regional pond volumes presented in Attachment B are the minimum volumes required to meet target release rates.

As above, based on the relative development size and density in comparison to the November 2013 memo, the proposed quantity control would be sufficient to maintain proposed conditions flows equal to or less than existing conditions flows in Fourteen Mile Creek at Queen Elizabeth Way for the 2- to 100-year and Regional storms. Similarly, annual average and peak flows in the creek would remain generally similar under existing and proposed conditions.

POND STAGE-STORAGE-DISCHARGE RELATIONSHIPS

Detailed stage-storage characteristics and pond outlet controls have been prepared for the proposed wet ponds to the north and south of the sanitary easement, and are presented in Attachment C. Pond operating conditions, as simulated in SWMHYMO based on the stage-storage-discharge relationships are also presented in Attachment C, along with extended detention drawdown time calculations for the north and south ponds. Note that the provided pond volumes differ somewhat from those presented in Attachment B, as they account for actual stage-storage characteristics and the limitations of real-world controls.

Yours truly,
J.F. Sabourin and Associates Inc.
L. Pipkins
Laura Pipkins, P.Eng.

LICENSED PROFESSIONAL ENGINEER
L. E. PIPKINS
100173786
PROVINCE OF ONTARIO

cc: J.F. Sabourin, M.Eng, P.Eng.
Director of Water Resources Projects

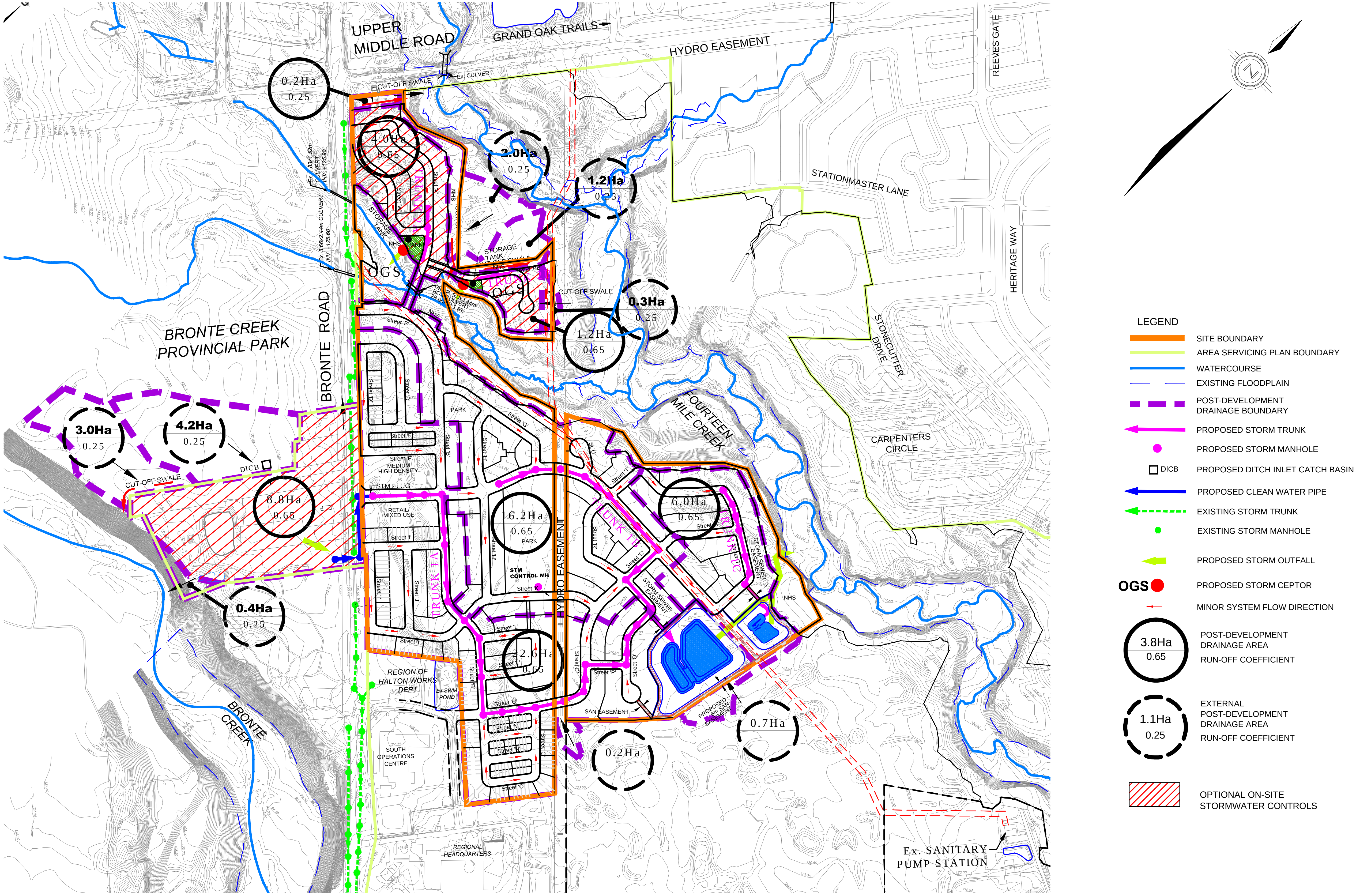
Attachment A: Post-Development Drainage Area
Attachment B: Preliminary Pond Sizing Results

ATTACHMENT

A

Post-Development Drainage Area

JFSA Water Resources and Environmental Consultants



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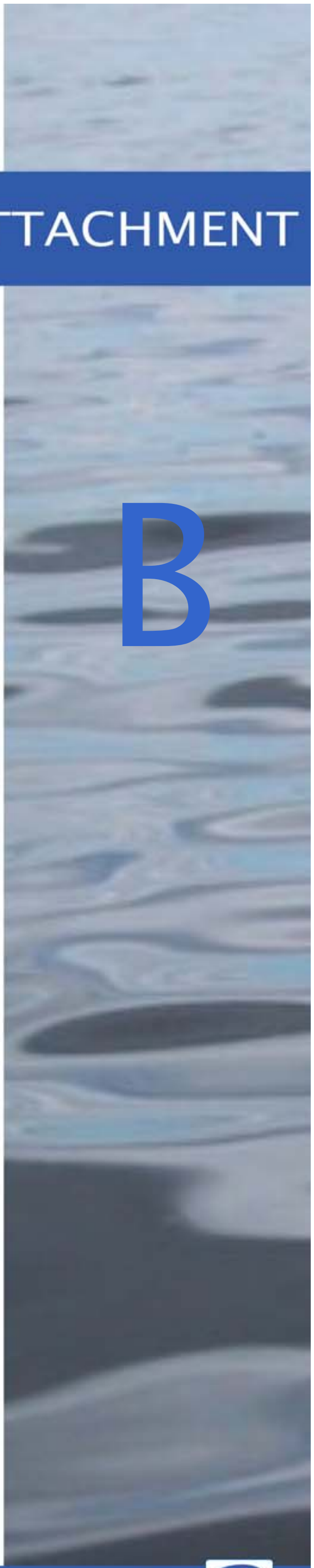
SAW-WHET GOLF COURSE

POST-DEVELOPMENT DRAINAGE AREA

DATE:	APRIL 2015
SCALE:	1:7500
PROJECT No.:	12-601
FIGURE	9



ATTACHMENT

B

Preliminary Pond Sizing Results

PRELIMINARY POND SIZING RESULTS

Table B-1: Summary of Total Proposed Drainage Area

SWM Facility Location	Area (ha)	Imperviousness (%)	Area x Imp.
North Pond (North of San. Ease.)	6.0	64	384.0
South Pond (South of San. Ease.) (1)	52.7	58	3082.1
West of Bronte Road	8.8	64	563.2
At Northwest Confluence	1.2	64	76.8
Upper Middle Road at Bronte Road	4.0	64	256.0
Total	72.7	60	4362.1

(1) Including unattenuated flows from 8.8 ha west of Bronte Road.

Table B-2A: Allowable Release Rates and Required Volumes for Proposed SWM Facilities

Pond Component	Unit Release Rate (4)	North Pond (North of San. Ease.) (6 ha)		South Pond (South of San. Ease.) (52.7 ha)		West of Bronte Road (8.8 ha)	
		Target Release Rate (5)	Required Storage	Target Release Rate (5)	Required Storage	Target Release Rate	Required Storage
	($m^3/s/ha$)	(m^3/s)	(m^3)	(m^3/s)	(m^3)	(m^3/s)	(m^3)
Permanent Pool (1)	N/A	N/A	1026	N/A	8274	N/A	1505
Quality Control (1)	N/A	N/A	240	N/A	2108	N/A	352
Ext. Detention (2)	N/A	0.0051	881	0.0410	7080	0.0075	1292
2yr/24hr Chicago (3)	0.005	0.013	1429	0.118	11590	0.044	1938
5yr/24hr Chicago	0.017	0.053	1831	0.464	15110	0.150	2489
10yr/24hr Chicago	0.022	0.076	2148	0.670	17780	0.194	2923
25yr/24hr Chicago	0.028	0.112	2578	0.988	21420	0.246	3541
50yr/24hr Chicago	0.033	0.148	2857	1.301	23770	0.290	3961
100yr/24hr Chicago	0.037	0.186	3138	1.630	26180	0.326	4398
Regional	0.085	0.426	5166	3.744	41740	0.748	6167

(1) Quality control and permanent pool requirements based on MOE guidelines for enhanced quality control for wet ponds;

(2) Extended detention based on the runoff from the 25 mm design storm with a drawdown time of 48 hours.

(3) 2-year unit release rate of 10 L/s/ha reduced by half to 5 L/s/ha to provide additional erosion control.

(4) Unit release rates on 14 Mile Creek at Lakeshore, as per "*Fourteen Mile Creek / McCarney Creek Flood Management Alternative Assessment* " (AMEC, July 17, 2013).

(5) Target release rates reduced by a factor of $0.4[\text{Return Period}]^{0.16}$ (where Regional = 100) to match existing conditions flows upstream of Queen Elizabeth Way, as simulated using AMEC's July 17, 2013 PCSWMM model.

PRELIMINARY POND SIZING RESULTS

Table B-2B: Allowable Release Rates and Required Volumes for Proposed SWM Facilities

Pond Component	Unit Release Rate [4] ($m^3/s/ha$)	At Northwest Confluence (1.2 ha)		Upper Middle Road at Bronte Road (4 ha)	
		Target Release Rate (m^3/s)	Required Storage (m^3)	Target Release Rate (m^3/s)	Required Storage (m^3)
Permanent Pool (1)	N/A	N/A	205	N/A	684
Quality Control (1)	N/A	N/A	48	N/A	160
Ext. Detention (2)	N/A	0.0010	176	0.0034	587
2yr/24hr Chicago (3)	0.005	0.006	266	0.020	881
5yr/24hr Chicago	0.017	0.020	342	0.068	1136
10yr/24hr Chicago	0.022	0.026	403	0.088	1335
25yr/24hr Chicago	0.028	0.034	488	0.112	1618
50yr/24hr Chicago	0.033	0.040	546	0.132	1809
100yr/24hr Chicago	0.037	0.044	606	0.148	2008
Regional	0.085	0.102	857	0.340	2826

(1) Quality control and permanent pool requirements based on MOE guidelines for enhanced quality control for wet ponds;

(2) Extended detention based on the runoff from the 25 mm design storm with a drawdown time of 48 hours.

(3) 2-year unit release rate of 10 L/s/ha reduced by half to 5 L/s/ha to provide additional erosion control.

(4) Unit release rates on 14 Mile Creek at Lakeshore, as per "*Fourteen Mile Creek / McCarney Creek Flood Management Alternative Assessment* " (AMEC, July 17, 2013).

ATTACHMENT

C

Detailed North and South Pond Designs

JFSA Water Resources and Environmental Consultants

PRELIMINARY POND SIZING RESULTS

Table C-1: Summary of Total Proposed Drainage Area

SWM Facility Location	Area (ha)	Imperviousness (%)	Area x Imp.	Required Volumes (1) (2) (m^3)		
				Permanent Pool	Quality Control	Ext. Detention
North Pond (North of San. Easement)	6.0	64	384.0	1026	240	881
South Pond (South of San. Easement) (3)	52.7	58	3082.1	8274	2108	7080
Total	58.7	59	3466.1	9299.9	2348.0	7961.0

(1) Quality control and permanent pool requirements based on MOE guidelines for enhanced quality control for wet ponds;

(2) Extended detention based on the runoff from the 25 mm design storm with a drawdown time of 48 hours.

(3) Including unattenuated flows from 8.8 ha west of Bronte Road.

Table C-2: Preliminary Operating Characteristics for Proposed SWM Facilities

Pond Component	Unit Release Rate (4) (m^3/s/ha)	North Pond (North of San. Easement) (6 ha)			South Pond (South of San. Easement) (52.7 ha)		
		Target Release Rate (5) (m^3/s)	Provided Release Rate (m^3/s)	Storage Used (m^3)	Target Release Rate (5) (m^3/s)	Provided Release Rate (m^3/s)	Storage Used (m^3)
Permanent Pool (1)	N/A	N/A	N/A	1231	N/A	N/A	11099
Quality Control (1)	N/A	N/A	0.005	240	N/A	0.032	2108
Ext. Detention (2)	N/A	N/A	0.014	1464	N/A	0.073	7545
2yr/24hr Chicago (3)	0.005	0.013	0.013	1387	0.118	0.102	11550
5yr/24hr Chicago	0.017	0.053	0.044	1827	0.464	0.394	15280
10yr/24hr Chicago	0.022	0.076	0.069	2138	0.670	0.646	17800
25yr/24hr Chicago	0.028	0.112	0.095	2579	0.988	0.984	21340
50yr/24hr Chicago	0.033	0.148	0.108	2891	1.301	1.209	23780
100yr/24hr Chicago	0.037	0.186	0.120	3217	1.630	1.431	26350
Regional	0.085	0.426	0.414	5667	3.744	3.621	43580

(1) Quality control and permanent pool requirements based on MOE guidelines for enhanced quality control for wet ponds;

(2) Extended detention based on the runoff from the 25 mm design storm with a drawdown time of 48 hours.

(3) 2-year unit release rate of 10 L/s/ha reduced by half to 5 L/s/ha to provide additional erosion control.

(4) Unit release rates on 14 Mile Creek at Lakeshore, as per "*Fourteen Mile Creek / McCarney Creek Flood Management Alternative Assessment*" (AMEC, July 17, 2013).

(5) Target release rates reduced by a factor of 0.4[Return Period]$^{0.16}$ (where Regional = 100) to match existing conditions flows upstream of Queen Elizabeth Way, as simulated using AMEC's July 17, 2013 PCSWMM model.

Table C-3A: Extended Detention Parameters for North SWM Facility

Permanent Pool Parameters			Quality Orifice Parameters		
Area (C3)	1367.62	m^2	Diameter	0.085	m
Volume	1231.01	m^3			
PP Elev	121.200	m	Area	0.006	m^2
QC Elev	121.363	m	Invert	121.200	m
h (m)	0.163	m	C_o	0.62	

Notes:
- C3 is the intercept from the area-depth linear regression.
- PP Elev indicates the elevation of the permanent pool.
- QC Elev indicates the elevation of the storage volume required by MOE for quality control.
- h is the maximum water elevation above the orifice (m).

Table C-3B: Extended Detention Drawdown Time for North SWM Facility

Elev. (m)	Active Storage			C2	Drawdown Time	Drawdown Time	Flow	Demarkation
	V (m^3)	A (m^2)	depth (m)	(m²/m)	(h)	(days)	(m^3/s)	Point
121.20	**0.00**	**1367.62**	**0.00**				**0.000**	**PP Elev**
121.25	68.59	1371.23	0.05	72	10.90	0.45	0.002	
121.30	142.12	1470.79	0.10	1032	15.78	0.66	0.004	
121.35	220.50	1585.55	0.15	1453	19.85	0.83	0.005	
121.363	**240.00**	**1611.91**	**0.16**	**1502**	**20.79**	**0.87**	**0.005**	**QC Elev**
121.40	297.83	1690.05	0.20	1612	23.47	0.98	0.006	
121.45	382.38	1690.05	0.25	1290	26.24	1.09	0.007	
121.50	468.45	1722.64	0.30	1183	28.95	1.21	0.008	
121.55	558.32	1801.49	0.35	1240	31.82	1.33	0.009	
121.60	649.52	1843.10	0.40	1189	34.33	1.43	0.009	
121.65	743.95	1895.63	0.45	1173	36.82	1.53	0.010	
121.70	839.80	1942.09	0.50	1148.93	39.20	1.63	0.011	
121.75	937.94	1982.46	0.55	1118	41.47	1.73	0.011	
121.80	1038.07	2026.35	0.60	1098	43.71	1.82	0.012	
121.85	1140.48	2071.86	0.65	1083	45.92	1.91	0.012	
121.90	1246.40	2120.59	0.70	1076	48.14	2.01	0.013	
121.95	1353.75	2168.95	0.75	1068	50.32	2.10	0.013	
122.00	**1463.86**	**2212.93**	**0.80**	**1057**	**52.43**	**2.18**	**0.014**	**Ext. Det.**
122.05	1575.10	2260.62	0.85	1051	54.56	2.27	0.024	
122.10	1689.77	2310.31	0.90	1047	56.70	2.36	0.033	
122.15	1807.19	2359.80	0.95	1044	58.82	2.45	0.043	
122.20	1926.32	2408.92	1.00	1041	60.92	2.54	0.053	
122.25	2044.31	2449.77	1.05	1031	62.92	2.62	0.063	
122.30	2168.76	2502.78	1.10	1032	65.05	2.71	0.072	
122.35	2294.82	2549.14	1.15	1027	67.10	2.80	0.080	
122.40	2424.97	2610.51	1.20	1036	69.33	2.89	0.087	
122.45	2563.48	2673.11	1.25	1044	71.58	2.98	0.094	
122.50	2698.86	2726.12	1.30	1045	73.71	3.07	0.100	
122.55	2836.99	2773.43	1.35	1041	75.76	3.16	0.106	
122.60	2958.87	2816.18	1.40	1035	77.75	3.24	0.111	
122.65	3101.66	2870.62	1.45	1037	79.89	3.33	0.116	
122.70	3246.53	2933.32	1.50	1044	82.16	3.42	0.121	

Notes:
- C2 is the slope coefficient from the area-depth linear regression.
- PP Elev indicates the elevation of the permanent pool.
- QC Elev indicates the elevation of the storage volume required by MOE for quality control.
- Ext Det indicates the elevation of extended detention provided based on a drawdown time of 48 hours.

Table C-4: Stage-Storage-Outflow Curve for North SWM Facility

			Quality Control 1		Quantity Control 1		Quantity Control 2		Emergency Spillway			
			Vertical Orifice		Vertical Orifice		Vertical Orifice		Broad Crested Weir			
			Dia (m)	0.085	Dia (m)	0.250	Dia (m)	0.400	L (m)	12.000		
			Area (m^2)	0.006	Area (m^2)	0.049	Area (m^2)	0.126				
			Invert (m)	121.20	Invert (m)	122.00	Invert (m)	122.75	C_w	1.580		
			C_o	0.62	C_o	0.62	C_o	0.62	Invert (m)	123.50		
			Q @ D	0.003	Q @ D	0.048	Q @ D	0.154	n contr.	0		
Elevation (m)	Active Sto. (m^3)	Demarkation Points	Head (m)	Outflow (m^3/s)	Head (m)	Outflow (m^3/s)	Head (m)	Outflow (m^3/s)	Head (m)	Outflow (m^3/s)	Outflow (m^3/s)	Storage (ha·m)
121.20	**0**	**PP Elev**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
121.25	69		0.050	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.007
121.30	142		0.100	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.014
121.35	220		0.150	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.022
121.363	**240**	**QC Elev**	**0.163**	**0.005**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.005**	**0.024**
121.40	298		0.200	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.030
121.45	382		0.250	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.038
121.50	468		0.300	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.047
121.55	558		0.350	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.056
121.60	650		0.400	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.065
121.65	744		0.450	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.074
121.70	840		0.500	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.011	0.084
121.75	938		0.550	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.011	0.094
121.80	1038		0.600	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.012	0.104
121.85	1140		0.650	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.012	0.114
121.90	1246		0.700	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.125
121.95	1354		0.750	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.135
122.00	**1464**	**Ext. Det.**	**0.800**	**0.014**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.014**	**0.146**
122.05	1575		0.850	0.014	0.050	0.010	0.000	0.000	0.000	0.000	0.024	0.158
122.10	1690		0.900	0.014	0.100	0.019	0.000	0.000	0.000	0.000	0.033	0.169
122.15	1807		0.950	0.015	0.150	0.029	0.000	0.000	0.000	0.000	0.043	0.181
122.20	1926		1.000	0.015	0.200	0.038	0.000	0.000	0.000	0.000	0.053	0.193
122.25	2044		1.050	0.016	0.250	0.048	0.000	0.000	0.000	0.000	0.063	0.204
122.30	2169		1.100	0.016	0.300	0.056	0.000	0.000	0.000	0.000	0.072	0.217
122.35	2295		1.150	0.016	0.350	0.064	0.000	0.000	0.000	0.000	0.080	0.229
122.40	2425		1.200	0.017	0.400	0.071	0.000	0.000	0.000	0.000	0.087	0.242
122.45	2563		1.250	0.017	0.450	0.077	0.000	0.000	0.000	0.000	0.094	0.256
122.50	2699		1.300	0.017	0.500	0.083	0.000	0.000	0.000	0.000	0.100	0.270
122.55	2837		1.350	0.018	0.550	0.088	0.000	0.000	0.000	0.000	0.106	0.284
122.60	2959		1.400	0.018	0.600	0.093	0.000	0.000	0.000	0.000	0.111	0.296
122.65	3102		1.450	0.018	0.650	0.098	0.000	0.000	0.000	0.000	0.116	0.310
122.70	3247		1.500	0.019	0.700	0.102	0.000	0.000	0.000	0.000	0.121	0.325
122.75	**3395**		**1.550**	**0.019**	**0.750**	**0.107**	**0.000**	**0.000**	**0.000**	**0.000**	**0.126**	**0.340**

Table C-4: Stage-Storage-Outflow Curve for North SWM Facility

			Quality Control 1		Quantity Control 1		Quantity Control 2		Emergency Spillway			
			Vertical Orifice		Vertical Orifice		Vertical Orifice		Broad Crested Weir			
			Dia (m)	0.085	Dia (m)	0.250	Dia (m)	0.400	L (m)	12.000		
			Area (m^2)	0.006	Area (m^2)	0.049	Area (m^2)	0.126				
			Invert (m)	121.20	Invert (m)	122.00	Invert (m)	122.75	C_w	1.580		
			C_o	0.62	C_o	0.62	C_o	0.62	Invert (m)	123.50		
			Q @ D	0.003	Q @ D	0.048	Q @ D	0.154	n contr.	0		
Elevation (m)	Active Sto. (m^3)	Demarkation Points	Head (m)	Outflow (m^3/s)	Head (m)	Outflow (m^3/s)	Head (m)	Outflow (m^3/s)	Head (m)	Outflow (m^3/s)	Outflow (m^3/s)	Storage (ha·m)
122.80	3546		1.600	0.019	0.800	0.111	0.050	0.019	0.000	0.000	0.149	0.355
122.85	3701		1.650	0.020	0.850	0.115	0.100	0.039	0.000	0.000	0.173	0.370
122.90	3859		1.700	0.020	0.900	0.119	0.150	0.058	0.000	0.000	0.197	0.386
122.95	4015		1.750	0.020	0.950	0.122	0.200	0.077	0.000	0.000	0.220	0.401
123.00	4170		1.800	0.021	1.000	0.126	0.250	0.096	0.000	0.000	0.243	0.417
123.05	4333		1.850	0.021	1.050	0.130	0.300	0.116	0.000	0.000	0.266	0.433
123.10	4501		1.900	0.021	1.100	0.133	0.350	0.135	0.000	0.000	0.289	0.450
123.15	4671		1.950	0.022	1.150	0.136	0.400	0.154	0.000	0.000	0.312	0.467
123.20	4847		2.000	0.022	1.200	0.140	0.450	0.173	0.000	0.000	0.334	0.485
123.25	5023		2.050	0.022	1.250	0.143	0.500	0.189	0.000	0.000	0.354	0.502
123.30	5202		2.100	0.022	1.300	0.146	0.550	0.204	0.000	0.000	0.373	0.520
123.35	5382		2.150	0.023	1.350	0.149	0.600	0.218	0.000	0.000	0.390	0.538
123.40	5567		2.200	0.023	1.400	0.152	0.650	0.232	0.000	0.000	0.407	0.557
123.45	5756		2.250	0.023	1.450	0.155	0.700	0.244	0.000	0.000	0.422	0.576
123.50	**5947**	**Ovf Elev**	**2.300**	**0.023**	**1.500**	**0.158**	**0.750**	**0.256**	**0.000**	**0.000**	**0.437**	**0.595**
123.55	6161		2.350	0.024	1.550	0.161	0.800	0.267	0.050	0.212	0.664	0.616
123.60	6553		2.400	0.024	1.600	0.164	0.850	0.278	0.100	0.600	1.065	0.655
123.65	6607		2.450	0.024	1.650	0.166	0.900	0.289	0.150	1.101	1.581	0.661
123.70	6818		2.500	0.024	1.700	0.169	0.950	0.299	0.200	1.696	2.188	0.682
123.75	7029		2.550	0.025	1.750	0.172	1.000	0.309	0.250	2.370	2.875	0.703
123.80	7246		2.600	0.025	1.800	0.174	1.050	0.318	0.300	3.115	3.633	0.725
123.85	7466		2.650	0.025	1.850	0.177	1.100	0.327	0.350	3.926	4.456	0.747
123.90	7690		2.700	0.025	1.900	0.180	1.150	0.336	0.400	4.797	5.338	0.769
123.95	7912		2.750	0.026	1.950	0.182	1.200	0.345	0.450	5.723	6.276	0.791
124.00	8142		2.800	0.026	2.000	0.185	1.250	0.354	0.500	6.703	7.267	0.814
124.05	8381		2.850	0.026	2.050	0.187	1.300	0.362	0.550	7.734	8.309	0.838
124.10	**8653**	**Top of Berm**	**2.900**	**0.026**	**2.100**	**0.189**	**1.350**	**0.370**	**0.600**	**8.812**	**9.398**	**0.865**

Notes :
- PP Elev indicates the elevation of the permanent pool.
- QC Elev indicates the elevation of the storage volume required by MOE for quality control.
- Ext Det indicates the elevation of extended detention provided.
- Ovf Elev indicates the elevation of the emergency overflow provided above the Regional water level.
- Top of Berm indicates the elevation at the top of the berm.

Table C-5A: Extended Detention Parameters for South SWM Facility

Permanent Pool Parameters			Quality Orifice Parameters		
Area (C3)	9438.54	m^2	Diameter	0.210	m
Volume	11099.04	m^3			
PP Elev	120.100	m	Area	0.035	m^2
QC Elev	120.315	m	Invert	120.100	m
h (m)	0.215	m	C_o	0.62	

Notes:
- C3 is the intercept from the area-depth linear regression.
- PP Elev indicates the elevation of the permanent pool.
- QC Elev indicates the elevation of the storage volume required by MOE for quality control.
- h is the maximum water elevation above the orifice (m).

Table C-5B: Extended Detention Drawdown Time for South SWM Facility

Elev.	Active Storage			C2	Drawdown Time	Drawdown Time	Flow	Demarkation
(m)	V (m^3)	A (m^2)	depth (m)	(m²/m)	(h)	(days)	(m^3/s)	Point
120.10	**0.00**	**9438.54**	**0.00**				**0.000**	**PP Elev**
120.15	471.96	9443.38	0.05	97	12.31	0.51	0.007	
120.20	957.13	9706.34	0.10	2678	17.57	0.73	0.015	
120.25	1454.64	10007.11	0.15	3790	21.75	0.91	0.022	
120.30	1950.64	10273.11	0.20	4173	25.34	1.06	0.029	
120.315	**2108.00**	**10275.06**	**0.22**	**3885**	**26.29**	**1.10**	**0.032**	**QC Elev**
120.35	2464.49	10279.48	0.25	3364	28.34	1.18	0.036	
120.40	2990.51	10528.38	0.30	3633	31.30	1.30	0.042	
120.45	3530.58	10839.88	0.35	4004	34.16	1.42	0.047	
120.50	4079.30	11088.97	0.40	4126	36.83	1.53	0.052	
120.55	4636.86	11300.63	0.45	4138	39.33	1.64	0.056	
120.60	5202.49	11452.35	0.50	4027.62	41.67	1.74	0.060	
120.65	5780.18	11539.94	0.55	3821	43.83	1.83	0.063	
120.70	6363.39	11681.30	0.60	3738	45.99	1.92	0.067	
120.75	6951.72	11800.52	0.65	3634	48.05	2.00	0.070	
120.80	**7544.52**	**11918.13**	**0.70**	**3542**	**50.05**	**2.09**	**0.073**	**Ext. Det.**
120.85	8143.40	12028.52	0.75	3453	51.99	2.17	0.079	
120.90	8750.83	12143.76	0.80	3382	53.90	2.25	0.084	
120.95	9363.49	12258.23	0.85	3317	55.76	2.32	0.089	
121.00	9982.32	12381.45	0.90	3270	57.60	2.40	0.093	
121.05	10603.71	12524.61	0.95	3248	59.45	2.48	0.097	
121.10	11231.38	12607.45	1.00	3169	61.15	2.55	0.101	
121.15	11864.27	12693.43	1.05	3100	62.83	2.62	0.104	
121.20	12508.18	12834.50	1.10	3087	64.59	2.69	0.108	
121.25	13156.65	12955.15	1.15	3058	66.30	2.76	0.176	
121.30	13812.72	13074.09	1.20	3030	67.97	2.83	0.244	
121.35	14469.64	13198.92	1.25	3008	69.64	2.90	0.312	
121.40	15142.15	13317.58	1.30	2984	71.28	2.97	0.380	
121.45	15810.38	13432.62	1.35	2959	72.90	3.04	0.448	
121.50	16493.90	13556.79	1.40	2942	74.52	3.10	0.516	
121.55	17171.73	13708.60	1.45	2945	76.19	3.17	0.584	
121.60	17864.09	13799.51	1.50	2907	77.70	3.24	0.652	

Notes:
- C2 is the slope coefficient from the area-depth linear regression.
- PP Elev indicates the elevation of the permanent pool.
- QC Elev indicates the elevation of the storage volume required by MOE for quality control.
- Ext Det indicates the elevation of extended detention provided based on a drawdown time of 48 hours.

Table C-6: Stage-Storage-Outflow Curve for South SWM Facility

			Quality Control 1		Quantity Control 1		Quantity Control 2		Quantity Control 3		Emergency Spillway			
			Vertical Orifice		Vertical Orifice		Vertical Orifice		Broad Crested Weir		Broad Crested Weir			
			Dia (m)	0.210	Dia (m)	0.100	Dia (m)	0.900	L (m)	1.000	L (m)	12.000		
			Area (m^2)	0.035	Area (m^2)	0.008	Area (m^2)	0.636						
			Invert (m)	120.10	Invert (m)	120.80	Invert (m)	121.20	C_w	1.580	C_w	1.580		
			C_o	0.62	C_o	0.62	C_o	0.62	Invert (m)	122.25	Invert (m)	123.55		
			Q @ D	0.031	Q @ D	0.005	Q @ D	1.172	n contr.	2	n contr.	0		
Elevation (m)	Active Sto. (m^3)	Demarkation Points	Head (m)	Outflow (m^3/s)	Head (m)	Outflow (m^3/s)	Head (m)	Outflow (m^3/s)	Head (m)	Outflow (m^3/s)	Head (m)	Outflow (m^3/s)	Outflow (m^3/s)	Storage (ha·m)
120.10	**0**	**PP Elev**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
120.15	472		0.050	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.047
120.20	957		0.100	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.015	0.096
120.25	1455		0.150	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.022	0.145
120.30	1951		0.200	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.029	0.195
120.315	**2108**	**QC Elev**	**0.215**	**0.032**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.032**	**0.211**
120.35	2464		0.250	0.036	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.036	0.246
120.40	2991		0.300	0.042	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.042	0.299
120.45	3531		0.350	0.047	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.047	0.353
120.50	4079		0.400	0.052	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.052	0.408
120.55	4637		0.450	0.056	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.056	0.464
120.60	5202		0.500	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.060	0.520
120.65	5780		0.550	0.063	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.063	0.578
120.70	6363		0.600	0.067	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.067	0.636
120.75	6952		0.650	0.070	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.070	0.695
120.80	**7545**	**Ext. Det.**	**0.700**	**0.073**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.073**	**0.754**
120.85	8143		0.750	0.076	0.050	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.079	0.814
120.90	8751		0.800	0.079	0.100	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.084	0.875
120.95	9363		0.850	0.082	0.150	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.089	0.936
121.00	9982		0.900	0.085	0.200	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.093	0.998
121.05	10604		0.950	0.087	0.250	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.097	1.060
121.10	11231		1.000	0.090	0.300	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.101	1.123
121.15	11864		1.050	0.092	0.350	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.104	1.186
121.20	**12508**		**1.100**	**0.095**	**0.400**	**0.013**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.108**	**1.251**
121.25	13157		1.150	0.097	0.450	0.014	0.050	0.065	0.000	0.000	0.000	0.000	0.176	1.316
121.30	13813		1.200	0.100	0.500	0.014	0.100	0.130	0.000	0.000	0.000	0.000	0.244	1.381
121.35	14470		1.250	0.102	0.550	0.015	0.150	0.195	0.000	0.000	0.000	0.000	0.312	1.447
121.40	15142		1.300	0.104	0.600	0.016	0.200	0.260	0.000	0.000	0.000	0.000	0.380	1.514
121.45	15810		1.350	0.106	0.650	0.017	0.250	0.326	0.000	0.000	0.000	0.000	0.448	1.581
121.50	16494		1.400	0.108	0.700	0.017	0.300	0.391	0.000	0.000	0.000	0.000	0.516	1.649
121.55	17172		1.450	0.110	0.750	0.018	0.350	0.456	0.000	0.000	0.000	0.000	0.584	1.717
121.60	17864		1.500	0.112	0.800	0.019	0.400	0.521	0.000	0.000	0.000	0.000	0.652	1.786
121.65	18552		1.550	0.114	0.850	0.019	0.450	0.586	0.000	0.000	0.000	0.000	0.720	1.855

Table C-6: Stage-Storage-Outflow Curve for South SWM Facility

			Quality Control 1		Quantity Control 1		Quantity Control 2		Quantity Control 3		Emergency Spillway			
			Vertical Orifice		Vertical Orifice		Vertical Orifice		Broad Crested Weir		Broad Crested Weir			
			Dia (m)	0.210	Dia (m)	0.100	Dia (m)	0.900	L (m)	1.000	L (m)	12.000		
			Area (m^2)	0.035	Area (m^2)	0.008	Area (m^2)	0.636						
			Invert (m)	120.10	Invert (m)	120.80	Invert (m)	121.20	C_w	1.580	C_w	1.580		
			C_o	0.62	C_o	0.62	C_o	0.62	Invert (m)	122.25	Invert (m)	123.55		
			Q @ D	0.031	Q @ D	0.005	Q @ D	1.172	n contr.	2	n contr.	0		
Elevation (m)	Active Sto. (m^3)	Demarkation Points	Head (m)	Outflow (m^3/s)	Head (m)	Outflow (m^3/s)	Head (m)	Outflow (m^3/s)	Head (m)	Outflow (m^3/s)	Head (m)	Outflow (m^3/s)	Outflow (m^3/s)	Storage (ha·m)
121.70	19265		1.600	0.116	0.900	0.020	0.500	0.651	0.000	0.000	0.000	0.000	0.787	1.926
121.75	19954		1.650	0.118	0.950	0.020	0.550	0.716	0.000	0.000	0.000	0.000	0.855	1.995
121.80	20671		1.700	0.120	1.000	0.021	0.600	0.781	0.000	0.000	0.000	0.000	0.922	2.067
121.85	21383		1.750	0.122	1.050	0.022	0.650	0.846	0.000	0.000	0.000	0.000	0.990	2.138
121.90	22111		1.800	0.124	1.100	0.022	0.700	0.912	0.000	0.000	0.000	0.000	1.057	2.211
121.95	22846		1.850	0.126	1.150	0.023	0.750	0.977	0.000	0.000	0.000	0.000	1.125	2.285
122.00	23582		1.900	0.127	1.200	0.023	0.800	1.042	0.000	0.000	0.000	0.000	1.192	2.358
122.05	24292		1.950	0.129	1.250	0.024	0.850	1.107	0.000	0.000	0.000	0.000	1.260	2.429
122.10	25041		2.000	0.131	1.300	0.024	0.900	1.172	0.000	0.000	0.000	0.000	1.327	2.504
122.15	25784		2.050	0.133	1.350	0.025	0.950	1.235	0.000	0.000	0.000	0.000	1.393	2.578
122.20	26547		2.100	0.134	1.400	0.025	1.000	1.296	0.000	0.000	0.000	0.000	1.455	2.655
122.25	**27318**		**2.150**	**0.136**	**1.450**	**0.026**	**1.050**	**1.353**	**0.000**	**0.000**	**0.000**	**0.000**	**1.515**	**2.732**
122.30	28097		2.200	0.138	1.500	0.026	1.100	1.409	0.050	0.017	0.000	0.000	1.590	2.810
122.35	28882		2.250	0.139	1.550	0.026	1.150	1.462	0.100	0.049	0.000	0.000	1.676	2.888
122.40	29672		2.300	0.141	1.600	0.027	1.200	1.513	0.150	0.089	0.000	0.000	1.770	2.967
122.45	30446		2.350	0.143	1.650	0.027	1.250	1.563	0.200	0.136	0.000	0.000	1.868	3.045
122.50	31234		2.400	0.144	1.700	0.028	1.300	1.611	0.250	0.188	0.000	0.000	1.970	3.123
122.55	32030		2.450	0.146	1.750	0.028	1.350	1.657	0.300	0.244	0.000	0.000	2.075	3.203
122.60	32838		2.500	0.147	1.800	0.029	1.400	1.703	0.350	0.304	0.000	0.000	2.183	3.284
122.65	33658		2.550	0.149	1.850	0.029	1.450	1.747	0.400	0.368	0.000	0.000	2.292	3.366
122.70	34483		2.600	0.150	1.900	0.029	1.500	1.790	0.450	0.434	0.000	0.000	2.404	3.448
122.75	35314		2.650	0.152	1.950	0.030	1.550	1.832	0.500	0.503	0.000	0.000	2.517	3.531
122.80	36150		2.700	0.153	2.000	0.030	1.600	1.874	0.550	0.574	0.000	0.000	2.630	3.615
122.85	36993		2.750	0.155	2.050	0.031	1.650	1.914	0.600	0.646	0.000	0.000	2.745	3.699
122.90	37842		2.800	0.156	2.100	0.031	1.700	1.953	0.650	0.720	0.000	0.000	2.861	3.784
122.95	38727		2.850	0.158	2.150	0.031	1.750	1.992	0.700	0.796	0.000	0.000	2.977	3.873
123.00	39591		2.900	0.159	2.200	0.032	1.800	2.030	0.750	0.872	0.000	0.000	3.093	3.959
123.05	40462		2.950	0.160	2.250	0.032	1.850	2.067	0.800	0.950	0.000	0.000	3.209	4.046
123.10	41285		3.000	0.162	2.300	0.032	1.900	2.104	0.850	1.028	0.000	0.000	3.326	4.129
123.15	42165		3.050	0.163	2.350	0.033	1.950	2.140	0.900	1.106	0.000	0.000	3.442	4.217
123.20	43051		3.100	0.165	2.400	0.033	2.000	2.175	0.950	1.185	0.000	0.000	3.558	4.305
123.25	43945		3.150	0.166	2.450	0.033	2.050	2.210	1.000	1.264	0.000	0.000	3.673	4.394
123.30	44845		3.200	0.167	2.500	0.034	2.100	2.244	1.050	1.343	0.000	0.000	3.788	4.484

Table C-6: Stage-Storage-Outflow Curve for South SWM Facility

			Quality Control 1		Quantity Control 1		Quantity Control 2		Quantity Control 3		Emergency Spillway			
			Vertical Orifice		Vertical Orifice		Vertical Orifice		Broad Crested Weir		Broad Crested Weir			
			Dia (m)	0.210	Dia (m)	0.100	Dia (m)	0.900	L (m)	1.000	L (m)	12.000		
			Area (m^2)	0.035	Area (m^2)	0.008	Area (m^2)	0.636						
			Invert (m)	120.10	Invert (m)	120.80	Invert (m)	121.20	C_w	1.580	C_w	1.580		
			C_o	0.62	C_o	0.62	C_o	0.62	Invert (m)	122.25	Invert (m)	123.55		
			Q @ D	0.031	Q @ D	0.005	Q @ D	1.172	n contr.	2	n contr.	0		
Elevation (m)	Active Sto. (m^3)	Demarkation Points	Head (m)	Outflow (m^3/s)	Head (m)	Outflow (m^3/s)	Head (m)	Outflow (m^3/s)	Head (m)	Outflow (m^3/s)	Head (m)	Outflow (m^3/s)	Outflow (m^3/s)	Storage (ha·m)
123.35	45751		3.250	0.169	2.550	0.034	2.150	2.278	1.100	1.422	0.000	0.000	3.903	4.575
123.40	46655		3.300	0.170	2.600	0.034	2.200	2.311	1.150	1.500	0.000	0.000	4.016	4.665
123.45	47831		3.350	0.171	2.650	0.035	2.250	2.344	1.200	1.578	0.000	0.000	4.129	4.783
123.50	49579		3.400	0.173	2.700	0.035	2.300	2.376	1.250	1.656	0.000	0.000	4.240	4.958
123.55	**49532**	**Ovf Elev**	**3.450**	**0.174**	**2.750**	**0.035**	**2.350**	**2.408**	**1.300**	**1.733**	**0.000**	**0.000**	**4.351**	**4.953**
123.60	50481		3.500	0.175	2.800	0.036	2.400	2.440	1.350	1.809	0.050	0.212	4.672	5.048
123.65	51431		3.550	0.177	2.850	0.036	2.450	2.471	1.400	1.884	0.100	0.600	5.167	5.143
123.70	52392		3.600	0.178	2.900	0.036	2.500	2.501	1.450	1.959	0.150	1.101	5.776	5.239
123.75	53358		3.650	0.179	2.950	0.037	2.550	2.532	1.500	2.032	0.200	1.696	6.475	5.336
123.80	54333		3.700	0.180	3.000	0.037	2.600	2.562	1.550	2.104	0.250	2.370	7.253	5.433
123.85	55314		3.750	0.182	3.050	0.037	2.650	2.591	1.600	2.174	0.300	3.115	8.100	5.531
123.90	56313		3.800	0.183	3.100	0.038	2.700	2.621	1.650	2.244	0.350	3.926	9.011	5.631
123.95	57289		3.850	0.184	3.150	0.038	2.750	2.650	1.700	2.311	0.400	4.797	9.980	5.729
124.00	58292		3.900	0.185	3.200	0.038	2.800	2.678	1.750	2.378	0.450	5.723	11.003	5.829
124.05	59314		3.950	0.187	3.250	0.039	2.850	2.707	1.800	2.442	0.500	6.703	12.077	5.931
124.10	**60410**	**Top of Berm**	**4.000**	**0.188**	**3.300**	**0.039**	**2.900**	**2.735**	**1.850**	**2.505**	**0.550**	**7.734**	**13.200**	**6.041**

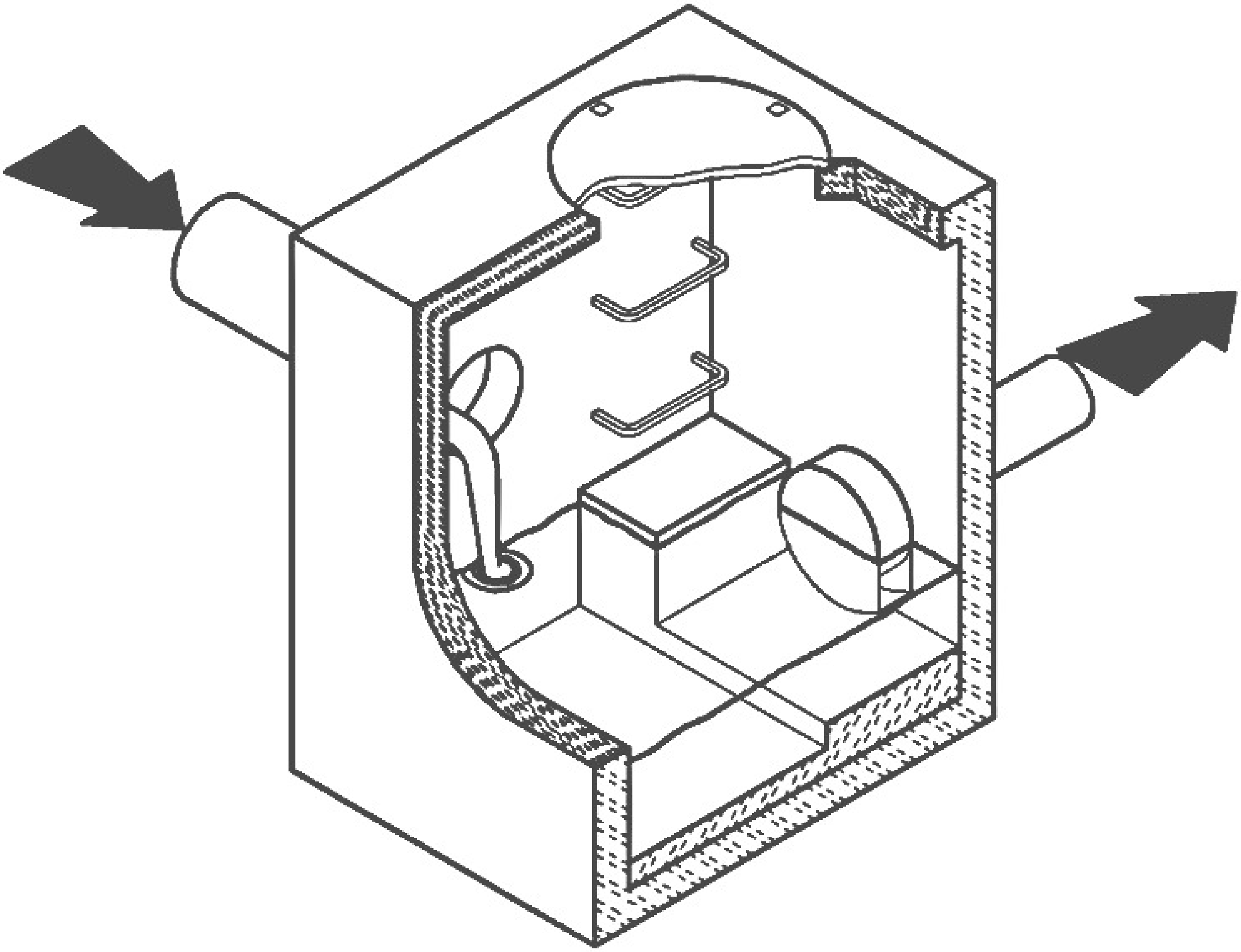
Notes :
- PP Elev indicates the elevation of the permanent pool.
- QC Elev indicates the elevation of the storage volume required by MOE for quality control.
- Ext Det indicates the elevation of extended detention provided.
- Ovf Elev indicates the elevation of the emergency overflow provided above the Regional water level.
- Top of Berm indicates the elevation at the top of the berm.

APPENDIX H

HYDROVEX FLOW REGULATOR CATALOGUE

CSO/STORMWATER MANAGEMENT

® HYDROVEX® VHV / SVHV
Vertical Vortex Flow Regulator



JOHN MEUNIER

HYDROVEX® VHV / SVHV VERTICAL VORTEX FLOW REGULATOR

APPLICATIONS

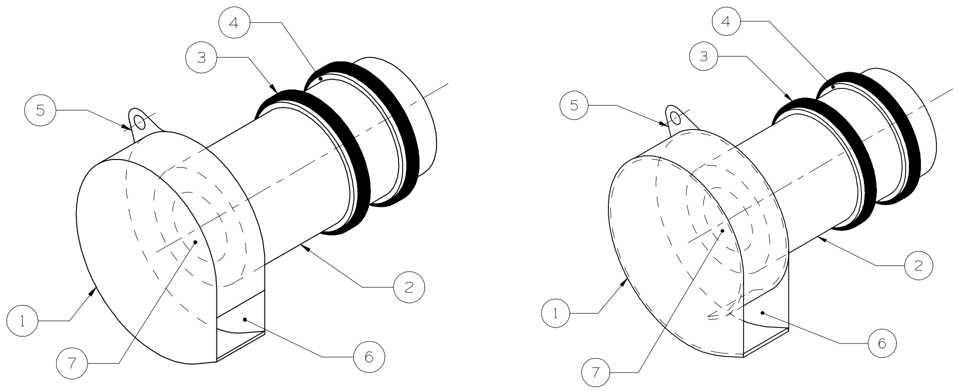
One of the major problems of urban wet weather flow management is the runoff generated after a heavy rainfall. During a storm event, uncontrolled flows may overload the drainage system and cause flooding. Sewer pipe wear and network deterioration are increased dramatically as a result of increased flow velocities. In a combined sewer system, the wastewater treatment plant will experience a significant increase in flows during storms, thereby losing its treatment efficiency.

A simple means of managing excessive water runoff is to control excessive flows at their point of origin, the manhole. **John Meunier Inc.** manufactures the **HYDROVEX® VHV / SVHV** line of vortex flow regulators for point source control of stormwater flows in sewer networks, as well as manholes, catch basins and other retention structures.

The **HYDROVEX® VHV / SVHV** design is based on the fluid mechanics principle of the forced vortex. The discharge is controlled by an air-filled vortex which reduces the effective water passage area without physically reducing orifice size. This effect grants precise flow regulation without the use of moving parts or electricity, thus minimizing maintenance. Although the concept is quite simple, over 12 years of research and testing have been invested in our vortex technology design in order to optimize its performance.

The **HYDROVEX® VHV / SVHV** Vertical Vortex Flow Regulators **(refer to Figure 1)** are manufactured entirely of stainless steel, and consist of a hollow body (**1**) (in which flow control takes place) and an outlet orifice (**7**). Two rubber "O" rings (**3**) seal and retain the unit inside the outlet pipe. Two stainless steel retaining rings (**4**) are welded on the outlet sleeve to ensure that there is no shifting of the "O" rings during installation and operation.

1. **BODY**
2. **SLEEVE**
3. **O-RING**
4. **RETAINING RINGS (SQUARE BAR)**
5. **ANCHOR PLATE**
6. **INLET**
7. **OUTLET ORIFICE**



VHV

SVHV

FIGURE 1: HYDROVEX® VHV-SVHV VERTICAL VORTREX FLOW REGULATORS

ADVANTAGES

- As a result of the air-filled vortex, a **HYDROVEX® VHV / SVHV** flow regulator will typically have an opening 4 to 6 times larger than an orifice plate. Larger opening sizes decrease the chance of blockage caused by sediments and debris found in stormwater flows. **Figure 2** shows the discharge curve of a vortex regulator compared to an equally sized orifice plate. One can see that for the same height of water and same opening size, the vortex regulator controls a flow approximately four times smaller than the orifice plate.

- Having no moving parts, they require minimal maintenance.

- Submerged inlet for floatables control.

- The **HYDROVEX® VHV / SVHV** line of flow regulators are manufactured entirely of stainless steel, making them durable and corrosion resistant.

- Installation of the **HYDROVEX® VHV / SVHV** flow regulators is quick and straightforward and is performed after all civil works are completed.

- Installation requires no assembly, special tools or equipment and may be carried out by any contractor.

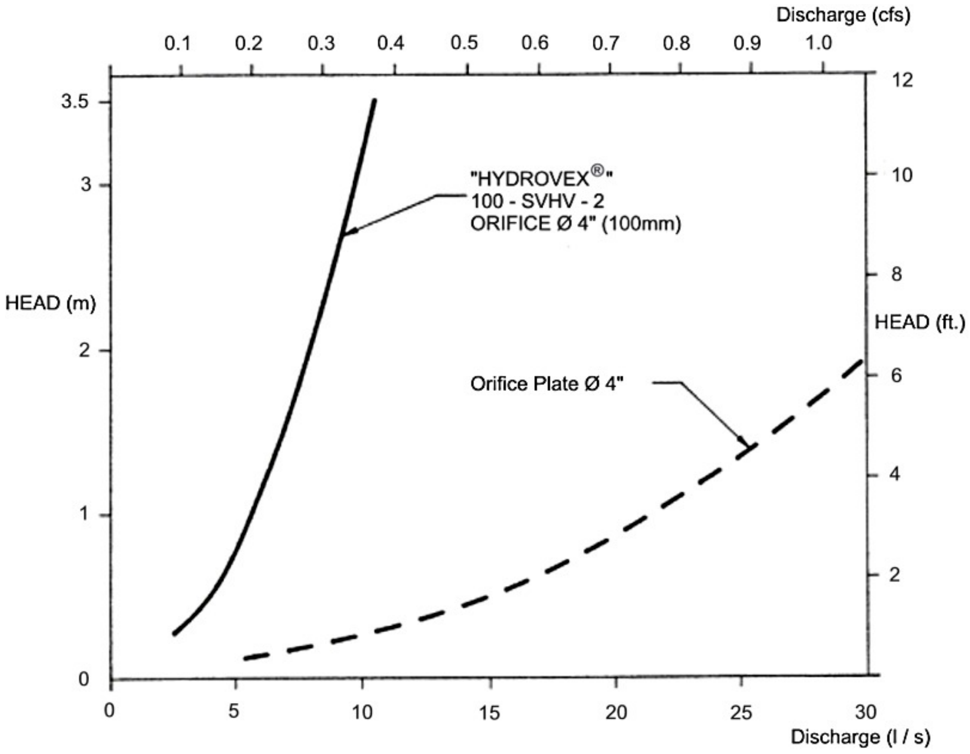


FIGURE 2: DISCHARGE CURVE SHOWING A HYDROVEX® FLOW REGULATOR VS AN ORIFICE PLATE

SELECTION

Selecting a **VHV or SVHV** regulator is easily achieved using the selection chart found at the end of this brochure (refer to **Figure 3)**. Each selection is made using the maximum allowable discharge rate and the maximum allowable water pressure (head) retained upstream from the regulator. The area in which the design point falls will designate the required VHV/SVHV model. The maximum design head is calculated as the difference between the maximum upstream water level and the invert of the outlet pipe. All selections should be verified by a John Meunier Inc. representative prior to fabrication.

Example:

✓ Maximum discharge	6 L/s (0.2 cfs)**
✓ Maximum design head	2m (6.56 ft.)

✓ Using **Figure 3** model required is a **75 VHV-1**

** It is important to verify the capacity of the manhole/catch basin outlet pipe. Should the outlet pipe be >80% full at design flow, the use of an air vent is required.

INSTALLATION REQUIREMENTS

HYDROVEX® VHV / SVHV flow regulators can be installed in circular or square manholes. **Figure 4** lists the minimum dimensions required for each regulator model. ***It is imperative to respect the minimum clearances shown to ensure ease of installation and proper functioning of the regulator.***

SPECIFICATIONS

In order to specify a **HYDROVEX® VHV/SVHV** flow regulator, the following parameters must be clearly indicated:

- The model number (ex: 75-VHV-1)
- The diameter and type of outlet pipe (ex: ø 6", SDR 35)
- The maximum discharge rate (ex: 6.0 L/s [0.21 CFS])
- The maximum upstream head (ex: 2.0 m [6.56 ft]) *
- The manhole diameter (ex: ø 900 mm [ø 36"])
- The minimum clearance "H" (ex: 150 mm [6 in]) as indicated in **Figure 4**
- The material type (ex: 304 stainless steel, standard)

* ***Upstream head is defined as the difference in elevation between the maximum upstream water level and the invert of the outlet pipe where the HYDROVEX® flow regulator is to be installed.***

PLEASE NOTE THAT WHEN REQUESTING A PROPOSAL, WE SIMPLY REQUIRE THAT YOU PROVIDE US WITH THE FOLLOWING INFORMATION:

- ***project design flow rate***
- ***pressure head***
- ***chamber's outlet pipe diameter and type***

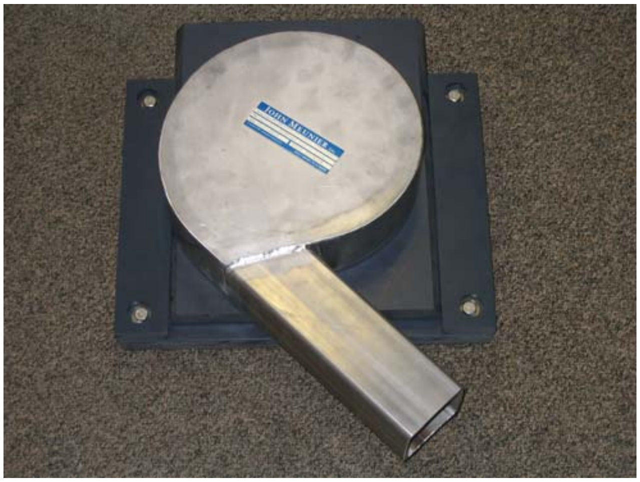
Typical HYDROVEX® VHV model

OPTIONS

VHV-1-O
(extended inlet for odor control)

FV–VHV
(mounted on sliding plate for emergency bypass)

VHV with Gooseneck assembly
(manhole without clearance below regulator)



FV–VHV-O
(sliding plate with extended inlet)

VHV with upstream air vent
(applications where outlet pipe is > 80% full
at peak flow)

HYDROVEX®

VHV/SVHV Vortex Flow Regulator

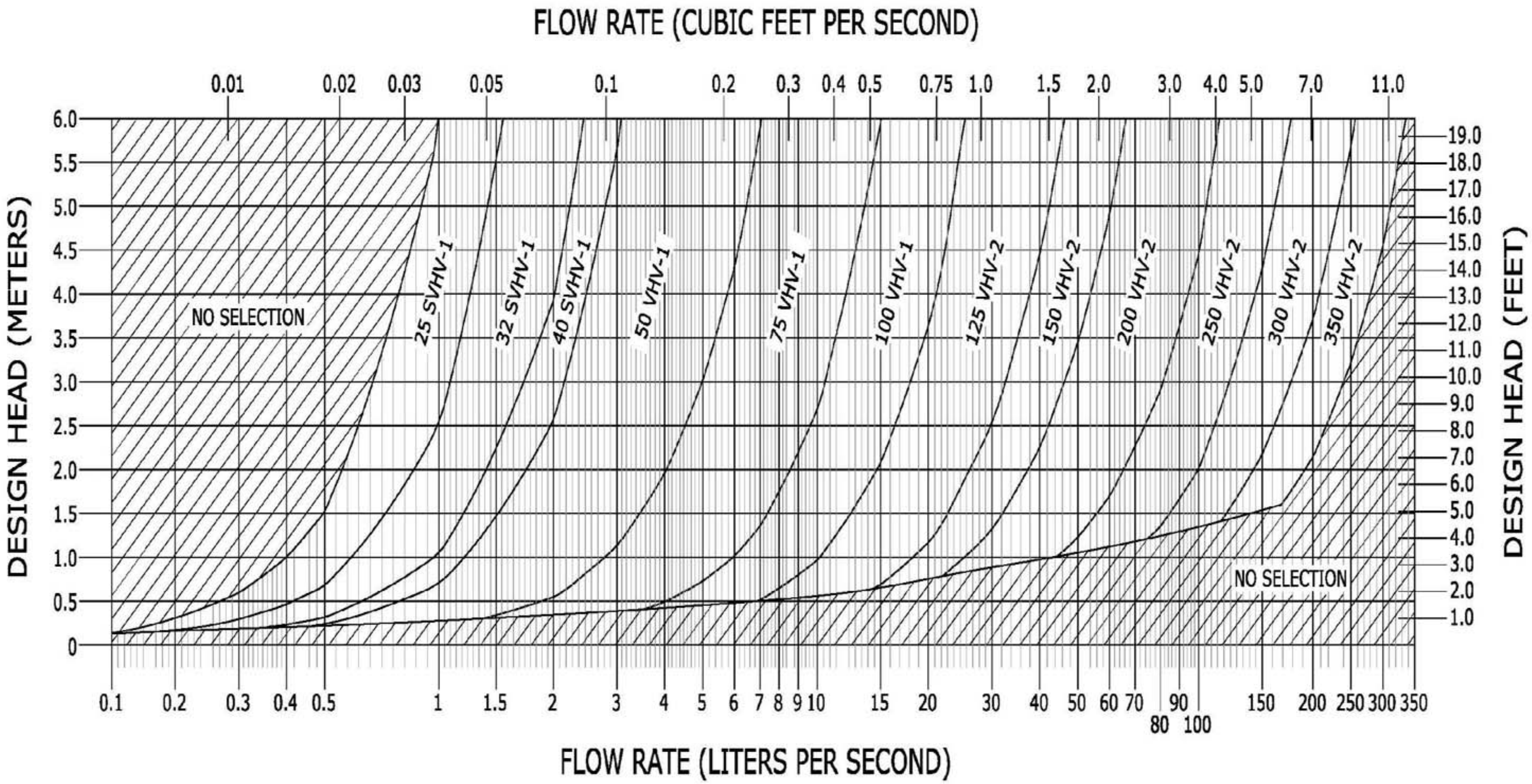


FIGURE 3

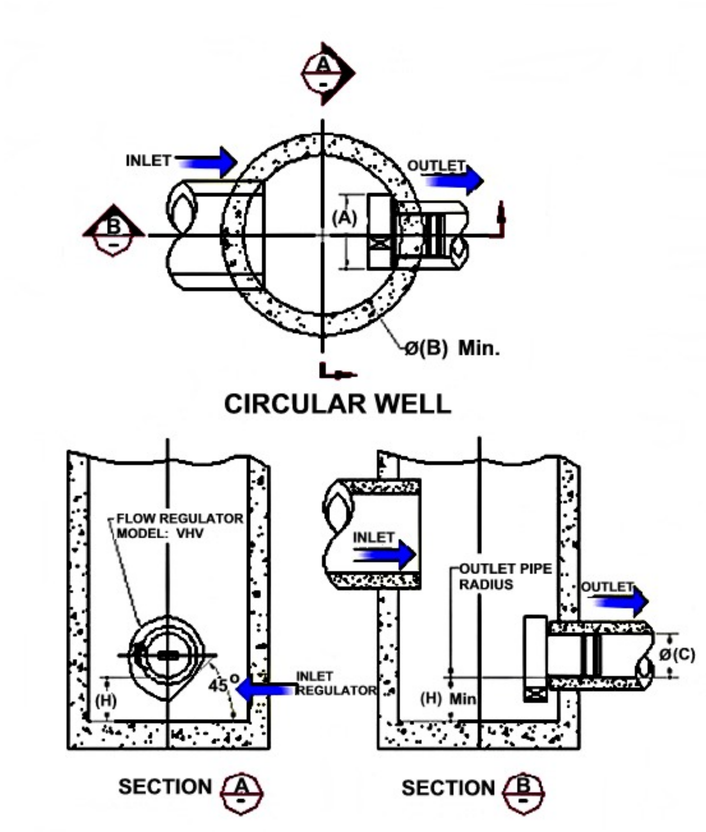
JOHN MEUNIER

TYPICAL INSTALLATION OF A VORTEX FLOW REGULATOR IN A CIRCULAR OR SQUARE/RECTANGULAR MANHOLE

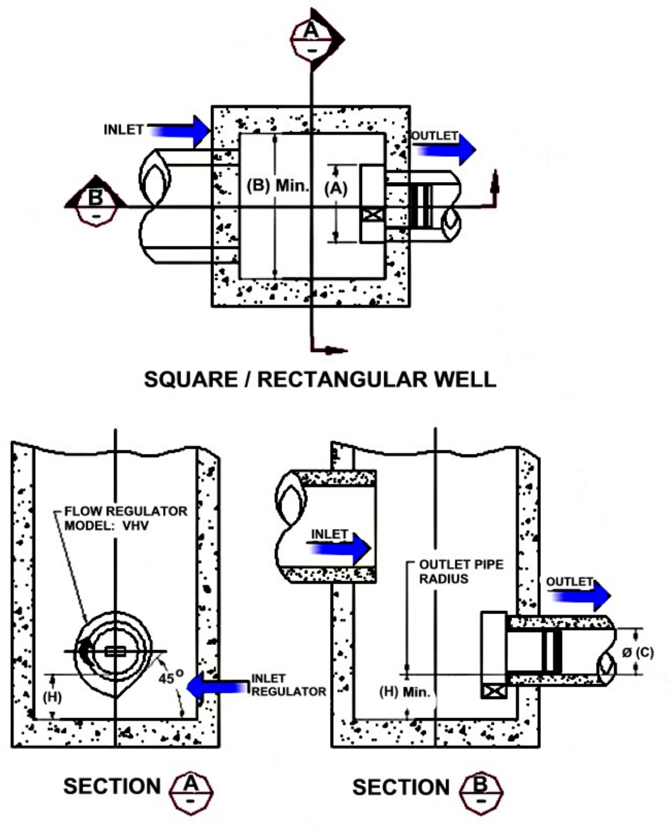
FIGURE 4

		CIRCULAR	**SQUARE**		
Model	Regulator Diameter **A** (mm) [in]	Minimum Manhole Diameter **B** (mm) [in]	Minimum Chamber Width **B** (mm) [in]	Minimum Outlet Pipe Diameter **C** (mm) [in]	Minimum Clearance **H** (mm) [in]
25 SVHV-1	125 [5]	600 [24]	600 [24]	150 [6]	150 [6]
32 SVHV-1	150 [6]	600 [24]	600 [24]	150 [6]	150 [6]
40 SVHV-1	200 [8]	600 [24]	600 [24]	150 [6]	150 [6]
50 VHV-1	150 [6]	600 [24]	600 [24]	150 [6]	150 [6]
75 VHV-1	250 [10]	600 [24]	600 [24]	150 [6]	150 [6]
100 VHV-1	325 [13]	900 [36]	600 [24]	150 [6]	200 [8]
125 VHV-2	275 [11]	900 [36]	600 [24]	150 [6]	200 [8]
150 VHV-2	350 [14]	900 [36]	600 [24]	150 [6]	225 [9]
200 VHV-2	450 [18]	1200 [48]	900 [36]	200 [8]	300 [12]
250 VHV-2	575 [23]	1200 [48]	900 [36]	250 [10]	350 [14]
300VHV-2	675 [27]	1600 [64]	1200 [48]	250 [10]	400 [16]
350VHV-2	800 [32]	1800 [72]	1200 [48]	300 [12]	500 [20]

Circular Manhole



Square / Rectangular Manhole



NOTE: ***In the case of a square manhole, the outlet pipe must be centered on the wall to ensure that there is enough clearance for installation of the regulator.***

INSTALLATION

The installation of a **HYDROVEX®** regulator may begin once the manhole and piping are in place. Installation consists of simply sliding the regulator into the outlet pipe of the manhole and securing it to the wall with an anchor (supplied). **John Meunier Inc.** recommends applying a lubricant on the inner surface of the outlet pipe, in order to facilitate the insertion and the manipulation of the flow controller.

MAINTENANCE

HYDROVEX® regulators are designed and manufactured to minimize maintenance requirements. We recommend a periodic visual inspection every 3-6 months (depending on local flow and sediment conditions) in order to ensure that neither the inlet nor the outlet has become blocked with debris. The manhole housing the vortex regulator should be inspected and cleaned with a vacuum truck periodically, especially after major storm events.

GUARANTY

The **HYDROVEX®** line of **VHV / SVHV** regulators are guaranteed against both design and manufacturing defects for a period of 5 years after sale. Should a flow regulator be found to be defective within the guarantee period, **John Meunier Inc.** will modify or replace the defective unit.

John Meunier Inc.
ISO 9001 : 2008

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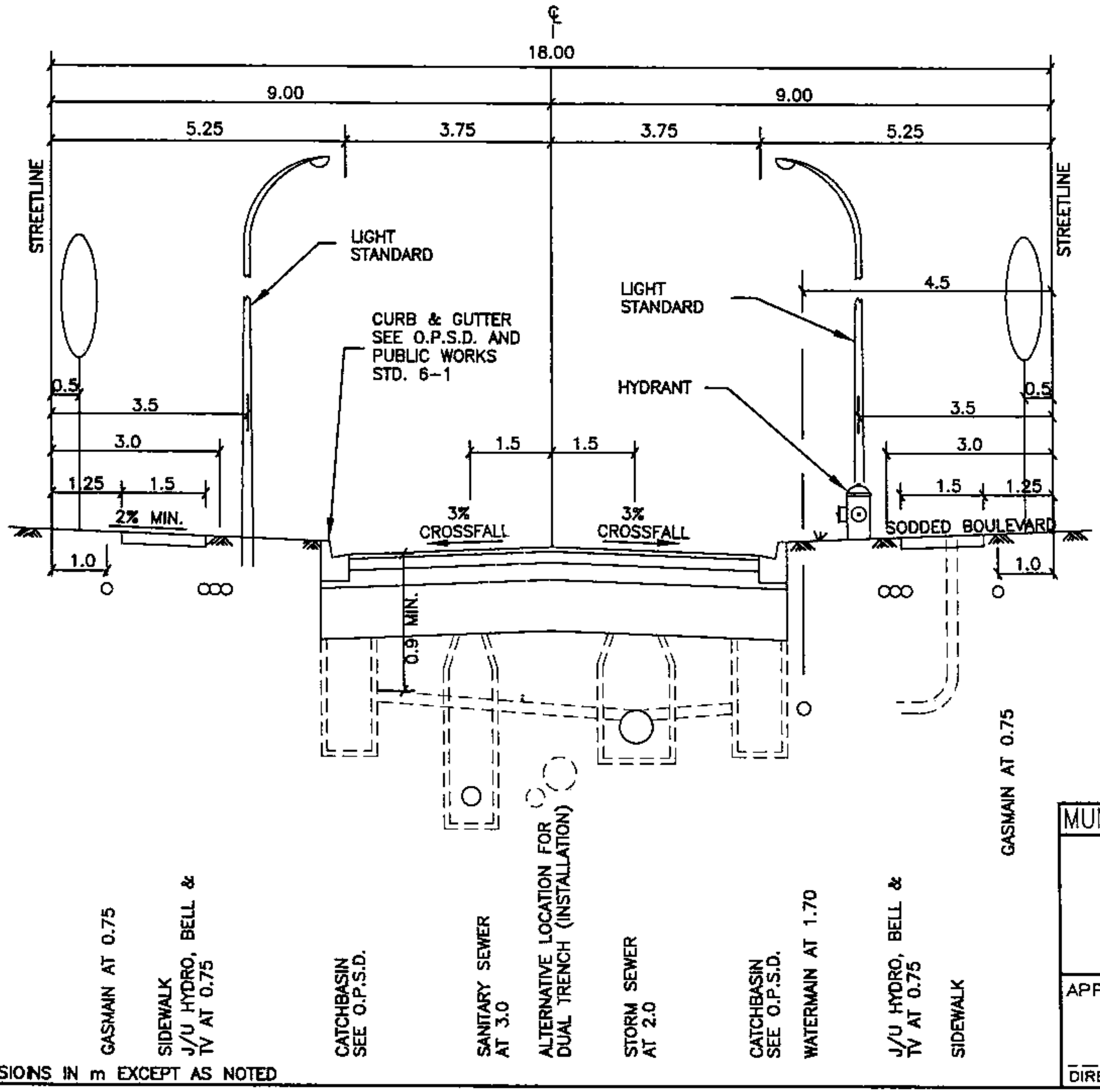
Revised: 2012-07-23

APPENDIX I

TOWN OF OAKVILLE STANDARD ROW CROSS SECTIONS



NOTE:

FOR GENERAL NOTES AND ASPHLALT REQUIREMENTS REFER TO STD. 7-2

DIMENSIONS IN m EXCEPT AS NOTED

MUNICIPALITY: TOWN OF OAKVILLE

STANDARD STREET SECTION FOR 18m ROAD ALLOWANCE

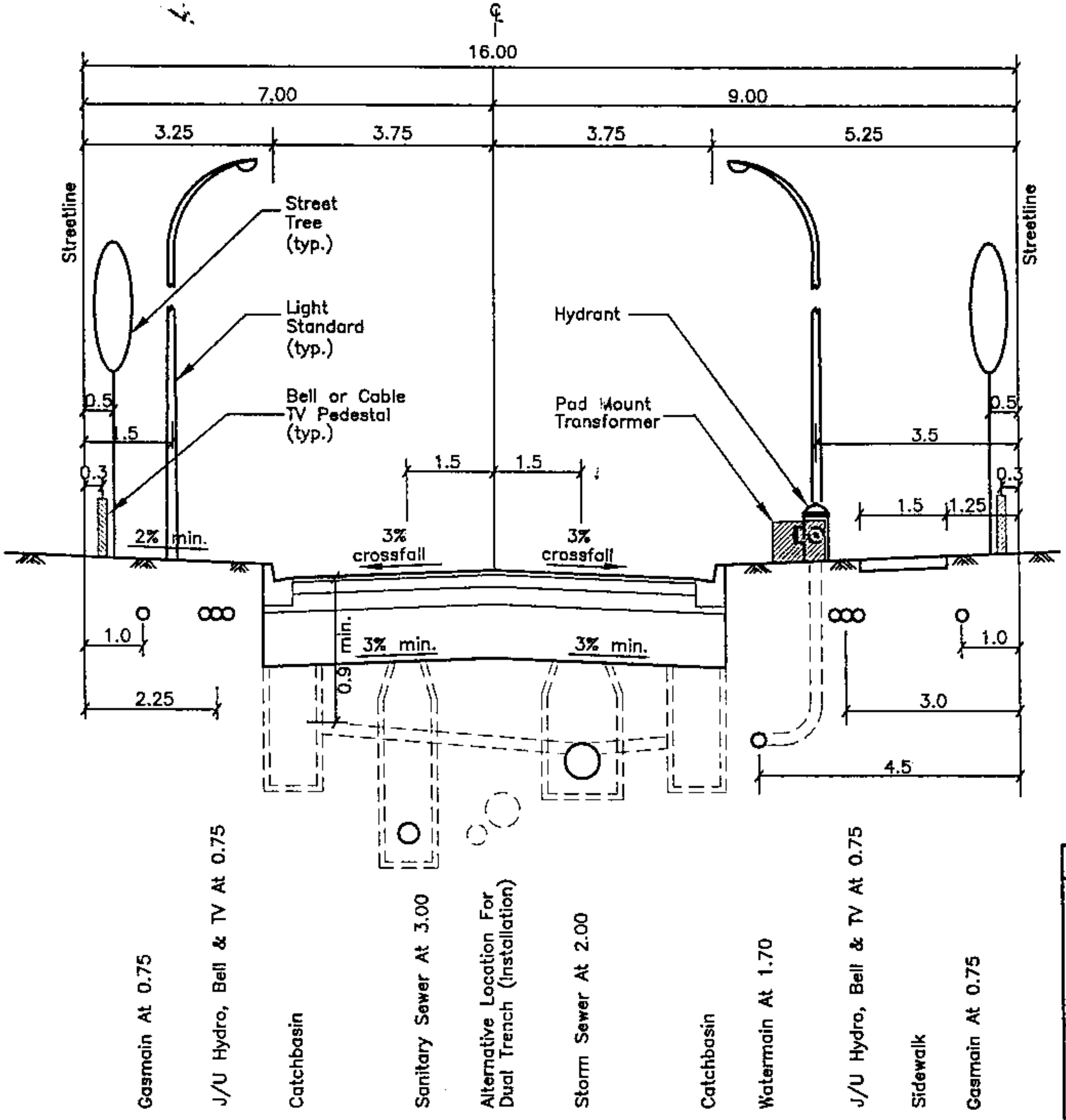
APPROVED

DIRECTOR OF PUBLIC WORKS

STD. 7-1

REVISION DATE

MARCH 22, 2001



Dimmensions In m Except As Noted

Notes

1. For additional notes and asphalt requirements refer to STD. 7–2.
2. STD. 7–1A applies to local residential streets serving less than 100 dwelling units.
3. Sidewalk may be deleted on a cul-de-sac without a park or walkway connection.
4. If sidewalk is required on both sides of the street, use STD. 7–1B.
5. 2m daylight triangles required at intersections.
6. Curb and Gutter is STD. 6–1 unless otherwise approved.

TOWN OF OAKVILLE

STANDARD STREET SECTION FOR 16m ROAD ALLOWANCE

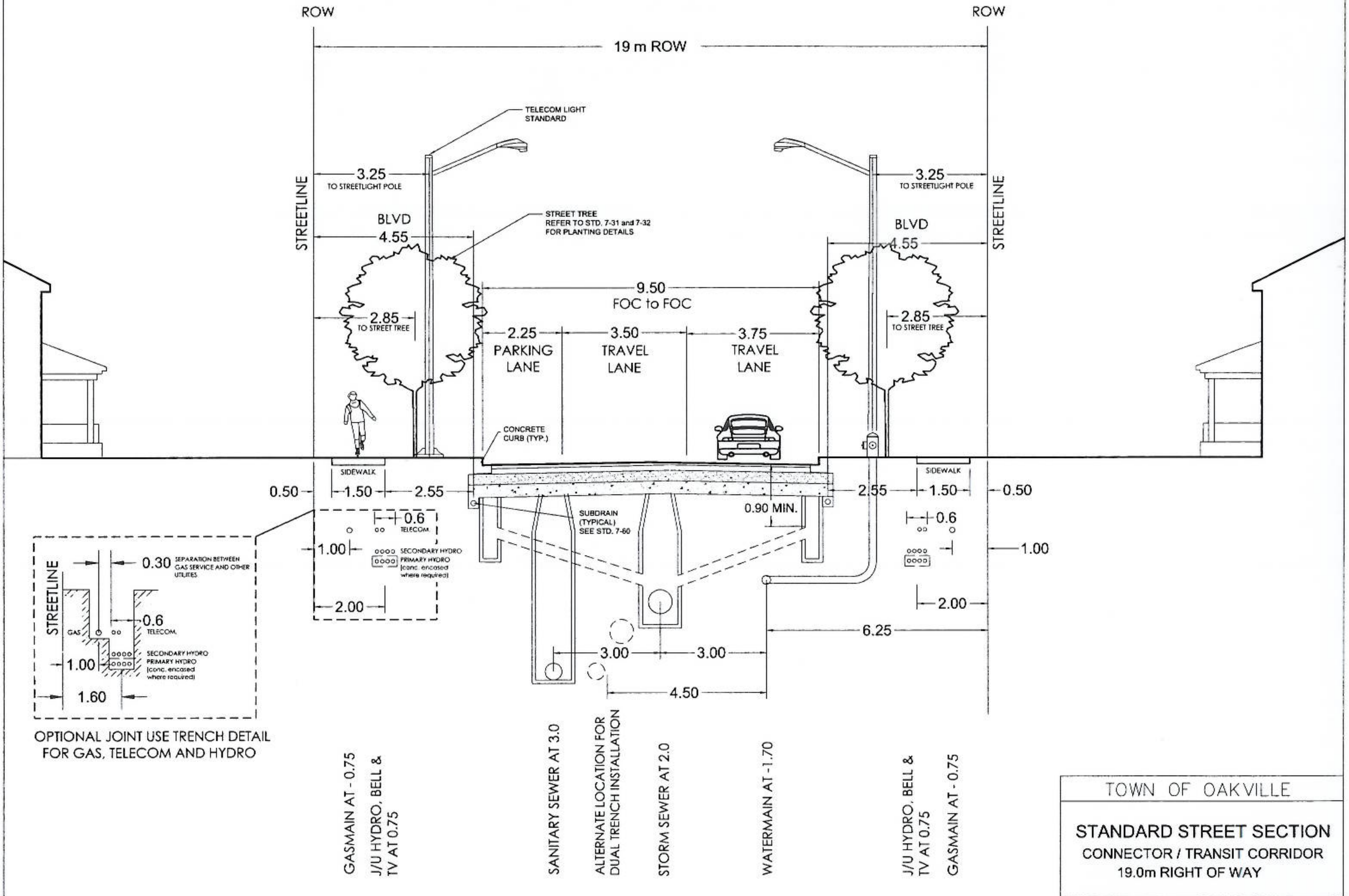
APPROVED

DIRECTOR OF PUBLIC WORKS

STD. 7–1A

REVISION DATE

MARCH 22, 2001



TOWN OF OAKVILLE

STANDARD STREET SECTION

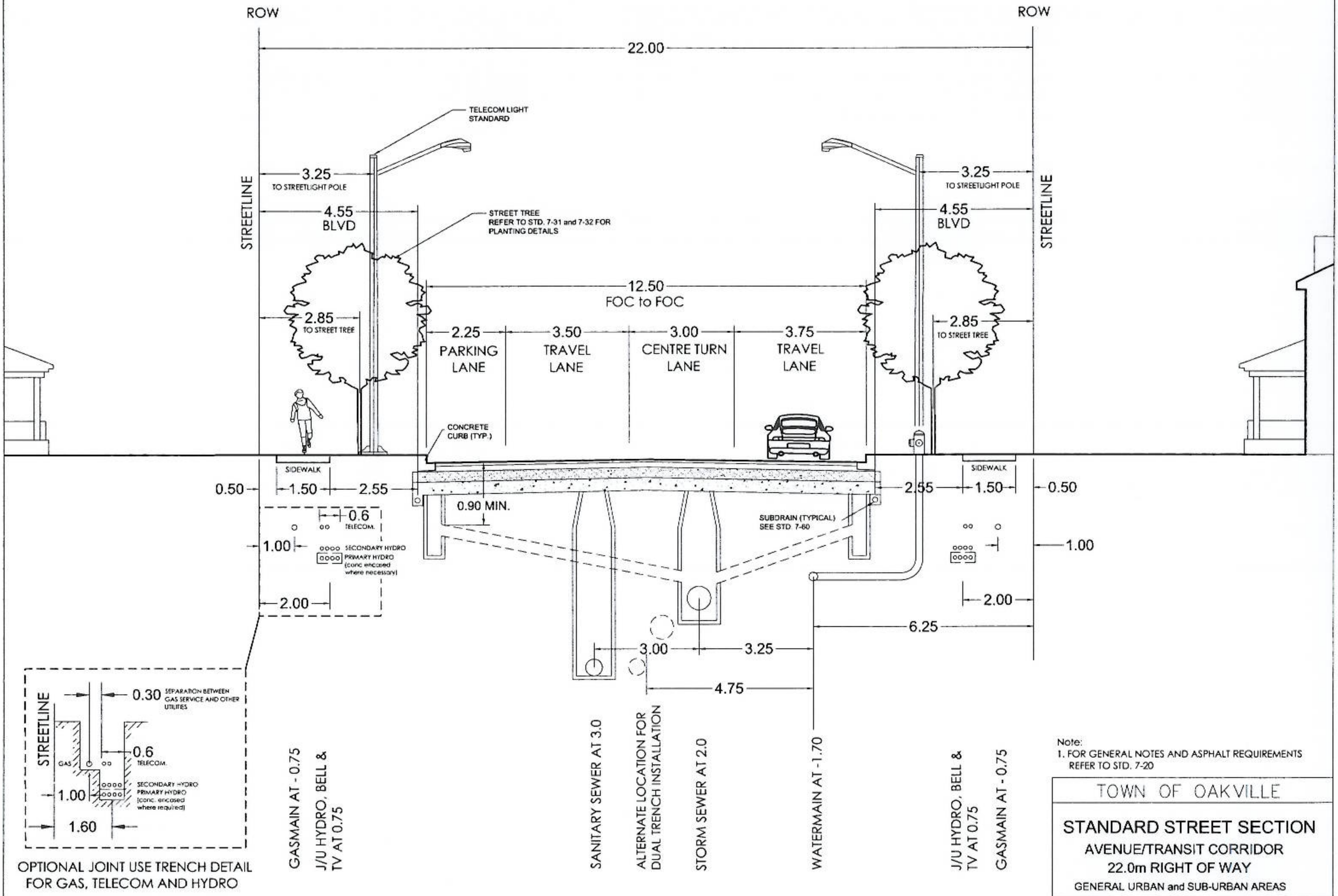
CONNECTOR / TRANSIT CORRIDOR
19.0m RIGHT OF WAY

APPROVED

DIRECTOR OF ENGINEERING AND CONSTRUCTION

STD 7-23

REVISION DATE
August 2009



OPTIONAL JOINT USE TRENCH DETAIL
FOR GAS, TELECOM AND HYDRO

Note:
1. FOR GENERAL NOTES AND ASPHALT REQUIREMENTS REFER TO STD. 7-20

TOWN OF OAKVILLE

STANDARD STREET SECTION

AVENUE/TRANSIT CORRIDOR
22.0m RIGHT OF WAY
GENERAL URBAN and SUB-URBAN AREAS

APPROVED

DIRECTOR OF ENGINEERING AND CONSTRUCTION

STD 7-24A

REVISION DATE
August 2009

APPENDIX J

RESPONSE TO CONSERVATION HALTON COMMENTS ON AREA SERVICING PLAN

PARISH GEOMORPHIX

PARISH
geomorphic

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Memorandum

To:	Mike Baldesarra David Schaeffer Engineering Ltd.	**Date:** **Ref:**	November 8, 2013 01-12-61
CC:	Tatiana Chiesa and Laura Maxwell, DSEL		
From:	Tatiana Hrytsak, M.Sc.		

Subject: Response to Conservation Halton comments on Area Servicing Plan-DSEL Oct 31, 2013

Mike,

The following comments on the DSEL Area Servicing Plan required geomorphic input:

1. Figures 11 to 13 show the crossing of a new Zone 3 watermain over Tributary 14W-W1 (naming convention per EIS Figure 7). Per the terms of reference for the ASP, included in Section 7.2.1, geomorphic input should be provided with respect to anticipated future downcutting and planform adjustment. Additional analysis including a detailed geotechnical analysis (including a hydrogeologic assessment) will also be required to support the proposed watermain installation.

2. For the new road crossing of Tributary 14W-W1, additional geomorphic analysis will be required to confirm the appropriateness of the crossing location and design, per 7.1.2b)iii.

3. The erosion hazard assessment for tributaries 14W-W1-3 and 14W-W1 must be re-assessed to consider the proposed diversion of Bronte Creek flows from the Enns Lands into the Fourteen Mile Creek system

4. A more detailed erosion assessment must be completed for watercourse 14W-W1-3 and 14W-W1 to demonstrate whether or not additional stormwater management controls are required to mitigate for the diversion of drainage from the Bronte Creek catchment to Fourteen mile Creek. Staff are unable to support any increase in erosion resulting from the diversion (which represents approximately 7% of the catchment area associated with 14W-W1-3). Special consideration should also be given to the existing 2400mm diameter HUSP sanitary sewer, which per Figure 6, crosses tributary 14W-W1-3 downstream of Bronte Road at a depth of approximately 1.0m below the invert of the channel.

Input from Parish Geomorphic is as follows
The DSEL Area Servicing Plan has proposed the following changes: a watermain, road crossing, and outfall located on Tributary 14W-W1 (specifically reach SW-3); an outfall further downstream on Tributary 14W-W1 (specifically in reach SW-2); and drainage diverted from the Enns Lands via a drainage ditch to Tributary 14W-W1-3 (reach SWS-1).

Comments 1 and 2: Reach SW-3, where the proposed road crossing and watermain are to be located, has been classified as In Regime. Currently this reach flows across an open fairway of the golf course. The channel itself is surrounded by grassy meadow vegetation that obscured any defined channel dimensions. The channel is only defined downstream of a cart path where the channel moved into a woodlot and became Reach SW-2. The dimensions at the downstream end were a bankfull width of 1.7m and bankfull depth of 0.25-0.35m. It should also be noted that during the original field assessment (Aug 30 2012) the channel was dry. There was some undercutting seen in a bend beyond the cart path likely resultant from the concentrated flow coming out of the CSPs under the cart path during heavy rainfall. This could be due to undersized CSPs and would be resolved when the area is redeveloped and the CSPs removed. It appears in Figures 11-13 of the DSEL ASP report that the watermain and road crossing will be placed in the area where the channel currently lacks defined dimensions and planform. It is not anticipated that there will be any issues with downcutting based on the current state of the channel. To ensure channel stability, the road crossing should be sized as 3 times the bankfull width (approximately 5.0m). This will provide adequate space for any future planform migration so that the channel does not become constrained by the crossing which would lead to erosion. This will also allow for the channel to adequately convey bankfull flows through the crossing. Based on the current state of the channel it is not anticipated that any future migration would be significant. The road crossing should be placed in a straight section of the reach and aligned perpendicular to the flow. This will ensure the channel flows properly through the crossing leaving space for future migration. A more detailed assessment and input can be provided at the detailed design stage. Finally, there is a proposed outfall as seen in Figures 15-17 located upstream of the road crossing/watermain. It is recommended that this is shifted downstream of the crossing/watermain to ensure there is no potential for exposure of the watermain due to erosion from the outfall. Based on the channel's current state, it is not appropriate to undertake an erosion threshold assessment for this reach. An erosion threshold could be calculated for the reach by using the threshold from Reach SW-2 (immediately downstream) and modifying it based on difference in drainage area for SW-2 and SW-3. This assessment can be confirmed with an additional field visit if necessary.

Reach SW-2, where a proposed outfall will be located, has been classified as Stressed/Transitional due to aggradation and widening. In the upstream portion of the reach the channel is heavily confined by the valley resulting in several eroding valley contacts. Progressing downstream the valley widens out, but numerous areas of bank erosion were still seen. The channel dimensions varied between wide shallow cross sections and narrow deeper sections. At time of assessment (August 30 2012), the channel was dry with the exception of some pools which had ~0.10m of depth. Based on the reach's current state of adjustment, the erosion threshold calculated for this reach (0.43m^3/s) should be used to ensure that the pre-development hydrograph is maintained and that discharge from the proposed outfall does not create isolated erosion. Due to the variable dimensions of the channel in this reach it is important that the outfall is located in a section where the channel dimensions are more appropriate for stormwater dissipation, such as a pool. During the detailed design and final location of the stormwater outfall it is recommended that a field visit be conducted (with the consulting geomorphologist) to appropriately locate the outfall for optimum performance and minimal impacts.

Comments 3 and 4: Reach SWS-1, which will receive flows diverted from the Enns Lands via a drainage ditch, was classified as In Regime and has little definition for most of the reach. The reach transitions through different several surrounding vegetation types: a phragmites stand, a small scrub/treelot, and finally a densely vegetated grassy meadow. At the upstream end of the reach, where the drainage ditch joins the channel, there is little definition and the channel was dry (Aug 30 2012). The drainage ditches on either side of the Bronte Road culvert were visible and surrounded by dense vegetation. It was also noted that there was a check dam along the drainage ditch that will reduce velocities as well as filter out some of the finer material. It is not anticipated that there would be any issues with erosion in this area. The DSEL ASP mentions that "…proposed stormwater flows be controlled on-site to match predevelopment levels for all events up to and including the regional storm…" (Page 24-25). Therefore there should be no increase in the flows conveyed through the drainage ditch between pre- and post- development conditions that would create potential erosion. Reach SWS-1 has conditions in SW-3 in which it is not appropriate to calculate a field based erosion threshold due to the lack of channel definition. If this is desired the same method could be used in this reach, calculating the difference in drainage area to modify the erosion threshold from SW-2 for the drainage area in SWS-1. This assessment can be confirmed with an additional field visit if necessary.

Tatiana Hrytsak, M.Sc.
Junior Fluvial Geomorphologist
Parish Geomorphic Ltd.