Sundial Homes (4th Line) Ltd.
Town of Milton

Functional Servicing and Stormwater Management Report

April 2023

Submitted by:

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SUBMISSION HISTORY

Submission	Date	In Support Of	Distributed To
1st	September 2021	Draft Plan Approval	Town of Milton, Regional Municipality of Halton, Conservation Halton, and Sundial Homes (4th Line) Limited
2nd	April 2023	Draft Plan Approval	Town of Milton, Regional Municipality of Halton, Conservation Halton, and Sundial Homes (4th Line) Limited

1.0 INTRODUCTION

SCS Consulting Group Ltd. has been retained by Sundial Homes (4th Line) Limited to prepare a Functional Servicing and Stormwater Management Report for a proposed development within Area 5B within the Boyne Survey Lands (East), located in the Town of Milton.

1.1 Purpose of the Functional Servicing Report

The Functional Servicing and Stormwater Management Report (FSSR) has been prepared in support of the Draft Plan Approval for the proposed development. The Draft Plan of Subdivision is provided in **Appendix A**. The proposed development consists of the following land uses:

- low density residential,
- medium density residential,
- major node area,
- parks,
- open space,
- SWM pond block, and
- proposed roads.

The purpose of this report is to demonstrate that the development can be graded and serviced in accordance with the Town of Milton, Conservation Halton, Region of Halton, and the Ministry of Environment, Conservation and Parks (MECP) design criteria.

1.2 Study Area

The study area is approximately 36.67 ha in size and is bound by Fourth Line to the west, James Snow Parkway to the east, Britannia Road to the south, and a future residential development to the north (see **Figure 1.1**).

The existing subject lands are comprised of agricultural land and open space areas. The proposed development is located within the Sixteen Mile Creek Subwatershed in the Town of Milton, and outlets to the Omagh Tributary.

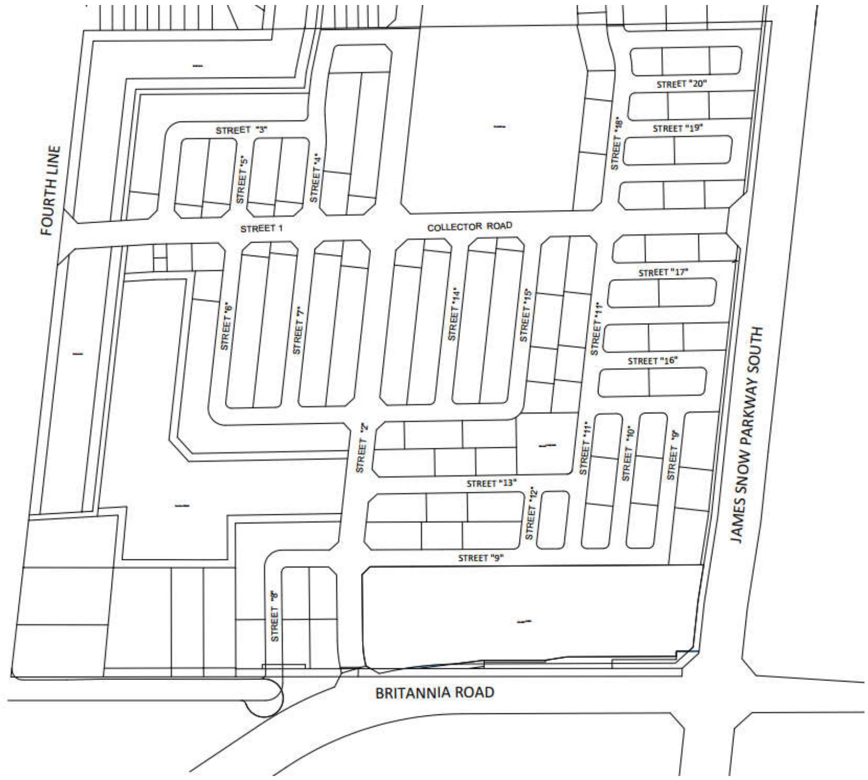


Figure 1.1 - Site Location Plan

1.3 Background Servicing Information

In preparation of the servicing and SWM strategies, the following design guidelines and standards were used:

- Engineering and Parks Standards, Town of Milton (March 2019);
- Water and Wastewater Linear Design Manual, Regional Municipality of Halton (April 2019); and
- Ministry of Environment, Conservation and Parks (MECP) Stormwater Management Planning and Design Manual (March 2003).

The servicing and SWM strategies in this report are based on the following approved reports:

- Subwatershed Impact Study for Areas 5A, 5B and 6 Boyne Survey Lands, Phase 3 Omagh Tributary (SIS), David Schaeffer Engineering Ltd. (June 2013);
- Subwatershed Impact Study for Areas 5A, 5B and 6 Boyne Survey Lands, Phase 3 Omagh Tributary Addendum (SIS Addendum), David Schaeffer Engineering Ltd. (February 2023);
- Water and Wastewater Area Servicing Plan for the Boyne Survey Lands (East) (ASP), DSEL (March 2018);
- Supplemental Assessment of Stormwater Management Facility Optimization for Boyne Survey SIS 5B Area (Omagh), Town of Milton (April 2022); and

- Functional Servicing and Environmental Management Strategy, Boyne Survey Secondary Plan Area, AMEC (2015).

Excerpts from the above listed documents are included in **Appendix B**.

2.0 STORMWATER MANAGEMENT

2.1 Stormwater Runoff Control Criteria

The following stormwater runoff control criteria have been established as per criteria set by the Subwatershed Impact Study (SIS) and further refinement and modelling outlined in the Wood Hydrologic Assessment Memo, which are attached, with relevant sections highlighted in **Appendix B** for reference. The SWM facility to service the subject lands is identified as SWM Pond S5B-2. The selected stormwater runoff criteria are summarized below in **Table 2.1**:

Table 2.1 – Stormwater Runoff Control Criteria

Criteria	Control Measure
Quantity Control	Control to required outflow for SWM Pond S5B-2, summarized in the SIS Addendum, and defined by hydrologic assessment conducted in the Wood Hydrologic Memo: Extended Detention: 0.0013 m^3/s/ha 25 year discharge: 0.0130 m^3/s/ha 100 year discharge: 0.0285 m^3/s/ha Regional discharge: 0.0760 m^3/s /ha Required pond storage volumes: Extended Detention: 275 m^3/imp-ha 25 year: 450 m^3/imp-ha 100 year: 725 m^3/imp-ha Regional: 1275 m^3/imp-ha
Quality Control	MECP Enhanced Level Protection (80% TSS Removal).
Erosion Control	As per the hydrologic assessment conducted for SIS Area 5B (**Appendix B**), an extended detention storage of 275 m^3/impervious-ha and discharge rate of 0.0013 m^3/s/ha will be required to provide erosion control.
Water Budget	As discussed in the SIS, the unmitigated development will cause a reduction in infiltration of approximately 50%. Results of a site wide water balance show that through the implementation of LID's and BMP's throughout the site, infiltration can be provided for the majority of the deficit. Suggested BMP's are discussed in **Section 2.2.2**. A site-specific water balance has been provided in **Appendix B**. The site is not located within a Wellhead Protection Area (WHPA) Q1/Q2 and is not within a Significant Groundwater Recharge Area. Therefore,

	an evaluation of mitigation options is to be considered in order to increase infiltration where possible.
Thermal Mitigation	The proposed SWM facility will be designed in accordance with MNRF's Redside Dace Thermal Mitigation Checklist. In order to achieve this, the SWM facility will implement the following: - A normal water level depth of 3.0 m. - A 3.0 m wide shelf for wetland planting, 0.30 m below the normal water level; - Side slopes at a 4:1 slope below the normal water level; and - A bottom draw outlet located a minimum of 2.5 m below the permanent pool elevation.

2.1.1 Allowable Release Rate and Required Storage Volume

The allowable release rate and required storage volume for the development has been established by the unitary rates established in the hydrologic assessment of SIS Area 5B, which can be found in **Appendix B**. The allowable release rates and required storage volume for SWM Pond S5B-2 are summarized in **Table 2.2** and **Table 2.3**.

Table 2.2 – Allowable Release Rates

Description	Unitary Release Rate (m^3/s/ha)	Drainage Area* (ha)	Release Rate (m^3/s)
Extended Detention	0.0013	44.5	0.058
25 Year	0.0130		0.579
100 Year	0.0285		1.268
Regional	0.0760		3.382

*Drainage area per SIS Addendum (DSEL, 2023)

Table 2.3 – Required Storage Volumes

Description	Unitary Storage Volume (m^3/imp-ha)	Impervious Drainage Area (imp-ha)*	Required Storage Volume (m^3)
Extended Detention	275	32.48	8,933
25 Year	525		7,055
100 Year	725		23,552
Regional	1,325		47,380**

*Drainage area per SIS Addendum (DSEL, 2023)
**Based on Restrictive D/S Conditions (DSEL, 2023)

2.2 Existing Drainage

Existing drainage boundaries have been delineated in the SIS, shown on "Figure 5" of the SIS Addendum and attached in **Appendix B**.

Runoff from 50.2 ha drains to the SE-3-B reach of the Omagh Tributary. Runoff from a small portion of the development area (7.2 ha) drains through existing culverts on Britannia Road, before reaching the Omagh Tributary. Runoff from 10.9 ha of external undeveloped land to the east also drains west onto the site through existing triple 600 mm diameter CSP culverts and to the Omagh Tributary. The culverts will connect to a proposed 4000x2500 mm box maintenance hole before entering the storm sewer Trunk 23 to SWM Pond S5B-2, as shown in the SIS Addendum, prepared by DSEL (February 2023). Refer to **Figure 3.1** for the Preliminary Servicing Plan and excerpts of the SIS Addendum in **Appendix B** of the FSSR.

2.2.1 Best Management Practices

A series of Low Impact Development (LID) solutions were evaluated in the approved SIS (LID review attached in **Appendix B**), which included a feasibility matrix discussing various lot level and conveyance controls for potential implementation.

Lot-level controls are at-source measures that reduce runoff prior to stormwater entering the conveyance system. These controls are typically proposed on private properties. Incorporating controls that require minimal maintenance can be an effective method in the treatment train approach to SWM. Conveyance controls provide treatment of stormwater during the transport of runoff from individual lots to the receiving watercourse or end-of-pipe facility and present opportunities to distribute stormwater management techniques throughout a development.

Controls that were deemed potentially beneficial by the SIS for the proposed development are discussed below. Please note that best management practices and low impact development measures (LIDs) for the park block will be considered and refined at the detailed design stage.

Enhanced Grassed Swales – A grassed swale will promote infiltration, filtration, and evapotranspiration, contributing to water quality and quantity control. Grassed swales need an unimpeded and relatively wide stretch of landscaped area, such as within a wide boulevard with no driveways, to function properly. While applicability on residential lots is limited, swales should be considered for public lands if the water balance warrants it.

Increased Topsoil Depth – An increase in the restored topsoil depth on lots can be used to promote lot level infiltration and evapotranspiration. Increased topsoil depth will contribute to lot-level quality and water balance control. A minimum depth of 0.30 m is proposed in all landscaped areas (not including the Town parkland), with up to 0.45 m of topsoil on pervious areas, not including boulevards. This is required throughout the SIS development lands.

Passive Landscaping/Bio-Retention – Planting of gardens and other vegetation designed to minimize local runoff or use rainwater as a watering source can be used to reduce rainwater runoff by increasing evaporation, transpiration, and infiltration. By promoting infiltration through passive landscaping, water quality and quantity control is provided for the volume of water retained. Passive landscaping can provide significant SWM benefits as part of the overall treatment train approach for the proposed development. This should be considered for individual lot use and commercial blocks.

Soak-away pits – Directing roof runoff to subsurface soak-away pits can be used to promote infiltration. By promoting infiltration water quality and quantity control is provided for the volume of water retained. Infiltration of roof runoff can provides a significant SWM benefits as part of the overall treatment train approach for the proposed development. These have a limited applicability for residential units but should be considered for public lands if the water balance requires it.

Roof overflow to Pervious Areas – Directing roof leaders to pervious areas will contribute to water quality and water balance control by encouraging stormwater retention. This is required in all residential areas per the SIS.

Vegetated Filter Strip – At source filtration and infiltration may be encouraged through the use of vegetated filter strips by directing sheet flow from impermeable areas to the strip prior to being collected via the storm system. Vegetated filter strips are best suited to parking lot areas with landscaped borders or islands, and should be considered and encouraged for public lands.

A water balance assessment has been conducted by R. J. Burnside and Associates Limited., taking into account the selected LIDS and quantifying the proposed rainwater retention volume. Further discussion is included in **Section 2.4.4** and the water balance assessment is attached in **Appendix B**.

2.3 Proposed Storm Drainage

It is proposed that the majority of the runoff from the site will drain to the proposed SWM Pond S5B-2, located along the west boundary of the site, and outletting to the realigned Omagh Tributary as described in the SIS.

Drainage from 16.06 ha of the site is proposed to drain to the north forebay, while runoff from 14.15 ha of the site will drain to the east forebay, with a small portion of runoff from 4 rear lots at the south west corner going to the main cell. Runoff from Catchment EXT1 will drain to Old Britannia Road. Major system conveyance will generally follow that of the minor system. Runoff from 10.9 (Catchment EXT2) ha of external drainage from future development to the east of the site will be conveyed by existing triple 600 mm diameter CSP culverts under James Snow Parkway. Flow from the culverts will be drain to a proposed 4000x25000 mm maintenance hole, which will then allow the flows to drain to storm Trunk 23 (per the SIS Addendum), and be conveyed to the east forebay of SWM Pond S5B-2. Storm trunk layout is attached in **Appendix B**.

The drainage area and imperviousness breakdown of the catchment area to the SWM Pond S5B-2 is included in Appendix C. As shown, the proposed drainage area to the SWM Pond S5B-2 is 44.30 ha, with an imperviousness of 73% (or 32.47 impervious-ha). These are less than what was assumed by the SIS Addendum (DSEL, February 2023), which assumed a total drainage area of 44.5 ha with an impervious drainage area of 32.48 impervious-ha. Therefore, the proposed drainage area is in compliance with the SIS Addendum.

2.4 Proposed Stormwater Management Plan

2.4.1 Quantity Control

The proposed end-of-pipe SWM facility (SWM Pond S5B-2) will control proposed flows from the site to determined flow rates based on the Wood Hydrologic Assessment Memo. The preliminary design requirements of the end-of-pipe SWM facility are discussed further in **Section 2.5**.

2.4.2 Quality Control

Quality control will be provided by the proposed SWM Pond S5B-2, which will be sized for a minimum of 80% TSS removal. The preliminary water quality sizing requirements of the SWM pond is discussed further in **Section 2.5.1**. A review of Low Impact Development (LID) treatment options has also been provided in the SIS, which will provide supplementary quality control where implemented.

2.4.3 Erosion Control

Erosion control criteria has been determined by the Wood Hydrologic Assessment Memo, and will be provided by the SWM Pond S5B-2. The preliminary design requirements of the wet pond are discussed further in **Section 2.5.2**. The extended detention volume and release rate are based on the unitary rates established by the Wood Hydrologic Assessment Memo, and summarized in **Section 2.1.1**.

2.4.4 Water Budget

Where feasible, measures to minimize impacts on the water budget will be incorporated into the development design. As noted in the site-specific Water Balance Assessment prepared by R.J. Burnside (**Appendix B),** the estimated existing infiltration volume on the subject lands is approximately 45,600 m^3. Without mitigation the proposed development infiltration volume is approximately 18,200m^3 (a 60% decrease from existing conditions).

As recommended in the water balance done for the SIS, low impact development measures, such as increased topsoil depth of 450 mm on pervious areas not including boulevards, 300 mm of topsoil on boulevards, and wetland pockets throughout the proposed channel will be implemented, where feasible, to maintain or increase existing infiltration rates. It is anticipated that a proposed infiltration volume of approximately 34,000 m^3 can be achieved through the proposed mitigation measures (25% decrease from existing conditions).

2.5 Stormwater Management Pond S5B-2

SWM Pond S5B-2 is located along the west boundary of the development and will outlet to the realigned Omagh Tributary (as per the SIS, discussed further in **Section 2.6**), which runs through the site.

SWM Pond S5B-2 is proposed to provide quantity, quality and erosion control for the proposed development, as well as for the external future development areas to the east. The pond has been sized to accommodate a backwater condition (i.e. restrictive downstream condition), as the pond outlet will be below flood water elevations within the adjacent realigned Omagh Tributary.

The total drainage area, shown in **Figure 2.2** and **Appendix C** shows a total drainage area to the pond of 44.30 ha, in comparison to DSEL drainage area of 44.5 ha. Therefore, the pond is in compliance with the SIS Addendum. It is noted that the drainage areas will be refined at detailed design stage and the hydrology model will be updated to reflect the detailed design.

2.5.1 Permanent Pool

The function of the permanent pool is to provide sediment removal from the storm runoff conveyed to the pond. SWM Pond S5B-2 will be designed to provide permanent pool storage based on MECP's Enhanced Level 1 Protection for a wet pond (see Table 3.2, 2003 MECP Guidelines).

The required permanent pool volume of 8,455 m^3 was provided by DSEL is based on a total developed area draining to the pond of 44.5 ha with an imperviousness of 73% (see **Appendix B** for volumes). The available permanent pool storage is 21,501 m^3 (see **Figure 2.3** and calculations in **Appendix C**).

2.5.2 Extended Detention

The attenuation of the extended detention volume in the pond will provide erosion protection for the downstream watercourse as well as promote sediment removal for water quality. The extended detention volume for the proposed stormwater management facilities will be sized based on the detention required, as per the Wood Hydrologic Assessment Memo provided in the SIS Addendum.

Based on the storage volume requirement of 275 m^3 per impervious hectare and an overall site impervious area of 32.48 ha, the required extended detention volume for SWM Pond S5B-2 is 9,627 m^3 (see **Appendix C**). The peak unitary discharge for the extended detention volume is 0.0013 m^3/s, as proposed in the Wood Hydrologic Assessment Memo. The proposed hydrologic modelling will be updated by Wood, which includes extended detention modelling.

2.5.3 Quantity Control

The proposed pond will control flows from the proposed development to the required flow rates as outlined in the Wood Hydrologic Assessment Memo.

A summary of the resulting storage requirements for the SWM pond (outlined by the Wood Hydrologic Assessment Memo), as well as the stage-storage characteristics of SWM Pond S5B-2 are provided in **Table 2.4**.

Table 2.4: SWM Pond Storage Requirements and Provided Stage-Storage Characteristics

Pond Component	Requirements		Provided	
	Discharge (m^3/s)	Storage (m^3)	Stage (m)	Storage (m^3)
Permanent Pool	N/A	8,455	190.80	21,501
Extended Detention	0.058	8,933	191.38	8,933
25 Year	0.579	17,055	192.06	21,320*
100 Year	1.268	23,552	192.24	25,060*
Regional	3.382	43,043	193.23	47,380*

*Based on Restrictive D/S Conditions (DSEL, 2023)

The proposed hydrologic modelling will be updated by Wood at the detailed design stage, which includes quantity control modelling. When the outlet control structure and hydrologic modeling is updated at the detailed design stage, the calculations and model will need to account for the backwater condition caused by the realigned Omagh Tributary to confirm that the pond is not overtopped.

2.5.4 General Pond Design Criteria

Preliminary pond grading is provided on **Figure 2.3**. The pond block size was established based on the following general criteria outlined in the SIS Addendum, which include guidelines for Thermal Mitigation as required by MNRF:

- A sediment forebay length to width ratio of approximately 4:1;
- A forebay depth of 1.5 m;
- A maximum normal water level depth of 3.0 m, graded with a maximum slope of 3:1, as per MNRF guidelines;
- An extended detention depth of 1.0, graded with a maximum slope of 5:1;
- Total active storage depth of 1.8 m, graded with a maximum slope of 5:1;
- Containment of the 10 mm storm event within the bottom 1.5 m of the permanent pool volume;
- A 4 m wide maintenance access road will be provided from a proposed municipal road with a maximum longitudinal slope of 10% and a crossfall of 2% (max). It will be used to facilitate machinery to access the forebay during

scheduled maintenance as well as to access the outlet structure for maintenance purposes;

- A 3.0 m wide flat shelf is to be provided 0.30 m below the normal water level to allow for wetland planting as per MNRF guidelines; and
- A bottom draw outlet located a minimum of 2.5 m below the normal water level.

2.5.5 Emergency Overland Flow

The emergency outlet from the pond will be graded such that the highest elevation of the overland flow will be less than the lower contour elevation of the pond buffer. This will ensure that the Regional Storm water level will not inundate any part of the pond buffer.

2.6 Omagh Tributary (Tributary SE-3-B)

As per the SIS, the SE-3-B watercourse in the Omagh Tributary is classified as medium-constraint, and is subject to realignment. This portion of the tributary runs immediately through the west side of the site and is where the proposed SWM facility will outlet to.

Flows from up to the Regional storm event will be contained within the realigned channel with the following dimensions:

- Total minimum corridor width of 55 m;
- An allowance of approximately 5 m of 3:1 bank sloping;
- 10 m of buffer space from the top of bank on either side of the watercourse; and
- 5 m of buffer on one side for a walkway/multiuse trail, where applicable.

2.7 Storm Servicing

The storm sewer system (minor system) will be designed for the 5 year return storm as per the Town of Milton standards.

The major system flow drainage (up to the 100 year storm event) will generally be conveyed overland along the road right-of-ways. In order to convey the major system flow at the site's critical location, decreased tangent lengths for the proposed saw-toothed grading as well as steepened boulevards are required in select locations, which is discussed further in **Sections 5.0** and **2.8.**

The storm sewer will have a minimum slope of 0.25% for pipe greater than or equal to 600 mm diameter, and 0.5% for pipes less than or equal to 525 mm diameter. The allowable velocity range is 0.75-6.0 m/s. The preliminary layout for the proposed storm sewer within the subject lands is provided on **Figure 3.1**. Due to the depth of the storm sewer, sump pumps are required for all units that have basements. As requested by the Town of Milton, at the major system capture points, the pipes will convey the captured flow by surcharging without upsizing them to accommodate the additional flows.

The storm drainage system will be designed in accordance with the Town of Milton and MECP guidelines, including the following:

- Pipes to be sized to accommodate runoff from a 5 year storm event,
- Minimum Pipe Size: 300 mm diameter,
- Maximum Flow Velocity: 6.0 m/s,
- Minimum Flow Velocity: 0.75 m/s,
- Minimum Pipe Depth: 1.5 m to obvert.

The rainfall intensity will be calculated as follows, where 'i' is the rainfall intensity (mm/hour) and A, B, and C are as per **Table 2.5**:

$$i = A / (T_c + B)^c$$

Table 2.5: Rainfall Intensity Parameters

Return Period Storm	A	B	C
2 Year	779	6	0.8206
5 Year	959	5.7	0.8024
10 Year	1089	5.7	0.7955
25 Year	1234	5.5	0.7863
50 Year	1323	5.3	0.7786
100 Year	1435	5.2	0.7751

2.8 Overland Flow

Major system flows (greater than the 5 year up to the 100 year storm event) will be conveyed within the road right-of-ways to the pond. Right-of-way capacity calculations are provided in **Appendix G** and show that the major system flows can be safely conveyed within the proposed road right-of-ways. Modifications to the typical saw-toothed grading as well as major system capture, are required in order to meet the Town of Milton's criteria for the flow depth to not be greater than 0.15 m over the crown of the road and be contained within the right-of-way limit.

At the critical location on Street 1 (collector road), the maximum allowable depth of flow is 0.248 m above the gutter at the local low point (which is at the right-of-way limit and 0.070 m above the crown of the road) and 0.098 m above the gutter at the local high point.

At the critical location for the overland flow on Street 13 (between Street 11 and 12), the maximum allowable depth of flow is 0.255 m above the gutter at the local low point (which is 0.15 m above the crown of the road and coincident with the right-of-way limit) and 0.12 m above the gutter at the local high point. This is achieved by decreasing the tangents of the saw-toothed grading.

A sketch in **Appendix G** shows the maximum flow depths at the local high and low point, to achieve the objectives of the Town of Milton criteria.

FlowMaster calculations in **Appendix G** show the available right-of-way capacity to achieve the Town of Milton criteria. Major system runoff that exceeds the available right-of-way capacity is proposed to be captured at major system capture points, as shown on **Figure 2.2**.

Flows at the critical locations also adhere to the MNRF's criteria for floodplain stability for humans, as the 'Depth x Velocity' does not exceed 0.37 m^2/s (refer to calculations in **Appendix G**). Therefore, the road right-of-ways within the site have sufficient capacity to convey the major system flows in accordance with the Town of Milton criteria.

3.0 SANITARY SERVICING

3.1 Existing Sanitary Sewer System

There is no existing sanitary infrastructure within the site. The Water and Wastewater Area Servicing Plan (ASP) was completed by DSEL in 2018 (**Appendix B**) to determine infrastructure required for servicing the subject lands. As such, the site is now bound by existing sanitary sewers that were sized to accommodate the proposed development. There is an existing 900 mm diameter trunk sanitary sewer running south on James Snow Parkway between Louis St. Laurent Avenue and Britannia Road, which then connects to a 1500 mm diameter trunk sanitary sewer running west on Britannia Road.

As described in the ASP, the trunk sanitary sewers were sized to accommodate the proposed development, using an average population density of 90 people per hectare for residential areas, 40 people per hectare for the proposed school block, and 285 people per hectare for the major node, with land uses to be later refined at the detailed design stage. Sizing can be found in the excerpts from the ASP report in **Appendix B**. The existing sanitary pipe layout is shown on **Figure 3.1**.

3.2 Proposed Sanitary Sewer System

As per the conceptual sanitary design outlined in the ASP, a 300 mm diameter sanitary trunk is proposed on the main north-south collector road (Street 2) (Sanitary design sheet is attached in **Appendix D**), which turns into a 375 mm diameter trunk draining west along Old Britannia Road, before connecting to the existing sanitary manhole MH 3 at Fourth Line. The rest of the site is proposed to be serviced by local sanitary sewers. Sanitary servicing for the park bock is not required, as was noted by the Town of Milton. Sanitary flows will ultimately be conveyed to the Mid-Halton Wastewater Treatment Plant.

The preliminary layout and drainage areas for the proposed sanitary sewer are provided in **Figure 3.2.** The sanitary sewer system will be designed in accordance with the Regional Municipality of Halton and MECP criteria, including but not limited to:

- Residential Sanitary Generation Rate: 275 l/c/d,
- Commercial Sanitary Generation Rate: 24.75 m^3/ha/day,
- Peaking Factor: Harmon (Max. 5.0),
- Infiltration Rate: 0.286 l/s/ha
- Minimum Pipe Size: 200 mm diameter,
- Minimum Pipe Cover: 2.75 m,
- Minimum Actual Velocity: 0.60 m/s, and
- Maximum Velocity: 3.0 m/s.

As per Regional Municipality of Halton criteria, the following population densities were used to size the proposed trunks within the site:

- Single Unit: 55 people/hectare;

- Townhouse Units: 100 people/ hectare;
- Back-to-back units: 135 people/hectare;
- Major Node population density: 285 people/hectare, and
- School Block: 40 people/hectare.

Due to the depth of certain portions of the trunk sanitary sewer, a second shallow local sanitary sewer will be proposed where the sanitary trunk is deeper than 7 m, which occurs along the south portion of Street 2. The local sewer will minimize the depth of service connections from lots front this section of the trunk sanitary sewer. The local sanitary sewer will be constructed directly above the deeper sewer, with common manholes and internal drop structures.

4.0 WATER SUPPLY AND DISTRIBUTION

4.1 Existing Water Distribution

As per the ASP, there is an existing 900 mm diameter watermain running north-south on Fourth Line, which connects to a 750 mm diameter watermain on Louis St. Laurent Avenue, and a 1200 mm diameter watermain on Britannia Road. A 1200 mm diameter watermain also runs on Britannia Road (estimated in-service date of 2021) from Fourth Line west to Regional Road 25. The site is located within the water pressure area Zone 4.The existing watermain system is illustrated on **Figure 3.1**.

4.2 Proposed Water System

The preliminary layout for the proposed watermain system is provided on **Figure 3.1**. A water analysis has been prepared by MES and is attached in **Appendix E**. The development is proposed to be serviced via connections to Britannia Road, as well as to the development to the north of the subject lands, per discussions with MES. Water servicing for the park is not required, as was noted by the Town of Milton..

The watermain system will be designed in accordance with the Region of Halton criteria including:

- Average Daily Demand: 0.275 m^3/capita
- Maximum Daily Demand Peaking Factor: 2.25
- Maximum Hourly Demand Peaking Factor – Residential: 4.00
- Maximum Hourly Demand Peaking Factor – Community Services: 2.25

5.0 GRADING

5.1 Existing Grading Conditions

Under existing conditions, the site generally slopes to the west, towards the existing Omagh Tributary. The existing topography has slopes in the range of 0.30% to 2%. The ground surface elevations through the study area range from approximately 194.0 m at the northeast corner to approximately 191.0 m along the southwest boundary, where the site naturally outlets to the Omagh Tributary.

5.2 Proposed Grading Concept

In general, the proposed development will be graded in a manner which will satisfy the following goals:

- Satisfy the Town of Milton lot and road grading criteria including:
  - Minimum Road Grade: 0.5%
  - Maximum Road Grade: 6.0%
  - Minimum Lot Grade: 2%
  - Maximum Lot Grade: 5%
- Provide continuous road grades for overland flow conveyance;
- Minimize the need for retaining walls;
- Minimize the volume of earth to be moved and minimize cut/fill differential;
- Minimize the need for rear lot catchbasins; and
- Achieve the stormwater management objectives required for the proposed development.

A preliminary grading plan is provided on **Figure 5.1**.

Saw-toothed road grading is proposed throughout the site in order to minimize required earthworks import. The average grade of the saw-toothing is shown on **Figure 5.1**. The site is graded to minimize steep sloping along the interface of the north east site boundary and James Snow Parkway South.

Along Street 13 it is proposed that the tangents used for the saw-toothing are shortened to minimize depth at local low points, in order to convey the major system flow without exceeding the right-of-way property line elevation. The proposed modifications are shown in **Figure 5.1**.

Retaining walls are proposed along the south boundary of the stormwater management pond, as well as along the back of lots 161-169, with an approximate maximum height of 1.5 m. The possibility of removing the retaining wall along blocks 161-189 was evaluated. Due to the bounding grades in the area, removing the retaining wall was not feasible as the existing grades adjacent to the rear yards are too low to provide a swale connection to the existing ditch on Britannia Road. A cross-section is provided in **Figure 5.4** to illustrate the retaining wall and lot grading.

At the detailed design stage, the preliminary grading shown on **Figure 5.1** will be subject to a more in-depth analysis in an attempt to minimize the import volume and minimize slopes and walls.

6.0 RIGHT-OF-WAYS AND SIDEWALKS

The proposed right-of-way cross-sections are provided in **Appendix F**. Overall, the right-of way will be constructed as per Milton's Standards. On Street 1 and 13, it is proposed that 3% boulevards be implemented in order to accommodate the major system overland flow conveyance. The proposed modified cross-sections are attached in **Appendix F**.

The proposed sidewalk location plan is provided on **Figure 5.2**. For the areas where sidewalk will be provided along one side of the street, sidewalks will be typically be located on north or east side of the boulevard or the boulevard side where the larger number of frontages can be serviced.

7.0 EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION

During the detailed design stage, erosion and sediment control measures will be designed with a focus on erosion control practices (such as stabilization, track walking, staged earthworks, etc.) as well as sediment controls (such as fencing, mud mats, catchbasin sediment control devices, rock check dams and temporary sediment control ponds). These measures will be designed and constructed as per the “Erosion and Sediment Control Guide for Urban Construction” document (TRCA, 2019). A detailed erosion and sediment control plan will be prepared for review and approval by the Municipality and Conservation Authority prior to any proposed grading being undertaken. This plan will address phasing, inspection and monitoring aspects of erosion and sediment control. All reasonable measures will be taken to ensure sediment loading to the adjacent watercourse and properties are minimized both during and following construction.

8.0 UTILITY CONSIDERATIONS

8.1 Hydro

Milton Hydro had no comment regarding the proposed plan. There is existing infrastructure within the assessed area, around the intersection of Britannia Road and James Snow Parkway.

8.2 Gas

The development plan has been circulated to local gas suppliers and no concerns regarding the proposed plan were raised.

8.3 Bell

Bell had no comments or concerns regarding the proposed plan.

8.4 Cable

Rogers had no comments regarding the proposed plan.

9.0 SUMMARY

This Functional Servicing and Stormwater Management Report has been prepared in support of the Draft Plan of Subdivision and Zoning By-law Amendment applications for the proposed Sundial Homes (4th Line) Limited development in the Town of Milton. This report outlines the means by which the proposed development can be graded and serviced in accordance with the Town of Milton, Conservation Halton, Region of Halton, and the Ministry of Environment, Conservation and Parks design criteria and policies.

General Information

- The existing land use is undeveloped and consists of pasture and farmland;
- The proposed development is located in the Sixteen Mile Creek subwatershed which outlets to the Omagh Tributary; and
- The proposed development consists of low and medium density residential units, as well as a SWM Pond Block, major node area, a school and proposed road.

Stormwater Management and Storm Servicing

- Quality Control: MECP Enhanced (Level 1) water quality protection can be provided through the proposed SWM wet pond;
- Erosion Control: Extended detention storage to accommodate 275 m^3/impervious-hectare with a maximum release rate of 0.0013 m^3/s/ha will be provided by the SWM wet pond. This value was set by the Wood Hydrologic Assessment Memo;
- Quantity Control: Quantity control will be provided via a SWM wet pond to control proposed runoff rates in the 2 through 100 year and Regional storm events to the unitary release rates set by the Wood Hydrologic Assessment Memo;
- Water Budget: R. J. Burnside has completed a water budget analysis to demonstrate that the proposed annual infiltration rates will be reduced by 25% with the proposed development and implementation of proposed BMP's;
- Storm Servicing:
  - Storm runoff will be conveyed by storm sewers designed in accordance with Municipality and MECP criteria;
  - Storm sewers will generally be designed for the 5 year storm event; and
  - Adequate major system overland flow routes will be provided. Local adjustments to the local road right-of-way boulevard grade is required to contain the major system overland flow; and
  - Major system capture is required on Street 1 and Street 13.
- Existing external drainage will be accommodated through the proposed development via a municipal storm sewer.

Sanitary Sewage Disposal

- The sanitary sewer will be designed in accordance with the Regional Municipality of Halton Water and Wastewater Linear Design Manual;
- The proposed sanitary sewer system will connect to the existing sanitary manhole MH3 at the intersection of Fourth Line and Britannia Road;
- The existing sewers that bound the site has capacity to service the proposed development as confirmed in the ASP.

Water Supply

- There are existing municipal watermains on Fourth Line, Louis St. Laurent Avenue and Britannia Road;
- The development is proposed to be serviced by connections to Britannia Road, as well as the proposed development to the north;
- MES has completed a watermain hydraulic analysis to show that there are sufficient domestic and fire flows to service the development; and
- Water supply allocation is required from the Halton Region.

Grading

- The proposed development grading has been developed to match to the existing surrounding grades, and provide conveyance of stormwater runoff, including external drainage;
- Saw-toothed road grading is proposed to minimize the soil import volume, and
- The lot grading will be subject to further grading design at the architectural design stage prior to the building permit applications.

Right-of-Ways and Sidewalks

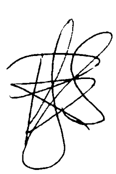
- Right-of-ways and sidewalks are proposed as per Town of Milton Engineering Guidelines;
- It is proposed that the boulevards of Street 1 and 13 be 3% in order to accommodate the major system overland flow from the area.

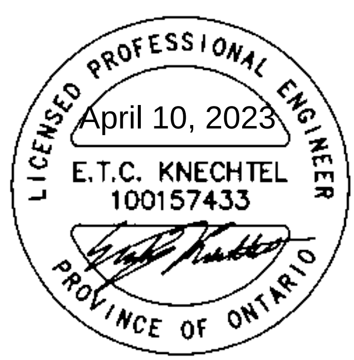
Erosion and Sediment Control during Construction

- An erosion and sediment control plan will be prepared at the detailed engineering stage, in accordance with the "Erosion and Sediment Control Guide for Urban Construction" document (December 2019).

Respectfully Submitted:

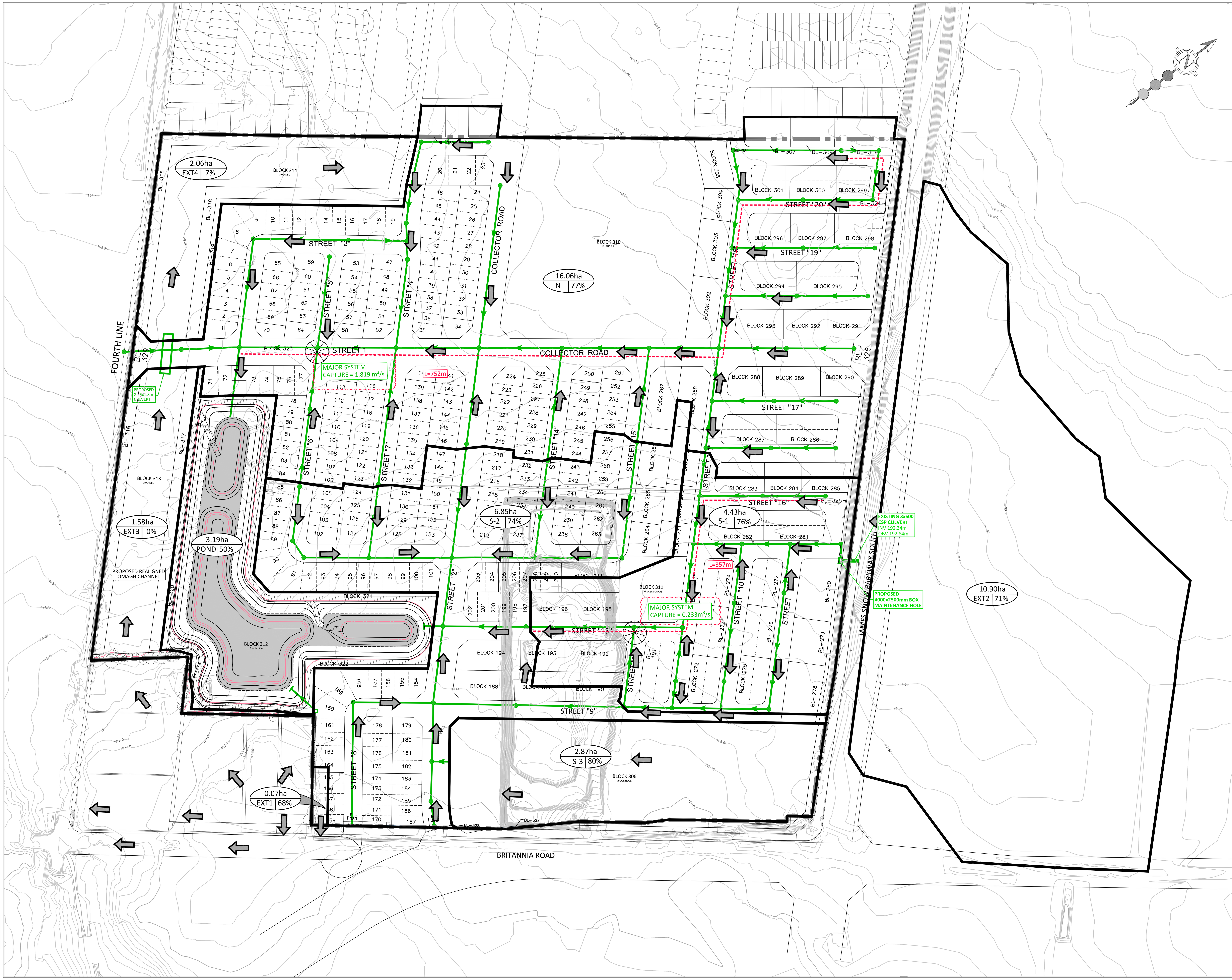
SCS Consulting Group Ltd.





Raquel Jara Soto , EIT
rjarasoto@scsconsultinggroup.com

Erich Knechtel, P.Eng.
eknechtel@scsconsultinggroup.com



LEGEND:

- PROPERTY LIMIT
- STORM DRAINAGE BOUNDARY
- PROPOSED STORM SEWER AND MANHOLE
- EXISTING STORM SEWER AND MANHOLE
- EXISTING CONTOUR AND ELEVATION (192.50)
- MAJOR SYSTEM - OVERLAND FLOW
- 0.80ha / 201 / 46%: DRAINAGE AREA (HECTARES); PERCENT (%) IMPERVIOUS; CATCHMENT ID
- MAJOR SYSTEM CAPTURE LOCATION
- TIME TO PEAK LENGTH

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

SCS consulting group ltd
30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

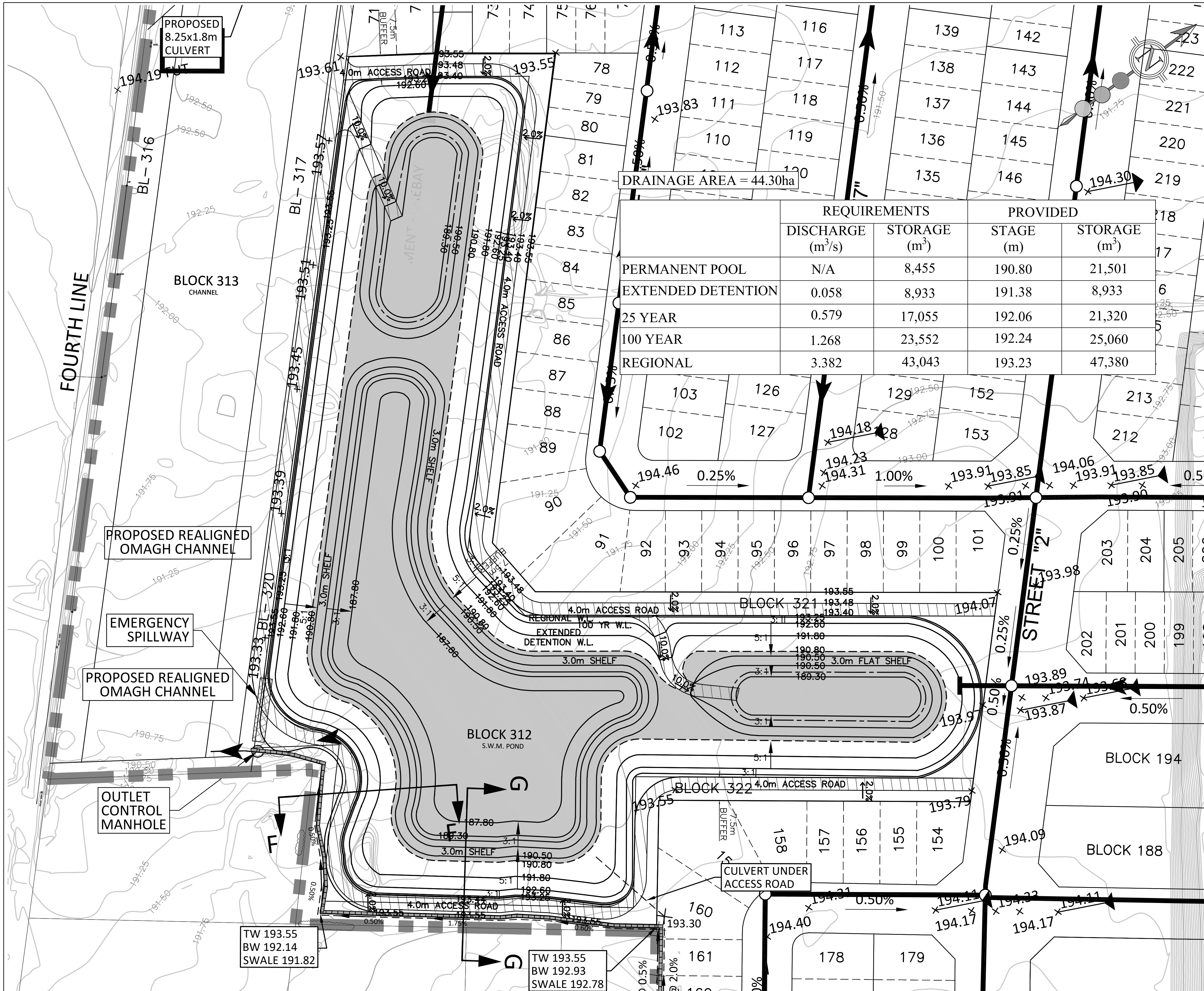
SUNDIAL HOMES (4th LINE) LIMITED

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

PROPOSED STORM DRAINAGE PLAN

DESIGNED BY:	R.J.S.	CHECKED BY:	E.T.C.K.
SCALE:	1:1500	DATE:	APRIL 2023
PROJECT No:	2084	FIGURE No:	2.2

File: P:\2084 Sundial Milton 4th\Drawings\FSP\Fig\Report Figures\2084P-STRM-PROP-2.2.dwg - Revised by <DDILAY> : Wed, Mar 01 2023 - 9:26am



DRAINAGE AREA = 44.30ha

	REQUIREMENTS		PROVIDED	
	DISCHARGE (m^3/s)	STORAGE (m^3)	STAGE (m)	STORAGE (m^3)
PERMANENT POOL	N/A	8,455	190.80	21,501
EXTENDED DETENTION	0.058	8,933	191.38	8,933
25 YEAR	0.579	17,055	192.06	21,320
100 YEAR	1.268	23,552	192.24	25,060
REGIONAL	3.382	43,043	193.23	47,380

LEGEND:

- LIMIT OF PROPERTY
- SWM POND CONTOUR AND ELEVATION (204.00)
- EXISTING CONTOUR AND ELEVATION (204.00)
- PROPOSED POND SLOPE (3:1)
- PROPOSED ELEVATION (× 193.51)
- RETAINING WALL
- PROPOSED STORM SEWER
- SWM MAINTENANCE ACCESS ROAD
- NORMAL WATER LEVEL
- REAR LOT CATCHBASIN
- PROPOSED SWALE

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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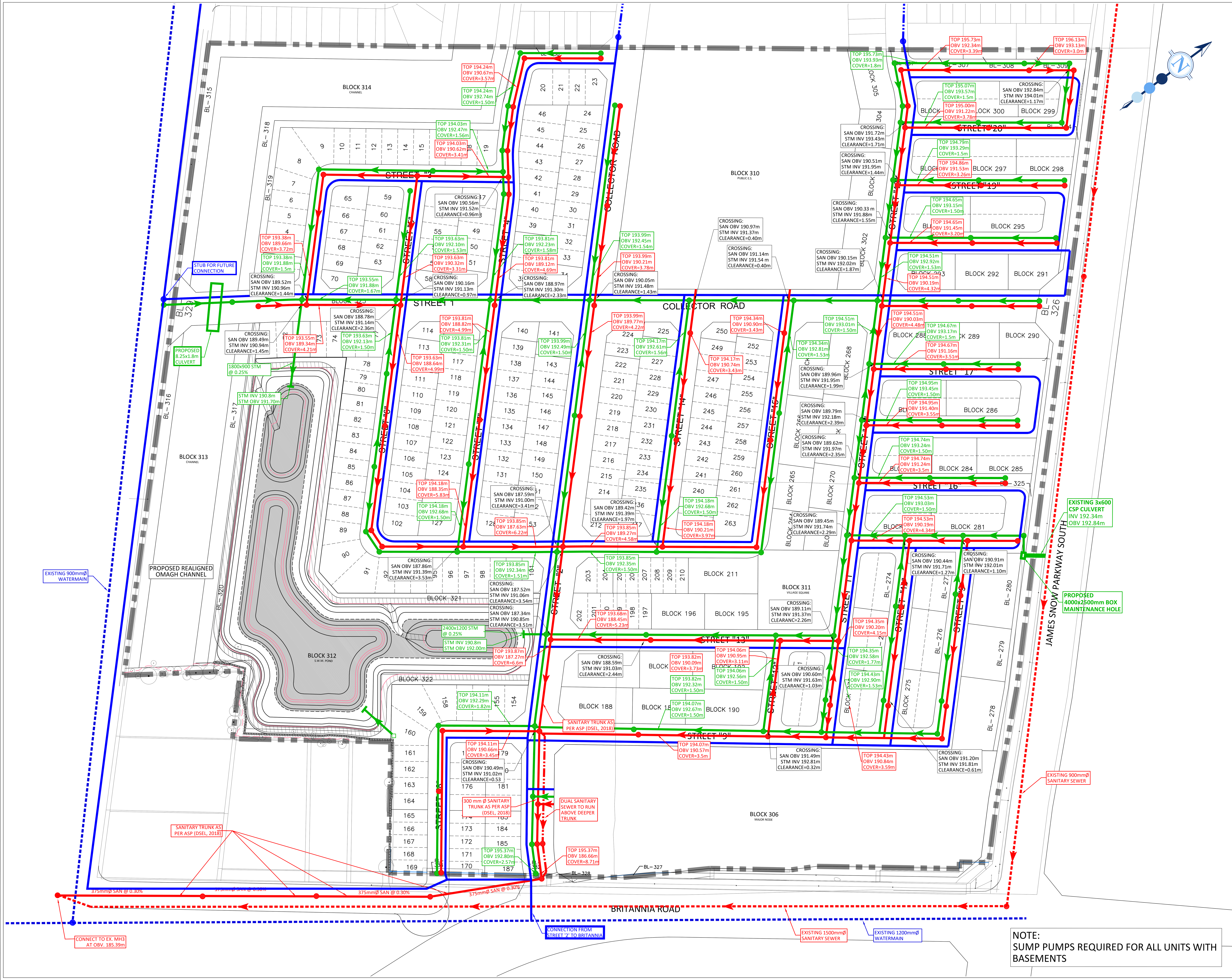
SUNDIAL HOMES (4th LINE) LIMITED

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

PROPOSED SWM POND S5B-2

DESIGNED BY:	R.J.S.	CHECKED BY:	E.T.CK.
SCALE:	1:1250	DATE:	APRIL 2023
PROJECT No:	2084	FIGURE No:	2.3



LEGEND:

- PROPERTY LIMIT
- PROPOSED STORM SEWER AND MANHOLE
- PROPOSED SANITARY SEWER AND MANHOLE
- EXISTING SANITARY SEWER AND MANHOLE
- PROPOSED SHALLOW LOCAL SANITARY SEWER
- PROPOSED WATERMAIN
- EXISTING WATERMAIN
- FUTURE WATERMAIN
- PROPOSED CONNECTION TO EXISTING WATERMAIN
- REAR LOT CATCH BASIN

NOTE:
SUMP PUMPS REQUIRED FOR ALL UNITS WITH BASEMENTS

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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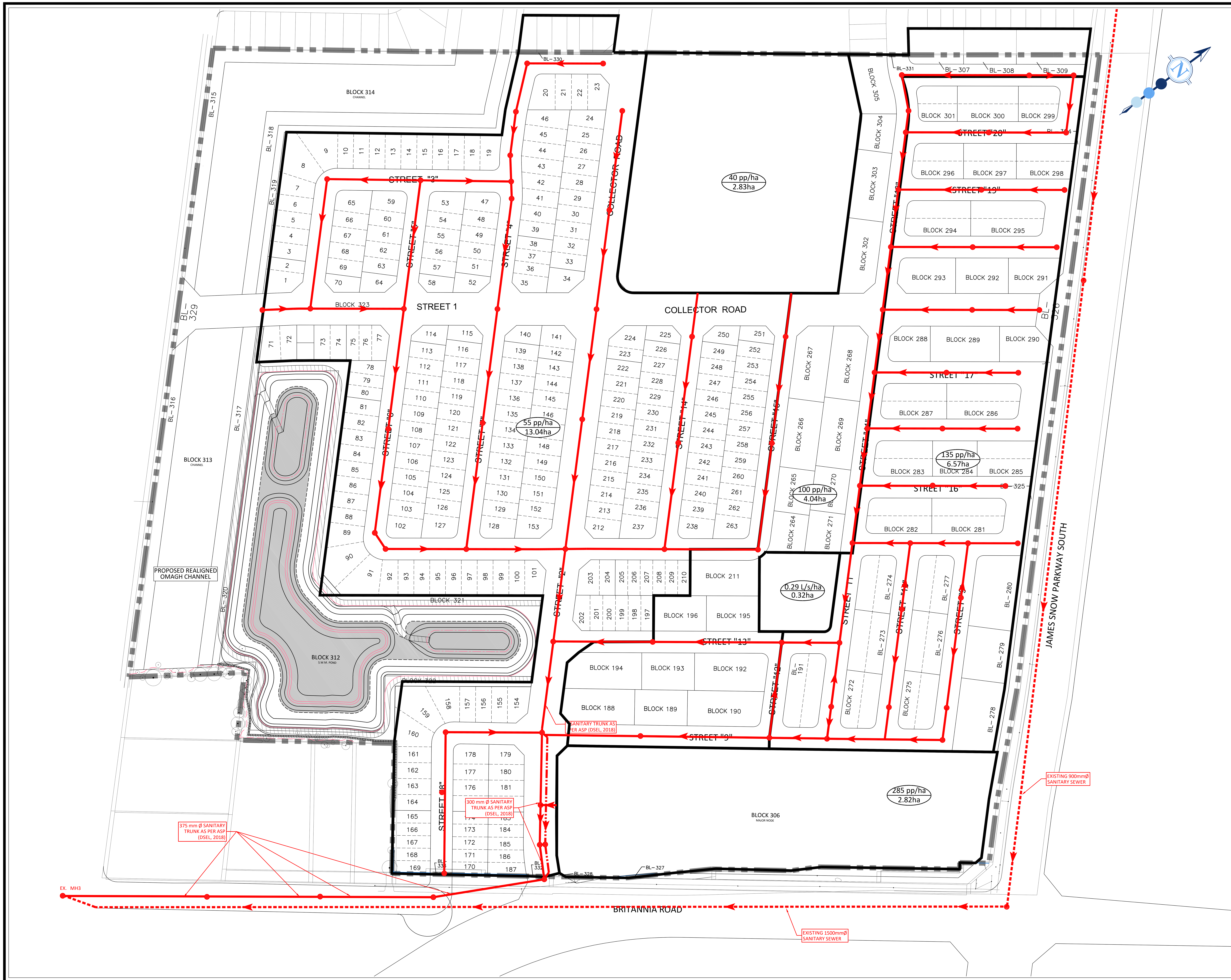
(4th LINE) LIMITED

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

PROPOSED SERVICING PLAN

DESIGNED BY:	R.J.S.	CHECKED BY:	E.T.C.K.
SCALE:	1:1250	DATE:	APRIL 2023
PROJECT No:	2084	FIGURE No:	3.1



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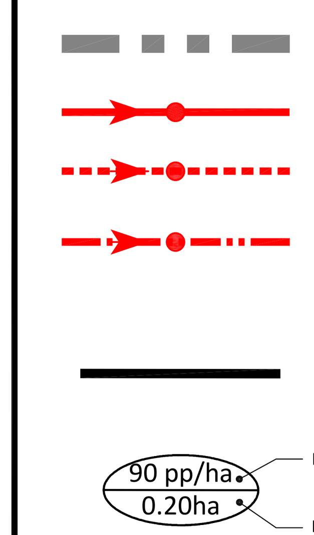

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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(4th LINE) LIMITED

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

SANITARY DRAINAGE PLAN

DESIGNED BY: R.J.S.	CHECKED BY: E.T.C.K.
SCALE: 1:1250	DATE: APRIL 2023
PROJECT No: 2084	FIGURE No: 3.2

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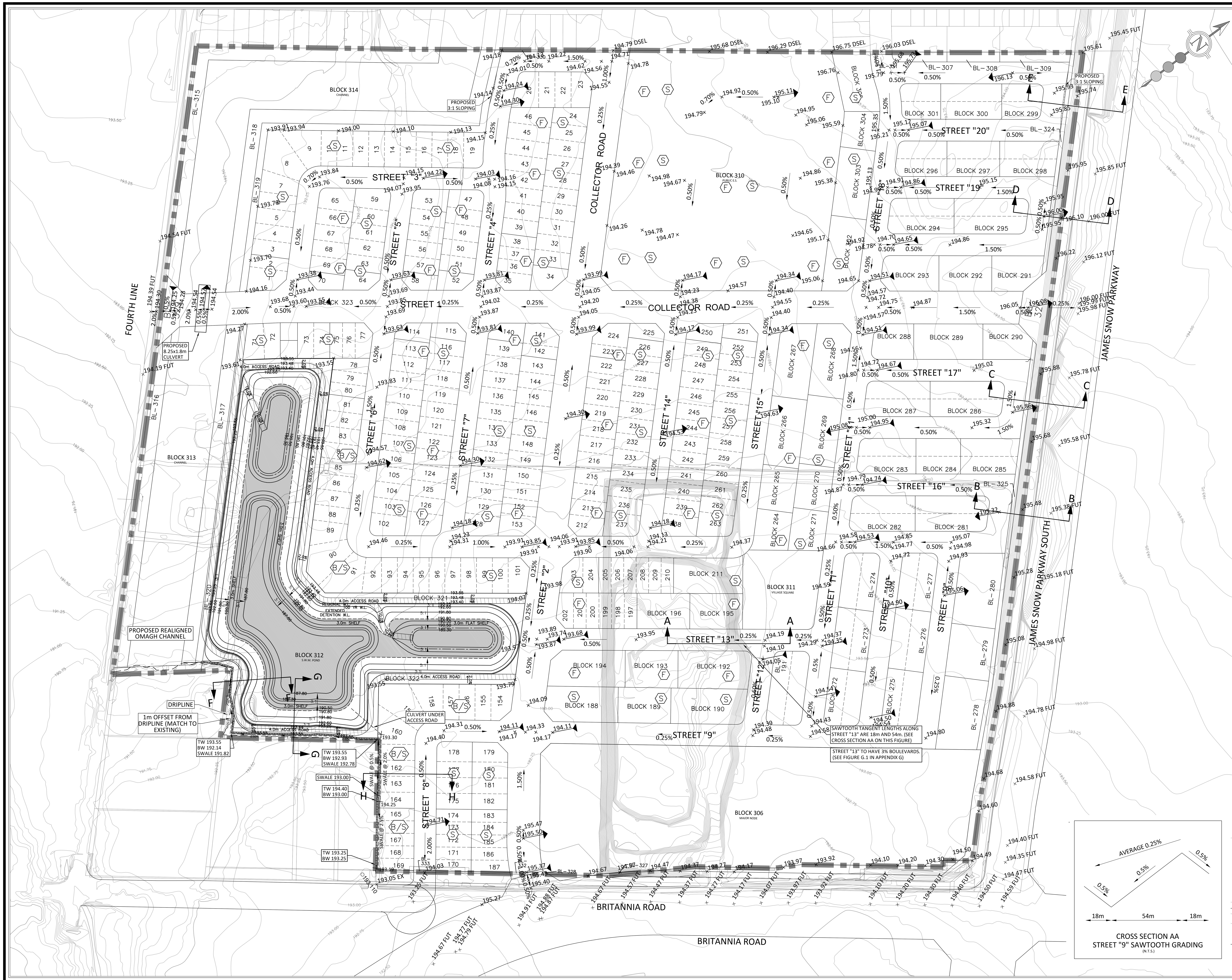

LEGEND:

	LIMIT OF PHASE/DEVELOPMENT
	LIMIT OF PHASE/DEVELOPMENT
× 223.91	PROPOSED ELEVATION
× 224.35FUT	FUTURE ELEVATION
× 224.35EX	EXISTING ELEVATION
× 223.91 DSEL	BOUNDARY ELEVATION (DSEL, 2020)
F	PROPOSED LOT TYPE (FRONT DRAIN)
S	PROPOSED LOT TYPE (SPLIT DRAIN)
B/S	PROPOSED LOT TYPE (BACKSPLIT)
W/O	PROPOSED LOT TYPE (WALKOUT)
2.0%	PROPOSED AVERAGE ROAD SLOPE
	REAR YARD SWALE
	RETAINING WALL

REFER TO FIGURES 5.3 AND 5.4 FOR CROSS-SECTION

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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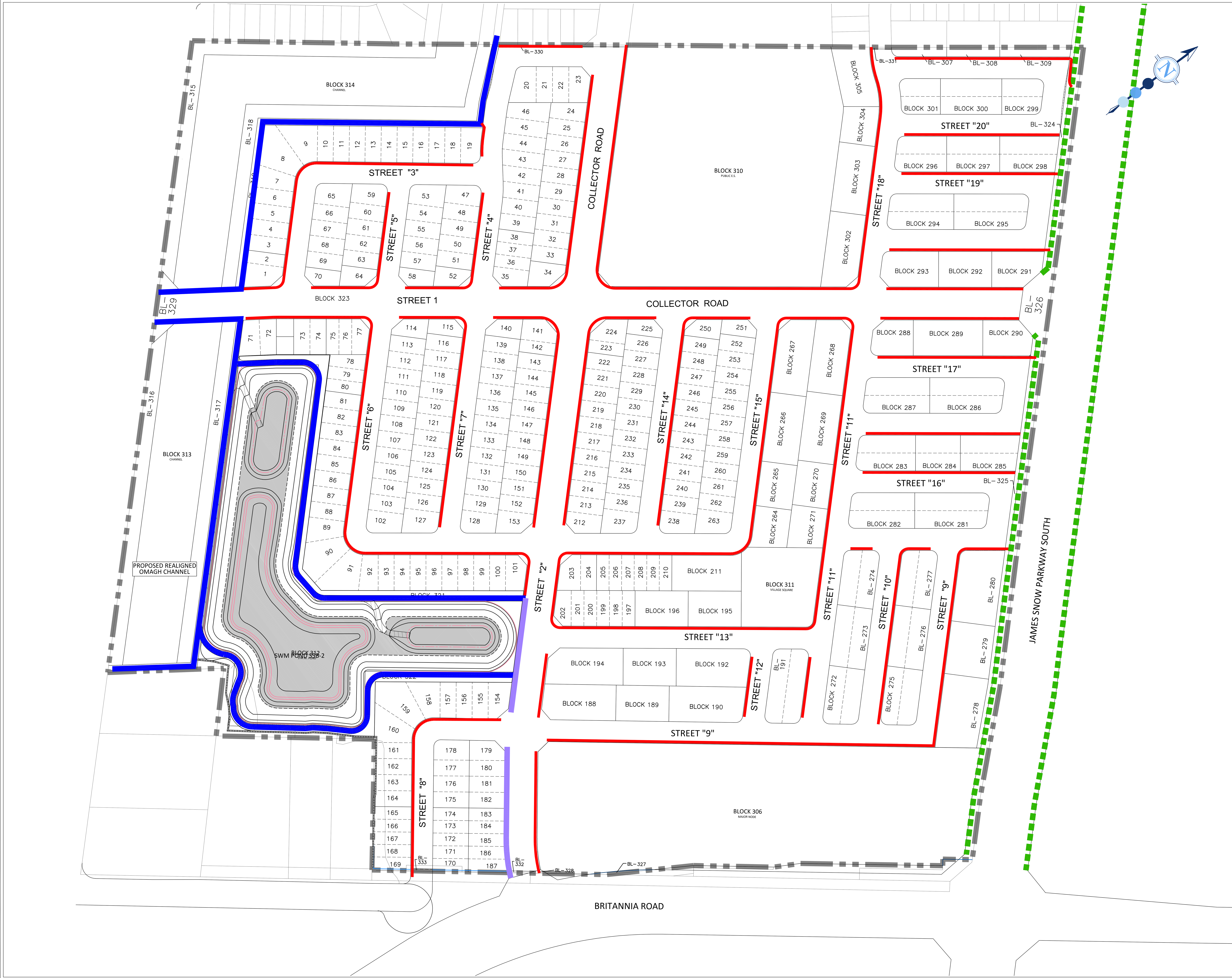
SUNDIAL HOMES (4th LINE) LIMITED

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

GRADING PLAN

DESIGNED BY:	R.J.S.	CHECKED BY:	E.T.C.K.
SCALE:	1:1250	DATE:	APRIL 2023
PROJECT No: 2084		FIGURE No: 5.1	



LEGEND:

- PROPERTY LIMIT
- PROPOSED SIDEWALK LOCATION
- PROPOSED MULTIUSE TRAIL (BY OTHERS)
- PROPOSED MULTIUSE TRAIL WITHIN CHANNEL OR SWM BLOCK
- PROPOSED MULTIUSE TRAIL

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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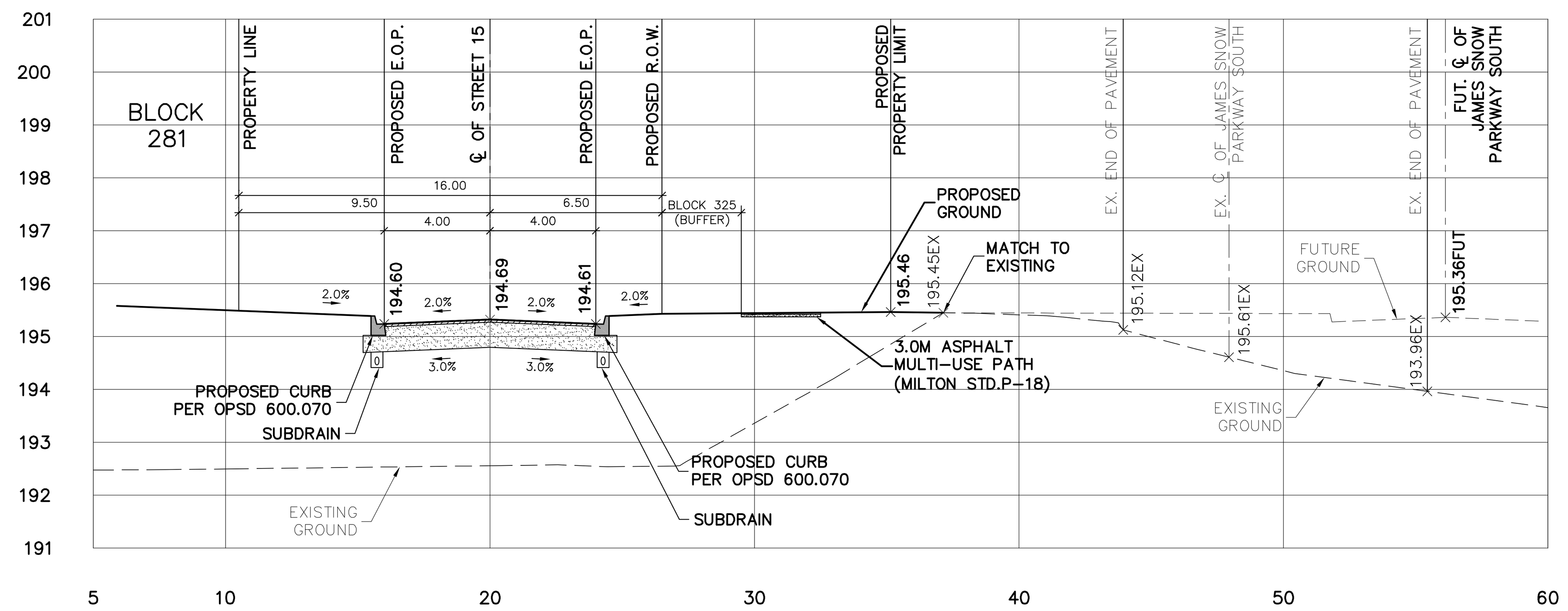
SUNDIAL HOMES
(4th LINE) LIMITED

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

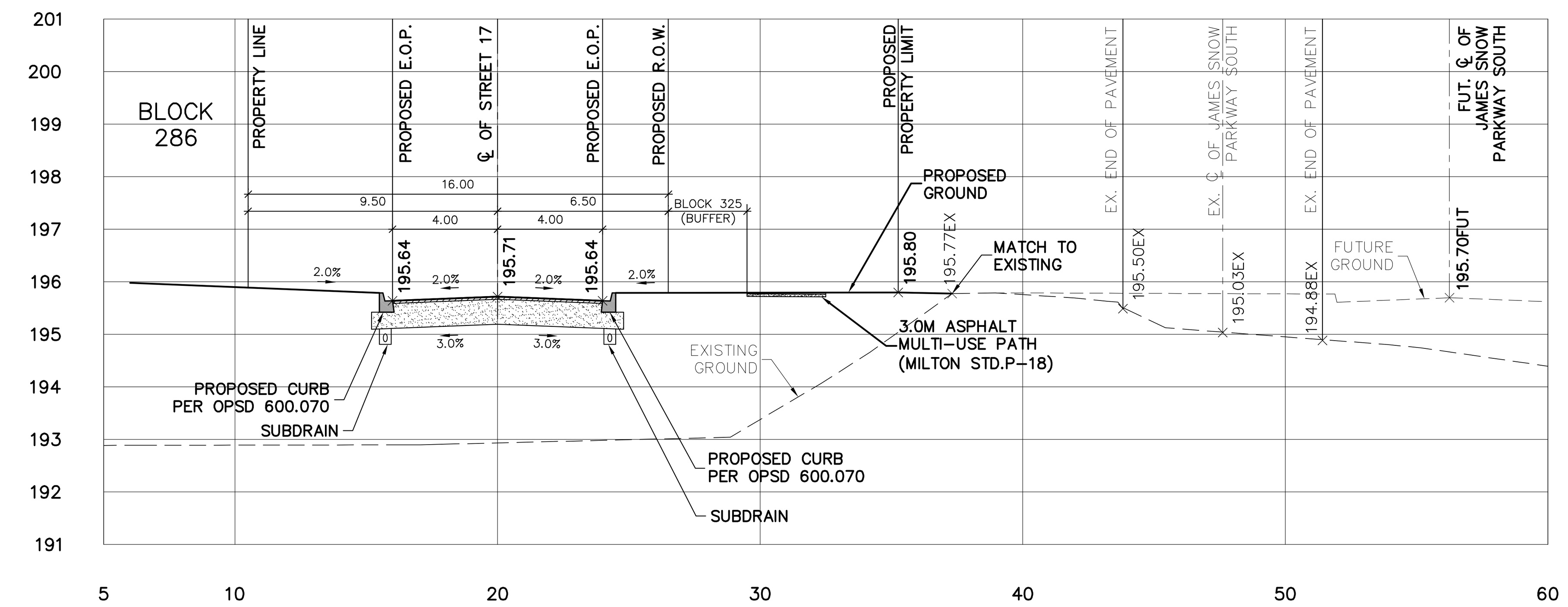
SIDEWALK LOCATION PLAN

DESIGNED BY:	R.J.S.	CHECKED BY:	E.T.C.K.
SCALE:	1:1250	DATE:	APRIL 2023
PROJECT No:	2084	FIGURE No:	5.2



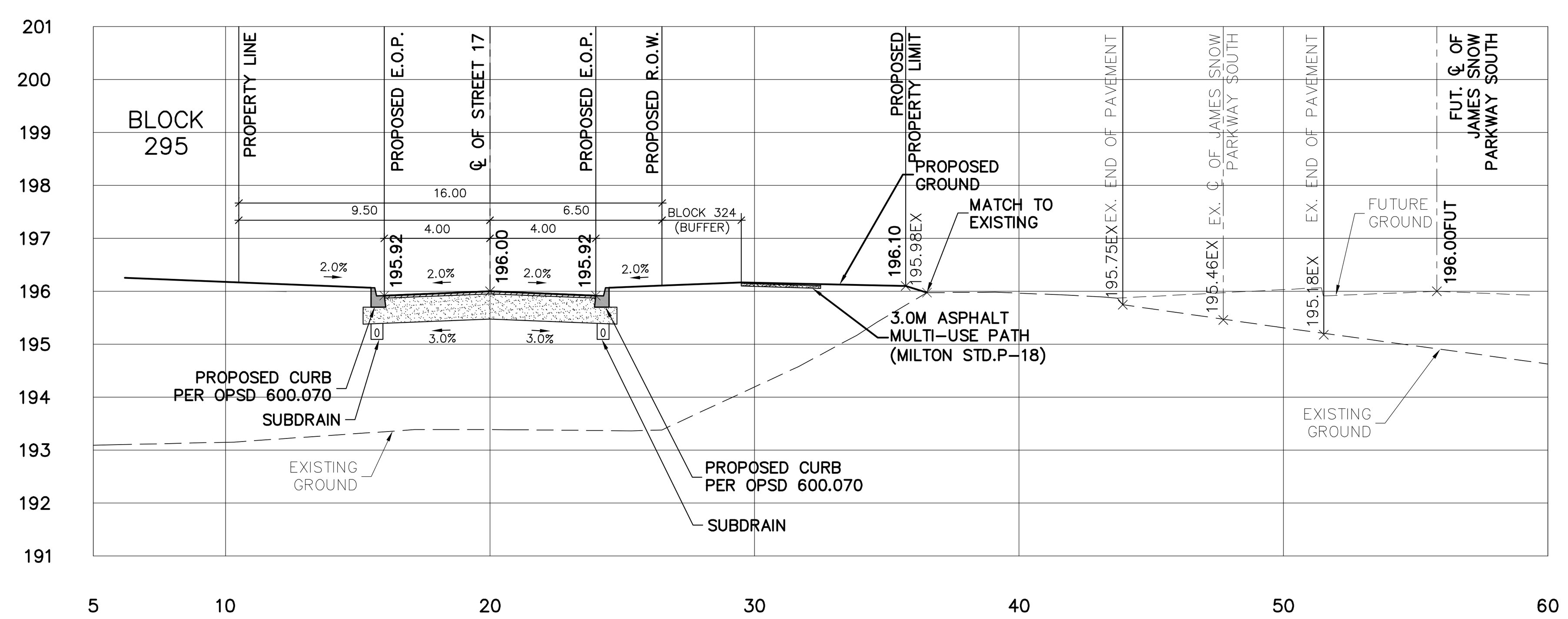
CROSS SECTION B-B

SCALE: H=1:200
V=1:100



CROSS SECTION C-C

SCALE: H=1:200
V=1:100



CROSS SECTION D-D

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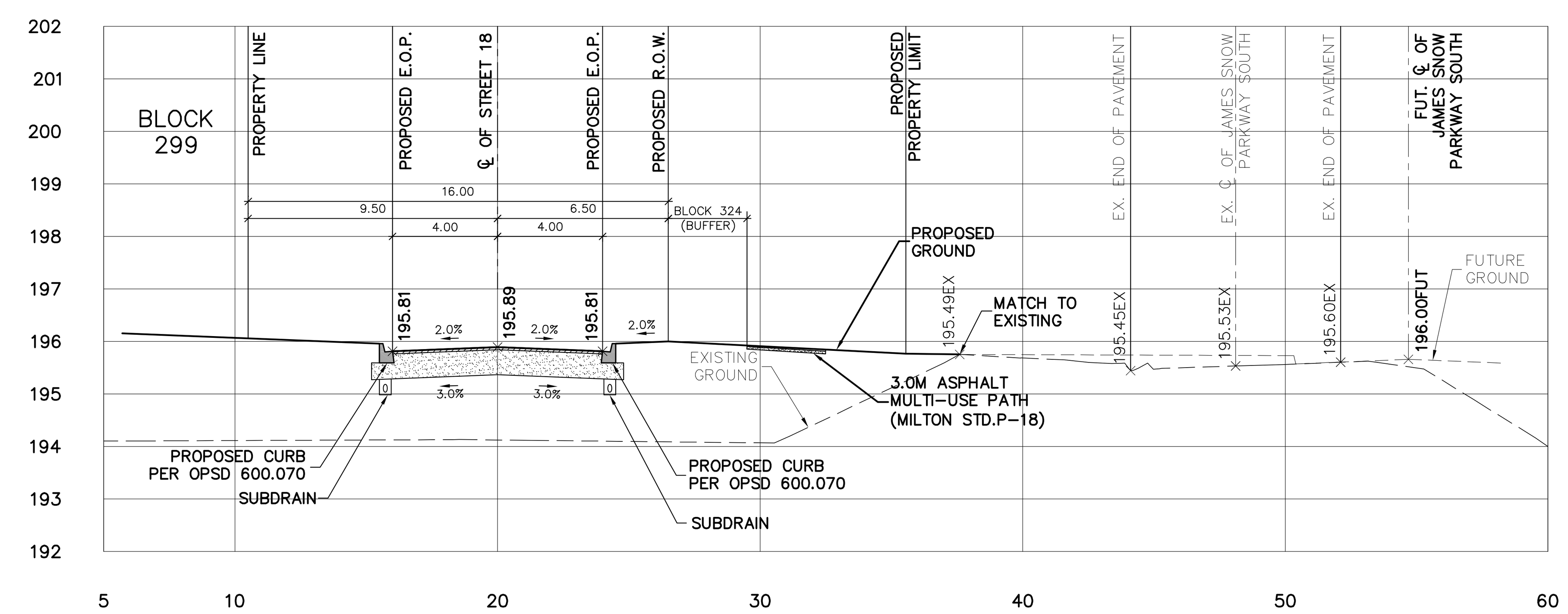
V=1:100



CROSS SECTION E-E

SCALE: H=1:200
V=1:100

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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SUNDIAL HOMES
(4th LINE) LIMITED

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

CROSS SECTION

DESIGNED BY:	R.J.S.	CHECKED BY:	E.T.C.K
SCALE:	AS SHOWN	DATE:	APRIL 2023
PROJECT No:	2084	FIGURE No:	5.3

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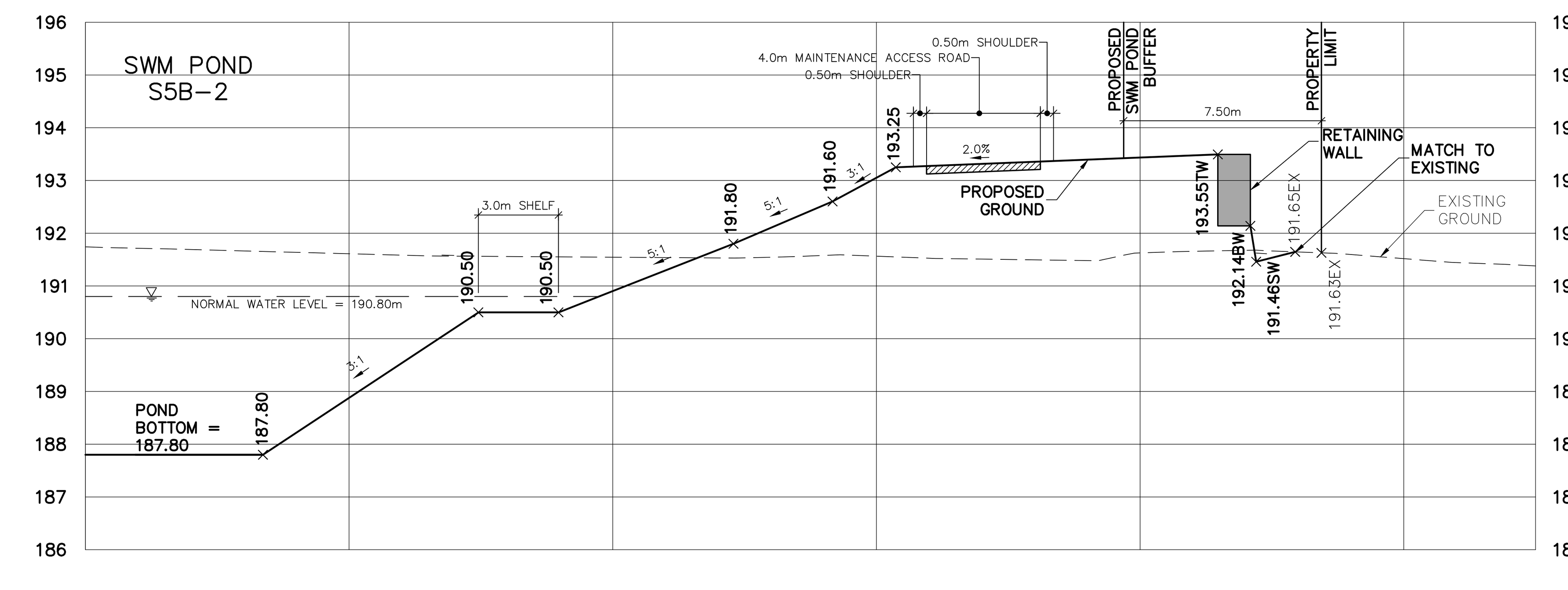

CROSS SECTION F-F

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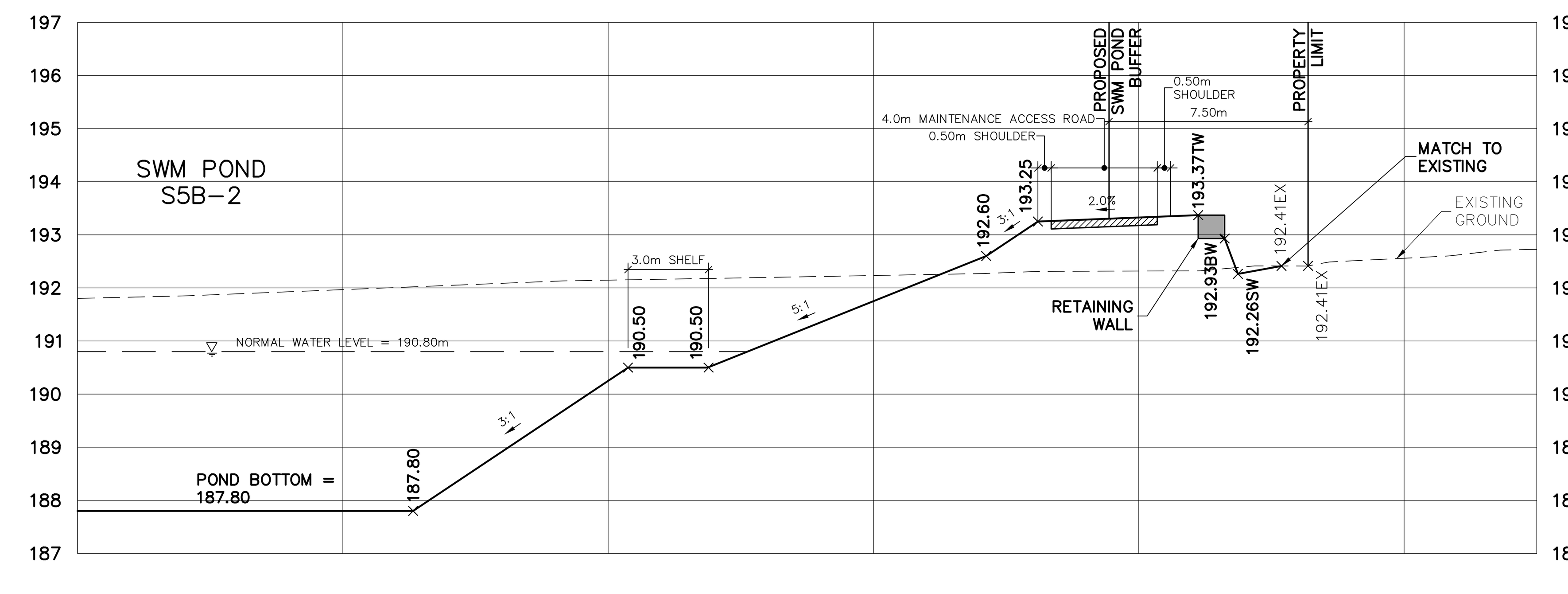
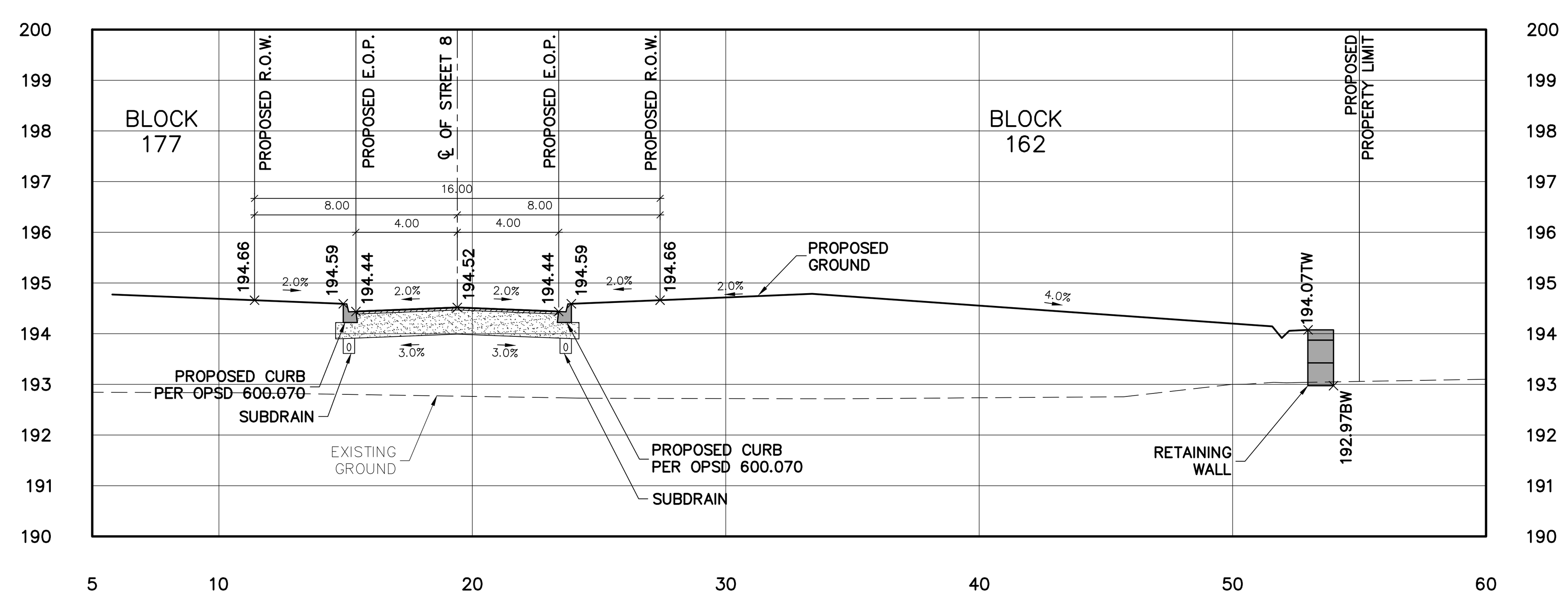
V=1:100



CROSS SECTION G-G

SCALE: H=1:200
V=1:100



CROSS SECTION H-H

SCALE: H=1:200
V=1:100

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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SUNDIAL HOMES
(4th LINE) LIMITED

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

CROSS SECTION

DESIGNED BY:	R.J.S.	CHECKED BY:	E.T.C.K
SCALE:	AS SHOWN	DATE:	APRIL 2023
PROJECT No:	2084	FIGURE No:	5.4

File: P:\2084 Sundial Milton 4th\Drawings\FSP\Fig\Report Figures\2084P-XSEC-5.2.dwg – Revised by <ESIRRS> : Mon, Apr 10 2023 – 6:42pm

APPENDIX A

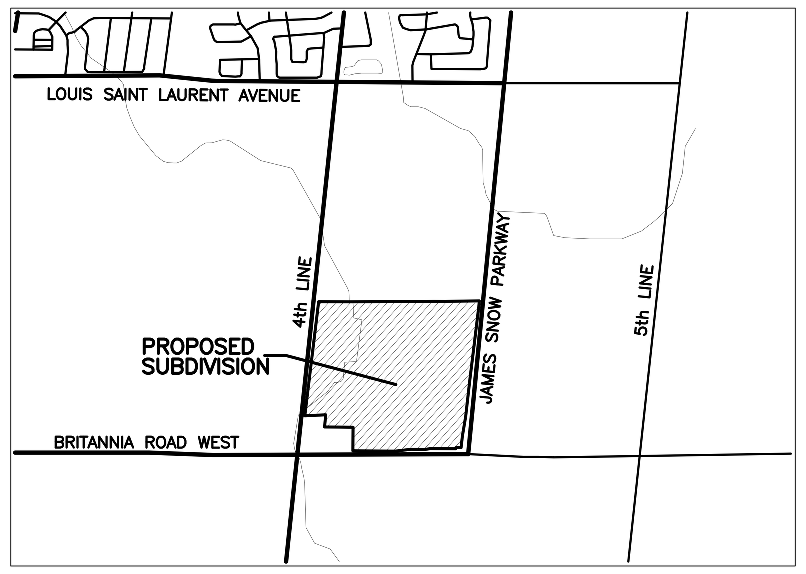
DRAFT PLAN

SCS consulting group ltd

DRAFT PLAN OF SUBDIVISION
PART OF LOT 6, CONCESSION 5, NEW SURVEY
(GEOGRAPHIC TOWNSHIP OF TRAFALGAR)
TOWN OF MILTON
REGIONAL MUNICIPALITY OF HALTON

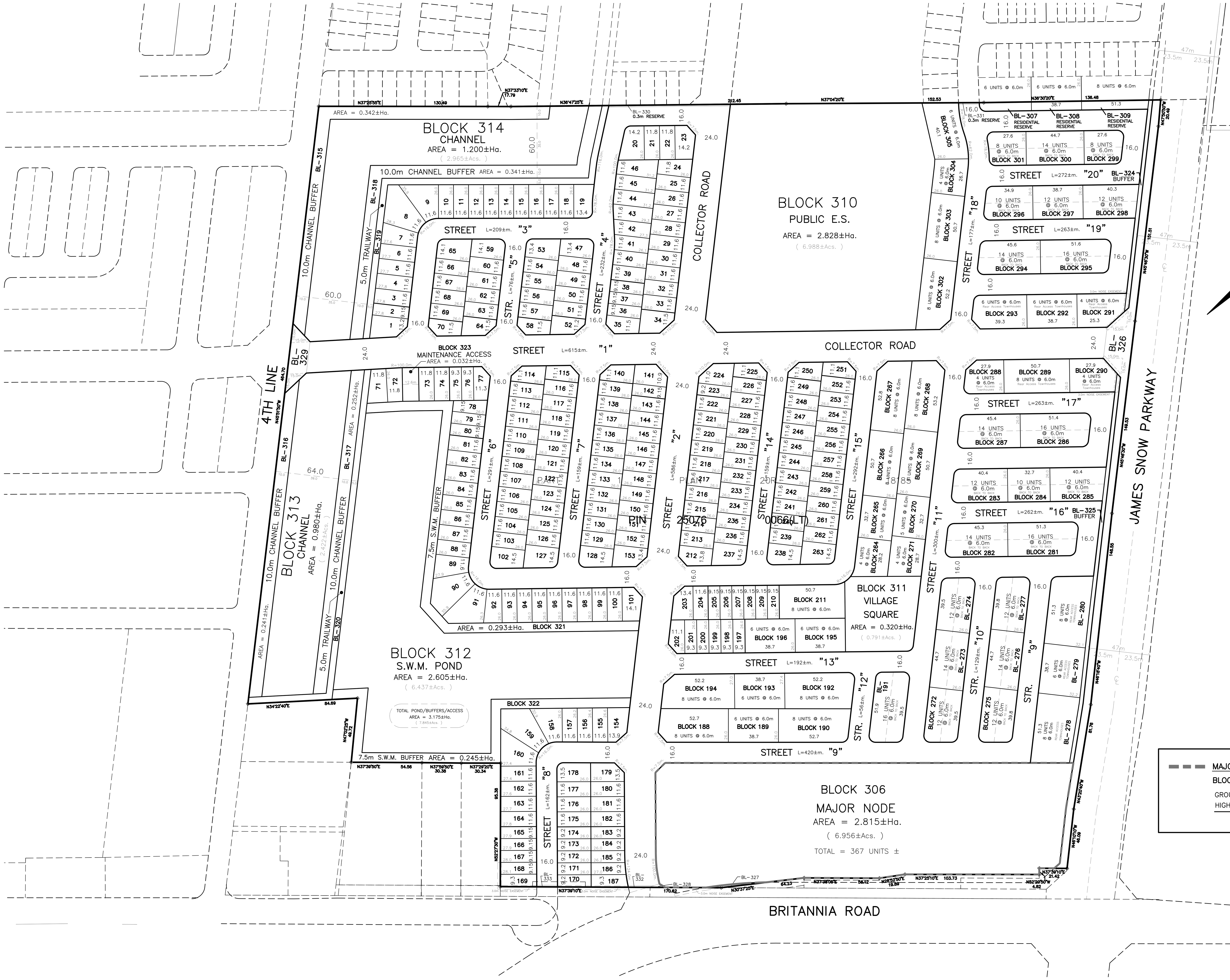
SCALE 1:1250

DRAFT PLAN T–



KEY PLAN

N.T.S.



SECTION 51, PLANNING ACT, ADDITIONAL INFORMATION

A. AS SHOWN ON DRAFT PLAN
B. AS SHOWN ON DRAFT PLAN
C. AS SHOWN ON DRAFT PLAN
D. SEE SCHEDULE OF LAND USE
E. AS SHOWN ON DRAFT PLAN
F. AS SHOWN ON DRAFT PLAN
G. AS SHOWN ON DRAFT PLAN
H. MUNICIPAL PIPED WATER AVAILABLE AT TIME OF DEVELOPMENT
I. CLAY–LOAM
J. AS SHOWN ON DRAFT PLAN
K. SANITARY AND STORM SEWERS, GARBAGE COLLECTION, FIRE PROTECTION
L. AS SHOWN ON DRAFT PLAN

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.

DATE ------------, 2023

SUNIL PERERA
ONTARIO LAND SURVEYOR

OWNER'S CERTIFICATE

I AUTHORIZE KLM PLANNING PARTNERS INC. TO PREPARE AND SUBMIT THIS DRAFT PLAN OF SUBDIVISION TO THE TOWN OF MILTON FOR APPROVAL.

OWNER

SUNDIAL HOMES (4th LINE) LIMITED

4576 YONGE STREET
SUITE 500
TORONTO, ONTARIO
M2N 6N4

ROBERT YANOWSKI
PRESIDENT

SCHEDULE OF LAND USE

TOTAL AREA OF LAND TO BE SUBDIVIDED = 36.670±Ha. (90.614±Acs)

DETACHED DWELLINGS	BLOCKS	LOTS	UNITS	±Ha.	±Acs.
LOTS 3–33. 39–51, 53–57, 59–63, 65–69, 71–74, 81–113, 116–139, 143–164, 175–182, 203–204, 212–222, 226–249 and 252–263 (MIN. LOT FRONTAGE=11.6m. MIN LOT AREA=301.60sq.m.)		199	199	6.390	15.790
LOTS 1–2, 34–38, 52, 58, 64, 70, 75–80, 114–115, 140–142, 165–174, 183–187, 197–202, 205–210, 223–225 and 250–251 (MIN. LOT FRONTAGE=9.15m. MIN LOT AREA=237.90sq.m.)		54	54	1.696	4.191
STREET TOWNHOUSES					
BLOCKS 188–190, 192–196, 211, 264–271 and 302–305 (MIN. UNIT FRONTAGE=6.0m.)	21		140	2.442	6.034
REAR ACCESS TOWNHOUSES					
BLOCKS 278–280 and 288–293 (MIN. UNIT FRONTAGE=6.0m.)	9		54	1.053	2.602
BACK TO BACK TOWNHOUSES					
BLOCKS 191, 272–277, 281–287 and 294–301 (MIN. UNIT FRONTAGE=6.0m.)	22		280	2.457	6.071
MAJOR NODE					
BLOCK 306	1		367 *	2.815	6.956
SUBTOTAL	53	253	1,094 *	16.853	41.644
BLOCK 307–309 – RESIDENTIAL RESERVE BLOCKS	3			0.089	0.219
BLOCK 310 – PUBLIC ELEMENTARY SCHOOL	1			2.828	6.988
BLOCK 311 – VILLAGE SQUARE	1			0.320	0.791
BLOCK 312 – STORMWATER MANAGEMENT POND	1			2.605	6.437
BLOCKS 313–314 – CHANNEL	2			2.180	5.387
BLOCKS 315–318 – CHANNEL BUFFER	4			1.176	2.906
BLOCKS 319–320 – TRAILWAY	2			0.329	0.814
BLOCKS 321–322 – S.W.M. BUFFER	2			0.538	1.329
BLOCK 323 – MAINTENANCE ACCESS	1			0.032	0.079
BLOCKS 324–325 – BUFFER	2			0.117	0.290
BLOCKS 326–329 – ROAD WIDENING	4			0.482	1.191
BLOCKS 330–333 – 0.3m RESERVE	4			0.007	0.019
STREETS (24.0m. WIDE TOTAL LENGTH=1,201±m. AREA= 2.882±Ha.; 16.0m. WIDE TOTAL LENGTH=3,914±m. AREA= 6.262±Ha.; TOTAL LENGTH=5,115±m. AREA= 9.144±Ha.)				9.114	22.520
TOTAL	80	253	1,094 *	36.670	90.614

NOTE – CANADIAN GEODETIC DATUM ELEVATIONS RELATED TO

NOTE – * SUBJECT TO FINAL CALCULATION

MAJOR NODE BREAKDOWN

BLOCK 306

GROUND RELATED TOWNHOUSES	= 72 UNITS	= 20%
HIGH DENSITY / APARTMENT	= 295 UNITS	= 80%
TOTAL	= 367 UNITS*	

PROJECT No. P-2181

SCALE 1:1250 APRIL 4, 2023

(2181DES31- 4TH LINE) - (2181MAS2 & 2181TOPO)

DWG. No. - 23:8

KLM PLANNING PARTNERS INC.
64 JARDIN DRIVE - UNIT 1B, CONCORD ONTARIO L4K 3P3
TEL: (905)669-4055 FAX: (905)669-0097 design@klmplanning.com

Planning • Design • Development

APPENDIX B

RELEVANT EXCERPTS

wood.

Memo

To: Rachel Ellerman, Town of Milton
Stephanie Vella, Town of Milton

From: Aaron Farrell/Abhijeet Patel

Date: September 2, 2022

File: TP113119

Re: **Supplemental Assessment of Stormwater Management Facility Optimization for Boyne Survey SIS 5B Area (Omagh), Town of Milton**

1. INTRODUCTION

As requested by the Town of Milton (ref. e-mail correspondence Ellerman-Farrell, May 26, 2022), and following authorization to proceed (ref. email correspondence Ellerman-Farrell, June 14, 2022), Wood has completed supplemental assessment to optimize the sizing of the stormwater facilities as proposed by David Schaeffer Engineering Ltd. et. al. within the Boyne Survey SIS 5B Area discharging toward the Omagh Tributary (ref., DSEL, March 2022). The analyses presented herein have built upon the previous hydrologic verifications completed for Boyne survey SIS 5B Area (ref. Farrell/Patel-Ellerman, April 20, 2022) and the recently completed verification of stormwater management facility S5B-7 for the Bayview-Lexis lands (ref. Farrell/Patel-Vella, August 15, 2022), and have specifically focused on optimizing the unitary sizing criteria for facilities S5B-1, S5B-2, S5B-3 and S5B-4 within the SIS Area. Consistent with the approach applied for the April 20, 2022 verification for the subject SIS Area, the hydrologic analyses for the optimization have considered the interim condition (i.e. prior to development of the McCann property) as well as the ultimate developed condition for SIS Area 5B. The following has been prepared to summarize the findings of this assessment.

2. PREVIOUSLY RECOMMENDED STORMWATER MANAGEMENT FACILITY SIZING

It was noted in the hydrologic verification conducted for Boyne Survey SIS Area 5B (ref. Farrell/Patel-Ellerman, April 20, 2022), based on the proposed stormwater management plan for Omagh Tributary by David Schaeffer Engineering Ltd. et. al. (ref., DSEL, March 2022), that the storage volumes proposed by DSEL for all SWM Facilities under interim and ultimate land use conditions were significantly higher (i.e., between +0.8% and +56.2%) than that required in accordance with the currently governing sizing criteria for all operating stages of the facility. Additionally, the release rates proposed by DSEL for all SWM Facilities under interim and ultimate land use conditions were noted to be significantly lower (i.e. differences/reductions ranging from -2.4% and -68.8%) than that required in accordance with the currently governing sizing criteria for all operating stages of the facility. Furthermore, under both the interim and ultimate land use conditions analyzed, the hydrologic analysis demonstrated that the proposed stormwater facility sizing would provide post-to-pre flood control up to and including the 100-year frequency flow condition at key locations (i.e., Node 7.302), however would fail to provide sufficient capacity to convey the 100-year frequency flow and Regional Storm peak flow rate at the designed operating condition. Additionally, the analyses demonstrated that the stormwater management facility sizes proposed by DSEL per the March 2022 SIS Addendum would also fail to provide post-to-pre flood control at key location (i.e., Node 7.302) for the Regional Storm event. Subsequently, a revised stormwater management sizing was suggested by Wood, as part of the April 20, 2022 verification, whereby the release rates would be modified to achieve the requisite 100 year capacity and quantity control. The analyses noted, however, that further refinement to the storage-discharge relationships could be completed, to optimize the sizing of the stormwater management facilities.

As noted in the most recent hydrologic verification for the Boyne Survey SIS Area 5B (ref. Farrell/Patel-Vella, August 15, 2022), the August 2022 revised stormwater management plan proposed by DSEL for the Bayview-Lexis development, combined with the stormwater management plan for the balance of the Boyne SIS 5B Area as proposed by David Schaeffer Engineering Ltd. et. al. (ref., DSEL, March 2022) would result in overcontrol for 2-100 year frequency flows at key downstream location (i.e., Node 7.302). This conclusion is consistent with the results from the April 20, 2022 hydrologic verification for the SIS Addendum. In addition, it the results noted that minor residual increases to downstream Regional Storm peak flow rates would occur under the interim land use condition analyzed. As such, it was recommended that additional analyses be completed as part of this optimization assessment for the SIS 5B Area to determine the unitary storage and discharge criteria, and corresponding storage-discharge relationships, which would be required in order to achieve the requisite flood control for the Omagh Tributary under both future land use conditions (i.e., interim and ultimate) within SIS Area 5B.

3. HYDROLOGIC ANALYSIS FOR SWM FACILITY OPTIMIZATION

The HSP-F hydrologic models for the interim and ultimate land use condition within the SIS 5B Area have been modified to incorporate the revised rating curve for the proposed SWM Facility S5B-7 (i.e., free outfall condition) for the Bayview-Lexis development. The unitary criteria for erosion control have not been changed since no revision to it has been warranted based on the previous hydrologic assessment. The unitary storage volumes for the operating conditions corresponding to the 25 year frequency flow, 100 year frequency flow, and Regional Storm event have been adjusted by increments of 25 m^3/impervious hectare until the requisite level of flood control has been achieved. In addition, the unitary release rates have also been adjusted by compared to the previously governing unitary release rates, until the requisite level of flood control has been achieved with minor differences to the frequency flows at the Omagh Tributary outlet from the SIS 5B Area. The updated unitary storage and discharge criteria for SIS Area 5B is presented in Table 1.

Table 1: Suggested Revised Unitary Storage and Discharge Criteria for Stormwater Management Facilities Within SIS 5B Area (Omagh Tributary)		
Operating Condition	Unitary Storage (m^3/Impervious Hectare)	Unitary Discharge (m^3/s/ha)
Extended Detention	275	0.0013
25 Year	525	0.0130
100 Year	725	0.0285
Regional Storm	1325	0.0760

The updated unitary storage and discharge criteria are noted to be comparable to the previously advanced criteria for stormwater management facilities within Boyne Survey area (ref. Farrell/Penney-Bateson, November 2016), however the unitary storage for the Regional Storm event is noted to be slightly higher than that previously required per the unitary criteria (i.e. 50 m^3/impervious ha higher). This slight increase is due to the required Regional Storm control under the interim land use condition, as a result of the revised rating curve for SWM Facility S5B-7 and the currently proposed stormwater management plan for the balance of SIS Area 5B.

Storage-discharge relationships have been developed for the end-of-pipe facilities within SIS Area 5B based upon the updated unitary sizing criteria presented in Table 1, and the size and imperviousness of the contributing drainage areas per the information presented in the March 2022 SIS. The resulting storage-discharge relationships have been compared with those presented in the March 2022 SIS Addendum. The results of this comparison are presented in Table 2.

Table 2: Comparison of Storage-Discharge Relationships for SWM Facilities within SIS Area 5B					
Quantity Component	Storage (m^3)		Discharge (m^3/s)		Difference in Storage Volume (m^3) (%)
	Proposed (DSEL, March 2022)	Suggested Revised (Wood, August 2022)	Proposed (DSEL, March 2022)	Suggested Revised (Wood, August 2022)	
SWM Facility S5B-1					
Erosion	7471	7411	0.037	0.039	-60(-0.8%)
25-year	17520	14149	0.279	0.501	-3371(-19.2%)
100-year	20980	19539	0.593	1.097	-1441(-6.9%)
Regional	37870	35709	2.983	2.926	-2161(-5.7%)
SWM Facility S5B-2					

Table 2: Comparison of Storage-Discharge Relationships for SWM Facilities within SIS Area 5B					
Quantity Component	Storage (m^3)		Discharge (m^3/s)		Difference in Storage Volume (m^3) (%)
	Proposed (DSEL, March 2022)	Suggested Revised (Wood, August 2022)	Proposed (DSEL, March 2022)	Suggested Revised (Wood, August 2022)	
Erosion	9644	8933	0.056	0.045	-711(-7.4%)
25-year	21640	17055	0.206	0.579	-4585(-21.2%)
100-year	25360	23552	0.633	1.268	-1808(-7.1%)
Regional	43530	43043	0.789	3.382	-487(-1.1%)
SWM Facility S5B-3					
Erosion	9971	9525	0.049	0.050	-446(-4.5%)
25-year	21530	18185	0.473	0.653	-3345(-15.5%)
100-year	26530	25113	0.789	1.431	-1417(-5.3%)
Regional	50270	45895	3.694	3.815	-4375(-8.7%)
SWM Facility S5B-4					
Erosion	5168	4966	0.022	0.025	-202(-3.9%)
25-year	11900	9518	0.118	0.319	-2382(-20%)
100-year	14540	13144	0.198	0.698	-1396(-9.6%)
Regional	29870	24022	1.875	1.862	-5848(-19.6%)

The results in Table 2 indicate that the suggested revised unitary criteria would reduce the storage volume requirements for SWM facilities by between 1.1% and 19.6%, compared to those proposed by DSEL per the March 2022 SIS Addendum.

The storage-discharge relationships corresponding to the revised unitary storage and discharge criteria have been incorporated into the HSP-F hydrologic model to represent the stormwater management facilities at the outlet of the respective drainage areas under both the interim and ultimate land use conditions. The HSP-F model has been executed for a 42-year continuous simulation, and frequency analyses have been completed using the Log Pearson Type III Distribution based upon the simulated annual maximum flows. In addition, the Regional Storm event has been simulated as a discrete storm event, and the simulated peak flows extracted from the model. The simulated peak frequency flows and Regional Storm event peak flows for the future land use conditions (i.e., interim and ultimate conditions) with the recommended stormwater management sizing criteria are summarized in Table 3, and the percent change in the frequency flows and Regional storm peak flows at downstream key locations, compared to existing conditions, are presented in Table 4.

Table 3: Simulated Peak Frequency Flows and Regional Storm Event Peak Flows At Key Locations Within SIS Area 5B Area Under Future Land Use Conditions per DSEL, March 2022 (m^3/s)								
Flow Node/Location	Frequency (Years)							Regional
	1.25	2	5	10	20	50	100	
Existing Land Use Conditions								
Node 7.302	1.02	1.48	2.25	2.87	3.56	4.59	5.48	17.9
Proposed Development and Stormwater Management as per DSEL, March 2022 – Interim land use conditions								
Node 7.302	0.96	1.45	2.25	2.87	3.54	4.51	5.33	17.9
SWM 5B-2	0.17	0.29	0.49	0.64	0.78	0.97	1.13	3.34
SWM 5B-3	0.20	0.33	0.55	0.72	0.89	1.13	1.32	3.79
SWM 5B-4	0.092	0.16	0.27	0.35	0.43	0.53	0.61	1.83
Proposed Development and Stormwater Management as per DSEL, March 2022 –Ultimate land use conditions								
Node 7.302	0.87	1.37	2.19	2.83	3.51	4.49	5.30	17.1
SWM 5B-1	0.15	0.26	0.43	0.55	0.68	0.86	1.00	2.90
SWM 5B-2	0.17	0.29	0.49	0.64	0.78	0.97	1.13	3.34
SWM 5B-3	0.20	0.33	0.55	0.72	0.89	1.13	1.32	3.79
SWM 5B-4	0.092	0.16	0.27	0.35	0.43	0.53	0.61	1.83

Table 4: Percent Change in Frequency Flows For Future Land Use and Stormwater Management Proposed by DSEL Compared to Existing Conditions (%)								
Flow Node/Location	Frequency (Years)							Regional
	1.25	2	5	10	20	50	100	
Proposed Development and Stormwater Management as per DSEL, March 2022 – Interim land use conditions								
Node 7.302	-5.9%	-2.0%	0.0%	0.0%	-0.6%	-1.7%	-2.7%	0.0%
Proposed Development and Stormwater Management as per DSEL, March 2022 – Ultimate land use conditions								
Node 7.302	-14.7%	-7.4%	-2.7%	-1.4%	-1.4%	-2.2%	-3.3%	-4.5%

The results in Tables 3 and 4 indicate that the suggested revised unitary criteria under the future land use conditions proposed by DSEL would provide post-to-pre control at the SIS Area 5B outlet for all events up to and including 100-year storm event and the Regional Storm event. Furthermore, the results indicate that the 100-year frequency flows and Regional Storm event peak flows at the outlets of the stormwater management facilities are less than the corresponding ordinates on the storage-discharge relationships for the stormwater management facilities, hence all stormwater management facilities would provide sufficient capacity for the 100 year frequency flow and Regional Storm operation conditions. It should be noted that while the ultimate conditions frequency flows and the Regional Storm peak flows indicate some overcontrol of peak flows at the outlet of the Omagh Tributary, further optimization of the facility sizing is not considered to be a viable option since the interim conditions represent the governing condition for the SWM facility sizing.

4. Summary of Findings

Based upon the foregoing, the following has been determined:

(i) Suggested revised unitary sizing criteria for the SWM Facilities within SIS Area 5B (i.e., S5B-1, S5B-2, S5B-3 and S5B-4) have been provided as outlined herein. The suggested revisions would modify the storage volumes as well as the release rates from the facilities for the respective SWM facilities.

(ii) Suggested revised unitary sizing criteria for the SWM Facilities within SIS Area 5B would reduce (i.e., between -1.1% and -19.6%) the total storage volumes compared to the volumes advanced by DSEL per the March 2022 SIS Addendum.

(iii) The interim land use condition represents the governing condition for establishing the suggested revised unitary sizing criteria, due to the residual increase to Regional Storm peak flow rates noted in the August 15, 2022 hydrologic verification for facility S5B-7.

(iv) The suggested revised unitary sizing criteria for the SWM Facilities presented herein for the corresponding drainage areas would provide sufficient capacity up to the 100-year frequency flow and Regional Storm operating conditions.

(v) The suggested revised unitary sizing criteria for the SWM Facilities presented herein for the corresponding drainage areas would control post-development flows to pre-development levels at key location downstream of the development (i.e., Node 7.302) for all events up to, and including, the Regional Storm event under both interim and ultimate land use conditions.

We trust that the foregoing satisfies your current requirements. Feel free to contact our office should you have any questions or wish to discuss.

AP/AF/ap/af

Table 1 : Summary of Total Drainage Area to Proposed SWM Facilities to Omagh Tributary

To SWM Facility	Area (ha)	Imperviousness (%)	Area x Imp.	Required Storage [1] (m^3)		
				Permanent Pool	Quality Control	10 mm R.V.
SWM Pond S5b-1	38.5	70	2695.00	7123	1540	2302
SWM Pond S5b-2	44.5	73	3248.50	8455	1780	2783
SWM Pond S5b-3	50.2	69	3463.80	9170	2008	2955
SWM Pond S5b-4	24.3	74	1798.20	4658	972	1542
SWM Pond S5b-7	17.396	62	1085.68	2910	696	1407
Total	174.9	70	12291.18	32315	6996	10990

(1) Permanent pool and quality control provided for MOE enhanced protection (Wet Pond).

Table 2 : Unit Release Rates and Storage Volumes for Proposed SWM Facilities

Pond Component	Pond S5b-1 to S5b-4 [1]		Pond S5b-7 [2]	
	Unit Outflow (m^3/s/ha)	Unit Storage (m^3/imp·ha)	Unit Outflow (m^3/s/ha)	Unit Storage (m^3/imp·ha)
Extended Detention	0.0013	275	0.0010	275
25-Year, 6-Hour AES	0.0130	525	0.0104	450
100-Year, 6-Hour AES	0.0285	725	0.0259	725
Regional	0.0760	1325	0.0848	1275

(1) As per Table 1 of the "*Supplemental Assessment of Stormwater Management Facility Optimization for Boyne Survey SIS 5B Area (Omagh), Town of Milton*" (September 2, 2022, Wood).

(2) As per sizing criteria for Node 7.302 (Omagh) in the "*Supplemental Erosion Potential Investigation of Omagh Tributary, Town of Milton*" (April 29, 2019, Wood).

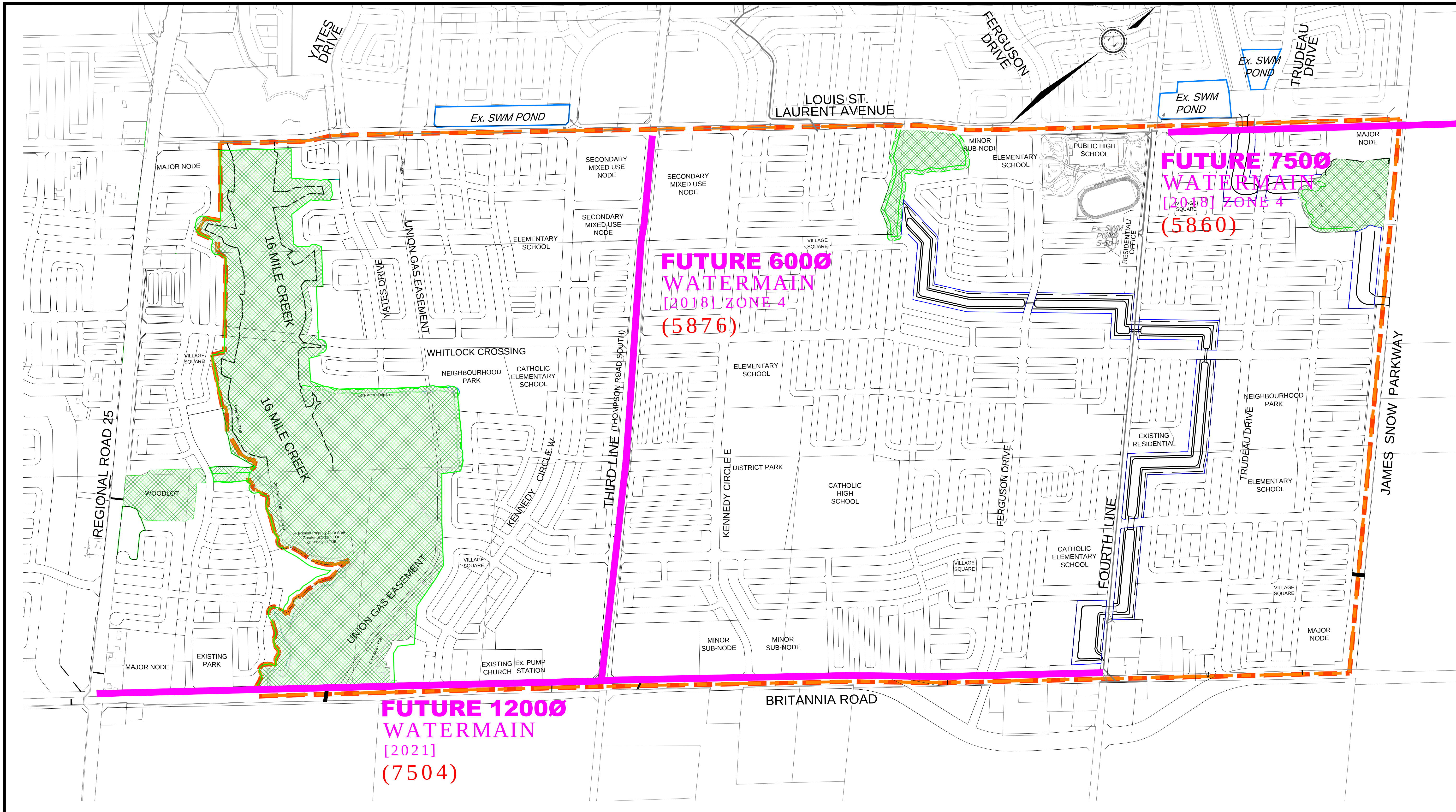
Table 3B: Simulated Release Rates and Volumes for SWM Pond S5b-2

Component	Target Release Rate [2] (m^3/s)	Target Storage [2] (m^3)	Free Outfall Conditions [3]		Restrictive D/S Conditions [3]	
			Release Rate (m^3/s)	Storage (m^3)	Release Rate (m^3/s)	Storage (m^3)
Permanent Pool [1]	N/A	8455	N/A	24554	N/A	24554
Quality Control [1]	N/A	1780	0.015	1780	0.015	1780
Extended Detention	0.058	8933	0.058	9627	0.058	9627
2-Year, 6-Hour AES	N/A	N/A	0.111	10290	0.000	11330
5-Year, 6-Hour AES	N/A	N/A	0.429	13060	0.000	15920
10-Year, 6-Hour AES	N/A	N/A	0.489	15520	0.000	19100
25-Year, 6-Hour AES	0.579	17055	0.559	18870	0.325	21320
50-Year, 6-Hour AES	N/A	N/A	0.785	21090	0.508	23090
100-Year, 6-Hour AES	1.268	23552	1.158	22730	0.653	25060
Regional	3.382	43043	3.247	42110	3.278	47380

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

(2) Target release rates and storage based on post-development drainage area to SWM Facility and unit values.

(3) Modelled based on detailed stage-storage-discharge relationship. Restrictive downstream conditions based on Regional water level of 191.96 m.



LEGEND

- MILTON PHASE 3 EAST STUDY LANDS
- FUTURE REGIONAL WATERMAIN INFRASTRUCTURE
- (5067) REGIONAL ID
- NHS
- [2017] ANTICIPATED IN-SERVICED DATE

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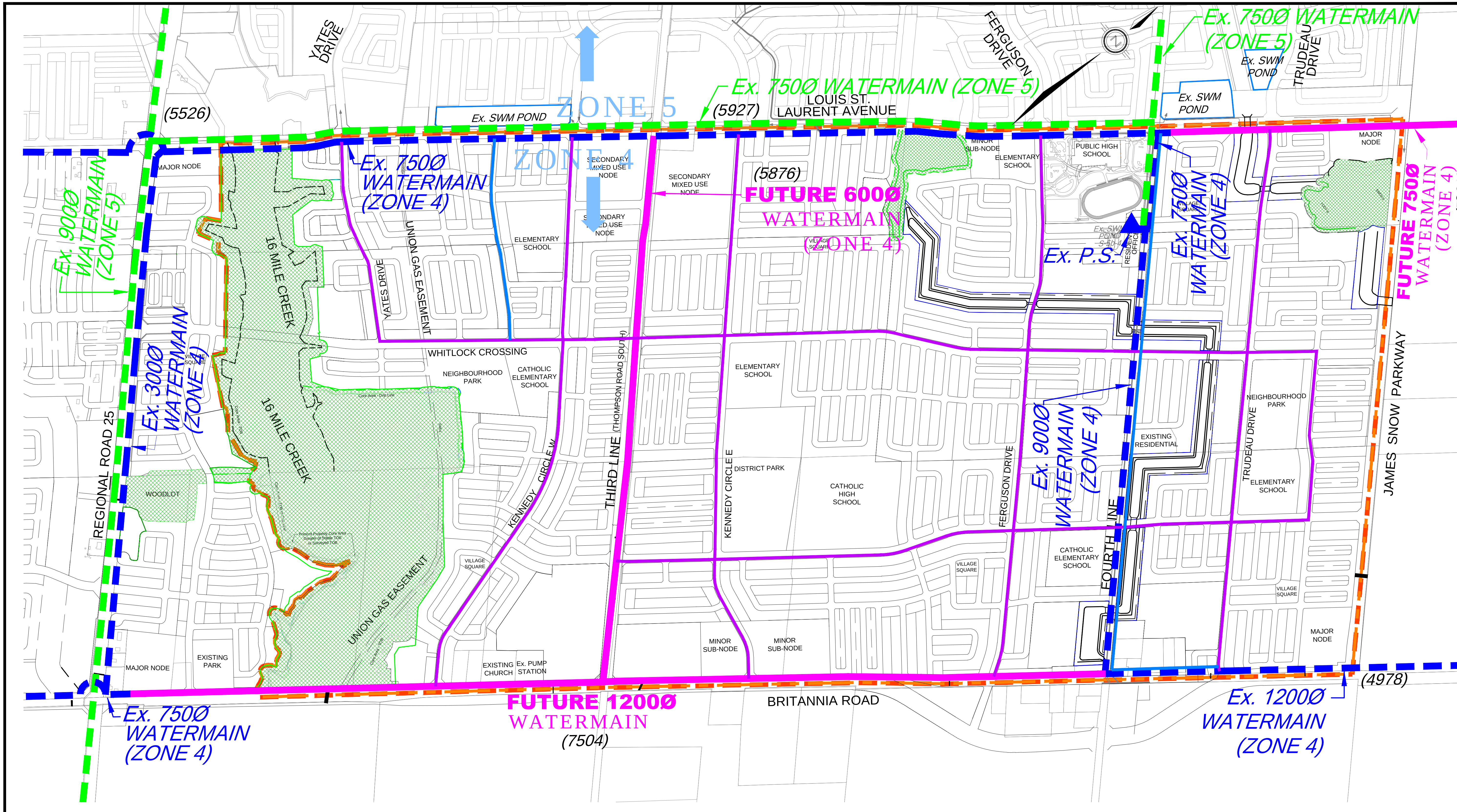
WATER AND WASTEWATER ASP

MILTON - PHASE 3 EAST

REGIONAL WATER PROJECTS

SCALE:	1:10000	PROJECT No.:	10-458
DATE:	MARCH 2018	FIGURE:	4



LEGEND

- MILTON PHASE 3 EAST
- STUDY LANDS
- EXISTING WATERMAIN (ZONE 4)
- EXISTING WATERMAIN (ZONE 5)
- FUTURE D.C. WATERMAIN (ZONE 4)
- PROPOSED 300Ø WATERMAIN (ZONE 4)
- PROPOSED 200Ø WATERMAIN (ZONE 4)
- (5067) REGIONAL ID
- NHS
- EXISTING PUMP STATION

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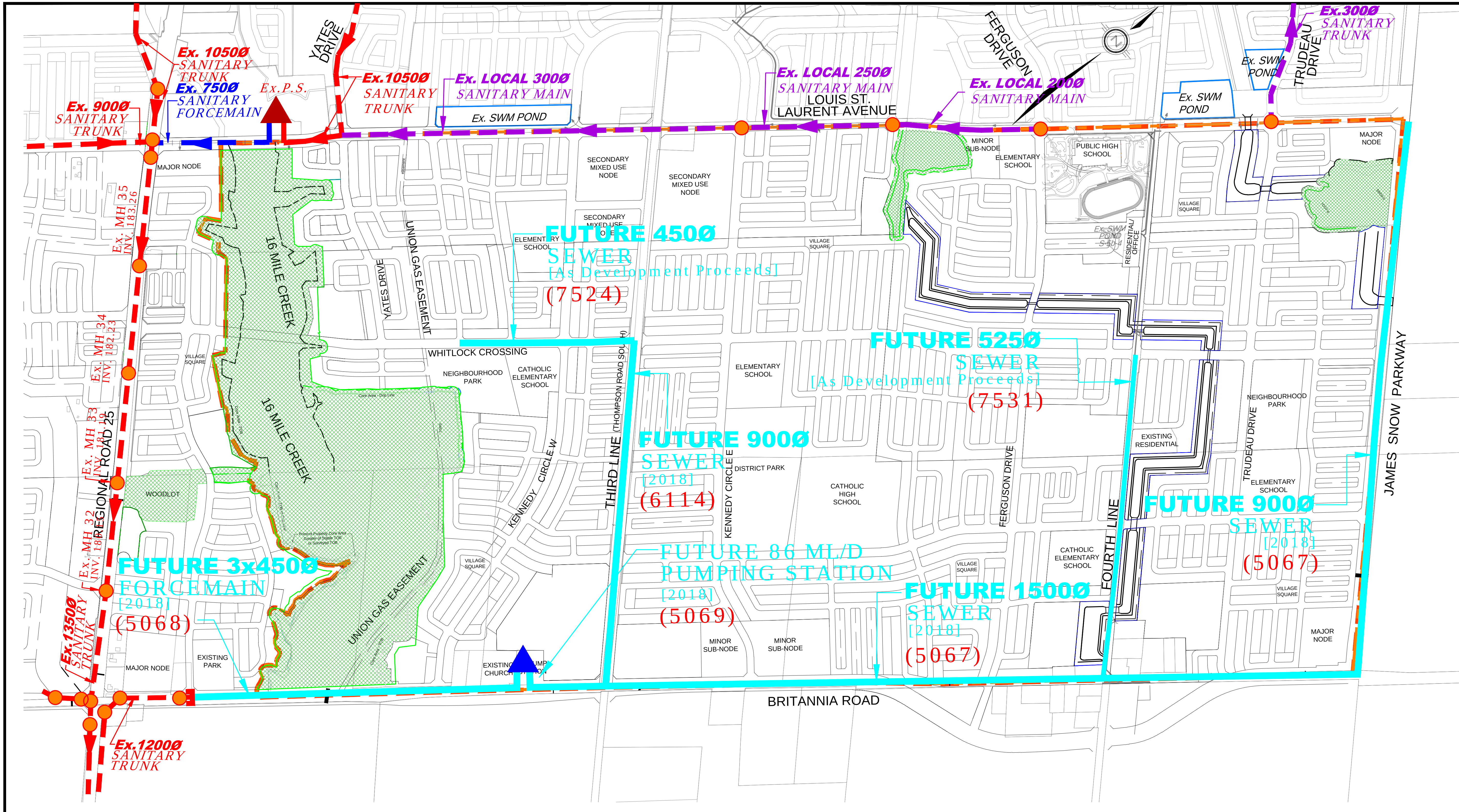
WATER AND WASTEWATER ASP

MILTON - PHASE 3 EAST

WATERMAIN SERVICING

SCALE:	1:10000	PROJECT No.:	10-458
DATE:	MARCH 2018	FIGURE:	5



LEGEND

	MILTON PHASE 3 EAST STUDY LANDS
	FUTURE REGIONAL WASTEWATER INFRASTRUCTURE
(7504)	REGIONAL ID
	NHS
[2018]	ANTICIPATED IN-SERVICE DATE
	FUTURE SANITARY PUMP STATION
	EXISTING SANITARY PUMP STATION
	EXISTING SANITARY MANHOLE
	EXISTING SANITARY TRUNK
	EXISTING SANITARY FORCEMAIN
	EXISTING LOCAL SANITARY MAIN

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WATER AND WASTEWATER ASP

MILTON - PHASE 3 EAST

REGIONAL WASTEWATER INFRASTRUCTURE

SCALE:	1:10000	PROJECT No.:	10-458
DATE:	MARCH 2018	FIGURE:	6

DAVID SCHAEFFER ENGINEERING LTD.
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MARKHAM, ONTARIO
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FAX: (905) 475-3081

THE REGIONAL MUNICIPALITY OF HALTON

LOCATION: Milton - Phase 3 East

SANITARY SEWER DESIGN

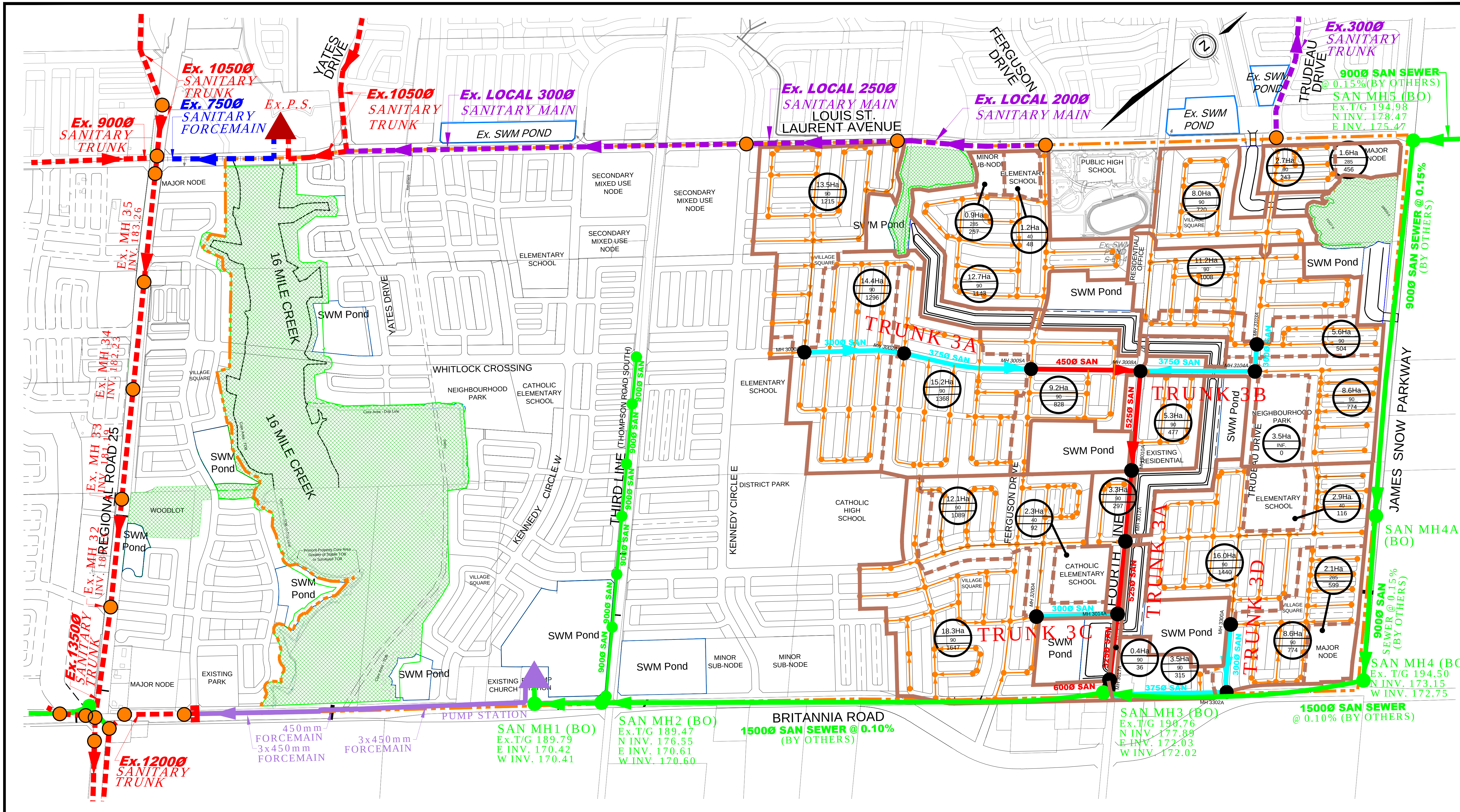
NODE 285 pph
MIXED 90 pph
SCHOOL 40 pph

PROJECT No.: 10-458
DATE: March, 2018
DESIGNED BY: V.C.
CHECKED BY: K.M.

n (PVC): 0.013
n (Conc): 0.013

Infil.Flow (INF): 0.286 L/s/ha

STREET	MANHOLE FROM	MANHOLE TO	LENGTH (m)	TRIBUTARY ARAE HECTARE INCREMENT NODE	TRIBUTARY ARAE HECTARE INCREMENT MIXED USE	TRIBUTARY ARAE HECTARE INCREMENT SCHOOL	TRIBUTARY ARAE HECTARE INCREMENT INFILT	TRIBUTARY ARAE HECTARE TOTAL	POPULATION TRIBUTARY INCREMENT NODE	POPULATION TRIBUTARY INCREMENT MIXED USE	POPULATION TRIBUTARY INCREMENT SCHOOL	POPULATION TRIBUTARY TOTAL	AVG. m^3/s INC.	AVG. m^3/s TOTAL	PEAKING FACTOR	MAX m^3/s	INF. m^3/s	MAX FLOW EXP.	SEWER SIZE	SEWER SLOPE	SEWER Q m^3/s	SEWER VEL (m/s) FULL	SEWER VEL (m/s) ACT.	PIPE TYPE	PIPE CLASS	REMARKS
				1.60	2.7			4.30	456	243		699														
					8.0			12.30		720		1419														
					11.2			23.50		1008		2427	0.0032	0.0077	3.52	0.0272	0.0067	0.0339	300	0.30	0.053	0.75	0.78	PVC	SDR-35	
	MH3103A	MH3104A			5.6			29.10		504		2931	0.0016	0.0093	3.45	0.0322	0.0083	0.0405	300	0.30	0.053	0.75	0.81	PVC	SDR-35	
	MH3104A	MH3008A			8.6		3.50	41.20		774		3705	0.0025	0.0118	3.36	0.0396	0.0118	0.0514	375	0.30	0.096	0.87	0.90	PVC	SDR-35	
To TRUNK 3A								41.20				3705														
TRUNK 3C																										
					18.3			18.30		1647		1647														
	MH3200A	MH3014A			12.1	2.30		32.70		1089	92	2828	0.0038	0.0090	3.46	0.0311	0.0094	0.0405	300	0.30	0.053	0.75	0.81	PVC	SDR-35	
To TRUNK 3A								32.70				2828														
TRUNK 3D																										
					16.0	2.90		18.90		1440	116	1556														
	MH3300A	MH3302A		2.10	8.6			29.60	599	774		2929	0.0044	0.0093	3.45	0.0322	0.0085	0.0406	300	0.30	0.053	0.75	0.82	PVC	SDR-35	
	MH3302A	MH3017A			3.5			33.10		315		3244	0.0010	0.0103	3.41	0.0352	0.0095	0.0447	300	0.30	0.053	0.75	0.83	PVC	SDR-35	
To TRUNK 3A								33.10				3244														
TRUNK 3A																										
					13.5			13.50		1215		1215														
	MH3000A	MH3002A			14.4			27.90		1296		2511	0.0041	0.0080	3.51	0.0281	0.0080	0.0360	300	0.30	0.053	0.75	0.79	PVC	SDR-35	
	MH3002A	MH3005A			15.2			43.10		1368		3879	0.0044	0.0123	3.35	0.0414	0.0123	0.0537	375	0.30	0.096	0.87	0.88	PVC	SDR-35	
				0.90	12.7	1.20		57.90	257	1143	48	5327														
	MH3005A	MH3008A			9.2			67.10		828		6155	0.0026	0.0196	3.16	0.0619	0.0192	0.0811	450	0.30	0.156	0.98	0.98	PVC	SDR-35	
Contribution from Trunk 3B								41.20				3705														
	MH3008A	MH3010A			5.3			113.60		477		10337	0.0015	0.0329	2.94	0.0967	0.0325	0.1292	525	0.30	0.236	1.09	1.10	CONC	SDR-35	
	MH3010A	MH3014A			3.3			116.90		297		10634	0.0009	0.0338	2.93	0.0992	0.0334	0.1326	525	0.30	0.236	1.09	1.10	CONC	SDR-35	
Contribution from Trunk 3C								32.70				2828														
	MH3014A	MH3017A			0.4			150.00		36		13498	0.0001	0.0430	2.82	0.1212	0.0429	0.1641	525	0.30	0.236	1.09	1.16	CONC	SDR-35	
Contribution from Trunk 3D								33.10				3244														
	MH3017A	MH3 (B.O.)						183.10				16742	0.0000	0.0533	2.73	0.1455	0.0524	0.1978	675	0.30	0.460	1.29	1.23	CONC	SDR-35	
To MH 3 (BY OTHERS)								183.10				16742														
Trunk 4B					2.7			2.70		243		243														
				1.60	18.5			22.80	456	1665		2364	0.0068	0.0075	3.53	0.0266	0.0065	0.0331	250	0.50	0.042	0.86	0.00	PVC	SDR-35	
	4100A	4013A			6.3			29.10		567		2931	0.0018	0.0093	3.45	0.0322	0.0083	0.0405	300	0.30	0.053	0.75	0.00	PVC	SDR-35	
To TRUNK 4A								29.10				2931														
Trunk 4A					13.5			13.50		1215		1215														
	4000A	4003A			14.4			27.90		1296		2511	0.0041	0.0080	3.51	0.0281	0.0080	0.0360	300	0.30	0.053	0.75	0.00	PVC	SDR-35	
	4003A	4004A			4.1			32.00		369		2880	0.0012	0.0092	3.46	0.0317	0.0092	0.0409	375	0.30	0.096	0.87	0.00	PVC	SDR-35	
	4004A	4007A			11.2			43.20		1008		3888	0.0032	0.0124	3.34	0.0413	0.0124	0.0537	375	0.30	0.096	0.87	0.00	PVC	SDR-35	
					12.7			55.90		1143		5031														
	4007A	4010A		1.00	8.9	1.20		67.00	285	801	48	6165	0.0036	0.0196	3.16	0.0620	0.0192	0.0812	450	0.30	0.156	0.98	0.00	PVC	SDR-35	
	4010A	4013A			6.9			73.90		621		6786	0.0020	0.0216	3.12	0.0674	0.0211	0.0885	450	0.30	0.156	0.98	0.00	PVC	SDR-35	
Contribution from Trunk 4B								29.10				2931														
	4013A	4015A			1.5		3.50	108.00		135		9852	0.0004	0.0314	2.96	0.0928	0.0309	0.1237	525	0.30	0.236	1.09	0.00	PVC	SDR-35	
	4015A	4016A			5.7			113.70		513		10365	0.0016	0.0330	2.94	0.0970	0.0325	0.1295	525	0.30	0.236	1.09	0.00	PVC	SDR-35	
	4016A	MH4A (B.O.)						113.70				10365	0.0000	0.0330	2.94	0.0970	0.0325	0.1295	525	0.30	0.236	1.09	0.00	PVC	SDR-35	
To MH4A (BY OTHERS)								113.70				10365														



LEGEND

- STUDY AREA
- PROPOSED SANITARY MAIN (BY REGION)
- PROPOSED SANITARY FORCEMAIN (BY REGION)
- PROPOSED LOCAL SANITARY TRUNK
- PROPOSED DC SANITARY TRUNK
- PROPOSED SANITARY MANHOLE (BY REGION OF HALTON)
- NHS
- EXISTING SANITARY TRUNK
- EXISTING SANITARY FORCEMAIN
- EXISTING LOCAL SANITARY MAIN
- EXISTING SANITARY MANHOLE
- PROPOSED SANITARY MANHOLE
- PROPOSED LOCAL SANITARY SEWER
- SANITARY DRAINAGE BOUNDARY
- EXISTING SANITARY PUMP STATION
- PROPOSED SANITARY PUMP STATION
- 25.6Ha / 90 / 2304 — DRAINAGE AREA / DENISTY (pph) / POPULATION

DSEL
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600 Alden Road, Suite 500
Markham, Ontario, L3R 0E7
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Fax. (905) 475-3081
www.DSEL.ca

WATER AND WASTEWATER ASP

MILTON - PHASE 3 EAST

CONCEPTUAL WASTEWATER SERVICING PLAN DRAINAGE AREA TO MH3

SCALE:	1:10000	PROJECT No.:	10-458
DATE:	MARCH 2018	FIGURE:	8

connect the Omagh woodlot and tributaries has a proposed low flow channel above elevation of 191 masl (from Britannia Rd) to 193 masl (to Louis St. Laurent Ave.) and is not expected to intercept the groundwater table. The bottom of the relocated Centre Tributary low flow channel will be around elevation 192.5 masl, with the shallow water table in the proposed relocation area around 188 to 190 masl. As a result, the channel is not expected to intersect the local groundwater table.

4.4.2 Residential Basement Flooding Risk and Monitoring

Given the relocation of the watercourses and the shallow depth to groundwater relative to the proposed final grade for the realigned Omagh Tributary, and surrounding area, there is a potential for high groundwater levels in the residential lots in the vicinity of Ferguson Drive and Britannia Road. Consequently, these homes may require underfloor drainage systems connected to a sump that discharges either to the storm water system or to the rear yard drainage system for each home.

It is recommended that during the detailed design phase, attention be given to monitoring water levels in any newly installed shallow monitors to assess the long term water level fluctuations in this area of the ***SIS***. During infrastructure construction, groundwater control may also be needed. For long term maintenance of local shallow flow systems, trench plugs should be incorporated into the subsurface infrastructure design.

It is expected that the LID strategies will be reviewed during the detail design stage, once the foundation drains, and subsurface design is finalized.

4.4.3 Groundwater Quality Mitigation Options

With the historical influences on groundwater quality in the area being primarily related to agricultural activities (e.g. crop fertilization and manure use/cattle grazing), it is expected that nitrate and phosphorous levels will decrease over the long term. However, impacts related to urbanization must also be considered. At the detailed design phase, consideration must be given to reducing groundwater quality impacts related to urbanization such as increases in sodium and chloride levels. The implementation of the Halton Region Salt Management Plan and other preventative measures such as only infiltrating water from roof tops will reduce the impacts from urbanization.

4.4.4 Infiltration Deficit Mitigation Options

The proposed development will result in decreased infiltration without mitigation. Measures to promote infiltration include a variety of LID measures designed to maximize water availability in pervious areas. Infiltration systems for proposed development must consider the hydraulic conductivity of local soils, topography, vegetative cover, and depth to water table.

In the residential areas, for example, surficial LID techniques may include (but not be limited to) increasing topsoil depths, setting lot grades such that roof runoff is directed towards lawns and gardens, side and rear yard swales, boulevards, parks, and open space areas throughout the development. The use of rain gardens, bioswales or other water retention features also enhances infiltration, and can be developed in schools, parks, and public areas. Increasing topsoil depths will allow for greater infiltration rates and bioremediation time for surficial runoff and precipitation. An increase in topsoil depth of 30 cm could facilitate improving these processes.

Calculations of post development effects on the water balance within the SIS area with LIDs for infiltration enhancement / management show the infiltration deficit is 3% less when compared to existing conditions. The results of the water balance with mitigation show that there will be enough water available to balance the infiltration deficit.

Subsurface infiltration measures may include an increased depth of topsoil, engineered infiltration basins, galleries and trenches, pervious storm pipe systems and soak-away pits. These are most effective in areas of relatively permeable unsaturated soils. By implementing BMPs, as outlined in the ***FSEMS*** report, the net change compared to existing conditions could be reduced to virtually nil compared to preconstruction infiltration.

Infiltration volumes will flow laterally through the subsurface with roughly 10% of this volume acting as groundwater recharge, the reminding 90% of the water is lost through evapotranspiration or becomes interflow through the subsurface.

There are several factors that limit the potential for implementation. Two limiting factors within the study area are low permeability native soils and high groundwater levels. The infiltration rates calculated based on in-situ results at the site are greater than Ontario Ministry of the Environment's recommended minimum soil infiltration rate for infiltration system designs. As such, directing roof runoff to vegetated surfaces, front and back lawns is considered to be one of the most practical mitigation measures at the subject site.

At the neighbourhood scale, opportunities for a full range of lot level controls should also be considered. Lot level stormwater management facilities include rain gardens / bioretention areas, green roofs, vegetated filter strips; or subsurface practices located below parking areas, roads, walkways, plazas, parks or sports fields that are not visible and take up no footprint at the surface. However, unlike conveyance and end-of-pipe controls that typically become property of the municipality and are operated and maintained as public infrastructure, operation and maintenance of lot level controls on private property are the responsibility of the individual property owners, managers or management organizations. Moreover, it is also difficult to ensure that all homeowners comply, making implementation and benefits difficult to measure / monitor. A summary table of the LID measures is found in ***Table 4-1***.

Table 4-1: LID Measures Feasibility Matrix

LID PRACTICE	DESCRIPTION	REQUIREMENTS	PROS AND CONS
Rainwater Harvesting	The process of intercepting, conveying and storing rainfall for future use in rain barrels (for residential uses) or large cisterns (for industrial / commercial uses)	• Downspouts to capture and convey rainfall. • Storage Tanks to store rainfall. • Pre-treatment devices required to remove debris, dust and leaves. • Maintenance is required by home owners. • Low Cost	Pros • Low Cost to Implement Cons • Limited overall impact • Difficult to enforce as the individual home owner will be responsible for inspection and maintenance of the barrels. Recommendation: • Encourage use in SIS
Green Roof	A thin layer of vegetation and growing medium installed on top of a conventional flat or sloped roofs	• Roof slope less than 10% • Roof to be designed for structural loading of rainfall and vegetation • High Cost	Pros • Roof area is a large portion of the overall impervious area and can have a large impact in reducing runoff Cons • Majority of rooftops are residential and will have steeper slopes than 10%. • High cost to implement • Owner maintenance is required • High cost to ensure supporting structures are designed and built to support green roofs Conclusion: • Limited application in SIS study area
Roof Downspout To Grade	Directing flow from roof downspouts to a pervious area that drains away from buildings. Discharge locations should be a minimum of 3 metres away from the building	• Swales to direct runoff away from the buildings graded at a minimum of 2.0% • Total roof area contributing to a downspout should not exceed 100 square metres • Low cost	Pros • Low Cost • Could have a significant impact as it can be implemented over all large areas. Cons • Homeowner renovations can lead to swale blockages Recommendation: • Require in all SIS residential areas

Soakaway, infiltration trench to chamber	These measures are underground excavations lined with geotextile fabric and filled with clean granular stone that receives runoff from a perforated or slotted pipe inlet to promote infiltration into the subsurface	• Bottom of infiltration trench should be at least 1 m from the water table. • Hydrologic soil group A or B are best for achieving infiltration • Trenches should be setback a minimum of 4 metres from building foundations. • Pre-treatment required to prevent clogging and failure • High Cost	Pros • Could be implemented in parks and channel blocks • Could be implemented on multi-family/commercial/industrial blocks under site plan control, with maintenance enforcement. • Can be used on individual residential lots • Can have high impact on large drainage areas Cons • Relatively high cost • If constructed on public lands, Municipality responsible for long term maintenance and replacement. • If constructed on individual residential lots, long term maintenance and replacement by home owner will be difficult to enforce. Education will be required. • Soils will need to be receptive to infiltration Conclusion: • Limited application anticipated in SIS study area for individual residential lots due to poor soils, and high cost for limited benefit. • Could be considered for public lands based on water balance needs.
Bioretention/ Bioswale/ Rain Gardens	Filter bed that temporarily stores, treats and infiltrates runoff.	• Maintenance is required by land owners • Hydrologic soil group A or B are best for achieving infiltration • Works best for smaller drainage areas	Pros • Reduces peak runoff • Provides Water Quality Benefits Cons • Soils should be receptive to infiltration • Works best for small drainage areas

		• Medium cost	• Would not be acceptable to most single family home owners Conclusion: • Could be encouraged for individual residential lots, but education of home owners to benefits will likely be required. • Should be considered and encouraged to maintain water quality on multi-family, commercial, and industrial blocks under site plan controls. • Should be considered and encouraged for public lands.
Vegetated Filter Strips	Gently sloping, densely vegetated areas that treat runoff sheet flow from adjacent impervious areas.	• A flow path of at least 5 metres is required • Pea gravel is recommended at the top of the slope. • Low cost	Pros • Relatively low cost • Provides water quality benefits • Can be placed within parks and channel space with relatively low impact to maintenance or function. Cons • Large footprint area required • Used in conjunction with grass swales and biorention. • Urbanized roads (curbs and storm sewers) render this method ineffective Conclusion: • Limited application in study area for individual residential lots. • Should be considered and encouraged for part of the water treatment of on-site controls for public lands if water balance warrants it.
Permeable Pavement	Pavements that allow stormwater to drain through them and into a stone reservoir where it is	• Base of pavement stone reservoir should be at least 1 metre from water table.	Pros • Can be constructed in place of asphalt on driveways and local roads. • Relatively medium cost Cons

	infiltrated into the underlying native soil or temporarily detained.	• Drainage area should not exceed 1.2 times the area of pavement. • Medium cost	• If soils are not receptive of infiltration, maintenance problems would occur. • Ongoing maintenance is required to maintain function which would be on the Municipality in public areas or require education for homeowners on residential lands. Conclusion: • Could be considered for on-site controls on multi-family/ commercial/ industrial blocks under site plan control. • Limited application anticipated in study area for individual residential lots
Enhanced Grass Swales	Vegetated open channels designed to convey, treat and attenuate stormwater runoff.	• Width of at least 2 metres is required • Established vegetation is required in swales • Low cost	Pros • Relatively low cost • Can be placed with public green spaces with relatively low impact to maintenance and function. Cons • Relative long lengths required to provide significant benefits. Conclusion: • Limited application anticipated in the SIS for individual residential lots. • Should be considered and encouraged for part of the water treatment of on-site controls for public lands if water balance warrants it. • Should be considered and encouraged for public lands.
Perforated Pipe Systems	Long infiltration trenches or linear soakaways that are designed for both conveyance and infiltration of stormwater runoff.	• Bottom of trenches should be at least 1 metre from the water table. • Hydrologic soil group A or B are best for	Pros • Can be installed with the public roads and can be used in place, or in conjunction with storm sewers to convey runoff. • Relatively medium cost Cons

		achieving infiltration • Pre-treatment is required • Installed in the road right-of-ways and maintained by the Municipalities • Medium cost	• Soils should be receptive to infiltration • Pre-treatment is required. If constructed throughout the development pre-treatment will be required on all catchbasins. • Added life cycle costs due to maintenance requirements. Conclusion: • Limited application anticipated in study area due to poor soils and limited benefits.
Extra Depth Topsoil	The placement of topsoil to depths greater than typically placed. Designed to retain and infiltrate a higher volume of runoff than typically achieved in shallow depth topsoil areas.	• Extra depths range from 150 mm to 600 mm depths of topsoil • Can only be placed in non-load bearing areas (ie. Landscaped areas) • Soil should be augmented with minimum 5-10% organic matter content. • Preparation of subgrade required – Compacted subsoils should be tilled or scarified to a minimum depth of 100 mm prior to application of topsoil. • Low Cost	Pros • Relatively low cost • Could have a significant impact as it can be implemented over all residential lots. • Increases the initial abstraction of grassed and landscaped areas, enhances infiltration, and decreases runoff generated from these areas. Cons • Potential for minor settlement in landscape areas Recommendation: • Require in SIS residential areas

It should be noted, that prior to or during construction, it is necessary to ensure that all inactive wells within the development footprint have been located and properly decommissioned by a licensed water well contractor according to Ontario Regulation 903. This regulation applies to the groundwater observation wells installed for this study unless they are maintained throughout the construction for monitoring purposes.

6.0 STORMWATER MANAGEMENT

6.1 Design Criteria

The ***SUS*** and ***FSEMS*** set stormwater management criteria which has been refined through subsequent verifications. The final pond sizing criteria can be found in the ***Wood Memo (2022)*** that is included in ***Appendix F***. These reports prescribe that the subject lands must provide stormwater management according to the criteria presented in ***Table 13.***

Table 13: Stormwater Management Criteria

QUALITY CONTROL		
Permanent Pool (m^3/ha)	Interpolated from ***SWMP Manual Table 3.2***, enhanced protection	
EXTENDED DETENTION		
Storage (m^3/imp ha)	All Ponds	275
Discharge (m^3/s/ha)	SWM Ponds S5b-1, S5b-2, S5b-3, & S5b-4	0.0013
	SWM Pond S5b-7	0.0010
QUANTITY CONTROL		
25 Year		
Storage (m^3/imp ha)	SWM Ponds S5b-1, S5b-2, S5b-3, & S5b-4	525
	SWM Pond S5b-7	450
Discharge (m^3/s/ha)	SWM Ponds S5b-1, S5b-2, S5b-3, & S5b-4	0.0130
	SWM Pond S5b-7	0.0104
100 Year		
Storage (m^3/imp ha)	All Ponds	725
Discharge (m^3/s/ha)	SWM Ponds S5b-1, S5b-2, S5b-3, & S5b-4	0.0285
	SWM Pond S5b-7	0.0259
Regional		
Storage (m^3/imp ha)	SWM Ponds S5b-1, S5b-2, S5b-3, & S5b-4	1325
	SWM Pond S5b-7	1275
Discharge (m^3/s/ha)	SWM Ponds S5b-1, S5b-2, S5b-3, & S5b-4	0.0760
	SWM Pond S5b-7	0.0848

6.2 Omagh Tributary Water Quality Diversion Resolution

Previous analyses in both the ***FSEMS*** and approved ***SIS*** proposed a stormwater diversion pipe to Sixteen Mile Creek for approximately 88 ha of land draining to stormwater management ponds (S5b-2 and S5b-3) in the Omagh Tributary. The strategy was proposed to address excessive fill requirements within the Study Area, due to the existing flat terrain in combination with the shallow storm outlets. As part of Wood's (formerly AMEC's) hydrologic analysis of the ***SIS***, the flows of the Omagh Tributary at key locations south of Britannia Road were seen to increase downstream erosion compared to existing conditions.

In April 2019, Wood and Matrix Solutions completed supplemental investigations regarding the downstream erosion potential within the Omagh Tributary. Their findings included in ***Appendix J***, concluded the erosion threshold for the Omagh Tributary was higher than determined in the ***FSEMS*** and ***SIS***, and therefore the diversion pipe was not required.

Therefore, for ***SIS Area 5B-O***, no ponds will have outflows diverted from the Omagh Tributary to Sixteen Mile Creek, and the storm strategy has been completed in conformance with Wood's April 2019 memorandum.

6.3 Pond Operating Characteristics

The proposed SWM ponds will be designed in accordance with the requirements of the ***SUS, FSEMS,*** and the ***SWMP 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 as per the ***FSEMS***

The conceptual designs of the SWM ponds are presented in ***Figures 10*** through ***14.*** The location and configuration of the ponds will be further refined through future detailed design and ***FSR*** submissions.

The impervious coverage of post-development lands has been estimated based on their respective land uses. The runoff coefficients used meet the runoff coefficients listed in the ***Town Standards*** and are summarized in ***Table 14*** below. Please note that the final impervious coverage will be updated at the detailed design stage based on the characteristics of the actual plan, and the pond sizing adjusted accordingly.

Table 14: Summary of Runoff Coefficients

Land Use	Runoff Coefficient
Parks & Open Space	0.25
Single Family Residential	0.65
Townhouses, Apartments, and Schools	0.75
Back-to-Back & Rear-Lane Townhouses	0.85-0.90
Site Plan Blocks	0.90

Applying the targets from the ***FSEMS*** to the specific drainage boundaries depicted in ***Figure 6***, the required pond sizing can be determined for each proposed SWM facility, as shown in ***Table 15*** below. Descriptions of the SWM Pond Components, and the On-Site Controls are further examined in ***Sections 6.4*** and ***6.5*** of this ***SIS Addendum***, respectively.

Table 15: Summary of Stormwater Management Facilities – Required Storage Volumes

FACILITY I.D.	DRAINAGE AREA (ha)	IMPERVIOUS-NESS (%)	PERMANENT POOL VOLUME (m^3)	EROSION CONTROL VOLUME (m^3)	25 YEAR FLOOD CONTROL VOLUME (m^3)	100 YEAR FLOOD CONTROL VOLUME (m^3)	REGIONAL FLOOD CONTROL VOLUME (m^3)
S5b-1	38.5	70	7123	7411	14149	19539	35709
S5b-2	44.5	73	8455	8933	17055	23552	43043
S5b-3	50.2	69	9170	9525	18185	25113	45895
S5b-4	24.3	74	4658	4945	9441	13037	23826
S5b-7	17.4	62	2910	2986	4886	7871	13842

Pond sizing is detailed in ***Appendix G*** with modelling files in ***Appendix L.***

6.4 Pond Components

6.4.1 Sediment Forebay

All proposed SWM ponds, as seen in ***Figures 10*** through ***14***, include sediment forebays to improve the pollutant removal by trapping larger particles near the inlet of the pond. The forebays have generally 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 depth of 1.5 m to minimize the potential for re-suspension.

6.4.2 Permanent Pool

The permanent pool has been sized to provide enhanced protection in accordance with the ***SWMP Manual***. The permanent pool designs (including elevations) are provided in ***Figures 10*** through ***14***. The permanent pool is generally 2 m deep in the main cell and 3 m in depth at the pond outlet, which exceeds the one- to two-metre-deep range recommended in the ***SUS***, and the 1.5 m depth in ***Town Standards***. The additional depth has been provided as part of the thermal mitigation strategy recommended by MNRF to provide cold water for Silver Shiner, a species at risk, as outlined in the approved ***SIS***. The Town of Milton has previously approved SWM ponds with this permanent pool design in the ***Boyne Survey Block 1 Subwatershed Impact Study***. The slopes in the permanent pool will be graded with side slopes of 3:1, with minor localized variations.

6.4.3 Extended Detention Storage

The proposed SWM ponds will be equipped with extended detention storage sized based on the criteria in the ***Wood Memo*** to provide further water quality refinement and erosion control. The extended detention component has been provided with side slopes of 5:1 with minor localized variations. The depth of extended detention storage in the ponds will not exceed 1.0 m in accordance with ***Town Standards.***

6.4.4 Extended Detention Outlet

The allowable release rates from the ***Wood Memo*** are incorporated into the pond designs shown in ***Figures 10*** through ***14.*** The details of the outlet structures for the SWM facilities will be determined at the detailed design stage. The extended detention volume will outlet through a reverse graded pipe. An orifice will be provided to discharge the extended detention volume at the allowable release rate for erosion control.

6.4.5 Quantity Control

In accordance with the ***FSEMS***, flood control is to be provided based on the unitary rates for 25-year, 100-year, and Regional storm return periods. The details of the outlet structures for each SWM facility will be determined at the detailed design stage. The locations of all SWM Ponds and On-Site Controls have been outlined in ***Figure 9***.

The required unit storage and peak rates in restrictive downstream conditions, as provided in the ***Wood Memo***, are summarized in ***Tables 16, 17,*** and ***18*** below, and have been incorporated into the pond design shown in ***Figures 10*** through ***14***.

- A drop inlet structure is provided at the pond outlet, which restricts flows to the required rates for 25-year,100-year, and Regional storm events by a combination of orifices and/or weirs.
- The outlet pipe will be sized such that the full flow capacity of the pipe will exceed the maximum SWM Facility outflow for the pond.
- The active storage depth for quantity control of the 100-year storms is maintained at or below 1.8 metres in accordance with ***Town Standards***.
- It is proposed that Regional storage be provided above the 100-year water level in the pond (e.g., above the 1.8 metre active storage depth associated with control of the 100-year storm event), thereby maintaining compact pond sizing.

In accordance with the approved ***SIS*** there is no requirement for storm stacking. However, each SWM Pond in the Omagh lands has been designed with overcontrol to accommodate proposed developments upstream which may not have quantity controls, and interim conditions which have uncontrolled flows from Fourth Line and the Omagh Hamlet (further discussed in ***Sections 6.5*** and ***5.8***, respectively).

Table 16: Unit and Required Storage

FACILITY I.D.	DRAINAGE AREA (ha)	IMPERVIOUS-NESS (%)	25 YEAR		100 YEAR		REGIONAL	
			UNIT STORAGE (m^3/imp.ha)	REQUIRED STORAGE (m^3)	UNIT STORAGE (m^3/imp.ha)	REQUIRED STORAGE (m^3)	UNIT STORAGE (m^3/imp.ha)	REQUIRED STORAGE (m^3)
S5b-1	38.5	70	525	14149	725	19539	1325	35709
S5b-2	44.5	73		17055		23552		43043
S5b-3	50.2	69		18185		25113		45895
S5b-4	24.5	74		9441		13037		23826
S5b-7	17.7	64	450	4886		7871	1275	13842

Table 17: Quantity Control – Unit and Allowable Peak Outflow Rates

FACILITY I.D.	DRAINAGE AREA (ha)	IMPERVIOUS-NESS (%)	25 YEAR		100 YEAR		REGIONAL	
			UNIT OUTFLOW RATES (m^3/s/ha)	PEAK OUTFLOW RATES (m^3/S)	UNIT OUTFLOW RATES (m^3/s/ha)	PEAK OUTFLOW RATES (m^3/S)	UNIT OUTFLOW RATES (m^3/s/ha)	PEAK OUTFLOW RATES (m^3/S)
S5b-1	38.5	70	0.013	0.338	0.0285	0.752	0.0760	2.878
S5b-2	44.5	73		0.325		0.653		3.278
S5b-3	50.2	69		0.586		1.193		3.780
S5b-4	24.5	74		0.209		0.478		1.826
S5b-7	17.7	64	0.0104	0.057	0.259	0.278	0.0848	1.373

Table 18: SWM Storage – Discharge Relationships

FACILITY I.D.	EROSION CONTROL		25 YEAR FLOOD CONTROL		100 YEAR FLOOD CONTROL		REGIONAL FLOOD CONTROL	
	STORAGE (m^3)	PEAK OUTFLOW RATES (m^3/s)	STORAGE (m^3)	PEAK OUTFLOW RATES (m^3/s)	STORAGE (m^3)	PEAK OUTFLOW RATES (m^3/s)	STORAGE (m^3)	PEAK OUTFLOW RATES (m^3/s)
S5b-1	8188	0.050	17230	0.338	20300	0.752	38640	2.878
S5b-2	9627	0.058	21320	0.325	25060	0.653	47380	3.278
S5b-3	9971	0.063	20820	0.586	25290	1.193	47120	3.780
S5b-4	5737	0.031	11160	0.209	13230	0.478	25270	1.826
S5b-7	3284	0.016	6985	0.057	7905	0.278	13126	1.373

6.4.6 Emergency Overflow

In the event of an emergency, blockage, or a storm greater than the Regional event or 100-yr event (for SWM Ponds and On-Site Controls, respectively), an emergency overflow weir has been provided for SWM Ponds to the realigned Omagh Channel. All proposed facilities will direct overflow into the realigned Omagh Channel except for SWM Pond S5b-3, which directs drainage to the Omagh Channel by sending it across Fourth Line. Additional modelling has been conducted to ensure flows crossing Fourth Line to not exceed the depths allowed per the ***Town Standards***. To do this, the outlet pipe and outlet controls of SWM Pond S5b-3 have been provided in ***Appendix G.*** Additional pond control details can be provided through future ***FSRs*** and detailed design submissions.

For the proposed on-site controls, quantity controls have been provided to achieve the 100-Year criteria set by the ***Wood Memo***. Where quantity control was not feasible (e.g., OGS's treating Fourth Line drainage), emergency overflows will also generally be directed to the Omagh Channel. For OGS-2, during emergency conditions, runoff will be conveyed by the road network to a spill point at the southern end of the hedgerow. The natural topography of the hedgerow will direct flows east to west towards the realigned Omagh Channel. Any flows that reach the southern side of the hedgerow will be intercepted by the cut-off swale provided to convey drainage resulting from the grading transition to the surrounding development from the Omagh Hedgerow to the realigned Omagh Channel.

The arborist report, provided in ***Appendix C5***, examined potential impacts to trees within the retained hedgerow. The arborist report concludes that it is possible future mortalities or damage associated with overland surface water flows from the emergency spillway into the retained hedgerow may occur for storm events larger than 100-year events. Given the uncertainties associated with Regional (>100-year) storm events; it is not possible to directly assess possible impacts to the hedgerow trees at this time. Therefore, taking into consideration these uncertainties and prior comments from the Town, pre-emptive compensation is recommended. An additional 11 trees (40mm caliper) will be planted within the 10 m buffer on the west side of the hedgerow as pre-emptive compensation to address potential future tree mortality associated with the emergency spillway.

These trees would be in addition to what is already required for tree planting in the buffer per the ***FSEMS*** Restoration Framework. The location and species of compensation plantings are shown on ***Figure 1*** of ***Appendix C5***. Hardy maple species that can tolerate wetter conditions are recommended due to the emergency spillway that may flow through the buffer / hedgerow during Regional storm events.

6.4.7 Pond Access Roads

Four-metre-wide access roads have been provided in order to facilitate routine inspection and maintenance activities in accordance with ***Town Standards***. The maximum slope of access roads is 10:1. Access roads have generally not been provided along edges of the pond block that are adjacent to a road.

6.4.8 Stormwater Pond Management Buffer Blocks

In accordance with ***Town Standards***, 7.5 m buffer blocks have been provided in the pond block adjacent to development. These buffer blocks may also contain access roads and/or pedestrian trails that will be refined through the draft plan/FSR and detailed design stages.

6.4.9 Silver Shiner Considerations

Several SWM Ponds will outlet into the Omagh Tributary, as seen in ***Figure 9***. As outlined in the approved ***SIS,*** the Omagh Tributary provides contributing functions that may support downstream habitat in Sixteen Mile Creek for Silver Shiner, a fish species that is classified as Threatened in Ontario and Canada.

In the absence of specific guidelines for Silver Shiner, the ponds have been designed in accordance with the ***MNRF Thermal Mitigation Checklist*** for ponds discharging to Redside Dace habitat with best efforts to maintain the following conditions:

- Discharge temperature below 24°C
- Dissolved oxygen concentrations at discharge of at least 7 mg/L, and
- TSS of less than 25 mg/L above background levels in the receiving tributaries.

Table 19 below outlines how the pond design will generally conform to the ***MNRF Thermal Mitigation Checklist***.

Table 19: Conformance with MNRF Thermal Mitigation Checklist

Design Feature	Implementation
1. Average permanent pool depth, of the open water component of the SWM facility, excluding the forebay area and other shallow water features is to be minimum 3.0m.	A 2.0m deep permanent pool in the main cell with a 3.0m deep permanent pool in the deep pool at the pond outlet has been provided in all SWM Ponds
2. Bottom draw outlet is to be located a minimum of 2.5m below the permanent pool elevation.	Bottom draw outlet to be located a minimum of 2.5m below the permanent pool elevation at the detailed design stage.
3. The perimeter of the pond at the permanent pool elevation is to include a minimum 3m wide flat shelf, 0.3 m deep, as a wetland planting area. The shelf will include 0.3 m of topsoil and planted with native emergent species (cattail and bulrushes) suited for fluctuating water levels.	A 0.3 m deep, 3.0m wide flat shelf has generally been provided at the permanent pool elevation. The planting strategy for the SWM facility will be finalized at the detailed design stage.
4. Side slopes below the normal water level of the permanent pool are 4:1.	Through previous correspondence with the MNRF, flexibility was given on this requirement where a 3m deep permanent pool is provided. 3:1 sloping below the permanent pool elevation is in accordance with ***Town Standards***.
5. The volume of water in the permanent pool between 1.5 m to 3 m depth is at least equivalent to the volume of runoff generated by a 10 mm storm event within the catchment of the pond. The calculated volume below 1.5 m depth is to be discharged over a minimum 24-hour period.	The volume between 1.5 and 3.0 m will be sized to provide the volume of runoff from the 10 mm rainfall event.
Additional design features as discussed in the ***SWMP Manual***	- The facilities have been designed with a high length to width ratio, where possible, to allow for effective shading with landscape material (landscaping to be determined in detailed design), see ***Figures 10*** through ***14***. - The landscape plans should have regard for best management practices, such as the

Design Feature	Implementation
	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 per ***CH*** Landscaping Guidelines.

Through avoidance and mitigation measures proposed within the Study Area, no negative impacts to downstream occupied Silver Shiner habitats are anticipated as a result of the proposed site alteration and/or development within the ***SIS Area 5B-O*** lands. A letter was submitted to the Ministry of Environment, Conservation and Parks (January 2021) that summarizes the mitigation and avoidance measures proposed above. A copy of this letter and email response (February 2021) from MECP is provided in ***Appendix C2***.

6.4.10 Thermal Mitigation

SWM Ponds outflows may experience increased temperatures due to solar inputs prior to discharging from the facility. Thermal mitigation techniques will be incorporated into the pond design in accordance with ***MNRF's Redside Dace Checklist***, as outlined above in ***Table 14.***

6.5 On-Site Controls

As noted in ***Section 5.1***, the proposed residential development on the HCDSB's residual holdings are proposed to use on-site controls for stormwater management and treatment. The proposed High School has a drainage area of approximately 7.1 ha, and will be treated by on-site controls (OGS-1) to meet stormwater quality and quantity targets. For the purposes of this ***SIS Addendum***, as the HCDSB is a non-participating property, it is assumed their OGS will be existing upon development of the adjacent residual residential lands and will need to be incorporated into any future downstream design. The drainage area of the remaining land (excluding NHS) is approximately 4.3 ha, which is less than the minimum 5 ha drainage area for a conventional SWM Pond set out in the ***SWMP Manual***. As such, an on-site control (OGS-2) has been proposed to meet quality targets for this area of future development. Note: the location of potential storage tanks on these lands, if deemed necessary, is subject to agency approval through the draft plan process, and may vary from what is illustrated in ***Figure 9.*** Sample sizing reports confirming how the quality requirements could be met with existing products have been included in ***Appendix G2.*** Please note that these outline sample control solutions, and that the actual units implemented on the sites are subject to detailed design.

As outlined in ***Section 5.4.2***, approximately 1.0 Ha of Fourth Line, south of SWM Pond S5b-3, swill drain and be treated by an OGS system (noted as OGS-3) in the interim condition, prior to being discharged to the Omagh Channel on the east side of Fourth Line. This system will be taken offline upon the ultimate development of SWM Pond S5b-1 in McCann's lands. ***Table 20*** below outlines the on-site controls proposed for the areas, with details to be provided at the FSR and detailed design stages:

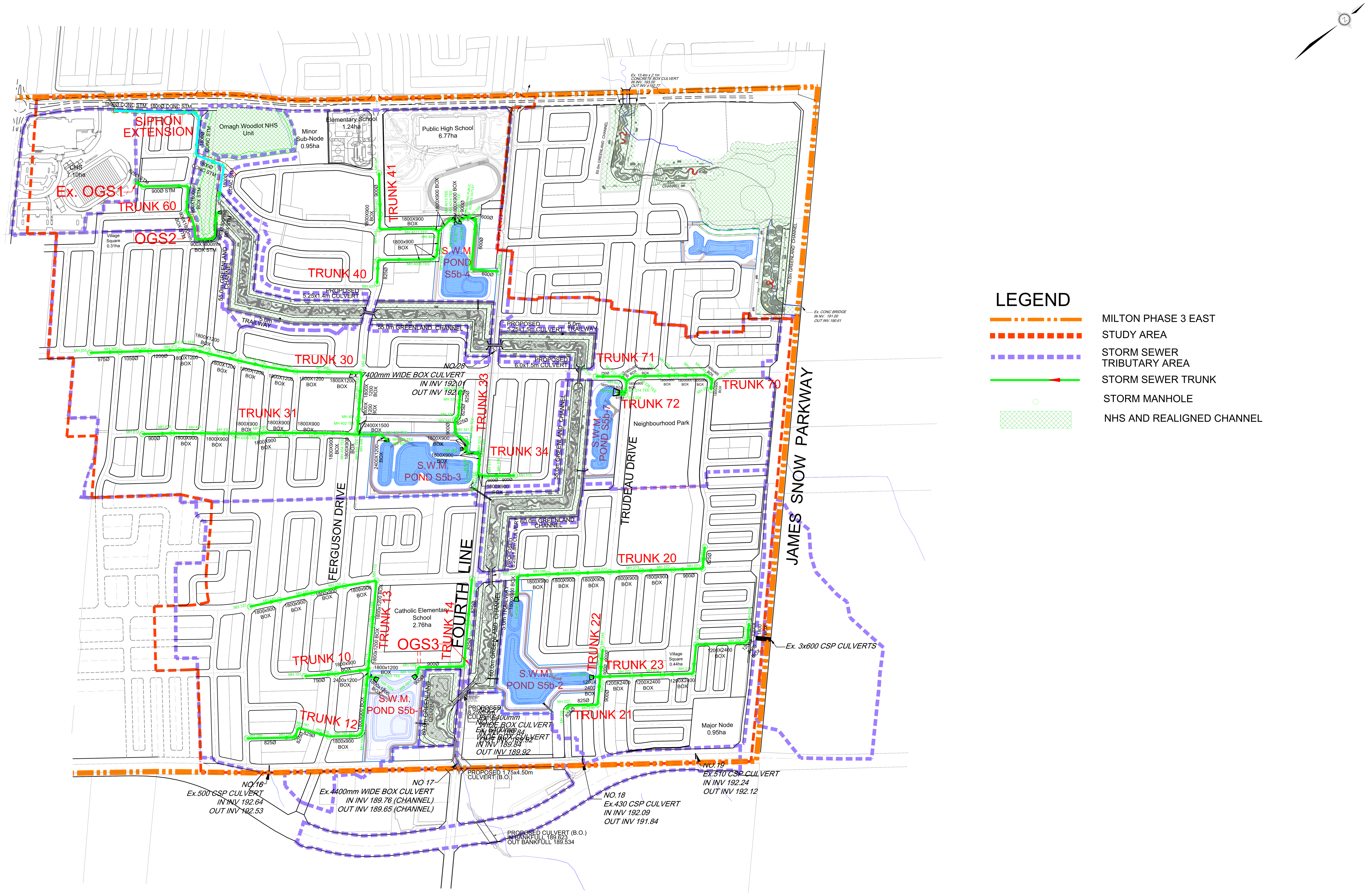
Table 20: On-Site Controls

LOCATION	QUALITY CONTROL	EROSION AND QUANTITY CONTROL	DRAINAGE AREA (Ha)	IMPERVIOUS-NESS (%)
HCDSB (OGS-1)	➢ Filtration Unit	➢ Quantity Controls provided on site and approved through Site Plan Application	7.1	79
Future Residential Lands (HCDSB Holdings) (OGS-2)	➢ Filtration Unit	➢ No Quantity Controls provided; specific SWM Ponds in the Omagh lands (S5b-1, 3, 4, and 7) were modified to overcontrol for areas that uncontrolled storm drainage	4.3	72
Fourth Line (OGS-3)	➢ Filtration Unit	➢ No Quantity Controls are provided; all SWM Ponds in the Omagh lands are modified to overcontrol for uncontrolled storm drainage	0.9	70

Note: the details of the proposed SWM facilities (OGS-1) may vary, depending on the actual HCDSB site plan, and are subject to an ongoing site plan application process.

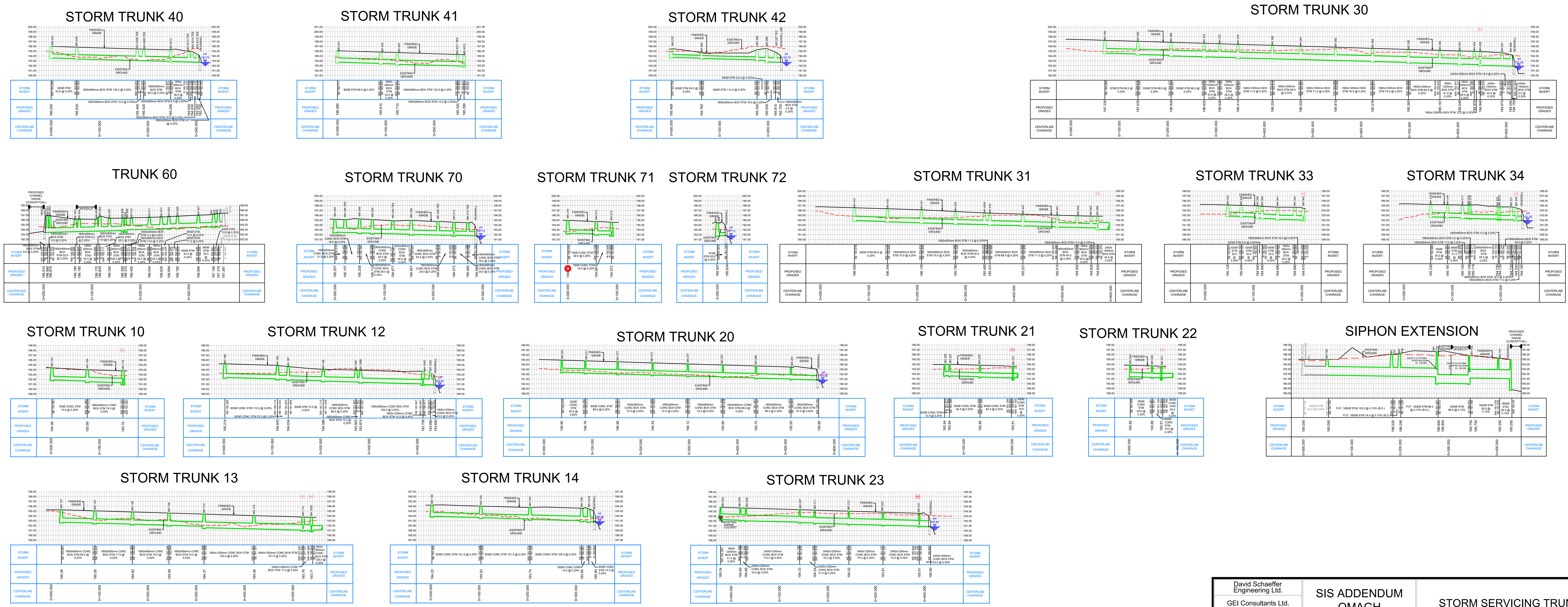
Per the Town's request, the ultimate strategy to convey the major and minor system flows on Fourth Line south of SWM Pond S5b-3 into the future developments for treatment by SWM Pond S5b-1 has not changed since the approved ***SIS.*** As seen in ***Figure 20*** or ***Drawing 10***, culvert OT-5 provides a future local high point, allowing the interim OGS treating partially urbanized Fourth Line to be removed in the ultimate condition.

There are filtration and OGS products that have been verified by ETV testing and generally accepted as meeting the enhanced protection level (no reduction in TSS removal efficiency) without the need for additional treatment. Any non-accredited filtration units are to be applied with a maximum of 50% TSS removal efficiency. Non-accredited OGS units are to follow ***CH***'s recommendation for credit of 50% TSS removal efficiency for units sized to provide 80% TSS removal. For both OGS and filtration units, the remaining fraction of TSS removal should be provided using other quality control methods. The final unit selected will be subject to approval by both the Town of Milton and ***CH***. The location of any proposed SWM tanks may change pending further analysis through property specific FSRs and detailed designs.

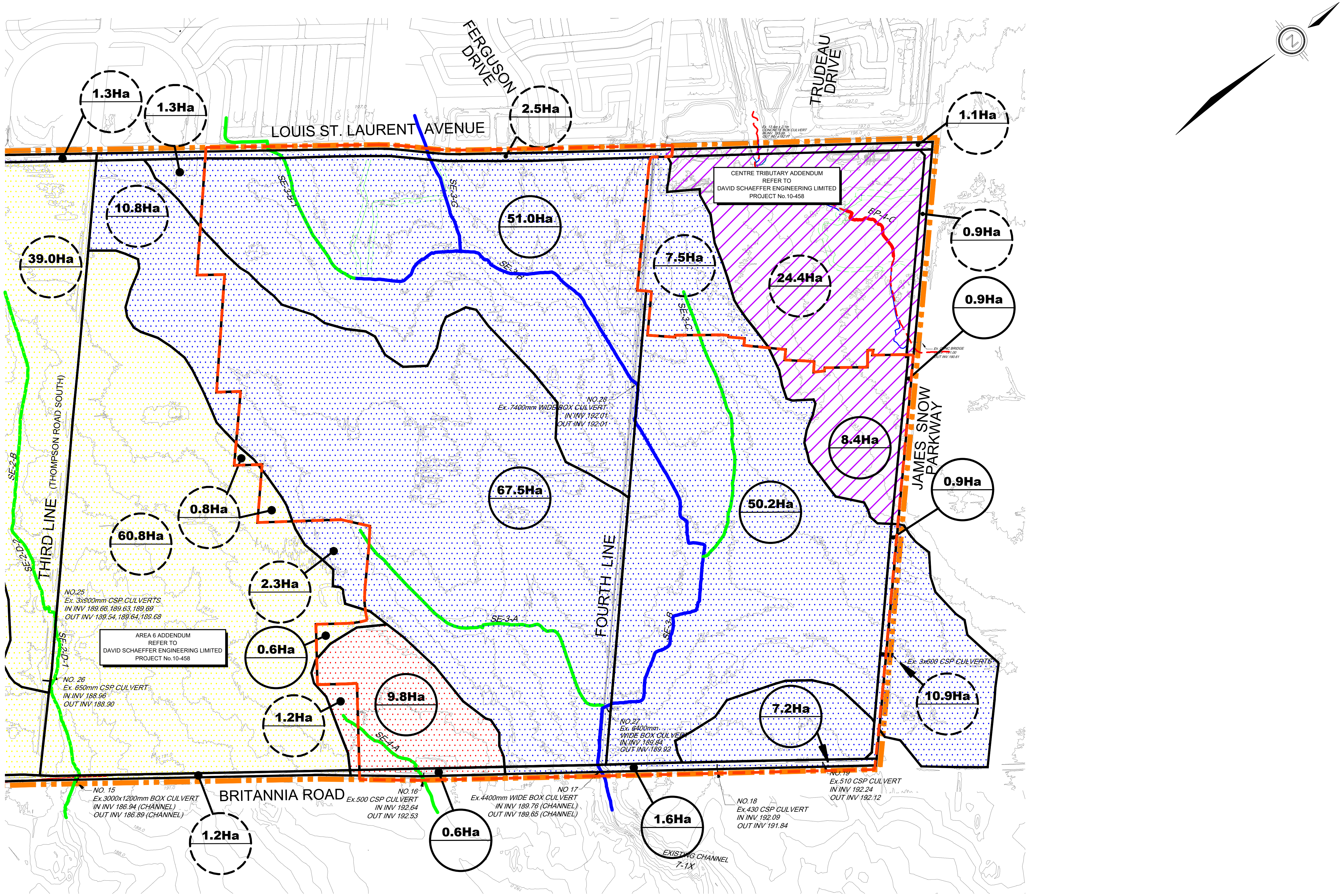


LEGEND

- MILTON PHASE 3 EAST
- STUDY AREA
- STORM SEWER TRIBUTARY AREA
- STORM SEWER TRUNK
- STORM MANHOLE
- NHS AND REALIGNED CHANNEL



David Schaeffer Engineering Ltd. GEI Consultants Ltd. J.F. Sabourin and Associates Inc. Geo Morphix Ltd. Jennifer Lawrence and Associates Inc.	SIS ADDENDUM OMAGH TRIBUTARY TOWN OF MILTON	STORM SERVICING TRUNK SCALE: 1:4000 PROJECT No.: 10-458 DATE: FEBRUARY 2023 DRAWING: 07



LEGEND

- MILTON PHASE 3 EAST STUDY LANDS
- SUBWATERSHED SE-2
- OMAGH SUBWATERSHED
- CENTRE SUBWATERSHED
- SE-4 SUBWATERSHED
- HIGH CONSTRAINT STREAM
- MEDIUM-HIGH CONSTRAINT STREAM
- MEDIUM CONSTRAINT STREAM
- LOW CONSTRAINT STREAM
- PRE-DEVELOPMENT DRAINAGE BOUNDARY
- 39.7Ha PRE-DEVELOPMENT DRAINAGE AREA
- 39.7Ha EXTERNAL PRE-DEVELOPMENT DRAINAGE AREA

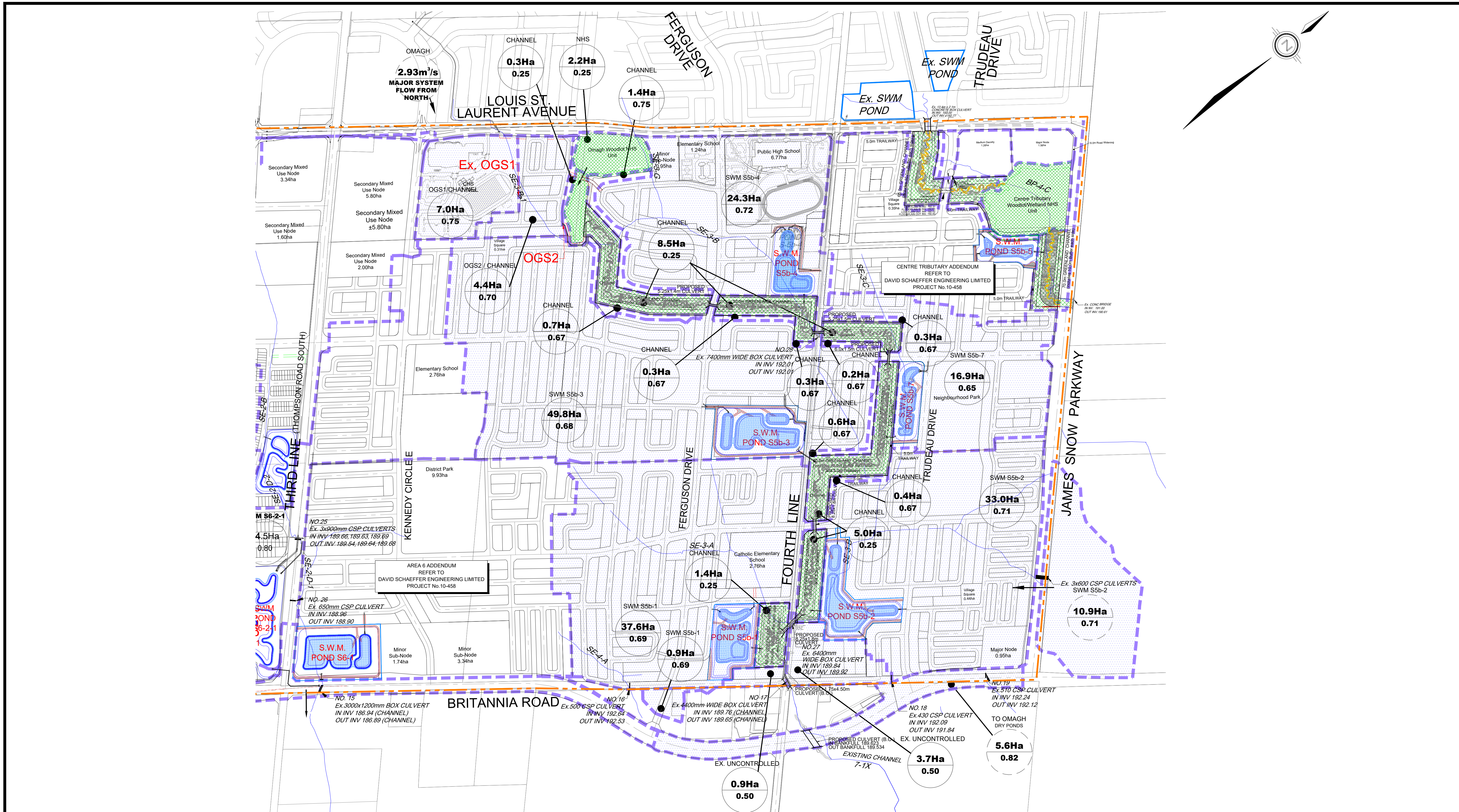
David Schaeffer Engineering Ltd.
GEI Consultants Ltd.
J.F. Sabourin and Associates Inc.
Geo Morphix Ltd.
Jennifer Lawrence and Associates Inc.

SIS ADDENDUM OMAGH TRIBUTARY

TOWN OF MILTON

PRE-DEVELOPMENT DRAINAGE AREAS

SCALE:	1:10000	PROJECT No.:	10-458
DATE:	FEBRUARY 2023	FIGURE:	5



LEGEND

- MILTON PHASE 3 EAST
- Ex. WATERCOURSE
- STUDY LANDS
- POST-DEVELOPMENT DRAINAGE BOUNDARY
- OMAGH SUBWATERSHED (SIS 5B-O)
- NHS AND REALIGNED CHANNEL
- 45.4Ha / 0.65 — TOTAL AREA / RUN-OFF COEFFICIENT
- 45.4Ha / 0.65 — TOTAL EXTERNAL AREA / RUN-OFF COEFFICIENT

David Schaeffer Engineering Ltd.

GEI Consultants Ltd.

J.F. Sabourin and Associates Inc.

Geo Morphix Ltd.

Jennifer Lawrence and Associates Inc.

SIS ADDENDUM OMAGH TRIBUTARY

TOWN OF MILTON

POST-DEVELOPMENT DRAINAGE AREAS

SCALE:	1:10000	PROJECT No.:	10-458
DATE:	FEBRUARY 2023	FIGURE:	6

APPENDIX C

STORMWATER MANAGEMENT POND SIZING CALCULATIONS

SCS consulting group ltd

SCS consulting group ltd

Impervious Area Calculations

Sundial Homes (4th Line) Limited
Project Number: 2084
Date: April 2023
Designer Initials: R.J.S.

AREAS DRAINING TO POND

North Forebay (Catchment N)				
		Area	Impervious Area	Imperviousness (%)
School Block	28,280	2.83	2.22	79%
Back to Back Units	12,455	1.25	1.05	84%
Townhouses	18,905	1.89	1.22	64%
Single Unit - 9.1 x 26 m	7,868	0.78677	0.53	68%
Single Unit - 11.6 x 26 m	37,120	3.71204	2.49	67%
Reserve	91	0.01	0.0081	88%
24m ROW	21,972	2.20	1.98	90%
16m ROW	28,285	2.83	2.50	88%
16m ROW (Single Loaded)	1,936	0.19	0.14	72%
Buffer	741	0.07	0.0053	7%
Road Widening	2,963	0.30	0.2670	90%
Overall	**160,617**	**16.06**	**12.42**	**77%**
South Forebay (Catchment S-1)				
		Area	Impervious Area	Imperviousness (%)
Village Square	2,764	0.28	0.08	29%
Back to Back Units	12,119	1.21	1.02	84%
Townhouses	11,314	1.13	0.73	64%
Single Unit - 9.1 x 26 m	357	0.04	0.02	68%
16m ROW	15,251	1.53	1.35	88%
16m ROW (Single Loaded)	645	0.06	0.05	72%
Buffer	627	0.06	0.004	7%
Road Widening	1,224	0.12	0.110	90%
Overall	**44,302**	**4.43**	**3.36**	**76%**
South Forebay (Catchment S-2)				
		Area	Impervious Area	Imperviousness (%)
Village Square	437	0.04	0.01	29%
Townhouses	9,927	0.99	0.64	64%
Single Unit - 9.1 x 26 m	5,664	0.57	0.38	68%
Single Unit - 11.6 x 26 m	28,326	2.83	1.90	67%
Reserve	23	0.00	0.002	88%
24m ROW	8,491	0.85	0.77	90%
16m ROW	15,536	1.55	1.37	88%
Road Widening	67	0.01	0.006	90%
Overall	**68,472**	**6.85**	**5.08**	**74%**
South Forebay (Catchment S-3)				
		Area	Impervious Area	Imperviousness (%)
Road Widening	45	0.05	0.04	90%
High Density Node	28,694	2.82	2.26	80%
Overall	**28,739**	**2.87**	**2.30**	**80%**
East External (Catchment EXT2)				
		Area	Impervious Area	Imperviousness (%)
Future Development	109,000	**10.90**	**7.72**	**71%**
Pond				
		Area	Impervious Area	Imperviousness (%)
Pond	31,931	**3.193**	1.60	**50%**
Total	**443,794**	**44.30**	**32.47**	**73%**

Impervious Area Calculations

EXTERNAL AREAS

South External (Catchment EXT1)				
		Area	Impervious Area	Imperviousness (%)
Singles	733	**0.07**	**0.050**	**68%**
Channel (Catchment EXT3)				
		Area	Impervious Area	Imperviousness (%)
Channel & Buffer	15,785	**1.58**	**0.000**	**0%**
Channel (Catchment EXT4)				
		Area	Impervious Area	Imperviousness (%)
Channel & Buffer	18,863	1.89	0.000	0%
Trailway	1,709	0.17	0.137	80%
Overall	**20,572**	**2.06**	**0.14**	**7%**
Total	**37,091**	**3.71**	**0.19**	**5%**

Impervious Area Calculations

Weighted Impervious Calculation

Catchment ID	Total Area	Imperviousness	Impervious Area
	(ha)	(%)	(ha)
Drainage Area	44.30	73%	0.32
Total	**44.30**	**73%**	**0.32**

Stage Storage Calculations

Elevation (m)	Area (m^2)	Area (m^2)	H (m)	Vol (m^3)	Volume (m^3)	Storage (m^3)	Depth (m)	
187.80	3,491.58				0		0	
		5247	1.5	7869.975				
189.30	7,001.72				7870		1.5	
		7548	0.5	3773.9925				
189.80	8,094.25				11644		2	
		8956	0.7	6269.529				
190.50	9,818.69				17913		2.7	
		11957	0.3	3587				
190.80	**14,095.92**				21501	**0**	**3**	**N.W.L.**
		16408	1	16408				
191.80	18,720.05				37909	16408	4	
		20527	0.8	16422				
192.60	22,334.35				54330	32830	4.8	
		23266	0.65	15123				
193.25	24,197.67				69453	47953	5.45	
		24469	0.15	3670				
193.40	24,740.60				73124	51623	5.6	
		27461	0.15	4119				
193.55	30,181.71				77243	55742	5.75	

Stage Storage Calculations

	Free Outfall Conditions	Restrictive D/S Conditions	
10 mm Storm Event =	2,783	2,783	m^3
Volume at 189.30m (1.5m - 3.0m Depth)	7870	7870	m^3
Permanent Pool Volume Required =	8,455	8,455	m^3
Permanent Pool Volume Provided =	21501	21501	m^3
Extended Detention volume required=	8,933	8,933	m^3
Extended Detention waterlevel =	191.38	191.38	m
2 year control volume required =	10,290	11,330	m^3
2 year control waterlevel =	191.46	191.52	m
2 year active fluctuation =	0.66	0.72	m
5 year control volume required =	13,060	15,920	m^3
5 year control waterlevel =	191.62	191.78	m
5 year active fluctuation =	0.82	0.98	m
10 year control volume required =	15,520	19,100	m^3
10 year control waterlevel =	191.75	191.94	m
10 year active fluctuation =	0.95	1.14	m
25 year control volume required =	18,870	21,320	m^3
25 year control waterlevel =	191.93	192.06	m
25 year active fluctuation =	1.13	1.26	m
50 year control volume required =	21,090	23,090	m^3
50 year control waterlevel =	192.04	192.14	m
50 year active fluctuation =	1.24	1.34	m
100 year control volume required =	22,730	25,060	m^3
100 year waterlevel =	192.13	192.24	m
Freeboard =	1.42	1.31	m
Regional control volume required=	42,110	47,380	m^3
Regional waterlevel =	193.01	193.23	m
Freeboard =	0.54	0.32	m

(Shaded cells) Volumes from DSEL SIS Addendum (February 2023) Appendix G-1

APPENDIX D

SANITARY FLOW CALCULATIONS

SCS consulting group ltd

Minimum Sewer Diameter (mm) =	200	Avg. Domestic Flow (l/cap/day) =	275	Milton 4th Line
Mannings n =	0.013	Infiltration Rate (l/s/ha) =	0.286	2084
Minimum Velocity (m/s) =	0.60	Max. Harmon Peaking Factor =	5.0	10-Apr-23
Maximum Velocity (m/s) =	3	Min. Harmon Peaking Factor =	1.5	R.J.S
				ETCK
Minimum Pipe Slope (%) =	0.50	NOMINAL PIPE SIZE USED		P:\2084 Sundial Milton 4th\Design\Pipe Design\Sanitary\[2084-Sanitary Sheet Design.xlsm]Design

LOCATION			Residential + School						FLOW CALCULATIONS	PIPE DATA				
STREET	MANHOLE FROM	MANHOLE TO	AREA (ha)	ACCUM. AREA (ha)	UNITS (#)	DENSITY PER HA (p/ha)	RESIDENTIAL POPULATION	ACCUM. RESIDENTIAL POPULATION	TOTAL FLOW (L/s)	PIPE DIAMETER (mm)	SLOPE (%)	FULL FLOW CAPACITY (L/s)	FULL FLOW VELOCITY (m/s)	ACTUAL VELOCITY (m/s)
Site Outlet Sizing			13.04	13.04	n/a	55.0	717.2	717.2	12.6					
			6.57	19.61	n/a	135.0	886.95	1604.15	24.3					
			4.04	23.65	n/a	100.0	404	2008.15	29.7					
			2.82	26.47	n/a	285.0	803.7	2811.85	38.6					
			0.32	26.79	n/a		0	2811.85	38.7					
	Site	EX MH3	2.828	29.618	n/a	40.0	113.12	2924.97	40.6	300	0.30	52.9	0.75	0.82

APPENDIX E

WATER DISTRIBUTION ANALYSIS

Municipal Engineering Solutions

April 10, 2023 Project No. 17002-101

Sent via email
c/o Mr. Robert Yanowski
Sundial Homes
4576 Yonge Street, Suite 500
Toronto, Ontario M2N 6N4

Subject: Sundial Milton 4th Line Development
Water Distribution Modeling
Town of Milton, Region of Halton

Dear Mr. Yanowski,

We are pleased to submit our report entitled "Sundial Milton 4th Line Development Watermain Analysis" outlining the results of our water distribution analysis for the proposed residential development in the Town of Milton, Region of Halton.

This report is an update to our July 28, 2021 report. This development layout was incorporated into the Region of Halton's existing Infowater water models dated August 2022 and revised to suit changes to the watermain layout and Region comments. The findings of our analysis are summarized in the following report.

We trust you find this report satisfactory. Should you have any questions or require further clarification, please call.

Yours truly,

Municipal Engineering Solutions

Per: John C. Bourrie, P.Eng.

/LMC

File Location: D:\Projects\2021\21-011 Sundial Halton SCS 17002-101\3.0 Report\Revised Draft April 2023\17002-101 Sundial Watermain Analysis_20230404.docx

SUNDIAL MILTON 4TH LINE DEVELOPMENT

WATER ANALYSIS

PREPARED BY:

MUNICIPAL ENGINEERING SOLUTIONS

FOR:

SUNDIAL HOMES
April 2023

Project Number: 17002-101

TABLE OF CONTENTS

APPENDICES

Section 1 – INTRODUCTION

Municipal Engineering Solutions ("MES") was retained by Sundial Homes to conduct a hydraulic water analysis for the proposed Sundial Milton 4th Line development located in the Town of Milton in the Region of Halton. As part of this hydraulic assessment MES was requested to undertake the following:

1. Calculate/verify water demands for the proposed development using Region of Halton, provincial and industry design standards;
2. Add the subject watermains/development to the Region's existing water model;
3. Run the model to size the subject mains to achieve service criteria during Average Day, Peak Hour, and fire flow during Maximum Day demand; and
4. Prepare a Report summarizing the modeling results for agency review and design purposes.

1.1 Development Background

The Sundial Milton 4th Line Development consists of 253 single family homes, 546 townhomes, 303 apartment units and one school block with located north of Britannia Road between 4th Line and James Snow Parkway in the Town of Milton. Twenty townhomes partially in the Bayview Lexis development on Street 20 were also included. The proposed development is shown below on **Figure 1**.

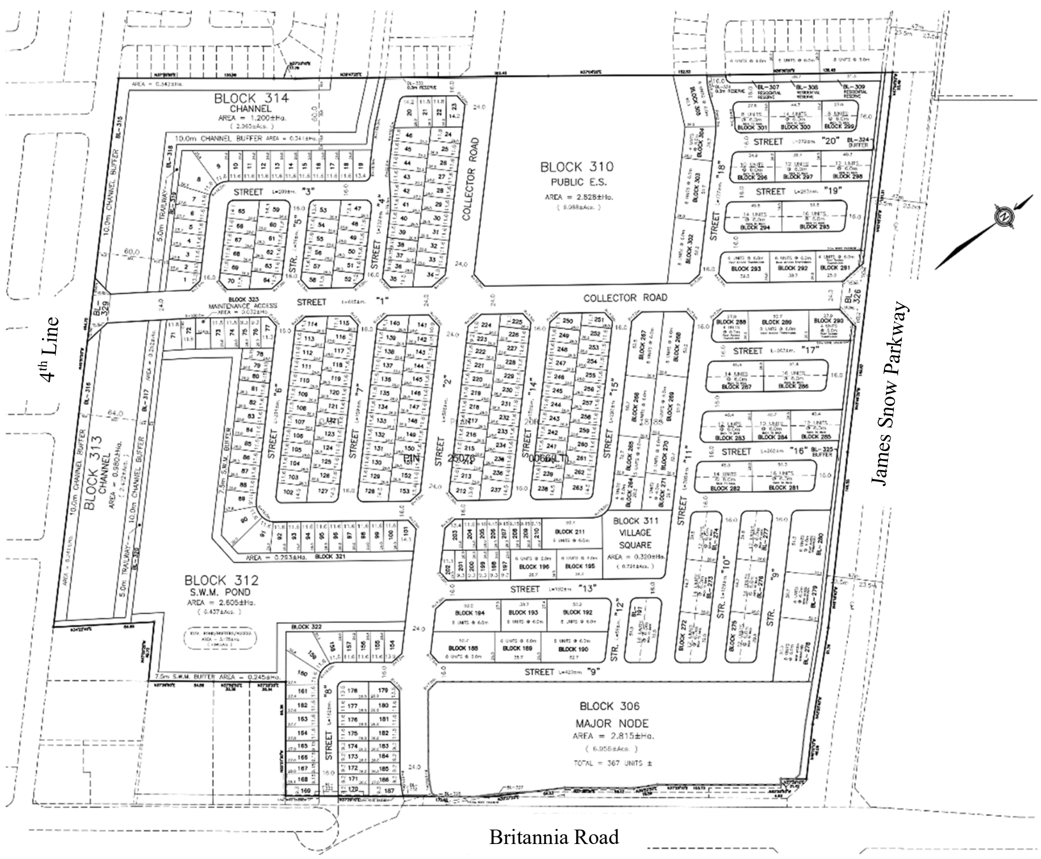


Figure 1 - Proposed Sundial Milton 4th Line Development

Section 2 – WATERMAIN DESIGN CRITERIA

The design criteria utilized to estimate the water demands for the hydraulic water model follows general industry standards and is calculated using the design criteria and guidelines outlined in the Region of Halton's October 2019 Water and Wastewater Linear Design Manual, the Ministry of the Environment, Conservation and Parks (MECP) Watermain Design Criteria, and the Fire Underwriters Survey.

The following sections summarize the specific design criteria used to carry out the hydraulic watermain assessment for this development.

2.1 Equivalent Population Densities & Water Design Factors

To calculate the equivalent population and water design factors for this development MES used Region of Halton standard population densities as noted in the *"Region of Halton Water and Wastewater Linear Design Manual, October 2019"*. **Table 1** summarizes the population densities and **Table 2** summarizes the average daily demand and peaking factors used for this analysis.

Table 1 – Equivalent Population Density

Type of Development	Equivalent Population (Persons/Ha)	Equivalent Population (Persons/Unit)
Single Family	55	3.772
Semi-Detached	100	3.772
Townhouse	135	2.536
Apartment	285	1.594
Light Commercial/Schools	90	
Community Services	40	

Source: Region of Halton Water and Wastewater Linear Design Manual, October 2019 and 2022 Development Charges Update December 2021

Table 2 - Water Design Factors

Type of Development	Average Daily Demand (m^3 per capita)	Maximum Daily Demand Peaking Factor	Peak Hourly Demand Peaking Factor
Residential	0.275	2.25	4.00
Industrial	0.275	2.25	2.25
Commercial	0.275	2.25	2.25
Community Services	0.275	2.25	2.25

Source: Region of Halton Water and Wastewater Linear Design Manual, October 2019

Section 3 –FLOW DEMANDS

Utilizing the equivalent population data from **Table 1** and the corresponding Average Day, Maximum Day, and Peak Hour data from **Table 2** the water demands for this development were calculated.

3.1 Equivalent Population Flow Demands

The calculated demands for the development are summarized in **Table 3**. For additional details on the development water demands and assigned demand nodes used in the water model see **Appendix A**.

`

Table 3 – Water Demand for Sundial Milton 4th Line Development

Development	Average Day Demand (L/S)	Maximum Day Demand (L/S)	Peak Hour Demand (L/S)
Sundial Milton 4th Line	**9.50**	**21.38**	**37.38**

3.2 Fire Flow Demands

The fire demands for this development were based on typical flows calculated using the Fire Underwriters Survey ("FUS") formula outlined in the *'Water Supply For Public Fire Protection Guideline',* dated 2020. Since the detailed design data (specifics) for the proposed units/buildings are not known at this time, fire flows that have been used by MES for other similar developments previously submitted in Halton were utilized. Once the building designs/configurations are known for the proposed development the fire flows for each unit/building must be confirmed using the FUS criteria to determine the actual fire flow required. Building construction and sprinkler systems may need to be designed to suit the available flow and pressure. The fire flows used are shown in **Table 4**.

Table 4 - Fire Flow Requirements

Building	Fire Flow (L/S)
Singles	**167**
Street Towns	**250**
B2B Towns	**267**
Medium Density Block	**267**
School	**283**

Source: Fire Underwriters Survey

3.3 External Demands

The Region of Halton InfoWater model that was provided by the Region to MES included water demands for existing and known future developments within the Region.

Section 4 – OTHER SYSTEM REQUIREMENTS

4.1 System Pressure Requirements

In addition to meeting the various flow requirements, the system must also satisfy minimum and maximum pressure requirements as outlined by the Region of Halton. The Region's pressure requirements are outlined in the Water and Wastewater Linear Design Manual and stipulate the following:

1. The water system shall be designed to maintain as close as possible to a maximum working pressure of 690 kPa (100 psi) as a best management practice.
2. The minimum system pressure shall not be less than 140 kPa (20 psi) at any point in the water system under fire flow conditions.
3. Under normal operating conditions, the water system shall have a target minimum static pressure of 345 kPa (50 psi). Under no operating conditions shall the static pressure within a distribution main fall below 275 kPa (40 psi).
4. The normal method of reduction of pressures to comply with the Ontario Building Code (reduction of pressures to 550 kPa, 80 psi) is by pressure reducing valves to be installed on individual services.

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4.2 Watermain Sizing

The Region of Halton also stipulates minimum pipe sizes and requires that all watermains are adequately sized to maintain demand flows at the required pressures without causing excessive energy loss or result in water quality decay. The watermain system must therefore be designed to accommodate the greater of the following:

- Maximum day plus fire demand
- Peak hour demand

The minimum pipe size for commercial and industrial areas shall be 300 mm diameter and for residential areas the minimum pipe size shall be 150 mm diameter. For distribution systems providing fire protection the minimum pipe size shall be 150 mm diameter in accordance with Ministry of the Environment, Conservation and Parks (MECP) and NFPA requirements.

To provide appropriate fire protection, reliable supply and pressures the water distribution system should be looped wherever possible to improve supply security and water quality.

4.3 Watermain C-Factor

In designing and modeling of the pipes the Coefficient of Roughness (C-Factor) factors from the Region's design manual were utilized. The Coefficient of Roughness assigned to each pipe size in summarized in **Table 6** below.

Table 5 - Hazen-Williams Coefficient of Roughness (C-Factors)

Size of Pipe (Diameter in mm)	Pipe Material	Coefficient of Roughness (C)
50 mm	Copper	120
100 mm to 400 mm	PVC/HDPE	130
Greater Than 400 mm	Concrete Lined	110

Source: Region of Halton Water and Wastewater Linear Design Manual, October 2019

Section 5 – ANALYSIS & MODELING RESULTS

In order to conduct the hydraulic water analysis for the proposed development the water demands were estimated by MES using the design criteria previously discussed and incorporated the demands into the existing Region of Halton InfoWater model (August 2022) which was provided by the Region and confirmed as most recent. The following sections discusses the model setup and results.

5.1 Model Setup

The Sundial development is located within the Region's Zone M4L which is currently part of the area to be changed through the Region's zone realignment. The Sundial site will be within the future Zone 250 when the zone change is completed. The zone realignment is considered as completed in the model.

The development elevations range from 193.6 m to 196.1 m, which is within the service range of Zone 250.

The development was modeled under 2021 and 2031 conditions with the entire subdivision watermains completed. Supply will be provided by watermains from the Bayview Lexis development on Street 2 (Trudeau Drive) and Street 19 (Leriche Way), and 4th Line plus a connection to the feedermain on Britannia Road at the other end of Street 2 (Trudeau Drive). A local watermain along Britannia Road and 4th Line was included linking Streets 1 (Logan Drive), Street 2 (Trudeau Drive), and Street 8.

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New nodes were created to add the flow demands and service elevation information from the development to the Region of Halton's existing Infowater hydraulic water distribution model system and the system analysis was carried out. Friction factor for the pipes were assigned according to **Table 5**.

5.2 Watermain Sizing and System Pressures

The analysis was conducted under 2021 and 2031 servicing conditions for Average Day, Maximum Day, Peak 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 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. The watermain on Street 1 (Logan Drive) was sized at 300 mm all the way to 4th Line with the assumption that it would be continued across 4th Line into future developments to the west. The local watermain on 4th Line and Britannia Road was sized at 200 mm as requested by the Region to supply other future development lands. The size of this local pipe must be confirmed by the Region. The Town requested a 200 mm watermain along 4th Line between Street 1 (Logan Drive) and Hemming Crescent across the storm channel.

The site Is adequately supplied from Zone 250 according to the model output. As noted in Section 5.1, both 2021 and 2031 scenarios considered that the zone switch had been completed. The top water level of Zone M4L is 236.0 which is 14 m lower than the top water level of Zone 250 so pressures could be ~20 psi (140 kPa) lower than the model results before the zone switch is completed. As the model pressures estimated to be around 70 psi, the pressures under Zone M4L would still be within the acceptable pressure range.

The pressures are near the upper limit of the OBC requirement of 80 psi (550 kPa) under 2031 average day conditions. As the Region does not examine minimum hour conditions, the pressure could be higher than shown in the results. Individual pressure reduction may be required in the units. Pressures should be confirmed in the field.

Modeled service pressures for the development are summarized in **Table 7**. All pressures lie within the required operating range under average day, maximum day, and peak hour demands.

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
2021	71.1 – 74.8 psi (490 to 516 kPa)	71.0 – 74.8 psi (490 to 516 kPa)	69.6 to 73.4 psi (480 to 506 kPa)	242 to 1,651L/s @ 20 psi
2031	75.4 – 79.1 psi (520 to 545 kPa)	74.0 – 77.7 psi (510 to 536 kPa)	59.8 to 63.5 psi (412 to 438 kPa)	247 to 1,759 L/s @ 20 psi

Section 6 – CONCLUSIONS

The results are summarized below.

- The service pressures are expected to range between 69.6 psi to 74.8 psi (480 kPa to 516 kPa) in 2021 and between 59.8 psi to 79.1 psi (412 kPa to 545 kPa) in 2031.
- The available fire flow meets the required fire flow demands at the minimum pressure of 140 kPa based on the proposed watermain configuration and assumptions made within this report.
- Pressures may exceed the OBC pressure criteria of 80 psi (550 kPa) under 2031 average day conditions. Pressure reduction may be required as the Region does not examine minimum hour conditions. Pressures should be confirmed in the field.

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- The sizing of the 200 mm local watermain along 4th Line and Britannia Road must be confirmed with the Region.
- The development was modeled under Zone 250 conditions. The top water level of Zone M4L is 14 m lower than Zone 250 so pressures could be ~20 psi (140 kPa) lower than the model results before the zone switch is completed. It is recommended that the zone change be confirmed with the Region and/or hydrant tests conducted to confirm flows and pressures.
- Confirmation and/or changes to the criteria should also be provided to and reviewed with MES prior to the finalization of the detailed design drawings and construction of the watermain system. Final design parameters are to be provided to MES prior to construction for further review to confirm that the actual (final) site conditions and building design(s) reflect those modeled by MES within this report.
- This report, including all modeling assumptions used, is to be submitted to and reviewed by the water operating authority (municipality) to confirm that the modeling parameters used are acceptable to the operating authority and/or confirm if modified domestic or fire flow requirements are required or should be implemented for this particular development.

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Appendix A

Demands

Halton Design Criteria

Water & Wastewater Linear Design Manual, October 2019

Equivalent Population by Unit

(2022 Development Charges Update, December 2021 Table A-4)

Type of Development	Equivalent Population Density *(Person/Unit)*
Single Family or Semi-Detached	3.772
Townhouse*	2.536
Apartment*	1.594

*average of ppu for each size unit (towns > or < 3 bdm, apartments > or < 2 bdrm)

Equivalent Population by Area

Type of Development	Equivalent Population Density *(Person/Hectare)*	Average Day Demands *(m3/ha/day)*
Single Family	55	15.13
Semi-detached duplex and 4-plex	100	27.50
Townhouse, Maisonette (<6 stories)	135	37.13
Block 1*	400	
Block 586/587*	250	
Apartments (>6 stories)	285	78.38
Light Commercial Areas	90	24.75
Community Services	40	11.00
Light Industrial Areas	125	34.38
Hospitals (persons/bed)	4	

*DSEL

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.)	Material	Coefficient of Roughness (C)
50	Copper	120
100-400	PVC/HDPE	130
Over 400	Concrete Lined	110

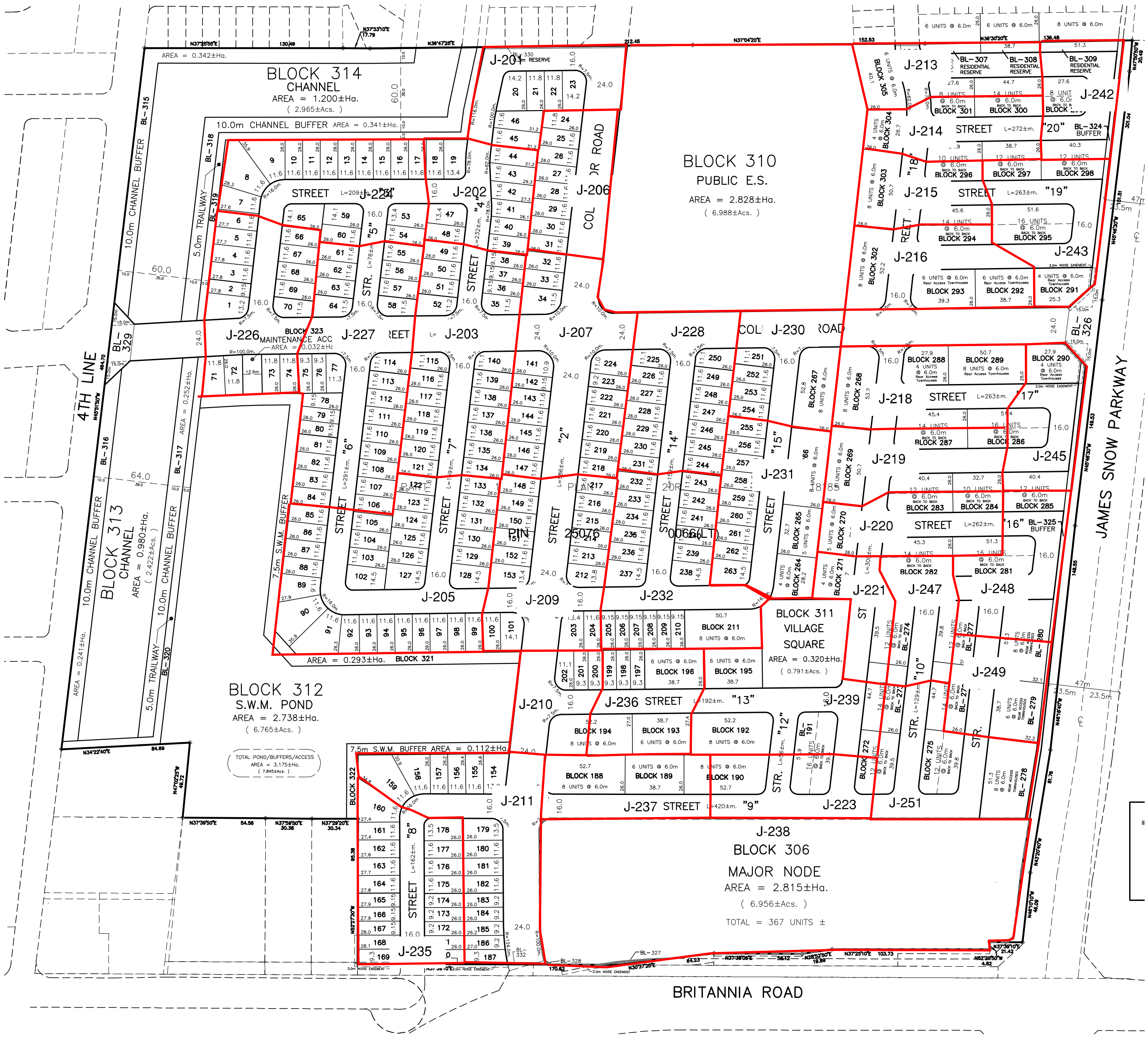
Minimum Pipe Size

Type of Development	Size of Pipe (mm Dia.)
Residential	150
Commercial/Industrial/Community	300

Working Pressures

Parameter	Pressure
Normal Condition	
Minimum Pressure	275 kPa (40 psi)
Target Pressure	350 kPa (50 psi)
Maximum (Building Code)	550 kPa (80 psi)
Maximum (Halton)	690 kPa (100 psi)
Fire Flow Conditions	
Minimum Pressure	140 kPa (20 psi)

Demand Layout



Water Demand
Sundial, Milton On
April 10, 2023

Municipal Engineering Solutions

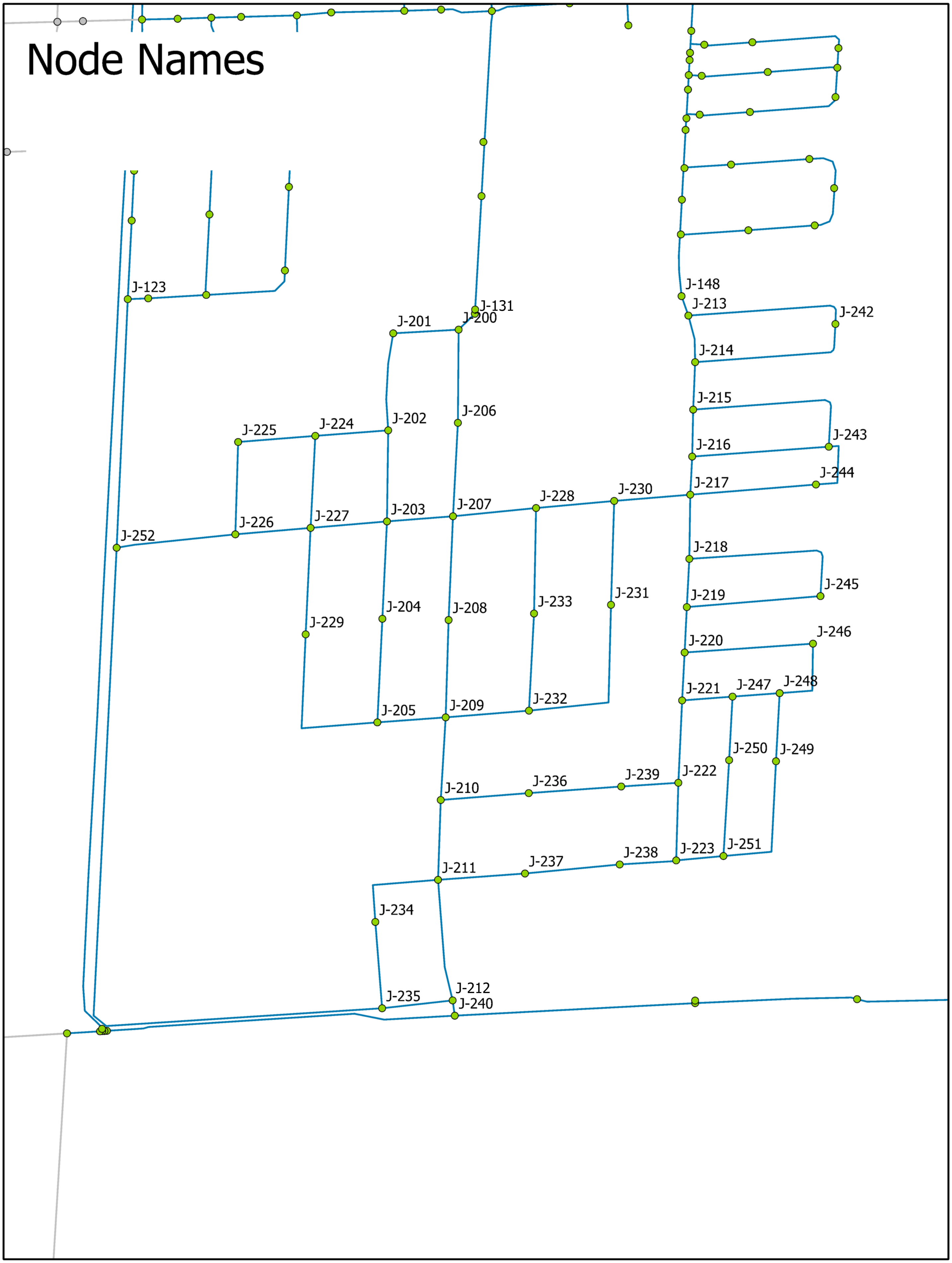
Node	Exist. Zone	Fut. Zone	Elevation	Type of Development							Equivalent Population		Demands			Fire Flow
				Single Family	Semi-Detached	Townhouse	Apartment	Commercial	Community	Industrial	Total Population	Total Population	ADD	MDD	PHD	Demands
			(m)	*(units)*	*(units)*	*(units)*	(units)	*(ha)*	*(ha)*	*(ha)*	*(Residential)*	*(ICI)*	*(L/s)*	*(L/s)*	*(L/s)*	*(L/s)*
J-200	M4L	250	194.56								0	0	0.00	0.00	0.00	167
J-201	M4L	250	194.01	6							23	0	0.07	0.16	0.29	167
J-202	M4L	250	194.16	10							38	0	0.12	0.27	0.48	167
J-203	M4L	250	194.02	22							83	0	0.26	0.59	1.06	167
J-204	M4L	250	194.25								0	0	0.00	0.00	0.00	167
J-205	M4L	250	194.31	31							117	0	0.37	0.84	1.49	167
J-206	M4L	250	194.39	8					*2.828*		30	113	0.46	1.03	1.19	283
J-207	M4L	250	194.20	17							64	0	0.20	0.46	0.82	167
J-208	M4L	250	194.30								0	0	0.00	0.00	0.00	167
J-209	M4L	250	194.06	16							60	0	0.19	0.43	0.77	167
J-210	M4L	250	193.89	3		4					21	0	0.07	0.15	0.27	250
J-211	M4L	250	194.33	15							57	0	0.18	0.41	0.72	167
J-212	M4L	250	195.40								0	0	0.00	0.00	0.00	167
J-213*	M4L	250	195.79			29					74	0	0.23	0.53	0.94	267
J-214	M4L	250	195.12			26					66	0	0.21	0.47	0.84	267
J-215	M4L	250	194.99			20					51	0	0.16	0.36	0.65	267
J-216	M4L	250	194.78			27					68	0	0.22	0.49	0.87	267
J-217	M4L	250	194.72								0	0	0.00	0.00	0.00	250
J-218	M4L	250	194.72			31					79	0	0.25	0.56	1.00	267
J-219	M4L	250	195.00			30					76	0	0.24	0.54	0.97	267
J-220	M4L	250	194.87			27					68	0	0.22	0.49	0.87	267
J-221	M4L	250	194.66			12					30	0	0.10	0.22	0.39	267
J-222	M4L	250	194.37								0	0	0.00	0.00	0.00	267
J-223	M4L	250	194.58			16					41	0	0.13	0.29	0.52	267
J-224	M4L	250	194.15	16							60	0	0.19	0.43	0.77	167
J-225	M4L	250	193.84								0	0	0.00	0.00	0.00	167
J-226	M4L	250	193.60	15							57	0	0.18	0.41	0.72	167
J-227	M4L	250	193.85	27							102	0	0.32	0.73	1.30	167
J-228	M4L	250	194.38	14							53	0	0.17	0.38	0.67	167
J-229	M4L	250	194.57								0	0	0.00	0.00	0.00	167
J-230	M4L	250	194.55	4		8					35	0	0.11	0.25	0.45	250
J-231	M4L	250	194.63	9		17					77	0	0.25	0.55	0.98	250
J-232	M4L	250	194.21	18		8					88	0	0.28	0.63	1.12	250
J-233	M4L	250	194.53								0	0	0.00	0.00	0.00	167
J-234	M4L	250	194.55								0	0	0.00	0.00	0.00	167
J-235	M4L	250	195.30	19							72	0	0.23	0.51	0.91	167
J-236	M4L	250	193.95	3		16					52	0	0.17	0.37	0.66	250
J-237	M4L	250	194.20			17					43	0	0.14	0.31	0.55	267
J-238	M4L	250	194.48			72	303				665	0	2.12	4.77	8.47	267
J-239	M4L	250	194.19			30					76	0	0.24	0.54	0.97	267
J-240	M4L	250	194.43								0	0	0.00	0.00	0.00	
J-242*	M4L	250	195.90			22					56	0	0.18	0.40	0.71	267
J-243	M4L	250	195.90			32					81	0	0.26	0.58	1.03	267
J-244	M4L	250	196.05								0	0	0.00	0.00	0.00	250
J-245	M4L	250	195.52			18					46	0	0.15	0.33	0.58	267
J-246	M4L	250	195.40								0	0	0.00	0.00	0.00	267
J-247	M4L	250	194.77			23					58	0	0.19	0.42	0.74	267
J-248	M4L	250	194.98			25					63	0	0.20	0.45	0.81	267
J-249	M4L	250	195.00			20					51	0	0.16	0.36	0.65	267
J-250	M4L	250	194.90								0	0	0.00	0.00	0.00	267
J-251	M4L	250	194.69			36					91	0	0.29	0.65	1.16	267
J-252	M4L	250	194.30								0	0	0.00	0.00	0.00	
			.													
Total				**253**	**0**	**566**	**303**	**0.00**	**2.83**	**0.00**	**2873**	**113**	**9.50**	**21.38**	**37.38**	

*includes future units

Appendix B

Model Results

Node Names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J-201
J-148
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J-242
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J-215
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J-216
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J-202
J-206
J-224
J-225
J-226
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J-218
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J-250
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J-222
J-210
J-236
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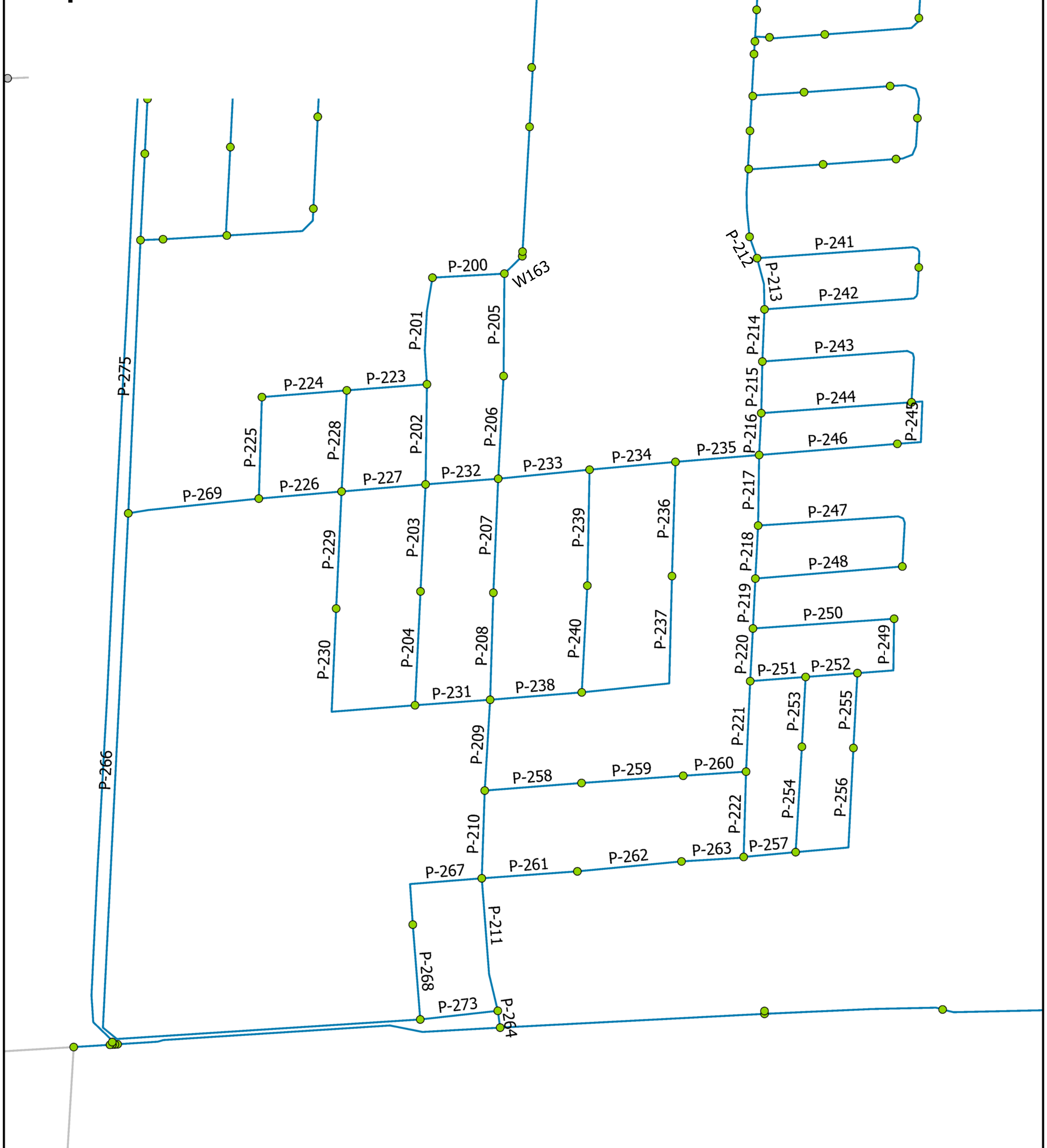
J-251
J-211
J-237
J-238
J-234
J-235
J-212
J-240

Pipe Names


P-200
W163
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P-205
P-275
P-224
P-223
P-225
P-228
P-202
P-206
P-269
P-226
P-227
P-232
P-233
P-234
P-235
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P-213
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P-214
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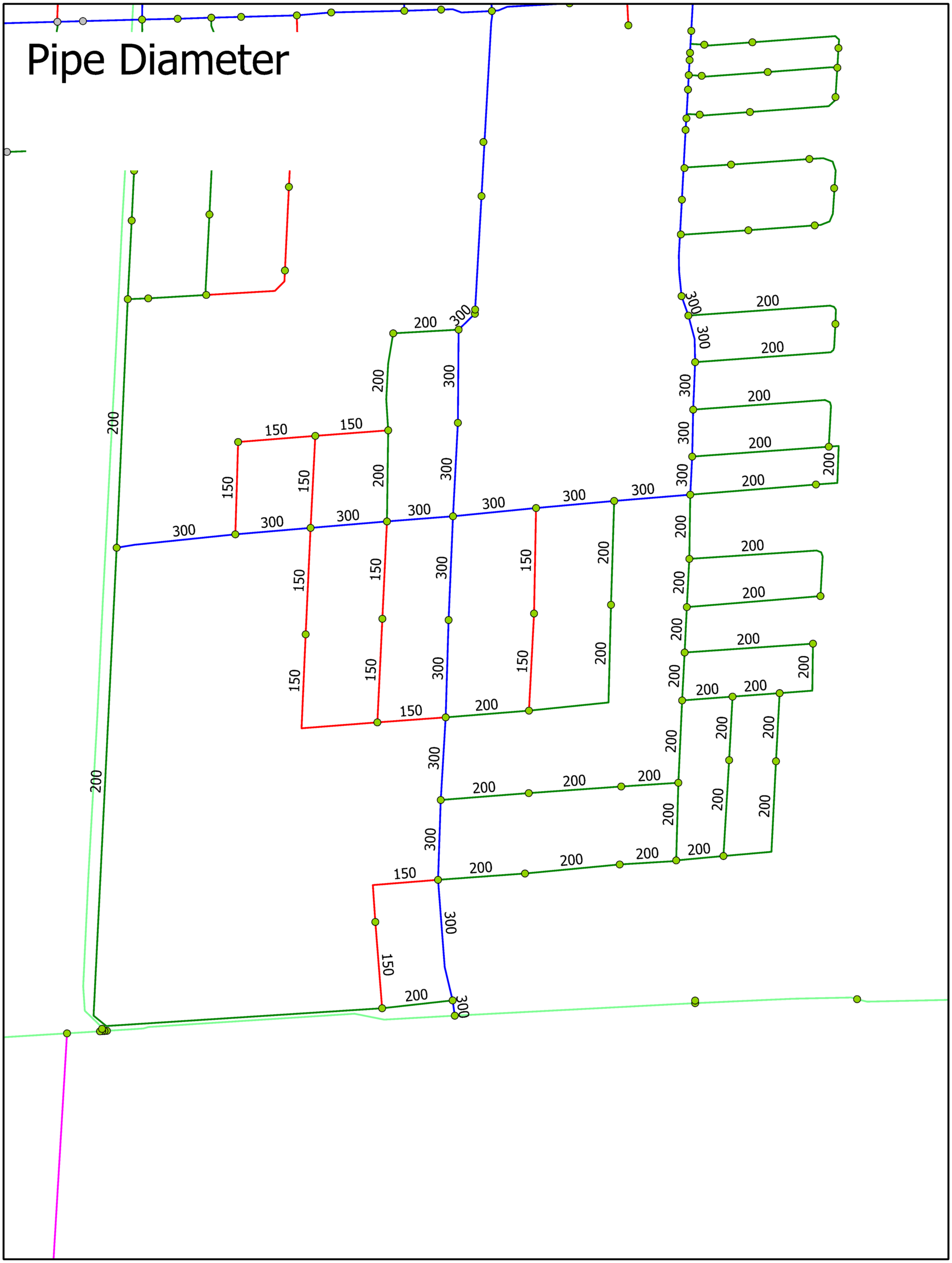

Pipe Diameter

2021 Conditions
Sundial, Milton On
April 10, 2023

Municipal Engineering Solutions

Average Day

Node Table

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-123	0.00	194.80	246.20	73.07
J-131	0.00	195.09	246.22	72.69
J-148	0.00	196.23	246.22	71.07
J-200	0.00	194.56	246.23	73.45
J-201	0.07	194.01	246.23	74.23
J-202	0.12	194.16	246.23	74.03
J-203	0.26	194.02	246.24	74.23
J-204	0.00	194.25	246.24	73.91
J-205	0.37	194.31	246.25	73.83
J-206	0.46	194.39	246.23	73.70
J-207	0.20	194.20	246.24	73.97
J-208	0.00	194.30	246.25	73.85
J-209	0.19	194.06	246.26	74.20
J-210	0.07	193.89	246.28	74.48
J-211	0.18	194.33	246.31	73.89
J-212	0.00	195.40	246.36	72.45
J-213	0.23	195.79	246.22	71.70
J-214	0.21	195.12	246.23	72.65
J-215	0.16	194.99	246.23	72.84
J-216	0.22	194.78	246.23	73.14
J-217	0.00	194.72	246.23	73.23
J-218	0.25	194.72	246.24	73.24
J-219	0.24	195.00	246.25	72.85
J-220	0.22	194.87	246.25	73.05
J-221	0.10	194.66	246.26	73.35
J-222	0.00	194.37	246.26	73.77
J-223	0.13	194.58	246.26	73.47
J-224	0.19	194.15	246.24	74.04
J-225	0.00	193.84	246.24	74.49
J-226	0.18	193.60	246.24	74.83
J-227	0.32	193.85	246.24	74.47
J-228	0.17	194.38	246.24	73.72
J-229	0.00	194.57	246.24	73.45
J-230	0.11	194.55	246.24	73.48
J-231	0.25	194.63	246.24	73.37
J-232	0.28	194.21	246.25	73.98
J-233	0.00	194.53	246.24	73.51
J-234	0.00	194.55	246.32	73.60
J-235	0.23	195.30	246.34	72.56
J-236	0.17	193.95	246.27	74.38
J-237	0.14	194.20	246.29	74.05
J-238	2.12	194.48	246.27	73.62
J-239	0.24	194.19	246.27	74.03
J-240	0.00	194.43	246.37	73.84
J-242	0.18	195.90	246.22	71.54
J-243	0.26	195.90	246.23	71.55
J-244	0.00	196.05	246.23	71.34
J-245	0.15	195.52	246.24	72.11
J-246	0.00	195.40	246.26	72.30
J-247	0.19	194.77	246.26	73.19
J-248	0.20	194.98	246.26	72.90
J-249	0.16	195.00	246.26	72.87
J-250	0.00	194.90	246.26	73.01
J-251	0.29	194.69	246.26	73.31
J-252	0.00	194.30	246.24	73.83

MIN		**193.60**		**71.07**
MAX		**196.23**		**74.83**

Pipe Table

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness (C)	Flow (ML/d)	Velocity (m/s)
P-200	J-201	J-200	58.75	200	130	0.21	0.08
P-201	J-202	J-201	87.44	200	130	0.22	0.08
P-202	J-202	J-203	81.64	200	130	-0.16	0.06
P-203	J-203	J-204	87.35	150	130	-0.10	0.07
P-204	J-204	J-205	92.97	150	130	-0.10	0.07
P-205	J-200	J-206	83.52	300	130	-0.66	0.11
P-206	J-206	J-207	83.87	300	130	-0.70	0.11
P-207	J-207	J-208	93.05	300	130	-1.00	0.16
P-208	J-208	J-209	87.31	300	130	-1.00	0.16
P-209	J-209	J-210	74.19	300	130	-1.60	0.26
P-210	J-210	J-211	71.90	300	130	-1.88	0.31
P-211	J-211	J-212	109.11	300	130	-2.19	0.36
P-212	J-148	J-213	18.48	300	130	-0.71	0.12
P-213	J-213	J-214	42.49	300	130	-0.66	0.11
P-214	J-214	J-215	42.57	300	130	-0.77	0.13
P-215	J-215	J-216	42.11	300	130	-0.67	0.11
P-216	J-216	J-217	34.20	300	130	-0.72	0.12
P-217	J-217	J-218	57.54	200	130	-0.38	0.14
P-218	J-218	J-219	43.28	200	130	-0.30	0.11
P-219	J-219	J-220	40.74	200	130	-0.44	0.16
P-220	J-220	J-221	43.00	200	130	-0.31	0.12
P-221	J-221	J-222	73.89	200	130	-0.27	0.10
P-222	J-222	J-223	69.91	200	130	-0.03	0.01
P-223	J-202	J-224	65.55	150	130	-0.06	0.04
P-224	J-224	J-225	69.40	150	130	-0.03	0.02
P-225	J-226	J-225	82.81	150	130	0.03	0.02
P-226	J-226	J-227	67.70	300	130	-0.06	0.01
P-227	J-227	J-203	68.73	300	130	-0.05	0.01
P-228	J-227	J-224	82.59	150	130	0.05	0.03
P-229	J-227	J-229	95.52	150	130	-0.08	0.06
P-230	J-229	J-205	152.44	150	130	-0.08	0.06
P-231	J-205	J-209	61.41	150	130	-0.22	0.14
P-232	J-203	J-207	59.39	300	130	-0.14	0.02
P-233	J-207	J-228	74.83	300	130	0.15	0.02
P-234	J-228	J-230	70.33	300	130	0.25	0.04
P-235	J-230	J-217	68.43	300	130	0.44	0.07
P-236	J-230	J-231	93.15	200	130	-0.20	0.07
P-237	J-231	J-232	159.23	200	130	-0.22	0.08
P-238	J-232	J-209	74.93	200	130	-0.36	0.13
P-239	J-228	J-233	94.57	150	130	-0.12	0.08
P-240	J-233	J-232	87.18	150	130	-0.12	0.08
P-241	J-213	J-242	147.20	200	130	-0.07	0.03
P-242	J-242	J-214	148.76	200	130	-0.09	0.03
P-243	J-215	J-243	163.67	200	130	-0.11	0.04
P-244	J-216	J-243	123.07	200	130	0.03	0.01
P-245	J-243	J-244	61.29	200	130	-0.11	0.04
P-246	J-244	J-217	113.33	200	130	-0.11	0.04
P-247	J-218	J-245	158.61	200	130	-0.10	0.04
P-248	J-245	J-219	120.52	200	130	-0.12	0.04
P-249	J-246	J-248	71.82	200	130	-0.14	0.05
P-250	J-246	J-220	115.64	200	130	0.14	0.05
P-251	J-221	J-247	45.32	200	130	-0.05	0.02
P-252	J-247	J-248	42.34	200	130	0.06	0.02
P-253	J-247	J-250	57.01	200	130	-0.12	0.05
P-254	J-250	J-251	86.40	200	130	-0.12	0.05
P-255	J-248	J-249	61.13	200	130	-0.10	0.04
P-256	J-249	J-251	124.78	200	130	-0.12	0.04
P-257	J-251	J-223	42.56	200	130	-0.26	0.10
P-258	J-210	J-236	79.15	200	130	0.28	0.10
P-259	J-236	J-239	83.08	200	130	0.26	0.10
P-260	J-239	J-222	51.35	200	130	0.24	0.09
P-261	J-237	J-211	78.16	200	130	-0.50	0.18
P-262	J-237	J-238	85.25	200	130	0.49	0.18
P-263	J-238	J-223	52.10	200	130	0.31	0.11
P-264	J-240	J-212	13.83	300	130	2.81	0.46
P-266	J-235	J-252	682.71	200	130	0.39	0.14
P-267	J-211	J-234	91.78	150	130	-0.21	0.14
P-268	J-234	J-235	77.59	150	130	-0.21	0.14
P-269	J-226	J-252	107.11	300	130	0.01	0.00
P-273	J-212	J-235	63.60	200	130	0.62	0.23
P-275	J-123	J-252	223.05	200	130	-0.40	0.15
W163	J-131	J-200	20.36	300	130	-0.87	0.14

2021 Conditions
Sundial, Milton On
April 10, 2023

Maximum Day

Node Table

ID	Demand (L/s)	Elevatio (m)	Head (m)	Pressure (psi)
J-123	0.00	194.80	246.16	73.02
J-131	0.00	195.09	246.20	72.66
J-148	0.00	196.23	246.19	71.03
J-200	0.00	194.56	246.20	73.42
J-201	0.16	194.01	246.21	74.20
J-202	0.27	194.16	246.22	74.00
J-203	0.59	194.02	246.22	74.21
J-204	0.00	194.25	246.23	73.89
J-205	0.84	194.31	246.23	73.82
J-206	1.03	194.39	246.21	73.67
J-207	0.46	194.20	246.22	73.95
J-208	0.00	194.30	246.24	73.84
J-209	0.43	194.06	246.26	74.21
J-210	0.15	193.89	246.30	74.51
J-211	0.41	194.33	246.36	73.97
J-212	0.00	195.40	246.49	72.62
J-213	0.53	195.79	246.20	71.66
J-214	0.47	195.12	246.20	72.62
J-215	0.36	194.99	246.21	72.81
J-216	0.49	194.78	246.21	73.11
J-217	0.00	194.72	246.21	73.20
J-218	0.56	194.72	246.22	73.22
J-219	0.54	195.00	246.23	72.83
J-220	0.49	194.87	246.24	73.03
J-221	0.22	194.66	246.25	73.34
J-222	0.00	194.37	246.26	73.77
J-223	0.29	194.58	246.26	73.47
J-224	0.43	194.15	246.22	74.02
J-225	0.00	193.84	246.22	74.46
J-226	0.41	193.60	246.22	74.80
J-227	0.73	193.85	246.22	74.45
J-228	0.38	194.38	246.22	73.69
J-229	0.00	194.57	246.23	73.43
J-230	0.25	194.55	246.22	73.45
J-231	0.55	194.63	246.22	73.35
J-232	0.63	194.21	246.24	73.97
J-233	0.00	194.53	246.23	73.50
J-234	0.00	194.55	246.40	73.71
J-235	0.51	195.30	246.44	72.69
J-236	0.37	193.95	246.29	74.40
J-237	0.31	194.20	246.32	74.09
J-238	4.77	194.48	246.27	73.62
J-239	0.54	194.19	246.27	74.03
J-240	0.00	194.43	246.51	74.04
J-242	0.40	195.90	246.20	71.50
J-243	0.58	195.90	246.21	71.52
J-244	0.00	196.05	246.21	71.31
J-245	0.33	195.52	246.23	72.08
J-246	0.00	195.40	246.25	72.28
J-247	0.42	194.77	246.25	73.18
J-248	0.45	194.98	246.25	72.88
J-249	0.36	195.00	246.25	72.86
J-250	0.00	194.90	246.25	73.00
J-251	0.65	194.69	246.25	73.30
J-252	0.00	194.30	246.22	73.81

MIN		**193.60**		**71.03**
MAX		**196.23**		**74.80**

Pipe Table

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness (C)	Flow (ML/d)	Velocity (m/s)
P-200	J-201	J-200	58.75	200	130	0.27	0.10
P-201	J-202	J-201	87.44	200	130	0.28	0.10
P-202	J-202	J-203	81.64	200	130	-0.22	0.08
P-203	J-203	J-204	87.35	150	130	-0.14	0.09
P-204	J-204	J-205	92.97	150	130	-0.14	0.09
P-205	J-200	J-206	83.52	300	130	-0.85	0.14
P-206	J-206	J-207	83.87	300	130	-0.93	0.15
P-207	J-207	J-208	93.05	300	130	-1.44	0.24
P-208	J-208	J-209	87.31	300	130	-1.44	0.24
P-209	J-209	J-210	74.19	300	130	-2.34	0.38
P-210	J-210	J-211	71.90	300	130	-2.85	0.47
P-211	J-211	J-212	109.11	300	130	-3.39	0.56
P-212	J-148	J-213	18.48	300	130	-0.88	0.14
P-213	J-213	J-214	42.49	300	130	-0.84	0.14
P-214	J-214	J-215	42.57	300	130	-1.00	0.16
P-215	J-215	J-216	42.11	300	130	-0.89	0.15
P-216	J-216	J-217	34.20	300	130	-0.98	0.16
P-217	J-217	J-218	57.54	200	130	-0.44	0.16
P-218	J-218	J-219	43.28	200	130	-0.37	0.13
P-219	J-219	J-220	40.74	200	130	-0.56	0.21
P-220	J-220	J-221	43.00	200	130	-0.42	0.15
P-221	J-221	J-222	73.89	200	130	-0.39	0.14
P-222	J-222	J-223	69.91	200	130	0.02	0.01
P-223	J-202	J-224	65.55	150	130	-0.08	0.05
P-224	J-224	J-225	69.40	150	130	-0.05	0.03
P-225	J-226	J-225	82.81	150	130	0.05	0.03
P-226	J-226	J-227	67.70	300	130	-0.02	0.00
P-227	J-227	J-203	68.73	300	130	-0.03	0.01
P-228	J-227	J-224	82.59	150	130	0.07	0.05
P-229	J-227	J-229	95.52	150	130	-0.12	0.08
P-230	J-229	J-205	152.44	150	130	-0.12	0.08
P-231	J-205	J-209	61.41	150	130	-0.32	0.21
P-232	J-203	J-207	59.39	300	130	-0.17	0.03
P-233	J-207	J-228	74.83	300	130	0.30	0.05
P-234	J-228	J-230	70.33	300	130	0.43	0.07
P-235	J-230	J-217	68.43	300	130	0.68	0.11
P-236	J-230	J-231	93.15	200	130	-0.28	0.10
P-237	J-231	J-232	159.23	200	130	-0.32	0.12
P-238	J-232	J-209	74.93	200	130	-0.54	0.20
P-239	J-228	J-233	94.57	150	130	-0.16	0.11
P-240	J-233	J-232	87.18	150	130	-0.16	0.11
P-241	J-213	J-242	147.20	200	130	-0.08	0.03
P-242	J-242	J-214	148.76	200	130	-0.12	0.04
P-243	J-215	J-243	163.67	200	130	-0.14	0.05
P-244	J-216	J-243	123.07	200	130	0.04	0.02
P-245	J-243	J-244	61.29	200	130	-0.15	0.05
P-246	J-244	J-217	113.33	200	130	-0.15	0.05
P-247	J-218	J-245	158.61	200	130	-0.12	0.04
P-248	J-245	J-219	120.52	200	130	-0.15	0.05
P-249	J-246	J-248	71.82	200	130	-0.18	0.07
P-250	J-246	J-220	115.64	200	130	0.18	0.07
P-251	J-221	J-247	45.32	200	130	-0.04	0.02
P-252	J-247	J-248	42.34	200	130	0.09	0.03
P-253	J-247	J-250	57.01	200	130	-0.17	0.06
P-254	J-250	J-251	86.40	200	130	-0.17	0.06
P-255	J-248	J-249	61.13	200	130	-0.13	0.05
P-256	J-249	J-251	124.78	200	130	-0.17	0.06
P-257	J-251	J-223	42.56	200	130	-0.39	0.14
P-258	J-210	J-236	79.15	200	130	0.50	0.18
P-259	J-236	J-239	83.08	200	130	0.46	0.17
P-260	J-239	J-222	51.35	200	130	0.42	0.15
P-261	J-237	J-211	78.16	200	130	-0.83	0.31
P-262	J-237	J-238	85.25	200	130	0.80	0.30
P-263	J-238	J-223	52.10	200	130	0.39	0.14
P-264	J-240	J-212	13.83	300	130	4.35	0.71
P-266	J-235	J-252	682.71	200	130	0.59	0.22
P-267	J-211	J-234	91.78	150	130	-0.33	0.21
P-268	J-234	J-235	77.59	150	130	-0.33	0.21
P-269	J-226	J-252	107.11	300	130	-0.07	0.01
P-273	J-212	J-235	63.60	200	130	0.96	0.35
P-275	J-123	J-252	223.05	200	130	-0.52	0.19
W163	J-131	J-200	20.36	300	130	-1.11	0.18

2021 Conditions
Sundial, Milton On
April 10, 2023

Municipal Engineering Solutions

Peak Hour

Node Table

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-123	0.00	194.80	245.14	71.56
J-131	0.00	195.09	245.17	71.20
J-148	0.00	196.23	245.16	69.56
J-200	0.00	194.56	245.18	71.95
J-201	0.29	194.01	245.18	72.74
J-202	0.48	194.16	245.19	72.54
J-203	1.06	194.02	245.19	72.74
J-204	0.00	194.25	245.20	72.43
J-205	1.49	194.31	245.21	72.36
J-206	1.19	194.39	245.18	72.21
J-207	0.82	194.20	245.19	72.49
J-208	0.00	194.30	245.22	72.39
J-209	0.77	194.06	245.25	72.77
J-210	0.27	193.89	245.31	73.10
J-211	0.72	194.33	245.40	72.60
J-212	0.00	195.40	245.60	71.36
J-213	0.94	195.79	245.16	70.19
J-214	0.84	195.12	245.16	71.14
J-215	0.65	194.99	245.17	71.33
J-216	0.87	194.78	245.17	71.64
J-217	0.00	194.72	245.18	71.73
J-218	1.00	194.72	245.18	71.74
J-219	0.97	195.00	245.19	71.35
J-220	0.87	194.87	245.20	71.54
J-221	0.39	194.66	245.20	71.85
J-222	0.00	194.37	245.22	72.29
J-223	0.52	194.58	245.22	71.99
J-224	0.77	194.15	245.19	72.56
J-225	0.00	193.84	245.19	73.00
J-226	0.72	193.60	245.19	73.34
J-227	1.30	193.85	245.19	72.99
J-228	0.67	194.38	245.19	72.23
J-229	0.00	194.57	245.20	71.97
J-230	0.45	194.55	245.18	71.98
J-231	0.98	194.63	245.19	71.88
J-232	1.12	194.21	245.22	72.51
J-233	0.00	194.53	245.20	72.04
J-234	0.00	194.55	245.46	72.38
J-235	0.91	195.30	245.52	71.39
J-236	0.66	193.95	245.27	72.96
J-237	0.55	194.20	245.31	72.66
J-238	8.47	194.48	245.23	72.14
J-239	0.97	194.19	245.24	72.57
J-240	0.00	194.43	245.64	72.79
J-242	0.71	195.90	245.16	70.03
J-243	1.03	195.90	245.17	70.05
J-244	0.00	196.05	245.17	69.84
J-245	0.58	195.52	245.18	70.60
J-246	0.00	195.40	245.20	70.80
J-247	0.74	194.77	245.20	71.70
J-248	0.81	194.98	245.20	71.40
J-249	0.65	195.00	245.20	71.37
J-250	0.00	194.90	245.21	71.52
J-251	1.16	194.69	245.21	71.82
J-252	0.00	194.30	245.19	72.35

MIN		**193.60**		**69.56**
MAX		**196.23**		**73.34**

Pipe Table

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness (C)	Flow (ML/d)	Velocity (m/s)
P-200	J-201	J-200	58.75	200	130	0.25	0.09
P-201	J-202	J-201	87.44	200	130	0.28	0.10
P-202	J-202	J-203	81.64	200	130	-0.24	0.09
P-203	J-203	J-204	87.35	150	130	-0.15	0.10
P-204	J-204	J-205	92.97	150	130	-0.15	0.10
P-205	J-200	J-206	83.52	300	130	-0.84	0.14
P-206	J-206	J-207	83.87	300	130	-0.94	0.15
P-207	J-207	J-208	93.05	300	130	-1.69	0.28
P-208	J-208	J-209	87.31	300	130	-1.69	0.28
P-209	J-209	J-210	74.19	300	130	-2.83	0.46
P-210	J-210	J-211	71.90	300	130	-3.58	0.59
P-211	J-211	J-212	109.11	300	130	-4.37	0.72
P-212	J-148	J-213	18.48	300	130	-0.77	0.13
P-213	J-213	J-214	42.49	300	130	-0.79	0.13
P-214	J-214	J-215	42.57	300	130	-0.98	0.16
P-215	J-215	J-216	42.11	300	130	-0.90	0.15
P-216	J-216	J-217	34.20	300	130	-1.04	0.17
P-217	J-217	J-218	57.54	200	130	-0.30	0.11
P-218	J-218	J-219	43.28	200	130	-0.30	0.11
P-219	J-219	J-220	40.74	200	130	-0.52	0.19
P-220	J-220	J-221	43.00	200	130	-0.41	0.15
P-221	J-221	J-222	73.89	200	130	-0.46	0.17
P-222	J-222	J-223	69.91	200	130	0.13	0.05
P-223	J-202	J-224	65.55	150	130	-0.08	0.05
P-224	J-224	J-225	69.40	150	130	-0.06	0.04
P-225	J-226	J-225	82.81	150	130	0.06	0.04
P-226	J-226	J-227	67.70	300	130	0.10	0.02
P-227	J-227	J-203	68.73	300	130	0.02	0.00
P-228	J-227	J-224	82.59	150	130	0.08	0.05
P-229	J-227	J-229	95.52	150	130	-0.12	0.08
P-230	J-229	J-205	152.44	150	130	-0.12	0.08
P-231	J-205	J-209	61.41	150	130	-0.40	0.26
P-232	J-203	J-207	59.39	300	130	-0.16	0.03
P-233	J-207	J-228	74.83	300	130	0.52	0.08
P-234	J-228	J-230	70.33	300	130	0.64	0.11
P-235	J-230	J-217	68.43	300	130	0.91	0.15
P-236	J-230	J-231	93.15	200	130	-0.30	0.11
P-237	J-231	J-232	159.23	200	130	-0.39	0.14
P-238	J-232	J-209	74.93	200	130	-0.67	0.25
P-239	J-228	J-233	94.57	150	130	-0.19	0.12
P-240	J-233	J-232	87.18	150	130	-0.19	0.12
P-241	J-213	J-242	147.20	200	130	-0.06	0.02
P-242	J-242	J-214	148.76	200	130	-0.12	0.04
P-243	J-215	J-243	163.67	200	130	-0.14	0.05
P-244	J-216	J-243	123.07	200	130	0.06	0.02
P-245	J-243	J-244	61.29	200	130	-0.16	0.06
P-246	J-244	J-217	113.33	200	130	-0.16	0.06
P-247	J-218	J-245	158.61	200	130	-0.08	0.03
P-248	J-245	J-219	120.52	200	130	-0.13	0.05
P-249	J-246	J-248	71.82	200	130	-0.18	0.07
P-250	J-246	J-220	115.64	200	130	0.18	0.07
P-251	J-221	J-247	45.32	200	130	0.01	0.00
P-252	J-247	J-248	42.34	200	130	0.12	0.04
P-253	J-247	J-250	57.01	200	130	-0.18	0.06
P-254	J-250	J-251	86.40	200	130	-0.18	0.06
P-255	J-248	J-249	61.13	200	130	-0.13	0.05
P-256	J-249	J-251	124.78	200	130	-0.18	0.07
P-257	J-251	J-223	42.56	200	130	-0.46	0.17
P-258	J-210	J-236	79.15	200	130	0.73	0.27
P-259	J-236	J-239	83.08	200	130	0.67	0.25
P-260	J-239	J-222	51.35	200	130	0.59	0.22
P-261	J-237	J-211	78.16	200	130	-1.15	0.42
P-262	J-237	J-238	85.25	200	130	1.10	0.41
P-263	J-238	J-223	52.10	200	130	0.37	0.14
P-264	J-240	J-212	13.83	300	130	5.60	0.92
P-266	J-235	J-252	682.71	200	130	0.73	0.27
P-267	J-211	J-234	91.78	150	130	-0.42	0.28
P-268	J-234	J-235	77.59	150	130	-0.42	0.28
P-269	J-226	J-252	107.11	300	130	-0.22	0.04
P-273	J-212	J-235	63.60	200	130	1.23	0.45
P-275	J-123	J-252	223.05	200	130	-0.51	0.19
W163	J-131	J-200	20.36	300	130	-1.09	0.18

2021 Conditions
Sundial, Milton On
April 10, 2023

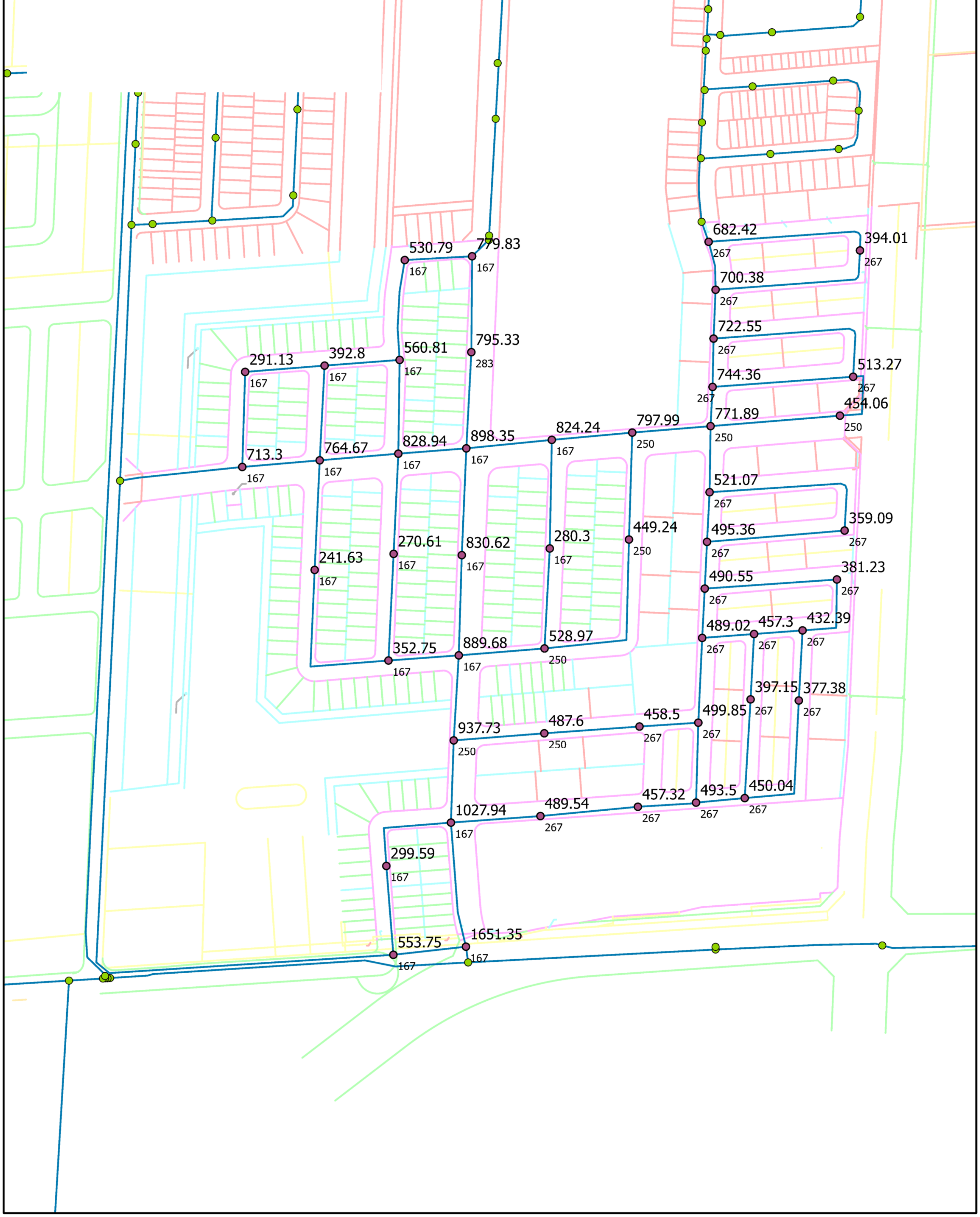
Municipal Engineering Solutions

Fire Flow Table

ID	Total Demand *(L/s)*	Available Flow *(L/s)*	Fire Flow Met?
J-200	167.00	779.83	TRUE
J-201	167.16	530.79	TRUE
J-202	167.27	560.81	TRUE
J-203	167.59	828.94	TRUE
J-204	167.00	270.61	TRUE
J-205	167.84	352.75	TRUE
J-206	284.03	795.33	TRUE
J-207	167.46	898.35	TRUE
J-208	167.00	830.62	TRUE
J-209	167.43	889.68	TRUE
J-210	250.15	937.73	TRUE
J-211	167.41	1027.94	TRUE
J-212	167.00	1651.35	TRUE
J-213	267.53	682.42	TRUE
J-214	267.47	700.38	TRUE
J-215	267.36	722.55	TRUE
J-216	267.49	744.36	TRUE
J-217	250.00	771.89	TRUE
J-218	267.56	521.07	TRUE
J-219	267.54	495.36	TRUE
J-220	267.49	490.55	TRUE
J-221	267.22	489.02	TRUE
J-222	267.00	499.85	TRUE
J-223	267.29	493.50	TRUE
J-224	167.43	392.80	TRUE
J-225	167.00	291.13	TRUE
J-226	167.41	713.30	TRUE
J-227	167.73	764.67	TRUE
J-228	167.38	824.24	TRUE
J-229	167.00	241.63	TRUE
J-230	250.25	797.99	TRUE
J-231	250.55	449.24	TRUE
J-232	250.63	528.97	TRUE
J-233	167.00	280.30	TRUE
J-234	167.00	299.59	TRUE
J-235	167.51	553.75	TRUE
J-236	250.37	487.60	TRUE
J-237	267.31	489.54	TRUE
J-238	271.77	457.32	TRUE
J-239	267.54	458.50	TRUE
J-242	267.40	394.01	TRUE
J-243	267.58	513.27	TRUE
J-244	250.00	454.06	TRUE
J-245	267.33	359.09	TRUE
J-246	267.00	381.23	TRUE
J-247	267.42	457.30	TRUE
J-248	267.45	432.39	TRUE
J-249	267.36	377.38	TRUE
J-250	267.00	397.15	TRUE
J-251	267.65	450.04	TRUE

MIN	**241.63**
MAX	**1651.35**

2021 Fire Flows



2031 Conditions
Sundial, Milton On
April 10, 2023

Average Day

Node Table

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-123	0.00	194.80	249.21	77.35
J-131	0.00	195.09	249.23	76.96
J-148	0.00	196.23	249.23	75.34
J-200	0.00	194.56	249.23	77.72
J-201	0.07	194.01	249.23	78.50
J-202	0.12	194.16	249.23	78.29
J-203	0.26	194.02	249.24	78.49
J-204	0.00	194.25	249.24	78.17
J-205	0.37	194.31	249.24	78.09
J-206	0.46	194.39	249.23	77.96
J-207	0.20	194.20	249.24	78.24
J-208	0.00	194.30	249.24	78.11
J-209	0.19	194.06	249.25	78.46
J-210	0.07	193.89	249.27	78.72
J-211	0.18	194.33	249.29	78.13
J-212	0.00	195.40	249.33	76.67
J-213	0.23	195.79	249.23	75.97
J-214	0.21	195.12	249.23	76.92
J-215	0.16	194.99	249.23	77.11
J-216	0.22	194.78	249.23	77.41
J-217	0.00	194.72	249.23	77.50
J-218	0.25	194.72	249.24	77.50
J-219	0.24	195.00	249.24	77.11
J-220	0.22	194.87	249.25	77.30
J-221	0.10	194.66	249.25	77.60
J-222	0.00	194.37	249.25	78.02
J-223	0.13	194.58	249.25	77.72
J-224	0.19	194.15	249.24	78.31
J-225	0.00	193.84	249.24	78.75
J-226	0.18	193.60	249.24	79.09
J-227	0.32	193.85	249.24	78.74
J-228	0.17	194.38	249.24	77.98
J-229	0.00	194.57	249.24	77.72
J-230	0.11	194.55	249.24	77.74
J-231	0.25	194.63	249.24	77.63
J-232	0.28	194.21	249.24	78.24
J-233	0.00	194.53	249.24	77.78
J-234	0.00	194.55	249.30	77.83
J-235	0.23	195.30	249.31	76.78
J-236	0.17	193.95	249.26	78.63
J-237	0.14	194.20	249.27	78.29
J-238	2.12	194.48	249.26	77.87
J-239	0.24	194.19	249.26	78.28
J-240	0.00	194.43	249.34	78.06
J-242	0.18	195.90	249.23	75.81
J-243	0.26	195.90	249.23	75.82
J-244	0.00	196.05	249.23	75.60
J-245	0.15	195.52	249.24	76.37
J-246	0.00	195.40	249.25	76.55
J-247	0.19	194.77	249.25	77.45
J-248	0.20	194.98	249.25	77.15
J-249	0.16	195.00	249.25	77.12
J-250	0.00	194.90	249.25	77.26
J-251	0.29	194.69	249.25	77.56
J-252	0.00	194.30	249.24	78.10

MIN		**193.60**		**75.34**
MAX		**196.23**		**79.09**

Pipe Table

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness (C)	Flow (ML/d)	Velocity (m/s)
P-200	J-201	J-200	58.75	200	130	0.17	0.06
P-201	J-202	J-201	87.44	200	130	0.17	0.06
P-202	J-202	J-203	81.64	200	130	-0.13	0.05
P-203	J-203	J-204	87.35	150	130	-0.08	0.05
P-204	J-204	J-205	92.97	150	130	-0.08	0.05
P-205	J-200	J-206	83.52	300	130	-0.53	0.09
P-206	J-206	J-207	83.87	300	130	-0.57	0.09
P-207	J-207	J-208	93.05	300	130	-0.85	0.14
P-208	J-208	J-209	87.31	300	130	-0.85	0.14
P-209	J-209	J-210	74.19	300	130	-1.36	0.22
P-210	J-210	J-211	71.90	300	130	-1.62	0.27
P-211	J-211	J-212	109.11	300	130	-1.90	0.31
P-212	J-148	J-213	18.48	300	130	-0.57	0.09
P-213	J-213	J-214	42.49	300	130	-0.53	0.09
P-214	J-214	J-215	42.57	300	130	-0.62	0.10
P-215	J-215	J-216	42.11	300	130	-0.55	0.09
P-216	J-216	J-217	34.20	300	130	-0.59	0.10
P-217	J-217	J-218	57.54	200	130	-0.30	0.11
P-218	J-218	J-219	43.28	200	130	-0.24	0.09
P-219	J-219	J-220	40.74	200	130	-0.36	0.13
P-220	J-220	J-221	43.00	200	130	-0.26	0.10
P-221	J-221	J-222	73.89	200	130	-0.23	0.09
P-222	J-222	J-223	69.91	200	130	-0.01	0.00
P-223	J-202	J-224	65.55	150	130	-0.05	0.03
P-224	J-224	J-225	69.40	150	130	-0.03	0.02
P-225	J-226	J-225	82.81	150	130	0.03	0.02
P-226	J-226	J-227	67.70	300	130	-0.05	0.01
P-227	J-227	J-203	68.73	300	130	-0.05	0.01
P-228	J-227	J-224	82.59	150	130	0.04	0.03
P-229	J-227	J-229	95.52	150	130	-0.07	0.05
P-230	J-229	J-205	152.44	150	130	-0.07	0.05
P-231	J-205	J-209	61.41	150	130	-0.19	0.12
P-232	J-203	J-207	59.39	300	130	-0.12	0.02
P-233	J-207	J-228	74.83	300	130	0.13	0.02
P-234	J-228	J-230	70.33	300	130	0.22	0.04
P-235	J-230	J-217	68.43	300	130	0.37	0.06
P-236	J-230	J-231	93.15	200	130	-0.17	0.06
P-237	J-231	J-232	159.23	200	130	-0.19	0.07
P-238	J-232	J-209	74.93	200	130	-0.31	0.11
P-239	J-228	J-233	94.57	150	130	-0.10	0.06
P-240	J-233	J-232	87.18	150	130	-0.10	0.06
P-241	J-213	J-242	147.20	200	130	-0.06	0.02
P-242	J-242	J-214	148.76	200	130	-0.07	0.03
P-243	J-215	J-243	163.67	200	130	-0.09	0.03
P-244	J-216	J-243	123.07	200	130	0.02	0.01
P-245	J-243	J-244	61.29	200	130	-0.09	0.03
P-246	J-244	J-217	113.33	200	130	-0.09	0.03
P-247	J-218	J-245	158.61	200	130	-0.08	0.03
P-248	J-245	J-219	120.52	200	130	-0.10	0.04
P-249	J-246	J-248	71.82	200	130	-0.12	0.04
P-250	J-246	J-220	115.64	200	130	0.12	0.04
P-251	J-221	J-247	45.32	200	130	-0.04	0.01
P-252	J-247	J-248	42.34	200	130	0.05	0.02
P-253	J-247	J-250	57.01	200	130	-0.10	0.04
P-254	J-250	J-251	86.40	200	130	-0.10	0.04
P-255	J-248	J-249	61.13	200	130	-0.08	0.03
P-256	J-249	J-251	124.78	200	130	-0.10	0.04
P-257	J-251	J-223	42.56	200	130	-0.23	0.08
P-258	J-210	J-236	79.15	200	130	0.25	0.09
P-259	J-236	J-239	83.08	200	130	0.24	0.09
P-260	J-239	J-222	51.35	200	130	0.22	0.08
P-261	J-237	J-211	78.16	200	130	-0.44	0.16
P-262	J-237	J-238	85.25	200	130	0.43	0.16
P-263	J-238	J-223	52.10	200	130	0.25	0.09
P-264	J-240	J-212	13.83	300	130	2.44	0.40
P-266	J-235	J-252	682.71	200	130	0.34	0.12
P-267	J-211	J-234	91.78	150	130	-0.18	0.12
P-268	J-234	J-235	77.59	150	130	-0.18	0.12
P-269	J-226	J-252	107.11	300	130	0.01	0.00
P-273	J-212	J-235	63.60	200	130	0.54	0.20
P-275	J-123	J-252	223.05	200	130	-0.34	0.13
W163	J-131	J-200	20.36	300	130	-0.70	0.11

2031 Conditions
Sundial, Milton On
April 10, 2023

Municipal Engineering Solutions

Maximum Day

Node Table

ID	Demand (L/s)	Elevatio (m)	Head (m)	Pressure (psi)
J-123	0.00	194.80	248.23	75.96
J-131	0.00	195.09	248.25	75.57
J-148	0.00	196.23	248.25	73.95
J-200	0.00	194.56	248.25	76.33
J-201	0.16	194.01	248.25	77.11
J-202	0.27	194.16	248.26	76.90
J-203	0.59	194.02	248.26	77.11
J-204	0.00	194.25	248.26	76.78
J-205	0.84	194.31	248.27	76.70
J-206	1.03	194.39	248.26	76.57
J-207	0.46	194.20	248.26	76.85
J-208	0.00	194.30	248.27	76.72
J-209	0.43	194.06	248.28	77.08
J-210	0.15	193.89	248.31	77.36
J-211	0.41	194.33	248.34	76.78
J-212	0.00	195.40	248.42	75.37
J-213	0.53	195.79	248.25	74.57
J-214	0.47	195.12	248.25	75.53
J-215	0.36	194.99	248.25	75.72
J-216	0.49	194.78	248.25	76.02
J-217	0.00	194.72	248.26	76.10
J-218	0.56	194.72	248.26	76.11
J-219	0.54	195.00	248.26	75.71
J-220	0.49	194.87	248.26	75.90
J-221	0.22	194.66	248.27	76.21
J-222	0.00	194.37	248.27	76.63
J-223	0.29	194.58	248.27	76.33
J-224	0.43	194.15	248.26	76.92
J-225	0.00	193.84	248.26	77.36
J-226	0.41	193.60	248.26	77.70
J-227	0.73	193.85	248.26	77.35
J-228	0.38	194.38	248.26	76.59
J-229	0.00	194.57	248.26	76.33
J-230	0.25	194.55	248.26	76.35
J-231	0.55	194.63	248.26	76.24
J-232	0.63	194.21	248.27	76.85
J-233	0.00	194.53	248.26	76.39
J-234	0.00	194.55	248.37	76.50
J-235	0.51	195.30	248.39	75.47
J-236	0.37	193.95	248.29	77.25
J-237	0.31	194.20	248.31	76.92
J-238	4.77	194.48	248.28	76.48
J-239	0.54	194.19	248.28	76.89
J-240	0.00	194.43	248.43	76.77
J-242	0.40	195.90	248.25	74.42
J-243	0.58	195.90	248.25	74.42
J-244	0.00	196.05	248.25	74.21
J-245	0.33	195.52	248.26	74.97
J-246	0.00	195.40	248.27	75.15
J-247	0.42	194.77	248.27	76.05
J-248	0.45	194.98	248.27	75.75
J-249	0.36	195.00	248.27	75.72
J-250	0.00	194.90	248.27	75.87
J-251	0.65	194.69	248.27	76.17
J-252	0.00	194.30	248.26	76.71

MIN		**193.60**		**73.95**
MAX		**196.23**		**77.70**

Pipe Table

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness (C)	Flow (ML/d)	Velocity (m/s)
P-200	J-201	J-200	58.75	200	130	0.16	0.06
P-201	J-202	J-201	87.44	200	130	0.17	0.06
P-202	J-202	J-203	81.64	200	130	-0.15	0.05
P-203	J-203	J-204	87.35	150	130	-0.09	0.06
P-204	J-204	J-205	92.97	150	130	-0.09	0.06
P-205	J-200	J-206	83.52	300	130	-0.51	0.08
P-206	J-206	J-207	83.87	300	130	-0.60	0.10
P-207	J-207	J-208	93.05	300	130	-1.03	0.17
P-208	J-208	J-209	87.31	300	130	-1.03	0.17
P-209	J-209	J-210	74.19	300	130	-1.71	0.28
P-210	J-210	J-211	71.90	300	130	-2.14	0.35
P-211	J-211	J-212	109.11	300	130	-2.60	0.43
P-212	J-148	J-213	18.48	300	130	-0.49	0.08
P-213	J-213	J-214	42.49	300	130	-0.49	0.08
P-214	J-214	J-215	42.57	300	130	-0.61	0.10
P-215	J-215	J-216	42.11	300	130	-0.55	0.09
P-216	J-216	J-217	34.20	300	130	-0.63	0.10
P-217	J-217	J-218	57.54	200	130	-0.21	0.08
P-218	J-218	J-219	43.28	200	130	-0.20	0.07
P-219	J-219	J-220	40.74	200	130	-0.33	0.12
P-220	J-220	J-221	43.00	200	130	-0.26	0.10
P-221	J-221	J-222	73.89	200	130	-0.28	0.10
P-222	J-222	J-223	69.91	200	130	0.07	0.02
P-223	J-202	J-224	65.55	150	130	-0.05	0.03
P-224	J-224	J-225	69.40	150	130	-0.04	0.02
P-225	J-226	J-225	82.81	150	130	0.04	0.02
P-226	J-226	J-227	67.70	300	130	0.03	0.01
P-227	J-227	J-203	68.73	300	130	0.00	0.00
P-228	J-227	J-224	82.59	150	130	0.05	0.03
P-229	J-227	J-229	95.52	150	130	-0.08	0.05
P-230	J-229	J-205	152.44	150	130	-0.08	0.05
P-231	J-205	J-209	61.41	150	130	-0.24	0.16
P-232	J-203	J-207	59.39	300	130	-0.11	0.02
P-233	J-207	J-228	74.83	300	130	0.28	0.05
P-234	J-228	J-230	70.33	300	130	0.36	0.06
P-235	J-230	J-217	68.43	300	130	0.52	0.09
P-236	J-230	J-231	93.15	200	130	-0.19	0.07
P-237	J-231	J-232	159.23	200	130	-0.23	0.09
P-238	J-232	J-209	74.93	200	130	-0.40	0.15
P-239	J-228	J-233	94.57	150	130	-0.11	0.08
P-240	J-233	J-232	87.18	150	130	-0.11	0.08
P-241	J-213	J-242	147.20	200	130	-0.04	0.01
P-242	J-242	J-214	148.76	200	130	-0.07	0.03
P-243	J-215	J-243	163.67	200	130	-0.08	0.03
P-244	J-216	J-243	123.07	200	130	0.04	0.01
P-245	J-243	J-244	61.29	200	130	-0.10	0.04
P-246	J-244	J-217	113.33	200	130	-0.10	0.04
P-247	J-218	J-245	158.61	200	130	-0.06	0.02
P-248	J-245	J-219	120.52	200	130	-0.09	0.03
P-249	J-246	J-248	71.82	200	130	-0.11	0.04
P-250	J-246	J-220	115.64	200	130	0.11	0.04
P-251	J-221	J-247	45.32	200	130	0.00	0.00
P-252	J-247	J-248	42.34	200	130	0.07	0.03
P-253	J-247	J-250	57.01	200	130	-0.11	0.04
P-254	J-250	J-251	86.40	200	130	-0.11	0.04
P-255	J-248	J-249	61.13	200	130	-0.08	0.03
P-256	J-249	J-251	124.78	200	130	-0.11	0.04
P-257	J-251	J-223	42.56	200	130	-0.28	0.10
P-258	J-210	J-236	79.15	200	130	0.42	0.16
P-259	J-236	J-239	83.08	200	130	0.39	0.14
P-260	J-239	J-222	51.35	200	130	0.35	0.13
P-261	J-237	J-211	78.16	200	130	-0.67	0.25
P-262	J-237	J-238	85.25	200	130	0.65	0.24
P-263	J-238	J-223	52.10	200	130	0.24	0.09
P-264	J-240	J-212	13.83	300	130	3.33	0.55
P-266	J-235	J-252	682.71	200	130	0.44	0.16
P-267	J-211	J-234	91.78	150	130	-0.25	0.16
P-268	J-234	J-235	77.59	150	130	-0.25	0.16
P-269	J-226	J-252	107.11	300	130	-0.11	0.02
P-273	J-212	J-235	63.60	200	130	0.73	0.27
P-275	J-123	J-252	223.05	200	130	-0.33	0.12
W163	J-131	J-200	20.36	300	130	-0.67	0.11

2031 Conditions
Sundial, Milton On
April 10, 2023

Municipal Engineering Solutions

Peak Hour

Node Table

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-123	0.00	194.80	238.29	61.82
J-131	0.00	195.09	238.29	61.41
J-148	0.00	196.23	238.29	59.79
J-200	0.00	194.56	238.29	62.17
J-201	0.29	194.01	238.29	62.95
J-202	0.48	194.16	238.29	62.74
J-203	1.06	194.02	238.29	62.94
J-204	0.00	194.25	238.29	62.61
J-205	1.49	194.31	238.29	62.53
J-206	1.19	194.39	238.29	62.41
J-207	0.82	194.20	238.29	62.68
J-208	0.00	194.30	238.30	62.55
J-209	0.77	194.06	238.30	62.90
J-210	0.27	193.89	238.32	63.16
J-211	0.72	194.33	238.35	62.57
J-212	0.00	195.40	238.41	61.15
J-213	0.94	195.79	238.29	60.41
J-214	0.84	195.12	238.29	61.36
J-215	0.65	194.99	238.29	61.55
J-216	0.87	194.78	238.29	61.85
J-217	0.00	194.72	238.29	61.93
J-218	1.00	194.72	238.28	61.92
J-219	0.97	195.00	238.28	61.52
J-220	0.87	194.87	238.28	61.70
J-221	0.39	194.66	238.28	62.00
J-222	0.00	194.37	238.28	62.42
J-223	0.52	194.58	238.27	62.12
J-224	0.77	194.15	238.29	62.75
J-225	0.00	193.84	238.29	63.19
J-226	0.72	193.60	238.29	63.53
J-227	1.30	193.85	238.29	63.18
J-228	0.67	194.38	238.29	62.42
J-229	0.00	194.57	238.29	62.15
J-230	0.45	194.55	238.29	62.18
J-231	0.98	194.63	238.29	62.06
J-232	1.12	194.21	238.29	62.67
J-233	0.00	194.53	238.29	62.21
J-234	0.00	194.55	238.37	62.29
J-235	0.91	195.30	238.39	61.25
J-236	0.66	193.95	238.30	63.05
J-237	0.55	194.20	238.31	62.71
J-238	8.47	194.48	238.27	62.26
J-239	0.97	194.19	238.28	62.68
J-240	0.00	194.43	238.43	62.54
J-242	0.71	195.90	238.29	60.25
J-243	1.03	195.90	238.28	60.25
J-244	0.00	196.05	238.29	60.04
J-245	0.58	195.52	238.28	60.78
J-246	0.00	195.40	238.27	60.95
J-247	0.74	194.77	238.27	61.85
J-248	0.81	194.98	238.27	61.55
J-249	0.65	195.00	238.27	61.52
J-250	0.00	194.90	238.27	61.66
J-251	1.16	194.69	238.27	61.96
J-252	0.00	194.30	238.29	62.54
MIN		**193.60**		**59.79**
MAX		**196.23**		**63.53**

Pipe Table

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness (C)	Flow (ML/d)	Velocity (m/s)
P-200	J-201	J-200	58.75	200	130	0.00	0.00
P-201	J-202	J-201	87.44	200	130	0.02	0.01
P-202	J-202	J-203	81.64	200	130	-0.07	0.02
P-203	J-203	J-204	87.35	150	130	-0.04	0.03
P-204	J-204	J-205	92.97	150	130	-0.04	0.03
P-205	J-200	J-206	83.52	300	130	-0.08	0.01
P-206	J-206	J-207	83.87	300	130	-0.19	0.03
P-207	J-207	J-208	93.05	300	130	-0.74	0.12
P-208	J-208	J-209	87.31	300	130	-0.74	0.12
P-209	J-209	J-210	74.19	300	130	-1.35	0.22
P-210	J-210	J-211	71.90	300	130	-1.87	0.31
P-211	J-211	J-212	109.11	300	130	-2.43	0.40
P-212	J-148	J-213	18.48	300	130	0.30	0.05
P-213	J-213	J-214	42.49	300	130	0.18	0.03
P-214	J-214	J-215	42.57	300	130	0.08	0.01
P-215	J-215	J-216	42.11	300	130	0.00	0.00
P-216	J-216	J-217	34.20	300	130	-0.11	0.02
P-217	J-217	J-218	57.54	200	130	0.36	0.13
P-218	J-218	J-219	43.28	200	130	0.19	0.07
P-219	J-219	J-220	40.74	200	130	0.14	0.05
P-220	J-220	J-221	43.00	200	130	0.00	0.00
P-221	J-221	J-222	73.89	200	130	-0.17	0.06
P-222	J-222	J-223	69.91	200	130	0.19	0.07
P-223	J-202	J-224	65.55	150	130	0.00	0.00
P-224	J-224	J-225	69.40	150	130	-0.03	0.02
P-225	J-226	J-225	82.81	150	130	0.03	0.02
P-226	J-226	J-227	67.70	300	130	0.18	0.03
P-227	J-227	J-203	68.73	300	130	0.07	0.01
P-228	J-227	J-224	82.59	150	130	0.03	0.02
P-229	J-227	J-229	95.52	150	130	-0.03	0.02
P-230	J-229	J-205	152.44	150	130	-0.03	0.02
P-231	J-205	J-209	61.41	150	130	-0.20	0.13
P-232	J-203	J-207	59.39	300	130	-0.05	0.01
P-233	J-207	J-228	74.83	300	130	0.43	0.07
P-234	J-228	J-230	70.33	300	130	0.44	0.07
P-235	J-230	J-217	68.43	300	130	0.50	0.08
P-236	J-230	J-231	93.15	200	130	-0.10	0.04
P-237	J-231	J-232	159.23	200	130	-0.18	0.07
P-238	J-232	J-209	74.93	200	130	-0.35	0.13
P-239	J-228	J-233	94.57	150	130	-0.07	0.05
P-240	J-233	J-232	87.18	150	130	-0.07	0.05
P-241	J-213	J-242	147.20	200	130	0.04	0.01
P-242	J-242	J-214	148.76	200	130	-0.02	0.01
P-243	J-215	J-243	163.67	200	130	0.03	0.01
P-244	J-216	J-243	123.07	200	130	0.03	0.01
P-245	J-243	J-244	61.29	200	130	-0.03	0.01
P-246	J-244	J-217	113.33	200	130	-0.03	0.01
P-247	J-218	J-245	158.61	200	130	0.09	0.03
P-248	J-245	J-219	120.52	200	130	0.04	0.01
P-249	J-246	J-248	71.82	200	130	0.07	0.02
P-250	J-246	J-220	115.64	200	130	-0.07	0.02
P-251	J-221	J-247	45.32	200	130	0.13	0.05
P-252	J-247	J-248	42.34	200	130	0.04	0.02
P-253	J-247	J-250	57.01	200	130	0.03	0.01
P-254	J-250	J-251	86.40	200	130	0.03	0.01
P-255	J-248	J-249	61.13	200	130	0.04	0.01
P-256	J-249	J-251	124.78	200	130	-0.02	0.01
P-257	J-251	J-223	42.56	200	130	-0.09	0.03
P-258	J-210	J-236	79.15	200	130	0.50	0.18
P-259	J-236	J-239	83.08	200	130	0.44	0.16
P-260	J-239	J-222	51.35	200	130	0.36	0.13
P-261	J-237	J-211	78.16	200	130	-0.72	0.27
P-262	J-237	J-238	85.25	200	130	0.67	0.25
P-263	J-238	J-223	52.10	200	130	-0.06	0.02
P-264	J-240	J-212	13.83	300	130	3.11	0.51
P-266	J-235	J-252	682.71	200	130	0.37	0.14
P-267	J-211	J-234	91.78	150	130	-0.23	0.15
P-268	J-234	J-235	77.59	150	130	-0.23	0.15
P-269	J-226	J-252	107.11	300	130	-0.27	0.04
P-273	J-212	J-235	63.60	200	130	0.68	0.25
P-275	J-123	J-252	223.05	200	130	-0.10	0.04
W163	J-131	J-200	20.36	300	130	-0.08	0.01

2031 Conditions
Sundial, Milton On
April 10, 2023

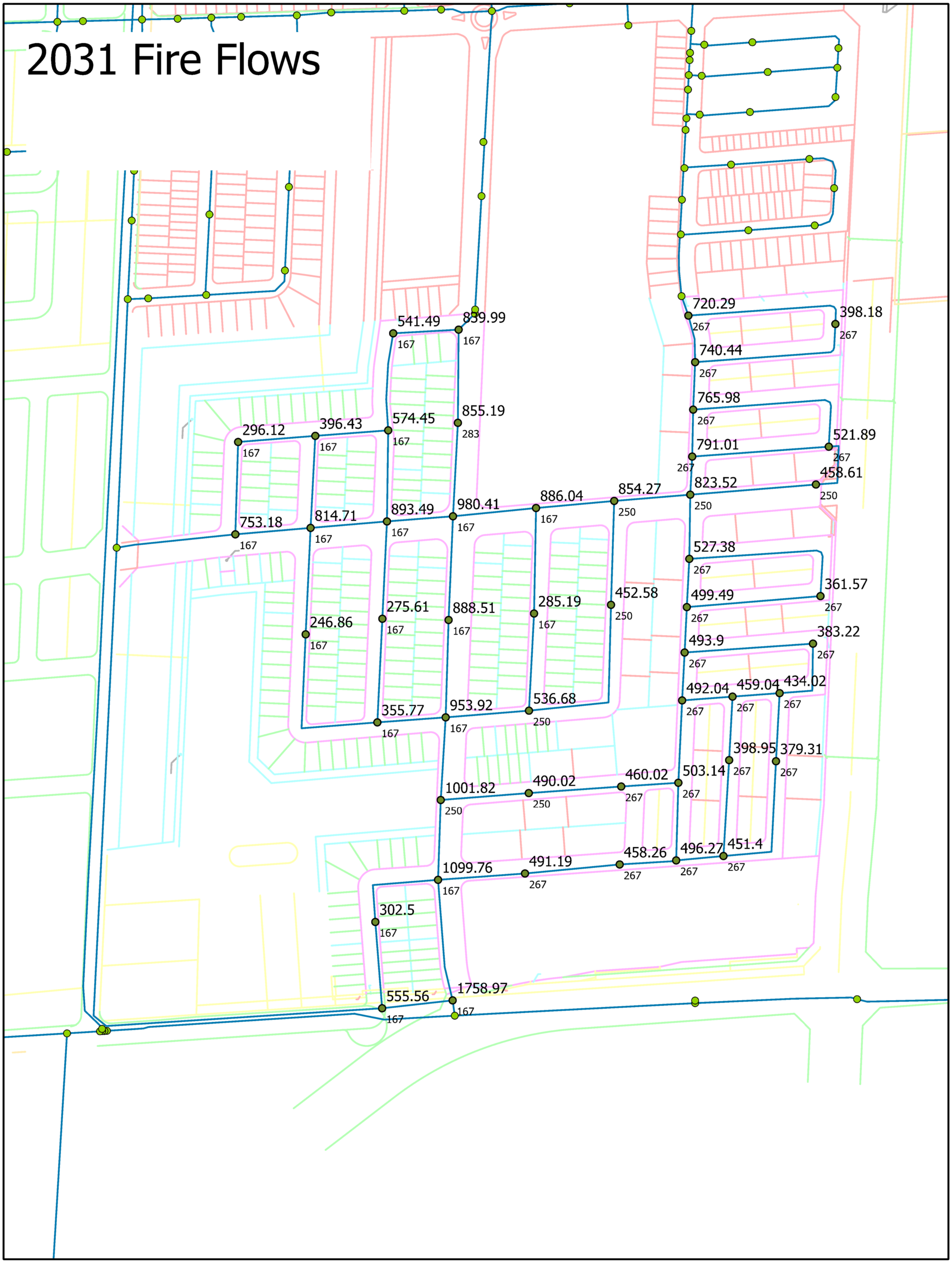
Municipal Engineering Solutions

Fire Flow Table

ID	Total Demand *(L/s)*	Available Flow *(L/s)*	Fire Flow Met?
J-200	167.00	839.99	TRUE
J-201	167.16	541.49	TRUE
J-202	167.27	574.45	TRUE
J-203	167.59	893.49	TRUE
J-204	167.00	275.61	TRUE
J-205	167.84	355.77	TRUE
J-206	284.03	855.19	TRUE
J-207	167.46	980.41	TRUE
J-208	167.00	888.51	TRUE
J-209	167.43	953.92	TRUE
J-210	250.15	1001.82	TRUE
J-211	167.41	1099.76	TRUE
J-212	167.00	1758.97	TRUE
J-213	267.53	720.29	TRUE
J-214	267.47	740.44	TRUE
J-215	267.36	765.98	TRUE
J-216	267.49	791.01	TRUE
J-217	250.00	823.52	TRUE
J-218	267.56	527.38	TRUE
J-219	267.54	499.49	TRUE
J-220	267.49	493.90	TRUE
J-221	267.22	492.04	TRUE
J-222	267.00	503.14	TRUE
J-223	267.29	496.27	TRUE
J-224	167.43	396.43	TRUE
J-225	167.00	296.12	TRUE
J-226	167.41	753.18	TRUE
J-227	167.73	814.71	TRUE
J-228	167.38	886.04	TRUE
J-229	167.00	246.86	TRUE
J-230	250.25	854.27	TRUE
J-231	250.55	452.58	TRUE
J-232	250.63	536.68	TRUE
J-233	167.00	285.19	TRUE
J-234	167.00	302.50	TRUE
J-235	167.51	555.56	TRUE
J-236	250.37	490.02	TRUE
J-237	267.31	491.19	TRUE
J-238	271.77	458.26	TRUE
J-239	267.54	460.02	TRUE
J-242	267.40	398.18	TRUE
J-243	267.58	521.89	TRUE
J-244	250.00	458.61	TRUE
J-245	267.33	361.57	TRUE
J-246	267.00	383.22	TRUE
J-247	267.42	459.04	TRUE
J-248	267.45	434.02	TRUE
J-249	267.36	379.31	TRUE
J-250	267.00	398.95	TRUE
J-251	267.65	451.40	TRUE

MIN	**246.86**
MAX	**1758.97**

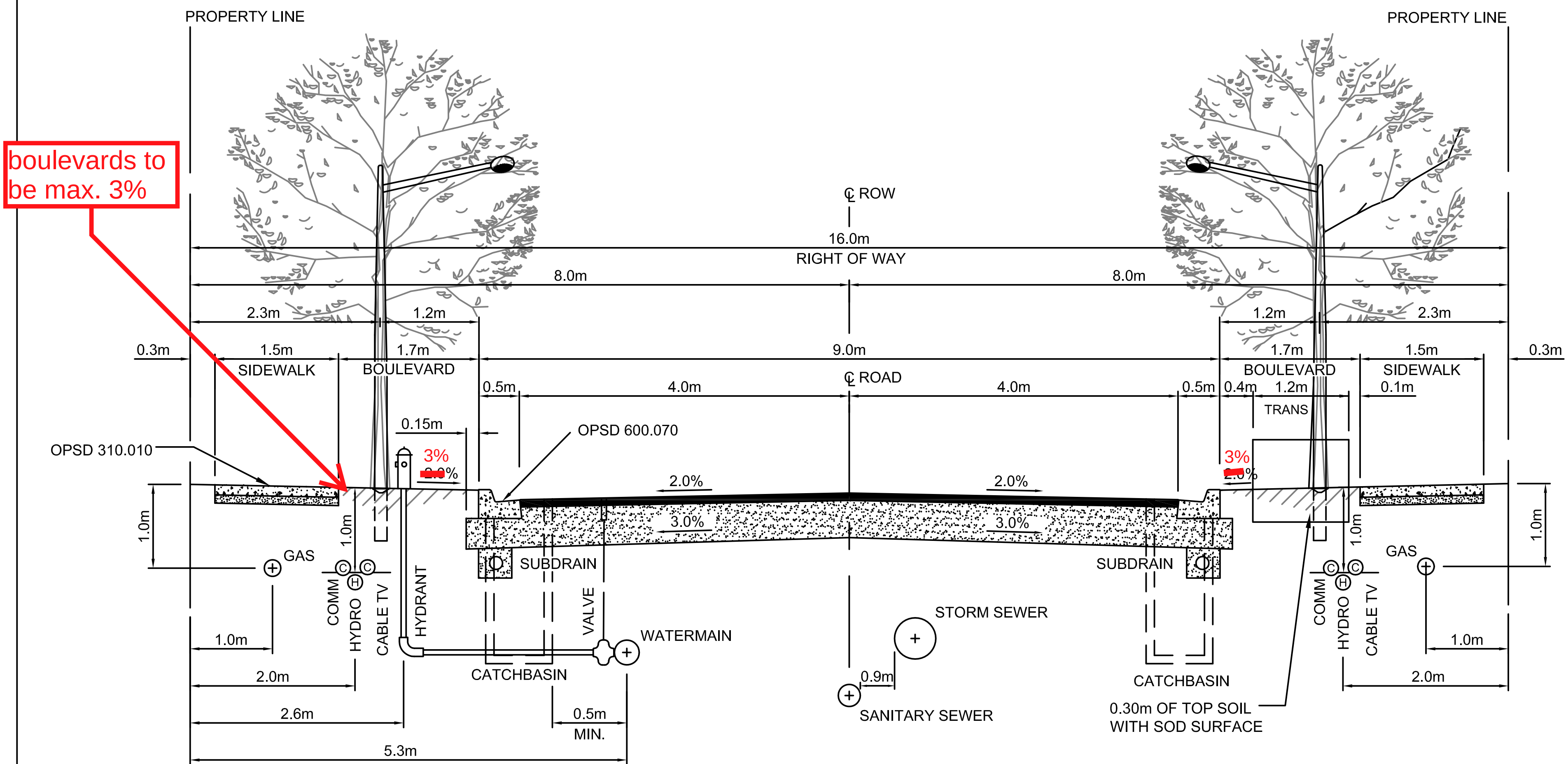
2031 Fire Flows



APPENDIX F

RIGHT-OF-WAY CONCEPTS

SCS consulting group ltd



MINIMUM ROAD STRUCTURE	
SURFACE COARSE	40mm HL3
BINDER COARSE	50mm HL8
BASE	150mm 19mm LIMESTONE
SUB BASE	300mm GRANULAR 'B', TYPE II

NOTE:

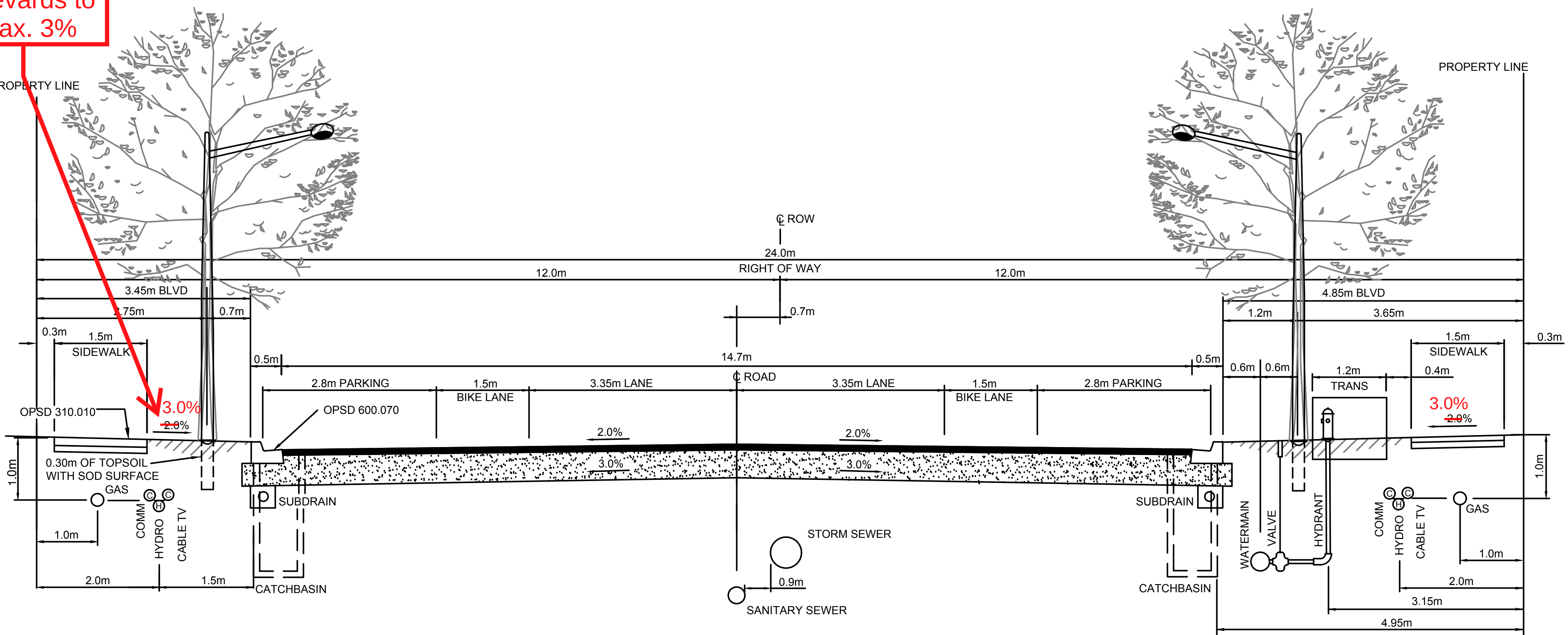
1. CABLE AND BELL PEDESTALS TO BE ALIGNED WITH LIGHT STANDARDS
2. SIDEWALKS ARE TO BE PLACED ON BOTH SIDES OF THE R.O.W., UNLESS JUSTIFIED BY THE PEDESTRIAN ROUTING PLAN
3. SINGLE AND DOUBLE LOADED REFERS TO BUILDINGS FRONTING THE R.O.W ON ONE OR BOTH SIDES, NOT TO SIDEWALK LOCATIONS.

TOWN OF MILTON	SCALE: N.T.S.
	DATE: MARCH 2017
16m ROAD ALLOWANCE - MINOR LOCAL - DOUBLE LOADED	STD. NO. E - 2

MILTON

Figure F.1
Modified 16m R.O.W. Section for Street 13
April 2023

boulevards to be max. 3%



MINIMUM ROAD STRUCTURE	
SURFACE COARSE	40mm HL3 High Stability
BINDER COARSE	100mm HL8
BASE	150mm 19mm LIMESTONE
SUB BASE	375mm GRANULAR 'B', TYPE II

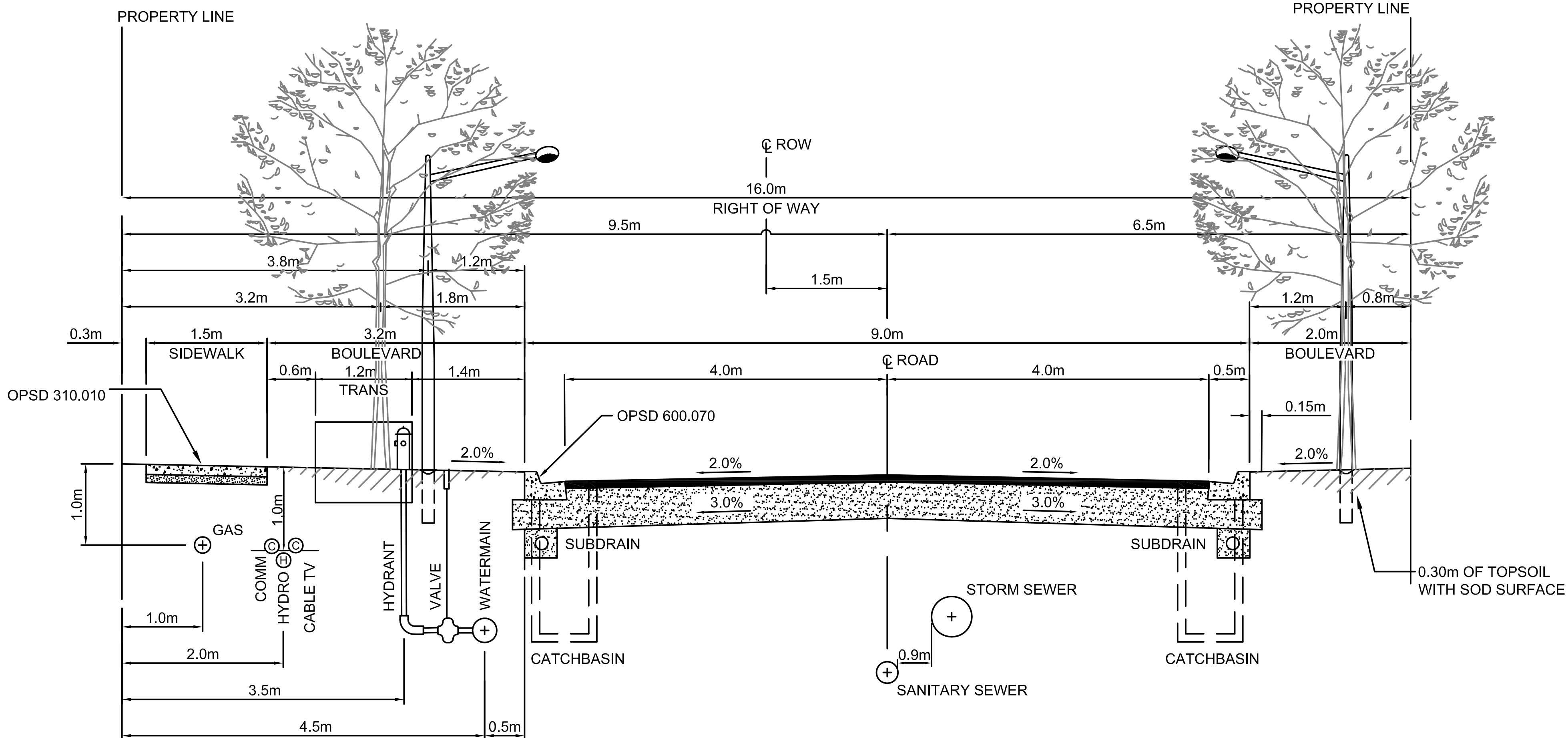
NOTE:

1. SINGLE AND DOUBLE LOADED REFERS TO BUILDINGS FRONTING THE R.O.W ON ONE OR BOTH SIDES, NOT TO SIDEWALK LOCATIONS.

TOWN OF MILTON	SCALE: N.T.S.
	DATE: MARCH 2017
24m ROAD ALLOWANCE - MINOR COLLECTOR - SINGLE OR DOUBLE LOADED	STD. NO. E - 4

MILTON

Figure F.2
Modified 24m R.O.W. Section for Street 1
April 2023



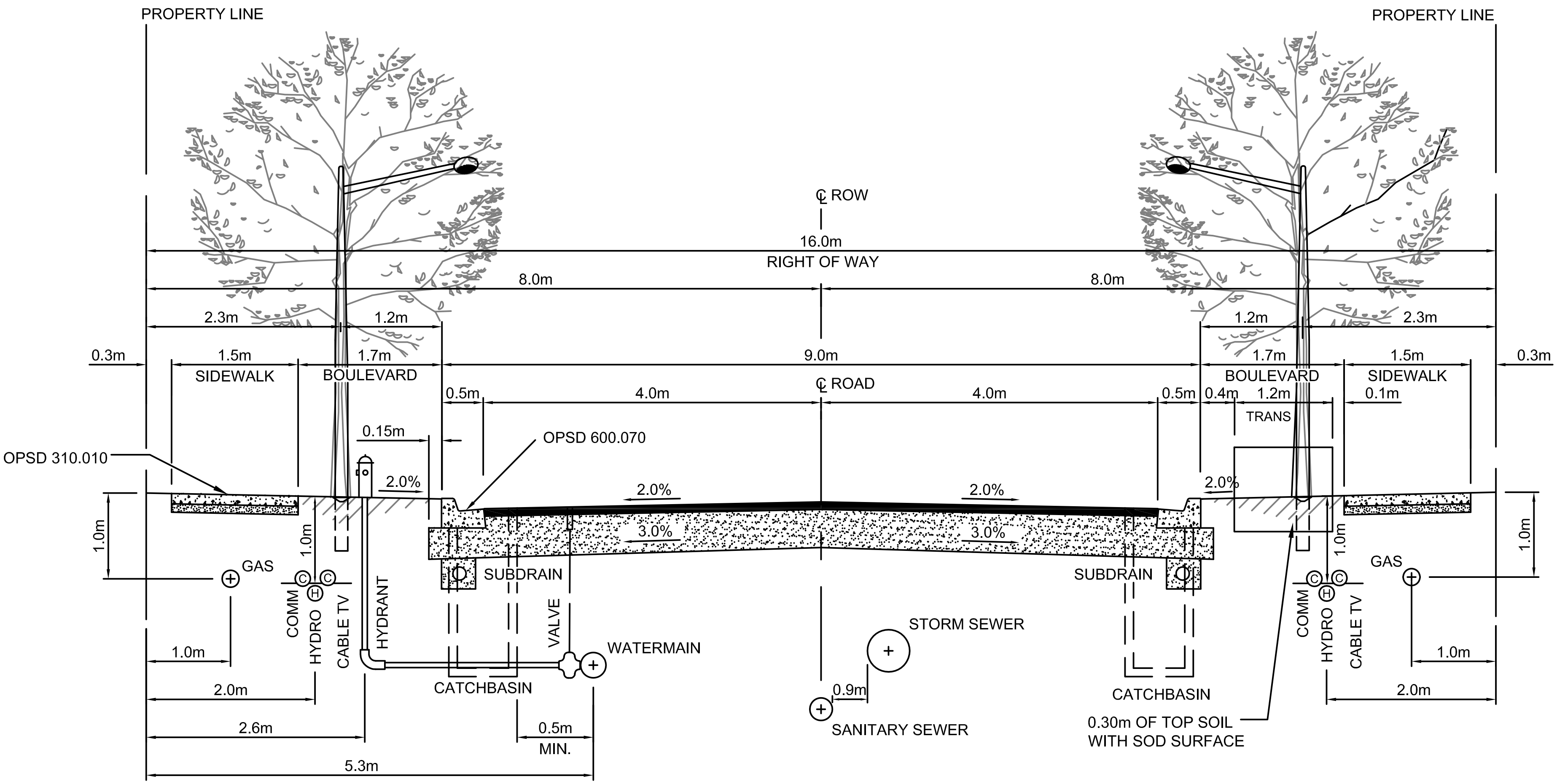
NOTE:

1. CABLE AND BELL PEDESTALS TO BE ALIGNED WITH LIGHT STANDARDS
2. SINGLE AND DOUBLE LOADED REFERS TO BUILDINGS FRONTING THE R.O.W ON ONE OR BOTH SIDES, NOT TO SIDEWALK LOCATIONS.

MINIMUM ROAD STRUCTURE	
SURFACE COARSE	40mm HL3
BINDER COARSE	50mm HL8
BASE	150mm 19mm LIMESTONE
SUB BASE	300mm GRANULAR 'B', TYPE II

TOWN OF MILTON	SCALE: N.T.S.
	DATE: MARCH 2017
16m ROAD ALLOWANCE - MINOR LOCAL - SINGLE LOADED	STD. NO. E-1

MILTON



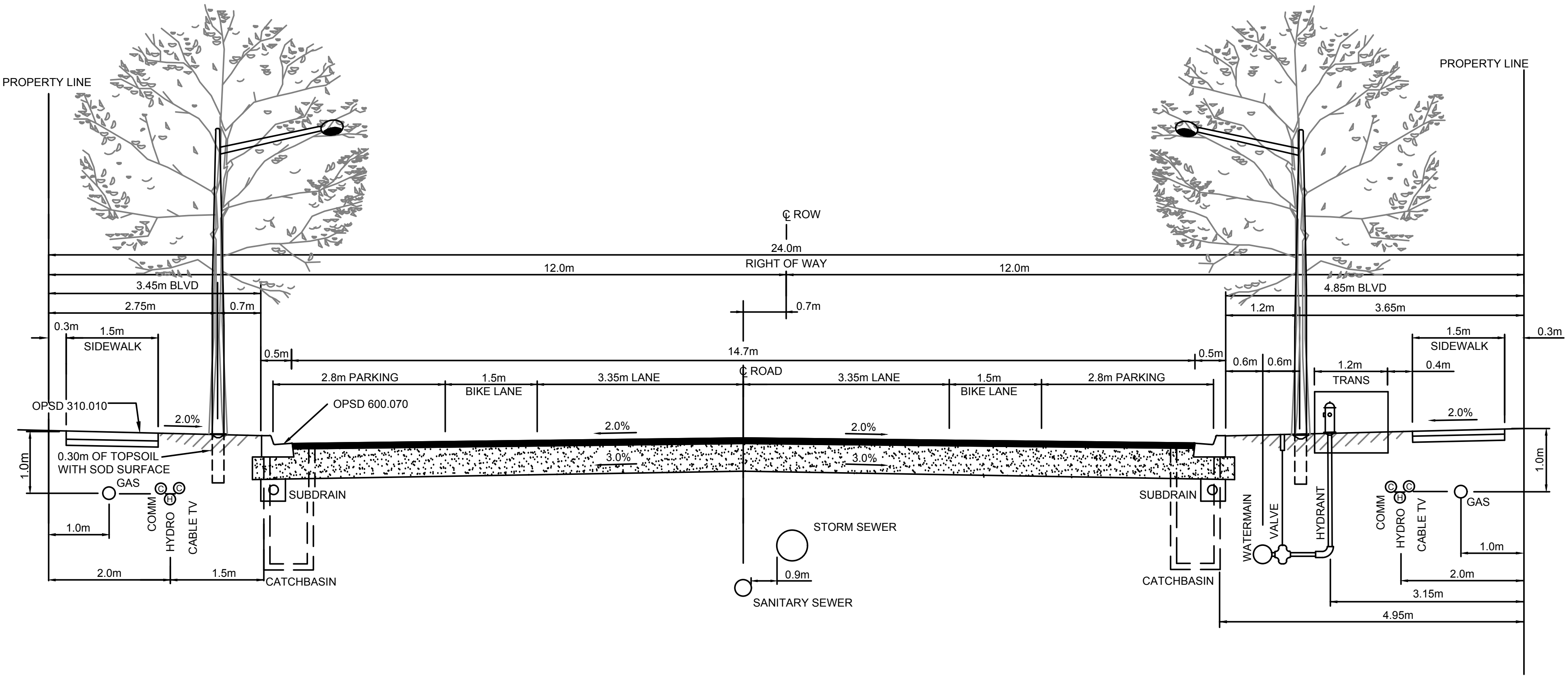
MINIMUM ROAD STRUCTURE	
SURFACE COARSE	40mm HL3
BINDER COARSE	50mm HL8
BASE	150mm 19mm LIMESTONE
SUB BASE	300mm GRANULAR 'B', TYPE II

NOTE:

1. CABLE AND BELL PEDESTALS TO BE ALIGNED WITH LIGHT STANDARDS
2. SIDEWALKS ARE TO BE PLACED ON BOTH SIDES OF THE R.O.W., UNLESS JUSTIFIED BY THE PEDESTRIAN ROUTING PLAN
3. SINGLE AND DOUBLE LOADED REFERS TO BUILDINGS FRONTING THE R.O.W ON ONE OR BOTH SIDES, NOT TO SIDEWALK LOCATIONS.

TOWN OF MILTON	SCALE: N.T.S.
	DATE: MARCH 2017
16m ROAD ALLOWANCE - MINOR LOCAL - DOUBLE LOADED	STD. NO. E - 2

MILTON



MINIMUM ROAD STRUCTURE	
SURFACE COARSE	40mm HL3 High Stability
BINDER COARSE	100mm HL8
BASE	150mm 19mm LIMESTONE
SUB BASE	375mm GRANULAR 'B', TYPE II

NOTE:

1. SINGLE AND DOUBLE LOADED REFERS TO BUILDINGS FRONTING THE R.O.W ON ONE OR BOTH SIDES, NOT TO SIDEWALK LOCATIONS.

TOWN OF MILTON	SCALE: N.T.S.
	DATE: MARCH 2017
24m ROAD ALLOWANCE - MINOR COLLECTOR - SINGLE OR DOUBLE LOADED	STD. NO. E-4

MILTON

APPENDIX G

OVERLAND FLOW CONVEYANCE CALCULATIONS

SCS consulting group ltd

OVERLAND FLOW CALCULATIONS - CATCHMENT N

North Catchment | **100 Year Return Period Factor =** 1.25

	Runoff Coefficient	Area (ha)*	Weighted Runoff Coefficient (5 Year)	Weighted Runoff Coefficient (100 Year)
Single - 9.1 x 26 m	0.65	8.49	0.34	0.43
Townhouse	0.75	2.04	0.10	0.12
Back-to-Backs	0.90	2.32	0.13	0.14
School	0.75	2.83	0.13	0.17
Buffer	0.30	0.07	0.00	0.00
Road Widening	0.84	0.30	0.02	0.02
Reserve	0.82	0.01	0.00	0.00
TOTAL		**16.06**	**0.718**	**0.879**

North Catchment	**Return Period**
	5 Year
Area (ha)=	16.06
Runoff Coeff. =	0.72
T_c (min)=	16.27 (10 min. plus 743 m @ m/s)
a =	**959**
b =	**5.70**
c =	**0.802**
Intensity (mm/hr) =	80.39
Runoff (m^3/s) =	**2.577**

North Catchment	**Return Period**
	100 Year
Area (ha)=	16.06
Runoff Coeff. =	0.88
T_c (min)=	16.27
a =	**1435**
b =	**5.2**
c =	**0.775**
Intensity (mm/hr) =	133.23
Runoff (m^3/s) =	**5.225**

*Area per Figure 2.2
*IDF parameters per Milton

5 Year Flow (N)

Q_{5yr} (m^3/s) = **2.577**

100 year Flow (N)

Q_{100yr} (m^3/s) = **5.225**

Required 100 Year Conveyance Capacity

$Q_{100-5yr}$ (m^3/s) = **2.649**

Overland flow conveyance for Street 1 (Collector Road)
April 2023

Worksheet for 3% blvd - 24m ROW - 0.25%

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.25 %
Normal Depth	98.0 mm

Section Definitions

Station (m)	Elevation (m)
0+00.00	0.248
0+00.30	0.239
0+01.80	0.193
0+03.25	0.150
0+03.40	0.150
0+03.45	0.000
0+03.75	0.025
0+11.30	0.176
0+18.85	0.025
0+19.15	0.000
0+19.20	0.150
0+19.35	0.150
0+22.20	0.236
0+23.70	0.280
0+24.00	0.289

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 0.248)	(0+00.30, 0.239)	0.025
(0+00.30, 0.239)	(0+01.80, 0.193)	0.013
(0+01.80, 0.193)	(0+03.25, 0.150)	0.025
(0+03.25, 0.150)	(0+19.35, 0.150)	0.013
(0+19.35, 0.150)	(0+22.20, 0.236)	0.025
(0+22.20, 0.236)	(0+23.70, 0.280)	0.013
(0+23.70, 0.280)	(0+24.00, 0.289)	0.025

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Discharge	0.14 m^3/s

Worksheet for 3% blvd - 24m ROW - 0.25%

Results

Roughness Coefficient	0.013
Elevation Range	0.000 to 0.289 m
Flow Area	0.3 m²
Wetted Perimeter	8.110 m
Hydraulic Radius	39.6 mm
Top Width	7.97 m
Normal Depth	98.0 mm
Critical Depth	87.6 mm
Critical Slope	0.52 %
Velocity	0.45 m/s
Velocity Head	0.010 m
Specific Energy	0.11 m
Froude Number	0.711
Flow Type	Subcritical

depth x velocity = 0.098 m x 0.45 m/s = 0.044 m2/s < 0.37 m2/s therefore the Town criteria is achieved.

GVF Input Data

Downstream Depth	0.0 mm
Length	0.000 m
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Downstream Velocity	0.00 m/s
Upstream Velocity	0.00 m/s
Normal Depth	98.0 mm
Critical Depth	87.6 mm
Channel Slope	0.25 %
Critical Slope	0.52 %

Worksheet for 3% blvd - 24m ROW - 0.25%

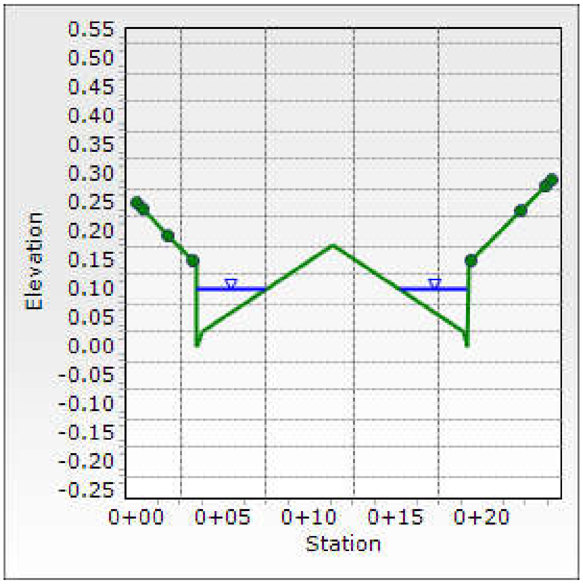
Messages:

Flow is divided.

Cross Section for 3% blvd - 24m ROW - 0.25%

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Channel Slope	0.25 %
Normal Depth	98.0 mm
Discharge	0.14 m^3/s



Required conveyance capacity = 2.649 m3/s
0.14 m3/s can be conveyed by the ROW with sawtooth grading therefore 2.649 - 0.14 = 2.509 m3/s must be captured in the North major system flow capture

OVERLAND FLOW CALCULATIONS - CATCHMENT S1

Catchment S-1 — **100 Year Return Period Factor =** 1.25

	Runoff Coefficient	Area (ha)*	Weighted Runoff Coefficient (5 Year)	Weighted Runoff Coefficient (100 Year)
Townhouse	0.75	1.66	0.28	0.35
Singles	0.65	0.04	0.01	0.01
Back-to-Backs	0.90	2.43	0.49	0.55
Village Square	0.40	0.12	0.01	0.01
Buffer	0.30	0.06	0.00	0.01
Road Widening	0.84	0.12	0.02	0.03
TOTAL		**4.43**	**0.79**	**0.92**

Catchment S-1	**Return Period**
	5 Year
Area (ha)=	4.43
Runoff Coeff. =	0.79
T_c (min)=	12.98
a =	**959**
b =	**5.70**
c =	**0.802**
Intensity (mm/hr) =	91.57
Runoff (m^3/s) =	**0.890**

(10 min. plus 357 m @ 2 m/s)

Catchment S-1	**Return Period**
	100 Year
Area (ha)=	4.43
Runoff Coeff. =	0.92
T_c (min)=	12.98
a =	**1435**
b =	**5.2**
c =	**0.775**
Intensity (mm/hr) =	151.58
Runoff (m^3/s) =	**1.715**

*Area per Figure 2.2
*IDF parameters per Milton

5 Year Flow (Catchment S-1)

Q_{5yr} (m^3/s) = **0.890**

100 Year Flow(Catchment S-1)

Q_{100yr} (m^3/s) = **1.715**

Required 100 Year Conveyance Capacity

$Q_{100-5yr}$ (m^3/s) = **0.824**

Overland flow conveyance for Street 13
Catchment S-1
April 2023

Worksheet for 3% blvd - 16m ROW - 0.25%

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Channel Slope	0.25 %
Normal Depth	120.0 mm

Section Definitions

Station (m)	Elevation (m)
0+00.00	0.255
0+00.30	0.246
0+01.80	0.201
0+03.50	0.150
0+03.65	0.150
0+03.70	0.000
0+04.00	0.025
0+08.00	0.105
0+12.00	0.025
0+12.30	0.000
0+12.35	0.150
0+12.50	0.150
0+16.00	0.255

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 0.255)	(0+00.30, 0.246)	0.025
(0+00.30, 0.246)	(0+01.80, 0.201)	0.013
(0+01.80, 0.201)	(0+03.50, 0.150)	0.025
(0+03.50, 0.150)	(0+12.50, 0.150)	0.013
(0+12.50, 0.150)	(0+16.00, 0.255)	0.025

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Discharge	0.29 m^3/s
Roughness Coefficient	0.013
Elevation Range	0.000 to 0.255 m
Flow Area	0.5 m^2

Worksheet for 3% blvd - 16m ROW - 0.25%

Results

Wetted Perimeter	8.857 m
Hydraulic Radius	57.5 mm
Top Width	8.68 m
Normal Depth	120.0 mm
Critical Depth	110.0 mm
Critical Slope	0.47 %
Velocity	0.57 m/s
Velocity Head	0.017 m
Specific Energy	0.14 m
Froude Number	0.755
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 mm
Length	0.000 m
Number Of Steps	0

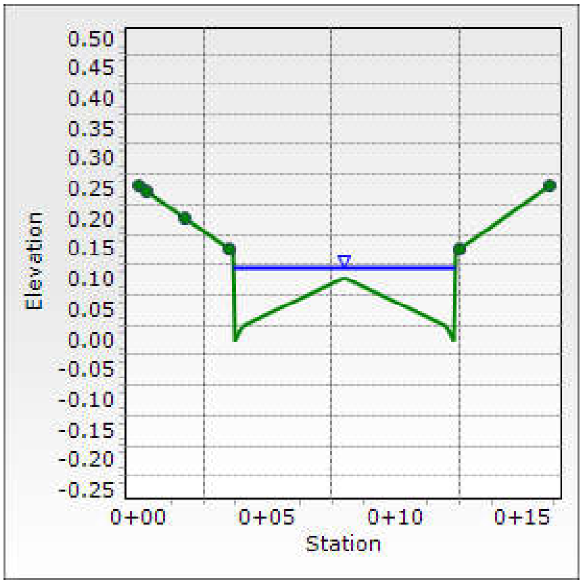
GVF Output Data

Upstream Depth	0.0 mm
Profile Description	N/A
Profile Headloss	0.00 m
Downstream Velocity	0.00 m/s
Upstream Velocity	0.00 m/s
Normal Depth	120.0 mm
Critical Depth	110.0 mm
Channel Slope	0.25 %
Critical Slope	0.47 %

Cross Section for 3% blvd - 16m ROW - 0.25%

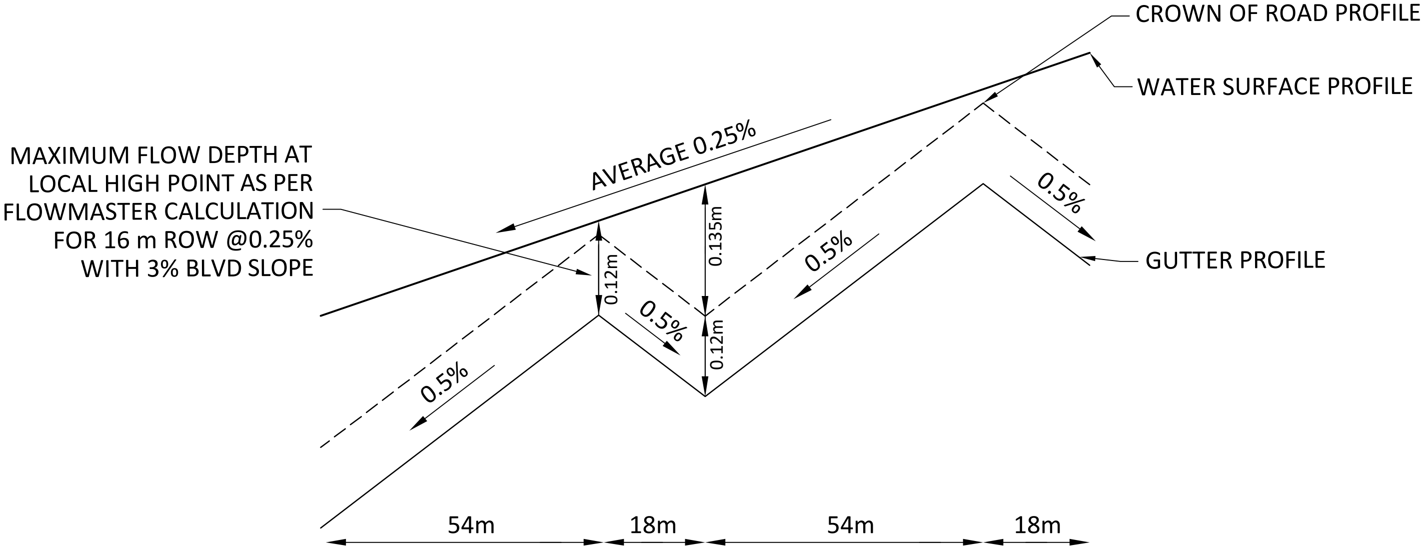
Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Channel Slope	0.25 %
Normal Depth	120.0 mm
Discharge	0.29 m³/s

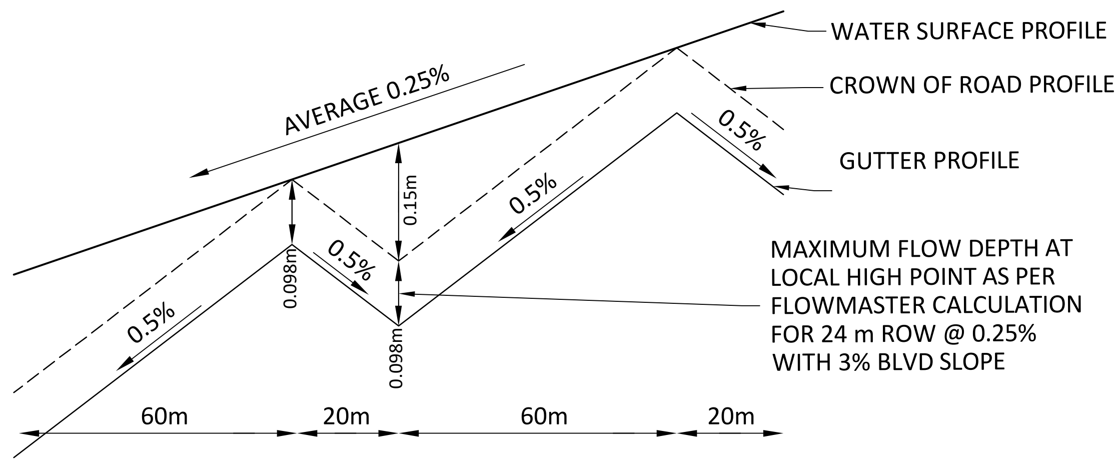


Required conveyance capacity (Catchment S-1) = 0.824 m3/s
0.29 m3/s can be conveyed by the ROW with sawtooth grading therefore 0.824 - 0.29 = 0.534 m3/s must be captured in the South major system flow capture

Saw Toothed Grading at Critical Location
April 2023



SAW TOOTHING ON 16 m ROW - STREET 13
N.T.S.



SAW TOOTHING ON 24 m ROW - STREET 1
N.T.S.

APPENDIX H

WATER BALANCE REPORT

BURNSIDE

Water Balance Assessment

Sundial Homes (4th Line) Ltd.
Milton, Ontario

Water Balance Assessment

Sundial Homes (4th Line) Ltd.
Milton, Ontario

R.J. Burnside & Associates Limited
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Guelph ON N1H 1C4 CANADA

May 2021 (Updated April 2023)
300053048.0000

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Record of Revisions

Revision	Date	Description
-	May 26, 2021	Initial Submission to SCS Consulting Group
1	April 6, 2023	Second Submission to SCS Consulting Group

R.J. Burnside & Associates Limited

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1.0 Introduction

R.J. Burnside & Associates Limited (Burnside) was retained by Sundial Homes (4^{th} Line) Limited (Sundial) to complete a water balance assessment report in support of the Draft Plan approval for a proposed residential development located in Milton, Ontario. The location of the subject property (herein referred to as the subject lands) is shown in Figure 1.

The subject lands are located at 6071 Fourth Line in Milton, bounded by James Snow Parkway to the east, Britannia Road to the south, Fourth Line to the west and open space/agricultural lands to the north (Figure 2). The lands are currently used for agriculture and rural residential. An area of about 3 ha is being used to stockpile soil off of Britannia Road.

1.1 Background and Previous Studies

Previous studies have been completed as part of various investigations for lands in the area of and including the subject lands in support of the urban development of the area. Applicable data that have been compiled in these previous investigations such as soil characteristics and hydrogeological conditions were reviewed and have been incorporated in this current assessment.

The subject lands are located within Block 5B of the Boyne Survey Lands which is bounded by Britannia Road to the south-east, James Snow Parkway to the north-east, Louis St. Laurent Avenue to the north-west and approximately 300 m north-west of Third Line. A water balance assessment was completed for Block 5B by Geomorphix in 2021 which was updated in March 2022. The water balance was a refinement of a water balance completed by WSP for Blocks 5A, 5B and 6 as part of the Phase 3 Subwatershed Impact Study. A geotechnical report for the subject lands was completed by Soil-Eng Limited in 2004. This report has been reviewed for information on soils on the subject lands.

2.0 Site Conditions

2.1 Physiography and Topography

The subject lands are located within a physiographic region referred to as the Peel Plain, an area characterized as being an undulating tract of clay and till soils gently sloping towards Lake Ontario (Chapman and Putnam, 1984).

The topography of the subject lands is characterized as having rolling and gently sloping topography. The topography of the subject lands slopes gently towards the south-west with elevations ranging from 191 meters above sea level (masl) to193 masl (Figure 3).

A portion of the subject lands along Britannia Road has been used to stockpile soil which is reflected in the topographic contours in Figure 3.

2.2 Drainage

The subject lands are located in the Lower Middle Branch subwatershed of Sixteen Mile Creek and are within the jurisdiction of the Conservation Halton (CH). Drainage on the subject lands is towards a watercourse that flows through the western portion of the subject lands entering from the northwest property boundary flowing southeast and leaving the subject lands at Fourth Line (Figure 3).

2.3 Geology

Surficial geology mapping published by the Ontario Geological Survey (2003) shows that the subject lands is covered by glacio-lacustrine silts and clay and silty to clayey till (Figure 4). The regional Phase 3 SIS study found that the bedrock in the area of the subject lands consists of red shale of the Queenston Formation which is weathered and fractured in the upper 1 to 5 m (Geomorphix, 2021). Water well records from the Ministry of Environment, Conservation and Parks (MECP) show bedrock found in water wells near the subject lands at about 15 m below ground surface.

2.4 Soils

Soils of Ontario mapping indicates the soils on the subject lands are Chinguacousy Clay Loam (Ontario, 2021).

Ten boreholes were drilled within the subject lands by Soil-Eng. Limited in 2004. The borehole logs are provided in Appendix A. The boreholes were completed to depths of 5 m and indicated that the overburden is generally composed of a silty clay till with some layers of sandy silt till, silty clay and silt seams within the till. Estimated permeability of the fine grained sediments is low in the range of 10^{-7} cm/sec (Soil-Eng, 2004). The lithology encountered by the boreholes is generally consistent with the lithology shown on the geological maps.

2.5 Groundwater Levels

Groundwater levels were measured by Burnside on April 23, 2021 at four monitoring wells located on the subject lands. The locations of the monitoring wells are shown on Figure 2 and the water levels are provided below in Table 1. Information about the construction of the monitoring wells or borehole logs were not available. Depths of wells collected in the field are provided below in Table 1.

Table 1: Groundwater Levels in Monitoring Wells

Well	Well Depth (mbgs)	Water Level (mbgs)
MW1	8.22	1.28
MW2	7.56	0.00
MW3	5.62	0.51
MW4	5.47	0.55

As summarized above in Table 1, the groundwater levels in the monitoring wells ranged from 0 m (at surface) to 2.1 m below ground surface. Shallow wells in southern Ontario typically show a pattern of groundwater fluctuations that is related to seasonal variations in precipitation and infiltration where the highest groundwater levels occur in the spring, levels decline throughout the summer and early fall and then rise again in the late fall/early winter. Seasonal variability in silty clay soils such as the subject lands can range from about 1 m to 3 m. The groundwater levels collected in April 2021 can be interpreted as seasonal high groundwater levels.

3.0 Water Balance

3.1 Water Balance Components

A water balance is an accounting of the water resources within a given area and is generally annualized for planning considerations. The groundwater balance focusses on the resulting groundwater components of the water balance such as infiltration and groundwater recharge. For the current assessment the water balance for the entirety of the subject lands is considered. As a concept, the water balance is relatively simple and may be estimated from the following equation:

$$P = S + ET + R + I$$

Where:

- P = precipitation
- S = change in groundwater storage
- ET = evapotranspiration/evaporation
- R = surface water runoff
- I = infiltration

The components of the water balance vary in space and time and depend on climatic conditions as well as the soil and land cover conditions (i.e., rainfall intensity, land slope, soil hydraulic conductivity and vegetation). Runoff, for example, occurs particularly during periods of snowmelt when the ground is frozen, or during intense rainfall events.

Precise measurement of the water balance components is difficult and as such, approximations and simplifications are made to characterize the water balance of a site. Field observations of the drainage conditions, land cover and soil types, groundwater levels and local climatic records are important input considerations for the water balance calculations. For the following assessment the water balance was computed based on the soil moisture approach that was outlined by Thornthwaite and Mather (1957). The groundwater balance components for the subject lands are discussed below:

Precipitation (P)

The long-term average annual precipitation for the subject lands was assumed to be 877 mm based on data from the Environment Canada Georgetown Waste Water Treatment Plant (Station 6152695, 43°38'24.018" N, 79°52'45.018" W, elevation 221.0 masl) for the period between 1981 and 2010. The climate station is located 15 km north of the subject lands and is interpreted to be the closest station with the required data that represents the subject lands. Average monthly records of precipitation and temperature from this station have been used for the water balance calculations in this study (Appendix B).

Storage (S)

Although there are groundwater storage gains and losses on a short-term basis throughout the year, the net change in groundwater storage on a long-term basis is assumed to be zero (losses balance out the gains) so this term is dropped from the equation.

Evapotranspiration (ET)/Evaporation (E)

Evapotranspiration and evaporation components vary based on the characteristics of the land surface cover (i.e., type of vegetation, soil moisture conditions, perviousness of surfaces, etc.). Potential evapotranspiration (PET) refers to the water loss from a vegetated surface to the atmosphere under conditions of an unlimited water supply. The actual rate of evapotranspiration (AET) is generally less than the PET under dry conditions (i.e., during the summer when there is a soil moisture deficit). The mean annual ET has been calculated for this study using a monthly soil-moisture balance approach considering the local climate conditions.

Water Surplus (R + I)

The difference between the mean annual P and the mean annual ET is referred to as the water surplus. Part of the water surplus travels across the surface of the soil as surface or overland runoff (R) and the remainder infiltrates (I) the surficial soil.

3.2 Approach and Methodology

The analytical approach to calculate the water balance involves monthly soil-moisture balance calculations to determine the pre-development (based on pre-development land use) infiltration volumes. A soil-moisture balance approach assumes that soils do not release water as potential recharge 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 and either become interflow (indirect runoff) or recharge (deep infiltration).

A soil moisture storage capacity of 200 mm was selected as a representative value for the existing vegetation and soil conditions which consists of predominantly short to moderate-rooted vegetation in the fields and agricultural areas in silt clay loam soils (Table B-1, Appendix B). A soil moisture storage capacity of 250 mm was used to represent the lands not being used for agriculture (Table B-2, Appendix B). A soil moisture storage capacity of 100 mm was used to represent the post-development vegetation which will be dominantly urban lawn (Table B-3, Appendix B). Tables B-1, B-2 and B-3 in Appendix B 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.

3.3 Water Balance Component Values

The detailed monthly calculations of the water balance components are provided in Tables B-1, B-2 and B-3 in Appendix B. The infiltration and runoff components have been calculated using the infiltration factor methodology from Table 3.1 of MECP SWM Planning and Design Manual (2003). The methodology accounts for topography, soil type and land cover assigning a factor between 0.1 and 0.3 to each component. The infiltration factors used in this analysis and rational are summarized below in Table 2 and are consistent with those used in the water balance for Boyne SIS Block Area 5B-O Subwatershed Impact Study Water Balance Report (Geomorphix, 2022).

Table 2: Infiltration Factors

Land Cover	Soil Max Moisture Storage	Topography	Soils	Cover	Infiltration Factor
Agricultural Crops	200 mm	Rolling – 0.2	Silty Clay – 0.15	Cultivated – 0.1	0.45
Pasture/Shrubs (Open Space)	250 mm	Rolling – 0.2	Silty Clay – 0.15	Wooded – 0.2	0.55
Urban Lawns	100 mm	Rolling – 0.2	Silty Clay – 0.15	Cultivated – 0.1	0.45

The calculations show that a water surplus is generally available from November to May and the period of surplus is illustrated in Figure B-1. The monthly water balance calculations illustrate how infiltration occurs during periods when there is sufficient water available to overcome the soil moisture storage requirements. The monthly calculations are summed to provide estimates of the annual water balance component values (Tables B-1, B-2 and B-3, Appendix B).

3.4 Pre-Development Water Balance (Existing Conditions)

The pre-development land cover includes agricultural lands, open space, rural residential and soil stock piling (Figure 5). The water balance component values from Tables B-1, B-2 and B-3 were used to calculate the average annual pre-development infiltration volumes in Table B-4, Appendix B. Based on these component values, the pre-development infiltration volume for the subject lands is calculated to be about 45,600 m^3/year (Table B-4, Appendix B).

3.5 Potential Urban Development Impacts to Water Balance

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. Evaporation from impervious surfaces remains under post-development conditions and evaporation 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 (about 64% of precipitation in the study area). 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 components (interflow and deep recharge) are reduced.

A water balance calculation of the potential water surplus for impervious areas is shown at the bottom of Table B-1 in Appendix B. For the purposes of the calculations in this study, the evaporation has been estimated to be 15% of precipitation. The remaining 85% of the precipitation that falls on impervious surfaces is assumed to become runoff. Therefore, assuming an evaporation/loss from impervious surfaces of 15% of the precipitation, there is a potential water surplus from impervious areas of 746 mm/year.

It is noted that the proposed development will be serviced by municipal water supply and wastewater services. Therefore, there will be no impact on the water balance and local groundwater or surface water quantity and quality conditions related to any on-site groundwater supply pumping or disposal of septic effluent.

3.6 Post-Development Water Balance with No Mitigation

To assess potential development impacts on infiltration, the post-development infiltration volumes for the subject lands have been calculated in Table B-4 in Appendix B. The total areas for the proposed land use and the associated percentage impervious factors were provided by SCS Consulting Group Ltd (March 2023).

The infiltration and runoff components for the post-development land uses have been calculated using the MECP SWM Planning and Design Manual (2003) methodology based on topography, soil type and land cover as shown on Table B-2 and Table B-3 in Appendix B. It should be noted that no mitigation has been applied to the results shown in this table and that they therefore represent the water balance under post-development conditions with no mitigation applied. The average calculated post-development infiltration volume (without mitigation) for the subject lands is about 18,200 m^3/year.

Comparing the pre- and post-development infiltration volumes, shows that development has the potential to reduce the infiltration on the subject lands from 45,600 m^3/year to 18,200 m^3/year, i.e., a reduction of about 27,500 m^3/year or 60%. These calculations assume no LID measures for stormwater management are in place. If mitigation were to be applied, it is anticipated that a reduction in the deficit could be achieved.

3.7 Mitigation Strategies for Infiltration

The use of Low Impact Development (LID) measures for stormwater management can be used to mitigate the potential impacts of development on the water balance.

The basic premise for low impact development is to try to manage stormwater to minimize the runoff of rainfall and increase the potential for infiltration. As outlined in the MECP SWMP Design Manual (2003) and Low Impact Development Stormwater Management Planning and Design Guide published by the CVC and TRCA (2010), there are a wide variety of mitigation techniques that can be used to try to reduce the increases in direct runoff that occur with land development and increase the potential for post-development infiltration.

Techniques to maximize the water availability in pervious areas such as designing grades to direct roof runoff towards lawns, side and rear yard swales, and other pervious areas throughout the development where possible can considerably increase the volume of infiltration in developed areas. These types of surface LID techniques promote natural infiltration simply by providing additional water volumes in the pervious areas (i.e., these areas would receive precipitation as well as extra water from roof runoff). This may be particularly effective in the summer months, when natural infiltration would not generally occur because the additional water overcomes the natural soil moisture deficit.

Other mitigation techniques that can be considered to mitigate increases in runoff and reductions in infiltration include such measures as: permeable pavements, rain gardens, bioswales, subsurface infiltration trenches, galleries and pervious pipe systems. Subsurface methods should only be considered in areas where there is sufficient depth to water table to accommodate the systems within the unsaturated zone and sufficient soil hydraulic conductivity to function effectively.

3.8 Mitigation Measures to be Implemented

The water balance calculations suggest that without mitigation the subject lands will receive about 60% of the current average annual groundwater infiltration after development. The overall deficit in groundwater infiltration has been estimated to be 27,500 m^3/year (see Table B-4 in Appendix B). The main constraint for implementation of mitigation measures is the low permeability of the native soils. In these soil conditions, surficial LID techniques are considered the most practical mitigation measures.

LID measures being proposed to mitigate the loss of infiltration on the subject lands include:

- Increased topsoil depths to 450 mm thickness in pervious area except boulevard areas and 300 mm in boulevards;
- Disconnection of roof leaders and discharge of rooftops to pervious areas; and
- Wetland pocket areas within the channel block.

The use of these mitigation measures is expected to increase post-development infiltration and result in a net benefit to the subject lands through a reduction in the deficit. We note that the quantification of the surficial LID techniques is challenging and there are no widely accepted quantification standards. Increased topsoil depths can promote infiltration by increasing the soil's capacity to retain water and allow for infiltration to occur.

3.8.1 Roof Downspout Disconnection

Disconnection of roof leaders and directing to pervious areas provides additional water to support infiltration. These pervious areas would receive precipitation as well as extra water from roof runoff, and with such increased water supply, evapotranspiration can occur at the maximum potential rate.

Roof leaders from the residential homes will be disconnected and directed to rear/side yards to provide additional water depth. The TRCA and CVC Stormwater Management Criteria (2010) indicates that a conservative estimate for the reduction in runoff due to roof leader disconnection is 25% for silt to clayey soils. To assess the potential effectiveness of this LID measure for the proposed development, water balance calculations have been completed assuming that runoff from residential roofs is directed to pervious areas. These calculations are provided in Table B-5, Appendix B. The calculations suggest that the direction of roof runoff to pervious areas could provide an additional 15,524 m^3/year.

3.8.2 Pocket Wetlands

Pocket wetlands are constructed wetlands over excavated depressions which are lined with a mix of soil and granular materials to provide both depressional and subsurface storage. By retaining flows over engineered, permeable soils the wetlands can provide opportunities for infiltration and evapotranspiration through the establishment of medium rooting vegetation communities and extended detention.

Based on the characteristics of pocket wetlands they are predicted to have a similar effect to bioretention cells as described within the TRCA/CVC LID SWM Guide (2010). The TRCA/CVC LID SWM Guide predicts a runoff reduction of 0.85 for features without underdrains and 0.45 for features with underdrains. For this study we have assumed a conservative runoff reduction fraction of 0.65 for the proposed pocket wetland areas. Pocket wetlands are assumed to be 15% of the channel block. This is consistent with the methodology used in the SIS water balance report (GEO Morphix, 2022).

Calculations for additional infiltration from pocket wetlands are provided in Table B-5, Appendix B. The calculations suggest that the use of pocket wetlands could provide an additional 454 m^3/year. These calculations only account for infiltration from precipitation that falls on the wetlands. They do not account for any infiltration that may result from directing surface water flowing within the channel through the wetlands.

The remaining deficit would therefore be 11,643 m^3/year (Table B-5, Appendix B). Therefore, total estimated post-development infiltration with mitigation measures is approximately 34,000 m^3/year which is 75% of the estimated pre-development infiltration. These calculations do not account for the increased topsoil depths or infiltration of surface water flowing in the pocket wetlands which are expected to make up the remaining infiltration deficit (GEO Morphix, 2022).

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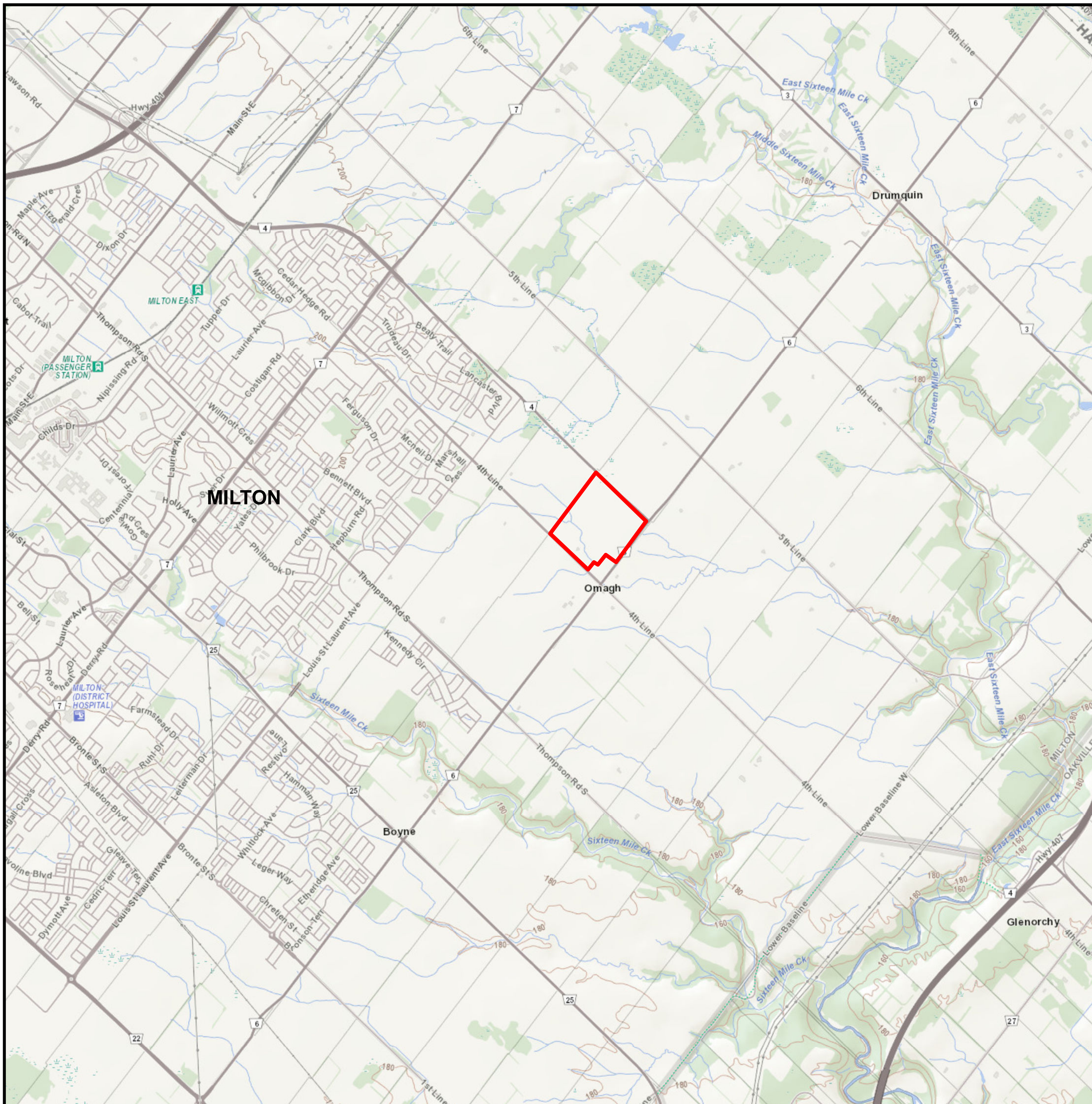
BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Figures

Figures



LEGEND

SUBJECT LANDS

0 250 500 1,000 1,500 2,000 2,500 3,000 3,500
Metres

N

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Client / Report

SUNDIAL HOMES (4TH LINE) LTD.
MILTON, ONTARIO

WATER BALANCE ASSESSMENT

Figure Title:

SITE LOCATION

Drawn	Checked	Date	Figure No.
SK	SC	MAY 2021	1
Scale		Project No.	
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File Path: Nigel/Shared Work Areas/053048 Sundial/06_GIS/053048 Site Location.mxd

LEGEND

SUBJECT LANDS

MONITORING WELL (SOURCE UNKNOWN)

0 50 100 200 300 400

Meters

N

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SUNDIAL HOMES (4TH LINE) LTD.
MILTON, ONTARIO

WATER BALANCE ASSESSMENT

Figure Title:

SITE PLAN

Drawn	Checked	Date	Figure No.
SK	SC	MAY 2021	2
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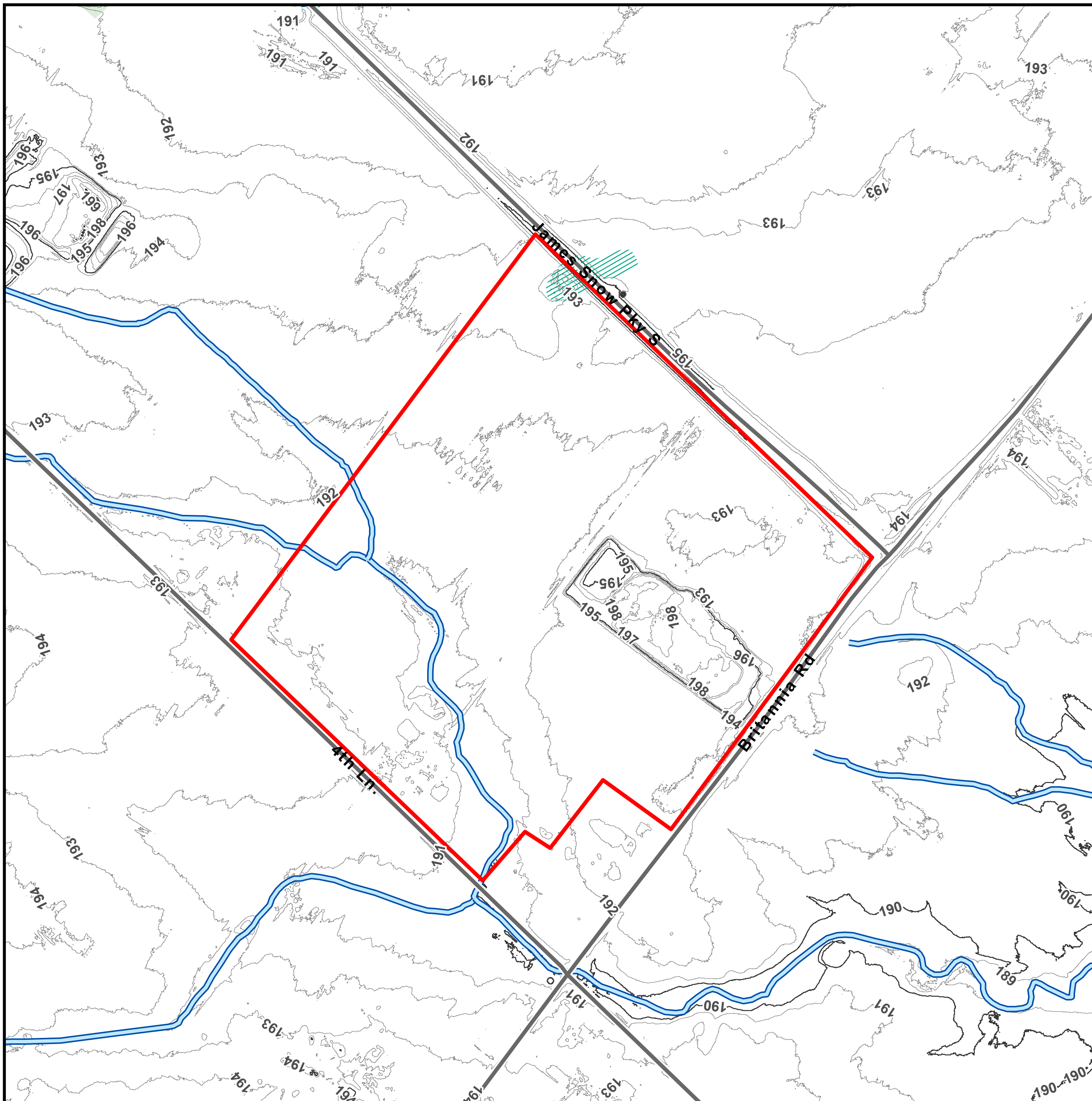

LEGEND

SUBJECT LANDS
ROADWAY
CONTOUR (1m intervals - masl)
CONTOUR (5m intervals - masl)
WATERCOURSE
WETLAND
WOODED AREA

0 50 100 200 300 400 500
Metres

N

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SUNDIAL HOMES (4TH LINE) LTD.
MILTON, ONTARIO

WATER BALANCE ASSESSMENT

Figure Title:

TOPOGRAHY AND DRAINAGE

Drawn	Checked	Date	Figure No.
SK	SC	MAY 2021	3
Scale		Project No.	
1:7,500		300053048	

File Path: Nigel/Shared Work Areas/053048 Sundial/06_GIS/053048 Topograhy & Drainage.mxd

LEGEND

- SUBJECT LANDS
- ROADWAY
- WATERCOURSE
- 5d: Till: Glaciolacustrine-derived silty to clayey till
- 8b: Fine-textured glaciolacustrine deposits: Interbedded flow till, rainout deposits and silt and clay
- 19: Modern alluvial deposits - clay, silt, sand, gravel, may contain organic matter

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SUNDIAL HOMES (4TH LINE) LTD.
MILTON, ONTARIO

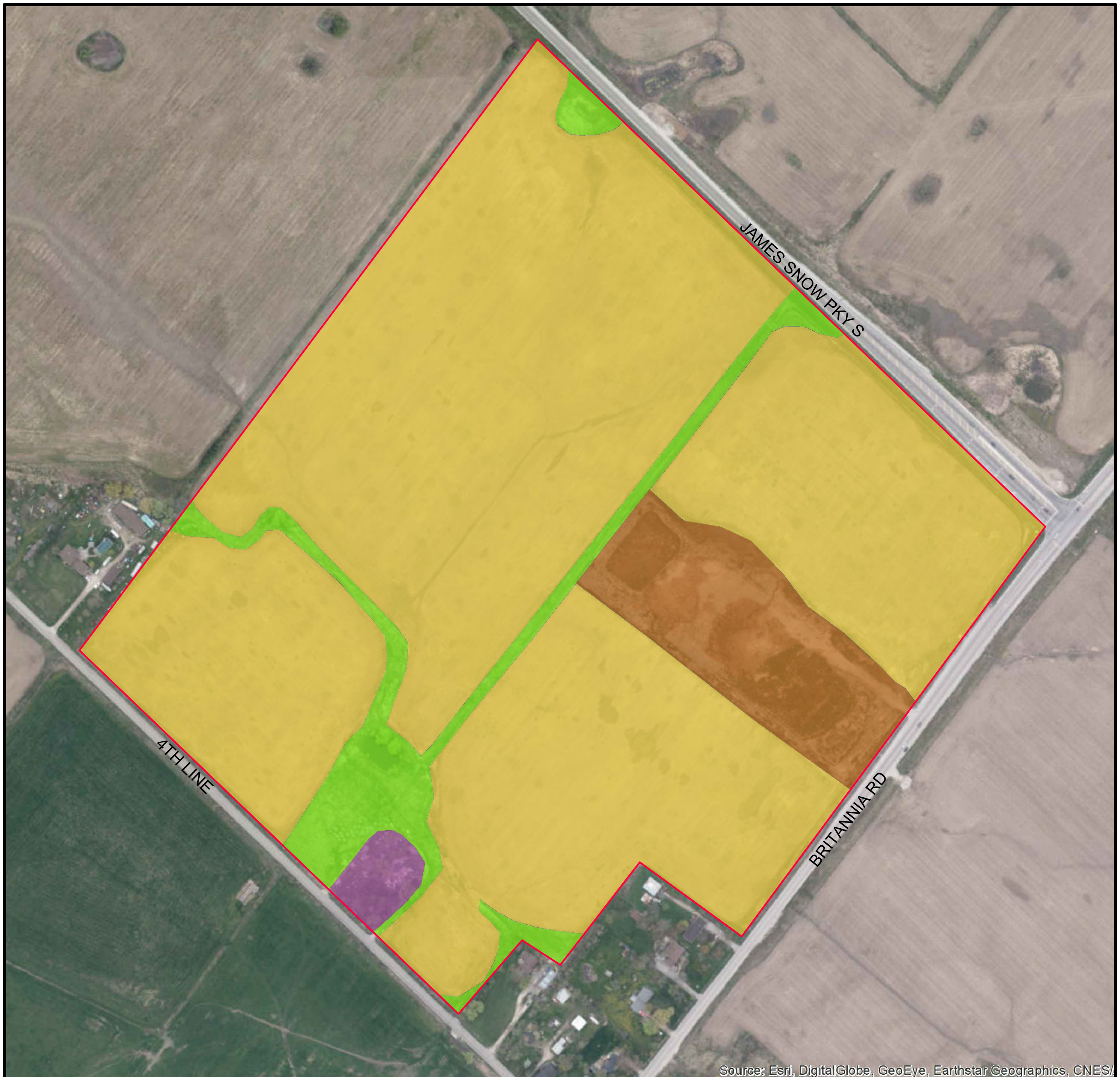
WATER BALANCE ASSESSMENT

Figure Title:

SURFICIAL GEOLOGY

Drawn	Checked	Date	Figure No.
SK	SC	MAY 2021	4
Scale		Project No.	
1:10,000		300053048	

File Path: Nigel/Shared Work Areas/053048 Sundial/06_GIS/053048 Surficial Geology.mxd



LEGEND

SUBJECT LANDS

LANDUSE:

AGRICULTUAL

OPEN SPACE / WETLAND

RURAL RESIDENTIAL

OTHER (STOCK PILE)

0 50 100 200 300 400

Metres

N

BURNSIDE

Client / Report

SUNDIAL HOMES (4TH LINE) LTD
MILTON, ONTARIO

WATER BALANCE ASSESSMENT

Figure Title

PRE-DEVELOPMENT LANDUSE

Drawn	Checked	Date	Figure No.
SK	SC	MAY 2021	5
Scale		Project No.	
1:5,000		300053048	

Appendix A

Borehole Logs

Appendix A

JOB NO.: 0404-S103

LOG OF BOREHOLE NO.: 1

FIGURE NO.: 1

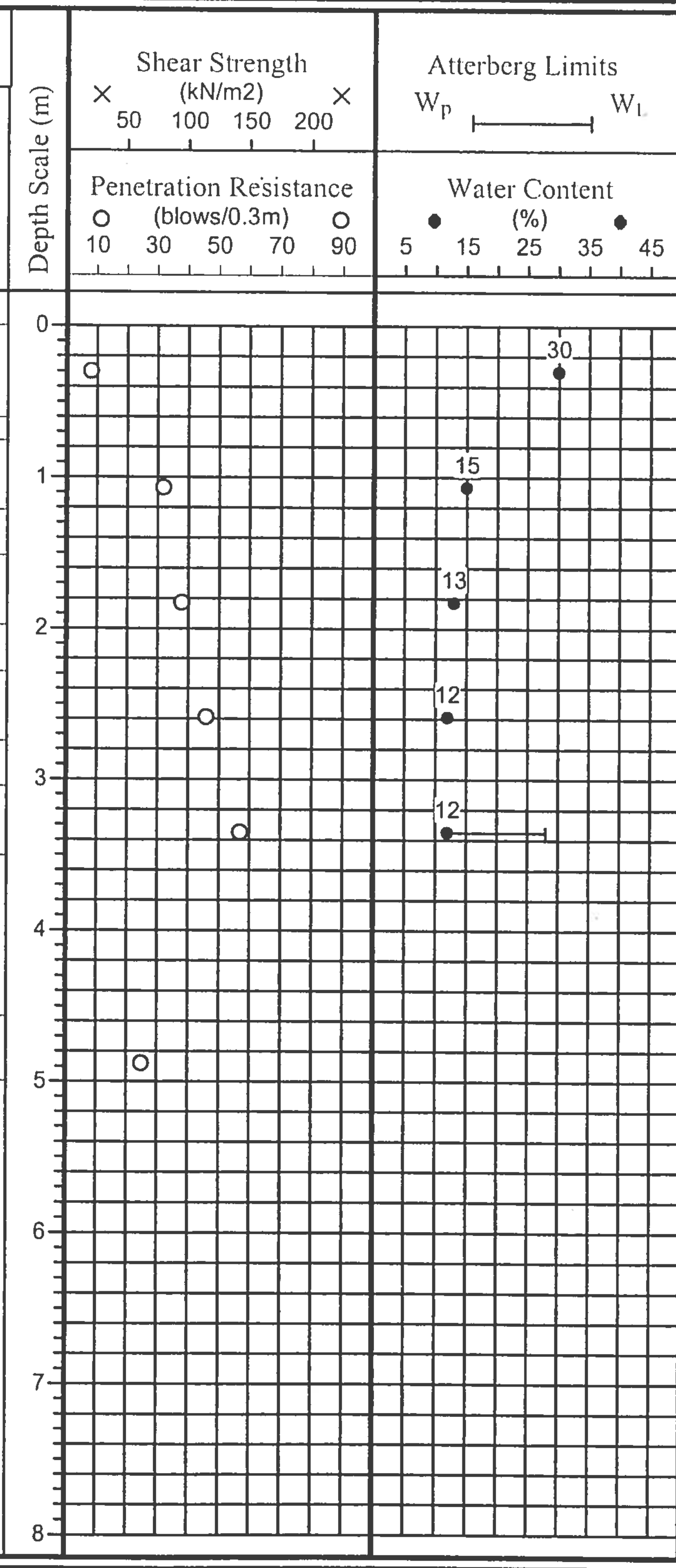
JOB DESCRIPTION: Proposed Residential Deveopment

JOB LOCATION: 1501 Fourth Line, Town of Milton

METHOD OF BORING: Flight-Auger

DATE: May 4, 2004

Elev. Depth (m)	SOIL DESCRIPTION	Sample Number	Sample Type	N-Value
	Ground Surface			
0.0	**30 cm TOPSOIL**			
	Brown to reddish-brown Stiff to hard weathered	1	DO	8
		2	DO	32
	SILTY CLAY, Till	3	DO	38
		4	DO	46
	some sand to sandy a tr. of gravel occ. cobbles, boulders, and sand seams some shale debris becoming frequent with depth	5	DO	57
		6	DO	25
5.0	**END OF BOREHOLE**			



WATER LEVEL: Dry on completion

SOIL-ENG LIMITED

JOB NO.: 0404-S103

LOG OF BOREHOLE NO.: 2

FIGURE NO.: 2

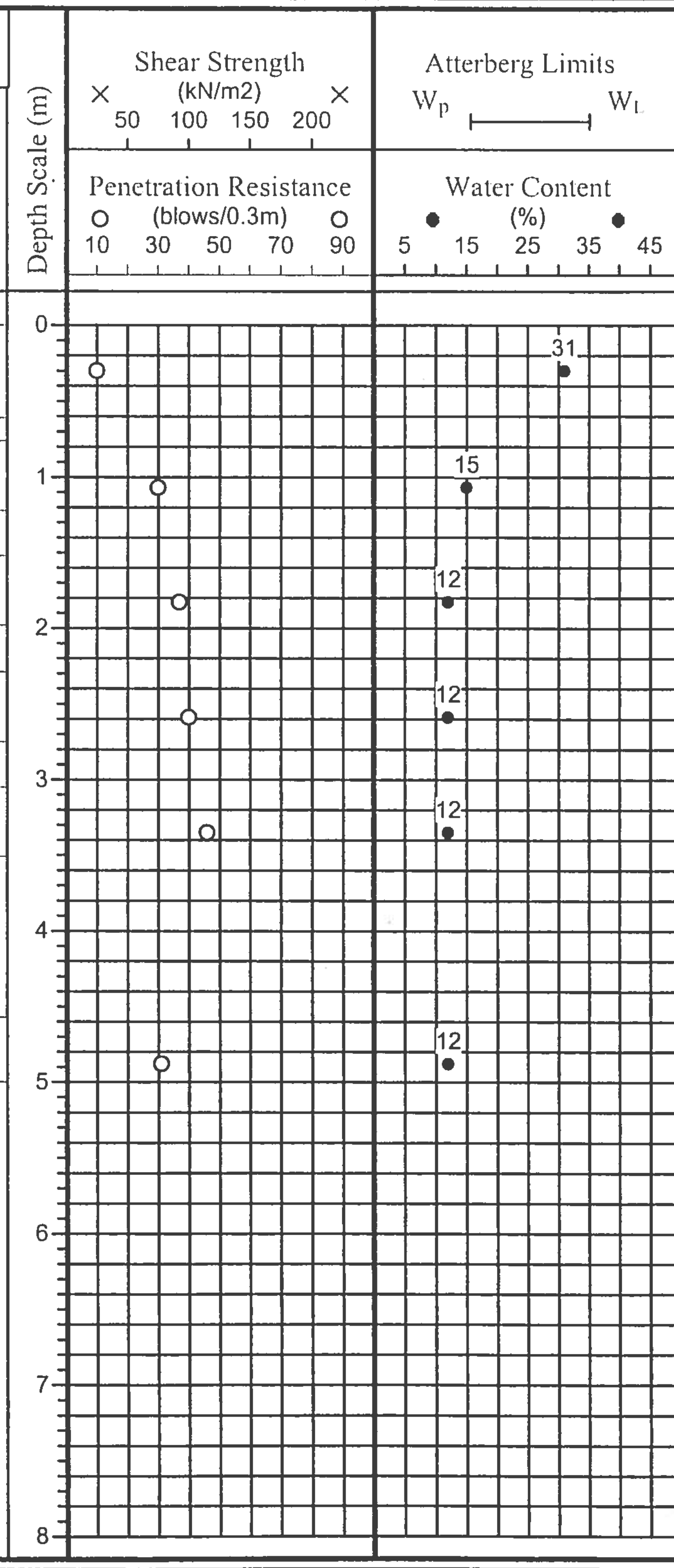
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1501 Fourth Line, Town of Milton

METHOD OF BORING: Flight-Auger

DATE: May 4, 2004

Elev. Depth (m)	SOIL DESCRIPTION	Sample Number	Type	N-Value	Water Content (%)	WATER LEVEL
	Ground Surface					Dry on completion
0.0	**45 cm TOPSOIL**	1	DO	10	31	
	Brown to reddish-brown, Stiff to hard, weathered	2	DO	30	15	
	SILTY CLAY, Till	3	DO	37	12	
		4	DO	40	12	
	some sand to sandy, a tr. of gravel, occ. cobbles, boulders, and sand seams, some shale debris becoming frequent with depth	5	DO	46	12	
		6	DO	31	12	
5.0	**END OF BOREHOLE**					



SOIL-ENG LIMITED

JOB NO.: 0404-S103

LOG OF BOREHOLE NO.: 3

FIGURE NO.: 3

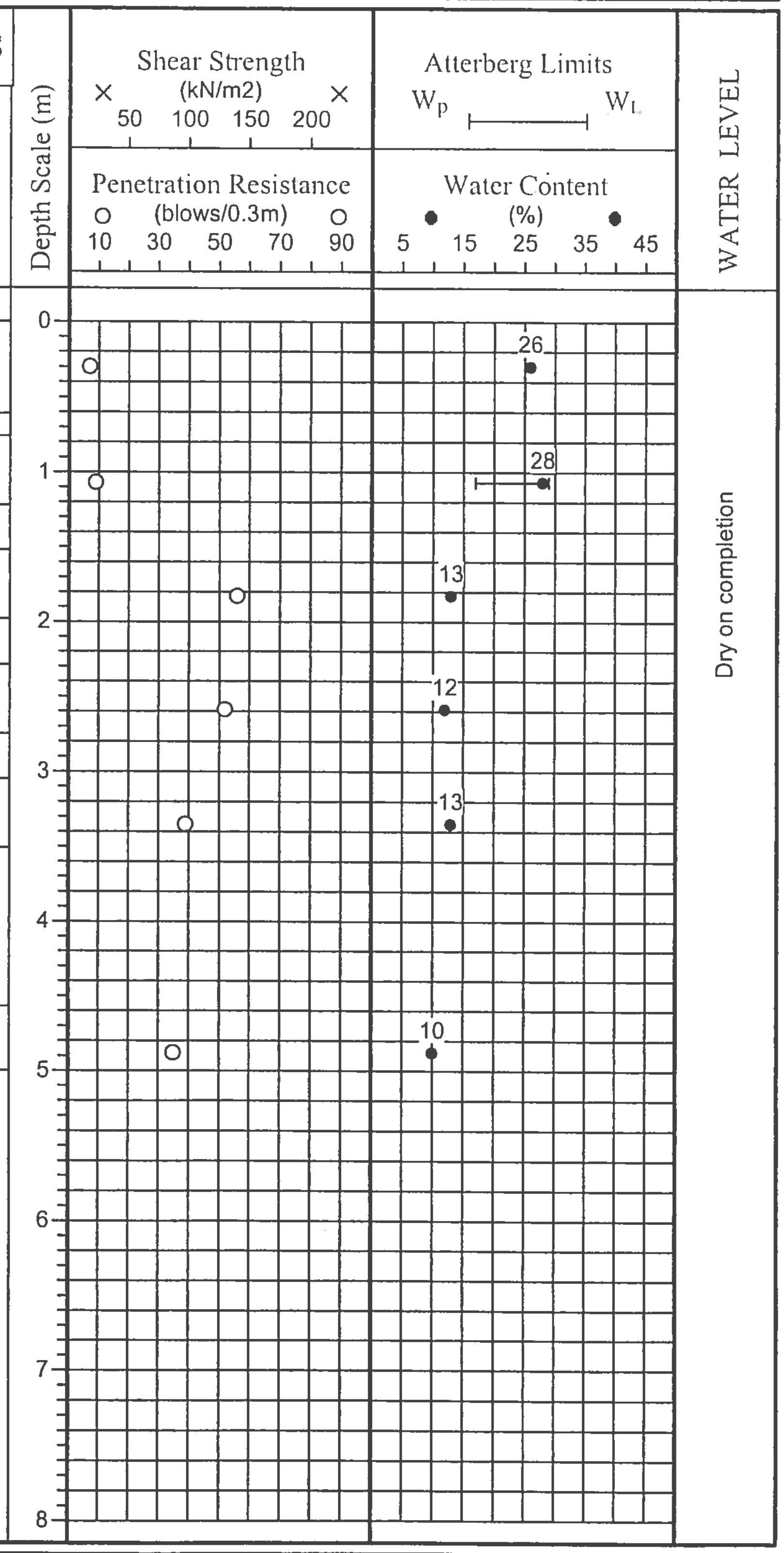
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1501 Fourth Line, Town of Milton

METHOD OF BORING: Flight-Auger

DATE: May 4, 2004

Elev. Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
	Ground Surface			
0.0	**30 cm TOPSOIL**	1	DO	7
	weathered	2	DO	9
	Firm to hard	3	DO	56
	SILTY CLAY, Till	4	DO	52
	some sand to sandy a tr. of gravel occ. cobbles, boulders, and sand seams some shale debris becoming frequent with depth	5	DO	39
		6	DO	35
5.0	**END OF BOREHOLE**			



SOIL-ENG LIMITED

JOB NO.: 0404-S103

LOG OF BOREHOLE NO.: 4

FIGURE NO.: 4

JOB DESCRIPTION: Proposed Residential Development

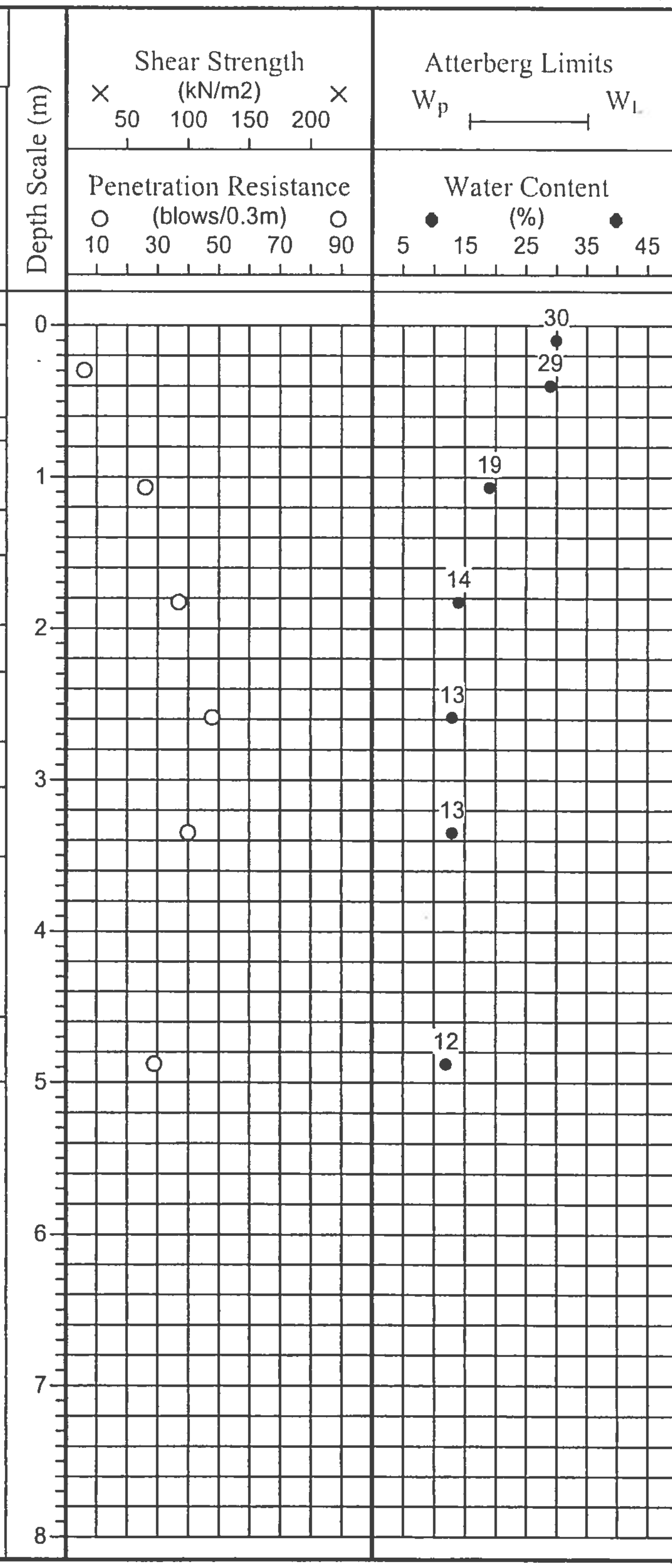
JOB LOCATION: 1501 Fourth Line, Town of Milton

METHOD OF BORING: Flight-Auger

DATE: May 4, 2004

Elev. Depth (m)	SOIL DESCRIPTION	Sample Number	Sample Type	N-Value	Water Content (%)
	Ground Surface				
0.0	30 cm TOPSOIL				30
		1	DO	6	29
	weathered	2	DO	26	19
	Brown to reddish-brown Firm to hard	3	DO	37	14
	SILTY CLAY, Till	4	DO	48	13
	some sand to sandy a tr. of gravel occ. cobbles, boulders, and sand seams some shale debris becoming frequent with depth	5	DO	40	13
		6	DO	29	12
5.0	END OF BOREHOLE				

WATER LEVEL: Dry on completion



SOIL-ENG LIMITED

JOB NO.: 0404-S103

LOG OF BOREHOLE NO.: 5

FIGURE NO.: 5

JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1501 Fourth Line, Town of Milton

METHOD OF BORING: Flight-Auger

DATE: May 4, 2004

Elev. Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Shear Strength (kN/m2) × 50 100 150 200 × / Penetration Resistance (blows/0.3m) ○ 10 30 50 70 90 ○	Atterberg Limits Wp ├─┤ WL / Water Content (%) ● 5 15 25 35 45 ●	WATER LEVEL
	Ground Surface							
0.0	**38 cm TOPSOIL**	1	DO	8	0	○	33	Dry on completion
	weathered							
	Brown to reddish-brown Stiff to hard	2	DO	31	1	○	14	
		3	DO	36	2	○	14	
	SILTY CLAY, Till	4	DO	55		○	12	
	some sand to sandy a tr. of gravel occ. cobbles, boulders, and sand seams some shale debris becoming frequent wiht depth	5	DO	58	3	○	11	
					4			
		6	DO	26		○	14	
5.0	**END OF BOREHOLE**				5			
					6			
					7			
					8			

SOIL-ENG LIMITED

JOB NO.: 0404-S103

LOG OF BOREHOLE NO.: 6

FIGURE NO.: 6

JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1501 Fourth Line, Town of Milton

METHOD OF BORING: Flight-Auger

DATE: May 4, 2004

Elev. Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Water Content (%)	WATER LEVEL
	Ground Surface					
0.0	36 cm TOPSOIL	1	DO	10	28	Dry on completion
	Brown to reddish-brown, Stiff to hard, SILTY CLAY, Till (weathered)	2	DO	26	27	
	some sand to sandy, a tr. of gravel, occ. cobbles, boulders, and sand seams, some shale debris becoming frequent with depth	3	DO	41	13	
		4	DO	44	13	
		5	DO	42	14	
		6	DO	19	10	
5.0	END OF BOREHOLE					

Depth Scale (m): 0–8

Shear Strength (kN/m2): × 50 100 150 200 ×

Penetration Resistance (blows/0.3m): ○ 10 30 50 70 90 ○

Atterberg Limits: Wp ⊢—⊣ WL

Water Content (%): ● 5 15 25 35 45 ●

SOIL-ENG LIMITED

JOB NO.: 0404-S103

LOG OF BOREHOLE NO.: 7

FIGURE NO.: 7

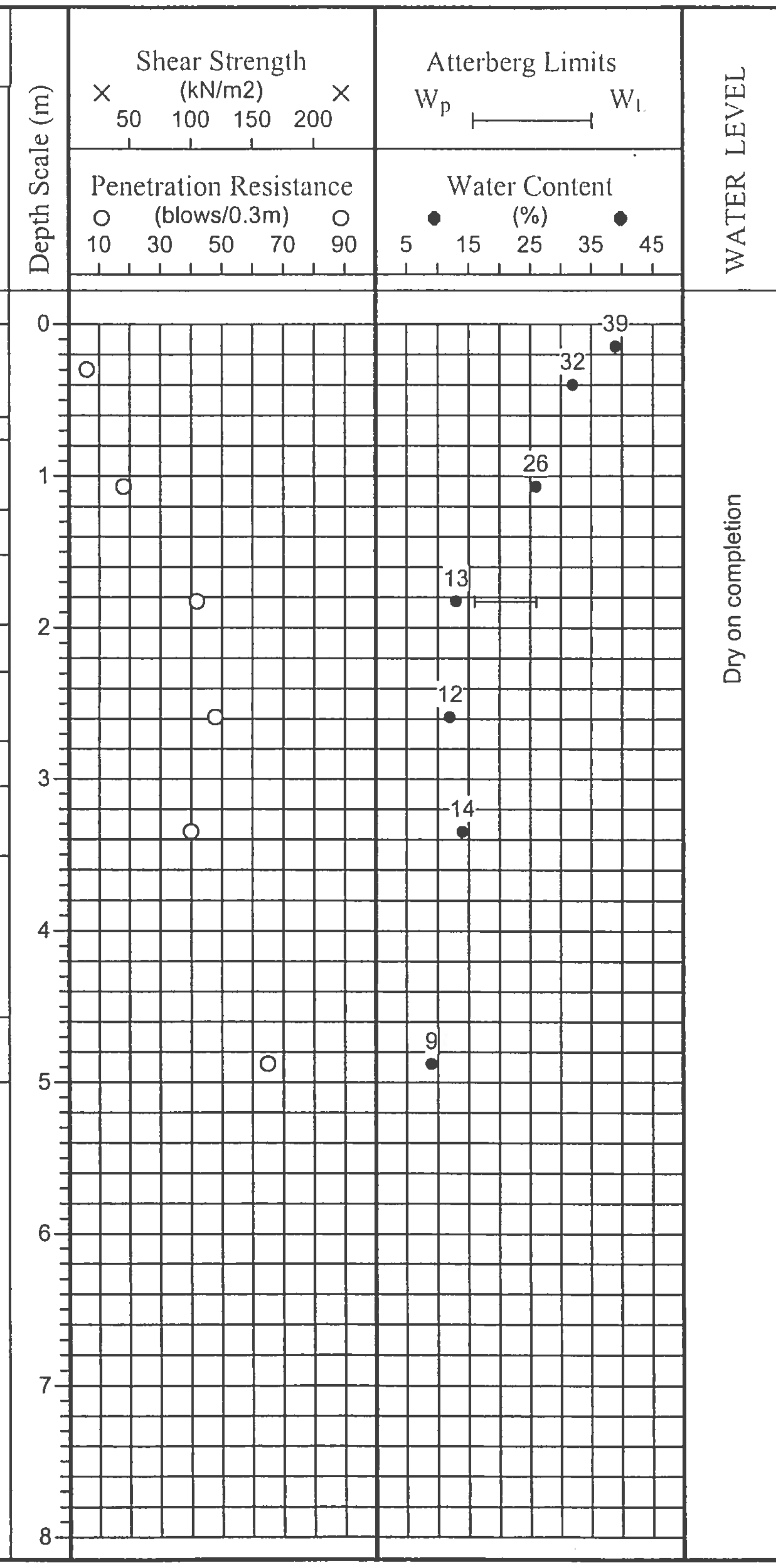
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1501 Fourth Line, Town of Milton

METHOD OF BORING: Flight-Auger

DATE: May 4, 2004

Elev. Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
	Ground Surface			
0.0	**25 cm TOPSOIL**	1	DO	6
	weathered	2	DO	18
	Brown to reddish-brown Firm to hard	3	DO	42
	SILTY CLAY, Till	4	DO	48
	some sand to sandy a tr. of gravel occ. cobbles, boulders, and sand seams some shale debris becoming frequent wiht depth	5	DO	40
		6	DO	65
5.0	**END OF BOREHOLE**			



SOIL-ENG LIMITED

JOB NO.: 0404-S103

LOG OF BOREHOLE NO.: 8

FIGURE NO.: 8

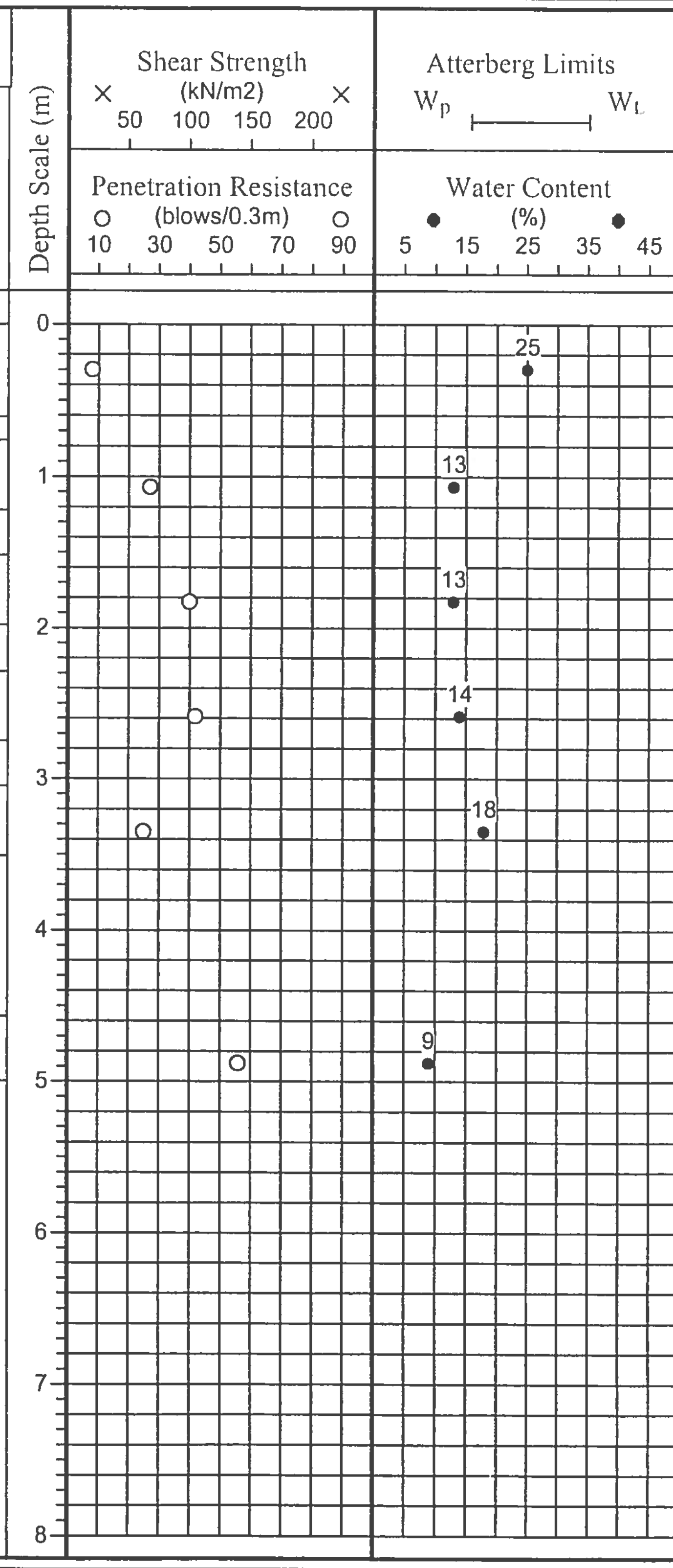
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1501 Fourth Line, Town of Milton

METHOD OF BORING: Flight-Auger

DATE: May 4, 2004

Elev. Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	Water Content (%)	WATER LEVEL
	Ground Surface					
0.0	**30 cm TOPSOIL**	1	DO	8	25	Dry on completion
	weathered; Brown to reddish-brown; Stiff to hard	2	DO	27	13	
	SILTY CLAY, Till	3	DO	40	13	
	some sand to sandy; a tr. of gravel; occ. cobbles, boulders, and sand seams; some shale debris becoming frequent with depth	4	DO	42	14	
		5	DO	25	18	
		6	DO	56	9	
5.0	**END OF BOREHOLE**					



SOIL-ENG LIMITED

JOB NO.: 0404-S103

LOG OF BOREHOLE NO.: 9

FIGURE NO.: 9

JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1501 Fourth Line, Town of Milton

METHOD OF BORING: Flight-Auger

DATE: May 4, 2004

Elev. Depth (m)	SOIL DESCRIPTION	Sample Number	Sample Type	N-Value	Water Content (%)	Water Level
	Ground Surface					
0.0	**23 cm TOPSOIL**	1	DO	9	15	Dry on completion
	weathered	2	DO	15	18	
	Brown to reddish-brown Stiff to hard	3	DO	27	12	
	SILTY CLAY, Till	4	DO	40	13	
	some sand to sandy a tr. of gravel occ. cobbles, boulders,and sand seams some shale debris becoming frequent with depth	5	DO	60	13	
		6	DO	42	15	
5.0	**END OF BOREHOLE**					

Shear Strength (kN/m2): 50, 100, 150, 200
Penetration Resistance (blows/0.3m): 10, 30, 50, 70, 90
Atterberg Limits: W_p, W_L
Water Content (%): 5, 15, 25, 35, 45
Depth Scale (m): 0–8

SOIL-ENG LIMITED

JOB NO.: 0404-S103

LOG OF BOREHOLE NO.: 10

FIGURE NO.: 10

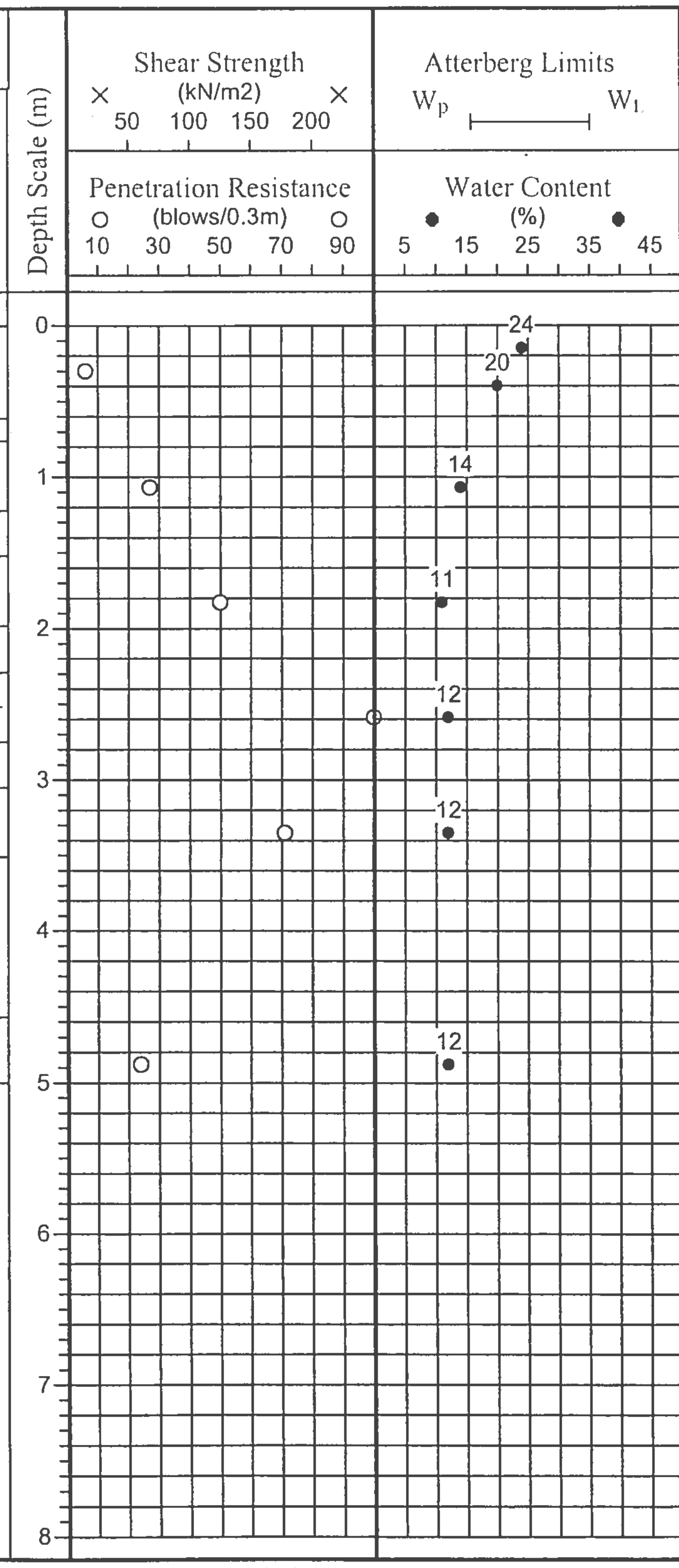
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: 1501 Fourth Line, Town of Milton

METHOD OF BORING: Flight-Auger

DATE: May 4, 2004

Elev. Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
	Ground Surface			
0.0	**30 TOPSOIL**	1	DO	6
	weathered	2	DO	27
	Brown to reddish-brown Firm to hard	3	DO	50
	SILTY CLAY, Till	4	DO	100+
	some sand to sandy a tr. of gravel occ. cobbles, boulders, and sand seams some shale debris becoming frequent with depth	5	DO	71
		6	DO	24
5.0	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

SOIL-ENG LIMITED

BURNSIDE

[THE DIFFERENCE IS OUR PEOPLE]

Appendix B

Water Balance Calculations

Appendix B

WATER BALANCE CALCULATIONS
Sundial Homes (4th Line) Ltd.
Milton, Ontario
Project #: 300053048.0000

TABLE B-1

Pre- and Post-Development Monthly Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 200 mm (moderately rooted vegetation in silt/clay loam soils)

Climate data from Georgetown WWTP MOE Climate Station (1981 - 2010)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Average Temperature (Degree C)	-6.3	-5.2	-0.9	6	12.3	17.4	20	19	14.8	8.4	2.8	-2.9	**7.1**
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.00	1.32	3.91	6.61	8.16	7.55	5.17	2.19	0.42	0.00	**35.3**
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	28.00	59.72	86.13	99.77	94.51	72.60	39.93	12.52	0.00	**493**
Adjusting Factor for U (Latitude 43^{o} 38' 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	
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	31	75	110	129	113	76	38	10	0	**583**
COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Precipitation (P)	68	60	57	77	79	75	74	79	86	68	89	66	**877**
Potential Evapotranspiration (PET)	0	0	0	31	75	110	129	113	76	38	10	0	**583**
P - PET	68	60	57	45	4	-35	-55	-34	11	30	78	66	**295**
Change in Soil Moisture Storage	0	0	0	0	0	-35	-55	-34	11	30	78	5	**0**
Soil Moisture Storage max 200 mm	200	200	200	200	200	165	109	75	86	116	195	200	
Actual Evapotranspiration (AET)	0	0	0	31	75	110	129	113	76	38	10	0	**583**
Soil Moisture Deficit max 200 mm	0	0	0	0	0	35	91	125	114	84	5	0	
Water Surplus - available for infiltration or runoff	68	60	57	45	4	0	0	0	0	0	0	61	**295**
Potential Infiltration (based on MOE methodology*; independent of temperature)	31	27	26	20	2	0	0	0	0	0	0	27	**133**
Potential Direct Surface Water Runoff (independent of temperature)	37	33	31	25	2	0	0	0	0	0	0	33	**162**
IMPERVIOUS AREA WATER SURPLUS													
Precipitation (P)	877	mm/year											
Potential Evaporation (PE) from impervious areas (assume 15%)	132	mm/year											
P-PE (surplus available for runoff from impervious areas)	746	mm/year											

Assume January storage is 100% of Soil Moisture Storage
Soil Moisture Storage 200 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 - silty clay loam	0.15	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - cultivated	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor	**0.45**	

Latitude of site (or climate station) 43 ^{O} N.

WATER BALANCE CALCULATIONS
Sundial Homes (4th Line) Ltd.
Milton, Ontario
Project #: 300053048.0000

BURNSIDE

TABLE B-2

Pre- and Post-Development Monthly Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 250 mm (pasture/shrubs in silt/clay loam soils)

Climate data from Georgetown WWTP MOE Climate Station (1981 - 2010)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Average Temperature (Degree C)	-6.3	-5.2	-0.9	6	12.3	17.4	20	19	14.8	8.4	2.8	-2.9	**7.1**
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.00	1.32	3.91	6.61	8.16	7.55	5.17	2.19	0.42	0.00	**35.3**
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	28.00	59.72	86.13	99.77	94.51	72.60	39.93	12.52	0.00	**493**
Adjusting Factor for U (Latitude 43° 38' 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	
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	31	75	110	129	113	76	38	10	0	**583**
COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Precipitation (P)	68	60	57	77	79	75	74	79	86	68	89	66	**877**
Potential Evapotranspiration (PET)	0	0	0	31	75	110	129	113	76	38	10	0	**583**
P - PET	68	60	57	45	4	-35	-55	-34	11	30	78	66	**295**
Change in Soil Moisture Storage	0	0	0	0	0	-35	-55	-34	11	30	78	5	**0**
Soil Moisture Storage max 250 mm	250	250	250	250	250	215	159	125	136	166	245	250	
Actual Evapotranspiration (AET)	0	0	0	31	75	110	129	113	76	38	10	0	**583**
Soil Moisture Deficit max 250 mm	0	0	0	0	0	35	91	125	114	84	5	0	
Water Surplus - available for infiltration or runoff	68	60	57	45	4	0	0	0	0	0	0	61	**295**
Potential Infiltration (based on MOE methodology*; independent of temperature)	37	33	31	25	2	0	0	0	0	0	0	33	**162**
Potential Direct Surface Water Runoff (independent of temperature)	31	27	26	20	2	0	0	0	0	0	0	27	**133**
IMPERVIOUS AREA WATER SURPLUS													
Precipitation (P)	877	mm/year											
Potential Evaporation (PE) from impervious areas (assume 15%)	132	mm/year											
P-PE (surplus available for runoff from impervious areas)	746	mm/year											

Assume January storage is 100% of Soil Moisture Storage
Soil Moisture Storage 250 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 - silt/clay loam soils	0.15	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - woodland	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor	**0.55**	

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

WATER BALANCE CALCULATIONS
Sundial Homes (4th Line) Ltd.
Milton, Ontario
Project #: 300053048.0000

TABLE B-3

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 lawn in silt/clay loam soils)

Climate data from Georgetown WWTP MOE Climate Station (1981 - 2010)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Average Temperature (Degree C)	-6.3	-5.2	-0.9	6	12.3	17.4	20	19	14.8	8.4	2.8	-2.9	**7.1**
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.00	1.32	3.91	6.61	8.16	7.55	5.17	2.19	0.42	0.00	**35.3**
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	28.00	59.72	86.13	99.77	94.51	72.60	39.93	12.52	0.00	**493**
Adjusting Factor for U (Latitude 43° 38' 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	
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	31	75	110	129	113	76	38	10	0	**583**
COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Precipitation (P)	68	60	57	77	79	75	74	79	86	68	89	66	**877**
Potential Evapotranspiration (PET)	0	0	0	31	75	110	129	113	76	38	10	0	**583**
P - PET	68	60	57	45	4	-35	-55	-34	11	30	78	66	**295**
Change in Soil Moisture Storage	0	0	0	0	0	-35	-55	-9	11	30	59	0	**0**
Soil Moisture Storage max 100 mm	100	100	100	100	100	65	9	0	11	41	100	100	
Actual Evapotranspiration (AET)	0	0	0	31	75	110	129	89	76	38	10	0	**558**
Soil Moisture Deficit max 100 mm	0	0	0	0	0	35	91	100	89	59	0	0	
Water Surplus - available for infiltration or runoff	68	60	57	45	4	0	0	0	0	0	19	66	**320**
Potential Infiltration (based on MOE metholodogy*; independent of temperature)	31	27	26	20	2	0	0	0	0	0	9	30	**144**
Potential Direct Surface Water Runoff (independent of temperature)	37	33	31	25	2	0	0	0	0	0	11	36	**176**
IMPERVIOUS AREA WATER SURPLUS													
Precipitation (P)	877	mm/year											
Potential Evaporation (PE) from impervious areas (assume 15%)	132	mm/year											
P-PE (surplus available for runoff from impervious areas)	746	mm/year											

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 land	0.2	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - silt/clay loam soils	0.15	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - urban lawn	0.1	<-- 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
Sundial Homes (4th Line) Ltd.
Milton, Ontario
Project #: 300053048.0000

TABLE B-4

Water Balance - Existing Conditions and Post-Development (With No Mitigation Measures)

	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 from Pervious Area** (m/a)	Infiltration Volume from Pervious Area (m^3/a)	Total Runoff Volume (m^3/a)	Total Infiltration Volume (m^3/a)
Exising Land Use												
Agricultural	306,873	0.00	0	0.746	0	306,873	0.162	49,749	0.133	40,704	49,749	40,704
Open Space/Wetland	25,608	0.00	0	0.746	0	25,608	0.133	3,397	0.162	4,152	3,397	4,152
Rural Residential	4,199	0.25	1,050	0.746	783	3,149	0.176	553	0.144	453	1,336	453
Soil Stock Pile	30,393	0.90	27,354	0.746	20,398	3,039	0.162	493	0.133	403	20,891	403
TOTAL PRE-DEVELOPMENT	**367,073**		**28,403**		**21,181**	**338,670**		**54,192**		**45,308**	**75,373**	**45,711**
Post-Development Land Use												
Single Detached	80,860	0.67	54,176	0.746	40,399	26,684	0.176	4,689	0.144	3,837	45,089	3,837
Townhouses	35,840	0.64	22,938	0.746	17,105	12,902	0.176	2,267	0.144	1,855	19,372	1,855
Back to Back Townhouses	24,570	0.84	20,639	0.746	15,390	3,931	0.176	691	0.144	565	16,081	565
High Density Node	28,215	0.80	22,572	0.746	16,832	5,643	0.176	992	0.144	811	17,824	811
Village Square	3,200	0.29	928	0.746	692	2,272	0.176	399	0.144	327	1,091	327
School	28,280	0.79	22,341	0.746	16,660	5,939	0.176	1,044	0.144	854	17,704	854
Channel/Buffer	34,730	0.00	69	0.746	52	34,661	0.133	4,597	0.162	5,619	4,649	5,619
Trailway	3,290	0.80	2,632	0.746	1,963	658	0.133	87	0.162	107	2,050	107
SWM Pond	31,750	0.50	15,875	0.746	11,838	15,875	0.133	2,106	0.162	2,574	13,944	2,574
Roads	91,448	0.88	80,474	0.746	60,010	10,974	0.176	1,928	0.144	1,578	61,938	1,578
Road Widening/Reserve	4,890	0.90	4,401	0.746	3,282	489	0.176	86	0.144	70	3,368	70
TOTAL POST-DEVELOPMENT	**367,073**		**247,046**		**184,223**	**120,028**		**18,887**		**18,196**	**203,110**	**18,196**
% Change from Pre to Post											269	60
Effect of development (with no mitigation)											2.7 times increase in runoff	60% reduction in infiltration

* data provided by SCS Consulting Group Ltd. (March 2023)
** figures from Table B-1, B-2 and B-3

To balance pre- to post-, the infiltration target (m^3/a)= **27,515** m^3/a

WATER BALANCE CALCULATIONS
Sundial Homes (4th Line) Ltd.
Milton, Ontario
Project #: 300053048.0000

TABLE B-5

Water Balance - Existing Conditions and Post-Development With Mitigation (LIDs)

		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 from Pervious Area** (m/a)	Infiltration Volume from Pervious Area (m^3/a)	Total Runoff Volume (m^3/a)	Total Infiltration Volume (m^3/a)
Exising Land Use													
Agricultural		306,873	0.00	0	0.746	0	306,873	0.162	49,749	0.133	40,704	49,749	40,704
Open Space/Wetland		25,608	0.00	0	0.746	0	25,608	0.133	3,397	0.162	4,152	3,397	4,152
Rural Residential		4,199	0.25	1,050	0.746	783	3,149	0.176	553	0.144	453	1,336	453
Soil Stock Pile		30,393	0.90	27,354	0.746	20,398	3,039	0.162	493	0.133	403	20,891	403
TOTAL PRE-DEVELOPMENT		**367,073**		**28,403**		**21,181**	**338,670**		**54,192**		**45,711**	**75,373**	**45,711**
Post-Development Land Use													
Residential	Roof to Grass - assume 25% of runoff volume infiltrates.	44,500	1.00	44,500	0.746	33,184	0	0.176	0	0.144	0	24,888	8,296
	Pervious and Hardscape/Driveway	36,360	0.27	9,817	0.746	7,321	26,543	0.176	4,664	0.144	3,816	11,985	3,816
Townhouses	Roof to Grass - assume 25% of runoff volume infiltrates.	22,700	1.00	22,700	0.746	16,928	0	0.176	0	0.144	0	12,696	4,232
	Pervious and Hardscape/Driveway	13,140	0.02	263	0.746	196	12,877	0.176	2,263	0.144	1,851	2,459	1,851
Back to Back Townhouses	Roof to Grass - assume 25% of runoff volume infiltrates.	16,200	1.00	16,200	0.746	12,080	0	0.176	0	0.144	0	9,060	3,020
	Pervious and Hardscape/Driveway	8,370	0.53	4,436	0.746	3,308	3,934	0.176	691	0.144	566	3,999	566
High Density Node		28,215	0.80	22,572	0.746	16,832	5,643	0.176	992	0.144	811	17,824	811
Village Square		3,200	0.29	928	0.746	692	2,272	0.176	399	0.144	327	1,091	327
School		28,280	0.79	22,341	0.746	16,660	5,939	0.176	1,044	0.144	854	17,704	854
Channel/Buffer	Channel/Buffer	29,483	0.00	59	0.746	44	29,424	0.133	3,903	0.162	4,770	3,947	4,770
	Pocket Wetlands - assume 65% of runoff infiltrates	5,247	0.00	0	0.746	0	5,247	0.133	696	0.162	851	244	1,303
SWM Pond		31,750	0.50	15,875	0.746	11,838	15,875	0.133	2,106	0.162	2,574	13,944	2,574
Roads		91,448	0.88	80,474	0.746	60,010	10,974	0.176	1,928	0.144	1,578	61,938	1,578
Road Widening/Reserve		4,890	0.90	4,401	0.746	3,282	489	0.176	86	0.144	70	3,368	70
TOTAL POST-DEVELOPMENT		**363,783**		**244,567**		**182,374**	**119,216**		**18,772**		**18,068**	**185,146**	**34,068**
% Change from Pre to Post												246	25
Effect of development (with no mitigation)												2.5 times increase in runoff	25% reduction in infiltration

* data provided by SCS Consulting Group Ltd. (March 2023)

** figures from Table B-1, B-2 and B-3

To balance pre- to post-,
the infiltration target (m^3/a)= **11,643** **m^3/a**

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