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910 March Road

Servicing and Stormwater Management Report

Prepared for: Lépine Corporation

Engineering excellence. Planning progress. Liveable landscapes.

910 MARCH ROAD
OTTAWA, ONTARIO

SERVICING AND STORMWATER MANAGEMENT REPORT

Prepared by:

NOVATECH
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario
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March 29, 2023
Revised: August 8, 2023
Revised: December 22, 2023
Revised: June 21, 2024
Revised: November 27, 2024

Ref: R-2023-051
Novatech File: 121186

NOVATECH
Engineers, Planners & Landscape Architects

November 27, 2024

Planning, Real Estate and Economic
Development Department
City of Ottawa
110 Laurier Avenue West
Ottawa, Ontario, K1P 1J1

Attention: Shahira Jalal– Planner, City of Ottawa

Dear Ms Jalal:

Reference: 910 March Road, Ottawa
Servicing and Stormwater Management Report
Our File No. : 121186

Please find enclosed the revised 'Servicing and Stormwater Management Report' for the above noted project. This report is submitted in support of the Site Plan Application for the proposed development and has been updated per City comments.

Should you have any questions or require additional information, please contact the undersigned.

Yours truly,

NOVATECH

Cara Ruddle, P.Eng.
Senior Project Manager | Land Development Engineering

cc: Pascale Lépine, Lepine Corporation

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1.0 INTRODUCTION

Novatech has been retained to prepare a Servicing and Stormwater Management Report for the proposed development located at 910 March Road, Ottawa (formerly Kanata), Ontario. **Figure 1** is a Key Plan showing the site location. The purpose of this report is to support the Site Plan application for the subject development.

2.0 EXISTING CONDITIONS

The property is approximately 2.72 hectares in size and is currently developed with 4 storage buildings and several sea containers within the site area. It is our understanding that previously the site included two residences with multiple barns and sheds which are now abandoned. The site is bound by March Road to the west, farmland to the north, an existing residential subdivision to the east, and a commercial property to the south. The topography of the site is relatively flat however it generally slopes to the existing Shirley's Brook tributaries along the north (Tributary 3), south (Tributary 4), and east (Tributary 2) property lines. ***Figure 2*** shows the existing site conditions and topography.

3.0 PROPOSED DEVELOPMENT

It is proposed to construct an apartment complex with commercial spaces on the ground level. The development will include 390 residential housing units and 521 m^2 of commercial space. Vehicular access to the site is provided with an entrance from March Road to a small surface parking lot, an entrance to underground parking and a roundabout drop off area by the central courtyard area. The proposed development has a multi-level building layout with a maximum height of 9 stories above grade level. **Figure 3** shows the proposed site plan.

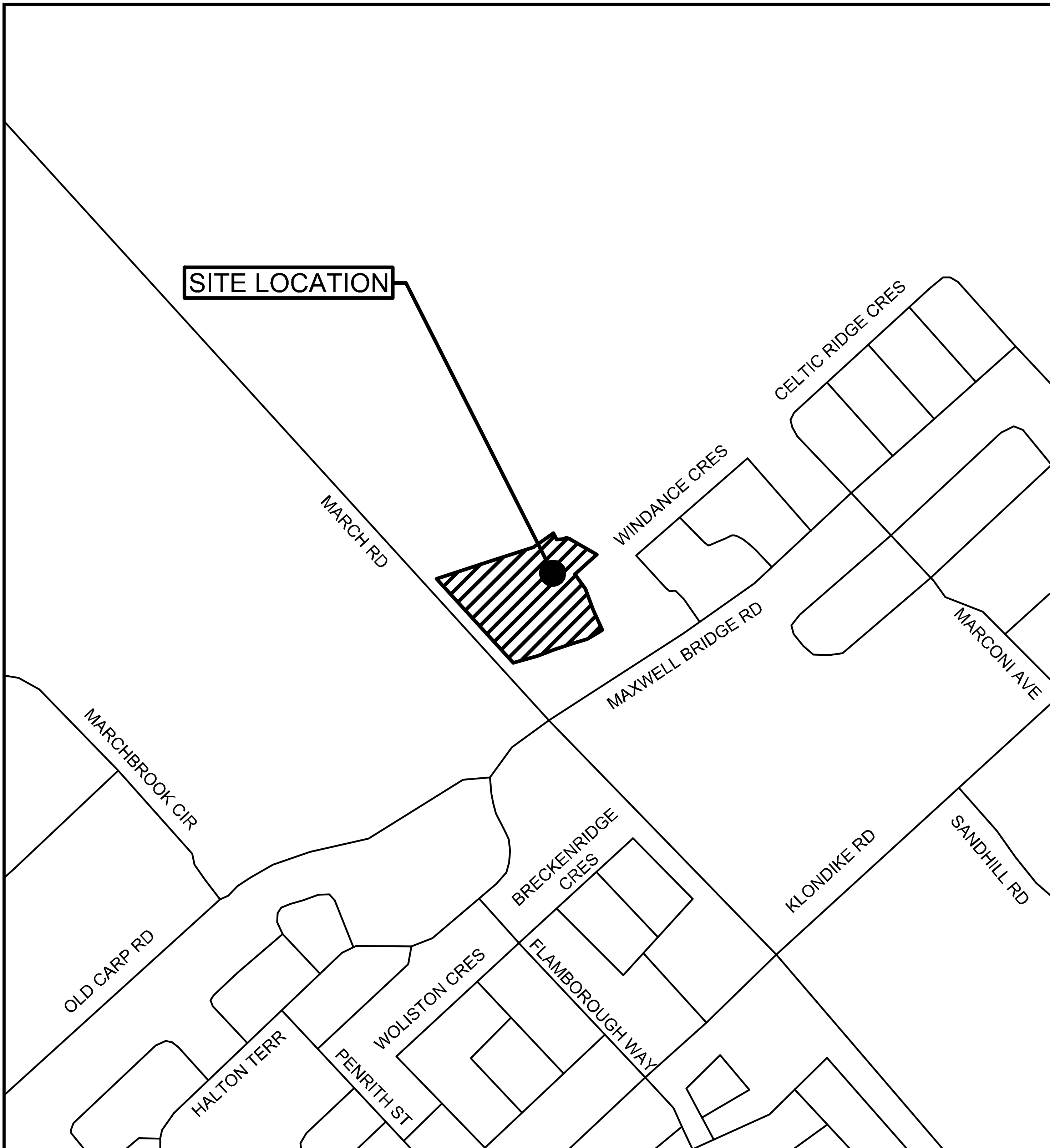
4.0 REFERENCE MATERIAL

[1] Geotechnical Investigation – Proposed Mixed Use Development 910 March Road, Ontario (Report No. PG5887-1), prepared by Paterson dated November 30, 2021.

[2] Environmental Impact Statement, Zoning By-Law Amendment, 910 March Road, Ottawa, Ontario, prepared by Gemtec dated December 2022.

[3] Kanata North Community Design Plan Master Servicing Study, prepared by Novatech dated June 28, 2016.

[4] Kanata North Community Design Plan Environmental Management Plan, prepared by Novatech dated June 28, 2016.



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910 MARCH RD

KEY PLAN

SCALE		
N.T.S		
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910 MARCH RD

EXISTING CONDITIONS PLAN

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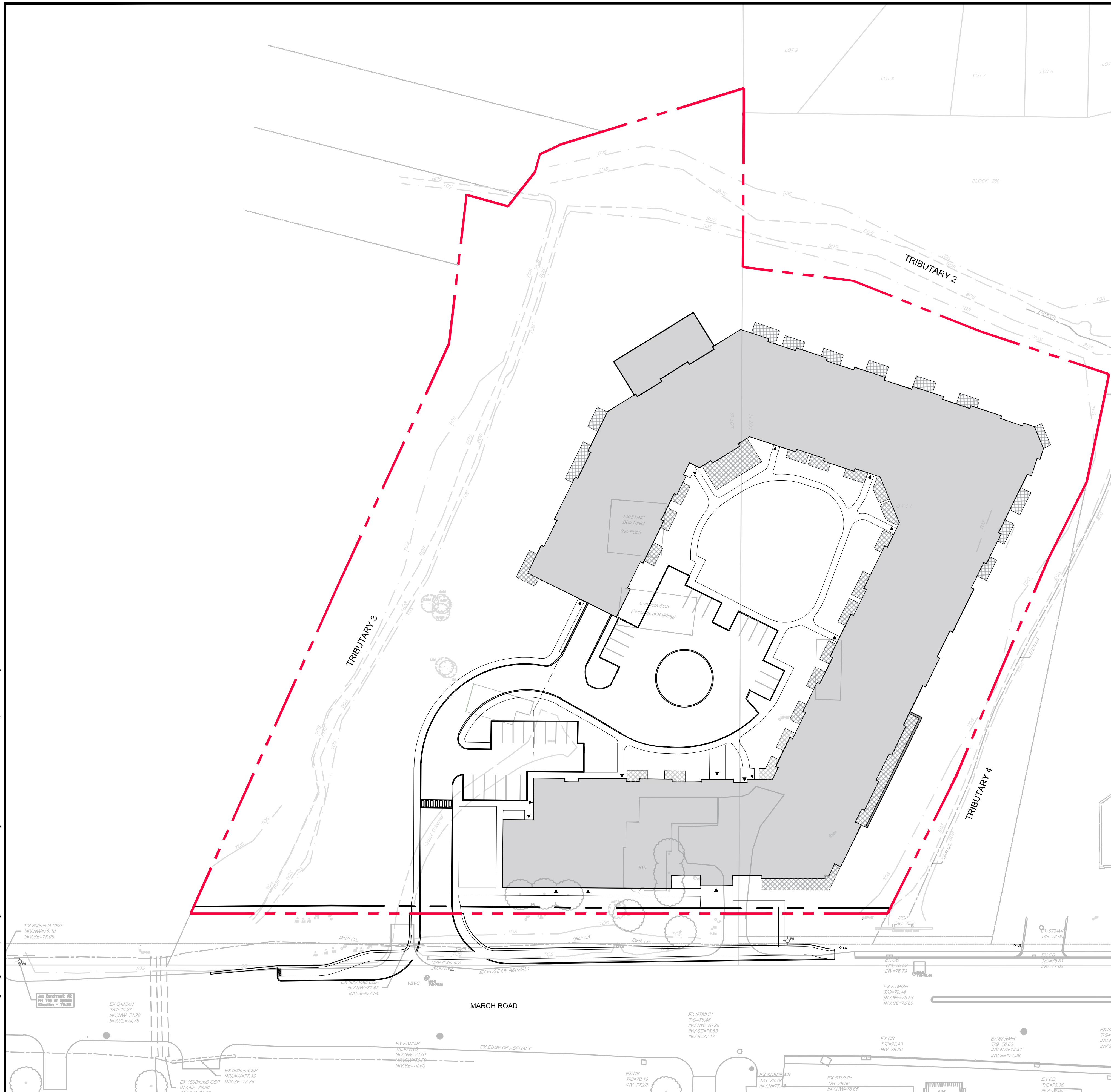

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910 MARCH RD

PROPOSED SITE PLAN

SCALE 1 : 1000

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5.0 SITE CONTSTRAINTS

There are numerous site constraints noted in various reports that may affect the development and engineering design of the subject development. These constraints are summarized below and are shown on **Figure 4 – Preliminary Constraints Plan**.

A geotechnical investigation was completed by Paterson Group Inc. and a report prepared entitled 'Geotechnical Investigation, Proposed Mixed Use Development, 910 March Road, Ontario' (rev 2) dated December 22, 2023. The report included the following recommendations.

- Bedrock was encountered between 2 and 10m below existing grade.

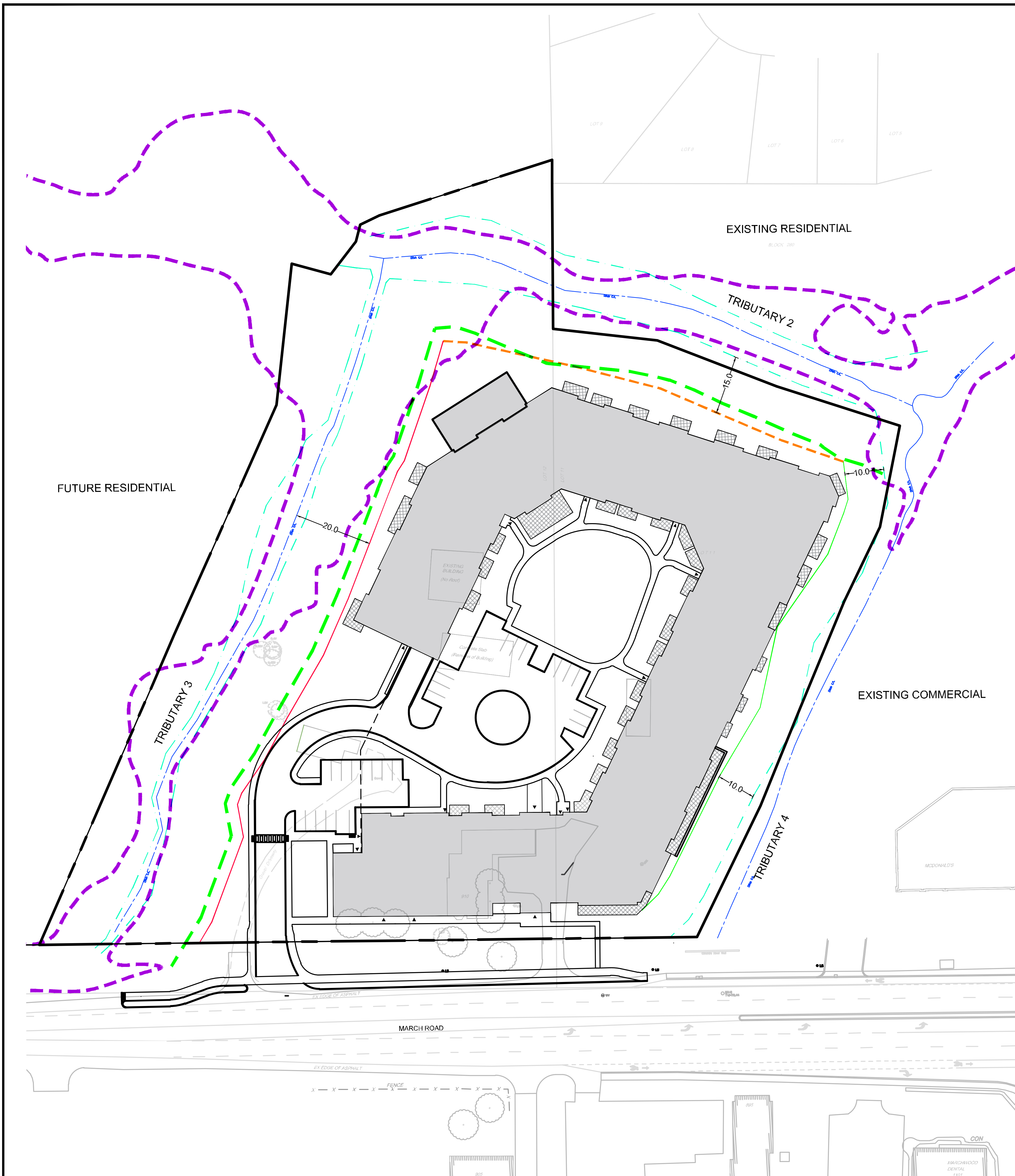
- During construction, groundwater volumes pumped could be between 50,000 to 400,000 L/day or greater. Therefore, it may be required to register on the Environmental Activity and Sector Registry (EASR) or obtain a Permit To Take Water. However, the construction will be managed such that groundwater pumping will be minimized to be maintained under the 50,000L/day threshold.

- A stable slope allowance is not required for the Subject Site as the slopes were determined to be stable under static and seismic conditions. Also, a Toe Erosion and Erosion Access Allowance is not required for the watercourses as there were no signs of active erosion and flow from the creek was observed to be minimal.

An 'Environmental Impact Statement, Zoning By-Law Amendment, 910 March Road, Ottawa, Ontario' (rev 5) was prepared by Gemtec dated December 2023 (Gemtec EIS Report). This report supersedes a 'Combined Environmental Impact Statement & Tree Conservation Report' prepared by McKinley Environmental Solutions dated June 2020. The Gemtec EIS Report identifies a number of constraints that may impact development. The constraints are described briefly below.

- Watercourse Tributaries – The subject site is bounded on three sides by watercourse tributaries to Shirley's Brook, Tributary 2 to the east, Tributary 3 to the north and Tributary 4 to the south and a setback is required along each tributary. The Gemtec EIS Report recommends a setback of 15m from top of slope from Tributary 2, 20m from centreline of watercourse for Tributary 3 and 10m from top of slope for Tributary 4. The setback area should be permanently vegetated by native or non-invasive, self-sustaining vegetation and protect the natural heritage feature against the impact of the adjacent land use.

- Turtle Habitat – the entire site lies within areas that qualify as either Category 2 or 3 habitat for Blanding's Turtle. The Gemtec EIS Report recommends setbacks from each of the tributaries as noted above. Gemtec has been in consultation with the MECP with respect to mitigation measures during construction as well as enhancements to the turtle habitat within the tributary corridors as part of the Overall Benefits Permit process.



LEGEND

- Site Boundary (AOV Survey, Dated January 17, 2022)
- Water Course Centreline (AOV Survey, Dated January 17, 2022)
- Top of Slope (Paterson Group 'Test hole location plan' Rev 2, Dated November 16, 2023)
- 20m from Centreline of Watercourse (Gemtec 'Environmental Impact Statement', Dated August 2, 2023, Rev #4)
- 10m from Top of Slope (Gemtec 'Environmental Impact Statement', Dated November 30, 2023, Rev #5)
- 1:100 Floodplain - MVCA (Interpolated from MVCA Mapping dated December 6, 2017)
- 15m from Top of Slope (Gemtec 'Environmental Impact Statement', Dated November 30, 2023, Rev #5)
- MEANDER BELT LIMIT Kanata North CDP, Environmental Master Plan, Novatech, Dated June 28, 2016

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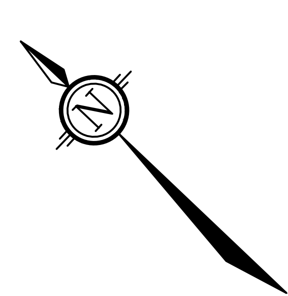

910 MARCH ROAD

PRELIMINARY CONSTRAINTS PLAN

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Additional site constraints are noted as follows:

- Floodplain – The 100-year floodplain for Tributaries 2 and 3, obtained from MVCA mapping, is another site constraint. Note all floodplain areas associated with the tributaries are captured within the recommended setbacks. Development is to occur outside the floodplain area and any storage of stormwater needs to be above the 100-year floodplain elevation. No development is proposed within floodplain.

- Meander Belt - The Environmental Management Plan (EMP) of KNCDP (2016) completed a fluvial geomorphological analysis of Shirley's Brook and its tributaries with respect to the KNUEA development to determine appropriate meander belt widths along the Tributaries 2 and 3. The meander belt limits are shown on **Figure 4**. Tributary 4 does not require a meander belt limit since it is considered an open drain or ditch lacking in natural geomorphic features (as noted in the KNCDP EMP).

6.0 WATER SERVICING

The existing development was previously serviced by a private well and septic system. However, the subject property is within the City of Ottawa 2W pressure Zone. It is proposed that this development connect to the existing 400mm diameter watermain in the March Road right-of-way that was installed as part of the Kanata North Urban Expansion development.

Water demand and fire flow calculations have been calculated using criteria from Section 4 of the City of Ottawa Water Distribution Guidelines. The required fire demand was calculated using the Fire Underwriters Survey (FUS) Guidelines using assumptions on building construction and setback requirements. The water demands were calculated for a population of 700 people and 521 m^2 of commercial space. The water demands and fire flow calculations are provided in **Appendix B** for reference. A summary of the water demands and fire flows are provided in **Table 6.1** below.

Table 6.1 Water Demand Summary

	Proposed Development
Water Demand Rate	Residential: 280 (L/c/d) Commercial: 75 (L/9.3m^2/day)
Units/Area	1 – studio, 224 – 1 Bed, 127 – 2 Bed, 38- 3-Bed
Density	1.4 ppu - 1 Bed, 2.1 ppu - 2 Bed, 3.1 ppu - 3 Bed,
Commercial Area (m^2)	521
Factors	Residential : MD=2.5, PH=2.20 Commercial: MD=1.5, PH =1.8
Average Day Demand (L/s)	2.32
Maximum Daily Demand (L/s)	5.74
Peak Hour Demand (L/s)	12.61
FUS Fire Flow Requirement (L/s)	133
Max Day+Fire Flow (L/s)	155.74

The above water demand information was submitted to the City of Ottawa for boundary conditions provided from the City's water model. The boundary conditions will determine whether the existing watermain infrastructure surrounding the development has capacity for the proposed development. The boundary conditions are provided in **Table 6.2**.

Table 6.2 Water Boundary Conditions

Criteria	Head (m)	Pressure (psi)
Connection #1 to Existing 406mm Watermain March Road (Ground Elevation = 78.9m)		
Maximum HGL	131.0	74.0
Peak Hour	125.9	66.8
Max Day + Fire Flow	123.9	64.0

These boundary conditions were used to analyze the performance of the proposed watermain for three theoretical conditions:

1) High Pressure check under Average Day conditions
2) Peak Hour demand
3) Maximum Day + Fire Flow demand.

The following **Table 6.3** summarizes the results from the hydraulic water analysis.

Table 6.3 Water Analysis Results Summary

Condition	Demand (L/s)	Min/Max Allowable Operating Pressures (psi)	Limits of Design Operating Pressures (psi)[1]
Connection #1 to Existing 406mm Watermain March Road (Ground Elevation = 78.9m)			
High Pressure [2]	2.27	80psi (Max)	79.6
Peak Hour	12.48	40psi (Min)	72.4
Max Day + Fire Flow [3]	155.67	20psi (Min)	69.5

[1] Pressures based on a service connection elevation of 75.00m
[2] Pressures based on previously submitted (higher) average day demand of 2.38 L/s
[3] Pressures based on previously submitted (higher) FUS fire flow of 150 L/s

Based on the proceeding analysis it can be concluded that the watermain, as designed, will provide adequate system pressures for the fire flow + maximum day demand and peak hour demand. The existing fire hydrants along March Road will provide sufficient fire protection for the proposed development. Refer to **Appendix B** for detailed hydraulic calculations and boundary conditions.

As per the City of Ottawa Technical Bulletin ISDTB-2014-02, the proposed development will require two service connections since the average day demand for the proposed development is greater than 50 cubic meters of water. Therefore, two 150mm diameter water services are proposed to service the building and will connect to the existing 406mm diameter watermain within the March Road right-of-way. The two services will be separated by an isolation valve within the existing watermain system in the event that maintenance is required on the City's system. In the average day (high pressure) condition, water pressures approach the 80psi threshold, therefore pressure reducing valves will be required on both service connections. Refer to the General Plan of Services drawing (**121186-GP**) for the water servicing information.

7.0 SANITARY SERVICING

As indicated previously, the existing development was serviced by an existing septic system which will be decommissioned upon development. There is an existing 600mm diameter sanitary trunk sewer along March Road fronting the proposed development which was constructed as part of the Kanata North Urban Expansion Area (KNUAE). It is proposed to service the development by connecting a 300mm diameter service to this existing sanitary trunk sewer within the March Road right-of-way.

A Master Servicing Study for the Kanata North Community Design Plan (KNCDP) was prepared by Novatech in 2016. Excerpts from this report can be found within **Appendix C**. This site is included in the sanitary drainage area MR-3 as part of the KNCDP design. The KNCDP sanitary design sheets indicate that the 600mm diameter trunk sewer that is fronting the proposed development has a residual capacity of 92 L/s.

Sanitary flows for the proposed development are calculated from criteria in Section 4 of the City of Ottawa Sewer Design Guidelines (October 2012). The sanitary flow demands were calculated for a population of 700 and a total commercial space of 521 m^2 using the following criteria:

- Average Daily Flow = 280 L/capita/day
- Residential Peaking Factor = Harmon Equation (max peaking factor = 4.0)
- Commercial/ Institutional Peaking Factor = 1.5
- Peak Extraneous Flows (Infiltration) = 0.33 L/s/ha

The peak sanitary design flow including infiltration was calculated to be **8.04 L/s**. Detailed sanitary flow calculations are provided in **Appendix C** for reference.

As indicated previously, given that this is a new sanitary trunk sewer along March Road, with a residual capacity of 92 L/s, it is anticipated that there will be no capacity concerns by connecting to this sewer.

8.0 STORM DRAINAGE AND STORMWATER MANAGEMENT

The stormwater management strategy for this site has been developed based on criteria provided by the City and Mississippi Valley Conservation Authority (MVCA).

8.1 Existing Conditions

The topography of the site is relatively flat with a general slope to Tributary 2 at the eastern property boundary. Stormwater currently sheet flows to the Shirley's Brook tributaries along the property boundaries. There are currently no storm sewers or structures within the March Road ROW servicing the site. Refer to **Appendix D** for a portion of the existing City Sewer Mapping included as reference.

8.2 Stormwater Management Criteria

8.2.1 Storm Sewer Design

The proposed storm sewers have been sized to convey the uncontrolled 2-year storm event using the Rational Method. The design criteria used in sizing the storm sewers are summarized in **Table 8.1**. Refer to **Appendix D** for detailed storm drainage area plans and storm sewer design sheets.

Table 8.1: Storm Sewer Design Parameters

Parameter	Design Criteria
Local Roads	2 Year Return Period
Storm Sewer Design	Rational Method
IDF Rainfall Data	City of Ottawa Sewer Design Guidelines
Initial Time of Concentration (Tc)	10 min
Minimum Velocity	0.8 m/s
Maximum Velocity	3.0 m/s
Minimum Diameter	250 mm

8.2.2 Stormwater Quality Control

An *Enhanced* level of stormwater quality control of 80% long-term removal of total suspended solids (TSS) is required for the proposed development. This will be provided through the installation of an oil grit separator unit. In direct runoff areas, there is minimal change to the runoff coefficient and the stormwater will sheet drain and/or travel along a grassed swale, therefore, quality control of stormwater is not required in these drainage areas.

Refer to **Appendix A** for pre-consultation notes on the stormwater quality control approach.

8.2.3 Stormwater Quantity Control – Allowable Release Rate

The City has specified that the stormwater quantity control is to be based on the following:

- IDF curves derived from the MacDonald Cartier Airport.
- The pre-development runoff coefficient or a maximum 'C' of 0.50, whichever is less.

- A calculated time of concentration (Cannot be less than 10 minutes).
- Flows to the storm sewer in excess of the 2-year storm release rate, up to and including the 100-year storm event, must be detained on site.

The allowable release rates for the 2, 5, and 100-year events were calculated using the Rational Method based on the above criteria and were calculated to be **135.7, 184.1,** and **387.8 L/s** respectively. Refer to **Appendix D** for Rational Method Calculations.

8.3 Proposed Storm Infrastructure

Along the perimeter of the property (areas B1, B2 and B3), between the proposed building and existing tributaries, stormwater will sheet drain away from the edge of building to the existing tributary. In order to accommodate grading changes along the north side of the building, a swale is proposed to ensure that drainage from a small grassed/patio area is directed away from the building and towards Tributary 2. Similarly, along the frontage adjacent to March Road, stormwater sheet drains away from the building and outlet to Tributary 4. Stormwater from the remainder of the site will be over- controlled to account for the uncontrolled release of stormwater along the site perimeter areas.

Stormwater from the building roof and central courtyard area above the underground parking will be captured by roof drains and area deck drains. These flows will be conveyed by internal building plumbing to an underground storage tank adjacent to the ramp to the underground parking garage. Stormwater from the front entrance road will be collected in catchbasins and which will also back up into the storage tank. Flows from the storage tank will be attenuated by a control structure which includes two inlet control devices and a weir prior to be treated by the proposed OGS unit and ultimately outletting to Tributary 3.

The stormwater storage tank will be concrete and cast in place with the building foundation walls. It is anticipated that the tank will be approximately 9.5m x 21.5m and provide a maximum of 385m^3 of storage. Two inlet control devices (214, 115 mm diameter) and a 0.6m wide trapezoidal weir will control the release of stormwater from the storage tank to 229.0 L/s in the 100-year event. The stormwater storage tank will include an access lid which will act as a vent and an emergency overflow. A backflow prevention valve should be installed on the inlet pipe to the tank to prevent stormwater backing up into the internal building plumbing system. A cross section detail of the storage tank is provided on the Notes and Detail drawing (121186-ND). Flows from the storage tank will be conveyed to the OGS unit then by a 450mm PVC sewer prior to the ultimate outlet at Tributary 3.

The OGS unit CDS PMSU2025-5-C achieves an 80% TSS removal based on the site drainage area of 1.31ha at 100% imperviousness. Detailed sizing for the CDC hydrodynamic separator is provided in **Appendix D**.

8.4 Stormwater Management Modeling

The performance of the proposed stormwater management system was evaluated using a dual-drainage model created in PCSWMM. The PCSWMM model simulates the storage and routing of flows through the proposed storm drainage network. The results of the analysis were used to:

- Calculate the storm sewer hydraulic grade line and storage volumes for the 2, 5, and 100-year storm events.
- Determine the allowable release rates from each drainage area and size the required inlet control devices (ICD's).
- Calculate the modelled runoff from the controlled portions of the site under post-development conditions.

The hydrologic analysis was completed using the following synthetic design storms:

Chicago Storms:	*SCS Type II Storms:*
3-hour Chicago storm	12-hour SCS Type II storm

The return periods analyzed include the 2, 5 and 100-year storm events. The IDF parameters used to generate the design storms were taken from the *City of Ottawa Sewer Design Guidelines* (October 2012). The drainage system was also stress tested using a 100-year+20% design storm which has a 20% higher intensity and total volume compared to the 100-year event.

The 3-hour Chicago storm distribution was found to generate the highest peak flows and storage requirements and was selected as the critical storm distribution for the design of the storm drainage system. The model results from this distribution are documented in the following tables. The model schematic, system parameters, and output files are provided in **Appendix D**.
Refer to the Post Development Drainage Area Plan (**Figure 6**) for the various drainage areas. **Table 8.2** below summarizes the flow, storage required, and storage provided for each of the site drainage areas.

Table 8.2 Stormwater Management Summary

Area ID	Area (ha)	1:5 Year Weighted Cw	2 Year Storm Event		5 Year Storm Event		100 Year Storm Event	
			Flow (L/s)	Req Vol (cu.m)	Flow (L/s)	Req Vol (cu.m)	Flow (L/s)	Req Vol (cu.m)
A	1.298	0.88	79.4	162.0	107.2	222.0	220.9	384.0
B1	0.273	0.31	17.2	-	23.4	-	47.8	-
B2	0.250	0.25	13.6	-	18.5	-	38.3	-
B3	0.476	0.23	23.3	-	31.6	-	66.5	-
Total			**133.5**		**180.7**		**373.5**	**384.0**
Allowable			**135.7**		**184.1**		**387.8**	

Refer to **Appendix D** for Rational Method calculations and PCSWMM modeling results. Refer to the Grading Plan (**121186-GR**) and the Post Development Drainage Area Plan (**Figure 6**) for more details.

8.5 Major Overland Flow Route

A major overland flow route will be provided for storms greater than the 100-year storm event. Stormwater from the central courtyard will be directed through the commercial parking area to the front entrance road and ultimately to the March Road right-of-way. Stormwater from the storage tank in the building will overflow out of the access lid and sheet drain across the grassed setback area to Tributary 3. The major overland system is shown on the Grading Plan drawing (**121186-GR**).

8.6 Tributary Impacts

As requested by the MVCA, the impacts of the proposed development on the three tributaries of Shirley's Brook that bound the site (Tributaries 2, 3 and 4) have been evaluated with respect to flooding and erosion.

Peak Flows

Under pre-development conditions, storm runoff from 910 March Road flows overland towards the three tributaries. Under post-development conditions, the total peak flow from the site will be controlled to pre-development conditions (as shown in **Table 8.2**), but due to the location of the proposed storm outlet, a higher percentage of the total runoff will be directed to Tributary 3 – see **Table 8.3**. Post-development flows from the uncontrolled areas draining to Tributaries 2 and 4 will be less than pre-development levels.

Table 8.3: Peak Flows from Site to Shirley's Brook Tributaries

Site Conditions	Peak Flow (L/s)								
	Tributary 2			Tributary 3			Tributary 4		
	2-yr	5-yr	100-yr	2-yr	5-yr	100-yr	2-yr	5-yr	100-yr
PRE	54	74	155	54	74	155	27	37	78
POST	14	19	38	103	139	287	17	23	48

The increase in peak flow will be localized to a relatively short section of Tributaries 2 and 3, from the proposed storm outlet of the site to the confluence of Tributaries 2 and 4 (a distance of approximately 250 m). There will be no increase in post-development flow downstream of the confluence of Tributaries 2 and 4.

Water Balance

A water balance assessment was completed using the Thornthwaite-Mather (1957) methodology, based on existing and proposed site conditions (land use, topography, soil characteristics, etc.). The results indicate that the proposed development will result in an overall reduction in infiltration of 99 mm/year (about 56%) compared to pre-development. Refer to **Appendix D** for water balance methodology and results.

Runoff volumes to Tributary 4 will be less under post-development conditions, but there will be an increase in runoff volume to Tributary 3 and Tributary 2. It should be noted that this analysis is conservative and considers the landscaped area in the central portion of the site to be impervious as it is situated over the parking garage. The site (2.3 ha) is located at the downstream end of Tributaries 2, 3 and 4, which have a total contributing drainage area of approximately 750 ha, and the overall impact on peak flows and runoff volumes in the tributaries will be negligible. Therefore, the proposed development should not have any adverse flooding or erosion impacts on the surrounding Shirley's Brook tributaries.

Furthermore, the surficial soils in the area (dense silty clay) have a relatively low infiltration potential and do not provide any significant amount of groundwater recharge. While there will be a landscaped area in the central portion of the site, it is located above the parking garage where infiltration is not possible. As a result, an engineered infiltration system is not being proposed as it would not provide any significant benefits.

9.0 EROSION AND SEDIMENT CONTROL

Temporary erosion and sediment control measures will be required on-site during construction in accordance with the Best Management Practices for Erosion and Sediment Control. This includes the following temporary measures:

- Filter socks will be placed in existing catchbasins and manholes, and will remain in place until vegetation has been established and construction is completed;
- Silt fencing will be placed along the surrounding construction limits;
- Mud mats will be installed at the site entrances;
- The contractor will be required to perform regular street sweeping and cleaning as required, to suppress dust and to provide safe and clean roadways adjacent to the construction site.

The erosion and sediment control measures will be required prior to construction and will remain in place during all phases of construction. Regular inspection and maintenance of the erosion control measures will be undertaken. Refer to the Erosion and Sediment Control Plan and Notes and Details Plan (**121186-ESC**, **121186-ND**) for additional information.

10.0 CONCLUSIONS AND RECOMMENDATIONS

The conclusions of this report are as follows:

- Water servicing for the proposed development will be serviced by two connections. Two 150mm diameter water services will connect to the existing 406mm diameter watermain within the March Road right-of-way. The two services will be separated by an isolation valve within the existing watermain system in the event maintenance on the City system is required. The existing watermain infrastructure can provide adequate domestic flows and pressure for fire protection. Pressure reducing valves will be required on both water service connections.
- The proposed building will be serviced by a 300mm diameter sanitary service. The proposed building service will connect to the existing 600mm sanitary sewer within the March Road right-of-way. The existing sanitary sewer has adequate excess capacity to service the development.
- Quality control of stormwater management will be provided to an enhanced level (80% TSS removal) by the proposed OGS unit (CDS PMSU2025-5-C) at the storm sewer outlet.
- Quantity control of stormwater will be provided through a stormwater storage tank to attenuate flows to the pre-development level for storms up to and including the 100-year event.
- An overland flow route will be provided from the proposed site to the March Road right-of-way.
- Erosion and sediment control measures will be implemented prior to and during construction.

The preceding report is respectfully submitted for review and approval. Please contact the undersigned should you have any questions or require additional information.

NOVATECH

Prepared by:

Reviewed by:

Micheal Adeoti, M.Eng., E.I.T.
Engineer in Training
Land Development Engineering

Cara Ruddle, P.Eng.
Senior Project Manager
Land Development Engineering

APPENDIX A
Correspondence

Pre-Consultation Meeting Notes

Site Address: 910 March Road
Location: Virtual - Microsoft Teams
Meeting Date: August 18, 2021

Attendees: Colette Gorni – Planner, City of Ottawa
Molly Smith – Planner, City of Ottawa
Santosh Kuruvilla – Project Manager (Infrastructure), City of Ottawa
Josiane Gervais – Project Manager (Transportation), City of Ottawa
Mark Young – Planner (Urban Design), City of Ottawa
Jeff Goettling – Planner (Parks), City of Ottawa
Matthew Hayley – Planner (Environmental), City of Ottawa
Jeffrey Ren – Co-op Student, City of Ottawa
Erica Ogden – MVCA
Francis Lepine – Lepine Corporation
Pascale Lepine – Lepine Corporation
Bruno St. Jean – Neuf Architects
Jack Stirling – The Stirling Group
Greg Winters – Novatech
Kayla Blakely – Novatech
Cara Ruddle – Novatech
Robin Marinac – CGH Transportation
Christopher Gordon – CGH Transportation

Regrets: Mark Richardson – Planning Forester, City of Ottawa
Mike Russett – Planner (Parks), City of Ottawa
Sami Rehman – Planner (Environmental), City of Ottawa
Mike Giampa – Project Manager (Transportation), City of Ottawa

Applicant Comments:

1. The commercial development that was previously proposed is no longer being considered; Lepine has purchased the site and is now proposing a mixed-use development
2. The March Road corridor is expected to support higher building heights and the draft new Official Plan designates the site as 'Mainstreet Corridor'
3. Lepine is proposing a mid-rise mixed-use building that is stepped from two to seven storeys; commercial space on the ground floor will be oriented along March Road; parking for the development will be predominantly underground

4. Tributaries of Shirley's Brook are found along the perimeter of the site; 20m setbacks are proposed for Tributary 2 and 3 with a smaller setback proposed for Tributary 4 to the south; the setback will be buffered by a natural zone
5. Existing residential neighbourhoods are located a significant distance away from the development given the proposed setbacks
6. Two new accesses, a new right-in access and a new full movement access, are proposed to be obtained off of March Road
7. A GM Zone, consistent with what adjacent properties along March Road, will be sought to permit the proposed development
8. The applicants have reached out to Councillor Sudds and Councillor El-Chantiry

Planning

1. Major Zoning By-law Amendment and Site Plan Control (Complex) applications are required to permit the proposed development. As there have already been applications submitted for the previous proposal, the owner has the following options for moving forward:
    a. Withdraw existing applications and resubmit new applications. The applicant would be entitled to a refund of 33.3% of the planning component of the application fee and 100% of the legal component of the application fee. Fees and forms for new applications can be found here. Please note that each planning application fee will be reduced by 10 per cent if two or more applications are submitted at the same time and for the same lands.
    b. Continue with existing applications and pay a re-circulation fee of $4,070.00 for each application. Due to the scope of changes to the proposal, the application would need to be re-circulated to surrounding property owners and new signs posted on site. Please note that the site plan recirculation fee can be paid at the time of registration, but the rezoning recirculation fee will need to be paid at the time of resubmission (instructions for payment to be provided following resubmission).
        - Please note that new affidavits will be required with the resubmission, as there has been a change in ownership on the site.
        - As required, all required plans and studies need be updated to reflect the new proposal.
2. Please ensure that the submission considers appropriate Official Plan policies that are applicable at the time of the submission of the application:

a. If a complete application is received by no later than the day before the new Official Plan is adopted (October 2021), it will be processed on the basis of existing Official Plan policy provided it is consistent with the 2020 Provincial Policy Statement.

b. Applications received after the day before the new Official Plan is adopted (October 2021), will be reviewed and evaluated on the basis of the policies of the new Official Plan, which is consistent with the 2020 Provincial Policy Statement.

3. Please consider opportunities for connections to existing path networks.
4. Cash-in-lieu of parkland and associated appraisal fee will be required as a condition of approval as per the Parkland Dedication By-law.
5. You are encouraged to contact Councillor Eli El-Chantiry, at Eli.El-Chantiry@ottawa.ca, and Councillor Jenna Sudds at Jenna.Sudds@ottawa.ca to discuss the revised proposal.

Please contact Colette Gorni, Planner, at Colette.Gorni@ottawa.ca if you have any questions or require additional information relating to the comments above.

Urban Design

1. A design brief is required. Please see attached terms of reference.
2. The introduction of a mix of uses, and the provision of commercial use at grade is appreciated as it is not required in this location.
3. Efforts to eliminate the front yard parking abutting March Road should be utilized. This may require parking in support of the commercial uses on the east side of this building wing. This will also address the lack of an adequate throat length for the access point to March Road.
4. Consider breaking the building into two. If a link is required, this should be glazed and allow for visibility and connectivity from the inner courtyard to the open space beyond.
5. Consideration should be given to massing options which minimize the impact of the four-storey component on the low-rise residential to the east. Consideration should be given to switching the location of the four-storey wing with the one-storey link.
6. The Lobby space for Building B should be a through Lobby configuration with direct frontage on March Road.
7. Consider a private pedestrian loop for residents along the perimeter of the site abutting the open space lands/feature. This pathway could include connections to outdoor residential terraces.

8. The architectural treatment of the buildings should include a clearly defined podium or base of 2-3 storeys. The materiality should include the use of noble materials for the base of the building such as masonry.

9. Is outdoor at-grade amenity space proposed at grade? It is recommended that this be provided, and the area should serve as a link between the indoor amenity and open space beyond.

Please contact Mark Young, Planner (Urban Design), at Mark.Young@ottawa.ca if you have any questions or require additional information relating to the comments above.

Engineering

1. The Servicing Study Guidelines for Development Applications are available at the following link: https://ottawa.ca/en/city-hall/planning-and-development/information-developers/development-application-review-process/development-application-submission/guide-preparing-studies-and-plans

2. Record drawings and utility plans are available for purchase from the City's Information Centre. Contact the City's Information Centre by email at informationcentre@ottawa.ca or by phone at (613) 580-2424 x44455.

3. Stormwater quantity control criteria – The post-development release rate is to be controlled to the pre-development release rate for all storms (2-yr up to 100-yr). The release rate is to be computed using the lesser of C=0.5 or existing and the Tc computed but no less than 10 minutes.

4. The subject property has been included in the overall sanitary sewer drainage area plan associated with the 600mm diameter trunk sanitary sewer to be constructed on March Road from Shirley's Brook Drive north to the future Street to service the Kanata North Urban Expansion Area. The sanitary sewer release rate shall be restricted to the allocations set in the above noted sanitary sewer drainage area plan and associated sanitary sewer design sheet. Construction of the 600mm diameter trunk sanitary sewer is anticipated to be complete at the end of the 2021 construction season. It is encouraged to combine construction efforts when developing the subject site to limit road cuts on March Road.

5. To service the Kanata North Urban Expansion area, a 400mm diameter watermain will also be extended up March Road from Maxwell Bridge Road to future Street 1. The subject site can connect to this future watermain. Construction of the 400mm watermain is anticipated to be complete at the end of the 2021 construction season. It is encouraged to combine construction efforts when developing the subject site to limit road cuts on March Road.

6. When basic water demand is greater than 50 cu. m. per day (about 50 homes), the site shall be connected with a minimum of two feeder mains to avoid the

creation of a vulnerable service area (see section 4.3 of the latest City of Ottawa Water Distribution Guideline).

7. Stormwater quality control criteria– Consult with the Conservation Authority (MVCA) for their requirements. Include the correspondence with MVCA in the stormwater/site servicing report.

8. As per the City of Ottawa Slope Stability Guidelines for Development Applications an engineering report is required for any retaining walls proposed 1.0 m or greater in height within the subject site that addresses the global stability of the wall and provides structural details. A Retaining Wall Stability Analysis Report and Retaining Wall Structural Details are required to be provided from a Professional Engineer licensed in the Province of Ontario that demonstrates the proposed retaining wall structure has been assessed for global instability as per City standards. Please ensure the analysis and required documentation are provided as part of the submission to address this comment.

9. Emergency routes will need to be satisfactory to Fire Services. Please show fire routes on the site plan. For information regarding fire route provisions, please consult with Kevin Heiss at kevin.heiss@ottawa.ca.

10. Clearly show and label the property lines on all sides of the property.

11. Clearly show and label all the easements (if any) on the property, on all plans.

12. When calculating the post development composite runoff coefficient (C), please provide a drawing showing the individual drainage area and its runoff coefficient.

13. When using the modified rational method to calculate the storage requirements for the site, the underground storage should not be included in the overall available storage. The modified rational method assumes that the restricted flow rate is constant throughout the storm which, in this case, underestimates the storage requirement prior to the 1:100-year head elevation being reached. Alternately, if you wish to include the underground storage, you may use an assumed average release rate equal to 50% of the peak allowable rate. Otherwise, disregard the underground storage as available storage or provide modeling to support the design.

14. Engineering plans are to be submitted on standard A1 size (594mm x 841mm) sheets.

15. Phase 1 ESA and Phase 2 ESA must conform to clause 4.8.4 of the Official Plan that requires that development applications conform to Ontario Regulation 153/04.

16. Provide the following information for water main boundary conditions:

    a. Location map with water service connection location(s).

b. Average daily demand (l/s).

c. Maximum daily demand (l/s).

d. Maximum hourly demand (l/s).

e. Fire flow demand (provide detailed fire flow calculations based on Fire Underwriters survey (FUS) Water Supply for Public Fire Protection). Exposure separation distances shall be defined on a figure to support the FUS calculation and required fire flow (RFF).

f. Hydrant capacity shall be assessed to demonstrate the RFF can be achieved. Please identify which hydrants are being considered to meet the RFF on a fire hydrant coverage plan as part of the boundary conditions request.

17. If you are proposing any exterior light fixtures, all must be included and approved as part of the site plan approval. Therefore, the lights must be clearly identified by make, model and part number. All external light fixtures must meet the criteria for full cut-off classification as recognized by the Illuminating Engineering Society of North America (IESNA or IES), and must result in minimal light spillage onto adjacent properties (as a guideline, 0.5 fc is normally the maximum allowable spillage). In order to satisfy these criteria, the applicant must provide certification from an acceptable professional engineer. The location of all exterior fixtures, a table showing the fixture types (including make, model, part number), and the mounting heights must be included on a plan.

18. As per Ottawa Sewer Design Guideline section 4.4.4.7, a monitoring maintenance hole shall be required just inside the property line for all non-residential and multi residential buildings connections from a private sewer to a public sewer. See the sewer use By-law 2003-514(14) monitoring devices for details.

19. Please contact Santosh Kuruvilla, Infrastructure Project Manager, at Santosh.Kuruvilla@ottawa.ca if you have any questions or require additional information relating to the comments above.

Environmental Planning

1. Please be aware that all of the Shirley's Brook (including both the branch and tributary) is identified as banding's turtle habitat and that habitat by definition is 30 m from edge of wetland/watercoures and an additional 240 m of what is called category 3 habitat.   However, the Kanata North CDP is proposing a reduced habitat protection area of 20 metres based on a proposed Endangered Species Act approval from MNRF/MECP. Similarly, for the subject site at 910 March, it may be possible to receive a reduced habitat protection area from MECP but that

will require an application under the ESA and compensation as per MECP requirements. MECP approval will be required prior to approval of development.

2. The site is subject to the Shirley's Brook & Watt's Creek Sub-watershed Study (1999) and Kanata North EMP (2001), both require 15 m setback from the top of bank for the Shirley's Brook branch and the tributary. It is adjacent to the KNUEA but not part of it, so any compensation for habitat needs to be worked out with MECP.

3. EIS – An Environmental Impact Statement is required, which shall comply with the Environmental Impact Statement Guidelines. The EIS will need to identify the limit of development based on the environmental attributes of the watercourses. The watercourse to the south will require a minimum 15 m setback from top of bank, the watercourse to the east and north will require a 30 m setback from normal highwater mark, floodplain or geotechnical limit which ever is greater. The northern watercourse is not located along the property line, the setback is to the watercourse highwater mark and not the property boundary and the watercourse cannot be moved.

4. Bird-safe development – Given the height of the proposal (mid to high rise) the proposal will need to review and incorporate bird safe design elements. Some of the risk factors include glass and related design traps such as corner glass and fly-through conditions, ventilation grates and open pipes, landscaping, light pollution. More guidance and solutions are available in the guidelines which can be found here: https://ottawa.ca/en/planning-development-and-construction/developing-property/development-application-review-process/development-application-submission/guide-preparing-studies-and-plans
.

Please contact Matthew Hayley, Environmental Planner, at Matthew.Hayley@ottawa.ca if you have any questions or require additional information relating to the comments above.

Transportation

1. Follow Traffic Impact Assessment Guidelines

    a. A full TIA is required. Please submit a Scoping report at your earliest convenience.

    b. Start this process asap. The application will not be deemed complete until the submission of the draft step 1-4, including the functional draft RMA package and/or monitoring report (if applicable).

    c. The proposed traffic signal on March Road will trigger an RMA. Request base mapping asap. Contact Engineering Services (https://ottawa.ca/en/city-hall/planning-and-development/engineering-services)

   d. An update to the *TRANS Trip Generation Manual* has been completed (October 2020). This manual is to be utilized for this TIA. A copy of this document can be provided upon request.

2. Signalized intersection:

   a. The City has concerns with signalizing this access and operations along March Road. Specifically, queuing and blocking of existing intersections along March Road. The TIA needs to address these concerns.

   b. Should the applicant wish to pursue a proposed signal, the developer will be responsible for the construction and maintenance cost of the intersection.

   c. The applicant must be aware that although the BRT on March Road is not listed on the Affordable Network of the TMP, when and if this infrastructure is constructed, the full movement access to the site will not be supported. As such, this signalized intersection is considered throw-away.

   d. The intersection may need to be fully protected, the specifics of the design will be reviewed as part of the RMA process.

   e. A signalized intersection in this location will impact the proposed subdivision to the west at 927 March Road (Application # D07-16-20-0034) as a right-in/right-out access was proposed at this location. Please coordinate with this applicant, a singe RMA for the intersection would be preferred.

3. ROW protection on March Rd between urban area limit and Terry Fox is 44.5m (Note: Subject to unequal widenings outlined in March Road ESR). Confirm this ROW protection is provided.

4. Clear throat requirements for >200 apartments on an arterial is 40m.

5. Corner clearances should follow minimum distances set out within TAC Figure 8.8.2.

6. 936 March Road and Street 1 is a nearby DC intersection.

7. TMP includes:

   a. Transit Priority Measures (Isolated) along March Road (2031 Affordable Concept)

   b. BRT (at-grade crossings) along March Road (2031 Network Concept)

   c. March Road widening (2031 Network Concept)

   d. Spine Route along March Road (Cycling Network)

8. Consider providing a connection to the cycling path at the rear of the site (this would require a crossing of the watercourse, therefore environmental constraints would need to be considered).

9. On site plan:

    a. Show all details of the roads abutting the site up to and including the opposite curb; include such items as pavement markings, accesses and/or sidewalks.

    b. Turning movement diagrams required for all accesses showing the largest vehicle to access/egress the site.

    c. Turning movement diagrams required for internal movements (loading areas, garbage).

    d. Show all curb radii measurements; ensure that all curb radii are reduced as much as possible

    e. Show dimensions for site elements (i.e. lane/aisle widths, access width and throat length, parking stalls, sidewalks, pedestrian pathways, etc.)

    f. Sidewalk is to be provided along property frontage.

    g. Sidewalk is not to be continuous across controlled intersection (if signalized) as per City Specification 7.4.

    h. Show slope of garage ramp on site plan. Note that underground ramps should be limited to a 12% grade and must contain a subsurface melting device when exceeding 6%. Ramp grades greater than 15% can be psychological barriers to some drivers.

    i. Ensure all crosswalks located internally on the site provide a TWSI at the depressed curb, per requirements of the Integrated Accessibility Standards Regulation under the AODA.

    j. Parking stalls at the end of dead-end parking aisles require adequate turning around space. Ensure this is provided.

    k. Grey out any area that will not be impacted by this application.

10. As the proposed site is mixed-use and accessible to the general public, AODA legislation applies. Consider using the City's Accessibility Design Standards as a reference for AODA requirements.

11. Noise Impact Studies required for the following:

    a. Road

   b. Stationary, due to the proximity to neighboring exposed mechanical equipment and/or if there will be any exposed mechanical equipment due to the proximity to neighboring noise sensitive land uses.

Please contact Josiane Gervais, Transportation Project Manager (TPM), at Josiane.Gervais@ottawa.ca if you have any questions or require additional information relating to the comments above.

Forestry

TCR Requirements

1. A Tree Conservation Report (TCR) must be supplied for review along with the suite of other plans/reports required by the City
   a. An approved TCR is a requirement of Site Plan approval.
   b. The TCR may be combined with eh LP provided all information is supplied
2. As of January 1 2021, any removal of privately-owned trees 10cm or larger in diameter, or publicly (City) owned trees of any diameter requires a tree permit issued under the Tree Protection Bylaw (Bylaw 2020 – 340); the permit will be based on an approved TCR and made available at or near plan approval.
3. The Planning Forester from Planning and Growth Management as well as foresters from Forestry Services will review the submitted TCR
   a. If tree removal is required, both municipal and privately-owned trees will be addressed in a single permit issued through the Planning Forester
   b. Compensation may be required for city owned trees – if so, it will need to be paid prior to the release of the tree permit
4. The TCR must list all trees on site, as well as off-site trees if the CRZ extends into the developed area, by species, diameter and health condition
5. Please identify trees by ownership – private onsite, private on adjoining site, city owned, co-owned (trees on a property line)
6. The TCR must list all trees on adjacent sites if they have a critical root zone that extends onto the development site
7. If trees are to be removed, the TCR must clearly show where they are, and document the reason they cannot be retained
8. All retained trees must be shown and all retained trees within the area impacted by the development process must be protected as per City guidelines available at Tree Protection Specification or by searching Ottawa.ca

a. The location of tree protection fencing must be shown on a plan

b. Show the critical root zone of the retained trees

c. If excavation will occur within the critical root zone, please show the limits of excavation

9. The City encourages the retention of healthy trees; if possible, please seek opportunities for retention of trees that will contribute to the design/function of the site.

For more information on the process or help with tree retention options, contact Mark Richardson mark.richardson@ottawa.ca or on City of Ottawa

MVCA

1. The subject property is regulated by MVCA under Ontario Regulation 153/06 and is surrounded by the tributaries of Shirley's Brook. Attached is a map of the regulated area on the subject property including the 1:100 year floodplain and the meander belt erosion hazard. Development is not permitted within the flood plain or erosion hazard. To the north is tributary 3, east is tributary 2 and south is tributary 4.

2. The Official Plan policy 4.7.3 requires a minimum watercourse setback which is the greater of the flood line, geotechnical limit, 30 metres from the normal high water or 15 metres from the existing top of bank, unless additional study to refine the setback and site-specific measures are implemented.

3. The subject property was not within Kanata North Urban Expansion Area Environmental Management Plan boundary which established only a 40 meter corridor for the tributaries based on enhancements and compensation provided in order to reduce the setback, as approved the by the City, MVCA and MECP.

4. The watercourse setbacks in the development proposal should be revised or a site specific assessment should be provided to ensure the proposed development is not located within the erosion hazard and will not impact water quality.

5. For tributary 4 a setback of 15 metres from top of bank should be provided to match the setback provided on the adjacent property.

6. As the stormwater for the proposed development will outlet directly to Shirley's Brook, an enhanced level of water quality treatment (80% long-term TSS removal) is required.

Please contact the MVCA's Planner, Erica Ogden, at EOgden@mvc.on.ca if you have any questions or require additional information relating to the comments above.

Next Steps

Please refer to the links to Guide to preparing studies and plans and fees for further information. Additional information is available related to building permits, development charges, and the Accessibility Design Standards. Be aware that other fees and permits may be required, outside of the development review process. You may obtain background drawings by contacting informationcentre@ottawa.ca.

These pre-con comments are valid for one year. If you submit a development application(s) after this time, you may be required to meet for another pre-consultation meeting and/or the submission requirements may change. You are as well encouraged to contact us for a follow-up meeting if the plan/concept will be further refined.

Please do not hesitate to Colette Gorni, at Colette.Gorni@ottawa.ca, if you have any questions.

APPENDIX B
Water Servicing Information

FUS - Fire Flow Calculations

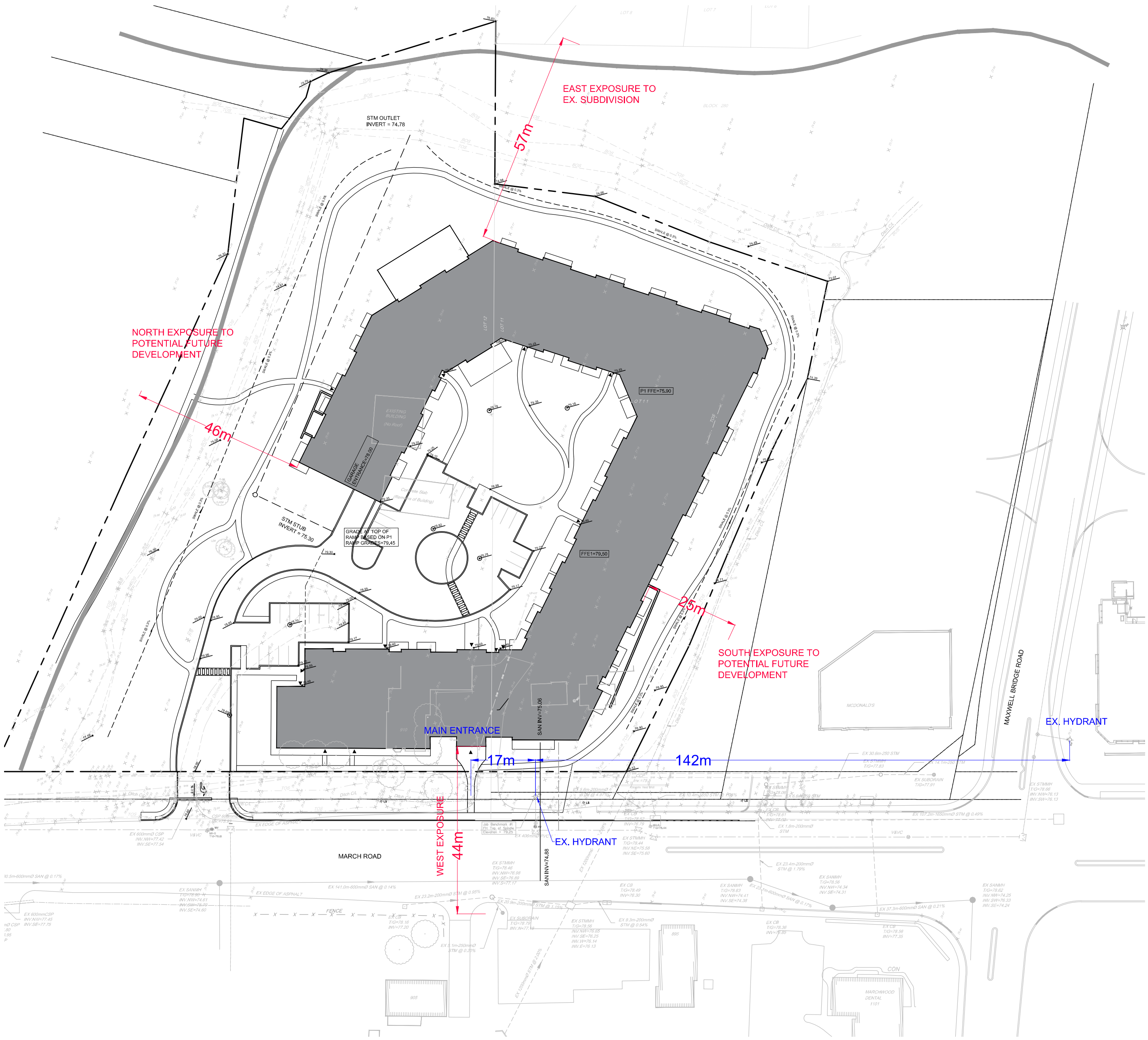
As per 1999 Fire Underwriter's Survey Guidelines

NOVATECH
Engineers, Planners & Landscape Architects

Novatech Project #:	121186
Project Name:	910 March Road
Date:	3/27/2023
Input By:	Zarak Ali
Reviewed By:	Mathew Hrehoriak
Revised By:	Spencer Manoryk
Building Description:	9-Storey Apartment Building

Legend	
	Input by User
	No Information or Input Required

Step			Choose		Value Used	Total Fire Flow (L/min)
Base Fire Flow						
1	**Construction Material**			**Multiplier**		
	Coefficient related to type of construction C	Wood frame		1.5	0.6	
		Ordinary construction		1		
		Non-combustible construction		0.8		
		Modified Fire resistive construction (2 hrs)	Yes	0.6		
		Fire resistive construction (> 3 hrs)		0.6		
2	**Floor Area**					
	A	Building Footprint (m^2)	7303			
		Number of Floors/Storeys	9			
		Protected Openings (1 hr)	Yes			
		Area of structure considered (m^2)			**10,955**	
	F	**Base fire flow without reductions**				**14,000**
		$F = 220\ C\ (A)^{0.5}$				
Reductions or Surcharges						
3	**Occupancy hazard reduction or surcharge**			**Reduction/Surcharge**		
	(1)	Non-combustible		-25%	-15%	**11,900**
		Limited combustible	Yes	-15%		
		Combustible		0%		
		Free burning		15%		
		Rapid burning		25%		
4	**Sprinkler Reduction**			**Reduction**		
	(2)	Adequately Designed System (NFPA 13)	Yes	-30%	-30%	**-5,950**
		Standard Water Supply	Yes	-10%	-10%	
		Fully Supervised System	Yes	-10%	-10%	
				Cumulative Total	**-50%**	
5	**Exposure Surcharge (cumulative %)**				**Surcharge**	
	(3)	North Side	> 45.1m		0%	**1,785**
		East Side	> 45.1m		0%	
		South Side	20.1 - 30 m		10%	
		West Side	30.1- 45 m		5%	
				Cumulative Total	**15%**	
Results						
6	**(1) + (2) + (3)**	**Total Required Fire Flow, rounded to nearest 1000L/min**			**L/min**	**8,000**
		(2,000 L/min < Fire Flow < 45,000 L/min)		or	L/s	**133**
				or	USGPM	2,114
7	**Storage Volume**	Required Duration of Fire Flow (hours)			Hours	2
		Required Volume of Fire Flow (m^3)			m^3	960


EAST EXPOSURE TO
EX. SUBDIVISION
57m
STM OUTLET
INVERT = 74.78
NORTH EXPOSURE TO
POTENTIAL FUTURE
DEVELOPMENT
46m
P1 FFE=75.90
STM STUB
INVERT = 75.30
GRADE AT TOP OF
RAMP BASED ON P1
RAMP GRADES=79.45
FFE1=79.50
25m
SOUTH EXPOSURE TO
POTENTIAL FUTURE
DEVELOPMENT
MAXWELL BRIDGE ROAD
EX. HYDRANT
MAIN ENTRANCE
SAN INV=75.06
17m
142m
WEST EXPOSURE
44m
EX. HYDRANT
MARCH ROAD
SAN INV=74.88

NOVATECH
Engineers, Planners & Landscape Architects

910 MARCH ROAD
Lépine Corporation
HYDRAULIC ANALYSIS

JOB NO. 121186
DATE PREPARED: March 2023

Table 1
Water Demand

	Unit Type					Total Demand (L/s)		
	1 Bed Apartment	**2 Bed Apartment**	**3 Bed Apartment**	**Commercial**	**Total**	**Avg Day**	**Max. Daily**	**Peak Hour**
Unit Count	225	127	38	n/a	390	2.27	5.67	12.48
Area (m^2)				521	521	0.05	0.07	0.13
Population	315	267	118	-	700	**2.32**	**5.74**	**12.61**

Design Parameters:

- Avg Apartment	1.8	persons/unit
- 1 Bed Apartment	1.4	persons/unit
- 2 Bed Apartment	2.1	persons/unit
- 3 Bed Apartment	3.1	persons/unit

Section 4.0 Ottawa Sewer Design Guidelines

- Average Domestic Flow 280 L/person/day

Ontario Building Code Table 8.2.1.3

- Office Area Flows 75 l/9.3m² /day

Peaking Factors: Table 4.2 Ottawa Design Guidelines - Water Distribution

Max. Daily Demand:

- Residential 2.5 x Avg Day
- Commercial 1.5 x Avg Day

Peak Hourly Demand:

- Residential 2.2 x Max Day
- Commercial 1.8 x Max Day

CALCULATED WATER DEMANDS:

Proposed Development (9 Storey Building)

Average Day (Maximum HGL)=	2.27	L/s
Maximum Day =	5.67	L/s
Peak Hour (Minimum HGL) =	12.48	L/s
Max Day + Fire =	155.67	L/s

City of Ottawa Boundary Conditions:

Bounday conditions based on (Zone 2W pressure zone) connection to 406mm dia. Watermain on March Road

Peak Hour (Minimum HGL) =	125.9	m
Average Day (Maximum HGL)=	131	m
Max Day + Fire =	123.9	m

Watermain Analysis:

Water Service Elevation = 75.00 m

High Pressure Test = Max. HGL - Water Service Elevation x 1.42197 PSI/m < 80 PSI

High Pressure = 79.6 PSI

Low Pressure Test = Min. HGL - Water Service Elevation x 1.42197 PSI/m > 40 PSI

Low Pressure = 72.4 PSI

Max Day + Fire Test = Max Day + Fire Flow - Water Service Elevation x 1.42197 PSI/m > 20 PSI

Max Day + Fire = 69.5 PSI

Spencer Manoryk

From:	Cara Ruddle
Sent:	Monday, September 26, 2022 12:47 PM
To:	Spencer Manoryk
Subject:	FW: 910 March Road - water boundary conditions request
Attachments:	910 March Road_26Sept2022.docx

Cara Ruddle, P.Eng., Senior Project Manager | Land Development Engineering
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 Ext: 220 | Cell: 613.261.7719 | Fax: 613.254.5867

From: Kuruvilla, Santhosh <Santhosh.Kuruvilla@ottawa.ca>
Sent: Monday, September 26, 2022 12:43 PM
To: Cara Ruddle <c.ruddle@novatech-eng.com>
Subject: RE: 910 March Road - water boundary conditions request

Hi Cara,

Please find attached the Boundary conditions for the subject application.

Thanks,

Santhosh Kuruvilla
Project Manager, Infrastructure Approvals
City of Ottawa
mailto:santhosh.kuruvilla@ottawa.ca

From: Cara Ruddle <c.ruddle@novatech-eng.com>
Sent: September 15, 2022 3:08 PM
To: Kuruvilla, Santhosh <Santhosh.Kuruvilla@ottawa.ca>
Subject: RE: 910 March Road - water boundary conditions request

for the update.

Cara Ruddle, P.Eng., Senior Project Manager | Land Development Engineering
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 Ext: 220 | Cell: 613.261.7719 | Fax: 613.254.5867

From: Kuruvilla, Santhosh <Santhosh.Kuruvilla@ottawa.ca>
Sent: Thursday, September 15, 2022 2:55 PM
To: Cara Ruddle <c.ruddle@novatech-eng.com>
Cc: Spencer Manoryk <s.manoryk@novatech-eng.com>
Subject: RE: 910 March Road - water boundary conditions request

Hi Cara,

I already made the request for the boundary conditions but haven't received it yet. It takes about 3 weeks nowadays to receive boundary conditions. As soon as I get it, I will send it to you.

Thanks,

Santhosh Kuruvilla
Project Manager, Infrastructure Approvals
City of Ottawa
mailto:santhosh.kuruvilla@ottawa.ca

From: Cara Ruddle <c.ruddle@novatech-eng.com>
Sent: September 15, 2022 2:37 PM
To: Kuruvilla, Santhosh <Santhosh.Kuruvilla@ottawa.ca>
Cc: Spencer Manoryk <s.manoryk@novatech-eng.com>
Subject: FW: 910 March Road - water boundary conditions request

Any update to my email below? Do you know when we can expect boundary conditions? I would like to provide an update to my client.

Thanks.

Cara Ruddle, P.Eng., Senior Project Manager | Land Development Engineering
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 Ext: 220 | Cell: 613.261.7719 | Fax: 613.254.5867

From: Cara Ruddle
Sent: Monday, August 29, 2022 3:00 PM
To: Kuruvilla, Santhosh <Santhosh.Kuruvilla@ottawa.ca>
Cc: Spencer Manoryk <s.manoryk@novatech-eng.com>
Subject: RE: 910 March Road - water boundary conditions request

Santhosh:
Please find below responses to your comments as well as supporting figures attached.

1. Location map with water service connection location(s).
    - See attached Boundary Conditions Sketch

2. Average daily demand (l/s).
    - Average Day = 2.38 L/s
3. Maximum daily demand (l/s).
    - Maximum Day = 5.91 L/s
4. Maximum hourly demand (l/s).
    - Peak Hour = 12.96 L/s
5. Fire flow demand (provide detailed fire flow calculations based on Fire Underwriters survey (FUS) Water Supply for Public Fire Protection). Exposure separation distances shall be defined on a figure to support the FUS calculation and required fire flow (RFF).
    - Fire Flow = 150 L/s
    - See attached Fire Flow Calculations
    - See attached figure for exposure separation distances
6. Hydrant capacity shall be assessed to demonstrate the RFF can be achieved. Please identify which hydrants are being considered to meet the RFF on a fire hydrant coverage plan as part of the boundary conditions request.
    - See attached figure for fire hydrants considered

Please confirm the information provided is satisfactory to obtain boundary conditions. Thanks.

Cara Ruddle, P.Eng., Senior Project Manager | Land Development Engineering
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 Ext: 220 | Cell: 613.261.7719 | Fax: 613.254.5867

From: Kuruvilla, Santhosh <Santhosh.Kuruvilla@ottawa.ca>
Sent: Thursday, August 18, 2022 11:27 AM
To: Cara Ruddle <c.ruddle@novatech-eng.com>
Subject: FW: 910 March Road - water boundary conditions request

Hi Cara,

Thanks for your request for the boundary condition for the subject application.

Please provide the following information (detailed) for the boundary condition request in one email:

1. Location map with water service connection location(s).
2. Average daily demand (l/s).
3. Maximum daily demand (l/s).
4. Maximum hourly demand (l/s).
5. Fire flow demand (provide detailed fire flow calculations based on Fire Underwriters survey (FUS) Water Supply for Public Fire Protection). Exposure separation distances shall be defined on a figure to support the FUS calculation and required fire flow (RFF).
6. Hydrant capacity shall be assessed to demonstrate the RFF can be achieved. Please identify which hydrants are being considered to meet the RFF on a fire hydrant coverage plan as part of the boundary conditions request.

Note: The fire flow requirements for a private property in an existing development area where no watermain sizing is required, the OBC method can be used if the fire demand for the private property is less than 9,000 L/min. If the OBC fire demand reaches 9000 L/min, then the FUS method is to be used.

Thanks,
Santhosh

From: Cara Ruddle <c.ruddle@novatech-eng.com>
Sent: August 15, 2022 1:09 PM
To: Kuruvilla, Santhosh <Santhosh.Kuruvilla@ottawa.ca>
Subject: 910 March Road - water boundary conditions request

CAUTION: This email originated from an External Sender. Please do not click links or open attachments unless you recognize the source.

ATTENTION : Ce courriel provient d'un expéditeur externe. Ne cliquez sur aucun lien et n'ouvrez pas de pièce jointe, excepté si vous connaissez l'expéditeur.

We are looking for boundary conditions for the existing watermain infrastructure to complete a water servicing analysis for the 910 March Road development. Attached is a geomap image showing the existing water infrastructure and our proposed connection location. Water Demands for the proposed development are provided below:

910 March Road

- Average Day = 2.38 L/s
- Maximum Day = 5.91 L/s
- Peak Hour = 12.96 L/s
- Maximum Day + Fire Flow = 172.91 L/s

Please provide boundary conditions at your earliest convenience. Please let me know if there are any questions.

Thanks.

Cara Ruddle, P.Eng., Senior Project Manager | Land Development Engineering
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 Ext: 220 | Cell: 613.261.7719 | Fax: 613.254.5867

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Boundary Conditions
910 March Road

Provided Information

Scenario	Demand	
	L/min	L/s
Average Daily Demand	143	2.38
Maximum Daily Demand	355	5.91
Peak Hour	778	12.96
Fire Flow Demand #1	9,000	150.00

Location

Results

Connection 1 – March Rd.

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	131.0	74.0
Peak Hour	125.9	66.8
Max Day plus Fire 1	123.9	64.0

Ground Elevation = 78.9 m

Notes

1. A second connection to the watermain, separated by an isolation valve, is required to decrease vulnerability of the water system in case of breaks.

Disclaimer

The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation. Fire Flow analysis is a reflection of available flow in the watermain; there may be additional restrictions that occur between the watermain and the hydrant that the model cannot take into account.

APPENDIX C
Sanitary Servicing Information

PROJECT #: 121186
PROJECT NAME: 910 MARCH ROAD
LOCATION: OTTAWA

NOVATECH
Engineers, Planners & Landscape Architects

DATE PREPARED: MARCH 2023

910 MARCH ROAD SANITARY FLOWS

LOCATION		Wastewater Flow Q(w)									EXTRANEOUS FLOW Q(i)			DESIGN FLOW Q(d)	PIPE					
		Apartment Units			Residential				Commercial											
FROM	TO	1 Bed Apartment	2 Bed Apartment	3 Bed Apartment	Pop.	Accum. Pop.	Peak Factor	Peak Flow (l/s)	Area	Peak Flow (l/s)	Total Area (ha)	Accum. Area (ha)	Infilt. Flow (l/s)	Total Flow (l/s)	Size (mm)	Slope (%)	Length (m)	Capacity (l/s)	Full Flow Vel. (m/s)	Q/Q_{full} (%)
910	SANMH3	225	127	38	700	700	3.1	7.07	521	0.07	2.72	2.72	0.90	8.04	300	1.50	3.3	118.3	1.68	6.8%
SANMH3	SANMH2							7.07		0.07			0.90	8.04	300	1.50	56.5	118.3	1.68	6.8%
SANMH2	SANMH1							7.07		0.07			0.90	8.04	300	1.50	15.2	118.3	1.68	6.8%
SANMH1	EX							7.07		0.07			0.90	8.04	300	0.80	30.0	86.4	1.22	9.3%

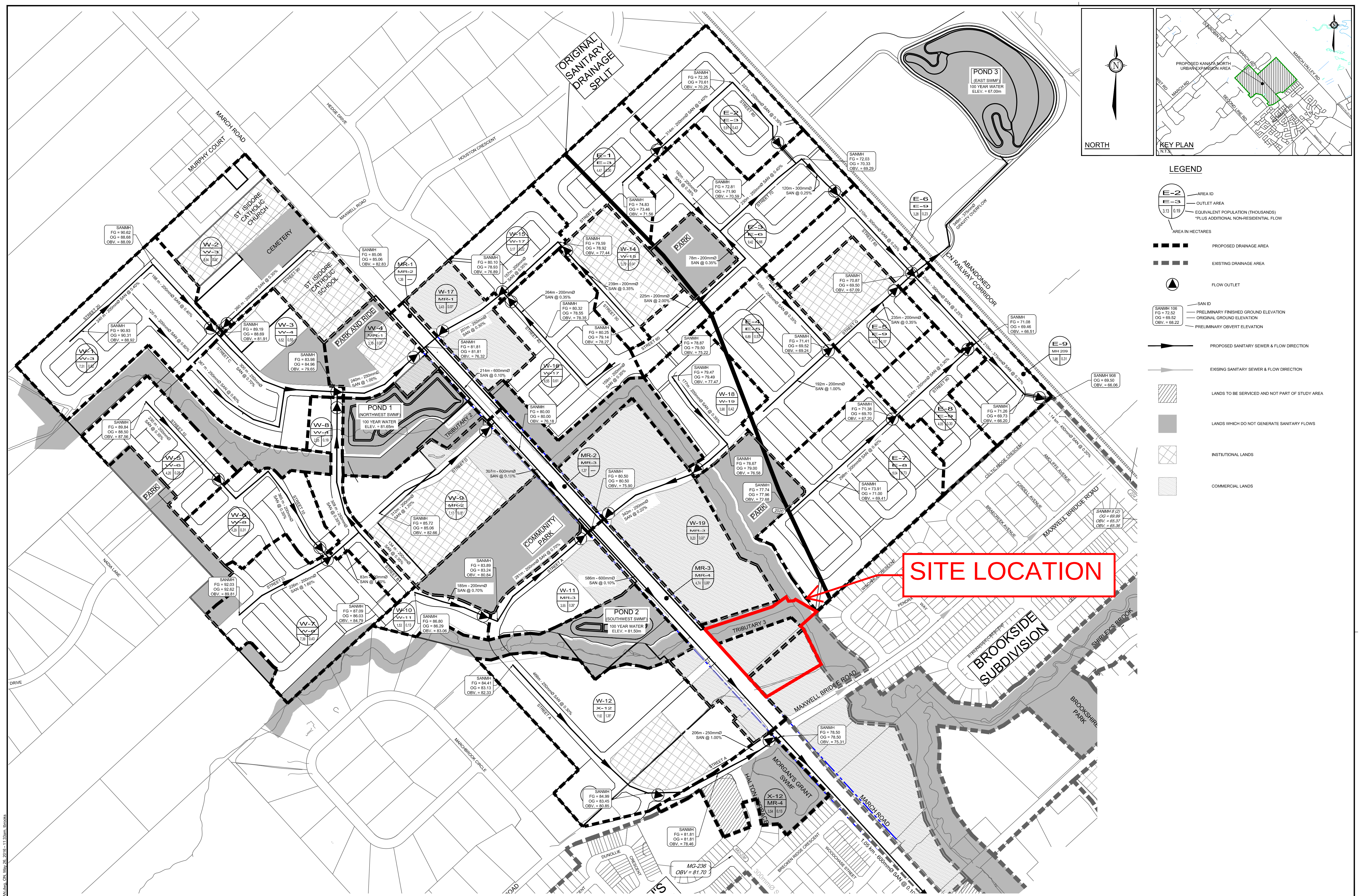
Design Parameters:

- Avg Apartment 1.8
- 1 Bed Apartment 1.4
- 2 Bed 2.1
- 3 Bed 3.1

Ontario Building Code Table 8.2.1.3
- Office Area Flows 75 l/9.3m² /day

Section 4.0 Ottawa Sewer Design Guidelines
- Average Domestic Flow 280 L/person/day
- Extraneous Flows 0.33 L/s/ha

1. Q(d) = Q(w) + Q(i) , where
2. Q(i) = 0.28 L/s/ha
3. Residential Peaking Facor = Harmon's
4. Commercial Peaking Factor = 1.5



NOTE:
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

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No.	REVISION	DATE	BY
3.	ISSUED WITH DRAFT MASTER SERVICING STUDY	MAY 20/16	JLS
2.	ISSUED WITH DRAFT MASTER SERVICING STUDY	APR 4/16	JLS
1.	ISSUED WITH DRAFT MASTER SERVICING STUDY	FEB 26/16	JLS

SCALE 1:3000

1:3000 (0 30 60 90 120)

DESIGN ARM / TB
CHECKED ARM
DRAWN TB
CHECKED CJR
APPROVED JLS

FOR REVIEW ONLY

NOVATECH
Engineers, Planners & Landscape Architects
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada K2M 1P6
Telephone (613) 254-9643
Facsimile (613) 254-5867
Website www.novatech-eng.com

LOCATION
KANATA NORTH URBAN EXPANSION AREA COMMUNITY DESIGN PLAN

DRAWING NAME
ONSITE SANITARY DRAINAGE AREA PLAN

PROJECT No. 112117-04
REV REV # 3
DRAWING No. 112117-SAN1

PLANB1.DWG - 1000mmx707mm

KANATA NORTH URBAN EXPANSION AREA
COMMUNITY DESIGN PLAN

TABLE C-6b:
SANITARY SEWER DESIGN SHEET

NOVATECH
Engineers, Planners & Landscape Architects

LOCATION				RESIDENTIAL AREA AND POPULATION										ICI								INFILTRATION				FLOW	PIPE					
									Cumulative					IND			COMM		INST													
Street	From Node	To Node	Total Area (ha)	Dwellings SFH 3.4	Dwellings SD/TH 2.7	Density (Net ha) Low[3] 101	Density (Net ha) High[4] 161	Pop.	Residential Area (ha)	Pop. New	Pop. Exist	Peak Factor	Peak Flow (l/s)	Area (ha)	Accu. Area (ha)	Peak Factor	Area (ha)	Accu. Area (ha)	Area (ha)	Accu. Area (ha)	Peak Flow (l/s)	Total Area (ha)	Accu. Area New (ha)	Accu. Area Exist	Infiltration Flow (l/s)	Total Flow (l/s)	Dia Act (mm)	Dia Nom (mm)	Slope (%)	Velocity (Full) (m/s)	Capacity (Full) (l/s)	Ratio Q/Qfull (%)
W-16	W-16	W-17	6.55			3.17	1.78	606.8	4.95	607		3.93	9.7								0.0	6.55	6.55		1.8	11.5	203	200	0.35	0.62	20.2	57%
W-17	W-17	MR-1	3.43					0.0	7.51	865		3.84	13.5				3.05	3.05		8.04	9.6	6.48	19.99		5.6	28.7	254	250	0.30	0.67	33.9	84%
MR-1 (MARCH ROAD)	MR-1	MR-2	1.36					0.0	30.73	3373		3.40	46.4					3.40		8.04	9.9	1.36	47.42		13.3	69.6	610	600	0.10	0.69	202.4	34%
W-9	W-9	MR-2	7.17				1.13	181.9	1.13	182		4.00	2.9				1.38	1.38	3.77	3.77	4.5	7.17	25.90		7.3	14.7	203	200	1.20	1.15	37.4	39%
MR-2 (MARCH ROAD)	MR-2	MR-3	1.37					0.0	33.23	3555		3.38	48.7					4.78		11.81	14.4	1.37	74.69		20.9	84.0	610	600	0.10	0.69	202.4	41%
W-10	W-10	W-11	1.53				0.78	125.6	0.78	126		4.00	2.0								0.0	1.53	1.53		0.4	2.5	203	200	0.70	0.88	28.6	9%
W-11	W-11	MR-3	3.55				1.64	264.0	2.42	390		4.00	6.3				1.08	1.08			0.9	3.55	5.08		1.4	8.7	203	200	0.70	0.88	28.6	30%
W-18	W-18	W-19	3.90			1.21	1.82	415.2	3.03	415		4.00	6.7								0.0	3.90	3.90		1.1	7.8	203	200	0.35	0.62	20.2	39%
W-19	W-19	MR-3	9.23					0.0	3.03	415		4.00	6.7				8.83	8.83			7.7	9.23	13.13		3.7	18.1	254	250	0.25	0.61	31.0	58%
MR-3 (MARCH ROAD)	MR-3	MR-4	4.74					0.0	38.68	4360		3.30	58.3				2.06	16.75		11.81	24.8	4.74	97.64		27.3	110.4	610	600	0.10	0.69	202.4	55%
W-12	W-12	X-12	11.62			2.24	6.98	1350.0	9.22	1350		3.71	20.3						2.01	2.01	1.7	11.62	11.62		3.3	25.3	254	250	0.30	0.67	33.9	75%
X-12 (BIDGOOD / HALTON TERRACE)	X-12	MR-4	3.54				0.79	127.2	10.01	1477		3.68	22.0								0.0	3.54	15.16		4.2	26.3	254	250	1.00	1.22	62.0	42%
X-5 (760 & 788 March Road)	X-5	MR-4	1.76				1.76	283.4	1.76	283		4.00	4.6								0.0	1.76	1.76		0.5	5.1						
MR-4 (MARCH ROAD)	MR-4	MH 186	4.71					0.0	50.45	6120		3.16	78.4					16.75		13.82	26.5	4.71	119.27		33.4	138.3	610	600	0.10	0.69	202.4	68%
X-6 (750 March Road, Blue Heron Co-op Homes)****	X-6	X-8	1.29		83			224.1	1.29		224	4.00	2.1								0.0	1.29		1.29	0.5	2.5						
			**** 83 units obtained from Co-op website (http://www.chaseo.ca/member/blue-heron-co-op/)																													
X-7 (Morgans Grant) *****	X-7	X-8	48.45					3188.0	49.74		3188	3.42	25.2								0.0	48.45		49.74	17.4	42.6						
			***** Information obtained from JL Richards #24566, Sanitary Design Sheet, July 2012																													
X-8 (Inverary Drive)	X-8	MH 186	4.31	39	49			264.9	54.05		3677	3.37	28.6								0.0	4.31		54.05	18.9	47.6						
Shirley's Brooke Drive	MH 186	MH 184	0.00					0.0	104.50	6120	3677	2.96	98.7					16.75		13.82	26.5	0.00	119.27	54.05	52.3	177.5	610	600	0.10	0.69	202.4	88%
X-9 (Mckinley Drive)	X-9	MH 184	7.84		117			315.9			316	4.00	2.9				2.73	2.73			2.4	7.84		7.84	2.7	8.0						
Shirleys Brooke Drive	MH 184	MH 182	0.00					0.0	104.50	6120	3993	2.95	100.4					19.48		13.82	28.9	0.00	119.27	61.89	55.1	184.4	610	600	0.10	0.69	202.4	91%
Shirleys Brooke Drive	MH 182	MH 1	0.00					0.0	104.50	6120	3993	2.95	100.4					19.48		13.82	28.9	0.00	119.27	61.89	55.1	184.4	610	600	0.10	0.69	202.4	91%
X-10 (Sandhill Road)		MH 1	11.62	9	60		5.32	1049.1	11.62		1049	3.79	9.2						2.11	2.11	1.8	11.62		11.62	4.1	15.1						
X-11		MH 1	0.87				0.87	140.1	0.87		140	4.00	1.3								0.0	0.87		0.87	0.3	1.6						
Briar Ridge Pump Station	PS	MH 1							72.88	3644	6094	2.97	85.623	0	35.08	3.1	0.00	6.76	0.00	5.25	35.6	0.00	92.96	88.15	56.9	178.1						
EAST MARCH TRUNK	MH 1	EMT	0.00					0.0	189.87	9764	11276	2.63	172.7		35.08	3.1		26.24		21.18	66.3	0.00	212.23	162.53	116.3	355.3	762	750	0.10	0.80	367.1	97%

DESIGN PARAMETERS

Average Daily Flow (Future)=	350	L/cap/day
Average Daily Flow (Existing)=	200	L/cap/day
Indust/Comm/Inst Flow (Future)=	50000	L/ha/day
Indust/Comm/Inst Flow (Existing)=	20000	L/ha/day
Max Res Peak Factor=	4.00	
Comm/Inst Peak Factor=	1.50	

Industrial Peak Factor= per MOE graph		
Extraneous Flow (Future)=	0.28	L/s/ha
Extraneous Flow (Existing)=	0.35	L/s/ha (Jan 2008 monitored event)
Minimum Velocity=	0.60	m/s
Manning's n=	0.013	

Designed:	Alex McAuley
Checked:	CJR
Dwg. Reference:	112117-SAN1 112117-SAN2

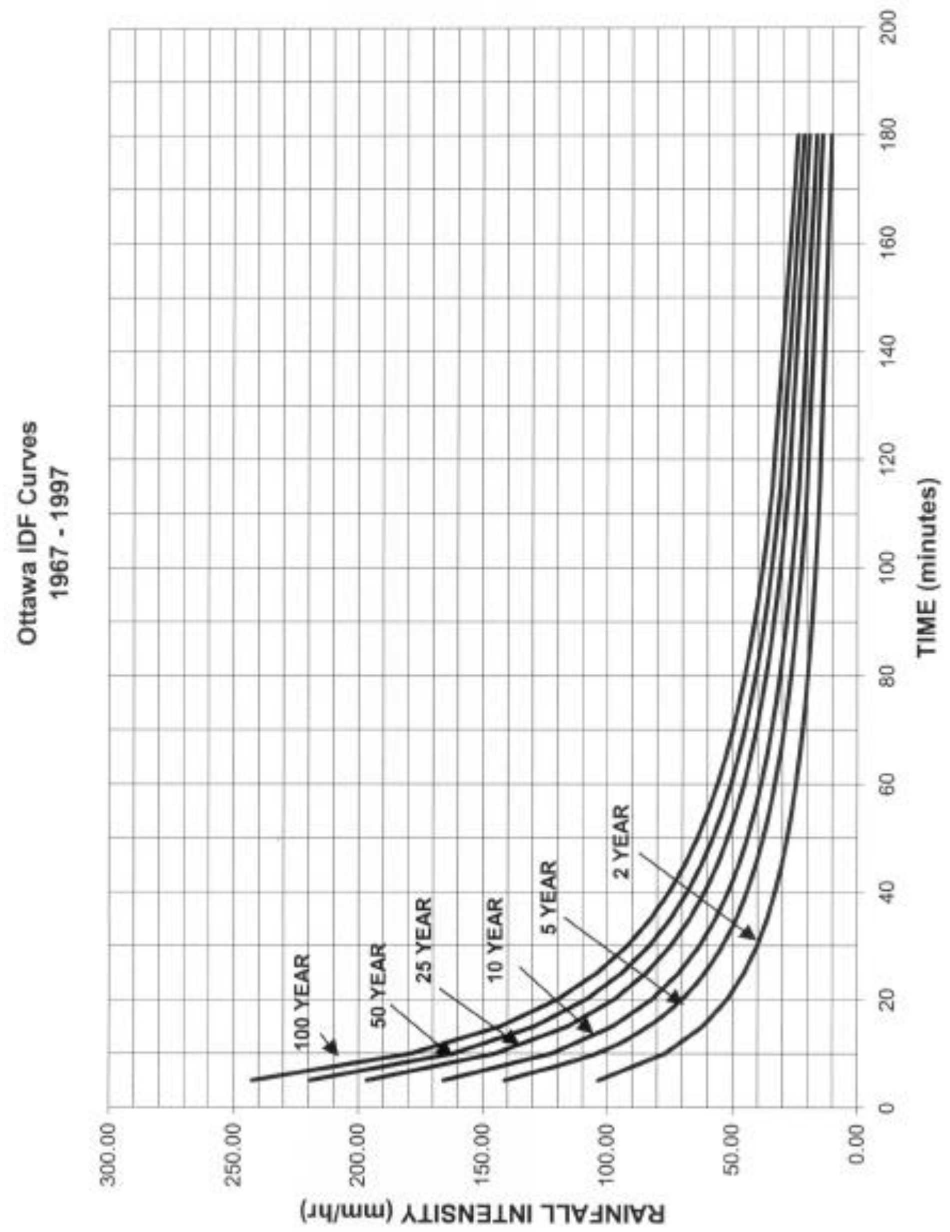
PROJECT:
Kanata North Community Design Plan
CLIENT:
Kanata North Land Owners
Date: May, 2016

Notes:
1. Existing sanitary sewers tributary to, and not receiving flow from the KNUEA Trunk sewer have not been analysed for capacity
2. Existing unit counts obtained from City of Ottawa geoOttawa (2014) parcel counts, unless otherwise indicated
3. Low Density based on (16.6 Singles/net ha * 3.4pers/unit) + (16.5 Towns/net ha * 2.7pers/unit)
4. High Density based on (35.8 Towns/net ha * 2.7pers/unit) + (35.8 Apartments/net ha * 1.8pers/unit)
5. Overall unit counts for the KNCDP are based on Demonstration Plan "A-24", plus 10% to allow for flexibility in unit type distribution

Upgraded Existing Sanitary Sewers

APPENDIX D
Stormwater Management Calculations

APPENDIX 5-A OTTAWA INTENSITY DURATION FREQUENCY (IDF) CURVE



RATIONAL METHOD

The Rational Method was used to determine both the allowable runoff as well as the post-development runoff for the proposed site. The equation is as follows:

$Q=2.78\ CIA$

Where:
Q is the runoff in L/s
C is the weighted runoff coefficient*
I is the rainfall intensity in mm/hr**
A is the area in hectares

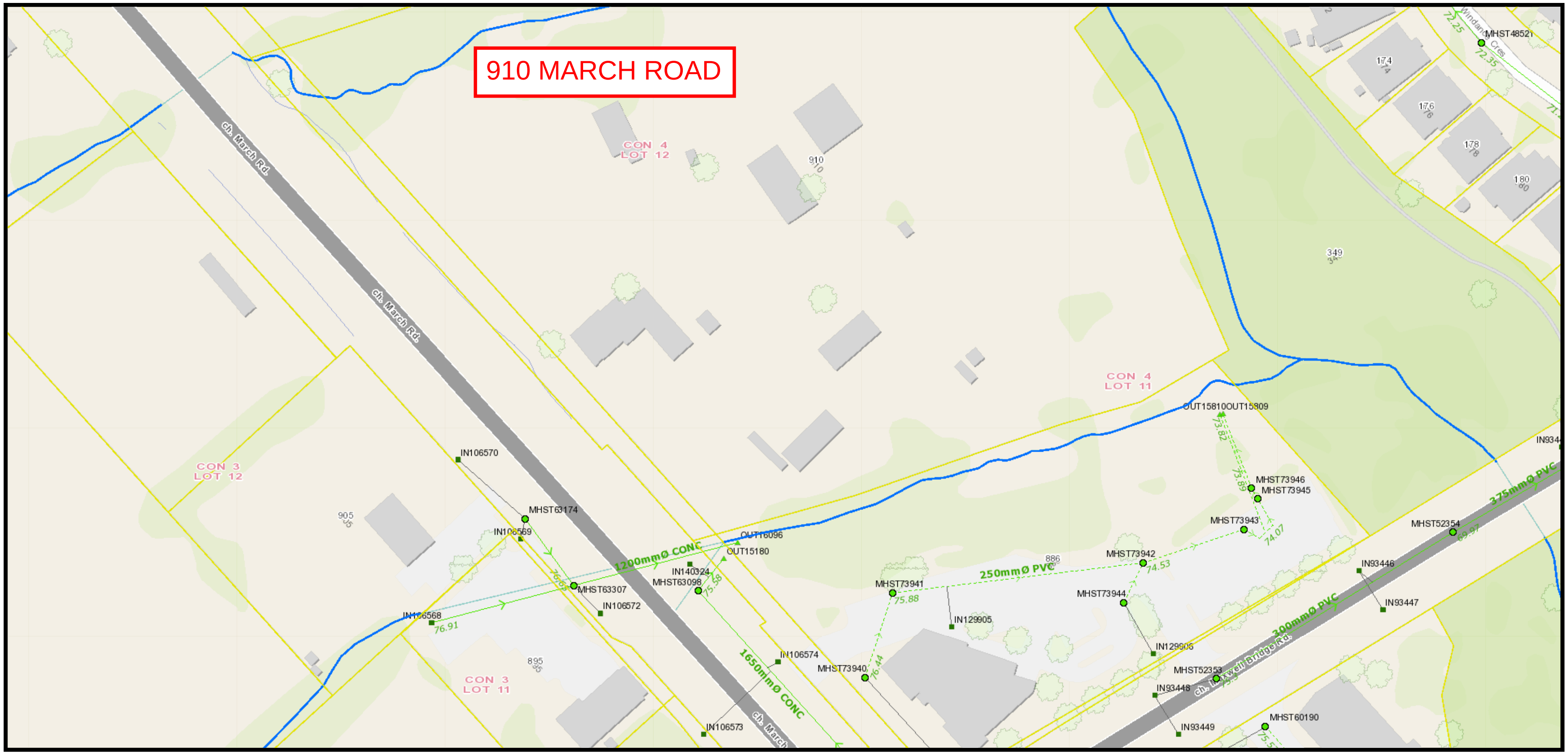
*The weighted runoff coefficient is determined for each of the catchment areas as follows:

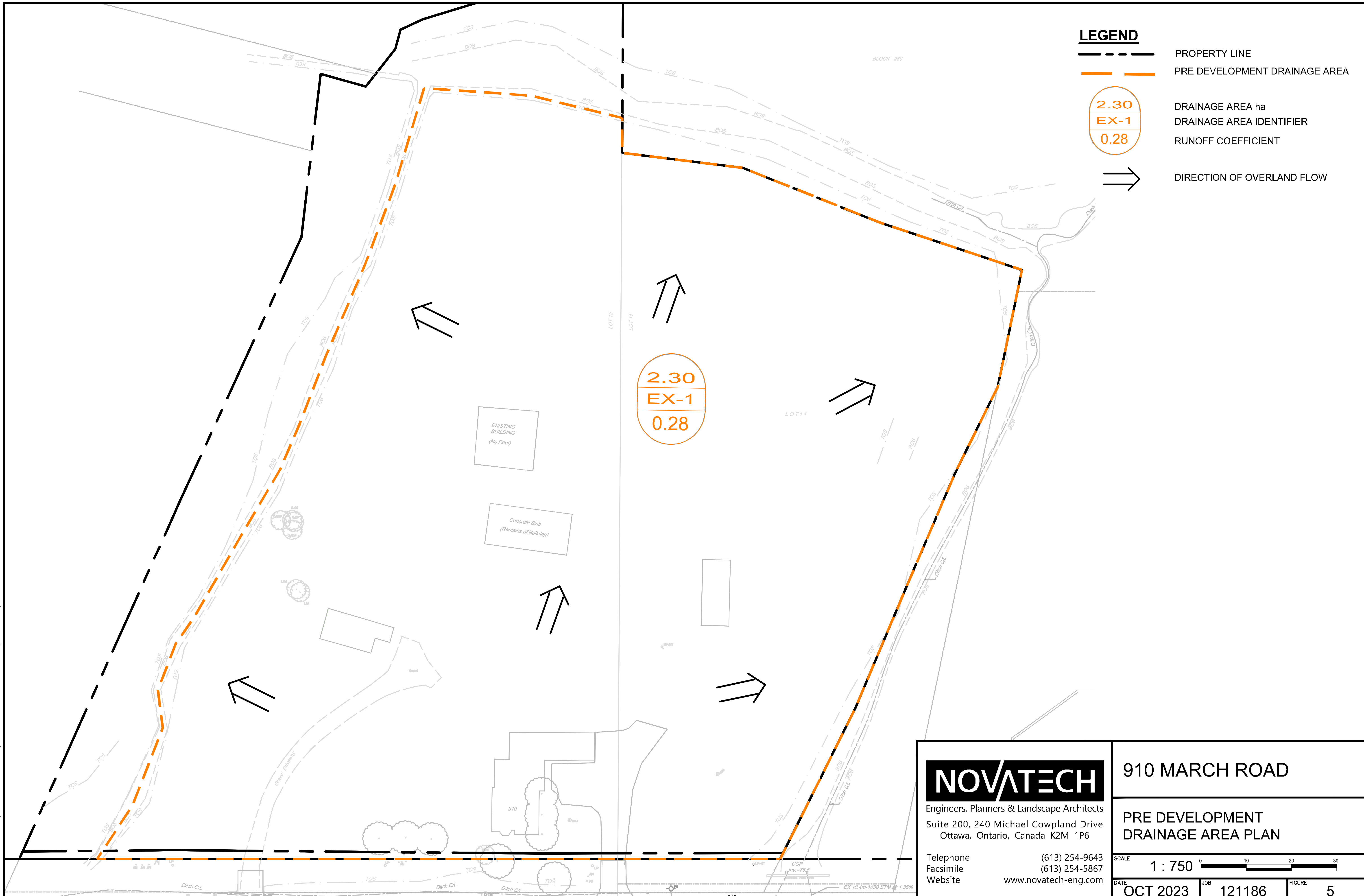
$$C = \frac{(A_p \times C_p) + (A_{imp} \times C_{imp})}{A_{tot}}$$

Where:
A_p is the pervious area in hectares
C_p is the pervious area runoff coefficient (C_{perv}=0.20)
A_{imp} is the impervious area in hectares
C_{imp} is the impervious area runoff coefficient (C_{imp}=0.90)
A_{tot} is the catchment area (A_{perv} + A_{imp}) in hectares

** The rainfall intensity is taken from the City of Ottawa IDF Curves using a time of concentration (tc) of 10 minutes resulting in a rainfall intensity of 104.2mm/hr and 178.6mm/hr for the 1:5 year and 1:100 year design events respectively.

Note: The post-development C values are to be increased by 25% for the 1:100 year event (max. C_{imp}=1.0).


910 MARCH ROAD
ch. March Rd.
CON 4
LOT 12
CON 4
LOT 11
CON 3
LOT 12
CON 3
LOT 11
1200mmØ CONC
1650mmØ CONC
250mmØ PVC
300mmØ PVC
375mmØ PVC
ch. Terwell Bridge Rd.



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Telephone (613) 254-9643
Facsimile (613) 254-5867
Website www.novatech-eng.com

910 MARCH ROAD

PRE DEVELOPMENT DRAINAGE AREA PLAN

SCALE	DATE	JOB	FIGURE
1 : 750	OCT 2023	121186	5

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SHT11X17.DWG - 279mmX432mm

LEGEND

PROPERTY LINE

PROPOSED STORM SEWER AND MANHOLE

PROPOSED CATCHBASIN

PROPOSED AREA DECK DRAIN BY OTHERS
(REFER TO MECH DRAWINGS FOR MORE INFO)

PROPOSED CATCHBASIN MANHOLE

DRAINAGE AREA BOUNDARY

1.167 / A1 / 0.90	DRAINAGE AREA (ha) DRAINAGE AREA ID RUNOFF COEFFICIENT

NOVATECH
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Ottawa, Ontario, Canada K2M 1P6

Telephone (613) 254-9643
Facsimile (613) 254-5867
Website www.novatech-eng.com

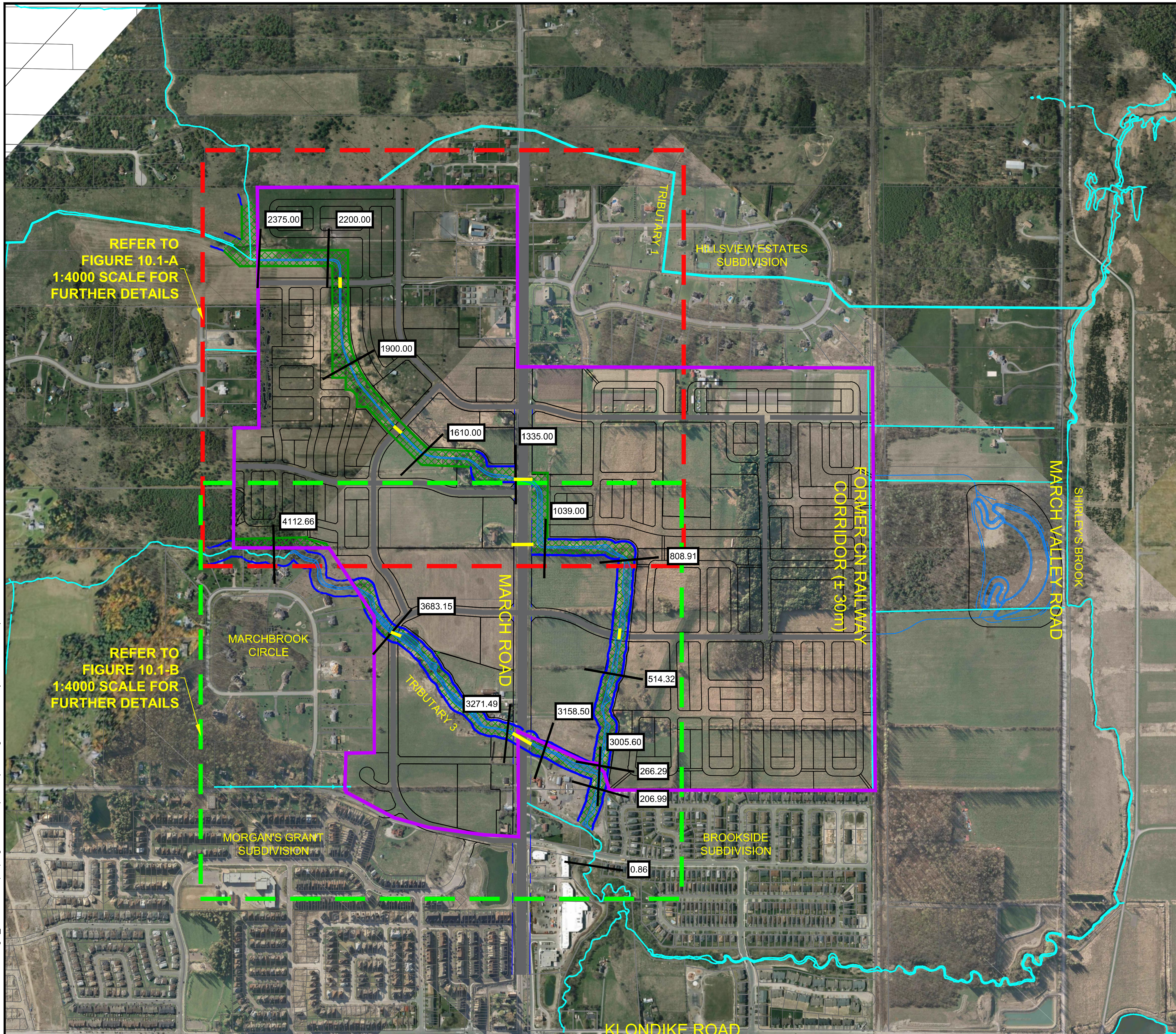
910 MARCH ROAD

POST DEVELOPMENT DRAINAGE AREA PLAN

SCALE	DATE	JOB	FIGURE
1 : 750	JUN 2024	121186	6

M:\2021\121186\CAD\Design\121186-SWM.dwg, SWM-11x17, Jun 18, 2024 - 9:19am, jappiahkubi

SHT11X17.DWG - 279mmX432mm



LEGEND

- KNUEA
- DRAINAGE CHANNEL
- PROPOSED CULVERT (1.8m WIDE x 1.2m HIGH)
- PROPOSED TRIBUTARY REALIGNMENT
- RETAINED TRIBUTARY CORRIDOR
- 2375.00 HEC-RAS STATION

TRIBUTARY 2			
STATION	2-YEAR WL	5-YEAR WL	100-YEAR WL
2375.00	88.64	88.69	88.85
2200.00	87.61	87.67	87.83
1900.00	85.98	86.04	86.19
1610.00	82.24	82.33	82.55
1335.00	79.20	79.30	79.52
1039.00	78.70	78.76	78.93
808.91	77.89	77.90	77.96
514.32	76.59	76.66	76.80
266.29	74.76	74.83	75.02
TRIBUTARY 3			
STATION	2-YEAR WL	5-YEAR WL	100-YEAR WL
4112.66	89.35	89.38	89.46
3683.15	81.68	81.78	82.10
3271.49	77.81	77.97	78.31
3158.50	76.69	76.76	76.93
3005.60	74.51	74.59	74.78
NORTHWEST BRANCH (CONFLUENCE OF TRIBUTARIES 2 & 3)			
STATION	2-YEAR WL	5-YEAR WL	100-YEAR WL
206.99	74.39	74.43	74.55
0.86	71.88	71.95	72.13

KANATA NORTH
COMMUNITY DESIGN PLAN

FIGURE NO. 10.1
PROPOSED FLOODPLAIN LIMITS

DATE MAY 2016
JOB 112117
SCALE 1:10,000
0 50 100m 200m

NOVATECH
Engineers, Planners & Landscape Architects

M:\2012\112117\CAD\Design_EMP\MEMO (CS)\Figure 10.1 Prop Floodplain.dwg, FIG-10.1, May 26, 2016 - 1:50pm, bthurber

SHT11x17.DWG - 279mmx432mm

Time to Peak Calculations - Existing Conditions

Time of Concentration (Uplands Overland Flow Method)

Area ID	Overland Flow						Channel Flow			Overall	
	Length (m)	Elevation U/S (m)	Elevation D/S (m)	Slope (%)	Velocity (Uplands) (m/s)	Travel Time (min)	Length (m)	Velocity * (m/s)	Travel Time (min)	Time of Concentration (min)	Time to Peak (min)
EX-1	120	78.39	74.32	3.4%	0.4	5	N/A	N/A	N/A	5	3

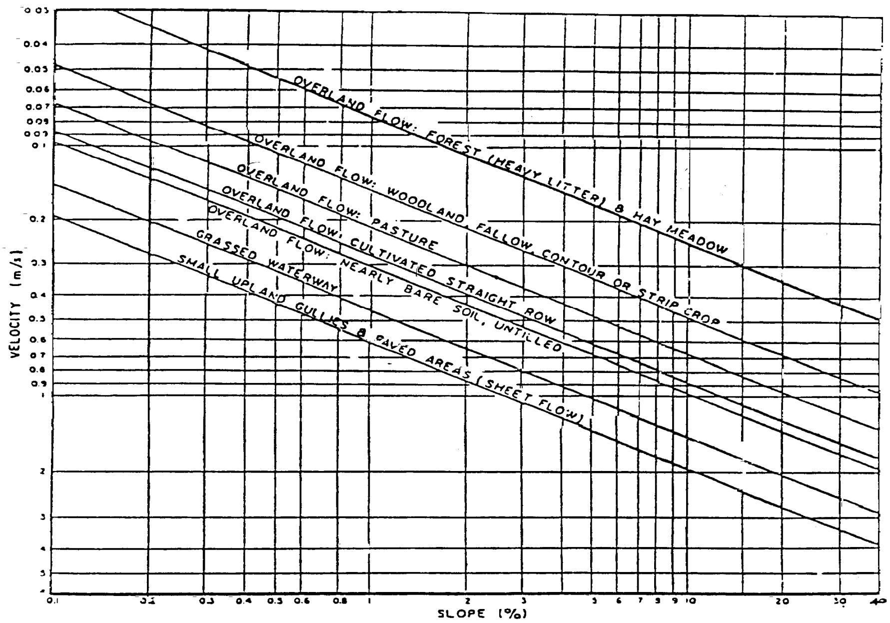


Figure A.5.2: Upland Method for Estimating Time of Concentration (SCS National Engineering Handbook, 1971)

TABLE 1A: Pre-Development Runoff Coefficient "C" - EX-1

Area	Surface	Ha	"C"	C_{avg}	*C_{100}
Total	Hard	0.11	0.90	0.28	0.34
2.300	Gravel	0.20	0.70		
	Soft	1.99	0.20		

Runoff Coefficient Equation

$C = (A_{hard} \times 0.9 + A_{soft} \times 0.2)/A_{Tot}$

* Runoff Coefficient increases by 25% up to a maximum value of 1.00 for the 100-Year event

TABLE 1B: Pre-Development / Allowable EX-1 Flows

Outlet Options	Area (ha)	C_{avg}	Tc (min)	$Q_{2\ Year}$ (L/s)	$Q_{5\ Year}$ (L/s)	$Q_{100\ Year}$ (L/s)
EX Ditch	2.30	0.28	10	**135.7**	**184.1**	**387.8**

Time of Concentration	Tc=	10	min
Intensity (2 Year Event)	I_2=	76.81	mm/hr
Intensity (5 Year Event)	I_5=	104.19	mm/hr
Intensity (100 Year Event)	I_{100}=	178.56	mm/hr

Equations:

Flow Equation

$Q = 2.78 \times C \times I \times A$

Where:

C is the runoff coefficient

I is the rainfall intensity, City of Ottawa IDF

A is the total drainage area

100 year Intensity = $1735.688 / (\text{Time in min} + 6.014)^{0.820}$

5 year Intensity = $998.071 / (\text{Time in min} + 6.053)^{0.814}$

2 year Intensity = $732.951 / (\text{Time in min} + 6.199)^{0.810}$

TABLE 2A: Post-Development Runoff Coefficient "C" - POST CATCHMENT A1

			5 Year Event		100 Year Event	
Area	Surface	Ha	"C"	C_{avg}	"C" + 25%	*C_{avg}
Total	Hard	1.171	0.90	0.90	1.00	1.00
1.171	Roof	0.000	0.90		1.00	
	Soft	0.000	0.20		0.25	

TABLE 2B: Post-Development Runoff Coefficient "C" - POST CATCHMENT A2

			5 Year Event		100 Year Event	
Area	Surface	Ha	"C"	C_{avg}	"C" + 25%	*C_{avg}
Total	Hard	0.028	0.90	0.62	1.00	0.70
0.047	Roof	0.000	0.90		1.00	
	Soft	0.019	0.20		0.25	

TABLE 2C: Post-Development Runoff Coefficient "C" - POST CATCHMENT A3

			5 Year Event		100 Year Event	
Area	Surface	Ha	"C"	C_{avg}	"C" + 25%	*C_{avg}
Total	Hard	0.021	0.90	0.86	1.00	0.95
0.022	Roof	0.000	0.90		1.00	
	Soft	0.001	0.20		0.25	

TABLE 2D: Post-Development Runoff Coefficient "C" - POST CATCHMENT A4

			5 Year Event		100 Year Event	
Area	Surface	Ha	"C"	C_{avg}	"C" + 25%	*C_{avg}
Total	Hard	0.027	0.90	0.87	1.00	0.96
0.028	Roof	0.000	0.90		1.00	
	Soft	0.001	0.20		0.25	

TABLE 2E: Post-Development Runoff Coefficient "C" - POST CATCHMENT A5

			5 Year Event		100 Year Event	
Area	Surface	Ha	"C"	C_{avg}	"C" + 25%	*C_{avg}
Total	Hard	0.023	0.90	0.74	1.00	0.83
0.030	Roof	0.000	0.90		1.00	
	Soft	0.007	0.20		0.25	

TABLE 2F: Post-Development Runoff Coefficient "C" - POST CATCHMENT A 1-5

			5 Year Event		100 Year Event	
Area	Surface	Ha	"C"	C_{avg}	"C" + 25%	*C_{avg}
Total	Hard	1.269	0.90	0.88	1.00	0.98
1.298	Roof	0.000	0.90		1.00	
	Soft	0.029	0.20		0.25	

Notes: Refer to PCSWMM model results for flow rates, ponding elevations and storage volume requirements.

TABLE 3A: Post-Development Runoff Coefficient "C" - POST CATCHMENT B1

Area	Surface	Ha	"C"	C_{avg}	$*C_{100}$
Total	Hard	0.037	0.90	0.29	0.35
0.274	Soft	0.237	0.20		

Runoff Coefficient Equation

$C = (A_{hard} \times 0.9 + A_{soft} \times 0.2)/A_{Tot}$

* Runoff Coefficient increases by 25% up to a maximum value of 1.00 for the 100-Year event

TABLE 3B: Post-Development Flows - POST CATCHMENT B1

Outlet Options	Area (ha)	C_{avg}	Tc (min)	$Q_{2\ Year}$ (L/s)	$Q_{5\ Year}$ (L/s)	$Q_{100\ Year}$ (L/s)
Tributary 4	0.274	0.29	10	**17.2**	**23.4**	**47.8**

Time of Concentration	Tc=	10	min
Intensity (2 Year Event)	I_2=	76.81	mm/hr
Intensity (5 Year Event)	I_5=	104.19	mm/hr
Intensity (100 Year Event)	I_{100}=	178.56	mm/hr

100 year Intensity = 1735.688 / (Time in min + 6.014) $^{0.820}$
5 year Intensity = 998.071 / (Time in min + 6.053) $^{0.814}$
2 year Intensity = 732.951 / (Time in min + 6.199) $^{0.810}$

Equations:
Flow Equation
$Q = 2.78 \times C \times I \times A$
Where:
C is the runoff coefficient
I is the rainfall intensity, City of Ottawa IDF
A is the total drainage area

TABLE 4A: Post-Development Runoff Coefficient "C" - POST CATCHMENT B2

Area	Surface	Ha	"C"	C_{avg}	*C_{100}
Total	Hard	0.020	0.90	0.25	0.31
0.250	Soft	0.230	0.20		

Runoff Coefficient Equation
$C = (A_{hard} \times 0.9 + A_{soft} \times 0.2)/A_{Tot}$
* Runoff Coefficient increases by 25% up to a maximum value of 1.00 for the 100-Year event

TABLE 4B: Post-Development Flows - POST CATCHMENT B2

Outlet Options	Area (ha)	C_{avg}	Tc (min)	$Q_{2\ Year}$ (L/s)	$Q_{5\ Year}$ (L/s)	$Q_{100\ Year}$ (L/s)
Tributary 2	0.250	0.25	10	**13.6**	**18.5**	**38.3**

Time of Concentration	Tc=	10	min
Intensity (2 Year Event)	I_2=	76.81	mm/hr
Intensity (5 Year Event)	I_5=	104.19	mm/hr
Intensity (100 Year Event)	I_{100}=	178.56	mm/hr

100 year Intensity = $1735.688 / (\text{Time in min} + 6.014)^{0.820}$
5 year Intensity = $998.071 / (\text{Time in min} + 6.053)^{0.814}$
2 year Intensity = $732.951 / (\text{Time in min} + 6.199)^{0.810}$

Equations:
Flow Equation
$Q = 2.78 \times C \times I \times A$
Where:
C is the runoff coefficient
I is the rainfall intensity, City of Ottawa IDF
A is the total drainage area

TABLE 5A: Post-Development Runoff Coefficient "C" - POST CATCHMENT B3

Area	Surface	Ha	"C"	C_{avg}	$*C_{100}$
Total	Hard	0.020	0.90	0.23	0.28
0.476	Soft	0.456	0.20		

Runoff Coefficient Equation
$C = (A_{hard} \times 0.9 + A_{soft} \times 0.2)/A_{Tot}$
* Runoff Coefficient increases by 25% up to a maximum value of 1.00 for the 100-Year event

TABLE 5B: Post-Development Flows - POST CATCHMENT B3

Outlet Options	**Area (ha)**	**C_{avg}**	**Tc (min)**	**$Q_{2\ Year}$ (L/s)**	**$Q_{5\ Year}$ (L/s)**	**$Q_{100\ Year}$ (L/s)**
Tributary 3	0.476	0.23	10	**23.3**	**31.6**	**66.5**

Time of Concentration	Tc=	10	min
Intensity (2 Year Event)	I_2=	76.81	mm/hr
Intensity (5 Year Event)	I_5=	104.19	mm/hr
Intensity (100 Year Event)	I_{100}=	178.56	mm/hr

100 year Intensity = $1735.688 / (\text{Time in min} + 6.014)^{0.820}$
5 year Intensity = $998.071 / (\text{Time in min} + 6.053)^{0.814}$
2 year Intensity = $732.951 / (\text{Time in min} + 6.199)^{0.810}$

Equations:
Flow Equation
$Q = 2.78 \times C \times I \times A$
Where:
C is the runoff coefficient
I is the rainfall intensity, City of Ottawa IDF
A is the total drainage area

Table 6: Post-Development Stormwater Mangement Summary

Area ID	Area (ha)	1:5 Year Weighted Cw	1:100 Year Weighted Cw	Outlet Location	Orifice	2 Year Storm Event			5 Year Storm Event			100 Year Storm Event		
						Release (L/s)	Ponding Depth (m)	Req'd Vol (cu.m)	Release (L/s)	Ponding Depth (m)	Req'd Vol (cu.m)	Release (L/s)	Ponding Depth (m)	Req'd Vol (cu.m)
A(1-5)	1.298	0.88	0.98	Tributary 3	N/A	79.4	0.84	162.0	107.2	1.14	222.0	220.9	1.92	384.0
B1	0.274	0.29	0.35	Tributary 4	N/A	17.2	N/A	0.0	23.4	N/A	0.0	47.8	N/A	0.0
B2	0.250	0.25	0.31	Tributary 2	N/A	13.6	N/A	0.0	18.5	N/A	0.0	38.3	N/A	0.0
B3	0.476	0.23	0.28	Tributary 3	N/A	23.3	N/A	0.0	31.6	N/A	0.0	66.5	N/A	0.0
Total						**133.5**			**180.7**			**373.5**		**384.0**
Allowable						**135.7**			**184.1**			**387.8**		

STORM SEWER DESIGN SHEET

NOVATECH
Engineers, Planners & Landscape Architects

Novatech Project #: 121186
Project Name: 910 March Road
Date Prepared: 3/24/2023
Date Revised: 6/21/2024
Input By: SM
Reviewed By: CJR
Drawing Reference: 121186-STM

Legend:
PROJECT SPECIFIC INFO
USER DESIGN INPUT
CUMILATIVE CELL
CALCULATED DESIGN CELL OUTPUT
USER AS-BUILT INPUT

LOCATION		DEMAND															CAPACITY								
		AREA							FLOW								PROPOSED SEWER PIPE SIZING / DESIGN								
From MH	To MH	Area ID	Building	Pavement	Gravel	Landscaped area	Total Area	Weighted Runoff Coefficient	Indivi 2.78 AR	Accum 2.78 AR	Time of Concentration	Rain Intensity (mm/hr) 2yr	5yr	100yr	Peak Flow	TOTAL PEAK FLOW (QDesign)	PIPE PROPERTIES LENGTH	SIZE / MATERIAL	ID ACTUAL	ROUGHNESS	DESIGN GRADE	CAPACITY	FULL FLOW VELOCITY	TIME OF FLOW	QPEAK DESIGN / QFULL
			0.90	0.90	0.60	0.20	(ha)				(min.)				(L/s)	(L/s)	(m)	(mm / type)	(m)		(%)	(L/s)	(m/s)	(min.)	(%)
CB-1	CBMH-103	A2	0.00	0.00 0.03 0.00		0.02	0.047	0.62	0.00 0.08 0.00	0.00 0.08 0.00	10.00 10.00 10.00	76.81			0.00 6.18 0.00	**6.2**	21.6	250 PVC	0.254	0.013	1.00	62.0	1.22	0.29	10.0%
CB-2	CBMH-103	A4		0.00 0.03 0.00		0.00	0.028	0.87	0.00 0.07 0.00	0.00 0.07 0.00	10.00 10.00 10.00	76.81			0.00 5.17 0.00	**5.2**	13.1	250 PVC	0.254	0.013	1.00	62.0	1.22	0.18	8.3%
CBMH-103	CBMH-102	A3		0.00 0.02 0.00		0.00	0.022	0.86	0.00 0.05 0.00	0.00 0.20 0.00	10.18 10.18 10.18	76.13			0.00 15.23 0.00	**15.2**	25.0	250 PVC	0.254	0.013	1.00	62.0	1.22	0.34	24.6%
CBMH-102	STMMH-101	A5		0.00 0.02 0.00		0.01	0.030	0.74	0.00 0.06 0.00	0.00 0.26 0.00	10.52 10.52 10.52	74.87			0.00 19.58 0.00	**19.6**	17.7	250 PVC	0.254	0.013	1.00	62.0	1.22	0.24	31.6%
SWM TANK	STMMH-101	A1		0.00 1.17 0.00			1.167	0.90	0.00 2.92 0.00	0.00 2.92 0.00	10.76 10.76 10.76	74.01			0.00 0.00 0.00	**79.1**	3.9	450 PVC	0.4572	0.013	0.50	210.3	1.28	0.05	37.6%
STMMH-101	OGS			0.00 0.00 0.00					0.00 0.00 0.00	0.00 3.18 0.00	10.81 10.81 10.81	73.83			0.00 0.00 0.00	**79.1**	3.8	450 PVC	0.4572	0.013	0.50	210.3	1.28	0.05	37.6%
OGS	OUTLET			0.00 0.00 0.00					0.00 0.00 0.00	0.00 3.18 0.00	10.86 10.86 10.86	73.65			0.00 0.00 0.00	**79.1**	11.5	450 PVC	0.4572	0.013	0.50	210.3	1.28	0.15	37.6%

DEMAND EQUATION
Q = 2.78 AIR

Where : **Q = Peak flow in litres per second (L/s)**
A = Area in hectares (ha)
R = Weighted runoff coefficient (increased by 25% for 100-year)
I = Rainfall intensity in millimeters per hour (mm/hr)
Rainfall Intensity (I) is based on City of Ottawa IDF data presented in the City of Ottawa Sewer Design Guidelines (Oct. 2012)

Note: Peak design flow values downstream of the SWM tank were taken from PCSWMM Model results. Refer to Novatech Site Servicing and SWM Report for further details.

CAPACITY EQUATION
Q full= (1/n) A R^(2/3)So^(1/2)

Where : **Q full = Capacity (L/s)**
n = Manning coefficient of roughness (0.013)
A = Flow area (m^2)
R = Wetter perimenter (m)
So = Pipe Slope/gradient

CONTECH ENGINEERED SOLUTIONS

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD BASED ON A FINE PARTICLE SIZE DISTRIBUTION

CDS TECHNOLOGIES

Project Name: 910 March Rd.
Location: Kanata, ON
OGS #: Scenario 1

Engineer: NOVATECH
Contact: Matthew Hrehoriak, P.Eng.
Report Date: 8-Feb-23

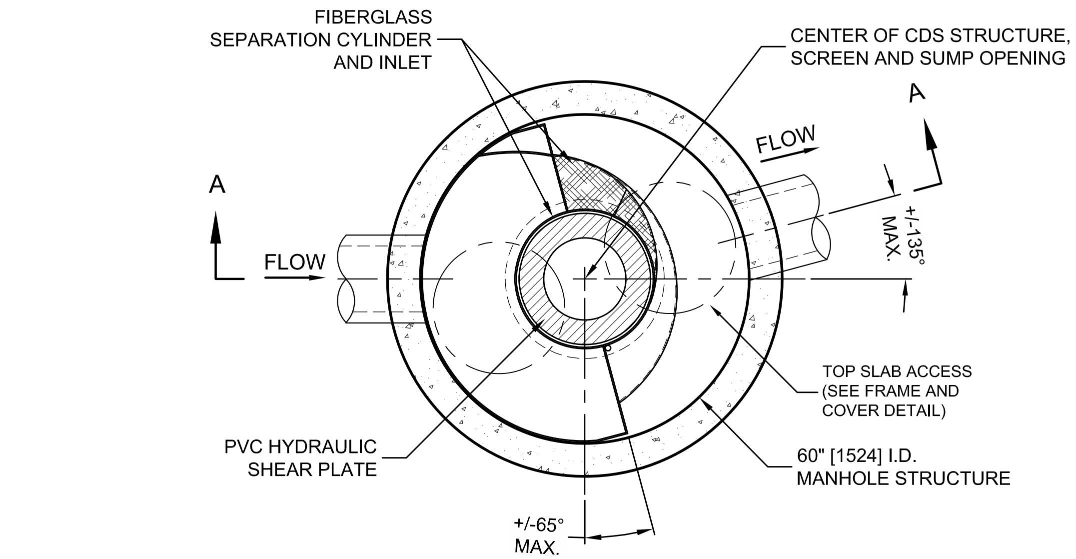
Area 1.31 ha
Weighted C 0.90
CDS Model 2025

Rainfall Station # 215
Particle Size Distribution FINE
CDS Treatment Capacity 45 l/s

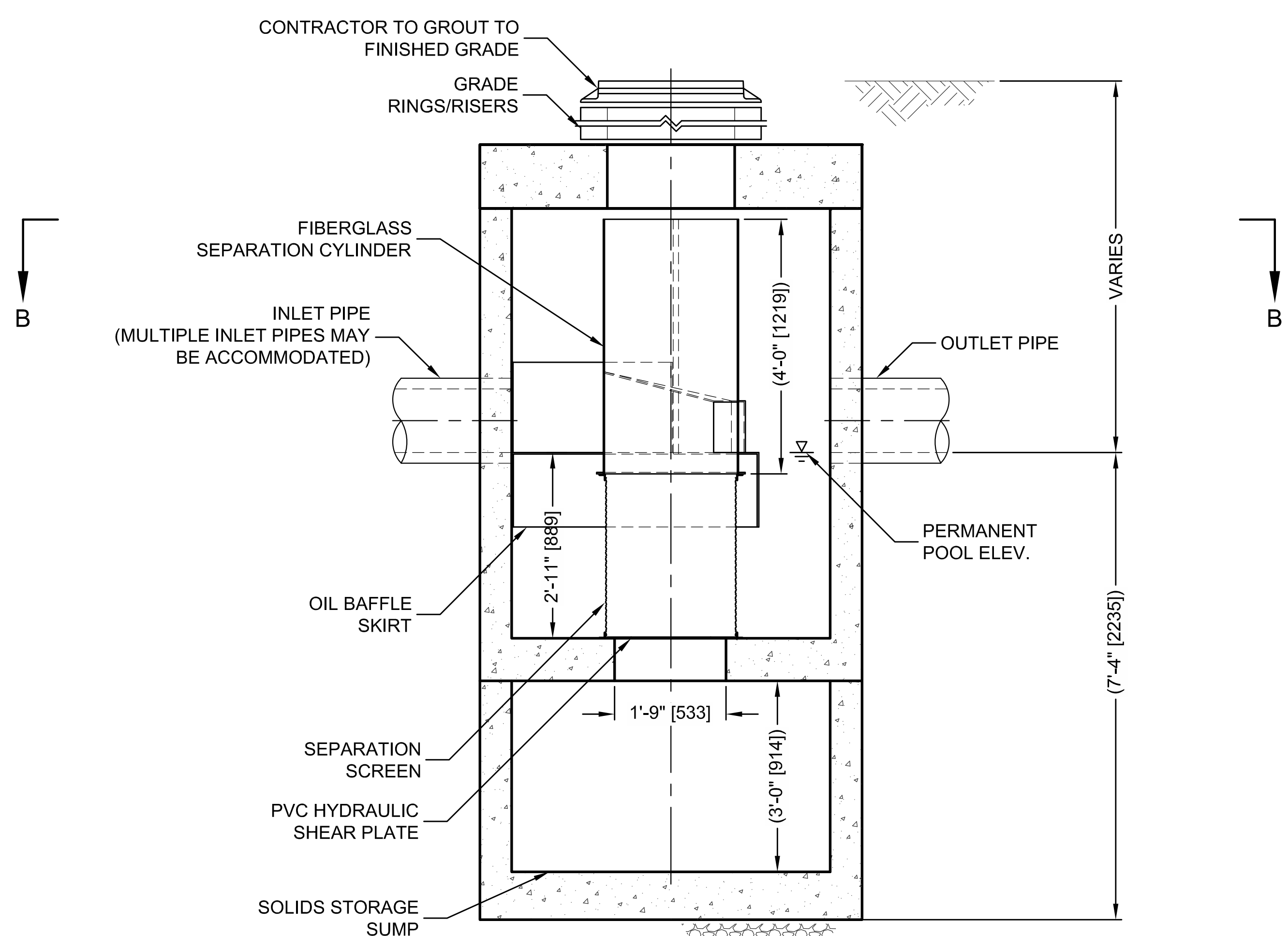
Rainfall Intensity[1] (mm/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (l/s)	Treated Flowrate (l/s)	Operating Rate (%)	Removal Efficiency (%)	Incremental Removal (%)
0.5	9.2%	9.2%	1.6	1.6	3.6	97.8	9.0
1.0	10.6%	19.8%	3.3	3.3	7.2	96.8	10.3
1.5	9.9%	29.7%	4.9	4.9	10.9	95.7	9.5
2.0	8.4%	38.1%	6.6	6.6	14.5	94.7	7.9
2.5	7.7%	45.8%	8.2	8.2	18.1	93.7	7.2
3.0	5.9%	51.7%	9.8	9.8	21.7	92.6	5.5
3.5	4.4%	56.1%	11.5	11.5	25.3	91.6	4.0
4.0	4.7%	60.7%	13.1	13.1	28.9	90.6	4.2
4.5	3.3%	64.0%	14.7	14.7	32.6	89.5	3.0
5.0	3.0%	67.1%	16.4	16.4	36.2	88.5	2.7
6.0	5.4%	72.4%	19.7	19.7	43.4	86.4	4.7
7.0	4.4%	76.8%	22.9	22.9	50.6	84.3	3.7
8.0	3.5%	80.3%	26.2	26.2	57.9	82.3	2.9
9.0	2.8%	83.2%	29.5	29.5	65.1	80.2	2.3
10.0	2.2%	85.3%	32.8	32.8	72.3	78.1	1.7
15.0	7.0%	92.3%	49.2	45.3	100.0	64.7	4.5
20.0	4.5%	96.9%	65.6	45.3	100.0	48.5	2.2
25.0	1.4%	98.3%	81.9	45.3	100.0	38.8	0.6
30.0	0.7%	99.0%	98.3	45.3	100.0	32.3	0.2
35.0	0.5%	99.5%	114.7	45.3	100.0	27.7	0.1
40.0	0.5%	100.0%	131.1	45.3	100.0	24.3	0.1
45.0	0.0%	100.0%	147.5	45.3	100.0	21.6	0.0
50.0	0.0%	100.0%	163.9	45.3	100.0	19.4	0.0
							86.2
						Removal Efficiency Adjustment[2] =	6.5%
						Predicted Net Annual Load Removal Efficiency =	**80%**
						Predicted Annual Rainfall Treated =	**96%**

1 - Based on 42 years of hourly rainfall data from Canadian Station 6105976, Ottawa ON

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.



PLAN VIEW B-B
N.T.S.

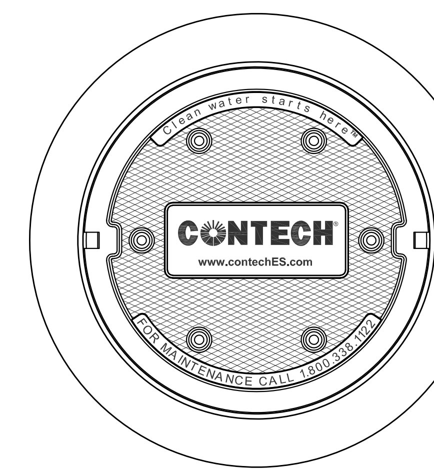


ELEVATION A-A
N.T.S.

CDS PMSU2025-5-C DESIGN NOTES

THE STANDARD CDS PMSU2025-5-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES
CUSTOMIZABLE SUMP DEPTH AVAILABLE
ANTI-FLOTATION DESIGN AVAILABLE UPON REQUEST



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS OR L/s)			*
PEAK FLOW RATE (CFS OR L/s)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*
NOTES/SPECIAL REQUIREMENTS:			

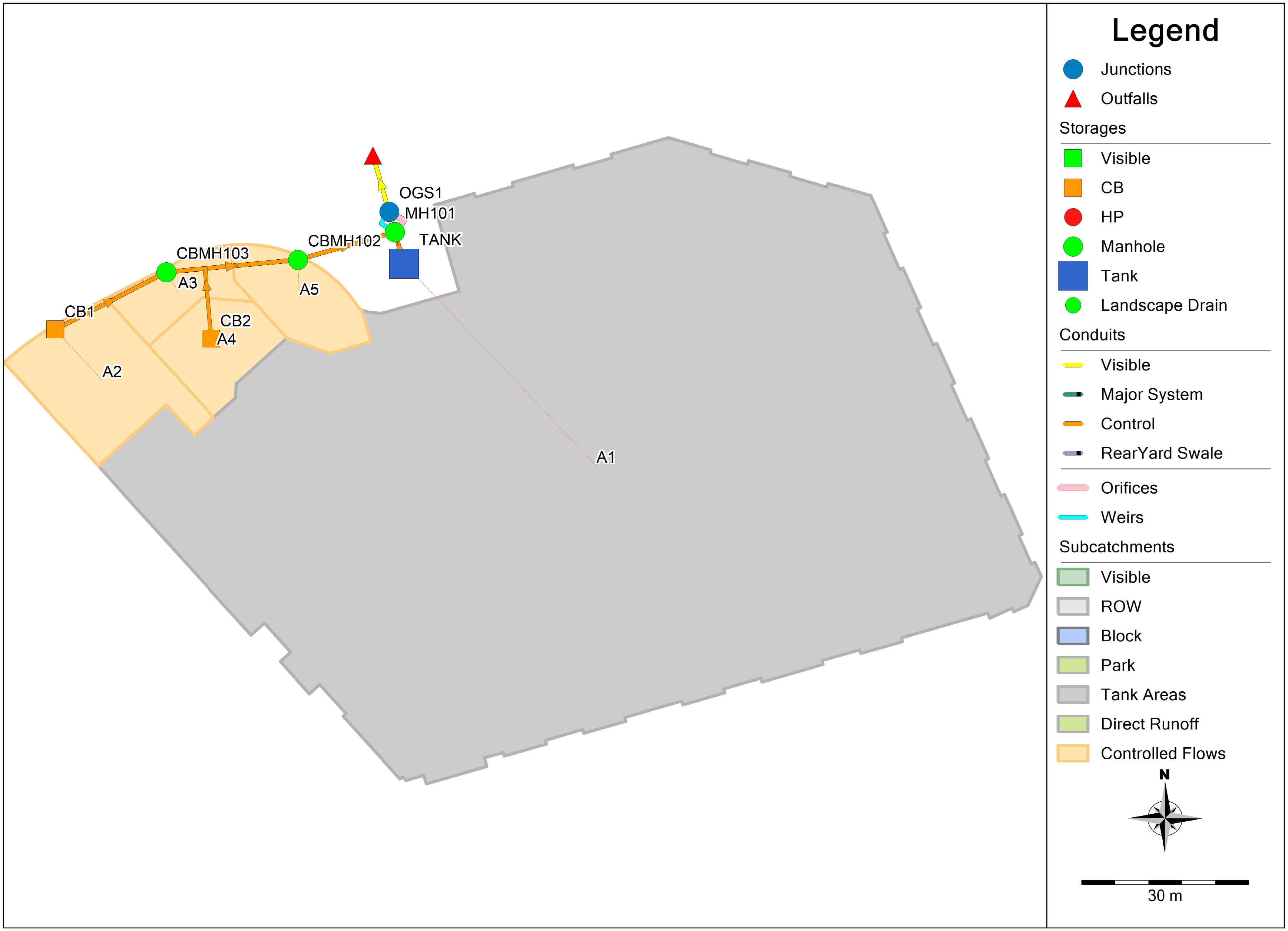
* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET HS20 (AASHTO M 306) LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS PMSU2025-5-C
INLINE CDS
STANDARD DETAIL


OGS1
MH101
TANK
CBMH102
CBMH103
A3
A5
CB1
CB2
A4
A2
A1
Legend
Junctions
Outfalls
Storages
Visible
CB
HP
Manhole
Tank
Landscape Drain
Conduits
Visible
Major System
Control
RearYard Swale
Orifices
Weirs
Subcatchments
Visible
ROW
Block
Park
Tank Areas
Direct Runoff
Controlled Flows
N
30 m

2 Year 3Hr Chicago Storm PCSWMM Results

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
--------------------------------------------------------------

WARNING 03: negative offset ignored for Link 2-103

*************
Element Count
*************
Number of rain gages ...... 1
Number of subcatchments ... 5
Number of nodes ........... 8
Number of links ........... 9
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                           Data       Recording
Name                 Data Source                           Type       Interval
------------------------------------------------------------------------------
Raingage1            C3-5                                  INTENSITY   10 min.


********************
Subcatchment Summary
********************
Name                        Area     Width   %Imperv    %Slope Rain Gage            Outlet
-----------------------------------------------------------------------------------------------------------
A1                          1.17    778.00    100.00    2.0000 Raingage1            TANK
A2                          0.05     23.50     60.00    2.0000 Raingage1            CB1
A3                          0.02     14.67     94.00    2.0000 Raingage1            CBMH103
A4                          0.03     21.54     96.00    2.0000 Raingage1            CB2
A5                          0.03     15.79     77.00    2.0000 Raingage1            CBMH102


************
Node Summary
************
```

```
                                            Invert      Max.    Ponded    External
Name                 Type                    Elev.     Depth      Area    Inflow
-------------------------------------------------------------------------------
OGS1                 JUNCTION                76.44      2.71       0.0
TANKOUTLET           OUTFALL                 76.39      0.45       0.0
CB1                  STORAGE                 77.23      1.62       0.0
CB2                  STORAGE                 77.10      1.98       0.0
CBMH102              STORAGE                 76.75      2.25       0.0
CBMH103              STORAGE                 77.01      1.99       0.0
MH101                STORAGE                 76.46      2.77       0.0
TANK                 STORAGE                 76.50      2.90       0.0


************
Link Summary
************
Name             From Node        To Node          Type            Length    %Slope Roughness
---------------------------------------------------------------------------------------------
102-101          CBMH102          MH101            CONDUIT           17.7    1.0170    0.0130
103-102          CBMH103          CBMH102          CONDUIT           25.0    1.0001    0.0130
1-103            CB1              CBMH103          CONDUIT           21.6    0.9723    0.0130
2-103            CB2              CBMH103          CONDUIT           13.1    0.6870    0.0130
STM-11_(STM)     OGS1             TANKOUTLET       CONDUIT           10.5    0.4773    0.0130
Tank-101         TANK             MH101            CONDUIT            3.9    0.5128    0.0130
ICD1A            MH101            OGS1             ORIFICE
OR1B             MH101            OGS1             ORIFICE
W1               MH101            OGS1             WEIR


*********************
Cross Section Summary
*********************
                                        Full     Full     Hyd.     Max.   No. of     Full
Conduit          Shape                 Depth     Area     Rad.    Width  Barrels     Flow
---------------------------------------------------------------------------------------
102-101          CIRCULAR               0.25     0.05     0.06     0.25        1    59.97
103-102          CIRCULAR               0.25     0.05     0.06     0.25        1    59.47
1-103            CIRCULAR               0.25     0.05     0.06     0.25        1    58.64
2-103            CIRCULAR               0.25     0.05     0.06     0.25        1    49.29
STM-11_(STM)     CIRCULAR               0.45     0.16     0.11     0.45        1   196.99
Tank-101         CIRCULAR               0.45     0.16     0.11     0.45        1   204.18
```

```
****************
Transect Summary
****************

Transect 20mROWlaf
Area:
           0.0008     0.0030     0.0068     0.0121     0.0189
           0.0270     0.0354     0.0440     0.0547     0.0677
           0.0832     0.1010     0.1212     0.1438     0.1676
           0.1913     0.2151     0.2389     0.2626     0.2864
           0.3102     0.3339     0.3577     0.3815     0.4052
           0.4290     0.4528     0.4766     0.5004     0.5241
           0.5479     0.5717     0.5955     0.6193     0.6431
           0.6668     0.6906     0.7144     0.7382     0.7620
           0.7858     0.8096     0.8334     0.8572     0.8810
           0.9048     0.9286     0.9524     0.9762     1.0000
Hrad:
           0.0387     0.0774     0.1162     0.1549     0.1936
           0.2510     0.3264     0.3981     0.4447     0.4684
           0.4771     0.4767     0.4711     0.4627     0.4586
           0.4606     0.4665     0.4751     0.4856     0.4976
           0.5106     0.5244     0.5389     0.5539     0.5693
           0.5851     0.6011     0.6174     0.6339     0.6506
           0.6674     0.6844     0.7014     0.7186     0.7358
           0.7532     0.7705     0.7880     0.8055     0.8230
           0.8406     0.8582     0.8759     0.8935     0.9112
           0.9289     0.9467     0.9644     0.9822     1.0000
Width:
           0.0635     0.1270     0.1906     0.2541     0.3176
           0.3495     0.3496     0.3996     0.4993     0.5991
           0.6989     0.7987     0.8984     0.9982     0.9982
           0.9983     0.9983     0.9984     0.9984     0.9985
           0.9985     0.9986     0.9986     0.9987     0.9987
           0.9988     0.9988     0.9989     0.9989     0.9990
           0.9990     0.9991     0.9991     0.9992     0.9992
           0.9993     0.9993     0.9994     0.9994     0.9995
           0.9995     0.9996     0.9996     0.9997     0.9997
           0.9998     0.9998     0.9999     0.9999     1.0000


Transect ROW20m
Area:
           0.0008     0.0030     0.0068     0.0121     0.0189
           0.0270     0.0354     0.0440     0.0547     0.0678
           0.0832     0.1011     0.1213     0.1439     0.1676
           0.1914     0.2152     0.2389     0.2627     0.2865
           0.3103     0.3340     0.3578     0.3816     0.4054
           0.4291     0.4529     0.4767     0.5005     0.5243
           0.5480     0.5718     0.5956     0.6194     0.6432
           0.6670     0.6907     0.7145     0.7383     0.7621
           0.7859     0.8097     0.8335     0.8572     0.8810
           0.9048     0.9286     0.9524     0.9762     1.0000
Hrad:
           0.0387     0.0774     0.1161     0.1548     0.1935
           0.2508     0.3262     0.3978     0.4443     0.4680
           0.4768     0.4764     0.4708     0.4624     0.4583
           0.4603     0.4662     0.4748     0.4854     0.4973
           0.5103     0.5242     0.5386     0.5536     0.5690
           0.5848     0.6009     0.6172     0.6337     0.6504
           0.6672     0.6842     0.7012     0.7184     0.7357
           0.7530     0.7704     0.7878     0.8053     0.8229
           0.8405     0.8581     0.8758     0.8934     0.9112
           0.9289     0.9466     0.9644     0.9822     1.0000
Width:
           0.0636     0.1272     0.1908     0.2544     0.3179
           0.3498     0.3499     0.3999     0.4998     0.5996
           0.6995     0.7993     0.8992     0.9990     0.9990
           0.9991     0.9991     0.9991     0.9991     0.9992
           0.9992     0.9992     0.9992     0.9993     0.9993
           0.9993     0.9994     0.9994     0.9994     0.9994
           0.9995     0.9995     0.9995     0.9996     0.9996
           0.9996     0.9996     0.9997     0.9997     0.9997
           0.9998     0.9998     0.9998     0.9998     0.9999
           0.9999     0.9999     0.9999     1.0000     1.0000


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
```

```
*********************************************************

****************
Analysis Options
****************
Flow Units ............... LPS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... HORTON
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 11/15/2021 00:00:00
Ending Date .............. 11/16/2021 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 00:05:00
Routing Time Step ........ 5.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.001500 m


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         0.055        42.512
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.001         0.800
Surface Runoff ...........         0.053        41.184
Final Storage ............         0.001         0.686
Continuity Error (%) .....        -0.373


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.053         0.533
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.053         0.533
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....        -0.009


***************************
Time-Step Critical Elements
***************************
Link Tank-101 (26.52%)
Link STM-11_(STM) (6.20%)


********************************
Highest Flow Instability Indexes
********************************
All links are stable.


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.34 sec
Average Time Step           :     4.19 sec
Maximum Time Step           :     5.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00
Percent Not Converging      :     0.00
Time Step Frequencies       :
    5.000 -  3.155 sec      :    76.80 %
```

```
3.155 -  1.991 sec      :    12.14 %
1.991 -  1.256 sec      :     7.81 %
1.256 -  0.792 sec      :     2.20 %
0.792 -  0.500 sec      :     1.05 %
```

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
A1	42.51	0.00	0.00	0.00	42.03	0.00	42.03	0.49	337.75	0.989
A2	42.51	0.00	0.00	14.80	24.66	2.36	27.03	0.01	9.95	0.636
A3	42.51	0.00	0.00	2.15	38.65	0.43	39.08	0.01	6.23	0.919
A4	42.51	0.00	0.00	1.44	39.46	0.29	39.75	0.01	7.99	0.935
A5	42.51	0.00	0.00	8.40	31.66	1.51	33.17	0.01	7.60	0.780

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
OGS1	JUNCTION	0.04	0.23	76.67	0 01:20	0.23
TANKOUTLET	OUTFALL	0.04	0.23	76.62	0 01:20	0.23
CB1	STORAGE	0.01	0.37	77.60	0 01:20	0.37
CB2	STORAGE	0.02	0.50	77.60	0 01:20	0.50
CBMH102	STORAGE	0.05	0.84	77.59	0 01:20	0.84
CBMH103	STORAGE	0.03	0.59	77.60	0 01:20	0.59
MH101	STORAGE	0.10	1.13	77.59	0 01:20	1.13
TANK	STORAGE	0.10	1.09	77.59	0 01:20	1.09

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow LPS	Maximum Total Inflow LPS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
OGS1	JUNCTION	0.00	107.21	0 01:20	0	0.533	-0.000
TANKOUTLET	OUTFALL	0.00	107.22	0 01:20	0	0.533	0.000
CB1	STORAGE	9.95	9.95	0 01:10	0.0127	0.0127	-0.107
CB2	STORAGE	7.99	7.99	0 01:10	0.0111	0.0111	-0.091
CBMH102	STORAGE	7.60	28.78	0 01:05	0.00996	0.0423	-0.281
CBMH103	STORAGE	6.23	22.80	0 01:07	0.00861	0.0325	0.393
MH101	STORAGE	0.00	107.33	0 01:20	0	0.533	-0.006
TANK	STORAGE	337.75	337.75	0 01:10	0.491	0.491	0.000

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow LPS
CB1	0.000	1	0	0	0.000	23	0 01:20	9.34
CB2	0.000	1	0	0	0.000	25	0 01:20	7.99
CBMH102	0.000	2	0	0	0.001	37	0 01:20	23.18
CBMH103	0.000	1	0	0	0.001	29	0 01:20	21.93
MH101	0.000	4	0	0	0.005	41	0 01:20	107.21
TANK	0.019	5	0	0	0.222	54	0 01:20	98.06

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
TANKOUTLET	54.68	20.40	107.22	0.533
System	54.68	20.40	107.22	0.533

****
Link Flow Summary
****

Link	Type	Maximum |Flow| LPS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
102-101	CONDUIT	23.18	0 01:06	0.59	0.39	1.00
103-102	CONDUIT	21.93	0 01:05	0.95	0.37	1.00
1-103	CONDUIT	9.34	0 01:08	0.63	0.16	1.00
2-103	CONDUIT	7.99	0 01:09	0.53	0.16	1.00
STM-11_(STM)	CONDUIT	107.22	0 01:20	1.31	0.54	0.51
Tank-101	CONDUIT	98.06	0 01:22	0.62	0.48	1.00
ICD1A	ORIFICE	93.80	0 01:20			1.00
OR1B	ORIFICE	13.41	0 01:20			1.00
W1	WEIR	0.00	0 00:00			0.00

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
		---------- Fraction of Time in Flow Class ----------								
102-101	1.00	0.02	0.00	0.00	0.21	0.00	0.00	0.77	0.04	0.00
103-102	1.00	0.02	0.00	0.00	0.11	0.00	0.00	0.86	0.02	0.00
1-103	1.00	0.02	0.00	0.00	0.08	0.01	0.00	0.89	0.03	0.00
2-103	1.00	0.02	0.00	0.00	0.98	0.00	0.00	0.00	0.94	0.00
STM-11_(STM)	1.00	0.01	0.00	0.00	0.78	0.21	0.00	0.00	0.00	0.00
Tank-101	1.00	0.01	0.00	0.00	0.25	0.00	0.00	0.74	0.00	0.00

****
Conduit Surcharge Summary
****

Conduit	--------- Hours Full -------- Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
102-101	1.07	1.07	1.40	0.01	0.01
103-102	0.67	0.67	1.05	0.01	0.01
1-103	0.35	0.35	0.65	0.01	0.01

2-103	0.53	0.53	0.67	0.01	0.01
Tank-101	1.15	1.15	1.18	0.01	0.01

Analysis begun on: Thu Jun 20 15:27:57 2024
Analysis ended on: Thu Jun 20 15:27:58 2024
Total elapsed time: 00:00:01

5 Year 3Hr Chicago Storm PCSWMM Results

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

WARNING 03: negative offset ignored for Link 2-103

Element Count

Number of rain gages 1
Number of subcatchments ... 5
Number of nodes 8
Number of links 9
Number of pollutants 0
Number of land uses 0

Raingage Summary

Name	Data Source	Data Type	Recording Interval
Raingage1	C3-100	INTENSITY	10 min.

Subcatchment Summary

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
A1	1.17	778.00	100.00	2.0000	Raingage1	TANK
A2	0.05	23.50	60.00	2.0000	Raingage1	CB1
A3	0.02	14.67	94.00	2.0000	Raingage1	CBMH103
A4	0.03	21.54	96.00	2.0000	Raingage1	CB2
A5	0.03	15.79	77.00	2.0000	Raingage1	CBMH102

Node Summary

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
OGS1	JUNCTION	76.44	2.71	0.0	
TANKOUTLET	OUTFALL	76.39	0.45	0.0	
CB1	STORAGE	77.23	1.62	0.0	
CB2	STORAGE	77.10	1.98	0.0	
CBMH102	STORAGE	76.75	2.25	0.0	
CBMH103	STORAGE	77.01	1.99	0.0	
MH101	STORAGE	76.46	2.77	0.0	
TANK	STORAGE	76.50	2.90	0.0	

Link Summary

Name	From Node	To Node	Type	Length	%Slope	Roughness
102-101	CBMH102	MH101	CONDUIT	17.7	1.0170	0.0130
103-102	CBMH103	CBMH102	CONDUIT	25.0	1.0001	0.0130
1-103	CB1	CBMH103	CONDUIT	21.6	0.9723	0.0130
2-103	CB2	CBMH103	CONDUIT	13.1	0.6870	0.0130
STM-11_(STM)	OGS1	TANKOUTLET	CONDUIT	10.5	0.4773	0.0130
Tank-101	TANK	MH101	CONDUIT	3.9	0.5128	0.0130
ICD1A	MH101	OGS1	ORIFICE			
OR1B	MH101	OGS1	ORIFICE			
W1	MH101	OGS1	WEIR			

Cross Section Summary

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
102-101	CIRCULAR	0.25	0.05	0.06	0.25	1	59.97
103-102	CIRCULAR	0.25	0.05	0.06	0.25	1	59.47
1-103	CIRCULAR	0.25	0.05	0.06	0.25	1	58.64
2-103	CIRCULAR	0.25	0.05	0.06	0.25	1	49.29
STM-11_(STM)	CIRCULAR	0.45	0.16	0.11	0.45	1	196.99
Tank-101	CIRCULAR	0.45	0.16	0.11	0.45	1	204.18

****
Transect Summary
****

Transect 20mROWlaf

Area:

0.0008	0.0030	0.0068	0.0121	0.0189
0.0270	0.0354	0.0440	0.0547	0.0677
0.0832	0.1010	0.1212	0.1438	0.1676
0.1913	0.2151	0.2389	0.2626	0.2864
0.3102	0.3339	0.3577	0.3815	0.4052
0.4290	0.4528	0.4766	0.5004	0.5241
0.5479	0.5717	0.5955	0.6193	0.6431
0.6668	0.6906	0.7144	0.7382	0.7620
0.7858	0.8096	0.8334	0.8572	0.8810
0.9048	0.9286	0.9524	0.9762	1.0000

Hrad:

0.0387	0.0774	0.1162	0.1549	0.1936
0.2510	0.3264	0.3981	0.4447	0.4684
0.4771	0.4767	0.4711	0.4627	0.4586
0.4606	0.4665	0.4751	0.4856	0.4976
0.5106	0.5244	0.5389	0.5539	0.5693
0.5851	0.6011	0.6174	0.6339	0.6506
0.6674	0.6844	0.7014	0.7186	0.7358
0.7532	0.7705	0.7880	0.8055	0.8230
0.8406	0.8582	0.8759	0.8935	0.9112
0.9289	0.9467	0.9644	0.9822	1.0000

Width:

0.0635	0.1270	0.1906	0.2541	0.3176
0.3495	0.3496	0.3996	0.4993	0.5991
0.6989	0.7987	0.8984	0.9982	0.9982
0.9983	0.9983	0.9984	0.9984	0.9985
0.9985	0.9986	0.9986	0.9987	0.9987
0.9988	0.9988	0.9989	0.9989	0.9990
0.9990	0.9991	0.9991	0.9992	0.9992
0.9993	0.9993	0.9994	0.9994	0.9995
0.9995	0.9996	0.9996	0.9997	0.9997
0.9998	0.9998	0.9999	0.9999	1.0000

Transect ROW20m

Area:

0.0008	0.0030	0.0068	0.0121	0.0189
0.0270	0.0354	0.0440	0.0547	0.0678
0.0832	0.1011	0.1213	0.1439	0.1676
0.1914	0.2152	0.2389	0.2627	0.2865
0.3103	0.3340	0.3578	0.3816	0.4054
0.4291	0.4529	0.4767	0.5005	0.5243
0.5480	0.5718	0.5956	0.6194	0.6432
0.6670	0.6907	0.7145	0.7383	0.7621
0.7859	0.8097	0.8335	0.8572	0.8810
0.9048	0.9286	0.9524	0.9762	1.0000

Hrad:

0.0387	0.0774	0.1161	0.1548	0.1935
0.2508	0.3262	0.3978	0.4443	0.4680
0.4768	0.4764	0.4708	0.4624	0.4583
0.4603	0.4662	0.4748	0.4854	0.4973
0.5103	0.5242	0.5386	0.5536	0.5690
0.5848	0.6009	0.6172	0.6337	0.6504
0.6672	0.6842	0.7012	0.7184	0.7357
0.7530	0.7704	0.7878	0.8053	0.8229
0.8405	0.8581	0.8758	0.8934	0.9112
0.9289	0.9466	0.9644	0.9822	1.0000

Width:

0.0636	0.1272	0.1908	0.2544	0.3179
0.3498	0.3499	0.3999	0.4998	0.5996
0.6995	0.7993	0.8992	0.9990	0.9990
0.9991	0.9991	0.9991	0.9991	0.9992
0.9992	0.9992	0.9992	0.9993	0.9993
0.9993	0.9994	0.9994	0.9994	0.9994
0.9995	0.9995	0.9995	0.9996	0.9996
0.9996	0.9996	0.9997	0.9997	0.9997
0.9998	0.9998	0.9998	0.9998	0.9999
0.9999	0.9999	0.9999	1.0000	1.0000

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.

```
*********************************************************

****************
Analysis Options
****************
Flow Units ............... LPS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... HORTON
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 11/15/2021 00:00:00
Ending Date .............. 11/16/2021 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 00:05:00
Routing Time Step ........ 5.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.001500 m


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         0.093        71.667
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.001         0.964
Surface Runoff ...........         0.091        70.209
Final Storage ............         0.001         0.686
Continuity Error (%) .....        -0.270


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.091         0.908
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.091         0.908
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....        -0.004


***************************
Time-Step Critical Elements
***************************
Link Tank-101 (24.48%)
Link STM-11_(STM) (10.40%)


********************************
Highest Flow Instability Indexes
********************************
All links are stable.


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     4.13 sec
Maximum Time Step           :     5.00 sec
Percent in Steady State     :    -0.00
Average Iterations per Step :     2.00
Percent Not Converging      :     0.00
Time Step Frequencies       :
    5.000 -  3.155 sec      :    74.08 %
```

3.155 - 1.991 sec : 14.50 %
1.991 - 1.256 sec : 7.59 %
1.256 - 0.792 sec : 2.65 %
0.792 - 0.500 sec : 1.17 %

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
A1	71.67	0.00	0.00	0.00	71.19	0.00	71.19	0.83	578.83	0.993
A2	71.67	0.00	0.00	17.80	42.13	11.60	53.73	0.03	20.86	0.750
A3	71.67	0.00	0.00	2.63	66.02	1.95	67.98	0.01	10.82	0.949
A4	71.67	0.00	0.00	1.75	67.41	1.31	68.72	0.02	13.81	0.959
A5	71.67	0.00	0.00	10.15	54.09	6.95	61.03	0.02	14.26	0.852

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
OGS1	JUNCTION	0.05	0.35	76.79	0 01:14	0.35
TANKOUTLET	OUTFALL	0.05	0.33	76.72	0 01:14	0.33
CB1	STORAGE	0.06	1.23	78.46	0 01:13	1.22
CB2	STORAGE	0.07	1.35	78.45	0 01:13	1.35
CBMH102	STORAGE	0.11	1.66	78.41	0 01:14	1.66
CBMH103	STORAGE	0.08	1.44	78.45	0 01:13	1.44
MH101	STORAGE	0.18	1.90	78.36	0 01:14	1.90
TANK	STORAGE	0.17	1.88	78.38	0 01:14	1.88

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow LPS	Maximum Total Inflow LPS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
OGS1	JUNCTION	0.00	220.87	0 01:14	0	0.908	0.001
TANKOUTLET	OUTFALL	0.00	220.92	0 01:14	0	0.908	0.000
CB1	STORAGE	20.86	20.86	0 01:10	0.0252	0.0252	-0.072
CB2	STORAGE	13.81	13.81	0 01:10	0.0192	0.0192	-0.063
CBMH102	STORAGE	14.26	43.34	0 01:10	0.0183	0.0777	-0.104
CBMH103	STORAGE	10.82	39.07	0 01:10	0.015	0.0595	0.168
MH101	STORAGE	0.00	220.95	0 01:14	0	0.908	-0.004
TANK	STORAGE	578.83	578.83	0 01:10	0.831	0.831	0.001

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow LPS
CB1	0.000	4	0	0	0.000	76	0 01:13	17.39
CB2	0.000	4	0	0	0.000	68	0 01:13	11.78
CBMH102	0.000	5	0	0	0.002	74	0 01:14	36.10
CBMH103	0.000	4	0	0	0.002	72	0 01:13	29.43
MH101	0.001	6	0	0	0.008	69	0 01:14	220.87
TANK	0.035	9	0	0	0.384	94	0 01:14	196.17

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
TANKOUTLET	56.33	32.62	220.92	0.908
System	56.33	32.62	220.92	0.908

****
Link Flow Summary
****

Link	Type	Maximum |Flow| LPS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
102-101	CONDUIT	36.10	0 01:10	0.74	0.60	1.00
103-102	CONDUIT	29.43	0 01:10	0.85	0.49	1.00
1-103	CONDUIT	17.39	0 01:10	0.69	0.30	1.00
2-103	CONDUIT	11.78	0 01:04	0.54	0.24	1.00
STM-11_(STM)	CONDUIT	220.92	0 01:14	1.70	1.12	0.76
Tank-101	CONDUIT	196.17	0 01:15	1.23	0.96	1.00
ICD1A	ORIFICE	122.86	0 01:14			1.00
OR1B	ORIFICE	28.14	0 01:14			1.00
W1	WEIR	69.88	0 01:14			0.32

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
		---------- Fraction of Time in Flow Class ----------								
102-101	1.00	0.01	0.00	0.00	0.24	0.00	0.00	0.74	0.03	0.00
103-102	1.00	0.01	0.00	0.00	0.16	0.00	0.00	0.82	0.02	0.00
1-103	1.00	0.01	0.00	0.00	0.13	0.02	0.00	0.84	0.03	0.00
2-103	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.92	0.00
STM-11_(STM)	1.00	0.01	0.00	0.00	0.79	0.21	0.00	0.00	0.00	0.00
Tank-101	1.00	0.01	0.00	0.00	0.28	0.00	0.00	0.72	0.00	0.00

****
Conduit Surcharge Summary
****

Conduit	--------- Hours Full -------- Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
102-101	1.69	1.69	2.08	0.01	0.01
103-102	1.29	1.29	1.67	0.01	0.01
1-103	1.03	1.03	1.28	0.01	0.01

2-103	1.18	1.18	1.29	0.01	0.01
STM-11_(STM)	0.01	0.01	0.01	0.15	0.01
Tank-101	1.77	1.77	1.81	0.01	0.01

Analysis begun on: Thu Jun 20 15:20:05 2024
Analysis ended on: Thu Jun 20 15:20:05 2024
Total elapsed time: < 1 sec

100Year 3Hr Chicago Storm PCSWMM Results

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

WARNING 03: negative offset ignored for Link 2-103

****
Element Count
****

Number of rain gages 1
Number of subcatchments ... 5
Number of nodes 8
Number of links 9
Number of pollutants 0
Number of land uses 0

****
Raingage Summary
****

Name	Data Source	Data Type	Recording Interval
Raingage1	C3-100	INTENSITY	10 min.

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
A1	1.17	778.00	100.00	2.0000	Raingage1	TANK
A2	0.05	23.50	60.00	2.0000	Raingage1	CB1
A3	0.02	14.67	94.00	2.0000	Raingage1	CBMH103
A4	0.03	21.54	96.00	2.0000	Raingage1	CB2
A5	0.03	15.79	77.00	2.0000	Raingage1	CBMH102

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
OGS1	JUNCTION	76.44	2.71	0.0	
TANKOUTLET	OUTFALL	76.39	0.45	0.0	
CB1	STORAGE	77.23	1.62	0.0	
CB2	STORAGE	77.10	1.98	0.0	
CBMH102	STORAGE	76.75	2.25	0.0	
CBMH103	STORAGE	77.01	1.99	0.0	
MH101	STORAGE	76.46	2.77	0.0	
TANK	STORAGE	76.50	2.90	0.0	

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
102-101	CBMH102	MH101	CONDUIT	17.7	1.0170	0.0130
103-102	CBMH103	CBMH102	CONDUIT	25.0	1.0001	0.0130
1-103	CB1	CBMH103	CONDUIT	21.6	0.9723	0.0130
2-103	CB2	CBMH103	CONDUIT	13.1	0.6870	0.0130
STM-11_(STM)	OGS1	TANKOUTLET	CONDUIT	10.5	0.4773	0.0130
Tank-101	TANK	MH101	CONDUIT	3.9	0.5128	0.0130
ICD1A	MH101	OGS1	ORIFICE			
OR1B	MH101	OGS1	ORIFICE			
W1	MH101	OGS1	WEIR			

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
102-101	CIRCULAR	0.25	0.05	0.06	0.25	1	59.97
103-102	CIRCULAR	0.25	0.05	0.06	0.25	1	59.47
1-103	CIRCULAR	0.25	0.05	0.06	0.25	1	58.64
2-103	CIRCULAR	0.25	0.05	0.06	0.25	1	49.29
STM-11_(STM)	CIRCULAR	0.45	0.16	0.11	0.45	1	196.99
Tank-101	CIRCULAR	0.45	0.16	0.11	0.45	1	204.18

```
****************
Transect Summary
****************

Transect 20mROWlaf
Area:
            0.0008     0.0030     0.0068     0.0121     0.0189
            0.0270     0.0354     0.0440     0.0547     0.0677
            0.0832     0.1010     0.1212     0.1438     0.1676
            0.1913     0.2151     0.2389     0.2626     0.2864
            0.3102     0.3339     0.3577     0.3815     0.4052
            0.4290     0.4528     0.4766     0.5004     0.5241
            0.5479     0.5717     0.5955     0.6193     0.6431
            0.6668     0.6906     0.7144     0.7382     0.7620
            0.7858     0.8096     0.8334     0.8572     0.8810
            0.9048     0.9286     0.9524     0.9762     1.0000
Hrad:
            0.0387     0.0774     0.1162     0.1549     0.1936
            0.2510     0.3264     0.3981     0.4447     0.4684
            0.4771     0.4767     0.4711     0.4627     0.4586
            0.4606     0.4665     0.4751     0.4856     0.4976
            0.5106     0.5244     0.5389     0.5539     0.5693
            0.5851     0.6011     0.6174     0.6339     0.6506
            0.6674     0.6844     0.7014     0.7186     0.7358
            0.7532     0.7705     0.7880     0.8055     0.8230
            0.8406     0.8582     0.8759     0.8935     0.9112
            0.9289     0.9467     0.9644     0.9822     1.0000
Width:
            0.0635     0.1270     0.1906     0.2541     0.3176
            0.3495     0.3496     0.3996     0.4993     0.5991
            0.6989     0.7987     0.8984     0.9982     0.9982
            0.9983     0.9983     0.9984     0.9984     0.9985
            0.9985     0.9986     0.9986     0.9987     0.9987
            0.9988     0.9988     0.9989     0.9989     0.9990
            0.9990     0.9991     0.9991     0.9992     0.9992
            0.9993     0.9993     0.9994     0.9994     0.9995
            0.9995     0.9996     0.9996     0.9997     0.9997
            0.9998     0.9998     0.9999     0.9999     1.0000

Transect ROW20m
Area:
            0.0008     0.0030     0.0068     0.0121     0.0189
            0.0270     0.0354     0.0440     0.0547     0.0678
            0.0832     0.1011     0.1213     0.1439     0.1676
            0.1914     0.2152     0.2389     0.2627     0.2865
            0.3103     0.3340     0.3578     0.3816     0.4054
            0.4291     0.4529     0.4767     0.5005     0.5243
            0.5480     0.5718     0.5956     0.6194     0.6432
            0.6670     0.6907     0.7145     0.7383     0.7621
            0.7859     0.8097     0.8335     0.8572     0.8810
            0.9048     0.9286     0.9524     0.9762     1.0000
Hrad:
            0.0387     0.0774     0.1161     0.1548     0.1935
            0.2508     0.3262     0.3978     0.4443     0.4680
            0.4768     0.4764     0.4708     0.4624     0.4583
            0.4603     0.4662     0.4748     0.4854     0.4973
            0.5103     0.5242     0.5386     0.5536     0.5690
            0.5848     0.6009     0.6172     0.6337     0.6504
            0.6672     0.6842     0.7012     0.7184     0.7357
            0.7530     0.7704     0.7878     0.8053     0.8229
            0.8405     0.8581     0.8758     0.8934     0.9112
            0.9289     0.9466     0.9644     0.9822     1.0000
Width:
            0.0636     0.1272     0.1908     0.2544     0.3179
            0.3498     0.3499     0.3999     0.4998     0.5996
            0.6995     0.7993     0.8992     0.9990     0.9990
            0.9991     0.9991     0.9991     0.9991     0.9992
            0.9992     0.9992     0.9992     0.9993     0.9993
            0.9993     0.9994     0.9994     0.9994     0.9994
            0.9995     0.9995     0.9995     0.9996     0.9996
            0.9996     0.9996     0.9997     0.9997     0.9997
            0.9998     0.9998     0.9998     0.9998     0.9999
            0.9999     0.9999     0.9999     1.0000     1.0000

*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
```

```
*********************************************************

****************
Analysis Options
****************
Flow Units ............... LPS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... HORTON
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 11/15/2021 00:00:00
Ending Date .............. 11/16/2021 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 00:05:00
Routing Time Step ........ 5.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.001500 m

**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         0.093        71.667
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.001         0.964
Surface Runoff ...........         0.091        70.209
Final Storage ............         0.001         0.686
Continuity Error (%) .....        -0.270
```

```
**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.091         0.908
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.091         0.908
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....        -0.004

***************************
Time-Step Critical Elements
***************************
Link Tank-101 (24.48%)
Link STM-11_(STM) (10.40%)

********************************
Highest Flow Instability Indexes
********************************
All links are stable.

*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.50 sec
Average Time Step           :     4.13 sec
Maximum Time Step           :     5.00 sec
Percent in Steady State     :    -0.00
Average Iterations per Step :     2.00
Percent Not Converging      :     0.00
Time Step Frequencies       :
    5.000 -  3.155 sec      :    74.08 %
```

```
3.155 -  1.991 sec      :    14.50 %
1.991 -  1.256 sec      :     7.59 %
1.256 -  0.792 sec      :     2.65 %
0.792 -  0.500 sec      :     1.17 %
```

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
A1	71.67	0.00	0.00	0.00	71.19	0.00	71.19	0.83	578.83	0.993
A2	71.67	0.00	0.00	17.80	42.13	11.60	53.73	0.03	20.86	0.750
A3	71.67	0.00	0.00	2.63	66.02	1.95	67.98	0.01	10.82	0.949
A4	71.67	0.00	0.00	1.75	67.41	1.31	68.72	0.02	13.81	0.959
A5	71.67	0.00	0.00	10.15	54.09	6.95	61.03	0.02	14.26	0.852

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
OGS1	JUNCTION	0.05	0.35	76.79	0 01:14	0.35
TANKOUTLET	OUTFALL	0.05	0.33	76.72	0 01:14	0.33
CB1	STORAGE	0.06	1.23	78.46	0 01:13	1.22
CB2	STORAGE	0.07	1.35	78.45	0 01:13	1.35
CBMH102	STORAGE	0.11	1.66	78.41	0 01:14	1.66
CBMH103	STORAGE	0.08	1.44	78.45	0 01:13	1.44
MH101	STORAGE	0.18	1.90	78.36	0 01:14	1.90
TANK	STORAGE	0.17	1.88	78.38	0 01:14	1.88

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow LPS	Maximum Total Inflow LPS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
OGS1	JUNCTION	0.00	220.87	0 01:14	0	0.908	0.001
TANKOUTLET	OUTFALL	0.00	220.92	0 01:14	0	0.908	0.000
CB1	STORAGE	20.86	20.86	0 01:10	0.0252	0.0252	-0.072
CB2	STORAGE	13.81	13.81	0 01:10	0.0192	0.0192	-0.063
CBMH102	STORAGE	14.26	43.34	0 01:10	0.0183	0.0777	-0.104
CBMH103	STORAGE	10.82	39.07	0 01:10	0.015	0.0595	0.168
MH101	STORAGE	0.00	220.95	0 01:14	0	0.908	-0.004
TANK	STORAGE	578.83	578.83	0 01:10	0.831	0.831	0.001

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

Storage Volume Summary

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow LPS
CB1	0.000	4	0	0	0.000	76	0 01:13	17.39
CB2	0.000	4	0	0	0.000	68	0 01:13	11.78
CBMH102	0.000	5	0	0	0.002	74	0 01:14	36.10
CBMH103	0.000	4	0	0	0.002	72	0 01:13	29.43
MH101	0.001	6	0	0	0.008	69	0 01:14	220.87
TANK	0.035	9	0	0	0.384	94	0 01:14	196.17

Outfall Loading Summary

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
TANKOUTLET	56.33	32.62	220.92	0.908
System	56.33	32.62	220.92	0.908

Link Flow Summary

Link	Type	Maximum |Flow| LPS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
102-101	CONDUIT	36.10	0 01:10	0.74	0.60	1.00
103-102	CONDUIT	29.43	0 01:10	0.85	0.49	1.00
1-103	CONDUIT	17.39	0 01:10	0.69	0.30	1.00
2-103	CONDUIT	11.78	0 01:04	0.54	0.24	1.00
STM-11_(STM)	CONDUIT	220.92	0 01:14	1.70	1.12	0.76
Tank-101	CONDUIT	196.17	0 01:15	1.23	0.96	1.00
ICD1A	ORIFICE	122.86	0 01:14			1.00
OR1B	ORIFICE	28.14	0 01:14			1.00
W1	WEIR	69.88	0 01:14			0.32

Flow Classification Summary

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
102-101	1.00	0.01	0.00	0.00	0.24	0.00	0.00	0.74	0.03	0.00
103-102	1.00	0.01	0.00	0.00	0.16	0.00	0.00	0.82	0.02	0.00
1-103	1.00	0.01	0.00	0.00	0.13	0.02	0.00	0.84	0.03	0.00
2-103	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.92	0.00
STM-11_(STM)	1.00	0.01	0.00	0.00	0.79	0.21	0.00	0.00	0.00	0.00
Tank-101	1.00	0.01	0.00	0.00	0.28	0.00	0.00	0.72	0.00	0.00

Conduit Surcharge Summary

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
102-101	1.69	1.69	2.08	0.01	0.01
103-102	1.29	1.29	1.67	0.01	0.01
1-103	1.03	1.03	1.28	0.01	0.01

2-103	1.18	1.18	1.29	0.01	0.01
STM-11_(STM)	0.01	0.01	0.01	0.15	0.01
Tank-101	1.77	1.77	1.81	0.01	0.01

Analysis begun on: Thu Jun 20 15:20:05 2024
Analysis ended on: Thu Jun 20 15:20:05 2024
Total elapsed time: < 1 sec

Overview

The Thornthwaite-Mather (1957) water balance models are conceptual models that are used to simulate steady-state climatic averages or continuous values of precipitation (rain + snow), snowpack, snowmelt, soil moisture, evapotranspiration, and water surplus (infiltration + runoff) (refer to **Figure 1**). Input parameters consist of daily precipitation *(PRECIP),* temperature *(MAX / MIN TEMP),* potential evapotranspiration *(PET)*, and the available water content *(AWC)* that can also be referred to as the water holding capacity of the soil. All water quantities in the model are based on monthly calculations and are represented as depths (volume per unit area) of liquid water over the area being simulated. *All model units are in millimetres (mm)*.

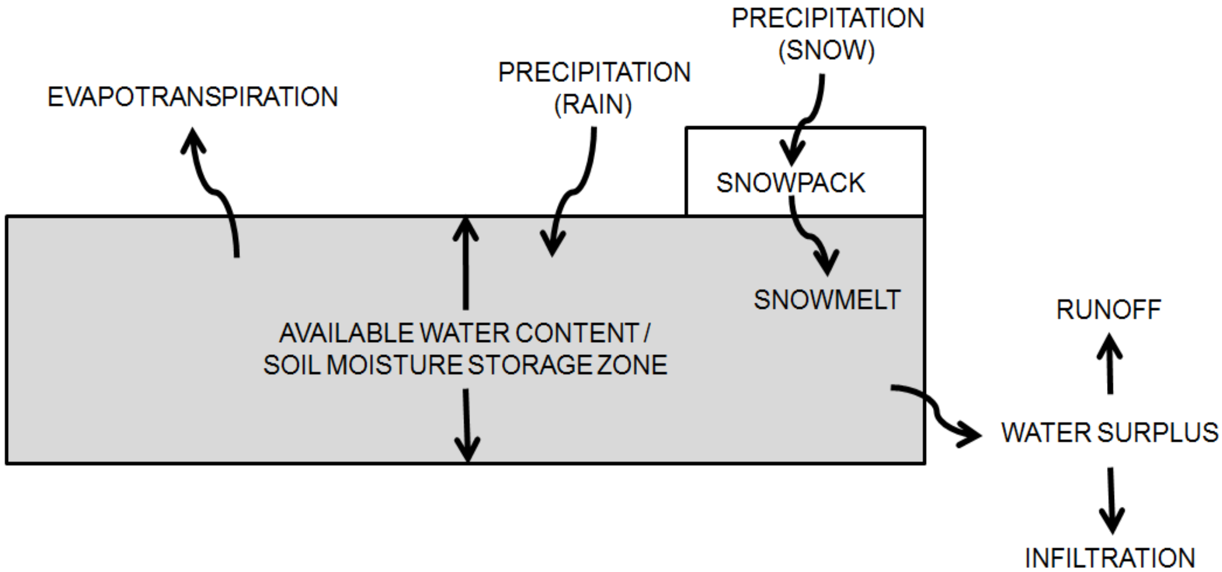


Figure 1: Conceptual Water Balance Model

Available Water Content (Water Holding Capacity)

The available water content (AWC) or water holding capacity of the soil was taken from Table 3.1 from the *Stormwater Management Planning & Design Manual (MOE, 2003)*, which has been reproduced in **Table 1** below. The available water content is the soil-moisture storage zone or the zone between the field capacity and vertical extent of the root zone.

Table 1: Water Holding Capacity Values (MOE, 2003)

Land Use / Soil Type	Hydrologic Soil Group	Water Holding Capacity (mm)
Urban Lawns / Shallow Rooted Crops (spinach, beans, beets, carrots)		
Fine Sand	A	50
Fine Sandy Loam	B	75
Silt Loam	C	125
Clay Loam	CD	100
Clay	D	75

Land Use / Soil Type	Hydrologic Soil Group	Water Holding Capacity (mm)
Moderately Rooted Crops (corn and cereal grains)		
Fine Sand	A	75
Fine Sandy Loam	B	150
Silt Loam	C	200
Clay Loam	CD	200
Clay	D	150
Pasture and Shrubs		
Fine Sand	A	100
Fine Sandy Loam	B	150
Silt Loam	C	250
Clay Loam	CD	250
Clay	D	200
Mature Forests		
Fine Sand	A	250
Fine Sandy Loam	B	300
Silt Loam	C	400
Clay Loam	CD	400
Clay	D	350

Precipitation

Daily precipitation *(PRECIP)* values consist of the total daily rainfall and water equivalent of snowmelt that fell on that day. Based on the mean daily temperature *(MEAN TEMP)* precipitation falls either as rainfall *(RAIN)* or the water equivalent of snowfall *(SNOW)*:

- *RAIN: If (MEAN TEMP >= 0, RAIN, SNOW)*
- *SNOW: If (MEAN TEMP < 0, SNOW, RAIN)*

Snowmelt / Snowpack / Water Input

Snowmelt *(MELT)* occurs if there is available snow (water equivalent) in the snowpack *(SNOWPACK)* and the maximum daily temperature *(MAX TEMP)* is greater than 0. The available snowmelt is limited to the available water in the snowpack.

Snowmelt is computed by a degree-day equation (Haith, 1985):

SNOWMELT (cm/d) = MELT COEFICIENT x [AIR TEMP (^{O}C) – MELT TEMP(^{O}C)]

The melt coefficient is typically 0.45 (cm of depth per degree-day, or cm x C^{-1} x day^{-1}) for northern climates (Haith, 1985). The melt temperature is assumed to be 0^{O}C. The air temperature is assumed to be the max temperature multiplied by a ratio of the max to min temperatures:

AIR TEMP = [*MAX TEMP / (MAX TEMP – MIN TEMP)]*

Therefore, the snowmelt equation is:

- *MELT: If (MAX TEMP > 0, IF(SNOWPACK > 0, MIN((0.45cm/°C-day*MAX TEMP*[MAX TEMP/(MAX TEMP – MIN TEMP)]*10mm/cm), SNOWPACK), 0), 0)*

Snow accumulates in the snowpack from the previous day if precipitation falls as snow and there is no snowmelt or the amount of snow that falls in a day exceeds the daily snowmelt:

$SNOWPACK_N = SNOWPACK_{N-1} + SNOW - MELT$

The initial snowmelt on day 1 (i.e. January 1) is assumed to be 0. The initial snowpack on day 1 is assumed to be the snowpack on the last day of simulation (i.e. December 31).

The total water input (W) is rain + snowmelt. This is the available water that fills the soil moisture storage zone each day.

Evaporation

Measured potential evaporation (PE) data (i.e. lake evaporation) is provided with the Environment Canada Climate Normals (see example below for Ottawa CDA). The data represents daily averages for each month over a 20+ year period.

▼ Evaporation

1981 to 2010 Canadian Climate Normals station data

Evaporation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Lake Evaporation (mm)	0	0	0	0	3.6	4.3	4.4	3.7	2.4	1.4	0	0	0	

The daily evaporation data was assumed to represent the middle or 15th of each month and 'smoothed' to represent the transition from month to month (see **Figure 2** below). As shown in **Figure 2**, this produces a more realistic curve of potential evapotranspiration.

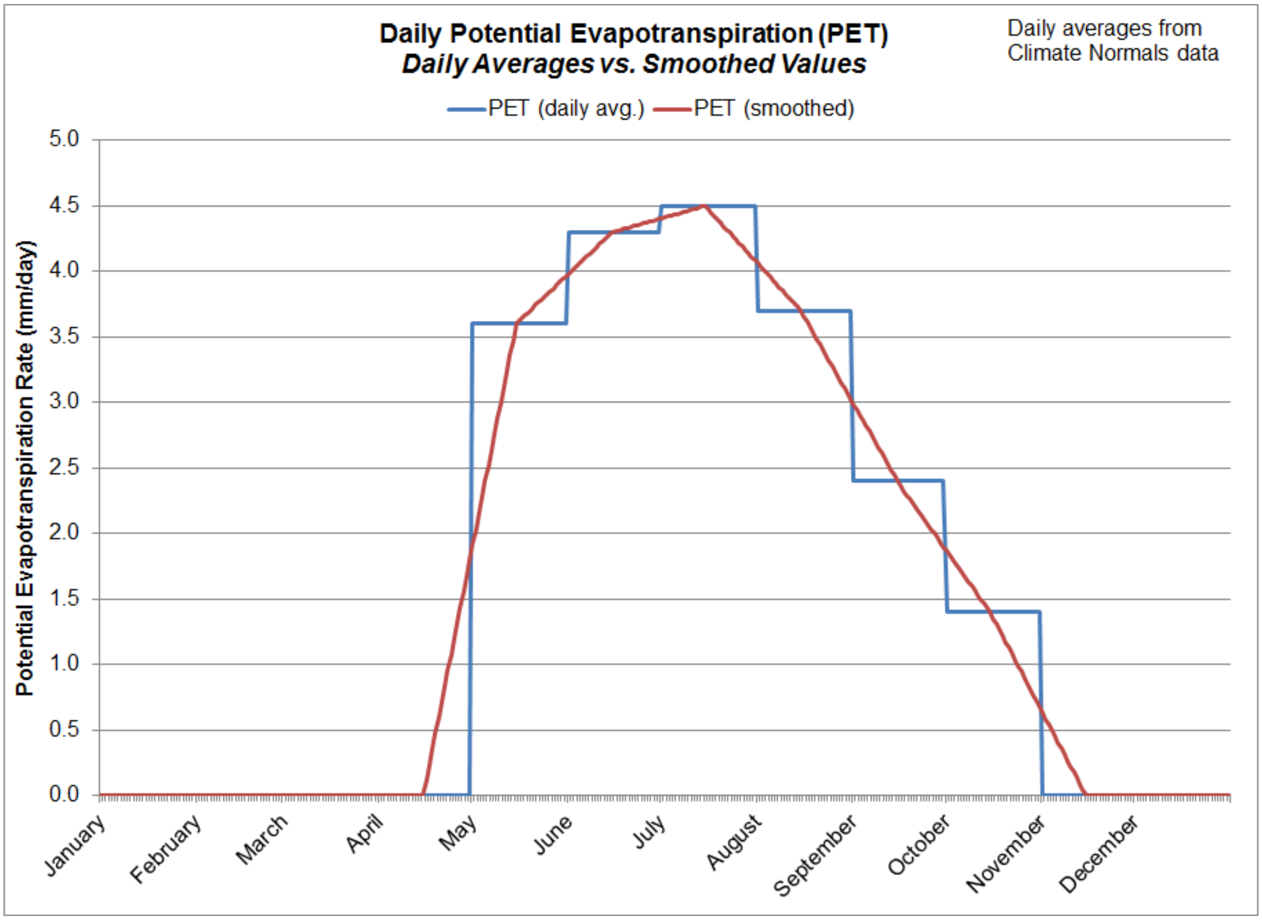


Figure 2: Daily Potential Evapotranspiration Rates (Daily Averages vs. Smoothed Values)

Potential Evapotranspiration

To convert potential evaporation data to potential crop evapotranspiration (PET) data a cover coefficient is applied based on land use and growing / dormant seasons:

PET = PE x Crop Cover Coefficient

Crop cover coefficients are based on the crop growth stages for different crop types (see **Figure 3**). A typical crop coefficient curve is shown in **Figure 4**, which depicts a crop that provides transpiration above the potential evaporation rates during the growing season.

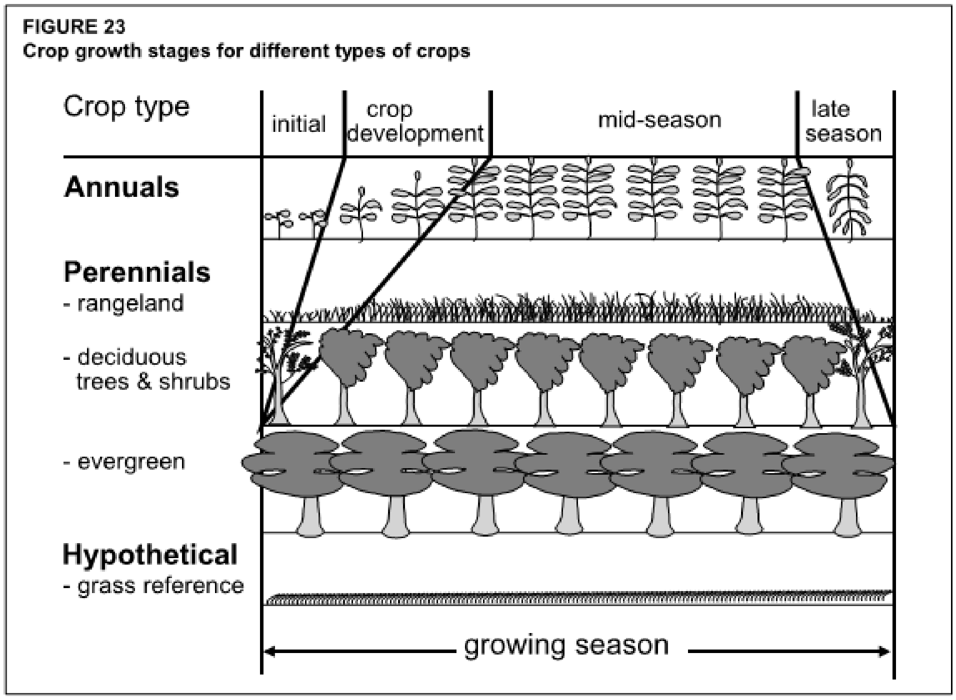


Figure 3: Crop Growth Stages for Different Types of Crops

Source: Food and Agriculture Organization of the United Nations (FAO), 1998, Crop Evapotranspiration - Guidelines for Computing Crop Water Requirements. FAO Irrigation and Drainage paper 56.

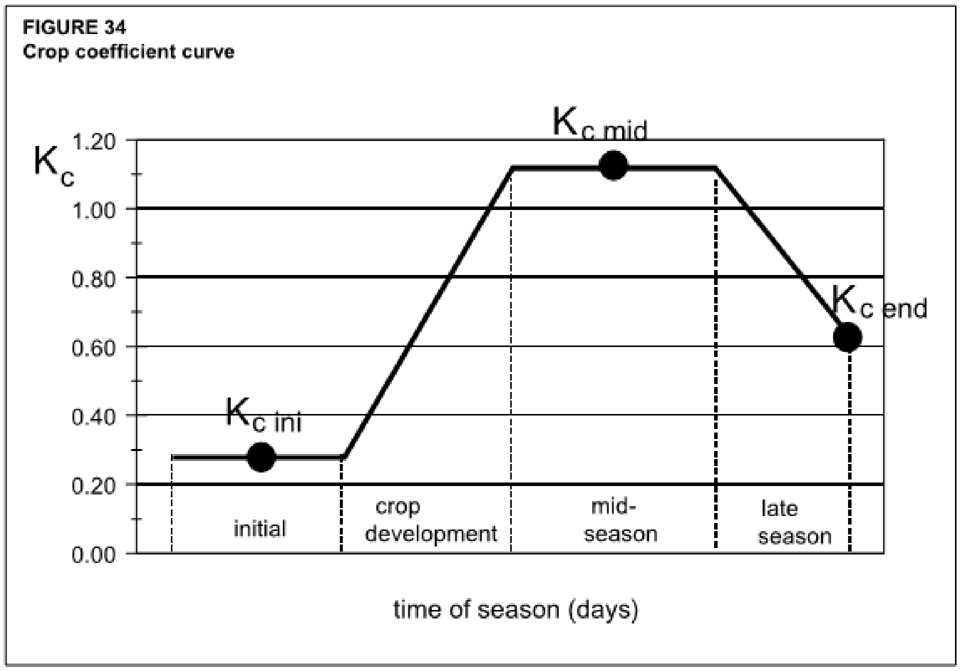


Figure 4: Crop Coefficient Curve

Source: Food and Agriculture Organization of the United Nations (FAO), 1998, Crop Evapotranspiration - Guidelines for Computing Crop Water Requirements. FAO Irrigation and Drainage paper 56.

The crop cover coefficients used in the water budget model for the various land use types is shown in **Table 2**. The growing / dormant seasons are shown in **Table 3**. The crop cover coefficients for the initial growing season are based on the average value of the dormant and middle of the growing season.

Table 2: Crop Cover Coefficients

Land Use	Dormant Season	Initial Growing Season	Middle of Growing Season	End of Growing Season
Urban Lawns / Shallow Rooted Crops*	0.40	0.78	1.15	0.55
Moderately Rooted Crops**	0.30	0.73	1.15	0.40
Pasture and Shrubs***	0.40	0.68	0.95	0.90
Mature Forest****	0.30	0.75	1.20	0.30
Impervious Areas	1.00	1.00	1.00	1.00

Reference: Data is based on Table 12 from the Food and Agriculture Organization of the United Nations (FAO), 1998, Crop Evapotranspiration - Guidelines for Computing Crop Water Requirements. FAO Irrigation and Drainage paper 56.

**Table 12, e. Legumes*

***Table 12, i. Cereals*

****Table 12, j. Forages (Alfalfa)*

*****Table 12, o. Wetlands*

Table 3: Crop Growing Season

Month(s)	Crop Growing Season
January – April	Dormant Season
May	Initial Growing Season
June - August	Middle of Growing Season
September	End of Growing Season
October - December	Dormant Season (harvest in October)

Reference: Food and Agriculture Organization of the United Nations (FAO), 1977, Crop Water Requirements. FAO Irrigation and Drainage paper 24.

<u>*Actual Evapotranspiration*</u>

Following Alley (1984), if the monthly water input (i.e. rain + snowmelt) is greater than the potential evapotranspiration (PET) rate, the actual evapotranspiration (AET) rate takes place at the potential evapotranspiration rate:

IF W > PET, then AET = PET

If the monthly water input is less than the potential evapotranspiration rate (i.e. W < PET) then the actual evapotranspiration rate is the sum of the water input and an increment removed from the available water in the soil moisture storage zone (SOIL WATER):

IF W < PET, then AET = W + ΔSOIL WATER

WHERE: $\Delta SOIL\ WATER = SOIL\ WATER_{N-1} - SOIL\ WATER_{N}$

Figure 5 shows a comparison of the average monthly potential evapotranspiration and actual evapotranspiration rates.

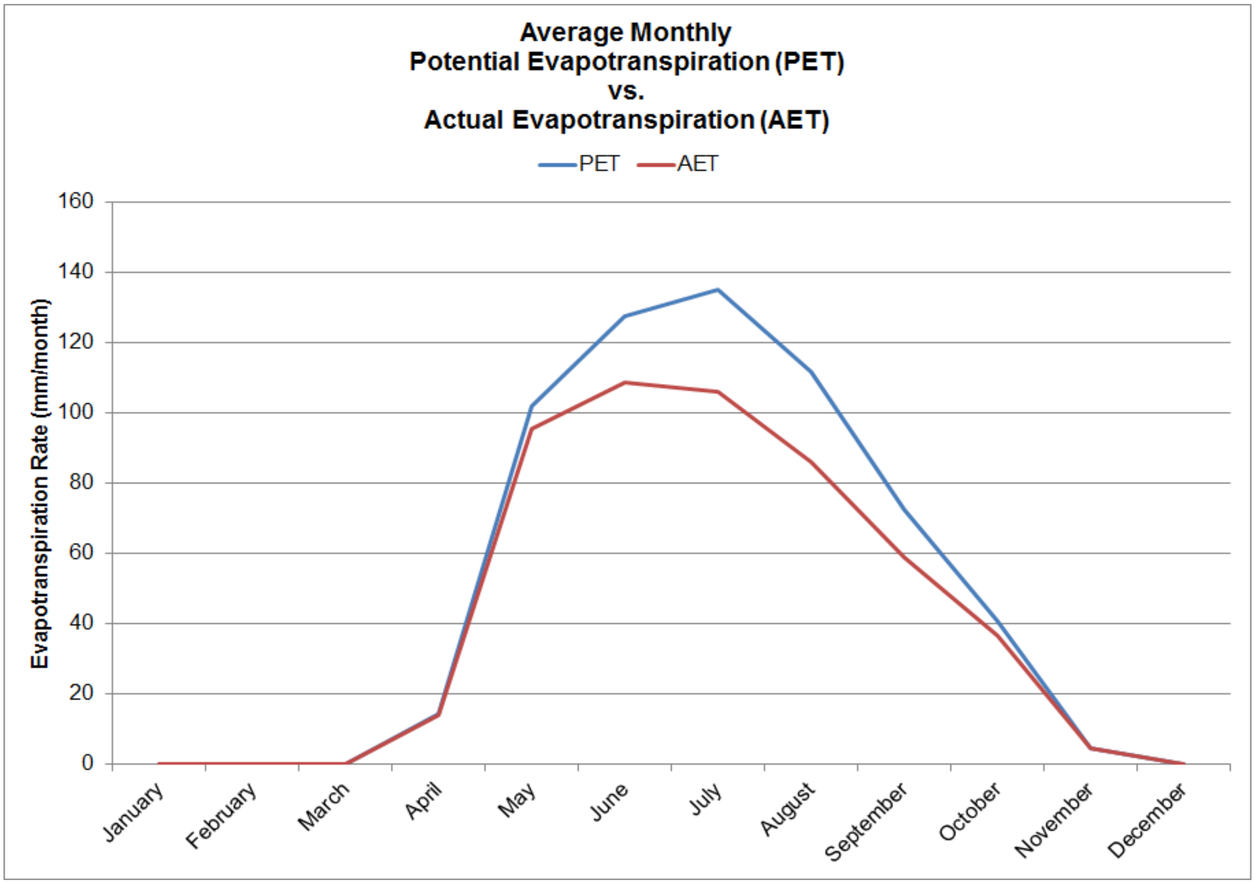


Figure 5: Average Monthly Potential Evapotranspiration vs. Actual Evapotranspiration

Soil Moisture

The soil moisture storage zone (SOIL WATER) is the amount of water available for actual evapotranspiration, but actual evapotranspiration is limited by the potential evapotranspiration rate.

The decrease / change in the soil moisture storage zone (ΔSOIL WATER) is based on the following relationship (Thornthwaite,1948), where AWC represents the available water content:

$$\Delta SOIL\ WATER = SOIL\ WATER_{N-1} \times [1 - \exp(-((PET - W) / AWC))]$$

The soil moisture storage zone is replenished with rainwater and snowmelt (i.e. the water input) to the maximum value of the available water content (AWC):

$SOIL\ WATER_N = min[(W – PET) + SOIL\ WATER_{N-1}), AWC]$

Water Surplus

The water surplus (SURPLUS) is defined as the excess water that is greater than the available water content (AWC).

$SURPLUS = W – AET - \Delta SOIL\ WATER$

The water surplus represents the difference between precipitation and evapotranspiration. It is an estimate of the water that is available to contribute to infiltration and runoff (i.e. streamflow).

Infiltration / Runoff

The amount of water surplus that is infiltrated is determined by summing the infiltration factors (IF) based on topography, soils, and land cover. Since the water surplus represents infiltration and runoff; direct runoff is the amount of water surplus remaining after taking into account infiltration: (1.0 – infiltration factor = runoff factor). The infiltration and runoff factors were applied to the average monthly water surplus values:

$INFILTRATION = IF \times SURPLUS$

$RUNOFF = (1.0 – IF) \times SURPLUS$

The infiltration factors are shown in **Table 4**, which was reproduced from Table 3.1 in the *Stormwater Management Planning & Design Manual (MOE, 2003)*. These infiltration factors were initially presented in the document *"Hydrogeological Technical Information Requirements for Land Development Applications" (MOE, 1995)*.

Table 4: Infiltration Factors (MOE, 2003)

Description	Value of Infiltration Factor
Topography	
Flat Land, average slope < 0.6 m/km	0.3
Rolling Land, average slope 2.8 m/km to 3.8 m/km	0.2
Hilly Land, average slope 28 m/km to 47 m/km	0.1
Surficial Soils	
Tight impervious clay	0.1
Medium combination of clay and loam	0.2
Open sandy loam	0.4
Land Cover	
Cultivated Land	0.1
Woodland	0.2

Each soil type been assigned a corresponding infiltration factor as per Table 3.1 in the *Stormwater Management Planning & Design Manual (MOE, 2003),* as shown in **Table 5** below.

Table 5: Soils Infiltration Factors

Soil Type	Hydrologic Soil Group	Infiltration Factor
Coarse Sand	A	0.40
Fine Sand	AB	0.40
Fine Sandy Loam	B	0.40
Loam	BC	0.30
Silt Loam	C	0.20
Clay Loam	CD	0.15
Clay	D	0.10

The land use was combined into five (5) main categories (mature forest, row crops, pasture / meadow, urban lawns, and impervious areas) to be consistent with Table 3.1 in the *Stormwater Management Planning & Design Manual (MOE, 2003)*. The land use infiltration factors are shown in **Table 6** below.

Table 6: Land Use Infiltration Factor

Land Use	Infiltration Factor
Urban Lawns	0.10
Row Crops	0.10
Pasture / Meadow	0.10
Mature Forest	0.20
Impervious Areas	0.00

Land Use / Soils / Topography

The available water content (AWC), infiltration factors (IF), and crop cover coefficients (CROP COEF) are determined based on the combination of land use, soils and topography, as shown in **Table 7**.

Table 7: Model Parameters based on Land Use / Soils (existing areas)

Land Use	Soils (HSG)	AWC (mm)	IF (Land Use)	IF (Soils)	Crop Cover Coefficient: Dormant Season	Crop Cover Coefficient: Initial Growing Season	Crop Cover Coefficient: Middle of Growing Season	Crop Cover Coefficient: End of Growing Season
Urban Lawns	A	50	0.10	0.40	0.40	0.78	1.15	0.55
	AB	62.5		0.40				
	B	75		0.40				
	BC	100		0.30				
	C	125		0.20				
	CD	100		0.15				
	D	75		0.10				
Row Crops	A	75	0.10	0.40	0.30	0.73	1.15	0.40
	AB	112.5		0.40				
	B	150		0.40				
	BC	175		0.30				
	C	200		0.20				
	CD	200		0.15				
	D	150		0.10				
Pasture / Meadow	A	100	0.10	0.40	0.40	0.68	0.95	0.90
	AB	125		0.40				
	B	150		0.40				
	BC	200		0.30				
	C	250		0.20				
	CD	250		0.15				
	D	200		0.10				
Mature Forest	A	250	0.20	0.40	0.30	0.75	1.20	0.30
	AB	275		0.40				
	B	300		0.40				
	BC	350		0.30				
	C	400		0.20				
	CD	400		0.15				
	D	350		0.10				
Impervious Areas	A	1.57	0.00	0.00	1.00	1.00	1.00	1.00
	AB	1.57						
	B	1.57						
	BC	1.57						
	C	1.57						
	CD	1.57						
	D	1.57						

**For impervious areas, potential evapotranspiration is equal to potential evaporation (i.e. crop cover coefficient = 1.00).*

910 March Road (121186)
Water Balance Model Parameters
Pre-Development Conditions

Surface Type	Area ID	Catchment Parameters						Infiltration Factor[1]				Crop Cover Coefficient[2]			
		AREA (m^2)	AREA (ha)	SOILS (HSG)	LAND USE	TOPOGRAPHY	AWC[1]	IF (soils)	IF (cover)	IF (topo)	IF (Total)	Dormant Season	Initial Growing Season	Middle of Growing Season	End of Growing Season
Impervious	1	1100	0.11	-	IMPERVIOUS	-	1.57	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
Gravel	2	2000	0.20	C/D	GRAVEL	HILLY	100.00	0.20	0.00	0.10	0.30	1.00	1.00	1.00	1.00
Pasture	3	19900	1.99	C/D	PASTURE	HILLY	250.00	0.20	0.10	0.10	0.40	0.40	0.68	0.95	0.90

Surface Type	Area ID	January	February	March	April	May	June	July	August	September	October	November	December
Potential Evaporation Rates (AVG. mm/d)[3]		0.0	0.0	0.0	0.0	3.6	4.3	4.4	3.7	2.4	1.4	0.0	0.0
Potential Evapotranspiration (AVG. mm/d)													
Impervious	1	0.00	0.00	0.00	0.00	3.60	4.30	4.40	3.70	2.40	1.40	0.00	0.00
Gravel	2	0.00	0.00	0.00	0.00	3.60	4.30	4.40	3.70	2.40	1.40	0.00	0.00
Pasture	3	0.00	0.00	0.00	0.00	2.45	4.09	4.18	3.52	2.16	0.56	0.00	0.00

[1]Available Water Content (AWC) and Infiltration Factors (IF) for pervious areas based on Table 3.1 from the Stormwater Management Planning and Design Manual (MOE, 2003). AWC for gravel areas based on approximate depth of gravel and porosity of 20%.

[2]Crop Cover Coefficients based on Table 12 from the Food and Agriculture Organization of the United Nations (FAO), 1998, Crop Evapotranspiration - Guidelines for Computing Crop Water Requirements - FAO Irrigation and Drainage paper 56

[3]Measured Potential Evaporation Data (i.e. Lake Evaporation) from the Environment Canada Canadian Climate Normals (Ottawa CDA, 1981-2010)

910 March Road (121186)
Water Balance Model Results
Pre-Development Conditions

Water Balance for Area 1: Impervious

Average Monthly Results											
Month	**Precip.**	**PET**	**Rain**	**Snow**	**Snowmelt**	**Water Input**	**W-PET**	**ΔSoil Water**	**AET**	**Surplus**	**Infiltration**	**Runoff**
January	63.3	0.0	10.9	52.4	47.1	58.0	58.0	0.0	0.0	58.0	0.0	58.0
February	51.9	0.0	10.1	41.8	42.7	52.7	52.7	0.0	0.0	52.7	0.0	52.7
March	60.0	0.0	24.8	35.2	61.5	86.4	86.4	0.0	0.0	86.4	0.0	86.4
April	76.6	14.4	73.1	3.5	6.7	79.8	65.4	-1.0	8.0	72.9	0.0	72.9
May	78.2	102.1	78.2	0.0	0.0	78.2	-23.9	0.0	35.9	42.4	0.0	42.4
June	96.0	127.0	96.0	0.0	0.0	96.0	-31.0	-0.1	43.3	52.7	0.0	52.7
July	91.1	133.0	91.1	0.0	0.0	91.1	-41.8	-0.2	40.6	50.7	0.0	50.7
August	87.2	111.4	87.2	0.0	0.0	87.2	-24.2	-0.1	33.4	53.9	0.0	53.9
September	88.2	72.4	88.2	0.0	0.0	88.2	15.8	0.5	28.1	59.5	0.0	59.5
October	88.7	40.8	87.8	0.9	0.6	88.4	47.6	0.1	22.2	66.0	0.0	66.0
November	73.9	4.7	58.3	15.5	12.9	71.2	66.5	0.8	3.3	67.1	0.0	67.1
December	71.0	0.0	20.5	50.5	28.3	48.8	48.8	0.0	0.0	48.8	0.0	48.8
ANNUAL TOTAL	**926.1**	**605.8**	**726.2**	**199.8**	**199.8**	**926.0**	**320.3**	**0.0**	**214.9**	**711.2**	**0.0**	**711.2**

Total Number of Years = 30

Average Annual Results												
Year	**Precip.**	**PET**	**Rain**	**Snow**	**Snowmelt**	**Water Input**	**W-PET**	**ΔSoil Water**	**AET**	**Surplus**	**Infiltration**	**Runoff**
1988	836.1	605.8	713.0	123.1	133.9	846.9	241.1	0.0	205.8	641.1	0.0	641.1
1989	817.1	605.8	620.0	197.1	153.8	773.8	168.0	0.0	180.5	593.3	0.0	593.3
1990	976.7	605.8	777.6	199.1	232.7	1010.3	404.5	0.0	207.6	802.7	0.0	802.7
1991	820.2	605.8	619.1	201.1	204.0	823.1	217.4	0.0	191.6	631.5	0.0	631.5
1992	908.3	605.8	651.9	256.4	260.2	912.1	306.4	0.0	211.4	700.8	0.0	700.8
1993	1019.3	605.8	754.0	265.3	266.3	1020.3	414.5	0.0	243.6	776.7	0.0	776.7
1994	909.5	605.8	681.6	227.9	234.2	915.8	310.1	0.0	224.9	690.9	0.0	690.9
1995	1038.4	605.8	809.4	229.0	138.2	947.6	341.9	0.0	197.5	750.2	0.0	750.2
1996	1004.7	605.8	866.9	137.8	213.7	1080.6	474.8	0.0	220.2	860.4	0.0	860.4
1997	773.0	605.8	475.9	297.1	309.5	785.4	179.7	0.0	178.1	607.3	0.0	607.3
1998	841.6	605.8	630.0	211.6	192.8	822.8	217.1	0.0	209.4	613.4	0.0	613.4
1999	830.5	605.8	623.3	207.2	219.8	843.1	237.3	0.0	192.7	650.4	0.0	650.4
2000	987.4	605.8	783.0	204.4	162.0	945.0	339.3	0.0	240.8	704.2	0.0	704.2
2001	753.6	605.8	580.3	173.3	213.1	793.4	187.7	0.0	195.0	598.5	0.0	598.5
2002	867.9	605.8	687.7	180.2	189.6	877.3	271.6	0.0	194.6	682.8	0.0	682.8
2003	1068.5	605.8	820.4	248.1	255.3	1075.7	469.9	0.0	233.9	841.8	0.0	841.8
2004	919.7	605.8	756.2	163.5	124.4	880.6	274.9	0.0	220.1	660.5	0.0	660.5
2005	939.6	605.8	784.9	154.7	175.8	960.7	354.9	0.0	218.2	742.5	0.0	742.5
2006	1152.0	605.8	970.6	181.4	183.1	1153.7	547.9	0.0	241.1	912.6	0.0	912.6
2007	901.0	605.8	728.8	172.2	170.0	898.8	293.1	0.0	205.7	693.1	0.0	693.1
2008	1057.6	605.8	681.6	376.0	391.5	1073.1	467.3	0.0	234.1	838.9	0.0	838.9
2009	946.5	605.8	800.3	146.2	93.4	893.7	288.0	0.0	256.2	637.5	0.0	637.5
2010	970.2	605.8	867.0	103.2	159.0	1026.0	420.2	0.0	245.4	780.5	0.0	780.5
2011	878.2	605.8	676.6	201.6	179.8	856.4	250.7	0.0	217.9	638.6	0.0	638.6
2012	807.5	605.8	596.6	210.9	147.0	743.6	137.8	0.0	208.6	535.0	0.0	535.0
2013	881.4	605.8	704.2	177.2	217.5	921.7	316.0	0.0	231.7	690.0	0.0	690.0
2014	903.1	605.8	759.5	143.6	189.0	948.5	342.7	0.0	230.4	718.0	0.0	718.0
2015	785.7	605.8	648.3	137.4	108.6	756.9	151.2	0.0	200.5	556.4	0.0	556.4
2016	917.9	605.8	656.4	261.5	262.2	918.6	312.9	0.0	171.9	746.8	0.0	746.8
2017	1268.5	605.8	1061.5	207.0	214.0	1275.5	669.7	0.0	236.8	1038.7	0.0	1038.7
AVERAGE	**926.1**	**605.8**	**726.2**	**199.8**	**199.8**	**926.0**	**320.3**	**0.0**	**214.9**	**711.2**	**0.0**	**711.2**

PRECIP	Total Precipitation
PET	Potential Evapotranspiration
W	Water Input (Rain + Snowmelt)
Soil Water (SW)	Available Water in the Soil Moisture Storage Zone
ΔSoil Water	Change in Soil Water
AET	Actual Evapotranspiration

The water balance calculations are conducted on a daily time step
All units in mm

910 March Road (121186)
Water Balance Model Results
Pre-Development Conditions

NOVATECH
Engineers, Planners & Landscape Architects

Water Balance for Area 2: Gravel

Average Monthly Results												
Month	**Precip.**	**PET**	**Rain**	**Snow**	**Snowmelt**	**Water Input**	**W-PET**	**ΔSoil Water**	**AET**	**Surplus**	**Infiltration**	**Runoff**
January	63.3	0.0	10.9	52.4	47.1	58.0	58.0	0.0	0.0	58.0	17.4	40.6
February	51.9	0.0	10.1	41.8	42.7	52.7	52.7	0.0	0.0	52.7	15.8	36.9
March	60.0	0.0	24.8	35.2	61.5	86.4	86.4	0.0	0.0	86.4	25.9	60.4
April	76.6	14.4	73.1	3.5	6.7	79.8	65.4	-5.2	14.1	71.0	21.3	49.7
May	78.2	102.1	78.2	0.0	0.0	78.2	-23.9	-22.2	87.2	13.3	4.0	9.3
June	96.0	127.0	96.0	0.0	0.0	96.0	-31.0	-9.7	94.6	11.1	3.3	7.8
July	91.1	133.0	91.1	0.0	0.0	91.1	-41.8	-6.2	91.0	6.3	1.9	4.4
August	87.2	111.4	87.2	0.0	0.0	87.2	-24.2	1.2	76.6	9.3	2.8	6.5
September	88.2	72.4	88.2	0.0	0.0	88.2	15.8	22.3	55.6	10.3	3.1	7.2
October	88.7	40.8	87.8	0.9	0.6	88.4	47.6	15.9	37.2	35.2	10.6	24.7
November	73.9	4.7	58.3	15.5	12.9	71.2	66.5	4.0	4.7	62.6	18.8	43.8
December	71.0	0.0	20.5	50.5	28.3	48.8	48.8	0.0	0.0	48.8	14.6	34.1
ANNUAL TOTAL	**926.1**	**605.8**	**726.2**	**199.8**	**199.8**	**926.0**	**320.3**	**0.0**	**461.1**	**465.0**	**139.5**	**325.5**

Total Number of Years = 30

Average Annual Results												
Year	**Precip.**	**PET**	**Rain**	**Snow**	**Snowmelt**	**Water Input**	**W-PET**	**ΔSoil Water**	**AET**	**Surplus**	**Infiltration**	**Runoff**
1988	836.1	605.8	713.0	123.1	133.9	846.9	241.1	0.0	450.2	396.7	119.0	277.7
1989	817.1	605.8	620.0	197.1	153.8	773.8	168.0	0.0	444.3	329.5	98.8	230.6
1990	976.7	605.8	777.6	199.1	232.7	1010.3	404.5	0.0	452.8	557.4	167.2	390.2
1991	820.2	605.8	619.1	201.1	204.0	823.1	217.4	0.0	388.4	434.8	130.4	304.3
1992	908.3	605.8	651.9	256.4	260.2	912.1	306.4	0.0	481.9	430.3	129.1	301.2
1993	1019.3	605.8	754.0	265.3	266.3	1020.3	414.5	0.0	463.7	556.6	167.0	389.6
1994	909.5	605.8	681.6	227.9	234.2	915.8	310.1	0.0	504.4	411.4	123.4	288.0
1995	1038.4	605.8	809.4	229.0	138.2	947.6	341.9	0.0	459.8	487.8	146.4	341.5
1996	1004.7	605.8	866.9	137.8	213.7	1080.6	474.8	0.0	482.3	598.3	179.5	418.8
1997	773.0	605.8	475.9	297.1	309.5	785.4	179.7	0.0	365.3	420.1	126.0	294.1
1998	841.6	605.8	630.0	211.6	192.8	822.8	217.1	0.0	440.8	382.0	114.6	267.4
1999	830.5	605.8	623.3	207.2	219.8	843.1	237.3	0.0	420.0	423.1	126.9	296.2
2000	987.4	605.8	783.0	204.4	162.0	945.0	339.3	0.0	516.7	428.3	128.5	299.8
2001	753.6	605.8	580.3	173.3	213.1	793.4	187.7	0.0	399.8	393.7	118.1	275.6
2002	867.9	605.8	687.7	180.2	189.6	877.3	271.6	0.0	434.9	442.4	132.7	309.7
2003	1068.5	605.8	820.4	248.1	255.3	1075.7	469.9	0.0	491.9	583.8	175.1	408.7
2004	919.7	605.8	756.2	163.5	124.4	880.6	274.9	0.0	451.2	429.5	128.8	300.6
2005	939.6	605.8	784.9	154.7	175.8	960.7	354.9	0.0	461.9	498.8	149.6	349.1
2006	1152.0	605.8	970.6	181.4	183.1	1153.7	547.9	0.0	512.2	641.5	192.4	449.0
2007	901.0	605.8	728.8	172.2	170.0	898.8	293.1	0.0	448.8	450.1	135.0	315.1
2008	1057.6	605.8	681.6	376.0	391.5	1073.1	467.3	0.0	497.4	575.7	172.7	403.0
2009	946.5	605.8	800.3	146.2	93.4	893.7	288.0	0.0	509.1	384.6	115.4	269.2
2010	970.2	605.8	867.0	103.2	159.0	1026.0	420.2	0.0	478.2	547.7	164.3	383.4
2011	878.2	605.8	676.6	201.6	179.8	856.4	250.7	0.0	443.8	412.7	123.8	288.9
2012	807.5	605.8	596.6	210.9	147.0	743.6	137.8	0.0	414.4	329.2	98.7	230.4
2013	881.4	605.8	704.2	177.2	217.5	921.7	316.0	0.0	496.7	425.0	127.5	297.5
2014	903.1	605.8	759.5	143.6	189.0	948.5	342.7	0.0	508.5	439.9	132.0	308.0
2015	785.7	605.8	648.3	137.4	108.6	756.9	151.2	0.0	464.1	292.8	87.9	205.0
2016	917.9	605.8	656.4	261.5	262.2	918.6	312.9	0.0	424.1	494.6	148.4	346.2
2017	1268.5	605.8	1061.5	207.0	214.0	1275.5	669.7	0.0	525.0	750.5	225.1	525.3
AVERAGE	**926.1**	**605.8**	**726.2**	**199.8**	**199.8**	**926.0**	**320.3**	**0.0**	**461.1**	**465.0**	**139.5**	**325.5**

PRECIP	Total Precipitation
PET	Potential Evapotranspiration
W	Water Input (Rain + Snowmelt)
Soil Water (SW)	Available Water in the Soil Moisture Storage Zone
ΔSoil Water	Change in Soil Water
AET	Actual Evapotranspiration

The water balance calculations are conducted on a daily time step
All units in mm

910 March Road (121186)
Water Balance Model Results
Pre-Development Conditions

Water Balance for Area 3: Pasture

Average Monthly Results											
Month	**Precip.**	**PET**	**Rain**	**Snow**	**Snowmelt**	**Water Input**	**W-PET**	**ΔSoil Water**	**AET**	**Surplus**	**Infiltration**	**Runoff**
January	63.3	0.0	10.9	52.4	47.1	58.0	58.0	0.0	0.0	58.0	23.2	34.8
February	51.9	0.0	10.1	41.8	42.7	52.7	52.7	0.0	0.0	52.7	21.1	31.6
March	60.0	0.0	24.8	35.2	61.5	86.4	86.4	0.0	0.0	86.4	34.5	51.8
April	76.6	9.8	73.1	3.5	6.7	79.8	70.1	-3.4	9.7	73.5	29.4	44.1
May	78.2	74.5	78.2	0.0	0.0	78.2	3.7	-16.9	71.6	23.5	9.4	14.1
June	96.0	117.4	96.0	0.0	0.0	96.0	-21.4	-23.2	105.7	13.5	5.4	8.1
July	91.1	126.3	91.1	0.0	0.0	91.1	-35.2	-19.5	105.5	5.2	2.1	3.1
August	87.2	105.3	87.2	0.0	0.0	87.2	-18.1	-3.1	85.6	4.7	1.9	2.8
September	88.2	63.0	88.2	0.0	0.0	88.2	25.2	28.5	53.2	6.5	2.6	3.9
October	88.7	20.5	87.8	0.9	0.6	88.4	67.9	32.6	19.3	36.5	14.6	21.9
November	73.9	1.9	58.3	15.5	12.9	71.2	69.3	5.1	1.9	64.3	25.7	38.6
December	71.0	0.0	20.5	50.5	28.3	48.8	48.8	0.0	0.0	48.8	19.5	29.3
ANNUAL TOTAL	**926.1**	**518.7**	**726.2**	**199.8**	**199.8**	**926.0**	**407.4**	**0.0**	**452.4**	**473.6**	**189.4**	**284.2**

Total Number of Years = *30*

Average Annual Results												
Year	**Precip.**	**PET**	**Rain**	**Snow**	**Snowmelt**	**Water Input**	**W-PET**	**ΔSoil Water**	**AET**	**Surplus**	**Infiltration**	**Runoff**
1988	836.1	518.7	713.0	123.1	133.9	846.9	328.2	0.0	452.2	394.7	157.9	236.8
1989	817.1	518.7	620.0	197.1	153.8	773.8	255.1	0.0	439.2	334.6	133.8	200.8
1990	976.7	518.7	777.6	199.1	232.7	1010.3	491.6	0.0	445.1	565.2	226.1	339.1
1991	820.2	518.7	619.1	201.1	204.0	823.1	304.5	0.0	400.4	422.8	169.1	253.7
1992	908.3	518.7	651.9	256.4	260.2	912.1	393.5	0.0	472.8	439.4	175.8	263.6
1993	1019.3	518.7	754.0	265.3	266.3	1020.3	501.6	0.0	453.7	566.6	226.6	340.0
1994	909.5	518.7	681.6	227.9	234.2	915.8	397.1	0.0	482.7	433.1	173.2	259.8
1995	1038.4	518.7	809.4	229.0	138.2	947.6	429.0	0.0	453.8	493.8	197.5	296.3
1996	1004.7	518.7	866.9	137.8	213.7	1080.6	561.9	0.0	470.0	610.6	244.2	366.4
1997	773.0	518.7	475.9	297.1	309.5	785.4	266.7	0.0	387.8	397.6	159.0	238.6
1998	841.6	518.7	630.0	211.6	192.8	822.8	304.1	0.0	447.1	375.7	150.3	225.4
1999	830.5	518.7	623.3	207.2	219.8	843.1	324.4	0.0	429.6	413.5	165.4	248.1
2000	987.4	518.7	783.0	204.4	162.0	945.0	426.4	0.0	481.9	463.1	185.2	277.9
2001	753.6	518.7	580.3	173.3	213.1	793.4	274.8	0.0	409.5	383.9	153.6	230.4
2002	867.9	518.7	687.7	180.2	189.6	877.3	358.7	0.0	435.6	441.8	176.7	265.1
2003	1068.5	518.7	820.4	248.1	255.3	1075.7	557.0	0.0	465.1	610.6	244.2	366.4
2004	919.7	518.7	756.2	163.5	124.4	880.6	362.0	0.0	450.6	430.0	172.0	258.0
2005	939.6	518.7	784.9	154.7	175.8	960.7	442.0	0.0	454.6	506.1	202.4	303.7
2006	1152.0	518.7	970.6	181.4	183.1	1153.7	635.0	0.0	482.5	671.2	268.5	402.7
2007	901.0	518.7	728.8	172.2	170.0	898.8	380.2	0.0	457.9	440.9	176.4	264.5
2008	1057.6	518.7	681.6	376.0	391.5	1073.1	554.4	0.0	475.7	597.3	238.9	358.4
2009	946.5	518.7	800.3	146.2	93.4	893.7	375.1	0.0	483.0	410.7	164.3	246.4
2010	970.2	518.7	867.0	103.2	159.0	1026.0	507.3	0.0	464.0	561.9	224.8	337.1
2011	878.2	518.7	676.6	201.6	179.8	856.4	337.8	0.0	434.9	421.5	168.6	252.9
2012	807.5	518.7	596.6	210.9	147.0	743.6	224.9	0.0	420.0	323.6	129.4	194.1
2013	881.4	518.7	704.2	177.2	217.5	921.7	403.0	0.0	468.4	453.3	181.3	272.0
2014	903.1	518.7	759.5	143.6	189.0	948.5	429.8	0.0	478.6	469.9	188.0	281.9
2015	785.7	518.7	648.3	137.4	108.6	756.9	238.2	0.0	455.2	301.7	120.7	181.0
2016	917.9	518.7	656.4	261.5	262.2	918.6	400.0	0.0	431.6	487.1	194.8	292.2
2017	1268.5	518.7	1061.5	207.0	214.0	1275.5	756.8	0.0	489.0	786.5	314.6	471.9
AVERAGE	**926.1**	**518.7**	**726.2**	**199.8**	**199.8**	**926.0**	**407.4**	**0.0**	**452.4**	**473.6**	**189.4**	**284.2**

PRECIP Total Precipitation
PET Potential Evapotranspiration
W Water Input (Rain + Snowmelt)
Soil Water (SW) Available Water in the Soil Moisture Storage Zone
ΔSoil Water Change in Soil Water
AET Actual Evapotranspiration

The water balance calculations are conducted on a daily time step
All units in mm

Overall Pre-Development Infiltration

Area ID	Area (ha)	Infiltration (mm/yr)	Infiltration (m^3/yr)
1	0.11	0	0
2	0.20	139	279
3	1.99	189	3,770
TOTAL	**2.30**	**176**	**4,049**

910 March Road (121186)
Water Balance Model Parameters
Post-Development Conditions

Potential Evaporation Rates (AVG. mm/d)[3]

January	February	March	April	May	June	July	August	September	October	November	December
0.0	0.0	0.0	0.0	3.6	4.3	4.4	3.7	2.4	1.4	0.0	0.0

Surface Type	Area ID	Catchment Parameters						Infiltration Factor[1]				Crop Cover Coefficient[2]				Potential Evapotranspiration (AVG. mm/d)											
		AREA (m^2)	AREA (ha)	SOILS (HSG)	LAND USE	TOPOGRAPHY	AWC[1]	IF (soils)	IF (cover)	IF (topo)	IF (Total)	Dormant Season	Initial Growing Season	Middle of Growing Season	End of Growing Season	January	February	March	April	May	June	July	August	September	October	November	December
Impervious	1	13640	1.36	-	IMPERVIOUS	-	1.57	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	3.60	4.30	4.40	3.70	2.40	1.40	0.00	0.00
Lawn	2	280	0.03	C/D	LAWN	HILLY	100.00	0.20	0.10	0.10	0.40	0.40	0.78	1.15	0.55	0.00	0.00	0.00	0.00	2.81	4.95	5.06	4.26	1.32	0.56	0.00	0.00
Pasture	3	9080	0.91	C/D	PASTURE	HILLY	250.00	0.20	0.10	0.10	0.40	0.40	0.68	0.95	0.90	0.00	0.00	0.00	0.00	2.45	4.09	4.18	3.52	2.16	0.56	0.00	0.00

[1]Available Water Content (AWC) and Infiltration Factors (IF) for pervious areas based on Table 3.1 from the Stormwater Management Planning and Design Manual (MOE, 2003).

[2]Crop Cover Coefficients based on Table 12 from the Food and Agriculture Organization of the United Nations (FAO), 1998, Crop Evapotranspiration - Guidelines for Computing Crop Water Requirements - FAO Irrigation and Drainage paper 56

[3]Measured Potential Evaporation Data (i.e. Lake Evaporation) from the Environment Canada Canadian Climate Normals (Ottawa CDA, 1981-2010)

910 March Road (121186)
Water Balance Model Results
Post-Development Conditions

Water Balance for Area 1: Impervious

Average Monthly Results											
Month	**Precip.**	**PET**	**Rain**	**Snow**	**Snowmelt**	**Water Input**	**W-PET**	**ΔSoil Water**	**AET**	**Surplus**	**Infiltration**	**Runoff**
January	63.3	0.0	10.9	52.4	47.1	58.0	58.0	0.0	0.0	58.0	0.0	58.0
February	51.9	0.0	10.1	41.8	42.7	52.7	52.7	0.0	0.0	52.7	0.0	52.7
March	60.0	0.0	24.8	35.2	61.5	86.4	86.4	0.0	0.0	86.4	0.0	86.4
April	76.6	14.4	73.1	3.5	6.7	79.8	65.4	-1.0	8.0	72.9	0.0	72.9
May	78.2	102.1	78.2	0.0	0.0	78.2	-23.9	0.0	35.9	42.4	0.0	42.4
June	96.0	127.0	96.0	0.0	0.0	96.0	-31.0	-0.1	43.3	52.7	0.0	52.7
July	91.1	133.0	91.1	0.0	0.0	91.1	-41.8	-0.2	40.6	50.7	0.0	50.7
August	87.2	111.4	87.2	0.0	0.0	87.2	-24.2	-0.1	33.4	53.9	0.0	53.9
September	88.2	72.4	88.2	0.0	0.0	88.2	15.8	0.5	28.1	59.5	0.0	59.5
October	88.7	40.8	87.8	0.9	0.6	88.4	47.6	0.1	22.2	66.0	0.0	66.0
November	73.9	4.7	58.3	15.5	12.9	71.2	66.5	0.8	3.3	67.1	0.0	67.1
December	71.0	0.0	20.5	50.5	28.3	48.8	48.8	0.0	0.0	48.8	0.0	48.8
ANNUAL TOTAL	**926.1**	**605.8**	**726.2**	**199.8**	**199.8**	**926.0**	**320.3**	**0.0**	**214.9**	**711.2**	**0.0**	**711.2**

Total Number of Years = 30

Average Annual Results												
Year	**Precip.**	**PET**	**Rain**	**Snow**	**Snowmelt**	**Water Input**	**W-PET**	**ΔSoil Water**	**AET**	**Surplus**	**Infiltration**	**Runoff**
1988	836.1	605.8	713.0	123.1	133.9	846.9	241.1	0.0	205.8	641.1	0.0	641.1
1989	817.1	605.8	620.0	197.1	153.8	773.8	168.0	0.0	180.5	593.3	0.0	593.3
1990	976.7	605.8	777.6	199.1	232.7	1010.3	404.5	0.0	207.6	802.7	0.0	802.7
1991	820.2	605.8	619.1	201.1	204.0	823.1	217.4	0.0	191.6	631.5	0.0	631.5
1992	908.3	605.8	651.9	256.4	260.2	912.1	306.4	0.0	211.4	700.8	0.0	700.8
1993	1019.3	605.8	754.0	265.3	266.3	1020.3	414.5	0.0	243.6	776.7	0.0	776.7
1994	909.5	605.8	681.6	227.9	234.2	915.8	310.1	0.0	224.9	690.9	0.0	690.9
1995	1038.4	605.8	809.4	229.0	138.2	947.6	341.9	0.0	197.5	750.2	0.0	750.2
1996	1004.7	605.8	866.9	137.8	213.7	1080.6	474.8	0.0	220.2	860.4	0.0	860.4
1997	773.0	605.8	475.9	297.1	309.5	785.4	179.7	0.0	178.1	607.3	0.0	607.3
1998	841.6	605.8	630.0	211.6	192.8	822.8	217.1	0.0	209.4	613.4	0.0	613.4
1999	830.5	605.8	623.3	207.2	219.8	843.1	237.3	0.0	192.7	650.4	0.0	650.4
2000	987.4	605.8	783.0	204.4	162.0	945.0	339.3	0.0	240.8	704.2	0.0	704.2
2001	753.6	605.8	580.3	173.3	213.1	793.4	187.7	0.0	195.0	598.5	0.0	598.5
2002	867.9	605.8	687.7	180.2	189.6	877.3	271.6	0.0	194.6	682.8	0.0	682.8
2003	1068.5	605.8	820.4	248.1	255.3	1075.7	469.9	0.0	233.9	841.8	0.0	841.8
2004	919.7	605.8	756.2	163.5	124.4	880.6	274.9	0.0	220.1	660.5	0.0	660.5
2005	939.6	605.8	784.9	154.7	175.8	960.7	354.9	0.0	218.2	742.5	0.0	742.5
2006	1152.0	605.8	970.6	181.4	183.1	1153.7	547.9	0.0	241.1	912.6	0.0	912.6
2007	901.0	605.8	728.8	172.2	170.0	898.8	293.1	0.0	205.7	693.1	0.0	693.1
2008	1057.6	605.8	681.6	376.0	391.5	1073.1	467.3	0.0	234.1	838.9	0.0	838.9
2009	946.5	605.8	800.3	146.2	93.4	893.7	288.0	0.0	256.2	637.5	0.0	637.5
2010	970.2	605.8	867.0	103.2	159.0	1026.0	420.2	0.0	245.4	780.5	0.0	780.5
2011	878.2	605.8	676.6	201.6	179.8	856.4	250.7	0.0	217.9	638.6	0.0	638.6
2012	807.5	605.8	596.6	210.9	147.0	743.6	137.8	0.0	208.6	535.0	0.0	535.0
2013	881.4	605.8	704.2	177.2	217.5	921.7	316.0	0.0	231.7	690.0	0.0	690.0
2014	903.1	605.8	759.5	143.6	189.0	948.5	342.7	0.0	230.4	718.0	0.0	718.0
2015	785.7	605.8	648.3	137.4	108.6	756.9	151.2	0.0	200.5	556.4	0.0	556.4
2016	917.9	605.8	656.4	261.5	262.2	918.6	312.9	0.0	171.9	746.8	0.0	746.8
2017	1268.5	605.8	1061.5	207.0	214.0	1275.5	669.7	0.0	236.8	1038.7	0.0	1038.7
AVERAGE	**926.1**	**605.8**	**726.2**	**199.8**	**199.8**	**926.0**	**320.3**	**0.0**	**214.9**	**711.2**	**0.0**	**711.2**

PRECIP	Total Precipitation
PET	Potential Evapotranspiration
W	Water Input (Rain + Snowmelt)
Soil Water (SW)	Available Water in the Soil Moisture Storage Zone
ΔSoil Water	Change in Soil Water
AET	Actual Evapotranspiration

The water balance calculations are conducted on a daily time step
All units in mm

910 March Road (121186)
Water Balance Model Results
Post-Development Conditions

Water Balance for Area 2: Lawn

Average Monthly Results											
Month	**Precip.**	**PET**	**Rain**	**Snow**	**Snowmelt**	**Water Input**	**W-PET**	**ΔSoil Water**	**AET**	**Surplus**	**Infiltration**	**Runoff**
January	63.3	0.0	10.9	52.4	47.1	58.0	58.0	0.0	0.0	58.0	23.2	34.8
February	51.9	0.0	10.1	41.8	42.7	52.7	52.7	0.0	0.0	52.7	21.1	31.6
March	60.0	0.0	24.8	35.2	61.5	86.4	86.4	0.0	0.0	86.4	34.5	51.8
April	76.6	11.2	73.1	3.5	6.7	79.8	68.6	-3.9	11.0	72.7	29.1	43.6
May	78.2	86.6	78.2	0.0	0.0	78.2	-8.4	-18.1	76.9	19.4	7.8	11.6
June	96.0	141.6	96.0	0.0	0.0	96.0	-45.6	-19.3	105.0	10.3	4.1	6.2
July	91.1	152.9	91.1	0.0	0.0	91.1	-61.8	-9.7	96.7	4.1	1.7	2.5
August	87.2	121.8	87.2	0.0	0.0	87.2	-34.6	3.8	77.1	6.2	2.5	3.7
September	88.2	46.5	88.2	0.0	0.0	88.2	41.7	36.7	35.7	15.8	6.3	9.5
October	88.7	17.6	87.8	0.9	0.6	88.4	70.8	9.9	17.0	61.4	24.6	36.8
November	73.9	1.9	58.3	15.5	12.9	71.2	69.3	0.6	1.9	68.8	27.5	41.3
December	71.0	0.0	20.5	50.5	28.3	48.8	48.8	0.0	0.0	48.8	19.5	29.3
ANNUAL TOTAL	**926.1**	**580.0**	**726.2**	**199.8**	**199.8**	**926.0**	**346.0**	**0.0**	**421.4**	**504.7**	**201.9**	**302.8**

Total Number of Years = 30

Average Annual Results												
Year	**Precip.**	**PET**	**Rain**	**Snow**	**Snowmelt**	**Water Input**	**W-PET**	**ΔSoil Water**	**AET**	**Surplus**	**Infiltration**	**Runoff**
1988	836.1	580.0	713.0	123.1	133.9	846.9	266.8	0.0	414.9	432.0	172.8	259.2
1989	817.1	580.0	620.0	197.1	153.8	773.8	193.8	0.0	397.5	376.3	150.5	225.8
1990	976.7	580.0	777.6	199.1	232.7	1010.3	430.2	0.0	417.5	592.8	237.1	355.7
1991	820.2	580.0	619.1	201.1	204.0	823.1	243.1	0.0	337.0	486.1	194.4	291.7
1992	908.3	580.0	651.9	256.4	260.2	912.1	332.1	0.0	451.5	460.6	184.2	276.4
1993	1019.3	580.0	754.0	265.3	266.3	1020.3	440.2	0.0	414.5	605.8	242.3	363.5
1994	909.5	580.0	681.6	227.9	234.2	915.8	335.8	0.0	482.7	433.1	173.2	259.8
1995	1038.4	580.0	809.4	229.0	138.2	947.6	367.6	0.0	422.0	525.6	210.2	315.4
1996	1004.7	580.0	866.9	137.8	213.7	1080.6	500.5	0.0	442.4	638.2	255.3	382.9
1997	773.0	580.0	475.9	297.1	309.5	785.4	205.4	0.0	324.0	461.4	184.5	276.8
1998	841.6	580.0	630.0	211.6	192.8	822.8	242.8	0.0	407.2	415.6	166.3	249.4
1999	830.5	580.0	623.3	207.2	219.8	843.1	263.0	0.0	378.3	464.8	185.9	278.9
2000	987.4	580.0	783.0	204.4	162.0	945.0	365.0	0.0	478.8	466.2	186.5	279.7
2001	753.6	580.0	580.3	173.3	213.1	793.4	213.4	0.0	351.4	442.0	176.8	265.2
2002	867.9	580.0	687.7	180.2	189.6	877.3	297.3	0.0	402.0	475.4	190.1	285.2
2003	1068.5	580.0	820.4	248.1	255.3	1075.7	495.6	0.0	439.9	635.8	254.3	381.5
2004	919.7	580.0	756.2	163.5	124.4	880.6	300.6	0.0	411.4	469.2	187.7	281.5
2005	939.6	580.0	784.9	154.7	175.8	960.7	380.7	0.0	416.9	543.8	217.5	326.3
2006	1152.0	580.0	970.6	181.4	183.1	1153.7	573.6	0.0	468.7	685.0	274.0	411.0
2007	901.0	580.0	728.8	172.2	170.0	898.8	318.8	0.0	421.4	477.4	191.0	286.5
2008	1057.6	580.0	681.6	376.0	391.5	1073.1	493.0	0.0	461.1	612.0	244.8	367.2
2009	946.5	580.0	800.3	146.2	93.4	893.7	313.7	0.0	477.2	416.6	166.6	250.0
2010	970.2	580.0	867.0	103.2	159.0	1026.0	445.9	0.0	434.0	592.0	236.8	355.2
2011	878.2	580.0	676.6	201.6	179.8	856.4	276.4	0.0	396.3	460.2	184.1	276.1
2012	807.5	580.0	596.6	210.9	147.0	743.6	163.5	0.0	363.9	379.7	151.9	227.8
2013	881.4	580.0	704.2	177.2	217.5	921.7	341.7	0.0	454.2	467.5	187.0	280.5
2014	903.1	580.0	759.5	143.6	189.0	948.5	368.4	0.0	461.0	487.5	195.0	292.5
2015	785.7	580.0	648.3	137.4	108.6	756.9	176.9	0.0	424.2	332.7	133.1	199.6
2016	917.9	580.0	656.4	261.5	262.2	918.6	338.6	0.0	389.6	529.0	211.6	317.4
2017	1268.5	580.0	1061.5	207.0	214.0	1275.5	695.4	0.0	500.1	775.4	310.2	465.2
AVERAGE	**926.1**	**580.0**	**726.2**	**199.8**	**199.8**	**926.0**	**346.0**	**0.0**	**421.4**	**504.7**	**201.9**	**302.8**

PRECIP	Total Precipitation
PET	Potential Evapotranspiration
W	Water Input (Rain + Snowmelt)
Soil Water (SW)	Available Water in the Soil Moisture Storage Zone
ΔSoil Water	Change in Soil Water
AET	Actual Evapotranspiration

The water balance calculations are conducted on a daily time step
All units in mm

910 March Road (121186)
Water Balance Model Results
Post-Development Conditions

Water Balance for Area 3: Pasture

Average Monthly Results												
Month	**Precip.**	**PET**	**Rain**	**Snow**	**Snowmelt**	**Water Input**	**W-PET**	**ΔSoil Water**	**AET**	**Surplus**	**Infiltration**	**Runoff**
January	63.3	0.0	10.9	52.4	47.1	58.0	58.0	0.0	0.0	58.0	23.2	34.8
February	51.9	0.0	10.1	41.8	42.7	52.7	52.7	0.0	0.0	52.7	21.1	31.6
March	60.0	0.0	24.8	35.2	61.5	86.4	86.4	0.0	0.0	86.4	34.5	51.8
April	76.6	9.8	73.1	3.5	6.7	79.8	70.1	-3.4	9.7	73.5	29.4	44.1
May	78.2	74.5	78.2	0.0	0.0	78.2	3.7	-16.9	71.6	23.5	9.4	14.1
June	96.0	117.4	96.0	0.0	0.0	96.0	-21.4	-23.2	105.7	13.5	5.4	8.1
July	91.1	126.3	91.1	0.0	0.0	91.1	-35.2	-19.5	105.5	5.2	2.1	3.1
August	87.2	105.3	87.2	0.0	0.0	87.2	-18.1	-3.1	85.6	4.7	1.9	2.8
September	88.2	63.0	88.2	0.0	0.0	88.2	25.2	28.5	53.2	6.5	2.6	3.9
October	88.7	20.5	87.8	0.9	0.6	88.4	67.9	32.6	19.3	36.5	14.6	21.9
November	73.9	1.9	58.3	15.5	12.9	71.2	69.3	5.1	1.9	64.3	25.7	38.6
December	71.0	0.0	20.5	50.5	28.3	48.8	48.8	0.0	0.0	48.8	19.5	29.3
ANNUAL TOTAL	**926.1**	**518.7**	**726.2**	**199.8**	**199.8**	**926.0**	**407.4**	**0.0**	**452.4**	**473.6**	**189.4**	**284.2**

Total Number of Years = 30

Average Annual Results												
Year	**Precip.**	**PET**	**Rain**	**Snow**	**Snowmelt**	**Water Input**	**W-PET**	**ΔSoil Water**	**AET**	**Surplus**	**Infiltration**	**Runoff**
1988	836.1	518.7	713.0	123.1	133.9	846.9	328.2	0.0	452.2	394.7	157.9	236.8
1989	817.1	518.7	620.0	197.1	153.8	773.8	255.1	0.0	439.2	334.6	133.8	200.8
1990	976.7	518.7	777.6	199.1	232.7	1010.3	491.6	0.0	445.1	565.2	226.1	339.1
1991	820.2	518.7	619.1	201.1	204.0	823.1	304.5	0.0	400.4	422.8	169.1	253.7
1992	908.3	518.7	651.9	256.4	260.2	912.1	393.5	0.0	472.8	439.4	175.8	263.6
1993	1019.3	518.7	754.0	265.3	266.3	1020.3	501.6	0.0	453.7	566.6	226.6	340.0
1994	909.5	518.7	681.6	227.9	234.2	915.8	397.1	0.0	482.7	433.1	173.2	259.8
1995	1038.4	518.7	809.4	229.0	138.2	947.6	429.0	0.0	453.8	493.8	197.5	296.3
1996	1004.7	518.7	866.9	137.8	213.7	1080.6	561.9	0.0	470.0	610.6	244.2	366.4
1997	773.0	518.7	475.9	297.1	309.5	785.4	266.7	0.0	387.8	397.6	159.0	238.6
1998	841.6	518.7	630.0	211.6	192.8	822.8	304.1	0.0	447.1	375.7	150.3	225.4
1999	830.5	518.7	623.3	207.2	219.8	843.1	324.4	0.0	429.6	413.5	165.4	248.1
2000	987.4	518.7	783.0	204.4	162.0	945.0	426.4	0.0	481.9	463.1	185.2	277.9
2001	753.6	518.7	580.3	173.3	213.1	793.4	274.8	0.0	409.5	383.9	153.6	230.4
2002	867.9	518.7	687.7	180.2	189.6	877.3	358.7	0.0	435.6	441.8	176.7	265.1
2003	1068.5	518.7	820.4	248.1	255.3	1075.7	557.0	0.0	465.1	610.6	244.2	366.4
2004	919.7	518.7	756.2	163.5	124.4	880.6	362.0	0.0	450.6	430.0	172.0	258.0
2005	939.6	518.7	784.9	154.7	175.8	960.7	442.0	0.0	454.6	506.1	202.4	303.7
2006	1152.0	518.7	970.6	181.4	183.1	1153.7	635.0	0.0	482.5	671.2	268.5	402.7
2007	901.0	518.7	728.8	172.2	170.0	898.8	380.2	0.0	457.9	440.9	176.4	264.5
2008	1057.6	518.7	681.6	376.0	391.5	1073.1	554.4	0.0	475.7	597.3	238.9	358.4
2009	946.5	518.7	800.3	146.2	93.4	893.7	375.1	0.0	483.0	410.7	164.3	246.4
2010	970.2	518.7	867.0	103.2	159.0	1026.0	507.3	0.0	464.0	561.9	224.8	337.1
2011	878.2	518.7	676.6	201.6	179.8	856.4	337.8	0.0	434.9	421.5	168.6	252.9
2012	807.5	518.7	596.6	210.9	147.0	743.6	224.9	0.0	420.0	323.6	129.4	194.1
2013	881.4	518.7	704.2	177.2	217.5	921.7	403.0	0.0	468.4	453.3	181.3	272.0
2014	903.1	518.7	759.5	143.6	189.0	948.5	429.8	0.0	478.6	469.9	188.0	281.9
2015	785.7	518.7	648.3	137.4	108.6	756.9	238.2	0.0	455.2	301.7	120.7	181.0
2016	917.9	518.7	656.4	261.5	262.2	918.6	400.0	0.0	431.6	487.1	194.8	292.2
2017	1268.5	518.7	1061.5	207.0	214.0	1275.5	756.8	0.0	489.0	786.5	314.6	471.9
AVERAGE	**926.1**	**518.7**	**726.2**	**199.8**	**199.8**	**926.0**	**407.4**	**0.0**	**452.4**	**473.6**	**189.4**	**284.2**

PRECIP	Total Precipitation
PET	Potential Evapotranspiration
W	Water Input (Rain + Snowmelt)
Soil Water (SW)	Available Water in the Soil Moisture Storage Zone
ΔSoil Water	Change in Soil Water
AET	Actual Evapotranspiration

The water balance calculations are conducted on a daily time step
All units in mm

Overall Post-Development Infiltration

Area ID	Area (ha)	Infiltration (mm/yr)	Infiltration (m^3/yr)
1	1.36	0	0
2	0.03	202	57
3	0.91	189	1,720
TOTAL	**2.30**	**77**	**1,777**

APPENDIX E
Development Servicing Study Checklist

4. Development Servicing Study Checklist

The following section describes the checklist of the required content of servicing studies. It is expected that the proponent will address each one of the following items for the study to be deemed complete and ready for review by City of Ottawa Infrastructure Approvals staff.

The level of required detail in the Servicing Study will increase depending on the type of application. For example, for Official Plan amendments and re-zoning applications, the main issues will be to determine the capacity requirements for the proposed change in land use and confirm this against the existing capacity constraint, and to define the solutions, phasing of works and the financing of works to address the capacity constraint. For subdivisions and site plans, the above will be required with additional detailed information supporting the servicing within the development boundary.

4.1 General Content

- N/A ☐ Executive Summary (for larger reports only).
- ☒ Date and revision number of the report.
- ☒ Location map and plan showing municipal address, boundary, and layout of proposed development.
- ☒ Plan showing the site and location of all existing services.
- ☒ Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to which individual developments must adhere.
- ☒ Summary of Pre-consultation Meetings with City and other approval agencies.
- ☒ Reference and confirm conformance to higher level studies and reports (Master Servicing Studies, Environmental Assessments, Community Design Plans), or in the case where it is not in conformance, the proponent must provide justification and develop a defendable design criteria.
- ☒ Statement of objectives and servicing criteria.
- ☒ Identification of existing and proposed infrastructure available in the immediate area.
- ☒ Identification of Environmentally Significant Areas, watercourses and Municipal Drains potentially impacted by the proposed development (Reference can be made to the Natural Heritage Studies, if available).

☒ Concept level master grading plan to confirm existing and proposed grades in the development. This is required to confirm the feasibility of proposed stormwater management and drainage, soil removal and fill constraints, and potential impacts to neighbouring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths.

N/A ☐ Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to address potential impacts.

N/A ☐ Proposed phasing of the development, if applicable.

☒ Reference to geotechnical studies and recommendations concerning servicing.

☒ All preliminary and formal site plan submissions should have the following information:

- Metric scale
- North arrow (including construction North)
- Key plan
- Name and contact information of applicant and property owner
- Property limits including bearings and dimensions
- Existing and proposed structures and parking areas
- Easements, road widening and rights-of-way
- Adjacent street names

4.2 Development Servicing Report: Water

☒ Confirm consistency with Master Servicing Study, if available

☒ Availability of public infrastructure to service proposed development

N/A ☐ Identification of system constraints

☒ Identify boundary conditions

☒ Confirmation of adequate domestic supply and pressure

☒ Confirmation of adequate fire flow protection and confirmation that fire flow is calculated as per the Fire Underwriter's Survey. Output should show available fire flow at locations throughout the development.

☒ Provide a check of high pressures. If pressure is found to be high, an assessment is required to confirm the application of pressure reducing valves.

N/A ☐ Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defined phases of the project including the ultimate design

☒ Address reliability requirements such as appropriate location of shut-off valves

N/A ☐ Check on the necessity of a pressure zone boundary modification.

- [X] Reference to water supply analysis to show that major infrastructure is capable of delivering sufficient water for the proposed land use. This includes data that shows that the expected demands under average day, peak hour and fire flow conditions provide water within the required pressure range
- [X] Description of the proposed water distribution network, including locations of proposed connections to the existing system, provisions for necessary looping, and appurtenances (valves, pressure reducing valves, valve chambers, and fire hydrants) including special metering provisions.
- N/A [ ] Description of off-site required feedermains, booster pumping stations, and other water infrastructure that will be ultimately required to service proposed development, including financing, interim facilities, and timing of implementation.
- [X] Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines.
- [X] Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.

4.3 Development Servicing Report: Wastewater

- [X] Summary of proposed design criteria (Note: Wet-weather flow criteria should not deviate from the City of Ottawa Sewer Design Guidelines. Monitored flow data from relatively new infrastructure cannot be used to justify capacity requirements for proposed infrastructure).
- [X] Confirm consistency with Master Servicing Study and/or justifications for deviations.
- N/A [ ] Consideration of local conditions that may contribute to extraneous flows that are higher than the recommended flows in the guidelines. This includes groundwater and soil conditions, and age and condition of sewers.
- [X] Description of existing sanitary sewer available for discharge of wastewater from proposed development.
- [X] Verify available capacity in downstream sanitary sewer and/or identification of upgrades necessary to service the proposed development. (Reference can be made to previously completed Master Servicing Study if applicable)
- [X] Calculations related to dry-weather and wet-weather flow rates from the development in standard MOE sanitary sewer design table (Appendix ‘C’) format.
- [X] Description of proposed sewer network including sewers, pumping stations, and forcemains.

N/A ☐ Discussion of previously identified environmental constraints and impact on servicing (environmental constraints are related to limitations imposed on the development in order to preserve the physical condition of watercourses, vegetation, soil cover, as well as protecting against water quantity and quality).

N/A ☐ Pumping stations: impacts of proposed development on existing pumping stations or requirements for new pumping station to service development.

N/A ☐ Forcemain capacity in terms of operational redundancy, surge pressure and maximum flow velocity.

N/A ☐ Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding.

N/A ☐ Special considerations such as contamination, corrosive environment etc.

4.4 Development Servicing Report: Stormwater Checklist

☒ Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property)

N/A ☐ Analysis of available capacity in existing public infrastructure.

☒ A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern.

☒ Water quantity control objective (e.g. controlling post-development peak flows to pre-development level for storm events ranging from the 2 or 5 year event (dependent on the receiving sewer design) to 100 year return period); if other objectives are being applied, a rationale must be included with reference to hydrologic analyses of the potentially affected subwatersheds, taking into account long-term cumulative effects.

☒ Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.

☒ Description of the stormwater management concept with facility locations and descriptions with references and supporting information.

N/A ☐ Set-back from private sewage disposal systems.

☒ Watercourse and hazard lands setbacks.

N/A ☐ Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed.

☒ Confirm consistency with sub-watershed and Master Servicing Study, if applicable study exists.

- [X] Storage requirements (complete with calculations) and conveyance capacity for minor events (1:5 year return period) and major events (1:100 year return period).
- [X] Identification of watercourses within the proposed development and how watercourses will be protected, or, if necessary, altered by the proposed development with applicable approvals.
- [X] Calculate pre and post development peak flow rates including a description of existing site conditions and proposed impervious areas and drainage catchments in comparison to existing conditions.
- N/A [ ] Any proposed diversion of drainage catchment areas from one outlet to another.
- [X] Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities.
- N/A [ ] If quantity control is not proposed, demonstration that downstream system has adequate capacity for the post-development flows up to and including the 100-year return period storm event.
- [X] Identification of potential impacts to receiving watercourses
- N/A [ ] Identification of municipal drains and related approval requirements.
- [X] Descriptions of how the conveyance and storage capacity will be achieved for the development.
- [X] 100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.
- [X] Inclusion of hydraulic analysis including hydraulic grade line elevations.
- [X] Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.
- [X] Identification of floodplains – proponent to obtain relevant floodplain information from the appropriate Conservation Authority. The proponent may be required to delineate floodplain elevations to the satisfaction of the Conservation Authority if such information is not available or if information does not match current conditions.
- N/A [ ] Identification of fill constraints related to floodplain and geotechnical investigation.

4.5 Approval and Permit Requirements: Checklist

The Servicing Study shall provide a list of applicable permits and regulatory approvals necessary for the proposed development as well as the relevant issues affecting each approval. The approval and permitting shall include but not be limited to the following:

☒ Conservation Authority as the designated approval agency for modification of floodplain, potential impact on fish habitat, proposed works in or adjacent to a watercourse, cut/fill permits and Approval under Lakes and Rivers Improvement Act. The Conservation Authority is not the approval authority for the Lakes and Rivers Improvement Act. Where there are Conservation Authority regulations in place, approval under the Lakes and Rivers Improvement Act is not required, except in cases of dams as defined in the Act.

☐ Application for Certificate of Approval (CofA) under the Ontario Water Resources Act.

N/A ☐ Changes to Municipal Drains.

N/A ☐ Other permits (National Capital Commission, Parks Canada, Public Works and Government Services Canada, Ministry of Transportation etc.)

4.6 Conclusion Checklist

☒ Clearly stated conclusions and recommendations

N/A ☐ Comments received from review agencies including the City of Ottawa and information on how the comments were addressed. Final sign-off from the responsible reviewing agency.

☒ All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario

APPENDIX F
Drawings

GENERAL NOTES:

1. COORDINATE AND SCHEDULE ALL WORK WITH OTHER TRADES AND CONTRACTORS.
2. DETERMINE THE EXACT LOCATION, SIZE, MATERIAL AND ELEVATION OF ALL EXISTING UTILITIES PRIOR TO COMMENCING CONSTRUCTION. PROTECT AND ASSUME RESPONSIBILITY FOR ALL EXISTING UTILITIES WHETHER OR NOT SHOWN ON THIS DRAWING.
3. OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA BEFORE COMMENCING CONSTRUCTION.
4. BEFORE COMMENCING CONSTRUCTION OBTAIN AND PROVIDE PROOF OF COMPREHENSIVE, ALL RISK AND OPERATIONAL LIABILITY INSURANCE FOR $5,000,000.00. INSURANCE POLICY TO NAME OWNERS, ENGINEERS AND ARCHITECTS AS CO-INSURED AND THE CITY OF OTTAWA AS THIRD PARTY.
5. RESTORE ALL DISTURBED AREAS ON-SITE AND OFF-SITE, INCLUDING TRENCHES AND SURFACES ON PUBLIC ROAD ALLOWANCES TO EXISTING CONDITIONS OR BETTER TO THE SATISFACTION OF THE CITY OF OTTAWA AND ENGINEER.
6. REMOVE FROM SITE ALL EXCESS EXCAVATED MATERIAL, ORGANIC MATERIAL AND DEBRIS UNLESS OTHERWISE INSTRUCTED BY ENGINEER. EXCAVATE AND REMOVE FROM SITE ANY CONTAMINATED MATERIAL. ALL CONTAMINATED MATERIAL SHALL BE DISPOSED OF AT A LICENSED LANDFILL FACILITY.
7. ALL ELEVATIONS ARE GEODETIC.
8. REFER TO GEOTECHNICAL REPORT (No. PG5887-1, DATED NOVEMBER 30, 2022), PREPARED BY PARSONS FOR SUBSURFACE CONDITIONS, CONSTRUCTION RECOMMENDATIONS, AND GEOTECHNICAL INSPECTION REQUIREMENTS. THE GEOTECHNICAL CONSULTANT IS TO REVIEW ON-SITE CONDITIONS AFTER EXCAVATION PRIOR TO PLACEMENT OF THE GRANULAR MATERIAL.
9. REFER TO ARCHITECT'S AND LANDSCAPE ARCHITECT'S DRAWINGS FOR BUILDING AND HARDSURFACE AREAS AND DIMENSIONS.
10. REFER TO STORMWATER MANAGEMENT REPORT (R-2023-051) PREPARED BY NOVATECH ENGINEERING CONSULTANTS LTD.
11. SAW CUT AND KEY GRIND ASPHALT AT ALL ROAD CUTS AND ASPHALT TIE IN POINTS AS PER CITY OF OTTAWA STANDARDS (R10).
12. PROVIDE LINE/PARKING PAINTING AS REQUIRED FOR REINSTATEMENT.
13. CONTRACTOR TO PROVIDE THE CONSULTANT WITH A GENERAL PLAN OF SERVICES INDICATING ALL SERVICING AS-BUILT INFORMATION SHOWN ON THIS PLAN. AS-BUILT INFORMATION MUST INCLUDE: PIPE MATERIAL, SIZES, LENGTHS, SLOPES, INVERT AND T/G ELEVATIONS, STRUCTURE LOCATIONS, VALVE AND HYDRANT LOCATIONS, T/WM ELEVATIONS AND ANY ALIGNMENT CHANGES, ETC.

GRADING NOTES:

1. ALL TOPSOIL, ORGANIC OR DELETERIOUS MATERIAL MUST BE ENTIRELY REMOVED FROM BENEATH THE PROPOSED PAVED AREAS AS DIRECTED BY THE SITE ENGINEER OR GEOTECHNICAL ENGINEER.
2. EXPOSED SUBGRADES IN PROPOSED PAVED AREAS SHOULD BE PROOF ROLLED WITH A LARGE STEEL DRUM ROLLER AND INSPECTED BY THE GEOTECHNICAL ENGINEER PRIOR TO THE PLACEMENT OF GRANULARS.
3. ANY SOFT AREAS EVIDENT FROM THE PROOF ROLLING SHOULD BE SUB-EXCAVATED AND REPLACED WITH SUITABLE MATERIAL THAT IS FROST COMPATIBLE WITH THE EXISTING SOILS AS RECOMMENDED BY THE GEOTECHNICAL ENGINEER.
4. THE GRANULAR BASE SHOULD BE COMPACTED TO AT LEAST 100% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY VALUE. ANY ADDITIONAL GRANULAR FILL USED BELOW THE PROPOSED PAVEMENT SHOULD BE COMPACTED TO AT LEAST 98% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY VALUE.
5. MINIMUM OF 2% GRADE FOR ALL GRASS AREAS UNLESS OTHERWISE NOTED.
6. MAXIMUM TERRACING GRADE TO BE 3:1 UNLESS OTHERWISE NOTED.
7. ALL GRADES BY CURBS ARE EDGE OF PAVEMENT GRADES UNLESS OTHERWISE INDICATED.
8. ALL CURBS SHALL BE BARRIER CURB (150mm) UNLESS OTHERWISE NOTED AND CONSTRUCTED AS PER CITY OF OTTAWA STANDARDS (SC1.1).
9. REFER TO LANDSCAPE PLAN FOR PLANTING AND OTHER LANDSCAPE FEATURE DETAILS.
10. CONTRACTOR TO PROVIDE THE CONSULTANT WITH A GRADING PLAN INDICATING AS-BUILT ELEVATIONS OF ALL DESIGN GRADES SHOWN ON THIS PLAN.

PAVEMENT STRUCTURE:

HEAVY DUTY PAVEMENT ABOVE PODIUM DECK ROOF
40mm HL3 OR SP 12.5
50mm HL8 PR SP 19.0
150mm OPSS GRANULAR "A"

HEAVY DUTY PAVEMENT
40mm HL3 OR SP 12.5
50mm HL8 PR SP 19.0
150mm OPSS GRANULAR "A"
450mm OPSS GRANULAR "B" TYPE II

EROSION AND SEDIMENT CONTROL NOTES:

1. THE OWNER AGREES TO PREPARE AND IMPLEMENT AN EROSION AND SEDIMENT CONTROL PLAN TO THE SATISFACTION OF THE CITY OF OTTAWA, APPROPRIATE TO THE SITE CONDITIONS, PRIOR TO UNDERTAKING ANY SITE ALTERATIONS (FILLING, GRADING, REMOVAL OF VEGETATION, ETC.) AND DURING ALL PHASES OF SITE PREPARATION AND CONSTRUCTION IN ACCORDANCE WITH THE CURRENT BEST MANAGEMENT PRACTICES FOR EROSION AND SEDIMENT CONTROL SUCH AS BUT NOT LIMITED TO INSTALLING FILTER CLOTHS ACROSS MANHOLE/CATCHBASIN LIDS TO PREVENT SEDIMENTS FROM ENTERING STRUCTURES AND INSTALL AND MAINTAIN A LIGHT DUTY SILT FENCE BARRIER AS REQUIRED.
2. THE CONTRACTOR SHALL PLACE FILTER CLOTH UNDER THE CATCHBASIN AND MANHOLE GRATES FOR THE DURATION OF CONSTRUCTION AND WILL REMAIN IN PLACE DURING ALL PHASES OF CONSTRUCTION.
3. SILT FENCING FOR ENTIRE PERIMETER OF SITE, SHALL BE UTILIZED TO CONTROL EROSION FROM THE SITE DURING CONSTRUCTION.
4. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.
5. EROSION AND SEDIMENT CONTROL MEASURES MAY BE MODIFIED IN THE FIELD AT THE DISCRETION OF THE CITY OF OTTAWA SITE INSPECTOR OR CONSERVATION AUTHORITY.

SEWER NOTES:

1. SPECIFICATIONS:

ITEM	SPEC. No.	REFERENCE
CATCHBASIN (600x600mm)	705.010	OPSD
STORM / SANITARY MANHOLE (1200Ø)	701.010	OPSD
CB, FRAME & COVER	400.020	OPSD
STORM / SANITARY MH FRAME	S25	CITY OF OTTAWA
SANITARY COVER	S24	CITY OF OTTAWA
STORM COVER (CLOSED)	S24.1	CITY OF OTTAWA
STORM COVER (OPEN)	S28.1	CITY OF OTTAWA
SEWER TRENCH	S6 & S7	CITY OF OTTAWA
STORM SEWER	PVC DR 35	CITY OF OTTAWA
SANITARY SEWER	PVC DR 35	CITY OF OTTAWA
STEEL CASING PROTECTION	F - 4412	CITY OF OTTAWA
ELBOW CB	S31	CITY OF OTTAWA
TEE CB	S30	CITY OF OTTAWA

2. SERVICES ARE TO BE CONSTRUCTED TO 1.0m FROM FACE OF BUILDING AT A MINIMUM SLOPE OF 1.0%.
3. INSULATE ALL PIPES (SAN/STM) THAT HAVE LESS THAN 2.0m COVER WITH 50mmX1200mm HI-40 INSULATION. PROVIDE 150mm CLEARANCE BETWEEN PIPE AND INSULATION.
4. PIPE BEDDING, COVER AND BACKFILL ARE TO BE COMPACTED TO AT LEAST 95% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY. THE USE OF CLEAR CRUSHED STONE AS A BEDDING LAYER SHALL NOT BE PERMITTED.
5. FLEXIBLE CONNECTIONS ARE REQUIRED FOR CONNECTING PIPES TO MANHOLES (FOR EXAMPLE KOR-N-SEAL, PSX: POSITIVE SEAL AND DURASEAL). THE CONCRETE CRADLE FOR THE PIPE CAN BE ELIMINATED.
6. THE OWNER SHALL REQUIRE THAT THE SITE SERVICING CONTRACTOR PERFORM FIELD TESTS FOR QUALITY CONTROL OF ALL SANITARY SEWERS. LEAKAGE TESTING SHALL BE COMPLETED IN ACCORDANCE WITH OPSS 410.07.16, 410.07.16.04 AND 407.07.24. DYE TESTING IS TO BE COMPLETED ON ALL SANITARY SERVICES TO CONFIRM PROPER CONNECTION TO THE SANITARY SEWER MAIN. THE FIELD TESTS SHALL BE PERFORMED IN THE PRESENCE OF A CERTIFIED PROFESSIONAL ENGINEER WHO SHALL SUBMIT A CERTIFIED COPY OF THE TEST RESULTS.
7. STORM MANHOLES AND CBMHS ARE TO HAVE 300mm SUMPS UNLESS OTHERWISE INDICATED.
8. CONTRACTOR TO TELEVISE (CCTV) ALL PROPOSED SEWERS, 200mmØ OR GREATER PRIOR TO BASE COURSE ASPHALT. UPON COMPLETION OF CONTRACT, THE CONTRACTOR IS RESPONSIBLE TO FLUSH AND CLEAN ALL SEWERS & APPURTENANCES.
9. DYE TESTING IS TO BE COMPLETED ON SANITARY SERVICES TO CONFIRM PROPER CONNECTION TO THE SANITARY SEWER MAIN.
10. A SANITARY BACKWATER VALVE ON THE SANITARY SERVICE IS REQUIRED.
11. ALL DRAINAGE FOR THE UNDERGROUND PARKING LEVELS IS REQUIRED TO BE DIRECTED TO THE SANITARY SEWER

WATERMAIN NOTES:

1. SPECIFICATIONS:

ITEM	SPEC. No.	REFERENCE
WATERMAIN TRENCHING	W17	CITY OF OTTAWA
THERMAL INSULATION IN SHALLOW TRENCHES	W22	CITY OF OTTAWA
WATERMAIN CROSSING OVER SEWER	W25.2	CITY OF OTTAWA
WATERMAIN	PVC DR 18	CITY OF OTTAWA
VALVE CHAMBER	W11	CITY OF OTTAWA
VALVE BOX	W24	CITY OF OTTAWA

2. SUPPLY AND CONSTRUCT ALL WATERMAINS AND APPURTENANCES IN ACCORDANCE WITH THE CITY OF OTTAWA STANDARDS AND SPECIFICATIONS. EXCAVATION, INSTALLATION, BACKFILL AND RESTORATION OF ALL WATERMAINS BY THE CONTRACTOR. CONNECTIONS AND SHUT-OFFS AT THE MAIN AND CHLORINATION OF THE WATER SYSTEM SHALL BE PERFORMED BY CITY OFFICIALS.
3. WATERMAIN SHALL BE MINIMUM 2.4m DEPTH BELOW GRADE UNLESS OTHERWISE INDICATED.
4. PROVIDE MINIMUM 0.25m CLEARANCE BETWEEN OUTSIDE OF PIPES AT ALL CROSSINGS.
5. WATER SERVICE IS TO BE CONSTRUCTED TO WITHIN 1.0m OF FOUNDATION WALL AND CAPPED, UNLESS OTHERWISE INDICATED.

SWM TANK NOTES:

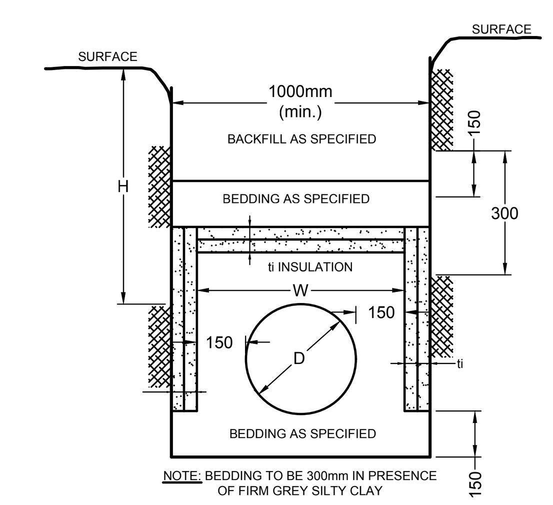
1. THE MINIMUM INTERNAL SIZE OF THE STORMWATER MANAGEMENT TANK IS TO BE 380m^3. REFER TO THE CROSS SECTION DETAIL AND THE ARCHITECT'S DRAWINGS FOR TANK DIMENSIONS, CONFIGURATION, MATERIALS AND WATERPROOFING DETAILS.
2. THE ACCESS HATCHES ARE TO OPERATE AS THE EMERGENCY OVERFLOW FOR THE SWM TANK. PROVIDE THE FRAME AND COVERS PER CITY OF OTTAWA DETAILS S25 & S28.1 RESPECTIVELY.
3. PROVIDE CIRCULAR HOLLOW ALUMINIUM MAINTENANCE HOLE STEPS ALONG TANK WALLS AT THE ACCESS HATCHES PER OPSD 405.010.

SEWER & WATERMAIN INSULATION NOTES:

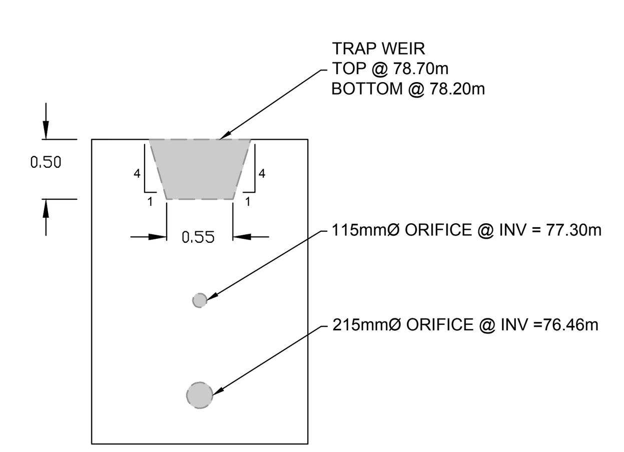
1. INSULATE ALL SEWER PIPES THAT HAVE LESS THAN 2.0m COVER AND ALL WATERMAIN WITH LESS THAN 2.4m OF COVER WITH EXPANDED POLYSTYRENE INSULATION AS PER OPSD 1109.030.
2. THE THICKNESS OF INSULATION SHALL BE THE EQUIVALENT OF 25mm FOR EVERY 300mm REDUCTION IN THE REQUIRED DEPTH OF COVER WITH 50mm MINIMUM (SEE TABLE)

T = THICKNESS OF INSULATION (mm)
W = WIDTH OF INSULATION (mm)
W = D + 300 (1000 min.)
D = O.D OF PIPE (mm)

COVER SEWER / WATER (mm)	INSULATION THICKNESS (mm)
2000-1700 / 2400-2100	50
1700-1400 / 2100-1800	75
1400-1100 / 1800-1500	100



INSULATION DETAIL FOR SHALLOW SEWERS & WATERMAIN
N.T.S



TRAP WEIR DETAIL
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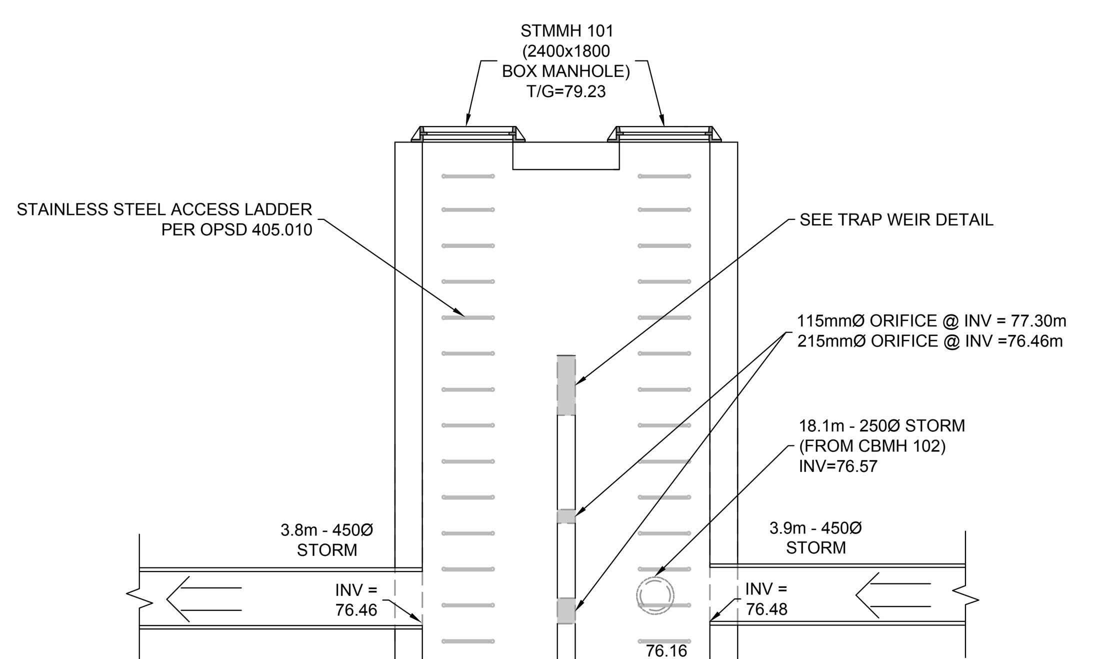
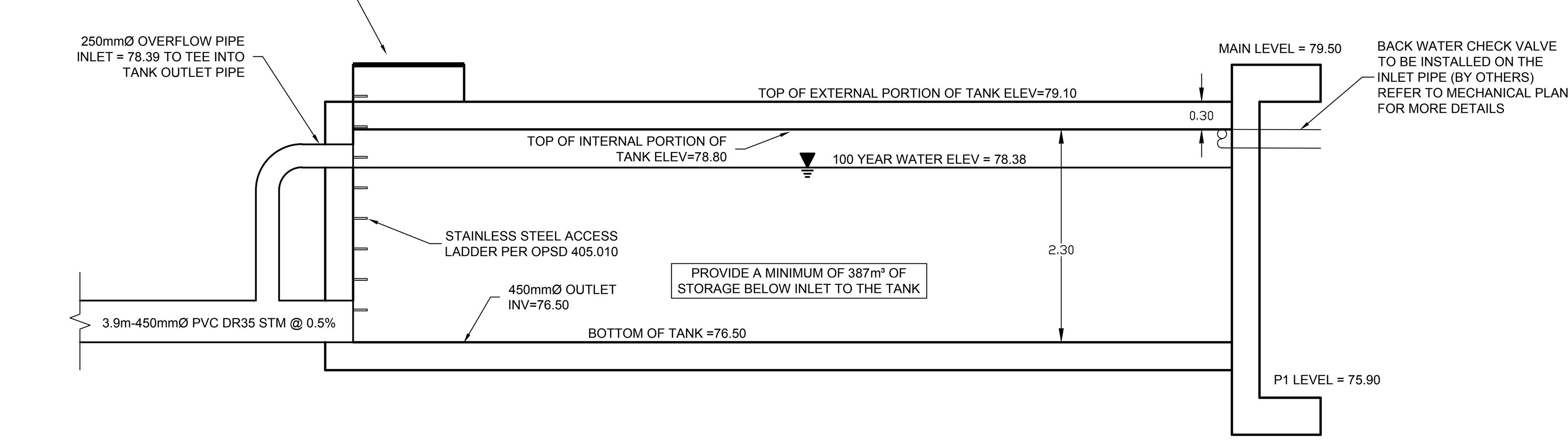


STMMH 101 DETAIL
SCALE: NTS

NOTE:
1. ELEVATIONS SHOWN ARE APPROXIMATE AND WILL BE CONFIRMED DURING BUILDING DETAILED DESIGN. REFER TO ARCHITECURAL, MECHANICAL AND STRUCTURAL DRAWINGS FOR MORE DETAILS.

STORMWATER STORAGE TANK TABLE			
DESIGN EVENT	CONTROLLED FLOW FROM STORAGE TANK	STORAGE TANK VOLUME	
		REQUIRED	PROVIDED
1:2 YR	79.4 L/s	162 m^3	>387 m^3
1:5 YR	107.2 L/s	222 m^3	
1:100 YR	220.9 L/s	384 m^3	

NOTES:
1. ALL DRAINAGE FROM AREA A-1 (PROPOSED COURTYARD AND ROOF) TO BE DIRECTED TO THE INTERNAL STORMWATER STORAGE TANK. REFER TO MECHANICAL PLANS FOR DETAILS.
2. REFER TO STRUCTURAL PLANS FOR EXACT SIZE AND DETAILS OF INTERNAL STORMWATER STORAGE TANK.
3. REFER TO ARCHITECTURAL AND MECHANICAL PLANS FOR LOCATION AND CONNECTIONS TO INTERNAL STORMWATER STORAGE TANK.



SWM TANK DETAIL
SCALE: 1:50

NOTE:
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

NOT FOR CONSTRUCTION

No.	REVISION	DATE	BY
1.6	ISSUED FOR FINAL APPROVAL	NOV 27/24	CJR
1.5	REVISED PER CITY AND MVCA COMMENTS	JUN 21/24	CJR
1.4	REVISED PER CITY COMMENTS	APR 18/24	CJR
1.3	REVISED PER CITY COMMENTS	DEC 22/23	CJR
1.2	REVISED PER CITY COMMENTS	DEC 14/23	CJR
1.1	RE-ISSUED FOR SITE PLAN	AUG 4/23	CJR
1.0	ISSUED FOR SITE PLAN	MAR 29/23	CJR

SCALE: AS NOTED

DESIGN: SM
CHECKED: CJR
DRAWN: SM
CHECKED: CJR
APPROVED: JLS

LICENSED PROFESSIONAL ENGINEER
C.J. RUDDLE
NOV 27/24
PROVINCE OF ONTARIO

NOVATECH
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Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada K2M 1P6
Telephone (613) 254-9643
Facsimile (613) 254-5867
Website www.novatech-eng.com

LOCATION
CITY OF OTTAWA
910 MARCH ROAD

DRAWING NAME
NOTES AND DETAILS PLAN

PROJECT No. 121186
REV: REV # 1.6
DRAWING No. 121186-ND

D02-02-20-0050 & D07-12-20-0089

PLAN #18358

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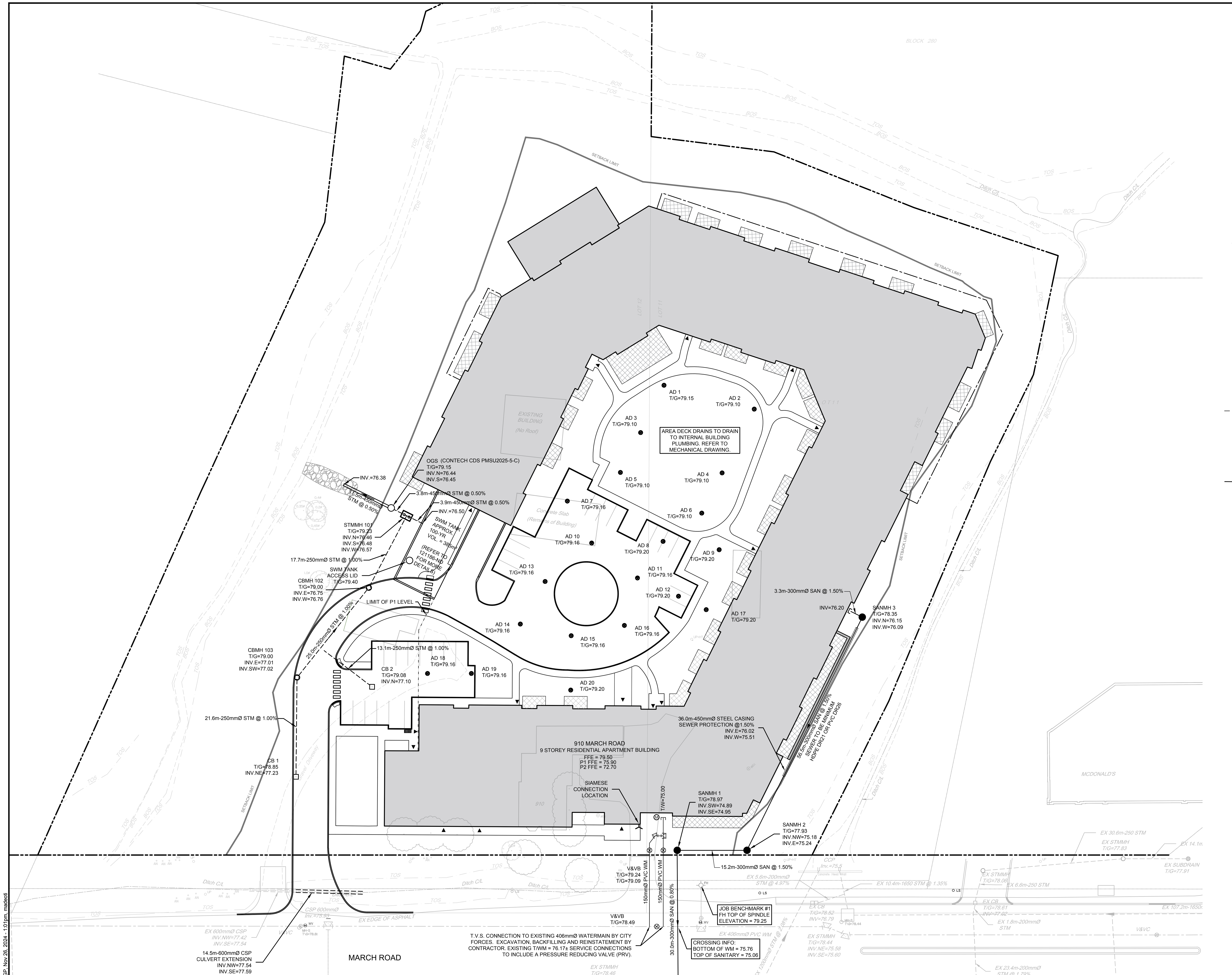

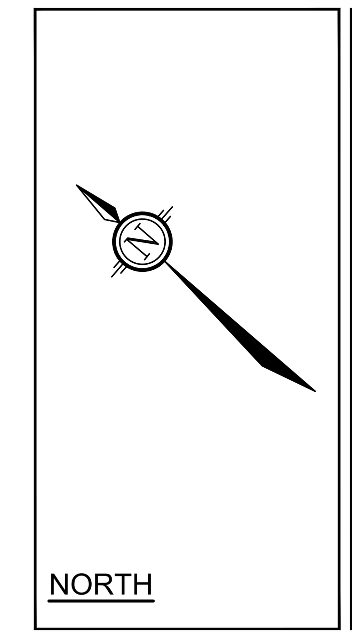

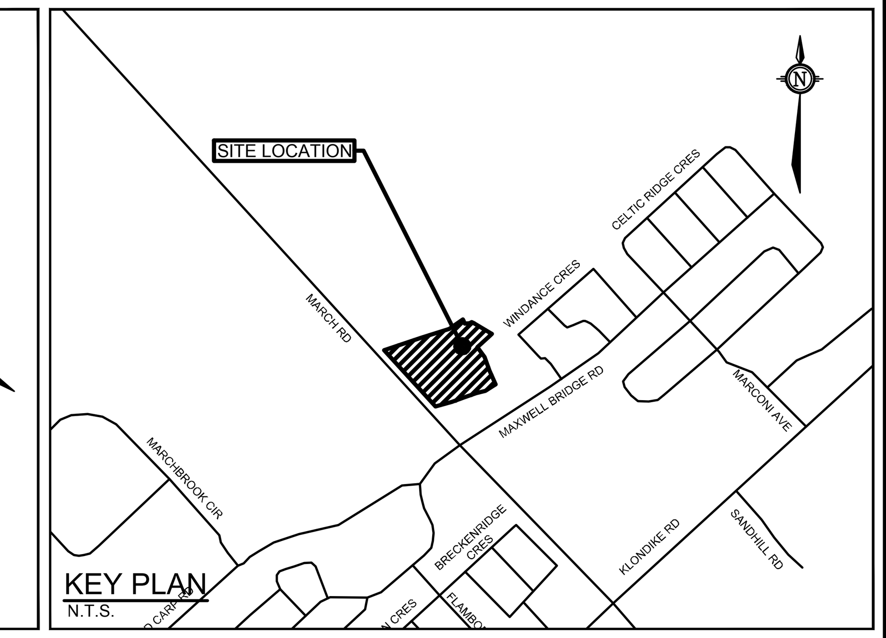

LEGEND

- PROPERTY LINE
- SETBACK LIMIT
- PROPOSED CURB
- PROPOSED DEPRESSED CURB
- PROPOSED STORM MANHOLE
- PROPOSED CATCHBASIN
- PROPOSED CATCHBASIN MANHOLE
- AD — PROPOSED AREA DECK DRAIN BY OTHERS (REFER TO MECH DRAWINGS FOR MORE INFO)
- SANMH — PROPOSED SANITARY SERVICE C/W MANHOLE
- PROPOSED WATER SERVICE
- PROPOSED STORM SEWER
- BUILDING ENTRANCE / EXIT
- UNDERGROUND PARKING P1 LIMIT
- V&VB — PROPOSED VALVE AND VALVE BOX
- PROPOSED CAP
- PROPOSED WATER METER
- SIAMESE CONNECTION
- WILDLIFE EXCLUSION FENCE
- EXISTING DITCH CENTRELINE
- TOS — EXISTING TOP OF SLOPE
- BOS — EXISTING BOTTOM OF SLOPE
- V&VB — EXISTING VALVE & VALVE BOX
- EXISTING SANITARY SEWER
- EXISTING WATERMAIN
- EXISTING STORM SEWER
- EX CB — EXISTING CATCHBASIN
- EX STMMH — EXISTING STORM MANHOLE
- WV — EXISTING WATER VALVE
- FH — EXISTING HYDRANT
- EX UP — EXISTING UTILITY POLE
- EXISTING FENCE

REFER TO 121186-ND FOR ADDITIONAL NOTES AND DETAILS

NOTE:
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

NOT FOR CONSTRUCTION

No.	REVISION	DATE	BY
1.6	ISSUED FOR FINAL APPROVAL	NOV 27/24	CJR
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1.2	REVISED PER CITY COMMENTS	DEC 14/23	CJR
1.1	RE-ISSUED FOR SITE PLAN	AUG 4/23	CJR
1.0	ISSUED FOR SITE PLAN	MAR 29/23	CJR

SCALE 1:400

DESIGN SM · CHECKED CJR · DRAWN SM · CHECKED CJR · APPROVED JLS

LICENSED PROFESSIONAL ENGINEER C.J. RUDDLE NOV 27/24 PROVINCE OF ONTARIO

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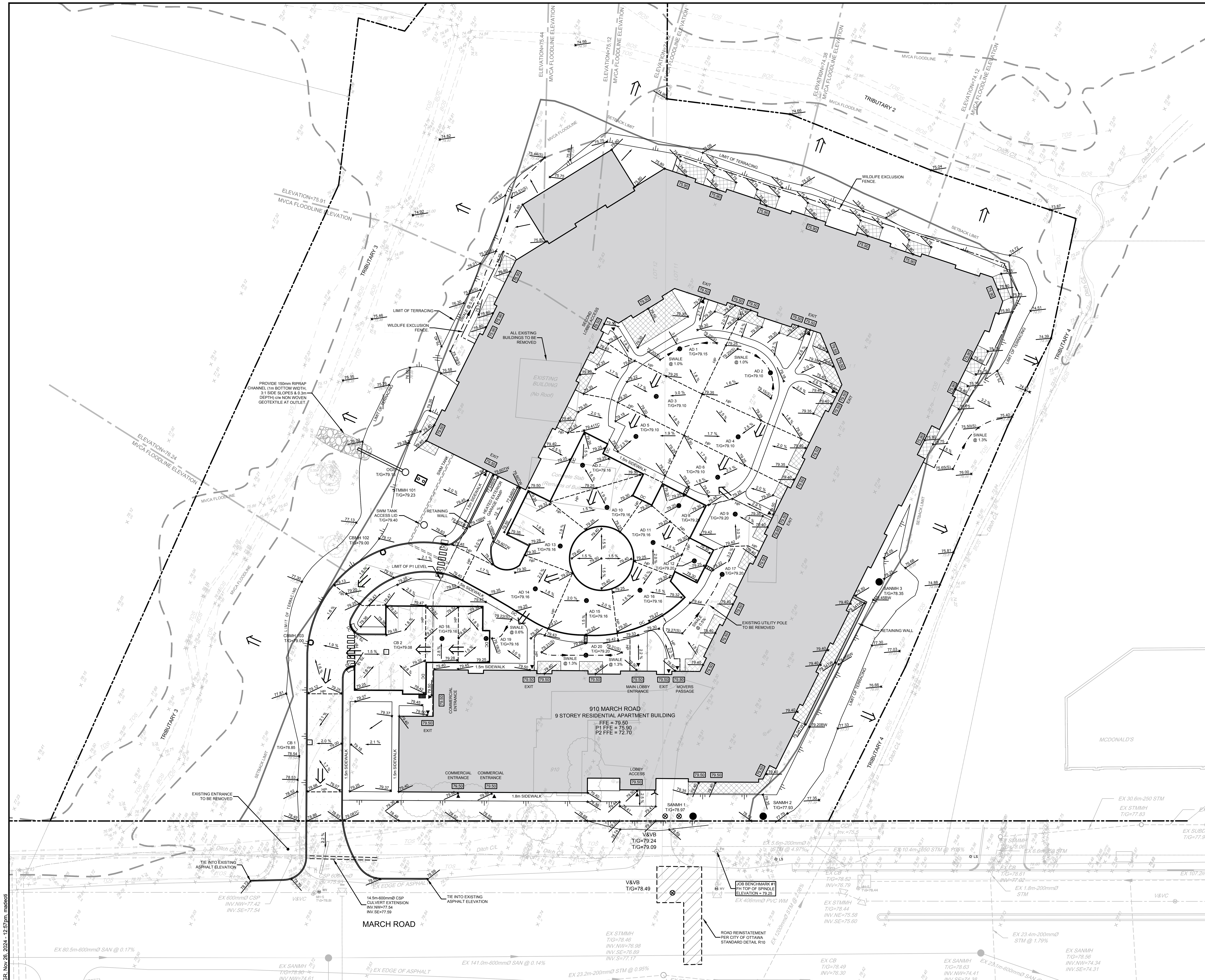
LOCATION
CITY OF OTTAWA
910 MARCH ROAD

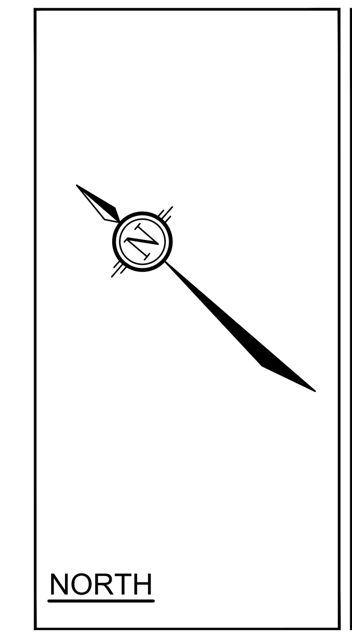
DRAWING NAME
GENERAL SERVICING PLAN

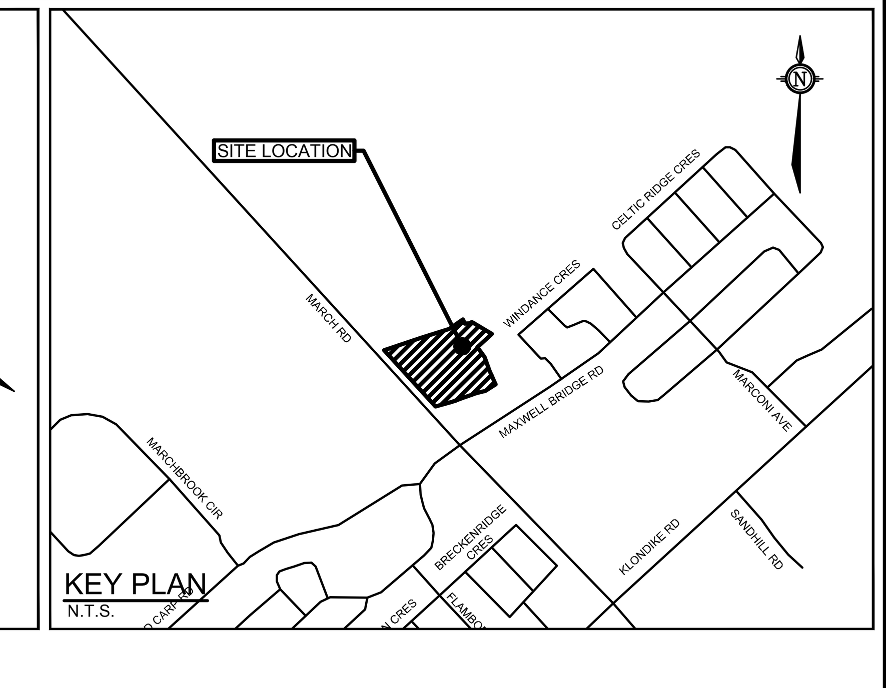
PROJECT No. 121186
REV # 1.6
DRAWING No. 121186-GP

D02-02-20-0050 & D07-12-20-0089

PLAN #18358







LEGEND

	PROPERTY LINE
	SETBACK LIMIT
75.80	PROPOSED ELEVATION
73.73	EXISTING ELEVATION
79.50TW	PROPOSED TOP OF WALL ELEVATION
79.35TC	PROPOSED TOP OF CURB ELEVATION
79.50	PROPOSED DOOR SILL ELEVATION
2.0 %	SLOPE AND DIRECTION
V&VB	PROPOSED VALVE AND VALVE BOX
	SIAMESE CONNECTION
	PROPOSED STORM MANHOLE
	PROPOSED CATCHBASIN
	PROPOSED CATCHBASIN MANHOLE
	PROPOSED AREA DECK DRAIN BY OTHERS (REFER TO MECH DRAWINGS FOR MORE INFO)
SANMH	PROPOSED SANITARY MANHOLE
	PROPOSED CAP
	PROPOSED BUILDING ENTRANCE / EXIT
	DIRECTION OF MAJOR OVERLAND FLOW
	PROPOSED TRENCH DRAIN
HP	PROPOSED HIGH POINT
	PROPOSED CURB
DC	PROPOSED DEPRESSED CURB
	TERRACING 3:1 SLOPE MAX (UNLESS OTHERWISE INDICATED)
	PROPOSED SWALE
	PROPOSED RETAINING WALL
	UNDERGROUND PARKING P1 LIMIT
	WILDLIFE EXCLUSION FENCE
	SAWCUT
	ROAD REINSTATEMENT

	EXISTING DITCH CENTRELINE
TOS	EXISTING TOP OF SLOPE
BOS	EXISTING BOTTOM OF SLOPE
V&VB	EXISTING VALVE & VALVE BOX
	EXISTING SANITARY SEWER
	EXISTING WATERMAIN
	EXISTING STORM SEWER
EX CB	EXISTING CATCHBASIN
EX STMMH	EXISTING STORM MANHOLE
WV	EXISTING WATER VALVE
FH	EXISTING HYDRANT
UP	EXISTING UTILITY POLE
AN	EXISTING ANCHOR

PAVEMENT STRUCTURE:

(blank)	HEAVY DUTY PAVEMENT ABOVE PODIUM DECK ROOF 40mm HL3 OR SP 12.5 50mm HL8 PR SP 19.0 150mm OPSS GRANULAR "A"
(stippled)	HEAVY DUTY PAVEMENT 40mm HL3 OR SP 12.5 50mm HL8 PR SP 19.0 150mm OPSS GRANULAR "A" 450mm OPSS GRANULAR "B" TYPE II

REFER TO 121186-ND FOR ADDITIONAL NOTES AND DETAILS

NOTE:
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

NOT FOR CONSTRUCTION

No.	REVISION	DATE	BY
1.6	ISSUED FOR FINAL APPROVAL	NOV 27/24	CJR
1.5	REVISED PER CITY AND MVCA COMMENTS	JUN 21/24	CJR
1.4	REVISED PER CITY COMMENTS	APR 18/24	CJR
1.3	REVISED PER CITY COMMENTS	DEC 22/23	CJR
1.2	REVISED PER CITY COMMENTS	DEC 14/23	CJR
1.1	RE-ISSUED FOR SITE PLAN	AUG 4/23	CJR
1.0	ISSUED FOR SITE PLAN	MAR 29/23	CJR

SCALE 1:400

DESIGN	SM
CHECKED	CJR
DRAWN	SM
CHECKED	CJR
APPROVED	JLS

LICENSED PROFESSIONAL ENGINEER C.J. RUDDLE NOV 27/24 PROVINCE OF ONTARIO

NOVATECH
Engineers, Planners & Landscape Architects
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada K2M 1P6
Telephone (613) 254-9643
Facsimile (613) 254-5867
Website www.novatech-eng.com

LOCATION
CITY OF OTTAWA
910 MARCH ROAD

DRAWING NAME
GRADING PLAN

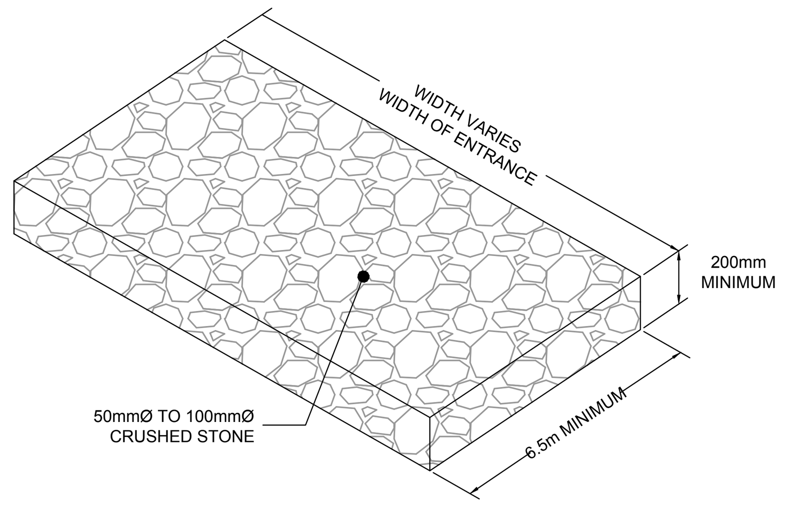
PROJECT No. 121186
REV # 1.6
DRAWING No. 121186-GR

D02-02-20-0050 & D07-12-20-0089

PLAN #18358

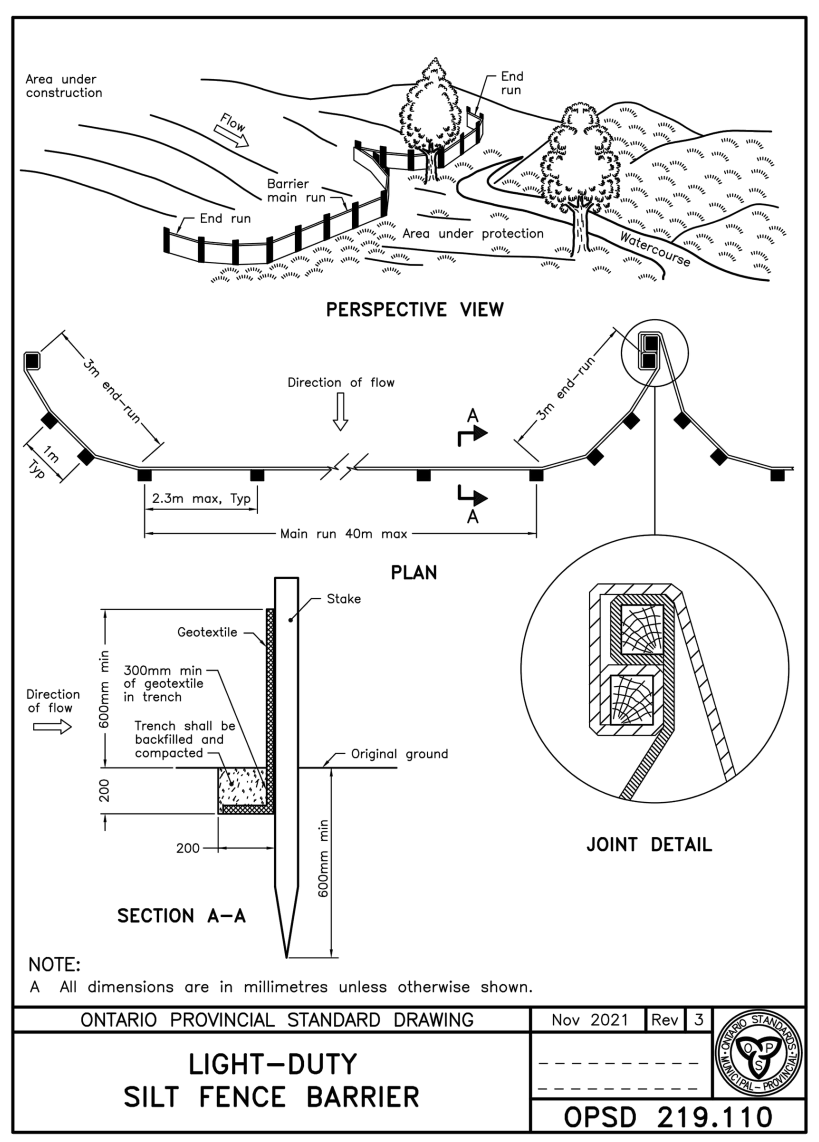
EROSION AND SEDIMENT CONTROL NOTES:

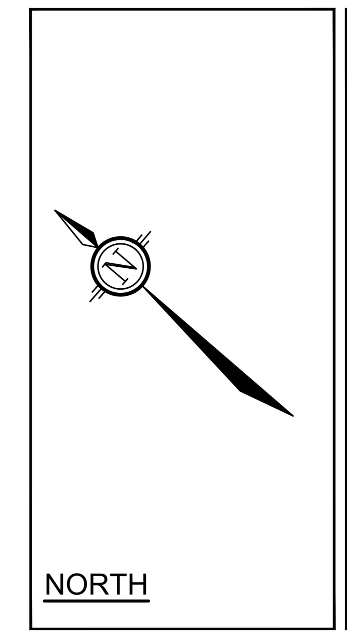
1. THE OWNER AGREES TO PREPARE AND IMPLEMENT AN EROSION AND SEDIMENT CONTROL PLAN TO THE SATISFACTION OF THE CITY OF OTTAWA, APPROPRIATE TO THE SITE CONDITIONS, PRIOR TO UNDERTAKING ANY SITE ALTERATIONS (FILLING, GRADING, REMOVAL OF VEGETATION, ETC.) AND DURING ALL PHASES OF SITE PREPARATION AND CONSTRUCTION IN ACCORDANCE WITH THE CURRENT BEST MANAGEMENT PRACTICES FOR EROSION AND SEDIMENT CONTROL SUCH AS BUT NOT LIMITED TO INSTALLING FILTER CLOTHS ACROSS MANHOLE/CATCHBASIN LIDS TO PREVENT SEDIMENTS FROM ENTERING STRUCTURES AND INSTALL AND MAINTAIN A LIGHT DUTY SILT FENCE BARRIER AS REQUIRED.
2. THE CONTRACTOR SHALL PLACE FILTER CLOTH UNDER THE CATCHBASIN AND MANHOLE GRATES FOR THE DURATION OF CONSTRUCTION AND WILL REMAIN IN PLACE DURING ALL PHASES OF CONSTRUCTION.
3. SILT FENCING FOR ENTIRE PERIMETER OF SITE, SHALL BE UTILIZED TO CONTROL EROSION FROM THE SITE DURING CONSTRUCTION.
4. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.
5. EROSION AND SEDIMENT CONTROL MEASURES MAY BE MODIFIED IN THE FIELD AT THE DISCRETION OF THE CITY OF OTTAWA SITE INSPECTOR OR CONSERVATION AUTHORITY.

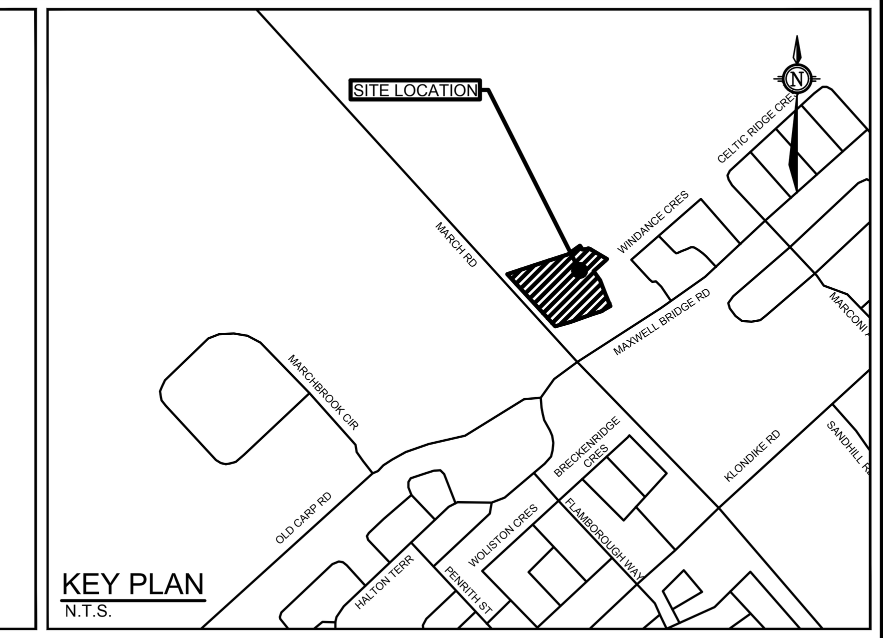


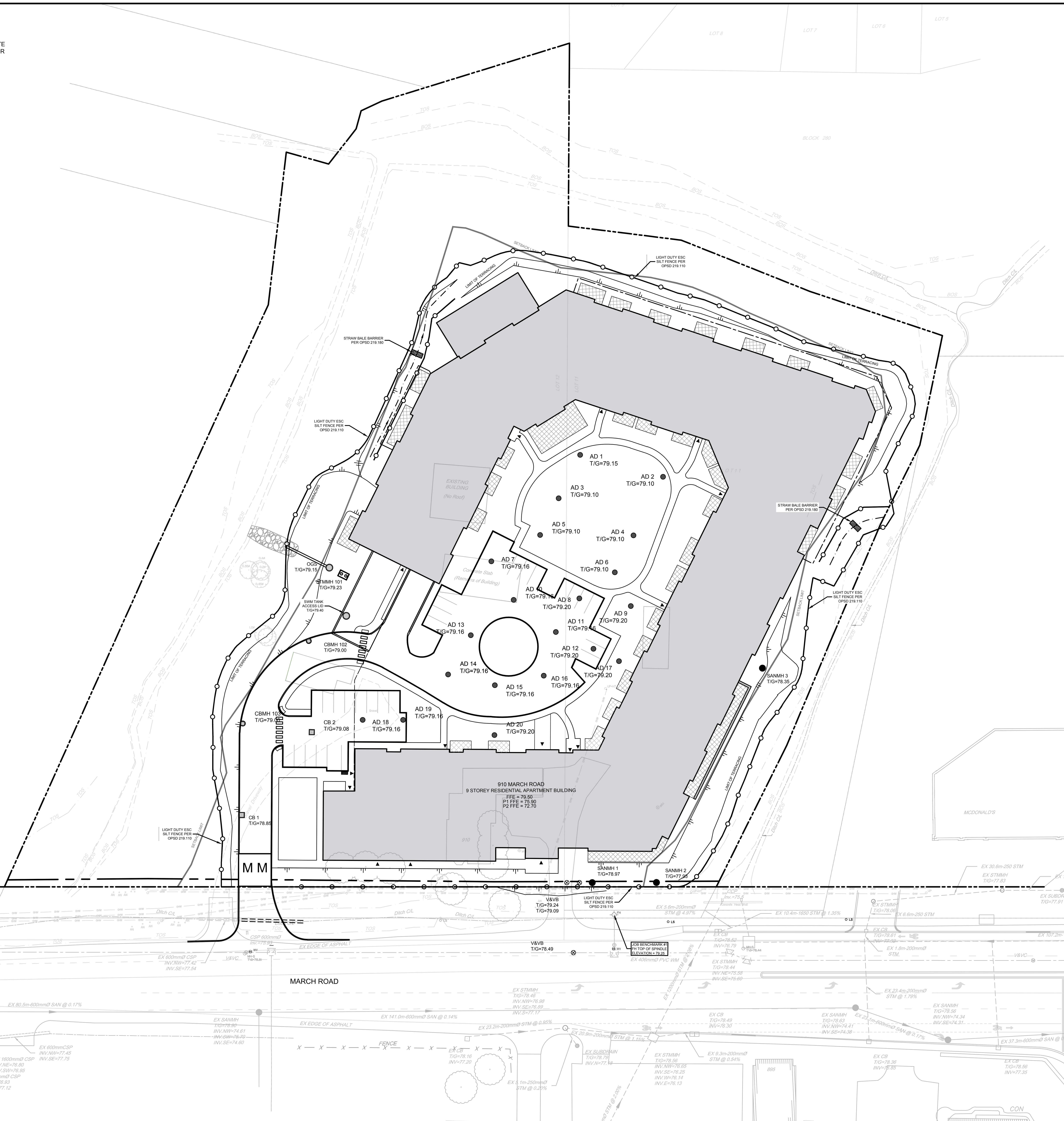
MUD MAT DETAIL

NOT TO SCALE









LEGEND

- PROPERTY LINE
- SETBACK LIMIT
- PROPOSED CURB
- PROPOSED DEPRESSED CURB
- TERRACING 3:1 SLOPE MAX (UNLESS OTHERWISE INDICATED)
- PROPOSED RETAINING WALL
- UNDERGROUND PARKING P1 LIMIT
- V&VB — PROPOSED VALVE AND VALVE BOX
- PROPOSED AREA DECK DRAIN BY OTHERS (REFER TO MECH DRAWINGS FOR MORE INFO)
- PROPOSED FILTER BAGS AT CATCHBASINS, CATCHBASIN MANHOLES AND AREA DRAINS
- WILDLIFE EXCLUSION FENCE
- LIGHT DUTY SILT FENCE (OPSD 219.110)
- M M — PROPOSED MUD MAT
- PROPOSED STRAW BALE BARRIER
- PROPOSED SWALE
- DRAINAGE DIRECTION
- EXISTING DITCH CENTRELINE
- TOS — EXISTING TOP OF SLOPE
- BOS — EXISTING BOTTOM OF SLOPE
- V&VB — EXISTING VALVE & VALVE BOX
- EXISTING SANITARY SEWER
- EXISTING WATERMAIN
- EXISTING STORM SEWER
- EX CB — EXISTING CATCHBASIN
- EX STMMH — EXISTING STORM MANHOLE
- WV — EXISTING WATER WALVE
- FH — EXISTING HYDRANT
- UP — EXISTING UTILITY POLE
- AN — EXISTING ANCHOR

REFER TO 121186-ND FOR ADDITIONAL NOTES

NOTE:
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1.0	ISSUED FOR SITE PLAN	MAR 29/23	CJR

SCALE 1:500

DESIGN SM | CHECKED CJR | DRAWN SM | CHECKED CJR | APPROVED JLS

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LOCATION
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DRAWING NAME
EROSION AND SEDIMENT CONTROL PLAN

PROJECT No. 121186
REV REV # 1.6
DRAWING No. 121186-ESC

D02-02-20-0050 & D07-12-20-0089

PLAN24x36.DWG - 914.4mmx609.6mm
PLAN #18358