CANADA LANDS COMPANY CLC LIMITED

530 TREMBLAY ROAD

SERVICING BRIEF

JANUARY 15, 2020

SIGNATURES

PREPARED BY

Philip de Sousa, P. Eng.
Project Engineer

REVIEWED BY

Martin Ennis, P.Eng.
Senior Project Manager

This report was prepared by WSP Canada Group Limited (WSP) for the Client, Canada Lands Company CLC Limited, in accordance with the professional services agreement. The disclosure of any information contained in this report is the sole responsibility of the intended recipient. The material in it reflects WSP Canada Group Limited's best judgement in light of the information available to it at the time of preparation. Any use which a third party, other than the City of Ottawa which can rely on this report, makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. WSP Canada Group Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This limitations statement is considered part of this report.

EXECUTIVE SUMMARY

WSP Canada Group Limited (“WSP”) was retained by Canada Lands Company CLC Limited (“CLC”) to prepare this Servicing Brief to provide the conceptual framework for water distribution, sanitary sewage, storm drainage and stormwater management in support of a proposed subdivision located in Ottawa, Ontario. The proposed plan includes the development of a mixed-use subdivision with residential, commercial, office, park, stormwater management pond and open space block components.

The proposed development will be serviced by existing Tremblay Road and internal roads which connect the proposed development blocks. The road elevations will be set to direct the major storm to the proposed stormwater management pond within the subject lands where possible.

The proposed development will be serviced from the City’s existing watermains on Tremblay Road and St. Laurent Boulevard. The watermain network will be sized and configured to provide a looped system to all areas of the proposed development.

The proposed sanitary flows from the development have been determined and are proposed to be split to separate existing systems on St. Laurent Boulevard and Tremblay Road. The existing systems have been confirmed to have adequate capacity to accommodate the estimated sanitary demand.

The subject property is located within the Cyrville Drain subwatershed and the Rideau Falls subwatershed. The storm servicing network will be sized and configured to direct flows in the Cyrville Drain subwatershed towards the stormwater management pond while the flows in the Rideau Falls subwatershed will be controlled before being directed to existing sewers.

The use of a stormwater management pond in the Cyrville Drain catchment will conform to MECP and City of Ottawa stormwater management guidelines. The Rideau River-Rideau Falls catchment will provide stormwater management through water storage, water quality treatment units and LID practices.

TABLE OF CONTENTS

TABLE OF CONTENTS

APPENDICES

1 INTRODUCTION

WSP Canada Group Limited ("WSP") was retained by Canada Lands Company CLC Limited ("CLC") to prepare this Servicing Brief in support of a proposed subdivision located in Ottawa, Ontario. CLC, through a collaborative process with Public Services and Procurement Canada (PSPC), is undertaking a planning application for the future development of the site. This report provides the conceptual framework for water distribution, sanitary sewage, storm drainage and stormwater management for the site, prior to detailed design being undertaken. The proposed plan involves the development of a mixed-use subdivision with residential, commercial, office, and park land uses. Additionally, proposed is the realignment of Tremblay Road along with regrading and reservicing.

This report has been prepared to accompany the submission for Draft Plan of Subdivision, known as 530 Tremblay Road (the "subject property"). In preparing this report we have consulted with the requirements of the City of Ottawa (Ottawa Sewer Design Guidelines, Second Edition, October 2012 and the Ottawa Design Guidelines - Water Distribution, First Edition, July 2010), the Ontario Ministry of Environment Stormwater Management Planning and Design Manual, March 2003, Rideau Valley Conservation Authority, the MOE Design Guidelines for Sewage Works, 2008 and the Technical Reference for Office Building Design, 2017. This report is intended to provide the functional design framework for the proposed development. All required approvals from City of Ottawa, Rideau Valley Conservation Authority, the MOE, and all other governing bodies will be obtained as part of the registration of the subdivision. This report looks at the servicing for the subject property. The Draft Plan of Subdivision is for the creation of the two roads and all blocks except the Federal Office Development block (PSPC lands).

1.1 SUBJECT PROPERTY DESCRIPTION

The subject property is located at the intersection of St. Laurent Boulevard and Tremblay Road in the City of Ottawa and occupies an area of 10.7 hectares (26.4 acres). The property is bounded by the Queensway Trans-Canada Highway to the north, Canadian National Railway to the south, St. Laurent Boulevard to the east, and the Eastway Gardens community to the west. The general location of the subject property is shown on **Figure 1**. The vision for the 10+ hectare subject property will offer a balance of places to live and places to work, connected by an integrated network of animated public open spaces.

The Draft Plan of Subdivision comprises:

- Block N and Part of Blocks K, L, & M and Part of Tremblay Street, Angus Street & Catherine Street Registered Plan 84; and
- Part of Lots 11 and 12 Concession Junction Gore. Geographic Township of Gloucester City of Ottawa.

The subject property is located south of Highway 417 and west of St. Laurent Boulevard in Ward 18 (Alta Vista) in the City of Ottawa, and has a dual frontage onto the existing Tremblay Road as well as

St. Laurent Boulevard. There is also an existing St. Laurent Transit Station pedestrian tunnel entrance located to the southwest of Highway 417 and northwest of the subject property.

The registered owner of the property is Her Majesty the Queen in Right of Canada, as represented by the Minister of Public Works and Government Services (PWGSC). The subject property is a former Ministry of Transportation of Ontario (MTO) property and is currently vacant.

The subject property lies on the boundary of two (2) subwatersheds. The south-east portion of the subject property is located within the Cyrville Drain watershed, which has a drainage area of 300 ha and outlets to the Ottawa River. The north-west portion of the subject property is located within the Rideau River – Rideau Falls watershed, which has a drainage area of 2800 ha and outlets to the Rideau River.

A topographic survey prepared by Annis, O'Sullivan, Vollebekk Ltd. dated August 22, 2019 determined the existing elevations for the subject property in this report. Benchmark elevations are geodetic and refer to the Canadian Geodetic Vertical Datum (1928), pre-1978 adjustment. Please see **Appendix J** for the topographic survey provided by Annis O'Sullivan Vollebekk Ltd. prepared August 22, 2019. The benchmarks used in the site design are Site Benchmark #1: Fire Hydrant – Top of Spindle (Elevation = 68.64) and Site Benchmark #2: Magnetic Nail – Set in Concrete Sidewalk (Elevation = 72.37).

1.2 DEVELOPMENT PROPOSAL

The Draft Plan of Subdivision for this proposed development, is presented in **Appendix A**.

As part of the proposed development, CLC will develop the mixed-use, residential, park, stormwater management pond and open space block component as well as build the realigned Tremblay Road and bring municipal services to the subject property. Each block of the development will be subject to a Site Plan Control application at a later stage.

PSPC will develop the federal office uses northeast of the subject property at a later date. The number of buildings and associated parking could be configured in numerous ways, which would be determined through the separate and future PSPC's RFQ / RFP Design Build procurement process. Accordingly, it does not form part of the Draft Plan of Subdivision.

The realigned Tremblay Road and the park block will be built by CLC and would ultimately be owned and maintained by the City of Ottawa. A pedestrian bridge is proposed to link the subject property to the St. Laurent Light Rail Transit (LRT) station.

The building configuration will be determined at the site plan control approval stage. The development will acknowledge the maximum buildings heights for each block. It will include up to 9-storeys for the block fronting Tremblay Road on the westerly portion of the subject property and up to 30-storeys along the southerly side of Tremblay Road.

The Draft Plan of Subdivision for the proposed development has an area of 10.7 ha which is comprised of residential, commercial, office, and park land uses including:

- Residential (1.29 ha);

- Parks and Open Space (2.40 ha);
- Mixed Use (1.16 ha);
- Stormwater Management Pond (1.00 ha);
- Realigned Tremblay Road (26.0m Right-of-Way) (1.16 ha);
- Local Street (18.0m Right-of-Way) (0.53 ha); and
- Federal Office Development Block (PSPC lands) (3.17ha).

Figure 1

2 ROADS AND GRADING

2.1 EXISTING CONDITIONS

The existing site topography is generally flat and the majority of surface runoff drains toward the south-east corner of the subject property. A smaller portion of the subject property, in the north-west corner, drains towards existing Tremblay Road. Within the middle of the subject property, the grades are relatively flat. The existing elevations vary between 65.55m to 68.45m. There is an existing topographic high ridge from the south-west corner of the subject property to the midpoint of the north site boundary, which mimics the drainage divide outlined in the Cyrville Drain memo dated February 2012. Additional slight topographic highs exist in the south and west portions of the interior of the subject property. Please see **Appendix J** for the topographic survey provided by Annis O'Sullivan Vollebekk prepared August 22, 2019.

2.2 ROAD LAYOUT

As shown on the Draft Plan of Subdivision found in **Appendix A,** the proposed development is planned to be serviced by the realignment of Tremblay Road and internal roads connecting the proposed development blocks. Access to the subdivision will be via the realigned Tremblay Road / existing Tremblay Road intersection, and the realigned Tremblay Road / St. Laurent Boulevard intersection. The subdivision will have an 18m ROW local road and a 26m ROW Realigned Tremblay Road (collector road) and provide traffic management accordingly. The Federal Office Development Block (PSPC lands) would have internal road networks that will be designed by others. Road and traffic design has been completed by WSP Transportation based on the transportation recommendations outlined in the City of Ottawa Transportation Impact Assessment Guidelines (2017) and is prepared under separate cover. The recommendations of the road and traffic design will be incorporated into the detailed design of this development.

2.3 PAVEMENT STRUCTURE

The pavement structure for the proposed subdivision will be in accordance with the WSP Geotechnical Study prepared November 2019, and the City of Ottawa minimum pavement thickness standards. Specifically, the minimum preliminary pavement structure requirements are as follows:

Road Type	Course	Thickness (mm)
Proposed Tremblay Road Realignment	Asphalt Surface (SP12.5)	50
	Asphalt Base (SP19)	50+50
	Granular Base (OPSS Granular ‘A’)	150
	Granular Sub-Base (OPSS Granular ‘B’ Type II)	500[1]
Existing Tremblay Road, Internal Roads, and Parking Areas	Asphalt Surface (HL3)	40
	Asphalt Binder (HL8)	50
	Granular Base (OPSS Granular ‘A’)	200
	Granular Sub-Base (OPSS Granular ‘B’ Type II)[2]	300

[1]Note: Excavated material could be reused for the subbase following the approval from the laboratory.

2.4 ROADS AND BLOCK GRADING

The existing grades will be maintained along the perimeter of the subject property, including the north limit of the existing Tremblay Road and the depression storage areas in the southeast corner within the subject property. Realigned Tremblay Road and the local road will be graded to achieve an overland flow route to the proposed stormwater management pond during the 100-year storm event. The overland flow route will also convey flows for storm events greater than the 100-year storm event. Refer to Section 6 Stormwater Management for the proposed drainage design of the pond.

The proposed preliminary elevations, provided in the Functional Grading Plan in **Appendix B**, are designed to minimize the earthmoving (cutting and filling) required for road and block construction, provide adequate cover for underground services, direct as much flow to the proposed stormwater management pond, and comply with the City of Ottawa Criteria. This will be analyzed and detailed further at the detail design stage.

Block grading will be designed to convey positive drainage. When setting the building finished floor and underside of footing elevations for each block, groundwater levels will be considered to mitigate flooding impacts to the buildings.

Internal to the site, finished grades are generally higher than existing in order to achieve adequate drainage toward the stormwater management pond. Along the west side of the subject property and the north side of existing Tremblay Road, 3:1 sloping is used to match into the existing ground elevation.

Road elevations will be set to direct the major storm to the proposed stormwater management pond within the subject property where possible. The existing highpoint ridge on the subject property has relatively been kept to mimic existing conditions and the subwatershed boundaries. As such, where major storm flows cannot be directed toward the proposed stormwater management pond, the subject property has been graded to direct drainage to travel west on existing Tremblay Road.

Roads will be designed with a minimum longitudinal grade of 0.7% and a maximum grade of 6.0%. A saw-toothed road grade has been proposed for the portion of realigned Tremblay Road south of the proposed Federal Office Development Block. If required at detailed design, saw-tooth grading may be introduced at other locations on the subject property to optimize the overall design. Saw-tooth road grading will conform to the minimum 0.7% road grade; however, the net grade over an extended length of road is reduced by introducing sections of reversed graded road. During major storm events, the saw-tooth will provide storage within the ROW and once the sags reach full ponding capacity (i.e. 0.15m maximum) the water will follow the net grade over the length of the road and runoff will flow toward the stormwater management pond. The minimum net grade over the length is 0.3%.

2.5 RIGHTS-OF-WAY

As shown on the Draft Plan of Subdivision, the proposed development includes local roads with 18.0m and 26.0m rights-of-way. The cross-section for the 18.0m right-of-way will conform to the City of Ottawa Standard Drawing ROW-18. The cross-section for the 26.0m right-of-way will conform to a version of the 26A Treed Boulevards Cross-Section from the City of Ottawa Designing Neighbourhood Collector Streets dated December 12, 2019. The proposed cross-sections for all right-of-way widths are shown in **Appendix C**.

3 WATER SERVICING

3.1 EXISTING WATER DISTRIBUTION

There is an existing 300mm watermain following the alignment of existing Tremblay Road within the north boulevard. Additionally, there is an existing 400mm watermain following the alignment of existing St. Laurent Boulevard within the east boulevard.

3.2 PROPOSED WATER DISTRIBUTION

The water distribution system for the development will be supplied from the 300mm watermain on existing Tremblay Road and from the 400mm watermain on St. Laurent Boulevard. A network of watermains will generally follow the internal road network in order to provide a looped system to all areas of the proposed development. The watermain proposed along the re-aligned Tremblay Road is expected to be 300mm in diameter and all other watermains within the subject property are expected to be 200mm in diameter.

In accordance with the Ottawa Design Guidelines - Water Distribution, First Edition, July 2010, hydrants will be spaced at a maximum distance of 90m with a standard hydrant lead of 150mm. Hydrants will be placed near street intersections whenever possible as per the guidelines. Existing hydrants are present within the adjacent collector and arterial roads.

To minimize disruptions during repairs, two (2) isolation valves are proposed at a tee intersection and three (3) valves are proposed at a cross-section. Valves will be located 2m away from the intersection, from the point where the projection of the property line intersects the watermain. In addition, isolation valves will be spaced at a maximum of 300m spacing. Valve design will be completed at detailed design.

If required, a water distribution analysis will be completed at the detailed design stage in order to ensure adequate service pressure and flows to the development.

The layout of the proposed internal watermains is shown on the Functional Servicing Plan included in **Appendix B**. All watermains will be designed per the Ottawa Design Guidelines - Water Distribution, First Edition, July 2010. The expected pipe size used in the proposed development is 200mm, but this will be confirmed during detailed design. All watermains will be installed at a minimum depth from finished road grade to the top of the watermain of 2.4m.

The Ottawa Design Guidelines - Water Distribution indicate under normal operating conditions the maximum operating pressure should range between 345 kPa (50 psi) and 552 kPa (80 psi) under a condition of maximum daily flow. Additionally, the distribution system will be sized so that under maximum hourly demand conditions the pressures are not less than 276 kPa (40 psi). Where fire flow has been provided, the residual pressure at any point in the distribution system will not be less than 140 kPa (20 psi) during periods of maximum day and fire flow demand. The maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way will not exceed

552 kPa (80 psi) and in an unoccupied area the maximum pressure will not exceed 689 kPa (100 psi). Operating pressures will not exceed 550 kPa (80 psi) for the development.

3.3 ESTIMATED DEMAND

In accordance with the Ottawa Design Guidelines – Water Distribution, the distribution system shall be sized so that under maximum hourly demand conditions the pressures are not less than 276 kPa (40 psi.).

The estimated domestic water demands for the development have been calculated based on the design criteria and are summarized below. Grey water re-use applications will be determined during the Site Plan Application process. Some of the applications that will be considered include irrigation, infiltration and grey water toilet flushing.

Residential Area	1.12 ha, 784 units
Equivalent Population Density	2.1 person / unit for two (2) bedroom, 1.4 person / unit for studio / one (1) bedroom
Residential Population	1,529 persons
Federal Office Development Block (PSPC Lands)	3.17 ha
Mixed-Use Area	1.16 ha
Residential Domestic Demand Rate	350 liters / person / day
Employment Demand Rate	28,000 liters / ha / day
Mixed Use Demand Rate	28,000 liters / ha / day
Maximum Hourly Demand Factor - Residential	2.2
Maximum Hourly Demand Factor – Employment	1.8
Maximum Hourly Demand Factor – Mixed Use	1.8
Maximum Hourly Demand	**23.37 L/s**
Maximum Daily Demand Factor – Residential	2.5
Maximum Daily Demand Factor – Employment	1.5
Maximum Daily Demand Factor – Mixed Use	1.5
Maximum Daily Demand	**23.60 L/s (2,039 m^3/day)**

We note that the projected water demands indicated above are conservative. Using this flow rate and factors above from the City of Ottawa Water Distribution Guidelines, the projected demands for this development would be 23.60 L/s (2,039 m^3/day) for Maximum Daily Demand and 23.37 L/s for Maximum Hourly Demand. Refer to **Appendix D** for detailed calculations.

A detailed fire flow calculation has been prepared using the recommendations of the Water Supply for Public Fire Protection, 1999 – Fire Underwriters Survey (FUS). The fire flow calculations are included in **Appendix D**. Fire flow calculations were completed for the three types of proposed buildings on the subject property: residential, office, and mixed use. The fire flow calculation indicates that the recommended fire flow for this proposed development is 7,388 USGPM, 1,583 USGPM, and 1,847 USGPM respectively (466 L/s, 100 L/s, and 117 L/s respectively).

Based on the estimated projected demands, the existing watermain and the proposed watermain network is sufficient to meet the servicing requirements of the development. At the time of detailed design, an analysis of the existing and proposed water distribution network will be performed to establish the watermain sizes throughout the development.

4 SANITARY SERVICING

4.1 EXISTING SANITARY SEWAGE SYSTEM

There is an existing 300mm sanitary sewer on the east side of St. Laurent Boulevard connecting into the Cyrville Road Trunk Collector sanitary trunk sewer. The sanitary flows from the trunk system travel north-east toward Robert O. Pickard Environmental Centre.

There is also an the existing 375mm sanitary sewer on the north-west side of Tremblay road directs sanitary flows west and north along Rideau River. The sewer then travels north-east toward the Robert O. Pickard Environmental Centre. From the wastewater treatment centre, the treated sanitary flows discharge into the Ottawa River.

4.2 PROPOSED SANITARY SEWER SYSTEM

There are two (2) branches of sanitary sewers proposed to service the development. The first branch will service a portion of the residential development and a portion of the office space and will connect to the existing sanitary sewer at the north-west corner of the subject property on the existing Tremblay Road. The second branch will service the office spaces on the east side of the subject property, directing sanitary flows to the existing sanitary sewer on St. Laurent Boulevard. The expected size of the sanitary sewer will be between 250mm in diameter, but will be confirmed during detailed design.

A preliminary design and location of the proposed sanitary sewers is shown on the Functional Servicing Plan included in **Appendix B**.

4.3 ESTIMATED DEMAND

An estimate of the post-development sanitary sewage flows from the subject property has been calculated. To calculate the approximate peak sanitary flows, the following Ottawa Sewer Design Guidelines have been utilized:

- Proposed Equivalent Population for Residential Development –1,529 persons (based on 784 units in the 1.12 ha residential development block as per the provided draft plan (CLC lands only), assuming 1.4 persons / studio and one (1) bedroom units, and 2.1 persons / two (2) bedroom unit);
- Proposed Design Flow for Residential Development - 350 L/cap/day;
- Proposed Design Flow for Federal Office Development Block – 50,000 L/ha/day;
- Proposed Design Flow for Mixed-Use areas – 50,000 L/ha/day;
- Infiltration Allowance – 0.28 L/s/ha;
- Peaking Factor for Residential Areas - Harmon Formula;

- Peaking Factor for Federal Office Development Block – 1.5; and
- Peaking Factor for Mixed-Use Areas – 1.5.

The total estimated demand from the development was determined based on the proposed land uses for the subject property and the associated average waste water flows for each land use. Based on the land uses, estimated populations, and average waste water flows, the total estimated demand from the development is 40.5 L/s. Of the total estimated sanitary demand, 30.9 L/s (76.3 %) will flow north towards the existing sanitary sewer system on existing Tremblay Road while 9.6 L/s (23.7%) will flow east towards the existing sanitary sewer system on St Laurent Boulevard. Refer to **Appendix E** for the detailed calculations.

4.4 IMPACTS TO DOWNSTREAM SYSTEM

The estimated proposed sanitary flows calculated in Section 4.3 has been provided to the City of Ottawa for review. The City has confirmed that the St. Laurent system does have capacity for the additional 25 L/s (email from Cody Oram at the City of Ottawa dated October 22, 2019). The Tremblay system was confirmed to have capacity to accommodate the anticipated 42 L/s (email from Cody Oram at the City of Ottawa dated September 30, 2019). As such, there will be no impacts to the downstream system given that the system has adequate capacity.

5 STORM SERVICING

5.1 EXISTING STORM SEWAGE SYSTEM

There is an existing 525mm storm sewer at the north-west corner of the proposed development along existing Tremblay Road flowing east.

A separate 300mm storm sewer starts in the north-west corner of the proposed development and follows the alignment of existing Tremblay Road. This sewer intersects an existing 1050mm storm sewer running along St. Laurent Boulevard at the intersection of Tremblay Road and St. Laurent Boulevard. This sewer continues south toward the Rail tracks and outlets into a ditch connecting to the South Cyrville Drain.

5.2 PROPOSED STORM SEWER SYSTEM

The subject property is to be serviced by storm sewers following the general layout of the internal roads within the proposed development. The proposed grading of the subject property mimics the existing drainage boundaries and subwatershed areas as seen in the Drainage Area Plan found in Appendix A of the "Engineers Report for the Improvement of the South Cyrville Municipal Drain" prepared by Stantec dated February 2012. The north-west portion of the subject property is part of the Rideau Falls subwatershed and the south-east portion of the subject property is within the Cyrville drain subwatershed. Existing highpoints, which will be maintained in the proposed development, split the drainage toward one of these two subwatersheds.

For the drainage boundary within the Cyville Drain subwatershed (84.1% of the subject property area), flows will be collected through catchbasins, area drains, and roof drains and directed to the stormwater management pond through the proposed sewer system. The stormwater management pond will control the release rate of the surface flows to pre-development flow conditions. For storm events in excess of the sewer capacity (100-year storm event), the grading design will be prepared such that the surface grades will direct surface drainage away from proposed buildings and toward the stormwater management pond. The pond then discharges at a released rate to a flat bottom swale channel connecting flows from the outlet of the stormwater management pond to the inlet of the Cyrville drain.

For the drainage boundary within the Rideau Falls subwatershed (i.e. northwest corner and 15.9% of the subject property area) stormwater management strategies will be dictated and be required by each development block for both quality and quantity. This generally will require each block to propose stormwater cisterns and treatment units which will have controlled flows before being released to the existing sewers west of the proposed development. The sewer and cistern layout for each block will further be designed at Site Plan Approval.

A preliminary sewer layout is shown in the Functional Servicing Plan in **Appendix B**. For storage and design flow calculations, refer to the Stormwater Management section of this report.

5.3 IMPACTS TO DOWNSTREAM

The proposed storm servicing design maintains the existing drainage boundaries present on the subject property and controls flows to pre-development conditions. As such, in the major and minor storm events there will be no impact downstream of the development. Refer to Section 6 Stormwater Management for details on the stormwater strategy. Refer to **Appendix B** for the Existing Servicing Conditions figure.

6 STORMWATER MANAGEMENT

6.1 INTRODUCTION

6.1.1 STORMWATER MANAGEMENT PLAN OBJECTIVES

The objectives of the stormwater management plan are as follows:

- Determine the site-specific stormwater management requirements to ensure that development proposals are in conformance with the Ontario Ministry of the Environment, Conservation and Parks (formerly Ministry of Environment) Stormwater Management Planning and Design Manual (SMPDM) (2003) and with the City of Ottawa Sewer Design Guidelines (SDG) (2012);
- Evaluate various stormwater management practices that meet the requirements of the City of Ottawa and the Rideau Valley Conservation Authority (RVCA) and recommend a preferred strategy; and
- Prepare a stormwater management strategy documenting the strategy along with the technical information necessary for the justification and preliminary sizing of the proposed stormwater management facilities.

6.1.2 DESIGN CRITERIA

The Ministry of Environment, Conservation, and Parks (MECP) issued the SMPDM document in March 2003 to provide direction on the management of rainfall and runoff inside the Province's jurisdiction. The City of Ottawa issued the SDG document in October 2012 to provide direction on sewer design inside the City's jurisdiction. A summary of the stormwater management criteria applicable to this project follows:

- Water Balance – While the City of Ottawa and SMPDM document do not have water balance requirements, common practice requires a site to retain stormwater on-site, to the extent practicable, to achieve the same level of annual volume of overland runoff allowable from the development site under pre-development conditions. Typically, the minimum on-site runoff retention will require the site to retain all runoff from 5mm storm event through infiltration, evapotranspiration or rainwater reuse;
- Water Quality – As per Section 3.3 of the SMPDM, the goal of water quality treatment is to maintain or enhance existing aquatic habitat, based on suspended solids removal. This development will target the *Enhanced* (level 1) protection level which corresponds to a long-term removal of 80% of total suspended solids (TSS) on an average annual loading basis;
- Erosion Control – The 24-hour on-site retention of the 25mm storm event shall be provided to the area draining to the SWM Pond for the erosion control objective. As the northwest portion

of the site is < 2 ha, erosion control in the form of stormwater detention is normally not required, provided the on-site minimum runoff retention from a small design rainfall event (typically 5mm) is achieved under the Water Balance Criteria. During construction, appropriate erosion and sediment controls will be implemented; and

- Water Quantity Control and Discharge to Municipal Infrastructure – Runoff from the 2-year to 100-year design storms must not exceed the allowable release rate as stated in SMPDM. The allowable release rate to the municipal storm sewer system from the development site is the 2-year pre-development flow rate based on a runoff coefficient of 0.50 or the capacity of the receiving sewer as per the City of Ottawa's requirements.

6.2 PRE-DEVELOPMENT CONDITIONS

6.2.1 RAINFALL INFORMATION

The rainfall intensity for the site was calculated using the following equation: $I = \frac{A}{(T+C)^B}$

Where;

I = rainfall intensity in mm/hour

T = time of concentration in minutes

A, B, and C = constant parameters (see below)

The parameters (A, B, & C) recommended for use by the City of Ottawa (per Section 5.4.2 of the SDG) are summarized in the following table.

Return Period (Years)	2	5	10	25	50	100
A	732.951	998.071	1174.184	1402.884	1569.580	1735.688
B	0.810	0.814	0.816	0.819	0.820	0.820
C	6.199	6.053	6.014	6.018	6.014	6.014

Source: City of Ottawa's SDG (October 2012)

A minimum initial time of concentration, Tc, of 10-15 minutes is recommended in the City's SDG document.

6.2.2 ALLOWABLE FLOW RATES

The subject property is located in an urbanized area. Relevant policies from the City of Ottawa require the discharge rate from this site to be controlled to the allowable rate for discharge to municipal sewers. Existing topography was used to determine drainage areas within the subject property with flow naturally being directed to either the Cyrville Drain or Rideau River – Rideau Falls watersheds.

CYRVILLE DRAIN – DRAINAGE AREA

The Bramsby-Williams Method was used to estimate the time of concentration. Using a pre-development area of 8.24 ha, an approximate flow length of 600m, and an overall slope of 0.90%, the time of concentration was estimated at 28 minutes. The target release rate to the municipal storm sewer system from the proposed development is 477 L/s, based on the 2-year pre-development flow rate calculated with the previously stated time of concentration and a runoff coefficient value of 0.50.

RIDEAU RIVER – RIDEAU FALLS – DRAINAGE AREA

The minimum time of concentration of 10 minutes was used for the area draining to the northwest. The target release rate to the municipal storm sewer system from the proposed development is 359 L/s, based on the 2-year pre-development flow rate calculated with the previously stated time of concentration, an area of 3.36 ha and a runoff coefficient value of 0.50. Detailed calculations are provided under **Appendix F**.

6.3 POST DEVELOPMENT CONDITIONS

As described in Section 1.2, the proposed development consists of various office, residential and commercial developments, as well as a large park and stormwater management pond block. Site land use details are included in the Draft Plan of Subdivision presented in **Appendix A.**

Drainage patterns on site mimic natural grading to preserve the natural drainage boundary between the Cyrville Drain and Rideau River-Rideau Falls watersheds (Section 5.2). The SWM strategy for each section varies and will be discussed separately in Section 6.3.1 and 6.3.2. The development boundary incorporates approximately 10.7 ha of the property. There exists a natural depression storage area in the southeast corner of the property boundary. As this area will remain unchanged throughout the development phases, it is not included in this analysis.

6.3.1 POND AREA – CYRVILLE DRAIN

GENERAL

Approximately 9.0 ha of the development area, including the realigned Tremblay Road and the local road, will drain to a wet SWM pond located along the southeast boundary of the subject property. The pond has been sized to address the various requirements from the MECP for water quantity, water quality, and erosion control requirements. A Visual OTTHYMO V5 hydrologic model was constructed using the Ottawa IDF parameters found in Section 5.4.2 of the SDG. The design storm selected for the model was a 6-hour Chicago storm as recommended in Section 5.4.3 of the SDG.

WATER QUALITY CONTROL

An overall imperviousness of 61% is estimated for the catchment area draining to the pond. Based on Table 3.2 in MECP's manual (2003), the Wet Pond will require 203m^3/ha to provide an "Enhanced Level of Protection" or 80% TSS removal, of which 40m^3/ha will be extended detention storage and

163m^3/ha will be permanent pool storage. Based on a drainage area of 9.00 ha, these objectives translate to a minimum required volume of 1,830m^3, of which 1,470m^3 is permanent pool and 360m^3 is extended detention storage.

EROSION CONTROL

In order to achieve the capture and controlled release of the 25mm rainfall event, the Visual OTTHYMO model was used to simulate a 25mm rainfall event to determine the associated runoff volume. From the hydrologic analysis results, 13.72mm out of 25mm rainfall is expected to contribute to excess runoff from the area contributing flows to the wet pond. This results in a volume of 1,235m^3. This volume is required as active storage and should be present above the permanent pool elevation. This volume is to be controlled by the pond outlet structure and shall be released over a period of 24-hours.

The extended detention volume for water quality control (360m^3) is smaller than the erosion control active storage volume (1,235m^3) therefore the extended detention volume is governed by the erosion control requirement. The drawdown time calculation is provided in **Appendix G**.

POND LAYOUT

The wet pond is designed to provide the required permanent pool and active storage volumes, and to conform to the grading of the site. The design of the pond may change as the site evolves, however a summary of required storage volumes and preliminary provided storage for water quality and erosion control based on the current site configuration is provided below.

The wet pond permanent pool elevation is set at 65.18m to conform the existing grading in the pond block. The wet pond will provide 1,879m^3 of permanent pool storage at an elevation 65.18m. The permanent pool storage has an average depth of 1.50m from the bottom of the pond.

An extended detention volume of 1,970m^3 is provided at the elevation 65.93m, with a depth of 0.75m above the permanent pool elevation. This volume shall be released over a 24-hour period.

The total active storage for the pond is 5,285m^3 with an additional 2,311m^3 available due to a 0.60m freeboard. The preliminary footprint of the pond is 4,062m^2, which does not include any required access road / pathways. Pond configuration details are included under **Appendix G**.

WATER QUANTITY CONTROL

The outlet structure for the wet pond will be located at the southeast end of the pond block, consisting of a low flow orifice plate, a high flow orifice tube, and an overflow emergency spillway.

The low flow outlet is sized to provide required extended detention for runoff from a 25mm storm event. A 130mm diameter orifice plate achieves a detention time of 25 hours for the 25mm storm event volume.

The high flow outlet is sized to provide quantity control of the 100-year storm event to less than the allowable release rate for the Cyrville Drain drainage area as discussed in Section 6.2.2. A 375mm diameter orifice tube has been sized and modeled to achieve this. The orifice tube will be contained within a ditch inlet catch basin structure to be designed in a later phase.

A 5m length emergency spillway is utilized to safely convey flows from storms larger than the 100-year, which is larger than the Regional inflow, to the downstream conveyance swale. The spillway in embankment has a lid elevation of 67.53m.

The following table shows the stage – storage - discharge relationship for the proposed wet pond. Detailed calculations are included in **Appendix G**.

Description	Stage (m)	Total Storage (m^3)	Active Storage (m^3)	Discharge (m^3/s)
Permanent Pool	65.18	1,879	-	-
Extended Detention	65.93	3,850	1,970	0.024
Top of Pond	67.53	7,165	5,285	0.401
Emergency Spillway	66.93	9,476	7,597	4.472

The pond performance can be found in the table below. The overall flow rate from the low and high flow outlets in the 100-year storm event are less than the allowable release rate of 477 L/s as outlined in the following table.

Storm Event	Inflow (m^3/s)	Outflow (m^3/s)	Utilized Storage (m^3)	Water Elevation (m)
6-Hour Chicago Distribution				
2-year	1.056	0.027	1,558	65.79
5-year	1.507	0.065	2,220	66.01
10-year	1.859	0.115	2,584	66.12
25-year	2.281	0.183	3,079	66.26
50-year	2.861	0.236	3,467	66.38
100-year	3.270	0.281	3,891	66.51
Erosion Control Event				
25-mm	0.760	0.020	1,049	65.60

The detailed VO5 model output can be found in **Appendix I**.

6.3.2 NORTH WEST AREA – RIDEAU RIVER – RIDEAU FALLS

GENERAL

Approximately 1.7 ha of the development area will drain to the existing storm sewer on Tremblay Road.

WATER QUALITY CONTROL

Water quality control will be required for the site to remove 80% of TSS as per MECP requirements. An Oil / Grit Separator (OGS) units sized to capture 90% of rainfall volume from all sediment generating areas would be sufficient to provide treatment for the site. Two (2) Stormceptor units (EF6 for the residential block and EF4 for the office / mixed use block) were sized to treat runoff from the two (2) developments currently proposed within the drainage boundary. Flows in excess of the treatment rate (i.e. greater than the 25mm rainfall event) will be bypassed by the unit. The proposed roadways will not be directed through a water quality unit. Details of the proposed water quality units are included under **Appendix H**.

EROSION CONTROL

Erosive potential from the site can be reduced by the retention of small storm events, generally the 5mm storm event. Please see Section 6.3.3 for information water balance and methods to help retain the 5mm storm event.

WATER QUANTITY CONTROL

The target discharge rate from both the controlled and uncontrolled areas of the site to the municipal sewer system is 359 L/s. This is equivalent to the peak runoff rate under pre-development conditions during a 2-year design storm event using a runoff coefficient of 0.50.

A detailed site plan is not available at the time of this report however using the Modified Rational Method, and an estimated runoff coefficient of 0.80, approximately 295m^3 of storage will be required to achieve the quantity control target. This storage volume assumes that the site will not have any uncontrolled areas. Detailed calculations can be found under **Appendix F**.

Quantity control options may include storage tanks, underground storage chambers, roof control, surface ponding, oversized pipes, or any combination thereof. Further detail will be provided during subsequent detailed design phases.

6.3.3 WATER BALANCE AND LOW IMPACT DEVELOPMENT (LID)

Water balance objectives aim to maintain the hydrologic cycle, protecting water quality, and preventing flooding and increased erosion. MECP Guidelines stipulate that ‘best efforts’ should be made to maintain the existing water balance. Retaining the 5mm storm event on site for evapotranspiration, infiltration, or reuse can be achieved through a number of lot level SWM practices that have been used extensively in southern Ontario, British Columbia and the United States. Included in these low impact development practices, or LIDs, are passive arrangements such as green roofs, enhanced landscaping (enhanced grass swales, 300mm absorbent topsoil, vegetated filter strips, dry swales) rain gardens and rainwater harvesting which do not require significant amounts of servicing, footprint area, cost or maintenance.

Green roofs on commercial buildings and condo towers, as well as absorbent topsoil are commonly used methods of reducing runoff by providing rainfall retention and promoting evapotranspiration through plant media. Rainwater harvesting for reuse of stormwater on site (i.e. irrigation supply) is also a suitable LID for commercial and high-density residential area. For medium density residential areas with higher amounts of pervious surfaces, enhanced landscaping can offer water quality improvement and promote infiltration through aesthetic measures such as rain gardens in landscaping areas, absorbent topsoil under sod, and enhanced swales for conveyance measures.

Walking or biking paths through park area benefit from vegetated filter strips to treat sheet runoff from impervious areas experiencing minor to moderate amount of sediment generating activities.

The design of an LID system to achieve water balance targets will require a more detailed site plan and therefore will be completed at a later phase.

6.4 EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION PERIOD

During construction, there is potential for short-term sediment wash-off from the site. To protect the downstream receiving sewer system and other natural features, on-site sediment control measures are necessary during construction.

As sediment and erosion control strategies focus on minimizing adverse environmental impacts by restricting the mobilization and transport of sediment, the following general practices will be observed:

- Sediment and erosion control works, as shown on the project's erosion and sedimentation control plans which will be provided during the detailed design stage, must be in place prior to the commencement of construction, and not removed until the end of the construction period, when the site has been stabilized;
- Construction phasing must be scheduled to minimize the extent and period to which disturbed soils are exposed to weathering. As such, all disturbed areas must be stabilized as quickly as possible. Stabilization of disturbed areas may be accomplished by sodding, seeding, mulching, hydro-seeding, planting, or covering of constructed slopes with appropriate material such as geotextile or jute mesh;
- Access to the construction site must be minimized; and
- A continuous siltation fence must be constructed along the perimeter of the proposed development. The silt fence must be in place prior to the commencement of construction, and must be removed at the end of the construction period.

7 CONCLUSION

7.1 PROPOSED DEVELOPMENT

The subject property is located at the intersection of St. Laurent Boulevard and Tremblay Road in the City of Ottawa. The subject property is located south of Highway 417 and west of St. Laurent Boulevard in Ward 18 (Alta Vista) in the City of Ottawa, and has a dual frontage onto the existing Tremblay Road as well as St. Laurent Boulevard. There is also an existing St. Laurent Transit Station pedestrian tunnel entrance located to the southwest of Highway 417 and northwest of the subject property. As part of the proposed development, CLC will develop the mixed-use, residential, park, stormwater management pond and open space block component as well as build the realigned Tremblay Road and bring municipal services to the subject property. Each block of the development will be subject to a Site Plan Control application at a later stage. Additionally, proposed is the realignment of Tremblay Road along with regrading and reservicing.

7.2 ROADS AND GRADING

As shown on the Draft Plan of Subdivision found in **Appendix A,** the proposed development is serviced by the realignment of Tremblay Road and internal roads connecting the proposed development blocks. The pavement structure proposed will be as outlined in Section 2.3 of this report.

The existing grades will be maintained along the perimeter of the property, including the north limit of existing Tremblay Road and the depression storage areas identified within the subject property. Existing Tremblay Road will be regraded and redeveloped as part of this development to achieve an overland flow route to the proposed stormwater management pond during the 100-year storm event.

Road elevations will be set to direct the major storm to the proposed stormwater management pond within the subject lands where possible. The existing highpoint ridge on the subject property has relatively been kept to mimic existing conditions and the subwatershed boundaries. As such, where major storm flows cannot be directed toward the proposed stormwater management pond, the subject property has been graded to direct drainage to travel west on existing Tremblay Road. Roads will be designed with a minimum longitudinal grade of 0.7% and a maximum grade of 6.0%. A saw-toothed road grade has been proposed for the portion of realigned Tremblay Road south of the proposed Federal Office Development Block. The minimum net grade over the length is 0.3%.

The proposed preliminary elevations are provided in the Functional Grading Plan in **Appendix B.**

7.3 WATER SERVICING

The proposed development at 530 Tremblay Road will be serviced from the City's existing 300mm watermain on existing Tremblay Road and from the 400mm watermain on St. Laurent Boulevard. A network of watermains will generally follow the internal road network in order to provide a looped system to all areas of the proposed development. The layout of the proposed internal watermains is shown on the Functional Servicing Plan included in **Appendix B**. Domestic and fire flow calculations for the proposed development have been completed and are included in **Appendix D**. The expected watermain size along the re-aligned Tremblay Road is 300mm in diameter while the expected watermain size for the other areas of the subject property is 200mm in diameter. Sizing and location of the proposed water services to the proposed buildings will be coordinated with the mechanical consultant at the detailed design stage.

7.4 SANITARY SERVICING

It is proposed that the development will be serviced by an existing 300mm sanitary sewer on the east side of St. Laurent Boulevard and an existing 375mm sanitary sewer on the north-west side of Tremblay Road. A preliminary design and location of the proposed sanitary sewers is shown on the Functional Servicing Plan included in **Appendix B**. Estimated demand calculations for the proposed development are included in **Appendix E**. The proposed sanitary flows from the development will be split such that some of the flow will be directed to the existing 300mm sanitary sewer on St. Laurent Boulevard while the rest will be directed to the existing 375mm sanitary sewer on Tremblay Road. The City has confirmed that the St. Laurent system does have capacity for the additional 25 L/s (email from Cody Oram at the City of Ottawa dated October 22, 2019). The Tremblay system was confirmed to have capacity to accommodate the anticipated 42 L/s (email from Cody Oram at the City of Ottawa dated September 30, 2019). The correspondence with Cody Oram has been included in **Appendix E**.

7.5 STORM SERVICING

The subject property is to be serviced by storm sewers following the general layout of the internal roads within the proposed development. The north-west portion of the subject property is part of the Rideau Falls subwatershed and the south-east portion of the subject property is within the Cyrville Drain subwatershed. Existing highpoints, which will be maintained in the proposed development, split the drainage toward one (1) of these two (2) subwatersheds. For the drainage boundary within the Cyville Drain subwatershed, flows will be collected through catchbasins, area drains, and roof drains and directed to the stormwater management pond through the proposed sewer system. For the drainage boundary within the Rideau Falls subwatershed, stormwater management strategies will be dictated and be required by each development block for both quality and quantity. This will require each block to propose stormwater cisterns and treatment units which will have controlled flows before being released to the existing sewers. A preliminary sewer layout is shown in the Functional Servicing Plan in **Appendix B** and preliminary grading plan is shown in the Functional Grading Plan in **Appendix B.**

7.6 STORMWATER MANAGEMENT

The proposed development is split into two drainage areas to maintain pre-existing drainage patterns and areas. The area in the “Cyrville Drain” catchment will conform with MECP, and City of Ottawa guidelines through the use of a stormwater management pond. A preliminary pond design is provided; detailed pond design will be provided under future phase development. Detailed calculations and estimates can be found in **Appendix G** and **I**. The “Rideau River – Rideau Falls” catchment will provide stormwater management through water storage, water quality treatment units (Oil / Grit Separators), and LID practices. The details of this design will be completed under future phases, when site plans are available. Detailed calculations and estimates can be found in **Appendix F** and **H**.

APPENDIX

A

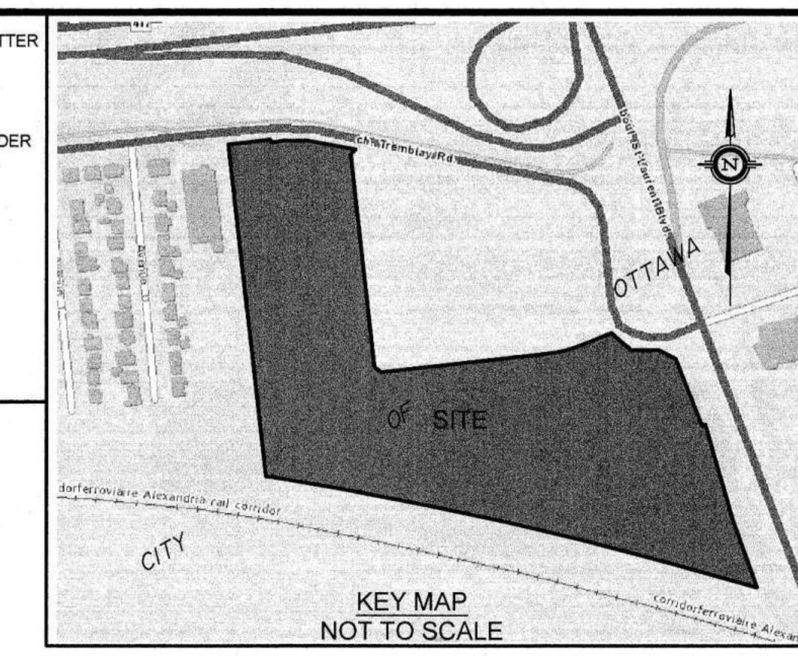
DRAFT PLAN OF SUBDIVISION

SUBJECT TO THE CONDITIONS, IF ANY, SET FORTH IN OUR LETTER DATED

____

THIS DRAFT PLAN IS APPROVED BY THE CITY OF OTTAWA UNDER SECTION 51 OF THE PLANNING ACT.
THIS ____ DAY OF ____________ 20__.

DOUGLAS JAMES, MCIP, RPP (A) MANAGER, DEVELOPMENT REVIEW-CENTRAL
PLANNING, INFRASTRUCTURE AND ECONOMIC DEVELOPMENT DEPARTMENT, CITY OF OTTAWA



DRAFT *PLAN OF SUBDIVISION OF*

PART OF BLOCKS K, L, M AND N
AND
PART OF TREMBLAY STREET, ANGUS STREET AND CATHERINE STREET
(All as Closed by By-Law 257-61, Inst. OT45384)
REGISTERED PLAN 84
AND
PART OF LOTS 11 AND 12
CONCESSION JUNCTION GORE
GEOGRAPHIC TOWNSHIP OF GLOUCESTER
CITY OF OTTAWA

Prepared by Annis , O'Sullivan , Vollebekk Ltd.

Scale 1 : 750

30 22.5 15 7.5 0 15 30 Metres

Metric
DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

SURVEYOR'S CERTIFICATE

I CERTIFY THAT :
The boundaries of the lands to be subdivided and their relationship to adjoining lands have been accurately and correctly shown.

FEB. 13, 2020
Date

E. H. Herweyer
ONTARIO LAND SURVEYOR

OWNER'S CERTIFICATE

This is to certify that I am the owner / agent of the lands to be subdivided and that this plan was prepared in accordance with my instructions.

Date
Tara Dinsmore, Vice President,
Real Estate (National Capital Region, Atlantic and Acquisitions)
Canada Lands Company CLC Limited
I have the authority to bind the corporation

Date
Chris Millier, Acting Senior Director
Real Estate (National Capital Region, Atlantic and Acquisitions)
Canada Lands Company CLC Limited
I have the authority to bind the corporation

ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51-17 OF THE PLANNING ACT
(a) see plan
(b) see plan
(c) see plan
(d) multi-family residential housing, park land, storm water management lands and open space.
(e) see plan
(f) see plan
(g) see plan
(h) City of Ottawa
(i) see soils report
(j) see plan
(k) sanitary, storm sewers, municipal water, bell, hydro, cable and gas to be available
(l) see plan

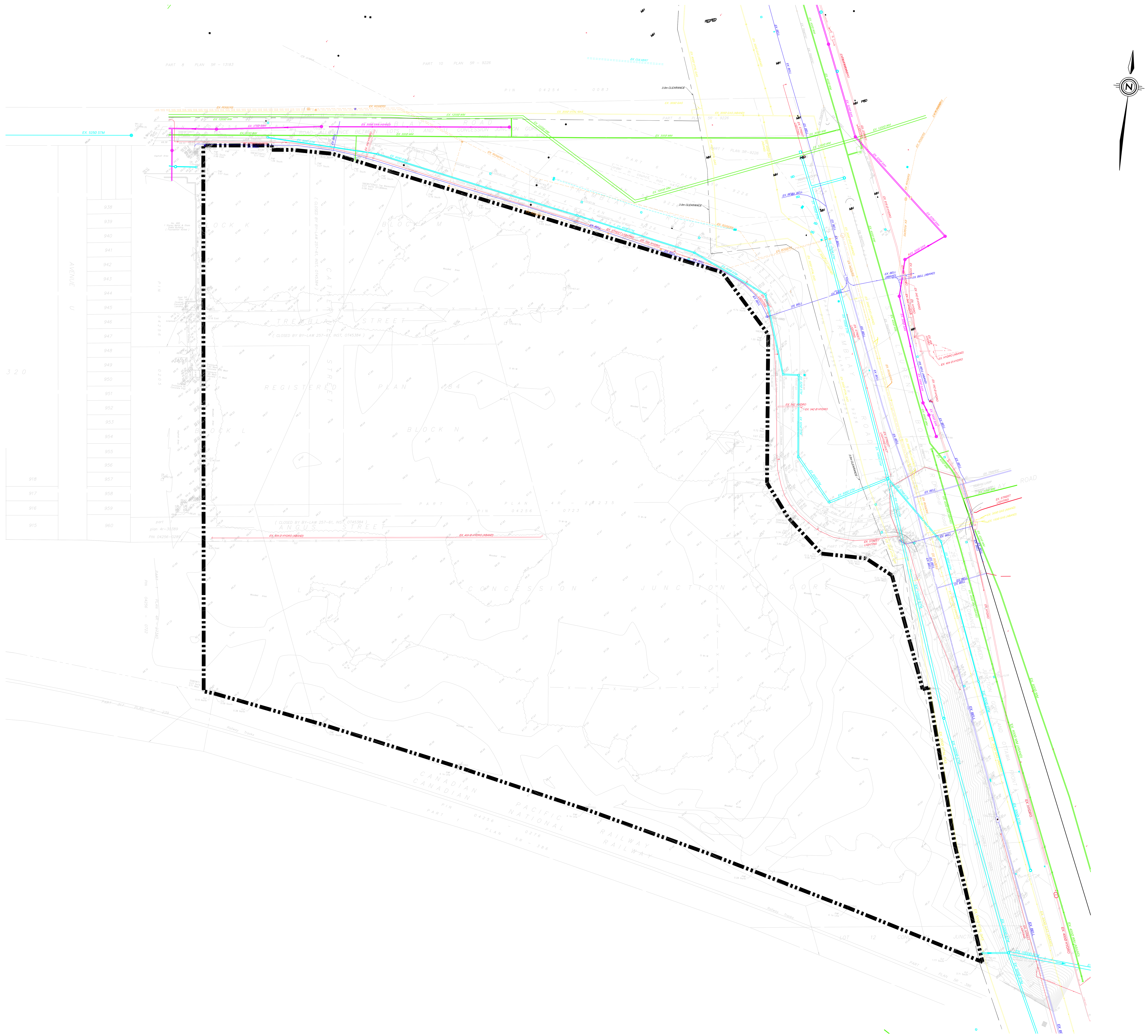
ANNIS, O'SULLIVAN, VOLLEBEKK LTD.
14 Concourse Gate, Suite 500
Nepean, Ont. K2E 7S6
Phone: (613) 727-0850 / Fax: (613) 727-1079
Email: Nepean@aovltd.com
Ontario Land Surveyors

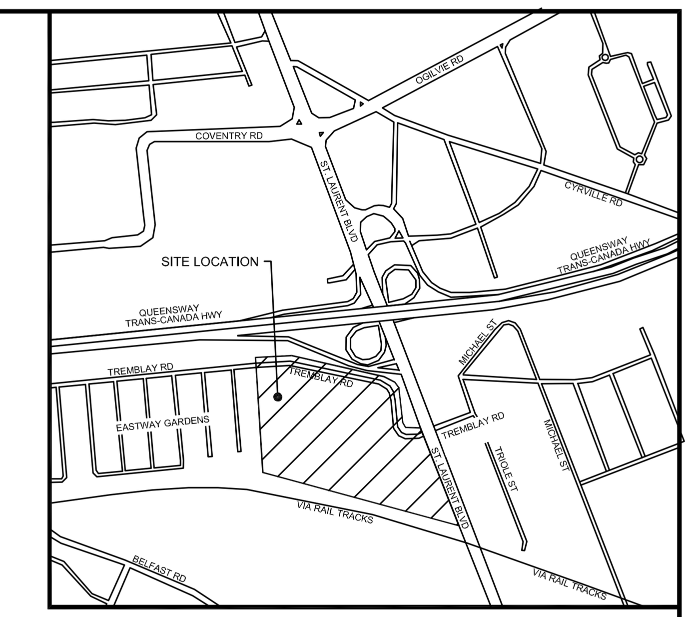
Job No. 17732-19 CLC L/Blks PL84 L11 JG DPS D4

APPENDIX

B

EXISTING SERVICING CONDITIONS (EC1), FUNCTIONAL SERVICING PLAN (SP1), AND FUNCTIONAL GRADING PLAN (GR1)





KEY PLAN NTS

LEGEND

- EX. SANITARY MANHOLE
- EX. STORM MANHOLE
- EX. STORM CATCHBASIN MANHOLE
- EX. CATCHBASIN
- EX. DOUBLE CATCHBASIN
- EX. VALVE AND BOX
- EX. VALVE CHAMBER
- EX. HYDRANT AND VALVE
- EX. ROGERS PEDESTAL
- EX. BELL PEDESTAL
- EX. STREET LIGHT
- EX. SERVICE ABANDONED
- PROPERTY LINE

No.	REVISIONS TO DRAWING	BY	DATE	APPR.
2	SECOND SUBMISSION	P.M.D	JAN/15/20	
1	FIRST SUBMISSION	P.M.D	NOV/07/19	

ALL PREVIOUS ISSUES OF THIS DRAWING ARE SUPERSEDED

CLIENT
CANADA LANDS COMPANY

MUNICIPALITY
Ottawa

PROJECT TITLE
530 TREMBLAY ROAD

SHEET TITLE
EXISTING SERVICING CONDITIONS

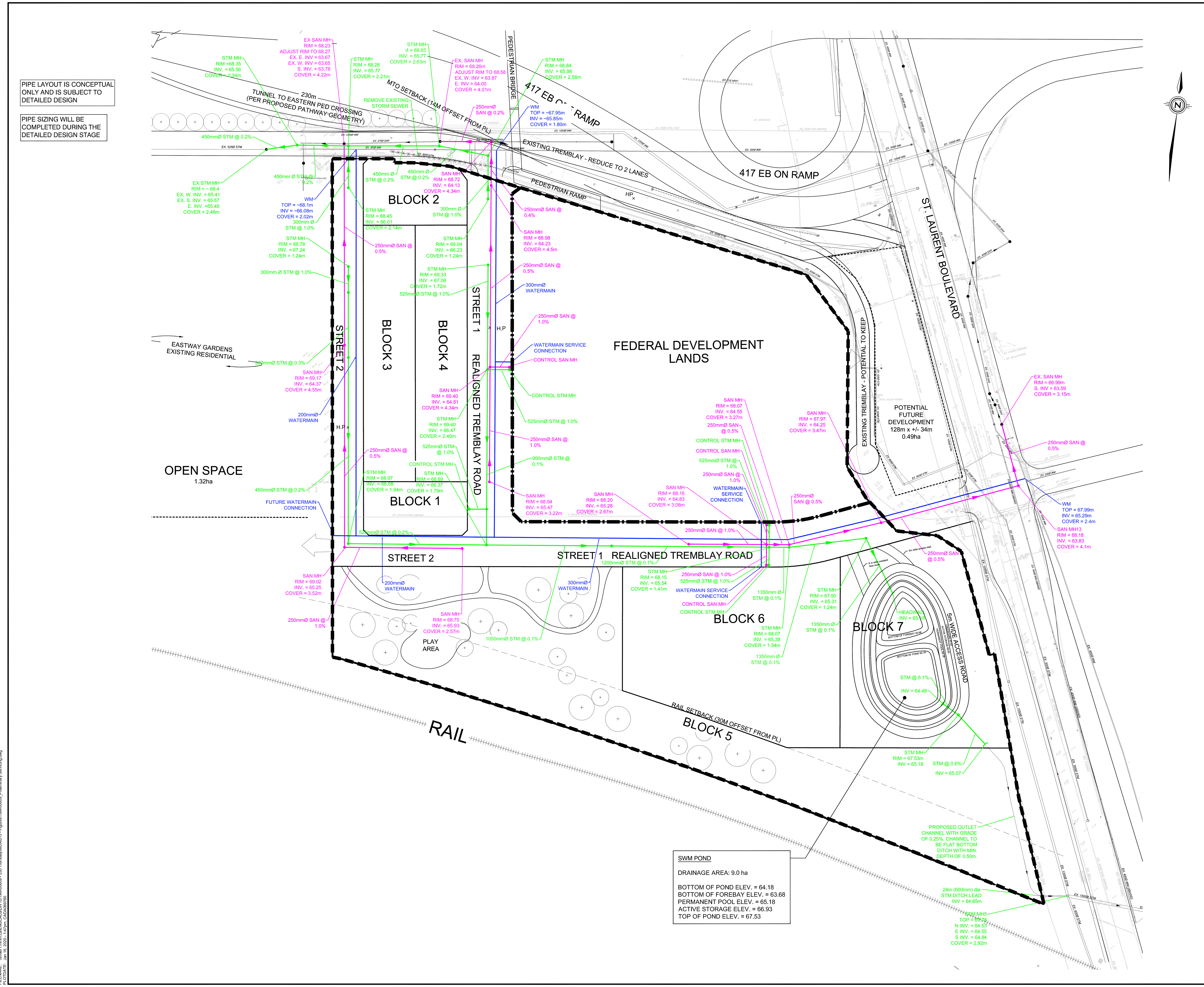
CONSULTANT
wsp
100 Commerce Valley Dr. West, Thornhill, ON Canada L3T 0A1
t: 905.882.1100 f: 905.882.0055 www.wsp.com

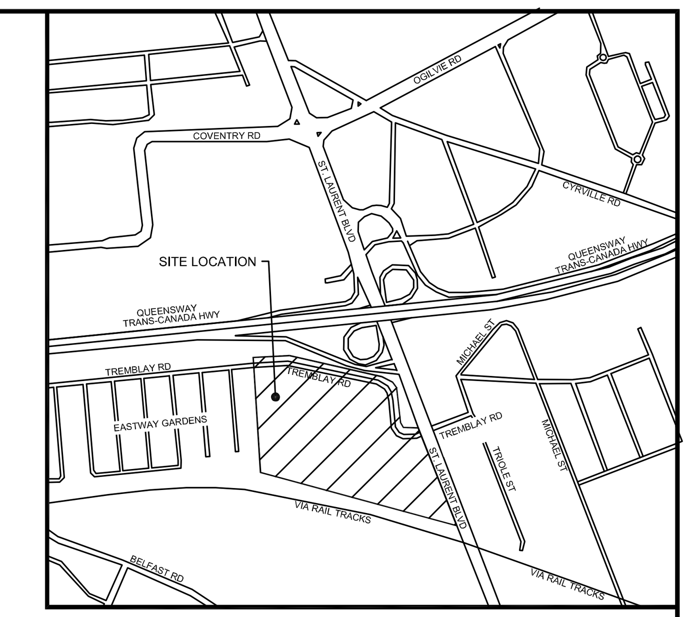
LICENSED PROFESSIONAL ENGINEER
P.M. DESOUSA
100204815
PROVINCE OF ONTARIO

DESIGNED	DRAWN	CHECKED
J.V. / R.W.B	10/12 CAD	P.M.D

SCALE	DATE
1:1000	OCT 2019

PROJECT NUMBER	DWG. NUMBER
19M-00609	EC1





KEY PLAN NTS

LEGEND

- PROPOSED DEVELOPMENT LIMIT
- FEDERAL OFFICE DEVELOPMENT BLOCK
- PROPOSED STORM SEWER
- PROPOSED SANITARY SEWER
- PROPOSED WATERMAIN
- EXISTING WATERMAIN
- EXISTING SANITARY SEWER
- EXISTING STORM SEWER
- EXISTING SANITARY SEWER (ABANDONED)
- H.P PROPOSED HIGH POINT

NOTE: FINISHED GRADES AT MANHOLES ARE APPROXIMATE ONLY. THEY ARE BASED ON CENTRELINE GRADES AND DO NOT ACCOUNT FOR CROSSFALL

No.	REVISIONS TO DRAWING	BY	DATE	APPR.
2	SECOND SUBMISSION	P.M.D	JAN/15/20	
1	FIRST SUBMISSION	P.M.D	NOV/07/19	

ALL PREVIOUS ISSUES OF THIS DRAWING ARE SUPERSEDED

CLIENT
CANADA LANDS COMPANY

MUNICIPALITY
Ottawa

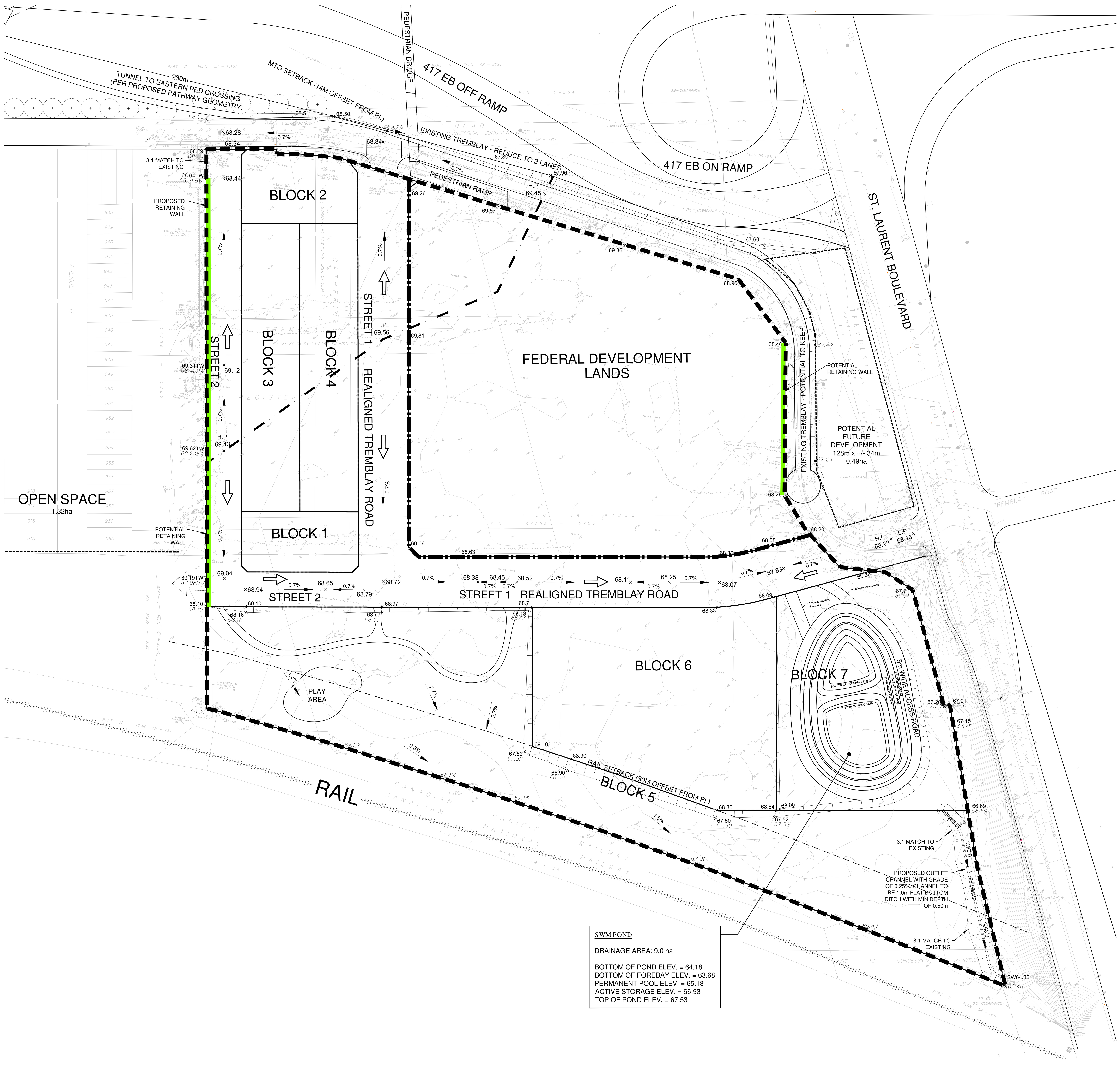
PROJECT TITLE
530 TREMBLAY ROAD

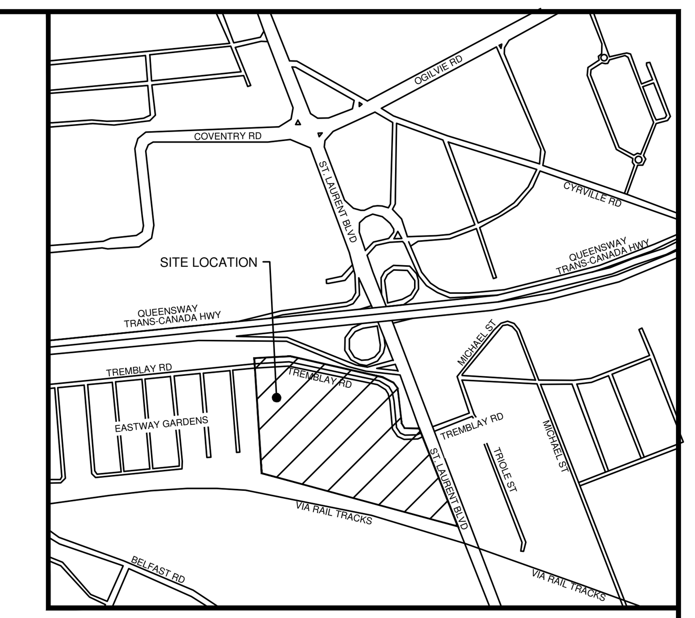
SHEET TITLE
SERVICING PLAN

CONSULTANT
wsp
100 Commerce Valley Dr. West, Thornhill, ON Canada L3T 0A1
t: 905.882.1100 f: 905.882.0055 www.wsp.com

LICENSED PROFESSIONAL ENGINEER
P.M. DESOUSA
100204815
PROVINCE OF ONTARIO

DESIGNED	DRAWN	CHECKED
J.V. / R.W.B	10/12 CAD	P.M.D
SCALE 1:1000	DATE OCT 2019	
PROJECT NUMBER 19M-00609		DWG. NUMBER SP1





KEY PLAN NTS

LEGEND

- PROPOSED DEVELOPMENT LIMIT
- FEDERAL OFFICE DEVELOPMENT BLOCK
- ×69.00 EXISTING GRADE
- + 69.00 PROPOSED GRADE
- 1.0% PROPOSED SLOPE
- DIRECTION OF OVERLAND FLOW
- MAX 3:1 SLOPING
- PROPOSED MANHOLE
- DRAINAGE BOUNDARY
- POTENTIAL RETAINING WALL

NOTE: PROPOSED GRADES AND SLOPES ARE CONCEPTUAL ONLY AND ARE SUBJECT TO DETAILED DESIGN. PROPOSED RETAINING WALL AND 3:1 SLOPING TO BE DETAILED IN DETAILED DESIGN.

No.	REVISIONS TO DRAWING	BY	DATE	APPR.
2	SECOND SUBMISSIOIN	P.M.D	JAN/15/20	
1	FIRST SUBMISSION	P.M.D	NOV/07/19	

ALL PREVIOUS ISSUES OF THIS DRAWING ARE SUPERSEDED

CLIENT
CANADA LANDS COMPANY

MUNICIPALITY
Ottawa

PROJECT TITLE
530 TREMBLAY ROAD

SHEET TITLE
PRELIMINARY GRADING

CONSULTANT
wsp
100 Commerce Valley Dr. West, Thornhill, ON Canada L3T 0A1
t: 905.882.1100 f: 905.882.0055 www.wsp.com

LICENSED PROFESSIONAL ENGINEER
P.M. DESOUSA
100204815
PROVINCE OF ONTARIO

DESIGNED	DRAWN	CHECKED
J.V. / R.W.B	10/12 CAD	P.M.D

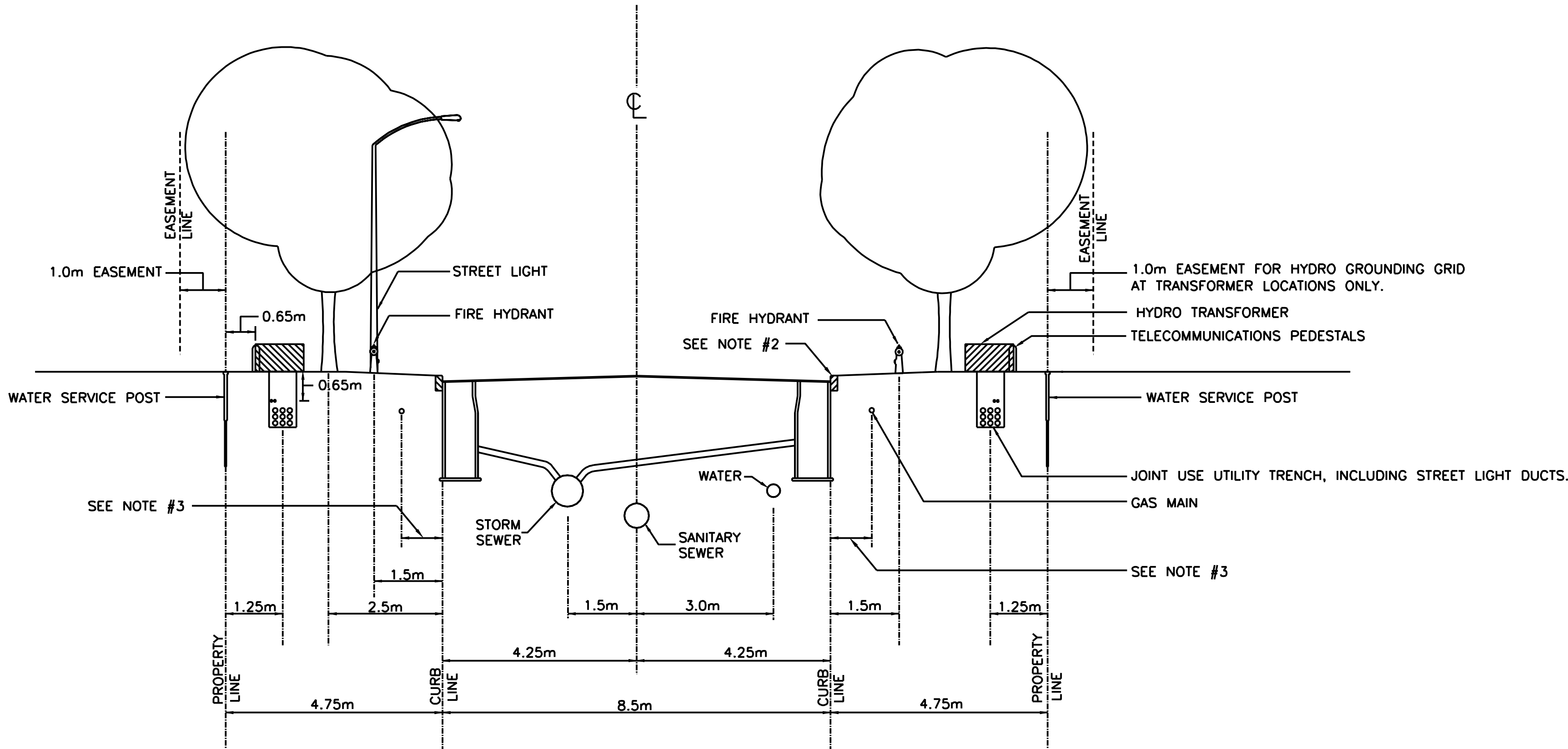
SCALE	DATE
1:1000	OCT 2019

PROJECT NUMBER	DWG. NUMBER
19M-00609	GR1

APPENDIX

C

ROAD CROSS-SECTIONS



SECTION

NOTES:

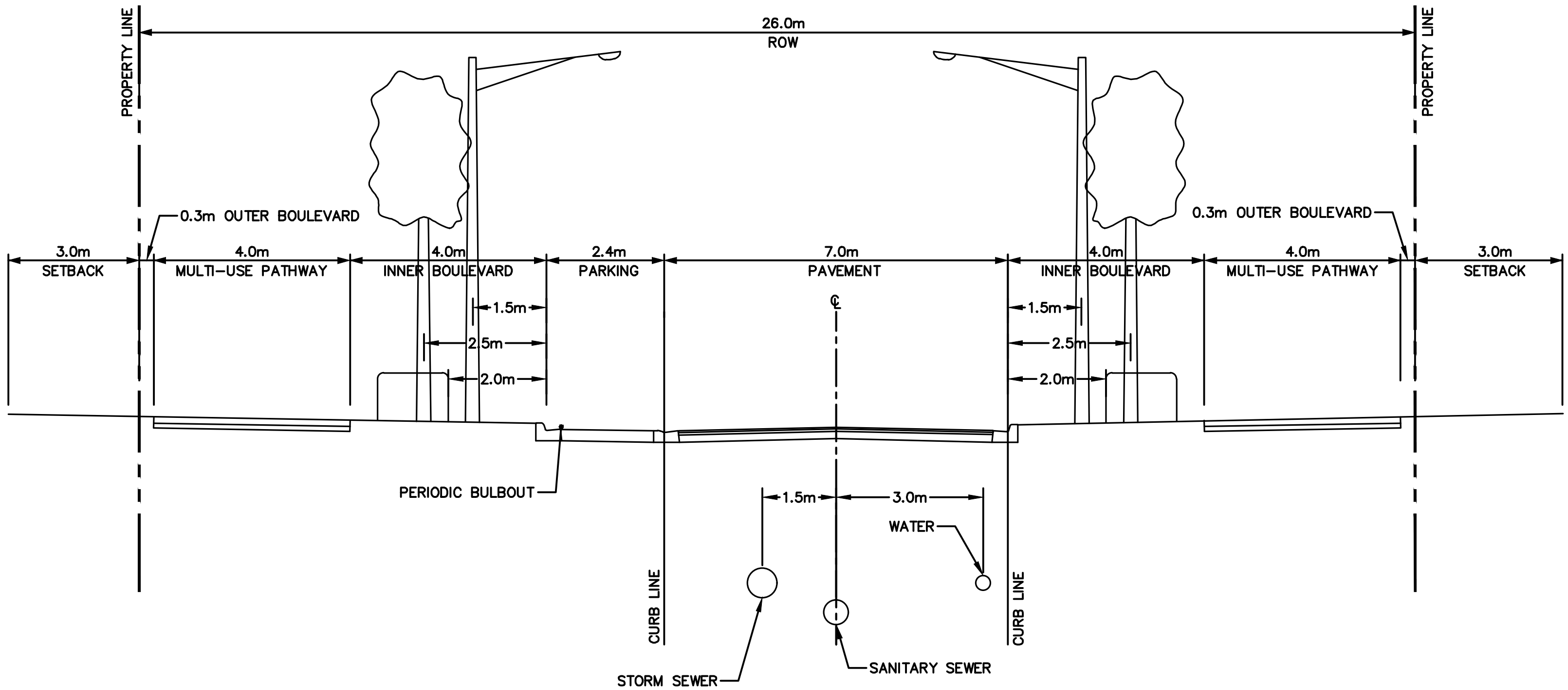
1. REFERENCE STANDARD NOTES ROAD ALLOWANCE (DGN:ROW-NOTES)
2. CONCRETE CURBS MAY BE BARRIER TYPE OR MOUNTABLE TYPE. CATCH BASIN TYPE WILL SUIT CURB DESIGN. SEE SEWER DESIGN GUIDELINES FOR CATCH BASIN PREFERENCE.
3. AT CATCH BASIN AND HYDRANT LOCATIONS THE GAS MAIN SHALL HAVE A MINIMUM 0.6m CLEARANCE FROM STRUCTURE.
4. STREET LIGHTS CAN BE LOCATED ON EITHER SIDE OF R.O.W.
5. FOR SINGLE LOADED ROAD, BOULEVARD ON SIDE WITH NO HOUSING MAY BE REDUCED TO A MINIMUM OF 1.5m

Ottawa

RESIDENTIAL ROAD
18.0m ROAD ALLOWANCE

DATE:	-
REV. DATE:	MARCH 2009
DWG. No.:	ROW-18

FILENAME: X:\DIV10\19M-00609 - 530 Tremblay\MUN\013 - Details\19M-00609 - Details.dwg
PLOTDATE: Oct 08, 2019 - 4:26pm, CAHB070415



PROPOSED 26.0m RESIDENTIAL ROADWAY CROSS SECTION
N.T.S.

CLIENT	CANADA LANDS COMPANY CLC LIMITED
TITLE	RESIDENTIAL ROAD 26.0m ROAD ALLOWANCE

WSP
100 Commerce Valley Dr. West, Thornhill, ON Canada L3T 0A1
t: 905.882.1100 f: 905.882.0055 www.wsp.com

Checked	P.M.D.	Drawn	H.B.
Date	OCT 2019	Proj. No.	19M-00609
Scale	N.T.S.	Figure No.	ROW-26

APPENDIX

D

WATER FLOW DEMAND CALCULATIONS

APPENDIX D

FIRE FLOW CALCULATIONS

Project: **530 Tremblay Road, City of Ottawa - Residential Development**
Job No.: **19M-00609**

Fire Flow Calculation Procedure per Water Supply for Public Fire Protection, 1999 by Fire Underwriter Survey, p 20.

$$F = 220\ C \sqrt{A}$$

where

F = Fire flow in Litres per minute (Lpm)
C = coefficient related to the type of construction
A = total floor area in square metres

A. **Determine Type of Construction**
=> Fire-resistive construction (fully protected frame, floors, roof)
Therefore C = 0.8

B. **Determine Ground Floor Area**
=> Total floor area in square meters (including all storeys, but excluding basements at least 50 percent below grade) in the building being considered

Therefore A = Total Floor Area
A = 12120*3
A = 36,360 m2

C. **Determine Height in Storeys**
=> 3 Storeys, no basements

D. **Determined the Fire Flow**
F = 220 x 0.8 x √36360
F = 34,000 Lpm

E. **Determine Increase or Decrease for Occupancy**
=> Reduction for Limited Combustible Occupancies
Therefore 15% reduction
15% reduction of 34000 Lpm = 5100 Lpm
34000 - 5100 = 28,900 Lpm

F. **Determine Decrease for Automatic Sprinkler Protection**
=> Has Automatic Sprinkler Protection (Per NFPA 13 Standards)
Therefore 30% reduction
30% reduction of 28900 Lpm = 8,670 Lpm

G. **Determine the Total Increase For Exposures**

Face	Distance (m)	Charge				
West Side	18.00	15%				
East Side	28.00	10%				
North Side	46.00	0%				
South Side	26.00	10%	See Note (1)			
	Total	35%	of	10,115	=	7,586 Lpm

H. **Req'd Fire Flow = D - F + G**
F = 27,816 Lpm
F = 28,000 Lpm (4,800 Lpm < F < 45,000 Lpm; OK)
F = 7,388 US GPM

NOTE: Residential development fire flows calculated as per Fire Underwriters Survey are overly conservative and unfeasible. Therefore, as per the City of Ottawa's technical bulletin ISDTB-2014-02,the residential buildings fire flow requirements will be governed by Ontario Building Code Rules and Regulations.

APPENDIX D

FIRE FLOW CALCULATIONS

Project: **530 Tremblay Road, City of Ottawa - Office Development**
Job No.: **19M-00609**

Fire Flow Calculation Procedure per Water Supply for Public Fire Protection, 1999 by Fire Underwriter Survey, p 20.

$$F = 220\ C \sqrt{A}$$

where

F = Fire flow in Litres per minute (Lpm)
C = coefficient related to the type of construction
A = total floor area in square metres

A. **Determine Type of Construction**
=> Fire-resistive construction (fully protected frame, floors, roof)
Therefore C = 0.6

B. **Determine Ground Floor Area**
=> Fire-resistive building with vertical openings and exterior vertical communications properly protected
Therefore A = Largest Floor + 25% of 2 immediately adjoining floors
A = 2387 + 0.25*(2387 + 2387)
A = 3,581 m2

C. **Determine Height in Storeys**
=> 24 Storeys

D. **Determined the Fire Flow**
F = 220 x 0.6 x √3581
F = 8,000 Lpm

E. **Determine Increase or Decrease for Occupancy**
=> Reduction for Limited Combustible Occupancies
Therefore 15% reduction
15% reduction of 8000 Lpm = 1,200 Lpm
8000 - 1200 = 6,800 Lpm

F. **Determine Decrease for Automatic Sprinkler Protection**
=> Has Automatic Sprinkler Protection (Per NFPA 13 Standards)
Therefore 30% reduction
30% reduction of 6800 Lpm = 2,040 Lpm

G. **Determine the Total Increase For Exposures**

Face	Distance (m)	Charge				
West Side	24.00	10%				
East Side	24.00	10%				
North Side	24.00	10%				
South Side	71.00	0%	See Note (1)			
	Total	30%	of	2,040	=	1,530 Lpm

H. **Req'd Fire Flow = D - F + G**
F = 6,290 Lpm
F = 6,000 Lpm (4,800 Lpm < F < 45,000 Lpm; OK)
F = 1,583 US GPM

APPENDIX D

FIRE FLOW CALCULATIONS

Project: **530 Tremblay Road, City of Ottawa - Mixed Use Development**
Job No.: **19M-00609**

Fire Flow Calculation Procedure per Water Supply for Public Fire Protection, 1999 by Fire Underwriter Survey, p 20.

$$\boxed{F = 220\ C \sqrt{A}}$$

where

F = Fire flow in Litres per minute (Lpm)
C = coefficient related to the type of construction
A = total floor area in square metres

A. **Determine Type of Construction**
=> Fire-resistive construction (fully protected frame, floors, roof)
Therefore C = 0.6

B. **Determine Ground Floor Area**
=> Fire-resistive building with vertical openings and exterior vertical communications properly protected
Therefore A = Largest Floor + 25% of 2 immediately adjoining floors
A = 2170 + 0.25*(2170 + 2170)
A = 3,255 m2

C. **Determine Height in Storeys**
=> 24 Storeys

D. **Determined the Fire Flow**
F = 220 x 0.6 x √3255
F = 8,000 Lpm

E. **Determine Increase or Decrease for Occupancy**
=> Reduction for Limited Combustible Occupancies
Therefore 15% reduction
15% reduction of 8000 Lpm = 1,200 Lpm
8000 - 1200 = 6,800 Lpm

F. **Determine Decrease for Automatic Sprinkler Protection**
=> Has Automatic Sprinkler Protection (Per NFPA 13 Standards)
Therefore 30% reduction
30% reduction of 6800 Lpm = 2,040 Lpm

G. **Determine the Total Increase For Exposures**

Face	Distance (m)	Charge				
West Side	28.00	10%				
East Side	24.00	10%				
North Side	13.00	15%				
South Side	24.00	10%	See Note (1)			
	Total	45%	of	3,060	=	2,295 Lpm

H. **Req'd Fire Flow = D - F + G**
F = 7,055 Lpm
F = 7,000 Lpm (4,800 Lpm < F < 45,000 Lpm; OK)
F = 1,847 US GPM

APPENDIX D

PROPOSED DOMESTIC WATER DEMAND

Project: **530 Tremblay Road, City of Ottawa**
Job No.: **19M-00609**

Proposed Development

Building	Studio/1 bed	Pop[1] (1.4ppu)	2 bed	Pop[1] (2.1ppu)	Total Population[1]
Residential	169	237	615	1,292	1,529
Federal Office Development Block	-	-	-	-	-
Mixed Use	-	-	-	-	-
TOTAL	**169**	**237**	**615**	**1,292**	**1,529**

Total # of Units = 784 units

Proposed Water Demands

Building	Population (see above)	Per Capita Flow [2] (L/cap/day)	Floor Area (m^2)	Land Area (m^2)	Flow Per Land Use [3][4] (L/gross ha/day)	Average Daily Demand (L/s)	Peak Hour		Max Day	
							Peaking Factor [5]	Demand (L/s)	Peaking Factor [5]	Demand (L/s)
Residential	1,529	350	-	-	-	6.19	2.20	13.63	2.50	15.48
Federal Office Development Block	-	-	150,000		28,000	4.86	1.80	8.75	1.50	7.29
Mixed Use	-	-	-	17,000	28,000	0.55	1.80	0.99	1.50	0.83
TOTAL	**1,529**	**350**			**28,000**	**11.61**		**23.37**		**23.60**

Note: Ground floor areas per Concept Plan prepared by WSP Planning dated August 6, 2019.
Note 1: Residential population assumption based upon 500 units, with only 2 bedroom units (2.1 people per unit)
Note 2: Refer to Section 3.3 of the Functional Servicing Report for Design Parameters (Residential Flow = 350 L/cap./day)
Note 3: Employment Flow per Land Use = 28,000L/floor ha/day x Office floor area (ha) x (# of floors)
Employment Flow per Land Use = 28,000L/ha/day x 0.6250ha x (1day/86400s) x (24 floors)
Employment Flow per Land Use = 4.86 L/s
Note 4: Mixed Use Wastewater Flow per Land Use = 28,000L/ha/day x Mixed use land area (ha)
Mixed Use Wastewater Flow per Land Use = 28,000L/ha/day x 1.7 ha x (1day/86400s)
Mixed Use Wastewater Flow per Land Use = 0.55 L/s
Note 5: Refer to Section 3.3 of the Functional Servicing Report for Design Parameters for Peaking Factors

APPENDIX

E

SANITARY FLOW DEMAND CALCULATIONS

APPENDIX E
PROPOSED SANITARY FLOW GENERATION

Project: **530 Tremblay Road, City of Ottawa**
Job No.: **19M-00609**

Proposed Development

Building	Studio/1 bed	Pop[1] (1.4ppu)	2 bed	Pop[1] (2.1ppu)	Total Population[1]
Residential	169	237	615	1,292	1,529
Federal Office Development Block	-	-	-	-	-
Mixed Use	-	-	-	-	-
TOTAL	**169**	**237**	**615**	**1,292**	**1,529**

Total # of Units = 784 units

Design Flows

Building	Population (see above)	Population Flow (L/s)[2]	Floor Area (m^2)	Land Area (m2)	Wastewater Flows per Land Use [3][4] (L/gross ha/day)	Peaking Factor[5]	Peak Flow (L/s)
Residential	1,529	6.19	-	-	-	3.67	22.75
Federal Office Development Block	-	-	150,000	-	50,000	1.50	13.02
Mixed Use	-	-	-	17,000	50,000	1.50	1.48
TOTAL (Entire Site)	**1,529**	**6.19**	**150,000**	**17,000**	**-**	**-**	**37.25**

Site Area = 11.6 ha
I/I = 3.25 L/s (0.28 L/s/ha)
Total Design Flow = 40.50 L/s

Note: Ground floor areas per Concept Plan prepared by WSP Planning dated August 6, 2019.
Note 1: Residential population density factors taken from City of Ottawa Sewer Design Guidelines Section 4.3
Note 2: Refer to Section 4.3 of the Functional Servicing Report for Design Parameters (Residential Flow = 350 L/cap./day)
Note 3: Employment Wastewater Flow per Land Use = 50,000L/floor ha/day x Office floor area (ha) x (# of floors)
Employment Wastewater Flow per Land Use = 50,000L/ha/day x 0.6250ha x (1day/86400s) x (24 floors)
Employment Wastewater Flow per Land Use = 8.68 L/s
Note 4: Mixed Use Wastewater Flow per Land Use = 50,000L/ha/day x Mixed use land area (ha)
Mixed Use Wastewater Flow per Land Use = 50,000L/ha/day x 1.7 ha x (1day/86400s)
Mixed Use Wastewater Flow per Land Use = 0.98 L/s
Note 5: Peaking Factor for Residential Flows = $1 + (14/(4+(P/1000)^{1/2}))$
Peaking Factor for Residential Flows = $1 + (14/(4+(1529/1000)^{1/2}))$
Peaking Factor for Residential Flows = 3.67

APPENDIX E
PROPOSED SANITARY FLOW GENERATION
(FLOWING NORTH TO EX.TREMBLAY ROAD)

Project: **530 Tremblay Road, City of Ottawa**
Job No.: **19M-00609**

Proposed Development

Building	Studio/1 bed	Pop[1] (1.4ppu)	2 bed	Pop[1] (2.1ppu)	Total Population[1]
Residential	169	237	615	1,292	1,529
Federal Office Development Block	-	-	-	-	-
Mixed Use	-	-	-	-	-
TOTAL	**169**	**237**	**615**	**1,292**	**1,529**

Total # of Units = 784 units

Design Flows

Building	Population (see above)	Population Flow (L/s)[2]	Floor Area (m^2)	Land Area (m2)	Wastewater Flows per Land Use [3][4] (L/gross ha/day)	Peaking Factor[5]	Peak Flow (L/s)
Residential	1,529	6.19	-	-	-	3.67	22.75
Federal Office Development Block	-	-	75,000	-	50,000	1.50	6.51
Mixed Use	-	-	-	0	50,000	1.50	0.00
TOTAL (Entire Site)	**1,529**	**6.19**	**75,000**	**0**	**-**	**-**	**29.26**

Site Area = 5.8 ha
I/I = 1.62 L/s (0.28 L/s/ha)
Total Design Flow = 30.88 L/s

Note: Ground floor areas per Concept Plan prepared by WSP Planning dated August 6, 2019.
Note 1: Residential population density factors taken from City of Ottawa Sewer Design Guidelines Section 4.3
Note 2: Refer to Section 4.3 of the Functional Servicing Report for Design Parameters (Residential Flow = 350 L/cap./day)
Note 3: Employment Wastewater Flow per Land Use = 50,000L/floor ha/day x Office floor area (ha) x (# of floors)
Employment Wastewater Flow per Land Use = 50,000L/ha/day x 0.6250ha x (1day/86400s) x (24 floors)
Employment Wastewater Flow per Land Use = 8.68 L/s
Note 4: Mixed Use Wastewater Flow per Land Use = 50,000L/ha/day x Mixed use land area (ha)
Mixed Use Wastewater Flow per Land Use = 50,000L/ha/day x 1.7 ha x (1day/86400s)
Mixed Use Wastewater Flow per Land Use = 0.98 L/s
Note 5: Peaking Factor for Residential Flows = $1 + (14/(4+(P/1000)^{1/2}))$
Peaking Factor for Residential Flows = $1 + (14/(4+(1529/1000)^{1/2}))$
Peaking Factor for Residential Flows = 3.67

APPENDIX E
PROPOSED SANITARY FLOW GENERATION
(FLOWING EAST TO ST.LAURENT BLVD)

Project: **530 Tremblay Road, City of Ottawa**
Job No.: **19M-00609**

Proposed Development

Building	Studio/1 bed	Pop[1] (1.4ppu)	2 bed	Pop[1] (2.1ppu)	Total Population[1]
Residential	169	237	615	1,292	1,529
Federal Office Development Block	-	-	-	-	-
Mixed Use	-	-	-	-	-
TOTAL	**169**	**237**	**615**	**1,292**	**1,529**

Total # of Units = 784 units

Design Flows

Building	Population (see above)	Population Flow (L/s)[2]	Floor Area (m^2)	Land Area (m2)	Wastewater Flows per Land Use [3][4] (L/gross ha/day)	Peaking Factor[5]	Peak Flow (L/s)
Residential	0	0.00	-	-	-	4.50	0.00
Federal Office Development Block	-	-	75,000	-	50,000	1.50	6.51
Mixed Use	-	-	-	17,000	50,000	1.50	1.48
TOTAL (Entire Site)	**0**	**0.00**	**75,000**	**17,000**	**-**	**-**	**7.99**

Site Area = 5.8 ha
I/I = 1.62 L/s (0.28 L/s/ha)
Total Design Flow = 9.61 L/s

Note: Ground floor areas per Concept Plan prepared by WSP Planning dated August 6, 2019.
Note 1: Residential population density factors taken from City of Ottawa Sewer Design Guidelines Section 4.3
Note 2: Refer to Section 4.3 of the Functional Servicing Report for Design Parameters (Residential Flow = 350 L/cap./day)
Note 3: Employment Wastewater Flow per Land Use = 50,000L/floor ha/day x Office floor area (ha) x (# of floors)
Employment Wastewater Flow per Land Use = 50,000L/ha/day x 0.6250ha x (1day/86400s) x (24 floors)
Employment Wastewater Flow per Land Use = 8.68 L/s
Note 4: Mixed Use Wastewater Flow per Land Use = 50,000L/ha/day x Mixed use land area (ha)
Mixed Use Wastewater Flow per Land Use = 50,000L/ha/day x 1.7 ha x (1day/86400s)
Mixed Use Wastewater Flow per Land Use = 0.98 L/s
Note 5: Peaking Factor for Residential Flows = $1 + (14/(4+(P/1000)^{1/2}))$
Peaking Factor for Residential Flows = $1 + (14/(4+(1529/1000)^{1/2}))$
Peaking Factor for Residential Flows = 3.67

From: Oram, Cody [mailto:Cody.Oram@ottawa.ca]
Sent: October-22-19 11:52 AM
To: Ennis, Martin <Martin.Ennis@wsp.com>; De Santi, Nadia <Nadia.De-Santi@wsp.com>; de Sousa, Philip <Philip.deSousa@wsp.com>
Cc: Hanifi, Michael <Michael.Hanifi@wsp.com>; Mary Jarvis <mjarvis@clc.ca>; Pascal Mongeau <Pascal.Mongeau@tpsgc-pwgsc.gc.ca>; Carolyn Walsh (J) <Carolyn.J.Walsh@tpsgc-pwgsc.gc.ca>; Zachary Riley <Zachary.Riley@tpsgc-pwgsc.gc.ca>; Erin Forzley <eforzley@clc.ca>; Moore, Sean <Sean.Moore@ottawa.ca>
Subject: RE: 530 Tremblay Road - Sanitary Capacity Check

Hi Martin,

Yes, it is reasonable to reserve the capacity at the time of draft plan approval. There will be a condition of draft plan approval that speaks to the expiry date for the reserved capacity if no construction commences by the expiry date. An acceptable expiry date will require further coordination to ensure that both CLC/PSPC and the City's interests are protected.

Regards,
Cody

From: Ennis, Martin <Martin.Ennis@wsp.com>
Sent: October 21, 2019 4:31 PM
To: Oram, Cody <Cody.Oram@ottawa.ca>; De Santi, Nadia <Nadia.De-Santi@wsp.com>; de Sousa, Philip <Philip.deSousa@wsp.com>
Cc: Hanifi, Michael <Michael.Hanifi@wsp.com>; Mary Jarvis <mjarvis@clc.ca>; Pascal Mongeau <Pascal.Mongeau@tpsgc-pwgsc.gc.ca>; Carolyn Walsh (J) <Carolyn.J.Walsh@tpsgc-pwgsc.gc.ca>; Zachary Riley <Zachary.Riley@tpsgc-pwgsc.gc.ca>; Erin Forzley <eforzley@clc.ca>; Moore, Sean <Sean.Moore@ottawa.ca>
Subject: RE: 530 Tremblay Road - Sanitary Capacity Check

Cody,

Thank you for your response. We will provide more detailed estimates of the flows that are being sent to each of the St Laurent and the Tremblay sewer systems as part of our Functional Servicing Report and the subsequent 1st Engineering submissions.

CLC and PSPC have requested that the required capacity in each system be reserved at the time of draft plan approval. This project is of key importance to the Federal Government and will be moving forward with the 1st detailed engineering submission being made in the New Year shortly after Draft Plan Approval. CLC/PSPC are not able to accept the project risk that we can get all the way through the detailed design process and find out at the last minute just before Registration that the design needs to be completely re-worked as the available sewer capacity has been allocated elsewhere.

Please confirm that the City will commit to the above so CLC/PSPC can provide the necessary certainty to their "higher ups".

Thank you.

Martin Ennis, P.Eng.
Manager
Land Development

T+ 1 289-982-4283
M+ 1 647-222-1928

From: Oram, Cody [mailto:Cody.Oram@ottawa.ca]
Sent: Monday, October 21, 2019 8:55 AM
To: De Santi, Nadia <Nadia.De-Santi@wsp.com>; de Sousa, Philip <Philip.deSousa@wsp.com>
Cc: Hanifi, Michael <Michael.Hanifi@wsp.com>; Ennis, Martin <Martin.Ennis@wsp.com>; Mary Jarvis <mjarvis@clc.ca>; Pascal Mongeau <Pascal.Mongeau@tpsgc-pwgsc.gc.ca>; Carolyn Walsh (J) <Carolyn.J.Walsh@tpsgc-pwgsc.gc.ca>; Zachary Riley <Zachary.Riley@tpsgc-pwgsc.gc.ca>; Erin Forzley <eforzley@clc.ca>; Moore, Sean <Sean.Moore@ottawa.ca>
Subject: RE: 530 Tremblay Road - Sanitary Capacity Check

Hi Philip,

The St. Laurent system does have capacity for the additional 25 L/s. The capacity is available at this time; however, the City will not reserve the allotment of flow from this site to the St. Laurent system until the development application is approved.

If you have any questions, please don't hesitate to call or email.

Regards,
Cody

Cody Oram, P.Eng. Senior Engineer
Development Review, South Services
Planning, Infrastructure and Economic Development Department | Services de planification, d'infrastructure et de développement économique
City of Ottawa | Ville d'Ottawa
110 Laurier Avenue West. Ottawa, ON | 110, avenue. Laurier Ouest. Ottawa (Ontario) K1P 1J1
613.580.2424 ext./poste **13422**, fax/téléc:613-580-2576, cody.oram@ottawa.ca

---

From: de Sousa, Philip <Philip.deSousa@wsp.com>
Sent: October 01, 2019 10:07 AM
To: Oram, Cody <Cody.Oram@ottawa.ca>
Cc: De Santi, Nadia <Nadia.De-Santi@wsp.com>; Hanifi, Michael <Michael.Hanifi@wsp.com>; Ennis, Martin

<Martin.Ennis@wsp.com>; Mary Jarvis <mjarvis@clc.ca>
Subject: RE: 530 Tremblay Road - Sanitary Capacity Check

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.

Hey Cody,

The rationale is that by splitting the flows we can reduce how much net fill earthworks material is required to complete the development. As the site currently stands, the pond is in the southeast corner and the sanitary sewer is in the northwest. The grade of the development will be positioned to promote positive drainage towards the pond (i.e. southeast). This means that to connect the entire sanitary sewer connection from the southeast corner all the way back up to the northwest corner, the sewer will be going against grade. In order to keep this sanitary sewer underground the entire time, a lot more fill will be required.

Splitting the drainage between the two sanitary systems allows the development to have reduced net fill earthworks numbers and will allow the development to jive better with the surrounding properties. I am hopeful this is something that the City will consider.

If you would like to discuss further, please feel free to reach out to me directly.

Thanks,
Pd

Philip de Sousa, P.Eng.
T+ 1 289 982 4281 NEW DIRECT LINE
M+ 1 416-602-0693

From: Oram, Cody [mailto:Cody.Oram@ottawa.ca]
Sent: October-01-19 8:42 AM
To: de Sousa, Philip <Philip.deSousa@wsp.com>
Cc: De Santi, Nadia <Nadia.De-Santi@wsp.com>; Hanifi, Michael <Michael.Hanifi@wsp.com>; Ennis, Martin <Martin.Ennis@wsp.com>; Mary Jarvis <mjarvis@clc.ca>
Subject: RE: 530 Tremblay Road - Sanitary Capacity Check

Hi Philip,
Could you explain the site constraints that do not allow all wastewater to enter the Tremblay system? Before the City will consider accepting additional catchment area into the St. Laurent system, we'll need to understand the constraints. Adding additional area to the St. Laurent system will reduce capacity for future development within the system. Ideally the flow from the site will remain within the Tremblay Rd catchment.
Cody

From: de Sousa, Philip <Philip.deSousa@wsp.com>
Sent: September 30, 2019 9:19 AM

To: Oram, Cody <Cody.Oram@ottawa.ca>
Cc: De Santi, Nadia <Nadia.De-Santi@wsp.com>; Hanifi, Michael <Michael.Hanifi@wsp.com>; Ennis, Martin <Martin.Ennis@wsp.com>; Mary Jarvis <mjarvis@clc.ca>; Gervais, Melanie <Melanie.Gervais@ottawa.ca>
Subject: Re: 530 Tremblay Road - Sanitary Capacity Check

Hi Cody,

Can you confirm if there is enough capacity to split the flows between Tremblay and St. Laurent Blvd? We're thinking 25L/sec each end?

Thanks,
Pd

Philip de Sousa, P. Eng
Land Development Ontario
WSP Canada Group Limited
416 602 0693

From: de Sousa, Philip
Sent: September-21-19 9:47 PM
To: Oram, Cody <Cody.Oram@ottawa.ca>
Cc: De Santi, Nadia <Nadia.De-Santi@wsp.com>; Hanifi, Michael <Michael.Hanifi@wsp.com>; Ennis, Martin <Martin.Ennis@wsp.com>; Mary Jarvis <mjarvis@clc.ca>
Subject: 530 Tremblay Road - Sanitary Capacity Check

Hi Cody,

During our meeting on August 1, 2019, I asked the question about sanitary flows and what sewer has the capacity for 42 L/sec. I did receive the pre-consultation meeting notes this past week, but the notes did not have the answer. Our intention is to send approximately 50% of flows to the Tremblay Road sanitary sewer and approximately 50% of flows to the sanitary sewer along St. Laurent. To be conservative, can you confirm if both sanitary systems have capacity for 25 L/second (as we do not know the accurate split of flows just yet)?

Thanks,

Pd

Philip de Sousa, P.Eng.

Varlow, Jordan

From: Oram, Cody [mailto:Cody.Oram@ottawa.ca]
Sent: September-30-19 8:06 AM
To: de Sousa, Philip <Philip.deSousa@wsp.com>
Cc: De Santi, Nadia <Nadia.De-Santi@wsp.com>; Hanifi, Michael <Michael.Hanifi@wsp.com>; Ennis, Martin <Martin.Ennis@wsp.com>; Mary Jarvis <mjarvis@clc.ca>; Gervais, Melanie <Melanie.Gervais@ottawa.ca>
Subject: Re: 530 Tremblay Road - Sanitary Capacity Check

Hi Philip,
The sanitary flow for this property is to discharge to the Tremblay system. The Tremblay system was confirmed to have capacity to accommodate the anticipated 42 L/s. My apologies if this was not clear in the pre-consultation follow up notes.
Should you have any questions, please let me know.
Cody

From: de Sousa, Philip
Sent: September-21-19 9:47 PM
To: Oram, Cody <Cody.Oram@ottawa.ca>
Cc: De Santi, Nadia <Nadia.De-Santi@wsp.com>; Hanifi, Michael <Michael.Hanifi@wsp.com>; Ennis, Martin <Martin.Ennis@wsp.com>; Mary Jarvis <mjarvis@clc.ca>
Subject: 530 Tremblay Road - Sanitary Capacity Check

Hi Cody,

During our meeting on August 1, 2019, I asked the question about sanitary flows and what sewer has the capacity for 42 L/sec. I did receive the pre-consultation meeting notes this past week, but the notes did not have the answer. Our intention is to send approximately 50% of flows to the Tremblay Road sanitary sewer and approximately 50% of flows to the sanitary sewer along St. Laurent. To be conservative, can you confirm if both sanitary systems have capacity for 25 L/second (as we do not know the accurate split of flows just yet)?

Thanks,
Pd

Philip de Sousa, P.Eng.
Project Engineer, Land Development

wsp

T+ 1 289-982-4281 NEW DIRECT LINE
M+ 1 416-602-0693

100 Commerce Valley Drive West

APPENDIX

F

RIDEAU RIVER CALCULATIONS

Project:	CLC 530 Tremblay	No.	19M-00609-00	
By	SE	Date	9/20/2019	Page
Checked	AMB	Checked	9/20/2019	1

Subject: Allowable Offsite Discharge Rate

Pre-Development Peak Flow Rates

Rational Method is used to calculate the pre-development peak flow rate from the site.

Q = 2.78 CIA

Where,
Q = Peak flow rate (litres/second)
C = Runoff coefficient
I = Rainfall intensity (mm/hour)
A = Catchment area (hectares)

Project Area, A 3.36 hectares
Runoff Coef, C 0.50

Rainfall Intensity (I) is calculated using the IDF equation for the City of Ottawa

The rainfall intensity for the subject site was calculated using the following equation:

$$I = \frac{A}{(B+T)^C}$$

Where,
I = Rainfall Intensity (mm/hour)
T = Time of Concentration (minutes)
A, B, C = Constant Coefficient

Return Period (Years)	2	5	10	25	50	100
A	732.951	998.071	1174.184	1402.884	1569.58	1735.688
B	6.199	6.053	6.014	6.018	6.014	6.014
C	0.81	0.814	0.816	0.819	0.82	0.82
T (mins) **	10	10	10	10	10	10
I (mm/hr)	76.8	104.2	122.1	144.7	161.5	178.6
Q (L/s)	359	487	570	676	754	834
Q (m^3/s)	0.36	0.49	0.57	0.68	0.75	0.83

	Project:	CLC 530 Tremblay	No.	19M-00609-00	
	By	SE	Date	9/20/2019	Page
	Checked	AMB	Checked	9/20/2019	1

Subject: **Modified Rational Method**

Surface Type: Impervious

Catchment ID:

Rainfall ID:

100-Yr Rainfall IDF		**Site Parameters**		
a	1735.7	C :	0.80	Estimated Runoff Coefficient
b	0.82	Q_{pre}:	0.3587 m^3/s	Target FlowRrate
c	6.014	A:	1.93 ha	Post Development Area
		T_c:	10 min	

t_d (min)	**i** (mm/hr)	**Discharge** (m^3/s)	**al** (m^3)	**Area Vol.** (m^3)	**Volume** (m^3)
5	242.7	1.041	312	161	151
10	178.6	0.766	459	215	244
20	120.0	0.514	617	323	295
30	91.9	0.394	709	430	279
40	75.1	0.322	773	538	235
50	64.0	0.274	823	646	177
60	55.9	0.240	863	753	110
70	49.8	0.214	897	861	36
80	45.0	0.193	926	969	0
90	41.1	0.176	952	1076	0
100	37.9	0.163	975	1184	0
110	35.2	0.151	996	1291	0
120	32.9	0.141	1016	1399	0
130	30.9	0.133	1034	1507	0
140	29.2	0.125	1050	1614	0
150	27.6	0.118	1066	1722	0
160	26.2	0.113	1080	1829	0
170	25.0	0.107	1094	1937	0
180	23.9	0.103	1107	2045	0
190	22.9	0.098	1120	2152	0
200	22.0	0.094	1131	2260	0
210	21.1	0.091	1143	2367	0
220	20.4	0.087	1153	2475	0
230	19.7	0.084	1164	2583	0
240	19.0	0.082	1174	2690	0
250	18.4	0.079	1183	2798	0
260	17.8	0.076	1193	2906	0
270	17.3	0.074	1202	3013	0
280	16.8	0.072	1210	3121	0
290	16.3	0.070	1219	3228	0
300	15.9	0.068	1227	3336	0
310	15.5	0.066	1235	3444	0

Max. Required Storage: 295 m^3

APPENDIX

G

POND CALCULATIONS

Wet Pond Detail Design

1.0 Proposed Drainage Plan

Description	Drainage Area (ha)	Imperviousness (%)	Notes
Residential	1.00	90%	Internal Drainage
Vehicular	2.52	100%	
Mixed Use	2.11	80%	
Open Space	2.66	0%	
Pond Block	0.71	50%	
Total	**9.00**	60.7%	

2.0 Design Criteria

2.1 Water Quality

As per Town's requirement, an Enhanced Level of Protection will be required to provide 80% total suspended solid (TSS) removal. The retained volume for water quality purpose should be released over 24 hours.

2.2 Erosion Control

The 25-mm storm event retention on site over 24 hours shall be provided to the Wet Pond for erosion control objective.

2.3 Water Quantity

Quantity control of the 100 year post development storm to the 2 year pre development storm is required

3.0 Rainfall Intensity

The design storm (6 hour Chicago distribution) was developed using the rainfall Intensity – Duration – Frequency (IDF) data specified in the City of Ottawa Design Standards and was used in the Visual OTTHYMO modeling.

The rainfall intensity for the subject site was calculated using the following equation:

$$I = \frac{A}{(B+T)^C}$$

Where,

I = Rainfall Intensity (mm/hour)
T = Time of Concentration (minutes)
A, B, C = Constant Coefficient

The coefficient for A, B, and C values used in the City of Ottawa are defined in Section 5.2.5 of the City of Ottawa Design Guidelines - Sewer (October 2012) and are summarized in below table.

Return Periods (Years)	A	B	C	6-Hour Rainfall Amount (mm)
2	732.95	6.199	0.81	36.9
5	998.07	6.053	0.81	49.0
10	1174.18	6.014	0.82	57.0
25	1402.88	6.018	0.82	66.9
50	1569.58	6.014	0.82	74.5
100	1735.69	6.014	0.82	82.3

4.0 Required Storage

4.1 Water Quality Controls

East Wet Pond must provide water quality control at Enhanced Protection Level

Refer to Table 3.2 in "Stromwater Management Planning and Design Manual" (MOE, 2003)

Protection Level	SWMP Type	Storage Volume (m^3/ha) for Impervious Level			
		35%	55%	70%	85%
Enhanced 80% long-term S.S. removal	Infiltration	25	30	35	40
	Wetlands	80	105	120	140
	Hybrid Wet Pond/Wetland	110	150	175	195
	Wet Pond	140	190	225	250

Total Drainage Area	9.00	ha			
Imperviousness	60.7	%			
SWMP Type	Wet Pond				
Enhanced Level Protection:	80	% TSS Removal			
Storage Volume per ha	203.3	m^3/ha	or	1830	m^3
Permanent Pool Storage	163.3	m^3/ha	or	**1470**	m^3
Extended Detention Volume	40.0	m^3/ha	or	360	m^3

4.2 Erosion Control

Runoff Volume for 25 mm event	13.72	mm	(Refer to VO5 output)
Extended Detention (Erosion Control)	**1235**	m^3	
Design Discharge	0.029	m^3/s	*=Extended Detention Volume / (24*3600)*2*

4.3 Quantity Control

VO model was simulated to estimate the required storage for quantity control

Return Period (Years)	2
A	732.951
B	6.199
C	0.81
T (mins)	28.32
I (mm/hr)	41.62
Pre-Dev Area (ha)	8.24

Rational Method is used to calculate the pre-development peak flow rate from the site.

Q = 2.78 CIA

Where,
Q = Peak flow rate (litres/second)
C = Runoff coefficient (0.50)
I = Rainfall intensity (mm/hour)
A = Catchment area (hectares)

Storm Event	Target Flow (m^3/s)	Required Storage (m^3)
	0.000	0
25 mm	0.029	1235
100-yr	0.477	3600

5.0 Wet Pond Designed Storage

5.1 Wet Pond Stage-Storage Relationship

Based on the preliminary grading of the Wet Pond, the stage-storage relationship was obtained.

Component		Stage (m)	Depth (m)	Area (m^2)	Segment Storage (m^3)	Cumulative Storage (m^3)	
Forebay	Bottom	63.68	0.00	279	0	0	*Bottom El = 63.80 m as reference.*
	Permanent Pool Elevation	65.18	1.50	801	810	810	
Main Cell	Bottom	64.18	0.00	801	0	0	
	Permanent Pool Elevation	65.18	1.00	1337	1069	1069	*P.P. depth 1m, meet MOE criteria*
Permanent Pool Storage						**1879**	*satisfy the required 1470 m^3 storage.*
Wet Pond	P.P. Elevation	65.18	0.00	2139	0	0	
		65.68	0.50	2833	1243	1243	
	Extended Detention	65.93	0.25	2988	728	**1970**	*satisfy the required 1235 m^3 storage.*
		66.93	1.00	3642	3315	5285	*VO5 model*
	Max Elevation	67.53	0.60	4062	2311	7597	*Max. Active Storage*

5.2 Features of Wet Pond v.s. MOE's Requirements

Storage Component	Storage Volume (m^3) Required	Storage Volume (m^3) Provided
Permanent Pool Storage	1470	1879
Extended Detention Storage	1235	1970

6.0 Forebay Length Sizing Calculation

6.1 Forebay Sizing Calculaion

Settling Length Calculation	
$Dist = \sqrt{\frac{rQ_p}{V_s}}$	Forebay
Dist - Forebay Length	13.8 m
Q - Peak Design Flow Rate (25mm - Pond Outflow)	0.029 m^3/s
r - Length to width ratio	2.00
V_s - Settling Velocity	0.0003 m/s
Dispersion Length Calculation	
$Dist = \frac{8Q}{dV_f};\ Width = \frac{Dist}{8}$	Forebay
Dist - Forebay Length	24.2 m
Q - Inlet Rate*	2.27 m^3/s
d - Depth of Permanent Pool	1.50 m
V_f - Desired Velocity in Forebay	0.50 m/s

Larger flows resulted from Chicago Storm
Minimum 1.0m as stipulated in MOE Manual
Max. permissible velocity in the forebay

** As per MOE 2003 required, 10 year storm is applied to size the Forebay.*

Required Adjusted Forebay Length: **24.2 m**
Required Minimum Bottom Width: **3.0 m**

6.2 Forebay Configuration

Description	Forebay	
	Required	Provided
Depth (m)	1.0	1.5
Settling Length (m)	13.8	33.0
Dispersion Length (m)	24.2	
Minimum Bottom Width of Forebay Deep Zone (m)	3.0	19.0

6.3 Average Flow Velocity in the forebay

A check should be made using the entire forebay cros-sectional area to ensure that the average velocity in the forebay is less than, or equal to , 0.15 m/s which is empirically recognized as the maximum permissible velocity before which erosion will occur in a channel.

$$V_{avg} = Q/A$$

Where,			Forebay
	V_{avg} =	Average velocity in the forebay	0.06 m/s
	Q =	Inlet flow rate from design storm (10-year)	2.27 m^3/s
		(Chicago storm results are selected as it gives the larger flows.)	
	A =	Entire forebay cross-sectional area	36.75 m^2
	d =	Depth of permanent pool in the forebay	1.50 m
	W_b =	Forebay Deep Zone Bottom Width	19.0 m
	W_t =	Forebay Deep Zone Top Width at Permanent Pool Elevation	30.0 m

Average velocities at the forebay is less than 0.15 m/s.

7.0 Outlet Structure Design

7.1 Low Flow Outlet & Extended Detention

Permanent Pool Elevation: 65.18 m

Extended Detention Water Surface Elevation: 65.93 m

25 mm Event Water Elevation 65.68 m

h= 0.497 m

PP Elevation: 65.18 m — Ap= 2139 m^2

25 mm Event Elevation: 65.68 m — Ap'= 2828 m^2

Storage Volume: V= 1235 m^3

Pond Water Surface Relationship: $A=C_2h+C_3$

C_2: 1388 m^2/m

C_3: 2139 m

Falling Head Orifice Equation: *(Equation 4.11, MOE SWMPDM, 2003)*

$$t = \frac{0.66 \times C_2 h^{1.5} + 2 \times C_3 \times \sqrt{h}}{2.75 \times A_0}$$

Detention Time: 24 hours = 86400 seconds

Solve for A_0: A_0= 0.0140 m^2

Diameter= **133.7** **mm**

Therefore, utilizing a **130** mm orifice plate

A_0= 0.0133 m^2

Drawdown Time = 25 hours

Orifice Flow Control : $Q = CA\sqrt{2gh}$

Low Flow Orifice Equation: $CA(2g)^{0.5}$ = 0.0370

$Q=0.1598*(h)^{0.5}$

where h= wsel - 65.245 m

Pond outflow rate (25mm event, maximum): 0.024 m^3/s

7.2 High Flow Outlets

Orifice tube is proposed to control the 2-year up to 100-year peak flow rates to allowable levels.

$$Q = CA\sqrt{2gh}$$

Where, Q = Orifice Tube Flow Rate (m^3/s)	0.353	m^3/s
C = Flow Coefficient for Orifice Tube	0.80	
d = Diameter of Orifice Tube	**375**	mm
A = Cross-section Area of Orifice Tube (m^2)	0.110	m^2
g = Gravity Acceleration (m/s^2)	9.81	m/s^2
E1 = Invert of Orifice Tube	65.93	m
E2 = Top of Storage	66.93	m
h = Head of Flow above Centerline of Orifice Tube	0.81	m

** Please note that flow will enter an angled ditch inlet catch basin (DICB) before the orifice flow control.
The DICB will not act as a control and will be included in the detailed design phase.

7.3 Emergency Spillway:

$$Q = CLH^{\frac{3}{2}}$$

Where, Q = Emergency Spillway Flow Rate (m^3/s)	3.950	m^3/s
C = Flow Coefficient for Broad Crested Weir	1.70	
L = Length of Weir	5.00	m
h = Water Head above Weir	0.60	m
The invert of the emergency spillway is set at	66.93	m
Top of Pond	67.53	m

7.4 Stage-Storage-Discharge Relationship

Elevation (m)	Depth (m)	Flow Rate (m^3/s)				Active Storage (m^3)	Total Storage (m^3)
		Detention Orifice	Quantity Orifice	Emergency Spillway	Total		
65.18	0.00	0.000	0.000	0.000	0.000	0	1879
65.68	0.50	0.024	0.000	0.000	0.024	1243	3122
65.93	0.75	0.031	0.000	0.000	0.031	1970	3850
66.43	1.25	0.040	0.219	0.000	0.259	3628	5507
66.93	1.75	0.048	0.353	0.000	0.401	5285	7165
67.53	2.35	0.056	0.465	3.950	4.472	7597	9476

8.0 Hydrologic Performance of the Facility

The storage-discharge relationship of the Wet Pond was input in VO5 model to result in the outflows and used storages responding to various storm events.
Water elevation was estimated using the interpolation of stage-storage relationship.

Storm Event	Inflow (m^3/s)	Outflow (m^3/s)	Used Storage (m^3)	Water Elevation (m)
6-Hour Chicago Distribution				
2-year	1.056	0.027	1558	65.79
5-year	1.507	0.065	2220	66.01
10-year	1.859	0.115	2584	66.12
25-year	2.281	0.183	3079	66.26
50-year	2.861	0.236	3467	66.38
100-year	3.270	0.281	3891	66.51
Erosion Control Event				
25-mm	0.760	0.020	1049	65.60

APPENDIX

H

WATER QUALITY UNITS

Stormceptor® EF

Stormceptor® EF Overview

imbrium®

About Imbrium® Systems

Imbrium® Systems is dedicated to protecting Canada's waterways. Based on our knowledge and experience in the Canadian stormwater industry, we have the ability to provide the most effective stormwater treatment technologies that capture and retain harmful pollutants from urban runoff before it enters our streams, rivers, lakes, and oceans.

Imbrium's engineered treatment solutions have been third-party tested and verified in accordance with the ISO 14034 Environmental Technology Verification (ETV) protocol to ensure performance in real-world conditions as designed. Our team of highly skilled engineers and partners provide the highest level of service from design to installation and long-term maintenance.

By working with Imbrium and our partners, you can expect superior treatment technology, unparalleled customer service, compliance with local stormwater regulations, and cleaner water. To find your local representative, please visit **www.imbriumsystems.com/localrep**.

Learn About the Stormceptor® EF

Go online and watch our animation to learn how the Stormceptor EF works. The animation highlights important features of the Stormceptor EF including:

- Functionality
- Applications
- Inspection and Maintenance

To view the Stormceptor EF animation, visit **www.imbriumsystems.com/stormceptoref**

Stormceptor® EF

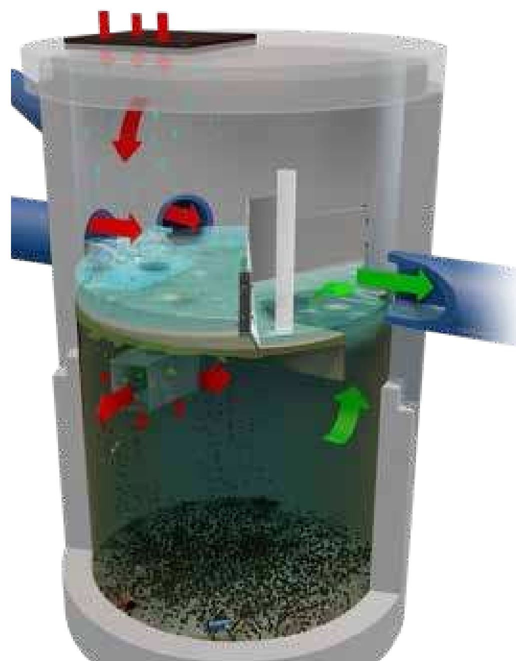
A CONTINUATION AND EVOLUTION OF THE MOST GLOBALLY RECOGNIZED OIL GRIT SEPARATOR (OGS) STORMWATER TREATMENT TECHNOLOGY

Stormceptor EF effectively targets sediment (TSS), free oils, gross pollutants and other pollutants that attach to particles, such as nutrients and metals. Stormceptor EF's independently tested and verified, patent- pending treatment and scour prevention platform ensures pollutants are captured and contained during all rainfall events.

Stormceptor EF also offers design flexibility in one platform, accepting flow from a single inlet pipe, multiple inlet pipes, and from the surface through an inlet grate. Stormceptor EF can also accommodate a 90-degree inlet to outlet bend angle, and tailwater conditions.

Ideal Uses

- Sediment (TSS) removal
- Hydrocarbon control and hotspots (Stormceptor EF)
- Debris and small floatables capture
- Pretreatment for filtration, detention/retention systems, ponds, wetlands, and bioretention
- Retrofit and redevelopment projects

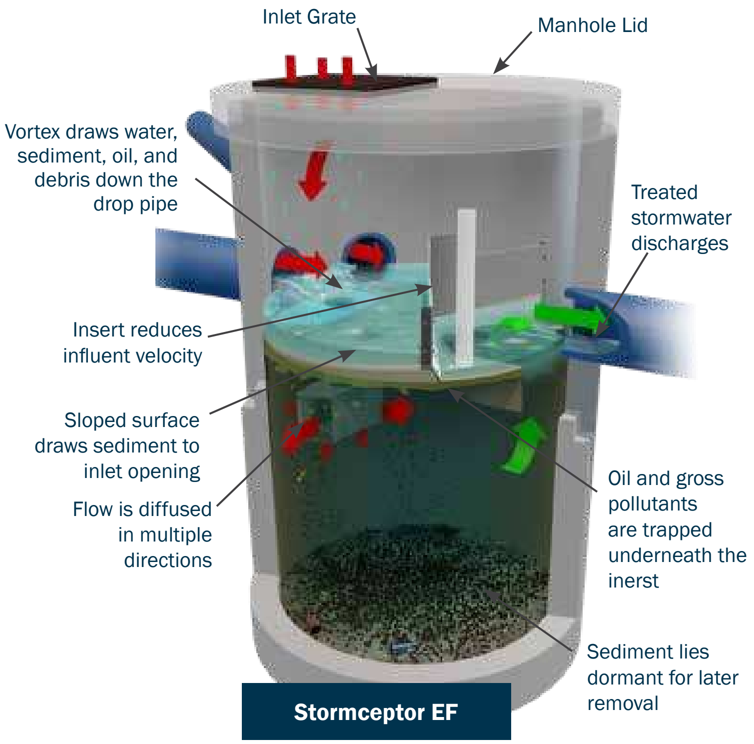


Stormceptor EF

Stormceptor EF and Stormceptor EFO have been verified in accordance with ISO 14034 Environment Management - Environmental Technology Verification (ETV) protocol.

How the Stormceptor® EF Works

- Flow enters the Stormceptor through one or more inlet pipes or an inlet grate.
- A specially designed insert reduces influent velocity by creating a pond upstream of the weir, allowing sediments to begin settling.
- Swirling flow sweeps water and pollutants across the sloped insert surface to the drop pipe, where a strong vortex draws water, sediment, oil, and debris down the drop pipe cone and into the lower chamber.
- Flow exits the drop pipe through two large rectangular openings, while also diffusing through perforations in multiple directions. This reduces stream velocities and increases pollutant removal efficiency while preventing resuspension and washout of previously captured pollutants.
- Floatables, such as oil and gross pollutants, rise up and are trapped beneath the insert.
- Sediment settles to the sump.
- Treated stormwater discharges to the top side of the insert downstream of the weir, where it exits through the outlet pipe.
- During intense storm events excess influent passes over the weir and exits through the outlet pipe. The pond continues to separate sediment from all incoming flows, while full treatment in the lower chamber continues at the maximum flow rate, without scour of previously captured pollutants.

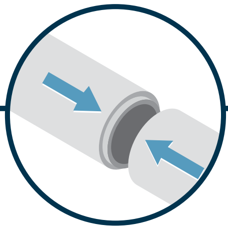


* Fiberglass system is an option

Stormceptor® EF Features & Benefits

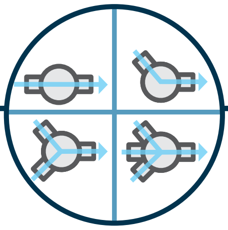
EASY TO INSTALL

Small footprint saves time and money with limited disruption to your site.



SEAMLESS

Minimal drop between inlet and outlet pipes makes Stormceptor ideal for retrofits and new development projects.



FLEXIBLE

Multiple inlets can connect to a single unit. Can be used as a bend structure.

FEATURES	BENEFITS
Patent-pending enhanced flow treatment and scour prevention technology	Superior, third-party verified performance
Third-party verified light liquid capture and retention (EFO version)	Proven performance for fuel/oil hotspot locations
Functions as bend, junction or inlet structure	Cost savings and design flexibility
Minimal drop between inlet and outlet	Site installation ease
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade

Stormceptor® EF Standard Configurations

Single Inlet Pipe

Multiple Inlet Pipes

Grate Inlet

High Tailwater

OPTIONS & ACCESSORIES

The following options and accessories are available for specific functions and site conditions:

- **Tailwater/Submerged Site** – For sites with standing water during dry weather periods, weir modifications can be implemented to ensure optimal performance.
- **Additional Sediment Storage Volume** – For sites with high pollutant loads or remote sites, additional sediment storage volume can easily be added.
- **Oil Alarm** – To mitigate spill liability, a monitoring system can be employed to trigger a visual and audible alarm when an oil or fuel spill occurs.
- **Additional Oil Capture** – A draw-off tank can be incorporated to increase spill storage capacity.
- **High Load** – Standard design loading is CHBDC or AASHTO H-20. Specialized loading can be designed to withstand very high loadings typical of airports and port facilities.
- **Lightweight** – Sites that required lightweight or above ground units are available as complete fiberglass systems.

Optional Oil Alarm

For any of these options or accessories, please contact your Stormceptor representative for design assistance.

Stormceptor® EFO

Accidents and spills happen, whether it is a fueling station, port, ndustrial site, or general hot spot with daily vehicle traffic. Protect the environment and your site from potentially costly clean-up, remediation, litigation and fines with the Stormceptor EFO configuration.

The Stormceptor EFO has been third-party tested to ensure oil capture, and retention during high flow events. The hydraulics of the Stormceptor EFO have been optimized to enhance oil and hydrocarbon capture.

STORMCEPTOR EFO – HYDROCARBON SPILL PROTECTION

- Stormceptor EFO configuration has been third-party performance tested for safe oil capture and retention.
- Patent-pending technology ensures captured oil and sediment are retained even during the largest rain events, for secure storage, environmental protection and easy removal.
- Stormceptor EFO provides double wall containment for captured hydrocarbons.
- Stormceptor EFO is ideal for gas stations, fuel depots, ports, garages, loading docks, industrial sites, fast food locations, high-collision intersections and other hotspots with spill-prone areas.
- Stormceptor EFO can accommodate an optional oil alarm and additional storage to increase spill storage capacity.

Stormceptor® Inspection & Maintenance

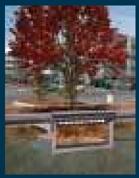
Conducted at grade, the Stormceptor EF design makes inspection and maintenance an easy and inexpensive process. Once maintained, the Stormceptor EF is functionally restored as designed, with full pollutant capture capacity.

MAINTENANCE RECOMMENDATIONS:

- Inspect every six months for the first year to determine the pollutant accumulation rate.
- In subsequent years, inspections can be based on observations or local requirements.
- Inspect the unit immediately after an oil, fuel or chemical spill. A licensed waste management company should remove oil and sediment, and dispose responsibly.

Stormceptor maintenance is performed at grade with a standard vacuum truck

FILTERRA BIORETENTION



The Filterra® Bioretention System is an engineered biofiltration device with components that make it similar to bioretention in pollutant removal and application, but has been optimized for high volume/flow treatment in a compact system.

JELLYFISH FILTER

The Jellyfish® Filter is a stormwater treatment technology featuring pretreatment and membrane filtration in a compact stand-alone treatment system that removes a high level and a wide variety of stormwater pollutants.

LITTATRAP CATCH BASIN

The LittaTrap™ is a simple and effective solution to remove sediment and trash from stormwater systems at its source. The LittaTrap sits inside the storm drain and captures and retains sediment and trash before it enters stormwater infrastructure, effectively pretreating downstream structures and aiding in pollutant removal.

LEARN MORE

- Access project profiles, photos, videos, and more online at **www.imbriumsystems.com/stormceptoref.**

REQUEST DESIGN ASSISTANCE

- Call us at (888) 279-8826 or 301-279-8827 to talk to one of our engineers for technical support or design assistance.

START A PROJECT

- Submit your system requirements on our product Design Worksheet at **www.imbriumsystems.com/pdw.**

FIND A LOCAL REPRESENTATIVE

- Visit **www.imbrumsystems.com/localrep** for contact information for your local Imbrium representative.

imbrium®

+1 416-960-9900

www.imbriumsystems.com

Imbrium® Systems is an engineered stormwater treatment company that designs and manufactures stormwater treatment solutions that protect water resources from harmful pollutants. By developing technologies to address the long-term impact of urban runoff, Imbrium ensures our clients' projects are compliant with government water quality regulations. For information, visit www.imbriumsystems.com or call +1 416-960-9900.

Get Social With Us!

IB-Stormceptor EF Bro 5/19 PDF

ESTIMATED NET ANNNUAL SEDIMENT (TSS) LOAD REDUCTION STORMCEPTOR®

Province :	Ontario
City :	Ottawa
Nearest Rainfall Station :	OTTAWA MACDONALD-CARTIER INT'L AP
NCDC Rainfall Station Id :	6000
Years Of Rainfall Data :	37

Project Name :	530 Tremblay
Project Number :	19M-00609-00
Designer Name :	Samer Elhallak
Designer Company :	WSP
Designer Email/Phone :	samer.elhallak@wsp.com
EOR Name :	
EOR Company :	
EOR Email/Phone :	

Site Name :	

Drainage Area (ha) :	0.317
% Imperviousness :	90.00

Runoff Coefficient 'c' : 0.84

Partical Size Distribution :	Fine
Target TSS Removal (%) :	80.0

Require Hydrocarbon Spill Capture?	No
Upstream Flow Control?	No
Required Water Quality Runoff Volume Capture (%) :	
Peak Conveyance (maximum) Flow Rate (L/s) :	
Site Sediment Transport Rate (kg/ha/yr) :	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EF4	83
EF6	88
EF8	90
EF10	91
EF12	92

Recommended Stormceptor EF Model : EF4

Estimated Net Annual Sediment (TSS) Load Reduction (%) : 83

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS fromthe frequent rainfall events that contribute the vast majority of annualrunoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICAL SIZE DISTRIBUTION (PSD)

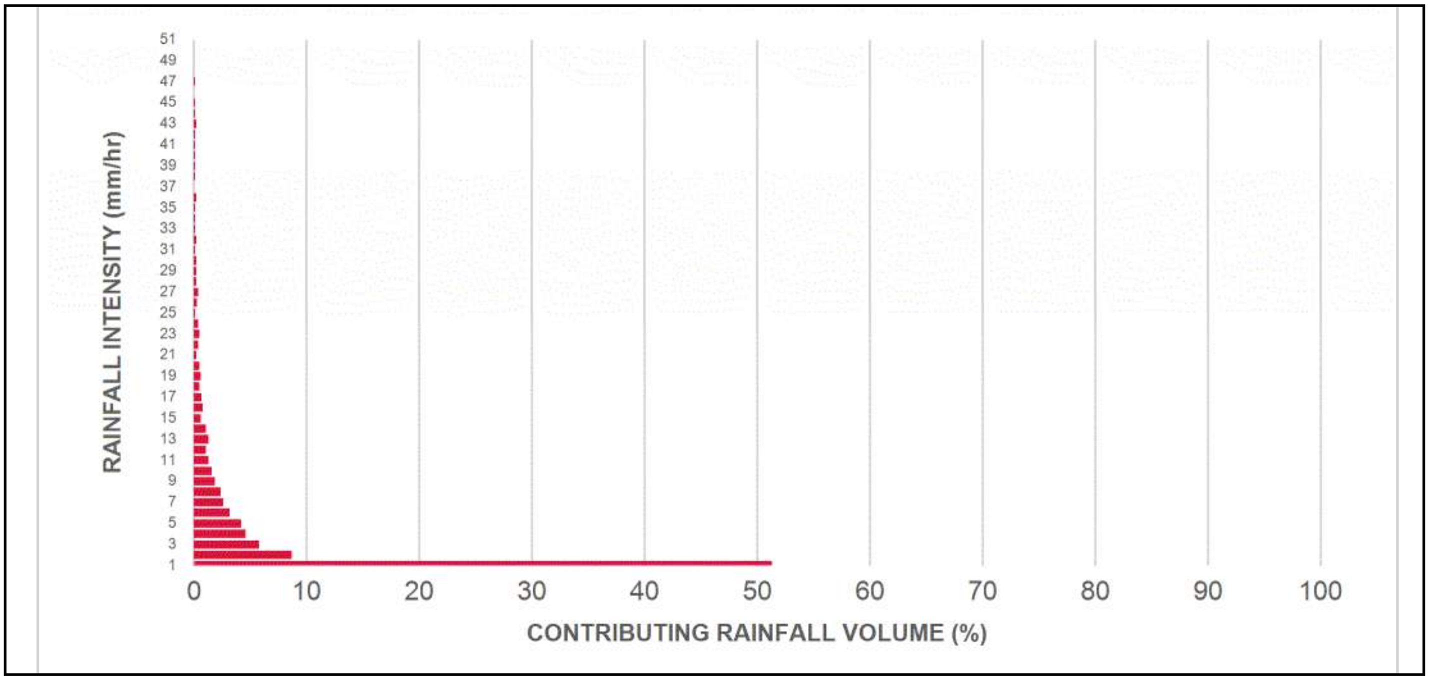
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (μm)	Percent Less Than	Particle Size Fraction (μm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

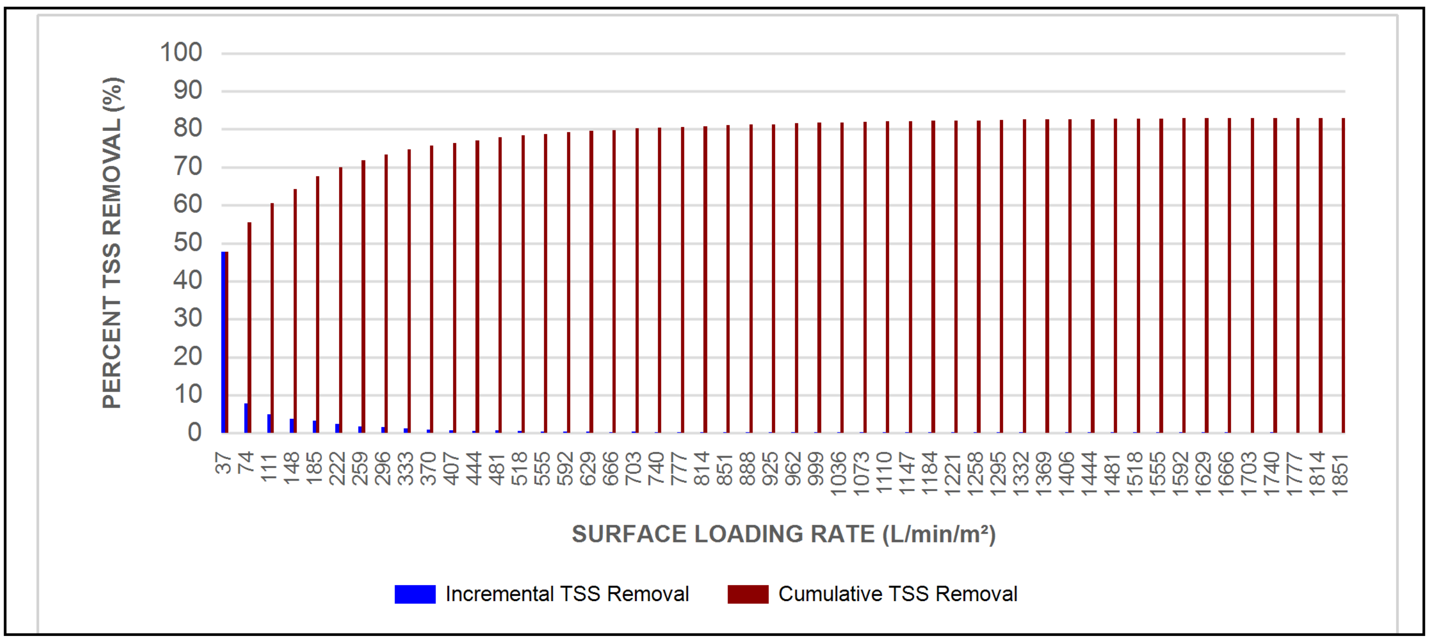
RainFall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
1	51.3	51.3	0.74	44.0	37.0	93	47.7	47.7
2	8.7	60.0	1.48	89.0	74.0	90	7.8	55.5
3	5.8	65.8	2.22	133.0	111.0	86	5.0	60.5
4	4.6	70.4	2.96	178.0	148.0	83	3.8	64.3
5	4.2	74.6	3.70	222.0	185.0	78	3.3	67.6
6	3.2	77.8	4.44	266.0	222.0	74	2.4	70.0
7	2.6	80.4	5.18	311.0	259.0	71	1.8	71.8
8	2.4	82.8	5.92	355.0	296.0	68	1.6	73.4
9	1.9	84.7	6.66	400.0	333.0	64	1.2	74.7
10	1.6	86.3	7.40	444.0	370.0	61	1.0	75.6
11	1.3	87.6	8.14	489.0	407.0	58	0.8	76.4
12	1.1	88.7	8.88	533.0	444.0	58	0.6	77.0
13	1.3	90.0	9.62	577.0	481.0	57	0.7	77.8
14	1.1	91.1	10.36	622.0	518.0	57	0.6	78.4
15	0.6	91.7	11.10	666.0	555.0	57	0.3	78.7
16	0.8	92.5	11.84	711.0	592.0	56	0.4	79.2
17	0.7	93.2	12.58	755.0	629.0	56	0.4	79.6
18	0.5	93.7	13.32	799.0	666.0	56	0.3	79.8
19	0.6	94.3	14.06	844.0	703.0	56	0.3	80.2
20	0.5	94.8	14.81	888.0	740.0	55	0.3	80.4
21	0.2	95.0	15.55	933.0	777.0	55	0.1	80.6
22	0.4	95.4	16.29	977.0	814.0	55	0.2	80.8
23	0.5	95.9	17.03	1022.0	851.0	55	0.3	81.1
24	0.4	96.3	17.77	1066.0	888.0	55	0.2	81.3
25	0.1	96.4	18.51	1110.0	925.0	54	0.1	81.3

RainFall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
26	0.3	96.7	19.25	1155.0	962.0	54	0.2	81.5
27	0.4	97.1	19.99	1199.0	999.0	54	0.2	81.7
28	0.2	97.3	20.73	1244.0	1036.0	54	0.1	81.8
29	0.2	97.5	21.47	1288.0	1073.0	55	0.1	81.9
30	0.2	97.7	22.21	1332.0	1110.0	55	0.1	82.0
31	0.1	97.8	22.95	1377.0	1147.0	56	0.1	82.1
32	0.2	98.0	23.69	1421.0	1184.0	56	0.1	82.2
33	0.1	98.1	24.43	1466.0	1221.0	57	0.1	82.3
34	0.1	98.2	25.17	1510.0	1258.0	57	0.1	82.3
35	0.1	98.3	25.91	1555.0	1295.0	58	0.1	82.4
36	0.2	98.5	26.65	1599.0	1332.0	58	0.1	82.5
37	0.0	98.5	27.39	1643.0	1369.0	59	0.0	82.5
38	0.1	98.6	28.13	1688.0	1406.0	59	0.1	82.5
39	0.1	98.7	28.87	1732.0	1444.0	57	0.1	82.6
40	0.1	98.8	29.61	1777.0	1481.0	56	0.1	82.7
41	0.1	98.9	30.35	1821.0	1518.0	55	0.1	82.7
42	0.1	99.0	31.09	1865.0	1555.0	53	0.1	82.8
43	0.2	99.2	31.83	1910.0	1592.0	52	0.1	82.9
44	0.1	99.3	32.57	1954.0	1629.0	51	0.1	82.9
45	0.1	99.4	33.31	1999.0	1666.0	50	0.1	83.0
46	0.0	99.4	34.05	2043.0	1703.0	49	0.0	83.0
47	0.1	99.5	34.79	2088.0	1740.0	47	0.0	83.0
48	0.0	99.5	35.53	2132.0	1777.0	47	0.0	83.0
49	0.0	99.5	36.27	2176.0	1814.0	46	0.0	83.0
50	0.0	99.5	37.01	2221.0	1851.0	45	0.0	83.0
Estimated Net Annual Sediment (TSS) Load Reduction =								**83 %**

RAINFALL DATA FROM OTTAWA MACDONALD-CARTIER INT'L AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

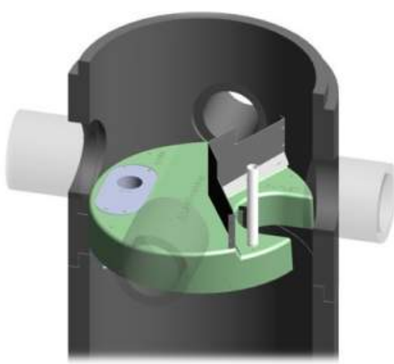
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

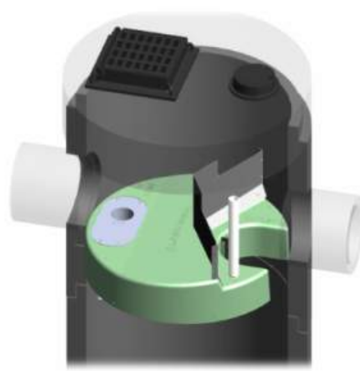
DESIGN FLEXIBILITY

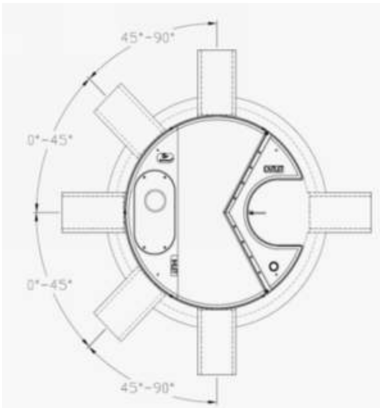
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0(degree)-45(degree):The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45(degree)-90(degree):The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft^3)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	197	52	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	348	92	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	545	144	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	874	231	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	1219	322	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft^3)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EF

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	46	1320	48	1980	35
30	70	690	46	1350	48	2010	34
60	67	720	45	1380	49	2040	34
90	63	750	45	1410	49	2070	33
120	61	780	45	1440	48	2100	33
150	58	810	45	1470	47	2130	32
180	56	840	45	1500	46	2160	32
210	54	870	45	1530	45	2190	31
240	53	900	45	1560	44	2220	31
270	52	930	44	1590	43	2250	30
300	51	960	44	1620	42	2280	30
330	50	990	44	1650	42	2310	30
360	49	1020	44	1680	41	2340	29
390	48	1050	45	1710	40	2370	29
420	48	1080	45	1740	39	2400	29
450	48	1110	45	1770	39	2430	28
480	47	1140	46	1800	38	2460	28
510	47	1170	46	1830	37	2490	28
540	47	1200	47	1860	37	2520	27
570	46	1230	47	1890	36	2550	27
600	46	1260	47	1920	36	2580	27
630	46	1290	48	1950	35		

Stormceptor FORTERRA

Stormceptor EF Sizing Report

ESTIMATED NET ANNNUAL SEDIMENT (TSS) LOAD REDUCTION STORMCEPTOR®

Province :	Ontario
City :	Ottawa
Nearest Rainfall Station :	OTTAWA MACDONALD-CARTIER INT'L AP
NCDC Rainfall Station Id :	6000
Years Of Rainfall Data :	37

Project Name :	530 Tremblay
Project Number :	19M-00609-00
Designer Name :	Samer Elhallak
Designer Company :	WSP
Designer Email/Phone :	samer.elhallak@wsp.com
EOR Name :	
EOR Company :	
EOR Email/Phone :	

Site Name :	
Drainage Area (ha) :	0.874
% Imperviousness :	90.00

Runoff Coefficient 'c' : 0.84

Partical Size Distribution :	Fine
Target TSS Removal (%) :	80.0

Require Hydrocarbon Spill Capture?	No
Upstream Flow Control?	No
Required Water Quality Runoff Volume Capture (%) :	
Peak Conveyance (maximum) Flow Rate (L/s) :	
Site Sediment Transport Rate (kg/ha/yr) :	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EF4	72
EF6	81
EF8	85
EF10	88
EF12	89

Recommended Stormceptor EF Model : EF6

Estimated Net Annual Sediment (TSS) Load Reduction (%) : 81

imbrium

THIRD-PARTY TESTING AND VERIFICATION

►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS fromthe frequent rainfall events that contribute the vast majority of annualrunoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICAL SIZE DISTRIBUTION (PSD)

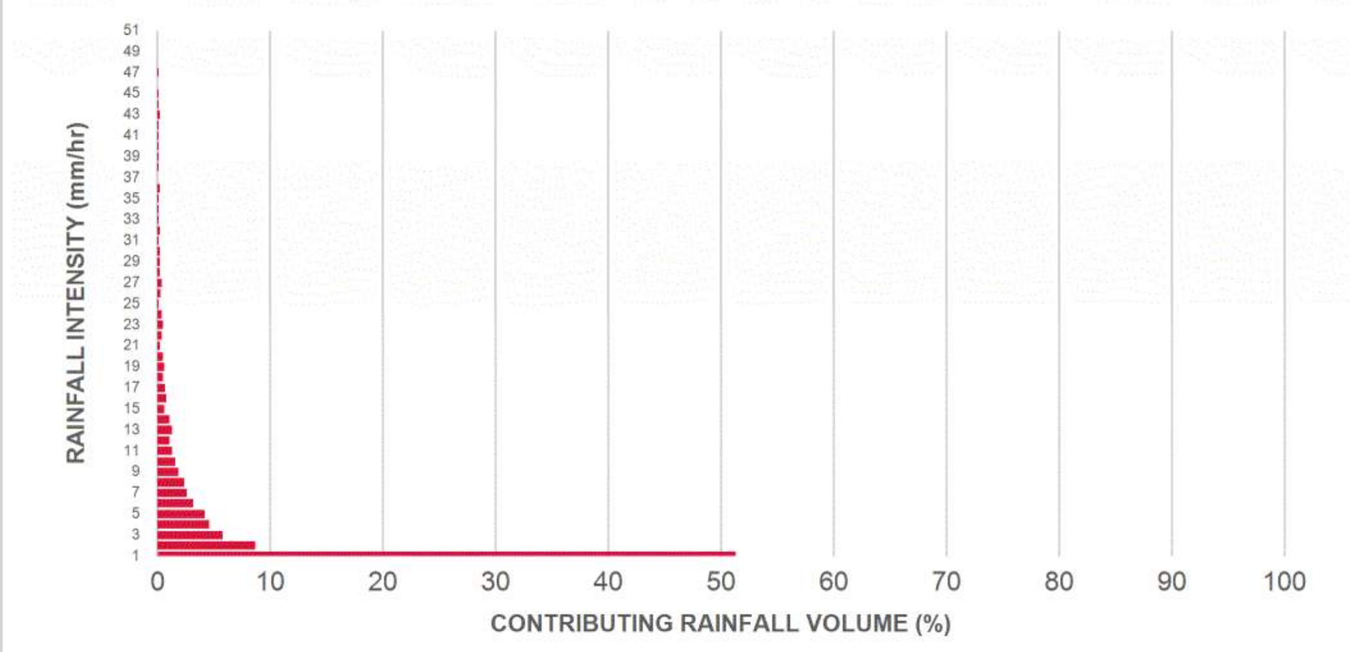
►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.

Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

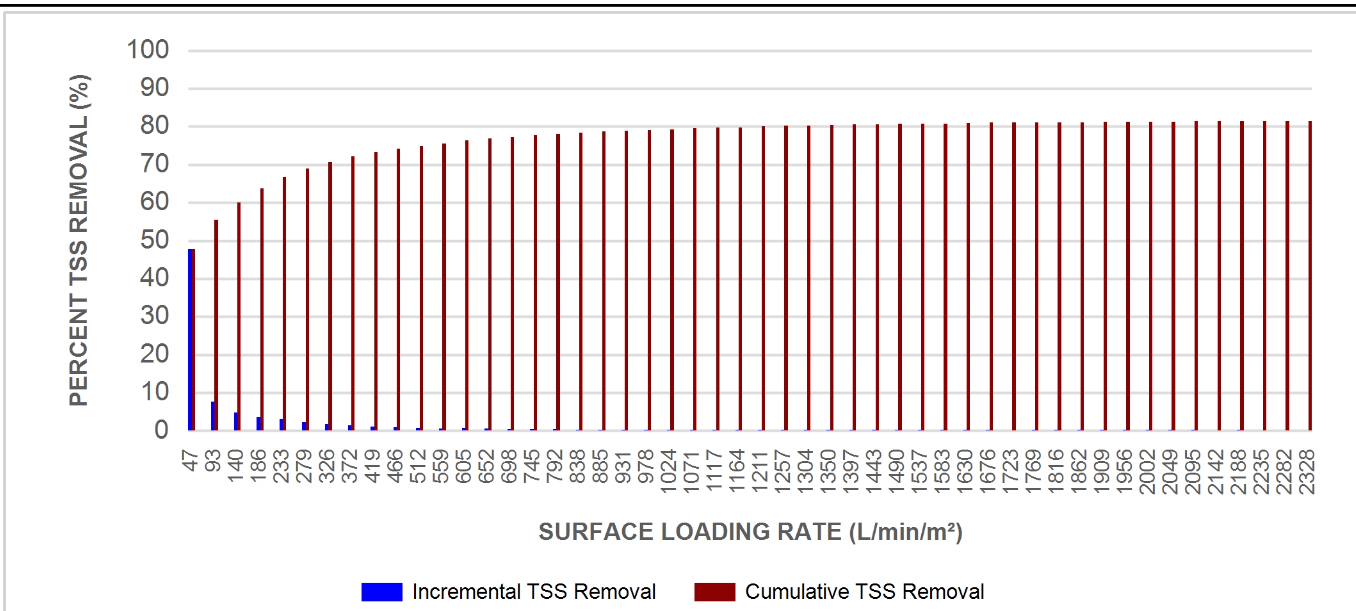
RainFall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
1	51.3	51.3	2.04	122.0	47.0	93	47.7	47.7
2	8.7	60.0	4.08	245.0	93.0	88	7.6	55.4
3	5.8	65.8	6.12	367.0	140.0	83	4.8	60.1
4	4.6	70.4	8.16	490.0	186.0	78	3.6	63.7
5	4.2	74.6	10.20	612.0	233.0	73	3.1	66.8
6	3.2	77.8	12.25	735.0	279.0	69	2.2	69.0
7	2.6	80.4	14.29	857.0	326.0	65	1.7	70.7
8	2.4	82.8	16.33	980.0	372.0	61	1.5	72.2
9	1.9	84.7	18.37	1102.0	419.0	58	1.1	73.3
10	1.6	86.3	20.41	1225.0	466.0	57	0.9	74.2
11	1.3	87.6	22.45	1347.0	512.0	57	0.7	74.9
12	1.1	88.7	24.49	1469.0	559.0	57	0.6	75.5
13	1.3	90.0	26.53	1592.0	605.0	56	0.7	76.3
14	1.1	91.1	28.57	1714.0	652.0	56	0.6	76.9
15	0.6	91.7	30.61	1837.0	698.0	56	0.3	77.2
16	0.8	92.5	32.66	1959.0	745.0	55	0.4	77.7
17	0.7	93.2	34.70	2082.0	792.0	55	0.4	78.1
18	0.5	93.7	36.74	2204.0	838.0	55	0.3	78.3
19	0.6	94.3	38.78	2327.0	885.0	55	0.3	78.7
20	0.5	94.8	40.82	2449.0	931.0	54	0.3	78.9
21	0.2	95.0	42.86	2572.0	978.0	54	0.1	79.0
22	0.4	95.4	44.90	2694.0	1024.0	54	0.2	79.2
23	0.5	95.9	46.94	2817.0	1071.0	55	0.3	79.5
24	0.4	96.3	48.98	2939.0	1117.0	55	0.2	79.7
25	0.1	96.4	51.02	3061.0	1164.0	56	0.1	79.8

RainFall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
26	0.3	96.7	53.07	3184.0	1211.0	57	0.2	80.0
27	0.4	97.1	55.11	3306.0	1257.0	57	0.2	80.2
28	0.2	97.3	57.15	3429.0	1304.0	58	0.1	80.3
29	0.2	97.5	59.19	3551.0	1350.0	58	0.1	80.4
30	0.2	97.7	61.23	3674.0	1397.0	59	0.1	80.5
31	0.1	97.8	63.27	3796.0	1443.0	57	0.1	80.6
32	0.2	98.0	65.31	3919.0	1490.0	55	0.1	80.7
33	0.1	98.1	67.35	4041.0	1537.0	54	0.1	80.8
34	0.1	98.2	69.39	4164.0	1583.0	52	0.1	80.8
35	0.1	98.3	71.43	4286.0	1630.0	51	0.1	80.9
36	0.2	98.5	73.47	4408.0	1676.0	49	0.1	81.0
37	0.0	98.5	75.52	4531.0	1723.0	48	0.0	81.0
38	0.1	98.6	77.56	4653.0	1769.0	47	0.0	81.0
39	0.1	98.7	79.60	4776.0	1816.0	46	0.0	81.1
40	0.1	98.8	81.64	4898.0	1862.0	44	0.0	81.1
41	0.1	98.9	83.68	5021.0	1909.0	43	0.0	81.2
42	0.1	99.0	85.72	5143.0	1956.0	42	0.0	81.2
43	0.2	99.2	87.76	5266.0	2002.0	41	0.1	81.3
44	0.1	99.3	89.80	5388.0	2049.0	40	0.0	81.3
45	0.1	99.4	91.84	5511.0	2095.0	40	0.0	81.4
46	0.0	99.4	93.88	5633.0	2142.0	39	0.0	81.4
47	0.1	99.5	95.93	5756.0	2188.0	38	0.0	81.4
48	0.0	99.5	97.97	5878.0	2235.0	37	0.0	81.4
49	0.0	99.5	100.01	6000.0	2282.0	36	0.0	81.4
50	0.0	99.5	102.05	6123.0	2328.0	36	0.0	81.4
Estimated Net Annual Sediment (TSS) Load Reduction =								81 %

RAINFALL DATA FROM OTTAWA MACDONALD-CARTIER INT'L AP RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

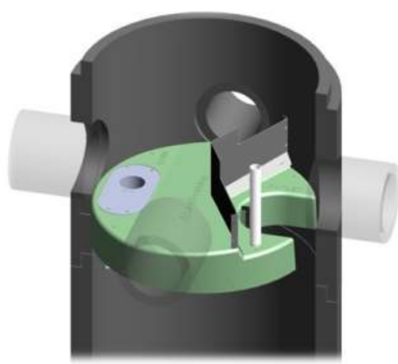
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

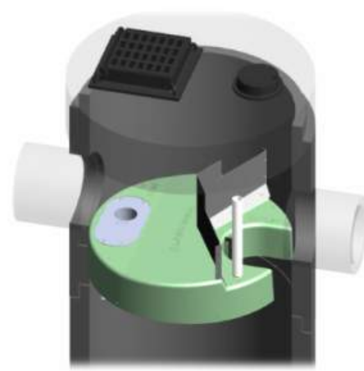
DESIGN FLEXIBILITY

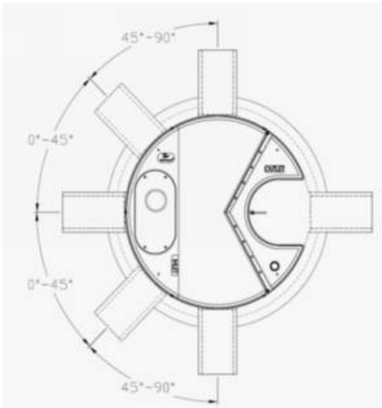
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0(degree)-45(degree):The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45(degree)-90(degree):The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	197	52	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	348	92	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	545	144	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	874	231	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	1219	322	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

Table of TSS Removal vs Surface Loading Rate Based on Third-Party Test Results
Stormceptor® EF

SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL	SLR (L/min/m²)	TSS % REMOVAL
1	70	660	46	1320	48	1980	35
30	70	690	46	1350	48	2010	34
60	67	720	45	1380	49	2040	34
90	63	750	45	1410	49	2070	33
120	61	780	45	1440	48	2100	33
150	58	810	45	1470	47	2130	32
180	56	840	45	1500	46	2160	32
210	54	870	45	1530	45	2190	31
240	53	900	45	1560	44	2220	31
270	52	930	44	1590	43	2250	30
300	51	960	44	1620	42	2280	30
330	50	990	44	1650	42	2310	30
360	49	1020	44	1680	41	2340	29
390	48	1050	45	1710	40	2370	29
420	48	1080	45	1740	39	2400	29
450	48	1110	45	1770	39	2430	28
480	47	1140	46	1800	38	2460	28
510	47	1170	46	1830	37	2490	28
540	47	1200	47	1860	37	2520	27
570	46	1230	47	1890	36	2550	27
600	46	1260	47	1920	36	2580	27
630	46	1290	48	1950	35		

APPENDIX

I

V05 MODELLING RESULTS

```
 ********************************
 ** SIMULATION:Run 01          **
 ********************************

 --------------------
 |   READ STORM     |    Filename: C:\Users\case070206\AppD
 |                  |              ata\Local\Temp\
 |                  |              5846322b-7111-463b-aa43-ba013eb39630\65e2df71
 | Ptotal= 25.00 mm |    Comments: 25mm4hr.stm
 --------------------
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.17    1.48 |  1.17    9.64 |  2.17    3.91 |  3.17    1.86
                 0.33    1.70 |  1.33   57.70 |  2.33    3.28 |  3.33    1.73
                 0.50    2.00 |  1.50   19.62 |  2.50    2.83 |  3.50    1.60
                 0.67    2.46 |  1.67    9.79 |  2.67    2.50 |  3.67    1.50
                 0.83    3.23 |  1.83    6.49 |  2.83    2.24 |  3.83    1.41
                 1.00    4.79 |  2.00    4.86 |  3.00    2.03 |  4.00    1.33

 ---------------------------------------------------------------------------

 --------------------
 | CALIB            |
 | STANDHYD ( 1001)|   Area    (ha)=   9.00
 |ID= 1 DT= 5.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  61.00
 --------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       5.49         3.51
     Dep. Storage     (mm)=       2.50         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     244.95        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                       ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    1.48 | 1.083    9.64 | 2.083    3.91 |  3.08    1.86
                0.167    1.48 | 1.167    9.64 | 2.167    3.91 |  3.17    1.86
                0.250    1.70 | 1.250   57.70 | 2.250    3.28 |  3.25    1.73
                0.333    1.70 | 1.333   57.70 | 2.333    3.28 |  3.33    1.73
                0.417    2.00 | 1.417   19.62 | 2.417    2.83 |  3.42    1.60
                0.500    2.00 | 1.500   19.62 | 2.500    2.83 |  3.50    1.60
                0.583    2.46 | 1.583    9.79 | 2.583    2.50 |  3.58    1.50
                0.667    2.46 | 1.667    9.79 | 2.667    2.50 |  3.67    1.50
                0.750    3.23 | 1.750    6.49 | 2.750    2.24 |  3.75    1.42
                0.833    3.23 | 1.833    6.48 | 2.833    2.24 |  3.83    1.42
                0.917    4.79 | 1.917    4.86 | 2.917    2.03 |  3.92    1.33
                1.000    4.79 | 2.000    4.86 | 3.000    2.03 |  4.00    1.33

     Max.Eff.Inten.(mm/hr)=      57.70          0.00
                over (min)       5.00        200.00
     Storage Coeff.  (min)=       5.45 (ii)  198.97 (ii)
     Unit Hyd. Tpeak (min)=       5.00        200.00
     Unit Hyd. peak  (cms)=       0.20          0.01
                                                         *TOTALS*
     PEAK FLOW       (cms)=       0.76          0.00       0.760 (iii)
     TIME TO PEAK    (hrs)=       1.33          0.00        1.33
     RUNOFF VOLUME    (mm)=      22.50          0.00       13.72
     TOTAL RAINFALL   (mm)=      25.00         25.00       25.00
     RUNOFF COEFFICIENT   =       0.90          0.00        0.55

 ***** WARNING: THE PERVIOUS AREA HAS NO FLOW .

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20         K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=  0.00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------
 --------------------
 | RESERVOIR(  3001)|
 | IN= 2---> OUT= 1 |
 | DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
 --------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000      0.0000   |   0.2590      0.3630
                          0.0240      0.1240   |   0.4010      0.5290
                          0.0310      0.1970   |   4.4720      0.7600

                                 AREA     QPEAK      TPEAK        R.V.
                                 (ha)     (cms)      (hrs)        (mm)
   INFLOW : ID= 2 (  1001)      9.000      0.760      1.33       13.72
   OUTFLOW: ID= 1 (  3001)      9.000      0.020      4.00       13.58

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  2.67
                  TIME SHIFT OF PEAK FLOW        (min)=160.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.1049

 ---------------------------------------------------------------------------
 ********************************
 ** SIMULATION:Run 02          **
 ********************************

 --------------------
 | CHICAGO STORM    |      IDF curve parameters: A= 732.951
 | Ptotal= 36.86 mm |                            B=   6.199
 --------------------                            C=   0.810
                           used in:   INTENSITY =  A / (t + B)^C

                           Duration of storm  =  6.00 hrs
                           Storm time step    = 10.00 min
                           Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.17    1.37 |  1.67    7.30 |  3.17    3.72 |  4.67    1.77
                 0.33    1.49 |  1.83   18.21 |  3.33    3.29 |  4.83    1.68
                 0.50    1.63 |  2.00   76.81 |  3.50    2.95 |  5.00    1.60
                 0.67    1.82 |  2.17   24.08 |  3.67    2.68 |  5.17    1.52
                 0.83    2.05 |  2.33   12.36 |  3.83    2.46 |  5.33    1.46
                 1.00    2.37 |  2.50    8.32 |  4.00    2.28 |  5.50    1.40
                 1.17    2.81 |  2.67    6.30 |  4.17    2.12 |  5.67    1.34
                 1.33    3.50 |  2.83    5.09 |  4.33    1.99 |  5.83    1.29
                 1.50    4.69 |  3.00    4.29 |  4.50    1.87 |  6.00    1.24

 ---------------------------------------------------------------------------
 --------------------
 | CALIB            |
 | STANDHYD ( 1001)|   Area    (ha)=   9.00
 |ID= 1 DT= 5.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  61.00
 --------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       5.49         3.51
     Dep. Storage     (mm)=       2.50         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     244.95        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                       ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    1.37 | 1.583    7.30 | 3.083    3.72 |  4.58    1.77
                0.167    1.37 | 1.667    7.30 | 3.167    3.72 |  4.67    1.77
                0.250    1.49 | 1.750   18.21 | 3.250    3.29 |  4.75    1.68
                0.333    1.49 | 1.833   18.21 | 3.333    3.29 |  4.83    1.68
                0.417    1.63 | 1.917   76.81 | 3.417    2.95 |  4.92    1.60
                0.500    1.63 | 2.000   76.80 | 3.500    2.95 |  5.00    1.60
                0.583    1.82 | 2.083   24.08 | 3.583    2.68 |  5.08    1.52
                0.667    1.82 | 2.167   24.08 | 3.667    2.68 |  5.17    1.52
                0.750    2.05 | 2.250   12.36 | 3.750    2.46 |  5.25    1.46
                0.833    2.05 | 2.333   12.36 | 3.833    2.46 |  5.33    1.46
                0.917    2.37 | 2.417    8.32 | 3.917    2.28 |  5.42    1.40
                1.000    2.37 | 2.500    8.32 | 4.000    2.28 |  5.50    1.40
                1.083    2.81 | 2.583    6.30 | 4.083    2.12 |  5.58    1.34
                1.167    2.81 | 2.667    6.30 | 4.167    2.12 |  5.67    1.34
                1.250    3.50 | 2.750    5.09 | 4.250    1.99 |  5.75    1.29
                1.333    3.50 | 2.833    5.09 | 4.333    1.99 |  5.83    1.29
                1.417    4.69 | 2.917    4.29 | 4.417    1.87 |  5.92    1.24
                1.500    4.69 | 3.000    4.29 | 4.500    1.87 |  6.00    1.24

     Max.Eff.Inten.(mm/hr)=      76.81          1.90
                over (min)       5.00         40.00
     Storage Coeff.  (min)=       4.86 (ii)   39.31 (ii)
     Unit Hyd. Tpeak (min)=       5.00         40.00
     Unit Hyd. peak  (cms)=       0.22          0.03
                                                         *TOTALS*
     PEAK FLOW       (cms)=       1.05          0.01       1.056 (iii)
     TIME TO PEAK    (hrs)=       2.00          2.58        2.00
     RUNOFF VOLUME    (mm)=      34.36          1.11       21.39
     TOTAL RAINFALL   (mm)=      36.86         36.86       36.86
     RUNOFF COEFFICIENT   =       0.93          0.03        0.58

 ***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20         K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=  0.00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------
 --------------------
 | RESERVOIR(  3001)|
 | IN= 2---> OUT= 1 |
 | DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
 --------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000      0.0000   |   0.2590      0.3630
                          0.0240      0.1240   |   0.4010      0.5290
                          0.0310      0.1970   |   4.4720      0.7600

                                 AREA     QPEAK      TPEAK        R.V.
                                 (ha)     (cms)      (hrs)        (mm)
   INFLOW : ID= 2 (  1001)      9.000      1.056      2.00       21.39
   OUTFLOW: ID= 1 (  3001)      9.000      0.027      4.75       21.25

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  2.56
                  TIME SHIFT OF PEAK FLOW        (min)=165.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.1558

 ---------------------------------------------------------------------------
 ********************************
 ** SIMULATION:Run 03          **
 ********************************

 --------------------
 | CHICAGO STORM    |      IDF curve parameters: A= 998.071
 | Ptotal= 49.04 mm |                            B=   6.053
 --------------------                            C=   0.814
                           used in:   INTENSITY =  A / (t + B)^C

                           Duration of storm  =  6.00 hrs
                           Storm time step    = 10.00 min
                           Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.17    1.78 |  1.67    9.61 |  3.17    4.87 |  4.67    2.31
                 0.33    1.94 |  1.83   24.17 |  3.33    4.30 |  4.83    2.19
                 0.50    2.13 |  2.00  104.19 |  3.50    3.86 |  5.00    2.08
                 0.67    2.37 |  2.17   32.04 |  3.67    3.51 |  5.17    1.99
                 0.83    2.68 |  2.33   16.34 |  3.83    3.22 |  5.33    1.90
                 1.00    3.10 |  2.50   10.96 |  4.00    2.98 |  5.50    1.82
                 1.17    3.68 |  2.67    8.29 |  4.17    2.77 |  5.67    1.75
                 1.33    4.58 |  2.83    6.69 |  4.33    2.60 |  5.83    1.68
                 1.50    6.15 |  3.00    5.63 |  4.50    2.44 |  6.00    1.62

 ---------------------------------------------------------------------------
 --------------------
 | CALIB            |
 | STANDHYD ( 1001)|   Area    (ha)=   9.00
 |ID= 1 DT= 5.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  61.00
 --------------------
                             IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       5.49         3.51
     Dep. Storage     (mm)=       2.50         5.00
     Average Slope     (%)=       1.00         2.00
     Length            (m)=     244.95        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.


                       ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.083    1.78 | 1.583    9.61 | 3.083    4.87 |  4.58    2.31
                0.167    1.78 | 1.667    9.61 | 3.167    4.87 |  4.67    2.31
                0.250    1.94 | 1.750   24.17 | 3.250    4.30 |  4.75    2.19
                0.333    1.94 | 1.833   24.17 | 3.333    4.30 |  4.83    2.19
                0.417    2.13 | 1.917  104.19 | 3.417    3.86 |  4.92    2.08
                0.500    2.13 | 2.000  104.19 | 3.500    3.86 |  5.00    2.08
                0.583    2.37 | 2.083   32.04 | 3.583    3.51 |  5.08    1.99
                0.667    2.37 | 2.167   32.04 | 3.667    3.51 |  5.17    1.99
                0.750    2.68 | 2.250   16.34 | 3.750    3.22 |  5.25    1.90
                0.833    2.68 | 2.333   16.34 | 3.833    3.22 |  5.33    1.90
                0.917    3.10 | 2.417   10.96 | 3.917    2.98 |  5.42    1.82
                1.000    3.10 | 2.500   10.96 | 4.000    2.98 |  5.50    1.82
                1.083    3.68 | 2.583    8.29 | 4.083    2.77 |  5.58    1.75
                1.167    3.68 | 2.667    8.29 | 4.167    2.77 |  5.67    1.75
                1.250    4.58 | 2.750    6.69 | 4.250    2.60 |  5.75    1.68
                1.333    4.58 | 2.833    6.69 | 4.333    2.60 |  5.83    1.68
                1.417    6.15 | 2.917    5.63 | 4.417    2.44 |  5.92    1.62
                1.500    6.15 | 3.000    5.63 | 4.500    2.44 |  6.00    1.62

     Max.Eff.Inten.(mm/hr)=     104.19         29.69
                over (min)       5.00         20.00
     Storage Coeff.  (min)=       4.30 (ii)   15.77 (ii)
     Unit Hyd. Tpeak (min)=       5.00         20.00
     Unit Hyd. peak  (cms)=       0.23          0.07
                                                         *TOTALS*
     PEAK FLOW       (cms)=       1.47          0.16       1.507 (iii)
     TIME TO PEAK    (hrs)=       2.00          2.25        2.00
     RUNOFF VOLUME    (mm)=      46.54          7.90       31.47
     TOTAL RAINFALL   (mm)=      49.04         49.04       49.04
     RUNOFF COEFFICIENT   =       0.95          0.16        0.64

 ***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

        (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20         K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=  0.00
       (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
            THAN THE STORAGE COEFFICIENT.
      (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

 ---------------------------------------------------------------------------
 --------------------
 | RESERVOIR(  3001)|
 | IN= 2---> OUT= 1 |
 | DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
 --------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000      0.0000   |   0.2590      0.3630
                          0.0240      0.1240   |   0.4010      0.5290
                          0.0310      0.1970   |   4.4720      0.7600

                                 AREA     QPEAK      TPEAK        R.V.
                                 (ha)     (cms)      (hrs)        (mm)
   INFLOW : ID= 2 (  1001)      9.000      1.507      2.00       31.47
   OUTFLOW: ID= 1 (  3001)      9.000      0.065      3.42       31.32

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  4.33
                  TIME SHIFT OF PEAK FLOW        (min)= 85.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.2220

 ---------------------------------------------------------------------------
 ********************************
 ** SIMULATION:Run 04          **
 ********************************

 --------------------
 | CHICAGO STORM    |      IDF curve parameters: A=1174.185
 | Ptotal= 57.02 mm |                            B=   6.014
 --------------------                            C=   0.816
                           used in:   INTENSITY =  A / (t + B)^C

                           Duration of storm  =  6.00 hrs
                           Storm time step    = 10.00 min
                           Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.17    2.05 |  1.67   11.13 |  3.17    5.63 |  4.67    2.66
                 0.33    2.23 |  1.83   28.10 |  3.33    4.97 |  4.83    2.52
                 0.50    2.45 |  2.00  122.14 |  3.50    4.46 |  5.00    2.40
                 0.67    2.73 |  2.17   37.28 |  3.67    4.05 |  5.17    2.29
                 0.83    3.09 |  2.33   18.95 |  3.83    3.71 |  5.33    2.19
                 1.00    3.57 |  2.50   12.70 |  4.00    3.43 |  5.50    2.09
                 1.17    4.25 |  2.67    9.59 |  4.17    3.20 |  5.67    2.01
                 1.33    5.29 |  2.83    7.73 |  4.33    2.99 |  5.83    1.94
                 1.50    7.11 |  3.00    6.50 |  4.50    2.81 |  6.00    1.87

 ---------------------------------------------------------------------------
 --------------------
 | CALIB            |
 | STANDHYD ( 1001)|   Area    (ha)=   9.00
 |ID= 1 DT= 5.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  61.00
 --------------------
                             IMPERVIOUS    PERVIOUS (i)
```

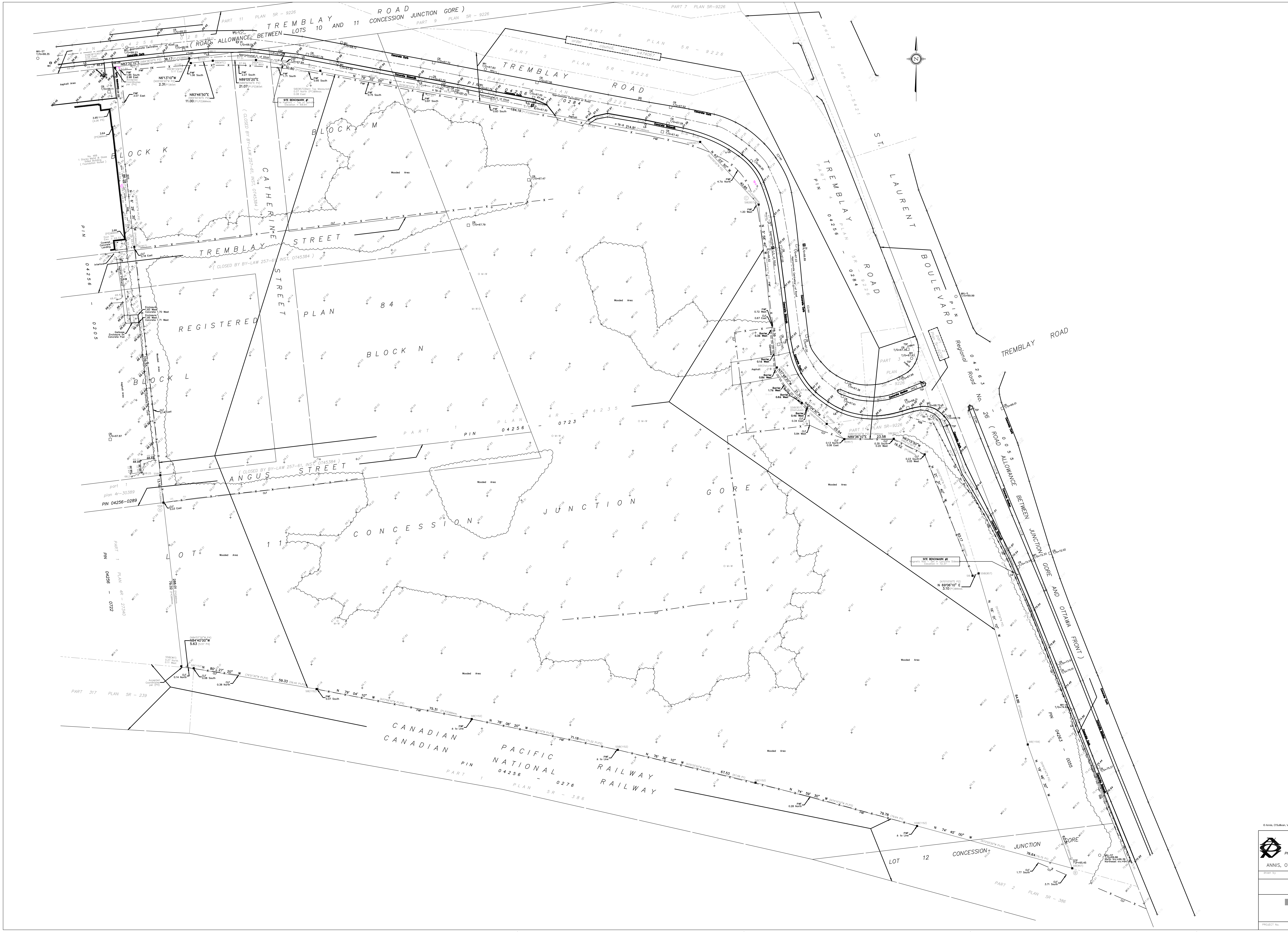
```
  Surface Area     (ha)=       5.49          3.51
  Dep. Storage     (mm)=       2.50          5.00
  Average Slope     (%)=       1.00          2.00
  Length            (m)=     244.95         40.00
  Mannings n          =      0.013          0.250

      NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                          ---- TRANSFORMED HYETOGRAPH ----
          TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
           hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
         0.083    2.05 | 1.583   11.13 | 3.083    5.63 |  4.58    2.66
         0.167    2.05 | 1.667   11.13 | 3.167    5.63 |  4.67    2.66
         0.250    2.23 | 1.750   28.10 | 3.250    4.97 |  4.75    2.52
         0.333    2.23 | 1.833   28.10 | 3.333    4.97 |  4.83    2.52
         0.417    2.45 | 1.917  122.14 | 3.417    4.46 |  4.92    2.40
         0.500    2.45 | 2.000  122.14 | 3.500    4.46 |  5.00    2.40
         0.583    2.73 | 2.083   37.28 | 3.583    4.05 |  5.08    2.29
         0.667    2.73 | 2.167   37.28 | 3.667    4.05 |  5.17    2.29
         0.750    3.09 | 2.250   18.95 | 3.750    3.71 |  5.25    2.19
         0.833    3.09 | 2.333   18.95 | 3.833    3.71 |  5.33    2.19
         0.917    3.57 | 2.417   12.70 | 3.917    3.43 |  5.42    2.09
         1.000    3.57 | 2.500   12.70 | 4.000    3.43 |  5.50    2.09
         1.083    4.25 | 2.583    9.59 | 4.083    3.20 |  5.58    2.01
         1.167    4.25 | 2.667    9.59 | 4.167    3.20 |  5.67    2.01
         1.250    5.29 | 2.750    7.73 | 4.250    2.99 |  5.75    1.94
         1.333    5.29 | 2.833    7.73 | 4.333    2.99 |  5.83    1.94
         1.417    7.11 | 2.917    6.50 | 4.417    2.81 |  5.92    1.87
         1.500    7.11 | 3.000    6.50 | 4.500    2.81 |  6.00    1.87

  Max.Eff.Inten.(mm/hr)=     122.14         60.64
             over (min)        5.00         15.00
  Storage Coeff.  (min)=       4.04 (ii)    12.66 (ii)
  Unit Hyd. Tpeak (min)=       5.00         15.00
  Unit Hyd. peak  (cms)=       0.24          0.08
                                                          *TOTALS*
  PEAK FLOW       (cms)=       1.74          0.30          1.859 (iii)
  TIME TO PEAK    (hrs)=       2.00          2.17           2.00
  RUNOFF VOLUME    (mm)=      54.52         12.78          38.24
  TOTAL RAINFALL   (mm)=      57.02         57.02          57.02
  RUNOFF COEFFICIENT  =       0.96          0.22           0.67

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

     (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
          Fo   (mm/hr)= 76.20         K  (1/hr)=  4.14
          Fc   (mm/hr)= 13.20    Cum.Inf.   (mm)=  0.00
    (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
         THAN THE STORAGE COEFFICIENT.
   (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR( 3001)|
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |      OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------       (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000    |   0.2590     0.3630
                          0.0240     0.1240    |   0.4010     0.5290
                          0.0310     0.1970    |   4.4720     0.7600

                                 AREA     QPEAK      TPEAK       R.V.
                                 (ha)     (cms)      (hrs)       (mm)
   INFLOW : ID= 2 (  1001)       9.000     1.859       2.00       38.24
   OUTFLOW: ID= 1 (  3001)       9.000     0.115       2.92       38.10

               PEAK   FLOW    REDUCTION [Qout/Qin](%)=  6.20
               TIME SHIFT OF PEAK FLOW         (min)= 55.00
               MAXIMUM  STORAGE   USED       (ha.m.)=  0.2584

--------------------------------------------------------------------------------
********************************
** SIMULATION:Run 05          **
********************************
--------------------
| CHICAGO STORM    |     IDF curve parameters: A=1402.884
| Ptotal= 66.93 mm |                           B=   6.018
--------------------                           C=   0.819
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  =  6.00 hrs
                         Storm time step    = 10.00 min
                         Time to peak ratio =  0.33

          TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
           hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
          0.17    2.37 |  1.67   13.01 |  3.17    6.54 |  4.67    3.08
          0.33    2.58 |  1.83   33.04 |  3.33    5.78 |  4.83    2.92
          0.50    2.84 |  2.00  144.69 |  3.50    5.18 |  5.00    2.77
          0.67    3.17 |  2.17   43.90 |  3.67    4.70 |  5.17    2.65
          0.83    3.58 |  2.33   22.22 |  3.83    4.31 |  5.33    2.53
          1.00    4.14 |  2.50   14.85 |  4.00    3.98 |  5.50    2.42
          1.17    4.93 |  2.67   11.19 |  4.17    3.71 |  5.67    2.33
          1.33    6.15 |  2.83    9.01 |  4.33    3.47 |  5.83    2.24
          1.50    8.28 |  3.00    7.57 |  4.50    3.26 |  6.00    2.16

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD ( 1001)|   Area    (ha)=   9.00
|ID= 1 DT= 5.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  61.00
--------------------
                         IMPERVIOUS    PERVIOUS (i)
  Surface Area     (ha)=       5.49          3.51
  Dep. Storage     (mm)=       2.50          5.00
  Average Slope     (%)=       1.00          2.00
  Length            (m)=     244.95         40.00
  Mannings n          =      0.013          0.250

      NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                          ---- TRANSFORMED HYETOGRAPH ----
          TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
           hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
         0.083    2.37 | 1.583   13.01 | 3.083    6.54 |  4.58    3.08
         0.167    2.37 | 1.667   13.01 | 3.167    6.54 |  4.67    3.08
         0.250    2.58 | 1.750   33.04 | 3.250    5.78 |  4.75    2.92
         0.333    2.58 | 1.833   33.04 | 3.333    5.78 |  4.83    2.92
         0.417    2.84 | 1.917  144.69 | 3.417    5.18 |  4.92    2.77
         0.500    2.84 | 2.000  144.69 | 3.500    5.18 |  5.00    2.77
         0.583    3.17 | 2.083   43.90 | 3.583    4.70 |  5.08    2.65
         0.667    3.17 | 2.167   43.90 | 3.667    4.70 |  5.17    2.65
         0.750    3.58 | 2.250   22.22 | 3.750    4.31 |  5.25    2.53
         0.833    3.58 | 2.333   22.22 | 3.833    4.31 |  5.33    2.53
         0.917    4.14 | 2.417   14.85 | 3.917    3.98 |  5.42    2.42
         1.000    4.14 | 2.500   14.85 | 4.000    3.98 |  5.50    2.42
         1.083    4.93 | 2.583   11.19 | 4.083    3.71 |  5.58    2.33
         1.167    4.93 | 2.667   11.19 | 4.167    3.71 |  5.67    2.33
         1.250    6.15 | 2.750    9.01 | 4.250    3.47 |  5.75    2.24
         1.333    6.15 | 2.833    9.01 | 4.333    3.47 |  5.83    2.24
         1.417    8.28 | 2.917    7.57 | 4.417    3.26 |  5.92    2.16
         1.500    8.28 | 3.000    7.57 | 4.500    3.26 |  6.00    2.16

  Max.Eff.Inten.(mm/hr)=     144.69         87.00
             over (min)        5.00         15.00
  Storage Coeff.  (min)=       3.77 (ii)    11.23 (ii)
  Unit Hyd. Tpeak (min)=       5.00         15.00
  Unit Hyd. peak  (cms)=       0.25          0.09
                                                          *TOTALS*
  PEAK FLOW       (cms)=       2.08          0.46          2.281 (iii)
  TIME TO PEAK    (hrs)=       2.00          2.17           2.00
  RUNOFF VOLUME    (mm)=      64.43         19.30          46.83
  TOTAL RAINFALL   (mm)=      66.93         66.93          66.93
  RUNOFF COEFFICIENT  =       0.96          0.29           0.70

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

     (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
          Fo   (mm/hr)= 76.20         K  (1/hr)=  4.14
          Fc   (mm/hr)= 13.20    Cum.Inf.   (mm)=  0.00
    (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
         THAN THE STORAGE COEFFICIENT.
   (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR( 3001)|
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |      OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------       (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000    |   0.2590     0.3630
                          0.0240     0.1240    |   0.4010     0.5290
                          0.0310     0.1970    |   4.4720     0.7600

                                 AREA     QPEAK      TPEAK       R.V.
                                 (ha)     (cms)      (hrs)       (mm)
   INFLOW : ID= 2 (  1001)       9.000     2.281       2.00       46.83
   OUTFLOW: ID= 1 (  3001)       9.000     0.183       2.75       46.68

               PEAK   FLOW    REDUCTION [Qout/Qin](%)=  8.03
               TIME SHIFT OF PEAK FLOW         (min)= 45.00
               MAXIMUM  STORAGE   USED       (ha.m.)=  0.3079

--------------------------------------------------------------------------------
********************************
** SIMULATION:Run 06          **
********************************
--------------------
| CHICAGO STORM    |     IDF curve parameters: A=1569.580
| Ptotal= 74.44 mm |                           B=   6.014
--------------------                           C=   0.820
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  =  6.00 hrs
                         Storm time step    = 10.00 min
                         Time to peak ratio =  0.33

          TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
           hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
          0.17    2.63 |  1.67   14.44 |  3.17    7.26 |  4.67    3.41
          0.33    2.86 |  1.83   36.76 |  3.33    6.40 |  4.83    3.23
          0.50    3.15 |  2.00  161.47 |  3.50    5.74 |  5.00    3.07
          0.67    3.51 |  2.17   48.88 |  3.67    5.21 |  5.17    2.93
          0.83    3.97 |  2.33   24.70 |  3.83    4.77 |  5.33    2.80
          1.00    4.59 |  2.50   16.49 |  4.00    4.41 |  5.50    2.68
          1.17    5.47 |  2.67   12.42 |  4.17    4.10 |  5.67    2.58
          1.33    6.82 |  2.83   10.00 |  4.33    3.84 |  5.83    2.48
          1.50    9.19 |  3.00    8.40 |  4.50    3.61 |  6.00    2.39

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD ( 1001)|   Area    (ha)=   9.00
|ID= 1 DT= 5.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  61.00
--------------------
                         IMPERVIOUS    PERVIOUS (i)
  Surface Area     (ha)=       5.49          3.51
  Dep. Storage     (mm)=       2.50          5.00
  Average Slope     (%)=       1.00          2.00
  Length            (m)=     244.95         40.00
  Mannings n          =      0.013          0.250

      NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                          ---- TRANSFORMED HYETOGRAPH ----
          TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
           hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
         0.083    2.63 | 1.583   14.44 | 3.083    7.26 |  4.58    3.41
         0.167    2.63 | 1.667   14.44 | 3.167    7.26 |  4.67    3.41
         0.250    2.86 | 1.750   36.76 | 3.250    6.40 |  4.75    3.23
         0.333    2.86 | 1.833   36.76 | 3.333    6.40 |  4.83    3.23
         0.417    3.15 | 1.917  161.47 | 3.417    5.74 |  4.92    3.07
         0.500    3.15 | 2.000  161.47 | 3.500    5.74 |  5.00    3.07
         0.583    3.51 | 2.083   48.88 | 3.583    5.21 |  5.08    2.93
         0.667    3.51 | 2.167   48.88 | 3.667    5.21 |  5.17    2.93
         0.750    3.97 | 2.250   24.70 | 3.750    4.77 |  5.25    2.80
         0.833    3.97 | 2.333   24.70 | 3.833    4.77 |  5.33    2.80
         0.917    4.59 | 2.417   16.49 | 3.917    4.41 |  5.42    2.68
         1.000    4.59 | 2.500   16.49 | 4.000    4.41 |  5.50    2.68
         1.083    5.47 | 2.583   12.42 | 4.083    4.10 |  5.58    2.58
         1.167    5.47 | 2.667   12.42 | 4.167    4.10 |  5.67    2.58
         1.250    6.82 | 2.750   10.00 | 4.250    3.84 |  5.75    2.48
         1.333    6.82 | 2.833   10.00 | 4.333    3.84 |  5.83    2.48
         1.417    9.19 | 2.917    8.40 | 4.417    3.61 |  5.92    2.39
         1.500    9.19 | 3.000    8.40 | 4.500    3.61 |  6.00    2.39

  Max.Eff.Inten.(mm/hr)=     161.47        107.63
             over (min)        5.00         10.00
  Storage Coeff.  (min)=       3.61 (ii)     8.48 (ii)
  Unit Hyd. Tpeak (min)=       5.00         10.00
  Unit Hyd. peak  (cms)=       0.25          0.12
                                                          *TOTALS*
  PEAK FLOW       (cms)=       2.34          0.69          2.861 (iii)
  TIME TO PEAK    (hrs)=       2.00          2.08           2.00
  RUNOFF VOLUME    (mm)=      71.94         24.55          53.46
  TOTAL RAINFALL   (mm)=      74.44         74.44          74.44
  RUNOFF COEFFICIENT  =       0.97          0.33           0.72

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

     (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
          Fo   (mm/hr)= 76.20         K  (1/hr)=  4.14
          Fc   (mm/hr)= 13.20    Cum.Inf.   (mm)=  0.00
    (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
         THAN THE STORAGE COEFFICIENT.
   (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| RESERVOIR( 3001)|
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |      OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------       (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000    |   0.2590     0.3630
                          0.0240     0.1240    |   0.4010     0.5290
                          0.0310     0.1970    |   4.4720     0.7600

                                 AREA     QPEAK      TPEAK       R.V.
                                 (ha)     (cms)      (hrs)       (mm)
   INFLOW : ID= 2 (  1001)       9.000     2.861       2.00       53.46
   OUTFLOW: ID= 1 (  3001)       9.000     0.236       2.67       53.31

               PEAK   FLOW    REDUCTION [Qout/Qin](%)=  8.26
               TIME SHIFT OF PEAK FLOW         (min)= 40.00
               MAXIMUM  STORAGE   USED       (ha.m.)=  0.3467

--------------------------------------------------------------------------------
********************************
** SIMULATION:Run 07          **
********************************
--------------------
| CHICAGO STORM    |     IDF curve parameters: A=1735.688
| Ptotal= 82.32 mm |                           B=   6.014
--------------------                           C=   0.820
                         used in:   INTENSITY =  A / (t + B)^C

                         Duration of storm  =  6.00 hrs
                         Storm time step    = 10.00 min
                         Time to peak ratio =  0.33

          TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
           hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
          0.17    2.90 |  1.67   15.97 |  3.17    8.02 |  4.67    3.77
          0.33    3.16 |  1.83   40.65 |  3.33    7.08 |  4.83    3.57
          0.50    3.48 |  2.00  178.56 |  3.50    6.35 |  5.00    3.40
          0.67    3.88 |  2.17   54.05 |  3.67    5.76 |  5.17    3.24
          0.83    4.39 |  2.33   27.32 |  3.83    5.28 |  5.33    3.10
          1.00    5.07 |  2.50   18.24 |  4.00    4.88 |  5.50    2.97
          1.17    6.05 |  2.67   13.74 |  4.17    4.54 |  5.67    2.85
          1.33    7.54 |  2.83   11.06 |  4.33    4.25 |  5.83    2.74
          1.50   10.16 |  3.00    9.29 |  4.50    3.99 |  6.00    2.64

--------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD ( 1001)|   Area    (ha)=   9.00
|ID= 1 DT= 5.0 min |   Total Imp(%)=  61.00   Dir. Conn.(%)=  61.00
--------------------
                         IMPERVIOUS    PERVIOUS (i)
  Surface Area     (ha)=       5.49          3.51
  Dep. Storage     (mm)=       2.50          5.00
  Average Slope     (%)=       1.00          2.00
  Length            (m)=     244.95         40.00
  Mannings n          =      0.013          0.250

      NOTE:  RAINFALL WAS TRANSFORMED TO   5.0 MIN. TIME STEP.

                          ---- TRANSFORMED HYETOGRAPH ----
          TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
           hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
         0.083    2.90 | 1.583   15.97 | 3.083    8.02 |  4.58    3.77
         0.167    2.90 | 1.667   15.97 | 3.167    8.02 |  4.67    3.77
         0.250    3.16 | 1.750   40.65 | 3.250    7.08 |  4.75    3.57
         0.333    3.16 | 1.833   40.66 | 3.333    7.08 |  4.83    3.57
         0.417    3.48 | 1.917  178.56 | 3.417    6.35 |  4.92    3.40
         0.500    3.48 | 2.000  178.56 | 3.500    6.35 |  5.00    3.40
         0.583    3.88 | 2.083   54.05 | 3.583    5.76 |  5.08    3.24
         0.667    3.88 | 2.167   54.05 | 3.667    5.76 |  5.17    3.24
         0.750    4.39 | 2.250   27.32 | 3.750    5.28 |  5.25    3.10
```

```
                0.833    4.39 | 2.333   27.32 | 3.833    5.28 |  5.33    3.10
                0.917    5.07 | 2.417   18.24 | 3.917    4.88 |  5.42    2.97
                1.000    5.07 | 2.500   18.24 | 4.000    4.88 |  5.50    2.97
                1.083    6.05 | 2.583   13.74 | 4.083    4.54 |  5.58    2.85
                1.167    6.05 | 2.667   13.74 | 4.167    4.54 |  5.67    2.85
                1.250    7.54 | 2.750   11.06 | 4.250    4.25 |  5.75    2.74
                1.333    7.54 | 2.833   11.06 | 4.333    4.25 |  5.83    2.74
                1.417   10.16 | 2.917    9.29 | 4.417    3.99 |  5.92    2.64
                1.500   10.16 | 3.000    9.29 | 4.500    3.99 |  6.00    2.64

     Max.Eff.Inten.(mm/hr)=     178.56       130.57
                over (min)        5.00        10.00
     Storage Coeff.  (min)=       3.47 (ii)    8.15 (ii)
     Unit Hyd. Tpeak (min)=       5.00        10.00
     Unit Hyd. peak  (cms)=       0.26         0.13
                                                           *TOTALS*
     PEAK FLOW       (cms)=       2.60         0.84          3.270 (iii)
     TIME TO PEAK    (hrs)=       2.00         2.08           2.00
     RUNOFF VOLUME    (mm)=      79.82        30.19          60.46
     TOTAL RAINFALL   (mm)=      82.32        82.32          82.32
     RUNOFF COEFFICIENT   =       0.97         0.37           0.73

***** WARNING: STORAGE COEFF. IS SMALLER THAN TIME STEP!

       (i) HORTONS EQUATION SELECTED FOR PERVIOUS LOSSES:
            Fo   (mm/hr)= 76.20          K  (1/hr)=  4.14
            Fc   (mm/hr)= 13.20     Cum.Inf.   (mm)=  0.00
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
--------------------
| RESERVOIR(  3001)|
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |   0.2590     0.3630
                          0.0240     0.1240   |   0.4010     0.5290
                          0.0310     0.1970   |   4.4720     0.7600

                                AREA     QPEAK     TPEAK       R.V.
                                (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  1001)      9.000      3.270      2.00      60.46
   OUTFLOW: ID= 1 (  3001)      9.000      0.281      2.58      60.32

                   PEAK   FLOW   REDUCTION [Qout/Qin](%)=  8.60
                   TIME SHIFT OF PEAK FLOW         (min)= 35.00
                   MAXIMUM  STORAGE   USED       (ha.m.)=  0.3891

------------------------------------------------------------------------------
```

APPENDIX

J

TOPOGRAPHIC SURVEY



TOPOGRAPHIC PLAN OF SURVEY OF

BLOCK N AND PART OF BLOCKS K, L, & M AND PART OF TREMBLAY STREET, ANGUS STREET & CATHERINE STREET

(All as Closed by By-Law 257-61, Inst. OT45384)

REGISTERED PLAN 84

AND

PART OF LOTS 11 AND 12
CONCESSION JUNCTION GORE
GEOGRAPHIC TOWNSHIP OF GLOUCESTER
CITY OF OTTAWA

Surveyed by Annis, O'Sullivan, Vollebekk Ltd.

Scale 1 : 500

20 15 10 5 0 10 20 Metres

Metric

DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

Surveyor's Certificate

I CERTIFY THAT :

1. This survey and plan are correct and in accordance with the Surveys Act, the Surveyors Act and the Land Titles Act and the regulations made under them.
2. The survey was completed on the 22nd day of August, 2019.

__________ Date

__________________ Katherine M. Sonier
Ontario Land Surveyor

ASSOCIATION OF ONTARIO LAND SURVEYORS
PLAN SUBMISSION FORM
2094119

THIS PLAN IS NOT VALID UNLESS IT IS AN EMBOSSED ORIGINAL COPY ISSUED BY THE SURVEYOR In accordance with Regulation 1026, Section 29 (3).

Notes & Legend

	Denotes	Survey Monument Planted
	"	Survey Monument Found
SIB	"	Standard Iron Bar
SSIB	"	Short Standard Iron Bar
IB	"	Iron Bar
(WIT)	"	Witness
Meas.	"	Measured
(AOG)	"	Annis, O'Sullivan, Vollebekk Ltd.
(P1)	"	Plan 4R-17835
(P2)	"	Plan 4R-24235
(P3)	"	Plan 4R-30389
(P4)	"	Plan 4R-27340
(P5)	"	(857) Plan dated April 25th, 1972
	"	Gate
CLF	"	Chain Link Fence
P&W	"	Post and Wire
BF	"	Board Fence
GR	"	Guard Rail
BOS	"	Bottom of Slope
TOS	"	Top of Slope
CSP	"	Corrugated Steel Pipe
CCP	"	Concrete Pipe
T/P	"	Top of Pipe
B/G	"	Bottom of Grate
T/G	"	Top of Grate
Inv.	"	Invert
MH-ST	"	Maintenance Hole (Storm Sewer)
MH-S	"	Maintenance Hole (Sanitary)
MH	"	Maintenance Hole (Unidentified)
VC	"	Valve Chamber (Watermain)
WV	"	Water Valve
CB	"	Catch Basin
DI	"	Ditch Inlet
FH	"	Fire Hydrant
UP	"	Utility Pole
AN	"	Anchor
LS	"	Light Standard
TSP	"	Traffic Signal Post
HH	"	Handhole
TB-B	"	Bell Terminal Box
TB-T	"	Traffic Terminal Box
TB	"	Unidentified Terminal Box
ICV	"	Irrigation Control Valve
M-W	"	Monitoring Well
S	"	Sign
B	"	Bollard
+65.00	"	Location of Elevations
+65.00	"	Location of Top of Curb Elevations

Distances shown on this plan are ground distances and can be converted to grid distances by multiplying by the combined scale factor of 0.999946.

Bearings are grid, derived from Can-Net 2016 Real Time Network GPS observations on reference points A and B, shown hereon, having a bearing of N68°05'23"W and are referenced to Specified Control Points 01919680105 and 019198434761, MTM Zone 9 (76°30' West Longitude) NAD-83 (original).

For comparison purposes, the bearings shown on plans (P1), (P2) and (P3) are UTM Grid.

Coordinates are derived from Can-Net 2016 Real Time Network GPS observations referenced to Specified Control Points 01919680105 and 0198434761, MTM Zone 9 (76°30' West Longitude) NAD-83 (original).

Coordinate values are to urban accuracy in accordance with O. Reg. 216/10.

. 01919680105	Northing	5024915.16	Easting	373971.65
. 019198434761	Northing	5036178.12	Easting	372436.11
. Point A	Northing	5031176.24	Easting	372218.41
. Point B	Northing	5031001.95	Easting	372651.74
. Point C	Northing	5031318.31	Easting	372502.23

Caution: Coordinates cannot, in themselves, be used to re-establish corners or boundaries shown on this plan.

To covert coordinates to MTM Zone 9 (76°30' West Longitude) NAD-83 (CSRS(2010)) apply a shift of -0.36 to the northing and a shift of -0.05 to the easting.

ELEVATION NOTES

1. Elevations shown are geodetic, derived from Control Monument 2011-0096, having an elevation of 68.24, and are referred to the CGVD28 geodetic datum.
2. To convert elevations to CGVD2013, subtract 0.30 from the elevations shown hereon.
3. It is the responsibility of the user of this information to verify that the job benchmark has not been altered or disturbed and that it's relative elevation and description agrees with the information shown on this drawing.

UTILITY NOTES

1. This drawing cannot be accepted as acknowledging all of the utilities and it will be the responsibility of the user to contact the respective utility authorities for confirmation.
2. Only visible surface utilities were located.
3. A field location of underground plant by the pertinent utility authority is mandatory before any work involving breaking ground, probing, excavating etc.

14 Concourse Gate, Suite 500
Nepean, Ont. K2E 7S6
Phone: (613) 727-0850 / Fax: (613) 727-1079
Email: Nepean@aovltd.com

ANNIS, O'SULLIVAN, VOLLEBEKK LTD.

CHECKED BY: KATHERINE M. SONIER

FILE: 17732-19 WSP PtLt11 JG T D3

drawn by ISW dessine par

Canada

Publics Works and Government Services Canada — Travaux publics et services gouvernementaux Canada

Real Property Branch — Direction générale des biens immobiliers

PROJECT No. PSPC No. PSPC no.