Half Moon Bay South Phase 7 (4159 Obsidian Street) - Servicing and Stormwater Management Report

Stantec Project No. 160402143

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1.0 INTRODUCTION

Mattamy Homes Ltd. has retained Stantec Consulting Ltd. to prepare this Stormwater and Servicing Report in support of a site plan control application for 4159 Obsidian Street (Half Moon Bay South Phase 7 - Residential). The subject site is located within the Brazeau Lands development area also known as The Ridge, located at 3809 Borrisokane Road within the Barrhaven South Urban Expansion Area (BSUEA) in the City of Ottawa. This proposed site is bounded by Obsidian Street to the west and Future Greenbank Road to the east, the previous Half Moon Bay South Phase 8 development at 3718 Greenbank Road to the north and undeveloped area with municipal address of 3882 Barnsdale Road to the south. **Figure 1** below identifies the site location in relation to existing adjacent properties.

Figure 1: Key Plan of Half Moon Bay South Phase 7 (4159 Obsidian Street) Development Area

The development land is approximately 1.22ha in area and comprises 5 blocks of townhomes with a total of 90 units. This servicing and stormwater management report will demonstrate that the subject site can be fully serviced by the existing municipal water, sanitary, and storm services while complying with established design criteria recommended in background studies and City of Ottawa guidelines. The proposed site plan is included in **Appendix B** for reference.

This parcel is currently zoned as GM[2800]H(14.5) General Mixed-used Zone. The site is within the Jock River watershed within the regulatory boundary of the Rideau Valley Conservation Authority (RVCA).

1.1 OBJECTIVE

This Site Servicing and Stormwater Management Report has been prepared to present a servicing scheme that is free of conflicts and presents the most suitable servicing approach that complies with the relevant City design guidelines. The use of the existing infrastructure as obtained from available as-built drawings has been determined in consultation with David Schaeffer Engineering Ltd. (DSEL), J. F. Sabourin and Associates Inc. (JFSA), City of Ottawa staff, and the adjoining property owners. Infrastructure requirements for water supply, sanitary sewer, and storm sewer services are presented in this report.

Criteria and constraints provided by Brazeau Lands (The Ridge) Design brief and the City of Ottawa with further iterations through the 3718 Greenbank Road Functional Servicing Report have been used as a basis for the servicing design of the proposed development. Specific elements and potential development constraints to be addressed are as follows:

- **Potable Water Servicing**
    - Estimate water demands to characterize the feed for the proposed development which will be serviced by an existing 300mm diameter PVC watermain fronting the site along Obsidian Street and the existing 250mm diameter PVC watermain within the previous Half Moon Bay South Phase 8 development at the north of this site for a loop connection.
    - Watermain servicing for the development is to be able to provide average day and maximum day and peak hour demands (i.e., non-emergency conditions) at pressures within the allowable range of 40 to 80 psi (276 to 552 kPa).
    - Under fire flow (emergency) conditions with maximum day demands, the water distribution system is to maintain a minimum pressure greater than 20 psi (140 kPa).
- Prepare a grading plan in accordance with the proposed site plan and existing grades.
- **Stormwater Management and Servicing**
    - Define major and minor conveyance systems in line with guidelines used for the stormwater management of the Brazeau lands subdivision, as well as those provided in the October 2012 City of Ottawa Sewer Design Guidelines and subsequent technical memorandums, and generally accepted stormwater management design guidelines.
    - As documented in the Barrhaven South Urban Expansion Area Master Servicing Study, by J. L Richards 2018 and Stantec's 2022 Functional Servicing Report for the area, the development will be required to meet water balance criteria for the region equivalent to retention and infiltration of the 22mm storm event.
    - Connect to the existing storm maintenance hole structure at the intersection of Epoch and Obsidian Street.
- **Wastewater Servicing**

- Estimate wastewater flows generated by the development and size sanitary sewers which will outlet to the existing sanitary manhole within the private sanitary network in the previous Half Moon Bay South Phase 8 site, and ultimately discharge into the existing 200mm diameter PVC sanitary sewer on Obsidian Street.

The accompanying **Drawing SSP-1** illustrates the proposed internal servicing scheme for the site.

2.0 REFERENCES

The following documents were referenced in the preparation of this stormwater management and servicing report:

- *City of Ottawa Sewer Design Guidelines*, 2nd Edition, City of Ottawa, October 2012.
- *City of Ottawa Design Guidelines – Water Distribution*, First Edition, Infrastructure Services Department, City of Ottawa, July 2010.
- *Design Brief for Cavian Greenbank Development Corporation,* The Ridge (Brazeau Lands), David Schaeffer Engineering Ltd., July 2020.
- *Geotechnical Investigation,* Proposed Mixed Use Development Half Moon Bay South – Phase 8 3718 Greenbank Road - Ottawa, PG5690-1, Paterson Group, May 2023.
- *Hydraulic Capacity and Modeling Analysis Brazeau Lands*, Final Report, GeoAdvice Engineering Inc., July 2020.
- *Master Servicing Study – Barrhaven South Urban Expansion Area,* J.L. Richards & Associates Limited, Revision 2, May 2018.
- *Pond Design Brief for Brazeau Subdivision,* by J.F. Sabourin and Associates, July 2020.
- *Stormwater Management Report for Brazeau Subdivision,* by J.F. Sabourin and Associates (July 2020).
- *Stormwater Planning and Design Manual,* Ministry of the Environment, March 2003.
- *Technical Bulletin ISTB-2014-02 Revision to Ottawa Design Guidelines – Water*, City of Ottawa, May 2014.
- *Technical Bulletin PIEDTB-2016-01 Revisions to Ottawa Design Guidelines – Sewer,* City of Ottawa, September 2016.
- *3718 Greenbank Road – Servicing and Stormwater Management Report*, Stantec Consulting Ltd., June 13, 2023.

3.0 POTABLE WATER SERVICING

3.1 BACKGROUND

The subject site is located within Zone 3SW of the City of Ottawa water distribution system. The proposed residential development will include 5 blocks with 90 townhome units.

The development will be serviced from the existing 300mm diameter watermain located within Obsidian Street and the existing 200mm diameter watermain in the previous Half Moon Bay South Phase 8 (3718 Greenbank Road) site for a looped connection.

In June 2023, Stantec conducted a watermain analysis to determine the hydraulic capacity of the watermain network within the previous phase development at 3718 Greenbank Road as shown in the *3718 Greenbank Road – Servicing and Stormwater Management Report* by Stantec in **Appendix E.1** The analysis result will be used as boundary condition at the private connection location.

The updated boundary conditions for the proposed development at Obsidian Street have been received from the City of Ottawa and are used in the hydraulic analysis for this site. The City of Ottawa boundary conditions are included in **Appendix A.1**.

3.2 PROPOSED WATERMAIN SIZING AND LAYOUT

The proposed watermain alignment and sizing for the development is demonstrated on **Drawing SSP-1**. A 200 mm diameter watermain is proposed to connect with the existing 300mm diameter watermain on Obsidian Street and extend with a looped 200mm watermain within the parking area at the center of this development, connecting to the existing 250mm watermain in the previous phase 8 site at the northwest of the site.

3.2.1 Ground Elevations

The proposed ground elevations within the development range from approximately 103 m to 108 m, with the ground elevations highest in the southeast corner of the site. This significant variation in ground elevations was largely dictated by the original topography of the site, and to suit tie-in elevations at Obsidian Street.

3.2.2 Domestic Water Demands

The Half Moon Bay South Phase 7 development will contain a total of 5 blocks with 90 townhome units and outdoor amenity areas having a total estimated population of 243 persons. Refer to **Appendix A.2** for detailed domestic water demand calculations.

Water demands for the development were calculated using the City of Ottawa's Water Distribution Design Guidelines. For residential developments, the average day (AVDY) per capita water demand is 280L/cap/d.

For maximum day (MXDY) demand, AVDY was multiplied by a factor of 2.5 and for peak hour (PKHR) demand, MXDY was multiplied by a factor of 2.2. For maximum day (MXDY) demand of amenity areas, AVDY was multiplied by a factor of 1.5 and for peak hour (PKHR) demand, MXDY was multiplied by a factor of 1.8. The calculated residential water consumption is represented in **Table 3-1** below:

Table 3–1: Residential Water Demands

Unit Type	Units/ Amenity areas (m^2)	Persons/Unit	Population	AVDY (L/s)	MXDY (L/s)	PKHR (L/s)
Townhome	90 units	2.7	243	0.79	1.97	4.33
		Total	**243**	**0.79**	**1.97**	**4.33**

3.3 LEVEL OF SERVICE

3.3.1 Allowable Pressures

The City of Ottawa Water Distribution Design Guidelines state that the desired range of system pressures under normal demand conditions (i.e. basic day, maximum day, and peak hour) should be in the range of 350 to 552 kPa (50 to 80 psi) and no less than 275 kPa (40 psi) at the ground elevation in the streets (i.e. at hydrant level). The maximum pressure at any point in the distribution system is to be no higher than 552 kPa (80 psi). As per the Ontario Building Code & Guide for Plumbing, if pressures greater than 552 kPa (80 psi) are anticipated, pressure relief measures (such as pressure reducing valves) are required. Under emergency fire flow conditions, the minimum pressure in the distribution system is allowed to drop to 138 kPa (20 psi).

3.3.2 Fire Flow

FUS fire flow calculation spreadsheets for the governing fire flow demand scenarios (see **Appendix A.3**) were generated to calculate the expected fire flow demands from the proposed site.

The ground floor area of each block was estimated based on the building footprints shown on the architectural plans. The building exposures were reviewed on a block-by-block basis. Although Blocks 1 and 2 were determined to be the critical units for assessment given by the exposure distance from the adjacent buildings and its building footprint, firewalls are proposed to reduce effective floor area and the resulting fire flow demand. By consideration of the adjusted effective floor area of Block 1 and 2 with firewalls, the maximum required fire flow for this development was estimated to be 250 L/s.

3.4 HYDRAULIC MODEL

A hydraulic model for the site was constructed using the PCSWMM program developed by Computational Hydraulics Inc. (CHI) to provide an accurate network analysis of the proposed water distribution system. The results are presented and discussed in the following sections.

3.4.1 System Layout

The proposed watermain alignment including model node IDs, reservoirs (representing boundary conditions at connections to the existing watermain network), and pipe sizing for the proposed development is shown in **Figure 2** below.

Figure 2: Watermain Model Nodes

3.4.2 Boundary Conditions

Hydraulic boundary conditions provided by the City of Ottawa dated April 2, 2025, are based on the anticipated domestic water demands and a fire flow demand of 10,000L/min (166.7L/s) and 15,000L/min (250 L/s). Due to the proposed site plan layout, it is anticipated that a 15,000L/min fire flow is required for this this project, and has been applied in the analysis. Two fixed head reservoirs simulating the boundary conditions were placed for the watermain connection points at the Eminence/Obsidian Street (south) intersection and the private watermain within Half Moon Bay Phase 8 site (north) in the hydraulic model. A summary of the boundary conditions is provided in **Table 2** which shows the ground elevation at the proposed connections and the HGLs for average day, peak hour, and maximum day plus fire flow demand scenarios that have been used in the hydraulic model. The boundary conditions are included in **Appendix A.1**.

Table 3–2: Boundary Conditions

Location	Ground Elevation (m)	AVDY (m)	PKHR (m)	MXDY+FF (15,000 L/min) (m)
Connection 1 – Half Moon Bay South Phase 8	106.0	148.1	143.0	130.1
Connection 2 – Eminence St/ Obsidian St (Post SUC Zone Reconfiguration)	108.9	146.8	142.7	129.6

3.4.3 Model Development

New watermains were added to the hydraulic model to simulate the proposed distribution system. A 200 mm dia. watermain network is used throughout the site. Hazen-Williams coefficients (C-factors) were applied to the proposed watermain in accordance with the City of Ottawa's Water Distribution Design Guidelines. The C-factors used are given in **Table 3-3** below.

Table 3–3: C-Factors Used in Watermain Hydraulic Model

Pipe Diameter (mm)	C-Factor
150	100
200 to 250	110
300 to 600	120
Over 600	130

The labelling of the watermain junctions and reservoirs (representing boundary conditions at connections to the existing watermain network) is shown in **Figure 2**.

3.5 HYDRAULIC MODELING RESULTS

3.5.1 Average Day (AVDY)

The hydraulic modeling results show that under basic day demands the pressure in the distribution network falls between 409.5 kPa (59.3 psi) and 382.5 kPa (55.5 psi). Hydraulic modeling results for the average day demand scenario is illustrated in **Figure 3**.

Figure 3: Pressures (psi) Under AVDY Demand Scenario

3.5.2 Peak Hour (PKHR)

The hydraulic modeling results show that under peak hour demands the pressure in the distribution network ranges between 337.9 kPa (49.0 psi) and 361.5 kPa (52.4 psi). Hydraulic modeling results for the peak hour demand scenario is illustrated in **Figure 4.**

Figure 4: Pressures (psi) Under PKHR Demand Scenario

3.5.3 Maximum Day Plus Fire Flow (MXDY+FF)

A hydraulic analysis using the PCSWMM EPANET2.2 Water model was conducted to determine if the proposed water distribution network can achieve the required FUS fire flow requirement while maintaining a residual pressure of at least 138 kPa (20 psi), per City Water Distribution Design Guidelines. This was accomplished using a steady-state maximum day demand scenario along with the automated fire flow simulation feature of the software. Hydraulic modeling results for the maximum day plus fire flow scenario is shown on **Figure 5**.

Figure 5: Available Fire Flows (L/s) for MXDY+FF Demand Scenario

A fire flow of 15,000 L/min (250 L/s) was achieved at all serviced nodes. Sufficient fire flows for each block can be provided at every point within the distribution network for the proposed development.

3.6 POTABLE WATER SUMMARY

The proposed watermain alignment and sizing can achieve the required level of service throughout the development. Based on the hydraulic analysis conducted using PCSWMM EPANET modeling, the following conclusions were made:

- The proposed water distribution system applying 200mm diameter distribution mains for the overall site to form a looped connection from the existing 250mm watermain in Half Moon Bay Phase 8 and 300mm watermain in Obsidian Street.
- During peak hour conditions, the proposed system is capable of operating above the minimum pressure objective of 276 kPa (40 psi).
- During fire conditions, the proposed system can provide 15,000 L/min fire flows at all modeled nodes, which are sufficient based on FUS calculations for the units within the proposed site.

4.0 WASTEWATER SERVICING

4.1 BACKGROUND

The subject site located at the south of the previous Half Moon Bay South Phase 8 (3718 Greenbank Road) within the study area of Barrhaven South Urban Expansion Area (BSUEA). JLR associates conducted a conceptual master servicing study in 2018, which provided design data for wastewater servicing and estimated residual capacities for sanitary trunk sewer in the area. The subject site is referred to as part of the Minto Lands (commercial) in this study. DSEL prepared a design brief for adjacent The Ridge subdivision (Brazeau Lands) based on this study. This design brief is used for the sanitary analysis for the earlier stage development and provided the preliminary sanitary drainage plan as a guidance for this following development.

There is an existing 200mm diameter sanitary sewer on Obsidian Street which collects wastewater from the private sanitary sewer network within the previous Half Moon Bay South Phase 8 development to the north, and which ultimately flows into the 375mm diameter sanitary sewer along the future Greenbank Road.

Refer to **Appendix E.1** for excerpts from The Ridge site servicing study by DSEL (2020). The estimated peak sanitary flows for the subject site as well as adjacent Phase 8 lands were originally determined as 4.45L/s (for a residential area of 1.90ha and a commercial area of 2.99ha) using City of Ottawa design criteria. This total of 4.89 ha land now includes both the subject site Phase 7 (4159 Obsidian Street) and the previous Phase 8 (3718 Greenbank Road) of Half Moon Bay South development.

In the *3718 Greenbank Road – Servicing and Stormwater Management Report* by Stantec in June 2023, the estimated Phase 8 (3718 Greenbank Road) development outflow was revised to a peak rate of 7.7L/s. The proposed development will be serviced by an onsite sanitary sewer network connected with the previous phase 8 sanitary system to direct the wastewater flow into the 200mm diameter sanitary sewer on Obsidian Street and ultimately into the 375mm sanitary sewer along future Greenbank Road.

4.2 DESIGN CRITERIA

As outlined in the City's Sewer Design Guidelines, the following design parameters were used to calculate estimated wastewater flow rates and to preliminarily size on-site sanitary sewers for the subject site:

- Minimum Full Flow Velocity – 0.6 m/s
- Maximum Full Flow Velocity – 3.0 m/s
- Manning's roughness coefficient for all smooth-walled pipes – 0.013
- Townhouse persons per unit – 2.7
- Extraneous Flow Allowance – 0.33 L/s/ha
- Residential Average Flows – 280 L/cap/day
- Maintenance Hole Spacing – 120 m

- Minimum Cover – 2.5m
- Harmon Correction Factor – 0.8

In addition, a residential peak factor based on Harmon's Equation was used to determine the peak design flows per Ottawa's Sewer Design Guidelines. Refer to **Appendix C.1** for the sanitary sewer design sheet for 4159 Obsidian Street

4.3 SANITARY SERVICING DESIGN

Sanitary servicing is provided via the 200 mm diameter onsite sanitary sewer network along the private roadways in front of each block and ultimately outlet to existing SAN MH 12 located within the neighboring previous Half Moon Bay South Phase 8 development.

The proposed layout of the sanitary infrastructure is shown on **Drawing SA-1.** The connections to the existing sanitary sewer network and the associated peak flows are summarized in **Table 4–1** below.

Table 4–1 Summary of Proposed Sanitary Peak Flows

Area ID Number	Total area (ha)	No. Units	Population	Total Peak Flow (L/s)
Proposed Half Moon Bay South Phase 7	1.22	90	243	3.2
Existing Half Moon Bay South Phase 8	3.09	228	616	7.8
To 200mm dia. sewer on Obsidian Street	4.31	318	859	11.0

A population density of 2.7ppu was applied to the residential townhouse units on site. A residential peak factor based on Harmon Equation was used to determine the peak design flows. An allowance of 0.33 L/s/effective gross ha (for all areas) was used to generate peak extraneous flows.

This total estimate combined sanitary flow to be discharged into the existing 200mm diameter sanitary sewer on Obsidian Street is larger than the previous estimated flow of 4.45L/s by DSEL. It is anticipated that the existing 200mm receiving sewer in Obsidian Street has sufficient capacity to receive the additional 6.55 L/s sanitary flow based on sanitary sewer design sheets for the Obsidian Road sewer.

JLR Associates identified in its MSS for the BSUEA that there is residual capacity within the sanitary sewers serving Mattamy lands west to new Greenbank road based on a Stantec (2015) hydrodynamic model of trunk sanitary sewers (450 mm in diameter and greater), which in turn demonstrated that the existing downstream trunk system could accommodate the flows generated with no risk of surcharging or basement flooding. Consequently, Stantec concluded that system upgrades were not required. The residual capacity in the sanitary sewer downstream of Greenbank Road was estimated at 74.0L/s (Refer to **Appendix E.1** for details).

5.0 STORMWATER MANAGEMENT AND SERVICING

The following sections describe the stormwater management (SWM) design for 3718 Greenbank Road in accordance with the background documents and governing criteria.

5.1 PROPOSED CONDITIONS

The proposed residential development encompasses approximately 1.2 ha of land and consists of 90 stacked townhomes and outdoor amenity areas. J.F. Sabourin and Associates Inc. (JFSA) were retained by David Schaeffer Engineering Ltd. (DSEL) to prepare a Stormwater Management (SWM) Plan for the adjacent Ridge (Brazeau) Subdivision.

The storm sewer collection system for the proposed site will discharge to an existing manhole (existing MH 225 within Obsidian Street) located near the northwest corner of the site, at the intersection of Obsidian Street and Epoch Street. This manhole is part of The Ridge's stormwater collections system which eventually discharges to a dry pond (referred to as the Drummond Pond) located in the northwest corner of the subdivision. This pond provides stormwater quantity control for the subdivision. OGS units upstream of the pond provide stormwater quality control for the subdivision.

Detailed grading of the site has been designed to direct emergency overland flows above the 100-year event northwards through other property owned by the applicant, and ultimately Obsidian Street which runs along the west side of the subject site.

Minor grassed areas at the boundary of the subject site cannot be graded to drain internally and as such will sheet drain uncontrolled offsite. The uncontrolled areas on the west side of the site will drain to the existing Obsidian Street ROW and those on the east side of the site will drain to the Future Greenbank Road ROW.

5.2 DESIGN CRITERIA AND CONSTRAINTS

The design criteria and guidelines used for the stormwater management of the subject subdivision are those that were developed in the background documents by JFSA, DSEL and JLR in the BSUEA MSS with iterations as noted in the 3718 Greenbank Road Functional Servicing Report, as well as those provided in the October 2012 *City of Ottawa Sewer Design Guidelines* and subsequent technical memorandums and generally accepted stormwater management design guidelines.

The SWM design will ensure that the majority of storm runoff within the site be controlled, and site release to Obsidian Street restricted to the peak flow rate of 170 L/s for the 2-Year storm event and peak flow rate of 175 L/s for the 100-Year storm as calculated using a proportional method for the site. Details can be found in Section 5.3.1. No improvements to downstream infrastructure will be required to service the site.

Storm runoff within the site will be controlled and directed to an existing storm control point identified as MH 225 in the JFSA SWM model. MH 225 has a maximum upstream Hydraulic Grade Line of 103.572m based on JFSA's simulation under the 100-year 3-hour Chicago storm, 100-year 24-hour SCS Type II storm, and the three historical events, and 103.592m under the climate change scenario.

As identified by the approved FSR and the City of Ottawa's Sewer Design Guidelines, the minor and major system stormwater management design criteria and constraints will consist of:

5.2.1 Minor System

a) Storm sewers are to be designed to provide a minimum 2-year level of service.

b) The 100-year hydraulic grade line (HGL) within the development minor systems must be maintained at least 0.3 m below the underside of footing elevation where gravity house connections are installed.

c) For less frequent storms (i.e. larger than 1:2 year), the minor system shall, if required, be limited with the use of inlet control devices to prevent excessive hydraulic surcharges and to maximize the use of surface storage on the road where desired.

d) Catchbasins on the road are to be equipped with City standard type S19 (fish) grates or City standard type S22 side inlets, and grates for catchbasins in rear yards, park and open spaces with pedestrian traffic are to be City standard type S19, S30 and S31.

e) Single catchbasins are to be equipped with 200 mm minimum lead pipes, and double catchbasins are to be equipped with 250 mm minimum lead pipes.

f) Rear yard catchbasins are to be equipped with 250 mm minimum lead pipes. Catchbasins installed on the street, where rear yard catchbasins connect to the main storm sewer through the catchbasin, are to be equipped with 250 mm minimum lead pipes for both single and double catchbasins.

g) Under full flow conditions, the allowable velocity in storm sewers is to be no less than 0.80 m/s and no greater than 3.0 m/s. Where velocities over 3.0 m/s are proposed, provisions shall be made to protect against displacement of sewers by sudden jarring or movement. Velocities greater than 6 m/s are not permitted.

5.2.2 Major System

a) The major system shall be designed with enough road surface storage to allow the excess runoff of a 100-year storm to be retained within road ponding areas where desired.

b) Inlet control devices to be sized such that they do not create surface ponding on the road during the 2-year design storm on local roads (5-year design storm on collector and 10-year design storm on arterial roads); it should be noted that surface ponding over grates is present during rainfall under any design, as an appropriate depth of water is required for runoff to enter the grate.

c) Roof leaders shall be installed to direct the runoff to splash pads and on to grassed areas.

d) For the 100-year storm, the maximum total depth of water (static + dynamic) on all roads shall not exceed 35 cm at the gutter.

e) During the 100-year + 20% stress test, the maximum extent of surface water on streets, rear yards, public space and parking areas shall not touch the building envelope.

f) When catch basins are installed in rear yards, safe overland flow routes are to be provided to allow the release of excess flows from such areas.

g) The product of the maximum flow depths on streets and maximum flow velocity must be less than 0.60 m^2/s on all roads.

h) The excess major system flows up to the 100-year return period are to be retained on-site in development blocks such as the proposed development.

i) There must be at least 15 cm of vertical clearance between the spill elevation on the street and the ground elevation at the nearest building envelope that is in the proximity of the flow route or ponding area.

j) There must be at least 30 cm of vertical clearance between the rear yard spill elevation and the ground elevation at the adjacent building envelope.

k) Provide adequate emergency overflow conveyance off-site to ensure water will spill to downstream rights-of-way in the event of a blockage.

5.2.3 Allowable Release Rate

Based on JFSA's Stormwater Management Plan for the Ridge (Brazeau) subdivision and iterated within the 3718 Greenbank Road Functional Servicing Study, the subject site is to control the 100-year flow on site and the minor system for the total site will be restricted to the 100-year storm event release rate of 175 L/s. The 2-year minor system outflow is to be controlled to 170 L/s. The noted flow rates are exclusively for the previously identified 1.22ha commercial development parcel as per the FSR. The target release rates have been pro-rated to determine an allowable release rate for the private site component of the parcel (1.12ha) versus the park block to be conveyed to the City (0.10ha).

Table 5–1 Target Release Rate

Study	Storm Event	Private Site	Park	Total
3718 Greenbank FSR (Commercial)	2-Year Flow Rate (L/s)	**156.0**	**14.0**	**170**
	100-Year Flow Rate (L/s)	**160.5**	**14.5**	**175**

5.3 MODELING METHODOLOGY

5.3.1 Modeling Rationale

A hydrologic/hydraulic model was completed with PCSWMM for the sewers and roadways/parking areas within the proposed development, accounting for the estimated major and minor systems to evaluate the storm sewer infrastructure and ensure release rates meet the previously defined target criteria. The use of PCSWMM for modeling of the site hydrology and hydraulics allowed for an analysis of the system response during various storm events. The following assumptions were applied to the model:

- Hydrologic parameters as per Ottawa Sewer Design Guidelines, including Horton infiltration, Manning's 'n', and depression storage values.
- 3-hour Chicago distributions and 12-hour SCS Type II distributions for 2-year and 100-year storm events were used to evaluate the urban component of the dual drainage (i.e. minor system capture rates, total overland flow depth, hydraulic grade line (HGL), etc.).
- A 22 mm, 4-hour Chicago storm was used to evaluate the performance of the proposed infiltration measures to coincide with values presented in the MSS.
- The 'climate change' scenarios created by adding 20% of the individual intensity values of the 100-year 3-hour Chicago storm and the 100-year 12-hour SCS Type II storm at their specified time step were used as an analytical tool to establish the function of the system under extreme events.
- Minor system capture rates within the proposed development were restricted to the 2-year peak runoff rate.

5.3.2 SWMM Dual Drainage Methodology

The proposed development is modeled in one PCSWMM model as a dual conduit system, where:

1) The minor system consists of storm sewers, represented by circular conduits, and manholes, represented by storage nodes;
2) The major system consists of overland spills, represented by weirs and irregular conduits using street-shaped cross-sections to represent the assumed overland road network with streets at varying slopes, and catch basins with surface ponding areas, represented by storage nodes.

The two systems are connected by outlet/orifice link objects, which represent inlet control devices (ICDs), that connect storage nodes representing catch basins to storage nodes representing manholes. Subcatchments are linked to the nodes representing catch basins and ponding areas so that generated hydrographs are directed there firstly.

5.3.3 Model Input Parameters

Drawing SD-1 summarizes the discretized subcatchments used in the analysis of the proposed development. All parameters were assigned as per applicable Ottawa Sewer Design Guidelines (OSDG); Ontario Ministry of the Environment, Conservation, and Parks (MECP); and background report requirements.

5.3.3.1 Hydrologic Parameters

Key parameters for the proposed development areas are summarized below, while example input files are provided for the 100-year, 3-hour Chicago storm in **Appendix D** which indicate all other parameters. For all other input files and results of storm scenarios, please examine the electronic model files located on the digital media provided with this report. This analysis was performed using PCSWMM, which is a front-end GUI to the EPA-SWMM engine. Model files can be examined in any program which can read EPA-SWMM files version 5.1.014.

Table 5–2: presents the general subcatchment parameters used for the proposed development.

Table 5–2: General Subcatchment Parameters

Parameter	Value
Infiltration Method	Horton
Max. Infil. Rate (mm/hr)	76.2
Min. Infil. Rate (mm/hr)	13.2
Decay Constant (1/hr)	4.14
N Imperv	0.013
N Perv	0.25
Dstore Imperv (mm)	1.57
Dstore Perv (mm)	4.67
Zero Imperv (%)	0

Table 5–3 presents the individual parameters that vary for each of the proposed subcatchments in the model. Subcatchment width parameters were determined by multiplying each subcatchment's area in hectares by 225. Subcatchment imperviousness was measured directly from the site plan within AutoCAD considering all paved access, sidewalks, and roof areas as entirely impervious areas, and remaining grassed areas as entirely pervious. Weighted runoff 'C' coefficients were determined for each subcatchment considering impervious areas as C=0.90, and pervious as C=0.20.

Table 5–3: Individual Subcatchment Parameters

Subcatchment ID	Area (ha)	Width (m)	Slope (%)	% Impervious
L200A	0.225	50.6	3.0	85.7
L201A	0.165	37.1	3.0	85.7
L201B	0.157	35.4	3.0	85.7
L201C	0.117	26.4	3.0	85.7
L202A	0.077	17.3	3.0	88.6
L202B	0.087	19.6	2.0	81.4
PARK	0.101	22.7	1.5	28.6
UNC-1	0.065	14.5	3.0	71.4
UNC-2	0.057	12.8	3.0	71.4
UNC-3	0.080	18.0	3.0	71.4
UNC-4	0.079	17.7	3.0	71.4

5.3.3.2 Surface and Subsurface Storage Parameters

Table 5-4 summarizes the storage node parameters used in the model. Storage nodes represent the depth of the proposed catch basin barrel plus an additional depth to represent the maximum allowable surface water ponding depth. Surface storage was estimated based on surface models created in AutoCAD for the proposed grading plan. See **Drawing SD-1** for surface storage depths, areas, and volumes. Park volume storage areas and volumes are conceptual, and have been set to allow retention of the 100-year storm based on allowable release rates via model iteration.

Table 5–4: Surface Storage Parameters

Subcatchment ID	Structure	Invert Elevation (m)	Rim Elevation (m)	CB Barrel Depth (m)	Ponding Depth at Spill (m)	Ponding Area (m2)	Ponding Volume (m3)
L200A	CB 200	104.76	106.14	1.38	0.20	161.7	10.8
L201A	CBMH201A	104.27	106.19	1.92	0.18	171.8	10.3
L201B	CB 201B	105.81	107.19	1.38	-	-	-
L201C	CB 201C	104.67	106.05	1.38	0.20	180.1	12.0
L202A	CB 202A	104.60	105.98	1.38	0.20	153.9	10.3
L202B	CB 202B	104.62	106.00	1.38	0.18	195.3	11.7
PARK	CBMH225A	103.43	106.42	2.99	0.30	70.0	7.0

Runoff captured from on-site catch basins (with the exception of the park block) is directed to a subsurface storage facility composed of modular perforated chambers within a clear stone bedding (StormTech Model

SC-740). Chambers within the facility are anticipated to maintain an invert of 103.70m, with top of chamber and top of clear stone elevations set at 104.46 and 104.62m respectively. The overall facility has been sized to provide an anticipated bottom area of 500m2, and is to provide a total storage volume of 500m3 at the top of stone elevation. Storage volumes within clear stone areas below the outgoing facility invert of 103.70 have been modeled as initially full of water for conservative analysis of the 2-year storm and larger event scenarios.

The facility is to be equipped with a 200mm outlet pipe directed to receiving on-site sewers, with discharge ultimately directed to the Obsidian Street storm sewer system. No building foundation drain connections are proposed to occur upstream of the proposed subsurface storage facility. In the event of blockage or storm event exceeding the design 100-year storm, an additional overflow sewer connection is proposed near the top of the facility (elevation 104.60m) to provide additional relief for surface catch basins. This pipe is unused for all modeled storm scenarios up to and including the 100-year storm event.

5.3.3.3 Hydraulic Parameters

As per the October 2012 City of Ottawa Sewer Design Guidelines, Manning's roughness values of 0.013 were used for sewer modeling and overland flow corridors representing roadways. Flow over grassed areas were modeled using a Manning's roughness value of 0.25. The storm sewers within the proposed development were modeled to estimate flow capacities and hydraulic grade lines (HGLs) in the proposed condition. The proposed storm sewer design sheet is included in **Appendix D**.

Exit losses at manholes were set for all pipe segments based on the flow angle through the structure. Exit losses were assigned as per City guidelines (Appendix 6b of the guidelines), see **Table 5-5** below.

Table 5–5: Exit Loss Coefficients for Bends at Manholes

Degrees	Coefficient
11	0.060
22	0.140
30	0.210
45	0.390
60	0.640
90	1.320
180	0.020

The proposed development's storm sewers were sized to convey runoff from a 2-Year storm using rational method calculations. The rational method design sheet can be found in **Appendix D**.

5.4 MODEL RESULTS AND DISCUSSION

The following section summarizes the key hydrologic and hydraulic model results. For detailed model results or inputs please refer to the example input files in **Appendix D** and the PCSWMM model on the enclosed digital files.

5.4.1 Hydrology

Table 5–6 summarizes the orifice link maximum flow rates and heads across the proposed development under the 2-year and 100-year storm scenarios. Discharge curves are as provided by the manufacturer for the selected IPEX Tempest ICDs. Note that several catch basins have not been provided with an inlet control device. These catch basins are controlled by their respective catch basin lead sizing to ensure full capture of 2-year storm event runoff. ICD sizing for the park block is conceptual in nature to meet target release rates and will be subject to future park block design by others.

Table 5–6 : Proposed ICD Schedule

Structure	Invert	ICD Type	100yr Head (m)	100yr Flow (L/s)	2yr Head (m)	2yr Flow (L/s)
CB 202A	104.60	IPEX TEMPEST HF 127mm	1.22	34.6	0.24	13.6
CB 202B	104.62	IPEX TEMPEST HF 102mm	1.51	25.0	0.58	15.0
CBMH225A	103.43	IPEX LMF 90	3.16	13.9	0.20	3.0

5.4.1.1 Uncontrolled Area

Due to grading restrictions, several subcatchments have been designed without a storage component. These catchment areas discharge off-site uncontrolled to the adjacent streets surrounding the proposed site. Peak discharge from uncontrolled areas UNC-3 and 4 is directed to the future Greenbank Road ROW, whereas areas UNC-1 and 2 are directed to the Obsidian Street ROW.

As noted in the SWM Reports for The Ridge and Drummond Subdivisions (JFSA 2020 and 2022), drainage to Greenbank Road is tributary the Clarke wet pond SWMF, whereas drainage to Obsidian (as well as the site minor system outlet) discharges to a downstream dry pond SWMF and oil/grit separator at Borrisokane Road. Both facilities ultimately outlet to the Jock River. As identified in the JFSA report for the Drummond Subdivision, a substantial flow reduction is proposed for peak flows to the Clarke Pond via the Half Moon Bay Trunk Sewer (approximately 2610L/s during the 100-Year 3hr Chicago event, and 1380L/s during the 100yr 24hr SCS event). Per report excerpts within **Appendix E**, it can be seen that the Clarke Pond can receive peak flows and volumes from the minor uncontrolled areas along the future realigned Greenbank Road without further need for flow control. Uncontrolled areas will be coordinated with the design of the future realigned Greenbank Road.

Peak flow rates from uncontrolled areas to Obsidian Street have been considered in the overall allowable flow allotment for the site, whereas outflow to Greenbank Road is to be considered in future roadway design.

5.4.2 Hydraulic Grade Line

A design sheet has been prepared for the proposed storm sewer in **Appendix D.1** demonstrating all on-site sewers remain free-flowing (HGLs within the sewer) using an uncontrolled 2-year rate.

Table 5–7 below summarizes the hydraulic grade line (HGL) results for the subject site's proposed minor system using the worst case storm event distribution. Per the City of Ottawa Sewer Design Guidelines (2012), a building's underside of footing (USF) must be a minimum 300 mm above the 100-year HGL in the nearest upstream storm manhole. In addition, the buildings USF must also be above the HGL resulting from the 100-year + 20% stress test event.

Table 5–7: Hydraulic Grade Line Results

Block #	USF (m)	Adjacent Upstream MH ID	Adjacent 100-Year HGL (m)	Freeboard (m)	Adjacent 100-Year +20% HGL (m)	Freeboard (m)
1	104.81	105	104.07	0.74	104.07	0.74
2	105.53	104	103.92	1.61	103.92	1.61
3	106.18	103	103.70	2.48	103.89	2.29
4	104.63	102	103.62	1.01	103.88	0.75
5	106.65	103	103.70	2.95	103.89	2.76
		EXMH	103.57		103.60	

Model results indicate that there is sufficient clearance between the 100-year and 100-year +20% stress test HGLs and the proposed USFs.

5.4.3 Overland Flow

Table 5-8 below presents the total surface water depths (static ponding depth + dynamic flow) on the proposed roads/parking areas for the 2-year and 100-year design storm distribution and the 100-year +20% climate change storm. In no case do surface water depths on roadways exceed 0.35m during the design storm events.

Table 5–8: Maximum Static and Dynamic Water Depths

Storage Node ID	Top of Grate Elevation (m)	Lowest Adjacent Building Elevation (m)	2-Year		100-Year		100-Year + 20%	
			Max Surface HGL (m)	Total Surface Ponding Depth (m)	Max Surface HGL (m)	Total Surface Ponding Depth (m)	Max Surface HGL (m)	Total Surface Ponding Depth (m)
CB 200A	106.14	106.68	105.09	0.00	106.22	0.08	106.36	0.22
CBMH201A	106.19	106.68	104.62	0.00	105.24	0.00	105.53	0.00

Storage Node ID	Top of Grate Elevation (m)	Lowest Adjacent Building Elevation (m)	2-Year		100-Year		100-Year + 20%	
			Max Surface HGL (m)	Total Surface Ponding Depth (m)	Max Surface HGL (m)	Total Surface Ponding Depth (m)	Max Surface HGL (m)	Total Surface Ponding Depth (m)
CB 201B*	107.19	107.40	105.95	0.00	106.39	0.00	106.69	0.00
CB 201C	106.05	106.48	104.84	0.00	105.68	0.00	106.10	0.05
CB 202A	105.98	106.45	104.84	0.00	105.82	0.00	106.10	0.12
CB 202B	106.00	106.45	105.20	0.00	106.13	0.13	106.18	0.18
PARK-S*	106.42	-	103.63	0.00	106.59	0.17	106.72	0.30

*Occurs within a managed landscaped area - not subject to road surface ponding.

Proposed site grading is such that should catch basin discharge orifices become blocked, flows will spill from catch basin grates overland to the site accesses in the northwest corner of the property, and out to Obsidian Street. Overland flows progress from Obsidian westward along existing Haiku Street.

5.4.4 Peak System Outflows

As identified in section 5.4.1.1 above, peak runoff from areas tributary to the realigned Greenbank Road proceed to a separate outfall designed with available capacity to receive such flows, and as such do not contribute directly to the allowable release rate to Obsidian Street. Peak discharge from the development is summarized in the table below:

Table 5–9: Peak Site Outflows

	2-Year	100-Year	100-Year + 20%
Minor System	33.0	72.6	229.1
Major System	0	0	0
UNC-1	9.9	29.1	36.0
UNC-2	8.7	25.6	31.6
Total	**51.6**	**127.3**	**296.7**
Allowable	**156.0**	**160.5**	**-**
Park	**3.0**	**13.9**	**14.2**
Allowable	**14.0**	**14.5**	**-**
Greenbank	**24.3**	**71.6**	**88.5**

Peak discharge from the development is within the allowable rate for the 2-year and 100-year storm events.

5.5 QUALITY CONTROL

Quality treatment of runoff will be partially provided through provision of an extended depth clear stone layer below the proposed underground SWM facility as highlighted in **Section 5.6** below. This system has been sized to collect and infiltrate runoff from first flush rainfall events up to and including the 22mm rainfall event to meet water balance requirements noted below. In addition, further quality control for the overall development will be provided by the existing downstream oil-grit separator (OGS) for The Ridge subdivision located downstream of the proposed development and discharging to the Jock River via an existing ditch on the west side of Borrisokane Road. The oil-and-grit separator has previously been sized to ensure 80% Total Suspended Solids (TSS) removal for the development inclusive of the proposed site. For more details regarding the OGS units within the downstream development, please refer to JFSA's July 2020, Pond Design Brief for the Ridge (Brazeau) Subdivision.

Based on assumptions made during design of the downstream phases, site development lands were assumed to contribute at an overall average imperviousness of 78.6% (C=0.75), and the OGS was sufficiently sized to provide the appropriate level of control at this value. The proposed development imperviousness is approximately 75%, which is within the assumed parameters for downstream OGS sizing.

According to Table 3.2 of the MOE Stormwater Management Planning and Design Manual, the storage volume required to achieve 80% long-term S.S. removal in an infiltration type system such as the proposed clear stone infiltration gallery is approximately 35 m3/impervious ha. The proposed 1.22ha development would then require approximately 42.7m3 of storage to provide quality control for the region. Per **Table 5-10** below, the proposed development provides approximately 180m3 of storage.

It is anticipated that the high level of treatment provided by implementation of the proposed on-site infiltration system (22mm of the required 25mm first flush storm event) in conjunction with the existing OGS via treatment train will provide more than adequate quality control to meet design criteria for the development.

5.6 WATER BALANCE

As a Best Management Practices (BMP) approach the Barrhaven South Urban Expansion Area (J.L. Richards & Associates, 2018) MSS requires the capture and infiltration of stormwater via exfiltration system installed on local roads, such as the private roads within the subject site, where the surface runoff is not impacted by the City's winter road salting program to meet pre-development water balance criteria. To avoid groundwater contamination, only salt-free agents may be used on site for winter maintenance of snow and ice. This includes, but is not limited to, all drive aisles, parking areas, sidewalks, and pathways.

The City and RVCA determined that predevelopment infiltration levels should be maintained under post development conditions and that the infiltration should be provided across the development. JFSA determined the infiltration target for the site to be of the average simulated annual rainfall volume (552.0 mm), which is calculated to be 220.8mm annually as reported by JFSA in **Appendix E.** Similar to the

BSUEA MSS, a 22mm storm event was selected for application within the current site plan to conservatively address post-development infiltration targets and water balance concerns.

An infiltration gallery has been proposed to be located below the stormwater management area of the subject site (Stormtech chambers), the proposed location of which is highlighted on **Drawing SD-1**.

For this exercise, the infiltration gallery has been conservatively sized assuming no infiltration during rain events (seepage = 0 mm/hr). The gallery will consist of a 900 mm clear stone layer with dimensions as identified on **Drawing SSP-1**. Minimum 600mm deep sumps (as per City of Ottawa standards) will be installed in upstream catch basins in order to prevent/mitigate debris and potential oils from entering the system. ICDs within proposed catch basins are proposed as Ipex Tempest models equipped with floatable controls to mitigate oil/debris incursion to the infiltration gallery.

Table 5–10: 22mm Event Simulated Infiltration Volumes

Location	Clear Stone Depth (m)	Gallery Area (m2)	Clear Stone Porosity	Available Volume (m^3)	Used Volume (m^3)
Stormtech Chamber Bedding	0.90	500	0.4	180.0	162.0

As can be seen in the above table, approximately 90% of the available volume in the gallery will be used in the 22mm event. There is no modeled outflow from controlled areas of the site during the 22mm event.

The Geotechnical Investigation for the adjacent residential development prepared by Paterson Group (May 2023) identifies hydraulic conductivity and infiltration values assumed to be roughly consistent with the proposed site. Table 2 on the Paterson report outlines infiltration rates determined through Pask Permeameter testing completed within six test pits for general coverage of the site (see table duplicated from the Paterson report below for reference).

Table 5–11: Summary of Field Saturated Hydraulic Conductivity Values and Infiltration Rates

Test Hole ID	Ground Surface Elevation (m)	Depth of Testing (m)	Kfs (m/sec)	Infiltration Rate (mm/hr)	Soil Type
TP1-23	103.01	2.7	Too Fast to Test		Silty to Medium Sand
		3.2	$3.2x10^{-4}$	216	
TP2-23	103.87	2.6	$9.6x10^{-5}$	156	Silty Sand
		3.2	Too Fast to Test		
TP3-23	104.37	2.5	$4.3x10^{-5}$	126	Silty Sand
		3.0	$9.6x10^{-5}$	156	
TP4-23	104.50	2.5	$9.6x10^{-5}$	156	Silty Sand
		3.0	$9.6x10^{-5}$	156	

Test Hole ID	Ground Surface Elevation (m)	Depth of Testing (m)	Kfs (m/sec)	Infiltration Rate (mm/hr)	Soil Type
TP5-23	104.70	2.5	$3.2x10^{-4}$	216	Silty Sand with Gravel, Cobbles, and Occasional Boulders
		3.3	Too Fast to Test		
TP6-23	104.94	2.5	$1.9x10^{-4}$	188	Silty to Medium Sand
		3.2	$2.2x10^{-4}$	195	

Infiltration rate testing at the lowest depth was used to assess inter-event drawdown times for the infiltration gallery. A safety factor of 3.5 was applied to the minimum infiltration rate at the lower elevation (156mm/hr) per suggestion of the *Low Impact Development Stormwater Management Planning and Design Guide* (Credit Valley Conservation, 2010), and was determined to be approximately 44.6mm/hr. Based on this rate, the known bottom area of the gallery, as well as anticipated volume retained per **Table 5-11** above, estimated drawdown rates have been determined for the gallery in the table below:

Table 5–12: 22mm Event Estimated Drawdown Times

Location	Bottom Area (m2)	Porosity	Used Volume (m^3)	Infiltration Rate (mm/hr)	Drawdown Time (hr)
Stormtech Chamber Bedding	500	0.4	162	44.6	18.2

Anticipated drawdown times are less than the required 48 hours for storm events up to and including 22mm of overall rainfall depth.

5.6.1 Monitoring During Construction

The following practices are recommended during construction:

- Surface flows to be directed away from clear stone bedding as it is being installed prior to backfill;
- Fueling of machinery to be done at designated locations away from proposed infiltration locations;
- Storage of machinery and material, fill, etc. to be done in designated areas away proposed infiltration locations;
- Equipment movement through proposed infiltration locations to be controlled;
- Regular inspection and maintenance of erosion control features corresponding to catch basins, catch basin manholes, and perforated subdrains.
- The infiltration system is to be jet flushed and inspected via CCTV upon construction completion prior to activation.

6.0 GEOTECHNICAL CONSIDERATIONS AND GRADING

6.1 GEOTECHNICAL INVESTIGATION

A geotechnical investigation report for the development was completed by Paterson Group on March 30, 2021, and revised in May 2023. The geotechnical investigation report is included in **Appendix E.3**.

The objective of the investigation was to determine the subsoil and groundwater conditions at this site by means of a borehole program and to provide geotechnical recommendations for the design of the proposed development based on the results on the boreholes and other soil information available.

Based on the Paterson's report, the subject site is a former agricultural land. The bulk of the current phase of the proposed development has been recently cleared of topsoil which has been stockpiled in several piles across the site. Generally, the ground surface across the subject site is relatively flat within the central portion and slopes up towards the edges. It should be noted that parts of the subject site had undergone excavation and in-filling activities as part of a previous sand extraction operation.

Generally, the subsurface profile across the subject site consists of varying amounts of fill consisting of silty sand mixed with occasional silty clay, gravel and cobbles. Practical refusal to augering was encountered at a range between 4.6 m and 8.3 m below existing ground surface.

6.1.1 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be low to moderate and controllable using open sumps. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

A temporary Ministry of the Environment, Conservation and Parks (MECP) permit to take water (PTTW) may be required for this project if more than 400,000 L/day of ground and/or surface water is to be pumped during the construction phase. A minimum of 4 to 5 months should be allowed for completion of the PTTW application package and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. Requirements for a PTTW or EASR registration are to be identified by the geotechnical consultant.

6.2 GRADING PLAN

The proposed development site measures 1.22ha in area. The existing topography across the site generally slopes in the northwest direction with an approximate 3 to 4 m elevation change from the southeast property line to the northwest property line.

A detailed Grading Plan (**Drawing GP-1)** has been provided to satisfy the stormwater management requirements, adhere to permissible grade raise restrictions, and provide for minimum cover requirements for the storm and sanitary sewers where possible. Site grading has been established to provide emergency overland flow routes required for stormwater management in accordance with City of Ottawa requirements.

The site maintains emergency overland flow routes through the previous phase 8 development via the onsite roadway and ultimately directed toward the Obsidian Street ROW in accordance with the subdivision design report. A primary grading consideration for this development is the interface between the subject lands and the future Greenbank Road ROW. The proposed elevations along the property line shared with the future Greenbank Road ROW have been coordinated with the design team for Greenbank Road for this submission. As the design for Greenbank Road is currently ongoing, further communication with the City of Ottawa and the design team for Greenbank Road will be required throughout the design stage to ensure the proposed site development utilizes the latest Greenbank Road profiles and resulting property line elevations.

It should be noted that parts of the subject site have undergone excavation and in-filling activities as part of a previous sand extraction operation.

7.0 APPROVALS

An Environmental Compliance Approval (ECA) may be required from the Ontario Ministry of the Environment, Conservation and Parks (MECP) for the proposed works should the site be operated as multiple separate entities along with downstream infrastructure in Phase 8. If the site remains under single ownership, it will comply with the exemptions from O.Reg. 525/98 and an ECA for traditional storm and sanitary sewers as well as the infiltration system would not be required. These exemptions require that the site is not on industrial land or for industrial use, would drain to an approved outlet and would be under single ownership. If, however, the land will be divided into separate legal properties either through severance or through the condominium process, approvals for the shared on-site storm sewers can be obtained through the EASR process. Sanitary sewers would continue to be exempt per the OWRA, as they continue to be discharged ultimately to municipal sewers.

Storm sewer extension for the proposed park block service will require an ECA, to be processed under the City of Ottawa's CLI-ECA (pre-approved activities).

The Rideau Valley Conservation Authority will need to be consulted in order to obtain municipal approval for site development.

An MECP Permit to Take Water (PTTW) or registration on the Environmental Activity and Sector Registry may be required as noted in **Section 5.0** above.

No other approval requirements from other regulatory agencies have been identified at the time of this report.

8.0 EROSION CONTROL

In order to protect downstream water quality and prevent sediment build up in catch basins and storm sewers, erosion and sediment control measures must be implemented during construction. The following recommendations will be included in the contract documents and communicated to the Contractor.

1. Implement best management practices to provide appropriate protection of the existing and proposed drainage system and the receiving water course(s).
2. Limit the extent of the exposed soils at any given time.
3. Re-vegetate exposed areas as soon as possible.
4. Minimize the area to be cleared and grubbed.
5. Protect exposed slopes with geotextiles, geogrid, or synthetic mulches.
6. Provide sediment traps and basins during dewatering works.
7. Install sediment traps (such as SiltSack® by Terrafix) between catch basins and frames.
8. Schedule the construction works at times which avoid flooding due to seasonal rains.

The Contractor will also be required to complete inspections and guarantee the proper performance of their erosion and sediment control measures at least after every rainfall. The inspections are to include:

- Verification that water is not flowing under silt barriers.
- Cleaning and changing the sediment traps placed on catch basins.

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 POTABLE WATER SERVICING

The PCSWMM EPANET Water model demonstrates that the pressures in the proposed development's watermain fall within the range of target system pressures under both domestic demand and fire flow scenarios.

The subject lands can be adequately serviced by 200mm watermain connection through the previous Phase 8 development and 300mm diameter watermain on Obsidian Street. The private distribution network, consisting of 200 mm diameter watermains with lopped connection, will provide sufficient fire flow to meet FUS requirements. System pressures will fall within the City of Ottawa Water Distribution Guidelines.

9.2 WASTEWATER SERVICING

The new phase 7 development is anticipated to generate an additional sanitary flow of 3.2 L/s. This in combination with the approved sanitary flow from the previous Phase 8 development equates to a total sanitary contribution of approximately 11L/s to the existing 200mm diameter sanitary sewer on Obsidian Street.

JLR Associates identified in its MSS for BSUEA stated that there is residual capacity within the sanitary sewers draining Mattamy lands west to new Greenbank Road based on a Stantec (2015) hydrodynamic model of trunk sanitary sewers (450 mm in diameter and greater), which in turn demonstrated that the existing downstream trunk system could accommodate the flows generated with no risk of surcharging or basement flooding.

9.3 STORMWATER MANAGEMENT AND SERVICING

The following summarizes the stormwater management conclusions for the proposed development:

- The proposed stormwater management plan is in compliance with the objectives specified in the City of Ottawa Sewer Design Guidelines and in the background reports for the site.
- The minor system (storm sewers) is sized to convey the 2-year storm event under free-flow conditions using City of Ottawa I-D-F parameters.
- ICDs installed on the proposed catch basins force flows in excess of the 2-year event to be conveyed by overland paved areas and stored within proposed parking and access regions.
- Quality control for the development has been provided by an existing downstream oil-grit separator in conjunction with the installation of an on-site infiltration system.

Clear stone storage for water retention and infiltration has been proposed to be located below the proposed quantity control SWMF within the subject site to meet water balance requirements of the BSUEA. The stormwater drainage plan has been designed to achieve stormwater servicing that is free of conflict with other services, respects the stormwater management requirement listed in background studies and in conformity with the City of Ottawa guidelines.

9.4 GRADING

The existing topography across the site generally slopes in the northwest direction with an approximate 3 to 4 m elevation change from the southeast property line to the northwest property line. A detailed Grading Plan has been provided to satisfy the stormwater management requirements, adhere to permissible grade raise restrictions, and provide for minimum cover requirements for the storm and sanitary sewers where possible. Terracing along the southeast property line is proposed to tie into existing grades within the adjacent property to the south.

9.5 APPROVALS/PERMITS

Approvals for shared storm infrastructure will be required via EASR through the Ontario Ministry of the Environment, Conservation and Parks (MECP) for the proposed works should the Phase 7 property be managed independently from receiving sewers within Phase 8. An MECP Permit to Take Water (PTTW) or registration on the Environmental Activity and Sector Registry may be required as noted in Section 6.0 above. Storm sewer extension for the proposed park block service will require an ECA, to be processed under the City of Ottawa's CLI-ECA (pre-approved activities). No other approval requirements from other regulatory agencies were identified at the time of this report. The Rideau Valley Conservation Authority will need to be consulted to obtain municipal approval for site development.

APPENDICES

Appendix A POTABLE WATER SERVICING

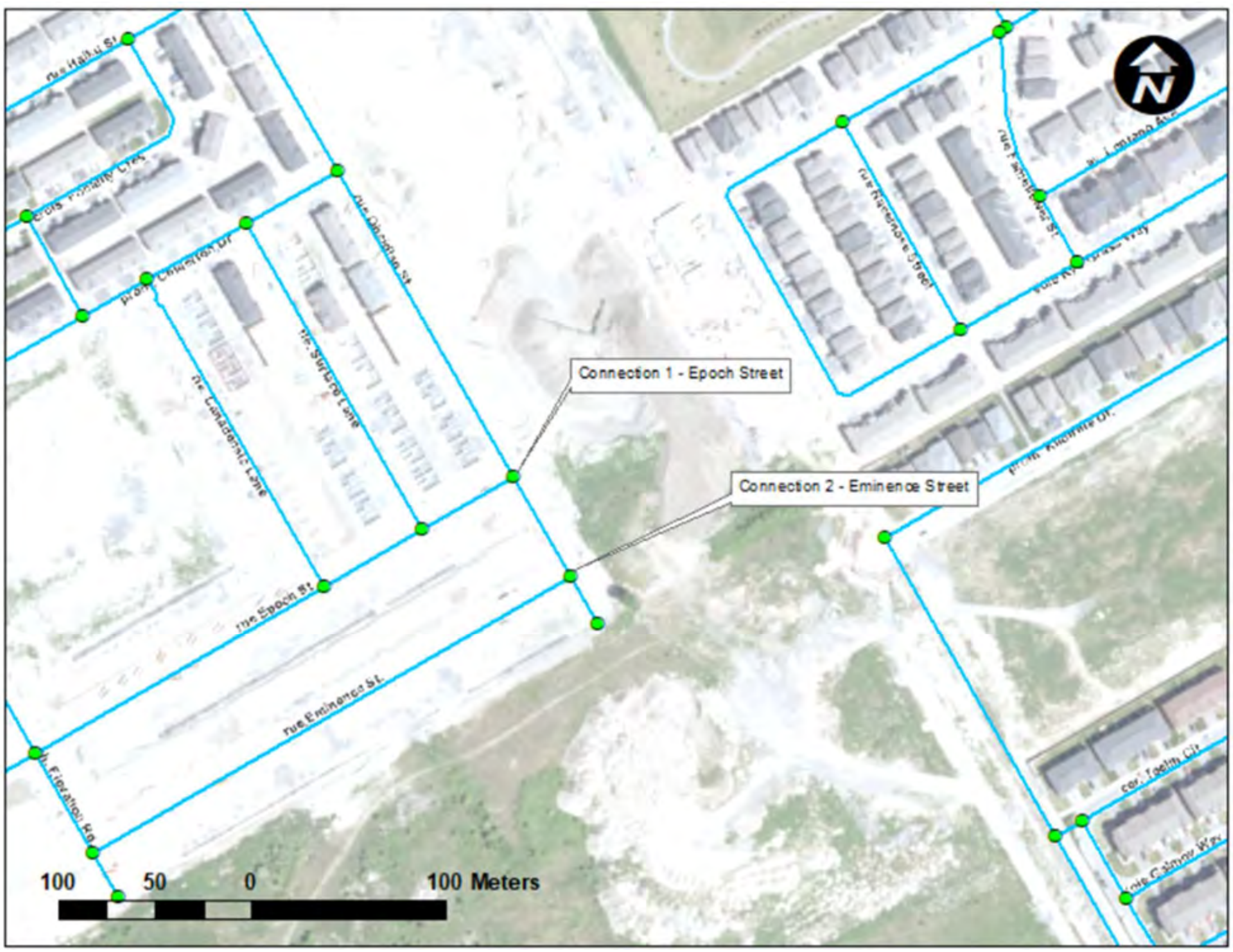
A.1 BOUNDARY CONDITIONS - CITY OF OTTAWA

Boundary Conditions
Half Moon Bay – Phase 7

Provided Information

Scenario	Demand	
	L/min	L/s
Average Daily Demand	47	0.79
Maximum Daily Demand	118	1.97
Peak Hour	260	4.33
Fire Flow Demand #1	10,000	166.67
Fire Flow Demand #2	15,000	250.00

Location



Results

Existing Condition (Pre- SUC Pressure Zone Reconfiguration)

Connection 1 – Epoch Street

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	156.5	78.2
Peak Hour	142.4	58.3
Max Day plus Fire Flow #1	138.6	52.8
Max Day plus Fire Flow #2	133.7	45.8

[1] Ground Elevation = 101.4 m

Connection 2 – Eminence Street

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	156.5	67.6
Peak Hour	142.4	47.7
Max Day plus Fire Flow #1	138.6	42.2
Max Day plus Fire Flow #2	132.5	33.6

[1] Ground Elevation = 108.9 m

Future Condition (Post- SUC Pressure Zone Reconfiguration)

Connection 1 - Epoch Street

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	146.8	64.4
Peak Hour	142.7	58.6
Max Day plus Fire Flow #1	138.0	52.0
Max Day plus Fire Flow #2	130.7	41.6

[1] Ground Elevation = 101.4 m

Connection 2 - Eminence Street

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	146.8	53.8
Peak Hour	142.7	48.1
Max Day plus Fire Flow #1	137.5	40.6
Max Day plus Fire Flow #2	129.6	29.5

[1] Ground Elevation = 108.9 m

Disclaimer

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

A.2 DOMESTIC WATER DEMAND CALCULATIONS

Domestic Water Demand Estimates - Half Moon Bay South Phase 7
Site Plan provided by Korsiak Urban Planning dated 2025-JUL-22
Project No. 160402143

Population densities as per Table 4.1 of the City of Ottawa Water Design Guidelines:		
Townhouses	2.7	ppu

Stantec

Block	Area (ha)	Units	Population	Daily Rate of Demand (L/cap/day) or (L/ha/day)	Avg Day Demand		Max Day Demand[1]		Peak Hour Demand[1]	
					(L/min)	(L/s)	(L/min)	(L/s)	(L/min)	(L/s)
Residential										
1		21	57	280	11.0	0.18	27.6	0.46	60.6	1.01
2		24	65	280	12.6	0.21	31.5	0.53	69.3	1.16
3		15	41	280	7.9	0.13	19.7	0.33	43.3	0.72
4		15	41	280	7.9	0.13	19.7	0.33	43.3	0.72
5		15	41	280	7.9	0.13	19.7	0.33	43.3	0.72
				Subtotal	**47.25**	**0.79**	**118.13**	**1.97**	**259.88**	**4.33**
Total Site :		**90**	**243**	**-**	**47.25**	**0.79**	**118.13**	**1.97**	**259.88**	**4.33**

Notes:

1. Population density for all residential units based on an population densities provided in Table 4.1 - Per Unit Populations of the City of Ottawa Water Distribution Design Guidelines (July 2010).
2. Average day water demand for residential areas: 280 L/cap/d per ISTB-2021-03
3. Average day water demand for commercial areas: 28,000 L/ha/d per *Table 4.2 Consumption Rates for subdivisions of 501 to 3,000 persons* (Ottawa Design Guidelines - Water Distribution, 2010)
4. The City of Ottawa water demand criteria used to estimate peak demand rates for residential areas are as follows:
   maximum day demand rate = 2.5 x average day demand rate for residential
   peak hour demand rate = 2.2 x maximum day demand rate for residential
5. Water demand criteria used to estimate peak demand rates for amenity/common areas are as follows:
   maximum daily demand rate = 1.5 x average day demand rate
   peak hour demand rate = 1.8 x maximum day demand rate

A.3 FUS (2020) FIRE FLOW REQUIREMENTS

Stantec

FUS Fire Flow Calculation Sheet - 2020 FUS Guidelines

Stantec Project #: 160401657
Project Name: Half Moon Bay phase 7
Date: 9/19/2025
Fire Flow Calculation #: 1
Description: Stacked Towhouse (Block 1 - West)

Notes: Three-storey wood frame stacked townhome with 21 unit, West portion separated by firewall

Step	Task	Notes										Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Type V - Wood Frame / Type IV-D - Mass Timber Construction										1.5	-
2	Determine Effective Floor Area	Sum of All Floor Areas										-	-
		465	465	465	0	0	0	0	0	0	0	1395.36	-
3	Determine Required Fire Flow	($F = 220 \times C \times A^{1/2}$). Round to nearest 1000 L/min										-	12000
4	Determine Occupancy Charge	Limited Combustible										-15%	10200
5	Determine Sprinkler Reduction	None										0%	0
		Non-Standard Water Supply or N/A										0%	
		Not Fully Supervised or N/A										0%	
		% Coverage of Sprinkler System										0%	
6	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall		Firewall / Sprinklered ?			-	-
		North	> 30	20	3	41-60	Type V		NO			0%	1734
		East	0 to 3	20	3	41-60	Type V		YES			0%	
		South	> 30	20	3	41-60	Type V		NO			0%	
		West	3.1 to 10	20	3	41-60	Type V		NO			17%	
7	Determine Final Required Fire Flow	Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min											12000
		Total Required Fire Flow in L/s											200.0
		Required Duration of Fire Flow (hrs)											2.50
		Required Volume of Fire Flow (m^3)											1800

FUS Fire Flow Calculation Sheet - 2020 FUS Guidelines

Stantec Project #: 160401657
Project Name: Half Moon Bay phase 7
Date: 9/19/2025
Fire Flow Calculation #: 2
Description: Stacked Towhouse (Block 1 - East)

Notes: Three-storey wood frame stacked townhome with 24 unit, East portion separated by firewall

Step	Task	Notes										Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Type V - Wood Frame / Type IV-D - Mass Timber Construction										1.5	-
2	Determine Effective Floor Area	Sum of All Floor Areas										-	-
		352	352	352	0	0	0	0	0	0	0	1055.28	-
3	Determine Required Fire Flow	(F = 220 x C x $A^{1/2}$). Round to nearest 1000 L/min										-	11000
4	Determine Occupancy Charge	Limited Combustible										-15%	9350
5	Determine Sprinkler Reduction	None										0%	0
		Non-Standard Water Supply or N/A										0%	
		Not Fully Supervised or N/A										0%	
		% Coverage of Sprinkler System										0%	
6	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall		Firewall / Sprinklered ?			-	-
		North	> 30	20	3	41-60	Type V		NO			0%	1122
		East	10.1 to 20	20	3	41-60	Type V		NO			12%	
		South	> 30	20	3	41-60	Type V		NO			0%	
		West	0 to 3	20	3	41-60	Type V		YES			0%	
7	Determine Final Required Fire Flow	Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min											10000
		Total Required Fire Flow in L/s											166.7
		Required Duration of Fire Flow (hrs)											2.00
		Required Volume of Fire Flow (m^3)											1200

FUS Fire Flow Calculation Sheet - 2020 FUS Guidelines

Stantec

Stantec Project #: 160401657
Project Name: Half Moon Bay phase 7
Date: 9/19/2025
Fire Flow Calculation #: 3
Description: Stacked Towhouse (Block 2)

Notes: Three-storey wood frame stacked townhome with 30 unit, West portion separated by firewall

Step	Task	Notes										Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Type V - Wood Frame / Type IV-D - Mass Timber Construction										1.5	-
2	Determine Effective Floor Area	Sum of All Floor Areas										-	-
		467	467	467	0	0	0	0	0	0	0	1401	-
3	Determine Required Fire Flow	(F = 220 x C x $A^{1/2}$). Round to nearest 1000 L/min										-	12000
4	Determine Occupancy Charge	Limited Combustible										-15%	10200
5	Determine Sprinkler Reduction	None										0%	0
		Non-Standard Water Supply or N/A										0%	
		Not Fully Supervised or N/A										0%	
		% Coverage of Sprinkler System										0%	
6	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall		Firewall / Sprinklered ?			-	-
		North	> 30	27	3	81-100	Type V		NO			0%	1734
		East	0 to 3	20	3	41-60	Type V		YES			0%	
		South	> 30	27	3	81-100	Type V		NO			0%	
		West	3.1 to 10	20	3	41-60	Type V		NO			17%	
7	Determine Final Required Fire Flow	Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min											12000
		Total Required Fire Flow in L/s											200.0
		Required Duration of Fire Flow (hrs)											2.50
		Required Volume of Fire Flow (m^3)											1800

FUS Fire Flow Calculation Sheet - 2020 FUS Guidelines

Stantec Project #: 160401657
Project Name: Half Moon Bay phase 7
Date: 9/19/2025
Fire Flow Calculation #: 4
Description: Stacked Towhouse (Block 2)

Notes: Three-storey wood frame stacked townhome with 30 unit, East portion separated by firewall

Step	Task	Notes										Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Type V - Wood Frame / Type IV-D - Mass Timber Construction										1.5	-
2	Determine Effective Floor Area	Sum of All Floor Areas										-	-
		467	467	467	0	0	0	0	0	0	0	1399.71	-
3	Determine Required Fire Flow	$(F = 220 \times C \times A^{1/2})$. Round to nearest 1000 L/min										-	12000
4	Determine Occupancy Charge	Limited Combustible										-15%	10200
5	Determine Sprinkler Reduction	None										0%	0
		Non-Standard Water Supply or N/A										0%	
		Not Fully Supervised or N/A										0%	
		% Coverage of Sprinkler System										0%	
6	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall		Firewall / Sprinklered ?			-	-
		North	> 30	27	3	81-100	Type V		NO			0%	1428
		East	> 30	20	3	41-60	Type V		NO			0%	
		South	10.1 to 20	27	3	81-100	Type V		NO			14%	
		West	0 to 3	20	3	41-60	Type V		YES			0%	
7	Determine Final Required Fire Flow	Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min											12000
		Total Required Fire Flow in L/s											200.0
		Required Duration of Fire Flow (hrs)											2.50
		Required Volume of Fire Flow (m^3)											1800

FUS Fire Flow Calculation Sheet - 2020 FUS Guidelines

Stantec Project #: 160401657
Project Name: Half Moon Bay phase 7
Date: 9/19/2025
Fire Flow Calculation #: 5
Description: Stacked Towhouse (Block 3)

Notes: Three-storey wood frame stacked townhome with 15 unit

Step	Task	Notes										Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Type V - Wood Frame / Type IV-D - Mass Timber Construction										1.5	-
2	Determine Effective Floor Area	Sum of All Floor Areas										-	-
		592	592	592	0	0	0	0	0	0	0	1775.16	-
3	Determine Required Fire Flow	(F = 220 x C x $A^{1/2}$). Round to nearest 1000 L/min										-	14000
4	Determine Occupancy Charge	Limited Combustible										-15%	11900
5	Determine Sprinkler Reduction	None										0%	0
		Non-Standard Water Supply or N/A										0%	
		Not Fully Supervised or N/A										0%	
		% Coverage of Sprinkler System										0%	
6	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall		Firewall / Sprinklered ?			-	-
		North	20.1 to 30	34	3	> 100	Type V		NO			10%	2975
		East	> 30	21	3	61-80	Type V		NO			0%	
		South	10.1 to 20	34	3	> 100	Type V		NO			15%	
		West	> 30	21	3	61-80	Type V		NO			0%	
7	Determine Final Required Fire Flow	Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min											15000
		Total Required Fire Flow in L/s											250.0
		Required Duration of Fire Flow (hrs)											3.00
		Required Volume of Fire Flow (m^3)											2700

FUS Fire Flow Calculation Sheet - 2020 FUS Guidelines

Stantec Project #: 160401657
Project Name: Half Moon Bay phase 7
Date: 9/19/2025
Fire Flow Calculation #: 6
Description: Stacked Towhouse (Block 4)

Notes: Three-storey wood frame stacked townhome with 15 unit

Step	Task	Notes										Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Type V - Wood Frame / Type IV-D - Mass Timber Construction										1.5	-
2	Determine Effective Floor Area	Sum of All Floor Areas										-	-
		592	592	592	0	0	0	0	0	0	0	1775.16	-
3	Determine Required Fire Flow	(F = 220 x C x $A^{1/2}$). Round to nearest 1000 L/min										-	14000
4	Determine Occupancy Charge	Limited Combustible										-15%	11900
5	Determine Sprinkler Reduction	None										0%	0
		Non-Standard Water Supply or N/A										0%	
		Not Fully Supervised or N/A										0%	
		% Coverage of Sprinkler System										0%	
6	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall		Firewall / Sprinklered ?			-	-
		North	> 30	34	3	> 100	Type V		NO			0%	1904
		East	20.1 to 30	21	3	61-80	Type V		NO			6%	
		South	20.1 to 30	34	3	> 100	Type V		NO			10%	
		West	> 30	21	3	61-80	Type V		NO			0%	
7	Determine Final Required Fire Flow	Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min											14000
		Total Required Fire Flow in L/s											233.3
		Required Duration of Fire Flow (hrs)											3.00
		Required Volume of Fire Flow (m^3)											2520

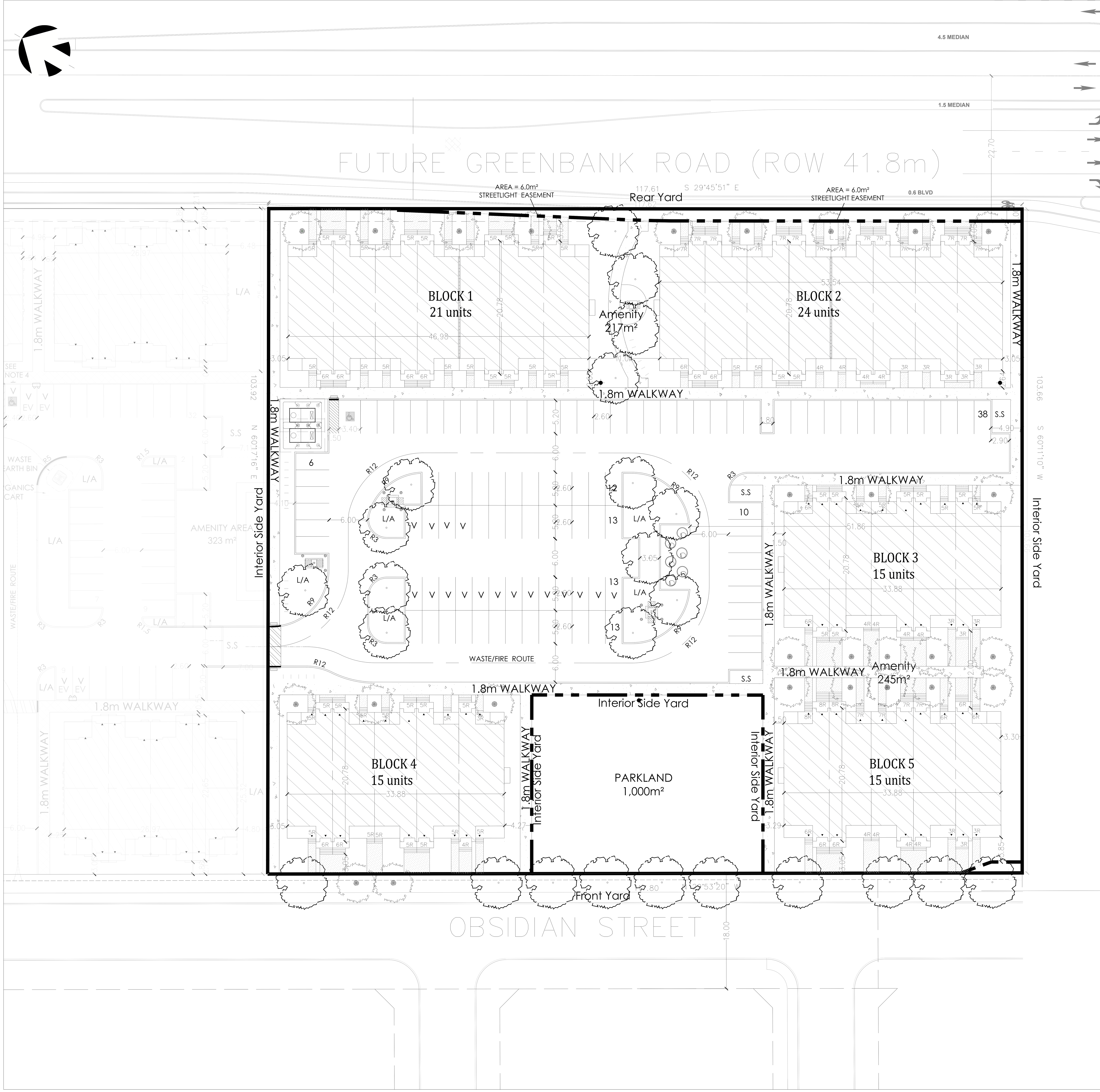
FUS Fire Flow Calculation Sheet - 2020 FUS Guidelines

Stantec Project #: 160401657
Project Name: Half Moon Bay phase 7
Date: 9/19/2025
Fire Flow Calculation #: 7
Description: Stacked Towhouse (Block 5)

Notes: Three-storey wood frame stacked townhome with 15 unit

Step	Task	Notes										Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Type V - Wood Frame / Type IV-D - Mass Timber Construction										1.5	-
2	Determine Effective Floor Area	Sum of All Floor Areas										-	-
		592	592	592	0	0	0	0	0	0	0	1776	-
3	Determine Required Fire Flow	($F = 220 \times C \times A^{1/2}$). Round to nearest 1000 L/min										-	14000
4	Determine Occupancy Charge	Limited Combustible										-15%	11900
5	Determine Sprinkler Reduction	None										0%	0
		Non-Standard Water Supply or N/A										0%	
		Not Fully Supervised or N/A										0%	
		% Coverage of Sprinkler System										0%	
6	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall		Firewall / Sprinklered ?			-	-
		North	10.1 to 20	34	3	> 100	Type V		NO			15%	2975
		East	> 30	21	3	61-80	Type V		NO			0%	
		South	20.1 to 30	34	3	> 100	Type V		NO			10%	
		West	> 30	21	3	61-80	Type V		NO			0%	
7	Determine Final Required Fire Flow	Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min											15000
		Total Required Fire Flow in L/s											250.0
		Required Duration of Fire Flow (hrs)											3.00
		Required Volume of Fire Flow (m^3)											2700

Appendix B DRAFT SITE PLAN



SITE STATISTICS AND DEVELOPMENT DATA

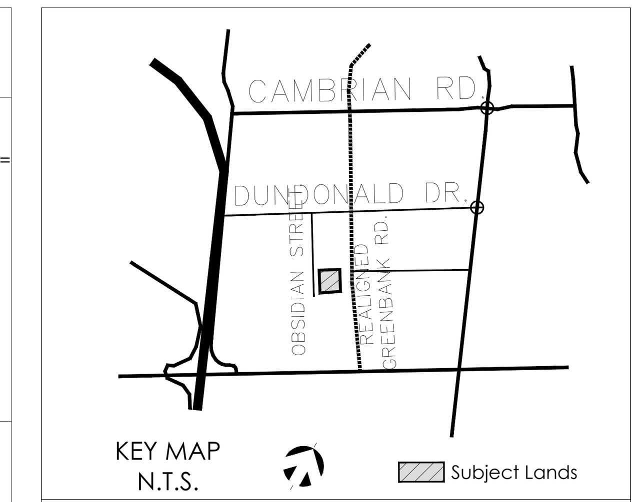
SITE AREA	12,217.33 m² (1.22 ha)
NET AREA	12,217 m² - 1000 m² (PARK) - 172 m²(ROAD WIDENING) = 11,045.97 m²
PAVED AREA	3,289.52 m² (30%)
LANDSCAPED AREA	4,163.02 m² (38%)
TOTAL BUILDING COVERAGE	3,595.67 m² (32%)
TOTAL GROSS FLOOR AREA	±10,324.40 m²
TOTAL UNITS	90
NET DENSITY (UPH)	82 UPH
ZONE CATEGORY	GM(2800)H(14.5)

DWELLING BLOCK	DWELLING TYPE	GROSS FLOOR AREA (m²)	UNITS
BLOCK 1	21 UNIT B2B STACKED DWELLING	±2,400.75	21
BLOCK 2	24 UNIT B2B STACKED DWELLING	±2,736.62	24
BLOCK 3	15 UNIT B2B STACKED DWELLING	±1,729.01	15
BLOCK 4	15 UNIT B2B STACKED DWELLING	±1,729.01	15
BLOCK 5	15 UNIT B2B STACKED DWELLING	±1,729.01	15
	TOTAL	**±10,324.40**	**90**

SECTION	ZONE PROVISION - PLANNED UNIT DEVELOPMENT	REQUIRED	PROPOSED
187 (Table)	MIN. LOT AREA (m²)	No minimum	12,217.33m²
187 (Table)	MIN. LOT WIDTH (m)	No minimum	117.7m
187 (Table)	MAX. BUILDING HEIGHT (m)	14.5m	11.2m
187 (Table)	MIN. FRONT YARD SETBACK (m)	3.0m	3.05m
187 (Table)	MIN. CORNER SIDE YARD SETBACK (m)	3.0m	N/A
	MIN. INTERIOR SIDE YARD SETBACK (m) FOR A BUILDING HIGHER THAN 11m:		
(2800)	NORTH INTERIOR SIDE LOT LINE	7.5m	3.05m
187 (Table)	SOUTH INTERIOR SIDE LOT LINE	3.0m	3.05m
	INTERIOR SIDE LOT LINE (ABUTTING PARK)	3.0m	4.27m/3.29m
187 (Table)	MIN. REAR YARD SETBACK:		
	ALL OTHER CASES (m)	No minimum	3.05m
187 (Table)	MAX. FLOOR SPACE INDEX	2	0.85
187 (Table)	MIN. WIDTH OF LANDSCAPED AREA		
	ABUTTING A STREET (m)	3m	3.05m
	ABUTTING A RESIDENTIAL ZONE	3m	3.05m
101 (Table)	RESIDENT PARKING - 1 spaces/unit	90	87
102 (Table)	VISITOR PARKING - 0.2 spaces/unit	18	18
111A (Table)	MIN. BICYCLE PARKING- 0.5 spaces/unit	45	48
131(Table)(1)	MIN. WIDTH OF PRIVATE WAY/ PARKING AISLE (m)	6.0m	6.0m
131(Table)(2)	MIN. SETBACK FOR ANY WALL OF A RESIDENTIAL USE BUILDING TO A PRIVATE WAY (m)	1.8m	3.5m
131(Table)(4)	MIN. SEPARATION DISTANCE BETWEEN BUILDINGS WITHIN A PLANNED UNIT DEVELOPMENT (m)	3.0m	11.04m

SECTION	ADDITIONAL PROVISIONS	REQUIRED	PROPOSED
65	PERMITTED PROJECTIONS INTO REQUIRED YARDS:		
65 (5)	FIRE ESCAPES, OPEN STAIRWAYS, STOOP (m)	>0.6m to lot line	N/A
65 (6)	COVERED OR UNCOVERED BALCONY, PORCH, DECK	>1m to lot line	N/A
57	MIN. TO CORNER SIGHT TRIANGLE (m)	0m	N/A
106 (1)(a)	MIN. PERPENDICULAR PARKING SPACE SIZE (m)	2.6m x 5.2m	2.6m x 5.2m
106 (2)(b)	MIN. BARRIER FREE PARKING*:	1	1
	TYPE A PARKING SPACE SIZE	3.4m wide	3.4m wide
	ACCESS AISLE (m)	1.5m	1.5m
111B(Table)	MIN. BICYCLE PARKING SPACE DIMENSIONS	0.6m x 1.8m	0.6m x 2.07m
109 (3)(b)	MAX. WALKWAY WIDTH PERMITTED IN YARD (m)	1.8m	1.8m
110 (Table)	LANDSCAPED AREA SURROUNDING PARKING LOT (100+ spaces):	15%	24%
	NOT ABUTTING A STREET (m)	3.0m	>3.0m
110 (3)	REFUSE COLLECTION AREAS:		
110 (3)(b)	MIN.WASTE COLLECTION SETBACK TO LOT LINE (m)	3.0m	51.86m
137 (Table)	AMENITY AREA**:		
	TOTAL MIN. AMENITY AREA (6m² per unit) (m²)	540m²	1,302 m²
	MIN. COMMUNAL AMENITY AREA (m²)(50% AREA)	270m²	462m²

*Per the 2014 Guide to the Integrated Accessibility Standards Regulation - Design of Public Spaces Standard, 4% of parking spaces provided for public use must be accessible. 1 of the provided 18 visitor spaces have been designed to be barrier-free, Type A size.
**Individual amenity areas are provided on the balconies



SCALE 1:300

LEGEND

- STACKED TOWNS
- ENTRANCE
- PORCH
- PROJECTION (STAIRS)
- CONCRETE
- CROSSWALK
- PAVERS
- CURB (0.2m)
- DEPRESSED CURB
- TACTILE WALKING SURFACE INDICATOR
- S.S SNOW STORAGE AREA
- L/A LANDSCAPED AREA
- PROPERTY LINE
- NO PARKING
- BARRIER FREE PARKING
- V VISITOR PARKING
- BIKE RACKS
- MOLOK BIN (6.5 yd³)
- R RISERS
- MINI-SUB
- SWITCHBOARD
- TRANSFORMER
- BOLLARD
- HYDRO CABINET
- LARGE DECIDUOUS TREE
- MEDIUM DECIDUOUS TREE
- PROPOSED FIRE HYDRANT

DATE [M.D.Y]	REVISION	BY
09/10/2025	2nd Submission	AS
05/14/2025	1st Submission	AS

GENERAL NOTES

1. DO NOT SCALE DRAWINGS FOR PRINT.
2. THIS DRAWING IS THE EXCLUSIVE PROPERTY OF KORSIAK URBAN PLANNING AND MATTAMY HOMES. COPYRIGHT RESERVED.
3. WALKWAYS AND CURBS TO BE TIED INTO PUBLIC ROW WHERE APPLICABLE.
4. REFERENCE CITY OF OTTAWA T.W.S.I. DETAIL SC7.3
5. SURVEY BOUNDARY PREPARED BY J.D BARNES LTD. 62 STEACIE DRIVE, SUITE 103, KANATA, ON K2K 2A9. TEL: (613) 731-7244 FAX: (613) 254-8659

PROJECT TEAM

SITE PLAN DESIGN: KORSIAK Urban Planning
LANDSCAPE ARCHITECTURE: NAK design strategies
PLANNING: FOTENN Planning + Design
TRANSPORTATION:
ARCHITECTURE: Q4A
MECHANICAL/ ELECTRICAL: LRL
CIVIL ENGINEER: Stantec

mattamyHOMES
50 Hines Road, Suite 100, Ottawa, ON Canada K2K 2M5

Half Moon Bay South
Phase 7 Condo Block

4159 Obsidian St, Ottawa

PART OF LOT 8
CONCESSION 3 (RIDEAU FRONT)
GEOGRAPHIC TOWNSHIP OF NEPEAN
CITY OF OTTAWA

TITLE: SITE PLAN

DATE:	September 10, 2025	DRAWN BY: AS CHECKED BY: CR	DRAWING NO. A
FILE NO.:	XXXXXXXXX		
JOB NO.:	Mattamy - Half Moon Bay		

Appendix C SANITARY SERVICING

C.1 SANITARY SEWER DESIGN SHEET

Stantec

SUBDIVISION:

Half Moon Bay South Phase 7

DATE:	9/19/2025
REVISION:	2
DESIGNED BY:	ZW
CHECKED BY:	DT

FILE NUMBER: 160402413

SANITARY SEWER DESIGN SHEET

(City of Ottawa)

DESIGN PARAMETERS

MAX PEAK FACTOR (RES.)=	4.0	AVG. DAILY FLOW / PERSON	280 l/p/day	MINIMUM VELOCITY	0.60 m/s
MIN PEAK FACTOR (RES.)=	2.0	COMMERCIAL	28,000 l/ha/day	MAXIMUM VELOCITY	3.00 m/s
PEAKING FACTOR (INDUSTRIAL):	2.4	INDUSTRIAL (HEAVY)	55,000 l/ha/day	MANNINGS n	0.013
PEAKING FACTOR (ICI >20%):	1.5	INDUSTRIAL (LIGHT)	35,000 l/ha/day	BEDDING CLASS	B
PERSONS / SINGLE	3.4	INSTITUTIONAL	28,000 l/ha/day	MINIMUM COVER	2.50 m
PERSONS / TOWNHOME	2.7	INFILTRATION	0.33 l/s/Ha	HARMON CORRECTION FACTOR	0.8
PERSONS / APARTMENT	1.8				

LOCATION			RESIDENTIAL AREA AND POPULATION									COMMERCIAL		INDUSTRIAL (L)		INDUSTRIAL (H)		INSTITUTIONAL		GREEN / UNUSED		C+I+I	INFILTRATION			TOTAL	PIPE								
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (ha)	UNITS SINGLE	UNITS TOWN	UNITS APT	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	FLOW (l/s)	LENGTH (m)	DIA (mm)	MATERIAL	CLASS	SLOPE (%)	CAP. (FULL) (l/s)	CAP. V PEAK FLOW (%)	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
R3A, R4A	4	3	0.68	0	60	0	162	0.68	162	3.54	1.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.68	0.68	0.2	2.1	99.0	200	PVC	SDR 35	0.40	21.1	**9.86%**	0.67	0.36
G3A	3	2	0.04	0	0	0	0	0.72	162	3.54	1.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.04	0.72	0.2	2.1	37.9	200	PVC	SDR 35	0.40	21.1	**9.94%**	0.66	0.35
R5A	5	2	0.46	0	27	0	73	0.46	73	3.62	0.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.46	0.46	0.2	1.0	101.3	200	PVC	SDR 35	0.40	21.1	**4.77%**	0.67	0.28
R2A	2	1	0.04	0	3	0	8	1.22	243	3.49	2.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.04	1.22	0.4	3.2	20.3	200	PVC	SDR 35	0.52	24.2	**13.04%**	0.76	0.43
																												200							

Appendix D STORMWATER MANAGEMENT

D.1 STORM SEWER DESIGN SHEET

Stantec

HMBS 7	
DATE:	2026-01-14
REVISION:	3
DESIGNED BY:	DT
CHECKED BY:	DT

STORM SEWER DESIGN SHEET
(City of Ottawa)

FILE NUMBER: **160402143**

DESIGN PARAMETERS

$I = a / (t+b)^c$ (As per City of Ottawa Guidelines, 2012)

	1:2 yr	1:5 yr	1:10 yr	1:100 yr					
a =	732.951	998.071	1174.184	1735.688	MANNING'S n =	0.013		BEDDING CLASS =	B
b =	6.199	6.053	6.014	6.014	MINIMUM COVER:	2.00	m		
c =	0.810	0.814	0.816	0.820	TIME OF ENTRY	10	min		

LOCATION / DRAINAGE AREA

AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (2-YEAR) (ha)	AREA (5-YEAR) (ha)	AREA (10-YEAR) (ha)	AREA (100-YEAR) (ha)	AREA (ROOF) (ha)	C (2-YEAR) (-)	C (5-YEAR) (-)	C (10-YEAR) (-)	C (100-YEAR) (-)	A x C (2-YEAR) (ha)	ACCUM AxC (2YR) (ha)	A x C (5-YEAR) (ha)	ACCUM. AxC (5YR) (ha)	A x C (10-YEAR) (ha)	ACCUM. AxC (10YR) (ha)	A x C (100-YEAR) (ha)	ACCUM. AxC (100YR) (ha)
L201C	201C	201A	0.12	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.096	0.096	0.000	0.000	0.000	0.000	0.000	0.000
L201B	201B	201A	0.16	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.128	0.128	0.000	0.000	0.000	0.000	0.000	0.000
L202B	202B	202	0.09	0.00	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.069	0.069	0.000	0.000	0.000	0.000	0.000	0.000
L202A	202	TANK	0.08	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.066	0.135	0.000	0.000	0.000	0.000	0.000	0.000
L201A	201A	TANK	0.17	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.136	0.360	0.000	0.000	0.000	0.000	0.000	0.000

DRAINAGE AREA (cont.) / PIPE SELECTION

AREA ID NUMBER	FROM M.H.	TO M.H.	T of C (min)	$I_{2\text{-YEAR}}$ (mm/h)	$I_{5\text{-YEAR}}$ (mm/h)	$I_{10\text{-YEAR}}$ (mm/h)	$I_{100\text{-YEAR}}$ (mm/h)	$Q_{CONTROL}$ (L/s)	ACCUM. $Q_{CONTROL}$ (L/s)	Q_{ACT} (CIA/360) (L/s)	LENGTH (m)	PIPE WIDTH OR DIAMETEI (mm)	PIPE HEIGHT (mm)	PIPE SHAPE (-)	MATERIAL (-)	CLASS (-)	SLOPE %	Q_{CAP} (FULL) (L/s)	% FULL (-)	VEL. (FULL) (m/s)	VEL. (ACT) (m/s)	TIME OF FLOW (min)
L201C	201C	201A	10.00	76.81	104.19	122.14	178.56	0.0	0.0	20.5	21.8	200	200	CIRCULAR	PVC	-	1.00	33.3	**61.49%**	1.05	0.95	0.38
			10.38									200	200									
L201B	201B	201A	10.00	76.81	104.19	122.14	178.56	0.0	0.0	27.3	31.3	250	250	CIRCULAR	PVC	-	4.35	126.0	**21.68%**	2.54	1.67	0.31
			10.31									250	250									
L202B	202B	202	10.00	76.81	104.19	122.14	178.56	0.0	0.0	14.8	9.8	200	200	CIRCULAR	PVC	-	1.01	33.4	**44.27%**	1.05	0.86	0.19
L202A	202	TANK	10.19	76.08	103.20	120.97	176.84	0.0	0.0	28.5	12.8	300	300	CIRCULAR	PVC	-	1.75	127.2	**22.41%**	1.81	1.21	0.18
			10.37									300	300									
L201A	201A	TANK	10.38	75.37	102.22	119.81	175.14	0.0	0.0	75.4	1.6	300	300	CIRCULAR	PVC	-	1.00	96.2	**78.38%**	1.37	1.34	0.02
			10.40									300	300									

Stantec	HMBS 7		STORM SEWER DESIGN SHEET (City of Ottawa)
	DATE:	2026-01-14	
	REVISION:	3	
	DESIGNED BY:	DT	FILE NUMBER: 160402143
	CHECKED BY:	DT	

DESIGN PARAMETERS

I = a / (t+b)[c] (As per City of Ottawa Guidelines, 2012)

	1:2 yr	1:5 yr	1:10 yr	1:100 yr			
a =	732.951	998.071	1174.184	1735.688	MANNING'S n =	0.013	BEDDING CLASS = B
b =	6.199	6.053	6.014	6.014	MINIMUM COVER:	2.00	m
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LOCATION / DRAINAGE AREA

AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (2-YEAR) (ha)	AREA (5-YEAR) (ha)	AREA (10-YEAR) (ha)	AREA (100-YEAR) (ha)	AREA (ROOF) (ha)	C (2-YEAR) (-)	C (5-YEAR) (-)	C (10-YEAR) (-)	C (100-YEAR) (-)	A x C (2-YEAR) (ha)	ACCUM AxC (2YR) (ha)	A x C (5-YEAR) (ha)	ACCUM. AxC (5YR) (ha)	A x C (10-YEAR) (ha)	ACCUM. AxC (10YR) (ha)	A x C (100-YEAR) (ha)	ACCUM. AxC (100YR) (ha)
	105	104	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	104	103	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	103	102	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	TANK 1	102	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	102	101	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	101	100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PARK	225A	225	0.10	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.040	0.040	0.000	0.000	0.000	0.000	0.000	0.000

FROM M.H.	TO M.H.	T of C (min)	I_{2-YEAR} (mm/h)	I_{5-YEAR} (mm/h)	$I_{10-YEAR}$ (mm/h)	$I_{100-YEAR}$ (mm/h)	$Q_{CONTROL}$ (L/s)	ACCUM. $Q_{CONTROL}$ (L/s)	Q_{ACT} (CIA/360) (L/s)
105	104	10.00	76.81	104.19	122.14	178.56	0.0	0.0	0.0
104	103	10.00	76.81	104.19	122.14	178.56	0.0	0.0	0.0
		10.00							
103	102	10.00	76.81	104.19	122.14	178.56	0.0	0.0	0.0
		10.00							
TANK 1	102	10.00	76.81	104.19	122.14	178.56	72.6	72.6	72.6
		10.07							
102	101	10.07	76.54	103.82	121.71	177.92	0.0	72.6	72.6
101	100	10.72	74.15	100.55	117.85	172.25	0.0	72.6	72.6
		11.02							
225A	225	10.00	76.81	104.19	122.14	178.56	0.0	0.0	8.5
		10.53							

PIPE SELECTION

FROM M.H.	TO M.H.	LENGTH (m)	PIPE WIDTH OR DIAMETE (mm)	PIPE HEIGHT (mm)	PIPE SHAPE (-)	MATERIAL (-)	CLASS (-)	SLOPE %	Q_{CAP} (FULL) (L/s)	% FULL (-)	VEL. (FULL) (m/s)	VEL. (ACT) (m/s)	TIME OF FLOW (min)
105	104	23.1	300	300	CIRCULAR	PVC	-	0.40	60.9	**0.00%**	0.87	0.00	0.00
104	103	40.5	300	300	CIRCULAR	PVC	-	0.40	60.8	**0.00%**	0.86	0.00	0.00
103	102	30.7	300	300	CIRCULAR	PVC	-	0.40	60.8	**0.00%**	0.86	0.00	0.00
TANK 1	102	6.1	450	450	CIRCULAR	CONCRETE	-	1.50	363.9	**19.95%**	2.22	1.44	0.07
102	101	31.2	525	525	CIRCULAR	CONCRETE	-	0.30	245.1	**29.62%**	1.10	0.80	0.65
101	100	14.3	525	525	CIRCULAR	CONCRETE	-	0.30	245.7	**29.54%**	1.10	0.80	0.30
			525	525									
225A	225	17.0	375	375	CIRCULAR	PVC	-	0.50	116.6	**7.32%**	1.11	0.53	0.53

D.2 SAMPLE PCSWMM INPUT (100YR CHICAGO)

```
[TITLE]
;;Project Title/Notes

[OPTIONS]
;;Option             Value
FLOW_UNITS           LPS
INFILTRATION         HORTON
FLOW_ROUTING         DYNWAVE
LINK_OFFSETS         ELEVATION
MIN_SLOPE            0
ALLOW_PONDING        YES
SKIP_STEADY_STATE    NO

START_DATE           04/25/2025
START_TIME           00:00:00
REPORT_START_DATE    04/25/2025
REPORT_START_TIME    00:00:00
END_DATE             04/26/2025
END_TIME             00:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          00:01:00
WET_STEP             00:01:00
DRY_STEP             00:01:00
ROUTING_STEP         1
RULE_STEP            00:00:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0
LENGTHENING_STEP     0
MIN_SURFAREA         0
MAX_TRIALS           8
HEAD_TOLERANCE       0.0015
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
```

```
THREADS              8

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
CONSTANT         0.0
DRY_ONLY         NO

[RAINGAGES]
;;Name           Format    Interval SCF      Source
;;-------------- --------- -------- -------- ----------
RG               INTENSITY 0:10     1.0      TIMESERIES 100C03

[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack

;;-------------- ---------------- ---------------- -------- -------- -------- -------- --------
----------------
;0.80
L200A            RG               200              0.224812 85.714   50.583   3        0

;0.80
L201A            RG               201A             0.165046 85.714   37.135   3        0

;0.80
L201B            RG               201B             0.157166 85.714   35.362   3        0

;0.80
L201C            RG               201C             0.117454 85.714   26.427   3        0

;0.82
L202A            RG               202A             0.076727 88.571   17.264   3        0

;0.77
L202B            RG               202B             0.087099 81.429   19.597   2        0

;0.40
PARK             RG               PARK-S           0.100819 28.571   22.684   1.5      0
```

```
;0.70
UNC-1            RG               OBSIDIAN         0.064545 71.429   14.523   3        0

;0.70
UNC-2            RG               OBSIDIAN         0.056712 71.429   12.76    3        0

;0.70
UNC-3            RG               GB               0.079886 71.429   17.974   3        0

;0.70
UNC-4            RG               GB               0.078723 71.429   17.713   3        0


[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
L200A            0.013      0.25       1.57       4.67       0          OUTLET
L201A            0.013      0.25       1.57       4.67       0          OUTLET
L201B            0.013      0.25       1.57       4.67       0          OUTLET
L201C            0.013      0.25       1.57       4.67       0          OUTLET
L202A            0.013      0.25       1.57       4.67       0          OUTLET
L202B            0.013      0.25       1.57       4.67       0          OUTLET
PARK             0.013      0.25       1.57       4.67       0          PERVIOUS   100
UNC-1            0.013      0.25       1.57       4.67       0          OUTLET
UNC-2            0.013      0.25       1.57       4.67       0          OUTLET
UNC-3            0.013      0.25       1.57       4.67       0          OUTLET
UNC-4            0.013      0.25       1.57       4.67       0          OUTLET

[INFILTRATION]
;;Subcatchment   Param1     Param2     Param3     Param4     Param5
;;-------------- ---------- ---------- ---------- ---------- ----------
L200A            76.2       13.2       4.14       7          0
L201A            76.2       13.2       4.14       7          0
L201B            76.2       13.2       4.14       7          0
L201C            76.2       13.2       4.14       7          0
L202A            76.2       13.2       4.14       7          0
L202B            76.2       13.2       4.14       7          0
PARK             76.2       13.2       4.14       7          0
UNC-1            76.2       13.2       4.14       7          0
```

```
UNC-2            76.2       13.2       4.14       7          0
UNC-3            76.2       13.2       4.14       7          0
UNC-4            76.2       13.2       4.14       7          0

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
GB               0          FREE                        NO
OBSIDIAN         0          FREE                        NO
STM225A          103.43     FIXED      103.572          NO
SWR-OUT          103        FIXED      103.572          NO

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve Name/Params            SurDepth Fevap
Psi      Ksat     IMD
;;-------------- -------- ---------- ---------- ---------- ---------------------------- -------- --------
-------- -------- --------
100              103.1    3.28       0.472      FUNCTIONAL  0         0         1.13     0        0
101              103.2    3.44       0.372      FUNCTIONAL  0         0         1.13     0        0
102              103.35   3.32       0.222      FUNCTIONAL  0         0         1.13     0        0
103              103.7    4.08       0          FUNCTIONAL  0         0         1.13     0        0
104              103.92   3.05       0          FUNCTIONAL  0         0         1.13     0        0
105              104.07   2.4        0          FUNCTIONAL  0         0         1.13     0        0
200              104.76   1.78       0          TABULAR     200-V                        0        0
201A             104.27   2.32       0          TABULAR     201A-V                       0        0
201B             105.81   1.78       0          FUNCTIONAL  0         0         0.36     0        0
201C             104.67   1.78       0          TABULAR     201C-V                       0        0
202              104.46   1.74       0          FUNCTIONAL  0         0         1.13     0        0
202A             104.6    1.78       0          TABULAR     202A-V                       0        0
202B             104.62   1.78       0          TABULAR     202B-V                       0        0
PARK-S           103.43   3.29       0          TABULAR     PARK-V                       0        0
TANK             102.8    3.18       0.9        TABULAR     TANK-V                       0        0

[CONDUITS]
;;Name           From Node        To Node          Length     Roughness  InOffset   OutOffset  InitFlow
MaxFlow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ----------
----------
100-OUT          100              SWR-OUT          7.861      0.013      103.1      103.053    0          0
```

```
101-100          101              100              14.34      0.013      103.2      103.16     0          0

102-101          102              101              31.15      0.013      103.35     103.26     0          0

103-102          103              102              30.74      0.013      103.7      103.58     0          0

104-103          104              103              40.525     0.013      103.92     103.76     0          0

105-104          105              104              23.146     0.013      104.07     103.98     0          0

201B-201         201B             201A             31.319     0.013      105.81     105.5      0          0

201-O            201A             TANK             1.625      0.013      104.27     104.25     0          0

202-TANK         202              TANK             12.791     0.013      104.46     104.24     0          0

OVR              TANK             102              10.105     0.013      104.6      104.5      0          0

[ORIFICES]
;;Name           From Node        To Node          Type         Offset     Qcoeff     Gated    CloseTime
;;-------------- ---------------- ---------------- ------------ ---------- ---------- -------- ----------
200-O            200              TANK             SIDE         104.76     0.61       NO       0
201C-O           201C             201A             SIDE         104.67     0.61       NO       0
202A-O           202A             202              SIDE         104.6      0.572      NO       0
202B-O           202B             202              SIDE         104.62     0.572      NO       0
OR1              TANK             102              SIDE         103.7      0.61       NO       0

[WEIRS]
;;Name           From Node        To Node          Type         CrestHt    Qcoeff     Gated    EndCon
EndCoeff   Surcharge  RoadWidth  RoadSurf   Coeff. Curve
;;-------------- ---------------- ---------------- ------------ ---------- ---------- -------- --------
---------- ---------- ---------- ---------- ----------------
W1               200              202A             TRANSVERSE   106.34     1.67       NO       0        0
       YES

[OUTLETS]
;;Name           From Node        To Node          Offset     Type             QTable/Qcoeff    Qexpon
Gated
;;-------------- ---------------- ---------------- ---------- ---------------- ---------------- ----------
--------
OL1              PARK-S           STM225A          103.43     FUNCTIONAL/HEAD  7.996            0.5
NO

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels    Culvert
;;-------------- ------------ ---------------- ---------- ---------- ---------- ---------- ----------
100-OUT          CIRCULAR     0.525            0          0          0          1
101-100          CIRCULAR     0.525            0          0          0          1
102-101          CIRCULAR     0.525            0          0          0          1
103-102          CIRCULAR     0.3              0          0          0          1
104-103          CIRCULAR     0.3              0          0          0          1
105-104          CIRCULAR     0.3              0          0          0          1
201B-201         CIRCULAR     0.25             0          0          0          1
201-O            CIRCULAR     0.3              0          0          0          1
202-TANK         CIRCULAR     0.3              0          0          0          1
OVR              CIRCULAR     0.45             0          0          0          1
200-O            CIRCULAR     0.2              0          0          0
201C-O           CIRCULAR     0.2              0          0          0
202A-O           CIRCULAR     0.127            0          0          0
202B-O           CIRCULAR     0.102            0          0          0
OR1              CIRCULAR     0.2              0          0          0
W1               RECT_OPEN    0.2              6          0          0

[LOSSES]
;;Link           Kentry     Kexit      Kavg       Flap Gate  Seepage
;;-------------- ---------- ---------- ---------- ---------- ----------
101-100          0          1.344      0          NO         0
102-101          0          1.344      0          NO         0
103-102          0          1.344      0          NO         0
104-103          0          1.344      0          NO         0
105-104          0          1.344      0          NO         0
201B-201         0          1.344      0          NO         0
201-O            0          1.344      0          NO         0
202-TANK         0          1.344      0          NO         0

[CURVES]
```

```
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
200-V            Storage    0          0.36
200-V                       1.38       0.36
200-V                       1.58       107.8
200-V                       1.58001    0
200-V                       1.78       0

201A-V           Storage    0          1.13
201A-V                      1.92       1.13
201A-V                      2.1        114.5
201A-V                      2.10001    0
201A-V                      2.32       0

201C-V           Storage    0          0.36
201C-V                      1.38       0.36
201C-V                      1.58       120.1
201C-V                      1.58001    0
201C-V                      1.78       0

202A-V           Storage    0          0.36
202A-V                      1.38       0.36
202A-V                      1.58       102.6
202A-V                      1.58001    0
202A-V                      1.78       0

202B-V           Storage    0          0.36
202B-V                      1.38       0.36
202B-V                      1.56       130.2
202B-V                      1.560001   0
202B-V                      1.78       0

PARK-V           Storage    0          1.13
PARK-V                      2.99       1.13
PARK-V                      3.29       70
PARK-V                      3.39       70

TANK-V           Storage    0          198.5478
TANK-V                      0.89999    198.5478
```

```
TANK-V                      0.9        496.3695
TANK-V                      0.9254     452.0556969
TANK-V                      0.9508     489.873437
TANK-V                      0.9762     445.5596339
TANK-V                      1.0016     483.377374
TANK-V                      1.027      439.0635709
TANK-V                      1.0524     470.385248
TANK-V                      1.0778     426.0714449
TANK-V                      1.1032     457.393122
TANK-V                      1.1286     413.0793189
TANK-V                      1.154      444.4009961
TANK-V                      1.1794     400.0871929
TANK-V                      1.2048     431.4088701
TANK-V                      1.2302     387.0950669
TANK-V                      1.2556     418.4167441
TANK-V                      1.281      374.1029409
TANK-V                      1.3064     405.4246181
TANK-V                      1.3318     361.110815
TANK-V                      1.3572     392.4324921
TANK-V                      1.3826     341.622626
TANK-V                      1.408      372.9443031
TANK-V                      1.4334     315.638374
TANK-V                      1.4588     346.9600512
TANK-V                      1.4842     289.654122
TANK-V                      1.5096     320.9757992
TANK-V                      1.535      263.6698701
TANK-V                      1.5604     294.9915472
TANK-V                      1.5858     237.6856181
TANK-V                      1.6112     262.5112323
TANK-V                      1.6366     200.0435965
TANK-V                      1.662      207.8740157
TANK-V                      1.6874     207.8740157
TANK-V                      1.7128     207.8740157
TANK-V                      1.7382     207.8740157
TANK-V                      1.7636     207.8740157
TANK-V                      1.789      207.8740157
TANK-V                      1.8144     207.8740157
TANK-V                      1.8154     0
TANK-V                      5          0
```

```
[TIMESERIES]
;;Name           Date       Time       Value     
;;-------------- ---------- ---------- ----------
002C03                      0:00       0
002C03                      0:10       2.81
002C03                      0:20       3.5
002C03                      0:30       4.69
002C03                      0:40       7.3
002C03                      0:50       18.21
002C03                      1:00       76.81
002C03                      1:10       24.08
002C03                      1:20       12.36
002C03                      1:30       8.32
002C03                      1:40       6.3
002C03                      1:50       5.09
002C03                      2:00       4.29
002C03                      2:10       3.72
002C03                      2:20       3.29
002C03                      2:30       2.95
002C03                      2:40       2.68
002C03                      2:50       2.46
002C03                      3:00       2.28

025M04                      0:10       1.516088055
025M04                      0:20       1.749115351
025M04                      0:30       2.078715445
025M04                      0:40       2.583625152
025M04                      0:50       3.461716789
025M04                      1:00       5.394996968
025M04                      1:10       13.44811663
025M04                      1:20       56.72433275
025M04                      1:30       17.78358976
025M04                      1:40       9.131254948
025M04                      1:50       6.147712357
025M04                      2:00       4.655383456
025M04                      2:10       3.762897479
025M04                      2:20       3.169361772
025M04                      2:30       2.745825503
```

```
025M04                      2:40       2.428071751
025M04                      2:50       2.180598417
025M04                      3:00       1.982179574
025M04                      3:10       1.819403154
025M04                      3:20       1.683310546
025M04                      3:30       1.567742242
025M04                      3:40       1.468311255
025M04                      3:50       1.381797508
025M04                      4:00       1.305793328

100C03                      0:00       0
100C03                      0:10       6.05
100C03                      0:20       7.54
100C03                      0:30       10.16
100C03                      0:40       15.97
100C03                      0:50       40.65
100C03                      1:00       178.56
100C03                      1:10       54.05
100C03                      1:20       27.32
100C03                      1:30       18.24
100C03                      1:40       13.74
100C03                      1:50       11.06
100C03                      2:00       9.29
100C03                      2:10       8.02
100C03                      2:20       7.08
100C03                      2:30       6.35
100C03                      2:40       5.76
100C03                      2:50       5.28
100C03                      3:00       4.88

120C03                      0:00       0
120C03                      0:10       7.26
120C03                      0:20       9.048
120C03                      0:30       12.192
120C03                      0:40       19.164
120C03                      0:50       48.78
120C03                      1:00       214.272
120C03                      1:10       64.86
120C03                      1:20       32.784
```

```
120C03                    1:30       21.888
120C03                    1:40       16.488
120C03                    1:50       13.272
120C03                    2:00       11.148
120C03                    2:10       9.624
120C03                    2:20       8.496
120C03                    2:30       7.62
120C03                    2:40       6.912
120C03                    2:50       6.336
120C03                    3:00       5.856

[REPORT]
;;Reporting Options
INPUT      YES
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]
Node       100              MN
Node       101              MN
Node       102              MN
Node       103              MN
Node       104              MN
Node       105              MN
Node       202              MN

[MAP]
DIMENSIONS       364298.29965     5011168.87725    364459.98535     5011337.91975
UNITS            Meters

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
GB               364427.324         5011284.686
OBSIDIAN         364312.148         5011261.709
STM225A          364327.852         5011229.961
SWR-OUT          364312.558         5011252.692
```

```
100              364319.4           5011257
101              364326.5           5011244.2
102              364353.5           5011259.7
103              364368.9           5011233.1
104              364404.2           5011252.9
105              364392.6           5011273
200              364376.6           5011253
201A             364383.8           5011268.6
201B             364402.9           5011243.8
201C             364372.8           5011287.5
202              364356.2           5011288.4
202A             364364.3           5011276
202B             364345.6           5011281
PARK-S           364342.617         5011235.299
TANK             364367.2           5011270

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
OVR              364359.373         5011261.981
W1               364374.603         5011264.235

[POLYGONS]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
L200A            364405.779         5011199.806
L200A            364364.35          5011176.561
L200A            364364.35          5011176.561
L200A            364375.628         5011186.877
L200A            364375.628         5011186.877
L200A            364356.58          5011218.736
L200A            364356.58          5011218.736
L200A            364368.332         5011225.543
L200A            364368.332         5011225.543
L200A            364350.414         5011256.811
L200A            364350.414         5011256.811
L200A            364351.681         5011258.628
L200A            364351.681         5011258.628
L200A            364353.385         5011261.689
```

L200A	364353.385	5011261.689
L200A	364360.449	5011265.848
L200A	364360.449	5011265.848
L200A	364374.533	5011273.926
L200A	364374.533	5011273.926
L200A	364383.06	5011259.348
L200A	364383.06	5011259.348
L200A	364383.439	5011252.595
L200A	364383.439	5011252.595
L200A	364374.978	5011247.755
L200A	364374.978	5011247.755
L200A	364377.213	5011243.846
L200A	364377.213	5011243.846
L200A	364378.549	5011241.015
L200A	364378.549	5011241.015
L200A	364378.58	5011238.047
L200A	364378.58	5011238.047
L200A	364378.475	5011231.586
L200A	364378.475	5011231.586
L200A	364380.335	5011228.614
L200A	364380.335	5011228.614
L200A	364387.224	5011232.561
L200A	364387.224	5011232.561
L200A	364403.829	5011202.916
L200A	364403.829	5011202.916
L200A	364405.779	5011199.806
L201A	364400.543	5011291.027
L201A	364407.321	5011279.171
L201A	364407.321	5011279.171
L201A	364423.139	5011278.933
L201A	364423.139	5011278.933
L201A	364413.044	5011269.815
L201A	364413.044	5011269.815
L201A	364421.472	5011254.899
L201A	364421.472	5011254.899
L201A	364404.02	5011244.417
L201A	364404.02	5011244.417
L201A	364397.66	5011240.275
L201A	364397.66	5011240.275

L201A	364387.224	5011232.561
L201A	364387.224	5011232.561
L201A	364380.335	5011228.614
L201A	364380.335	5011228.614
L201A	364378.475	5011231.586
L201A	364378.475	5011231.586
L201A	364378.58	5011238.047
L201A	364378.58	5011238.047
L201A	364378.549	5011241.015
L201A	364378.549	5011241.015
L201A	364377.213	5011243.846
L201A	364377.213	5011243.846
L201A	364374.978	5011247.755
L201A	364374.978	5011247.755
L201A	364383.439	5011252.595
L201A	364383.439	5011252.595
L201A	364383.06	5011259.348
L201A	364383.06	5011259.348
L201A	364374.533	5011273.926
L201A	364374.533	5011273.926
L201A	364391.607	5011285.728
L201A	364391.607	5011285.728
L201A	364400.543	5011291.027
L201B	364421.472	5011254.899
L201B	364439.372	5011223.103
L201B	364439.372	5011223.103
L201B	364429.792	5011214.106
L201B	364429.792	5011214.106
L201B	364405.779	5011199.806
L201B	364405.779	5011199.806
L201B	364403.829	5011202.916
L201B	364403.829	5011202.916
L201B	364387.224	5011232.561
L201B	364387.224	5011232.561
L201B	364397.66	5011240.275
L201B	364397.66	5011240.275
L201B	364404.02	5011244.417
L201B	364404.02	5011244.417
L201B	364421.472	5011254.899

L201C	364355.509	5011307.185
L201C	364383.43	5011323.177
L201C	364383.43	5011323.177
L201C	364383.979	5011319.944
L201C	364383.979	5011319.944
L201C	364400.543	5011291.027
L201C	364400.543	5011291.027
L201C	364391.607	5011285.728
L201C	364391.607	5011285.728
L201C	364374.533	5011273.926
L201C	364374.533	5011273.926
L201C	364366.362	5011288.723
L201C	364366.362	5011288.723
L201C	364363.242	5011290.781
L201C	364363.242	5011290.781
L201C	364361.178	5011292.468
L201C	364361.178	5011292.468
L201C	364359.811	5011295.159
L201C	364359.811	5011295.159
L201C	364357.685	5011303.702
L201C	364357.685	5011303.702
L201C	364355.509	5011307.185
L202A	364338.945	5011250.313
L202A	364337.03	5011253.849
L202A	364337.03	5011253.849
L202A	364330.155	5011265.967
L202A	364330.155	5011265.967
L202A	364340.668	5011272.009
L202A	364340.668	5011272.009
L202A	364345.602	5011275.299
L202A	364345.602	5011275.299
L202A	364346.858	5011277.574
L202A	364346.858	5011277.574
L202A	364351.317	5011280.08
L202A	364351.317	5011280.08
L202A	364356.583	5011283.08
L202A	364356.583	5011283.08
L202A	364355.121	5011285.646
L202A	364355.121	5011285.646

L202A	364363.242	5011290.781
L202A	364363.242	5011290.781
L202A	364366.362	5011288.723
L202A	364366.362	5011288.723
L202A	364374.533	5011273.926
L202A	364374.533	5011273.926
L202A	364360.449	5011265.848
L202A	364360.449	5011265.848
L202A	364353.385	5011261.689
L202A	364353.385	5011261.689
L202A	364351.681	5011258.628
L202A	364351.681	5011258.628
L202A	364350.414	5011256.811
L202A	364350.414	5011256.811
L202A	364345.559	5011254.023
L202A	364345.559	5011254.023
L202A	364338.945	5011250.313
L202B	364333.798	5011294.846
L202B	364332.559	5011297.136
L202B	364332.559	5011297.136
L202B	364337.769	5011300.131
L202B	364337.769	5011300.131
L202B	364341.49	5011299.213
L202B	364341.49	5011299.213
L202B	364355.509	5011307.185
L202B	364355.509	5011307.185
L202B	364357.685	5011303.702
L202B	364357.685	5011303.702
L202B	364359.811	5011295.159
L202B	364359.811	5011295.159
L202B	364361.178	5011292.468
L202B	364361.178	5011292.468
L202B	364363.242	5011290.781
L202B	364363.242	5011290.781
L202B	364355.121	5011285.646
L202B	364355.121	5011285.646
L202B	364356.583	5011283.08
L202B	364356.583	5011283.08
L202B	364351.317	5011280.08

L202B	364351.317	5011280.08
L202B	364346.858	5011277.574
L202B	364346.858	5011277.574
L202B	364345.602	5011275.299
L202B	364345.602	5011275.299
L202B	364340.668	5011272.009
L202B	364340.668	5011272.009
L202B	364330.155	5011265.967
L202B	364330.155	5011265.967
L202B	364320.064	5011283.491
L202B	364320.064	5011283.491
L202B	364326.957	5011287.451
L202B	364326.957	5011287.451
L202B	364329.64	5011290.478
L202B	364329.64	5011290.478
L202B	364333.798	5011294.846
PARK	364356.58	5011218.736
PARK	364344.176	5011211.621
PARK	364344.176	5011211.621
PARK	364326.099	5011243.356
PARK	364326.099	5011243.356
PARK	364338.945	5011250.313
PARK	364338.945	5011250.313
PARK	364345.559	5011254.023
PARK	364345.559	5011254.023
PARK	364350.414	5011256.811
PARK	364350.414	5011256.811
PARK	364368.332	5011225.543
PARK	364368.332	5011225.543
PARK	364356.58	5011218.736
UNC-1	364338.945	5011250.313
UNC-1	364326.099	5011243.356
UNC-1	364326.099	5011243.356
UNC-1	364305.649	5011278.69
UNC-1	364305.649	5011278.69
UNC-1	364333.798	5011294.846
UNC-1	364333.798	5011294.846
UNC-1	364329.64	5011290.478
UNC-1	364329.64	5011290.478
UNC-1	364326.957	5011287.451
UNC-1	364326.957	5011287.451
UNC-1	364320.064	5011283.491
UNC-1	364320.064	5011283.491
UNC-1	364330.155	5011265.967
UNC-1	364330.155	5011265.967
UNC-1	364337.03	5011253.849
UNC-1	364337.03	5011253.849
UNC-1	364338.945	5011250.313
UNC-2	364364.35	5011176.561
UNC-2	364344.176	5011211.621
UNC-2	364344.176	5011211.621
UNC-2	364356.58	5011218.736
UNC-2	364356.58	5011218.736
UNC-2	364375.628	5011186.877
UNC-2	364375.628	5011186.877
UNC-2	364364.35	5011176.561
UNC-3	364413.044	5011269.815
UNC-3	364423.139	5011278.933
UNC-3	364423.139	5011278.933
UNC-3	364452.636	5011227.196
UNC-3	364452.636	5011227.196
UNC-3	364429.792	5011214.106
UNC-3	364429.792	5011214.106
UNC-3	364439.372	5011223.103
UNC-3	364439.372	5011223.103
UNC-3	364421.472	5011254.899
UNC-3	364421.472	5011254.899
UNC-3	364413.044	5011269.815
UNC-4	364383.979	5011319.944
UNC-4	364383.43	5011323.177
UNC-4	364383.43	5011323.177
UNC-4	364395.885	5011330.236
UNC-4	364395.885	5011330.236
UNC-4	364423.139	5011278.933
UNC-4	364423.139	5011278.933
UNC-4	364407.321	5011279.171
UNC-4	364407.321	5011279.171
UNC-4	364400.543	5011291.027

```
UNC-4            364400.543         5011291.027
UNC-4            364383.979         5011319.944

;;Storage Node   X-Coord            Y-Coord
;;-------------- ------------------ ------------------

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
```

D.3 SAMPLE PCSWMM OUTPUT (100YR CHICAGO)

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.4)

****
Element Count
****
Number of rain gages 1
Number of subcatchments ... 11
Number of nodes 19
Number of links 17
Number of pollutants 0
Number of land uses 0

****
Raingage Summary
****

Name	Data Source	Data Type	Recording Interval
RG	100C03	INTENSITY	10 min.

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
L200A	0.22	50.58	85.71	3.0000	RG	200
L201A	0.17	37.13	85.71	3.0000	RG	201A
L201B	0.16	35.36	85.71	3.0000	RG	201B
L201C	0.12	26.43	85.71	3.0000	RG	201C
L202A	0.08	17.26	88.57	3.0000	RG	202A
L202B	0.09	19.60	81.43	2.0000	RG	202B
PARK	0.10	22.68	28.57	1.5000	RG	PARK-S
UNC-1	0.06	14.52	71.43	3.0000	RG	OBSIDIAN
UNC-2	0.06	12.76	71.43	3.0000	RG	OBSIDIAN
UNC-3	0.08	17.97	71.43	3.0000	RG	GB
UNC-4	0.08	17.71	71.43	3.0000	RG	GB

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
GB	OUTFALL	0.00	0.00	0.0	
OBSIDIAN	OUTFALL	0.00	0.00	0.0	
STM225A	OUTFALL	103.43	0.00	0.0	
SWR-OUT	OUTFALL	103.00	0.58	0.0	
100	STORAGE	103.10	3.28	0.0	
101	STORAGE	103.20	3.44	0.0	
102	STORAGE	103.35	3.32	0.0	
103	STORAGE	103.70	4.08	0.0	
104	STORAGE	103.92	3.05	0.0	
105	STORAGE	104.07	2.40	0.0	
200	STORAGE	104.76	1.78	0.0	
201A	STORAGE	104.27	2.32	0.0	
201B	STORAGE	105.81	1.78	0.0	
201C	STORAGE	104.67	1.78	0.0	
202	STORAGE	104.46	1.74	0.0	
202A	STORAGE	104.60	1.78	0.0	
202B	STORAGE	104.62	1.78	0.0	
PARK-S	STORAGE	103.43	3.29	0.0	
TANK	STORAGE	102.80	3.18	0.0	

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
100-OUT	100	SWR-OUT	CONDUIT	7.9	0.5979	0.0130
101-100	101	100	CONDUIT	14.3	0.2789	0.0130

102-101	102	101	CONDUIT	31.1	0.2889	0.0130
103-102	103	102	CONDUIT	30.7	0.3904	0.0130
104-103	104	103	CONDUIT	40.5	0.3948	0.0130
105-104	105	104	CONDUIT	23.1	0.3888	0.0130
201B-201	201B	201A	CONDUIT	31.3	0.9899	0.0130
201-O	201A	TANK	CONDUIT	1.6	1.2309	0.0130
202-TANK	202	TANK	CONDUIT	12.8	1.7202	0.0130
OVR	TANK	102	CONDUIT	10.1	0.9897	0.0130
200-O	200	TANK	ORIFICE			
201C-O	201C	201A	ORIFICE			
202A-O	202A	202	ORIFICE			
202B-O	202B	202	ORIFICE			
OR1	TANK	102	ORIFICE			
W1	200	202A	WEIR			
OL1	PARK-S	STM225A	OUTLET			

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
100-OUT	CIRCULAR	0.53	0.22	0.13	0.53	1	332.56
101-100	CIRCULAR	0.53	0.22	0.13	0.53	1	227.15
102-101	CIRCULAR	0.53	0.22	0.13	0.53	1	231.18
103-102	CIRCULAR	0.30	0.07	0.07	0.30	1	60.42
104-103	CIRCULAR	0.30	0.07	0.07	0.30	1	60.77
105-104	CIRCULAR	0.30	0.07	0.07	0.30	1	60.30
201B-201	CIRCULAR	0.25	0.05	0.06	0.25	1	59.17
201-O	CIRCULAR	0.30	0.07	0.07	0.30	1	107.29
202-TANK	CIRCULAR	0.30	0.07	0.07	0.30	1	126.84
OVR	CIRCULAR	0.45	0.16	0.11	0.45	1	283.65

****
Analysis Options
****

Flow Units .... LPS

Process Models:
  Rainfall/Runoff .... YES
  RDII .... NO
  Snowmelt .... NO
  Groundwater .... NO
  Flow Routing .... YES
  Ponding Allowed .... YES
  Water Quality .... NO
Infiltration Method ...... HORTON
Flow Routing Method ...... DYNWAVE
Surcharge Method .... EXTRAN
Starting Date 04/25/2025 00:00:00
Ending Date 04/26/2025 00:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:01:00
Dry Time Step 00:01:00
Routing Time Step .... 1.00 sec
Variable Time Step .... NO
Maximum Trials 8
Number of Threads 1
Head Tolerance .... 0.001500 m

Runoff Quantity Continuity	Volume hectare-m	Depth mm
Total Precipitation	0.087	71.667
Evaporation Loss	0.000	0.000
Infiltration Loss	0.013	10.376
Surface Runoff	0.073	60.149
Final Storage	0.001	1.217
Continuity Error (%)	-0.106	

Flow Routing Continuity	Volume hectare-m	Volume 10^6 ltr
Dry Weather Inflow	0.000	0.000

Wet Weather Inflow	0.073	0.727
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.073	0.726
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.019	0.187
Final Stored Volume	0.019	0.188
Continuity Error (%)	0.013	

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

****
Most Frequent Nonconverging Nodes
****
Convergence obtained at all time steps.

****
Routing Time Step Summary
****

Minimum Time Step	:	1.00 sec
Average Time Step	:	1.00 sec
Maximum Time Step	:	1.00 sec
% of Time in Steady State	:	0.00
Average Iterations per Step	:	2.00
% of Steps Not Converging	:	0.00

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
L200A	71.67	0.00	0.00	6.31	60.15	3.93	64.09	0.14	108.42	0.894
L201A	71.67	0.00	0.00	6.31	60.15	3.93	64.09	0.11	79.59	0.894
L201B	71.67	0.00	0.00	6.31	60.15	3.93	64.09	0.10	75.79	0.894
L201C	71.67	0.00	0.00	6.31	60.15	3.93	64.09	0.08	56.64	0.894
L202A	71.67	0.00	0.00	5.04	62.15	3.16	65.32	0.05	37.30	0.911
L202B	71.67	0.00	0.00	8.26	57.14	5.06	62.19	0.05	41.07	0.868
PARK	71.67	0.00	0.00	36.38	20.06	34.89	34.89	0.04	24.84	0.487
UNC-1	71.67	0.00	0.00	12.77	50.13	7.72	57.85	0.04	29.14	0.807
UNC-2	71.67	0.00	0.00	12.77	50.13	7.72	57.85	0.03	25.60	0.807
UNC-3	71.67	0.00	0.00	12.77	50.13	7.72	57.85	0.05	36.07	0.807
UNC-4	71.67	0.00	0.00	12.77	50.13	7.72	57.85	0.05	35.54	0.807

****
Node Depth Summary

****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
GB	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
OBSIDIAN	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
STM225A	OUTFALL	0.14	0.14	103.57	0 00:00	0.14
SWR-OUT	OUTFALL	0.57	0.57	103.57	0 00:00	0.57
100	STORAGE	0.47	0.47	103.57	0 01:21	0.47
101	STORAGE	0.37	0.39	103.59	0 01:23	0.39
102	STORAGE	0.22	0.27	103.62	0 01:23	0.27
103	STORAGE	0.00	0.00	103.70	0 00:00	0.00
104	STORAGE	0.00	0.00	103.92	0 00:00	0.00
105	STORAGE	0.00	0.00	104.07	0 00:00	0.00
200	STORAGE	0.02	1.48	106.24	0 01:10	1.47
201A	STORAGE	0.02	0.97	105.24	0 01:10	0.97
201B	STORAGE	0.01	0.57	106.38	0 01:10	0.57
201C	STORAGE	0.01	1.01	105.68	0 01:10	1.01
202	STORAGE	0.01	0.19	104.65	0 01:10	0.19
202A	STORAGE	0.02	1.39	105.99	0 01:10	1.39
202B	STORAGE	0.03	1.51	106.13	0 01:11	1.51
PARK-S	STORAGE	0.21	3.16	106.59	0 01:21	3.16
TANK	STORAGE	0.96	1.73	104.53	0 01:23	1.73

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow LPS	Maximum Total Inflow LPS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
GB	OUTFALL	71.61	71.61	0 01:10	0.0918	0.0918	0.000
OBSIDIAN	OUTFALL	54.74	54.74	0 01:10	0.0701	0.0701	0.000
STM225A	OUTFALL	0.00	13.88	0 01:21	0	0.0353	0.000
SWR-OUT	OUTFALL	0.00	72.63	0 01:24	0	0.529	0.000
100	STORAGE	0.00	72.62	0 01:24	0	0.53	-0.000
101	STORAGE	0.00	72.62	0 01:24	0	0.53	-0.000
102	STORAGE	0.00	72.61	0 01:23	0	0.53	0.000
103	STORAGE	0.00	0.00	0 00:00	0	0	0.000 ltr
104	STORAGE	0.00	0.00	0 00:00	0	0	0.000 ltr
105	STORAGE	0.00	0.00	0 00:00	0	0	0.000 ltr
200	STORAGE	108.42	108.42	0 01:10	0.144	0.144	0.015
201A	STORAGE	79.59	211.22	0 01:10	0.106	0.282	0.018
201B	STORAGE	75.79	75.79	0 01:10	0.101	0.101	0.019
201C	STORAGE	56.64	56.64	0 01:10	0.0753	0.0753	-0.000
202	STORAGE	0.00	61.92	0 01:10	0	0.104	0.181
202A	STORAGE	37.30	37.30	0 01:10	0.0501	0.0501	-0.000
202B	STORAGE	41.07	41.07	0 01:10	0.0542	0.0542	0.010
PARK-S	STORAGE	24.84	24.84	0 01:10	0.0352	0.0353	0.020
TANK	STORAGE	0.00	372.48	0 01:10	0	0.709	-0.026

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow LPS
100	0.001	14.4	0.0	0.0	0.001	14.4	0 01:21	72.63
101	0.000	10.8	0.0	0.0	0.000	11.3	0 01:23	72.62
102	0.000	6.8	0.0	0.0	0.000	8.2	0 01:23	72.62
103	0.000	0.0	0.0	0.0	0.000	0.0	0 00:00	0.00
104	0.000	0.0	0.0	0.0	0.000	0.0	0 00:00	0.00
105	0.000	0.0	0.0	0.0	0.000	0.0	0 00:00	0.00
200	0.000	0.1	0.0	0.0	0.003	26.6	0 01:10	99.60
201A	0.000	0.2	0.0	0.0	0.001	8.7	0 01:10	211.04
201B	0.000	0.6	0.0	0.0	0.000	32.0	0 01:10	75.26
201C	0.000	0.0	0.0	0.0	0.000	2.9	0 01:10	56.43
202	0.000	0.4	0.0	0.0	0.000	11.1	0 01:10	61.90
202A	0.000	0.1	0.0	0.0	0.001	4.7	0 01:10	36.93
202B	0.000	0.4	0.0	0.0	0.007	55.6	0 01:11	25.03
PARK-S	0.000	2.0	0.0	0.0	0.007	48.2	0 01:21	13.88
TANK	0.206	41.4	0.0	0.0	0.480	96.5	0 01:23	72.61

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
GB	14.05	7.55	71.61	0.092
OBSIDIAN	13.71	5.92	54.74	0.070
STM225A	7.57	5.40	13.88	0.035
SWR-OUT	85.25	7.18	72.63	0.529
System	30.14	26.06	194.19	0.726

****
Link Flow Summary
****

Link	Type	Maximum |Flow| LPS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
100-OUT	CONDUIT	72.63	0 01:24	0.34	0.22	0.95
101-100	CONDUIT	72.62	0 01:24	0.41	0.32	0.76
102-101	CONDUIT	72.62	0 01:24	0.57	0.31	0.57
103-102	CONDUIT	0.00	0 00:00	0.00	0.00	0.07
104-103	CONDUIT	0.00	0 00:00	0.00	0.00	0.00
105-104	CONDUIT	0.00	0 00:00	0.00	0.00	0.00
201B-201	CONDUIT	75.26	0 01:10	1.57	1.27	0.94
201-O	CONDUIT	211.04	0 01:10	2.99	1.97	1.00
202-TANK	CONDUIT	61.90	0 01:10	1.49	0.49	0.64
OVR	CONDUIT	0.00	0 00:00	0.00	0.00	0.00
200-O	ORIFICE	99.60	0 01:10			1.00
201C-O	ORIFICE	56.43	0 01:10			1.00
202A-O	ORIFICE	36.93	0 01:10			1.00
202B-O	ORIFICE	25.03	0 01:11			1.00
OR1	ORIFICE	72.61	0 01:23			1.00
W1	WEIR	0.00	0 00:00			0.00
OL1	DUMMY	13.88	0 01:21			

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
100-OUT	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
101-100	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
102-101	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00

103-102	1.00	0.91	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
104-103	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
105-104	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
201B-201	1.00	0.02	0.00	0.00	0.00	0.00	0.00	0.98	0.00	0.00
201-O	1.00	0.02	0.00	0.00	0.03	0.00	0.00	0.96	0.00	0.00
202-TANK	1.00	0.02	0.00	0.00	0.03	0.00	0.00	0.95	0.03	0.00
OVR	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

****
Conduit Surcharge Summary
****

	--------- Hours Full --------			Hours	Hours
Conduit	Both Ends	Upstream	Dnstream	Above Full Normal Flow	Capacity Limited
201B-201	0.01	0.15	0.01	0.13	0.01
201-O	0.13	0.34	0.13	0.18	0.13

Analysis begun on: Mon Jan 12 16:07:38 2026
Analysis ended on: Mon Jan 12 16:07:40 2026
Total elapsed time: 00:00:02

Appendix E EXTERNAL REPORTS

E.1 DESIGN BRIEF (SITE SERVICING STUDY) FOR THE RIDGE (BRAZEAU LANDS) BY DSEL (JULY 2020)

120 Iber Road, Suite 103
Ottawa, Ontario K2S 1E9
Tel. (613)836-0856
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www.DSEL.ca

DESIGN BRIEF

FOR

CAIVAN GREENBANK DEVELOPMENT CORPORATION

THE RIDGE (BRAZEAU LANDS)

3809 BORRISOKANE ROAD

CITY OF OTTAWA

PROJECT NO.: 18-1030
JULY 27TH , 2020
4TH SUBMISSION

DESIGN BRIEF
FOR
CAIVAN GREENBANK DEVELOPMENT CORPORATION

THE RIDGE (BRAZEAU LANDS)

PROJECT NO: 18-1030

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DESIGN BRIEF
FOR
CAIVAN GREENBANK DEVELOPMENT CORPORATION

THE RIDGE (BRAZEAU LANDS)

CITY OF OTTAWA
PROJECT NO: 18-1030

1.0 INTRODUCTION

David Schaeffer Engineering Limited (DSEL) has been retained to prepare the detailed design of the Brazeau Lands development area located at 3809 Borrisokane Road within the Barrhaven South Urban Expansion Area (***BSUEA***) on behalf of Caivan Greenbank Development Corporation (CGDC). This design brief is submitted in support of that development. The development is now being referred to as “The Ridge” Subdivision for marketing purposes.

The proposed development area is illustrated in ***Figure 1*** (see ***Appendix A***) and is located north of Barnsdale Road, east of Highway 416 (and Borrisokane Road), south of Cambrian Road and west of the future New Greenbank Road alignment. The current zoning is Mineral Extraction (ME) and is amended to permit low-rise residential uses. The western portion of the property is outside of the urban boundary and will remain at the current zoning while the eastern side (approximately 24.7 ha) is within the urban boundary and is to be rezoned as noted above. The development will also include a 0.91 ha block for a road connection to Borrisokane Road, a future 0.89 ha right-of-way (ROW) area within the Drummond Lands (also owned by CGDC) for servicing outlets, and a 3.94 ha pond block within the Drummond Lands that will service both properties. The lands are planned to be developed with a mix of detached single homes, townhomes, park blocks, SWM blocks, open space and a road network (see ***Figure 2*** for the lotted legal plan in ***Appendix A***).

This design brief is prepared to demonstrate conformance with the design criteria of the City of Ottawa, background studies, including the Master Servicing Study, and general industry practice.

1.1 Existing Conditions

The Ridge subdivision was previously an aggregate extraction pit operated in accordance with the Ontario Aggregate Resources Act and Regulations. Processes have been undertaken to remove this designation.

The property ground surface is significantly disturbed as a result of the mineral extraction activities that have occurred over the years with stockpiles of materials at various locations and elevations. The eastern portion of the site adjacent to the New Greenbank Road future alignment range in elevations from approximately 108.0m to 104.5m. On-site elevations vary due to the various stockpiles of materials but are general averaging about 99.0m. Drainage is generally conveyed westward towards Borrisokane Road which is owned by, and under the jurisdiction of, the Ministry of Transportation.

The property is within the Jock River watershed and is under the jurisdiction of the Rideau Valley Conservation Authority (RVCA).

2.0 GUIDELINES, PREVIOUS STUDIES, AND REPORTS

2.1 Existing Studies, Guidelines, and Reports

The following studies were utilized in the preparation of this report.

- Ottawa Sewer Design Guidelines,
  City of Ottawa, *SDG002,* October 2012
  *(**Sewer Design Guidelines**)*

  - Technical Bulletin ISDTB-2014-01
    City of Ottawa, February 5, 2014
    (ITSB-2014-01)
  - Technical Bulletin PIEDTB-2016-01
    City of Ottawa, September 6, 2016
    (PIEDTB-2016-01)
  - Technical Bulletin ISTB-2018-01
    City of Ottawa, March 21, 2018
    (ISTB-2018-01)
  - Technical Bulletin ISTB-2018-04
    City of Ottawa, June 27, 2018
    (ISTB-2018-04)
- Ottawa Design Guidelines – Water Distribution
  City of Ottawa, July 2010.
  *(**Water Supply Guidelines**)*

  - Technical Bulletin ISD-2010-2
    City of Ottawa, December 15, 2010.
    (ISD-2010-2)
  - Technical Bulletin ISDTB-2014-2
    City of Ottawa, May 27, 2014.
    (ISDTB-2014-2)

  - Technical Bulletin ISTB-2018-02
    City of Ottawa, March 21, 2018
    (ISTB-2018-02)

- Design Guidelines for Sewage Works,
  Ministry of the Environment, Conservation and Parks, 2008. (formerly MOECC)
  *(**MECP Design Guidelines**)*

- Highway Drainage Design Standards (MTO 2008)

- Drainage Management Manual (MTO 1997),
  Ministry of Transportation.
  *(**MTO Manuals**)*

- Stormwater Planning and Design Manual,
  Ministry of the Environment, March 2003.
  *(**SWMP Design Manual**)*

- City of Ottawa Official Plan,
  adopted by Council 2003.
  *(**Official Plan**)*

- South Nepean Collector: Phase 2 Hydraulics Review / Assessment Technical Memorandum
  Novatech, August 2015
  *(**Novatech SNC Memo**)*

- Master Servicing Study – Barrhaven South Urban Expansion Area, J.L. Richards & Associates Limited, Revision 2, May 2018
  *(**BSUEA MSS**)*

- Servicing Brief – Quinn's Pointe Residential Stages 2, 3 & 4, J.L. Richards & Associates Limited, Revision 1, October 2018 (File No. 26610-001.1)
  *(**Quinn's Pointe Brief**)*

- Stormwater Management Report for Brazeau Subdivision, by J.F. Sabourin and Associates (July 2020)
  *(**JFSA SWM Report**)*

- Pond Design Brief for Brazeau Subdivision, by J.F. Sabourin and Associates (July 2020)
  *(**JFSA Pond Report**)*

- Caivan Brazeau/Drummond Development – LID Design Update, by J.F. Sabourin and Associates (July 2020)
  *(**JFSA LID Analysis**)*

- Geotechnical Investigation, Proposed Residential Development, Brazeau Lands – Borrisokane Road, Paterson Group (January 2019)
  *(**Geotechnical Report**)*

- Groundwater Infiltration Review, Proposed Residential Development, Brazeau Pit and Drummonds Pit – Borrisokane Road, Paterson Group (August 2019)
  *(**Infiltration Review**)*

- Supplemental Hydrogeological Review, Proposed Residential Development, The Ridge – Borrisokane Road, Paterson Group (March 4, 2020)
  *(**Hydrogeological Review**)*

- Borrisokane Ditch Erosion Assessment: The Ridge (Brazeau) Subdivision, J.F. Sabourin and Associates Inc. (June 2020)
  *(**JFSA Erosion Assessment**)*

3.0 WATER SUPPLY SERVICING

3.1 Existing Water Supply Services

The ***BSUEA MSS*** provided an overview of the existing watermain infrastructure associated with the BSUEA. The ***BSUEA MSS*** completed an overall assessment of the water supply for the area in order to examine the feasibility of the extension of existing infrastructure that would meet the required City and MECP criteria for the whole of the development area.

The 'Master Watermain" plan (Drawing MWM) from the ***BSUEA MSS*** is provided in ***Appendix B*** and illustrates the existing watermains in proximity to The Ridge development area. In addition, a conceptual watermain plan (Drawing CWM) from the preliminary Servicing Brief for Minto's Quinn's Pointe (Stages 2, 3 & 4) residential area is provided for reference. The proposed watermain servicing connections points for The Ridge development area are as follows:

- Existing 300mm diameter watermain terminating at Dundonald Drive and the future New Greenbank Road alignment;
- Proposed 300mm diameter watermain from the existing Cambrian Road 400mm diameter watermain forming part of the Tamarack Meadows development network located north of The Ridge and Drummond lands.

As adjacent developments to the east are advanced there will be a future required connection to the development from the existing 300mm diameter watermain on Kilbirnie Drive at Alex Polowin Avenue (or future extension location that is dependent upon the advancement of the Quinn's Pointe development).

3.2 Water Supply Servicing Design

The ***BSUEA MSS*** presents overall watermain infrastructure details for the BSUEA. The subject property was deemed serviceable and the ***MSS*** reviewed a number of servicing scenarios (i.e. existing and built-out conditions) that confirmed that the area could be adequately serviced conforming to relevant City and MECP Guidelines and Policies.

The water analysis contained in the ***BSUEA MSS*** utilized system level water demands as developed by the City due to the fact that the number of units and densities resulted in an overall population that would exceed 3,000. The excerpt of the system level demands listed in Table 7-1 of the ***MSS*** can be found in ***Appendix B*** and are summarized as follows:

Table 1A: Water Supply Design Criteria (System Level Demands)

Land Use Type	Consumption Rate
JLR BSUEA MSS, May 2018 for Population Exceeding 3000 Persons	
Single Family Residential	180 L/cap/day
Multi-unit Residential (Townhouse / Back to Back)	198 L/cap/day
Apartment Residential	219 L/cap/day
Commercial	50,000 L/ha/day
Institutional	50,000 L/ha/day
Outdoor Water Demand	1049 L/unit/day (single detached)

The estimated water demands within the ***BSUEA MSS*** were summarized in Table 7-2 (excerpt found in ***Appendix B***). The table summarized a total population of 1,194 for the Brazeau Lands development area along with some commercial and institutional components. Based on the current development concept the water demand table is refined to reflect a revised residential unit count and the removal of the commercial, institutional and high density components. Based on the development layout illustrated in ***Figure 2*** the development area will have 347 single family homes and 279 towns with associated populations of 1,180 and 754 respectively. The adjusted water demands for comparison purposes are summarized in the following table:

Table 1B: Estimated Water Demands - Brazeau Land Updates

Design Parameter	Area (ha)	Units	Pop.	ADD SFH [1]	ADD MLT [2]	ADD APT [3]	ADD COM [4]	ADD INS [5]	Total BSDY	OWD[6]	Total MXDY
From Table 7-2 of MSS	12.72	398	1194	1.56	0.87	0.17	0.39	0.85	3.84	2.67	6.51
Revised per Updated Development Plan (Residential Area)	23.83	626[7]	1934	2.45	1.73	0	0	0	4.18	4.21	8.39
		+228	+740						**+0.34**	+1.54	**+1.88**

1 Daily Demand, Single Family Homes, L/s (see Table 1A for Consumption Rate)
2 Average Daily Demand, Multi-Units (Townhouses and Back to Back Unit) L/s
3 Average Daily Demand, Apartment Units, L/s
4 Average Daily Demand, Commercial, L/s
5 Average Daily Demand, Institutional, L/s
6 Outdoor Water Demand, L/s, calculated as 1,049 L per SFH unit per day per MSS
7 Comprised of 347 Singles Family Homes and 279 Townhouses

With reference to Table 7-2, the overall Total BSDY increased by 0.34 L/s (to 19.00 L/s) which is a 1.8% increase over the previous 18.66 L/s. The total MXDY increases by 1.88 L/s which is a 5.9% increase over the previous 31.48 L/s.

The typical Water Supply Design Criteria used are as summarized in the following table:

Table 1C: Water Supply Design Criteria

Design Parameter	Value
Residential – Single Family	3.4 p/unit
Residential – Semi-Detached	2.7 p/unit
Residential – Townhome	2.7 p/unit
Residential – Average Daily Demand	350 L/p/day
Residential – Maximum Daily Demand	2.5 x Average Daily Demand
Residential – Maximum Hourly Demand	2.2 x Maximum Daily Demand
Residential – Minimum Hourly Demand	0.5 x Average Daily Demand
Commercial / Institutional Average Daily Demand	50,000 L/ha/day
Park Average Daily Demand	28,000 L/ha/day
Commercial / Institutional / Park Maximum Daily Demand	1.5 x Average Daily Demand
Commercial / Institutional / Park Maximum Hour Demand	1.8 x Maximum Daily Demand
Commercial / Institutional / Park Minimum Hourly Demand	0.5 x Average Daily Demand
Fire Flow	Calculated as per the Fire Underwriter's Survey 1999.
Minimum Watermain Size	150 mm diameter
Service Lateral Size	19 mm dia. Copper or equivalent
Minimum Depth of Cover	2.4 m from top of watermain to finished grade
Peak hourly demand operating pressure	275 kPa and 690 kPa
Fire flow operating pressure minimum	140 kPa
Extracted from Section 4: Ottawa Design Guidelines, Water Distribution (July 2010), ISDTB-2010-2	

A boundary condition request was submitted (provided in ***Appendix B*** for reference) in order to obtain water supply parameters for use in the hydraulic modelling assessment of the network. A hydraulic analysis was prepared for the water distribution network to confirm that water supply is available within the required pressure range, under the anticipated demand during average day, peak hour and fire flow conditions and was based on boundary conditions requested from the City of Ottawa. Refer to the *Hydraulic Capacity and Modeling Analysis, Brazeau Lands* prepared by *GeoAdvice Engineering Inc. dated June 10, 2020* ***(GeoAdvice Water Analysis)***, enclosed in ***Appendix B.***

The proposed water layout is shown in the general plan of services overview presented in ***Figures 3, 3A, 3B*** at the back of this report as well as in the GeoAdvice report figures. The Ridge development will initially require a minimum of two watermain feeds to the service the property. Based on the nearby existing infrastructure, and surrounding development plans, it is proposed that an extension of the existing Dundonald Drive 300mm watermain will provide service to the northeast portion of the property. In addition, the second proposed feed to service The Ridge will be through the Drummond Lands from the proposed 300mm watermain that is being advanced for the Tamarack Meadows development north of the property. Ultimately there will be future connections to Greenbank Road and Kilbirnie Drive (to the south) when those development areas are advanced.

3.3 Summary of Hydraulic Modeling Analysis

A complete watermain analysis has been prepared to confirm that the network is sized adequately, which is the greater of maximum day plus fire and maximum hour for both the Phase 1 and Phase 1&2 scenario. Refer to the ***GeoAdvice Report,*** enclosed in ***Appendix B.***

System Pressures

The modeling indicates that the development can be adequately serviced by the proposed watermain network. Modeled service pressures for the development are summarized in the following table. The detailed pipe and junction tables are contained in the ***GeoAdvice Report***, enclosed in ***Appendix B.***

Table 1D: Summary of Available System Pressures

	Minimum Hour Demand Maximum Pressure		**Peak Hour Demand Minimum Pressure**	
	kPA	psi	kPA	psi
Phase 1	538	78	290	42
Phases 1&2	538	78	262	38

The generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi) as outlined in the City of Ottawa Design Guidelines. Low pressures (slightly below 40 psi) are predicted in the south and southeast area of the site due to higher ground elevations. However, this is without considering provision of the future watermain connection from the Quinn's Pointe development area. Per Section 4.1 of the ***GeoAdvice Report***, this future additional connection (as required by the ***BSUEA MSS***) will provide an additional head of up to seven meters and resolve this low pressure condition. Should the availability of the additional watermain feed not be in place during the advancement of Phase 2 of The Ridge, it would be recommended that oversized service laterals be provided in order to compensate. For now, the current design drawings have demonstrated the requirement of a 25mm water service lateral in the areas that are slightly below the 40psi threshold.

3.4 Fire Flows – Fire Underwriters Survey

Fire Flow requirements are established in the boundary condition request found in ***Appendix B*** as prepared by GeoAdvice. Calculations for the single detached dwellings and traditional townhomes reached the City of Ottawa's cap of 10,000 L/min (167 L/s) as outlined in *ISDTB-2014-02*. At this time, there is not enough information available to calculate the required fire flows of the park so a required fire flow of 250 L/s was assumed, which is a typical requirement for similar land uses. The fire flows are calculated in accordance with the Fire Underwriters Survey's Water Supply for Public

Fire Protection Guideline (1999). Detailed FUS calculations can be found in the GeoAdvice reporting.

Available Fire Flows

The minimum allowable pressure under fire flow conditions is 140 kPa (20 psi) at the location of the fire. A summary of the available fire flows is presented in the following table. The detailed fire flow reports are found in the ***GeoAdvice Report*** enclosed in ***Appendix B***.

1E: Summary of Available Fire Flows

	Required Fire Flow (L/s)	Minimum Available Flow (L/s)	Junction ID
Phase 1	167	177	J-45
	250	249	J-47
Phase 1 & 2	167	194	J-66
	250	269	J-47

As shown in the above table the model predicts the network will be able to provide all required fire flows within the development limits. Detailed results are included in the ***GeoAdvice Report***, enclosed in ***Appendix B***.

3.5 Water Supply Conclusion

The subject lands have been previously reviewed within the ***BSUEA MSS*** for the BSUEA development areas. The interim condition of The Ridge subdivision can be serviced by City of Ottawa infrastructure through the extension of the existing 300mm watermain from Dundonald Road from the east side of the property and a proposed connection north of the property, through the Drummond Lands, to a new 300mm watermain extension from Cambrian Road. In the interim condition for Phase 2 areas (i.e. only two feeds into the development area) there are pockets of low pressure (slightly below 40psi) areas along the southern boundary that are proposed to have 25mm water service laterals to compensate. Ultimately there will be additional connections to future watermains along Greenbank Road and Kilbirnie Drive (from the south as the Minto Quinn's Pointe development advances) that will alleviate the low pressure condition. See ***Figure WAT-1*** in ***Appendix B*** for the watermain network overview. These extensions are in accordance with the ***MSS*** projected infrastructure. The proposed water supply design conforms to all relevant City and MECP Guidelines and Policies.

4.0 WASTEWATER SERVICING

4.1 Existing Wastewater Services

Sanitary flows from the ***BSUEA*** were proposed to outlet to the existing 900mm diameter Greenbank Road sanitary trunk sewer. The existing South Nepean Collector (SNC) will provide the sanitary outlet for the entire Barrhaven South Community, which includes the BSUEA development area.

Trunk sanitary sewers exist north of the Brazeau Lands area and are located along Cambrian Road (see JLR's *Master Sanitary Drainage Area* plan 'MSAN' in ***Appendix C***). The outlet connection point to existing for the Brazeau Lands is as follows:

- Existing 500 mm / 600 mm / 750 mm diameter sanitary trunk running east on Cambrian Road then extending north along existing Greenbank Road and east to the South Nepean Collector (SNC). The current sewer termination is at the New Greenbank Road alignment.

As per the ***BSUEA MSS*** the subject property is tributary to the existing sanitary trunk sewer along Cambrian Road.

4.2 Wastewater Design

The subject property will be serviced by an internal gravity sanitary sewer system that will generally follow the local road network with select servicing easements and land crossing permissions as required to achieve efficiencies in servicing and grading designs. The wastewater layout can be found in the general plan of services overview presented in ***Figures 3, 3A and 3B*** at the back of this report. The sanitary drainage area plans and design sheets, along with background ***BSUEA MSS*** information, can all be found in ***Appendix C*** for reference.

The ***BSUEA MSS*** proposed that the wastewater outlet from the Brazeau Lands would tie into the off-site Cambrian Road trunk sewer at existing sanitary 'EX MH57A' via the Future Greenbank Road alignment and that is now the intent of The Ridge (Brazeau) design. The *Master Sanitary Drainage Area* plan 'MSAN' from the ***BSUEA MSS*** is provided in ***Appendix C*** for reference. Sanitary flows from the adjacent Drummond Lands were originally proposed to be conveyed to Cambrian Road (MA11 to MA10) through Tamarack's "The Meadows Phase 7 & 8" (***Meadows***) development area at 3640 Greenbank Road (D07-16-18-0011) in the ***BSUEA MSS***. Although there were prior concepts of bringing The Ridge sanitary flows through the Drummond/Tamarack properties, the current sanitary sewer alignments, that are in line with the ***BSUEA MSS,*** are proposed in order to minimize overall sewer depths and alleviate City concerns with alternate routing.

4.2.1 Brazeau (The Ridge) Lands

In the ***BSUEA MSS***, Table 6-3 (provided in ***Appendix C***) summarized the anticipated flows from the "Brazeau Aggregate Extraction Area" lands (i.e. The Ridge development). With the more detailed development concept, the site statistics are refined and the sanitary design sheet found in ***Appendix C*** more accurately reflects the anticipated sanitary flows. As per Section 3.2 of this report, the anticipated unit count for The Ridge is 347 single family homes and 279 townhouse units.
When applying the City of Ottawa wastewater design criteria the estimated peak sanitary flows from The Ridge and other areas tributary to the sewer network results in the following:

i) The Ridge residential area + 4.3 ha of Drummond lands (~31.06 L/s);
ii) Drummond Lands (direct to Greenbank Road (~20.29 L/s);
iii) Mattamy lands adjacent to Future Greenbank Road (residential area of 1.90 ha and commercial area of 2.99 ha) (~4.45 L/s);
iv) Future Brazeau commercial area (13.83 ha) west of the subdivision (~9.05 L/s)
v) Commercial area (ABIC) (~4.84 L/s)

For comparison to the ***MSS*** Table 6-3 values, criteria the estimated peak sanitary flows from The Ridge and Mattamy areas is approximately 49.38 L/s. This would be in comparison to the ***MSS*** sum of the 21.50 L/s (Brazeau Lands flow), 1.8 L/s Mattamy Commercial, and approximately 1.9 L/s Mattamy Residential. For comparison this would be 69.69 L/s versus the 25.2 L/s (i.e. +44.49 L/s) previously summarized in the JLR's Table 6-3.

Table 6-4 in the ***BSUEA MSS*** identified critical residual capacities in existing trunk sanitary sewers associated with the BSUEA area. Specifically, the Cambrian Road sewer is the outlet for the Brazeau Lands property and has a limiting pipe reach from existing MH13A to MH15A with a residual capacity of approximately 52.9 L/s. The additional 44.49 L/s of anticipated sanitary flows uses approximately ~84% of the residual capacity leaving 8.41 L/s. Review of the ***BSUEA MSS*** sanitary design sheet indicates that there are no other sanitary sewer constraints up to the SNC.

4.2.2 Greenbank Road Sewer Alignment

As noted, the sanitary outlet for The Ridge will be along the Future Greenbank Road EA alignment as per the ***BSUEA MSS***. As per JLR's *Master Sanitary Drainage Area* plan 'MSAN' in ***Appendix C*** this alignment is represented by the sewer run from MH900 to EXMH57A on Cambrian Road ranging in size from 250mm to 375mm. The proposed design has a 375mm sanitary (capacities of the design can be seen in the sewer design sheet). MH900 would equate to the MH402A proposed within The Ridge design. Per Section 6.3.1.2 the depth of the sewer at this location was estimated to have a cover depth of approximately 7.43m. Based on The Ridge detailed design, which has taken into consideration all of the site grading and sewer crossing constraints that result from detailed design, the proposed cover is 8.5m at MH402A per the profile drawing for this trunk sewer (See Drawing 61 in ***Appendix C***). The elevated EA road profile results in the greater depth of the sewer at this location. As the sewer progresses northward towards Cambrian Road the depth of cover is gradually reduced as the road profile drops down in elevation. The proposed sanitary sewer is set at either minimum slopes, to mitigate depth of cover, or at slopes to establish flow capacities that are approximately 75%-78% of the proposed sewer's capacity. See markups of the profile drawings in ***Appendix C*** for reference.

4.2.3 Wastewater Design Criteria

The following table summarizes the City design guidelines and criteria applied in the preliminary sanitary design information above and detailed in ***Appendix C***.

Table 2: Wastewater Design Criteria

Design Parameter	Value
Current Design Guidelines	
Residential - Single Family / Townhome	3.4 p/unit & 2.7 p/unit respectively
Residential – Apartment	1.8 p/unit
Average Daily Demand	280 L/d/person
Peaking Factor	Harmon's Peaking Factor. Max 4.0, Min 2.0
Commercial / Institutional Flows	28,000 L/ha/day
Commercial / Institutional Peak Factor	1.5
Infiltration and Inflow Allowance	0.33 L/s/ha
Park Flows	28,000 L/ha/d
Park Peaking Factor	1.0
Sanitary sewers are to be sized employing the Manning's Equation	$Q = \frac{1}{n} A R^{2/3} S^{1/2}$
Minimum Sewer Size	200mm diameter
Minimum Manning's 'n'	0.013
Minimum Depth of Cover	2.5m from crown of sewer to grade
Minimum Full Flowing Velocity	0.6m/s
Maximum Full Flowing Velocity	3.0m/s
Extracted from Sections 4 and 6 of the City of Ottawa Sewer Design Guidelines, October 2012, and recent residential subdivisions in City of Ottawa.	

4.3 Wastewater Servicing Conclusion

The subject property will be serviced by local sanitary sewers which will outlet to the Future Greenbank Road ROW alignment via new sanitary sewers. The sewer will connect to existing sewers along Cambrian Road as demonstrated in the ***BSUEA MSS*** at 'EX MH57A' per JLR's *Drawing **MSAN***. There is residual capacity in the downstream sewers providing sufficient capacity for the peak sanitary flows for the subject property.

5.0 STORMWATER CONVEYANCE

5.1 Existing Stormwater Drainage

The ***BSUEA*** is tributary to three sub-watersheds as depicted in the 'Figure 3-1' excerpt from the ***BSUEA MSS*** provided in ***Appendix D***. The Brazeau Lands are within the Jock River Subwatershed.

Due to the recent land use for mineral extraction the majority of the land area is lower than the surrounding topography. As identified in the ***BSUEA MSS***, the BSUEA *Existing Condition Report* identified that the original drainage pattern for the development area was northwards via overland flow paths with no defined channels. Per the existing topography characterized within available City of Ottawa base mapping, flows from the subject property will now be ultimately conveyed to the Jock River by storm systems (pipes and ditches as required) along Borrisokane Road.

5.2 Proposed Stormwater Management Strategy

The future flows from the land area are planned to meet the following criteria per the ***BSUEA MSS***:

- Meet the existing flow in the downstream system;
- Meet the quality control target of 80% TSS removal as per the Jock River Reach One Subwatershed Study (Stantec, 2007); and,
- Preserve pre-infiltration condition levels (Section 5.3.4 of ***BSUEA MSS***)

In order to provide drainage conveyance to a Borrisokane Road storm outlet, the site grading will be adjusted to convey flows westward. As noted in the ***BSUEA MSS***, the *Existing Conditions Report* for the BSUEA identified that the culvert downstream of the aggregate properties receives a pre-development flow of 1,300 L/s during the 1:100 year event (see Figure 3-1, and Tables 5-2 and 5-5 in ***Appendix D*** from the ECR noting the constrained culvert CVR-C1). Servicing of both The Ridge and Drummond properties have been developed such that the downstream pre-development flow is not exceeded. Any downstream systems should have sufficient capacity for the pre-development flow.

The ***BSUEA MSS*** conceptualized the following requirements for the development areas:

- The design of the storm drainage system has been undertaken using the dual-drainage approach. The ***BSUEA MSS*** sets out the design criteria for future draft plan and site plan applications for the BSUEA.

- Two (2) separate storm servicing solutions were developed; one conventional servicing strategy and one that incorporates the Etobicoke Exfiltration System (EES) or alternative, which was recommended (see ***BSUEA MSS*** Drawing MST-2 for details and Section 5.2.1 of this report for discussion).
- The downstream boundary conditions or flow criteria to achieve are developed in the ***BSUEA MSS*** and are used in the design constraints.
- Allowable minor system release rates were set at the required storm event and future design should maintain the same release rate criteria.
- Stormwater management facilities have been identified in the stormwater management solution for the aggregate extraction areas.

The stormwater management designs will consist of:

- A storm sewer system designed to capture at least the minimum design capture events required under PIETB-2016-01;
- One dry Stormwater Management (SWM) Pond designed to provide required quantity controls along with oil-grit separator (OGS) units that will provide an Enhanced Level of Protection [80% total suspended solids (TSS) removal] per MECP guidelines. The SWM pond will provide controls to levels which respect any downstream pre-development flows;
- An on-site road network designed to maximize the available storage in the on-site road network for the 100-year design event, where possible, with controlled release of stormwater to the minor storm system; and
- An overland flow route designed to safely convey stormwater runoff flows in excess of the on-site road storage.

5.2.1 Infiltration – Etobicoke Exfiltration System (EES)

Within the ***BSUEA MSS***, Section 5.4.4 discussed the recommendation of distributed infiltration for development areas. An analysis was carried out and summarized in the *Existing Conditions Report* which determined the various contributions of the water budget based on long-term simulation.

The section also notes that the overall pre-development infiltration from the ***BSUEA MSS*** area was determined but that the aggregate extraction areas were excluded in that determination. Ongoing investigations for both the Brazeau and Drummond properties have been completed and are summarized in the attached "*Groundwater Infiltration Review*" memorandum completed by Paterson Group (see ***Appendix D*** for reference). The memorandum summarizes the estimate infiltration rates that could be anticipated throughout the sites for various soil type conditions that were found during their investigations. These values were used during the detailed design determinations.

Section 5.5 of the ***BSUEA MSS*** discusses the various storm servicing strategies for the development areas. The section went through the various options to achieve the required infiltration targets with the preferred arrangement being the Etobicoke Exfiltration System (EES) Infiltration Strategy. Other alternatives were reviewed, however the EES system is the most suitable for the site and is proposed to be implemented in accordance with the City's preference.

A key point of note, as required by the ***MSS***, is that capture of stormwater by the exfiltration system has strategically located insofar as the system is to be installed on local roads (where required to achieve the required infiltration levels) where the surface runoff is less impacted by the City's winter road salting program. Therefore collector and arterial roads will have conventional storm sewer installations that will convey flows to a proposed downstream oil-grit-separator (OGS) units and end-of-line dry pond facility. JFSA has prepared their ***JFSA LID Analysis*** design memo to assess the infiltration volumes anticipated for the EES system proposed. See ***Appendix D*** for the analysis. A visual representation of the EES system and drainage capture areas can be seen in the *Figure 2* of the JFSA technical memorandum and can also be seen in the Storm Drainage Area plans.

As summarized in the JFSA analysis, there will be a total of 24 EES systems implemented within the development area in order to meet the infiltration requirements. The EES units will be installed underneath storm sewers within the ROW in specific areas determined as being suitable based on site constraints. Each system will consist of one or two 250 mm diameter perforated pipes surrounded by a 0.85 m deep by 1.20 m wide clear stone trench. Goss traps will be installed in upstream catchbasins in order to prevent/mitigate debris and potential oils from entering the perforated pipe system. Detail drawings of the proposed EES units provided in Figure 1 of the ***JFSA LID Analysis***. See ***Appendix D*** for the full summary of the design parameters for each EES in Tables A1 and A2 (pipe diameter, system lengths and volumes, inverts etc).

For protection measures of the EES system during construction see Section 7.1.

5.2.2 EES Temporary Monitoring

As per Section 5.5.1.8 of the ***BSUEA MSS*** there are requirements for temporary monitoring of the proposed infiltration system in order to assess and confirm that the EES operates as intended. The objectives of the monitoring will be to estimate the drawdown time of the EES (i.e. time for water levels to drop) to see if the infiltration values projected are in line with the results, and to determine the average rate of capture before runoff is conveyed by the traditional storm sewer system. The final locations and configuration will be coordinated with City staff through this detailed design process as it has been indicated that the City has vetted a "Smart Cover" arrangement through the advancement of the adjacent Minto development area.

Proposed monitoring locations have been circulated to the City and are identified in a markup of the *Figure 2* from the ***JFSA LID Analysis*** provided in ***Appendix D***. The City has concurred with the preliminary locations pending full acceptance of the EES design.

5.3 Post-Development Stormwater Management Targets

Stormwater management requirements for the proposed alternative Stormwater management scheme have been adopted from the ***Jock River SWS***, ***City Standards***, and the ***MECP SWMP Manual***.

Given the general criteria mentioned above, the following specific standards are expected to be required for stormwater management within the subject property:

- Enhanced quality treatment will be provided for stormwater runoff from the subject property, corresponding to a long-term average TSS removal efficiency of 80%, as defined by the MECP prescribed treatment levels;
- Downstream receiving drainage features, culverts, and sewers will be assessed for responses to planned stormwater management outflows, and infrastructure rehabilitation or capacity improvement measures will be planned, as required;
- Storm sewers on local roads are to be designed to provide at least a 2-year level of service without any ponding per the City's latest Technical Bulletin PIEDTB-2016-01;
- Storm sewers on collector roads are to be designed to provide at least a 5-year level of service without any ponding per the City's latest Technical Bulletin PIEDTB-2016-01;
- For less frequent storms (i.e. larger than 2-year or 5-year), the minor system sewer capture will be restricted with the use of inlet control devices to prevent excessive hydraulic surcharges;
- Under full flow conditions, the allowable velocity in storm sewers is to be no less than 0.80 m/s and no greater than 6.0 m/s;
- For the 100-year storm and for all roads, the maximum depth of water (static and/or dynamic) on streets, rear yards, public space and parking areas shall not exceed 0.35 m at the gutter;
- The major system shall be designed with sufficient capacity to allow the excess runoff of a 100-year storm to be conveyed within the public right-of-way ROW, or adjacent to the ROW, provided the water level does not touch any part of the building envelope; must remain below all building openings during the stress test event (100-year + 20%); and must maintain 15 cm vertical clearance between spill elevation on the street and the ground elevation at the nearest building envelope;

- Flow across road intersections shall not be permitted for minor storms (generally 5-year or less);
- When catchbasins are installed in rear yards, safe overland flow routes are to be provided to allow the release of excess flows from such areas. A minimum of 30 cm of vertical clearance is required between the rear yard spill elevation and the ground elevation at the adjacent building envelope; and
- The product of the maximum flow depths on streets and maximum flow velocity must be less than 0.60 m^2/s on all roads.

5.3.1 Quality Control

As per the ***Jock River SWS,*** Enhanced quality treatment will be provided for stormwater runoff from the subject property, corresponding to a long-term average Total Suspended Solid removal efficiency of 80%, as described by the MECP prescribed treatment levels. This will be achieved via the proposed EES system installations (where possible) and OGS unit(s) for all other areas. The location/details of the OGS units near the SWM pond inlet can be seen in '*Storm Drainage Plan'* Drawing No. 88 and SWM Pond Drawings No. 77/79 found in ***Appendix D***.

The ***BSUEA MSS*** reviewed the quality control aspects of the proposed EES installations. Section 5.5.1.3 of the ***MSS*** concludes that based on the EES sizing for the 22mm rainfall (i.e. 95^{th} percentile rainfall event) the storage requirements satisfies the requirements for water quality control per the MECP land uses and further downstream control measures would not be required.

5.3.1.1 EES Infiltration Targets

As a part of the ***BSUEA MSS*** it was determined that pre-development infiltration within the study area accounted for 40% of the overall site's water budget. The City and RVCA determined that pre-development infiltration levels should be maintained under post-development conditions and that the infiltration should be provided across the development and not simply concentrated to one or two locations.

The EES is intended to capture frequent storm events and the initial "first flush" of large storm events by trapping flow in the perforated pipe sub drain and surrounding media. It is also intended to infiltrate runoff from frequent events into the surrounding soils, while runoff from larger events will overtop the capacity of the EES system and would then overflow to the conventional storm sewer system above

As specified by the Master Servicing Study, the proposed development should infiltrate 40% of the annual runoff. As the hourly rainfall data used in this simulation does not extend the full year, the infiltration target for this analysis has been assumed to be 40% of the average simulated rainfall volume (552.0 mm), which is calculated to be 220.8mm or 59,744 m^3 based on the study area. See the ***JFSA LID Analysis*** for full details.

5.3.2 Quantity Control – Dry Pond

The ***BSUEA MSS*** currently shows a stormwater pond servicing scenario on each of The Ridge and Brazeau Lands outside of the urban development area (refer to attached '*Barrhaven South Urban Expansion Area – Master Storm Drainage Plan EES'*) drawing from the ***BSUEA MSS*** for illustration). However, this two pond concept was proposed in the ***BSUEA MSS*** due to the desire at that time in order to not have the two properties 'linked' and therefore they would not be dependent upon one another in order to advance development.

As noted in prior sections of this report, the two properties have now coordinated servicing strategies to the benefit of both properties, as well as the City, as follows (refer to the Storm Drainage Area Plan and Pond Plan in ***Appendix D***):

- The single pond option will be a dry facility with OGS units to treat stormwater requiring treatment. This is in line with the ***MSS***;
- If a pond was proposed within the Brazeau Lands location shown in the ***MSS***, it would have required a large box culvert outlet in order to convey emergency flow out to Borrisokane Road due to topography constraints. Based on an increase in elevation downstream of that outlet, the emergency flows could not be conveyed overland. With the single pond concept on the Drummond Lands, a box culvert would no longer be required due to the more suitable topography at the Drummond outlet and the associated availability of emergency relief;
- A single pond option keeps more infrastructure within the new development areas and minimizes infrastructure proposed within the Borrisokane Road right-of-way (ROW);
- In accordance with the City's typical preference, there will be a reduction in maintenance costs with one less facility to manage.

Similar to the changes associated with the sanitary outlet revision, the only impacted properties are those proponents that are directly benefitting from the changes and would be considered a Minor Change per Section 11.1.1 of the ***BSUEA MSS***.

As noted in the ***Jock River SWS***, quantity control is not required for the Jock River; however, based on past reports (***BSUEA MSS*** and Existing Condition Report), the limited capacity of the ditch infrastructure along Borrisokane Road will require that the stormwater management facility provide a storage volume for quantity control. Any infrastructure upgrades or adjustments relating to the Borrisokane Road ROW will require appropriate permits and approvals from the Ministry of Transportation until such time as the ongoing process for the transfer of the roadway to be under the jurisdiction of the City of Ottawa is completed.

5.3.2.1 Erosion Targets – Borrisokane Road ROW

As requested by City staff an erosion assessment has been completed for the Borrisokane Road ditch outlet. JFSA has prepared a technical memorandum under separate cover entitled “*Borrisokane Ditch Erosion Assessment: The Ridge (Brazeau) Subdivision*” (June 2020) which reviewed the pond outlet for the site (the west ditch of Borrisokane Road north of Cambrian Road). The study concluded that the critical erosion velocity of the receiver is approximately 1.2 m/s which was then converted to a critical discharge threshold using a 1D HEC-RAS model of the ditch which determined that the threshold ranges from 4.20 m^3/s to 7.9 m^3/s for the middle and lower reaches of the ditch. From JFSA’s hydrologic modelling of the ditch, under proposed conditions, the peak flow is assessed at 3.82 m^3/s for the 100-year 24-hour SCS event which is lower than the existing threshold range determined.

5.4 Stormwater Management Design

As shown in the *Storm Drainage Area Plan*, the proposed stormwater management design consists of OGS units for quality control and an end-of-line dry SWM pond for quantity control prior to discharge along Borrisokane Road. The pond will be located within the portion of the Drummond quarry land that is between the future Drummond residential area to be developed (within the urban boundary) and Borrisokane Road. The facility will be sized to meet the required level of quantity control based on a restricted outflow of 1,300 L/s as noted in Section 5.2. See the ***JFSA Pond Report*** under separate cover for full details of the SWM pond design.

In accordance with the Paterson ***Hydrogeological Review*** (under separate cover) for the area of the pond, the bottom elevation has been set at an elevation of 96.00m and will be lined as required to mitigate the inflow of perched groundwater in the area due to seasonal conditions.

The SWM pond will outlet to the Borrisokane Road roadside ditch. It is proposed that there will be a new 900mm/1200mm storm sewer installation along Borrisokane Road which extends northward to the vicinity of Cambrian Road where it discharges to the western roadside ditch. The proposed alignment was submitted via the City’s Municipal Consent process at the City’s request. No significant concerns were raised with the proposal.

5.4.1 Borrisokane Road – Ministry of Transportation Requirements

Borrisokane Road, along the frontage of The Ridge development area and northwards to Cambrian Road, is currently owned by, and under the jurisdiction of, the Ministry of Transportation. As such, any proposed underground stormwater infrastructure or grading/landscaping will require permits to facilitate the design and implementation of those works until such time that the process underway to transfer jurisdiction to the City of Ottawa is complete. We are working directly with MTO for the required permitting.

Culverts:
For any stormwater flows outletting to any existing, or new, Borrisokane Road ROW culverts the stormwater management reporting will evaluate peak flow rates, velocities and headwater levels at pre- and post-development conditions for design and regulatory storms.

Ditches:
For any stormwater flows outletting to existing Borrisokane Road ROW ditches, the stormwater management reporting will evaluate peak flow rates, velocities and depth of flow at pre- and post-development conditions for design and regulatory storms.

Inlet Control Devices:
Insofar as the Ministry has indicated that they do not recognize any benefit from the attenuation of storm water runoff from inlet control devices. In the circumstance where on-site SWM measures do not operate as intended water from the pond will spill to the Borrisokane roadside ditch via a reinforced grassed emergency spillway as shown in the '*SWM Pond'* Drawing No. 76.

5.5 Proposed Minor System

The subject property will be serviced by an internal gravity storm sewer system that follows the local road network and servicing easements as required. The drainage is conveyed within the underground piped sewer system to the proposed SWM pond with select areas of local streets that will have the EES installed to achieve infiltration targets.

Street catchbasins will collect drainage from the streets and front yards, while rear yard catchbasins will capture drainage from backyards. Perforated catch basin leads will be provided in rear yards, to add to the infiltration network, except the last segment where it connects to the right-of-way which will be solid pipe, per City standards.

The preliminary rational method design of the minor system captures drainage for storm events up to and including the 2-year (local) and 5-year (collector) event assuming the use of inlet control devices (ICD) for all catchbasins within the subject property. The peak design flows are calculated based on an average predicted runoff coefficient (C-value) ranging from 0.71 to 0.54 for most of the development area (see storm design sheet in ***Appendix D*** for details. The storm system has also been sized to consider the potential for future commercial lands to the west where required.

The following table summarizes the standards that will be employed in the detailed design of the storm sewer network. The drainage area information can be found in the *Storm Drainage Plans* and rational method design sheets provided in ***Appendix D***.

Table 3: Storm Sewer Design Criteria

Design Parameter	Value
Minor System Design Return Period	1:2 yr (PIEDTB-2016-01) for local roads, without ponding 1:5 yr for collector roads, without ponding
Major System Design Return Period	1:100 year
Intensity Duration Frequency Curve (IDF) 2-year storm event: A=732.951 | B=6.199 | C=0.810 5-year storm event: A = 998.071 | B = 6.053 | C = 0.814	$i = \frac{A}{(t_c + B)^C}$
Minimum Time of Concentration	10 minutes
Rational Method	$Q = CiA$
Storm sewers are to be sized employing the Manning's Equation	$Q = \frac{1}{n} A R^{2/3} S^{1/2}$
Runoff coefficient for paved and roof areas	0.9
Runoff coefficient for landscaped areas	0.2
Minimum Sewer Size	250 mm diameter
Minimum Manning's 'n' for pipe flow	0.013
Minimum Depth of Cover	1.5 m from crown of sewer to grade
Minimum Full Flowing Velocity	0.8 m/s
Maximum Full Flowing Velocity	6.0 m/s
Clearance from 100-Year Hydraulic Grade Line to Building Opening	0.30 m
Max. Allowable Flow Depth on Municipal Roads	35 cm above gutter (PIEDTB-2016-01)
Extent of Major System	Contained within the ROW, or adjacent to the ROW, provided that the water level not touch any part of the building envelope and remains below the lowest building opening during the stress test event (100-year + 20%) and 15cm vertical clearance is maintained between spill elevation on the street and the ground elevation at the building envelope (PIEDTB-2016-01)
Stormwater Management Model	DDSWMM (release 2.1), SWMHYMO (v. 5.02)
Model Parameters	Fo = 76.2 mm/hr, Fc = 13.2 mm/hr, DCAY = 4.14/hr, D.Stor.Imp. = 1.57 mm, D.Stor.Per. = 4.67 mm
Imperviousness	Based on runoff coefficient (C) where Percent Imperviousness = (C - 0.2) / 0.7 x 100%.
Design Storms	Chicago 3-hour Design Storms and 24-hour SCS Type II Design Storms. Max. Intensity averaged over 10 minutes.
Historical Events	July 1st, 1979, August 4th, 1988 and August 8th, 1996
Climate Change Street Test	20% increase in the 100-year, 3-hour Chicago storm
Design Parameter	**Value**
Extracted from City of Ottawa Sewer Design Guidelines, October 2012, and ISSU,	

5.6 Quality Control (OGS Units)

Enhanced quality treatment for the development, corresponding to a long-term average Total Suspended Solid removal efficiency of 80%, will be achieved via the proposed EES system installations and two OGS unit(s). The location/details of the OGS units near the SWM pond inlet can be seen in '*Storm Drainage Plan'* Drawing No. 88 and SWM Pond Drawings No. 77/79 found in ***Appendix D*** along with the details of the OGS unit sizing provided by Contech. The units have been configured as off-line units to allow for the bypass of larger flows.

5.7 Hydraulic Grade Line Analysis

A detailed hydraulic grade line (HGL) modelling analysis has been completed for the proposed system based on the 100-year 3-hour Chicago, 12-hour SCS, and 24-hour SCS design storms, including historical design storms and climate change stress test as required. The HGL is provided in the plan and profile drawings for the subdivision and details of the modelling can be found in the ***JFSA SWM Report***.

5.8 Proposed Major System

Major system conveyance, or overland flow (OLF), is provided to accommodate flows in excess of the minor system capacity. OLF is accommodated by generally storing stormwater up to the 100-year design event in road sags then routing additional surface flow along the road network and service easements towards the proposed drainage features to the Jock River, as shown in the *Storm Drainage Plans*. Stormwater ultimately discharges to the Borrisokane Road ROW which will require appropriate permits and approvals from the Ministry of Transportation if the process to change the jurisdiction to the City of Ottawa does not occur.

5.9 Stormwater Servicing Conclusions

The stormwater runoff is designed to be captured by an internal gravity sewer system that is to convey flows to an end-of-line dry SWM pond facility and OGS units for the quality control treatment of stormwater flows that originate from collector and arterial roadways due to City salting procedures. An Enhanced Level of protection will be provided for stormwater runoff from the subject property before ultimately being discharged to the Jock River. Quantity control is not required for the Jock River, notwithstanding, some quantity control by on-site and SWM pond storage will be provided due to downstream infrastructure constraints.

Infiltration targets noted in the MSS will be achieved via the installation of the EES system within local ROWs which will also provide Enhanced Level quality control as detailed in the ***MSS***.

6.0 PROPOSED GRADING

The grading design includes a saw-toothed road design with varying road grades in order to maximize available surface storage for management of flows up to the 100-year design event where possible. The proposed site grading has also been developed to optimize earthworks and provide major system conveyance to the end-of-line facility which eventually outlets to the Borrisokane Road ROW and then to the Jock River. Roadway connections to the future New Greenbank Road will be coordinated with that future design based on the Environmental Assessment Study profile for that roadway. Reduced size grading plans are found in ***Appendix E*** in order to provide an overview context for the proposed grading.

The geotechnical review of the site makes note of the significant grade raises that will be found within the development area. No grade raise restrictions are indicated for the site. However, an extensive earthworks program is being undertaken which will be continuously monitored by the geotechnical consultant in order to ensure that appropriate fill material, placement, and compaction are provided throughout the property. The monitoring program is based on the detailed grading proposed and will ultimately be reviewed and signed off by a licensed Geotechnical Engineer. Any grading onto adjacent properties has been coordinated with adjacent landowners for permissions and retaining walls will be implemented where required.

7.0 EROSION AND SEDIMENT CONTROL

Soil erosion occurs naturally and is a function of soil type, climate and topography. The extent of erosions losses is exaggerated during construction where the vegetation has been removed and the top layer of soil is disturbed.

- Erosion and sediment controls must be in place during construction. The following recommendations to the contractor will be included in contract documents.
- Limit extent of exposed soils at any given time.
- Re-vegetate exposed areas as soon as possible.
- Minimize the area to be cleared and grubbed.
- Protect exposed slopes with plastic or synthetic mulches.
- Install silt fence to prevent sediment from entering existing ditches.
- No refueling or cleaning of equipment near existing watercourses.
- Provide sediment traps and basins during dewatering.
- Install filter cloth between catch basins and frames.
- Installation of mud mats at construction accesses.

7.1 EES Protection During Construction

From the *Low Impact Development Stormwater Management Planning and Design Guide* prepared by CVC and TRCA (ver 1.0, 2010):

- Prior to site works, the location of LIDs should be marked and vehicles are to avoid the area other than during the installation of the LID. Drainage not to be directed to the LID;
- To minimize siltation in the newly installed EES system, both the upstream and downstream ends of the EES system should be plugged immediately during the construction phase. The upstream plug is to be removed at approximately an occupancy of 80% similar to the Quinn's Pointe development;
- Upland drainage areas need to be properly stabilized with vegetation as soon as possible in order to reduce sediment loads;
- The facility should be excavated to design dimensions from the side using a backhoe or excavator. The base of the facility should be level or match the slope of the above storm sewer;
- The bottom of the facility should be scarified to improve infiltration; and
- Geotextile fabric should be correctly installed to optimize system function. When laying the geotextile, the width should include sufficient material to compensate for perimeter irregularities in the facility and a 150mm minimum top overlap.

8.0 CONCLUSION AND RECOMMENDATIONS

This report provides details on the planned on-site municipal services for the subject property and demonstrates that adequate municipal infrastructure capacity for the planned development of the subject property:

- The subject lands have been reviewed by the ***BSUEA MSS*** and has shown that water supply to the property can be provided. An analysis completed by GeoAdvice also documents the water supply network and results. The network will be expanded through neighboring properties to enhance/meet the water demands of the proposed development as adjacent properties are also developed.

- Sanitary service is to be provided to the subject property via connection to the sanitary sewer located along Cambrian Road through the Future Greenbank Road ROW as per the ***MSS***. With the inclusion of the subject property, the existing downstream sewers have sufficient capacity to accommodate the subject property's proposed sanitary flows.

- Stormwater service is to be provided by capturing stormwater runoff via an internal gravity sewer system that will convey flows to a proposed end-of-line dry SWM pond facility for quantity control. Quality control will be provided for arterial and collector roadway (and select local roadway) drainage via the use of OGS units to an Enhanced Level of protection (80% TSS removal) prior to discharge to the SWM Pond. Quality control for local streets will be provided via the proposed Etobicoke Exfiltration System as documented in the ***MSS***, as well as within the OGS units downstream. Quantity control is not required for the Jock River, however, some quantity control by on-site and SWM pond storage will be provided due to downstream infrastructure constraints. An erosion threshold assessment has been completed by JFSA for the Borrisokane Road west side ditch north of Cambrian Road (pond outlet) and has confirmed that the projected flows are lower than the threshold determined.

- As suggested in the ***BSUEA MSS*** the infiltration will be achieved via use of the preferred EES system. The JFSA reporting demonstrates that the required infiltration targets are met.

- Erosion and sediment control measures will be implemented and maintained throughout construction.

- The design of The Ridge has been completed in general conformance with the City of Ottawa Design Guidelines and criteria presented in other background study documents.

Prepared by,
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LICENSED PROFESSIONAL ENGINEER
K.L. MURPHY
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July 28/20
PROVINCE OF ONTARIO

Per: Kevin L. Murphy, P.Eng.

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Hydraulic Capacity and Modeling Analysis Brazeau Lands

Final Report

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Project: 2019-091-DSE

Document History and Version Control

Revision No.	Date	Document Description	Revised By	Reviewed By
R0	November 7, 2019	Draft	Ben Loewen	Werner de Schaetzen
R1	December 20, 2019	Final	Ben Loewen	Werner de Schaetzen
R2	June 10, 2020	Updated Draft	Ferdinand de Schoutheete	Werner de Schaetzen
R3	July 28, 2020	Final	Ferdinand de Schoutheete	Werner de Schaetzen

Statement of Qualifications and Limitations
This document represents GeoAdvice Engineering Inc. best professional judgment based on the information available at the time of its completion and as appropriate for the project scope of work. Services performed in developing the content of this document have been conducted in a manner consistent with that level and skill ordinarily exercised by a member of the engineering profession currently practicing under similar conditions. No warranty, express or implied is made.

Contents

1 Introduction

GeoAdvice Engineering Inc. ("GeoAdvice") was retained by David Schaeffer Engineering Ltd. ("DSEL") to size the proposed water main network for the Brazeau Lands development ("Development") in the City of Ottawa, ON ("City").

Under existing conditions, the development will be serviced by the Barrhaven pressure zone; however, in the future, it will be serviced by pressure zone 3C.

There are 347 single detached dwellings, 279 traditional townhomes and 1 park serviced as part of the development.

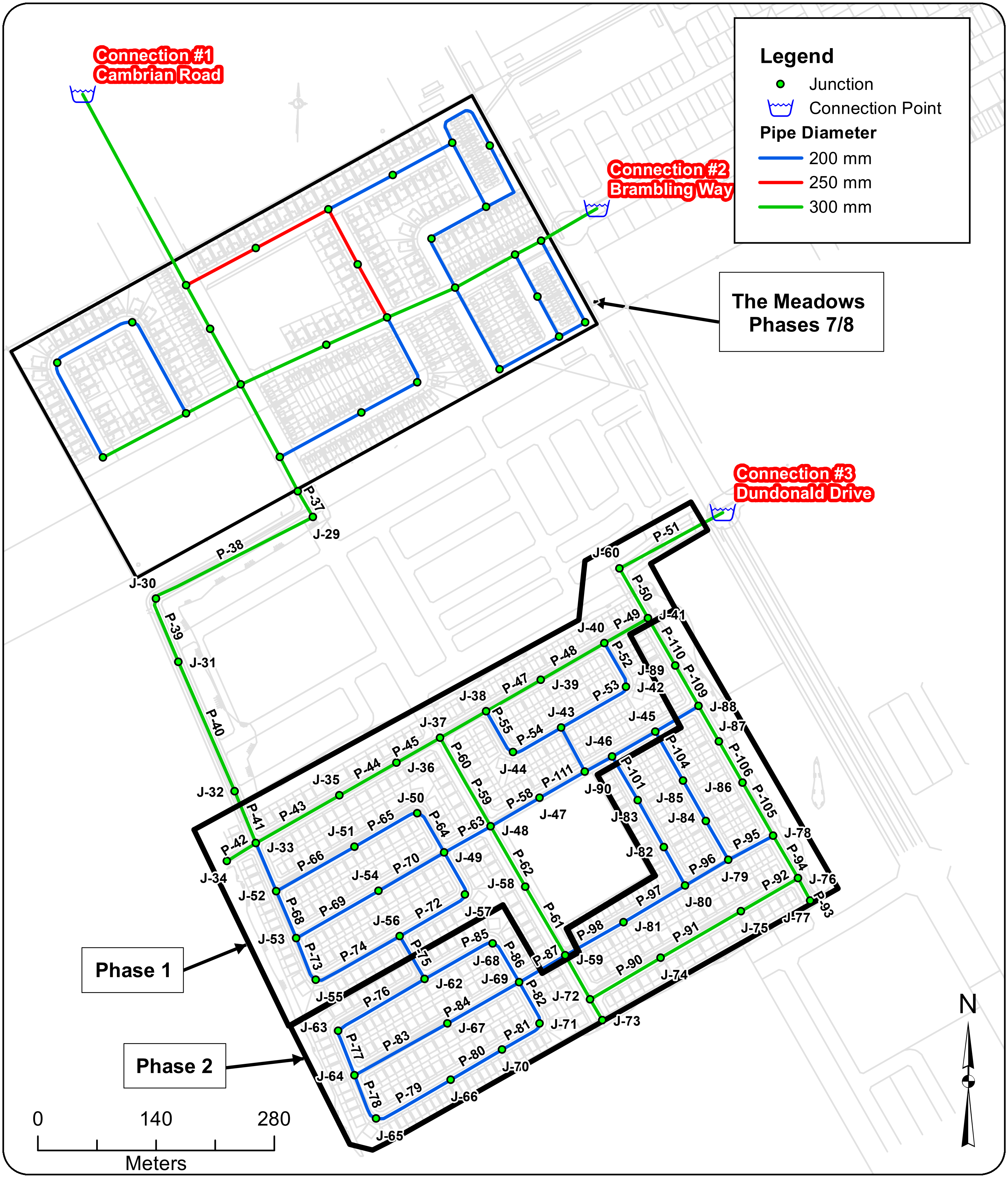
The Brazeau Lands development will have three (3) connections to the City water distribution system:

- Connection 1: Apolune Street and Cambrian Road;
- Connection 2: Jackdaw Avenue and Future Greenbank Road; and
- Connection 3: Dundonald Drive and Future Greenbank Road.

The development site is shown in **Figure 1.1** on the following page, with the final recommended pipe diameters.

This report describes the assumptions and results of the hydraulic modeling and capacity analysis using InfoWater (Innovyze), a GIS water distribution system modeling and management software application.

The results presented in this memo are based on the analysis of steady state simulations. The predicted available fire flows, as calculated by the hydraulic model, represent the flow available in the water main while maintaining a residual pressure of 20 psi. No extended period simulations were completed in this analysis to assess the water quality or to assess the hydraulic impact on storage and pumping.



GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis of the Brazeau Lands**
Client: **David Schaeffer Engineering Ltd.**
Date: **June 2020**
Created by: **BL**
Reviewed by: **WdS**

DISCLAIMER: GeoAdvice does not warrant in any way the accuracy and completeness of the information shown on this map. Field verification of the accuracy and completeness of the information shown on this map is the sole responsibility of the user.

Brazeau Lands Site Layout and Connection Points

Figure 1.1

2 Modeling Considerations

2.1 Water Main Configuration

The water main network was modeled based on the drawing prepared by DSEL (1030_Gen_Rev4.dwg) and provided to GeoAdvice on June 2nd, 2020.

2.2 Elevations

Elevations of the modeled junctions were assigned according to a site grading plan prepared by DSEL (1030_Grad_Rev4.dwg) and provided to GeoAdvice on June 2nd, 2020.

2.3 Consumer Demands

Demand factors used for this analysis were taken according to the City of Ottawa 2010 Design Guidelines *Table 4.2 Consumption Rate for Subdivisions of 501 to 3,000 Persons*. Population densities were assigned according to *Table 4.1 Per Unit Populations* from the City of Ottawa Design Guidelines. A summary of these tables highlighting relevant data for this development is shown in **Table 2.1** below.

Table 2.1: City of Ottawa Demand Factors

Demand Type	Amount	Units
Average Day Demand		
Residential	350	L/c/d
Park	28,000	L/ha/d
Maximum Daily Demand		
Residential	2.5 x avg. day	L/c/d
Park	1.5 x avg. day	L/ha/d
Peak Hour Demand		
Residential	2.2 x max. day	L/c/d
Park	1.8 x max. day	L/ha/d
Minimum Hour Demand		
Residential	0.5 x avg. day	L/c/d
Park	0.5 x avg. day	L/ha/d

Table 2.2 and **Table 2.4** summarize the residential water demand calculations for the Brazeau Lands development.

Table 2.2: Development Population and Demand Calculations – Phase 1

Dwelling Type	Number of Units	Persons Per Unit*	Population	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Single Detached	172	3.4	585	2.37	5.92	13.03	1.18
Traditional Townhome	133	2.7	360	1.46	3.65	8.02	0.73

***City of Ottawa Design Guidelines**

Table 2.3: Development Population and Demand Calculations – Phases 1&2

Dwelling Type	Number of Units	Persons Per Unit*	Population	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Single Detached	347	3.4	1,180	4.78	11.95	26.29	2.39
Traditional Townhome	279	2.7	754	3.05	7.64	16.80	1.53

***City of Ottawa Design Guidelines**

Table 2.6 summarizes the non-residential water demand calculations for the Brazeau Lands development (included in both Phase 1 and Phases 1&2).

Table 2.4: Non-Residential Demand Calculations

Land Use Type	Area (ha)	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Park	1.72	0.56	0.84	1.51	0.28

Table 2.5 summarizes the demands for the Meadows Phases 7/8 subdivision development located north of the Brazeau Lands and downstream of Connections 1 and 2 (accounted for in the HGLs provided by the City in the boundary conditions request).

Table 2.5: The Meadows Phases 7/8

Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
6.20	13.50	28.50	3.10

Demands were grouped into demand polygons then uniformly distributed to the model nodes located within each polygon. Detailed calculations of demands as well as the illustrated allocation areas are shown in **Appendix A**.

2.4 Fire Flow Demand

Fire flow calculations were completed for all dwelling types in accordance with the Fire Underwriters Survey's (FUS) Water Supply for Public Fire Protection Guideline (1999) and City of Ottawa Technical Bulletin ISTB-2018-02 as summarized in **Appendix B**.

All the single detached dwellings have a minimum separation of 10 m between the backs of adjacent units and are, therefore, subject to the 10,000 L/min (167 L/s) cap outlined in City of Ottawa Technical Bulletin ISDTB-2014-02.

Most of the traditional townhouse dwellings comply with the City of Ottawa Technical Bulletin ISDTB-2014-02 and are, therefore, subject to the 10,000 L/min (167 L/s) cap.

The traditional townhouse dwellings located on Blocks 168 and 384 do not have a minimum separation of 10 m between the backs of adjacent units and therefore do not comply with the provisions under the City of Ottawa Technical Bulletin ISDTB-2014-02. The required fire flow for those blocks were calculated to be 167 L/s based on the Fire Underwriters Survey's (FUS) Water Supply for Public Fire Protection Guideline (1999). The agreement of this calculation with the City of Ottawa cap of 167 L/s is purely coincidental.

At this time, there is not enough information available to calculate the required fire flow of the park. As such, a required fire flow of 250 L/s was assumed for the park. This is a typical, conservative value for similar land use.

Fire flow simulations were completed at each model node in the Brazeau development. The locations of nodes do not necessarily represent hydrant locations.

Detailed FUS fire flow calculations as well as the illustrated spatial allocation of the required fire flows are shown in **Appendix B**.

2.5 Boundary Conditions

The boundary conditions were provided by the City of Ottawa in the form of Hydraulic Grade Line (HGL) at the following locations:

- Connection 1: Apolune Street and Cambrian Road;
- Connection 2: Jackdaw Avenue and Future Greenbank Road; and
- Connection 3: Dundonald Drive and Future Greenbank Road.

The above connection points are illustrated in **Figure 1.1**.

Boundary conditions were provided for Peak Hour, Maximum Day plus Fire and Minimum Hour (high pressure check) conditions.

Under existing conditions, the Brazeau Lands development will be serviced by the Barrhaven pressure zone; however, in the future, it will be serviced by pressure zone 3C. As such, boundary conditions were provided under the existing and future pressure zone configurations.

In total, two (2) sets of boundary conditions were provided by the City and can be found in **Appendix C**.

The boundary conditions for the existing pressure zone configuration are more conservative. As such, the results presented in this report are based on the boundary conditions for the existing pressure zone configuration.

Table 2.6 summarizes the boundary conditions used to size the Brazeau Lands water network.

Table 2.6: Existing Boundary Conditions

Condition	Connection 1 HGL (m)	Connection 2 HGL (m)	Connection 3 HGL (m)
Min Hour (max. pressure)	156.4	156.4	156.4
Peak Hour (min. pressure)	135.7	135.6	135.7
Max Day + Fire Flow (167 L/s)	144.0	141.2	142.0
Max Day + Fire Flow (250 L/s)	135.4	129.9	131.5

3 Hydraulic Capacity Design Criteria

3.1 Pipe Characteristics

Pipe characteristics of internal diameter (ID) and Hazen-Williams C factors were assigned in the model according to the City of Ottawa Design Guidelines for PVC water main material. Pipe characteristics used for the development are outlined in **Table 3.1** below.

Table 3.1: Model Pipe Characteristics

Nominal Diameter (mm)	ID PVC (mm)	Hazen Williams C-Factor (/)
200	204	110
250	250	110
300	297	120

3.2 Pressure Requirements

As outlined in the City of Ottawa Design Guidelines, the generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi). The maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way shall not exceed 552 kPa (80 psi). Pressure requirements are outlined in **Table 3.2.**

Table 3.2: Pressure Requirements

Demand Condition	Minimum Pressure		Maximum Pressure	
	(kPa)	(psi)	(kPa)	(psi)
Normal Operating Pressure (maximum daily flow)	350	50	480	70
Peak Hour Demand (minimum allowable pressure)	276	40	-	-
Maximum Fixture Pressure (Ontario Building Code)	-	-	552	80
Maximum Distribution Pressure (minimum hour check)	-	-	552	80
Maximum Day Plus Fire	140	20	-	-

4 Hydraulic Capacity Analysis

The proposed water mains within the development were sized to the minimum diameter which would satisfy the greater of maximum day plus fire and peak hour demand. Modeling was carried out for minimum hour, peak hour and maximum day plus fire flow using InfoWater. Only the existing pressure zone configuration was analyzed, since the boundary conditions are more conservative.

Detailed pipe and junction model input data can be found in **Appendix D**.

4.1 Development Pressure Analysis

Modeled service pressures for the development are summarized in **Table 4.1** below.

Table 4.1: Summary of the Brazeau Lands Available Service Pressures

Phase	Minimum Hour Demand Maximum Pressure	Peak Hour Demand Minimum Pressure
Phase 1	538 kPa (78 psi)	290 kPa (42 psi)
Phases 1&2	538 kPa (78 psi)	**262 kPa (38 psi)**

As outlined in the City of Ottawa Design Guidelines, the generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi). The maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way shall not exceed 552 kPa (80 psi).

Low pressures are predicted at junctions J-66, J-70, J-71, J-72, J-73, J-74, J-75, J-76 and J-77 under peak hour demand. Those low pressures are due to high elevations in the southern part of the Brazeau Lands development and are within 5% of the minimum allowable pressure of 276 kPa (40 psi). The future Zone 3C boundary conditions will provide an additional head of about seven (7) meters at each connection point, and will thus resolve the low PHD pressures at the southern part of the Brazeau Lands development.

Detailed pipe and junction result tables and maps can be found in **Appendix E**.

4.2 Development Fire Flow Analysis

A summary of the minimum available fire flows in the Brazeau Lands development is shown below in **Table 4.2**.

Table 4.2: Summary of the Brazeau Lands Minimum Available Fire Flows

Phase	Required Fire Flow	Minimum Available Flow	Junction ID
Phase 1	167 L/s	177 L/s	J-45
	250 L/s	249 L/s	J-47
Phases 1&2	167 L/s	194 L/s	J-66
	250 L/s	269 L/s	J-47

As shown in the table above, the available fire flow is greater than the required fire flow under both Phase 1 and Phases 1&2 conditions.

A summary of the residual pressures in the Brazeau Lands is shown below in **Table 4.3**. The minimum allowable pressure under fire flow conditions is 140 kPa (20 psi) at the location of the fire.

Table 4.3: Summary of the Brazeau Lands Residual Pressures (MDD + FF)

Phase	Maximum Residual Pressure	Average Residual Pressure	Minimum Residual Pressure
Phase 1	365 kPa (53 psi)	296 kPa (43 psi)	140 kPa (20 psi)
Phases 1&2	365 kPa (53 psi)	296 kPa (43 psi)	159 kPa (23 psi)

There is sufficient residual pressure at all the junctions within the Brazeau Lands development.

Detailed fire flow results and figures illustrating the fire flow results can be found in **Appendix F**.

5 Other Servicing Considerations

5.1 Water Supply Security

The City of Ottawa Design Guidelines allow single feed systems for developments up to a total average day demand of 50 m^3/day and require two (2) feeds if the development exceeds 50 m^3/day for supply security, according to Technical Bulletin ISDTB-2014-02.

The Brazeau Lands services a total average day demand of 725 m^3/day; as such, two (2) feeds are required.

5.2 Valves

No comment has been made in this technical memorandum with respect to exact placement of isolation valves within the distribution network for the Brazeau Lands other than to summarize the City of Ottawa Design Guidelines for number, location, and spacing of isolation valves:

- Tee intersection – two (2) valves
- Cross intersection – three (3) valves
- Valves shall be located 2 m away from the intersection
- 300 m spacing for 150 mm to 400 mm diameter valves
- Gate valves for 100 mm to 300 mm diameter mains
- Butterfly valves for 400 mm and larger diameter mains

Drain valves are not strictly required under the City of Ottawa Design Guidelines for water mains under 600 mm in diameter. The Guidelines indicate that "small diameter water mains shall be drained through hydrant via pumping if needed."

Air valves are not strictly required under the City of Ottawa Design Guidelines for water mains up to and including 400 mm in diameter. The Guidelines indicate that air removal "can be accomplished by the strategic positioning of hydrant at the high points to remove the air or by installing or utilizing available 50 mm chlorination nozzles in 300 mm and 400 mm chambers."

The detailed engineering drawings for the Brazeau Lands are expected to identify valves in accordance with the requirements noted above.

5.3 Hydrants

No comment has been made in this technical memorandum with respect to exact placement of hydrants within the distribution network for the Brazeau Lands other than to summarize the City of Ottawa Design Guidelines for maximum hydrant spacing:

- 125 m for single family unit residential areas on lots where frontage at the street line is 15 m or longer
- 110 m for single family unit residential areas on lots where frontage at the street line is less than 15 m and for residential areas zoned for row housing, doubles or duplexes
- 90 m for institutional, commercial, industrial, apartments and high-density areas

The detailed engineering drawings for the Brazeau Lands development are expected to identify hydrants in accordance with the requirements noted above.

6 Conclusions

The hydraulic capacity and modeling analysis of Phase 1 of the Brazeau Lands development yielded the following conclusions:

- The proposed water main network can deliver all domestic flows, with service pressures expected to range between 290 kPa (42 psi) and 538 kPa (78 psi).
- The proposed water main network is able to deliver fire flows to all junctions.
- Hydraulic modeling was only completed for the existing pressure zone configuration since the boundary conditions are more conservative.

The hydraulic capacity and modeling analysis of Phases 1&2 of the Brazeau Lands development yielded the following conclusions:

- The proposed water main network can deliver all domestic flows except for junctions J-66, J-70, J-71, J-72, J-73, J-74, J-75, J-76 and J-77, with service pressures expected to range between 262 kPa (38 psi) and 538 kPa (78 psi).
- The junctions with low pressures are due to high elevations in the southern part of the Brazeau Lands development and are within 5% of the minimum allowable pressure of 276 kPa (40 psi).
- The future Zone 3C boundary conditions will provide an additional head of about seven (7) meters at each connection point, and will thus resolve the low PHD pressures at the southern part of the Brazeau Lands development.
- The proposed water main network is able to deliver fire flows to all junctions.
- Hydraulic modeling was only completed for the existing pressure zone configuration since the boundary conditions are more conservative.

Submission

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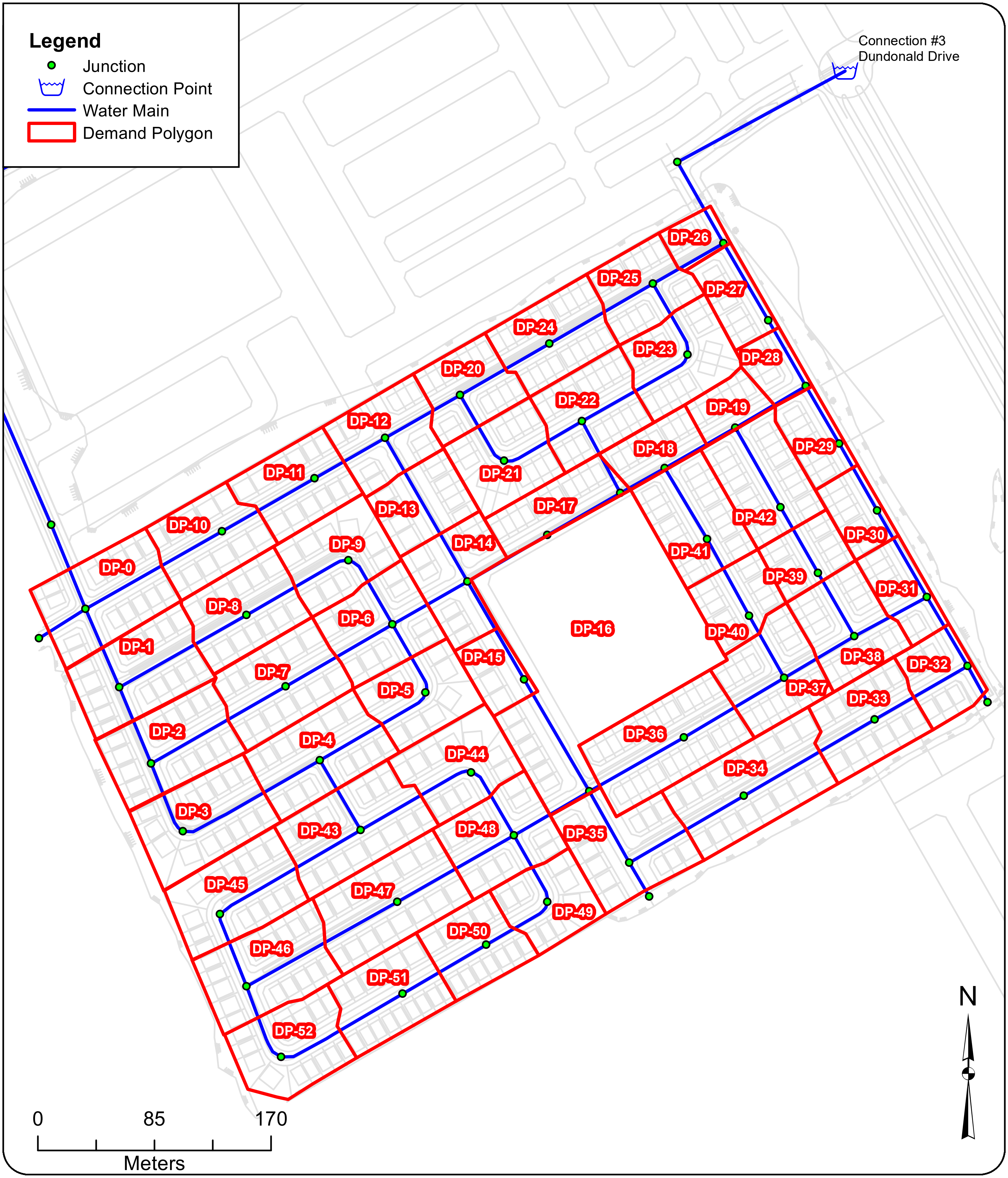
Appendix A Domestic Water Demand Calculations and Allocation

Appendix A Domestic Water Demand Calculations and Allocation



GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis of the Brazeau Lands**
Client: **David Schaeffer Engineering Ltd.**
Date: **June 2020**
Created by: **BL**
Reviewed by: **WdS**

Demand Allocation Phases 1&2

Figure A.1

Consumer Water Demands

Phase 1 Residential Demands

Dwelling Type	Number of Units	Population **		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	172	3.4	585	350	204,750	2.37	5.92	167*	13.03	1.18
Traditional Townhome	133	2.7	360		126,000	1.46	3.65	167*	8.02	0.73
Subtotal	**305**		**945**		**330,750**	**3.83**	**9.57**		**21.05**	**1.91**

Phases 1&2 Residential Demands

Dwelling Type	Number of Units	Population **		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	347	3.4	1,180	350	413,000	4.78	11.95	167*	26.29	2.39
Traditional Townhome	279	2.7	754		263,900	3.05	7.64	167*	16.80	1.53
Subtotal	**626**		**1,934**		**676,900**	**7.83**	**19.59**		**43.09**	**3.92**

Non Residential Demands

Property Type	Area (ha)		Average Day Demand			Max Day 1.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 1.8 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
			** (L/ha/d)	(L/d)	(L/s)				
Park w/ Splash Pad	1.72		28,000	48,160	0.56	0.84	250**	1.51	0.28
Subtotal	**1.72**			**48,160**	**0.56**	**0.84**		**1.51**	**0.28**

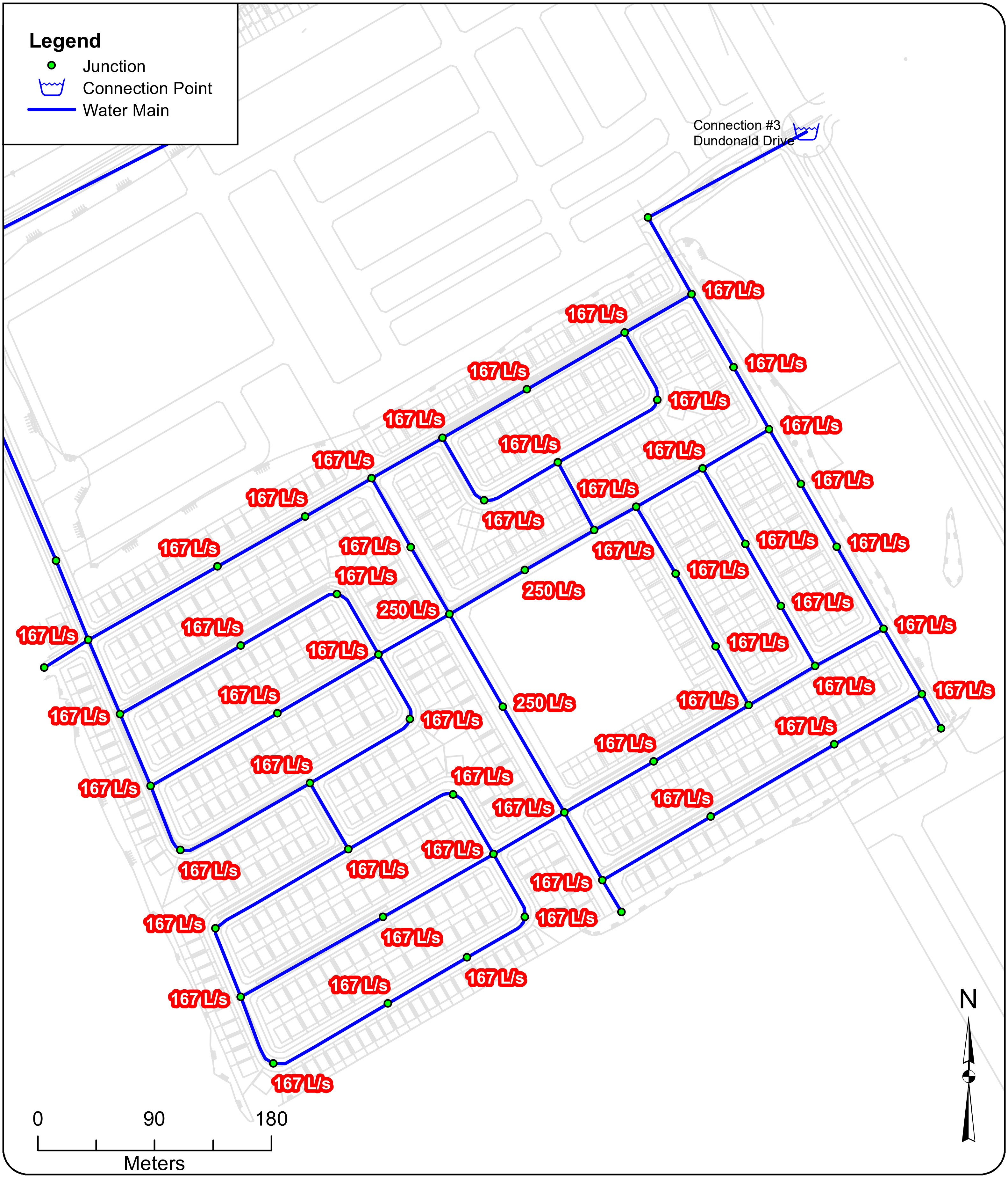
The Meadows Phases 7/8		**ADD (L/s)**	**MDD (L/s)**	**PHD (L/s)**	**MHD (L/s)**
Total Demand:		**6.20**	**13.50**	**28.50**	**3.10**

		ADD (L/s)	**MDD (L/s)**	**PHD (L/s)**	**MHD (L/s)**
Without the Meadows Phases 7/8 Demands	Phase 1	**4.39**	**10.41**	**22.56**	**2.19**
	Phases 1&2	**8.39**	**20.42**	**44.59**	**4.20**
With the Meadows Phases 7/8 Demands	Phase 1	**10.59**	**23.91**	**51.06**	**5.29**
	Phases 1&2	**14.59**	**33.92**	**73.09**	**7.30**

*Based on FUS fire flow calculation

**Assumed based on similar information from previously completed projects, as agreed upon with DSEL

Appendix B FUS Fire Flow Calculations and Allocation



GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis of the Brazeau Lands**
Client: **David Schaeffer Engineering Ltd.**
Date: **June 2020**
Created by: **BL**
Reviewed by: **WdS**

Required Fire Flow Phases 1&2

Figure B.1

FUS Required Fire Flow Calculation

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.

Client: David Schaeffer Engineering Ltd.
Project: 2019-091-DSE
Development: Brazeau Lands   Blocks 300-313, Single Detached
Zoning: Multi Family Residential
Date: November 6, 2019

A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 1927 m^2

Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2

Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

Note: The single detached dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 14 units is considered in this calculation.

D. Required Fire Flow*: $F = 220C\sqrt{A}$

C: Coefficient related to the type of construction — **C =** 1.5

A: Effective area — **A =** 3854 m^2 (Combined area of 14 units)

The total floor area in m^2 in the building being considered

F = 20,486 L/min **D = 20,000 L/min***

E. Occupancy

Occupancy content hazard — Limited Combustible — -15 % of **D** — **-3,000 L/min** — **E = 17,000 L/min**

F. Sprinkler Protection

Automatic sprinkler protection — None — 0 % of **E** — **0 L/min** — **F = 17,000 L/min**

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	20.1 to 30 m	0-30 m-storeys	Wood Frame or Non-Combustible	8%
East	20.1 to 30 m	0-30 m-storeys	Wood Frame or Non-Combustible	8%
North	10.1 to 20 m	Over 120 m-storeys	Wood Frame or Non-Combustible	15%
South	20.1 to 30 m	Over 120 m-storeys	Wood Frame or Non-Combustible	10%
			Total	**41%**

% of **E** — **+ 6,970 L/min** — **G = 23,970 L/min**

H. Wood Shake Charge — No — **0 L/min** — **H = 23,970 L/min**

For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.2. The single detached dwellings comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	**10,000**	**L/min***
	167	**L/s**
Required Duration of Fire Flow	**2**	**Hrs**
Required Volume of Fire Flow	**1,200**	**m^3**

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m^2)	3,854
Required Fire Flow (L/min)	20,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	8%
East (%)	8%
South (%)	15%
West (%)	10%
Total Exposure (%)	41%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167

FUS Required Fire Flow Calculation

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.

Client: David Schaeffer Engineering Ltd.
Project: 2019-091-DSE
Development: Brazeau Lands — Blocks 173, Traditional Townhouse
Zoning: Multi Family Residential
Date: November 6, 2019

A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 474 m^2

Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2

Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

Note: The townhouse dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 5 units is considered in this calculation.

D. Required Fire Flow*: $F = 220C\sqrt{A}$

C: Coefficient related to the type of construction — **C =** 1.5

A: Effective area — **A =** 947 m^2 (Combined area of 5 units)

The total floor area in m^2 in the building being considered

F = 10,156 L/min **D = 10,000 L/min***

E. Occupancy

Occupancy content hazard — Limited Combustible — -15 % of **D** — **-1,500 L/min** — **E = 8,500 L/min**

F. Sprinkler Protection

Automatic sprinkler protection — None — 0 % of **E** — **0 L/min** — **F = 8,500 L/min**

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
East	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
North	10.1 to 20 m	61-90 m-storeys	Wood Frame or Non-Combustible	14%
South	20.1 to 30 m	31-60 m-storeys	Wood Frame or Non-Combustible	8%
			Total	**56%**

% of E **+ 4,760 L/min** **G = 13,260 L/min**

H. Wood Shake Charge — No — **0 L/min** — **H = 13,260 L/min**

For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.2. The townhouse dwellings comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	**10,000**	**L/min***
	167	**L/s**
Required Duration of Fire Flow	**2**	**Hrs**
Required Volume of Fire Flow	**1,200**	**m^3**

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m^2)	947
Required Fire Flow (L/min)	10,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	17%
East (%)	17%
South (%)	14%
West (%)	8%
Total Exposure (%)	56%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167

FUS Required Fire Flow Calculation

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.

Client: David Schaeffer Engineering Ltd.
Project: 2019-091-DSE
Development: Brazeau Lands
Zoning: Multi Family Residential   Blocks 384, Traditional Townhouse
Date: November 6, 2019

A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 380 m^2

Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2

Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

Note: The townhouse dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 4 units is considered in this calculation.

D. Required Fire Flow*: $F = 220C\sqrt{A}$

C: Coefficient related to the type of construction — **C =** 1.5

A: Effective area — **A =** 760 m^2 (Combined area of 4 units)

The total floor area in m^2 in the building being considered

F = 9,095 L/min **D = 9,000 L/min***

E. Occupancy

Occupancy content hazard: Limited Combustible — -15 % of **D** **-1,350 L/min** **E = 7,650 L/min**

F. Sprinkler Protection

Automatic sprinkler protection: None — 0 % of **E** **0 L/min** **F = 7,650 L/min**

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	10.1 to 20 m	0-30 m-storeys	Wood Frame or Non-Combustible	12%
East	Beyond 45 m	0-30 m-storeys	Wood Frame or Non-Combustible	0%
North	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
South	20.1 to 30 m	0-30 m-storeys	Wood Frame or Non-Combustible	8%
			Total	**37%**

% of **E** **+ 2,831 L/min** **G = 10,481 L/min**

H. Wood Shake Charge No — **0 L/min** **H = 10,481 L/min**

For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.2. The townhouse dwellings **do not** comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	**10,000**	**L/min***
	167	**L/s**
Required Duration of Fire Flow	**2**	**Hrs**
Required Volume of Fire Flow	**1,200**	**m^3**

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

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* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m^2)	760
Required Fire Flow (L/min)	9,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	12%
East (%)	0%
South (%)	17%
West (%)	8%
Total Exposure (%)	37%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167

FUS Required Fire Flow Calculation

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.

Client: David Schaeffer Engineering Ltd.
Project: 2019-091-DSE
Development: Brazeau Lands
Zoning: Multi Family Residential   Blocks 168, Traditional Townhouse
Date: November 6, 2019

A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 380 m^2

Note: ground floor area based on drawing provided to GeoAdvice on September 12, 2019.

C. Number of Storeys: 2

Note: all buildings, including adjacent buildings, assumed to be 2 storeys.

Note: The townhouse dwellings are separated by less than 3 m; therefore, they must be considered as one fire area. The combined area of 4 units is considered in this calculation.

D. Required Fire Flow*: $F = 220C\sqrt{A}$

C: Coefficient related to the type of construction — **C =** 1.5

A: Effective area — **A =** 760 m^2 (Combined area of 4 units)

The total floor area in m^2 in the building being considered

F = 9,095 L/min **D = 9,000 L/min***

E. Occupancy

Occupancy content hazard: Limited Combustible — -15 % of **D** **-1,350 L/min** **E = 7,650 L/min**

F. Sprinkler Protection

Automatic sprinkler protection: None — 0 % of **E** **0 L/min** **F = 7,650 L/min**

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
West	30.1 to 45 m	0-30 m-storeys	Wood Frame or Non-Combustible	5%
East	10.1 to 20 m	0-30 m-storeys	Wood Frame or Non-Combustible	12%
North	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
South	Beyond 45 m	31-60 m-storeys	Wood Frame or Non-Combustible	0%
			Total	**34%**

% of **E** **+ 2,601 L/min** **G = 10,251 L/min**

H. Wood Shake Charge No — **0 L/min** **H = 10,251 L/min**

For wood shingle or shake roofs

The required fire flow exceeds the cap in the City of Ottawa Technical Bulletin ISDTB-2014-02 4.2. The townhouse dwellings **do not** comply with the provisions of the Bulletin; therefore, the required fire flow is:

Total Fire Flow Required	**10,000**	**L/min***
	167	**L/s**
Required Duration of Fire Flow	**2**	**Hrs**
Required Volume of Fire Flow	**1,200**	**m^3**

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Brazeau Lands development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Notes to calculations

Type of Construction	Coefficient	Unit
Wood Frame Construction	1.5	-
Ordinary Construction	1	-
Non-Combustible Construction	0.8	-
Fire Resistive Construction (< 2 hrs)	0.7	-
Fire Resistive Construction (> 2 hrs)	0.6	-

Occupancy Fire Hazard	Factor	Unit
Non-Combustible	-25	%
Limited Combustible	-15	%
Combustible	0	%
Free Burning	15	%
Rapid Burning	25	%

Sprinkler Protection	Factor	Unit
None	0	%
Automatic	-30	%
Automatic + Standard Supply	-40	%
Fully Supervised	-50	%
Fully Supervised + Fire Resistive	-70	%

Zoning
Single Family Residential
Multi Family Residential
Commercial
Institutional
Industrial

Wood Shake Charge	Factor	Unit
Yes	4000	L/min
No	0	L/min

Required Duration of Fire Flow	
Fire Flow Required (L/min)	Duration (hours)
2,000 or less	1.00
3000	1.25
4000	1.50
5000	1.75
6000	2.00
7000	2.00
8000	2.00
9000	2.00
10000	2.00
11000	2.25
12000	2.50
13000	2.75
14000	3.00
15000	3.25
16000	3.50
17000	3.75
18000	4.00
19000	4.25
20000	4.50
21000	4.75
22000	5.00
23000	5.25
24000	5.50
25000	5.75
26000	6.00
27000	6.25
28000	6.50
29000	6.75
30000	7.00
31000	7.25
32000	7.50
33000	7.75
34000	8.00
35000	8.25
36000	8.50
37000	8.75
38000	9.00
39000	9.25
40000 and over	9.50

Notes to calculations

Separation Distance	Length-Height Factor of Exposed Wall of Adjacent Structure	Construction of Exposed Wall of Adjacent Structure			
		Wood Frame or Non-Combustible	Ordinary or Fire-Resistive with Unprotected Openings	Ordinary or Fire-Resistive with Semi-Protected Openings	Ordinary or Fire-Resistive with Blank Wall
0.0 to 3 m	0-30 m-storeys	22%	21%	16%	0%
	31-60 m-storeys	23%	22%	17%	0%
	61-90 m-storeys	24%	23%	18%	0%
	91-120 m-storeys	25%	24%	19%	0%
	Over 120 m-storeys	25%	25%	20%	0%
3.1 to 10 m	0-30 m-storeys	17%	15%	11%	0%
	31-60 m-storeys	18%	16%	12%	0%
	61-90 m-storeys	19%	18%	14%	0%
	91-120 m-storeys	20%	19%	15%	0%
	Over 120 m-storeys	20%	19%	15%	0%
10.1 to 20 m	0-30 m-storeys	12%	10%	7%	0%
	31-60 m-storeys	13%	11%	8%	0%
	61-90 m-storeys	14%	13%	10%	0%
	91-120 m-storeys	15%	14%	11%	0%
	Over 120 m-storeys	15%	15%	12%	0%
20.1 to 30 m	0-30 m-storeys	8%	6%	4%	0%
	31-60 m-storeys	8%	7%	5%	0%
	61-90 m-storeys	9%	8%	6%	0%
	91-120 m-storeys	10%	9%	7%	0%
	Over 120 m-storeys	10%	10%	8%	0%
30.1 to 45 m	0-30 m-storeys	5%	5%	5%	0%
	31-60 m-storeys	5%	5%	5%	0%
	61-90 m-storeys	5%	5%	5%	0%
	91-120 m-storeys	5%	5%	5%	0%
	Over 120 m-storeys	5%	5%	5%	0%
Beyond 45 m	0-30 m-storeys	0%	0%	0%	0%
	31-60 m-storeys	0%	0%	0%	0%
	61-90 m-storeys	0%	0%	0%	0%
	91-120 m-storeys	0%	0%	0%	0%
	Over 120 m-storeys	0%	0%	0%	0%
Fire Wall	0-30 m-storeys	10%	10%	10%	10%
	31-60 m-storeys	10%	10%	10%	10%
	61-90 m-storeys	10%	10%	10%	10%
	91-120 m-storeys	10%	10%	10%	10%
	Over 120 m-storeys	10%	10%	10%	10%

Brazeau Lands - FUS Required Fire Flow Summary

Brazeau Lands	
Type of Construction	Wood Frame Construction
Construction Coefficient	1.5
Effective Total Area (m^2)	760
Required Fire Flow (L/min)	9,000
Occupancy Charge	-15
Sprinkler Protection Reduction	0
Exposure (%)	
North (%)	5%
East (%)	12%
South (%)	17%
West (%)	0%
Total Exposure (%)	34%
Wood Shake Charge (L/min)	0
Total Required Fire Flow (L/min)	10,000
Total Required Fire Flow (L/s)	167

Appendix C Boundary Conditions

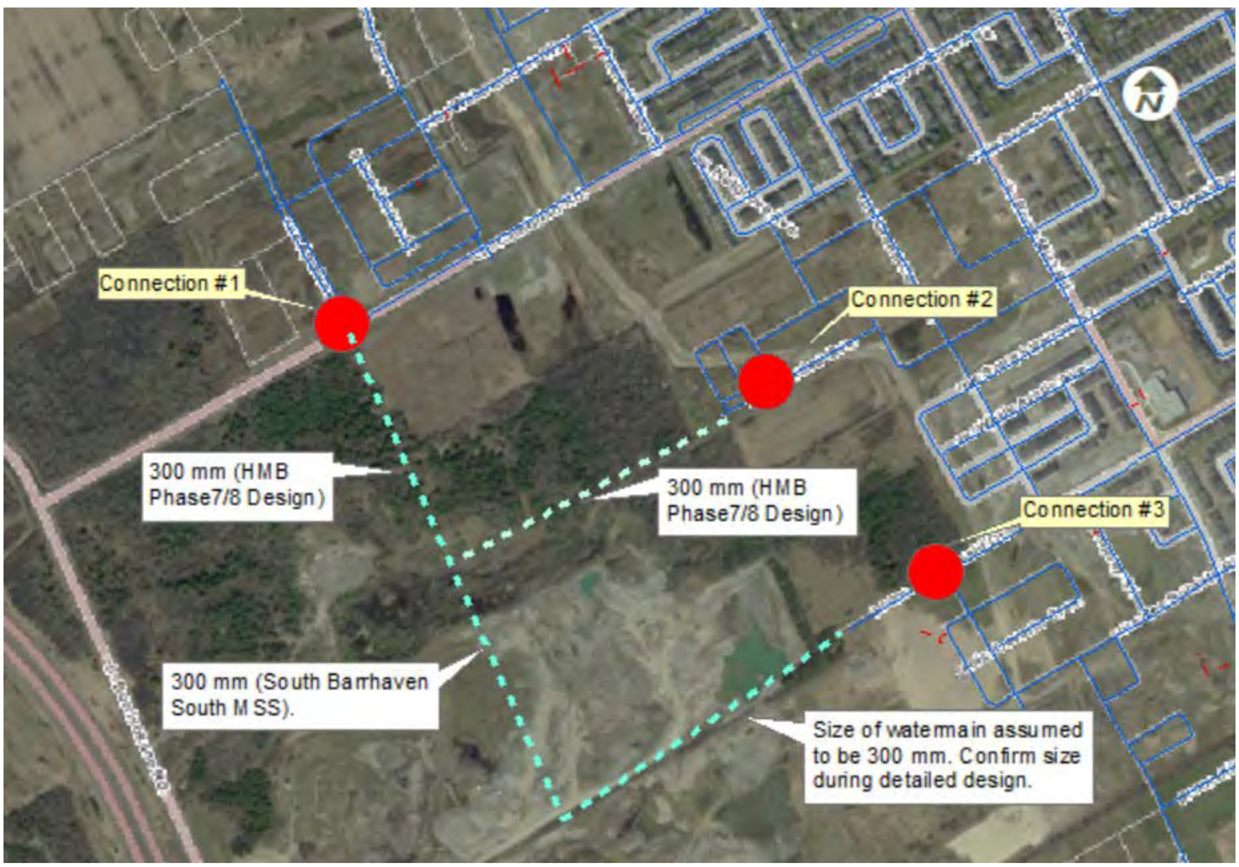
Boundary Conditions for HMB Phases 7 and 8 and Brazeau Lands

Information Provided:

Date provided: September 2019

Scenario	Demand	
	L/min	L/s
Average Daily Demand	846	14.10
Maximum Daily Demand	1961	32.69
Peak Hour	4224	70.40
Fire Flow Demand #1	10000	166.67
Fire Flow Demand #2	15000	250.00
Fire Flow Demand #3	17000	283.33

Location:



Results

Connection 1 - Cambrian Road

Demand Scenario	Existing Barrhaven PZ		Future Zone 3C	
	Head (m)	Pressure[1] (psi)	Head (m)	Pressure[1] (psi)
Maximum HGL	156.4	102.9	147.7	77.3
Peak Hour	135.7	60.4	142.8	70.4
Max Day plus Fire (#1)	144.0	72.2	140.0	66.4
Max Day plus Fire (#2)	135.4	59.9	134.9	59.2
Max Day plus Fire (#3)	133.7	57.4	132.5	55.7

[1] Ground Elevation = 93.3 m

Connection 2 - Brambling Way

Demand Scenario	Existing Barrhaven PZ		Future Zone 3C	
	Head (m)	Pressure[1] (psi)	Head (m)	Pressure[1] (psi)
Maximum HGL	156.4	100.1	147.7	74.6
Peak Hour	135.6	57.4	142.7	67.5
Max Day plus Fire (#1)	141.2	65.4	139.9	63.5
Max Day plus Fire (#2)	129.9	49.4	134.6	56.0
Max Day plus Fire (#3)	126.6	44.7	132.1	52.4

[1] Ground Elevation = 95.2 m

Connection 3 - Dundonald Drive

Demand Scenario	Existing Barrhaven PZ		Future Zone 3C	
	Head (m)	Pressure[1] (psi)	Head (m)	Pressure[1] (psi)
Maximum HGL	156.4	86.5	147.7	61.0
Peak Hour	135.7	43.9	142.6	53.7
Max Day plus Fire (#1)	142.0	52.9	138.6	48.1
Max Day plus Fire (#2)	131.5	38.0	132.2	38.9
Max Day plus Fire (#3)	128.7	34.0	128.9	34.3

[1] Ground Elevation = 104.8 m

Notes:

1) As per the Ontario Building Code in areas that may be occupied, the static pressure at any fixture shall not exceed 552 kPa (80 psi.) Pressure control measures to be considered are as follows, in order of preference:
    a) If possible, systems to be designed to residual pressures of 345 to 552 kPa (50 to 80 psi) in all occupied areas outside of the public right-of-way without special pressure control equipment.

b) Pressure reducing valves to be installed immediately downstream of the isolation valve in the home/ building, located downstream of the meter so it is owner maintained.

2) A third pump was turned on during all fire simulations under Existing Barrhaven Pressure.
3) Future pipes were added to the water model as shown in the figure above.

Disclaimer

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

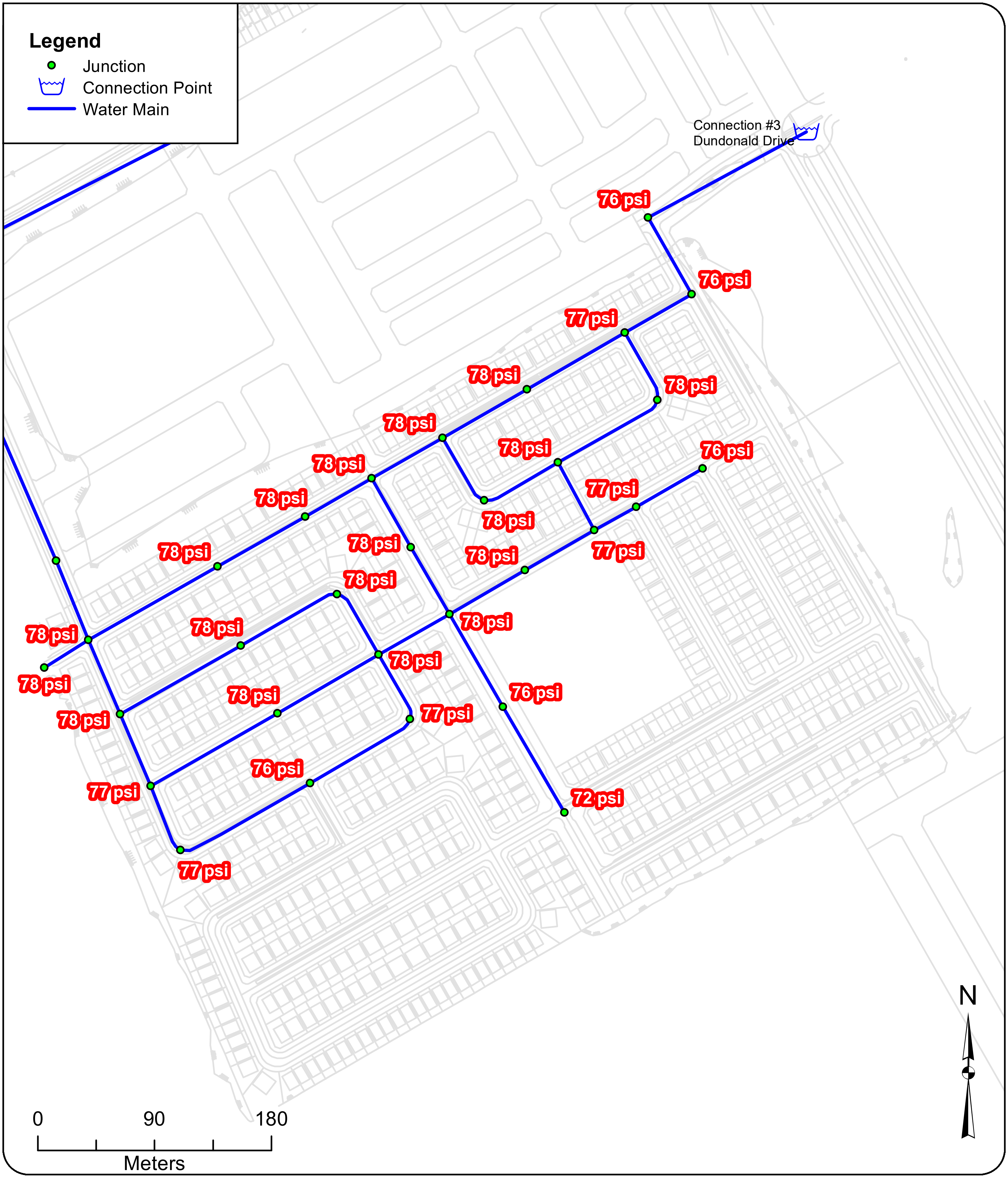
Appendix D Pipe and Junction Model Inputs

Model Inputs - Phases 1 and 2

ID	From	To	Length (m)	Diameter (mm)	Roughness ()
P-100	J-82	J-83	63.79	204	110
P-101	J-83	J-46	60.03	204	110
P-102	J-79	J-84	53.32	204	110
P-103	J-84	J-85	55.04	204	110
P-104	J-85	J-45	66.63	204	110
P-105	J-78	J-86	72.81	297	120
P-106	J-86	J-87	55.90	297	120
P-107	J-87	J-88	48.49	297	120
P-108	J-45	J-88	59.54	204	110
P-109	J-88	J-89	55.04	297	120
P-110	J-89	J-41	65.11	297	120
P-111	J-90	J-47	61.51	204	110
P-112	J-43	J-90	59.19	204	110
P-42	J-33	J-34	40.11	297	120
P-43	J-33	J-35	114.35	297	120
P-44	J-35	J-36	77.83	297	120
P-45	J-36	J-37	59.20	297	120
P-46	J-37	J-38	62.88	297	120
P-47	J-38	J-39	74.92	297	120
P-48	J-39	J-40	87.18	297	120
P-49	J-40	J-41	59.39	297	120
P-50	J-41	J-60	67.93	297	120
P-51	J-60	CONNECTION_3	138.92	297	120
P-52	J-40	J-42	58.39	204	110
P-53	J-42	J-43	83.72	204	110
P-54	J-43	J-44	72.67	204	110
P-55	J-44	J-38	58.67	204	110
P-56	J-45	J-46	59.20	204	110
P-57	J-46	J-90	81.24	204	110
P-58	J-47	J-48	84.62	204	110
P-59	J-48	J-61	59.65	297	120
P-60	J-61	J-37	60.99	297	120
P-61	J-59	J-58	94.07	297	120
P-62	J-58	J-48	82.47	297	120
P-63	J-48	J-49	63.07	204	110
P-64	J-49	J-50	57.71	204	110
P-65	J-50	J-51	84.62	204	110
P-66	J-51	J-52	106.76	204	110
P-67	J-33	J-52	62.05	204	110
P-68	J-52	J-53	60.2	204	110
P-69	J-53	J-54	112.78	204	110
P-70	J-54	J-49	90	204	110
P-71	J-49	J-57	56.32	204	110
P-72	J-57	J-56	92.28	204	110
P-73	J-53	J-55	55.27	204	110
P-74	J-55	J-56	113.38	204	110
P-75	J-56	J-62	58.69	204	110
P-76	J-62	J-63	119.4	204	110
P-77	J-63	J-64	56.35	204	110
P-78	J-64	J-65	58.6	204	110
P-79	J-65	J-66	100.76	204	110
P-80	J-66	J-70	70.42	204	110
P-81	J-70	J-71	55.7	204	110
P-82	J-71	J-69	54.8	204	110
P-83	J-64	J-67	125.85	204	110
P-84	J-67	J-69	97.99	204	110
P-85	J-62	J-68	92.12	204	110
P-86	J-68	J-69	56.42	204	110
P-87	J-69	J-59	63.46	204	110
P-88	J-59	J-72	59.77	297	120
P-89	J-72	J-73	28.67	297	120
P-90	J-72	J-74	96.85	297	120
P-91	J-74	J-75	110.13	297	120
P-92	J-75	J-76	78.16	297	120
P-93	J-77	J-76	30.34	297	120
P-94	J-76	J-78	58.2	297	120
P-95	J-78	J-79	59.97	204	110
P-96	J-79	J-80	59.39	204	110
P-97	J-80	J-81	85.15	204	110
P-98	J-81	J-59	79.25	204	110
P-99	J-80	J-82	51.74	204	110

ID	Elevation (m)	ADD (L/s)
J-33	101.29	0.18
J-34	101.41	0.00
J-35	101.33	0.16
J-36	101.25	0.16
J-37	101.64	0.06
J-38	101.46	0.14
J-39	101.83	0.20
J-40	101.96	0.14
J-41	102.65	0.04
J-42	101.87	0.16
J-43	101.72	0.18
J-44	101.59	0.16
J-45	103.27	0.06
J-46	102.38	0.08
J-47	101.77	0.12
J-48	101.83	0.06
J-49	101.74	0.14
J-50	101.40	0.12
J-51	101.41	0.18
J-52	101.35	0.20
J-53	102.22	0.20
J-54	101.87	0.20
J-55	102.52	0.20
J-56	103.00	0.20
J-57	102.46	0.12
J-58	102.95	0.06
J-59	105.68	0.64
J-60	102.80	0.00
J-61	101.51	0.06
J-62	104.21	0.00
J-63	106.39	0.20
J-64	106.74	0.20
J-65	107.17	0.20
J-66	107.78	0.18
J-67	106.62	0.20
J-68	106.00	0.22
J-69	107.07	0.14
J-70	108.43	0.14
J-71	108.62	0.16
J-72	107.85	0.12
J-73	108.47	0.16
J-74	107.68	0.00
J-75	108.00	0.24
J-76	108.27	0.16
J-77	108.93	0.08
J-78	106.17	0.00
J-79	105.57	0.06
J-80	105.54	0.18
J-81	105.54	0.18
J-82	104.30	0.28
J-83	103.10	0.12
J-84	104.73	0.20
J-85	103.68	0.12
J-86	105.81	0.20
J-87	105.51	0.08
J-88	104.78	0.08
J-89	103.69	0.04
J-90	102.07	0.08

Appendix E MHD and PHD Model Results



GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis of the Brazeau lands**
Client: **David Schaeffer Engineering Ltd.**
Date: **June 2020**
Created by: **BL**
Reviewed by: **WdS**

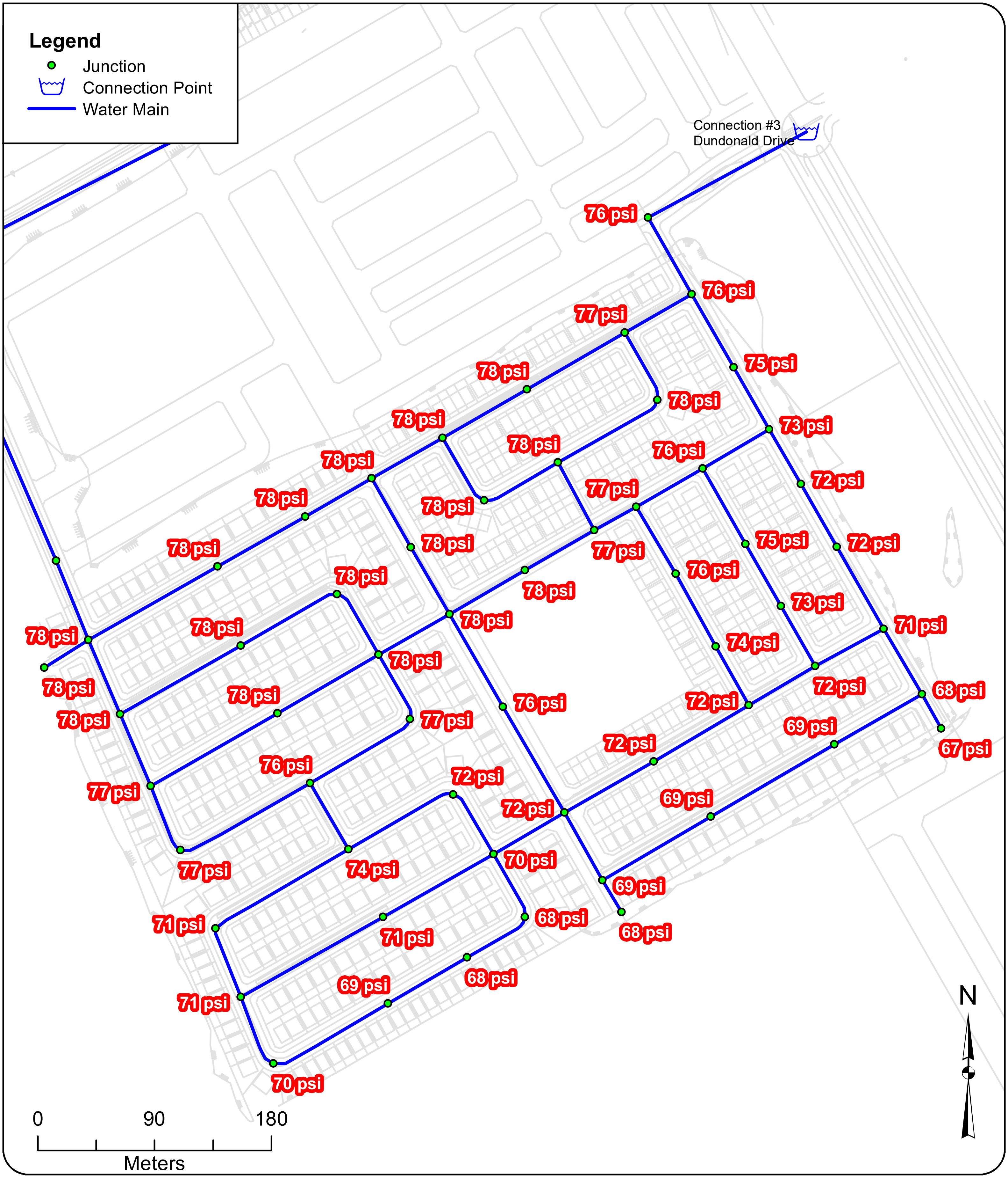
MHD Pressure Results - Phase 1

Figure E.1

Minimum Hour Demand Modeling Results - Phase 1

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/km)
P-42	J-33	J-34	40.11	297	120	0.00	0.00	0.00	0.00
P-43	J-33	J-35	114.35	297	120	-0.09	0.00	0.00	0.00
P-44	J-35	J-36	77.83	297	120	-0.16	0.00	0.00	0.00
P-45	J-36	J-37	59.20	297	120	-0.25	0.00	0.00	0.00
P-46	J-37	J-38	62.88	297	120	-0.88	0.01	0.00	0.00
P-47	J-38	J-39	74.92	297	120	-1.05	0.02	0.00	0.00
P-48	J-39	J-40	87.18	297	120	-1.15	0.02	0.00	0.00
P-49	J-40	J-41	59.39	297	120	-1.68	0.02	0.00	0.00
P-50	J-41	J-60	67.93	297	120	-1.69	0.02	0.00	0.00
P-51	J-60	CONNECTION_3	138.92	297	120	-1.69	0.02	0.00	0.00
P-52	J-40	J-42	58.39	204	110	0.45	0.01	0.00	0.00
P-53	J-42	J-43	91.90	204	110	0.37	0.01	0.00	0.00
P-54	J-43	J-44	64.49	204	110	-0.02	0.00	0.00	0.00
P-55	J-44	J-38	58.67	204	110	-0.10	0.00	0.00	0.00
P-56	J-45	J-46	59.20	204	110	-0.03	0.00	0.00	0.00
P-57	J-46	J-90	37.06	204	110	-0.08	0.00	0.00	0.00
P-58	J-47	J-48	67.31	204	110	0.16	0.00	0.00	0.00
P-59	J-48	J-61	59.65	297	120	-0.58	0.01	0.00	0.00
P-60	J-61	J-37	60.99	297	120	-0.61	0.01	0.00	0.00
P-61	J-59	J-58	94.07	297	120	-0.32	0.00	0.00	0.00
P-62	J-58	J-48	82.47	297	120	-0.35	0.01	0.00	0.00
P-63	J-48	J-49	63.07	204	110	0.36	0.01	0.00	0.00
P-64	J-49	J-50	57.71	204	110	0.04	0.00	0.00	0.00
P-65	J-50	J-51	84.62	204	110	-0.02	0.00	0.00	0.00
P-66	J-51	J-52	106.76	204	110	-0.11	0.00	0.00	0.00
P-67	J-33	J-52	62.05	204	110	0.42	0.01	0.00	0.00
P-68	J-52	J-53	60.20	204	110	0.21	0.01	0.00	0.00
P-69	J-53	J-54	112.78	204	110	-0.01	0.00	0.00	0.00
P-70	J-54	J-49	90.00	204	110	-0.10	0.00	0.00	0.00
P-71	J-49	J-57	56.32	204	110	0.14	0.00	0.00	0.00
P-72	J-57	J-56	92.28	204	110	0.08	0.00	0.00	0.00
P-73	J-53	J-55	55.27	204	110	0.12	0.00	0.00	0.00
P-74	J-55	J-56	113.38	204	110	0.02	0.00	0.00	0.00
P-111	J-90	J-47	61.51	204	110	0.22	0.01	0.00	0.00
P-112	J-43	J-90	59.19	204	110	0.30	0.01	0.00	0.00

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-33	0.09	101.29	156	78
J-34	0.00	101.41	156	78
J-35	0.08	101.33	156	78
J-36	0.08	101.25	156	78
J-37	0.03	101.64	156	78
J-38	0.07	101.46	156	78
J-39	0.10	101.83	156	78
J-40	0.07	101.96	156	77
J-41	0.02	102.65	156	76
J-42	0.08	101.87	156	78
J-43	0.09	101.72	156	78
J-44	0.08	101.59	156	78
J-45	0.03	103.27	156	76
J-46	0.04	102.38	156	77
J-47	0.06	101.77	156	78
J-48	0.03	101.83	156	78
J-49	0.07	101.74	156	78
J-50	0.06	101.40	156	78
J-51	0.09	101.41	156	78
J-52	0.10	101.35	156	78
J-53	0.10	102.22	156	77
J-54	0.10	101.87	156	78
J-55	0.10	102.52	156	77
J-56	0.10	103.00	156	76
J-57	0.06	102.46	156	77
J-58	0.03	102.95	156	76
J-59	0.32	105.68	156	72
J-60	0.00	102.80	156	76
J-61	0.03	101.51	156	78
J-90	0.00	102.07	156	77



GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis of the Brazeau Lands**
Client: **David Schaeffer Engineering Ltd.**
Date: **June 2020**
Created by: **BL**
Reviewed by: **WdS**

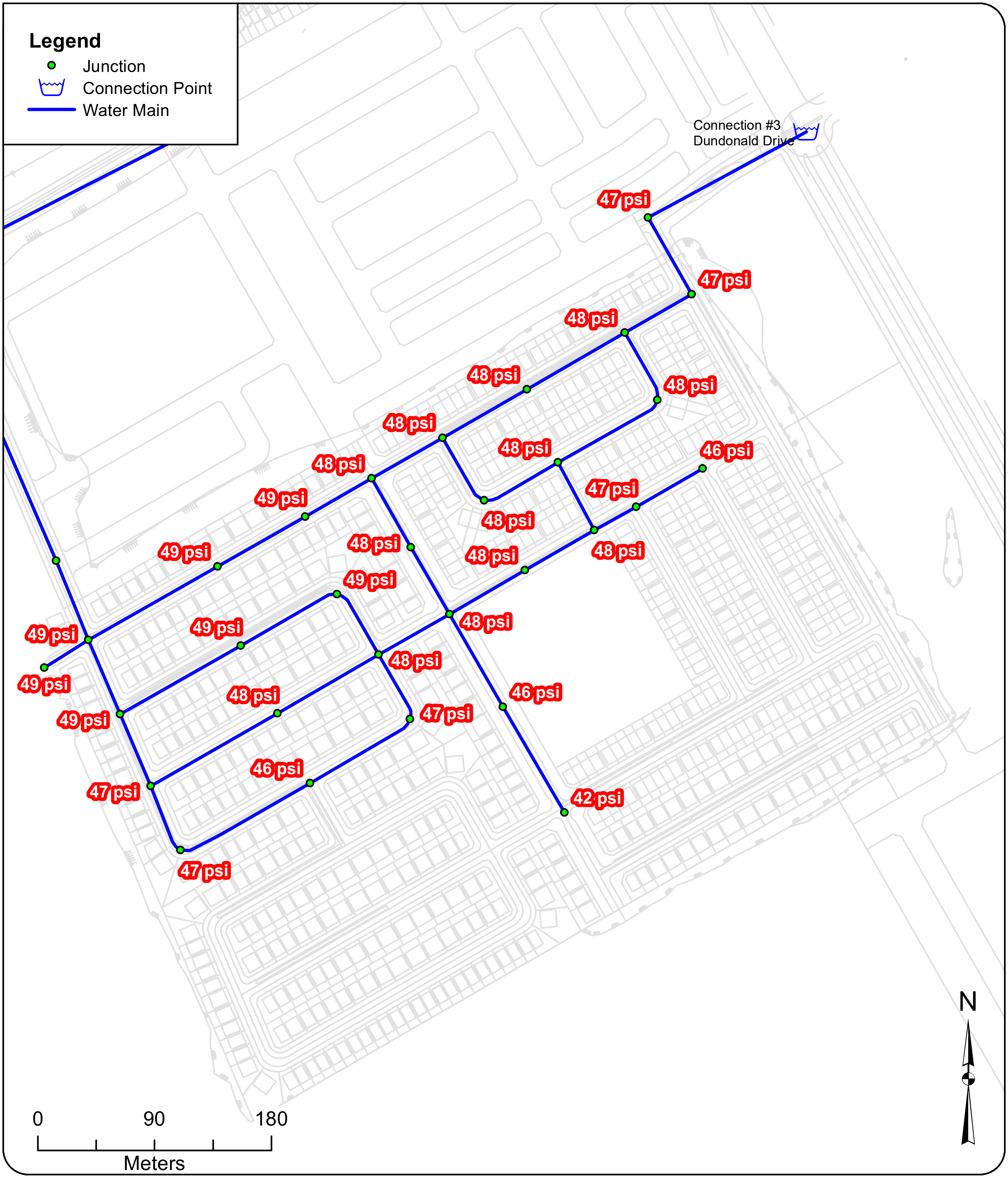
MHD Pressure Results - Phases 1&2

Figure E.2

Minimum Hour Demand Modeling Results - Phases 1 and 2

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/km)
P-42	J-33	J-34	40.11	297	120	0.00	0.00	0.00	0.00
P-43	J-33	J-35	114.35	297	120	0.35	0.01	0.00	0.00
P-44	J-35	J-36	77.83	297	120	0.28	0.00	0.00	0.00
P-45	J-36	J-37	59.20	297	120	0.20	0.00	0.00	0.00
P-46	J-37	J-38	62.88	297	120	-0.73	0.01	0.00	0.00
P-47	J-38	J-39	74.92	297	120	-0.95	0.01	0.00	0.00
P-48	J-39	J-40	87.18	297	120	-1.05	0.02	0.00	0.00
P-49	J-40	J-41	59.39	297	120	-1.56	0.02	0.00	0.00
P-50	J-41	J-60	67.93	297	120	-3.05	0.04	0.00	0.01
P-51	J-60	CONNECTION_3	138.92	297	120	-3.05	0.04	0.00	0.01
P-52	J-40	J-42	58.39	204	110	0.44	0.01	0.00	0.00
P-53	J-42	J-43	83.72	204	110	0.35	0.01	0.00	0.00
P-54	J-43	J-44	72.67	204	110	-0.07	0.00	0.00	0.00
P-55	J-44	J-38	58.67	204	110	-0.15	0.00	0.00	0.00
P-56	J-45	J-46	59.20	204	110	0.21	0.01	0.00	0.00
P-57	J-46	J-90	81.24	204	110	-0.10	0.00	0.00	0.00
P-58	J-47	J-48	84.62	204	110	0.18	0.01	0.00	0.00
P-59	J-48	J-61	59.65	297	120	-0.87	0.01	0.00	0.00
P-60	J-61	J-37	60.99	297	120	-0.90	0.01	0.00	0.00
P-61	J-59	J-58	94.07	297	120	-0.53	0.01	0.00	0.00
P-62	J-58	J-48	82.47	297	120	-0.56	0.01	0.00	0.00
P-63	J-48	J-49	63.07	204	110	0.45	0.01	0.00	0.00
P-64	J-49	J-50	57.71	204	110	-0.03	0.00	0.00	0.00
P-65	J-50	J-51	84.62	204	110	-0.09	0.00	0.00	0.00
P-66	J-51	J-52	106.76	204	110	-0.18	0.01	0.00	0.00
P-67	J-33	J-52	62.05	204	110	0.62	0.02	0.00	0.00
P-68	J-52	J-53	60.20	204	110	0.33	0.01	0.00	0.00
P-69	J-53	J-54	112.78	204	110	-0.03	0.00	0.00	0.00
P-70	J-54	J-49	90.00	204	110	-0.13	0.00	0.00	0.00
P-71	J-49	J-57	56.32	204	110	0.28	0.01	0.00	0.00
P-72	J-57	J-56	92.28	204	110	0.22	0.01	0.00	0.00
P-73	J-53	J-55	55.27	204	110	0.26	0.01	0.00	0.00
P-74	J-55	J-56	113.38	204	110	0.17	0.01	0.00	0.00
P-111	J-90	J-47	61.51	204	110	0.24	0.01	0.00	0.00
P-112	J-43	J-90	59.19	204	110	0.33	0.01	0.00	0.00
P-75	J-56	J-62	58.69	204	110	0.29	0.01	0.00	0.00
P-76	J-62	J-63	119.4	204	110	0.19	0.01	0.00	0.00
P-77	J-63	J-64	56.35	204	110	0.10	0.00	0.00	0.00
P-78	J-64	J-65	58.6	204	110	0.09	0.00	0.00	0.00
P-79	J-65	J-66	100.76	204	110	0.00	0.00	0.00	0.00
P-80	J-66	J-70	70.42	204	110	-0.10	0.00	0.00	0.00
P-81	J-70	J-71	55.7	204	110	-0.18	0.01	0.00	0.00
P-82	J-71	J-69	54.8	204	110	-0.24	0.01	0.00	0.00
P-83	J-64	J-67	125.85	204	110	-0.09	0.00	0.00	0.00
P-84	J-67	J-69	97.99	204	110	-0.20	0.01	0.00	0.00
P-85	J-62	J-68	92.12	204	110	0.00	0.00	0.00	0.00
P-86	J-68	J-69	56.42	204	110	-0.07	0.00	0.00	0.00
P-87	J-69	J-59	63.46	204	110	-0.59	0.02	0.00	0.00
P-88	J-59	J-72	59.77	297	120	-0.29	0.00	0.00	0.00
P-89	J-72	J-73	28.67	297	120	0.00	0.00	0.00	0.00
P-90	J-72	J-74	96.85	297	120	-0.37	0.01	0.00	0.00
P-91	J-74	J-75	110.13	297	120	-0.49	0.01	0.00	0.00
P-92	J-75	J-76	78.16	297	120	-0.57	0.01	0.00	0.00
P-93	J-77	J-76	30.34	297	120	0.00	0.00	0.00	0.00
P-94	J-76	J-78	58.2	297	120	-0.61	0.01	0.00	0.00
P-95	J-78	J-79	59.97	204	110	0.21	0.01	0.00	0.00
P-96	J-79	J-80	59.39	204	110	0.22	0.01	0.00	0.00
P-97	J-80	J-81	85.15	204	110	0.23	0.01	0.00	0.00
P-98	J-81	J-59	79.25	204	110	0.09	0.00	0.00	0.00
P-99	J-80	J-82	51.74	204	110	-0.10	0.00	0.00	0.00
P-100	J-82	J-83	63.79	204	110	-0.16	0.00	0.00	0.00
P-101	J-83	J-46	60.03	204	110	-0.26	0.01	0.00	0.00
P-102	J-79	J-84	53.32	204	110	-0.09	0.00	0.00	0.00
P-103	J-84	J-85	55.04	204	110	-0.15	0.00	0.00	0.00
P-104	J-85	J-45	66.63	204	110	-0.25	0.01	0.00	0.00
P-105	J-78	J-86	72.81	297	120	-0.86	0.01	0.00	0.00
P-106	J-86	J-87	55.9	297	120	-0.89	0.01	0.00	0.00
P-107	J-87	J-88	48.49	297	120	-0.93	0.01	0.00	0.00
P-108	J-45	J-88	59.54	204	110	-0.49	0.01	0.00	0.00
P-109	J-88	J-89	55.04	297	120	-1.44	0.02	0.00	0.00
P-110	J-89	J-41	65.11	297	120	-1.48	0.02	0.00	0.00

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-33	0.09	101.29	156	78
J-34	0.00	101.41	156	78
J-35	0.08	101.33	156	78
J-36	0.08	101.25	156	78
J-37	0.03	101.64	156	78
J-38	0.07	101.46	156	78
J-39	0.10	101.83	156	78
J-40	0.07	101.96	156	77
J-41	0.02	102.65	156	76
J-42	0.08	101.87	156	78
J-43	0.09	101.72	156	78
J-44	0.08	101.59	156	78
J-45	0.03	103.27	156	76
J-46	0.04	102.38	156	77
J-47	0.06	101.77	156	78
J-48	0.03	101.83	156	78
J-49	0.07	101.74	156	78
J-50	0.06	101.40	156	78
J-51	0.09	101.41	156	78
J-52	0.10	101.35	156	78
J-53	0.10	102.22	156	77
J-54	0.10	101.87	156	78
J-55	0.10	102.52	156	77
J-56	0.10	103.00	156	76
J-57	0.06	102.46	156	77
J-58	0.03	102.95	156	76
J-59	0.32	105.68	156	72
J-60	0.00	102.80	156	76
J-61	0.03	101.51	156	78
J-90	0.00	102.07	156	77
J-62	0.10	104.21	156	74
J-63	0.10	106.39	156	71
J-64	0.10	106.74	156	71
J-65	0.09	107.17	156	70
J-66	0.10	107.78	156	69
J-67	0.11	106.62	156	71
J-68	0.07	106.00	156	72
J-69	0.07	107.07	156	70
J-70	0.08	108.43	156	68
J-71	0.06	108.62	156	68
J-72	0.08	107.85	156	69
J-73	0.00	108.47	156	68
J-74	0.12	107.68	156	69
J-75	0.08	108.00	156	69
J-76	0.04	108.27	156	68
J-77	0.00	108.93	156	67
J-78	0.03	106.17	156	71
J-79	0.09	105.57	156	72
J-80	0.09	105.54	156	72
J-81	0.14	105.54	156	72
J-82	0.06	104.30	156	74
J-83	0.10	103.10	156	76
J-84	0.06	104.73	156	73
J-85	0.10	103.68	156	75
J-86	0.04	105.81	156	72
J-87	0.04	105.51	156	72
J-88	0.02	104.78	156	73
J-89	0.04	103.69	156	75



GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis of the Brazeau Lands**
Client: **David Schaeffer Engineering Ltd.**
Date: **June 2020**
Created by: **BL**
Reviewed by: **WdS**

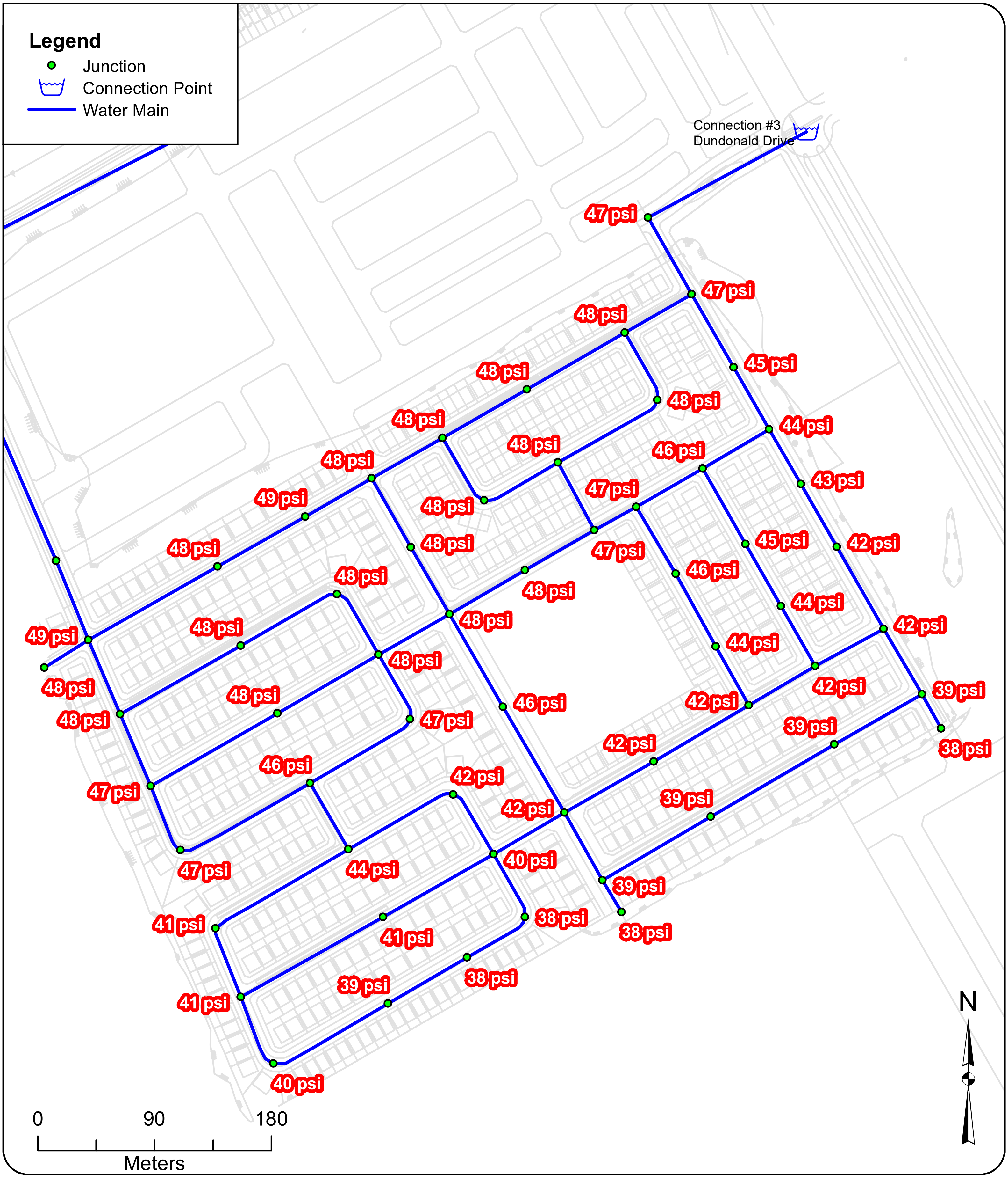
PHD Pressure Results - Phase 1

Figure E.3

Peak Hour Demand Modeling Results - Phase 1

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/km)
P-42	J-33	J-34	40.11	297	120	0.00	0.00	0.00	0.00
P-43	J-33	J-35	114.35	297	120	-2.53	0.04	0.00	0.01
P-44	J-35	J-36	77.83	297	120	-3.36	0.05	0.00	0.01
P-45	J-36	J-37	59.20	297	120	-4.27	0.06	0.00	0.02
P-46	J-37	J-38	62.88	297	120	-10.16	0.15	0.01	0.11
P-47	J-38	J-39	74.92	297	120	-11.85	0.17	0.01	0.15
P-48	J-39	J-40	87.18	297	120	-13.00	0.19	0.02	0.18
P-49	J-40	J-41	59.39	297	120	-18.81	0.27	0.02	0.35
P-50	J-41	J-60	67.93	297	120	-18.99	0.27	0.02	0.36
P-51	J-60	CONNECTION_3	138.92	297	120	-18.99	0.27	0.05	0.36
P-52	J-40	J-42	58.39	204	110	5.02	0.15	0.01	0.23
P-53	J-42	J-43	91.90	204	110	4.12	0.13	0.01	0.16
P-54	J-43	J-44	64.49	204	110	-0.06	0.00	0.00	0.00
P-55	J-44	J-38	58.67	204	110	-0.91	0.03	0.00	0.01
P-56	J-45	J-46	59.20	204	110	-0.36	0.01	0.00	0.00
P-57	J-46	J-90	37.06	204	110	-0.84	0.03	0.00	0.01
P-58	J-47	J-48	67.31	204	110	1.65	0.05	0.00	0.03
P-59	J-48	J-61	59.65	297	120	-5.28	0.08	0.00	0.03
P-60	J-61	J-37	60.99	297	120	-5.59	0.08	0.00	0.04
P-61	J-59	J-58	94.07	297	120	-1.96	0.03	0.00	0.01
P-62	J-58	J-48	82.47	297	120	-2.26	0.03	0.00	0.01
P-63	J-48	J-49	63.07	204	110	4.29	0.13	0.01	0.17
P-64	J-49	J-50	57.71	204	110	0.63	0.02	0.00	0.00
P-65	J-50	J-51	84.62	204	110	-0.06	0.00	0.00	0.00
P-66	J-51	J-52	106.76	204	110	-1.04	0.03	0.00	0.01
P-67	J-33	J-52	62.05	204	110	4.28	0.13	0.01	0.17
P-68	J-52	J-53	60.20	204	110	2.10	0.06	0.00	0.04
P-69	J-53	J-54	112.78	204	110	-0.21	0.01	0.00	0.00
P-70	J-54	J-49	90.00	204	110	-1.27	0.04	0.00	0.02
P-71	J-49	J-57	56.32	204	110	1.63	0.05	0.00	0.03
P-72	J-57	J-56	92.28	204	110	0.95	0.03	0.00	0.01
P-73	J-53	J-55	55.27	204	110	1.17	0.04	0.00	0.02
P-74	J-55	J-56	113.38	204	110	0.11	0.00	0.00	0.00
P-111	J-90	J-47	61.51	204	110	2.31	0.07	0.00	0.05
P-112	J-43	J-90	59.19	204	110	3.16	0.10	0.01	0.10

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-33	0.99	101.29	136	49
J-34	0.00	101.41	136	49
J-35	0.83	101.33	136	49
J-36	0.91	101.25	136	49
J-37	0.30	101.64	136	48
J-38	0.78	101.46	136	49
J-39	1.15	101.83	136	48
J-40	0.78	101.96	136	48
J-41	0.18	102.65	136	47
J-42	0.90	101.87	136	48
J-43	1.02	101.72	136	48
J-44	0.84	101.59	136	48
J-45	0.36	103.27	136	46
J-46	0.48	102.38	136	47
J-47	0.66	101.77	136	48
J-48	0.38	101.83	136	48
J-49	0.76	101.74	136	48
J-50	0.68	101.40	136	49
J-51	0.99	101.41	136	49
J-52	1.14	101.35	136	49
J-53	1.14	102.22	136	47
J-54	1.06	101.87	136	48
J-55	1.06	102.52	136	47
J-56	1.06	103.00	136	46
J-57	0.68	102.46	136	47
J-58	0.30	102.95	136	46
J-59	1.96	105.68	136	42
J-60	0.00	102.80	136	47
J-61	0.30	101.51	136	48
J-90	0.00	102.07	136	48



GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis of the Brazeau Lands**
Client: **David Schaeffer Engineering Ltd.**
Date: **June 2020**
Created by: **BL**
Reviewed by: **WdS**

PHD Pressure Results - Phases 1&2

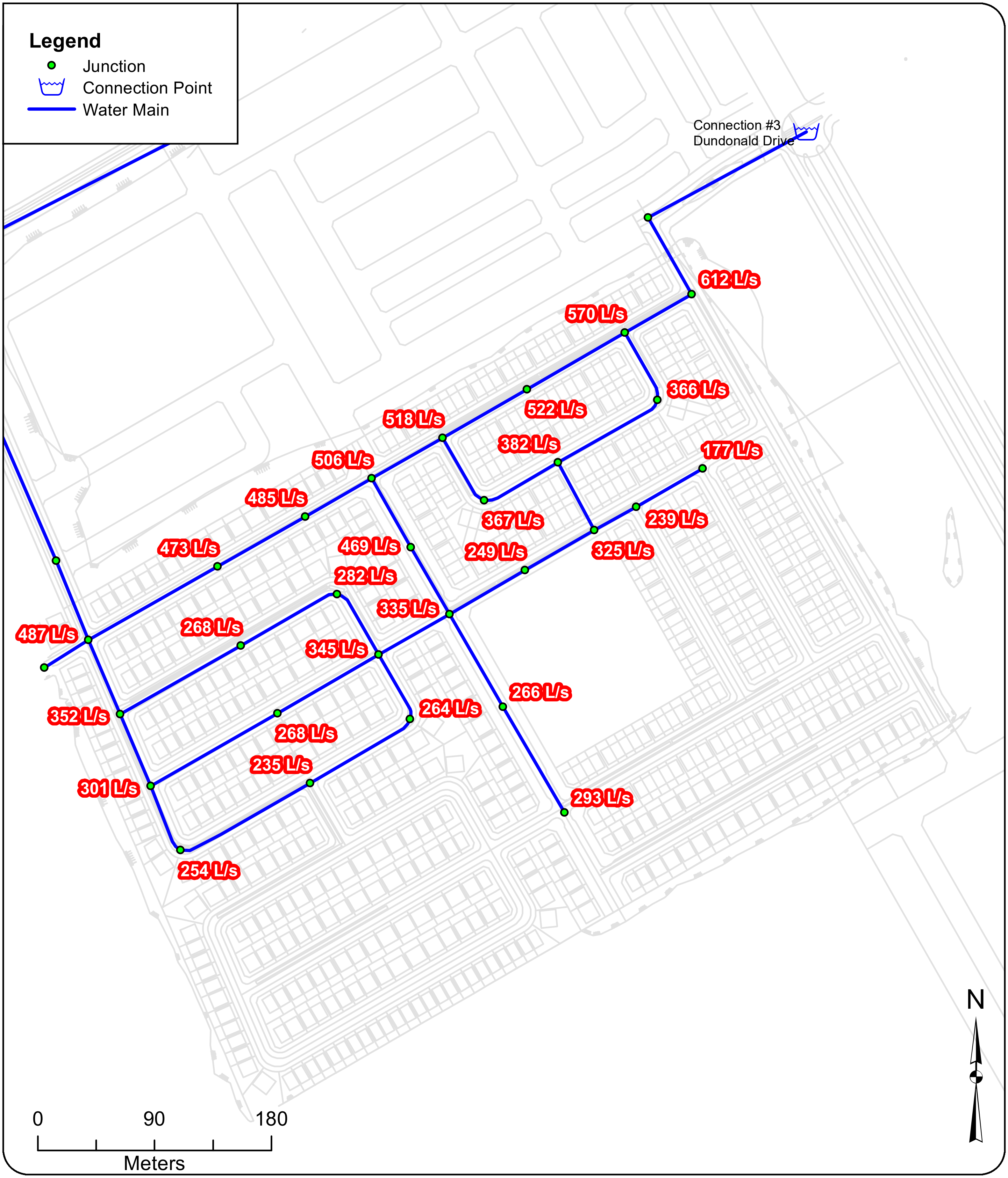
Figure E.4

Peak Hour Demand Modeling Results -Phases 1 and 2

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/km)
P-42	J-33	J-34	40.11	297	120	0.00	0.00	0.00	0.00
P-43	J-33	J-35	114.35	297	120	3.16	0.05	0.00	0.01
P-44	J-35	J-36	77.83	297	120	2.33	0.03	0.00	0.01
P-45	J-36	J-37	59.20	297	120	1.42	0.02	0.00	0.00
P-46	J-37	J-38	62.88	297	120	-8.04	0.12	0.00	0.07
P-47	J-38	J-39	74.92	297	120	-10.35	0.15	0.01	0.12
P-48	J-39	J-40	87.18	297	120	-11.49	0.17	0.01	0.14
P-49	J-40	J-41	59.39	297	120	-17.00	0.25	0.02	0.29
P-50	J-41	J-60	67.93	297	120	-33.05	0.48	0.07	1.01
P-51	J-60	CONNECTION_3	138.92	297	120	-33.05	0.48	0.14	1.01
P-52	J-40	J-42	58.39	204	110	4.72	0.14	0.01	0.20
P-53	J-42	J-43	83.72	204	110	3.82	0.12	0.01	0.14
P-54	J-43	J-44	72.67	204	110	-0.68	0.02	0.00	0.01
P-55	J-44	J-38	58.67	204	110	-1.52	0.05	0.00	0.02
P-56	J-45	J-46	59.20	204	110	2.27	0.07	0.00	0.05
P-57	J-46	J-90	81.24	204	110	-0.92	0.03	0.00	0.01
P-58	J-47	J-48	84.62	204	110	1.88	0.06	0.00	0.04
P-59	J-48	J-61	59.65	297	120	-8.86	0.13	0.01	0.09
P-60	J-61	J-37	60.99	297	120	-9.16	0.13	0.01	0.09
P-61	J-59	J-58	94.07	297	120	-4.98	0.07	0.00	0.03
P-62	J-58	J-48	82.47	297	120	-5.28	0.08	0.00	0.03
P-63	J-48	J-49	63.07	204	110	5.08	0.16	0.01	0.23
P-64	J-49	J-50	57.71	204	110	-0.22	0.01	0.00	0.00
P-65	J-50	J-51	84.62	204	110	-0.90	0.03	0.00	0.01
P-66	J-51	J-52	106.76	204	110	-1.89	0.06	0.00	0.04
P-67	J-33	J-52	62.05	204	110	6.57	0.20	0.02	0.37
P-68	J-52	J-53	60.20	204	110	3.54	0.11	0.01	0.12
P-69	J-53	J-54	112.78	204	110	-0.41	0.01	0.00	0.00
P-70	J-54	J-49	90.00	204	110	-1.48	0.05	0.00	0.02
P-71	J-49	J-57	56.32	204	110	3.06	0.09	0.01	0.09
P-72	J-57	J-56	92.28	204	110	2.38	0.07	0.01	0.06
P-73	J-53	J-55	55.27	204	110	2.82	0.09	0.00	0.08
P-74	J-55	J-56	113.38	204	110	1.76	0.05	0.00	0.03
P-111	J-90	J-47	61.51	204	110	2.55	0.08	0.00	0.06
P-112	J-43	J-90	59.19	204	110	3.47	0.11	0.01	0.11
P-75	J-56	J-62	58.69	204	110	3.08	0.09	0.01	0.09
P-76	J-62	J-63	119.4	204	110	2.11	0.06	0.01	0.05
P-77	J-63	J-64	56.35	204	110	1.05	0.03	0.00	0.01
P-78	J-64	J-65	58.6	204	110	0.97	0.03	0.00	0.01
P-79	J-65	J-66	100.76	204	110	-0.01	0.00	0.00	0.00
P-80	J-66	J-70	70.42	204	110	-1.15	0.04	0.00	0.01
P-81	J-70	J-71	55.7	204	110	-2.06	0.06	0.00	0.04
P-82	J-71	J-69	54.8	204	110	-2.67	0.08	0.00	0.07
P-83	J-64	J-67	125.85	204	110	-1.06	0.03	0.00	0.01
P-84	J-67	J-69	97.99	204	110	-2.27	0.07	0.01	0.05
P-85	J-62	J-68	92.12	204	110	-0.17	0.01	0.00	0.00
P-86	J-68	J-69	56.42	204	110	-0.93	0.03	0.00	0.01
P-87	J-69	J-59	63.46	204	110	-6.63	0.20	0.02	0.38
P-88	J-59	J-72	59.77	297	120	-2.83	0.04	0.00	0.01
P-89	J-72	J-73	28.67	297	120	0.00	0.00	0.00	0.00
P-90	J-72	J-74	96.85	297	120	-3.74	0.05	0.00	0.02
P-91	J-74	J-75	110.13	297	120	-5.03	0.07	0.00	0.03
P-92	J-75	J-76	78.16	297	120	-5.93	0.09	0.00	0.04
P-93	J-77	J-76	30.34	297	120	0.00	0.00	0.00	0.00
P-94	J-76	J-78	58.2	297	120	-6.39	0.09	0.00	0.05
P-95	J-78	J-79	59.97	204	110	2.36	0.07	0.00	0.06
P-96	J-79	J-80	59.39	204	110	2.34	0.07	0.00	0.05
P-97	J-80	J-81	85.15	204	110	2.34	0.07	0.00	0.05
P-98	J-81	J-59	79.25	204	110	0.78	0.02	0.00	0.01
P-99	J-80	J-82	51.74	204	110	-0.96	0.03	0.00	0.01
P-100	J-82	J-83	63.79	204	110	-1.63	0.05	0.00	0.03
P-101	J-83	J-46	60.03	204	110	-2.71	0.08	0.00	0.07
P-102	J-79	J-84	53.32	204	110	-0.94	0.03	0.00	0.01
P-103	J-84	J-85	55.04	204	110	-1.54	0.05	0.00	0.03
P-104	J-85	J-45	66.63	204	110	-2.62	0.08	0.00	0.07
P-105	J-78	J-86	72.81	297	120	-9.11	0.13	0.01	0.09
P-106	J-86	J-87	55.9	297	120	-9.53	0.14	0.01	0.10
P-107	J-87	J-88	48.49	297	120	-9.95	0.14	0.01	0.11
P-108	J-45	J-88	59.54	204	110	-5.25	0.16	0.01	0.24
P-109	J-88	J-89	55.04	297	120	-15.45	0.22	0.01	0.25
P-110	J-89	J-41	65.11	297	120	-15.87	0.23	0.02	0.26

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-33	0.99	101.29	135	49
J-34	0.00	101.41	135	48
J-35	0.83	101.33	135	49
J-36	0.91	101.25	135	49
J-37	0.30	101.64	135	48
J-38	0.78	101.46	135	48
J-39	1.15	101.83	135	48
J-40	0.78	101.96	135	48
J-41	0.18	102.65	135	47
J-42	0.90	101.87	135	48
J-43	1.02	101.72	135	48
J-44	0.84	101.59	135	48
J-45	0.36	103.27	135	46
J-46	0.48	102.38	135	47
J-47	0.66	101.77	135	48
J-48	0.38	101.83	135	48
J-49	0.76	101.74	135	48
J-50	0.68	101.40	135	48
J-51	0.99	101.41	135	48
J-52	1.14	101.35	135	48
J-53	1.14	102.22	135	47
J-54	1.06	101.87	135	48
J-55	1.06	102.52	135	47
J-56	1.06	103.00	135	46
J-57	0.68	102.46	135	47
J-58	0.30	102.95	135	46
J-59	1.96	105.68	135	42
J-60	0.00	102.80	136	47
J-61	0.30	101.51	135	48
J-90	0.00	102.07	135	47
J-62	1.14	104.21	135	44
J-63	1.06	106.39	135	41
J-64	1.14	106.74	135	41
J-65	0.98	107.17	135	40
J-66	1.14	107.78	135	39
J-67	1.21	106.62	135	41
J-68	0.76	106.00	135	42
J-69	0.76	107.07	135	40
J-70	0.91	108.43	135	38
J-71	0.61	108.62	135	38
J-72	0.91	107.85	135	39
J-73	0.00	108.47	135	38
J-74	1.29	107.68	135	39
J-75	0.91	108.00	135	39
J-76	0.45	108.27	135	39
J-77	0.00	108.93	135	38
J-78	0.36	106.17	135	42
J-79	0.96	105.57	135	42
J-80	0.96	105.54	135	43
J-81	1.56	105.54	135	42
J-82	0.66	104.30	135	44
J-83	1.08	103.10	135	46
J-84	0.60	104.73	135	44
J-85	1.08	103.68	135	45
J-86	0.42	105.81	135	42
J-87	0.42	105.51	135	43
J-88	0.24	104.78	135	44
J-89	0.42	103.69	135	45

Appendix F MDD+FF Model Results



GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis of the Brazeau Lands**
Client: **David Schaeffer Engineering Ltd.**
Date: **June 2020**
Created by: **BL**
Reviewed by: **WdS**

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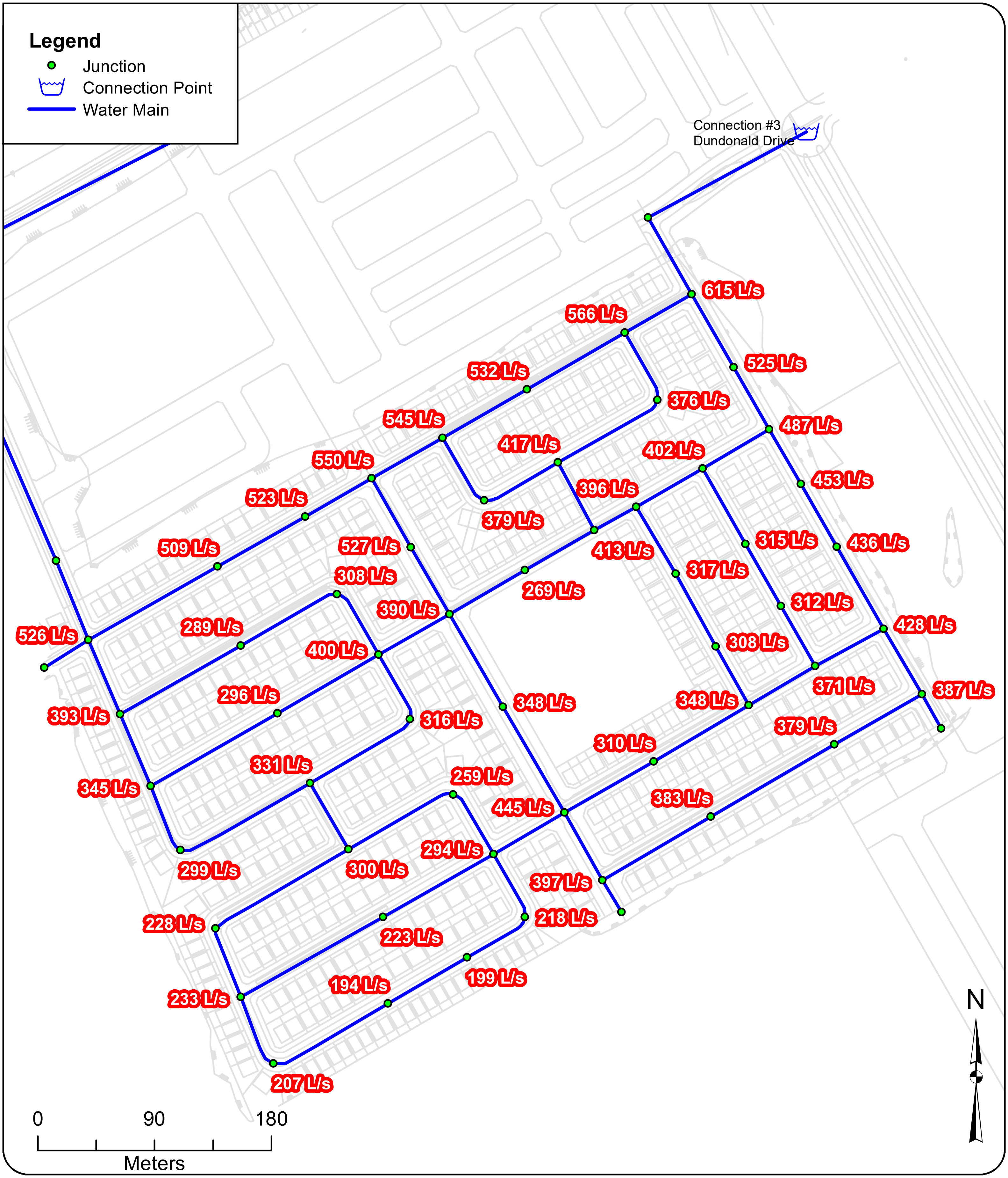
Available Fire Flow @ 20 psi - Phase 1

Figure F.1



GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis of the Brazeau Lands**
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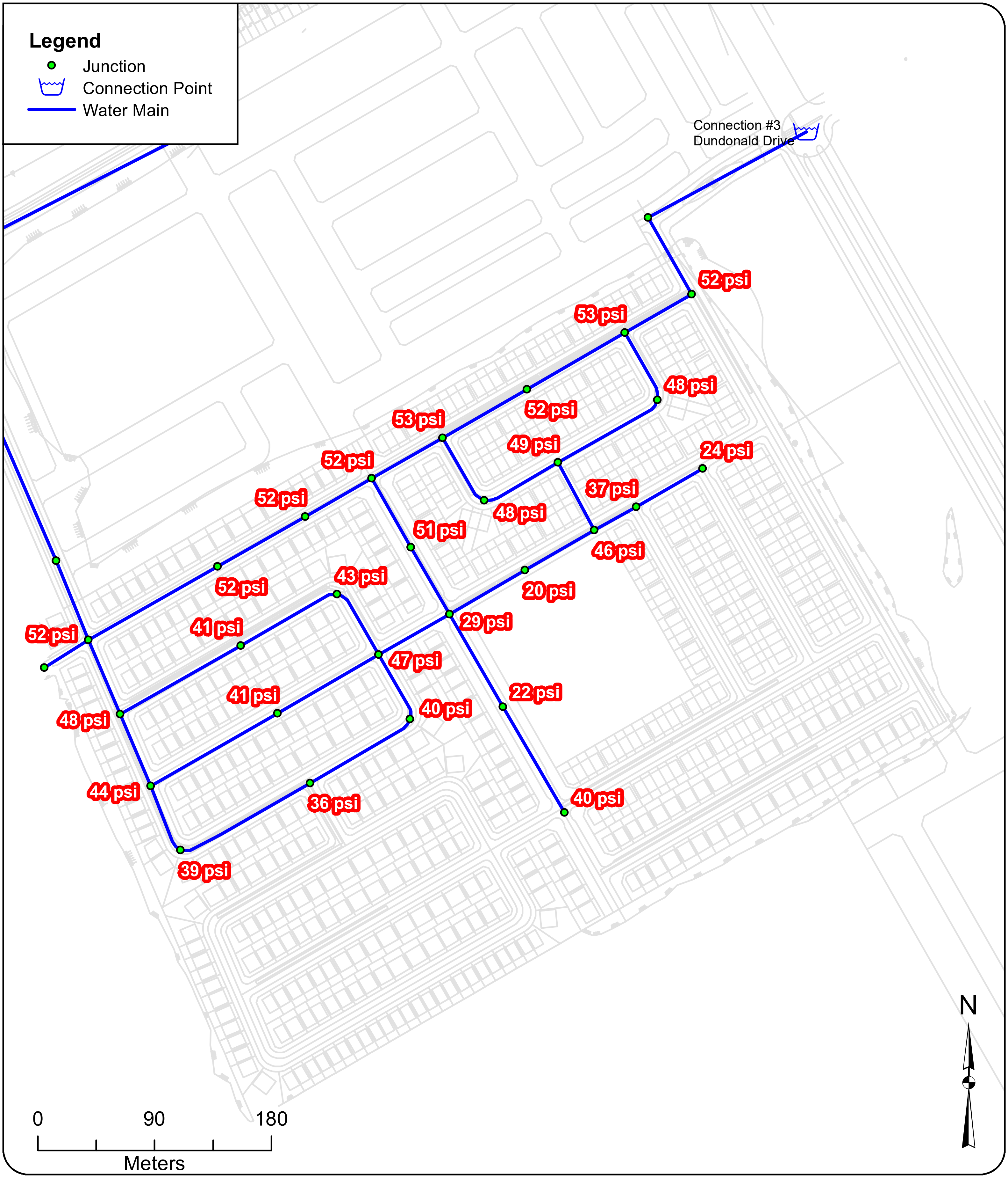
Available Fire Flow @ 20 psi - Phases 1&2

Figure F.2



GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis of the Brazeau Lands**
Client: **David Schaeffer Engineering Ltd.**
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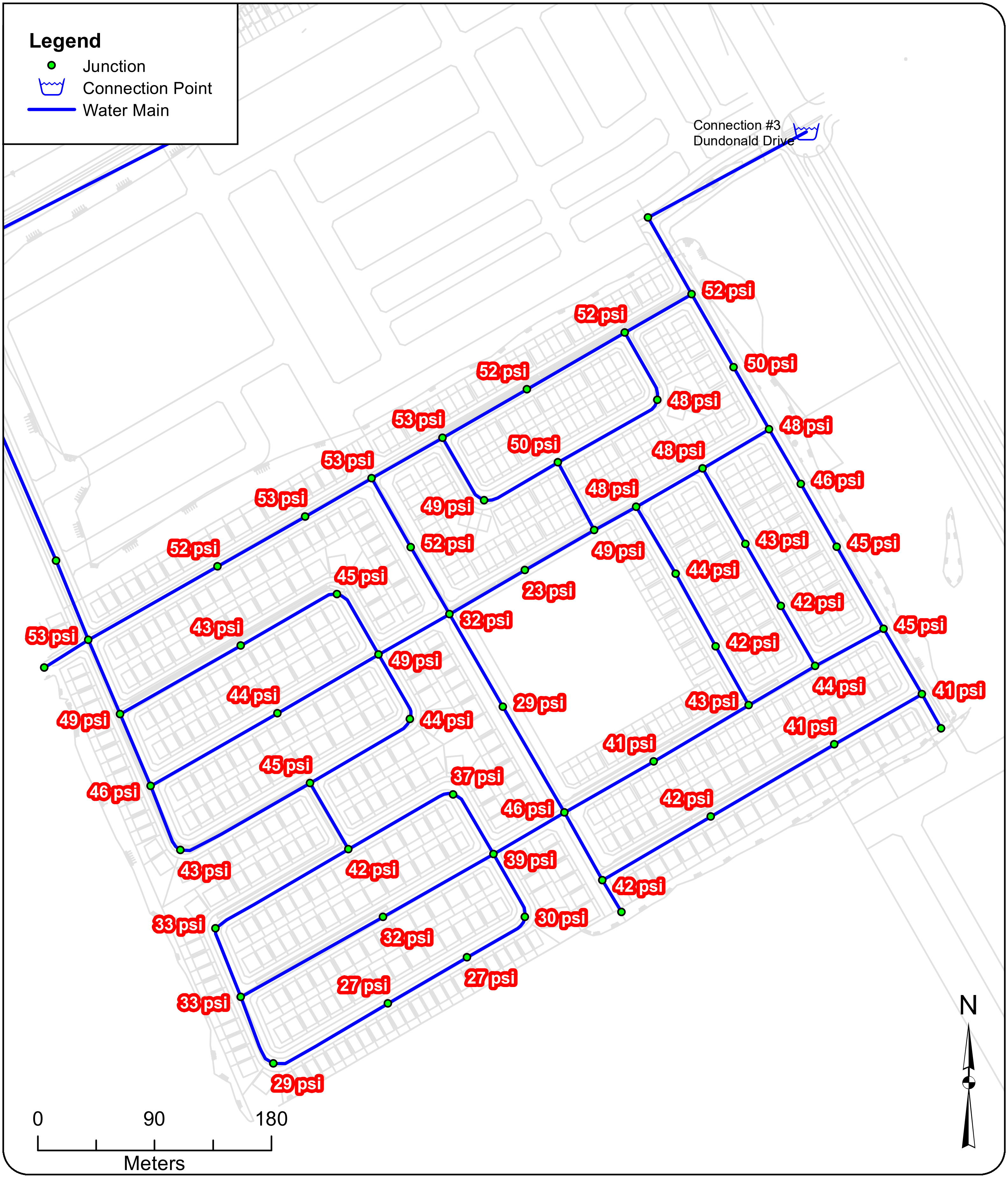
Residual Pressure @ Required Fire Flow - Phase 1

Figure F.3



GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis of the Brazeau Lands**
Client: **David Schaeffer Engineering Ltd.**
Date: **June 2020**
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Residual Pressure @ Required Fire Flow - Phases 1&2

Figure F.4

Fire Flow Modeling Results - Phase 1

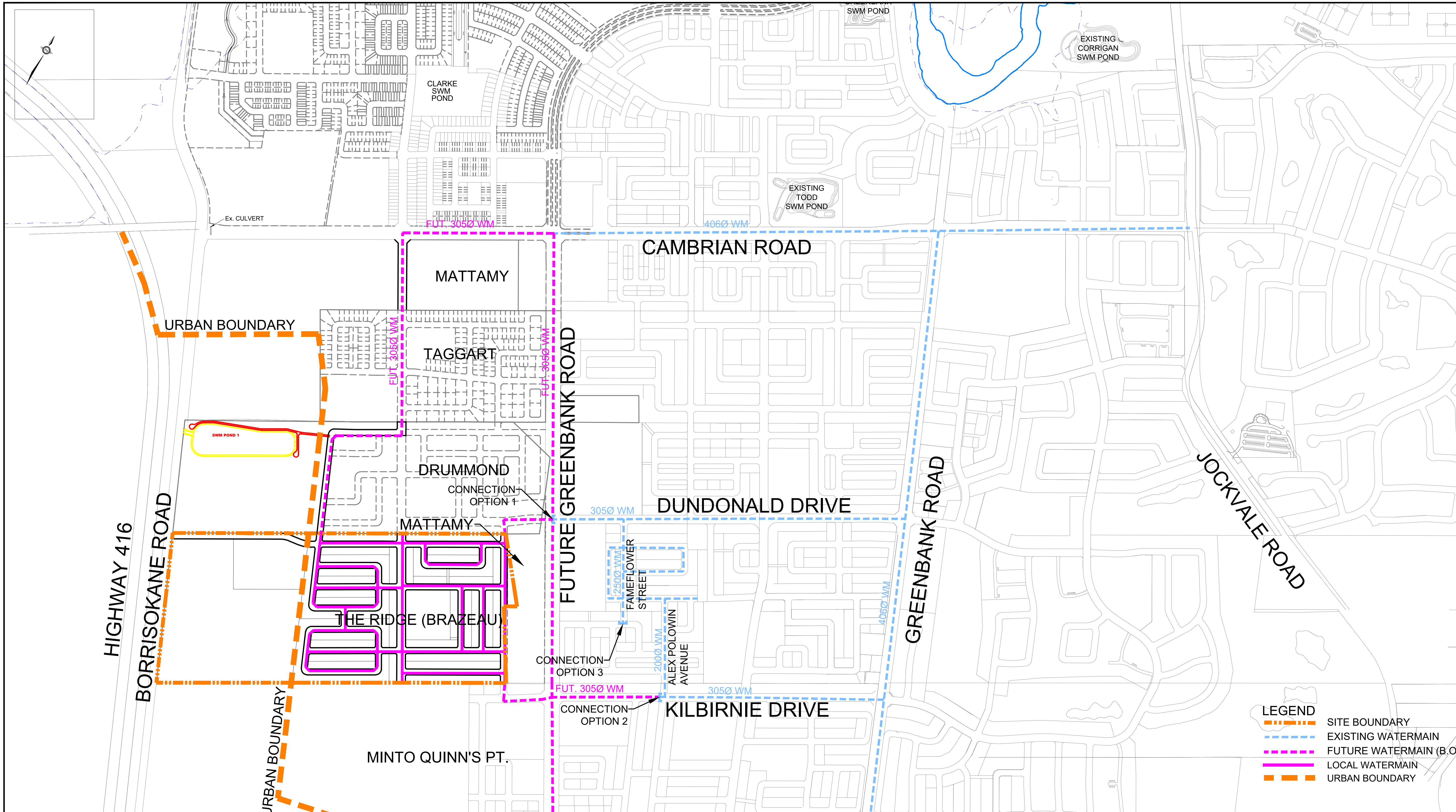
ID	Static Demand (L/s)	Fire-Flow Demand (L/s)	Residual Pressure (psi)	Available Flow at Hydrant (L/s)	Available Flow Pressure (psi)
J-33	0.45	167	52	487	20
J-35	0.38	167	52	473	20
J-36	0.41	167	52	485	20
J-37	0.14	167	52	506	20
J-38	0.36	167	53	518	20
J-39	0.52	167	52	522	20
J-40	0.36	167	53	570	20
J-41	0.08	167	52	612	20
J-42	0.41	167	48	366	20
J-43	0.47	167	49	382	20
J-44	0.38	167	48	367	20
J-45	0.16	167	24	177	20
J-46	0.22	167	37	239	20
J-49	0.34	167	47	345	20
J-50	0.31	167	43	282	20
J-51	0.45	167	41	268	20
J-52	0.52	167	48	352	20
J-53	0.52	167	44	301	20
J-54	0.48	167	41	268	20
J-55	0.48	167	39	254	20
J-56	0.48	167	36	235	20
J-57	0.31	167	40	264	20
J-59	1.04	167	40	293	20
J-61	0.14	167	51	469	20
J-90	0.00	167	46	325	20
J-47	0.30	250	20	249	20
J-48	0.17	250	29	335	20
J-58	0.14	250	22	266	20

Fire Flow Modeling Results - Phases 1 and 2

ID	Static Demand (L/s)	Fire-Flow Demand (L/s)	Residual Pressure (psi)	Available Flow at Hydrant (L/s)	Available Flow Pressure (psi)
J-33	0.45	167	53	526	20
J-35	0.38	167	52	509	20
J-36	0.41	167	53	523	20
J-37	0.14	167	53	550	20
J-38	0.36	167	53	545	20
J-39	0.52	167	52	532	20
J-40	0.36	167	52	566	20
J-41	0.08	167	52	615	20
J-42	0.41	167	48	376	20
J-43	0.47	167	50	417	20
J-44	0.38	167	49	379	20
J-45	0.16	167	48	402	20
J-46	0.22	167	48	396	20
J-49	0.34	167	49	400	20
J-50	0.31	167	45	308	20
J-51	0.45	167	43	289	20
J-52	0.52	167	49	393	20
J-53	0.52	167	46	345	20
J-54	0.48	167	44	296	20
J-55	0.48	167	43	299	20
J-56	0.48	167	45	331	20
J-57	0.31	167	44	316	20
J-59	1.04	167	46	445	20
J-61	0.14	167	52	527	20
J-62	0.52	167	42	300	20
J-63	0.48	167	33	228	20
J-64	0.52	167	33	233	20
J-65	0.45	167	29	207	20
J-66	0.52	167	27	194	20
J-67	0.55	167	32	223	20
J-68	0.34	167	37	259	20
J-69	0.34	167	39	294	20
J-70	0.41	167	27	199	20
J-71	0.28	167	30	218	20
J-72	0.41	167	42	397	20
J-74	0.58	167	42	383	20
J-75	0.41	167	41	379	20
J-76	0.21	167	41	387	20
J-78	0.16	167	45	428	20
J-79	0.44	167	44	371	20
J-80	0.44	167	43	349	20
J-81	0.71	167	41	310	20
J-82	0.30	167	42	308	20
J-83	0.49	167	44	317	20
J-84	0.27	167	42	312	20
J-85	0.49	167	43	315	20
J-86	0.19	167	45	436	20
J-87	0.19	167	46	453	20
J-88	0.11	167	48	487	20
J-89	0.19	167	50	525	20
J-90	0.00	167	49	413	20
J-47	0.30	250	23	269	20
J-48	0.17	250	32	390	20
J-58	0.14	250	29	348	20

Connection point 1: Existing watermain node off Haiku/ Obsidian street intersection fronting Block 1. (J-41)

Connection point 2: Existing watermain node on Obsidian street (J-86)



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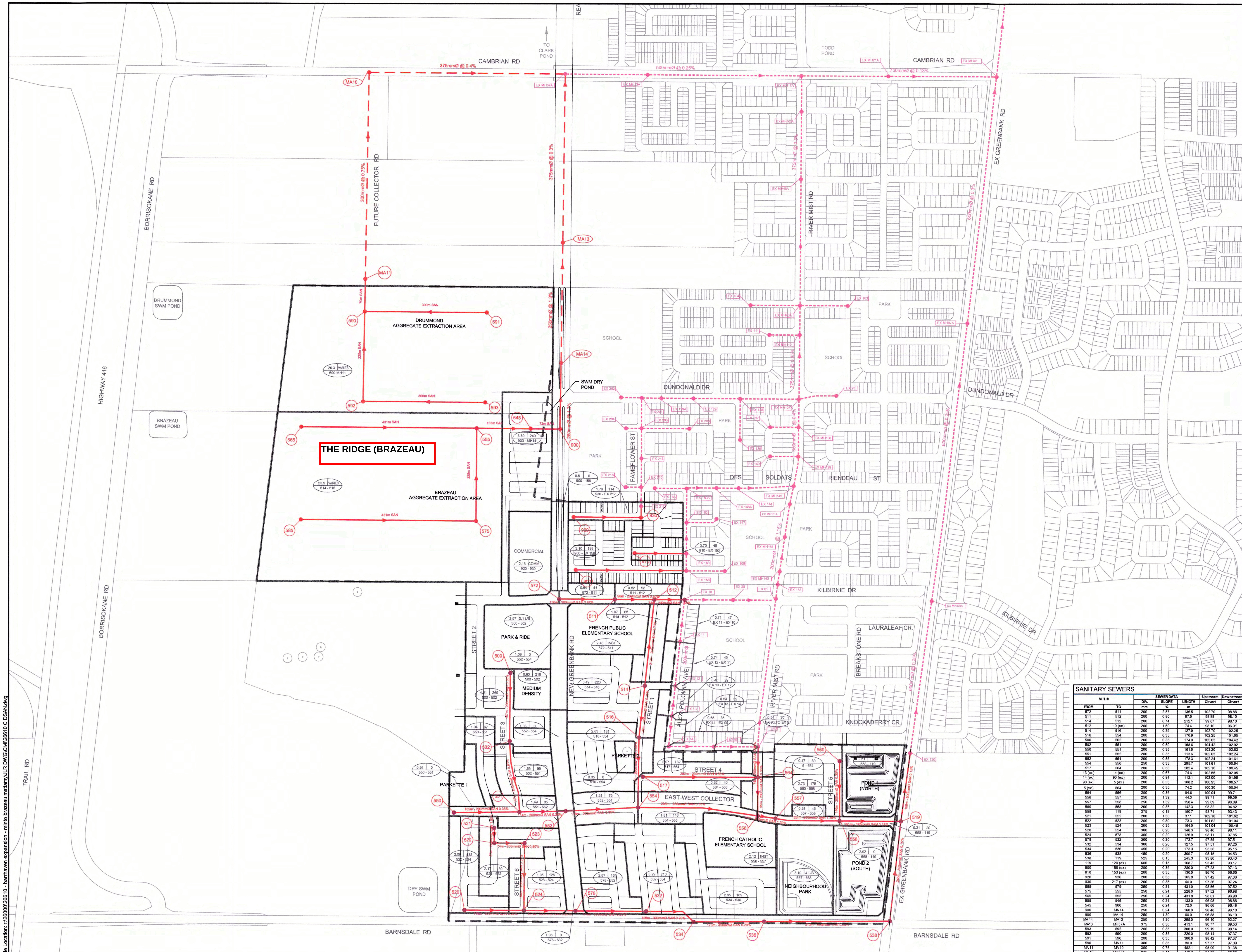
CAIVAN - BRAZEAU
WATERMAIN SERVICING PLAN
CITY OF OTTAWA

PROJECT No.:	18-1030
SCALE:	1:10,000
DATE:	APRIL 2020
FIGURE:	WAT-1

APPENDIX C



SANITARY SEWERS

M.H. #		SEWER DATA			Upstream	Downstream
		DIA.	SLOPE	LENGTH	Obvert	Obvert
FROM	TO	mm	%	m		
572	511	200	2.87	136.5	102.79	98.88
511	512	200	0.80	97.5	98.88	98.10
514	512	200	0.74	212.1	99.67	98.10
512	10 (ex.)	200	1.60	74.4	98.10	96.91
514	516	200	0.35	127.9	102.70	102.25
516	554	200	0.35	170.9	102.25	101.65
500	502	200	0.35	174.0	105.03	104.42
502	551	200	0.89	168.6	104.42	102.92
550	551	200	0.35	161.5	103.20	102.63
551	552	200	0.35	113.6	102.63	102.24
552	554	200	0.35	178.3	102.24	101.61
554	556	250	0.33	295.7	101.61	100.64
517	564	200	0.58	282.4	102.10	100.45
13 (ex.)	14 (ex.)	200	0.67	74.6	102.55	102.05
14 (ex.)	90 (ex.)	200	0.94	112.1	102.00	101.95
90 (ex.)	5 (ex.)	200	0.35	108.2	100.95	100.57
5 (ex.)	564	200	0.35	74.2	100.30	100.04
564	556	200	0.35	94.6	100.04	99.71
556	557	250	1.39	44.3	99.71	99.09
557	558	250	1.39	158.4	99.09	96.89
560	558	200	0.35	142.3	95.32	94.82
558	119	375	0.18	150.7	93.71	93.43
521	522	200	1.50	37.1	102.18	101.62
522	523	200	0.80	73.3	101.62	101.04
523	524	200	0.35	164.0	101.04	100.46
520	524	300	0.20	146.3	98.40	98.11
524	578	300	0.20	126.9	98.11	97.85
578	532	300	0.20	173.7	97.85	97.51
532	534	300	0.20	127.5	97.51	97.25
534	536	450	0.20	173.3	95.50	95.15
536	538	450	0.20	309.7	95.15	94.53
538	119	525	0.15	245.3	93.80	93.43
119	120 (ex.)	600	0.15	168.7	93.43	93.17
900	158 (ex.)	200	0.35	280.0	97.23	97.13
910	153 (ex.)	200	0.35	130.0	96.70	96.65
920	930	200	0.35	165.0	97.42	97.36
930	217 (ex.)	200	0.35	40.0	97.36	97.24
585	575	250	0.24	431.0	98.56	97.52
575	555	250	0.24	228.0	97.52	96.98
565	555	250	0.24	431.0	98.01	96.98
555	545	250	0.24	133.0	96.98	96.66
545	900	250	0.24	72.0	96.66	96.48
900	MA 14	250	0.24	160.0	96.48	96.10
900	MA 14	250	1.30	60.0	96.88	96.10
MA 14	MA13	250	1.30	295.0	96.10	92.27
MA13	MH57A	375	0.30	413.1	90.77	89.53
593	592	200	0.35	300.0	99.19	98.14
592	590	200	0.35	220.0	98.14	97.37
591	590	200	0.35	300.0	98.42	97.37
590	MA 11	300	0.35	80.0	97.37	97.09
MA 11	MA 10	300	0.75	482.1	95.00	91.38
MA 10	MH57A	375	0.41	449.7	91.38	89.53

LEGEND

- PROPOSED SANITARY, PER 2018 BSUEA MSS
- FUTURE SANITARY, PER 2014 BS MSS
- EXISTING SANITARY
- DRAINAGE BOUNDARY
- LIMIT OF STUDY AREA FOR BSUEA
- AREA IN HECTARES
- POPULATION
- PIPE REACH UPSTREAM MAINTENANCE HOLE TO DOWNSTREAM MAINTENANCE HOLE

COMM COMMERCIAL
INST INSTITUTIONAL
VARIES SEE DESIGN SHEET FOR CONTRIBUTING FLOWS

No.	ISSUE / REVISION	DD/MM/YY
4	ISSUED FOR PLANNING COMMITTEE APPROVAL	04/05/18
3	ADDRESS COMMENTS, RE-ISSUE BSUEA MSS 2ND SUBMISSION	26/02/18
2	ISSUED AS PART OF DRAFT MSS	20/09/17
1	ISSUED FOR PRE-TAC WORKING MEETING	31/08/17

VERIFY SHEET SIZE AND SCALES. BAR TO THE RIGHT IS 25mm IF THIS IS A FULL SIZE DRAWING. 0 25mm

SCALE: 1:4000

CLIENT:

CONSULTANT: www.jlrichards.ca

J.L.Richards ENGINEERS · ARCHITECTS · PLANNERS

CONSULTANT:

PROFESSIONAL STAMP

LICENSED PROFESSIONAL ENGINEER M. N. L. DALRYMPLE PROVINCE OF ONTARIO

PROJECT NORTH

PROJECT:

BARRHAVEN SOUTH URBAN EXPANSION AREA (BSUEA)

DRAWING:

MASTER SANITARY DRAINAGE AREA

DESIGN: JW

DRAWN: CJM

CHECKED: LD

JLR #: 26610

DRAWING #: MSAN

PLOT DATE: May 3, 2018 4:34:47 PM

File Location: r:\26000\26610 - barrhaven expansion - minto brazeau mattamy\JLR DWG\Civil\26610 C DSAN.dwg was assumed to have 4 washbasins that deliver 375 L/d and four (4) water closets that generate 150 L/hr for 10 hr/day resulting in a total flow of 7500 L/day.

Table 6-3: Land Use and Theoretical Wastewater Flows

Land Use	Flow Rate	Area (ha)	Units	Pop.	Average Flow (L/S)	Peak Factor	Infiltration	Total Flows (L/s)
Minto and Mattamy Lands								
Schools	28,000 L/ha/d	4.55			1.50	1.5	1.50	3.8
Park Block	4 L/s	4.39			4.0	1	1.45	5.5
Commercial	28,000 L/ha/d	2.13			0.70	1.5	0.70	1.8
Low-Medium density Residential	280 l/c/d	35.26	1080	3378	11.0	2.92	11.64	43.6
High Density Residential	280 l/c/d	0.90	120	216	0.7	3.51	0.30	2.8
Roads	-	27.00				1	8.91	8.9
Park and Ride		2.57			0.1	1	0.85	1.0
Total		**76.8**	**1200**	**3594**	**17.95**		**25.35**	**67.4**
Brazeau Aggregate Extraction Area								
Schools	28,000 L/ha/d	1.47			0.48	1.5	0.49	1.2
Commercial	28,000 L/ha/d	0.67			0.22	1.5	0.22	0.6
Low-Medium Density Residential	280 l/c/d	10.27	360	1126	3.65	3.21	3.39	15.1
High Density Residential	280 l/c/d	0.28	38	68	0.22	3.63	0.09	0.9
Roads	-	7.95				1	2.62	2.6
Park Block	-	1.48				1	0.49	0.5
Pond Blocks	-	1.78				1	0.59	0.6
Total		**23.9**		**1194**	**4.57**		**7.89**	**21.5**
Drummond Aggregate Extraction Area								
Schools	28,000 L/ha/d	1.25			0.41	1.5	0.41	1.0
Commercial	28,000 L/ha/d	0.57			0.18	1.5	0.19	0.5
Low-Medium Density Residential	280 l/c/d	8.72	288	900	2.92	3.26	2.88	12.4
High Density Residential	280 l/c/d	0.24	32	58	0.19	3.64	0.08	0.8
Roads	-	6.75				1	2.23	2.2

Land Use	Flow Rate	Area (ha)	Units	Pop.	Average Flow (L/S)	Peak Factor	Infiltration	Total Flows (L/s)
Park Blocks	-	1.26				1	0.42	0.4
Pond Blocks	-	1.51				1	0.50	0.5
Total		**20.3**		**958**	**3.70**		**6.71**	**17.8**
Barrhaven South Urban Expansion Area Totals								
Total		**121.0**		**5746**	**26.22**		**40.0**	**106.7**

Based on the land uses presented on the Demonstration Plan (Figure 4-2), the BSUEA would generate a peak wastewater flow of approximately 106.7 L/s.

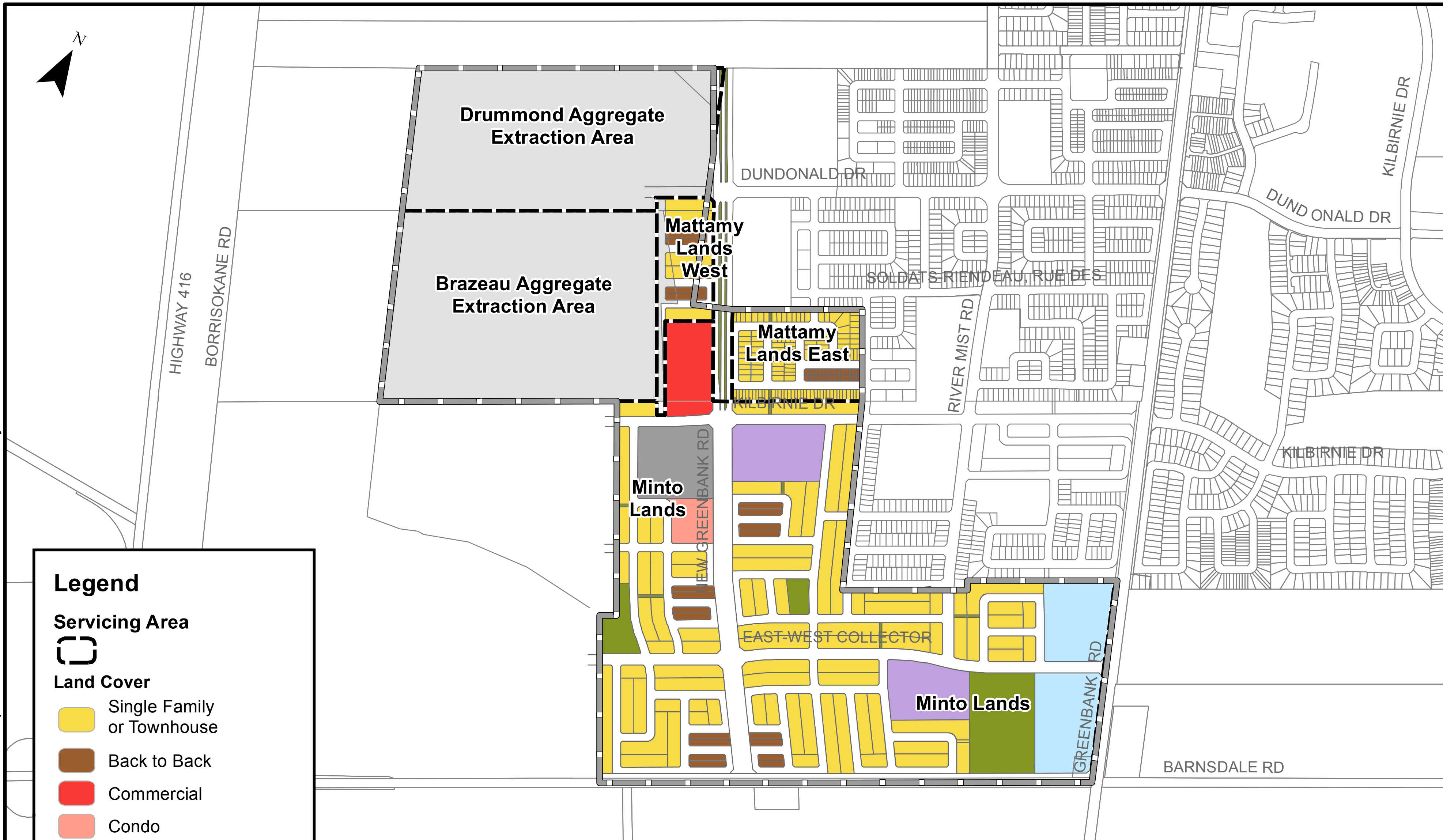
6.3 Wastewater Collection System Strategy

6.3.1 Proposed Sewer System Layout and Sizing

A trunk sanitary sewer system layout was developed based on the ROW corridors identified on the BSUEA Demonstration Plan for the purposes of demonstrating the feasibility of providing wastewater servicing for the BSUEA lands, refer to the Key Servicing Plans. Proposed trunk sanitary sewers were sized based on the aforementioned design criteria and the drainage areas depicted on the Master Sanitary Drainage Area Drawing MSAN, refer to the BSUEA Sanitary Sewer Design Sheet (Appendix J) for detailed calculations. Final configuration and sizing of the wastewater collection system will be confirmed at detailed design of each subdivision stage. At such time, refinements may be implemented.

The proposed BSUEA trunk sanitary sewers will discharge to existing/planned sanitary sewers at the following six (6) locations, as shown on Figure 6-2:

1. The Future Collector Road
2. New Greenbank Road
3. Flameflower Street
4. Alex Polowin Avenue
5. Kilbirnie Drive
6. Greenbank Road



File Location: R:\26000\26610 - Barrhaven Expansion - Minto Brazeau Mattamy\JLR DWG\GIS\26610 C CDP.mxd

PROJECT:

BARRHAVEN SOUTH URBAN EXPANSION AREA

OTTAWA, ONTARIO

DRAWING:

CDP DEMONSTRATION PLAN AND SERVICING AREAS

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS
www.jlrichards.ca

DESIGN:	BP
DRAWN:	KTK
CHECKED:	GF
JLR #:	26610

DRAWING #:

FIGURE 4-2

Plot Date: April 30, 2018 3:27:45 PM

It is noted that the residual capacity in the River Mist Road trunk sanitary sewer has in fact increased with the addition of the BSUEA peak flows. This is the result of adding a relatively small tributary area while reducing the average daily residential flow from 350 L/cap to 280 L/cap combined with diverting some existing drainage areas, located in Quinn's Pointe, away from the outlet.

Table 6-4: Residual Capacity Comparison in the BSC Trunk Sanitary Sewers

Existing Trunk Sanitary Sewer	Limiting Pipe reach	Current Minimum Residual Capacity	Proposed BSUEA Tributary Lands	Proposed BSUEA Tributary Area	Revised Minimum Residual Capacity with inclusion of BSUEA Peak Flow
Cambrian Road	MH 13A to MH15A	51.4 L/s	Drummond, Brazeau, Mattamy West (Residential only)	48 ha	52.9 L/s
River Mist Road	MH 102A to MH 17A	14.4 L/s	Mattamy East, Mattamy West (Commercial only), Northwest corner of Minto	12 ha	30.5 L/s
River Mist Road	MH 1 to MH 163	5.58 L/s	Minto	5 ha	4.63 L/s
Greenbank Road	MH 45 to MH 435A	295.4 L/s	Minto	60 ha	283.2 L/s

With the addition of the BSUEA lands, a total theoretical peak wastewater flow of 403.7 L/s was calculated at the most downstream maintenance hole in the BSC (MH 501A on Greenbank Road), as indicated in the Sanitary Sewer Design Sheet in Appendix J. This calculated theoretical peak flow is less than the 590 L/s allocated for all of the BSC in Stantec's City-wide 2013 Wastewater Collection System Assessment. In this assessment, Stantec created a hydrodynamic model of trunk sanitary sewers (450 mm in diameter and greater) which demonstrated that the existing downstream trunk system could accommodate the theoretical flow of 590 L/s generated by the BSC with no risk of surcharging or basement flooding. Consequently, Stantec concluded that system upgrades were not required to accommodate the anticipated growth in the BSC. Since the Stantec assessment considered a peak flow that was 186 L/s greater than that calculated for the BSC and the BSUEA combined, it is understood that the existing trunk sanitary sewers located downstream of the BSC can accommodate the additional flows generated by the BSUEA.

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

BARRHAVEN SOUTH URBAN EXPANSION (BSUEA)

BSUEA SANITARY SEWER DESIGN SHEET

CITY OF OTTAWA
MINTO COMMUNITIES INC.
JLR NO. 26610

Designed by: A.T
Checked by: H.M
Date : February 2018

			DESIGN PARAMETERS		
Single Family	3.4	pers/unit	q =	280	L/cap/day
Semi-Detached/Townhouse (row)	2.7	pers/unit	I =	0.330	L/s/ha
Apt Units	1.8	pers/unit	Inst. =	28000	L/ha/day
Manning's Coeff. N =	0.013		ICI Peaking Factor* =	1.0/1.5	

*ICI Peaking Factor = 1.5 if ICI in contributing area is >20%, 1.0 if ICI in contributing area is <20%

STREET	M.H. # FROM	M.H. # TO	RESIDENTIAL – NUMBER OF UNITS SING.	MULT.	APT.	AREA ha	POPUL. peop.	CUMULATIVE POPUL. peop.	CUMULATIVE AREA ha	PEAKING FACTOR	POPUL. FLOW l/s	COMMERCIAL AREA ha	COMMERCIAL CUMM. AREA ha	COMMERCIAL INST. FLOW l/s	INSTITUTIONAL AREA ha	INSTITUTIONAL CUMM. AREA ha	INSTITUTIONAL INST. FLOW l/s	(Infiltration) PEAK EXTR. FLOW l/s	PLUG FLOW l/s	PEAK DES. FLOW l/s	SEWER DATA DIA. mm	SLOPE %	CAPAC. l/s	VEL. m/s	LENGTH m	RESIDUAL CAP. l/s	UPSTREAM Center Line	UPSTREAM Obvert	UPSTREAM Invert	UPSTREAM Cover	DOWNSTREAM Center Line	DOWNSTREAM Obvert	DOWNSTREAM Invert	DOWNSTREAM Cover	ICI Peaking Factor ICI/ TOTAL	P.F
MINTO LANDS WITHIN BSUEA (OUTLETS TO RIVER MIST.)																																				
Kilbirnie Dr.	572	511		10		0.64	27	27	0.64	3.69	0.32		0.00	0.00	2.43	2.43	1.18	1.01		2.52	200	2.87	57.9	1.79	136.50	55.40	107.40	102.79	102.59	4.61	103.50	98.88	98.68	4.62	0.79	1.50
Kilbirnie Dr.	511	512		27		0.82	73	100	1.46	3.59	1.16	0.00	0.00	0.00	0.00	2.43	0.79	1.28		3.24	200	0.80	30.6	0.94	97.52	27.37	103.50	98.88	98.68	4.62	103.40	98.10	97.90	5.30	0.00	1.00
Street 1	514	512	21			1.07	71	71	1.07	3.62	0.84	0.00	0.00	0.00	0.00	0.00	0.00	0.35		1.19	200	0.74	29.4	0.91	212.06	28.24	105.60	99.67	99.47	5.93	103.40	98.10	97.90	5.30	0.00	1.00
Kilbirnie Dr.	512	10 (ex.)					0	171	2.53	3.54	1.96	0.00	0.00	0.00	0.00	2.43	0.79	1.64		4.39	200	1.60	43.3	1.33	74.41	38.89	103.40	98.10	97.90	5.30	101.18	96.91	96.71	4.27	0.00	1.00
MINTO LANDS WITHIN BSUEA (OUTLETS TO EXISTING GREENBANK)																																				
Street 1	514	516	14	104		3.49	328	328	3.49	3.45	3.67		0.00	0.00		0.00	0.00	1.15		4.82	200	0.35	20.2	0.62	127.86	15.42	105.60	102.70	102.50	2.90	105.40	102.25	102.05	3.15	0.00	1.00
Street 1	516	554	20	54		3.18	214	542	6.67	3.36	5.91		0.00	0.00		0.00	0.00	2.20		8.11	200	0.35	20.2	0.62	170.90	12.13	105.40	102.25	102.05	3.15	105.20	101.65	101.45	3.55	0.00	1.00
Street 3	500	502	25	70	115	7.16	481	481	7.16	3.39	5.28		0.00	0.00		0.00	0.00	2.36	0.10	7.74	200	0.35	20.2	0.62	174.02	12.50	108.10	105.03	104.827	3.07	107.90	104.42	104.218	3.48	0.00	1.00
Street 3	502	551	8	44		1.55	146	627	8.71	3.34	6.78		0.00	0.00		0.00	0.00	2.87		9.76	200	0.89	32.3	1.00	168.60	22.52	107.90	104.42	104.218	3.48	105.90	102.92	102.717	2.98	0.00	1.00
East-West Collector	550	551	20			1.98	68	68	1.98	3.63	0.80		0.00	0.00		0.00	0.00	0.65		1.45	200	0.35	20.2	0.62	161.54	18.79	105.50	103.20	103.00	2.30	105.90	102.63	102.43	3.27	0.00	1.00
East-West Collector	551	552	22			1.49	75	770	12.18	3.30	8.23		0.00	0.00		0.00	0.00	4.02		12.34	200	0.35	20.2	0.62	113.56	7.90	105.90	102.63	102.43	3.27	106.15	102.24	102.03	3.91	0.00	1.00
East-West Collector	552	554	12	20		3.36	95	865	15.54	3.27	9.17		0.00	0.00		0.00	0.00	5.13		14.40	200	0.35	20.2	0.62	178.26	5.84	106.15	102.24	102.03	3.91	105.20	101.61	101.41	3.59	0.00	1.00
East-West Collector	554	556	11	34		1.81	129	1536	24.02	3.14	15.62		0.00	0.00		0.00	0.00	7.93		23.65	250	0.33	35.6	0.70	295.67	11.99	105.20	101.61	101.36	3.59	103.55	100.64	100.38	2.91	0.00	1.00
Street 4	517	564	20	35		2.07	163	163	2.07	3.54	1.87		0.00	0.00		0.00	0.00	0.68		2.55	200	0.58	26.2	0.81	282.43	23.60	105.30	102.10	101.90	3.20	103.65	100.45	100.25	3.20	0.00	1.00
Alex Polowin Ave.	13 (ex.)	14 (ex.)	12			0.54	41	41	0.54	3.67	0.49		0.00	0.00		0.00	0.00	0.18		0.67	200	0.67	28.0	0.86	74.56	27.34	105.00	102.55	102.35	2.45	105.52	102.05	101.85	3.47	0.00	1.00
Alex Polowin Ave.	14 (ex.)	90 (ex.)	13			0.65	44	85	1.19	3.61	0.99		0.00	0.00		0.00	0.00	0.39		1.39	200	0.94	33.2	1.02	112.06	31.79	105.00	102.00	101.80	3.00	103.96	101.95	101.75	2.01	0.00	1.00
Russet Terrace	90 (ex.)	5 (ex.)	6			0.54	20	105	1.73	3.59	1.22		0.00	0.00		0.00	0.00	0.57		1.79	200	0.35	20.2	0.62	108.16	18.45	103.93	100.95	100.75	2.98	103.80	100.57	100.37	3.23	0.00	1.00
River Mist Rd.	5 (ex.)	564	8			0.47	27	132	2.20	3.57	1.53		0.00	0.00		0.00	0.00	0.73		2.25	200	0.35	20.2	0.62	74.22	17.99	103.90	100.30	100.10	3.60	103.80	100.04	99.84	3.76	0.00	1.00
River Mist Rd.	564	556	7	9		0.64	48	343	4.91	3.44	3.83		0.00	0.00		0.00	0.00	1.62		5.55	200	0.35	20.2	0.62	94.59	14.70	103.65	100.04	99.84	3.61	103.55	99.71	99.51	3.84	0.00	1.00
East-West Collector	556	557					0	1879	28.93	3.09	18.79		0.00	0.00	2.20	2.20	0.71	10.27		29.87	250	1.39	73.1	1.44	44.25	43.27	103.55	99.71	99.46	3.84	102.78	99.09	98.84	3.69	0.07	1.00
East-West Collector	557	558	6			1.12	20	1899	30.05	3.08	18.97		0.00	0.00	2.86	5.06	1.64	11.59	4.00	36.30	250	1.39	73.1	1.44	158.35	36.85	102.78	99.09	98.84	3.69	99.90	96.89	96.64	3.01	0.09	1.00
Street 5	560	558	50			3.09	170	170	3.09	3.54	1.95		0.00	0.00		0.00	0.00	1.02		2.97	200	0.35	20.2	0.62	142.27	17.27	98.80	95.32	95.12	3.48	99.90	94.82	94.62	5.08	0.00	1.00
East-West Collector	558	119				5.74	0	2069	38.88	3.06	20.51		0.00	0.00		5.06	1.64	14.50		40.75	375	0.18	77.6	0.68	150.71	36.85	99.90	93.71	93.32	6.20	99.55	93.43	93.05	6.12	0.00	1.00
Street 6	521	522	24	33		2.17	171	171	2.17	3.54	1.96		0.00	0.00		0.00	0.00	0.72		2.68	200	1.50	41.9	1.29	37.09	39.23	105.18	102.18	101.98	3.00	104.50	101.62	101.42	2.88	0.00	1.00
	522	523					0	171	2.17	3.54	1.96		0.00	0.00		0.00	0.00	0.72		2.68	200	0.80	30.6	0.94	73.27	27.93	104.50	101.62	101.42	2.88	105.11	101.04	100.83	4.07	0.00	1.00
	523	524		71		1.95	192	363	4.12	3.43	4.04		0.00	0.00		0.00	0.00	1.36		5.40	200	0.35	20.2	0.62	164.00	14.84	105.11	101.04	100.83	4.07	103.50	100.46	100.26	3.04	0.00	1.00
Adjacent to Barnsdale Rd	520	524	41			2.06	139	139	2.06	3.56	1.60		0.00	0.00		0.00	0.00	0.68		2.28	300	0.20	45.1	0.62	146.25	42.83	102.80	98.40	98.10	4.40	103.50	98.11	97.80	5.39	0.00	1.00
Adjacent to Barnsdale Rd	524	578					0	502	6.18	3.38	5.50		0.00	0.00		0.00	0.00	2.04		7.54	300	0.20	45.1	0.62	126.92	37.58	103.50	98.11	97.80	5.39	104.92	97.85	97.55	7.07	0.00	1.00
Adjacent to Barnsdale Rd	578	532		87		3.63	235	737	9.81	3.31	7.89		0.00	0.00		0.00	0.00	3.24		11.13	300	0.20	45.1	0.62	173.72	33.98	104.92	97.85	97.55	7.07	103.80	97.51	97.20	6.29	0.00	1.00
Adjacent to Barnsdale Rd	532	534	50	26		3.29	240	977	13.10	3.25	10.27		0.00	0.00		0.00	0.00	4.32		14.60	300	0.20	45.1	0.62	127.45	30.52	103.80	97.51	97.20	6.29	103.00	97.25	96.95	5.75	0.00	1.00
Adjacent to Barnsdale Rd	534	536	55			2.96	187	1164	16.06	3.21	12.09		0.00	0.00		0.00	0.00	5.30		17.39	450	0.20	133.0	0.81	173.27	115.63	103.00	95.50	95.04	7.50	101.56	95.15	94.70	6.41	0.00	1.00
Easement (Barnsdale to E-W Collector)	536	538					0	1164	16.06	3.21	12.09		0.00	0.00		0.00	0.00	5.30		17.39	450	0.20	133.0	0.81	309.73	115.63	101.56	95.15	94.70	6.41	99.75	94.53	94.08	5.22	0.00	1.00
	538	119					0	1164	16.06	3.21	12.09		0.00	0.00		0.00	0.00	5.30		17.39	525	0.15	173.8	0.78	245.34	156.37	99.75	93.80	93.26	5.95	99.55	93.43	92.89	6.12	0.00	1.00
Ex. Greenbank Rd.	119	120 (ex.)					0	3233	54.94	2.93	30.72		0.00	0.00		5.06	1.64	19.80		56.26	600	0.15	248.1	0.85	168.66	191.83	99.55	93.43	92.82	6.12		93.17	92.57		0.00	1.00
																					600	0.25														
MATTAMY LANDS EAST OUTLETS TO DUNDONALD DR. & DES SOLDATS																																				
	900	158 (ex.)	31	51		3.10	243	243	3.10	3.49	2.75	0.00	0.00	0.00		0.00	0.00	1.02		3.77	200	0.35	20.2	0.62	280.00	16.47	106.62	97.23	97.02	9.39	101.03	97.13	97.13	3.90	0.00	1.00
	910	153 (ex.)		28		0.71	76	76	0.71	3.62	0.89	0.00	0.00	0.00		0.00	0.00	0.23		1.12	200	0.35	20.2	0.62	130.00	19.12	104.00	96.70	96.49	7.30	100.35	96.65	96.65	3.70	0.00	1.00
	920	930	36			1.81	122	122	1.81	3.57	1.42	2.13	2.13	1.04		0.00	0.00	1.30		3.75	200	0.35	20.2	0.62	165.00	16.49	106.07	97.42	97.21	8.65	101.70	97.36	97.16	4.34	0.54	1.50
	930	217 (ex.)						122	1.81	3.57	1.42	0.00	2.13	1.04		0.00	0.00	1.30		3.75	200	0.35	20.2	0.62	40.00	16.49	101.70	97.36	97.16	4.34	101.70	97.24	97.04	4.46	0.54	1.50
BRAZEAU AGGREGATE EXTRACTION AREA OUTLETS TO NEW GREENBANK ROAD*																																				
	585	575	178	236	37	21.77	1309	1309	21.77	3.18	13.48	0.68	0.68	0.22	1.45	1.45	0.47	7.89		22.06	250	0.24	30.4	0.60	431.00	8.34		98.56	98.30			97.52	97.27		0.09	1.00
	575	555					0	1309	21.77		0.00		0.68	0.22		1.45	0.47	7.89		8.58	250	0.24	30.4	0.60	228.00	21.82		97.52	97.27			96.98	96.72		0.03	1.00
	565	555					0	0	0.00		0.00		0.00	0.00		0.00	0.00	0.00		0.00	250	0.24	30.4	0.60	431.00	30.39		98.01	97.76			96.98	96.72		0.00	1.00
	555	545					0	1309	21.77		0.00		0.68	0.22		1.45	0.47	7.89		8.58	250	0.24	30.4	0.60	133.00	21.82		96.98	96.72			96.66	96.40		0.03	1.00
	545	900					0	1309	21.77		0.00		0.68	0.22		1.45	0.47	7.89		8.58	250	0.24	30.4	0.60	72.00	21.82	104.31	96.66	96.40	7.65	103.00	96.48	96.23	6.52	0.03	1.00
	900	MA 14																			250	0.24	30.4	0.60	160.00	30.39		96.48	96.23			96.10	95.85			
MATTAMY LANDS WEST OUTLETS TO NEW GREENBANK RD																																				
Realigned Greenbank Rd.	900	MA 14	8	102		3.89	303	1612	25.66	3.13	16.32	0.00	0.68	0.22	0.00	1.45	0.47	9.17		26.18	250	1.30	70.7	1.40	60.00	44.55	104.31	96.88	96.63	7.43	103.00	96.10	95.85	6.90	0.03	1.00
	MA 14	MA13				0.00	0	1612	25.66	3.13	16.32	0.00	0.68	0.22	0.00	1.45	0.47	9.17		26.18	250	1.30	70.7	1.40	295.00	44.50	103.00	96.10	95.85	6.90	95.20	92.27	92.02	2.93	0.03	1.00
	MA13	MH57A						1612	25.66	3.13	16.32		0.68	0.22		1.45	0.47	9.17		26.18	375	0.30	100.2	0.88	413.10	74.00	92.27	90.77	90.39	1.50	93.60	89.53	89.15	4.07	0.03	1.00
DRUMMOND AGGREGATE EXTRACTION AREA OUTLETS TO PROPOSED COLLECTOR RD.*												1																								
	593	592																			200	0.35	20.2	0.62	300.00	20.24		99.19	98.99			98.14	97.94			1.00
	592	590																			200	0.35	20.2	0.62	220.00	20.24		98.14	97.94			97.37	97.17			1.00
	591	590																			200	0.35	20.2	0.62	300.00	20.24		98.42	98.22			97.37	97.17			1.00
	590	MA 11	151	226	31	18.48	1179	1179	18.48	3.20	12.24	0.58	0.58	0.19	0.40	0.40	0.13	6.42		18.98	300	0.35	59.7	0.82	80.00	40.70		97.37	97.07		100.00	97.09	96.79	2.91	0.05	1.00
	MA 11	MA 10					0	1179	18.48	3.20	12.24		0.58	0.19		0.40		6.42		18.85	300	0.75	87.4	1.20	482.10	68.52	100.00	95.00	94.69	5.00	93.50	91.38	91.08	2.12	0.03	1.00
	MA 10	MH57A					0	1179	18.48	3.20	12.24		0.58	0.19		0.40		6.42		18.85	375	0.41	117.3	1.03	449.70	98.47	93.50	91.38	91.00	2.12	93.60	89.53	89.15	4.07		1.00
							0																													

*ONLY FLOW CONTRIBUTIONS FROM BSUEA ARE SHOWN, FOR SANITARY FLOWS FROM OTHER CONTRIBUTING AREAS TRIBUTARY TO CAMBRIAN ROAD, SEE OVERALL SANITARY SPREADSHEET

BARRHAVEN SOUTH URBAN EXPANSION AREA (BSUEA)

CITY OF OTTAWA
MINTO COMMUNITIES INC.
JLR NO. 26610

BARRHAVEN SOUTH SANITARY SEWER DESIGN SHEET

Designed by: AT
Checked by:HM

			PROPOSED AND BSUEA DESIGN PARAMETERS		
Single Family	3.4	pers/unit	q =	280	L/cap/day
Semi-Detached/Townhouse (row)	2.7	pers/unit	I =	0.330	L/s/ha
Apt Units	1.8	pers/unit	Inst./Comm. =	28000	L/ha/day
Manning's Coeff. N =	0.013		Commerial PF*=	1.0/1.5	

*1.5 if ICI in contributing area is >20%, 1.0 if ICI in contributing area is <20%

Sources:	
	Half Moon Bay South Subdivision - Phase 4 - Excluding Arterials- Sanitary sewer design sheet prepared by Stantec (2015)
	Quinn's Pointe - Excluding Arterials-Sanitary sewer design sheet prepared by J.L Richards (2015)
	Barrhaven South Master Servicing Study Addendum - Sanitary sewer design sheet prepared Stantec (2014)

Legend
- Proposed
- Proposed by Others
- Existing

TOTAL PEAK FLOW TO MH57A = 112.80 L/s
(USING CUMULATIVE AREAS,
POPULATIONS AND PEAK FACTORS)

Date: February 2018

STREET	SOURCE	M.H. # FROM	M.H. # TO	RESIDENTIAL NUMBER OF UNITS SING.	MULT.	APT.	AREA TOTAL ha	POPULATION TOTAL peop.	CUMULATIVE POPUL. peop.	CUMULATIVE AREA ha	PEAKING FACTOR	POPUL. FLOW l/s	COMMERCIAL AREA ha	CUMM. AREA ha	INST. FLOW l/s	INSTITUTIONAL AREA ha	CUMM. AREA ha	INST. FLOW l/s	GREEN/UNUSED AREA ha	CUMM. AREA ha	PEAK EXTR. FLOW l/s	PLUG FLOW l/s	PEAK DES. FLOW l/s	SEWER DATA DIA. mm	SLOPE %	CAPAC. l/s	VEL. m/s	LENGTH m	RESIDUAL CAP. l/s	ICI/ TOTAL	ICI* Peaking Factor
CAMBRIAN ROAD OUTLET VIA FUTURE REALIGNED GREENBANK AND FUTURE COLLECTOR																															
Drummond Aggregate Extraction Area		545	MA11	151	226	31.00	18.48	1179	1179	18.48	3.20	12.24	0.58	0.58	0.19	1.23	1.23	0.40		0.00	6.70		19.5	300	0.75	87.4	1.20	300.00	67.85	0.09	1.00
Future Collector Road	Stantec (2014)	MA11	MA10				14.23	1523	2702	32.71	2.98	26.13		0.58	0.19	2.80	4.03	1.31	2.50	2.50	13.14		40.77	300	0.75	87.4	1.20	482.10	46.60	0.12	1.00
Cambrian Rd.	Stantec (2014)	MA10	MH57A				12.81	1371	4073	45.52	2.86	37.76		0.58	0.19	7.22	11.25	3.65	14.49	16.99	24.53		66.13	375	0.40	115.7	1.01	449.70	49.55	0.16	1.00
Brazeau Aggregate Extraction Area + Mattamy Lands		900	MA14	186	368	37.00	25.66	1693	1693	25.66	3.11	17.08	0.68	0.68	0.22	1.45	1.45	0.47		0.00	9.17		26.9	250	1.30	70.7	1.40	350.00	43.80	0.08	1.00
New Greenbank Road	Stantec (2014)	MA14	MA13				4.79	513	2206	30.45	3.04	21.75		0.68	0.33	7.45	8.90	4.33		0.00	13.21		39.61	250	1.30	70.7	1.40	295.00	31.12	0.24	1.50
New Greenbank Road	Stantec (2014)	MA13	MH57A				10.99	1176	3382	41.44	2.92	31.98		0.68	0.22		8.90	2.88	0.53	0.53	17.01		52.10	375	0.30	100.2	0.88	413.10	48.09	0.19	1.00
Cambrian Road	Stantec	MH57A	MH13A				4.29	458	7913	91.25	2.64	67.80	3.44	4.70	1.52	0.00	20.15	6.53		17.52	44.09		119.95	500	0.25	197.0	0.97	216.50	77.01	0.19	1.00
Cambrian Road	Stantec	MH13A	MH15A				6.21	634	8547	97.46	2.62	72.51		4.70	1.52	0.00	20.15	6.53		17.52	46.14		126.70	500	0.20	176.2	0.87	165.20	49.46	0.18	1.00
Cambrian Road	Stantec	MH15A	MH17A				5.61	870	9417	103.07	2.58	78.87		4.70	1.52	0.00	20.15	6.53		17.52	48.00		134.92	600	0.13	231.0	0.79	202.00	96.04	0.17	1.00
QUINN'S POINTE OUTLET TO MH163 RIVER MIST RD.							103.07	9417																							
Kilbirnie Drive		572	511		10		0.64	27	27	0.64	3.69	0.32		0.00	0.00	2.43	2.43	1.18		0.00	1.01		2.52	200	2.87	57.9	1.79	136.50	55.38	0.79	1.50
Kilbirnie Drive		511	512		27		0.82	73	100	1.46	3.59	1.17		0.00	0.00		2.43	1.18		0.00	1.28		3.63	200	0.80	30.6	0.94	97.50	26.97	0.62	1.50
Future Collector Road		514	512	21			1.07	71	71	1.07	3.63	0.83		0.00	0.00		0.00	0.00		0.00	0.35		1.19	200	0.74	29.4	0.91	212.10	28.25	0.00	1.00
Kilbirnie Drive		512	EX10				0.00	0	171	2.53	3.54	1.96		0.00	0.00		2.43	1.18		0.00	1.64		4.78	200	1.60	43.3	1.33	74.00	38.50	0.49	1.50
River Mist Road		EX5	EX4	12			0.55	41	41	0.55	3.67	0.49		0.00	0.00		0.00	0.00		0.00	0.18		0.67	200	0.33	19.8	0.61	74.90	19.10	0.00	1.00
Boddington Street		EX101	EX100	14			0.72	48	48	0.72	3.65	0.57		0.00	0.00		0.00	0.00		0.00	0.24		0.81	200	0.98	33.8	1.04	90.13	33.00	0.00	1.00
Boddington Street		EX100	EX4	8			0.44	27	75	1.16	3.62	0.88		0.00	0.00		0.00	0.00		0.00	0.38		1.26	200	0.91	32.6	1.01	91.40	31.34	0.00	1.00
River Mist Road		EX4	EX3	12			0.53	41	157	2.24	3.55	1.81		0.00	0.00		0.00	0.00		0.00	0.74		2.54	200	0.32	19.4	0.60	74.95	16.82	0.00	1.00
Clonfadda Terrace		EX111	EX110	13			0.62	44	44	0.62	3.66	0.52		0.00	0.00		0.00	0.00		0.00	0.20		0.73	200	1.04	34.8	1.07	76.25	34.10	0.00	1.00
Clonfadda Terrace		EX110	EX3	15			0.64	51	95	1.26	3.60	1.11		0.00	0.00		0.00	0.00		0.00	0.42		1.52	200	0.83	31.2	0.96	108.32	29.67	0.00	1.00
River Mist Road		EX3	EX2	3			0.32	10	262	3.82	3.48	2.96		0.00	0.00		0.00	0.00		0.00	1.26		4.22	200	0.35	20.2	0.62	100.22	16.00	0.00	1.00
River Mist Road		EX2	EX1		14		0.55	38	300	4.37	3.46	3.37		0.00	0.00		0.00	0.00		0.00	1.44		4.81	200	1.77	45.5	1.40	112.11	40.65	0.00	1.00
Alex Polowin Avenue		EX13	EX12	11			0.46	37	37	0.46	3.67	0.44		0.00	0.00		0.00	0.00		0.00	0.15		0.59	200	1.01	34.4	1.06	74.36	33.77	0.00	1.00
Alex Polowin Avenue		EX12	EX11	24			0.74	82	119	1.20	3.58	1.38		0.00	0.00		0.00	0.00		0.00	0.40		1.78	200	2.14	50.1	1.54	107.77	48.32	0.00	1.00
Alex Polowin Avenue		EX11	EX10	17			0.71	58	177	1.91	3.53	2.03		0.00	0.00		0.00	0.00		0.00	0.63		2.66	200	1.65	44.0	1.36	103.97	41.35	0.00	1.00
Kilbirnie Drive		EX10	EX20		14		0.57	38	386	5.01	3.42	4.28		0.00	0.00		2.43	1.18		0.00	2.46		7.92	200	0.32	19.3	0.60	118.98	11.42	0.33	1.50
Block 251 (School)		Stub	EX20				0.00	0	0	0.00	3.80	0.00		0.00	0.00	2.83	2.83	1.38		0.00	0.93		2.31	200	0.32	19.3	0.60	11.00	16.99	1.00	1.50
Kilbirnie Drive		EX20	EX1		15		0.54	41	427	5.55	3.41	4.71		0.00	0.00		5.26	2.56		0.00	3.57		10.84	200	0.32	19.4	0.60	106.01	8.52	0.49	1.50
River Mist Road		EX1	MH163				0.08	0	727	10.00	3.31	7.79		0.00	0.00		5.26	2.56		0.00	5.04		15.39	200	0.32	19.3	0.60	39.41	3.96	0.34	1.50
MH163 TO MH17A RIVERMIST ROAD OUTLETS VIA CAMBRIAN ROAD							10.00	727																							
River Mist Road	Stantec (2015)	MH163	EX162				0.08	0	727	10.08	3.31	7.79		0.00	0.00		5.26	2.56		0.00	5.06		15.41	250	0.85	57.2	1.13	36.30	41.78	0.34	1.50
River Mist Road	↓	EX162	EX161				0.20	0	727	10.28	3.31	7.79		0.00	0.00		5.26	2.56		0.00	5.13		15.48	250	1.15	66.5	1.31	44.40	51.05	0.34	1.50
River Mist Road	↓	EX161A	EX161				0.00	0	0	0.00	3.80	0.00		0.00	0.00		0.00	0.00	0.91	0.91	0.30		0.30	150	1.00	15.9	0.87	14.00	15.59	0.00	1.00
River Mist Road	↓	EX161	151				0.19	0	727	10.47	3.31	7.79		0.00	0.00		5.26	2.56		0.91	5.49		15.84	250	1.15	66.5	1.31	57.70	50.69	0.32	1.50
River Mist Road	↓	EX151A	151				0.00	0	0	0.00	3.80	0.00		0.00	0.00	2.77	2.77	1.35		0.00	0.91		2.26	150	1.00	15.9	0.87	12.70	13.63	1.00	1.50
River Mist Road	↓	151	EX151				0.09	0	727	10.56	3.31	7.79		0.00	0.00		8.03	3.90		0.91	6.44		18.13	300	1.40	119.4	1.64	17.90	101.23	0.41	1.50
River Mist Road	↓	EX151	MH142				0.00	0	727	10.56	3.31	7.79		0.00	0.00		8.03	3.90		0.91	6.44		18.13	300	1.40	119.4	1.64	44.40	101.23	0.41	1.50
Buffalograss Cres.	Stantec (2015)	EX159	EX158		24		0.56	65	65	0.56	3.63	0.77		0.00	0.00		0.00	0.00		0.00	0.18		0.95	200	0.40	21.6	0.67	95.50	20.69	0.00	1.00
Mattamy Lands East		900	EX158	31	51		3.10	243	243	3.10	3.49	2.75		0.00	0.00		0.00	0.00		0.00	1.02		3.77	200	0.35	20.2	0.62	280.00	16.46	0.00	1.00
Alex Polowin ave.		EX158	EX153	0	0		0.13	0	308	3.79	3.46	3.45		0.00	0.00		0.00	0.00		0.00	1.25		4.70	200	0.40	21.6	0.67	45.00	16.94	0.00	1.00
Mattamy Lands East		910	EX153		28		0.71	76	76	0.71	3.62	0.89		0.00	0.00		0.00	0.00		0.00	0.23		1.13	200	0.35	20.2	0.62	130.00	19.12	0.00	1.00
Alex Polowin ave.		EX153	EX152				0.12	0	384	4.62	3.42	4.26		0.00	0.00		0.00	0.00		0.00	1.52		5.79	200	0.80	30.6	0.94	70.00	24.82	0.00	1.00
Alex Polowin ave.		EX152	EX150				0.00	0	384	4.62	3.42	4.26		0.00	0.00		0.00	0.00		0.00	1.52		5.79	200	0.80	30.6	0.94	85.70	24.82	0.00	1.00
Rue Des Soldats Riendeau St.		EX165	EX150	17			0.67	58	58	0.67	3.64	0.68		0.00	0.00		0.00	0.00		0.00	0.22		0.91	200	1.50	41.9	1.29	101.20	41.00	0.00	1.00
Rue Des Soldats Riendeau St.	Stantec (2015)	EX150	EX146	6			0.30	20	462	5.59	3.39	5.08		0.00	0.00		0.00	0.00		0.00	1.84		6.93	200	0.80	30.6	0.94	72.00	23.68	0.00	1.00

BARRHAVEN SOUTH URBAN EXPANSION AREA (BSUEA)

CITY OF OTTAWA
MINTO COMMUNITIES INC.
JLR NO. 26610

BARRHAVEN SOUTH SANITARY SEWER DESIGN SHEET

Designed by: AT
Checked by:HM

			PROPOSED AND BSUEA DESIGN PARAMETERS		
Single Family	3.4	pers/unit	q =	280	L/cap/day
Semi-Detached/Townhouse (row)	2.7	pers/unit	I =	0.330	L/s/ha
Apt Units	1.8	pers/unit	Inst./Comm. =	28000	L/ha/day
Manning's Coeff. N =	0.013		Commerial PF*=	1.0/1.5	

*1.5 if ICI in contributing area is >20%, 1.0 if ICI in contributing area is <20%

Sources:	Half Moon Bay South Subdivision - Phase 4 - Excluding Arterials- Sanitary sewer design sheet prepared by Stantec (2015)
	Quinn's Pointe - Excluding Arterials-Sanitary sewer design sheet prepared by J.L Richards (2015)
	Barrhaven South Master Servicing Study Addendum - Sanitary sewer design sheet prepared Stantec (2014)

Legend
- Proposed
- Proposed by Others
- Existing

Date: February 2018

STREET	SOURCE	M.H. #		RESIDENTIAL									COMMERCIAL			INSTITUTIONAL			GREEN/UNUSED		PEAK EXTR.	PLUG	PEAK DES.	SEWER DATA					RESIDUAL		ICI*
				NUMBER OF UNITS			AREA	POPULATION	CUMULATIVE		PEAKING	POPUL.		CUMM.	INST.		CUMM.	INST.		CUMM.	FLOW	FLOW	FLOW						CAP.	ICI/	Peaking
		FROM	TO	SING.	MULT.	APT.	TOTAL ha	TOTAL peop.	POPUL. peop.	AREA ha	FACTOR	FLOW l/s	AREA ha	AREA ha	FLOW l/s	AREA ha	AREA ha	FLOW l/s	AREA ha	AREA ha	l/s	l/s	l/s	DIA. mm	SLOPE %	CAPAC. l/s	VEL. m/s	LENGTH m	l/s	TOTAL	Factor
Remora Way		EX147	EX146	20			0.94	68	68	0.94	3.63	0.80		0.00	0.00		0.00	0.00		0.00	0.31		1.11	200	1.00	34.2	1.06	78.20	33.11	0.00	1.00
Rue Des Soldats Riendeau St.		EX146	EX145	2			0.08	7	537	6.61	3.37	5.86		0.00	0.00		0.00	0.00		0.00	2.18		8.04	200	0.50	24.2	0.75	19.30	16.15	0.00	1.00
Rue Des Soldats Riendeau St.		EX145	EX144				0.07	0	537	6.68	3.37	5.86		0.00	0.00		0.00	0.00		0.00	2.20		8.06	200	0.50	24.2	0.75	35.90	16.13	0.00	1.00
Rue Des Soldats Riendeau St.		EX144	EX143	9			0.54	31	568	7.22	3.36	6.18		0.00	0.00		0.00	0.00		0.00	2.38		8.56	200	0.50	24.2	0.75	114.90	15.63	0.00	1.00
Rue Des Soldats Riendeau St.		EX143	MH142				0.00	0	568	7.22	3.36	6.18		0.00	0.00		0.00	0.00		0.00	2.38		8.56	200	0.40	21.6	0.67	21.50	13.08	0.00	1.00
River Mist Road		MH142	EX139	3			0.26	10	1305	18.04	3.18	13.44		0.00	0.00		8.03	3.90		0.91	8.90		26.25	300	0.40	63.8	0.87	74.80	37.56	0.30	1.50
		EX140	EX139	7			0.40	24	24	0.40	3.70	0.29		0.00	0.00		0.00	0.00		0.00	0.13		0.42	200	0.65	27.6	0.85	67.70	27.17	0.00	1.00
River Mist Road		EX139	EX136	10			0.47	34	1363	18.91	3.17	13.99		0.00	0.00		8.03	3.90		0.91	9.19		27.08	300	0.41	64.6	0.89	64.70	37.51	0.29	1.50
		EX137	EX136	15			0.84	51	51	0.84	3.65	0.60		0.00	0.00		0.00	0.00		0.00	0.28		0.88	200	0.65	27.6	0.85	67.80	26.71	0.00	1.00
River Mist Road		EX136	MH126	4			0.29	14	1428	20.04	3.16	14.60		0.00	0.00		8.03	3.90		0.91	9.56		28.07	300	0.41	64.6	0.89	78.90	36.52	0.28	1.50
Mattamy Lands East		920	930	36			1.83	122	122	1.83	3.58	1.41	2.13	2.13	1.04		0.00	0.00		0.00	1.31		3.76	200	0.35	20.2	0.62	165.00	15.50	0.54	1.50
Mattamy Lands East		930	EX217					0	122	1.83	3.58	1.41		2.13	1.04		0.00	0.00		0.00	1.31		3.76	200	0.36	20.5	0.63	40.00	15.50	0.54	1.50
Flameflower St.		EX217	EX215				0.05	0	122	1.88	3.58	1.41		2.13	1.04		0.00	0.00		0.00	1.32		3.77	200	2.00	48.4	1.49	34.50	44.62	0.53	1.50
Flameflower St.	Stantec (2015)	EX216	EX215		5		0.19	14	14	0.19	3.72	0.17		0.00	0.00		0.00	0.00		0.00	0.06		0.23	200	0.65	27.6	0.85	45.20	27.35	0.00	1.00
Flameflower St.		EX215	EX214		15		0.34	41	177	2.41	3.53	2.03		2.13	1.04		0.00	0.00		0.00	1.50		4.56	200	2.00	48.4	1.49	72.00	43.83	0.47	1.50
Flameflower St.		EX214	EX203		15		0.35	41	218	2.76	3.51	2.48		2.13	1.04		0.00	0.00		0.00	1.61		5.13	200	2.00	48.4	1.49	73.50	43.26	0.44	1.50
Devario Cres.		EX204	EX203				0.54	62	62	0.54	3.64	0.73		0.00	0.00		0.00	0.00	3.10	3.10	1.20		1.93	200	1.50	41.9	1.29	36.50	39.97	0.00	1.00
Devario Cres.		EX208	EX203				2.50	187	187	2.50	3.53	2.14		0.00	0.00		0.00	0.00		0.00	0.83		2.96	200	0.40	21.6	0.67	120.00	18.68	0.00	1.00
Flameflower St.		EX203	EX201				0.12	0	467	5.92	3.39	5.13		2.13	0.69		0.00	0.00		3.10	3.68		9.50	200	0.40	21.6	0.67	73.70	12.14	0.19	1.00
Dundonald Dr.		EX202	EX201	4			0.53	14	14	0.53	3.72	0.17		0.00	0.00		0.00	0.00		0.00	0.17		0.34	200	3.25	61.7	1.90	50.00	61.34	0.00	1.00
Dundonald Dr.		EX201	EX129A	3			0.21	10	491	6.66	3.38	5.38		2.13	0.69		0.00	0.00		3.10	3.92		10.00	200	0.40	21.6	0.67	47.80	11.64	0.18	1.00
Dundonald Dr.		EX129A	EX129	18			0.75	61	552	7.41	3.36	6.01		2.13	0.69		0.00	0.00		3.10	4.17		10.87	200	0.40	21.6	0.67	100.90	10.77	0.17	1.00
Dundonald Dr.		EX129	EX128	11			0.58	37	589	7.99	3.35	6.39		2.13	0.69		0.00	0.00		3.10	4.36		11.45	200	0.40	21.6	0.67	91.70	10.19	0.16	1.00
Lamprey St.		EX130	EX128				1.16	85	85	1.16	3.61	0.99		0.00	0.00		0.00	0.00	0.40	0.40	0.51		1.51	200	0.50	24.2	0.75	96.50	22.69	0.00	1.00
Dundonald Dr.		EX128	EX127	9			0.37	31	705	9.52	3.31	7.57		2.13	0.69		0.00	0.00		3.50	5.00		13.26	200	0.50	24.2	0.75	49.80	10.93	0.14	1.00
Dundonald Dr.		EX127	MH126	13			0.66	44	749	10.18	3.30	8.01		2.13	0.69		0.00	0.00		3.50	5.22		13.92	200	0.32	19.4	0.60	97.80	5.43	0.13	1.00
Dundonald Dr.		EX23	MH126				1.06	71	71	1.06	3.63	0.83		0.00	0.00		0.00	0.00		0.00	0.35		1.18	200	1.47	41.5	1.28	89.30	40.30	0.00	1.00
School		EX123A	EX123				0.00	0	0	0.00	3.80	0.00		0.00	0.00	2.06	2.06	1.00		0.00	0.68		1.68	250	0.89	58.5	1.16	15.80	56.85	1.00	1.50
River Mist. Dr.		MH126	EX123		5		0.29	14	2262	31.57	3.03	22.25		2.13	1.04		8.03	3.90		4.41	15.23		42.41	375	0.45	122.7	1.08	122.00	80.29	0.22	1.50
River Mist. Rd.		EX123	MH112		7		0.34	19	2281	31.91	3.03	22.42		2.13	1.04		10.09	4.90		4.41	16.02		44.38	375	0.42	118.5	1.04	90.30	74.16	0.25	1.50
White Arctic Ave.		EX111	MH112				3.39	378	378	3.39	3.43	4.20		0.00	0.00		0.00	0.00		0.00	1.12		5.32	200	0.32	19.4	0.60	74.80	14.04	0.00	1.00

BARRHAVEN SOUTH URBAN EXPANSION AREA (BSUEA)

CITY OF OTTAWA
MINTO COMMUNITIES INC.
JLR NO. 26610

BARRHAVEN SOUTH SANITARY SEWER DESIGN SHEET

Designed by: AT
Checked by:HM

			PROPOSED AND BSUEA DESIGN PARAMETERS		
Single Family	3.4	pers/unit	q =	280	L/cap/day
Semi-Detached/Townhouse (row)	2.7	pers/unit	I =	0.330	L/s/ha
Apt Units	1.8	pers/unit	Inst./Comm. =	28000	L/ha/day
Manning's Coeff. N =	0.013		Commerial PF*=	1.0/1.5	

*1.5 if ICI in contributing area is >20%, 1.0 if ICI in contributing area is <20%

Sources:
- Half Moon Bay South Subdivision - Phase 4 - Excluding Arterials- Sanitary sewer design sheet prepared by Stantec (2015)
- Quinn's Pointe - Excluding Arterials-Sanitary sewer design sheet prepared by J.L Richards (2015)
- Barrhaven South Master Servicing Study Addendum - Sanitary sewer design sheet prepared Stantec (2014)

Legend
- Proposed
- Proposed by Others
- Existing

Date: February 2018

STREET	SOURCE	M.H. # FROM	M.H. # TO	RESIDENTIAL NUMBER OF UNITS SING.	MULT.	APT.	AREA TOTAL ha	POPULATION TOTAL peop.	CUMULATIVE POPUL. peop.	CUMULATIVE AREA ha	PEAKING FACTOR	POPUL. FLOW l/s	COMMERCIAL AREA ha	CUMM. AREA ha	INST. FLOW l/s	INSTITUTIONAL AREA ha	CUMM. AREA ha	INST. FLOW l/s	GREEN/UNUSED AREA ha	CUMM. AREA ha	PEAK EXTR. FLOW l/s	PLUG FLOW l/s	PEAK DES. FLOW l/s	SEWER DATA DIA. mm	SLOPE %	CAPAC. l/s	VEL. m/s	LENGTH m	RESIDUAL CAP. l/s	ICI/ TOTAL	ICI* Peaking Factor
River Mist. Rd.		MH112	EX102				0.14	0	2659	35.44	2.99	25.76		2.13	1.04		10.09	4.90		4.41	17.18		48.88	375	0.31	101.8	0.89	68.00	52.96	0.23	1.50
Dutchmans Way		EX103	EX102	18			0.80	61	61	0.80	3.64	0.72		0.00	0.00		0.00	0.00		0.00	0.26		0.98	200	2.02	48.6	1.50	120.00	47.65	0.00	1.00
Song Sparrow St.		EX104	EX102				3.83	386	386	3.83	3.42	4.28		0.00	0.00		0.00	0.00		0.00	1.26		5.55	200	0.44	22.7	0.70	114.60	17.15	0.00	1.00
River Mist Road	Stantec (2015)	EX102	EX101				0.07	0	3106	40.14	2.94	29.63		2.13	1.04		10.09	4.90		4.41	18.73		54.30	375	0.29	98.5	0.86	34.00	44.20	0.22	1.50
	Stantec (2014)	EX101	MH43A				0.00	0	3106	40.14	2.94	29.63		2.13	1.04		10.09	4.90		4.41	18.73		54.30	375	0.30	100.2	0.88	38.00	45.88	0.22	1.50
		MH43A	MH44A				6.56	352	3458	46.70	2.91	32.63		2.13	0.69		10.09	3.27		4.41	20.90		57.49	375	0.30	100.2	0.88	81.00	42.70	0.19	1.00
		MH44A	MH45A				0.00	0	3458	46.70	2.91	32.63		2.13	0.69		10.09	3.27		4.41	20.90		57.49	375	0.30	100.2	0.88	64.00	42.70	0.19	1.00
		MH45A	MH46A				0.00	0	3458	46.70	2.91	32.63		2.13	0.69		10.09	3.27		4.41	20.90		57.49	375	0.30	100.2	0.88	85.00	42.70	0.19	1.00
		MH46A	MH47A				8.40	562	4020	55.10	2.87	37.33		2.13	0.69		10.09	3.27	1.60	6.01	24.20		65.49	375	0.30	100.2	0.88	41.00	34.70	0.17	1.00
		MH47A	MH101A				0.00	0	4020	55.10	2.87	37.33		2.13	0.69		10.09	3.27		6.01	24.20		65.49	375	0.30	100.2	0.88	64.00	34.70	0.17	1.00
		MH101A	MH102A				0.00	0	4020	55.10	2.87	37.33		2.13	0.69		10.09	3.27		6.01	24.20		65.49	375	0.30	100.2	0.88	64.00	34.70	0.17	1.00
River Mist Road	Stantec (2014)	MH102A	MH17A				5.24	420	4440	60.34	2.83	40.78		2.13	0.69		10.09	3.27		6.01	25.93		70.67	375	0.30	100.2	0.88	81.00	29.52	0.16	1.00
CAMBRIAN RD. FROM MH17A TO MH45A							60.34	4440																							
Cambrian Rd.	Stantec (2014)	MH17A	MH21A				26.01	1956	15813	189.42	2.76	141.19		6.83	2.21	2.96	33.20	10.76	5.10	28.63	75.72		229.88	750	0.13	419.5	0.92	204.30	189.62	0.16	1.00
Cambrian Rd.	Stantec (2014)	MH21A	MH45				7.04	408	16221	196.46	2.74	144.25		6.83	2.21		33.20	10.76	0.00	28.63	78.04		235.26	750	0.13	419.5	0.92	277.80	184.24	0.15	1.00
MINTO LANDS WITHIN BSUEA OUTLETS TO 120 (QUINN'S POINTE) EXISTING GREENBANK RD.							196.46																								
Future Collector		514	516	16	104		3.49	335	335	3.49	3.45	3.74		0.00	0.00	0.00	0.00	0.00		0.00	1.15		4.89	200	0.35	20.2	0.62	127.90	15.35	0.00	1.00
Future Collector		516	554	20	54		3.18	214	549	6.67	3.36	5.98		0.00	0.00	0.00	0.00	0.00		0.00	2.20		8.18	200	0.35	20.2	0.62	170.90	12.06	0.00	1.00
Future Collector																0.00															
Future Collector		500	502	25	70	115	7.16	481	481	7.16	3.39	5.28		0.00	0.00	0.00	0.00	0.00		0.00	2.36	0.10	7.74	200	0.35	20.2	0.62	174.00	11.41	0.00	1.00
Future Collector		502	551	8	44		1.55	146	627	8.71	3.34	6.78		0.00	0.00	0.00	0.00	0.00		0.00	2.87		9.76	200	0.88	32.1	0.99	171.30	20.22	0.00	1.00
East-West Collector		550	551	20			1.98	68	68	1.98	3.63	0.80		0.00	0.00	0.00	0.00	0.00		0.00	0.65		1.45	200	0.35	20.2	0.62	99.90	18.73	0.00	1.00
East-West Collector		551	552	22	0		1.49	75	770	12.18	3.30	8.23		0.00	0.00	0.00	0.00	0.00		0.00	4.02		12.34	200	0.35	20.2	0.62	175.00	7.90	0.00	1.00
East-West Collector		552	554	12	20		3.36	95	865	15.54	3.27	9.17		0.00	0.00	0.00	0.00	0.00		0.00	5.13		14.40	200	0.35	20.2	0.62	178.30	3.37	0.00	1.00
East-West Collector		554	556	11	34		1.81	129	1543	24.02	3.14	15.68		0.00	0.00	0.00	0.00	0.00		0.00	7.93		23.71	250	0.33	35.6	0.70	295.60	9.15	0.00	1.00
Future Collector		517	564	20	35		2.07	163	163	2.07	3.54	1.87		0.00	0.00	0.00	0.00	0.00		0.00	0.68		2.55	200	0.59	26.3	0.81	280.00	23.71	0.00	1.00
Alex Polowin Ave.		13	14	12	0		0.54	41	41	0.54	3.67	0.49		0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.49	200	0.67	28.0	0.86	74.56	27.53	0.00	1.00
Alex Polowin Ave.		14	90	13	0		0.65	44	85	1.19	3.61	0.99		0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.99	200	0.94	33.1	1.02	112.06	32.13	0.00	1.00
Alex Polowin Ave.		90	5	11	0		0.54	37	122	1.73	3.58	1.41		0.00	0.00	0.00	0.00	0.00		0.00	0.00		1.41	200	0.35	20.3	0.63	108.16	18.87	0.00	1.00
River Mist Road		5	563	0			0.00	0	122	1.73	3.58	1.41		0.00	0.00	0.00	0.00	0.00		0.00	0.00		1.41	200	0.42	22.2	0.68	80.00	20.76	0.00	1.00
River Mist Road		563	564	8			0.47	27	149	2.20	3.55	1.72		0.00	0.00	0.00	0.00	0.00		0.00	0.73		2.44	200	0.42	22.2	0.68	50.00	19.73	0.00	1.00
River Mist Road		564	556	7	9		0.64	48	360	4.91	3.43	4.01		0.00	0.00		0.00	0.00		0.00	1.62		5.63	200	0.35	20.2	0.62	95.00	14.62	0.00	1.00
East-West Collector		556	557						1903	28.93	3.08	19.01		0.00	0.00	2.20	2.20	0.71		0.00	10.27		30.09	300	1.39	118.9	1.63	44.30	84.53	0.07	1.00
East-West Collector		557	558	6			1.12	20	1923	30.05	3.08	19.19		0.00	0.00	2.86	5.06	1.64		0.00	11.59	4.00	36.42	300	1.39	118.9	1.63	158.40	80.38	0.14	1.00
Future Collector		560	558	50	0		3.09	170	170	3.09	3.54	1.95		0.00	0.00		0.00	0.00		0.00	1.02		2.97	200	0.35	20.2	0.62	150.00	17.27	0.00	1.00
East-West Collector		558	119				5.74	0	2093	38.88	3.06	20.73		0.00	0.00		5.06	1.64		0.00	14.50		40.97	450	0.13	107.2	0.65	150.00	63.75	0.12	1.00
Future Collector		521	522	24	33		2.17	171	171	2.17	3.54	1.96		0.00	0.00		0.00	0.00		0.00	0.72		2.68	200	1.26	38.4	1.18	230.00	35.74	0.00	1.00
		522	523						171	2.17				0.00	0.00		0.00	0.00		0.00											
		523	524		71		1.95	192	363	4.12				0.00	0.00		0.00	0.00		0.00										0.00	1.00
Future Collector		520	524	41			2.06	139	139	2.06	3.56	1.60		0.00	0.00		0.00	0.00		0.00	0.68		2.28	200	0.26	17.4	0.54	72.20	15.16	0.00	1.00
Future Collector		524	578		0		0.00	0	502	6.18	3.38	5.50		0.00	0.00		0.00	0.00		0.00	2.04		7.54	300	0.20	45.1	0.62	200.90	37.58	0.00	1.00
Future Collector		578	532		87		3.63	235	737	9.81	3.31	7.89		0.00	0.00		0.00	0.00		0.00	3.24		11.13	300	0.20	45.1	0.62	173.70	33.98	0.00	1.00
Future Collector		532	534	50	26		3.29	240	977	13.10	3.25	10.27		0.00	0.00		0.00	0.00		0.00	4.32		14.60	300	0.20	45.1	0.62	127.45	30.52	0.00	1.00
Future Collector		534	536	55			2.96	187	1164	16.06	3.21	12.09		0.00	0.00		0.00	0.00		0.00	5.30		17.39	450	0.20	133.0	0.81	173.27	115.63	0.00	1.00
Future Collector		536	538				0.00	0	1164	16.06	3.21	12.09		0.00	0.00	0.00	0.00	0.00		0.00	5.30		17.39	450	0.20	133.0	0.81	309.73	115.63	0.00	1.00
		538	119	0			0.00	0	1164	16.06	3.21	12.09		0.00	0.00		0.00	0.00		0.00	5.30		17.39	525	0.15	173.8	0.78	245.34	156.37	0.00	1.00
Greenbank Rd.		119	EX120					0	3257	54.94	2.93	30.92		0.00	0.00		5.06	1.64		0.00	19.80		56.46	600	0.15	248.1	0.85	168.66	187.53	0.08	1.00
QUINN'S POINTE OUTLETS TO MH205A EXISTING GREENBANK RD.							54.94	3257																							
Greenbank Road		EX120	EX121				0.22	0	3257	55.16	2.93	30.92		0.00	0.00	0.00	5.06	1.64		0.00	19.87		56.53	600	0.16	259.0	0.89	58.09	202.51	0.08	1.00
Greenbank Road		EX121	EX122				0.28	0	3640	61.99	2.90	34.16		0.00	0.00	0.00	6.63	2.15		0.00	22.64		63.05	600	0.33	369.2	1.27	75.27	306.17	0.10	1.00

BARRHAVEN SOUTH URBAN EXPANSION AREA (BSUEA)

CITY OF OTTAWA
MINTO COMMUNITIES INC.
JLR NO. 26610

BARRHAVEN SOUTH SANITARY SEWER DESIGN SHEET

Designed by: AT
Checked by:HM

PROPOSED AND BSUEA DESIGN PARAMETERS

Single Family	3.4	pers/unit	q =	280	L/cap/day
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Apt Units	1.8	pers/unit	Inst./Comm. =	28000	L/ha/day
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Legend
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Date: February 2018

STREET	SOURCE	M.H. # FROM	M.H. # TO	RESIDENTIAL: NUMBER OF UNITS SING.	MULT.	APT.	AREA TOTAL ha	POPULATION TOTAL peop.	CUMULATIVE POPUL. peop.	CUMULATIVE AREA ha	PEAKING FACTOR	POPUL. FLOW l/s	COMMERCIAL: AREA ha	CUMM. AREA ha	INST. FLOW l/s	INSTITUTIONAL: AREA ha	CUMM. AREA ha	INST. FLOW l/s	GREEN/UNUSED: AREA ha	CUMM. AREA ha	PEAK EXTR. FLOW l/s	PLUG FLOW l/s	PEAK DES. FLOW l/s	SEWER DATA: DIA. mm	SLOPE %	CAPAC. l/s	VEL. m/s	LENGTH m	RESIDUAL CAP. l/s	ICI/ TOTAL	ICI* Peaking Factor
Greenbank Road		EX122	EX123R				0.45	0	3640	62.44	2.90	34.16		0.00	0.00	0.00	6.63	2.15		0.00	22.79		63.20	600	0.21	291.1	1.00	121.02	227.90	0.10	1.00
Easement		EX44	EX123R				0.00	0	259	2.62	3.48	2.93		0.00	0.00	0.00	0.00	0.00		0.00	0.86		3.79	300	0.35	59.9	0.82	19.00	56.12	0.00	1.00
Greenbank Road		EX123R	MH205A				0.43	0	3899	65.49	2.87	36.32		0.00	0.00	0.00	6.63	2.15		0.00	23.80		66.37	600	0.25	319.2	1.09	120.80	252.85	0.09	1.00
Kilbirnie Drive	JLR (2016)	EX24	MH205A		3		0.11	8	224	2.15	3.50	2.54		0.00	0.00	0.00	0.00	0.00		0.00	0.71		3.25	200	0.71	28.8	0.89	28.70	25.59	0.00	1.00
Existing Greenbank Road		MH205A	EX98A					0	4123	67.64	2.86	38.18		0.00	0.00	0.00	6.63	2.15		0.00	24.51		73.94	600	0.25	320.3	1.10	126.00	246.34	0.09	1.00
EXISTING GREENBANK RD. FROM MH 98A TO MH45A							6.15	484																							
Existing Greenbank Road	IBI	EX98A	MH99A				0.00	0	4123	67.64	2.86	38.18		0.00	0.00		6.63	2.15		0.00	24.51		73.94	600	0.25	320.3		125.00	246.34	0.09	1.00
Existing Greenbank Road	IBI	MH99A	MH100A				0.00	0	4123	67.64	2.86	38.18		0.00	0.00		6.63	2.15		0.00	24.51		73.94	600	0.25	320.3		108.00	246.34	0.09	1.00
Existing Greenbank Road	IBI	MH100A	MH204A				0.00	0	4123	67.64	2.86	38.18		0.00	0.00		6.63	2.15		0.00	24.51		73.94	600	0.25	320.3		105.00	246.34	0.09	1.00
Existing Greenbank Road	IBI	MH204A	MH206A				0.00	0	4123	67.64	2.86	38.18		0.00	0.00		6.63	2.15		0.00	24.51		73.94	600	0.25	320.3		103.00	246.34	0.09	1.00
Existing Greenbank Road	IBI	MH206A	MH97A				0.00	0	4123	67.64	2.86	38.18		0.00	0.00		6.63	2.15		0.00	24.51		73.94	600	0.25	320.3		125.00	246.34	0.09	1.00
Existing Greenbank Road	IBI	MH97A	MH96A				19.95	1631	5754	87.59	2.75	51.29		0.00	0.00		6.63	2.15	0.81	0.81	31.36		93.90	600	0.30	350.8		98.00	256.95	0.07	1.00
Existing Greenbank Road	IBI	MH96A	MH95A				0.00	0	5754	87.59	2.75	51.29		0.00	0.00		6.63	2.15		0.81	31.36		93.90	600	0.30	350.8		129.00	256.95	0.07	1.00
Existing Greenbank Road	IBI	MH95A	MH201A				0.00	0	5754	87.59	2.75	51.29		0.00	0.00		6.63	2.15		0.81	31.36		93.90	600	0.30	350.8		123.00	256.95	0.07	1.00
Existing Greenbank Road	IBI	MH201A	MH201B				12.13	787	6541	99.72	2.71	57.40		0.00	0.00		6.63	2.15		0.81	35.36		104.01	600	0.30	350.8		124.00	246.83	0.06	1.00
Existing Greenbank Road	IBI	MH201B	MH200A				0.00	0	6541	99.72	2.71	57.40		0.00	0.00		6.63	2.15		0.81	35.36		104.01	600	0.30	350.8		68.00	246.83	0.06	1.00
Existing Greenbank Road	IBI	MH200A	MH200C				0.00	0	6541	99.72	2.71	57.40		0.00	0.00		6.63	2.15		0.81	35.36		104.01	600	0.50	452.9		48.00	348.93	0.06	1.00
Existing Greenbank Road	IBI	MH200C	MH45				0.00	0	6541	99.72	2.71	57.40		0.00	0.00		6.63	2.15		0.81	35.36		104.01	600	0.12	221.9		26.00	117.88	0.06	1.00
Existing Greenbank Road North	Stantec (2014)	MH45	MH435A				5.12	548	23310	301.30	2.27	171.38		6.83	2.21		39.83	12.91	0.00	29.44	124.54		320.14	900	0.10	597.2		296.00	277.08	0.12	1.00
	↓	MA9	MA8				22.23	2378	2378	22.23	3.02	23.28	0.00	0.00	0.00	2.45	2.45	0.79	9.54	9.54	11.29		35.37	450	0.11	98.4		507.50	63.03	0.07	1.00
	↓	MA8	MA7				2.88	308	2686	25.11	2.99	25.99	0.00	0.00	0.00	0.00	2.45	0.79	0.78	10.32	12.50		39.29	450	0.11	98.4		317.10	59.11	0.06	1.00
	↓	MA7	MA6				18.50	1979	4665	43.61	2.82	42.61	0.00	0.00	0.00	0.00	2.45	0.79	0.00	10.32	18.61		62.01	450	0.11	98.4		573.10	36.39	0.04	1.00
Realigned Greenbank Road	↓	MA6	MA5				21.68	2320	6985	65.29	2.69	60.80	0.00	0.00	0.00	0.00	2.45	0.79	0.00	10.32	25.76		87.36	525	0.10	140.5		473.90	53.14	0.03	1.00
Realigned Greenbank Road	↓	MA5	MA4				9.53	1020	8005	74.82	2.64	68.49	0.00	0.00	0.00	0.00	2.45	0.79	0.00	10.32	28.90		98.19	525	0.10	140.5		439.40	42.31	0.03	1.00
Realigned Greenbank Road	↓	MA4	MH521A				8.07	863	8868	82.89	2.61	74.87	0.00	0.00	0.00	0.00	2.45	0.79	2.42	12.74	32.37		108.03	525	0.10	140.5		530.70	32.47	0.02	1.00
	↓	MH521A	MH522A				3.80	231	9099	86.69	2.60	76.56	0.00	0.00	0.00	0.00	2.45	0.79	0.02	12.76	33.63		110.98	600	0.10	201.5		49.90	90.52	0.02	1.00
	↓	MH522A	MH435A				0.00	0	9099	86.69	2.60	76.56	0.00	0.00	0.00	0.00	2.45	0.79	0.00	12.76	33.63		110.98	600	0.10	201.5		11.10	90.52	0.02	1.00
		MH435A	MH501A				0.00	0	32409	387.99	2.16	226.39	0.00	6.83	2.21	0.00	42.28	13.70	0.00	42.20	158.17		409.57	900	0.10	597.0		13.30	187.43	0.10	1.00

Sanitary design calculation for the proposed HMB phase 8 site by DSEL (2020)

SANITARY SEWER CALCULATION SHEET

Ottawa

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION									COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	UNITS Singles	UNITS Townhouse	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
Drummond Future Road																													
	Plug	305A	0.89				67	0.89	67	3.63	0.79		0.00		0.00		0.00	0.00	0.89	0.89	0.29	1.08	8.0	200	0.35	19.40	0.06	0.62	0.33
To Expansion Road, Pipe 305A - 306A								0.89	67				0.00		0.00		0.00			0.89									
Future Residential																													
	Ctrl 3A	109A	1.90				162	1.90	162	3.54	1.86		0.00		0.00		0.00	0.00	1.90	1.90	0.63	2.49	11.0	200	0.35	19.40	0.13	0.62	0.42
To Obsidian Street, Pipe 109A - 400A								1.90	162				0.00		0.00		0.00			1.90									
Focality Crescent																													
	107A	108A	0.14	3		3	9	0.14	9	3.74	0.11		0.00		0.00		0.00	0.00	0.14	0.14	0.05	0.16	12.5	200	2.45	51.34	0.00	1.63	0.36
	108A	110A	0.17	5		5	14	0.31	23	3.70	0.28		0.00		0.00		0.00	0.00	0.17	0.31	0.10	0.38	50.5	200	0.35	19.40	0.02	0.62	0.24
To Haiku Street, Pipe 110A - 1100A								0.31	23				0.00		0.00		0.00			0.31									
	107A	112A	0.45	18		18	49	0.45	49	3.65	0.58		0.00		0.00		0.00	0.00	0.45	0.45	0.15	0.73	73.5	200	0.70	27.44	0.03	0.87	0.37
	112A	113A	0.43	16		16	44	0.88	93	3.60	1.09		0.00		0.00		0.00	0.00	0.43	0.88	0.29	1.38	70.5	200	0.35	19.40	0.07	0.62	0.36
	113A	114A	0.12	3		3	9	1.00	102	3.59	1.19		0.00		0.00		0.00	0.00	0.12	1.00	0.33	1.52	12.5	200	0.35	19.40	0.08	0.62	0.36
	114A	115A	0.18	5		5	14	1.18	116	3.58	1.35		0.00		0.00		0.00	0.00	0.18	1.18	0.39	1.74	50.5	200	0.40	20.74	0.08	0.66	0.40
To Haiku Street, Pipe 115A - 111A								1.18	116				0.00		0.00		0.00			1.18									
Sturnidae Street																													
	124A	125A	0.60	18	18		62	0.60	62	3.64	0.73		0.00		0.00		0.00	0.00	0.60	0.60	0.20	0.93	101.0	200	0.65	26.44	0.04	0.84	0.39
	125A	126A	0.50	12	12		41	1.10	103	3.59	1.20		0.00		0.00		0.00	0.00	0.50	1.10	0.36	1.56	91.0	200	0.35	19.40	0.08	0.62	0.37
Contribution From Montology Way, Pipe 123A - 126A								0.81	63				0.00		0.00		0.00		0.81	1.91									
	126A	106A						1.91	166	3.54	1.91		0.00		0.00		0.00	0.00	0.00	1.91	0.63	2.54	63.0	200	0.35	19.40	0.13	0.62	0.42
To Elevation Road, Pipe 106A - 116A								1.91	166				0.00		0.00		0.00			1.91									
Park																													
	Ctrl 4A	104A						0.00					0.00		0.00	1.72	1.72	0.19	1.72	1.72	0.57	0.75	10.5	200	0.35	19.40	0.04	0.62	0.29
To Chillerton Drive, Pipe 104A - 106A								0.00	0				0.00		0.00		1.72			1.72									
Canadensis Lane																													
	229A	230A	0.42	15		15	41	0.42	41	3.67	0.49		0.00		0.00		0.00	0.00	0.42	0.42	0.14	0.63	73.5	200	2.00	46.38	0.01	1.48	0.51
	230A	103A	0.48	18		18	49	0.90	90	3.60	1.05		0.00		0.00		0.00	0.00	0.48	0.90	0.30	1.35	90.0	200	3.00	56.81	0.02	1.81	0.75
To Chillerton Drive, Pipe 103A - 104A								0.90	90				0.00		0.00		0.00			0.90									
Surface Lane																													
	227A	228A	0.47	18		18	49	0.47	49	3.65	0.58		0.00		0.00		0.00	0.00	0.47	0.47	0.16	0.74	72.5	200	2.00	46.38	0.02	1.48	0.53
	228A	102A	0.48	18		18	49	0.95	98	3.60	1.14		0.00		0.00		0.00	0.00	0.48	0.95	0.31	1.46	90.0	200	0.85	30.24	0.05	0.96	0.49
To Chillerton Drive, Pipe 102A - 103A								0.95	98				0.00		0.00		0.00			0.95									
Chillerton Drive																													
	101A	102A	0.14	3		3	9	0.14	9	3.74	0.11		0.00		0.00		0.00	0.00	0.14	0.14	0.05	0.16	25.5	200	2.60	52.89	0.00	1.68	0.34
Contribution From Surface Lane, Pipe 228A - 102A								0.95	98				0.00		0.00		0.00		0.95	1.09									
	102A	103A	0.22	7		7	19	1.31	126	3.57	1.46		0.00		0.00		0.00	0.00	0.22	1.31	0.43	1.89	59.0	200	1.70	42.76	0.04	1.36	0.67
Contribution From Canadensis Lane, Pipe 230A - 103A								0.90	90				0.00		0.00		0.00		0.90	2.21									
	103A	104A	0.46	14		14	38	2.67	254	3.49	2.87		0.00		0.00		0.00	0.00	0.46	2.67	0.88	3.75	120.0	200	0.50	23.19	0.16	0.74	0.54
Contribution From Park, Pipe 4A - 104A								0.00	0				0.00		0.00		1.72		1.72	4.39									
	104A	106A	0.08	1		1	3	2.75	257	3.49	2.90		0.00		0.00		1.72	0.19	0.08	4.47	1.48	4.56	45.5	200	0.35	19.40	0.24	0.62	0.50
To Elevation Road, Pipe 106A - 116A								2.75	257				0.00		0.00		1.72			4.47									

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha					
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph				
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow =		0.330	L/s/ha	
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity =		0.600	m/s	
Max Res. Peak Factor =	3.80				Manning's n =	(Conc)	0.013	(Pvc)	0.013
Commercial/Inst./Park Peak Factor =	1.00				Townhouse coeff=		2.7		
Institutional =	0.32	l/s/Ha			Single house coeff=		3.4		

Designed: SLM	PROJECT: Ciavan Communities - Brazeau Phase 1		
Checked: ADF	LOCATION: City of Ottawa		
Dwg. Reference: Sanitary Drainage Plan, Dwgs. No. 80-83	File Ref: 18-1030	Date: 27 Jul 2020	Sheet No. 1 of 6

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION: STREET		FROM M.H.	TO M.H.	RESIDENTIAL AREA AND POPULATION: AREA (ha)	UNITS	UNITS Singles	UNITS Townhouse	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	COMM: AREA (ha)	COMM: ACCU. AREA (ha)	INSTIT: AREA (ha)	INSTIT: ACCU. AREA (ha)	PARK: AREA (ha)	PARK: ACCU. AREA (ha)	C+I+I: PEAK FLOW (l/s)	INFILTRATION: TOTAL AREA (ha)	INFILTRATION: ACCU. AREA (ha)	INFILTRATION: INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	PIPE: DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
Epoch Street																														
		220A	221A	0.42	10		10	27	0.42	27	3.69	0.32		0.00		0.00		0.00	0.00	0.42	0.42	0.14	0.46	77.5	200	0.95	31.97	0.01	1.02	0.35
		221A	222A	0.49	18		18	49	0.91	76	3.62	0.89		0.00		0.00		0.00	0.00	0.49	0.91	0.30	1.19	93.0	200	0.35	19.40	0.06	0.62	0.34
		222A	223A	0.52	20		20	54	1.43	130	3.57	1.50		0.00		0.00		0.00	0.00	0.52	1.43	0.47	1.98	100.5	200	0.35	19.40	0.10	0.62	0.40
To Elevation Road, Pipe 223A - 105A									1.43	130				0.00		0.00		0.00			1.43									
Eminence Street																														
		215A	216A	0.49	12	12		41	0.49	41	3.67	0.49		0.00		0.00		0.00	0.00	0.49	0.49	0.16	0.65	75.5	200	0.85	30.24	0.02	0.96	0.39
		216A	217A	0.72	17	17		58	1.21	99	3.60	1.15		0.00		0.00		0.00	0.00	0.72	1.21	0.40	1.55	113.5	200	0.35	19.40	0.08	0.62	0.37
		217A	219A	0.45	12	12		41	1.66	140	3.56	1.62		0.00		0.00		0.00	0.00	0.45	1.66	0.55	2.16	83.5	200	0.35	19.40	0.11	0.62	0.41
To Elevation Road, Pipe 219A - 223A									1.66	140				0.00		0.00		0.00			1.66									
Elevation Road																														
		218A	219A	0.13	2	2		7	0.13	7	3.74	0.08		0.00		0.00		0.00	0.00	0.13	0.13	0.04	0.13	24.0	200	2.65	53.39	0.00	1.70	0.35
Contribution From Eminence Street, Pipe 217A - 219A									1.66	140				0.00		0.00		0.00		1.66	1.79									
		219A	223A	0.23	4	4		14	2.02	161	3.54	1.85		0.00		0.00		0.00	0.00	0.23	2.02	0.67	2.52	59.0	200	0.85	30.24	0.08	0.96	0.58
Contribution From Epoch Street, Pipe 222A - 223A									1.43	130				0.00		0.00		0.00		1.43	3.45									
		223A	105A	0.42	6	6		21	3.87	312	3.46	3.50		0.00		0.00		0.00	0.00	0.42	3.87	1.28	4.77	82.5	200	0.70	27.44	0.17	0.87	0.65
		105A	106A	0.42	7	7		24	4.29	336	3.45	3.75		0.00		0.00		0.00	0.00	0.42	4.29	1.42	5.17	94.0	200	1.30	37.40	0.14	1.19	0.83
Contribution From Chillerton Drive, Pipe 104A - 106A									2.75	257				0.00		0.00		1.72		4.47	8.76									
Contribution From Sturnidae Street, Pipe 126A - 106A									1.91	166				0.00		0.00		0.00		1.91	10.67									
				0.35	11		11	30	9.30	789				0.00		0.00		1.72		0.35	11.02									
		106A	116A	0.35	8	8		28	9.65	817	3.28	8.69		0.00		0.00		1.72	0.19	0.35	11.37	3.75	12.63	118.0	200	0.35	19.40	0.65	0.62	0.66
To Haiku Street, Pipe 116A - 1160A									9.65	817				0.00		0.00		1.72			11.37									
				1.57				118	1.57	118				0.00		0.00		0.00		1.57	1.57									
		309A	310A	5.67				595	7.24	713	3.31	7.65		0.00		0.00		0.00	0.00	5.67	7.24	2.39	10.04	15.0	250	0.25	29.73	0.34	0.61	0.55
To Expansion Road, Pipe 310A - 1311A									7.24	713				0.00		0.00		0.00			7.24									
Drummond Future Road																														
		301A	302A	1.27				95	1.27	95	3.60	1.11		0.00		0.00		0.00	0.00	1.27	1.27	0.42	1.53	94.5	200	0.35	19.40	0.08	0.62	0.36
To Expansion Road, Pipe 302A - 1180A									1.27	95				0.00		0.00		0.00			1.27									
Drummond Future Road																														
				0.22				23	0.22	23				0.00		0.00	1.45	1.45		1.67	1.67									
		1303A	3031A	0.61				46	0.83	69	3.63	0.81		0.00		0.00		1.45	0.16	0.61	2.28	0.75	1.72	108.0	200	0.35	19.40	0.09	0.62	0.38
To Expansion Road, Pipe 3031A - 302A									0.83	69				0.00		0.00		1.45			2.28									
Expansion Road																														
				0.16				17	0.16	17				0.00		0.00		0.00		0.16	0.16									
		303A	3031A	0.19				14	0.35	31	3.68	0.37		0.00		0.00		0.00	0.00	0.19	0.35	0.12	0.49	65.0	200	0.65	26.44	0.02	0.84	0.32
Contribution From Drummond Future Road, Pipe 1303A - 3031A									0.83	69				0.00		0.00		1.45		2.28	2.63									
		3031A	302A	0.22				17	1.40	117	3.58	1.36		0.00		0.00		1.45	0.16	0.22	2.85	0.94	2.45	59.0	200	0.35	19.40	0.13	0.62	0.42
Contribution From Expansion Road, Pipe 301A - 302A									1.27	95				0.00		0.00		0.00		1.27	4.12									
		302A	1180A	0.20				15	2.87	227	3.50	2.58		0.00		0.00		1.45	0.16	0.20	4.32	1.43	4.16	49.5	200	0.35	19.40	0.21	0.62	0.49
		1180A	118A						2.87	227	3.50	2.58		0.00		0.00		1.45	0.16	0.00	4.32	1.43	4.16	11.0	200	0.35	19.40	0.21	0.62	0.49
To Haiku Street, Pipe 118A - 117A									2.87	227				0.00		0.00		1.45			4.32									

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha
Average Daily Flow =	280	l/p/day		
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha
Max Res. Peak Factor =	3.80			
Commercial/Inst./Park Peak Factor =	1.00			
Institutional =	0.32	l/s/Ha		

Industrial Peak Factor = as per MOE Graph

Extraneous Flow =		0.330	L/s/ha	
Minimum Velocity =		0.600	m/s	
Manning's n =	(Conc)	0.013	(Pvc)	0.013
Townhouse coeff=		2.7		
Single house coeff=		3.4		

Designed: SLM	PROJECT: Ciavan Communities - Brazeau Phase 1
Checked: ADF	LOCATION: City of Ottawa
Dwg. Reference: Sanitary Drainage Plan, Dwgs. No. 80-83	File Ref: 18-1030
Date: 27 Jul 2020	Sheet No. 2 of 6

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

STREET	FROM M.H.	TO M.H.	RESIDENTIAL AREA (ha)	UNITS	UNITS Singles	UNITS Townhouse	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	COMM AREA (ha)	COMM ACCU. AREA (ha)	INSTIT AREA (ha)	INSTIT ACCU. AREA (ha)	PARK AREA (ha)	PARK ACCU. AREA (ha)	C+I+I PEAK FLOW (l/s)	INFILTRATION TOTAL AREA (ha)	INFILTRATION ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	PIPE DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
			0.19				20	0.19	20				0.00		0.00		0.00		0.19	0.19									
	303A	305A	0.21				16	0.40	36	3.67	0.43		0.00		0.00		0.00	0.00	0.21	0.40	0.13	0.56	69.5	200	2.45	51.34	0.01	1.63	0.52
Contribution From Drummond Future Road, Pipe 1305A - 305A								0.89	67				0.00		0.00		0.00		0.89	1.29									
			0.13				14	1.42	117				0.00		0.00		0.00		0.13	1.42									
	305A	306A	0.16				12	1.58	129	3.57	1.49		0.00		0.00		0.00	0.00	0.16	1.58	0.52	2.01	53.5	200	0.35	19.40	0.10	0.62	0.40
	306A	307A	0.13				10	1.71	139	3.56	1.60		0.00		0.00		0.00	0.00	0.13	1.71	0.56	2.17	10.5	200	0.35	19.40	0.11	0.62	0.41
	307A	308A	0.41				31	2.12	170	3.54	1.95		0.00		0.00		0.00	0.00	0.41	2.12	0.70	2.65	78.0	200	0.35	19.40	0.14	0.62	0.43
	308A	3033A	0.39				29	2.51	199	3.52	2.27		0.00		0.00		0.00	0.00	0.39	2.51	0.83	3.10	67.0	200	0.35	19.40	0.16	0.62	0.45
	3033A	310A	0.31				23	2.82	222	3.50	2.52		0.00		0.00		0.00	0.00	0.31	2.82	0.93	3.45	62.0	200	0.40	20.74	0.17	0.66	0.49
Contribution From Drummond Future Road, Pipe 309A - 310A								7.24	713.00				0.00		0.00		0.00		0.00	7.24									
			0.07				5	10.13	940				0.00		0.00		0.00		0.07	10.13									
	310A	1311A	1.22				128	11.35	1068	3.23	11.16		0.00		0.00		0.00	0.00	1.22	11.35	3.75	14.91	111.5	250	0.25	29.73	0.50	0.61	0.61
	1311A	1312A						11.35	1068	3.23	11.16		0.00		0.00		0.00	0.00	0.00	11.35	3.75	14.91	111.0	250	0.25	29.73	0.50	0.61	0.61
	1312A	1313A	4.04				424	15.39	1492	3.14	15.21		0.00		0.00		0.00	0.00	4.04	15.39	5.08	20.29	108.5	250	0.25	29.73	0.68	0.61	0.65
	1313A	405A						15.39	1492	3.14	15.21		0.00		0.00		0.00	0.00	0.00	15.39	5.08	20.29	89.0	250	0.25	29.73	0.68	0.61	0.65
To Future Greenbank Road, Pipe 405A - 406A								15.39	1492				0.00		0.00		0.00			15.39									
Drummond Commercial																													
	1321A	3211A						0.00				7.40	7.40		0.00		0.00	2.40	7.40	7.40	2.44	4.84	11.0	200	0.50	23.19	0.21	0.74	0.58
To Haiku Street, Pipe 3211A - 133A								0.00	0				7.40		0.00		0.00			7.40									
Brazeau Commercial																													
	Ctrl 1A	132A						0.00				13.83	13.83		0.00		0.00	4.48	13.83	13.83	4.56	9.05	15.5	200	0.35	19.40	0.47	0.62	0.60
To Haiku Street, Pipe 132A - 3211A								0.00	0				13.83		0.00		0.00			13.83									
Haiku Street																													
Contribution From Brazeau Commercial, Pipe 1A - 132A								0.00	0				13.83		0.00		0.00		13.83	13.83									
	132A	3211A	0.69				0	0.69	0				13.83		0.00		0.00	4.48	0.69	14.52	4.79	9.27	63.5	200	0.35	19.40	0.48	0.62	0.61
Contribution From Drummond Commercial, Pipe 1321A - 3211A								0.00	0				7.40		0.00		0.00		7.40	21.92									
	3211A	133A						0.69	0				21.23		0.00		0.00	6.88	0.00	21.92	7.23	14.11	9.5	200	0.35	19.40	0.73	0.62	0.67
	133A	134A	0.16				0	0.85	0				21.23		0.00		0.00	6.88	0.16	22.08	7.29	14.17	61.5	200	0.35	19.40	0.73	0.62	0.67
	134A	135A	0.06				0	0.91	0				21.23		0.00		0.00	6.88	0.06	22.14	7.31	14.19	39.5	200	0.35	19.40	0.73	0.62	0.67
To Haiku Street, Pipe 135A - 118A								0.91	0				21.23		0.00		0.00			22.14									
Montology Way																													
	1260A	127A	0.24	3	3		11	0.24	11	3.73	0.13		0.00		0.00		0.00	0.00	0.24	0.24	0.08	0.21	37.5	200	0.65	26.44	0.01	0.84	0.24
	127A	128A	0.13	2	2		7	0.37	18	3.71	0.22		0.00		0.00		0.00	0.00	0.13	0.37	0.12	0.34	12.5	200	0.35	19.40	0.02	0.62	0.23
	128A	129A	0.48	12	12		41	0.85	59	3.64	0.70		0.00		0.00		0.00	0.00	0.48	0.85	0.28	0.98	76.5	200	0.35	19.40	0.05	0.62	0.32
	129A	130A	0.60	17	17		58	1.45	117	3.58	1.36		0.00		0.00		0.00	0.00	0.60	1.45	0.48	1.84	102.0	200	0.35	19.40	0.09	0.62	0.39
	130A	131A						1.45	117	3.58	1.36		0.00		0.00		0.00	0.00	0.00	1.45	0.48	1.84	7.5	200	0.35	19.40	0.09	0.62	0.39
To Montology Way, Pipe 131A - 135A								1.45	117				0.00		0.00		0.00			1.45									
Rugosa Street																													
	211A	204A	0.49	12	12		41	0.49	41	3.67	0.49		0.00		0.00		0.00	0.00	0.49	0.49	0.16	0.65	89.0	200	0.80	29.34	0.02	0.93	0.37
	204A	205A	0.74	19	19		65	1.23	106	3.59	1.23		0.00		0.00		0.00	0.00	0.74	1.23	0.41	1.64	120.0	200	0.35	19.40	0.08	0.62	0.37
	205A	206A						1.23	106	3.59	1.23		0.00		0.00		0.00	0.00	0.00	1.23	0.41	1.64	13.5	200	0.35	19.40	0.08	0.62	0.37
To Appalachian Circle, Pipe 206A - 207A								1.23	106				0.00		0.00		0.00			1.23									

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha	
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow = 0.330 L/s/ha
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity = 0.600 m/s
Max Res. Peak Factor =	3.80				Manning's n = (Conc) 0.013 (Pvc) 0.013
Commercial/Inst./Park Peak Factor =	1.00				Townhouse coeff= 2.7
Institutional =	0.32	l/s/Ha			Single house coeff= 3.4

Designed: SLM	PROJECT: Ciavan Communities - Brazeau Phase 1			
Checked: ADF	LOCATION: City of Ottawa			
Dwg. Reference: Sanitary Drainage Plan, Dwgs. No. 80-83	File Ref: 18-1030	Date: 27 Jul 2020	Sheet No.	3 of 6

1030_SAN_slm.xlsx

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION									COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	UNITS Singles	UNITS Townhouse	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
Appalachian Circle																													
	209A	210A	0.08	1	1		4	0.08	4	3.76	0.05		0.00		0.00		0.00	0.00	0.08	0.08	0.03	0.08	12.5	200	2.95	56.33	0.00	1.79	0.29
	210A	211A	0.20	4	4		14	0.28	18	3.71	0.22		0.00		0.00		0.00	0.00	0.20	0.28	0.09	0.31	50.5	200	3.80	63.94	0.00	2.04	0.52
	211A	212A	0.19	4	4		14	0.47	32	3.68	0.38		0.00		0.00		0.00	0.00	0.19	0.47	0.16	0.54	50.0	200	0.45	22.00	0.02	0.70	0.29
	212A	213A	0.09	1	1		4	0.56	36	3.67	0.43		0.00		0.00		0.00	0.00	0.09	0.56	0.18	0.61	12.5	200	1.55	40.83	0.02	1.30	0.47
	213A	214A	0.53	14	14		48	1.09	84	3.61	0.98		0.00		0.00		0.00	0.00	0.53	1.09	0.36	1.34	86.5	200	2.35	50.28	0.03	1.60	0.68
To Foundation Lane, Pipe 214A - 119A								1.09	84				0.00		0.00		0.00			1.09									
	209A	201A	0.58	18	18		62	0.58	62	3.64	0.73		0.00		0.00		0.00	0.00	0.58	0.58	0.19	0.92	93.5	200	0.65	26.44	0.03	0.84	0.39
	201A	202A	0.69	22	22		75	1.27	137	3.56	1.58		0.00		0.00		0.00	0.00	0.69	1.27	0.42	2.00	116.5	200	0.95	31.97	0.06	1.02	0.56
	202A	203A	0.18	3	3		11	1.45	148	3.55	1.70		0.00		0.00		0.00	0.00	0.18	1.45	0.48	2.18	13.5	200	0.80	29.34	0.07	0.93	0.54
	203A	206A	0.17	4	4		14	1.62	162	3.54	1.86		0.00		0.00		0.00	0.00	0.17	1.62	0.53	2.40	50.5	200	1.10	34.40	0.07	1.09	0.62
Contribution From Rugosa Street, Pipe 205A - 206A								1.23	106				0.00		0.00		0.00		1.23	2.85									
	206A	207A	0.20	5	5		17	3.05	285	3.47	3.21		0.00		0.00		0.00	0.00	0.20	3.05	1.01	4.21	50.5	200	0.35	19.40	0.22	0.62	0.49
	207A	208A	0.12	2	2		7	3.17	292	3.47	3.28		0.00		0.00		0.00	0.00	0.12	3.17	1.05	4.33	12.0	200	0.35	19.40	0.22	0.62	0.50
	208A	214A	0.65	18	18		62	3.82	354	3.44	3.94		0.00		0.00		0.00	0.00	0.65	3.82	1.26	5.20	112.5	200	1.90	45.21	0.12	1.44	0.95
To Unknown Road1 - 07, Pipe 214A - 119A								3.82	354				0.00		0.00		0.00			3.82									
Foundation Lane																													
Contribution From Appalachian Circle, Pipe 208A - 214A								3.82	354				0.00		0.00		0.00		3.82	3.82									
Contribution From Appalachian Circle, Pipe 213A - 214A								1.09	84				0.00		0.00		0.00		1.09	4.91									
	214A	119A	0.08				0	4.99	438	3.40	4.83		0.00		0.00		0.00	0.00	0.08	4.99	1.65	6.48	59.0	200	0.35	19.40	0.33	0.62	0.55
To Montology Way, Pipe 119A - 120A								4.99	438				0.00		0.00		0.00			4.99									
Travertine Way																													
	119A	122A	0.52	13	13		45	0.52	45	3.66	0.53		0.00		0.00		0.00	0.00	0.52	0.52	0.17	0.71	86.5	200	0.65	26.44	0.03	0.84	0.36
	122A	123A	0.09	1	1		4	0.61	49	3.65	0.58		0.00		0.00		0.00	0.00	0.09	0.61	0.20	0.78	12.5	200	1.50	40.17	0.02	1.28	0.50
	123A	126A	0.20	4	4		14	0.81	63	3.63	0.74		0.00		0.00		0.00	0.00	0.20	0.81	0.27	1.01	50.0	200	3.20	58.67	0.02	1.87	0.70
To Sturnidae Street, Pipe 126A - 106A								0.81	63				0.00		0.00		0.00			0.81									
Contribution From Foundation Lane, Pipe 214A - 119A								4.99	438				0.00		0.00		0.00		4.99	4.99									
	119A	120A	0.60	17	17		58	5.59	496	3.38	5.43		0.00		0.00		0.00	0.00	0.60	5.59	1.84	7.28	103.5	200	0.35	19.40	0.38	0.62	0.57
	120A	121A	0.14	2	2		7	5.73	503	3.38	5.51		0.00		0.00		0.00	0.00	0.14	5.73	1.89	7.40	13.5	200	0.35	19.40	0.38	0.62	0.57
	121A	131A	0.43	10	10		34	6.16	537	3.37	5.86		0.00		0.00		0.00	0.00	0.43	6.16	2.03	7.89	110.0	200	0.90	31.12	0.25	0.99	0.82
Contribution From Montology Way, Pipe 130A - 131A								1.45	117				0.00		0.00		0.00		1.45	7.61									
	131A	135A	0.19	4	4		14	7.80	668	3.32	7.20		0.00		0.00		0.00	0.00	0.19	7.80	2.57	9.77	58.5	200	0.35	19.40	0.50	0.62	0.62
To Haiku Street, Pipe 135A - 118A								7.80	668				0.00		0.00		0.00			7.80									
Haiku Street																													
Contribution From Montology Way, Pipe 131A - 135A								7.80	668				0.00		0.00		0.00		7.80	7.80									
Contribution From Haiku Street, Pipe 134A - 135A								0.91	0				21.23		0.00		0.00		22.14	29.94									
	135A	118A						8.71	668	3.32	7.20		21.23		0.00		0.00	6.88	0.00	29.94	9.88	23.96	6.5	250	0.25	29.73	0.81	0.61	0.67
Contribution From Expansion Road, Pipe 1180A - 118A								2.87	227				0.00		0.00		1.45		4.32	34.26									
	118A	117A						11.58	895	3.26	9.47		21.23		0.00		1.45	7.04	0.00	29.94	9.88	26.38	119.0	300	0.20	43.25	0.61	0.61	0.64
Contribution From Haiku Street - Local Sewer, Pipe 118A - 117A								0.70	65				0.00		0.00		0.00			0.70									
	117A	116A						12.28	960	3.25	10.11		21.23		0.00		1.45	7.04	0.00	30.64	10.11	27.26	125.5	375	0.15	67.91	0.40	0.61	0.58
Contribution From Elevation Road, Pipe 106A - 116A								9.65	817				0.00		0.00		1.72		11.37	42.01									
	116A	1160A						21.93	1777	3.10	17.85		21.23		0.00		3.17	7.22	0.00	42.01	13.86	38.94	17.0	375	0.15	67.91	0.57	0.61	0.63
To Haiku Street, Pipe 1160A - 1150A								21.93	1777				21.23		0.00		3.17			42.01									

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha					
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph				
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow =		0.330	L/s/ha	
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity =		0.600	m/s	
Max Res. Peak Factor =	3.80				Manning's n =	(Conc)	0.013	(Pvc)	0.013
Commercial/Inst./Park Peak Factor =	1.00				Townhouse coeff=		2.7		
Institutional =	0.32	l/s/Ha			Single house coeff=		3.4		

Designed: SLM

Checked: ADF

Dwg. Reference: Sanitary Drainage Plan, Dwgs. No. 80-83

PROJECT: **Ciavan Communities - Brazeau Phase 1**

LOCATION: **City of Ottawa**

File Ref: 18-1030

Date: **27 Jul 2020**

Sheet No. 4 of 6

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION									COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	UNITS Singles	UNITS Townhouse	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
Haiku Street - Local Sewer																													
	109A	1100A	0.20	6		6	17	0.20	17	3.71	0.20		0.00		0.00		0.00	0.00	0.20	0.20	0.07	0.27	55.5	200	1.00	32.80	0.01	1.04	0.30
To Haiku Street, Pipe 1100A - 109A								0.20	17				0.00		0.00		0.00			0.20									
	1150A	1160A	0.24	6		6	17	0.24	17	3.71	0.20		0.00		0.00		0.00	0.00	0.24	0.24	0.08	0.28	41.5	200	0.65	26.44	0.01	0.84	0.27
To Haiku Street, Pipe 1160A - 115A								0.24	17				0.00		0.00		0.00			0.24									
	110A	111A	0.41	16		16	44	0.41	44	3.66	0.52		0.00		0.00		0.00	0.00	0.41	0.41	0.14	0.66	74.5	200	0.65	26.44	0.02	0.84	0.35
To Haiku Street, Pipe 111A - 110A								0.41	44				0.00		0.00		0.00			0.41									
	111A	115A	0.49	19		19	52	0.49	52	3.65	0.61		0.00		0.00		0.00	0.00	0.49	0.49	0.16	0.78	87.5	200	0.65	26.44	0.03	0.84	0.37
To Haiku Street, Pipe 115A - 111A								0.49	52				0.00		0.00		0.00			0.49									
	118A	117A	0.70	19	19		65	0.70	65	3.63	0.77		0.00		0.00		0.00	0.00	0.70	0.70	0.23	1.00	119.0	200	0.65	26.44	0.04	0.84	0.40
To Haiku Street, Pipe 117A - 116A								0.70	65				0.00		0.00		0.00			0.70									
	117A	116A	0.67	15	15		51	0.67	51	3.65	0.60		0.00		0.00		0.00	0.00	0.67	0.67	0.22	0.82	125.5	200	0.65	26.44	0.03	0.84	0.38
To Haiku Street, Pipe 116A - 1160A								0.67	51				0.00		0.00		0.00			0.67									
Haiku Street																													
Contribution From Haiku Street, Pipe 116A - 1160A								22.60	1828				21.23		0.00		3.17		42.68	42.68									
Contribution From Haiku Street - Local Sewer, Pipe 1150A - 1160A								0.24	17.00				0.00		0.00		0.00		0.00	0.24									
	1160A	1150A						22.84	1845	3.09	18.48		21.23		0.00		3.17	7.22	0.00	42.92	14.16	39.86	41.5	375	0.15	67.91	0.59	0.61	0.64
	1150A	115A						22.84	1845	3.09	18.48		21.23		0.00		3.17	7.22	0.00	42.92	14.16	39.86	4.5	375	0.15	67.91	0.59	0.61	0.64
Contribution From Focality Crescent, Pipe 114A - 115A								1.18	116				0.00		0.00		0.00		1.18	44.10									
Contribution From Haiku Street - Local Sewer, Pipe 111A - 115A								0.67	51.00				0.00		0.00		0.00		0.00	0.67									
	115A	111A						24.69	2012	3.07	20.00		21.23		0.00		3.17	7.22	0.00	44.77	14.77	41.99	87.5	375	0.15	67.91	0.62	0.61	0.65
Contribution From Haiku Street - Local Sewer, Pipe 110A - 111A								0.70	65.00				0.00		0.00		0.00		0.00	0.70									
	111A	110A						25.39	2077	3.06	20.59		21.23		0.00		3.17	7.22	0.00	45.47	15.01	42.81	74.5	375	0.15	67.91	0.63	0.61	0.65
Contribution From Focality Crescent, Pipe 108A - 110A								0.31	23				0.00		0.00		0.00		0.31	45.78									
	110A	1100A						25.70	2100	3.06	20.79		21.23		0.00		3.17	7.22	0.00	45.78	15.11	43.12	4.0	375	0.15	67.91	0.64	0.61	0.65
Contribution From Haiku Street - Local Sewer, Pipe 109A - 1100A								0.20	17.00				0.00		0.00		0.00		0.00	0.20									
	1100A	109A						25.90	2117	3.05	20.95		21.23		0.00		3.17	7.22	0.00	45.98	15.17	43.34	55.5	375	0.15	67.91	0.64	0.61	0.65
To Obsidian Street, Pipe 109A - 400A								25.90	2117				21.23		0.00		3.17			45.98									
Future Commercial																													
	2A	2250A						0.00				2.99	2.99		0.00		0.00	0.97	2.99	2.99	0.99	1.96	11.0	200	0.35	19.40	0.10	0.62	0.39
To Obsidian Street, Pipe 2250A - 226A								0.00	0				2.99		0.00		0.00			2.99									
Obsidian Street																													
	224A	225A	0.33	9		9	25	0.33	25	3.69	0.30		0.00		0.00		0.00	0.00	0.33	0.33	0.11	0.41	75.0	200	0.65	26.44	0.02	0.84	0.30
	225A	2250A	0.27	8		8	22	0.60	47	3.66	0.56		0.00		0.00		0.00	0.00	0.27	0.60	0.20	0.75	67.5	200	0.90	31.12	0.02	0.99	0.41
Contribution From Future Commercial, Pipe 2A - 2250A								0.00	0				2.99		0.00		0.00		2.99	3.59									
	2250A	226A	0.15	3		3	9	0.75	56	3.64	0.66		2.99		0.00		0.00	0.97	0.15	3.74	1.23	2.86	46.0	200	1.40	38.81	0.07	1.24	0.71
	226A	109A	0.34	9		9	25	1.09	81	3.61	0.95		2.99		0.00		0.00	0.97	0.34	4.08	1.35	3.26	92.0	200	1.60	41.49	0.08	1.32	0.78
Contribution From Haiku Street, Pipe 1100A - 109A								25.90	2117				21.23		0.00		3.17		45.98	50.06									
Contribution From Future Residential, Pipe 3A - 109A								1.90	162				0.00		0.00		0.00		1.90	51.96									
	109A	400A	0.09				0	28.98	2360	3.02	23.12		24.22		0.00		3.17	8.19	0.09	52.05	17.18	48.49	63.0	375	0.15	67.91	0.71	0.61	0.67
To Drummond Future Road , Pipe 400A - 401A								28.98	2360				24.22		0.00		3.17			52.05									

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha				
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph			
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow =		0.330	L/s/ha
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity =		0.600	m/s
Max Res. Peak Factor =	3.80				Manning's n =	(Conc)	0.013 (Pvc)	0.013
Commercial/Inst./Park Peak Factor =	1.00				Townhouse coeff=		2.7	
Institutional =	0.32	l/s/Ha			Single house coeff=		3.4	

Designed: SLM	PROJECT: **Ciavan Communities - Brazeau Phase 1**	
Checked: ADF	LOCATION: **City of Ottawa**	
Dwg. Reference: Sanitary Drainage Plan, Dwgs. No. 80-83	File Ref: 18-1030	Date: **27 Jul 2020** Sheet No. 5 of 6

1030_SAN_slm.xlsx

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION									COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	UNITS Singles	UNITS Townhouse	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
Drummond Future Road																													
Contribution From Obsidian Street, Pipe 109A - 400A								28.98	2360				24.22		0.00		3.17		52.05	52.05									
	400A	401A	0.24				25	29.22	2385	3.02	23.34		24.22		0.00		3.17	8.19	0.24	52.29	17.26	48.79	72.5	375	0.15	67.91	0.72	0.61	0.67
	401A	402A	0.14				15	29.36	2400	3.02	23.48		24.22		0.00		3.17	8.19	0.14	52.43	17.30	48.97	62.0	375	0.15	67.91	0.72	0.61	0.67
To future Greenbank Road, Pipe 402A - 403A								29.36	2400				24.22		0.00		3.17			52.43									
Future Greenbank Road																													
Contribution From Drummond Future Road, Pipe 401A - 402A								29.36	2400				24.22		0.00		3.17		52.43	52.43									
	402A	403A	0.38				0	29.74	2400	3.02	23.48		24.22		0.00		3.17	8.19	0.38	52.81	17.43	49.09	80.0	375	0.15	67.91	0.72	0.61	0.67
	403A	404A	0.33				0	30.07	2400	3.02	23.48		24.22		0.00		3.17	8.19	0.33	53.14	17.54	49.20	80.0	375	0.15	67.91	0.72	0.61	0.67
	404A	405A	0.33				0	30.40	2400	3.02	23.48		24.22		0.00		3.17	8.19	0.33	53.47	17.65	49.31	81.0	375	0.15	67.91	0.73	0.61	0.67
Contribution From Expansion Road, Pipe 1313A - 405A							0	15.39	1492				0.00		0.00		0.00		0.00	15.39									
	405A	406A	0.25				0	46.04	3892	2.88	36.26		24.22		0.00		3.17	8.19	0.25	69.11	22.81	67.26	59.5	375	0.25	87.67	0.77	0.79	0.87
	406A	407A	0.35				0	46.39	3892	2.88	36.26		24.22	6.06	6.06		3.17	10.15	6.41	75.52	24.92	71.34	83.5	375	0.30	96.03	0.74	0.87	0.95
	407A	408A	0.46				0	46.85	3892	2.88	36.26		24.22		6.06		3.17	10.15	0.46	75.98	25.07	71.49	110.0	375	0.30	96.03	0.74	0.87	0.95
	408A	409A	0.40				0	47.25	3892	2.88	36.26		24.22		6.06		3.17	10.15	0.40	76.38	25.21	71.62	96.5	375	0.30	96.03	0.75	0.87	0.95
	409A	410A	0.51				0	47.76	3892	2.88	36.26		24.22		6.06		3.17	10.15	0.51	76.89	25.37	71.79	120.0	375	0.30	96.03	0.75	0.87	0.95
	410A	570A	0.30				0	48.06	3892	2.88	36.26		24.22		6.06		3.17	10.15	0.30	77.19	25.47	71.89	63.0	375	0.30	96.03	0.75	0.87	0.95
	570A	57A						48.06	3892	2.88	36.26		24.22		6.06		3.17	10.15	0.00	77.19	25.47	71.89	15.0	375	0.50	123.98	0.58	1.12	1.16

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha	
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow = 0.330 L/s/ha
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity = 0.600 m/s
Max Res. Peak Factor =	3.80				Manning's n = (Conc) 0.013 (Pvc) 0.013
Commercial/Inst./Park Peak Factor =	1.00				Townhouse coeff= 2.7
Institutional =	0.32	l/s/Ha			Single house coeff= 3.4

Designed: SLM	PROJECT: **Ciavan Communities - Brazeau Phase 1**
Checked: ADF	LOCATION: **City of Ottawa**
Dwg. Reference: Sanitary Drainage Plan, Dwgs. No. 80-83	File Ref: 18-1030
Date: **27 Jul 2020**	Sheet No. 6 of 6

E.2 STORMWATER MANAGEMENT REPORT FOR HALF MOON BAY SOUTH PHASE 8 BY STANTEC (JUNE, 2023)

3718 Greenbank Road: Servicing and Stormwater Management Report

Stantec Project No. 160401657

June 13, 2023

Prepared for:

Mattamy Homes Ltd.

Prepared by:

Stantec Consulting Ltd.
400-1331 Clyde Avenue
Ottawa ON K2C 3G4

Revision	Description	Author		Quality Check		Independent Review	
1	Issued for Approval	NN	2022-01-13	NC	2021-01-14	DT	2021-01-18
2	Revised per City Comments	DT	2023-03-20	DT	2023-03-24	SG	2023-03-24
3	Revised per City Comments	DT	2023-06-09	DT	2023-06-13	SG	2023-06-13

Prepared by ____

Davide Milos, EIT

Reviewed by ____

Neal Cody, P.Eng.

Approved by ____

Dustin Thiffault, P.Eng.

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1.0 INTRODUCTION

Mattamy Homes Ltd. has retained Stantec Consulting Ltd. to prepare this Stormwater and Servicing Report in support of a site plan control application for 3718 Greenbank Road (Half Moon Bay South Phase 8 - Residential). The subject site is located within the Brazeau Lands development area otherwise known as The Ridge, located at 3809 Borrisokane Road within the Barrhaven South Urban Expansion Area (BSUEA) in the City of Ottawa. It is bound by Dundonald Drive to the north, Obsidian Street to the west and Future Greenbank Road to the east as illustrated in **Figure 1** below.

Figure 1: Key Plan of 3718 Greenbank Road Development Area

The development land is approximately 3.09ha in area and comprising 19 blocks of townhouses with a total of 228 units. This servicing and stormwater management report will demonstrate that the subject site can be freely serviced by the existing municipal water, sanitary, and storm services while complying with established design criteria recommended in background studies and City of Ottawa guidelines. The proposed site plan is included in **Appendix B** for reference.

This parcel is currently zoned R4Z. The bulk of the current phase of the proposed development has been recently cleared of topsoil which has been stockpiled in several piles across the site. Generally, the ground surface across the subject site is relatively flat within the central portion of the development and sloping sharply towards the north and east property lines. It should be noted that parts of the subject site had undergone excavation and in-filling activities as part of a previous sand extraction operation. The property is within the Jock River watershed and is under the jurisdiction of the Rideau Valley Conservation Authority (RVCA).

1.1 OBJECTIVE

This Site Servicing and Stormwater Management Brief has been prepared to present a servicing scheme that is free of conflicts and presents the most suitable servicing approach that complies with the relevant City design guidelines. The use of the existing infrastructure as obtained from available as-built drawings has been determined in consultation with David Schaeffer Engineering Ltd. (DSEL), J. F. Sabourin and Associates Inc. (JFSA), City of Ottawa staff, and the adjoining property owners. Infrastructure requirements for water supply, sanitary sewer, and storm sewer services are presented in this report.

Criteria and constraints provided by Brazeau Lands (The Ridge) Design brief and the City of Ottawa with further iterations through the 3718 Greenbank Road Functional Servicing Report have been used as a basis for the servicing design of the proposed development. Specific elements and potential development constraints to be addressed are as follows:

- **Potable Water Servicing**
    - Estimate water demands to characterize the feed for the proposed development which will be serviced by an existing 300mm diameter PVC watermain fronting the site along Obsidian Street.
    - Watermain servicing for the development is to be able to provide average day and maximum day and peak hour demands (i.e., non-emergency conditions) at pressures within the allowable range of 40 to 80 psi (276 to 552 kPa).
    - Under fire flow (emergency) conditions with maximum day demands, the water distribution system is to maintain a minimum pressure greater than 20 psi (140 kPa).
- Prepare a grading plan in accordance with the proposed site plan and existing grades.
- **Stormwater Management and Servicing**
    - Define major and minor conveyance systems inline with guidelines used for the stormwater management of the Brazeau lands subdivision, as well as those provided in the October 2012 City

of Ottawa Sewer Design Guidelines and subsequent technical memorandums, and generally accepted stormwater management design guidelines.

- As documented in the Barrhaven South Urban Expansion Area Master Servicing Study, by J. L Richards 2018 and Stantec's 2022 Functional Servicing Report for the area, the development will also have Etobicoke Exfiltration Systems (EES) implemented within this subdivision. These EES will be installed within local roadways of the subdivision, to exfiltrate runoff from the development for the more frequent events.
- Connect to the existing storm maintenance hole structure at the intersection of Haiku and Obsidian Street.

- **Wastewater Servicing**
  - Estimate wastewater flows generated by the development and size sanitary sewers which will outlet to the existing sanitary sewer stub fronting the site, located off the Haiku and Obsidian Street intersection. The existing maintenance hole (SAN MH3A) will be relocated and cored into for the proposed connection.

The accompanying **Drawing SSP-1** illustrates the proposed internal servicing scheme for the site.

2.0 REFERENCES

The following documents were referenced in the preparation of this stormwater management and servicing report:

- *City of Ottawa Sewer Design Guidelines*, 2nd Edition, City of Ottawa, October 2012.
- *City of Ottawa Design Guidelines – Water Distribution*, First Edition, Infrastructure Services Department, City of Ottawa, July 2010.
- *Design Brief for Cavian Greenbank Development Corporation,* The Ridge (Brazeau Lands), David Schaeffer Engineering Ltd., July 2020.
- *Geotechnical Investigation,* Proposed Mixed Use Development Half Moon Bay South – Phase 8 3718 Greenbank Road - Ottawa, PG5690-1, Paterson Group, May 2023.
- *Hydraulic Capacity and Modeling Analysis Brazeau Lands*, Final Report, GeoAdvice Engineering Inc., July 2020.
- *Master Servicing Study – Barrhaven South Urban Expansion Area,* J.L. Richards & Associates Limited, Revision 2, May 2018.
- *Pond Design Brief for Brazeau Subdivision,* by J.F. Sabourin and Associates, July 2020.
- *Stormwater Management Report for Brazeau Subdivision,* by J.F. Sabourin and Associates (July 2020).
- *Stormwater Planning and Design Manual,* Ministry of the Environment, March 2003.
- *Technical Bulletin ISTB-2014-02 Revision to Ottawa Design Guidelines – Water*, City of Ottawa, May 2014.
- *Technical Bulletin PIEDTB-2016-01 Revisions to Ottawa Design Guidelines – Sewer,* City of Ottawa, September 2016.
- *3718 Greenbank Road – Functional Servicing Report*, Stantec Consulting Ltd., September 14, 2022.

3.0 POTABLE WATER SERVICING

3.1 BACKGROUND

The subject site is located within Zone 3SW of the City of Ottawa water distribution system. The proposed residential development will include 19 blocks with 228 townhome units. The subject site is within The Ridge (Brazeau lands) subdivision for which David Schaeffer Engineering Ltd. (DSEL) conducted a servicing and stormwater management study in July 2020.

The development will be serviced via two existing 200mm diameter private watermain services located within Obsidian Street and fed from the existing 300mm diameter watermain terminating at Dundonald Drive and the future New Greenbank Road alignment and a 400mm diameter watermain from the existing Cambrian Road forming part of the Tamarack Meadows, as shown in the design brief by DSEL in **Appendix E.1**.

In July 2020, GeoAdvice carried out a watermain analysis to determine the hydraulic capacity of the watermain network within Brazeau Lands which includes the residential portion of 3718 Greenbank Road. The GeoAdvice analysis was previously used to generate the hydraulic boundary conditions, however, the updated boundary conditions for the proposed development have been received from the City of Ottawa and are used in the updated hydraulic analysis. The City of Ottawa boundary conditions are included in **Appendix A.1**.

3.2 PROPOSED WATERMAIN SIZING AND LAYOUT

The proposed watermain alignment and sizing for the development is demonstrated on **Drawing SSP-1**. A 250 mm diameter watermain is proposed to loop within the street fronting Block 1 and extend southeast/southwest fronting Block 17 to the connection within Obsidian, and 200 mm diameter watermains will extend from the main distribution line to service blocks not fronting the 250 mm diameter distribution loop. The connection points are as follows:

- A 250mm diameter watermain will loop and connect to the existing 200mm stub at Haiku Street via 45° horizontal bend.
- A 250mm diameter watermain will loop and connect to the existing 300mm watermain along Obsidian Street via existing 200mm stub connection at the southwest boundary of the site.

3.2.1 Ground Elevations

The proposed ground elevations within the development range from approximately 103.1 m to 106.5 m, with the ground elevations highest in the southeast corner of the site. This significant variation in ground elevations was largely dictated by the original topography of the site, and to suit tie-in elevations at Obsidian Street.

3.2.2 Domestic Water Demands

The 3718 Greenbank Road development will contain a total of 19 blocks with 228 townhome units and outdoor amenity areas having a total estimated population of 616 persons. Refer to **Appendix A.2** for detailed domestic water demand calculations.

Water demands for the development were calculated using the City of Ottawa's Water Distribution Design Guidelines. For residential developments, the average day (AVDY) per capita water demand is 280L/cap/d. For maximum day (MXDY) demand, AVDY was multiplied by a factor of 2.5 and for peak hour (PKHR) demand, MXDY was multiplied by a factor of 2.2. For maximum day (MXDY) demand of amenity areas, AVDY was multiplied by a factor of 1.5 and for peak hour (PKHR) demand, MXDY was multiplied by a factor of 1.8. The calculated residential water consumption is represented in **Table 3-1** below:

Table 3–1: Residential Water Demands

Unit Type	Units/ Amenity areas (m^2)	Persons/Unit	Population	AVDY (L/s)	MXDY (L/s)	PKHR (L/s)
Townhome	228 units	2.7	616	1.99	4.99	10.97
		Total	**616**	**1.99**	**4.99**	**10.97**

3.3 LEVEL OF SERVICE

3.3.1 Allowable Pressures

The City of Ottawa Water Distribution Design Guidelines state that the desired range of system pressures under normal demand conditions (i.e. basic day, maximum day, and peak hour) should be in the range of 350 to 552 kPa (50 to 80 psi) and no less than 275 kPa (40 psi) at the ground elevation in the streets (i.e. at hydrant level). The maximum pressure at any point in the distribution system is to be no higher than 552 kPa (80 psi). As per the Ontario Building Code & Guide for Plumbing, if pressures greater than 552 kPa (80 psi) are anticipated, pressure relief measures (such as pressure reducing valves) are required. Under emergency fire flow conditions, the minimum pressure in the distribution system is allowed to drop to 138 kPa (20 psi).

3.3.2 Fire Flow

The FUS fire flow calculation spreadsheets for the governing fire flow demand scenarios (see **Appendix A.3**) were generated to calculate the expected fire flow demands from the proposed site.

The ground floor area of a single storey of each block was estimated to be 476 m^2 based on the building footprints shown on the site plan. For assessment of the worst-case fire flow requirement, building exposures were reviewed on a block-by-block basis. Blocks 1, Blocks 4-15, and Blocks 18-19 were determined to be the critical units for assessment given exposures from adjacent units on all sides. The remaining blocks maintain exposures on at most three sides. Blocks 1 and 8 were selected for assessment as they are generally representative of these two site conditions. Fire flow calculations were performed and for the specified configurations the maximum required fire flow for most blocks was estimated to be 250 L/s.

Based on the site plan updates, fire separation via firewalls will no longer be required to keep the maximum ground floor area of residential blocks below 600m^2 as per building code requirements, and the 250 L/s fire flow requirement will govern the hydraulic analysis and design.

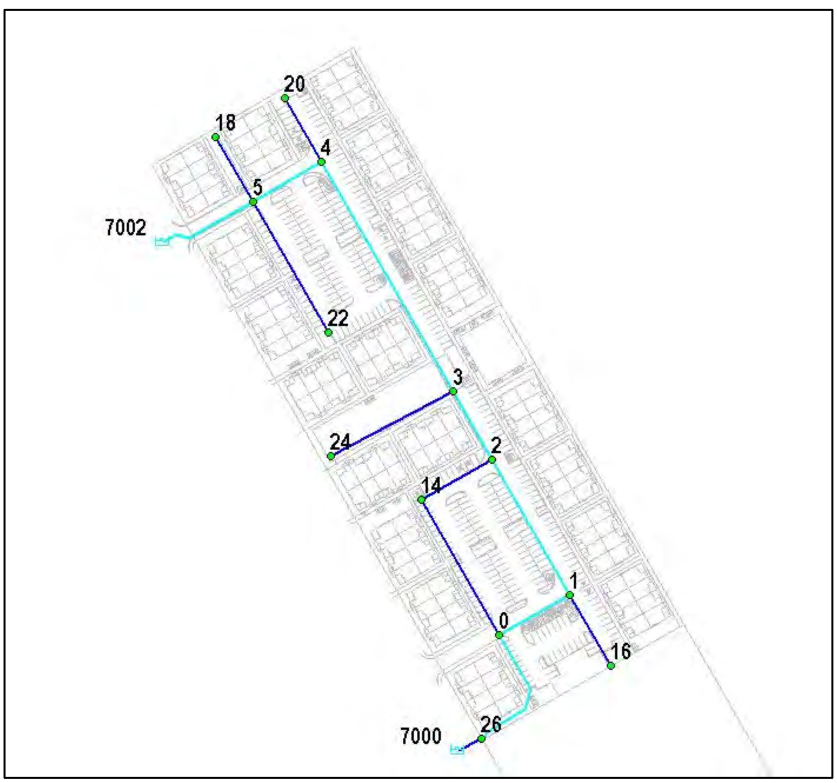
3.4 HYDRAULIC MODEL

A hydraulic model for the site was constructed using the H2OMap Water program developed by Innovyze to provide an accurate network analysis of the proposed water distribution system. The results are presented and discussed in the following sections.

3.4.1 System Layout

The proposed watermain alignment including model node IDs, reservoirs (representing boundary conditions at connections to the existing watermain network), and pipe sizing for the proposed development is shown in **Figure 2** below. Proposed 250 mm and 200 mm diameter watermains are identified in teal and blue, respectively.

Figure 2: Watermain Model Nodes



3.4.2 Boundary Conditions

The updated hydraulic boundary conditions provided by the City of Ottawa dated June 22, 2022, are based on the anticipated domestic water demands and a fire flow demand of 15,000 L/min (250 L/s). Two fixed head reservoirs simulating the boundary conditions were placed for the watermain connection points at the Haiku Street/Obsidian Street (North) intersection and Obsidian Street (South) in the hydraulic model. A summary of the boundary conditions is provided in **Table 2** which shows the ground elevation at the proposed connections and the HGLs for average day, peak hour, and maximum day plus fire flow demand scenarios that have been used in the hydraulic model. The boundary conditions are included in **Appendix A.1**.

Table 3–2: Boundary Conditions (SUC Zone Reconfiguration)

Location	Ground Elevation (m)	AVDY (m)	PKHR (m)	MXDY+FF (15,000 L/min) (m)
Connection 1 - Obsidian North	98.68	148.1	143.0	131.2
Connection 2 - Obsidian South	105.14	148.1	143.0	129.7

3.4.3 Model Development

New watermains were added to the hydraulic model to simulate the proposed distribution system. A 250 mm and 200 mm dia. watermain network is used throughout the site with the main 250 mm diameter distribution line following the locations of proposed hydrants. Hazen-Williams coefficients (C-factors) were applied to the proposed watermain in accordance with the City of Ottawa's Water Distribution Design Guidelines. The C-factors used are given in **Table 3-3** below.

Table 3–3: C-Factors Used in Watermain Hydraulic Model

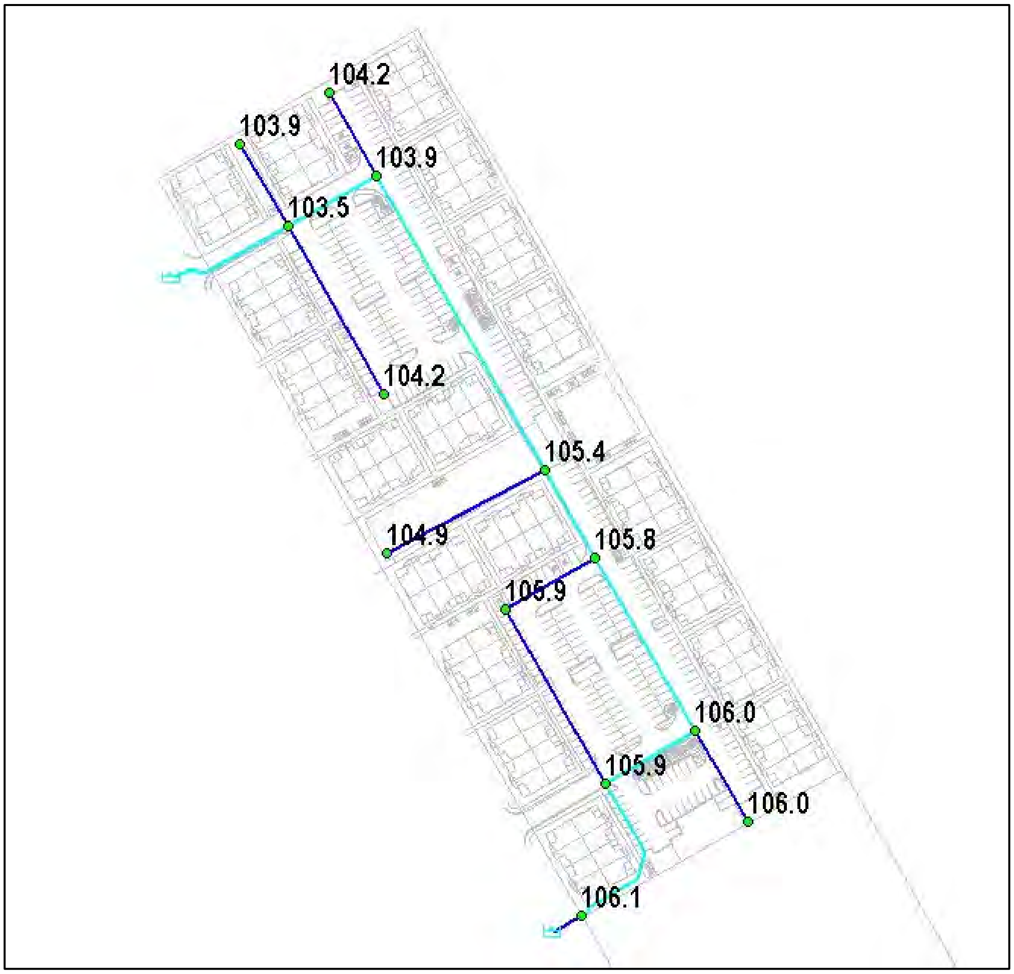
Pipe Diameter (mm)	C-Factor
150	100
200 to 250	110
300 to 600	120
Over 600	130

The labelling of the watermain junctions and reservoirs (representing boundary conditions at connections to the existing watermain network) is shown in **Figure 2**.

3.4.4 Ground Elevations

The ground elevations used at each node along the watermain model network are shown in **Figure 3** below. These elevations were interpolated from the detailed grading plan for the site (**Drawing GP-1**, included in **Appendix E**).

Figure 3: Ground Elevations (m) in Hydraulic Model

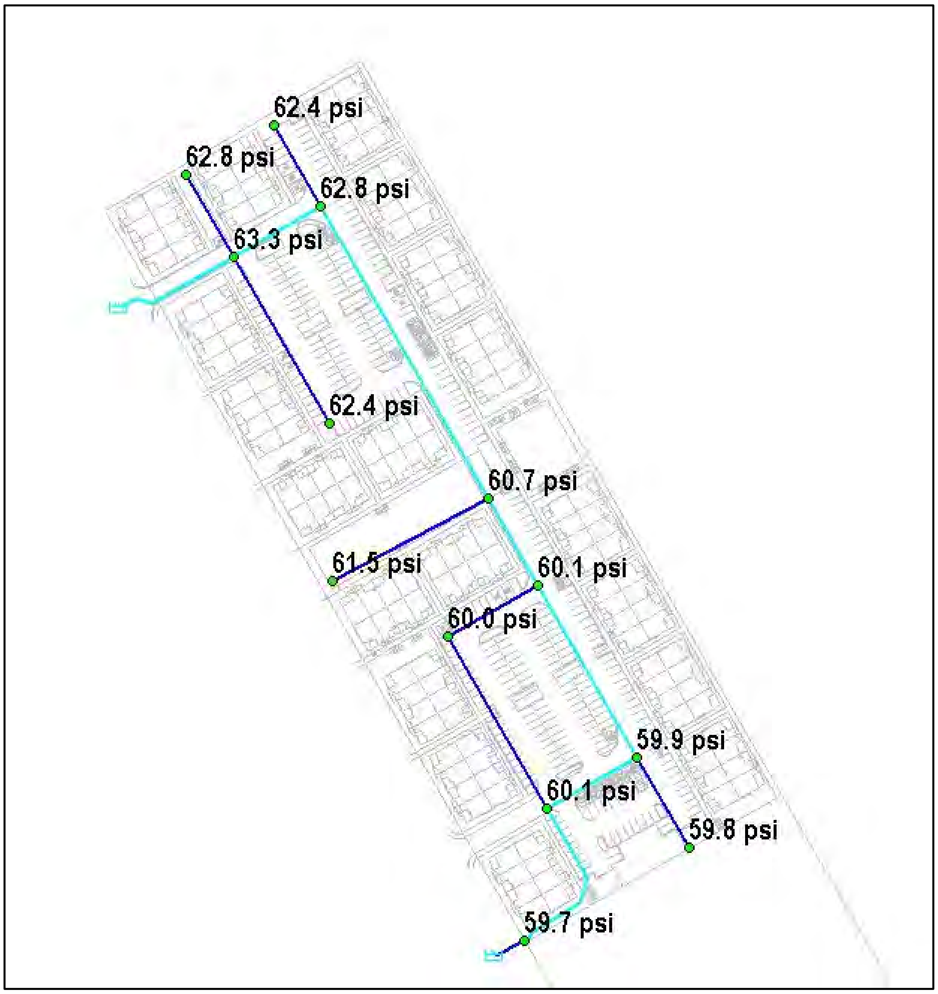


3.5 HYDRAULIC MODELING RESULTS

3.5.1 Average Day (AVDY)

The hydraulic modeling results show that under basic day demands the pressure in the distribution network falls between 412 kPa (59.7 psi) and 436 kPa (63.3 psi). Hydraulic modeling results for the average day demand scenario is illustrated in **Figure 4**.

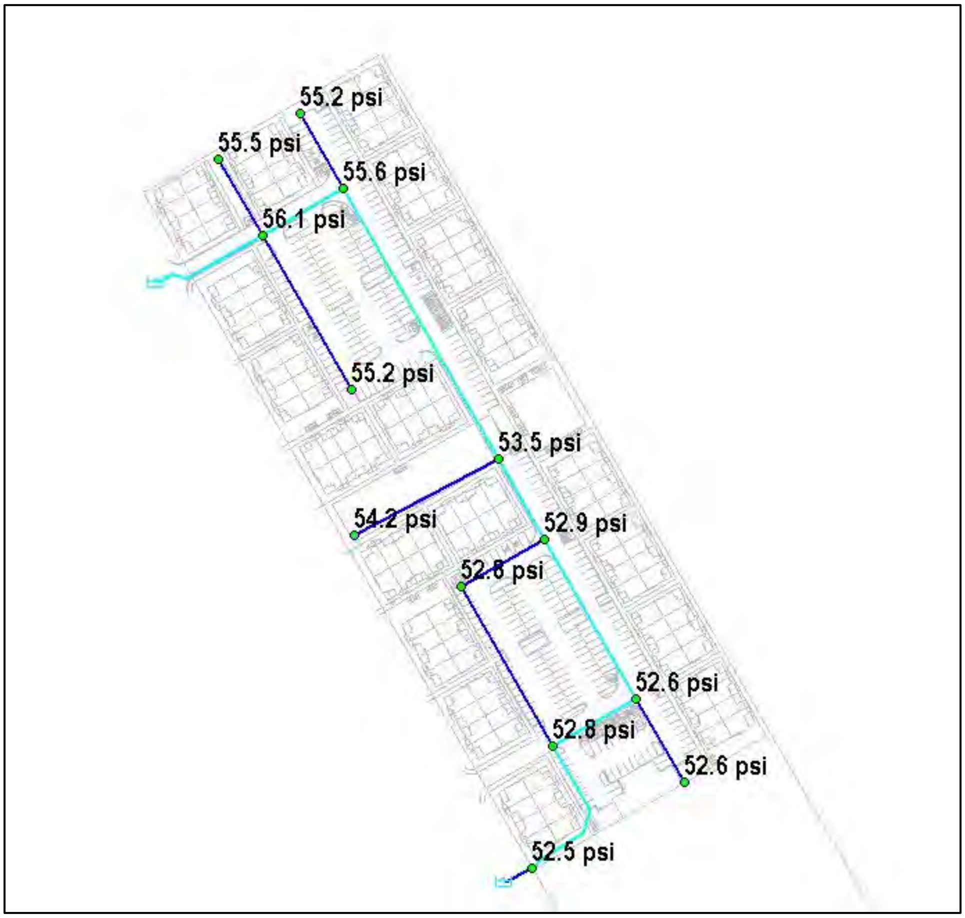
Figure 4: Pressures (psi) Under AVDY Demand Scenario



3.5.2 Peak Hour (PKHR)

The hydraulic modeling results show that under peak hour demands the pressure in the distribution network ranges between 362 kPa (52.5 psi) and 387 kPa (56.1 psi). Hydraulic modeling results for the peak hour demand scenario is illustrated in **Figure 5.**

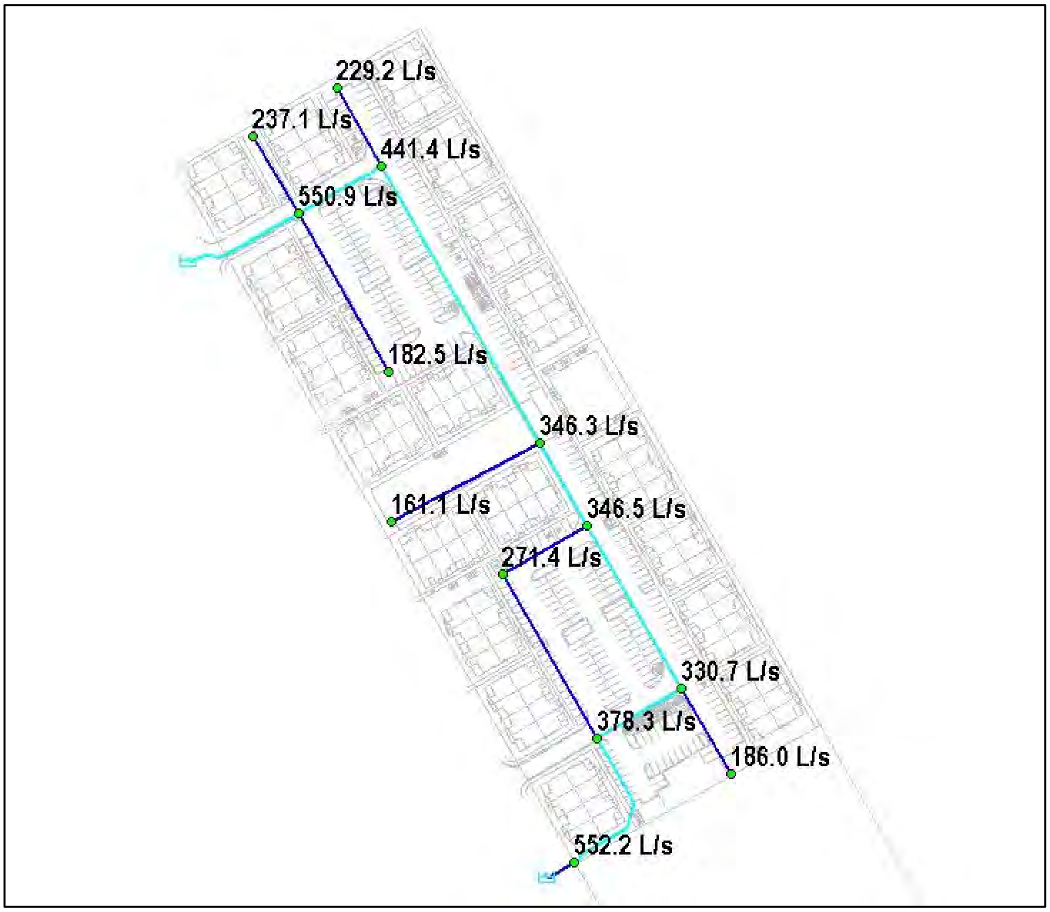
Figure 5: Pressures (psi) Under PKHR Demand Scenario



3.5.3 Maximum Day Plus Fire Flow (MXDY+FF)

A hydraulic analysis using the H2OMap Water model was conducted to determine if the proposed water distribution network can achieve the required FUS fire flow requirement while maintaining a residual pressure of at least 138 kPa (20 psi), per City Water Distribution Design Guidelines. This was accomplished using a steady-state maximum day demand scenario along with the automated fire flow simulation feature of the software. Hydraulic modeling results for the maximum day plus fire flow scenario is shown on **Figure 6**.

Figure 6: Available Fire Flows (L/s) for MXDY+FF Demand Scenario



A fire flow of 15,000 L/min (250 L/s) was achieved at all serviced nodes (see **Appendix A.4** for details). Sufficient fire flows for each block can be provided at every point within the distribution network for the proposed development.

3.6 POTABLE WATER SUMMARY

The proposed watermain alignment and sizing can achieve the required level of service throughout the development. Based on the hydraulic analysis conducted using H2OMap Water, the following conclusions were made:

- The proposed water distribution system consists of a combination of 250 mm and 200mm diameter distribution mains.
- During peak hour conditions, the proposed system is capable of operating above the minimum pressure objective of 276 kPa (40 psi).
- During fire conditions, the proposed system can provide 15,000 L/min fire flows at all modeled nodes, which are sufficient based on FUS calculations for the units within the proposed site.

4.0 WASTEWATER SERVICING

4.1 BACKGROUND

The subject site is located within the study of the Barrhaven South Urban Expansion Area (BSUEA) for which JLR associates prepared a Master Servicing Study in 2018. The study at conceptual level, provided design data for wastewater servicing and estimated residual capacities for sanitary trunk sewer in the area, as shown in the MSS extract in **Appendix E.1.** The subject site is referred to as Mattamy West (Residential) in this study. DSEL relied on this study to prepare a design brief for adjacent The Ridge subdivision (Brazeau Lands).

There is an existing 375mm diameter sanitary sewer collecting wastewater from the Ridge (Brazeau lands), which includes 3718 Greenbank Road, and flows into the sanitary sewer on Greenbank Road. Refer to **Appendix E.1** for The Ridge site servicing study by DSEL (2020). The estimated peak sanitary flows for the subject site were originally determined as 4.45L/s (for a residential area of 1.90ha and a commercial area of 2.99ha) using City of Ottawa design criteria. DSEL estimated the subject site (referred to as Mattamy West (residential) area) to be 1.90ha with a projected population of 162 persons, peak factor of 3.54 and total flow of 2.49L/s which is 13% of the sanitary sewer full capacity. The residential area has subsequently been expanded to 3.09 ha for this site plan application with a corresponding reduction in the future commercial lands.

The proposed development will be serviced by the existing sanitary sewer stub fronting the site, located off the Haiku and Obsidian Street intersection. The existing maintenance hole (SAN MH3A) will be relocated and cored into for the future connection. The wastewater contributions from the site will tie-in to this structure via a 200mm diameter PVC pipe.

4.2 DESIGN CRITERIA

As outlined in the City's Sewer Design Guidelines, the following design parameters were used to calculate estimated wastewater flow rates and to preliminarily size on-site sanitary sewers for the subject site:

- Minimum Full Flow Velocity – 0.6 m/s
- Maximum Full Flow Velocity – 3.0 m/s
- Manning's roughness coefficient for all smooth-walled pipes – 0.013
- Townhouse persons per unit – 2.7
- Extraneous Flow Allowance – 0.33 L/s/ha
- Residential Average Flows – 280 L/cap/day
- Maintenance Hole Spacing – 120 m
- Minimum Cover – 2.5m
- Harmon Correction Factor – 0.8

In addition, a residential peak factor based on Harmon's Equation was used to determine the peak design flows per Ottawa's Sewer Design Guidelines. Refer to **Appendix C.1** for the sanitary sewer design sheet for 3718 Greenbank Road

4.3 SANITARY SERVICING DESIGN

200 mm diameter sanitary sewers are proposed along the private roadways of the subject site. All sanitary sewers within the site ultimately outlet to existing SAN MH 3A located off Haiku/Obsidian Street at the intersection fronting Block 1. Existing MH SAN 3A is proposed to be relocated slightly closer to the site and cored to allow for connection to the property.

The proposed layout of the sanitary infrastructure is shown on **Drawing SA-1.** Sanitary peak flows will be directed to the 200mm diameter sanitary sewer on Obsidian Street which discharges to a 375mm diameter PVC sanitary sewer at Dundonald Drive which is ultimately directed to the sanitary sewer on Future Greenbank road. The connections to the existing sanitary sewer network and the associated peak flows are summarized in **Table 4–1** below.

Table 4–1 Summary of Proposed Sanitary Peak Flows

Area ID Number	Total area (ha)	No. Units	Population	Total Peak Flow (L/s)
Total Site	3.09	228	616	7.8

A population density of 2.7ppu was applied to the residential townhouse units on site. A residential peak factor based on Harmon Equation was used to determine the peak design flows. An allowance of 0.33 L/s/effective gross ha (for all areas) was used to generate peak extraneous flows.

The total design peak flow for the subject site to be conveyed to the connections at the Obsidian street sewer is 7.8L/s. This value is slightly higher than the previous estimate of 2.49L/s by DSEL based on a service area of 1.9 ha and population of 162 people. The difference (4.68L/s) can be accommodated by the 200mm receiving sewer in Obsidian Street. Estimated peak flows roughly coincide with that previously identified under the approved 3718 Greenbank Road Functional Servicing Report.

JLR Associates identified in its MSS for the BSUEA that there is residual capacity within the sanitary sewers draining Mattamy lands west to new Greenbank road based on a Stantec (2015) hydrodynamic model of trunk sanitary sewers (450 mm in diameter and greater), which in turn demonstrated that the existing downstream trunk system could accommodate the flows generated with no risk of surcharging or basement flooding. Consequently, Stantec concluded that system upgrades were not required. The residual capacity in the sanitary sewer downstream of Greenbank road was estimated as 74.0L/s (Refer to **Appendix E.1** for details).

5.0 STORMWATER MANAGEMENT AND SERVICING

The following sections describe the stormwater management (SWM) design for 3718 Greenbank Road in accordance with the background documents and governing criteria.

5.1 PROPOSED CONDITIONS

The proposed residential development encompasses approximately 3.09 ha of land and consists of 228 back-to-back townhomes and outdoor amenity areas. J.F. Sabourin and Associates Inc. (JFSA) were retained by David Schaeffer Engineering Ltd. (DSEL) to prepare a Stormwater Management (SWM) Plan for the adjacent Ridge (Brazeau) Subdivision.

The storm sewer collection system for the proposed site will discharge to an existing manhole (existing MH 109 within Obsidian Street) located near the northwest corner of the site, at the intersection of Obsidian Street and Haiku Street. This manhole is part of The Ridge's stormwater collections system which eventually discharges to a dry pond (referred to as the Drummond Pond) located in the northwest corner of the subdivision. This pond provides stormwater quantity control for the subdivision. OGS units upstream of the pond provide stormwater quality control for the subdivision.

Detailed grading of the site has been designed to direct emergency overland flows above the 100-year event to Obsidian Street, which runs along the west side of the subject site.

Minor grassed and roof areas at the boundary of the subject site cannot be graded to drain internally and as such will sheet drain uncontrolled offsite. The uncontrolled areas on the west side of the site will drain to the existing Obsidian Street ROW and those on the east side of the site will drain to the Future Greenbank Road ROW.

5.2 DESIGN CRITERIA AND CONSTRAINTS

The design criteria and guidelines used for the stormwater management of the subject subdivision are those that were developed in the background documents by JFSA, DSEL and JLR in the BSUEA MSS with iterations as noted in the 3718 Greenbank Road Functional Servicing Report, as well as those provided in the October 2012 *City of Ottawa Sewer Design Guidelines* and subsequent technical memorandums and generally accepted stormwater management design guidelines.

The SWM design will ensure that the majority of storm runoff within the site be controlled, and site release restricted to the peak flow rate of 402 L/s for the 2-Year storm event and peak flow rate of 437 L/s for the 100-Year storm as calculated using a proportional method for the site. Details can be found in Section 5.3.1. No improvements to downstream infrastructure will be required to service the site, however, a revision in catch basin configuration and inlet control device (ICD) sizing is required for catch basins along the east side of Obsidian Street to account for uncontrolled roof drainage from within the development, and to ensure a 2-year level of service is provided with respect to elimination of surface ponding within downstream roadways.

Storm runoff within the site will be controlled and directed to an existing storm control point identified as MH 3 in the JFSA SWM model. MH 3 has a maximum upstream Hydraulic Grade Line of 99.716m based on JFSA's simulation under the 100-year 3-hour Chicago storm, 100-year 24-hour SCS Type II storm, and the three historical events.

As identified by the approved FSR and the City of Ottawa's Sewer Design Guidelines, the minor and major system stormwater management design criteria and constraints will consist of:

5.2.1 Minor System

a) Storm sewers are to be designed to provide a minimum 2-year level of service.

b) The 100-year hydraulic grade line (HGL) within the development minor systems must be maintained at least 0.3 m below the underside of footing elevation where gravity house connections are installed.

c) For less frequent storms (i.e. larger than 1:2 year), the minor system shall, if required, be limited with the use of inlet control devices to prevent excessive hydraulic surcharges and to maximize the use of surface storage on the road where desired.

d) Catchbasins on the road are to be equipped with City standard type S19 (fish) grates or City standard type S22 side inlets, and grates for catchbasins in rear yards, park and open spaces with pedestrian traffic are to be City standard type S19, S30 and S31.

e) Single catchbasins are to be equipped with 200 mm minimum lead pipes, and double catchbasins are to be equipped with 250 mm minimum lead pipes.

f) Rear yard catchbasins are to be equipped with 250 mm minimum lead pipes. Catchbasins installed on the street, where rear yard catchbasins connect to the main storm sewer through the catchbasin, are to be equipped with 250 mm minimum lead pipes for both single and double catchbasins.

g) Under full flow conditions, the allowable velocity in storm sewers is to be no less than 0.80 m/s and no greater than 3.0 m/s. Where velocities over 3.0 m/s are proposed, provisions shall be made to protect against displacement of sewers by sudden jarring or movement. Velocities greater than 6 m/s are not permitted.

h) City of Ottawa staff have indicated a requirement to ensure no storage is considered within the EES system for modeling of peak runoff.

5.2.2 Major System

a) The major system shall be designed with enough road surface storage to allow the excess runoff of a 100-year storm to be retained within road ponding areas where desired.

b) Inlet control devices would be sized such that they do not create surface ponding on the road during the 2-year design storm on local roads (5-year design storm on collector and 10-year design storm on arterial roads); it should be noted that surface ponding over grates is present during rainfall under any design, as an appropriate depth of water is required for runoff to enter the grate.

c) Roof leaders shall be installed to direct the runoff to splash pads and on to grassed areas.

d) For the 100-year storm, the maximum total depth of water (static + dynamic) on all roads shall not exceed 35 cm at the gutter.

e) During the 100-year + 20% stress test, the maximum extent of surface water on streets, rear yards, public space and parking areas shall not touch the building envelope.

f) When catchbasins are installed in rear yards, safe overland flow routes are to be provided to allow the release of excess flows from such areas.

g) The product of the maximum flow depths on streets and maximum flow velocity must be less than 0.60 m^2/s on all roads.

h) The excess major system flows up to the 100-year return period are to be retained on-site in development blocks such as the proposed development.

i) There must be at least 15 cm of vertical clearance between the spill elevation on the street and the ground elevation at the nearest building envelope that is in the proximity of the flow route or ponding area.

j) There must be at least 30 cm of vertical clearance between the rear yard spill elevation and the ground elevation at the adjacent building envelope.

k) Provide adequate emergency overflow conveyance off-site to ensure water will spill to downstream rights-of-way in the event of a blockage.

5.2.3 Allowable Release Rate

Based on JFSA's Stormwater Management Plan for the Ridge (Brazeau) subdivision and iterated within the 3718 Greenbank Road Functional Servicing Study, the subject site is to control the 100-year flow on site and the minor system for the total site will be restricted to the 100-year storm event release rate of 437 L/s. The 2-year minor system outflow is to be controlled to 402 L/s. The noted flow rates are exclusively for the 3.09ha residential component of the development. The previously identified target release rates for the future 1.22ha commercial development parcel remain unchanged as per the FSR.

Table 5–1 Target Release Rate

Study	Storm Event	Subcatchment A109RES	Subcatchment A2260COM	Total
3718 Greenbank FSR (Residential)	2-Year Flow Rate (L/s)	201	201	**402**
	100-Year Flow Rate (L/s)	230	207	**437**

5.3 MODELING METHODOLOGY

5.3.1 Modeling Rationale

A hydrologic/hydraulic model was completed with PCSWMM for the sewers and roadways/parking areas within the proposed development, accounting for the estimated major and minor systems to evaluate the storm sewer infrastructure and ensure release rates meet the previously defined target criteria. The use of PCSWMM for modeling of the site hydrology and hydraulics allowed for an analysis of the system response during various storm events. The following assumptions were applied to the model:

- Hydrologic parameters as per Ottawa Sewer Design Guidelines, including Horton infiltration, Manning's 'n', and depression storage values.
- 3-hour Chicago distributions and 12-hour SCS Type II distributions for 2-year and 100-year storm events were used to evaluate the urban component of the dual drainage (i.e. minor system capture rates, total overland flow depth, hydraulic grade line (HGL), etc.).
- A 22 mm, 4-hour Chicago storm was used to evaluate the performance of the proposed Etobicoke exfiltration system.
- The 'climate change' scenarios created by adding 20% of the individual intensity values of the 100-year 3-hour Chicago storm and the 100-year 12-hour SCS Type II storm at their specified time step were used as an analytical tool to establish the function of the system under extreme events.
- Minor system capture rates within the proposed development were restricted to the 2-year peak runoff rate.

5.3.2 SWMM Dual Drainage Methodology

The proposed development is modeled in one PCSWMM model as a dual conduit system, where:

1) The minor system consists of storm sewers, represented by circular conduits, and manholes, represented by storage nodes;

2) The major system consists of overland spills, represented by weirs and irregular conduits using street-shaped cross-sections to represent the assumed overland road network with streets at varying slopes, and catch basins with surface ponding areas, represented by storage nodes.

The two systems are connected by outlet/orifice link objects, which represent inlet control devices (ICDs), that connect storage nodes representing catch basins to storage nodes representing manholes. Subcatchments are linked to the nodes representing catch basins and ponding areas so that generated hydrographs are directed there firstly.

5.3.3 Modified Dual Drainage Methodology to Support EES

To account for the presence of the proposed Etobicoke exfiltration system, the PCSWMM model was modified to include additional rectangular conduits in parallel to the conventional sewer lines. Rectangular conduits have been used to simulate drainage properties and dimensions of the clear stone media and perforated pipe but use a width equal to 40% of the actual trench width to simulate the porosity of the trench media. Inverts and obverts of the conduit can therefore still be consistent with design drawings, yet allow hydraulic modeling performed by PCSWMM to simulate hydraulic grade lines within the trench as it slopes upwards to follow traditional sewer grades. In such a manner, unused portions of the EES can be identified and minimized to ensure that an appropriate level of volume control is still provided for the site overall. Additional “dummy” manholes with zero storage were added to the upstream ends of EES conduits in the model to create dead ends. This was done to represent the fact that EES pipes will be capped at their upstream ends and will not convey stormwater through the minor system.

The simulation described above was repeated with varying EES trench depths, lengths, and widths to ensure complete capture of the 22 mm event as described in **Section 5.6** below.

5.3.4 Model Input Parameters

Drawing SD-1 summarizes the discretized subcatchments used in the analysis of the proposed development. All parameters were assigned as per applicable Ottawa Sewer Design Guidelines (OSDG); Ontario Ministry of the Environment, Conservation, and Parks (MECP); and background report requirements.

5.3.4.1 Hydrologic Parameters

Key parameters for the proposed development areas are summarized below, while example input files are provided for the 100-year, 3-hour Chicago storm in Appendix D which indicate all other parameters. For all other input files and results of storm scenarios, please examine the electronic model files located on the digital media provided with this report. This analysis was performed using PCSWMM, which is a front-end GUI to the EPA-SWMM engine. Model files can be examined in any program which can read EPA-SWMM files version 5.1.014.

Table 5–2: presents the general subcatchment parameters used for the proposed development.

Table 5–2: General Subcatchment Parameters

Parameter	Value
Infiltration Method	Horton
Max. Infil. Rate (mm/hr)	76.2

Min. Infil. Rate (mm/hr)	13.2
Decay Constant (1/hr)	4.14
N Imperv	0.013
N Perv	0.25
Dstore Imperv (mm)	1.57
Dstore Perv (mm)	4.67
Zero Imperv (%)	0

Table 5–3 presents the individual parameters that vary for each of the proposed subcatchments in the model. Subcatchment width parameters were determined by multiplying each subcatchment's area in hectares by 225. Subcatchment imperviousness was measured directly from the site plan within AutoCAD considering all paved access, sidewalks, and roof areas as entirely impervious areas, and remaining grassed areas as entirely pervious. Weighted runoff 'C' coefficients were determined for each subcatchment considering impervious areas as C=0.90, and pervious as C=0.20.

Table 5–3: Individual Subcatchment Parameters

Subcatchment ID	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	% Impervious
COM	1.220	274.5	44.4	0.5	90.00
L100D	0.095	21.4	44.4	3.0	72.86
L101A	0.021	4.7	44.4	3.0	60.00
L102A	0.437	98.3	44.4	3.0	84.29
L103A	0.132	29.8	44.4	3.0	80.00
L104A	0.658	148.0	44.4	3.0	78.57
L105B	0.198	44.5	44.4	3.0	54.29
L105C	0.105	23.7	44.4	3.0	25.71
L108A	0.339	76.3	44.4	3.0	85.71
L110A	0.153	34.5	44.4	3.0	70.00
L110B	0.053	11.8	44.4	3.0	71.43
L110C	0.316	71.0	44.4	3.0	88.57
UNC-1	0.155	34.9	44.4	3.0	81.43
UNC-2	0.159	35.9	44.4	3.0	81.43
UNC-3	0.135	30.4	44.4	3.0	75.71
UNC-4	0.132	29.7	44.4	3.0	78.57

5.3.4.2 Surface and Subsurface Storage Parameters

Table 5-4 summarizes the storage node parameters used in the model. Storage nodes represent the depth of the proposed catch basin barrel plus an additional depth to represent the maximum allowable surface water ponding depth. Surface storage was estimated based on surface models created in AutoCAD for the proposed grading plan. See **Drawing SD-1** for surface storage depths, areas, and volumes.

Table 5–4: Surface Storage Parameters

Subcatchment ID	Structure	Invert Elevation (m)	Rim Elevation (m)	CB Barrel Depth (m)	Ponding Depth at Spill (m)	Ponding Area (m2)	Ponding Volume (m3)
L101A	CB 101A	101.89	103.30	1.41	0.05	10.9	0.2
L102A	CB 102A	101.99	103.37	1.38	0.35	552.6	64.5
L103A	CB 103A	102.23	103.60	1.37	0.25	328.9	27.4
L104A	CB 104A	102.66	104.00	1.34	0.35	773.2	90.2
L105B	STM111	101.58	105.38	3.80	-	-	-
L105C	CB 105C	103.82	105.15	1.33	0.05	19.0	0.3
L108A	CB 108A	103.97	105.35	1.38	0.35	898.2	104.8
L110A	CB 110A	104.27	105.65	1.38	0.35	595.4	69.5
L110B	CB 110B	104.05	105.43	1.38	0.25	98.4	8.2
L110C	CB 110C	103.97	105.35	1.38	0.35	863.6	100.8
L110D	CB 110D	104.34	105.72	1.38	0.22	256.9	18.8

At several locations, underground storage was required to ensure there was no surface ponding during 2-year storm events. Big O or “umbilical” storage pipes were added to catch basin barrels to provide this storage. These were modeled using conduits to provide the required storage. Note that the EES system was not included in the 2-year, 100-year, or 100-year + 20% models. This was done at the request of the City of Ottawa which did not want the storage volume provided by the EES to be considered in these events.

Underground storage volumes are summarized in the table below:

Table 5–5: Surface Storage Parameters

Subcatchment ID	Structure	Storage Pipe Diameter (mm)	Storage Pipe Length (m)	Available Storage Volume (m3)
L102A	CB 102A	900	100	63.6
L104A	CB 104A	900	80	50.9
L105B	STM 105B	750	57.5	25.4
L108A	CB 108A	900	70	44.5

L110C	CB 110C	900	48	30.5

5.3.4.3 Hydraulic Parameters

As per the October 2012 City of Ottawa Sewer Design Guidelines, Manning's roughness values of 0.013 were used for sewer modeling and overland flow corridors representing roadways. Flow over grassed areas were modeled using a Manning's roughness value of 0.25. The storm sewers within the proposed development were modeled to estimate flow capacities and hydraulic grade lines (HGLs) in the proposed condition. The proposed storm sewer design sheet is included in **Appendix D**.

Exit losses at manholes were set for all pipe segments based on the flow angle through the structure. Exit losses were assigned as per City guidelines (Appendix 6b of the guidelines), see **Table 5-6** below.

Table 5–6: Exit Loss Coefficients for Bends at Manholes

Degrees	Coefficient
11	0.060
22	0.140
30	0.210
45	0.390
60	0.640
90	1.320
180	0.020

The proposed development's storm sewers were sized to convey runoff from a 2-Year storm using rational method calculations. The rational method design sheet can be found in **Appendix D**.

5.4 MODEL RESULTS AND DISCUSSION

The following section summarizes the key hydrologic and hydraulic model results. For detailed model results or inputs please refer to the example input files in **Appendix D** and the PCSWMM model on the enclosed digital files.

5.4.1 Hydrology

Table 5–7 summarizes the orifice link maximum flow rates and heads across the proposed development under the 2-year and 100-year storm scenarios. Discharge curves are as provided by the manufacturer for the selected IPEX Tempest ICDs.

Table 5–7 : Proposed ICD Schedule

Structure	Invert	ICD Type	100yr Head (m)	100yr Flow (L/s)	Storm Dist.	2yr Head (m)	2yr Flow (L/s)	Storm Dist.
CB 101A	101.89	IPEX TEMPEST LMF 90	0.99	7.2	Chicago	0.15	2.7	Chicago
CB 102A	101.99	IPEX TEMPEST HF 127mm	1.65	40.5	Chicago	0.70	25.6	SCS
CB 103A	102.23	IPEX TEMPEST HF 102mm	1.54	25.2	Chicago	1.21	22.3	Chicago
CB 104A	102.66	IPEX TEMPEST HF 154mm	1.68	59.9	Chicago	0.94	44.0	Chicago
STM 111	101.58	IPEX TEMPEST HF 127mm	1.91	43.6	SCS	0.32	16.4	Chicago
CB 105C	103.82	IPEX TEMPEST LMF 105	1.46	11.8	SCS	0.35	5.8	Chicago
CB 108A	103.97	IPEX TEMPEST HF 108mm	1.58	28.7	Chicago	0.88	21.2	Chicago
CB 110A	104.27	IPEX TEMPEST HF 127mm	1.50	38.4	Chicago	0.57	22.9	Chicago
CB 110B	104.05	IPEX TEMPEST LMF 90	1.56	9.0	Chicago	1.01	7.2	Chicago
CB 110C	103.97	IPEX TEMPEST HF 108mm	1.60	28.9	Chicago	0.90	21.4	SCS
CB 110D	104.34	IPEX TEMPEST HF 102mm	1.49	24.8	Chicago	0.56	14.8	Chicago

5.4.1.1 Uncontrolled Area

Due to grading restrictions, four subcatchments has been designed without a storage component. The catchment areas discharge off-site uncontrolled to the adjacent streets surrounding the proposed site. Peak discharges from uncontrolled areas UNC-1 and UNC-2 are directed to the future Greenbank Roda ROW, whereas areas UNC-3 and UNC-4 are directed to the Obsidian Street ROW. As noted in the SWM Reports for The Ridge and Drummond Subdivisions (JFSA 2020 and 2022), drainage to Greenbank Road is tributary the Clarke wet pond SWMF, whereas drainage to Obsidian (as well as the site minor system outlet) discharges to a downstream dry pond SWMF and oil/grit separator at Borrisokane Road. Both facilities ultimately outlet to the Jock River. As identified in the JFSA report for the Drummond Subdivision, a substantial flow reduction is proposed for peak flows to the Clarke Pond via the Half Moon Bay Trunk Sewer (approximately 2610L/s during the 100-Year 3hr Chicago event, and 1380L/s during the 100yr 24hr SCS event). Per report excerpts within **Appendix E**, it can be seen that the Clarke Pond can receive peak flows and volumes from the minor uncontrolled areas along the future realigned Greenbank Road (estimated as 149L/s and 196m3 during the 100-Year 3hr Chicago event and 108.4L/s and 260m3 during the 100-Year 24hr SCS event) without further need for flow control.

It was originally noted within the Functional Servicing Report for 3718 Greenbank Road that catch basin ICDs within the existing Obsidian Street would be reassessed based on peak discharge from uncontrolled areas adjacent to Obsidian. On further review, it was noted that the PCSWMM model for The Ridge Subdivision containing Obsidian Street considered all catch basins along Obsidian to be along a continuous grade, and controlled by catch basin grate openings rather than installed ICDs. The PCSWMM model for The Ridge had also assumed that catch basin CB72 (located at the eastern side of Obsidian at the intersection with Haiku Street to the west) would also be located at a segment of continuous road grade to

Dundonald Drive north of the proposed site. The current design for the Drummond Subdivision now considers a sag at Haiku/Obsidian, although the supplied PCSWMM model for The Ridge was not adjusted to correct this change.

As such, contributing road major system segments as noted in the drainage area plan for the Drummond Subdivision as well as all upstream contributions to minor and major systems along Obsidian Street from The Ridge Subdivision have been included in the PCSWMM model for the proposed 3718 Greenbank Road development both to ensure road ponding depths and flow spread do not exceed City of Ottawa criteria during design storm events, but also to consider the effect of peak discharge from uncontrolled areas along Obsidian on downstream infrastructure as reported in JFSA's Stormwater Management Report for The Ridge (Brazeau) Subdivision. Modeled minor system segments include all contributing flows to existing MH109, and major system segments include all contributing flows to the approach to existing CB109, located west of the intersection of Obsidian and Haiku Street.

Report excerpts from SWM report noted above (see **Appendix E**) identify the following peak outflow rates:

Table 5–8: Previously Approved Model Outflow – The Ridge Subdivision

Location	Design Storm	Discharge (L/s)
Minor System – MH109	100-Year 3hr Chicago	790
	100-Year 24hr SCS	770
	100-Year 3hr Chicago + 20%	900
Major System – CB109	100-Year 3hr Chicago	152

Table 5–9: Previously Approved Model HGL – The Ridge Subdivision

Location	Design Storm	HGL (m)
MH109	100-Year 3hr Chicago	99.961
	100-Year 24hr SCS	99.681
	100-Year 3hr Chicago + 20%	100.231

5.4.2 Hydraulic Grade Line

A design sheet has been prepared for the proposed storm sewer in **Appendix D.1** demonstrating all on-site sewers remain free-flowing (HGLs within the sewer) using an uncontrolled 2-year rate.

Table 5–10 below summarizes the hydraulic grade line (HGL) results for the subject site's proposed minor system using the worst case storm event distribution. Per the City of Ottawa Sewer Design Guidelines (2012), a building's underside of footing (USF) must be a minimum 300 mm above the 100-year HGL in the nearest upstream storm manhole. In addition, the buildings USF must also be above the HGL resulting from the 100-year + 20% stress test event.

Table 5–10: Hydraulic Grade Line Results

Block #	USF (m)	Adjacent Upstream MH ID	Adjacent 100-Year HGL (m)	Freeboard (m)	Adjacent 100-Year +20% HGL (m)	Freeboard (m)
1	101.73	101	99.74	1.99	99.77	1.96
2	101.83	101	99.74	2.09	99.77	2.06
3	102.43	103	100.13	2.30	100.14	2.29
4	102.83	104	100.92	1.91	100.94	1.89
5	103.18	104	100.92	2.26	100.94	2.24
6	102.18	102	100.80	1.38	100.80	1.38
7	102.51	102	100.80	1.71	100.80	1.71
8	103.03	106	101.50	1.53	101.50	1.53
9	103.09	106	101.50	1.59	101.50	1.59
10	103.43	105	101.39	2.04	101.41	2.02
11	103.80	106	101.50	2.30	101.50	2.30
12	103.80	106	101.50	2.30	101.50	2.30
13	103.98	107	101.82	2.16	101.82	2.16
14	104.08	109	102.11	1.97	102.11	1.97
15	104.18	109	102.11	2.07	102.11	2.07
16	104.23	109	102.11	2.12	102.11	2.12
17	104.03	110	102.44	1.59	102.44	1.59
18	103.77	110	102.44	1.33	102.44	1.33
19	103.74	110	102.44	1.30	102.44	1.30
		EXMH109	99.68		99.70	

Model results indicate that there is sufficient clearance between the 100-year and 100-year +20% stress test HGLs and the proposed USFs. Additionally, HGL at the downstream existing MH109 does not exceed the previously assumed values per approved background reports (99.69 and 100.23 in the 100-year and 100-year +20% events respectively).

5.4.3 Overland Flow

Table 5-11 below presents the total surface water depths (static ponding depth + dynamic flow) on the proposed roads/parking areas for the worst case 2-year and 100-year design storm distribution and the 100-year +20% climate change storm. In no case do surface water depths on roadways exceed 0.35m during the design storm events. Table rows for CB66, CB68, CB70 and CB72 refer to existing catch basins within Obsidian Street. The noted 2-year water depths for these rows refer to anticipated flow spread at each catch basin along a continuous grade to ensure that modeled flow spreads do not exceed ½ of the associated travel lane per the OSDG (approximate depth of 0.06m). 2-year storm runoff is entirely captured at sag CB72 without presence of surface ponding. The existing CB72 is proposed to be replaced with a double catch basin inlet complete with a 250mm CB lead to convey the required level of surface runoff.

Table 5–11: Maximum Static and Dynamic Water Depths

Storage Node ID	Top of Grate Elevation (m)	Lowest Adjacent Building Opening (m)	2-Year		100-Year		100-Year + 20%	
			Max Surface HGL (m)	Total Surface Ponding Depth (m)	Max Surface HGL (m)	Total Surface Ponding Depth (m)	Max Surface HGL (m)	Total Surface Ponding Depth (m)
101A	103.30	103.55	102.04	0.00	102.88	0.00	103.39	0.09
102A	103.37	103.85	102.69	0.00	103.64	0.27	103.76	0.39
103A	103.60	104.05	103.44	0.00	103.77	0.17	103.80	0.20
104A	104.00	104.64	103.60	0.00	104.34	0.34	104.39	0.39
105B	104.66	104.87	101.90	0.00	102.78	0.00	104.64	0.00
105C	105.15	105.42	104.17	0.00	105.28	0.13	105.28	0.13
108A	105.35	105.95	104.85	0.00	105.55	0.20	105.61	0.26
110A	105.65	106.24	104.84	0.00	105.77	0.12	105.81	0.16
110B	105.43	105.92	105.06	0.00	105.61	0.18	105.66	0.23
110C	105.35	105.95	104.87	0.00	105.57	0.22	105.61	0.26
110D	105.72	106.25	104.90	0.00	105.83	0.11	105.87	0.15
CB72	102.85	102.97	101.82	0.00	103.01	0.16	103.03	0.18
CB70	104.21	104.38	104.25	0.04	104.28	0.07	104.29	0.08
CB68	104.59	104.89	104.64	0.05	104.68	0.09	104.69	0.10
CB66	105.77	106.00	105.80	0.03	105.82	0.05	105.84	0.07

*Occurs within a managed landscaped area - not subject to road surface ponding.

Proposed site grading is such that should catch basin discharge orifices become blocked, flows will spill from catch basin grates overland to the site accesses in the northwest and southwest corners of the property, and out to Obsidian Street. Overland flows progress from Obsidian westward along existing Haiku Street.

5.4.4 Peak System Outflows

As identified in section 5.4.1.1 above, peak runoff from areas tributary to the realigned Greenbank Road proceed to a separate outfall designed with available capacity to receive such flows, and as such do not contribute directly to the allowable release rate to Obsidian Street. Remaining peak discharge from the development is summarized in the table below:

Table 5–12: Peak Site Outflows

Area/ Location	2-Year		100-Year		100-Year + 20%	
	SCS	**Chicago**	**SCS**	**Chicago**	**SCS**	**Chicago**
Minor System	183.4	195.4	324.3	317.7	333.4	333.5
Major System	0	0	0	0	14.4	47.9
UNC-3	17.6	21.9	46.1	62.4	55.7	76.6
UNC-4	17.8	22.2	45.3	61.9	54.6	75.6
Total	**218.8**	**239.5**	**415.7**	**442.0**	**458.1**	**533.6**
Allowable	**402**		**437**		**-**	

Peak discharge from the development slightly exceeds the allowable rate for the 100-year storm event. As additional storage and adjusted ICDs within Obsidian Street have been considered beyond that originally included in the PCSWMM model for the approved The Ridge Subdivision, downstream flow conditions within the receiving minor and major system along Haiku were assessed based on previously approved reported HGLs and flow rates. Comparison of the current modeled rates to that originally assumed is detailed in the tables below, and underscores that no negative impacts to downstream infrastructure are anticipated based on the proposed development:

Table 5–13: Proposed Downstream Flow Conditions

Location	Design Storm	Previously Approved Discharge (L/s)	Revised Model Discharge (L/s)
Minor System – MH109	100-Year 3hr Chicago	790	765.3
	100-Year 24hr SCS	770	757.5
	100-Year 3hr Chicago + 20%	900	816.4
Major System – CB109	100-Year 3hr Chicago	152	138.5

Table 5–14: Proposed Downstream HGL

Location	Design Storm	Previously Approved HGL (m)	Revised Model HGL (m)
MH109	100-Year 3hr Chicago	99.961	99.67
	100-Year 24hr SCS	99.681	99.67
	100-Year 3hr Chicago + 20%	100.231	99.70

5.5 QUALITY CONTROL

Quality treatment of runoff will be partially provided through installation of an Etobicoke Exfiltration System (EES) as highlighted in **Section 5.6** below. This system has been sized to collect and infiltrate runoff from first flush rainfall events up to and including the 22mm rainfall event to meet water balance requirements noted below. In addition, further quality control for the overall development will be provided by the existing downstream oil-grit separator (OGS) for The Ridge subdivision located downstream of the proposed development and discharging to the Jock River via an existing ditch on the west side of Borrisokane Road. The oil-and-grit separator has previously been sized to ensure 80% Total Suspended Solids (TSS) removal for the development inclusive of the proposed site. For more details regarding the OGS units within the downstream development, please refer to JFSA's July 2020, Pond Design Brief for the Ridge (Brazeau) Subdivision.

Based on assumptions made during design of the downstream phases, Phase 8 lands were assumed to contribute at an overall average imperviousness of 68%, and the OGS was sufficiently sized to provide the appropriate level of control at this value. The Phase 8 residential development lands encompass 3.09ha. At the previously assumed imperviousness of 68%, this equates to an impervious area of 2.10ha. Based on subcatchment parameters listed above, and excluding uncontrolled runoff to the realigned Greenbank Road discharging to Clarke Pond, the proposed development overall imperviousness is 76.7%, with a treatable impervious area of 2.13ha.

According to Table 3.2 of the MOE Stormwater Management Planning and Design Manual, the storage volume required to achieve 80% long-term S.S. removal in an infiltration type system such as the proposed EES is about 38 m3/impervious ha. The proposed development would then require approximately 81m3 of storage to provide quality control for the region. Per **Table 5-15** below, the proposed development provides approximately 442m3 of storage.

It is anticipated that the high level of treatment provided by implementation of the proposed on-site EES system (22mm of the required 25mm first flush storm event) in conjunction with the existing OGS via treatment train will provide more than adequate quality control to meet design criteria for the development despite the marginal increase in impervious area to the downstream OGS.

5.6 WATER BALANCE – ETOBICOKE EXFILTRATION SYSTEM

As a Best Management Practices (BMP) approach the Barrhaven South Urban Expansion Area (J.L. Richards & Associates, 2018) MSS requires the capture and infiltration of stormwater via exfiltration system installed on local roads, such as the private roads within the subject site, where the surface runoff is not impacted by the City's winter road salting program to meet pre-development water balance criteria. To avoid groundwater contamination, only salt-free agents may be used on site for winter maintenance of snow and ice. This includes, but is not limited to, all drive aisles, parking areas, sidewalks, and pathways..

The City and RVCA determined that predevelopment infiltration levels should be maintained under post development conditions and that the infiltration should be provided across the development and not simply concentrated to one or two locations. JFSA determined the infiltration target for the site to be of the average simulated annual rainfall volume (552.0 mm), which is calculated to be 220.8mm annually as reported by JFSA in **Appendix E.2.** Similar to the BSUEA MSS, a 22mm storm event was selected for application within the current site plan to conservatively address post-development infiltration targets and water balance concerns.

An Etobicoke Exfiltration System (EES) has been proposed to be located below the storm sewer of the subject site (on sewer sections not identified as catch basin leads), the proposed locations of which are highlighted on **Drawing SD-1**.

For this exercise, the EES has been conservatively sized assuming no infiltration during rain events (seepage = 0 mm/hr). The EES units will be installed underneath storm sewers in specific areas and will consist of a 300 mm diameter perforated pipe surrounded by a clear stone trench with varying dimensions as identified on **Drawing SSP-1**. Minimum 600mm deep sumps (as per City of Ottawa standards) will be installed in upstream catchbasins in order to prevent/mitigate debris and potential oils from entering the perforated pipe system. ICDs within proposed catch basins are proposed as Ipex Tempest models equipped with floatable controls to mitigate oil/debris incursion to the EES.

Table 5–15: 22mm Event Simulated EES Volumes

Pipe ID	Length (m)	Trench Height (m)	Trench Width (m)	Available Volume (m^3)	Used Volume (m^3)[3]
101-100-E	36.2	1.7	1.575	38.8	28.6
102-101-E	62.9	1.6	1.20	48.3	35.5
103-101-E	32.0	1.6	1.425	29.2	27.3
104-103-E	70.3	1.6	1.425	64.1	51.5
105-104-E	44.7	1.7	1.35	41.0	37.2
107-105-E	45.4	1.7	1.35	41.6	36.7
108-107-E	36.1	1.7	1.425	35.0	30.7
109-107-E	70.5	1.7	1.20	57.5	45.3
110-108-E	79.9	2.0	1.35	86.3	80.4
Total	**477.9**			**441.9**	**373.2**

1. Trench widths in the PCSWMM model are set at 40% of the values provided in this table to account for 40% clear stone porosity.
2. The available volume for each trench section was calculated based on the above dimensions and assuming 40% clear stone porosity.
3. Volumes used incorporate storage volume provided via 300mm perforated pipe within the EES.

As can be seen in the above table, approximately 84.5% of the available volume in the overall EES system will be used in the 22mm event. In sections where the used volume is greater than the available volume, water spills into the next downstream segment, however there is no outflow from controlled areas of the site during the 22mm event.

The Geotechnical Investigation for the proposed residential development prepared by Paterson Group (May 2023) identifies hydraulic conductivity and infiltration values for the site. Table 2 on the Paterson report outlines infiltration rates determined through Pask Permeameter testing completed within six test pits for general coverage of the site (see table duplicated from the Paterson report below for reference).

Table 5–16: Summary of Field Saturated Hydraulic Conductivity Values and Infiltration Rates

Test Hole ID	Ground Surface Elevation (m)	Depth of Testing (m)	Kfs (m/sec)	Infiltration Rate (mm/hr)	Soil Type
TP1-23	103.01	2.7	Too Fast to Test		Silty to Medium Sand
		3.2	$3.2x10^{-4}$	216	
TP2-23	103.87	2.6	$9.6x10^{-5}$	156	Silty Sand
		3.2	Too Fast to Test		
TP3-23	104.37	2.5	$4.3x10^{-5}$	126	Silty Sand
		3.0	$9.6x10^{-5}$	156	
TP4-23	104.50	2.5	$9.6x10^{-5}$	156	Silty Sand
		3.0	$9.6x10^{-5}$	156	
TP5-23	104.70	2.5	$3.2x10^{-4}$	216	Silty Sand with Gravel, Cobbles, and Occasional Boulders
		3.3	Too Fast to Test		
TP6-23	104.94	2.5	$1.9x10^{-4}$	188	Silty to Medium Sand
		3.2	$2.2x10^{-4}$	195	

Infiltration rate testing at the lowest depth was used to assess inter-event drawdown times for the EES. A safety factor of 3.5 was applied to the minimum infiltration rate at the lower elevation (156mm/hr) per suggestion of the *Low Impact Development Stormwater Management Planning and Design Guide* (Credit Valley Conservation, 2010), and was determined to be approximately 44.6mm/hr. Based on this rate, the known bottom area of the EES, as well as anticipated volume retained per **Table 5-15** above, estimated drawdown rates have been determined for each EES segment in the table below:

Table 5–17: 22mm Event Estimated EES Drawdown Times

Pipe ID	Length (m)	Trench Width (m)	Used Volume $(m^3)^3$	Infiltration Rate (mm/hr)	Drawdown Time (hr)
101-100-E	36.2	1.575	28.6	44.6	11.2
102-101-E	62.9	1.20	35.5	44.6	10.5
103-101-E	32.0	1.425	27.3	44.6	13.4
104-103-E	70.3	1.425	51.5	44.6	11.5
105-104-E	44.7	1.35	37.2	44.6	138

Pipe ID	Length (m)	Trench Width (m)	Used Volume (m^3)[3]	Infiltration Rate (mm/hr)	Drawdown Time (hr)
107-105-E	45.4	1.35	36.7	44.6	13.4
108-107-E	36.1	1.425	30.7	44.6	13.4
109-107-E	70.5	1.20	45.3	44.6	12.0
110-108-E	79.9	1.35	80.4	44.6	16.7

In all cases, drawdown times are less than the required 48 hours.

5.6.1 Etobicoke Exfiltration System Monitoring

Due to the unique nature of the proposed site stormwater management plan, monitoring requirements have been included for construction stages in addition to the post-construction criteria. In order to ensure the stormwater infrastructure is functioning as designed, the following maintenance and monitoring is recommended for the site. Monitoring described below is in addition to groundwater quality monitoring requirements described further within the BSUEA Environmental Management Plan.

5.6.2 Monitoring During Construction

The following practices are recommended during construction:

- Surface flows to be directed away from EES clear stone bedding as it is being installed prior to backfill;
- Fueling of machinery to be done at designated locations away from proposed EES locations;
- Storage of machinery and material, fill, etc. to be done in designated areas away proposed EES locations;
- Equipment movement through proposed EES locations to be controlled;
- Regular inspection and maintenance of erosion control features corresponding to catch basins, catch basin manholes, and perforated subdrains.
- The EES system is to be jet flushed and inspected via CCTV upon construction completion prior to activation.

5.6.3 Monitoring Post Construction

The post-construction monitoring program is recommended to be phased into two periods as follows:

<u>Stage 1 – years 1 to 2:</u> frequent monitoring and inspection following significant rainfall events >22mm or at least twice per year from May to October (inclusive)

<u>Stage 2 – after year 2:</u> annual monitoring and inspection in the spring to identify any maintenance needed as a result of winter weather/operations.

Monitoring during stage 1 will be required to provide sufficient evidence of compliant performance of the LID features as required by the City of Ottawa for LID projects. Monitoring during stage 2 will be required to ensure the system continues to operate properly and is in compliance with assumed criteria outlined in the MECP ECA to be established for the development.

Monitoring locations are to be within manholes located immediately upstream of City rights-of-way to limit requirements for access easements/agreements, as well as to minimize requirements for additional infrastructure and related costs. The proposed monitoring location for the development is manhole STM 100.

Monitoring wells are to be installed at the base of these manholes for groundwater monitoring, and pressure transducers for continuous water level monitoring are to be installed within the adjacent clear stone media of the EES at the upstream perforated pipe connection to monitor water levels within the EES system. Flow monitoring is to be completed for the outgoing traditional storm sewer to identify EES overflows. Grab samples for quality (TSS% sampling) can be attempted within the same manhole locations and are to occur once per year following significant rainfall events (>22mm) during potential EES overflow events, or as determined through continuous water level monitoring. The monitoring program is expected to continue for the entirety of Stage 1.

Monitoring data is to confirm that the facility is able to drawdown to below the invert level of the perforated pipe connection within 48 hours after a significant rainfall event. Significant increase in drawdown time identifies the need for maintenance flushing of the EES system.

During stage 2, annual inspections of the system at the manholes is to visually confirm that drawdown is occurring within the manhole sump to the invert level of the upstream perforated pipe of the EES within 48 hours of a rainfall event.

5.6.4 Annual Maintenance

Annual maintenance of the EES is to occur during both Stages 1 and 2, and is to include:

- Removal of accumulated trash and debris from sumps and grates
- Removal of accumulated sediment depth in manholes / catch basins

Preventative maintenance via jet pressure washing of the conventional and EES system perforated pipes is to occur every 20 years, or as identified through annual drawdown inspections

6.0 GEOTECHNICAL CONSIDERATIONS AND GRADING

6.1 GEOTECHNICAL INVESTIGATION

A geotechnical investigation report for the development was completed by Paterson Group on March 30, 2021, and revised in May 2023. The geotechnical investigation report is included in **Appendix E.3**.

The objective of the investigation was to determine the subsoil and groundwater conditions at this site by means of a borehole program and to provide geotechnical recommendations for the design of the proposed development based on the results on the results of the boreholes and other soil information available.

Based on the Paterson's report, the subject site is a former agricultural land. The bulk of the current phase of the proposed development has been recently cleared of topsoil which has been stockpiled in several piles across the site. Generally, the ground surface across the subject site is relatively flat within the central portion and slopes up towards the edges. It should be noted that parts of the subject site had undergone excavation and in-filling activities as part of a previous sand extraction operation.

Generally, the subsurface profile across the subject site consists of varying amounts of fill consisting of silty sand mixed with occasional silty clay, gravel and cobbles. Practical refusal to augering was encountered at a range between 4.6 m and 8.3 m below existing ground surface.

6.1.1 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be low to moderate and controllable using open sumps. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

A temporary Ministry of the Environment, Conservation and Parks (MECP) permit to take water (PTTW) may be required for this project if more than 400,000 L/day of ground and/or surface water is to be pumped during the construction phase. A minimum of 4 to 5 months should be allowed for completion of the PTTW application package and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. Requirements for a PTTW or EASR registration are to be identified by the geotechnical consultant.

6.2 GRADING PLAN

The proposed development site measures 3.09ha in area. The topography across the site includes a moderate grade change with site grades on the east side of the property measuring approximately three (3) metres higher than the western property line. A detailed Grading Plan (**Drawing GP-1)** has been provided to satisfy the stormwater management requirements, adhere to permissible grade raise restrictions, and provide for minimum cover requirements for the storm and sanitary sewers where possible. Site grading has been established to provide emergency overland flow routes required for stormwater management in accordance with City of Ottawa requirements.

The site maintains emergency overland flow routes for flows in excess of major system storm events to Obsidian Street in accordance with the subdivision design report. A primary grading consideration for this development is the interface between the subject lands and the future Greenbank Road ROW. The proposed elevations along the property line shared with the future Greenbank Road ROW have been coordinated with the design team for Greenbank Road for this submission. As the design for Greenbank Road is currently ongoing, further communication with the City of Ottawa and the design team for Greenbank Road will be required throughout the design stage to ensure the proposed site development utilizes the latest Greenbank Road profiles and resulting property line elevations.

7.0 APPROVALS

An Environmental Compliance Approval (ECA) may be required from the Ontario Ministry of the Environment, Conservation and Parks (MECP) for the proposed works. If the site remains under single ownership, it will comply with the exemptions from O.Reg. 525/98 and an ECA for traditional storm and sanitary sewers as well as the EES system would not be required. These exemptions require that the site is not on industrial land or for industrial use, would drain to an approved outlet and would be under single ownership. If, however, the land will be divided into separate legal properties either through severance or through the condominium process an ECA would then be required for traditional storm and sanitary sewers in addition to the EES. The Rideau Valley Conservation Authority will need to be consulted in order to obtain municipal approval for site development.

An MECP Permit to Take Water (PTTW) or registration on the Environmental Activity and Sector Registry may be required as noted in **Section 6.0** above.

No other approval requirements from other regulatory agencies have been identified at the time of this report.

8.0 EROSION CONTROL

In order to protect downstream water quality and prevent sediment build up in catch basins and storm sewers, erosion and sediment control measures must be implemented during construction. The following recommendations will be included in the contract documents and communicated to the Contractor.

1. Implement best management practices to provide appropriate protection of the existing and proposed drainage system and the receiving water course(s).
2. Limit the extent of the exposed soils at any given time.
3. Re-vegetate exposed areas as soon as possible.
4. Minimize the area to be cleared and grubbed.
5. Protect exposed slopes with geotextiles, geogrid, or synthetic mulches.
6. Provide sediment traps and basins during dewatering works.
7. Install sediment traps (such as SiltSack® by Terrafix) between catch basins and frames.
8. Schedule the construction works at times which avoid flooding due to seasonal rains.

The Contractor will also be required to complete inspections and guarantee the proper performance of their erosion and sediment control measures at least after every rainfall. The inspections are to include:

- Verification that water is not flowing under silt barriers.
- Cleaning and changing the sediment traps placed on catch basins.

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 POTABLE WATER SERVICING

The H2OMAP Water model demonstrates that the pressures in the proposed development's watermain stubs fall within the range of target system pressures with a maximum basic day pressure of 70.2 psi and 61.1 psi at Obsidian Street North (Connection 1) and Obsidian Street South (Connection 2), respectively.

The subject lands can be adequately serviced by the 300mm watermain along Haiku Street and 300mm diameter watermain on Obsidian Street. The private distribution network, consisting of 200 mm and 250 mm diameter watermains, will provide sufficient fire flow to meet FUS requirements. System pressures will fall within the City of Ottawa Water Distribution Guidelines.

9.2 WASTEWATER SERVICING

The total design peak flow for the subject site to be conveyed to the connections at the Obsidian Street. Design flows are slightly higher than the previous estimate of 2.49L/s by DSEL based on a service area of 1.9 ha and population of 162 people. The difference (4.68L/s) can be accommodated by the 200mm receiving sewer in Obsidian Street.

JLR Associates identified in its MSS for BSUEA stated that there is residual capacity within the sanitary sewers draining Mattamy lands west to new Greenbank Road based on a Stantec (2015) hydrodynamic model of trunk sanitary sewers (450 mm in diameter and greater), which in turn demonstrated that the existing downstream trunk system could accommodate the flows generated with no risk of surcharging or basement flooding.

9.3 STORMWATER MANAGEMENT AND SERVICING

The following summarizes the stormwater management conclusions for the proposed development:

- All storm runoff within the site will be controlled and directed to an existing storm control point identified as MH 109 in JFSA SWM model.
- The proposed stormwater management plan is in compliance with the objectives specified in the City of Ottawa Sewer Design Guidelines and in the background reports for the site.
- The minor system (storm sewers) is sized to convey the 2-year storm event under free-flow conditions using City of Ottawa I-D-F parameters.
- ICDs installed on the proposed catch basins force flows in excess of the 2-year event to be conveyed by overland paved areas and stored within proposed parking and access regions.
- Quality control for the development has been provided by an existing downstream oil-grit separator in conjunction with installation of an on-site Etobicoke Exfiltration System.

An Etobicoke Exfiltration System has been proposed to be located below the storm sewer on private roads of the subject site to meet water balance requirements of the BSUEA. The stormwater drainage plan has been designed to achieve stormwater servicing that is free of conflict with other services, respects the stormwater management requirement listed in background studies and in conformity with the City of Ottawa guidelines.

9.4 GRADING

The topography across the site includes a moderate grade change with site grades on the east side of the property measuring three (3) metres higher than the western property line. A detailed Grading Plan has been provided to satisfy the stormwater management requirements, adhere to permissible grade raise restrictions, and provide for minimum cover requirements for the storm and sanitary sewers where possible. A primary grading consideration for this development is the interface between the subject lands and the future Greenbank Road ROW.

9.5 APPROVALS/PERMITS

An Environmental Compliance Approval (ECA) will be required from the Ontario Ministry of the Environment, Conservation and Parks (MECP) for the proposed works. An MECP Permit to Take Water (PTTW) or registration on the Environmental Activity and Sector Registry may be required as noted in Section 6.0 above. No other approval requirements from other regulatory agencies were identified at the time of this report. The Rideau Valley Conservation Authority will need to be consulted to obtain municipal approval for site development.

E.3 GEOTECHNCIAL INVESTIGATION REPORT BY PATERSON INC.

PATERSON GROUP

Geotechnical Investigation

Proposed Residential Development

Half Moon Bay South – Phase 8
3718 Greenbank Road - Ottawa

Prepared for Mattamy Homes

Report PG5690-1 Revision 4 dated May 9, 2023

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1.0 Introduction

Paterson Group (Paterson) was commissioned by Mattamy Homes to conduct a geotechnical investigation for the proposed development located at 3718 Greenbank Road, in the City of Ottawa (refer to Figure 1 - Key Plan presented in Appendix 2).

The objectives of the geotechnical investigation were to:

- Determine the subsoil and groundwater conditions at this site by means of borehole and test pit program.

- Provide geotechnical recommendations for the design of the proposed development based on the results of the boreholes and other soil information available.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes geotechnical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report.

2.0 Proposed Development

It is understood that the current phase of the proposed development will consist of residential condominium blocks with or without basements and a commercial block. Associated driveways, local roadways and landscaping areas are also anticipated as part of the proposed development. Specific details of the commercial block were not available at the time of issuance of this report. Therefore, our present recommendations should not be considered for the commercial block development until review of the block details can be completed by Paterson.

It is further understood that the proposed development will be serviced by future municipal water, sanitary and storm services.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The initial field program for the current geotechnical investigation was carried out between February 17 and 23, 2021 and consisted of advancing a total of 12 boreholes to a maximum depth of 9.8 m below the existing grade.

A supplemental field program for the current geotechnical investigation was carried out between July 11 and 12, 2021 and consisted of advancing a total of 7 boreholes to a maximum depth of 8.2 m below the existing grade. The scope of the supplemental field program was to further delineate the fill material placed throughout the south and southwest portions of the site.

An additional test pitting program was recently conducted on April 25, 2023 and consisted of advancing 6 test pits to a maximum depth of 5.0 m below the existing grade. The scope of the additional field program was to determine the hydraulic conductivity and infiltration rates of the native soils below the inverts of the proposed Low Impact Design (LID) system.

Previous investigations were completed within the general area and surroundings of the subject site and consisted of a series of boreholes and test pits advanced to a maximum depth of 9.1 m below ground surface. The borehole locations were distributed in a manner to provide general coverage of the subject site and taking into consideration current site conditions. The test holes locations and fill locations are shown on Drawings PG5690-1 - Test Hole Location Plan and PG5690-2 - Fill Delineation Plan, respectively, included in Appendix 2.

The test holes were completed using a track mounted drill operated by a two-person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer. The drilling procedure consisted of drilling to the required depths at the selected locations, and sampling and testing the overburden.

Sampling and In Situ Testing

Soil samples were collected from the boreholes by sampling directly from the auger flights (AU) or collected using a 50 mm diameter split- spoon (SS) sampler. Grab samples (G) from the test pits were recovered from the side walls of the open excavation. The depths at which the auger, and split-spoon samples were recovered from the test holes are shown as AU, SS, and G, respectively, on the Soil Profile and Test Data sheets presented in Appendix 1.

All soil samples were visually inspected and initially classified on site. The auger, split-spoon and grab samples were placed in sealed plastic bags and transported to the our laboratory for examination and classification.

A Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split-spoon samples. The SPT results are recorded as “N” values on the Soil Profile and Test Data sheets. The “N” value is the number of blows required to drive the split-spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

The thickness of the silty sand deposit was evaluated by a dynamic cone penetration testing (DCPT) completed at BH 7-21. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at the tip, using a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment.

The subsurface conditions observed at the test hole locations were recorded in detail in the field. Our findings are presented in the Soil Profile and Test Data sheets in Appendix 1.

Groundwater Monitoring

Boreholes BH 1-21 to BH 12-21 were fitted with flexible piezometers to allow groundwater level monitoring. The groundwater observations are discussed in Subsection 4.3 and presented in the Soil Profile and Test Data sheets in Appendix 1.

Sample Storage

All samples from the supplemental field program will be stored in the laboratory for a period of one month after issuance of this report. They will then be discarded unless we are otherwise directed.

3.2 Field Survey

The test hole locations were determined by Paterson personnel and surveyed in the field by Paterson using a handheld, high precision GPS. The ground surface elevation at each test hole location is referenced to a geodetic datum. The locations of the boreholes are presented on Drawing PG5690-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Soil samples were collected from the subject site during the investigations and were visually examined in our laboratory to review the results of the field logging. A total of five (5) grain size distribution analyses were completed on selected soil samples as part of the initial and additional field programs. The results of our testing are presented in Subsection 4.2 and on Grain Size Distribution Analysis sheets presented in Appendix 1.

3.4 Analytical Testing

One (1) soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The sample was submitted to determine the concentration of sulphate and chloride, the resistivity and the pH of the sample. The results are presented in Appendix 1 and are discussed further in Subsection 6.7

3.5 Permeameter Testing

In-situ permeameter testing was conducted using a Pask (Constant Head Well) Permeameter to confirm infiltration rates of the surficial soils at the subject site. At each location, two (2) 83 mm holes, located approximately 1.5 m away each other, were excavated using a Riverside/Bucket auger to approximate depths ranging from 2.5 to 2.7 and 3.0 to 3.2 m below the existing ground surface. All soils from the auger flights were visually inspected and initially classified on-site. The permeameter reservoir was filled with water and inverted into the hole, ensuring that it was relatively vertical and rested on the bottom of the hole. As the water infiltrated into the soil, the water level of the reservoir was monitored at various time intervals until the rate of fall reached equilibrium, known as *"quasi steady state"* flow rate. Quasi steady state flow can be considered to have been obtained after measuring 3 to 5 consecutive rate of fall readings with identical values. The values for the steady state rate of fall were recorded for each location.

The results of testing are further discussed in Subsection 4.4.

4.0 Observations

4.1 Surface Conditions

The subject site is former agricultural land. The bulk of the current phase of the proposed development has been recently cleared of topsoil, peat and fill which has been stockpiled in several piles across the site.

The ground surface across the condominium block is currently flat and gradually slopes down in a northern direction from an approximate geodetic elevation of 105 to 103 m and is about 1.5 m lower than the adjacent areas. The commercial block (southern portion) is observed to contain piles of fill material to an approximate elevation of 106 to 109 m.

It should be noted that parts of the subject site had undergone excavation and in-filling activities as part of a previous sand extraction operation. Historical aerial photographs of the site indicating fill movement activities since 1976 are presented in Appendix 2.

The site is bordered to the north and south by vacant land, to the west by existing residential development, and the east by the future Greenbank Road.

4.2 Subsurface Profile

Generally, the subsurface profile across the subject site consisted of a fill layer and/or a deep deposit of brown silty sand.

Fill, consisting of brown silty sand with varying amounts of gravel, crushed stone, cobble, clay and topsoil, were generally observed in test holes across the subject site with an approximate thickness ranging between 0.2 and 2.9 m. The fill layers extended deep to maximum depths of 4.6, 8.2, 8.2 and 6.7 m in boreholes BH 9-21, BH 10-21, BH 11-21, and BH 19-21, respectively. A significant amount of fill material was present above the existing surface within the proposed commercial block (southern portion) with a thickness of 4.6 to 8.2 m and an approximate minimum geodetic elevation of 97.8 m.

The deep deposit of compact to very dense, brown silty sand was observed underlying the fill layer, or at ground surface. Gravel and cobbles were occasionally encountered within the silty sand layer. The silty sand was observed to be underlain by a glacial till deposit composed of dense, brown sandy silt to silty sand with gravel, cobbles and boulders within borehole BH 3-21.

Practical refusal to augering was encountered at a range between 4.6 and 9.0 m below ground surface. Practical refusal to DCPT was encountered at 9.8 m below existing ground surface at borehole BH 7-21.

Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for specific details of the soil profiles encountered at each test hole location.

Bedrock

Based on available geological mapping, the bedrock in the subject area consists of Paleozoic interbedded Sandstone and Dolomite from the March formation, with an overburden drift thickness of 10 to 15 m depth.

Grain Size Distribution and Hydrometer Testing

Grain size distribution (sieve and hydrometer analysis) testing was completed on three selected soil samples. The results of the grain size analysis are summarized in Table 1 and presented on the Grain-Size Distribution and Hydrometer Testing Results sheets in Appendix 1.

Table 1- Grain Size Distribution

Test Hole	Sample	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH2-21	SS3 & SS4	1.5-2.9	1.8	89.4	8.8	
BH4-21	SS4 & SS5	2.3-3.7	0.0	88.9	11.1	
BH8-21	SS4 & SS5	2.3-3.7	46.9	43.1	10.0	
TP2-23	G4	2.4-2.7	0.0	94.6	5.4	
TP5-23	G4	2.2-2.5	31.3	67.2	1.5	

4.3 Groundwater

Groundwater levels were measured in piezometers on March 4, 2021. The piezometers in BH 7-21, BH 11-21 and BH 12-21 were damaged or buried and could not be recorded. The remaining boreholes were dry upon completion. Also, no groundwater was observed during the 2023 test pit program.

Long-term groundwater levels can also be estimated based on the observed moisture levels, colour and consistency of the recovered soil samples. Based on these observations, the long-term groundwater table can be expected well below 8 m below existing ground surface. It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater level could vary at the time of construction.

4.4 Low Impact Development Review

Based on the latest Site Servicing Plan prepared by Stantec Consulting Ltd. dated January 14, 2022, it is our understanding that Low Impact Development (LID) measures are being considered for the current phase of the proposed development. It is further understood that the proposed LID will incorporate a treatment train approach that includes an Etobicoke Exfiltration System (EES) along select roadways within the proposed development.

Upon reviewing the subsurface profile across the subject site and the site servicing plan details, it is anticipated that the subsoil below the proposed exfiltration system will generally consist of either a deep silty sand deposit with varying amounts of gravel, or fill material comprised of silty sand with varying amounts of silty clay, gravel and cobbles. The silty sand deposit has been identified within the north and central portion of the current phase, while the fill material has been generally observed within the south portion of the development.

Hydraulic Conductivity and Infiltration Values (Permeameter Tests)

Permeameter tests were conducted at 6 locations (2 tests at each location) to provide general coverage of the subject site on April 25, 2023. Preparation and testing of this investigation are in accordance with the Canadian Standards Association (CSA) B65-12-Annex E. Field saturated hydraulic conductivity (K_{fs}) values and estimated infiltration values are presented in Table 2 below.

Field saturated hydraulic conductivity values were determined using the Engineering Technologies Canada (ETC) Ltd. Reference tables provided in the most recent ETC Past Permeameter User Guide dated July 2018. Infiltration rates have been determined based on approximate relationships provided by the Ontario Ministry of Municipal Affairs and Housing – Supplementary Guidelines to the Ontario Building Code, 1997 – SG-6 – Percolation Time and Soil Descriptions.

Table 2 – Summary of field saturated hydraulic conductivity values and infiltration rates

Test Hole ID	Ground Surface Elevation (m)	Depth of Permeameter Testing (m)	K_{fs} (m/sec)	Infiltration Rate (mm/hr)	Soil Type
TP 1-23	103.01	2.7	Too fast to test		Silty to medium sand
		3.2	3.2×10^{-4}	216	

Table 2 – Summary of field saturated hydraulic conductivity values and infiltration rates

Test Hole ID	Ground Surface Elevation (m)	Depth of Permeameter Testing (m)	K_{fs} (m/sec)	Infiltration Rate (mm/hr)	Soil Type
TP 2-23	103.87	2.6	9.6x10^{-5}	156	Silty sand
		3.2	Too fast to test		
TP 3-23	104.37	2.5	4.3x10^{-5}	126	Silty sand
		3.0	9.6x10^{-5}	156	
TP 4-23	104.50	2.5	9.6x10^{-5}	156	Silty sand
		3.0	9.6x10^{-5}	156	
TP 5-23	104.70	2.5	3.2x10^{-4}	216	Silty sand with gravel, cobbles and occasional boulders
		3.3	Too fast to test		
TP 6-23	104.94	2.5	1.9x10^{-4}	188	Silty to medium sand
		3.2	2.2x10^{-4}	195	

Suitability of LID's

Given the measured field saturated hydraulic conductivity and infiltration rates noted in Table 2, both the native silty sand deposit and fill material anticipated below the proposed exfiltration system are considered suitable for the use of LIDs.

Across the majority of the site, infiltration rates ranged from 126 to 216 mm/hr. Therefore, the proposed EES is considered suitable from a geotechnical perspective. However, it is important to note that the infiltration rates derived from the K_{fs} values in the table above are unfactored. Prior to use for design purposes, a minimum safety correction factor of 2.5 will need to be applied to the above infiltration rates to account for a number of factors including variations in soil composition and anticipated accumulation of fine-grained material over time. It should also be noted that for most LID measures, the bottom of the facility should be separated at least 1 m from the highest groundwater table.

Groundwater

Based on the groundwater levels and physical soil parameters that were measured during the field investigations, the long-term groundwater table is expected at a depth greater than 8 to 9 m below existing ground surface. As such, sufficient separation between the proposed exfiltration system and the groundwater table is anticipated at the subject site.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed residential development. It is anticipated that the proposed buildings will be founded over conventional footings placed over an undisturbed compact to dense silty sand or dense glacial till bearing surface or an engineered fill pad over an approved fill subgrade bearing medium.

To adequately distribute the foundation loads in areas where the existing fill is encountered below the building footprint, a woven geotextile liner, such as Terratrack 200 or equivalent, should be placed 500 mm below design underside of footing level and extend at least 1 m horizontally beyond the footing face. A biaxial geogrid, such as Terrafix TBX2500 or equivalent, should be placed over the woven geotextile liner. A minimum 500 mm thick pad, consisting of a Granular B Type II, compacted to 98% of its SPMDD should be placed up to design underside of footing level. Prior to placement of the above noted engineered fill pad, it is recommended that a proof-rolling program be completed by a vibratory roller making several passes and approved by Paterson personnel over the sub-excavated area below the proposed footings.

For areas where a fill layer is encountered below the granular layer for the floor slab, it is recommended to sub-excavate 500 mm below the underside of floor slab granulars and place a woven geotextile liner, such as Terratrack 200W or equivalent, and a biaxial geogrid, such as Terrafix TBX2500 or equivalent. It is recommended that a proof-rolling program be completed by a vibratory roller making several passes and approved by Paterson personnel prior to placement of the geotextile liner and biaxial geogrid. Any poor performing areas should be removed and reinstated with a select subgrade fill compacted to 98% of its SPMDD under dry and above freezing temperatures.

The proof-rolling program should also be completed across paved areas to ensure that any poor performing soils are removed prior to pavement structure placement.

Due to the absence of a silty clay deposit, the aforementioned site will not be subjected to permissible grade raise restrictions. Also, no tree planting setback restrictions are required for the subject phase of the proposed development due to the absence of a silty clay deposit.

The above and other considerations are further discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing organic materials, should be stripped from under any buildings, paved areas, pipe bedding and other settlement sensitive structures.

Fill Placement

Fill used for grading beneath the proposed building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. The fill should be placed in lifts of 300 mm thick or less and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the building areas should be compacted to at least 99% of the Standard Proctor Maximum Dry Density (SPMDD).

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill and beneath parking areas where settlement of the ground surface is of minor concern. In landscaped areas, these materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of the SPMDD.

Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

Proof Rolling

Proof rolling of the subgrade is required in areas where the existing fill, free of significant amounts of organics and deleterious materials, is encountered. It is recommended that the subgrade surface be proof-rolled **under dry conditions and in above freezing temperatures** by an adequately sized roller making several passes to achieve optimum compaction levels. The compaction program should be reviewed and approved by the geotechnical consultant at the time of construction.

5.3 Foundation Design

Conventional Spread Footing

Footings placed directly on an undisturbed, compact silty sand or glacial till bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **225 kPa**. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

Footings placed over a minimum 500 mm thick geogrid reinforced engineered pad, consisting of a Granular A or Granular B Type II or approved granular fill alternative placed in maximum 300 mm loose lifts and compacted to 98% of its SPMDD, placed over a subgrade soil approved by the Paterson personnel at the time of construction, can be designed using a bearing resistance value at SLS of **150 kPa** and a factored bearing resistance value at ULS of **250 kPa**.

An undisturbed soil bearing surface consists of a surface from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

Footings placed on a soil bearing surface and designed using the bearing resistance values at SLS given above will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively.

Where the silty sand subgrade is found to be in a loose state, the contractor should compact the subgrade under dry conditions and above freezing temperatures, using suitable compaction equipment, making several passes and approved by Paterson.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to the in-situ bearing medium soils above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class D**. Based on the current information, including the level of groundwater table and compactness of the underlying sand layer, the soil underlying the subject site is not susceptible to liquefaction. Reference should be made to the latest revision of the 2012 Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Basement Slab

With the removal of all topsoil and fill, containing significant amounts of deleterious or organic materials, the native soil and/or approved fill pad (placed as per Subsection 5.0) will be considered to be an acceptable subgrade surface on which to commence backfilling for the floor slab. Any poor performing areas should be removed and reinstated with an engineered fill, such as Granular B Type II.

For slab-on-grade areas, it is recommended that the upper 200 mm of sub-slab fill consist OPSS Granular A crushed stone. For basement slabs, it is recommended that the upper 200 mm of sub-floor fill consist of 19 mm clear crushed stone

5.6 Basement Wall

There are several combinations of backfill materials and retained soils that could be applicable for the basement walls of the subject structure. However, the conditions can be well-represented by assuming the retained soil consists of a material with an angle of internal friction of 30 degrees and a bulk (drained) unit weight of 18 kN/m^3.

Where undrained conditions are anticipated (i.e. below the groundwater level), the applicable effective (undrained) unit weight of the retained soil can be taken as 13 kN/m^3, where applicable. A hydrostatic pressure should be added to the total static earth pressure when using the effective unit weight.

Lateral Earth Pressure

The static horizontal earth pressure (p_o) can be calculated using a triangular earth pressure distribution equal to $K_o \cdot \gamma \cdot H$ where:

K_o = at-rest earth pressure coefficient of the applicable retained soil (0.5)
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)

An additional pressure having a magnitude equal to $K_o \cdot q$ and acting on the entire height of the wall should be added to the above diagram for any surcharge loading, q (kPa), that may be placed at ground surface adjacent to the wall. The surcharge pressure will only be applicable for static analyses and should not be used in conjunction with the seismic loading case.

Actual earth pressures could be higher than the “at-rest” case if care is not exercised during the compaction of the backfill materials to maintain a minimum separation of 0.3 m from the walls with the compaction equipment.

Seismic Earth Pressures

The total seismic force (P_{AE}) includes both the earth force component (P_o) and the seismic component (ΔP_{AE}).

The seismic earth force (ΔP_{AE}) can be calculated using $0.375 a_c \cdot \gamma \cdot H^2/g$ where:

a_c = $(1.45 - a_{max}/g) a_{max}$
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)
g = gravity, 9.81 m/s^2

The peak ground acceleration, (a_{max}), for the Ottawa area is 0.32g according to OBC 2012. Note that the vertical seismic coefficient is assumed to be zero.

The earth force component (P_o) under seismic conditions can be calculated using $P_o = 0.5 K_o \gamma H^2$, where $K_o = 0.5$ for the soil conditions noted above.

The total earth force (P_{AE}) is considered to act at a height, h (m), from the base of the wall, where:

$h = \{P_o \cdot (H/3) + \Delta P_{AE} \cdot (0.6)$

5.7 Pavement Structure

Driveways, local residential roadways, heavy truck parking/loading areas and roadways with bus traffic are anticipated at this site. The proposed pavement structures are shown in Tables 3, 4 and 5 below.

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project. If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable vibratory equipment. Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

Table 3 - Recommended Pavement Structure - Driveways and at-grade car parking areas

Thickness (mm)	Material Description
50	**Wear Course** - HL 3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 4 - Recommended Pavement Structure - Local Residential Roadways and Heavy Truck Parking / Loading Areas

Thickness (mm)	Material Description
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
400	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil	

Table 5 - Recommended Pavement Structure - Roadways with Bus Traffic

Thickness mm	Material Description
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete
50	**Upper Binder Course** - Superpave 19.0 Asphaltic Concrete
50	**Lower Binder Course** - Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
600	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either in situ soil or OPSS Granular B Type II material placed over in situ soil	

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

A perimeter foundation drainage system is recommended for proposed structures. The system should consist of a 100 to 150 mm diameter, geotextile-wrapped, perforated, corrugated, plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Foundation Backfill

Backfill against the exterior sides of the foundation walls should consist of free-draining, non frost susceptible granular materials. The site materials will be frost susceptible and, as such, are not recommended for re-use as backfill unless a composite drainage system (such as system Delta Drain 6000 or Miradrain G100N) connected to a perimeter drainage system is provided.

6.2 Protection Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effect of frost action. A minimum 1.5 m thick soil cover should be provided for adequate frost protection of heated structured, or an equivalent combination of soil cover and foundation insulation.

Exterior unheated footings, such as those for isolated exterior piers and loading docks, are more prone to deleterious movement associated with frost action than the exterior walls of the heated structure and require additional protection, such as soil cover of 2.1 m or an equivalent combination of soil cover and foundation insulation.

6.3 Excavation Side Slopes

The side slopes of the excavations in the soil and fill overburden materials should either be cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is expected that sufficient room will be available for the greater part of the excavation to be undertaken by open- cut methods (i.e. unsupported excavations).

Unsupported Excavations

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or shallower. The shallower slope is required for excavation below groundwater level. The subsoil at this site is considered to be mainly Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by “cut and cover” methods and excavations will not be left open for extended periods of time.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications and Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Services Branch of the City of Ottawa.

At least 150 mm of OPSS Granular A should be used for pipe bedding for sewer and water pipes. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe, should consist of OPSS Granular A or Granular B Type II with a maximum size of 25 mm. The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to 98% of the material’s SPMDD.

It should generally be possible to re-use the site excavated materials above the cover material if the operations are carried out in dry weather conditions.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone, (about 1.5 m below finished grade) and above the cover material should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 225 mm thick lifts and compacted to 95% of the materials SPMDD.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be low to moderate and controllable using open sumps. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

Permit to Take Water

A temporary Ministry of the Environment, Conservation and Parks (MECP) permit to take water (PTTW) may be required for this project if more than 400,000 L/day of ground and/or surface water is to be pumped during the construction phase. A minimum of 4 to 5 months should be allowed for completion of the PTTW application package and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

6.6 Winter Construction

Precautions must be taken if winter construction is considered for this project, where excavations are completed in proximity of existing structures which may be adversely affected due to the freezing conditions.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the installation of straw, propane heaters and tarpaulins or other suitable means. The base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

Trench excavations and pavement construction are difficult activities to complete during freezing conditions without introducing frost in the subgrade or in the excavation walls and bottoms. Precautions should be considered if such activities are to be completed during freezing conditions. Additional information could be provided, if required.

6.7 Corrosion Potential and Sulphate

The results on analytical testing show that the sulphate content is less than 0.1%. The results are indicative that Type 10 Portland Cement (normal cement) would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a very low to slightly aggressive corrosive environment.

7.0 Recommendations

It is recommended that the following be completed once the master plan and site development are determined.

- ❑ Review detailed grading plan(s) from a geotechnical perspective.
- ❑ Observation of all bearing surfaces prior to the placement of concrete.
- ❑ Sampling and testing of the concrete and fill materials.
- ❑ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- ❑ Observation of all subgrades prior to backfilling.
- ❑ Field density tests to determine the level of compaction achieved.
- ❑ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that these works have been conducted in general accordance with Paterson's recommendations could be issued upon the completion of a satisfactory material testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

The recommendations made in this report are in accordance with Paterson's present understanding of the project. Paterson requests permission to review the grading plan once available. Paterson's recommendations should be reviewed when the drawings and specifications are complete.

The client should be aware that any information pertaining to soils and the test hole log are furnished as a matter of general information only. Test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests to be notified immediately in order to permit reassessment of the recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Mattamy Homes, or their agents, is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of the report.

Paterson Group Inc.

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Report Distribution:

- ❑ Mattamy Homes (email copy)
- ❑ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

GRAIN SIZE DISTRIBUTION ANALYSIS

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay South-Phase 8 - 3718 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

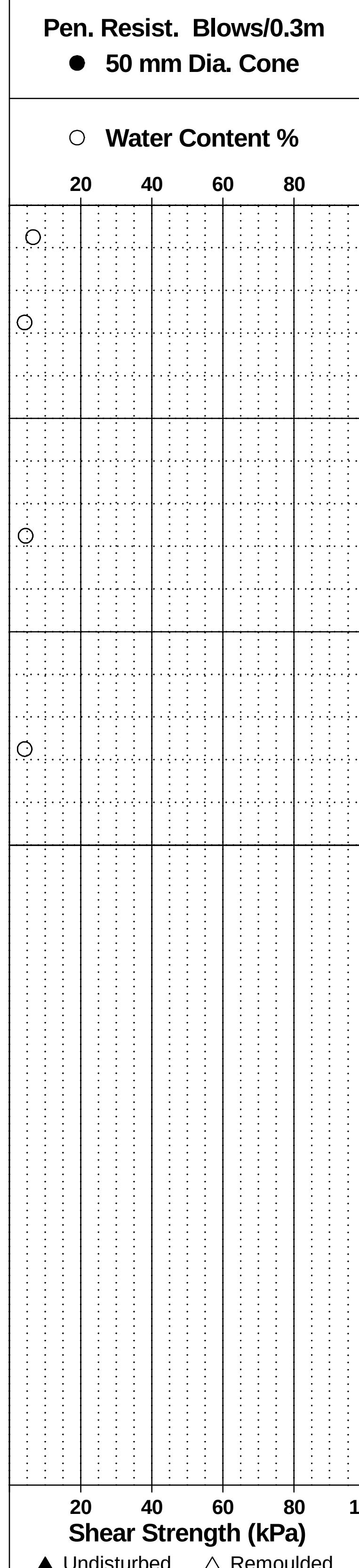
FILE NO. **PG5690**

REMARKS

HOLE NO. **TP 1-23**

BORINGS BY Backhoe **DATE** April 25, 2023

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
Ground Surface						0	103.01	
FILL: Brown silty sand, some gravel, crushed stone, wood and trash		G	1					
0.40								
		G	2					
						1	102.01	
Compact, brown **SILTY SAND,** trace gravel		G	3					
						2	101.01	
		G	4					
3.00						3	100.01	
End of Test Pit								



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay South-Phase 8 - 3718 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Backhoe

DATE April 25, 2023

FILE NO. PG5690

HOLE NO. TP 2-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
Ground Surface						0	103.87		
FILL: Brown silty sand, some gravel, crushed stone, wood and trash (to 0.20)		G	1						
Compact, brown **SILTY SAND**		G	2						
						1	102.87		
		G	3						
						2	101.87		
		G	4						
(to 3.00)						3	100.87		
End of Test Pit									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay South-Phase 8 - 3718 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Backhoe

DATE April 25, 2023

FILE NO. PG5690

HOLE NO. TP 3-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
Ground Surface						0	104.37		
FILL: Brown silty sand, some topsoil, gravel, crushed stone, cobbles, boulders, trace clay and organics		G	1						
1.00						1	103.37		
Compact, brown **SILTY SAND**		G	2						
		G	3			2	102.37		
		G	4			3	101.37		
						4	100.37		
		G	5						
5.00						5	99.37		
End of Test Pit									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay South-Phase 8 - 3718 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Backhoe

DATE April 25, 2023

FILE NO. PG5690

HOLE NO. TP 4-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
Ground Surface						0	104.50		
FILL: Brown silty sand, some gravel, crushed stone, trace organics (to 0.20)		G	1						
Compact, brown **SILTY SAND**		G	2						
						1	103.50		
		G	3						
						2	102.50		
		G	4						
						3	101.50		
						4	100.50		
		G	5						
End of Test Pit (5.00)						5	99.50		

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay South-Phase 8 - 3718 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Backhoe

DATE April 25, 2023

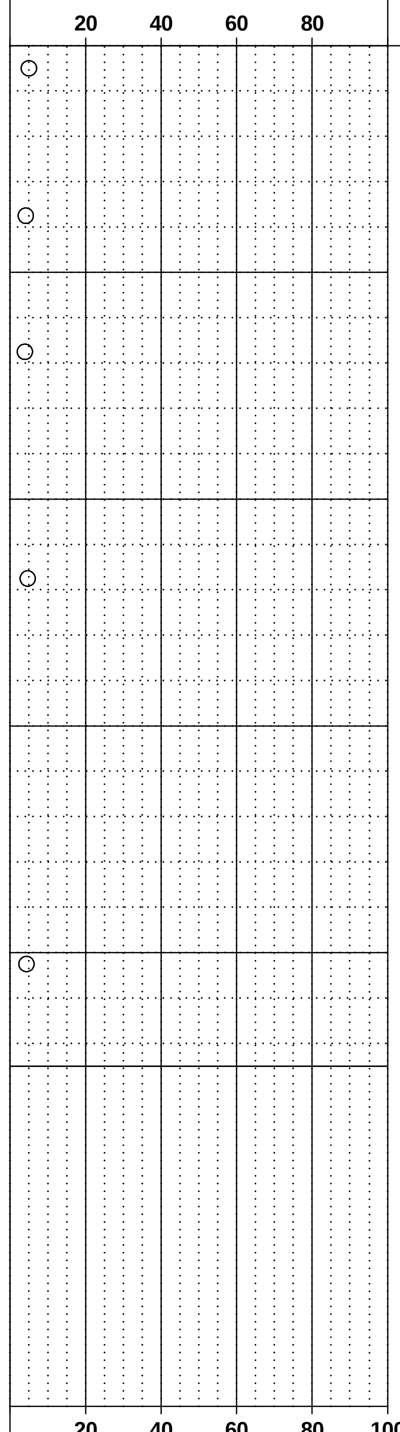
FILE NO. PG5690

HOLE NO. TP 5-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
Ground Surface						0	104.70
FILL: Brown silty sand, some gravel and crushed stone, occasional cobbles and boulders (0.20)		G	1				
Compact, brown **SILTY SAND,** trace gravel (1.20)		G	2			1	103.70
Dense, brown **SILTY SAND** with gravel, cobbles and boulders		G	3			2	102.70
		G	4			3	101.70
(4.50)		G	5			4	100.70
End of Test Pit							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay South-Phase 8 - 3718 Greenbank Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Backhoe

DATE April 25, 2023

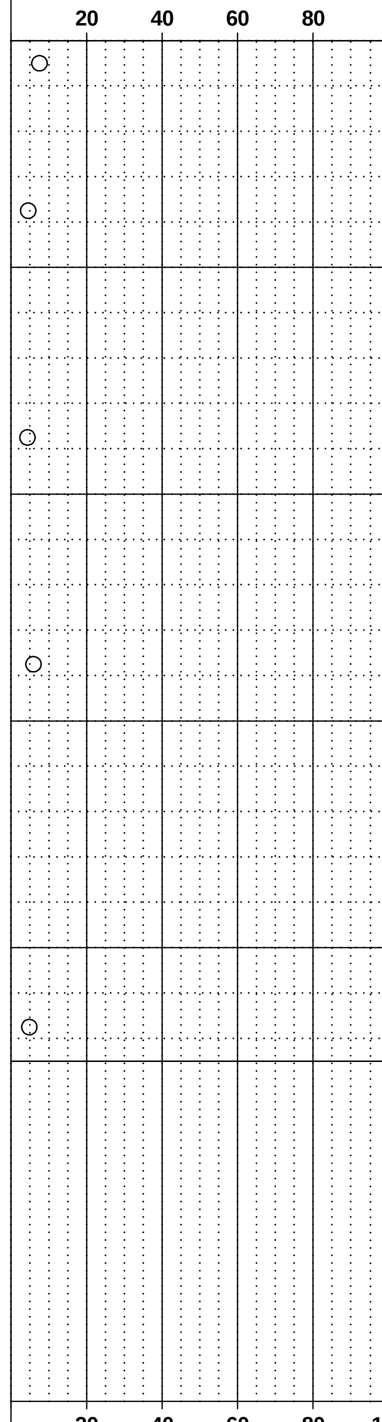
FILE NO. PG5690

HOLE NO. TP 6-23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
Ground Surface						0	104.94
FILL: Brown silty sand, trace gravel, crushed stone and organics (to 0.20)		G	1				
Compact, brown **SILTY SAND**		G	2			1	103.94
		G	3			2	102.94
		G	4			3	101.94
		G	5			4	100.94
End of Test Pit (4.50)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Piezometer Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

FILE NO. **PG5690**

REMARKS

HOLE NO. **BH 1-21**

BORINGS BY CME 55 Power Auger

DATE 2021 February 17

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.45
Compact to dense, brown **SILTY SAND**	AU	1				
	SS	2	75	17	1	102.45
	SS	3	75	14	2	101.45
	SS	4	83	17		
- Trace gravel by 3.0 m depth	SS	5	83	13	3	100.45
	SS	6	67	25	4	99.45
	SS	7	75	11	5	98.45
	SS	8	75	20		
	SS	9	83	27	6	97.45
	SS	10	92	35	7	96.45
	SS	11	83	24	8	95.45
8.99	SS	12	83	32		

End of Borehole

(Piezometer dry - March 4, 2021)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2021 February 17

FILE NO. PG5690

HOLE NO. BH 2-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	102.61
Compact to dense, brown **SILTY SAND**		AU	1				
		SS	2	75	25	1	101.61
		SS	3	75	19	2	100.61
		SS	4	75	56		
		SS	5	83	32	3	99.61
		SS	6	67	39	4	98.61
		SS	7	75	28	5	97.61
		SS	8	75	32		
		SS	9	75	33	6	96.61
		SS	10	75	30	7	95.61
- Trace gravel by 7.5 m depth		SS	11	75	37	8	94.61
8.99		SS	12	75	30		
End of Borehole							
(Piezometer dry - March 4, 2021)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

FILE NO. PG5690

REMARKS

HOLE NO. BH 3-21

BORINGS BY CME 55 Power Auger

DATE 2021 February 18

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	107.88
FILL: Brown silty sand, some crushed stone and gravel (to 0.61)		AU	1				
Dense brown **SILTY SAND** some gravel (0.61 to 1.07)							
GLACIAL TILL: Dense brown sandy silt to silty sand with gravel, cobbles and boulders (1.07 to 6.86)		SS	2	33	+50	1	106.88
		SS	3	25	+50	2	105.88
		SS	4	50	+50	3	104.88
		SS	5	50	+50	4	103.88
		SS	6	33	+50	5	102.88
		SS	7	42	+50	6	101.88
		SS	8	33	+50		
		SS	9	42	+50		
6.86							

End of Borehole

Practical refusal to augering at 6.86 m depth

(Piezometer dry - March 4, 2021)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2021 February 18

FILE NO. PG5690

HOLE NO. BH 4-21

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	105.21
FILL: Brown silty sand some clay, gravel, cobbles, trace topsoil	AU	1				
0.76						
Compact to dense, brown **SILTY SAND**	SS	2	50	14	1	104.21
	SS	3	50	27	2	103.21
	SS	4	83	28		
	SS	5	83	25	3	102.21
	SS	6	83	30	4	101.21
	SS	7	83	28	5	100.21
	SS	8	83	34		
	SS	9	83	35	6	99.21
	SS	10	83	29	7	98.21
	SS	11	75	25	8	97.21
	SS	12	58	31		
8.99						

End of Borehole

(Piezometer dry - March 4, 2021)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

FILE NO. **PG5690**

REMARKS

HOLE NO. **BH 5-21**

BORINGS BY CME 55 Power Auger

DATE 2021 February 18

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	105.57
FILL: Brown silty sand with clay, gravel, trace topsoil		AU	1				
0.81							
Compact to dense, reddish brown **SILTY SAND**		SS	2	58	25	1	104.57
		SS	3	58	7	2	103.57
- Brown by 2.2 m depth		SS	4	83	14		
		SS	5	83	9	3	102.57
		SS	6	58	18	4	101.57
		SS	7	83	32	5	100.57
		SS	8	100	16	6	99.57
		SS	9	83	11		
		SS	10	75	19	7	98.57
		SS	11	75	23	8	97.57
		SS	12	75	24		
8.99							
End of Borehole							
(Piezometer dry - March 4, 2021)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2021 February 19

FILE NO. PG5690

HOLE NO. BH 6-21

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.25
FILL: Brown silty sand	AU	1				
0.61					1	102.25
Compact to dense brown **SILTY SAND**	SS	2	75	46		
	SS	3	58	22	2	101.25
	SS	4	75	25		
	SS	5	75	23	3	100.25
	SS	6	67	29	4	99.25
	SS	7	67	28	5	98.25
	SS	8	67	26		
	SS	9	75	27	6	97.25
	SS	10	67	22	7	96.25
	SS	11	67	22	8	95.25
8.99	SS	12	67	20		
End of Borehole						
(Piezoemter dry - March 4, 2021)						

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

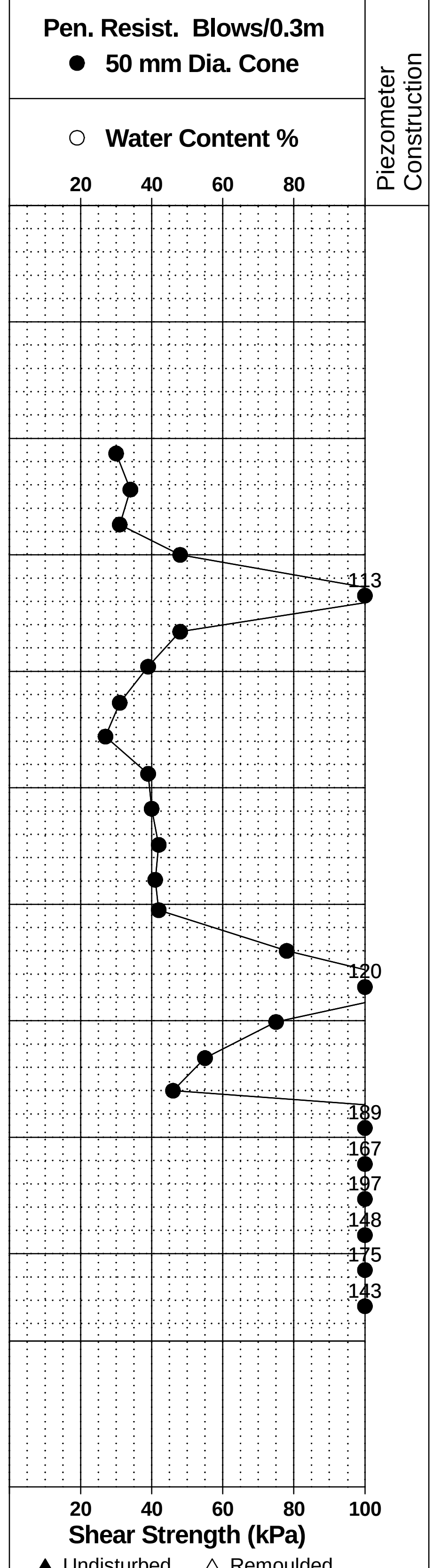
FILE NO. PG5690

REMARKS

HOLE NO. BH 7-21

BORINGS BY CME 55 Power Auger **DATE** 2021 February 19

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.78
FILL: Brown silty sand, some gravel		AU	1				
0.84							
Compact to dense, brown **SILTY SAND**		SS	2	50	25	1	102.78
		SS	3	75	28	2	101.78
Dynamic Cone Penetration Test commenced at 2.13 m depth.		SS	4	75	17		
		SS	5	75	17	3	100.78
		SS	6	67	20	4	99.78
- Trace gravel by 4.5 m depth		SS	7	67	53	5	98.78
		SS	8	67	45	6	97.78
		SS	9	67	23		
- Some gravel by 6.7 m depth		SS	10	75	49	7	96.78
		SS	11	67	83	8	95.78
		SS	12	75	57	9	94.78
Practical refusal to augering 8.99 m depth							
9.75							
End of Borehole							
Practical refusal to DCPT at 9.75 m depth							



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

FILE NO. PG5690

REMARKS

HOLE NO. BH 8-21

BORINGS BY CME 55 Power Auger

DATE 2021 February 22

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	106.13
FILL: Brown silty sand with gravel and crushed stone (to 0.61)	AU	1				
Compact to dense, brown **SILTY SAND** with gravel and cobbles	SS	2	75	47	1	105.13
	SS	3	75	55	2	104.13
	SS	4	50	45		
	SS	5	50	51	3	103.13
	SS	6	50	56	4	102.13
	SS	7	33	49	5	101.13
	SS	8	50	61	6	100.13
	SS	9	50	24		
	SS	10	33	31	7	99.13
	SS	11	50	51	8	98.13
(to 8.38)						

End of Borehole

Practical refusal to augering at 8.38 m depth

(Piezometer dry - March 4, 2021)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

Shear Strength (kPa): 20 40 60 80 100
▲ Undisturbed △ Remoulded

Piezometer Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

FILE NO. PG5690

REMARKS

HOLE NO. BH 9-21

BORINGS BY CME 55 Power Auger **DATE** 2021 February 22

SOIL DESCRIPTION	Depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	109.17
ORGANICS	0.05						
FILL: Brown silty sand with gravel	0.69	AU	1				
FILL: Brown silty clay with sand, gravel, cobbles, trace topsoil		SS	2	17	21	1	108.17
		SS	3	25	11	2	107.17
		SS	4	8	4	3	106.17
		SS	5	50	7	4	105.17
	4.57	SS	6	17	26		

End of Borehole

Practical refusal to augering at 4.57 m depth

(Piezometer dry - March 4, 2021)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2021 February 23

FILE NO. PG5690

HOLE NO. BH10-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	107.98
TOPSOIL 0.05							
FILL: Brown to grey silty clay with sand, gravel, cobbles, trace topsoil		AU	1				
		SS	2	42	12	1	106.98
		SS	3	42	5	2	105.98
		SS	4	17	3	3	104.98
		SS	5	33	5	4	103.98
		SS	6	25	5		
		SS	7	50	10	5	102.98
5.49							
FILL: Brown silty sand, some gravel		SS	8	33	7		
6.02						6	101.98
FILL: Brown to grey silty clay with sand, gravel, trace wood and organics		SS	9	42	8		
		SS	10	33	6	7	100.98
		SS	11	4	9	8	99.98
8.23							
End of Borehole							
(Piezometer dry - March 4, 2021)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2021 February 23

FILE NO. PG5690

HOLE NO. BH11-21

SOIL DESCRIPTION	Strata depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	105.87
TOPSOIL	0.05						
FILL: Brown silty clay some sand, gravel, trace topsoil		AU	1				
- Wood fragments present at 0.9 m depth		SS	2	50	4	1	104.87
		SS	3	33	5	2	103.87
		SS	4	50	6	3	102.87
	3.51	SS	5	42	23		
FILL: Brown silty sand with gravel, trace clay		SS	6	8	28	4	101.87
	5.03	SS	7	33	21	5	100.87
FILL: Brown silty clay with sand, gravel, cobbles, trace organics		SS	8	25	11		
- Increasing sand with depth		SS	9	33	5	6	99.87
	7.54	SS	10	17	+50	7	98.87
FILL: Brown silty sand with gravel, trace topsoil	8.23	SS	11	42	28	8	97.87
Compact brown **SILTY SAND** with gravel, trace cobbles	9.14	SS	12	42	67	9	96.87
End of Borehole		SS	13	0	+50		
(Piezometer destroyed - March 4, 2021)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

FILE NO. PG5690

REMARKS

HOLE NO. BH12-21

BORINGS BY CME 55 Power Auger

DATE 2021 February 23

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	101.30		
FILL: Brown silty sand with gravel, trace clay		AU	1						
						1	100.30		
		SS	2	50	64				
		SS	3	50	69				
						2	99.30		
		SS	4	42	28				
2.90									
End of Borehole (Piezometer destroyed - March 4, 2021)									

Pen. Resist. / Water Content % axis: 20, 40, 60, 80

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

FILE NO. PG5690

REMARKS

HOLE NO. BH 13-21

BORINGS BY CME-55 Low Clearance Drill **DATE** July 12, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	101.59
FILL: Brown silty sand with gravel, occasional cobbles 0.13		AU	1				
		SS	2	71	37	1	100.59
Dense to compact, light brown **SILTY SAND,** trace gravel		SS	3	75	31	2	99.59
		SS	4	83	23	3	98.59
3.66		SS	5		27		
End of Borehole (BH dry upon completion)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Piezometer Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE July 12, 2021

FILE NO. PG5690

HOLE NO. BH 14-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	102.34		
FILL: Dark brown silty sand, trace crushed stone, gravel and topsoil		AU	1						
		SS	2	75	5	1	101.34		
1.45									
Loose to dense, light brown **SILTY SAND,** trace gravel		SS	3	83	4	2	100.34		
		SS	4	67	2				
		SS	5	67	1	3	99.34		
		SS	6	83	16	4	98.34		
		SS	7		42	5	97.34		
5.18									
End of Borehole									
(BH dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE July 12, 2021

FILE NO. PG5690

HOLE NO. BH 15-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	102.82		
FILL: Brown silty sand, some crushed stone, gravel, trace topsoil (0.30)		SS	1	83	11				
		SS	2	83	19	1	101.82		
		SS	3	79	31	2	100.82		
Compact, light brown **SILTY SAND**		SS	4	75	28				
		SS	5	75	17	3	99.82		
		SS	6	75	28	4	98.82		
(5.18)		SS	7	67	27	5	97.82		
End of Borehole (BH dry upon completion)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

FILE NO. PG5690

REMARKS

HOLE NO. BH 16-21

BORINGS BY CME-55 Low Clearance Drill **DATE** July 12, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.04
FILL: Brown silty sand, some gravel, trace topsoil (to 0.15)		SS	1	92	10		
Compact, light brown **SILTY SAND**		SS	2	83	18	1	102.04
		SS	3	75	29	2	101.04
		SS	4	92	31	3	100.04
		SS	5	83	24	4	99.04
		SS	6	83	22	5	98.04
(to 5.18)		SS	7	75	24		
End of Borehole (BH dry upon completion)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

FILE NO. PG5690

REMARKS

HOLE NO. BH 17-21

BORINGS BY CME-55 Low Clearance Drill **DATE** July 12, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.95
FILL: Brown silty sand with gravel, occasional cobbles (to 0.46)		SS	1	83	25		
		SS	2	75	14	1	102.95
		SS	3	75	15	2	101.95
Compact to dense, light brown **SILTY SAND**		SS	4	67	18		
		SS	5	67	50+	3	100.95
		SS	6		37	4	99.95
		SS	7		50+		
(to 5.18)						5	98.95
End of Borehole							
(BH dry upon completion)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

FILE NO. PG5690

REMARKS

HOLE NO. BH 18-21

BORINGS BY CME-55 Low Clearance Drill **DATE** July 12, 2021

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	105.86		
FILL: Brown silty and with gravel, cobbles, boudlers		SS	1	83	10				
0.76		SS	2	89	50+	1	104.86		
Very dense, brown **SILTY SAND** with gravel, cobbles, occasional boulders		SS	3	75	44	2	103.86		
		SS	4	75	87	3	102.86		
		SS	5	87	72				
4.11		SS	6	83	52	4	101.86		
Very dense, light brown **SILTY SAND,** trace gravel		SS	7	88	51	5	100.86		
		SS	8	100	50+				
5.94									
End of Borehole (BH dry upon completion)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed Use Development
3718 Greenbank Road - Ottawa, Ontraio

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE July 13, 2021

FILE NO. PG5690

HOLE NO. BH 19-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	112.43		
						1	111.43		
FILL: Brown silty clay with sand, gravel, cobbles, trace topsoil		SS	1	21	7	2	110.43		
		SS	2	33	6	3	109.43		
						4	108.43		
		SS	3	4	10	5	107.43		
6.70		SS	4	18	50+	6	106.43		
Compact, light brown **SILTY SAND**		SS	5	96	20	7	105.43		
8.23		SS	6	96	15	8	104.43		
End of Borehole (BH dry upon completion)									

Water Content % axis: 20, 40, 60, 80

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Barrhaven South Urban Expansion
Ottawa, Ontario

DATUM Geodetic elevations interpolated from City of Ottawa basemap.

FILE NO. PG3607

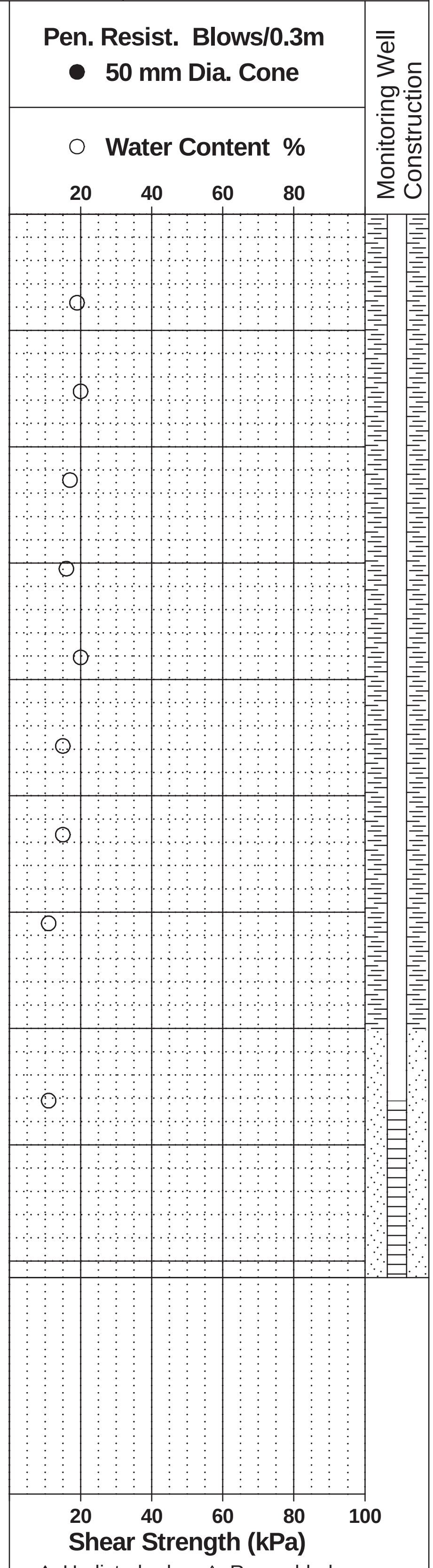
REMARKS

HOLE NO. BH 5-15

BORINGS BY CME 75 Power Auger **DATE** December 10, 2015

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
FILL: Grey silty sand with clay, gravel and wood		SS	1	42	13
		SS	2	25	21
		SS	3	33	5
		SS	4	42	4
		SS	5	42	3
		SS	6	42	3
		SS	7	17	5
		SS	8	25	37
		SS	9	0	50+
		SS	10	58	9
9.14		SS	11	0	1
End of Borehole (BH dry to 9.14m depth - July 28, 2016)					

DEPTH (m)	ELEV. (m)
0	108.75
1	107.75
2	106.75
3	105.75
4	104.75
5	103.75
6	102.75
7	101.75
8	100.75
9	99.75



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Barrhaven South Urban Expansion
Ottawa, Ontario

DATUM Geodetic elevations interpolated from City of Ottawa basemap.

REMARKS

BORINGS BY Backhoe

DATE December 2, 2015

FILE NO. PG3607

HOLE NO. TP 1-15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	105.10		
TOPSOIL 0.10		G	1						
						1	104.10		
Compact, brown **SILTY SAND**, trace boulders and cobbles		G	2						
						2	103.10		
3.00						3	102.10		
End of Test Pit									
(TP dry upon completion)									

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Barrhaven South Urban Expansion
Ottawa, Ontario

DATUM Geodetic elevations interpolated from City of Ottawa basemap.

REMARKS

BORINGS BY Backhoe

DATE December 2, 2015

FILE NO. PG3607

HOLE NO. TP 2-15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE						0	106.80		
TOPSOIL 0.10									
		G	1						
						1	105.80		
Compact, brown **SILTY SAND**									
						2	104.80		
		G	2						
3.00						3	103.80		
End of Test Pit									
(TP dry upon completion)									

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Barrhaven South Urban Expansion
Ottawa, Ontario

DATUM Geodetic elevations interpolated from City of Ottawa basemap.

REMARKS

BORINGS BY Backhoe

DATE December 1, 2015

FILE NO. PG3607

HOLE NO. TP 8-15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	109.30		
Dense, brown **SILTY SAND**		G	1						
						1	108.30		
						2	107.30		
3.00		G	2			3	106.30		
End of Test Pit (TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Barrhaven South Urban Expansion
Ottawa, Ontario

DATUM Geodetic elevations interpolated from City of Ottawa basemap.

REMARKS

BORINGS BY Backhoe

DATE December 2, 2015

FILE NO. PG3607

HOLE NO. TP 9-15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	108.40		
TOPSOIL 0.20									
		G	1			1	107.40		
Brown **SILTY SAND**, trace cobbles						2	106.40		
3.00		G	2			3	105.40		
End of Test Pit									
(TP dry upon completion)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the relative strength of cohesionless soils is the compactness condition, usually inferred from the results of the Standard Penetration Test (SPT) ‘N’ value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm. An SPT N value of “P” denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

Compactness Condition	‘N’ Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

Consistency	Undrained Shear Strength (kPa)	‘N’ Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity:	$S_t < 2$
Medium Sensitivity:	$2 < S_t < 4$
Sensitive:	$4 < S_t < 8$
Extra Sensitive:	$8 < S_t < 16$
Quick Clay:	$S_t > 16$

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	**ROCK QUALITY**
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube, generally recovered using a piston sampler
G	-	"Grab" sample from test pit or surface materials
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC%	-	Natural water content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic Limit, % (water content above which soil behaves plastically)
PI	-	Plasticity Index, % (difference between LL and PL)
Dxx	-	Grain size at which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D30)^2 / (D10 \times D60)$
Cu	-	Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay (more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

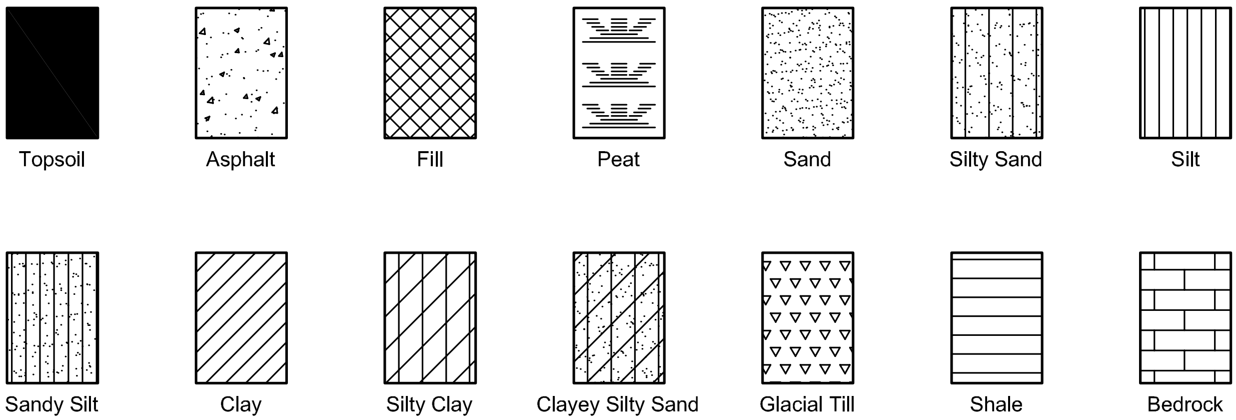
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

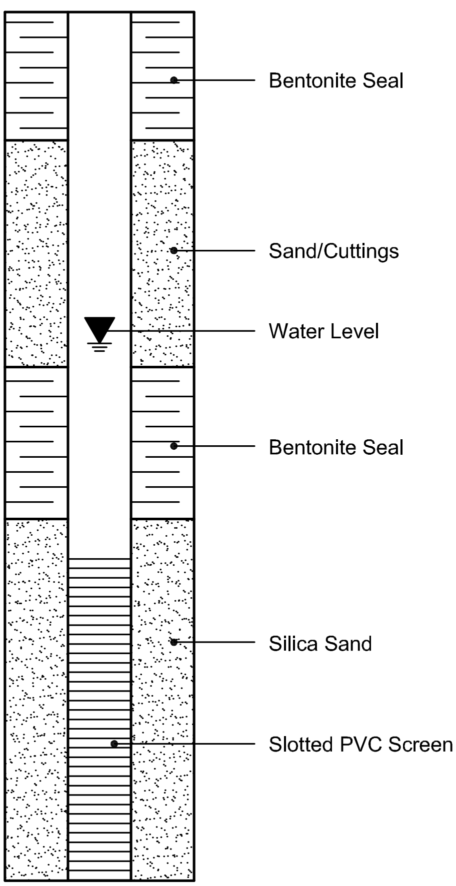
SYMBOLS AND TERMS (continued)

STRATA PLOT

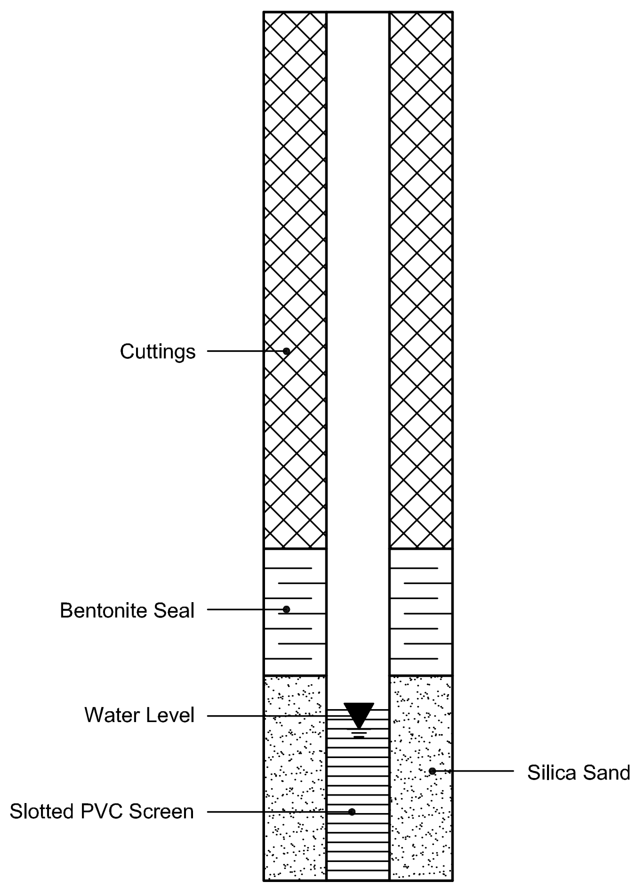


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



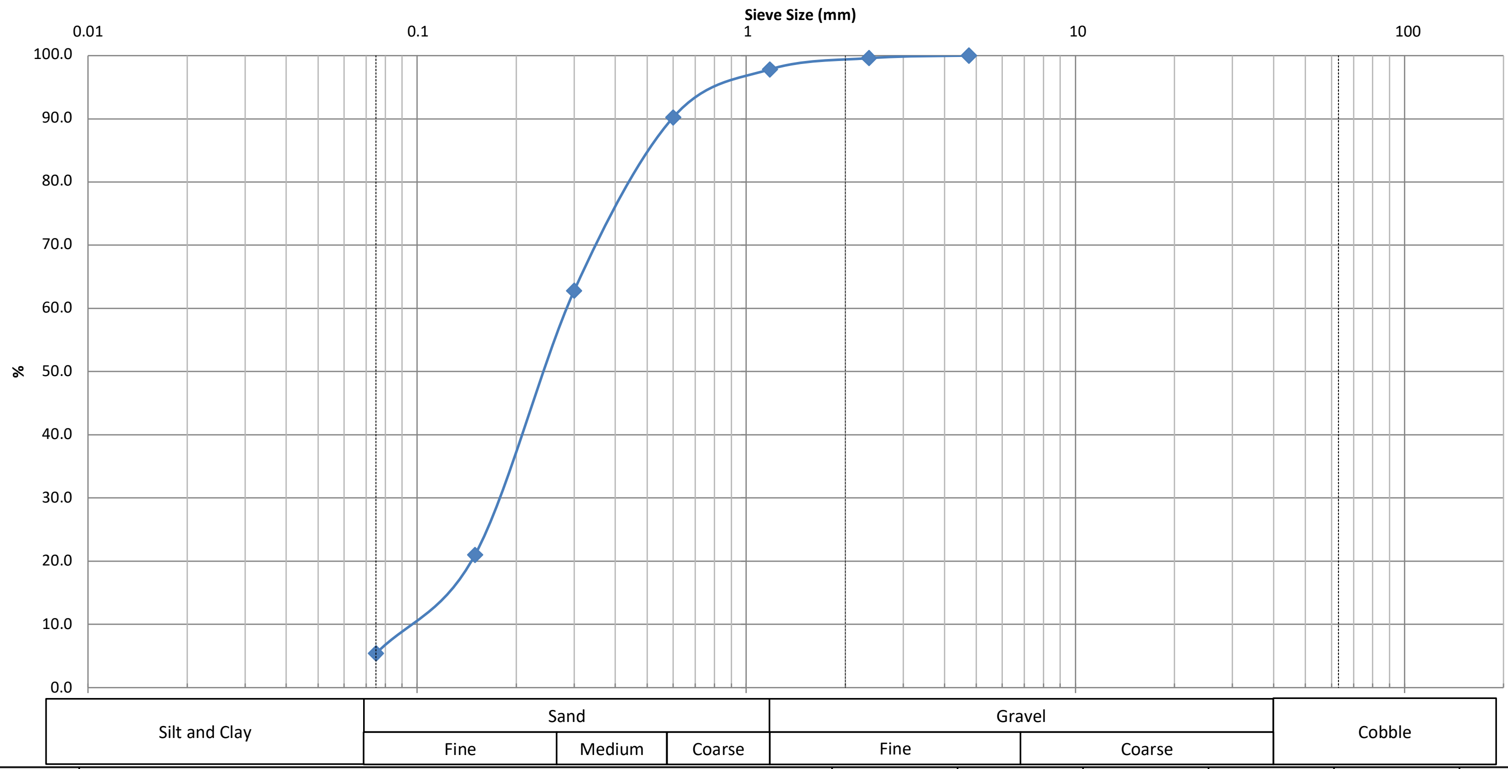
PIEZOMETER CONSTRUCTION



PATERSON GROUP

SIEVE ANALYSIS **ASTM C136**

CLIENT:	Mattamy Homes	DESCRIPTION:	Fine Aggregate	FILE NO:	PG5690
CONTRACT NO.:	-	SPECIFICATION:	**Sand**	LAB NO:	42436
PROJECT:	3718 Greenbank Rd.	INTENDED USE:	-	DATE RECEIVED:	3-May-23
		PIT OR QUARRY:	Pit	DATE TESTED:	4-May-23
DATE SAMPLED:	25-Apr-23	SOURCE LOCATION:	-	DATE REPORTED:	9-May-23
SAMPLED BY:	J.P	SAMPLE LOCATION:	TP2-23 G4 / 2.4-2.7m	TESTED BY:	C.P/A.L/M.O



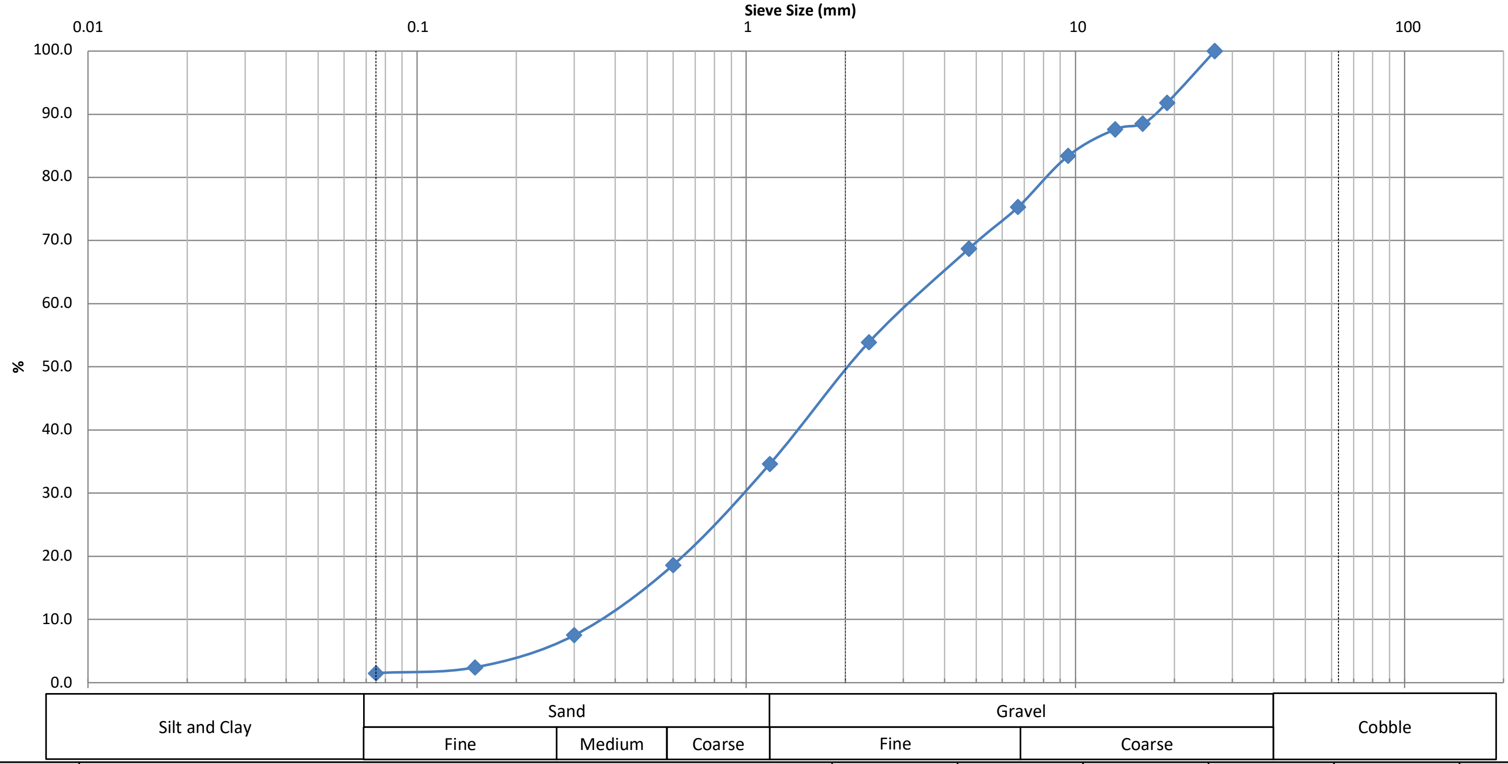
Identification	**Soil Classification**				**MC(%)**	**LL**	**PL**	**PI**	**Cc**	**Cu**
									1.18	3.0
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)
	4.75	0.295	0.185	0.098	0.0	94.6		5.4		

Comments:

REVIEWED BY:	**Curtis Beadow**	**Joe Fosyth, P. Eng.**

PATERSON GROUP		**SIEVE ANALYSIS** ASTM C136

CLIENT:	Mattamy Homes	DESCRIPTION:	Fine Aggregate	FILE NO:	PG5690
CONTRACT NO.:	-	SPECIFICATION:	**Sand/Gravel w Cobbles**	LAB NO:	42437
PROJECT:	3718 Greenbank Rd.	INTENDED USE:	-	DATE RECEIVED:	3-May-23
		PIT OR QUARRY:	Pit	DATE TESTED:	4-May-23
DATE SAMPLED:	25-Apr-23	SOURCE LOCATION:	-	DATE REPORTED:	9-May-23
SAMPLED BY:	J.P	SAMPLE LOCATION:	TP5-23 G4 / 2.2-2.5m	TESTED BY:	C.P/A.L/M.O



Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
						0.83	8.4

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
26.5	3.12	0.98	0.37	31.3	67.2	1.5	

Comments:

REVIEWED BY:	**Curtis Beadow**	**Joe Fosyth, P. Eng.**

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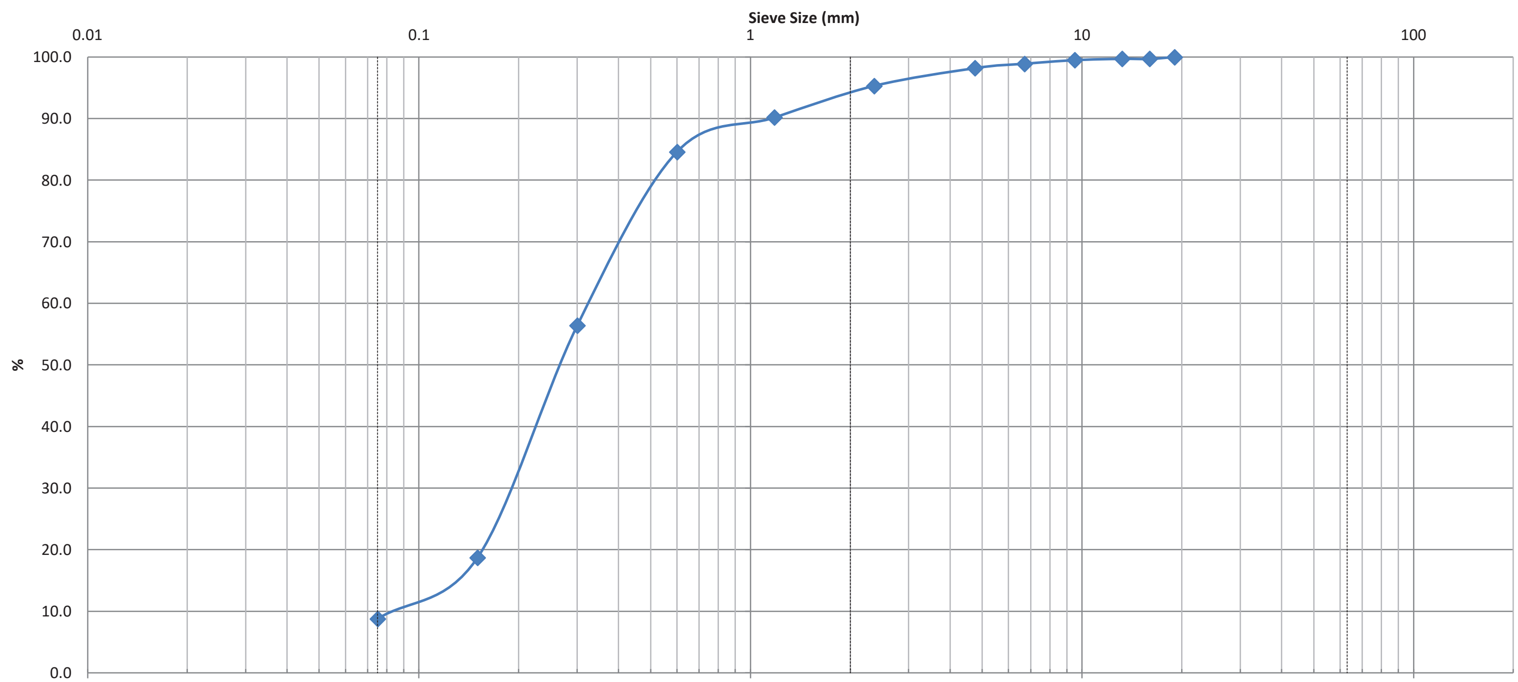
SIEVE ANALYSIS
ASTM C136

CLIENT:	Mattamy Homes	DESCRIPTION:	Soil	FILE NO:	PG5690
CONTRACT NO.:	-	SPECIFICATION:	**Silty Sand**	LAB NO:	23721
PROJECT:	3718 Greenbank Road	INTENDED USE:	-	DATE RECEIVED:	25-Mar-21
		PIT OR QUARRY:	in-Situ	DATE TESTED:	26-Mar-21
DATE SAMPLED:	17-Feb-21	SOURCE LOCATION:	BH2-21 SS3 & SS4	DATE REPORTED:	29-Mar-21
SAMPLED BY:	G. Paterson	SAMPLE LOCATION:	1.5 - 2.9 m	TESTED BY:	DK



Silt and Clay	Sand			Gravel		Cobble
	Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
						1.38	3.9

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
19.0	0.32	0.19	0.082	1.8	89.4	8.8	

Comments:

REVIEWED BY:	Curtis Beadow	Joe Fosyth, P. Eng.

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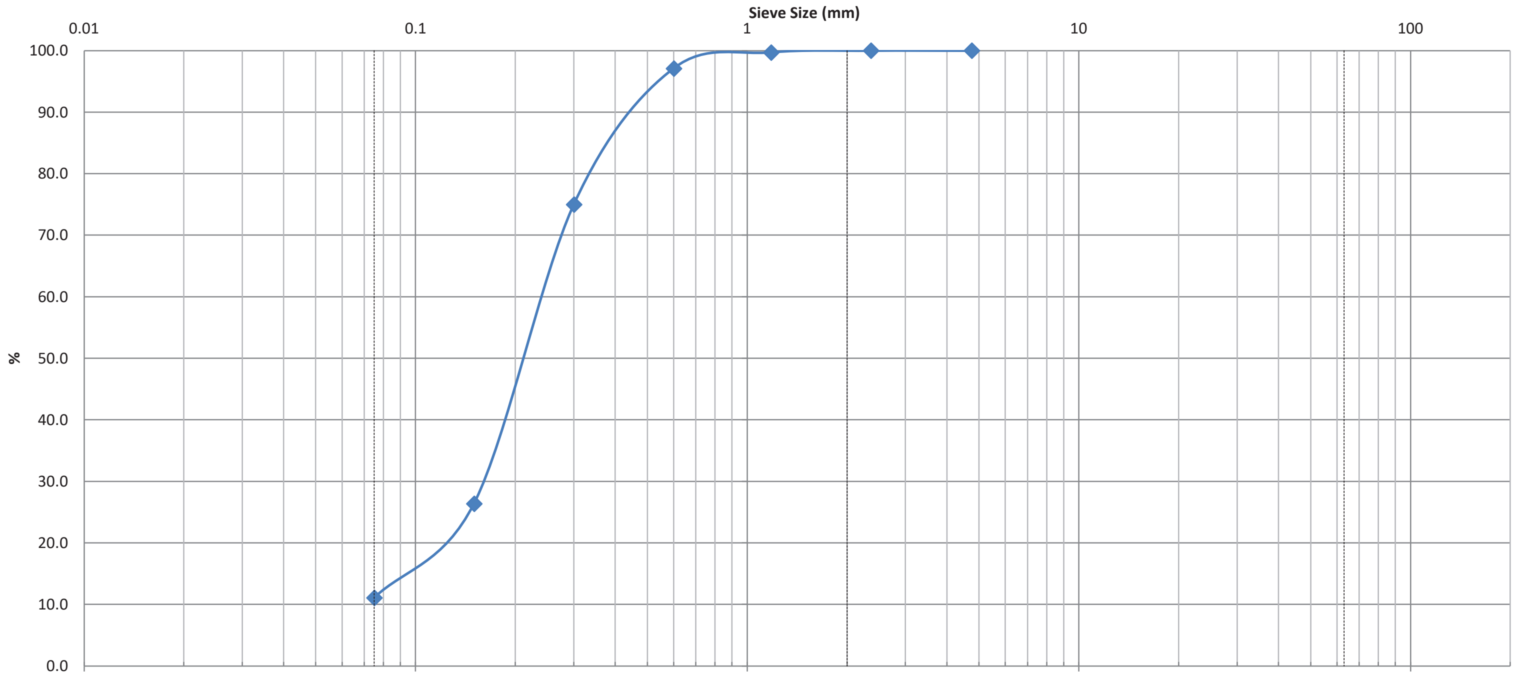
SIEVE ANALYSIS
ASTM C136

CLIENT:	Mattamy Homes	DESCRIPTION:	Soil	FILE NO:	PG5690
CONTRACT NO.:	-	SPECIFICATION:	**Silty Sand**	LAB NO:	23722
PROJECT:	3718 Greenbank Road	INTENDED USE:	-	DATE RECEIVED:	25-Mar-21
		PIT OR QUARRY:	in-Situ	DATE TESTED:	26-Mar-21
DATE SAMPLED:	17-Feb-21	SOURCE LOCATION:	BH4-21 SS4 & SS5	DATE REPORTED:	29-Mar-21
SAMPLED BY:	G. Paterson	SAMPLE LOCATION:	2.29 - 3.66 m	TESTED BY:	DK



Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
									1.80	3.3
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)
	4.8	0.23	0.17	0.07	0.0	88.9		11.1		

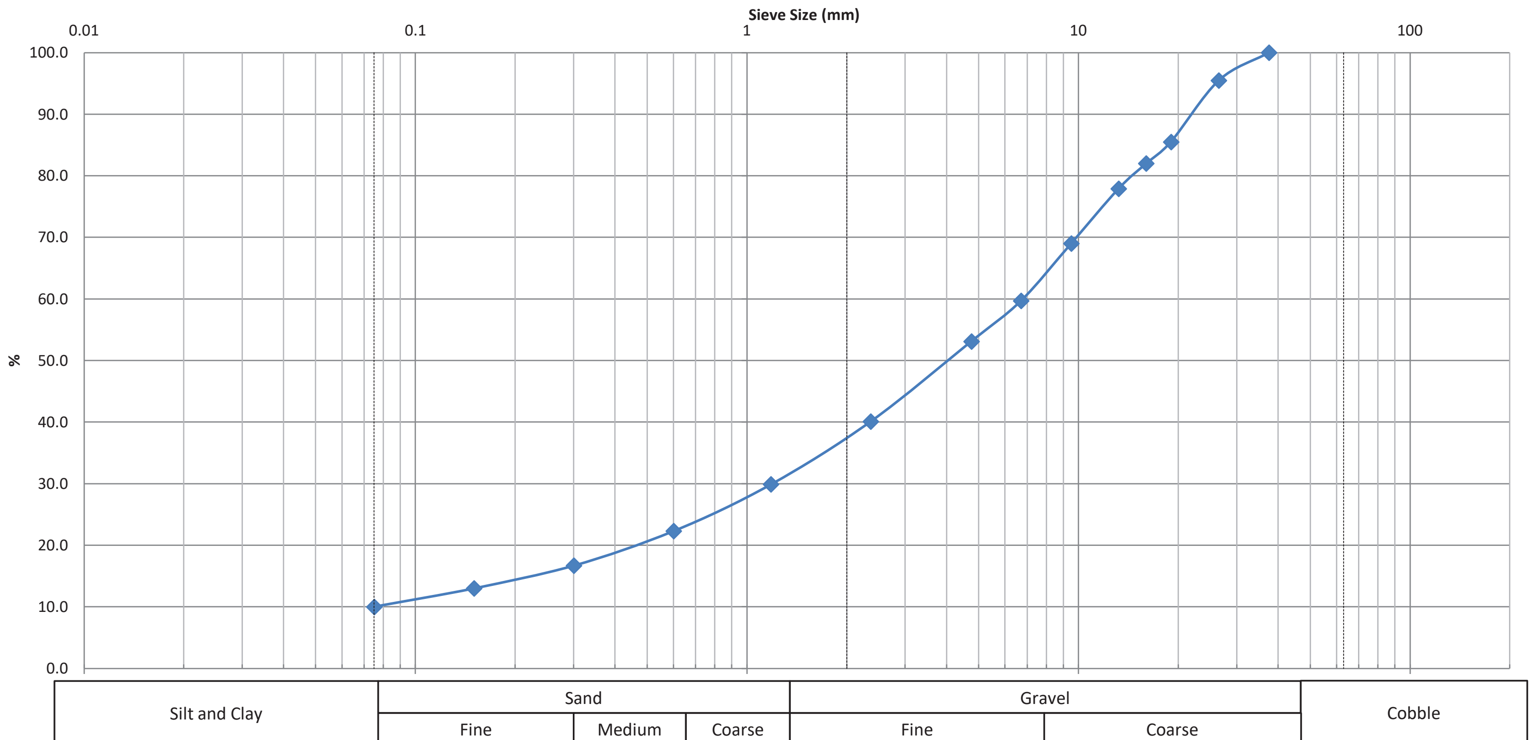
Comments:

REVIEWED BY:	Curtis Beadow	Joe Fosyth, P. Eng.

patersongroup
consulting engineers

SIEVE ANALYSIS
ASTM C136

CLIENT:	Mattamy Homes	DESCRIPTION:	Soil	FILE NO:	PG5690
CONTRACT NO.:	-	SPECIFICATION:	**Silty Sand**	LAB NO:	23723
PROJECT:	3718 Greenbank Road	INTENDED USE:	-	DATE RECEIVED:	25-Mar-21
		PIT OR QUARRY:	in-Situ	DATE TESTED:	26-Mar-21
DATE SAMPLED:	17-Feb-21	SOURCE LOCATION:	BH8-21 SS4 & SS5	DATE REPORTED:	29-Mar-21
SAMPLED BY:	G. Paterson	SAMPLE LOCATION:	2.29 - 3.66 m	TESTED BY:	DK



Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
									3.54	104.6
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)
	37.5	6.8	1.25	0.065	46.9	43.1		10.0		

Comments:

REVIEWED BY:	Curtis Beadow	Joe Fosyth, P. Eng.

PARACEL LABORATORIES LTD.

Order #: 2108430

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 31927

Report Date: 25-Feb-2021

Order Date: 19-Feb-2021

Project Description: PG5690

	MDL/Units				
Client ID:		BH7-21-SS5	-	-	-
Sample Date:		19-Feb-21 09:00	-	-	-
Sample ID:		2108430-01	-	-	-
		Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	95.7	-	-	-
General Inorganics					
pH	0.05 pH Units	7.30	-	-	-
Resistivity	0.10 Ohm.m	143	-	-	-
Anions					
Chloride	5 ug/g dry	7	-	-	-
Sulphate	5 ug/g dry	<5	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURE 2 TO 5 – AERIAL PHOTOGRAPHS

DRAWING PG5690-1 – TEST HOLE LOCATION PLAN

FIGURE 1

KEY PLAN

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FIGURE 2

Aerial Photograph - 1976

FIGURE 3

Aerial Photograph - 2002

FIGURE 4

Aerial Photograph - 2008

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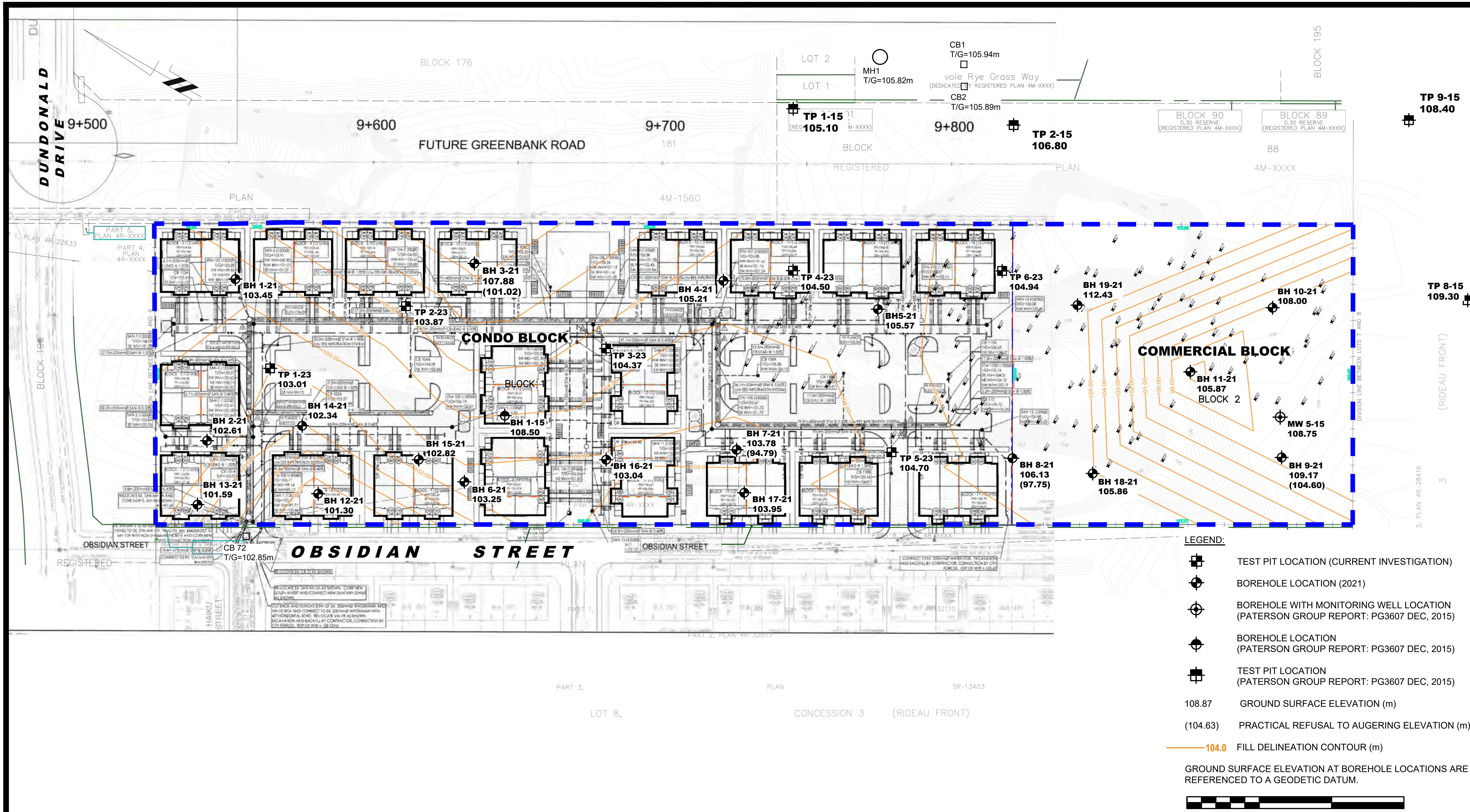
FIGURE 5

Aerial Photograph - 2019



PATERSON GROUP
9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
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NO.	REVISIONS	DATE	INITIAL
2	REVISED TO INCLUDE NEW 2023 TEST PITS UPDATED TO NEW CONCEPTUAL PLAN	05/05/2023	SK
1	REVISED TO INCLUDE NEW 2021 TEST PITS	14/07/2021	OC

MATTAMY HOMES

GEOTECHNICAL INVESTIGATION
HALF MOON BAY - SOUTH - PHASE 8

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1250	Date: 03/2021
Drawn by: YA	Report No.: PG5690-1
Checked by: KP	Dwg No.: PG5690-1
Approved by: DJG	Revision No.: 2

p:\autocad drawings\geotechnical\pg56xx\pg5690\pg5690-1-test hole location plan (rev.02).dwg