Wellings of Brockville: Servicing and Stormwater Management Report

Stantec Project No. 160401602

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Prepared for:

Nautical Lands General Contractors Inc. / Wellings of Brockville Inc.

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1.0 INTRODUCTION

Nautical Lands Group has commissioned Stantec Consulting Ltd. (Stantec) to prepare the following Servicing and Stormwater Management (SWM) Report in support of Site Plan Control approval for the proposed first phase of the Wellings of Brockville Independent Senior Living development within the City of Brockville. The report supports the development application for the subject site, which is located in the City of Brockville approximately two kilometres northwest of the downtown core. The site is bound by Parkedale Avenue to the south, residential uses and undeveloped woodlot to the west and east, and undeveloped woodlot and watercourse immediately to the north. Access to the site is provided via frontage onto Parkedale Avenue to the south. The entire subject site is identified in **Figure.1** with a pale orange dashed boundary. The area of the proposed development, which excludes the existing environmental protection area, is shown with a solid orange hatch. Within the solid orange hatch, phase 1 of the development will be situated along the south portion of the property and will be further developed in the future.

Figure 1. Key Map of the Wellings of Brockville Site

The existing property is undeveloped apart from two detached dwellings in the southeast corner of the site, located at municipal addresses 3064 and 3076 Parkedale Avenue. The undeveloped portion of the site is a mix of grassed land within its centre with a woodlot along its perimeter. The site drains to the north towards an existing unnamed watercourse.

The subject property occupies approximately 5.59 ha of land. The majority of the site is currently zoned as Mixed Use and Commercial per Schedule 1 of the City of Brockville's Official Plan. The northwest corner of the site (approximately 1.83 ha) is zoned as Parks and Open Space Area. At full buildout, the proposed development is expected to consist of 120 single-storey, slab-on-grade townhome units (58 1-bedroom units and 62 2-bedroom units). Phase 1 of the Wellings of Brockville development will consist of 20 1-bedroom units, 23 2-bedroom units, and a community clubhouse. Background for the site was obtained through correspondence with City of Brockville staff (see correspondence in **Appendix E – Correspondence with the City of Brockville** from Stantec's *Functional Servicing and Stormwater Management Brief (2021))*.

1.1 OBJECTIVE

This site Servicing and Stormwater Management (SWM) Report has been prepared to present an internal servicing scheme that is free of conflicts and provides detailed on-site servicing in accordance with all applicable City of Brockville and provincial design guidelines, and recommendations included in the various background studies outlined in **Section 1.2.** Criteria and constraints provided by Nautical Lands Group and the City of Brockville have been used as a basis for the servicing design of the proposed development. Design objectives for the proposed site include:

1.1.1 Grading Design

- Establish detailed grading with consideration to grading constraints (i.e., high-points, major system relief, sufficient cover, grade raise restrictions), while respecting the natural topography and subsurface soil conditions.

1.1.2 Underground Servicing

- Define and size the internal water distribution system with connections to the existing 300 mm diameter watermain on Parkedale Avenue and the existing 300mm diameter watermain on Chelsea Street.
- Define and size the internal sanitary collection system for the proposed development that will discharge to the existing 375 mm diameter sanitary sewer on Chelsea Street.
- Define major and minor storm conveyance systems in conjunction with the grade control plan including overland flow routes and storm sewers to the proposed stormwater management facility to provide quantity control and water quality treatment prior to discharging into an unnamed watercourse to the north.

The accompanying **Drawing SSP-1 to SSP-5** included in **Appendix F** illustrates the proposed internal servicing scheme for the site.

1.2 BACKGROUND RESOURCES

This report has been prepared in accordance with the following documents:

- City of Brockville Site Plan Control Manual – Requirements & Guidelines, City of Brockville, January 2018.
- Cataraqui Source Protection Plan, Cataraqui Source Protection Authority, November 2014.
- Stage 1 Archaeological Assessment: Proposed Wellings of Brockville Development, Stantec Consulting Ltd, February 18, 2021.
- Draft Geotechnical Investigation Report – Proposed Residential Subdivision (Wellings of Brockville), Stantec Consulting Ltd, February 2021.
- Preliminary Geotechnical Investigation Report - Proposed Residential Subdivision (Wellings of Brockville), Stantec Consulting Ltd, March 2021.
- Phase 1 Environmental Site Assessment – 3064 and 3076 Parkedale Avenue, Brockville, Ontario, XCG Consultants Ltd, September 8, 2020.
- Phase 2 Environmental Site Assessment – 3064 and 3076 Parkedale Avenue, Brockville, Ontario, XCG Consultants Ltd, January 5, 2021.
- Enhanced Phase 1/ Phase 2 Environmental Site Assessment - 3064 Parkedale Avenue and 3076 Parkedale Avenue, Brockville, Ontario, XCG Consultants Ltd, June 12, 2003.
- Planning Rationale Report – Official Plan Amendment and Zoning By-law Amendment, Wellings of Brockville, Stantec Consulting Ltd, December 18, 2020.
- Stormwater Management Planning and Design Guidelines, Ontario Ministry of the Environment, 2003.
- Design Guidelines for Sewage Works, Ontario Ministry of the Environment, 2008.
- Design Guidelines for Drinking Water Systems, Ontario Ministry of the Environment, 2008.
- Environmental Planning Policies, Cataraqui Region Conservation Authority, 2021.

2.0 POTABLE WATER SERVICING

2.1 BACKGROUND

The proposed Wellings of Brockville development is located just outside of the City of Brockville's existing water distribution system. An existing 300 mm diameter watermain is located southeast of the subject site on Parkedale Avenue, terminating approximately 100 m east of the site near the intersection with Kent Boulevard. This watermain currently services the detached dwellings and businesses along a stretch of Parkedale Avenue. Additionally, an existing 300 mm diameter watermain is located northeast of the subject site within Chelsea Street, terminating several meters past Hydrant H660 at the entrance of the cul-de-sac. Refer to **Drawing SSP-1** and **SSP-5** in **Appendix F**, which shows the location of existing watermains.

Through consultation with the City of Brockville, hydrant flow testing data was acquired and used to evaluate the hydraulic boundary conditions for the proposed development. The nearest hydrants are: i) Hydrant H846 on Parkedale Avenue approximately 100 m east of the subject site and ii) Hydrant H660 on Chelsea Street approximately 330 m northeast from the site's frontage. The testing results indicate that the average fire flow at 20 psi for H846 and H660 is approximately 1365 US gpm (5,167 L/min) and 2157 US gpm (8165 L/min), respectively. Each hydrant had a static pressure of 70 psi at the time the testing was conducted. The hydrant testing results are provided in **Appendix A.5**.

2.1.1 Connections to Existing Infrastructure

The watermain alignment and sizing for the development is demonstrated on **Drawings SSP-1** to **SSP-5**. A 200 mm diameter watermain, internal to the site, is proposed to follow the alignment of the roads within the subject property and extend northeast with the following connection points:

1) At the existing 300 mm diameter watermain immediately east of the site within Parkedale Avenue. A 300 mm watermain extension will front the site with a 200 mm diameter watermain servicing the site internally.

2) At the existing 300 mm diameter watermain within Chelsea Street (northeast of the site), through a proposed watermain extension extending south into the subject site.

The Chelsea Street watermain connection crosses land owned by other parties and as such preliminary negotiations with the property owners, as well as approval from the City of Brockville has been communicated. Additionally, the Cataraqui Conservation Authority has been made aware of the connection to the north that will require the crossing through an existing watercourse.

2.1.2 Allowable Pressures

The City of Ottawa's Water Distribution Design Guidelines and the the MECP's Design Guidelines for Drinking-Water Systems (2008) 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 kPa to 552 kPa (50 to 80 psi) and no less than 275 kPa (40 psi) at ground elevation. 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).

2.2 DOMESTIC WATER DEMANDS

The proposed Wellings of Brockville development will ultimately consist of 58 one-bedroom bungalow units, 62 two-bedroom bungalow units, and a one-storey clubhouse providing approximately 628 m^2 of amenity space for the community. Water demands for the development were estimated using both the City of Ottawa's Water Distribution Design Guidelines and the MECP's Design Guidelines for Drinking-Water Systems (2008). The methodology of adopting both guidelines is employed to represent the demands most accurately for the development in the absence of available flow data. For residential developments, the average day (AVDY) per capita water demand is 280 L/p/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 commercial areas, an average flow of 28,000 L/ha/d was used. For maximum day (MXDY) demand, 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 water demands for the development are illustrated in **Table 2.1** and the domestic water demand calculations are provided in **Appendix A.2**.

Table 2.1: Water Demands for Wellings of Brockville (Ultimate Buildout)

Phase/Unit Type	Units	Persons/Unit	Population	AVDY (L/s)	MXDY (L/s)	PKHR (L/s)
1-bedroom bungalow units	58	1.4	81	0.26	0.66	1.45
2-bedroom bungalow units	62	2.1	130	0.42	1.50	3.32
1-storey clubhouse (628 m^2)	N/A	N/A	N/A	0.02	0.03	0.05
Total	**120**	**-**	**211**	**0.70**	**2.19**	**4.82**

1. Populations rounded to the nearest whole number.

2.3 LEVEL OF SERVICE

2.3.1 Fire Flow Requirements

The City of Brockville does not have its own design guidelines to follow with respect to fire flow requirements. Typically, communities without guidelines refer to the OFM and the Fire Underwriters Survey Guideline (FUS) for new development fire flow requirements. However, the available flow to be provided in a development within a rural community is a function of that community's fire services capabilities. Depending on the fire service capabilities, communities can be rated for minimum protection resulting in higher insurance costs or alternatively fully protected systems with lower insurance costs. As a guiding principle, we attempt to achieve higher protection when feasible however with the understanding of the limitations of distribution systems, in some cases, a lesser protection is completely acceptable for a rural community. With the above considered, the fire flow requirement for the residential properties and the clubhouse within the proposed development were estimated based on the Office of the Fire Marshal's (OFM) Fire Protection Water Supply Guideline for Part 3 in the Ontario Building Code (OBC).

The OFM guideline provides the most reasonable fire protection for the proposed development, while the FUS methodology was determined to overstate the fire flow requirement given the development location and the distribution system's limitations. The FUS criteria has traditionally been suggested for use in design and layout of proposed watermains, however, the fire flow requirement for the Wellings of Brockville community is better reflected using the OFM guidelines noting that the watermain within Parkedale Avenue and Chelsea Street is expected to meet a fire flow demand of 5,167 L/min and 8,165 L/min, respectively, at the minimum 20 psi pressure requirement for the system.

Based on the largest proposed building area and conservative estimates of building exposure distances, the required fire flows for the residential blocks and the clubhouse were estimated at 2,700 L/min. **Table 2.2** provides an overview of the OBC fire flow calculations and **Appendix A.3** can be referred to for the detailed OBC fire flow calculations for the governing bungalow unit blocks and the clubhouse. Residential buildings on-site are considered as combustible without fire resistance ratings per the OBC. In comparison, using the FUS formula the required fire flow increases up to 9,000 L/min for the five-unit bungalow blocks with no fire separation. Based on the hydrant flow testing, the FUS criteria can be met but would require the implementation of fire separation within residential blocks to reduce the fire flow requirement. The implementation of fire protection within these blocks is considered unwarranted and adequate fire flow can be provided to meet the site-specific requirements. Based on the hydrant flow testing data, the available fire flow at 20 psi at hydrants H846 and H660 is approximately 1365 US gpm (5,167 L/min) and 2157 US gpm (8165 L/min), respectively. The available flow at minimum pressure far exceeds the required fire flow per the OBC calculation. The static pressure of 70 psi measured at Hydrant H846 and H660 should also be adequate for all domestic water demand scenarios.

Fire flow requirement estimates were completed using the Office of the Fire Marshal (OFM) guidelines which meet the requirements of Section 3 of the Ontario Building Code (OBC). The results of the fire flow calculations are summarized in **Table 2.2** below.

Table 2.2: Fire Flow Calculations Using OFM/OBC Methodology

Unit Type	Description	Required Fire Flow Volume (L)	Min. Required Fire Flow (L/min)	Min. Required Fire Flow (L/s)
Five-unit block of bungalow units (Block 6)	Five-unit block of one-storey slab-on-grade units, no firewall, wood frame construction (Block 6), worst-case exposure distances	39,537	2,700	45
Five-unit block of bungalow units (Block 8)	Five-unit block of one-storey slab-on-grade units, no firewall, wood frame construction (Block 8), worst-case exposure distances	39,537	2,700	45

Unit Type	Description	Required Fire Flow Volume (L)	Min. Required Fire Flow (L/min)	Min. Required Fire Flow (L/s)
One-storey clubhouse	One-storey clubhouse (Including future extension area) with a 628 m^2 footprint	44,045	2,700	45

Based on the buildings proposed as part of the Wellings of Brockville development, using the OBC fire flow methodology, a minimum fire flow requirement of 2,700 L/min (45 L/s) and a required fire flow volume of 44,045 L will govern for the proposed development.

2.3.2 PHASING & WATERMAIN SIZING

The future Phases 2 and 3 of the development will be located north of Phase 1. Watermain stubs will be left at the limits of Phase 1 of the development for future connections to be made. It is expected that Phases 2 and 3 of the development can be supported via the same watermain network.

2.4 HYDRAULIC MODEL

A hydraulic model for the Wellings of Brockville 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.

2.4.1 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. Note that Phase 1 of the development is shown in dark green while Phases 2 and 3 are shown in light grey in the figures.

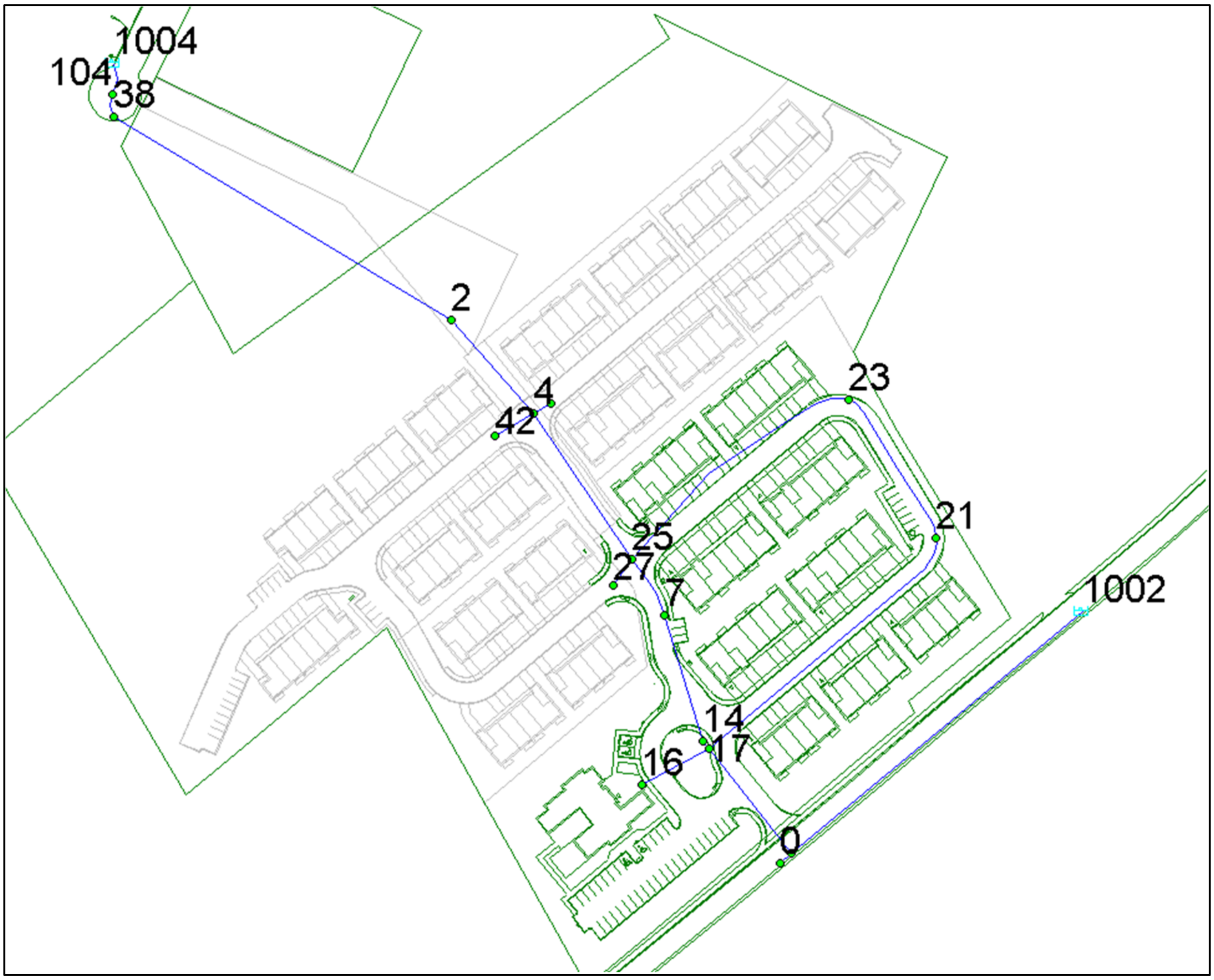


Figure 2. Watermain model layout with labelled nodes & reservoirs

2.4.2 Boundary Conditions

Boundary conditions for the development were determined via linear interpolation between the pressure at the nearest hydrants (Hydrant H846 & H660) versus the total flow generated from the hydrant as obtained from the hydrant flow test data. At 20 psi, hydrant H846 and H660 can provide approximately 5,167 L/min and 8165 L/min, respectively, while in a static state (0 L/min) the pressure inside each system is 70 psi. With that information, the demand at the connection point is used in the linear interpolation equation to generate the pressure, for a given demand scenario. The pressure is converted to a head value and added to the elevation of the ground surface at the watermain connection to estimate the HGL at the boundary location. A fixed head reservoir simulating the boundary conditions was placed for the watermain connection points on Parkedale Avenue and Chelsea Street in the hydraulic model. The assumptions and the modelled values are based on available data which sufficiently represents the modeled demand scenario in the absence of more detailed hydraulic information. A summary of the boundary conditions is provided in **Table 2.3** which shows the ground elevation at the proposed connections and the HGLs for average day, peak hour, and maximum day plus fire flow that are used in the hydraulic model.

Table 2.3: Watermain Boundary Conditions

Location	Ground Elevation (m)	AVDY (m)	PKHR (m)	MXDY+FF (2,700L/min) (m)
Connection 1 – Parkedale Avenue	114.8	163.9	163.5	145.4
Connection 2 – Chelsea Street	106.6	155.8	155.5	144.0

2.4.3 Model Development

New watermains were added to the Phase 1 hydraulic model to simulate the proposed distribution system. A 200 mm dia. watermain network is used internally throughout the site, with 300 mm dia. watermain extensions on Parkedale Avenue and Chelsea Street. Hazen-Williams coefficients (C-factors) were applied to the proposed watermain in accordance with the Ottawa Design Guidelines for Water Distribution and the MECP's Design Guidelines for Drinking-Water Systems (2008). The C-factors used are given in **Table 2.3** below.

Table 2.3: 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

2.4.4 Ground Elevations

The ground elevations used at each node along the watermain model network are shown in **Figure 3** below. These elevations were extracted from the detailed grading plan for the site (**Drawing GP-1** to **GP-5,** included in **Appendix F**).

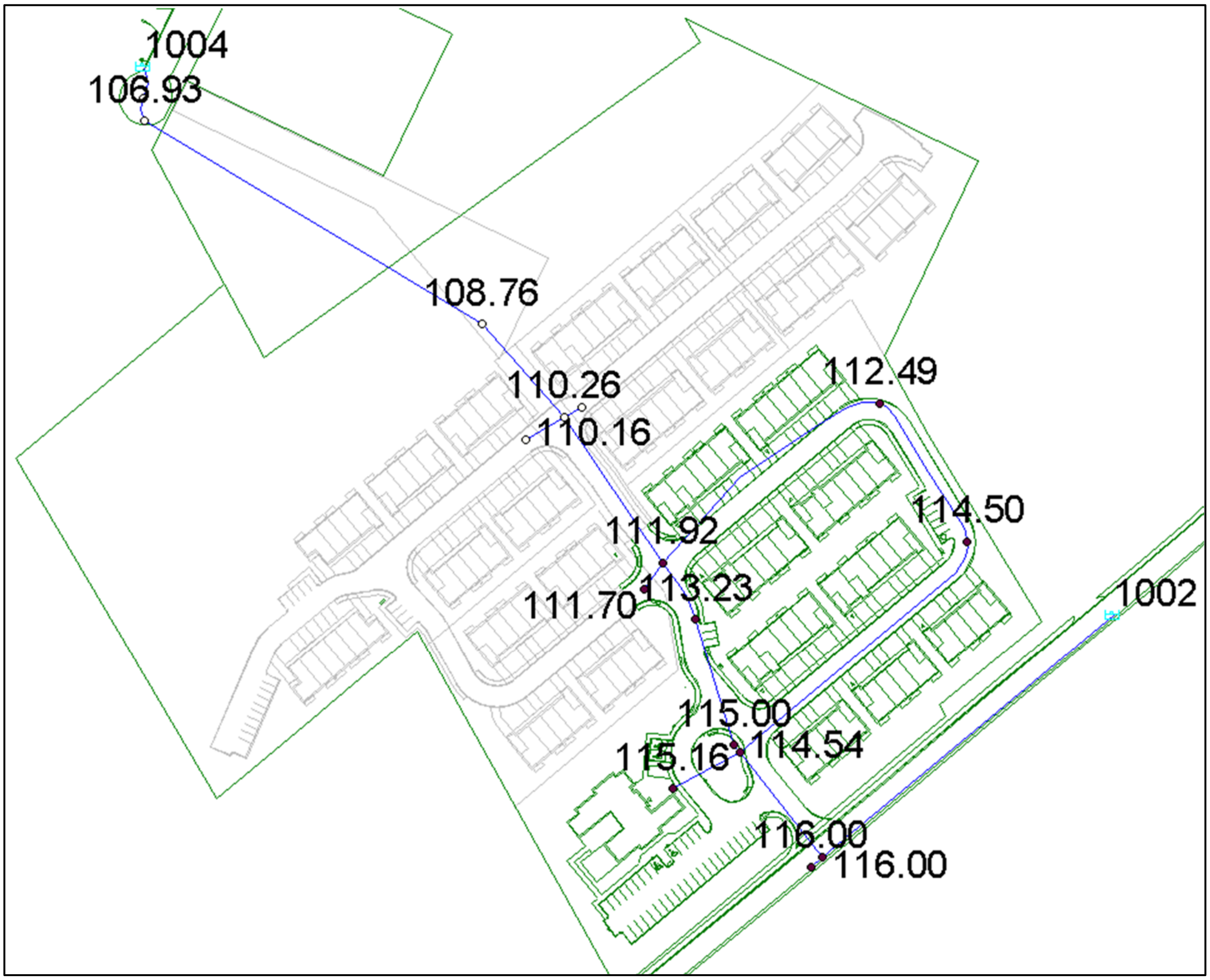


Figure 3. Ground elevations (m) at watermain nodes in H2OMAP Hydraulic Model

2.5 HYDRAULIC MODELLING RESULTS

2.5.1 Average Day Demand (AVDY)

The Phase 1 hydraulic modeling results show that, under basic day demands, the pressure in the distribution network falls between 463 kPa (67.1 psi) and 494 kPa (71.6 psi). This pressure is within the minimum/maximum objective pressures of 552 kPa (80 psi) and 275 kPa (40 psi) as specified in the MECP's Design Guidelines for Drinking-Water Systems (2008) and the City of Ottawa's Water Distribution Design Guidelines. Hydraulic modeling results are given in **Figure 4**.

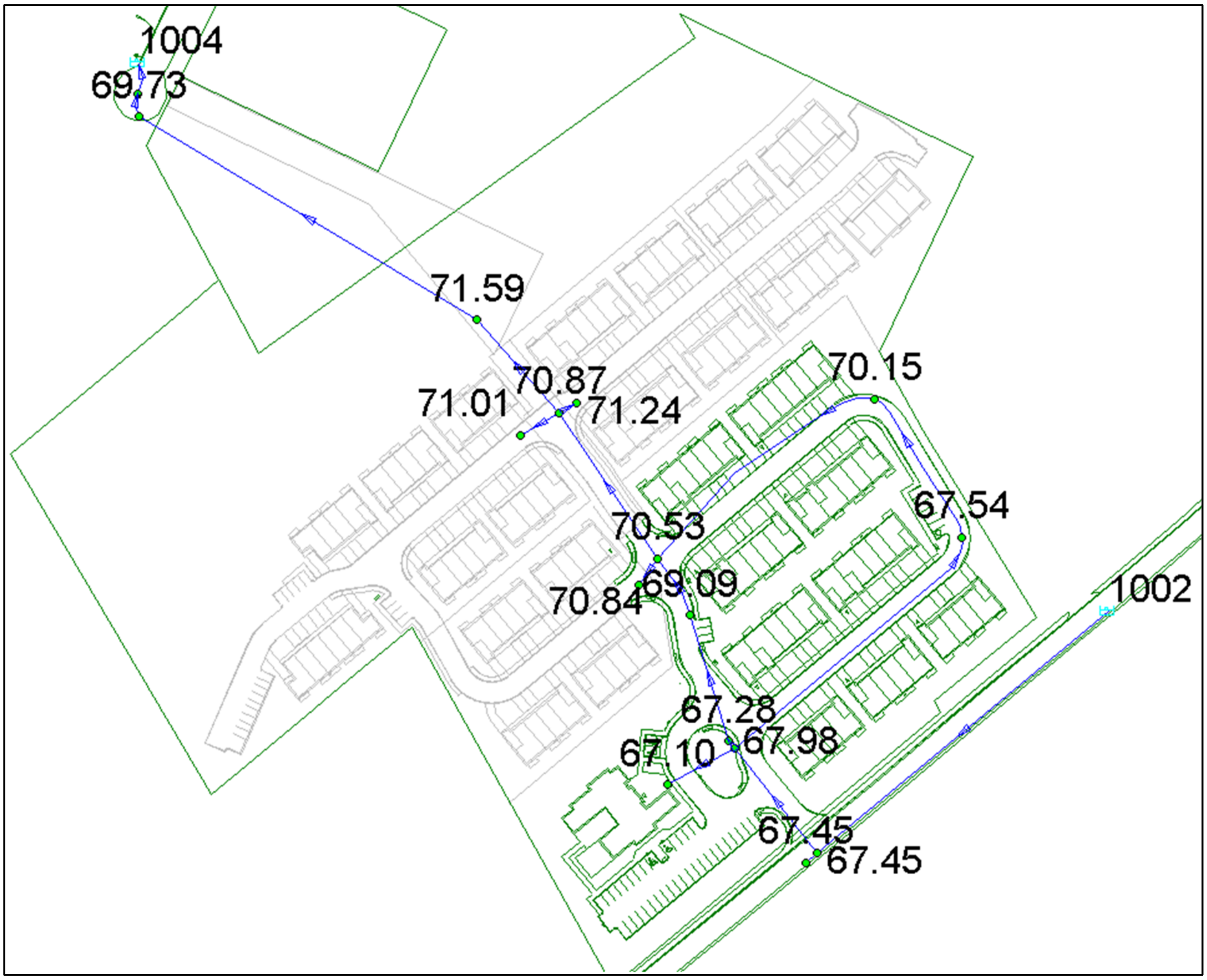


Figure 4. Pressures (psi) under AVDY demands for proposed Phase 1 zone configuration

2.5.2 Peak Hour Demand (PKHR)

The Phase 1 hydraulic modeling results show that, under peak hour demands, the pressure in the distribution network ranges between 458 kPa (66.4 psi) and 489 kPa (71 psi). These pressures are greater than the minimum objective pressure of 40 psi as specified in the City of Ottawa's Water Distribution Design Guidelines. Hydraulic modeling results are given in **Figure 5**.

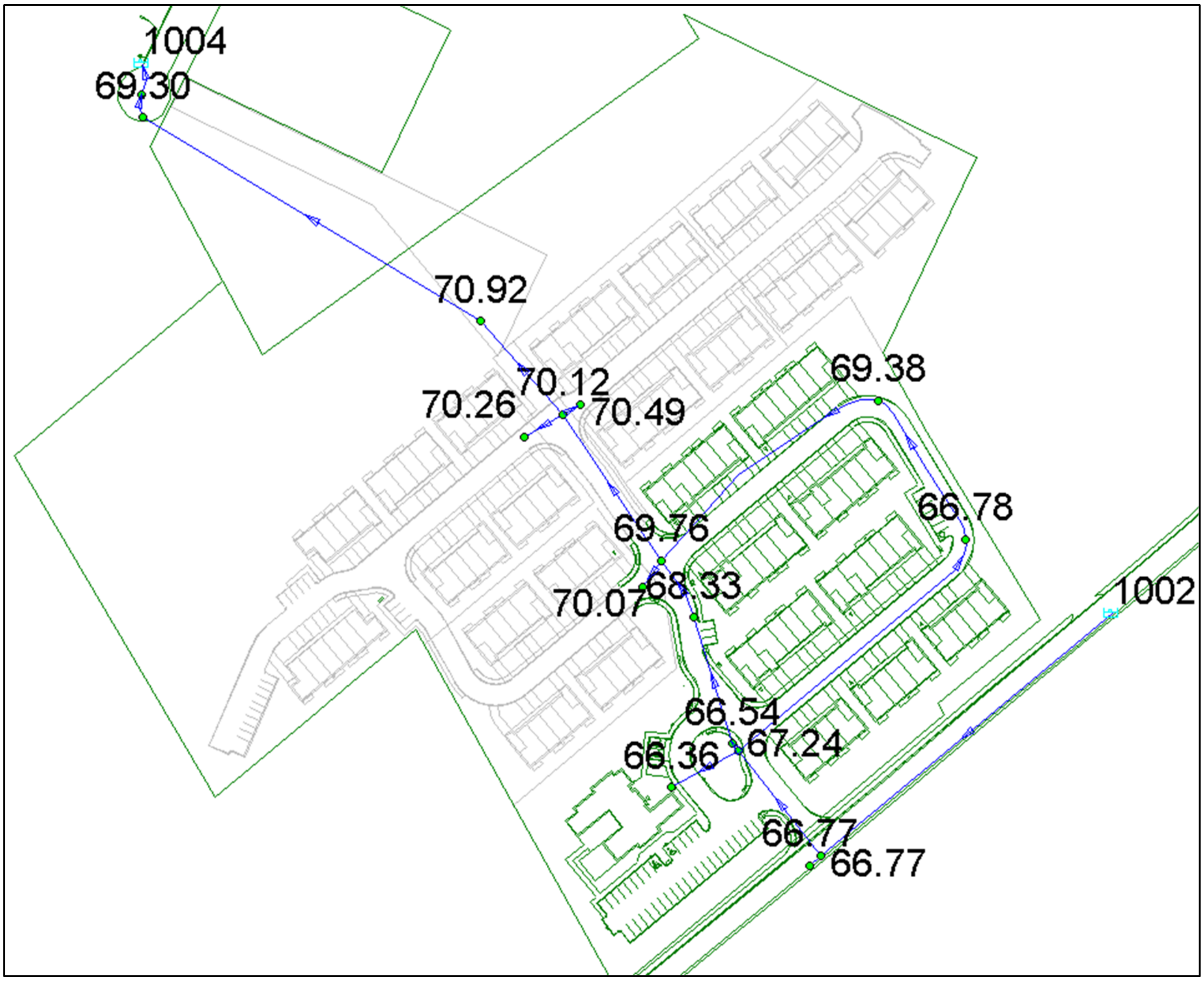


Figure 5. Pressures (psi) under PKHR demands for proposed Phase 1 zone configuration

2.5.3 Maximum Day Demand + Fire Flow (MXDY+FF)

The maximum day demand plus fire flow scenario was formulated in the hydraulic model to determine if the proposed water distribution network can achieve the maximum day demand and the required OFM/OBC fire flow while maintaining a residual pressure of at least 138 kPa (20 psi), per the City of Ottawa's 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.

Figure 6 illustrates that the proposed distribution network can deliver sufficient flow to meet the critical demand scenario while maintaining a residual pressure of 138 kPa (20 psi). Additionally, **Figure 7** illustrates that the system has available flow in excess of the required fire flow rate and that sufficient flow is available under emergency conditions. Results from the hydraulic modeling for the Wellings of Brockville development are included for reference in **Appendix A.4**.

Under the proposed watermain configuration, all nodes in the hydraulic model for the site can meet the maximum day demand plus the 2,700 L/min (45 L/s) fire flow demand. The hydraulic model output data indicates that the proposed watermain configuration can provide adequate flow under emergency fire flow conditions while meeting all design criteria.

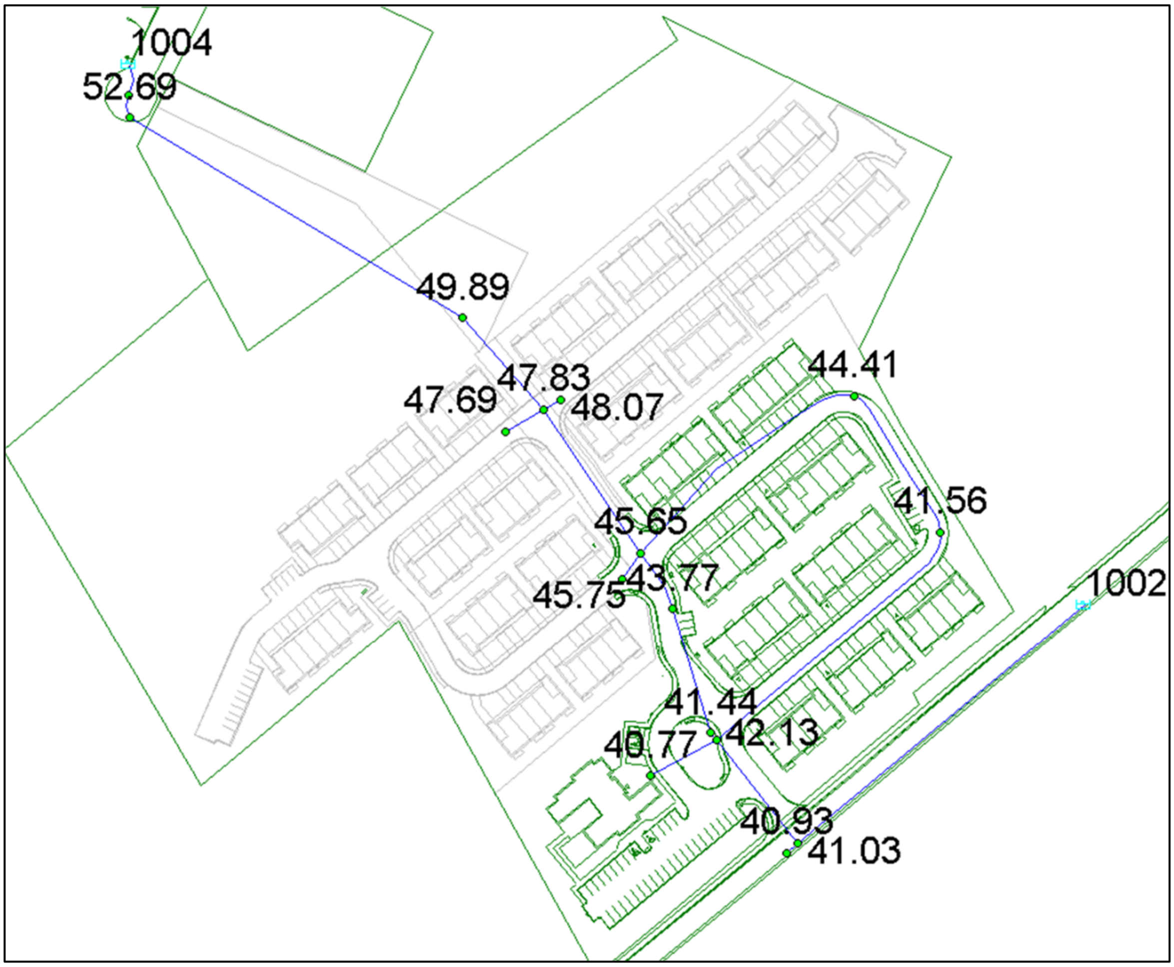


Figure 6. Residual pressure (psi) for MXDY+FF demands for proposed Phase 1 zone configuration with Phases 2 and 3 MXDY demands

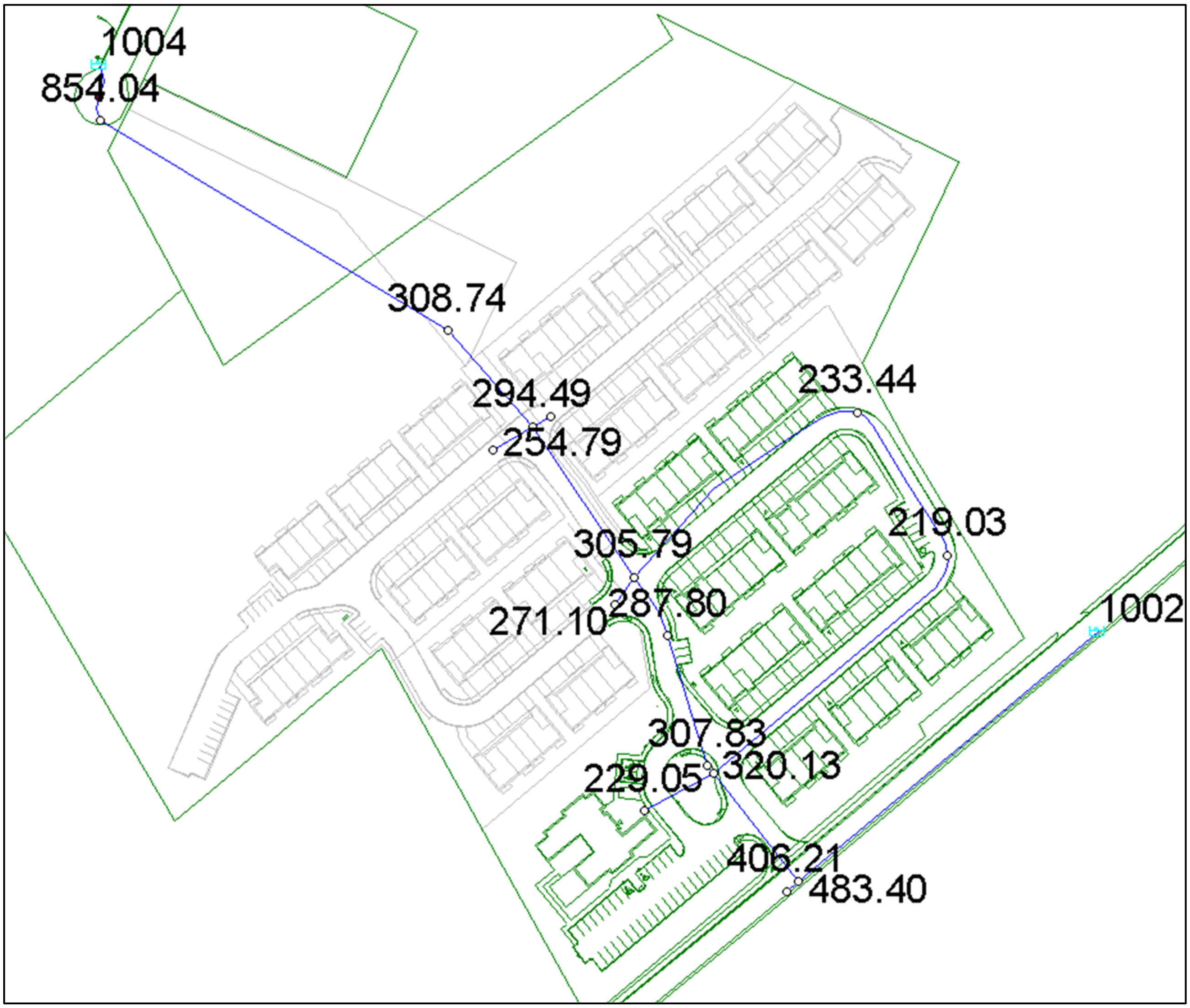


Figure 7. Available fire flows (L/s) for MXDY+FF demands for proposed Phase 1 zone configuration

2.6 POTABLE WATER SUMMARY

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

- The proposed water distribution network consists of 200 mm dia. and 300 mm dia. watermain with two connections to the existing 300 mm dia. watermain on Parkedale Avenue and Chelsea Street, respectively.
- During peak hour conditions, the proposed system can operate above the minimum pressure objective of 276 kPa (40 psi).
- During emergency conditions, the proposed system can provide 2,700 L/min fire flows at all nodes and has sufficient available flow while operating above the minimum pressure objective of 138 kPa (20 psi).

Based on the findings of the report, the proposed network can service the development area and meet all servicing requirements as per the City of Ottawa’s Water Distribution Design Guidelines and the MECP’s Design Guidelines for Drinking-Water Systems (2008) under typical demand conditions (peak hour and average day conditions) as well as under emergency fire demand conditions (maximum day + fire flow).

3.0 WASTEWATER SERVICING

3.1 BACKGROUND

A 200 mm diameter gravity sanitary sewer is located along Parkedale Avenue, immediately south of the subject site. The existing sewer flows from west to east and covers the entire southern frontage of the site.

Two existing forcemains (a 100mm and a 150mm) along Parkedale Avenue, used for leachate collection, discharge to this 200 mm gravity sewer near the southwest corner of the site. Since most of the proposed site would be below the available sanitary invert due to the natural topography of the site and grading constraints, to avoid the requirement to install a private pump station, an alternative sanitary servicing strategy has been proposed for the site.

A 375 mm diameter gravity sanitary sewer exists on Chelsea Street, north of the subject site, terminating at a maintenance hole at the western limit of Chelsea Street. This sanitary sewer outlet will provide a gravity outlet of choice for the design of the Wellings of Brockville development. The proposed connection is separated from the subject site by wooded lands owned by others, as well as an existing watercourse, and will require an approval from Cataraqui Region Conservation Authority for the crossing of the EP zone and the watercourse.

3.2 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:

- 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
- 1-Bedroom unit density (persons per unit) – 1.4
- 2-Bedroom unit density (persons per unit) – 2.1
- Extraneous Flow Allowance – 0.28 L/s/ha
- Residential Average Flows – 450 L/cap/day
- Commercial/Mixed Use Flows – 50 p/ha/day
- Maintenance Hole Spacing – 110 m
- Minimum Cover – 2.50 m
- 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 B.1** for the sanitary sewer design sheet for the proposed Wellings of Brockville development.

3.3 SANITARY SERVICING DESIGN

The proposed sanitary servicing layout will consist of 200 mm, 300 mm, and 375 mm dia. sanitary sewer that will outlet via gravity to the existing 375 mm diameter sanitary sewer on Chelsea Street. This servicing layout involves passing below the wetland buffer and will extend to the existing sewer on Chelsea Street. The sanitary sewers in Phase 1 have been designed to accommodate future peak flows from future phases, with capped ends provided at Phase 1 boundaries to allow for future connections.

As previously stated, this servicing layout involves crossing below the existing watercourse, with sufficient cover being provided over the sanitary sewer at the location of the creek crossing. This servicing option has been confirmed based on negotiations with the property owners, as well as approvals from the Cataraqui Conservation Authority and from the City of Brockville.

The detailed sanitary sewer layout for the subject site is shown in **Drawing SSP-1** to **SSP-5** in **Appendix F**.

A sanitary sewer design sheet for the entire site was prepared using the population estimates for the entire site. A 450 L/p/day average daily demand (per the Brockville Site Plan Control Manual 2018) was used for the residential portion of the site, and a 50p/ha/day demand was attributed to the clubhouse, which has a total footprint of 628 m^2. The proposed sanitary sewer alignment is shown on **Drawing SA-1** to **SA-5**, while the sanitary sewer design sheet is included in **Appendix B.1**. The peak flows from the proposed ultimate development are summarized in **Table 3.1** below.

Table 3.1: Sanitary Peak Flows from Wellings of Brockville

Source	Area (ha)	Population	Peak Flow (L/s)
58 1-br and 62 2-br Bungalow Townhomes	3.87	211	3.82
Ex. Chelsea Street Units	1.28	8	0.14
1-Storey Clubhouse	0.53	27	0.51
Green/Unused	0.57	-	-
Infiltration	6.25	-	1.75
Total:	**6.25**	**246**	**6.22**

1. Total area of the site considers only the portion of the site which will be developed (i.e., excludes the environmental protection area as shown on the site plan dated March 2, 2021).

The capacity of the existing 375 mm dia. sanitary sewer system on Chelsea Street can provide a sufficient outlet for the proposed development.

4.0 STORMWATER MANAGEMENT AND STORM SERVICING

The following sections describe the stormwater management (SWM) plan for the Wellings of Brockville development in the context of the governing criteria.

4.1 STORMWATER MANAGEMENT DESIGN CRITERIA

The stormwater management (SWM) criteria for the site were established based on the City of Brockville Site Plan Control Manual Requirements and Guidelines, the Cataraqui Region Conservation Authority (CRCA) Environmental Planning Policies, and the Ontario Ministry of the Environment, Conservation, and Parks (MECP) Stormwater Management Planning and Design Manual. The following summarizes the criteria, with the source of each criterion indicated in brackets:

General

- Use of the dual drainage principle (MECP).
- Assess the impacts of the 2-year, 5-year, 10-year, and 100-year design storm events on the proposed major and minor drainage systems (MECP).
- Provide “Enhanced” water quality protection (80% TSS removal) for the proposed development (MECP/CRCA).

Storm Sewer and Inlet Control

- Minor system inflow to be restricted for all contributing areas to capture at minimum the 5-year event (MECP, CRCA).
- Post-development peak discharge from the site will be limited to pre-development runoff rates for the 2-year, 5-year, 10-year, and 100-year design storm events. (CRCA)
- 100-year surface HGL to be a minimum of 0.3 m below proposed building openings (MECP).

Surface Storage and Overland Flow

- Overland flow to be directed within proposed rights-of-way to the downstream SWM pond (MECP).
- No surface ponding is to be permitted on roads during the 5-year storm event (MECP).
- Maximum depth of static ponding is not to exceed 0.25 m for design storm events (i.e., up to 100-year storm) (CRCA/Town of Brockville).
- Water must not encroach upon proposed building envelopes and must remain below all proposed building openings during the climate change event.
- Provide adequate emergency overflow conveyance off-site (MECP).

4.2 EXISTING CONDITIONS

4.2.1 Existing Site Description

The existing 5.59 ha site consists mostly of meadow/grassland in its centre with a mature woodlot around its perimeter. Only the southeast corner of the site is currently developed and contains two detached dwellings complete with gravel driveways fronting Parkedale Avenue. Most of the site drains to the north where runoff is split between two existing, unnamed watercourses. A small portion of the site drains south to the existing ditches along Parkedale Avenue. Existing grades range between approximately 105.3 m and 116.1 m, with the lowest grades at the northwest corner of the site along the existing watercourse, and the highest grades located on the south end of the site near Parkedale Avenue.

The existing watercourse along the northwest of the site drains west and appears to be tributary to Grants Creek. The existing watercourse along the northeast of the site drains east where it appears to pond in a low, wooded area adjacent to Stewart Boulevard before spilling through an existing 900 mm culvert which drains to the Brockville stormwater management system. The existing ditch south of the site drains east along Parkdale Avenue until it is picked up by a culvert which drains to the existing Brockville stormwater management system. The site falls within the Cataraqui Source Protection Area.

4.2.2 Existing Model Input Parameters

A hydrologic analysis was conducted using PCSWMM software to determine pre-development peak runoff rates leaving the existing site during each design storm. Intensity Duration Frequency (IDF) curves were sourced using the Ministry of Transportation of Ontario (MTO) IDF lookup tool in reference to Environment Canada climatological data. These IDF curves were used to develop 2-year, 5-year, 10-year, and 100-year 24-hour SCS Type II distributions which were used to generate a pre-development peak runoff rate from the site area.

See **Figure 8** for existing subcatchment boundaries. PCSWMM's watershed delineation tool was used with a DEM surface generated from LiDAR data to produce existing drainage boundaries. These drainage boundaries were then clipped to only include the proposed site. This was considered reasonable as proposed cut-off swales will convey run-on from adjacent properties around the developed site to maintain existing drainage patterns and ensure positive drainage of adjacent properties.

The DEM surface was also used to estimate existing catchment slopes and flow lengths. Impervious area was estimated using site survey of existing hard surfaces/structures.

Figure 8. Existing Stormwater Catchment Boundaries of Wellings of Brockville Site

Key parameters for the existing subcatchment boundaries are summarized below. Example input files are provided for the 100-year, 24-hour SCS storm which indicate all other parameters used for the existing subcatchment boundaries in **Appendix C.2**. For all other input files and results of storm scenarios, please examine the electronic model files located on the CD 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 5.1.015.

Table 4.1 presents the general subcatchment parameters used for the existing model:

Table 4.1: General Existing Subcatchment Parameters

Subcatchment 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

The Preliminary Geotechnical Investigation Report, Proposed Residential Subdivision (Wellings of Brockville), Stantec 2021, found that most of the existing site was covered in topsoil, underlain by a layer of silty sand which ranged from very loose to very dense. However, the report did not include a soil infiltration analysis. In the absence of site-specific data, the infiltration parameters recommended by the Ottawa Sewer Design Guidelines were used. These values are presented in **Table 4.1**, above, and include a minimum infiltration rate of 13.2 mm/hr. These guidelines were set assuming developed lawns in an urban area which we believe is applicable to this development. For comparison, the *User's Guide to SWMM5, 13th Edition*, by W. James, L.E. Rossman, and W. R. C. James, provides minimum infiltration values of 10.9 mm/hr for Sandy Loam and 30.0 mm/hr for Loamy Sand. The maximum infiltration rate reached by any of the existing catchments during the 100-year 24-hour SCS Type II storm was 13.4 mm/hr, demonstrating that the model results are relatively insensitive to any maximum infiltration rate larger than that. For that reason the value from the Ottawa Sewer Design Guidelines was maintained.

Table 4.2 presents the individual parameters that vary for each of the existing subcatchments.

Table 4.2: Individual Existing Subcatchment Parameters

Catchment ID	Catchment Area (ha)	Flow Length (m)	Slope (%)	Percent Impervious (%)
EX-1	1.51	50	6.3	0
EX-2	0.24	7	6.6	6.5
EX-3	0.45	30	6.7	0
EX-4	0.49	30	8.1	0
EX-5	2.74	50	6.8	0.4

Table 4.3 presents the peak pre-development offsite flow results for various return periods of the 24-hour SCS Type II storm distribution.

Table 4.3: Existing Condition Peak Flow Rates Leaving Site

Outfall	Contributing Catchments	Flow (L/s)			
		2-Year	5-Year	10-Year	100-Year
Parkedale Avenue	EX-2	30.8	48.3	58.3	87.9
West Watercourse	EX-1 & EX-3	87.2	221.0	318.1	588.2
East Watercourse	EX-4 & EX-5	145.8	367.7	528.1	973.8

4.3 PROPOSED DEVELOPMENT CONDITIONS

The proposed Phase 1 of this development consists of townhomes, a club house, parking lot, and green space. Additional townhomes are proposed in the future Phases 2 and 3. Major and Minor systems have been designed to capture stormwater and direct it to the proposed SWM Pond in the north corner of the site. This pond has been designed to provide both water quality and quantity control to the ultimate buildout condition of Phases 1-3. The pond ultimately drains to the existing east watercourse described in **Section 4.2.1**. Small portions of the site which, due to grading constraints, cannot be captured by the proposed SWM system, sheet flow south-east to Parkedale Avenue, and north to the existing east and west unnamed watercourses.

Allowances have been made in the major and minor systems to account for flow from the future Phases 2 and 3. This includes the sizing of the downstream minor system and the SWM Pond.

Drawing SD-1 to **SD-5** outlines the proposed storm sewer system, overland flow route directions, drainage boundaries and labels, and the proposed SWM Pond location and configuration.

4.4 PROPOSED DEVELOPMENT MODEL – RATIONALE AND METHODOLOGY

A hydrologic/hydraulic model was built using PCSWMM software to evaluate the performance of the proposed storm sewers and pond. Infrastructure proposed in Phase 1 was modelled as per the design drawings while assumptions were made to account for future Phase 2 and Phase 3 infrastructure. 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.
- 24-hour SCS Type II distributions for the 2-year, 5-year, 10-year, and 100-year storm events, 12-hour SCS Type II distributions for the 2-year, 5-year, 10-year, and 100-year storm events, and 1-hour AES distributions for the 2-year, 5-year, 10-year, and 100-year storm events were used to evaluate the urban component of the dual drainage system (i.e., minor system capture rates, total overland flow depth, hydraulic grade line (HGL), etc.). These distributions were developed using IDF curves sourced using the MTO IDF lookup tool in reference to Environment Canada climatological data.
- A 25 mm, 4-hour Chicago Storm and the 24-hour SCS Type II distributions for the 2-year, 5-year, 10-year, and 100-year return periods were used to evaluate the proposed SWM Pond performance and to compare post development peak flows leaving the site to pre-development flow.

- The ‘climate change’ scenario, created by adding 20% of the individual intensity values of the 100-year 24-hour SCS Type II storm at each specified time step, was used as an analytical tool to establish the function of the system under extreme events.
- Runoff coefficients based on pervious and impervious areas were calculated and converted to percent imperviousness using the relationship %IMP = ((C - 0.2) / 0.7) x 100.
- Flow length parameters were calculated by measuring the average distance of sheet flow across each drainage area before channelization (typically the distance to road gutters).
- Flow length parameters for the future Phases 2 and 3 were calculated using the same method as Phase 1, except preliminary building and road layouts were used instead of detailed design layouts.
- Minor system capture rates were restricted to the 5-year storm event runoff.
- Phase 1 was reviewed to develop a unit area surface storage rate of 25 m^3/ha. This value was then applied to future phase subcatchments to estimate the future surface storage. See **Section 4.4.1** for details.
- All major system flows were designed to cascade to the SWM Pond.

4.4.1 SWMM Dual Drainage Methodology

The site will be designed using the “dual drainage” principle, whereby the minor (pipe) system is designed to convey the peak rate of runoff from the 5-year design storm, and runoff from larger events is conveyed by both minor (pipe) and major (overland) channels, such as roadways and walkways, safely to the proposed pond without impacting proposed surrounding properties.

The storm sewer design sheet is included in **Appendix C.1**.

The proposed development is modeled in one modeling program as a dual conduit system (see **Figure 9**) with:

1. Circular conduits representing sewers and storage nodes representing manholes; and
2. Irregular conduits using street-shaped cross-sections representing assumed overland road network with streets at varying slopes and storage nodes representing catchbasins.

The dual drainage systems are connected via outlet/orifice link objects from storage node (i.e., inlets) to storage node (i.e., MH), and represent inlet control devices (ICDs) for areas within the proposed Phase 1 and capture rates for lumped drainage areas within the future phases. Subcatchments are linked to the storage node on the surface so that generated hydrographs are directed there firstly.

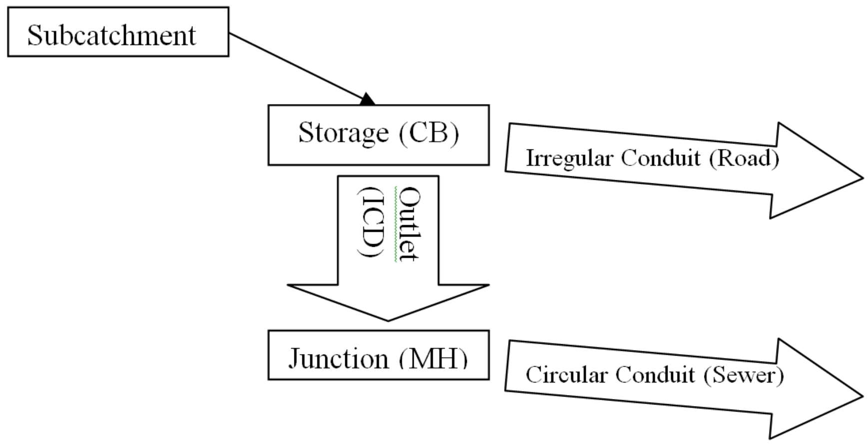


Figure 9. Schematic Representing Model Object Roles

Storage nodes are used in the model to represent drainage area outlets as well as manholes and major system junctions. For storage nodes representing drainage area outlets, the invert of the storage node represents the invert of the minor system inlet (1.38 m below proposed road grade), and the rim of the storage node is assumed to be equal to the proposed road grade plus the allowable static ponding depth on the street (i.e., 0.25 m for the 100-year storm), plus a buffer (generally 0.15 m). If the available storage volume in a storage node is exceeded, flows spill above the storage node and into the downstream street segment conduit and continue routing through the system until ultimately flows either re-enter the minor system or reach the outfall of the major system.

Storage values for back of lot storage areas include subsurface storage (trench volume with porosity = 0.4), plus surface storage within low areas.

Storage nodes that serve as outlets for the conceptual lumped areas within future phases of the development were assigned a storage curve assuming a maximum storage of 25 m^3/ha. 25 m^3/ha was calculated by averaging the storage volume provided in the residential area of the proposed Phase 1 (i.e., Subcatchments C105A, C105B, C109A, and C109B). Storage curves in PCSWMM are required to be input as depth-area curves, as such an equivalent area was calculated for each depth along the curve. All storage was assumed to be between the top of grate and a flow depth of 0.40 m (i.e., between a depth of 1.38 m and 1.78 m).

Minor system capture rates are specified in outflow/orifice links defined to restrict inflows to the minor system to the 5-year rate as described in **Section 4.4**.

Subarea routing in rear yard areas and areas which sheet-flow offsite has been set to route 100% of the impervious area in each subcatchment through the pervious area of the subcatchment. This was done to account for directly connected imperviousness.

4.4.2 Hydrologic Parameters

Key parameters for the proposed development areas are summarized below. Example input files are provided for the 100-year, 24-hour SCS storm which indicate all other parameters for the development areas tributary to the proposed SWM Pond in **Appendix C.2**. For all other input files and results of storm scenarios, please examine the electronic model files located on the CD 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 5.1.012.

As noted in Section 4.4, the model was run using 24-hour SCS Type II distributions, 12-hour SCS Type II distributions, and 1-hour AES distributions for each of the 2-year, 5-year, 10-year, and 100-year storm events. At every return period, the 24-hour SCS storms were found to govern as they produced the largest minor system flows, major system flows, and major system ponding depths. For this reason, only the results of the 24-hour SCS storms are provided in the below results tables. For the results of all other storm scenarios, please examine the electronic model files located on the CD provided with this report.

Table 4.4 presents the general subcatchment parameters used for proposed development areas:

Table 4.4: General Proposed Subcatchment Parameters

Subcatchment 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 4.5 presents the individual parameters that vary for each of the proposed and future subcatchments in the Mahogany SWM Pond 2 model.

Table 4.5: Individual Proposed Subcatchment Parameters

Catchment ID	Catchment Area (ha)	Flow Length (m)	Slope (%)	Percent Impervious (%)
C100A	1.01	13	2	64
C103AA	0.96	13	2	57
C104AA	0.64	13	2	57
C105A	0.51	16	2	71
C105B	0.2	11	2	57
C109A	0.3	14	2	71
C109B	0.18	10	2	29
C111A	0.12	17	2	50
C111B	0.1	18	2	50
POND	0.42	15	20	29
UNK-1	0.05	6	2	0
UNK-2	0.01	6	2	29
UNK-3	0.45	30	6.7	0
UNK-4	0.49	30	8.1	0

Table 4.6 summarizes the storage node parameters used in the model. Lumped catchment areas are modeled assuming storage node depths of 1.78 m (i.e., 1.38 m between catchbasin invert and catchbasin top of grate, and 0.40 m flow depth above catchbasin top of grate). For future residential areas, a maximum of 25 m^3/ha of surface storage was assumed. Storage is assumed to be available between depths 1.38 and 1.78 m in the storage node.

Table 4.6: Storage Node Parameters

Storage Node	Invert Elevation (m)	Rim Elevation (m)	Total Depth (m)
C100A-S-Fut	108.05	109.83	1.88
C103AA-S-Fut	108.28	110.06	1.78
C104AA-S-Fut	109.93	111.58	1.78
C105A-S	109.93	111.71	1.78
C105B-S	109.42	111.82	2.40
C109A-S	112.91	114.69	1.78
C109B-S	112.33	114.73	2.40
C111A-S	113.57	115.35	1.78
C111B-S	113.71	115.51	1.80

4.4.3 Hydraulic Parameters

As per the OSDG 2012, Manning's roughness values of 0.013 were used for sewer modeling and overland flow corridors representing roadways.

The proposed storm sewers within Phase 1 were modeled to estimate flow capacities and hydraulic grade lines (HGLs) in the proposed condition with consideration of the SWM Pond backwater acting on the sewers. The proposed storm sewer design sheet is included in **Appendix C.1**. As no building basements or footing drains are proposed to be hydraulically connected to the storm sewer, HGL to underside of footing (USF) freeboard was not determined to be a requirement for operation of the system.

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 of Ottawa guidelines (Appendix 6b), see **Table 4.7** below.

Table 4.7: 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

Table 4.8 below presents the parameters for the orifice and outlet link objects in the model, which represent ICDs within the proposed Phase 1 subcatchments. A coefficient of 0.572 was applied when using orifices to conform to head/discharge curves as supplied by the manufacturer for IPEX Tempest HF model ICDs with circular openings and floatable and odor control. Coefficients and exponents for outlets varied and were set to conform to head/discharge curves for individual ICD sizes as supplied by the manufacturer for IPEX Tempest LMF model ICDs.

Table 4.8: Phase 1 Orifice & Outlet Parameters

Orifice/ Outlet Name	Tributary Area ID	Inlet (Catchbasin) ID	Outlet (Manhole) ID	ICD Type
C105A-O1	C105A	C105A-S	105	No ICD – 200mm CB Lead
C105A-O2	C105A	C105A-S	105	No ICD – 200mm CB Lead
C105B-O	C105B	C105B-S	105	No ICD – 200mm CB Lead
C109A-O1	C109A	C109A-S	109	IPEX TEMPEST HF (152mm Orifice)
C109A-O2	C109A	C109A-S	109	IPEX TEMPEST HF (178mm Orifice)
C109B-O	C109B	C109B-S	109	IPEX TEMPEST LMF-40
C111A-O	C111A	C111A-S	111	IPEX TEMPEST HF (102mm Orifice)
C111B-O	C111B	C111B-S	111	IPEX TEMPEST HF (95mm Orifice)

Table 4.9 below presents the parameters for the orifice link objects in the model, which represent minor system inlets for the future Phase 2 and Phase 3 subcatchments.

Table 4.9: Future Phase Orifice Parameters

Orifice Name	Tributary Area ID	Inlet Storage Node ID	Minor System Outlet ID	100-Year, 24-Hour SCS Type II Capture (L/s)	Major System Outlet ID	100-Year, 24-Hour SCS Type II Major System Overflow (L/s)
C100A-O-Fut	C100A	C100A-S-Fut	102	243	C100A-FOREBAY	207

Orifice Name	Tributary Area ID	Inlet Storage Node ID	Minor System Outlet ID	100-Year, 24-Hour SCS Type II Capture (L/s)	Major System Outlet ID	100-Year, 24-Hour SCS Type II Major System Overflow (L/s)
C103AA-O-Fut	C103AA	C103AA-S-Fut	103A	225	103AA-100A	263
C104AA-O-Fut	C104AA	C104AA-S-Fut	104A	155	104AA-103AA	106

4.4.4 Boundary Conditions

The PCSWMM hydrology for the proposed and future phases, along with the proposed storm sewers, were used to assess the peak inflows and hydraulic grade line (HGL) in the development. Storage nodes representing the proposed SWM Pond (one for the pond forebay and one for the main cell), as well as the components of the proposed outlet structure, are included in the model.

The SWM Pond discharges to the existing east unnamed watercourse. A review of the surrounding topography and infrastructure found that this watercourse will pond adjacent to Stewart Boulevard before spilling through an existing 900 mm culvert with an invert elevation of 103.89. The outlet of the SWM pond is set at an elevation of 106.94. As the pond outlet is more than three meters above the east watercourse's spill, we have found it reasonable to assume that there is no potential backwater from the east watercourse into the pond and a free outfall can be used.

4.5 PROPOSED DEVELOPMENT 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 C.2** and the electronic model files on the enclosed CD.

4.5.1 Hydrology Results

Table 4.10 summarizes the orifice link and outlet link maximum flow rates and heads across the proposed development.

Table 4.10: Proposed ICD Schedule

Orifice/ Outlet Name	Tributary Area ID	ICD Type	2-Year, 24-Hour SCS Type II Head (m)	100-Year, 24-Hour SCS Type II Head (m)	2-Year, 24-Hour SCS Type II Flow (L/s)	100-Year, 24-Hour SCS Type II Flow (L/s)
C105A-O1	C105A	No ICD – 200mm CB Lead	0.33	1.5	40.9	95.8
C105A-O2	C105A	No ICD – 200mm CB Lead	0.33	1.5	40.9	95.8
C105B-O	C105B	No ICD – 200mm CB Lead	0.25	1.55	32.9	85.0
C109A-O1	C109A	IPEX TEMPEST HF (152mm Orifice)	0.28	1.24	20.8	49.5
C109A-O2	C109A	IPEX TEMPEST HF (178mm Orifice)	0.28	1.24	27.6	67.5
C109B-O	C109B	IPEX TEMPEST LMF-40	1.37	1.93	1.6	1.9

Orifice/ Outlet Name	Tributary Area ID	ICD Type	2-Year, 24-Hour SCS Type II Head (m)	100-Year, 24-Hour SCS Type II Head (m)	2-Year, 24-Hour SCS Type II Flow (L/s)	100-Year, 24-Hour SCS Type II Flow (L/s)
C111A-O	C111A	IPEX TEMPEST HF (102mm Orifice)	0.65	1.52	15.3	24.3
C111B-O	C111B	IPEX TEMPEST HF (95mm Orifice)	0.54	1.52	12.6	21.8

4.5.2 Hydraulic Results

Table 4.11 presents the total surface water depths (static ponding depth + dynamic flow depth) on the proposed roads for the 100-year design storm and climate change storm.

Based on the model results, the maximum total surface water depths do not extend to adjacent building openings during the 100-year event or climate change (100-year +20%) event. The maximum surface water elevations during the 100-year event are more than 0.3 m below the proposed adjacent building finished first floor elevations. The maximum surface water elevations during the climate change scenario are below the adjacent building first floor elevations and are not expected to impact proposed buildings within the development.

Table 4.11: Maximum Surface Water Depths

Storage Node ID	Top of Grate Elevation (m)	Lowest Adjacent Building Finished First Floor Elevation (m)	100-Year, 24-Hour SCS Type II			100-Year, 24-Hour SCS Type II + 20%		
			Max Surface Ponding Elevation (m)	Total Surface Ponding Depth (m)	Max Surface Ponding to First Floor Elevation (m)	Max Surface Ponding Elevation (m)	Total Surface Ponding Depth (m)	Max Surface Ponding to First Floor Elevation (m)
C105A-S	111.31	111.73	111.43	0.12	0.3	111.48	0.17	0.25
C105B-S	111.42	111.93	110.97	0	N/A	111.23	0	N/A
C109A-S	114.29	114.63	114.15	0	N/A	114.38	0.09	0.25
C109B-S	114.33	114.83	114.26	0	N/A	114.44	0.11	0.39
C111A-S	114.95	115.65	115.09	0.14	0.56	115.13	0.18	0.52
C111B-S	115.11	115.65	115.23	0.12	0.42	115.25	0.14	0.40

4.6 SWM POND DESIGN

As noted in **Section 4.3**, the proposed SWM Pond is located in the north corner of the site and discharges to the existing unnamed east watercourse. The pond will be constructed as part of Phase 1, but it has been designed to provide water quality and quantity control for the ultimate condition tributary drainage area of 4.44 ha.

4.6.1 Water Quality Control

The proposed SWM Pond has been designed to achieve an “enhanced” level of treatment of urban runoff according to Ministry of the Environment, Conservation and Parks (MECP) criteria – representing an 80% removal of total suspended solids (TSS).

The end-of-pipe facility has been designed according to the recommendations of the Ministry of the Environment Stormwater Management Planning and Design Manual. **Table 4.12** shows the storage requirements recommended by the MECP as well as the volumes that can be provided by the proposed SWM Pond. Detailed calculations for the proposed SWM Pond are included in **Appendix C.3**.

Table 4.12: SWM Pond – Water Quality Requirements

Enhanced Level of Protection – Overall Removal Efficiency of TSS 80%					
Drainage Area (ha)	Imperviousness Ratio (%)	Permanent Pool (m^3)		Extended Detention Storage (m^3)	
		Required	Provided	Required	Provided
4.44	57.0	674	820	178	444

For additional calculations related to drawdown time and erosion control, see **Section 4.6.4**.

4.6.2 Water Quantity Control

The proposed SWM Pond has been designed to attenuate post-development peak flows leaving the development site and entering the unnamed east watercourse to ensure they are less than or equal to pre-development flows for events up to the 100-year storm event.

Table 4.13 shows the pre- to post-development peak flow rate comparison for the 24-hour SCS Type II distribution for the 2-year, 5-year, 10-year, and 100-year storm events.

Table 4.13: Proposed Site Pre- to Post-Development Outflow Comparison

Outfall	Scenario	Contributing Catchments	Total Contributing Area (ha)	Flow (L/s)			
				2-Year	5-Year	10-Year	100-Year
Parkedale Avenue	Pre-Development	EX-2	0.24	30.8	48.3	58.3	87.9
	Post Development	UNK-2	0.01	1.3	2.1	2.5	3.7
West Watercourse	Pre-Development	EX-1 & EX-3	1.96	87.2	221.0	318.1	588.2
	Post Development	UNK-1 & UNK-3	0.50	32.0	72.4	98.6	168.3
East Watercourse	Pre-Development	EX-4 & EX-5	3.23	145.8	367.7	528.1	973.8
	Post Development	UNK-4, POND, C100A, C103AA, C104AA, C105A, C105B, C109A, C109B, C111A, C111B	4.93	123.3	330.4	484.6	949.2

The above table shows that the proposed SWM Pond and outlet configuration will meet the allowable pre-development release rates in all scenarios.

4.6.3 Pond Grading and Storage Design

The pond bottom has been set at 106.0 m in both the pond forebay and main cell. The permanent pool has been set at 107.0 m resulting in a permanent water depth of 1.0 m. The pond has been graded at maximum slope of 5:1 for 3.0 m on either side of the permanent pool, and at a maximum slope of 3:1 everywhere else, see **Drawing PND-1** for detailed grading.

The first pond outlet is a 90 mm orifice at invert at 107.0 m which was sized to retain the quality storage volume for a period greater than 24 hours as per MECP recommendations. The second pond outlet is a 1100 mm-wide by 510 mm-high weir with a weir crest at 107.34 m which was sized to meet pre-development peak discharge flows to the unnamed east watercourse. A 5.0 m-wide riprap-lined spillway at invert 107.84 m is provided to manager a portion of the 100-year flow. This spillway will also act as an emergency overflow path should an event beyond the 100-year design storm, or a blockage of the proposed orifice, occur. See **Section 4.6.7** for details.

The stage-storage relationship for the entire facility was established using the average end area method as presented in **Appendix C.3**.

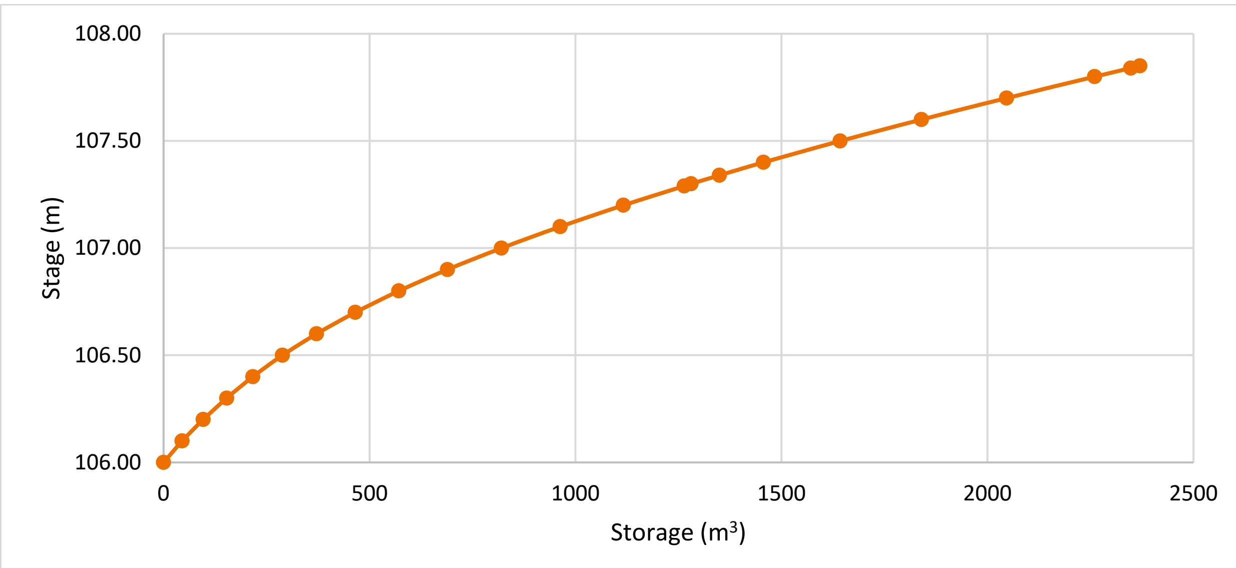


Figure 10. SWM Pond Stage-Storage Relationship

4.6.4 Slope Stability and Erosion Control

Due to the high inlet flow rates to the pond, erosion control and flow dampening measures are proposed to maintain slope stability and prevent sediment re-suspension. For side slope stability, the pond has been graded at a maximum slope of 5:1 for 3.0 m on either side of the permanent pool, and at a maximum slope of 3:1 everywhere else. Exposed slopes should be lined with biodegradable erosion control blankets and seeded with grass seed mulch once weather conditions are suitable for growth. The overflow spillway is to be lined with 400 mm riprap underlain by woven geotextile and seeded with standard roadside mix grass seed.

For erosion control purposes, as per the Ministry of the Environment Stormwater Management Planning and Design Manual, we also modeled the 25 mm, 4-hr Chicago event to confirm that the proposed orifice provides a minimum 24-hr drawdown time in the pond (the preferred range is 24-48 hours). Stantec can confirm that 48 hours after the pond has reached its peak, the water level has returned to within 1 cm of the permanent pool elevation, satisfying the MECP condition.

4.6.5 Inlet Design

The inlet of the SWM Pond is partially submerged, approximately 0.09 m below the permanent pool. This is due to site grading constraints.

4.6.6 Forebay Design

The purpose of the forebay is to act as the primary settling zone in the pond for the initial influx of coarse sediment and associated pollutants flushing off the sewershed. The forebay is designed to provide sufficient cross-section and length to reduce velocities and promote settling, minimize resuspension of settled solids, minimize percentage of overall permanent pool, provide sufficient sediment storage for infrequent clean out (>=5 years), and have adequate accessibility and bottom-treatment for maintenance operations.

The required forebay characteristics dictate a required forebay settling length of 14.3 m. Similarly, the required forebay dispersion length is equal to 22.1 m. The provided length is approximately 22.8 m. The resulting average length to width ratio of the proposed configuration is approximately 7.1:1, also meeting MECP design recommendations. The provision of 1.0 m depth within the forebay provides for 0.35 m sediment accumulation prior to recommended cleanout while maintaining 0.65 m permanent pool depth. The designed sediment storage volume provided in the bottom 0.35 m corresponds to an estimated sediment removal frequency of approximately 5 years for the forebay. Detailed forebay calculations have been provided in **Appendix C.3**.

The forebay berm to the main cell will be 0.3 m lower than the permanent pool at an elevation of 106.7 m and will be constructed of clay soil and rip-rap stone as shown on **Drawing PND-1**.

4.6.7 Outlet Design

The following subsections describe the pond outlet design. **Drawing PND-2** and **Drawing PND-3** illustrate the outlet structure in plan and sectional view.

The outlet will be located at the opposite end of the pond from the inlet and will discharge to the unnamed east watercourse. A concrete outlet structure will house the required extended detention orifice, quantity control weir, and outlet pipe, including the associated maintenance infrastructure (i.e., sluice gates, etc.).

4.6.7.1 Extended Detention Control

The design of the required outlet structure incorporates a dual control configuration. Firstly, a 90 mm orifice provides an approximate 25-hour extended detention for quality control. The entire extended detention volume is stored between 107.0 m and 107.29 m, as calculated below.

<u>Required Storage:</u>
Tributary Area = 4.44 ha
Extended Detention Storage = 40 m^3/ha
Storage = 4.44 x 40 = 178 m^3

<u>Provided Storage</u>:
Forebay area at PP (107.0 m) = 369 m^2
Forebay area at 107.29 m = 471 m^2

Main Cell area at PP (107.0 m) = 1002 m^2
Main Cell area at 107.29 m = 1217 m^2

Provided Depth = 107.29 – 107.00 = 0.29 m
Provided Extended Detention Active Volume = 444 m^3

4.6.7.2 Flow Control Weir

Quantity control of the pond discharge above the extended detention elevation is provided by a flow control weir within the outlet structure. This weir has been incorporated into the outlet structure to lower the water levels in the pond, while meeting the target peak outflows to the unnamed east water course. A 1,100mm-long by 510 mm-high weir with invert at 107.34 m is proposed to meet quantity control requirements.

4.6.7.3 Overland Spillway

The spillway location is separate from the outlet control structure. The spillway elevation is set to 107.84 m and acts as a broad-crested weir, approximately 5.0 m wide with 3:1 side slopes and 0.5 m deep. Should the SWM Pond's outlet structure clog, the spillway is designed to safely convey runoff to the unnamed east watercourse (see **Drawings PND-1 and PND-2**).

4.6.7.4 Stage-Discharge Relationship

A stage-discharge relationship was estimated using standard orifice and weir equations as outlined in **Appendix C.3**. The resulting stage-discharge relationship is presented in **Figure 11** below.

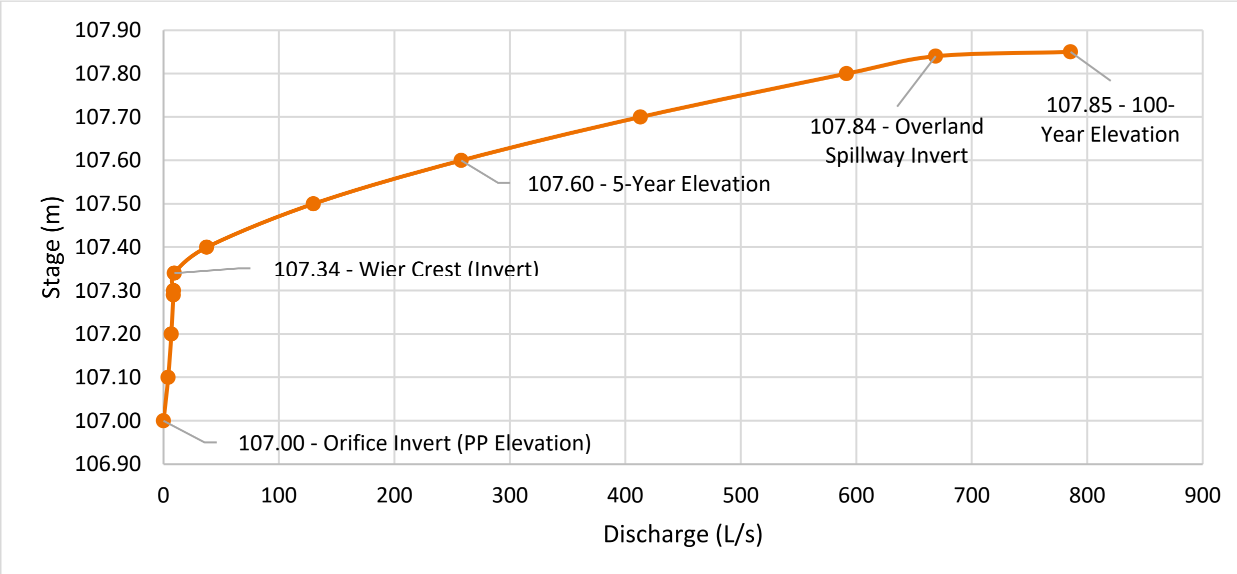


Figure 11. SWM Pond Stage-Discharge Relationship

4.6.7.5 Outlet Channel

A 5 m-wide channel is proposed to convey pond discharge from the outlet headwall (HWL-2) to the unnamed east watercourse. The channel has a trapezoidal cross section with 3:1 side slopes and is lined with rip-rap stone as shown on **Drawing PND-1.**

4.6.8 Pond Performance

As **Table 4.14** indicates, the water quality objectives of the SWM facility are met by providing extended detention of 24-48 hours and exceeding the MECP recommended water quality volumes.

Table 4.14: SWM Facility Operational Characteristics

SWM Basin Parameters	Basin Value
Total Contributing Area	4.44 ha
Imperviousness of Contributing Area (of Sewershed Area)	57.0 %
Unit Area Storage Volume Requirements as per SWMPD Manual	191.8 m^3/ha
Required Total Water Quality Volume	852 m^3
Wet Pond Bottom Elevation	106.0 m
Required Permanent Pool Volume	674 m^3
Permanent Pool Volume Provided (excluding sediment storage)	785 m^3
Permanent Pool Elevation	107 m
Permanent Pool Surface Area	1,371 m^2
Required Extended Detention Volume	178 m^3
Extended Detention Volume Provided	444 m^3
Peak Release Rate for Extended Detention	0.009 m^3/s
Extended Detention Drawdown Time	25 hours
Extended Detention Elevation	107.29 m
5-Year Storm Maximum Ponding Level (24-hour SCS Type II)	107.60 m
5-Year Storm Peak Pond Release (24-hour SCS Type II)	0.258 m^3/s
100-Year Storm Maximum Ponding Level (24-hour SCS Type II)	107.85 m
100-Year Storm Peak Pond Release (24-hour SCS Type II)	0.691 m^3/s
100-Year Storm Active Volume Required (24-hour SCS Type II)	1,550 m^3
Top of Berm (minimum grade of surrounding properties)	108.15 m
Forebay Parameters	
Forebay Bottom Elevation	106.0 m
Sediment Accumulation Depth	0.35 m
Forebay Depth from Permanent Pool	1.0 m
Required Forebay Length	22.1 m
Actual Forebay Length	22.8 m
Clean Out Frequency	~5 years
Outlet Parameters	
Quality Orifice Size	90 mm
Quality Orifice Invert	107.00 m
Quantity Weir Size	1,100mm-W x 510mm-H
Quantity Weir Crest Invert	107.34 m
Overland Spillway Width	5.00 m
Overland Spillway Elevation	107.84 m

4.6.9 Other Considerations

Additional key design notes include the following:

- A 1.5 m wide access road with 1.0 m shoulders has been provided for ease of inspection and maintenance of the inlet, forebay, and outlet. The access road will have an engineered base consisting of granular 'A' and granular 'B' for durability and strength, while the surface will be asphaltic concrete for erosion protection. The route has been designed with minimal slope to facilitate maintenance equipment maneuverability.
- The pond's permanent pool elevation (107.0) is set below the existing groundwater level measured in the Preliminary Geotechnical Investigation Report, Proposed Residential Subdivision (Wellings of Brockville), Stantec 2021. The pond will require a clay liner to prevent groundwater seepage. See **Drawings PND-1** and **PND-2** for details.

4.6.10 SWM Pond Operations and Maintenance

As with any SWM facility, maintenance will be required to ensure the operational efficiency and functionality of the proposed SWM Pond. As this is a private site, the developer will be responsible for any maintenance/operation/monitoring works. The preparation of an Operations, Maintenance and Monitoring Manual for the SWM Pond will be required at a later date and submitted under separate cover.

4.6.10.1 Maintenance Program

The following summarizes the key components to be considered for the maintenance program:

- **Inventory of Stormwater System Components** (e.g., conveyance locations, elevations, outfalls, contributing drainage area, receiving watercourse, control structure components and specifications, material types, vegetative species, and other pertinent information)
- **Periodic and Scheduled Inspections** (performed on a regular basis as determined in consultation with the City, MECP, and conservation authority)
- **Maintenance Scheduling and Performance** (e.g., vegetation/landscaping maintenance, trash and debris removal, dewatering, sediment removal and disposal, pond bank stabilization, inlet/outlet structure repairs, equipment testing/troubleshooting, etc.)
- **Documentation and Reporting** (e.g., frequent inspection reports to the municipality and conservation authority during construction).

4.6.10.2 Monitoring

Monitoring of the proposed SWM Pond will be conducted to ensure proper hydraulic and water quality performance of the facility as designed. A detailed monitoring plan will be prepared following the receipt of MECP Environmental Compliance Approval (ECA). Monitoring criteria outlined in the MECP ECA, Cataraqui Regional Conservation Authority (CRCA) permits, and as required by the City of Brockville, will be used to prepare a monitoring plan for the facility.

4.6.10.3 SWM Pond Dewatering Procedure

A sump pit below the pond bottom elevation and a 300 mm diameter opening with a sluice gate at elevation 106.0 m have been incorporated within the outlet structure to allow for the water level in the main cell to be drained completely by lowering a sump pump into the outlet structure and directing pumping discharge into the outlet pipe. In addition, the forebay berm has been designed to be impervious with clay to allow for water level separation between the forebay and the main cell. A drawdown structure has been provided next to the forebay berm with a 300 mm diameter pipe connecting the bottom of the forebay to the drawdown structure and a second 300 mm diameter pipe connecting the drawdown structure to the bottom of the main cell. Sluice gates for both pipes have been incorporated within the drawdown structure to facilitate maintenance. As the forebay bottom and the main cell bottom are at the same elevation, the forebay could be drained by gravity into the main cell once the main cell is empty, by opening both sluice gates. Alternatively, a sump pit has been provided in the drawdown structure to allow for the forebay to be drained with a sump pump from the drawdown structure.

4.6.10.4 Sediment Removal and Storage

Access roads have been provided to the inlet structure, outlet structure, and drawdown structure. The pond forebay area is located such that sediment removal activities can be conducted with access from the south end of the forebay. Stop log access hatches and guides are provided in the outlet and inlet headwalls to facilitate sediment removal and maintenance activities.

Sediment removal is estimated to be required at approximately 5-year intervals or at a sediment accumulation depth of 0.35 m in the forebay. Sediment accumulation within the forebay is variable and dependent on many factors including the condition of the tributary lands and the frequency of rainfall events. Therefore, sediment removal may be required at shorter or longer intervals than 5 years. Monitoring of sediment depth should be conducted regularly, and a hydrometric survey should be completed at regular intervals to confirm sediment accumulation rates. Sediment accumulation within the main cell will occur at lower rates and therefore require less frequent clean-outs than the forebay cell.

A sediment management area adjacent to the forebay has been provided with capacity to store sediment in excess of the 37 m^3 required for one cleanout of the forebay.

Any sediment removed from the site to be disposed of off-site must be analyzed for Ontario Regulation 347 criteria. Analytical results must meet inert fill requirements if the sediment is to be used for land application and meet non-hazardous requirements as per the TCLP leachate test in O.Reg. 347 if it is to be disposed of in a municipal landfill.

4.7 CUT-OFF SWALE SIZING

As noted in Section 4.2.2, cut-off swales are proposed to intercept run-on from the adjacent properties and direct it around the proposed development to maintain existing drainage patterns. These swales were sized to manage runoff from the 100-year 24-hour SCS Type II storm event. In all cases, the depth of flow in the swales is less than 0.3 m and the product of flow depth and flow velocity is less than 0.6. See **Drawings GP-3 and GP-4** for details.

5.0 GEOTECHNICAL CONSIDERATIONS

5.1 PRELIMNARY GEOTECHNICAL INVESTIGATION

A preliminary geotechnical field investigation was completed by Stantec Consulting Ltd. between January 12, 2021 and January 14, 2021. Eight boreholes were advanced throughout the subject site to characterize the subsurface conditions (MW21-2 to MW21-9), test pitting was completed to delineate shallow subsurface soil and groundwater conditions, and the installation of six (6) monitoring wells was completed to measure groundwater levels and characterize groundwater conditions. For details which are not summarized below, please see Stantec's Preliminary Geotechnical Investigation Report (2021) in **Appendix D**.

The site is currently undeveloped with dense trees covering the eastern and western portion of the site. The site generally slopes down towards the north and a swampy area was noted in the northwest corner of the site during the topographic survey.

The subsurface profile generally consists of topsoil over silty sand to silty sand with gravel over limestone and sandstone bedrock. Possible fill was encountered at several borehole locations below the topsoil. Topsoil was found at ground surface in all the boreholes, ranging in thickness from 125 mm to 600 mm. Layers of yellow-brown to brown silty sand were encountered below the topsoil material in several boreholes and identified as possible fill material. The thickness of the fill material ranged from 0.8 m to 1.9 m. A layer of silty sand to silty sand with gravel was encountered in all boreholes below the topsoil or fill material, with the thickness ranging from approximately 1.5 m to 5.1 m. A till material was encountered beneath the sand layer in two boreholes with the thickness ranging from approximately 0.6 m to 1.4 m. The till was described as silty sand to silty sand with gravel with occasional cobbles and boulders inferred given that glacial till deposits are often crowded with cobbles and boulders set in a matrix of finer-grained material (gravel, sand, silt, and clay); large boulders more than 1 m are common.

Bedrock was encountered and characterized based on coring or auger refusal with bedrock depths varying from 3.4 m to 5.0 m below the ground surface. The bedrock consisted of grey limestone and sandstone. Monitoring wells were installed at six of the boreholes and the groundwater levels were found to range from approximately 0.11 m to 0.82 m below the ground surface, noting that fluctuations in the groundwater levels due to seasonal variations or in response to precipitation events should be expected.

Based on the conditions outlined above, the native soils are suitable to support moderate foundation loads using conventional spread footing foundations. The foundations will be slab-on-grade and the removal of existing fill, test pit backfill, topsoil and other deleterious materials beneath the building floor slabs and from the influence zone of the foundation and replaced with compacted Structural Fill is recommended for the subject site. It should be anticipated that cobbles and boulders will be encountered during excavation.

It is specified that a permissible grade raise is not required for the site.

Based on the observed groundwater levels, if dewatering activities are anticipated to exceed 50,000 L/day, a Ministry of the Environment Permit to Take Water (PTTW) will be required.

The required pavement structure for the local roadways is outlined in **Table 5.1** below.

Table 5.1 Recommended Pavement Structure for Local Roads

Thickness (mm)	Material Description
40	Wear Course – Superpave SP 12.5 Asphalt (PG 58-34, Traffic Level A)
50	Binder Course – Superpave SP 19 Asphalt (PG 58-34, Traffic Level A)
150	Base - OPSS Granular ‘A’ crushed stone
300	Subbase - OPSS Granular ‘B’ Type II

The required pavement structure for the collector roadways is outlined in **Table 5.2** below.

Table 5.2 Recommended Pavement Structure for Collector Roads

Thickness (mm)	Material Description
50	Wear Course – Superpave SP 12.5 Asphalt (PG 58-34, Traffic Level B)
70	Binder Course – Superpave SP 19 Asphalt (PG 58-34, Traffic Level B)
150	Base - OPSS Granular ‘A’ crushed stone
500	Subbase - OPSS Granular ‘B’ Type II

6.0 GRADING AND DRAINAGE

The proposed development site measures approximately 5.59 ha in area and consists of undeveloped land with dense trees covering the eastern and western portion of the site. The topography across the site generally slopes from the south to north direction, towards a swampy area located at the northwestern boundary of the property. A detailed grading plan (see **Drawings GP-1** to **GP-5**) has been provided to satisfy the stormwater management requirements, adhere to any geotechnical restrictions (see **Section 5.0**) for the site, and provide for minimum cover requirements for storm and sanitary sewers where possible. Site grading has been established to provide emergency overland flow routes required for stormwater management.

7.0 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.

Refer to **Drawing EC-1** to **Drawing EC-5** for the proposed location of erosion control measure

8.0 UTILITIES

As the subject site is bound by an existing arterial road to the south, and by existing residential properties and commercial business along Parkedale Avenue, Hydro, Internet, Gas and Cable servicing for the proposed development should be readily available through existing infrastructure that runs east-west along Parkedale Avenue at the southern boundary of the proposed subdivision. It is anticipated that existing infrastructure will be sufficient to provide the means of distribution for the proposed site. Exact size, location, and routing of utilities, along with determination of any off-site works required for redevelopment, will be finalized after design circulation.

9.0 APPROVALS

Ontario Ministry of Environment, Conservation and Parks (MECP) Environmental Compliance Approvals (ECAs, formerly Certificates of Approval (CofA)) under the Ontario Water Resources Act are anticipated to be required for proposed on-site SWM wet pond that discharges into an existing ditch north of the development.

It is the intent that a maintenance agreement will be pursued with the municipality to ensure proper monitoring of private watermains within the site.

The Cataraqui Regional Conservation Authority (CRCA) will be circulated on design submissions so that CA sign-off and approval may be given.

A MECP Permit to Take Water (PTTW) may be required for the site if dewatering activities exceed 50,000 L/day

10.0 CONCLUSIONS AND RECOMMENDATIONS

The results of the conceptual servicing assessment indicate that the proposed residential adult-living community can be serviced using the existing infrastructure as outlined in the sections above. Confirmation regarding residual sanitary sewer capacity in the existing system will be required from the City of Brockville.

It is of note that calculations for the proposed development concept are high-level estimates based on the latest concept plan. Detailed analysis will be required at a later stage to determine detailed infrastructure capacities and requirements.

10.1 POTABLE WATER SERVICING

The proposed watermain design will achieve the level of service required by the City of Brockville. The following conclusions related to the potable water servicing for the subject site were made:

- The proposed development will be serviced by 200 mm diameter watermains that will provide required service to the retirement community development.
- The boundary conditions determined via hydrant flow testing data obtained from the City of Brockville demonstrates that the existing municipal watermain can provide sufficient domestic flow to meet the requirements of the development. The pressures during average day, peak hour, and max day plus fire flow fall within the targets outlined in City of Ottawa Water Distribution Guidelines.
- The boundary conditions determined via hydrant flow testing data obtained from the City of Brockville demonstrate that the existing municipal watermain can provide sufficient fire flow to meet the requirements of the development while maintaining minimum residual pressures.

10.2 WASTEWATER SERVICING

The existing municipal sanitary sewers have adequate capacity to convey the wastewater design flows for the site. The following conclusions related to the wastewater servicing for the subject site were made:

- The Wellings of Brockville development is proposed to be serviced by a network of 200 mm and 300 mm diameter gravity sanitary sewers and will have a single connection to the existing 375 mm diameter local sanitary sewer on Chelsea Street.
- The current sanitary infrastructure along Chelsea Street has adequate residual capacity to manage the total peak wastewater flows from the proposed sanitary sewers on the site. The total peak wastewater design flow from the site is 6.22 L/s.

10.3 STORMWATER MANAGEMENT AND SERVICING

The proposed stormwater management plan complies with the requirements outlined in the background documents, the City of Brockville Site Plan Control Manual Requirements and Guidelines, the Cataraqui Region Conservation Authority (CRCA) Environmental Planning Policies, and the Ontario Ministry of the Environment, Conservation, and Parks (MECP) Stormwater Management Planning and Design Manual. The following conclusions associated with the stormwater management for the subject site were made:

- The proposed SWM Pond will provide “Enhanced” water quality protection (80% TSS removal) for the site.
- The proposed SWM Pond will restrict peak discharge leaving the site to pre-development levels for events up to and including the 100-year design storm.
- The maximum depth of static ponding has been designed not to exceed 0.25 m for events up to and including the 100-year design storm.
- Inlets to the minor system have been sized to capture, at minimum, the 5-year storm event. The minor system has been sized to convey, at minimum, flows from the 5-year event.

10.4 GRADING

A detailed grading plan has been prepared accounting for required overland flow conveyance, cover over sewers, and recommendations by the draft geotechnical investigation (Stantec, 2021). Updates to the site grading may be expected to address inputs provided by the Geotechnical Engineer regarding final grading of the site and SWM pond requirements. Additional grading recommendations for sections of the proposed Phase 1 development should be anticipated.

10.5 UTILITIES

Utility infrastructure exists within the general area of the subject site. It is anticipated that existing infrastructure will be sufficient to provide a means of distribution for the proposed site. Exact size, location and routing of utilities will be finalized once detailed design has been finalized.

APPENDICES

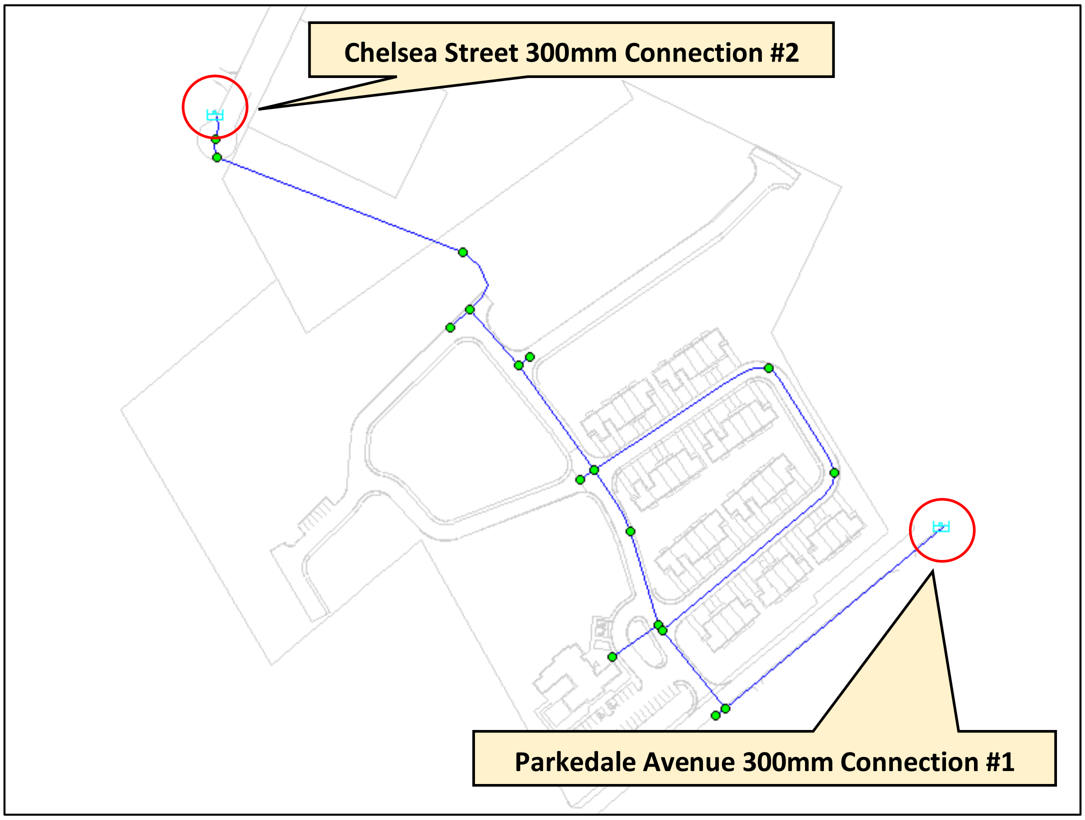
Appendix A – POTABLE WATER SERVICING

A.1 BOUNDARY CONDITIONS

Boundary Conditions for Wellings of Brockville (Phase 1)

Scenario	Demand	
	L/min	L/s
Average Daily Demand	15.8	0.26
Maximum Daily Demand	38.3	0.64
Peak Hour Demand	83.7	1.40
Fire Flow Demand	2700	45

Number of connections: 2



Connection 1 – Parkedale Avenue 300mm Connection

Demand Scenario	Head (m)	Pressure[1] (psi)
Average Day	163.94	69.8
Peak Hour	163.48	69.2
Max Day + Fire Flow (2700L/min)	145.39	43.5

[1]**Ground Elevation =** 114.82 m

Connection 2 – Chelsea Street 300mm Connection

Demand Scenario	Head (m)	Pressure[1] (psi)
Average Day	155.75	69.9
Peak Hour	155.46	69.5
Max Day + Fire Flow (2700L/min)	144.03	53.2

[1]**Ground Elevation =** 106.59 m

A.2 DOMESTIC WATER DEMAND CALCULATIONS

Wellings of Brockville (160401602) - Domestic Water Demand Estimates

Total Development

Last updated based on Conceptual Site Plan July 10, 2023 prepared by NLGC Inc.

Population densities as per MECP Guidelines:

1 Bedroom Apt. (Bungalow)	1.4	ppu
2 Bedroom Apt. (Bungalow)	2.1	ppu

Demand conversion factors as per MECP Guidelines:

Residential	280	L/cap/day
Institutional (Clubhouse)	28000	L/ha/day

Building ID	Area (m^2)	Number of 1 br Units	Number of 2 br Units	Population	Daily Rate of Demand ($L/m^2/day$)	Avg. Day Demand		Max. Day Demand [1]		Peak Hour Demand [1]	
						(L/min)	(L/s)	(L/min)	(L/s)	(L/min)	(L/s)
Phase 1											
Block 1	-	2	2	7	280	1.4	0.023	3.4	0.057	7.5	0.125
Block 2	-	2	2	7	280	1.4	0.023	3.4	0.057	7.5	0.125
Block 3	-	2	2	7	280	1.4	0.023	3.4	0.057	7.5	0.125
Block 4	-	2	3	9	280	1.8	0.029	4.4	0.074	9.7	0.162
Block 5	-	2	3	9	280	1.8	0.029	4.4	0.074	9.7	0.162
Block 6	-	2	3	9	280	1.8	0.029	4.4	0.074	9.7	0.162
Block 7	-	2	3	9	280	1.8	0.029	4.4	0.074	9.7	0.162
Block 8	-	2	3	9	280	1.8	0.029	4.4	0.074	9.7	0.162
Block 9	-	4	2	10	280	1.9	0.032	4.8	0.079	10.5	0.175
Clubhouse	546	-	-	-	2.8	1.1	0.018	1.6	0.03	2.9	0.048
Phase 1 Total		**20**	**23**	**76**		**15.9**	**0.26**	**38.7**	**0.64**	**84.5**	**1.41**
Phase 2											
Block 10	-	2	3	9	280	1.8	0.029	4.4	0.074	9.7	0.162
Block 11	-	2	2	7	280	1.4	0.023	3.4	0.057	7.5	0.125
Block 16	-	2	2	7	280	1.4	0.023	3.4	0.057	7.5	0.125
Block 17	-	2	3	9	280	1.8	0.029	4.4	0.074	9.7	0.162
Block 18	-	2	2	7	280	1.4	0.023	3.4	0.057	7.5	0.125
Block 19	-	2	2	7	280	1.4	0.023	3.4	0.057	7.5	0.125
Block 20	-	2	2	7	280	1.4	0.023	3.4	0.057	7.5	0.125
Block 21	-	2	2	7	280	1.4	0.023	3.4	0.057	7.5	0.125
Phase 2 Total		**16**	**18**	**60**		**11.7**	**0.20**	**29.3**	**0.49**	**64.4**	**1.07**
Phase 3A											
Block 12	-	2	3	9	280	1.8	0.029	4.4	0.074	9.7	0.162
Block 13	-	2	2	7	280	1.4	0.023	3.4	0.057	7.5	0.125
Block 14	-	2	2	7	280	1.4	0.023	3.4	0.057	7.5	0.125
Block 15	-	2	2	7	280	1.4	0.023	3.4	0.057	7.5	0.125
Phase 3A Total		**8**	**9**	**30**		**5.9**	**0.10**	**14.6**	**0.24**	**32.2**	**0.54**
Phase 3B											
Block 22	-	2	2	7	280	1.4	0.023	3.4	0.057	7.5	0.125
Block 23	-	2	2	7	280	1.4	0.023	3.4	0.057	7.5	0.125
Block 24	-	4	2	10	280	1.9	0.032	4.8	0.079	10.5	0.175
Block 25	-	2	2	7	280	1.4	0.023	3.4	0.057	7.5	0.125
Block 26	-	2	2	7	280	1.4	0.023	3.4	0.057	7.5	0.125
Block 27	-	2	2	7	280	1.4	0.023	3.4	0.057	7.5	0.125
Phase 3B Total		**14**	**12**	**45**		**8.7**	**0.15**	**21.8**	**0.36**	**47.9**	**0.80**
Total Site :		**58**	**62**	**211**		**42.2**	**0.70**	**131.3**	**2.19**	**289.0**	**4.82**

A.3 FIRE FLOW REQUIREMENTS (OFM METHODOLOGY)

Fire Flow Calculations as per OFM Guidelines (per Requirements of OBC, Section 3)

Project # 160401602 (Wellings of Brockville, Detailed Design)
Date 2022-03-07

Designed by: PM
Checked by:

Description: 5-unit Bungalow Towns, Phase 1 - Block 6

$$Q = KVS_{tot}$$

Q = Volume of water required (L)
V = Total building volume (m3)
K = Water supply coefficient from Table 1
S_{tot} = Sotal of spatial coefficeint values from property line exposures on all sides as obtained from the formula

$$S_{tot} = 1.0 + [S_{side1} + S_{side2} + S_{side3} + S_{side4}]$$

1	Type of construction	Building Classification		Water Supply Coefficient
	combustible without Fire-Resistance Ratings	A-2, B-1, B-2, B-3, C, D		23
2	Area of one floor (m^2)	number of floors	height of ceiling (m)	Total Building Volume (m^3)
	402	1	2.85	1,146
3	Side	Exposure Distance (m)	Spatial Coefficient	Total Spatial Coefficeient
	North	24	0	1.5
	East	4	0.5	
	South	18	0	
	West	19	0	
4	Established Fire Safety Plan?	Reduction in Volume (%)		Total Volume Reduction
	no	0%		0%
5				**Total Volume 'Q' (L)**
				39,537
				Minimum Required Fire Flow (L/min)
				2,700

1. Based on conceptual site plan by NLG dated 2021-11-09.

Fire Flow Calculations as per OFM Guidelines (per Requirements of OBC, Section 3)

Project # 160401602 (Wellings of Brockville, Detailed Design)
Date 2022-03-07

Designed by: PM
Checked by:

Description: 5-unit Bungalow Towns, Phase 1 - Block 8

$$Q = KVS_{tot}$$

Q = Volume of water required (L)
V = Total building volume (m3)
K = Water supply coefficient from Table 1
S_{tot} = Sotal of spatial coefficeint values from property line exposures on all sides as obtained from the formula

$$S_{tot} = 1.0 + [S_{side1} + S_{side2} + S_{side3} + S_{side4}]$$

1	Type of construction	Building Classification		Water Supply Coefficient
	combustible without Fire-Resistance Ratings	A-2, B-1, B-2, B-3, C, D		23
2	Area of one floor (m^2)	number of floors	height of ceiling (m)	Total Building Volume (m^3)
	402	1	2.85	1,146
3	Side	Exposure Distance (m)	Spatial Coefficient	Total Spatial Coeffiecient
	North	12	0	1.5
	East	4	0.5	
	South	24	0	
	West	16	0	
4	Established Fire Safety Plan?	Reduction in Volume (%)		Total Volume Reduction
	no	0%		0%
5				**Total Volume 'Q' (L)**
				39,537
				Minimum Required Fire Flow (L/min)
				2,700

1. Based on conceptual site plan by NLG dated 2021-11-09.

Fire Flow Calculations as per OFM Guidelines (per Requirements of OBC, Section 3)

Project # 160401602 (Wellings of Brockville, Detailedl Design)
Date 2022-03-07

Designed by: PM
Checked by:

Description: One-storey Clubhouse

$$Q = KVS_{tot}$$

Q = Volume of water required (L)
V = Total building volume (m3)
K = Water supply coefficient from Table 1
S_{tot} = Sotal of spatial coefficeint values from property line exposures on all sides as obtained from the formula

$$S_{tot} = 1.0 + [S_{side1} + S_{side2} + S_{side3} + S_{side4}]$$

1	Type of construction	Building Classification		Water Supply Coefficient
	combustible without Fire-Resistance Ratings	A-2, B-1, B-2, B-3, C, D		23
2	Area of one floor (m^2)	number of floors	height of ceiling (m)	Total Building Volume (m^3)
	628	1	3.05	1,915
3	Side	Exposure Distance (m)	Spatial Coefficient	Total Spatial Coeffeicient
	North	43	0	1
	East	51	0	
	South	88	0	
	West	13	0	
4	Established Fire Safety Plan?	Reduction in Volume (%)		Total Volume Reduction
	no	0%		0%
5				**Total Volume 'Q' (L)**
				44,045
				Minimum Required Fire Flow (L/min)
				2,700

1. Clubhouse to be one storey tall. Area as shown includes future additions.
2. Based on conceptual site plan by NLG dated 2021-11-09.

A.4 WATERMAIN HYDRAULIC ANALYSIS RESULTS

Model last revised on 2023-11-28.

Hydraulic Model Results – Average Day Demand (AVDY)

Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(kPa)
0	0	116	163.45	67.45	465.05
102	0.2	110	160.11	71.24	491.18
104	0	106.77	155.79	69.69	480.50
12	0	116	163.45	67.45	465.05
14	0	115	162.33	67.28	463.88
16	0.02	115.16	162.36	67.1	462.64
17	0	114.54	162.36	67.98	468.71
2	0	108.76	159.12	71.59	493.60
21	0.13	114.50	162.01	67.54	465.67
23	0	112.49	161.83	70.15	483.67
25	0.12	111.92	161.53	70.53	486.29
27	0.09	111.7	161.53	70.84	488.42
38	0	106.93	155.98	69.73	480.77
4	0	110.26	160.11	70.87	488.63
42	0.15	110.16	160.11	71.01	489.60
7	0	113.23	161.83	69.09	476.36

Pipe Results

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)		(L/s)	(m/s)
101	12	0	5.39	204	110	0.00	0.00
103	12	17	45.32	204	110	62.46	1.91
104	16	17	25.97	204	110	-0.02	0.00
106	17	14	3.04	204	110	41.26	1.26
107	14	7	44.64	204	110	41.26	1.26
110	17	21	107.02	204	110	21.19	0.65
111	21	23	56.33	204	110	21.06	0.64
112	7	25	22.4	204	100	41.26	1.26
113	23	25	94	204	110	21.06	0.64
114	25	27	10.93	204	110	0.09	0.00
116	25	4	59.79	204	110	62.10	1.90
118	4	102	6.83	204	110	0.20	0.01
120	4	2	42.4	204	110	61.75	1.89
122	42	4	15.18	204	110	-0.15	0.00
126	38	2	133.74	204	110	-61.75	1.89
134	38	104	8.07	204	110	61.75	1.89
136	104	1004	11.04	297	110	61.75	0.89
140	1002	12	128.39	297	110	62.46	0.90

Model last revised on 2023-11-28.

Hydraulic Model Results – Peak Hour Demand (PKHR)

Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(kPa)
0	0	116	162.97	66.77	460.36
102	1.11	110	159.59	70.49	486.01
104	0	106.77	155.5	69.27	477.60
12	0	116	162.97	66.77	460.36
14	0	115	161.81	66.54	458.78
16	0.05	115.16	161.84	66.36	457.54
17	0	114.54	161.84	67.24	463.60
2	0	108.76	158.65	70.92	488.98
21	0.7	114.5	161.48	66.78	460.43
23	0	112.49	161.29	69.38	478.36
25	0.65	111.92	160.99	69.76	480.98
27	0.5	111.7	160.99	70.07	483.12
38	0	106.93	155.68	69.3	477.81
4	0	110.26	159.59	70.12	483.46
42	0.8	110.16	159.59	70.26	484.43
7	0	113.23	161.3	68.33	471.12

Pipe Results

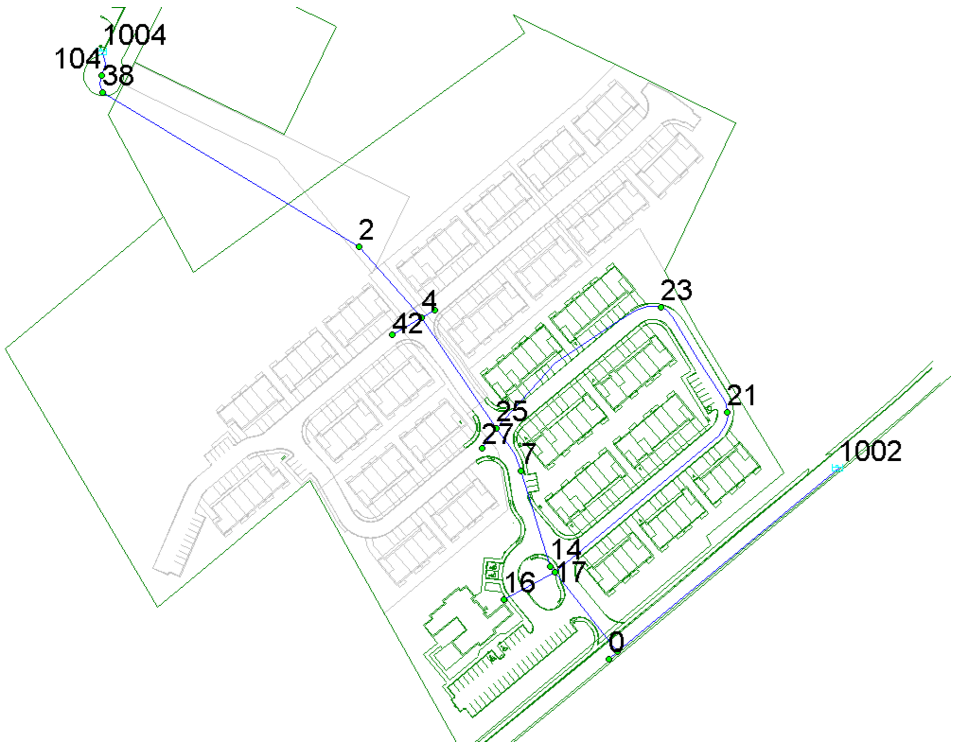
ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)		(L/s)	(m/s)
101	12	0	5.39	204	110.00	0.00	0.00
103	12	17	45.32	204	110.00	63.72	1.95
104	16	17	25.97	204	110.00	-0.05	0.00
106	17	14	3.04	204	110.00	41.85	1.28
107	14	7	44.64	204	110.00	41.85	1.28
110	17	21	107.02	204	110.00	21.82	0.67
111	21	23	56.33	204	110.00	21.12	0.65
112	7	25	22.40	204	100.00	41.85	1.28
113	23	25	94.00	204	110.00	21.12	0.65
114	25	27	10.93	204	110.00	0.50	0.02
116	25	4	59.79	204	110.00	61.82	1.89
118	4	102	6.83	204	110.00	1.11	0.03
120	4	2	42.40	204	110.00	59.91	1.83
122	42	4	15.18	204	110	-0.80	0.02
126	38	2	133.74	204	110	-59.91	1.83
134	38	104	8.07	204	110	59.91	1.83
136	104	1004	11.04	297	110	59.91	0.86
140	1002	12	128.39	297	110	63.72	0.92

Model last revised on 2023-11-28.

Hydraulic Model Results – Maximum Day Demand + Fire Flow (MXDY + FF (45 L/s))

ID	Static Demand	Static Pressure		Static Head	Fire-Flow Demand	Residual Pressure		Available Flow at Hydrant	Available Flow Pressure	
	(L/s)	(psi)	(kPa)	(m)	(L/s)	(psi)	(kPa)	(L/s)	(psi)	(kPa)
0	0	41.66	287.24	145.3	45	40.93	282.20	406.21	20	137.9
102	0.51	49.36	340.33	144.72	45	48.07	331.43	276.39	20	137.9
104	0	52.98	365.28	144.04	45	52.96	365.15	1989.52	20	137.9
12	0	41.66	287.24	145.3	45	41.03	282.89	483.40	20	137.9
14	0	42.79	295.03	145.1	45	41.44	285.72	307.83	20	137.9
16	0.03	42.58	293.58	145.11	45	40.77	281.10	229.05	20	137.9
17	0	43.45	299.58	145.11	45	42.13	290.48	320.13	20	137.9
2	0	50.9	350.94	144.57	45	49.89	343.98	308.74	20	137.9
21	0.32	43.42	299.37	145.05	45	41.56	286.55	219.03	20	137.9
23	0	46.24	318.81	145.01	45	44.41	306.20	233.44	20	137.9
25	0.3	46.97	323.85	144.96	45	45.65	314.75	305.79	20	137.9
27	0.23	47.29	326.05	144.96	45	45.75	315.44	271.10	20	137.9
38	0	52.79	363.97	144.07	45	52.69	363.28	854.04	20	137.9
4	0	48.99	337.77	144.72	45	47.83	329.78	294.49	20	137.9
42	0.36	49.14	338.81	144.72	45	47.69	328.81	254.79	20	137.9
7	0	45.18	311.51	145.01	45	43.77	301.78	287.8	20	137.9

H2OMAP Hydraulic Analysis - Tank & Node Identification



NODEID

TANKID

JUNCTION (VALUE)
- Less than 20 psi
- Greater than 20 psi

TANK (MOTYPE)
- Active Tank
- Domain Tank
- Active Reservoir
- Domain Reservoir

PIPE (MOTYPE)
- Active Pipe
- Domain Pipe
- Active Check Valve
- Domain Check Valve

PUMP (MOTYPE)
- Active
- Domain

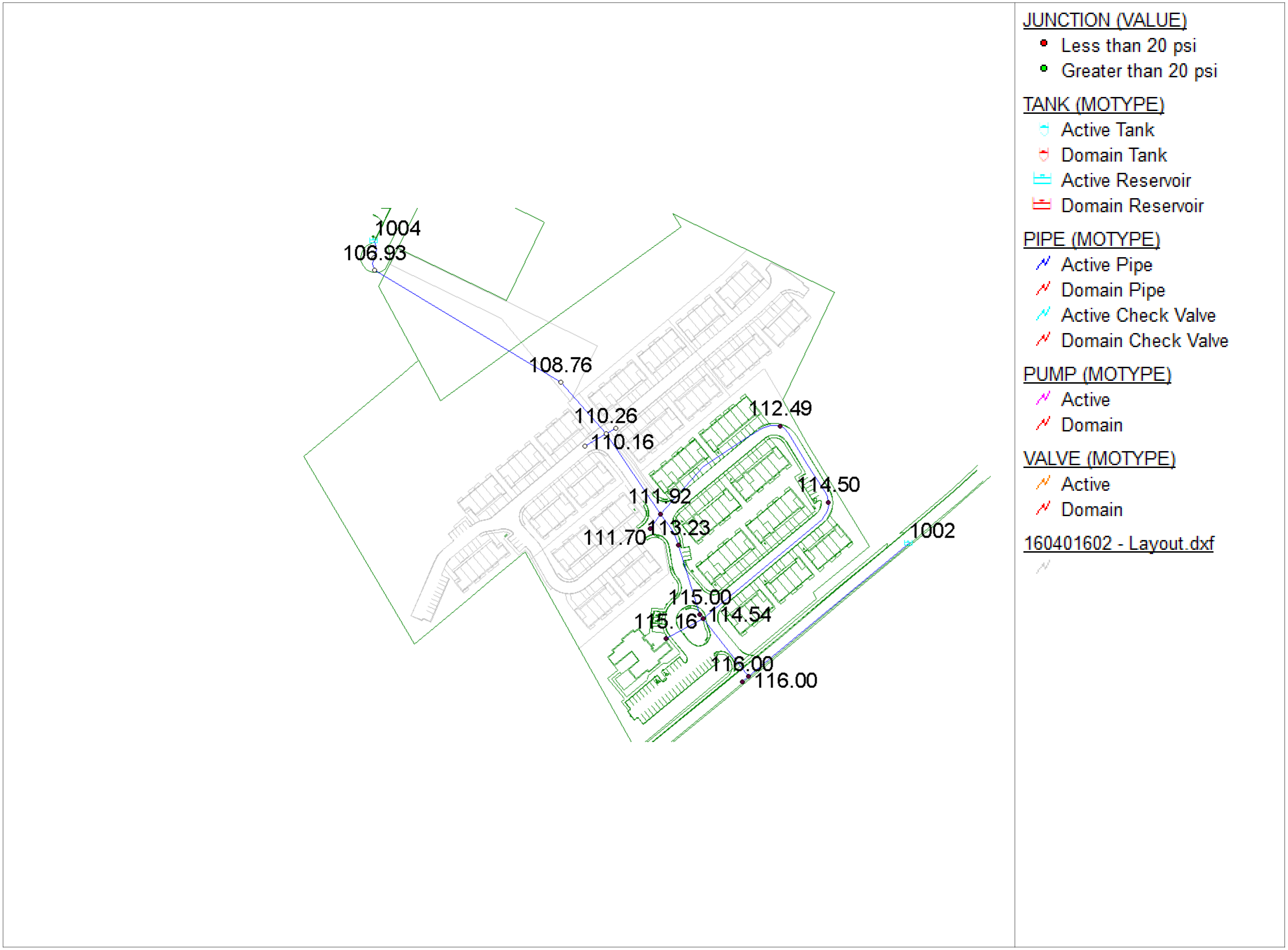
VALVE (MOTYPE)
- Active
- Domain

160401602 - Layout.dxf

Prepared By: Michael Wu

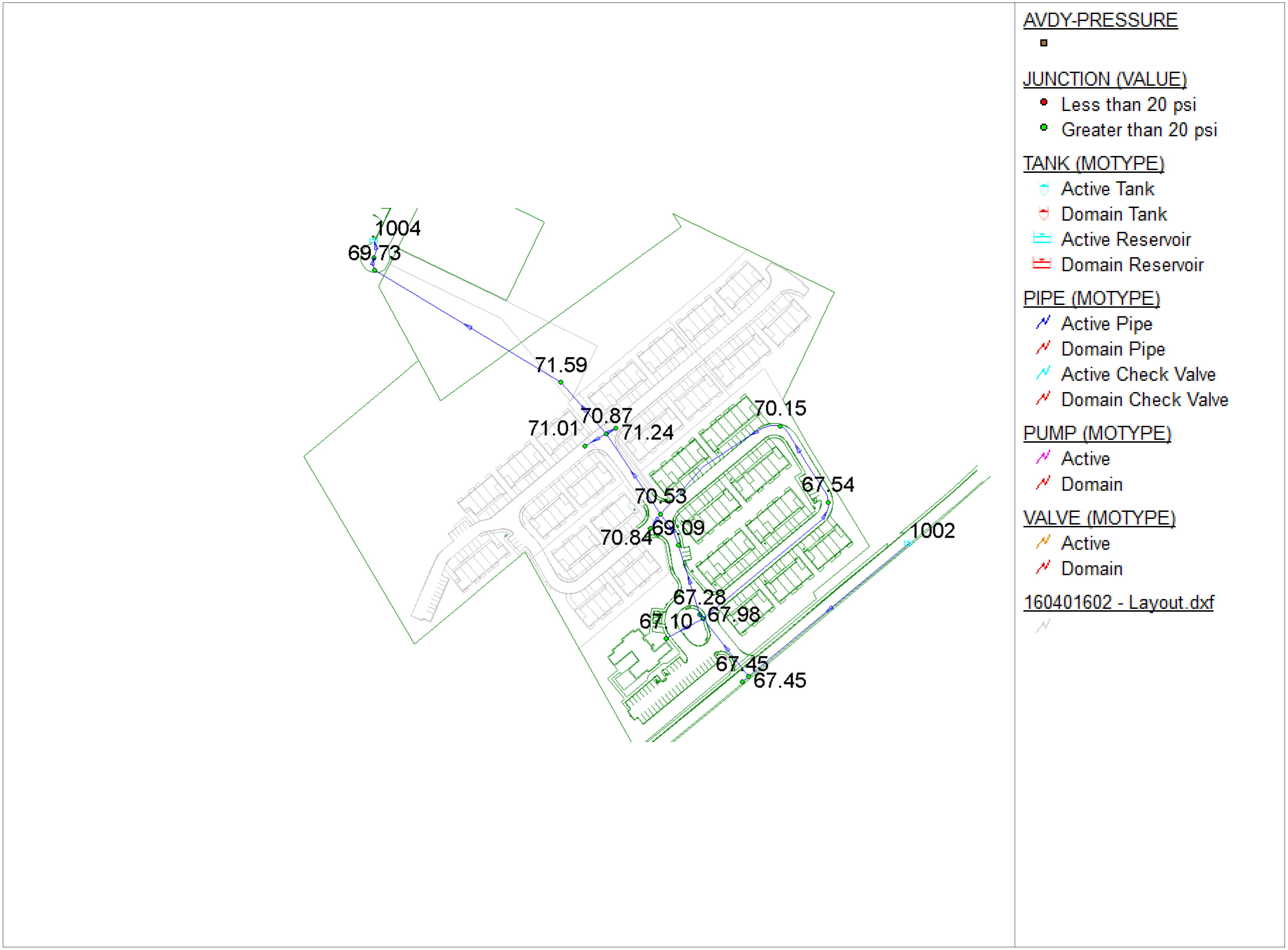
Date: November 28, 2023

H2OMAP Hydraulic Analysis - Tank & Node Identification



Prepared By: Michael Wu | Elevation in Meters (m) | Date: November 28, 2023

H2OMAP Hydraulic Analysis - AVDY Watermain Zone Configuration

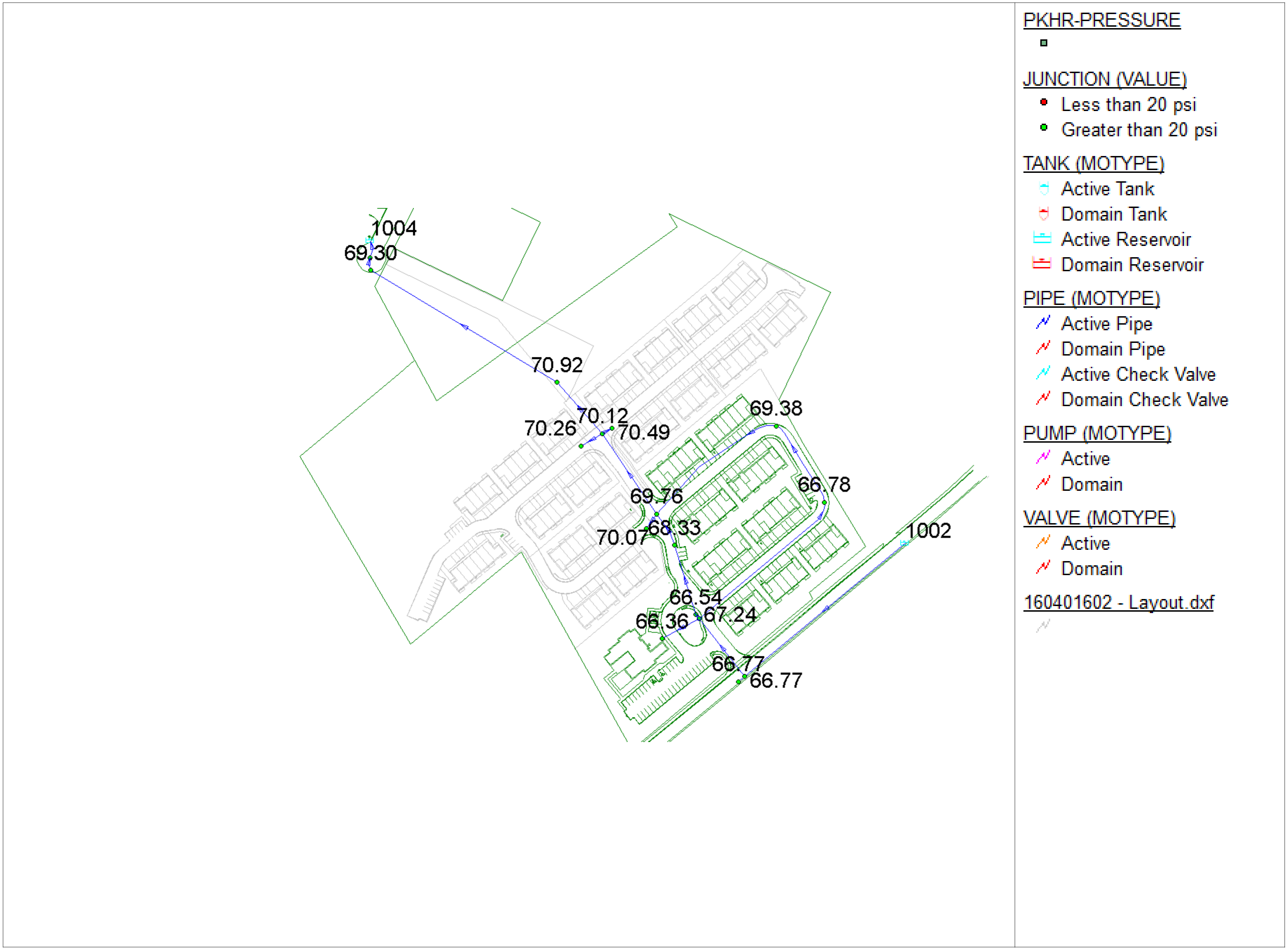


Prepared By: Michael Wu

Pressure in Pounds per Square Inch (psi)

Date: November 28, 2023

H2OMAP Hydraulic Analysis - PKHR Watermain Zone Configuration

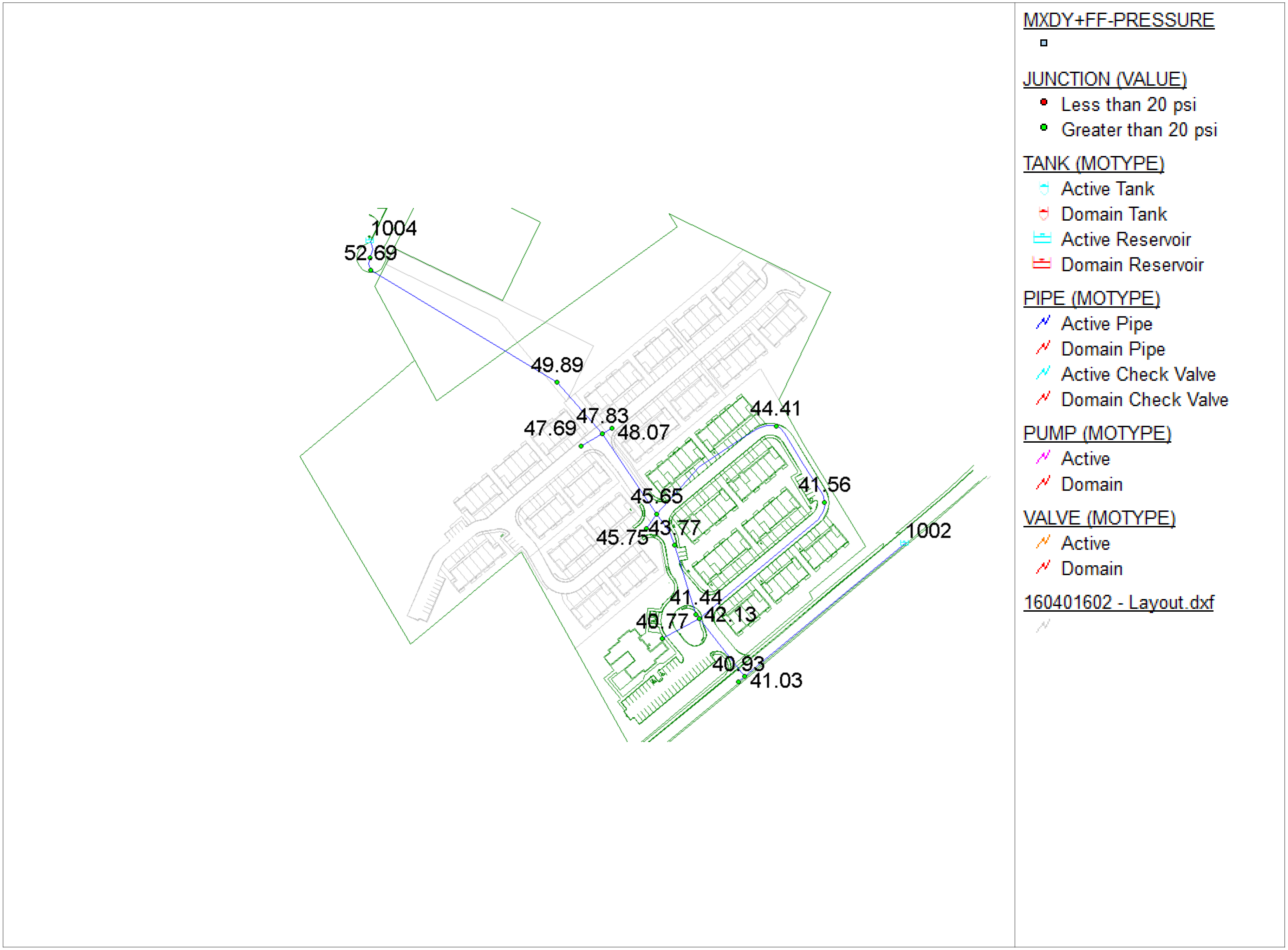


Prepared By: Michael Wu

Pressure in Pounds per Square Inch (psi)

Date: November 28, 2023

H2OMAP Hydraulic Analysis - MXDY+FF Watermain Zone Configuration

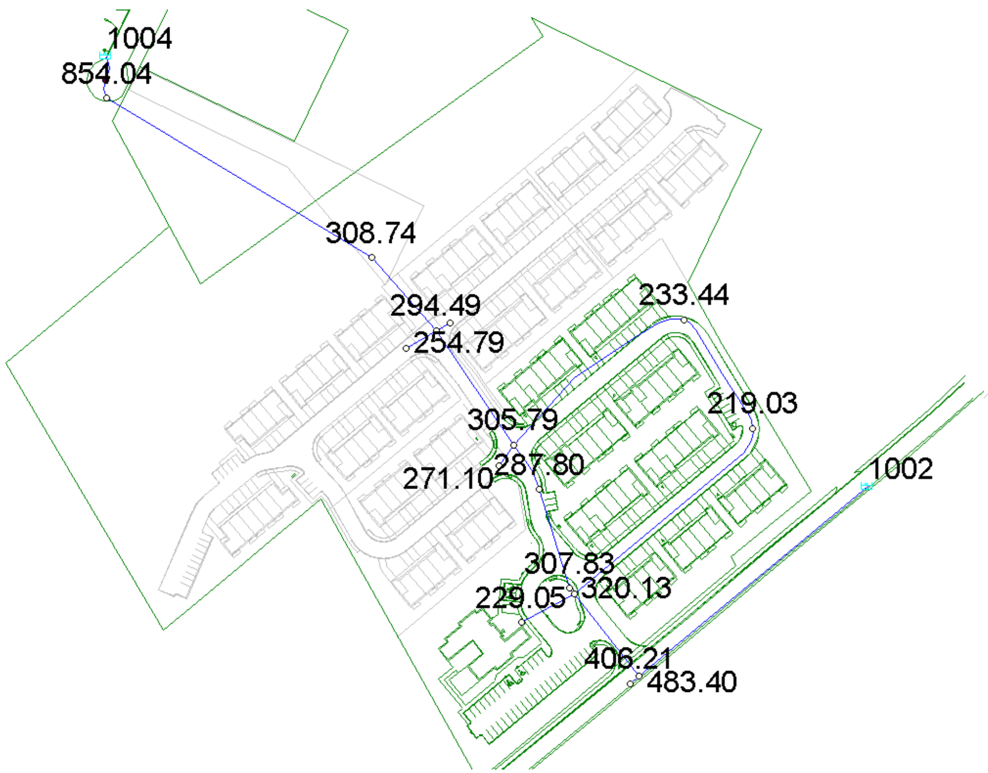


Prepared By: Michael Wu

Pressure in Pounds per Square Inch (psi)

Date: November 28, 2023

H2OMAP Hydraulic Analysis - MXDY+FF Watermain Zone Configuration



MXDY+FFAVFLOW

JUNCTION (VALUE)
- Less than 20 psi
- Greater than 20 psi

TANK (MOTYPE)
- Active Tank
- Domain Tank
- Active Reservoir
- Domain Reservoir

PIPE (MOTYPE)
- Active Pipe
- Domain Pipe
- Active Check Valve
- Domain Check Valve

PUMP (MOTYPE)
- Active
- Domain

VALVE (MOTYPE)
- Active
- Domain

160401602 - Layout.dxf

Prepared By: Michael Wu | Available Flow in L/s | Date: November 28, 2023

A.5 REPORT EXCERPTS AND HYDRANT FLOW DATA

Westport Wellhead Protection Area

A portion of the Westport Wellhead Protection Area is located in the Cataraqui Source Protection Area, within the Township of Rideau Lakes. For additional information about the Westport Wellhead Protection Area, please refer to the Assessment Report and Source Protection Plan for the Mississippi-Rideau Source Protection Region. The policies about highly vulnerable aquifers and significant groundwater recharge areas in the Cataraqui Plan apply to these lands, in addition to any policies about the WHPA in the Mississippi-Rideau Source Protection Plan.

Picton Intake Protection Zone

The intake protection zone for the Picton Water Treatment Plant extends into the CSPA from the neighbouring Quinte Source Protection Region. The IPZ is located in the Town of Greater Napanee, Loyalist Township, the City of Kingston and the Township of South Frontenac. The reader is invited to review the Assessment Report and Source Protection Plan for the Quinte Source Protection Region for more information about this vulnerable area. The policies about highly vulnerable aquifers and significant groundwater recharge areas in the Cataraqui Plan apply to these lands, in addition to any policies about the IPZ in the Quinte Source Protection Plan.

Highly Vulnerable Aquifers and Significant Groundwater Recharge Areas

In eastern Ontario, HVAs and SGRAs occupy a large proportion of the landscape in the Cataraqui, Mississippi-Rideau, and Quinte Source Protection Regions. They also involve shared municipalities; therefore, there is a need for coordination and consistency in policies about these vulnerable areas. At this time, the source protection plans for these source protection regions contain similar policies that address waste disposal sites, and promote education and outreach initiatives in the HVAs and SGRAs within their jurisdictions.

2.6.2 New York State

The official Brockville Intake Protection Zone ends at the International Boundary between Canada and the United States of America. The modeled intake protection zones for Brockville, however, extend past the International Boundary into New York State waters.

The majority of the Brockville Intake Protection Zone consists of the St. Lawrence River, which is a shared waterway with New York State and is a major shipping route. Activities on the River and in New York are governed by legislation that is beyond the influence of the *Clean Water Act*. The Source Protection Plan will be shared with agencies such as the New York Department of Environmental Conservation, the St. Lawrence Seaway Management Corporation (Canada) and the Saint Lawrence Seaway Development Corporation (United States). These agencies will be encouraged to incorporate the information into their spill prevention and contingency plans, and to ensure that procedures are in place to notify the City of Brockville of any water or land-based spills that could impact the City's drinking water.

7.1.2 Brockville Intake Protection Zone

The Brockville water treatment plant in the City of Brockville draws water from the St. Lawrence River. The water is treated and distributed to 22,000 residents and businesses in the City of Brockville and 1,000 residents in the Township of Elizabethtown-Kitley along County Road 2.

The majority of the Brockville Intake Protection Zone (IPZ) consists of the St. Lawrence River (see **Schedule F**). On land, the IPZ consists mainly of urban and rural residential properties. The urban properties are connected to municipal sanitary servicing while the rural properties are connected to on-site sewage systems. It also includes the Brockville water treatment plant, a City park and docking facility, a golf course, and the Brockville downtown core, which has a variety of professional and retail land uses.

A number of landowners in the IPZ have implemented site-specific management practices to reduce the risk to drinking water that is associated with the activities undertaken on their properties.

IPZ-1 has a vulnerability score of 9.0 and IPZ-2 has a score of 8.1 as shown in the Assessment Report. This area has a high vulnerability score, therefore certain activities could be significant drinking water threats in the Brockville Intake Protection Zone.

7.1.3 James W. King Intake Protection Zone

The James W. King water treatment plant in the Town of Gananoque draws water from the St. Lawrence River. The water is treated and distributed to the 5,200 residents and businesses in Gananoque.

The majority of the James W. King Intake Protection Zone (IPZ) consists of the St. Lawrence River (see **Schedule G**). On land, the IPZ consists mainly of urban and island residential properties. It also includes farmland, the James W. King water treatment plant, open spaces, marinas and docking facilities, and the Gananoque downtown core, which has a variety of professional and retail land uses.

A number of landowners in the IPZ have implemented site-specific management practices to reduce the risk to drinking water that is associated with the activities undertaken on their properties.

IPZ-1 has a vulnerability score of 9.0 and IPZ-2 has a score of 8.1 based on the Assessment Report. Because of the high vulnerability score, certain activities can be considered to be significant drinking water threats in the James W. King IPZ.

7.1.4 Point Pleasant and Kingston Central Intake Protection Zones

The Kingston West (Point Pleasant) water treatment plant in the City of Kingston draws water from Lake Ontario. The water taken from the lake is treated and distributed to about 44,000 residents and businesses in Kingston West (urban area west of Little Cataraqui Creek).

The King Street (Kingston Central) water treatment plant in the City of Kingston also draws water from Lake Ontario. The water taken from the lake is treated and distributed to about 80,000

The *intake protection zone* for the Picton intake, also located in the Quinte Source Protection Region, extends into the Cataraqui Source Protection Area.

The eight municipal intakes listed above were all part of a technical study conducted by the Centre for Water and the Environment at Queen's University. This study *modeled* winds, water currents and weather patterns to delineate *intake protection zones* for each of these intakes. These are shown in **Maps 6-1** to **6-58**.

Vulnerability scoring for each of the eight intakes was also undertaken as part of this study. The calculation of this scoring is laid out in the Ministry of Environment technical rules.

Brockville

The Brockville water treatment plant is operated by the City of Brockville. It serves 22,000 residents of Brockville and 1,000 residents of the Township of Elizabethtown-Kitley. The intake pipe is located in the St. Lawrence River (see **Maps 6-1** and **6-2**).

Vulnerability scores help us to measure how vulnerable the *drinking water* source is to *contamination* (see **Map 6-3**). The vulnerability scores are nine for *intake protection zone* 1 and 8.1 for *intake protection zone* 2. This means that the water is very susceptible to *contamination*.

Escherichia coli is considered to be a *drinking water issue* in the untreated water for this system. Further study is needed to determine the source.

An assessment of *threats* was conducted within the *intake protection zone* 1 and 2 around this water treatment plant. For existing *activities*, we found three locations with significant *threats*, 293 with moderate *threats* and eight with low-ranked *threats*. This represents a total of 304 parcels with 356 individual *threats*.

James W. King (Gananoque)

The James W. King WTP is operated by the Town of Gananoque. It serves 5,200 residents of Gananoque. The intake pipe is located in the St. Lawrence River (see **Map 6-9**).

The vulnerability scores are nine for *intake protection zone* 1 and 8.1 for *intake protection zone* 2 (see **Map 6-10**). This means that the water is very susceptible to *contamination*.

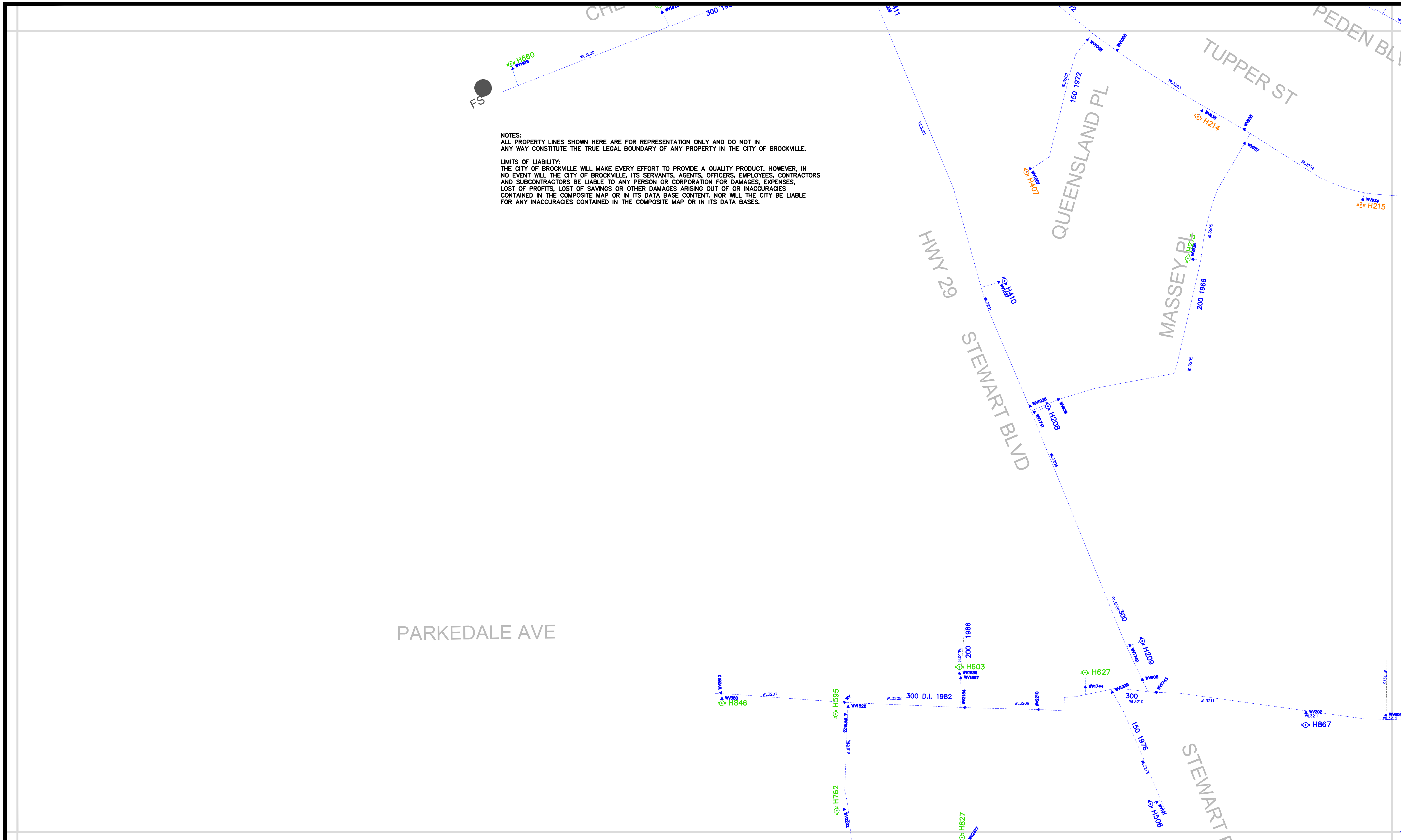
There are no substances considered to be a *drinking water issue* in the untreated water for this system.

An assessment of *threats* was conducted within the *intake protection zone* 1 and 2 around this water treatment plant. For existing *activities*, we found one location with significant *threats*, 166 with moderate *threats* and 12 with low-ranked *threats*. This represents a total of 179 parcels and 229 individual *threats*.

City of Kingston

The City of Kingston is served by two *drinking water* treatment plants, one in the central part of the city (Beverley Street) and one in the western part (Point Pleasant). Both plants draw their water from Lake Ontario (see **Maps 6-16** and **6-23**).

The Kingston Central plant serves a population of 80,000 while the Point Pleasant plant serves 44,000 people.



NOTES:
ALL PROPERTY LINES SHOWN HERE ARE FOR REPRESENTATION ONLY AND DO NOT IN ANY WAY CONSTITUTE THE TRUE LEGAL BOUNDARY OF ANY PROPERTY IN THE CITY OF BROCKVILLE.

LIMITS OF LIABILITY:
THE CITY OF BROCKVILLE WILL MAKE EVERY EFFORT TO PROVIDE A QUALITY PRODUCT. HOWEVER, IN NO EVENT WILL THE CITY OF BROCKVILLE, ITS SERVANTS, AGENTS, OFFICERS, EMPLOYEES, CONTRACTORS AND SUBCONTRACTORS BE LIABLE TO ANY PERSON OR CORPORATION FOR DAMAGES, EXPENSES, LOST OF PROFITS, LOST OF SAVINGS OR OTHER DAMAGES ARISING OUT OF OR INACCURACIES CONTAINED IN THE COMPOSITE MAP OR IN ITS DATA BASE CONTENT. NOR WILL THE CITY BE LIABLE FOR ANY INACCURACIES CONTAINED IN THE COMPOSITE MAP OR IN ITS DATA BASES.

MASTER WATERMAIN PLAN

0 100 200m

SCALE 1 : 2 , 0 0 0

BROCKVILLE
CITY OF THE 1000 ISLANDS

DRAWING No. 32
DATE 2012 06 13

CITY OF BROCKVILLE, OPERATIONS DEPARTMENT BASE PLAN PREPARED BY : D.G.D.

Hydrant: H846

Flow Rate	
Main Size	
make	
Shut Off V	
Install Date	
Date Last	
Date next	
Active	1.00
STEAMER_CA	
QUICK_CONN	
Number	
Type	
Activity Id	419464996877
LastActivity	Fire Flow Test
DateStamp	5/8/2018, 8:00 PM
OpTime	13:32
OperatedBy	lcuthbert
Manufacturer	Mueller
HydrantType	
ModelId	
InstallYear	
StaticPsi	70
ResidPsi	42
Pitot	35
OrificeSize	2.5
FlowMin	13
ResidualLocation	Parkedale
Comments	Long key
BarrelDiameter	
FreeChlorine	1.22
Turbinity	2.78
Ph	7.60
HydrantColor	GREEN
Operator	Other,Other
AddressNumber	Pizza Hut
PumperPort	47A
FlowGpm	998
Flow20	1365
GalsUsed	12974
Address	Parkedale

Zoom to

Hydrant: H660

Main Size	0.00	ResidPsi	58
make	C V - Century	Pitot	35
Active	1.00	OrificeSize	2.5
STEAMER_CA	0.00	FlowMin	16
QUICK_CONN	0.00	ResidualLocation	Chelsea
Number	660	Comments	
Type	Hydrant	BarrelDiameter	
Activity Id	420	FreeChlorine	1.08
LastActivity	Fire Flow Test	Turbinity	2.23
DateStamp	11/4/2020, 7:00 PM	Ph	
OpTime	15:08	HydrantColor	BLUE
OperatedBy	jmcconnell	Operator	Cameron Deir,David MacFarlane
Manufacturer	Mueller	AddressNumber	
HydrantType		PumperPort	47A
ModelId		FlowGpm	998
InstallYear		Flow20	2157
StaticPsi	70	GalsUsed	15968

Appendix B – WASTEWATER SERVICING CALCULATIONS

B.1 SANITARY SEWER DESIGN SHEET

Stantec

SUBDIVISION:

WELLINGS OF BROCKVILLE

DATE: 11/24/2023
REVISION: 4
DESIGN BY: JP
CHECKED BY: MW

FILE NUMBER: 160401602

SANITARY SEWER DESIGN SHEET
(City of Ottawa)

DESIGN PARAMETERS

MAX PEAK FACTOR (RES.)=	4.0	AVG. DAILY FLOW / PERSON	450 l/p/day	MINIMUM VELOCITY	0.60 m/s
MIN PEAK FACTOR (RES.)=	2.0	COMMERCIAL	50 p/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	2.5	INSTITUTIONAL	28,000 l/ha/day	MINIMUM COVER	2.50 m
PERSONS / 1-BED UNIT	1.4	INFILTRATION	0.28 l/s/Ha	HARMON CORRECTION FACTOR	0.8
PERSONS / 2-BED UNIT	2.1				

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 1-BED	UNITS 2-BED	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)
R10A	10	9	0.69	0	10	12	39	0.69	39	3.67	0.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.69	0.69	0.2	0.9	72.6	200	PVC	SDR 35	0.65	27.0	**3.50%**	0.85
C9AA	9A	9	0.00	0	0	0	27	0.00	27	3.69	0.5	0.53	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.53	0.53	0.1	0.7	31.0	200	PVC	SDR 35	3.00	57.9	**1.14%**	1.82
R9A	9	8	0.04	0	0	0	0	0.73	66	3.63	1.2	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.04	1.26	0.4	1.6	30.2	200	PVC	SDR 35	3.50	62.6	**2.56%**	1.97
R8A	8	7	0.05	0	0	0	0	0.78	66	3.63	1.2	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.05	1.31	0.4	1.6	20.0	200	PVC	SDR 35	3.50	62.6	**2.58%**	1.97
	7	5	0.00	0	0	0	0	0.78	66	3.63	1.2	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.00	1.31	0.4	1.6	13.6	200	PVC	SDR 35	3.50	62.6	**2.58%**	1.97
R6A	6	5	0.59	0	10	11	37	0.59	37	3.67	0.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.59	0.59	0.2	0.9	55.7	200	PVC	SDR 35	0.80	29.9	**2.93%**	0.94
R5AA	5A	5	0.48	0	8	8	28	0.48	28	3.69	0.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.48	0.48	0.1	0.7	17.0	200	PVC	SDR 35	0.75	29.0	**2.32%**	0.91
R5A	5	4	0.08	0	0	0	0	1.92	131	3.57	2.4	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.08	2.46	0.7	3.1	64.9	200	PVC	SDR 35	1.64	42.9	**7.29%**	1.35
R4AA	4A	4	0.88	0	14	12	45	0.88	45	3.66	0.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.88	0.88	0.2	1.1	12.7	200	PVC	SDR 35	0.32	18.9	**5.82%**	0.59
R4BA	4B	4	1.06	0	16	19	62	1.06	62	3.64	1.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	1.06	1.06	0.3	1.5	13.9	200	PVC	SDR 35	0.32	18.9	**7.79%**	0.60
G4A	4	3	0.00	0	0	0	0	3.87	238	3.50	4.3	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.57	0.0	0.57	4.97	1.4	5.7	90.9	200	PVC	SDR 35	2.74	55.3	**10.35%**	1.74
R3A	3	2	0.63	1	0	0	3	4.50	241	3.49	4.4	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.0	0.63	5.60	1.6	5.9	94.2	300	PVC	SDR 35	0.19	42.2	**14.11%**	0.60
R2A	2	1	0.64	2	0	0	5	5.14	246	3.49	4.5	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	0.0	0.64	6.25	1.7	6.2	30.4	375	PVC	SDR 35	0.30	88.9	**6.99%**	0.84
																												375						

B.2 BACKGROUND REPORT EXCERPTS

	recreation areas • Existing contours every 0.5 m for slopes of less than 5% and at every 1.0 m for slopes greater than 5%. • Spot elevations at key points such as building corners, lot corners, tops and bottom of slopes, walls, curbs and steps, tops of proposed grate elevations, and invert elevations for all sewers. In addition, spot elevations 1.0 m outward from site corners (adjacent properties) are to be shown. • Lot numbers and all lot lines. • Stamp of Professional Engineer licensed in Ontario. • Title, location, date of project, name and address of developer(s) and agent(s). • North arrow, scale, legend, Key Plan. • Proposed grading slopes for asphalt and soft areas with arrows indicating direction and % of slope. • Parking lot surface(s) are to be constructed of a material acceptable to the City of Brockville as per the City of Brockville Zoning By-law. • Fire Access Route and Fire Protection Requirements (see Appendix E)	
7.	**LANDSCAPE PLAN** The location and type of all trees, shrubs, plantings, flowerbeds, earth mounds, gardens, etc. is required. Vegetation must be labeled using common botanical names (refer to Appendix G of this manual).	**8 full size sets (24 x 36) and 1 (11 x 17) set.**
8.	**SERVICING PLAN – DESIGN CRITERIA FOR MUNICIPAL SERVICES** <u>Sanitary Sewers</u> • Design flow: ► use minimum design flow 1125 (450 x peaking factor) litres per capita per day (0.013 l/s per person) plus an infiltration allowance of 0.28 l/s per gross hectare; ► for residential row dwellings and apartments, use 2.5 persons per unit; ► for light commercial areas, use the minimum equivalent of 50 persons per hectare (or actual population density if known) plus infiltration allowance of 0.28 l/s per gross hectare. • Flow Velocities: ► maximum 3.0 m/s, pipe flowing full; ► minimum 0.6 m/s at actual flow. • Connections from Sewer to Streetline: ► for multiple family residential blocks and light commercial areas the minimum size shall be 150 mm diameter or as required, P.V.C. DR 28 C.S.A.B182.1; ► minimum depth at streeline shall be 1.80 cover; ► minimum grade shall be 1%. 2% is desirable. ► a 1200.0 mm diameter sampling manhole, complete with benching (701.010) frame and closed cover (401.040 'A') shall be installed at streetline. • Sanitary Sewage Characteristics: please contact the Engineering Division of the Environmental Services Department (613-342-8772) regarding City of Brockville Sewer Use By-law.	**8 full size sets (24 x 36) and 1 (11 x 17) set.**

Appendix C – STORMWATER MANAGEMENT

C.1 STORM SEWER DESIGN SHEET

Stantec	Brockville		STORM SEWER DESIGN SHEET (City of Ottawa)
	DATE:	2022-03-07	
	REVISION:	1	
	DESIGNED BY:	JP	FILE NUMBER: 160401602
	CHECKED BY:	PM	

DESIGN PARAMETERS

$I = a / (t+b)^c$ (As per EC station # 6100971 for Brockville, ON)

	1:2 yr	1:5 yr	1:10 yr	1:100 yr					
a =	341.527	470.846	556.335	821.208	MANNING'S n =	0.013		BEDDING CLASS =	B
b =	0.000	0.000	0.000	0.000	MINIMUM COVER:	2.00	m		
c =	0.680	0.685	0.687	0.690	TIME OF ENTRY	10	min		

DRAINAGE AREA

LOCATION 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)
C111B, C111A	111	110	0.00	0.22	0.00	0.00	0.00	0.00	0.55	0.00	0.00	0.000	0.000	0.118	0.118	0.000	0.000	0.000	0.000
	110	108	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.118	0.000	0.000	0.000	0.000
C109B, C109A	109	108	0.00	0.48	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	0.282	0.282	0.000	0.000	0.000	0.000
	108	107	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.401	0.000	0.000	0.000	0.000
	107	106	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.401	0.000	0.000	0.000	0.000
	106	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	0.401	0.000	0.000	0.000	0.000
C105A, C105B	105	104	0.00	0.71	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.000	0.000	0.475	0.475	0.000	0.000	0.000	0.000
C104AA	104A	104	0.00	0.64	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.000	0.000	0.383	0.383	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	1.259	0.000	0.000	0.000	0.000
C103AA	103A	103	0.00	0.96	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.000	0.000	0.577	0.577	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	1.837	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	1.837	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	1.837	0.000	0.000	0.000	0.000
C100A	100	100A	0.00	1.01	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.000	0.000	0.655	2.492	0.000	0.000	0.000	0.000
	100A	HWL-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	2.492	0.000	0.000	0.000	0.000
	100D	HWL-2	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

DRAINAGE AREA (continued) / PIPE SELECTION

LOCATION AREA ID NUMBER	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)	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)
C111B, C111A	111	110	10.00	71.36	97.25	114.38	167.67	0.0	0.0	32.0	55.1	300	300	CIRCULAR	PVC	-	1.00	96.2	**33.26%**	1.37	1.04	0.89
	110	108	10.89	67.35	91.75	107.90	158.13	0.0	0.0	30.2	25.4	300	300	CIRCULAR	PVC	-	3.50	179.9	**16.77%**	2.56	1.57	0.27
			11.15																			
C109B, C109A	109	108	10.00	71.36	97.25	114.38	167.67	0.0	0.0	76.3	37.0	300	300	CIRCULAR	PVC	-	0.65	77.5	**98.43%**	1.10	1.15	0.54
			10.54																			
	108	107	11.15	66.24	90.23	106.10	155.49	0.0	0.0	100.5	27.9	375	375	CIRCULAR	PVC	-	3.50	308.4	**32.58%**	2.92	2.19	0.21
	107	106	11.37	65.40	89.08	104.74	153.48	0.0	0.0	99.2	21.8	375	375	CIRCULAR	PVC	-	3.50	308.4	**32.16%**	2.92	2.19	0.17
	106	104	11.53	64.76	88.20	103.70	151.96	0.0	0.0	98.2	11.0	375	375	CIRCULAR	PVC	-	3.50	308.4	**31.85%**	2.92	2.19	0.08
			11.62																			
C105A, C105B	105	104	10.00	71.36	97.25	114.38	167.67	0.0	0.0	128.4	49.8	375	375	CIRCULAR	PVC	-	0.80	147.4	**87.10%**	1.40	1.41	0.59
			10.59																			
C104AA	104A	104	10.00	71.36	97.25	114.38	167.67	0.0	0.0	103.5	15.3	375	375	CIRCULAR	PVC	-	0.75	142.8	**72.53%**	1.35	1.29	0.20
			10.20																			
	104	103	11.62	64.44	87.76	103.19	151.20	0.0	0.0	307.0	68.2	450	450	CIRCULAR	CONCRETE	-	1.65	381.6	**80.46%**	2.32	2.29	0.50
			12.11																			
C103AA	103A	103	10.00	71.36	97.25	114.38	167.67	0.0	0.0	156.0	11.2	600	600	CIRCULAR	CONCRETE	-	0.20	286.5	**54.46%**	0.98	0.86	0.22
			10.22																			
	103	102	12.11	62.64	85.28	100.27	146.90	0.0	0.0	435.2	14.0	750	750	CIRCULAR	CONCRETE	-	0.25	580.7	**74.94%**	1.27	1.23	0.19
	102	101	12.30	61.98	84.38	99.21	145.34	0.0	0.0	430.6	130.3	825	825	CIRCULAR	CONCRETE	-	0.10	473.6	**90.93%**	0.86	0.88	2.48
	101	100	14.78	54.71	74.41	87.45	128.05	0.0	0.0	379.7	25.9	825	825	CIRCULAR	CONCRETE	-	0.10	473.6	**80.18%**	0.86	0.85	0.51
C100A	100	100A	15.29	53.46	72.70	85.44	125.08	0.0	0.0	503.2	18.7	825	825	CIRCULAR	CONCRETE	-	0.13	539.9	**93.19%**	0.98	1.01	0.31
	100A	HWL-1	15.60	52.74	71.71	84.27	123.37	0.0	0.0	496.3	6.2	825	825	CIRCULAR	CONCRETE	-	0.11	496.7	**99.93%**	0.90	0.94	0.11
			15.71									825	825									
	100D	HWL-2	10.00	71.36	97.25	114.38	167.67	0.0	0.0	0.0	6.3	600	600	CIRCULAR	CONCRETE	-	0.70	535.9	**0.00%**	1.84	0.00	0.00
			10.00									600	600									

C.2 PCSWMM INPUT FILE EXAMPLES

Appendix C

PCSWMM Model Data

Stantec

PRE-DEVELOPMENT MODEL – 100-YEAR 24-HOUR SCS DESIGN STORM

```
[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           07/23/2009
START_TIME           00:00:00
REPORT_START_DATE    07/23/2009
REPORT_START_TIME    00:00:00
END_DATE             07/24/2009
END_TIME             06:00:00
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              6

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

[RAINGAGES]
;;Name           Format    Interval SCF      Source
;;-------------- --------- -------- -------- ----------
RG1-SCS          INTENSITY 0:15     1.0      TIMESERIES 100yr-24h-SCS

[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- ----------------
EX-1             RG1-SCS          WestWatercourse2 1.51     0        302      6.3      0
EX-2             RG1-SCS          ParkedaleAvenue  0.24     6.5      342.857  6.6      0
EX-3             RG1-SCS          WestWatercourse1 0.45     0        150      6.7      0
EX-4             RG1-SCS          EastWatercourse1 0.49     0        163.333  8.1      0
EX-5             RG1-SCS          EastWatercourse2 2.74     0.4      548      6.8      0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
EX-1             0.013      0.25       1.57       4.67       0          PERVIOUS   100
EX-2             0.013      0.25       1.57       4.67       0          PERVIOUS   100
EX-3             0.013      0.25       1.57       4.67       0          PERVIOUS   100
EX-4             0.013      0.25       1.57       4.67       0          PERVIOUS   100
```

```
EX-5             0.013      0.25       1.57       4.67       0          PERVIOUS   100

[INFILTRATION]
;;Subcatchment   Param1     Param2     Param3     Param4     Param5
;;-------------- ---------- ---------- ---------- ---------- ----------
EX-1             76.2       13.2       4.14       7          0
EX-2             76.2       13.2       4.14       7          0
EX-3             76.2       13.2       4.14       7          0
EX-4             76.2       13.2       4.14       7          0
EX-5             76.2       13.2       4.14       7          0

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
EastWaterCourse1 0          FREE                        NO
EastWaterCourse2 0          FREE                        NO
ParkedaleAvenue  0          FREE                        NO
WestWatercourse1 0          FREE                        NO
WestWatercourse2 0          FREE                        NO

[TRANSECTS]
;;Transect Data in HEC-2 format
;
NC 0.025    0.025    0.013
X1 11.6_ROW_1.3_X-Fall  7        -5.8     5.8      0.0      0.0      0.0      0.0      0.0
GR 0.198    -7.4     0.15     -5.8     0        -5.8     0.075    0        0.15     5.8
GR 0.3      5.8      0.349    7.4
;
NC 0.025    0.025    0.013
X1 14.75_ROW        7        1.5      10       0.0      0.0      0.0      0.0      0.0
GR 0.2      0        0.15     1.5      0        1.5      0.13     5.75     0        10
GR 0.15     10       0.35     14.75
;
NC 0.025    0.025    0.013
X1 18.00_ROW        7        4.75     13.25    0.0      0.0      0.0      0.0      0.0
GR 0.35     0        0.15     4.75     0        4.75     0.13     9        0        13.25
GR 0.15     13.25    0.35     18
;
NC 0.025    0.025    0.013
X1 18.00_ROW_LS     4        4.75     9        0.0      0.0      0.0      0.0      0.0
GR 0.35     0        0.15     4.75     0        4.75     0.13     9
;
NC 0.025    0.025    0.013
X1 6.40_ROW_0.6_X-Fall  5        -3.2     3.2      0.0      0.0      0.0      0.0      0.0
GR 0.15     -3.2     0        -3.2     0.02     0        0.04     3.2      0.19     3.2
;
NC 0.025    0.025    0.013
X1 6.40_ROW_1.2_X-Fall  5        -3.2     3.2      0.0      0.0      0.0      0.0      0.0
GR 0.15     -3.2     0        -3.2     0.04     0        0.08     3.2      0.23     3.2
;
NC 0.025    0.025    0.013
X1 6.40_ROW_1.4_X-Fall  7        -3.2     3.2      0.0      0.0      0.0      0.0      0.0
GR 0.213    -5.3     0.15     -3.2     0        -3.2     0.045    0        0.09     3.2
GR 0.24     3.2      0.288    4.8
;
NC 0.025    0.025    0.013
X1 6.40_ROW_1.6_X-Fall  5        -3.2     3.2      0.0      0.0      0.0      0.0      0.0
GR 0.15     -3.2     0        -3.2     0.05     0        0.1      3.2      0.25     3.2
;
NC 0.025    0.025    0.013
X1 6.40_ROW_2.0_X-Fall  7        -3.2     3.2      0.0      0.0      0.0      0.0      0.0
GR 0.216    -5.4     0.15     -3.2     0        -3.2     0.065    0        0.13     3.2
GR 0.28     3.2      0.328    4.8
;
NC 0.025    0.025    0.013
X1 6.40_ROW_2.3_X-Fall  7        -3.2     3.2      0.0      0.0      0.0      0.0      0.0
GR 0.267    -7.1     0.15     -3.2     0        -3.2     0.075    0        0.15     3.2
GR 0.3      3.2      0.417    7.1
;
NC 0.025    0.025    0.013
```

```
X1 7.9_ROW_1.4_X-Fall  5         -3.95    3.95     0.0      0.0      0.0      0.0      0.0
GR 0.15     -3.95    0        -3.95    0.055    0        0.11     3.95     0.26     3.95
;
NC 0.025    0.025    0.013
X1 7_Pavement_Half   5        -3.5     0.0      0.0      0.0      0.0      0.0      0.0
GR 0.242    -8.1     0.182    -5.1     0.15     -3.5     0        -3.5     0.07     0

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
P1-Q             Pump1      0          2
P1-Q                        1000       2

C100A            Storage    0          0.36
C100A                       1.38       0.36
C100A                       1.56       419.19
C100A                       1.88       419.19

C103AA-V         Storage    0          0.36
C103AA-V                    1.38       0.36
C103AA-V                    1.6        309.02
C103AA-V                    1.88       309.02

C104AA-V         Storage    0          0.36
C104AA-V                    1.38       0.36
C104AA-V                    1.49       182.54
C104AA-V                    1.88       182.54

C105A-V          Storage    0          0.36
C105A-V                     1.38       0.36
C105A-V                     1.5        220
C105A-V                     1.88       220.01

C109A-V          Storage    0          0.36
C109A-V                     1.38       0.36
C109A-V                     1.53       349
C109A-V                     1.88       349.01

C109B-V          Storage    0          0.36
C109B-V                     1.95       0.36
C109B-V                     2.09       84.6
C109B-V                     2.45       84.61

C111A-V          Storage    0          0.36
C111A-V                     1.38       0.36
C111A-V                     1.68       427.4
C111A-V                     1.88       427.41

C111B-V          Storage    0          0.36
C111B-V                     1.4        0.36
C111B-V                     1.52       163.8
C111B-V                     1.9        163.81

FOREBAY-V        Storage    0          76.67
FOREBAY-V                   0.4        143.8
FOREBAY-V                   1          355.68
FOREBAY-V                   1.6        630.52
FOREBAY-V                   2          758.15

MAIN_CELL-V      Storage    0          282.78
MAIN_CELL-V                 0.4        438.92
MAIN_CELL-V                 1          878.18
MAIN_CELL-V                 1.6        1389.36
MAIN_CELL-V                 2          1614.73

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
100yr-24h-SCS               0:00:00    1.2969
100yr-24h-SCS               0:15:00    1.2969
```

100yr-24h-SCS	0:30:00	1.2969
100yr-24h-SCS	0:45:00	1.2969
100yr-24h-SCS	1:00:00	1.2969
100yr-24h-SCS	1:15:00	1.2969
100yr-24h-SCS	1:30:00	1.2969
100yr-24h-SCS	1:45:00	1.2969
100yr-24h-SCS	2:00:00	1.2969
100yr-24h-SCS	2:15:00	1.5327
100yr-24h-SCS	2:30:00	1.5327
100yr-24h-SCS	2:45:00	1.5327
100yr-24h-SCS	3:00:00	1.5327
100yr-24h-SCS	3:15:00	1.5327
100yr-24h-SCS	3:30:00	1.5327
100yr-24h-SCS	3:45:00	1.5327
100yr-24h-SCS	4:00:00	1.5327
100yr-24h-SCS	4:15:00	1.8864
100yr-24h-SCS	4:30:00	1.8864
100yr-24h-SCS	4:45:00	1.8864
100yr-24h-SCS	5:00:00	1.8864
100yr-24h-SCS	5:15:00	1.8864
100yr-24h-SCS	5:30:00	1.8864
100yr-24h-SCS	5:45:00	1.8864
100yr-24h-SCS	6:00:00	1.8864
100yr-24h-SCS	6:15:00	2.1222
100yr-24h-SCS	6:30:00	2.1222
100yr-24h-SCS	6:45:00	2.1222
100yr-24h-SCS	7:00:00	2.1222
100yr-24h-SCS	7:15:00	2.5938
100yr-24h-SCS	7:30:00	2.5938
100yr-24h-SCS	7:45:00	2.5938
100yr-24h-SCS	8:00:00	2.5938
100yr-24h-SCS	8:15:00	3.0654
100yr-24h-SCS	8:30:00	3.0654
100yr-24h-SCS	8:45:00	3.3012
100yr-24h-SCS	9:00:00	3.3012
100yr-24h-SCS	9:15:00	3.7728
100yr-24h-SCS	9:30:00	3.7728
100yr-24h-SCS	9:45:00	4.2444
100yr-24h-SCS	10:00:00	4.2444
100yr-24h-SCS	10:15:00	5.4234
100yr-24h-SCS	10:30:00	5.4234
100yr-24h-SCS	10:45:00	7.3098
100yr-24h-SCS	11:00:00	7.3098
100yr-24h-SCS	11:15:00	11.3184
100yr-24h-SCS	11:30:00	11.3184
100yr-24h-SCS	11:45:00	34.8984
100yr-24h-SCS	12:00:00	144.3096
100yr-24h-SCS	12:15:00	16.9776
100yr-24h-SCS	12:30:00	16.9776
100yr-24h-SCS	12:45:00	8.7246
100yr-24h-SCS	13:00:00	8.7246
100yr-24h-SCS	13:15:00	6.3666
100yr-24h-SCS	13:30:00	6.3666
100yr-24h-SCS	13:45:00	4.9518
100yr-24h-SCS	14:00:00	4.9518
100yr-24h-SCS	14:15:00	3.537
100yr-24h-SCS	14:30:00	3.537
100yr-24h-SCS	14:45:00	3.537
100yr-24h-SCS	15:00:00	3.537
100yr-24h-SCS	15:15:00	3.537
100yr-24h-SCS	15:30:00	3.537
100yr-24h-SCS	15:45:00	3.537
100yr-24h-SCS	16:00:00	3.537
100yr-24h-SCS	16:15:00	2.1222
100yr-24h-SCS	16:30:00	2.1222
100yr-24h-SCS	16:45:00	2.1222
100yr-24h-SCS	17:00:00	2.1222
100yr-24h-SCS	17:15:00	2.1222
100yr-24h-SCS	17:30:00	2.1222
100yr-24h-SCS	17:45:00	2.1222

100yr-24h-SCS	18:00:00	2.1222
100yr-24h-SCS	18:15:00	2.1222
100yr-24h-SCS	18:30:00	2.1222
100yr-24h-SCS	18:45:00	2.1222
100yr-24h-SCS	19:00:00	2.1222
100yr-24h-SCS	19:15:00	2.1222
100yr-24h-SCS	19:30:00	2.1222
100yr-24h-SCS	19:45:00	2.1222
100yr-24h-SCS	20:00:00	2.1222
100yr-24h-SCS	20:15:00	1.4148
100yr-24h-SCS	20:30:00	1.4148
100yr-24h-SCS	20:45:00	1.4148
100yr-24h-SCS	21:00:00	1.4148
100yr-24h-SCS	21:15:00	1.4148
100yr-24h-SCS	21:30:00	1.4148
100yr-24h-SCS	21:45:00	1.4148
100yr-24h-SCS	22:00:00	1.4148
100yr-24h-SCS	22:15:00	1.4148
100yr-24h-SCS	22:30:00	1.4148
100yr-24h-SCS	22:45:00	1.4148
100yr-24h-SCS	23:00:00	1.4148
100yr-24h-SCS	23:15:00	1.4148
100yr-24h-SCS	23:30:00	1.4148
100yr-24h-SCS	23:45:00	1.4148
100yr-24h-SCS	24:00:00	0
10yr-24h-SCS	0:00:00	0.902
10yr-24h-SCS	0:15:00	0.902
10yr-24h-SCS	0:30:00	0.902
10yr-24h-SCS	0:45:00	0.902
10yr-24h-SCS	1:00:00	0.902
10yr-24h-SCS	1:15:00	0.902
10yr-24h-SCS	1:30:00	0.902
10yr-24h-SCS	1:45:00	0.902
10yr-24h-SCS	2:00:00	0.902
10yr-24h-SCS	2:15:00	1.066
10yr-24h-SCS	2:30:00	1.066
10yr-24h-SCS	2:45:00	1.066
10yr-24h-SCS	3:00:00	1.066
10yr-24h-SCS	3:15:00	1.066
10yr-24h-SCS	3:30:00	1.066
10yr-24h-SCS	3:45:00	1.066
10yr-24h-SCS	4:00:00	1.066
10yr-24h-SCS	4:15:00	1.312
10yr-24h-SCS	4:30:00	1.312
10yr-24h-SCS	4:45:00	1.312
10yr-24h-SCS	5:00:00	1.312
10yr-24h-SCS	5:15:00	1.312
10yr-24h-SCS	5:30:00	1.312
10yr-24h-SCS	5:45:00	1.312
10yr-24h-SCS	6:00:00	1.312
10yr-24h-SCS	6:15:00	1.476
10yr-24h-SCS	6:30:00	1.476
10yr-24h-SCS	6:45:00	1.476
10yr-24h-SCS	7:00:00	1.476
10yr-24h-SCS	7:15:00	1.804
10yr-24h-SCS	7:30:00	1.804
10yr-24h-SCS	7:45:00	1.804
10yr-24h-SCS	8:00:00	1.804
10yr-24h-SCS	8:15:00	2.132
10yr-24h-SCS	8:30:00	2.132
10yr-24h-SCS	8:45:00	2.296
10yr-24h-SCS	9:00:00	2.296
10yr-24h-SCS	9:15:00	2.624
10yr-24h-SCS	9:30:00	2.624
10yr-24h-SCS	9:45:00	2.952
10yr-24h-SCS	10:00:00	2.952
10yr-24h-SCS	10:15:00	3.772
10yr-24h-SCS	10:30:00	3.772
10yr-24h-SCS	10:45:00	5.084

10yr-24h-SCS	11:00:00	5.084
10yr-24h-SCS	11:15:00	7.872
10yr-24h-SCS	11:30:00	7.872
10yr-24h-SCS	11:45:00	24.272
10yr-24h-SCS	12:00:00	100.368
10yr-24h-SCS	12:15:00	11.808
10yr-24h-SCS	12:30:00	11.808
10yr-24h-SCS	12:45:00	6.068
10yr-24h-SCS	13:00:00	6.068
10yr-24h-SCS	13:15:00	4.428
10yr-24h-SCS	13:30:00	4.428
10yr-24h-SCS	13:45:00	3.444
10yr-24h-SCS	14:00:00	3.444
10yr-24h-SCS	14:15:00	2.46
10yr-24h-SCS	14:30:00	2.46
10yr-24h-SCS	14:45:00	2.46
10yr-24h-SCS	15:00:00	2.46
10yr-24h-SCS	15:15:00	2.46
10yr-24h-SCS	15:30:00	2.46
10yr-24h-SCS	15:45:00	2.46
10yr-24h-SCS	16:00:00	2.46
10yr-24h-SCS	16:15:00	1.476
10yr-24h-SCS	16:30:00	1.476
10yr-24h-SCS	16:45:00	1.476
10yr-24h-SCS	17:00:00	1.476
10yr-24h-SCS	17:15:00	1.476
10yr-24h-SCS	17:30:00	1.476
10yr-24h-SCS	17:45:00	1.476
10yr-24h-SCS	18:00:00	1.476
10yr-24h-SCS	18:15:00	1.476
10yr-24h-SCS	18:30:00	1.476
10yr-24h-SCS	18:45:00	1.476
10yr-24h-SCS	19:00:00	1.476
10yr-24h-SCS	19:15:00	1.476
10yr-24h-SCS	19:30:00	1.476
10yr-24h-SCS	19:45:00	1.476
10yr-24h-SCS	20:00:00	1.476
10yr-24h-SCS	20:15:00	0.984
10yr-24h-SCS	20:30:00	0.984
10yr-24h-SCS	20:45:00	0.984
10yr-24h-SCS	21:00:00	0.984
10yr-24h-SCS	21:15:00	0.984
10yr-24h-SCS	21:30:00	0.984
10yr-24h-SCS	21:45:00	0.984
10yr-24h-SCS	22:00:00	0.984
10yr-24h-SCS	22:15:00	0.984
10yr-24h-SCS	22:30:00	0.984
10yr-24h-SCS	22:45:00	0.984
10yr-24h-SCS	23:00:00	0.984
10yr-24h-SCS	23:15:00	0.984
10yr-24h-SCS	23:30:00	0.984
10yr-24h-SCS	23:45:00	0.984
10yr-24h-SCS	24:00:00	0

2yr-24hr-SCS	0:00:00	0.5841
2yr-24hr-SCS	0:15:00	0.5841
2yr-24hr-SCS	0:30:00	0.5841
2yr-24hr-SCS	0:45:00	0.5841
2yr-24hr-SCS	1:00:00	0.5841
2yr-24hr-SCS	1:15:00	0.5841
2yr-24hr-SCS	1:30:00	0.5841
2yr-24hr-SCS	1:45:00	0.5841
2yr-24hr-SCS	2:00:00	0.5841
2yr-24hr-SCS	2:15:00	0.6903
2yr-24hr-SCS	2:30:00	0.6903
2yr-24hr-SCS	2:45:00	0.6903
2yr-24hr-SCS	3:00:00	0.6903
2yr-24hr-SCS	3:15:00	0.6903
2yr-24hr-SCS	3:30:00	0.6903
2yr-24hr-SCS	3:45:00	0.6903

2yr-24hr-SCS	4:00:00	0.6903
2yr-24hr-SCS	4:15:00	0.8496
2yr-24hr-SCS	4:30:00	0.8496
2yr-24hr-SCS	4:45:00	0.8496
2yr-24hr-SCS	5:00:00	0.8496
2yr-24hr-SCS	5:15:00	0.8496
2yr-24hr-SCS	5:30:00	0.8496
2yr-24hr-SCS	5:45:00	0.8496
2yr-24hr-SCS	6:00:00	0.8496
2yr-24hr-SCS	6:15:00	0.9558
2yr-24hr-SCS	6:30:00	0.9558
2yr-24hr-SCS	6:45:00	0.9558
2yr-24hr-SCS	7:00:00	0.9558
2yr-24hr-SCS	7:15:00	1.1682
2yr-24hr-SCS	7:30:00	1.1682
2yr-24hr-SCS	7:45:00	1.1682
2yr-24hr-SCS	8:00:00	1.1682
2yr-24hr-SCS	8:15:00	1.3806
2yr-24hr-SCS	8:30:00	1.3806
2yr-24hr-SCS	8:45:00	1.4868
2yr-24hr-SCS	9:00:00	1.4868
2yr-24hr-SCS	9:15:00	1.6992
2yr-24hr-SCS	9:30:00	1.6992
2yr-24hr-SCS	9:45:00	1.9116
2yr-24hr-SCS	10:00:00	1.9116
2yr-24hr-SCS	10:15:00	2.4426
2yr-24hr-SCS	10:30:00	2.4426
2yr-24hr-SCS	10:45:00	3.2922
2yr-24hr-SCS	11:00:00	3.2922
2yr-24hr-SCS	11:15:00	5.0976
2yr-24hr-SCS	11:30:00	5.0976
2yr-24hr-SCS	11:45:00	15.7176
2yr-24hr-SCS	12:00:00	64.9944
2yr-24hr-SCS	12:15:00	7.6464
2yr-24hr-SCS	12:30:00	7.6464
2yr-24hr-SCS	12:45:00	3.9294
2yr-24hr-SCS	13:00:00	3.9294
2yr-24hr-SCS	13:15:00	2.8674
2yr-24hr-SCS	13:30:00	2.8674
2yr-24hr-SCS	13:45:00	2.2302
2yr-24hr-SCS	14:00:00	2.2302
2yr-24hr-SCS	14:15:00	1.593
2yr-24hr-SCS	14:30:00	1.593
2yr-24hr-SCS	14:45:00	1.593
2yr-24hr-SCS	15:00:00	1.593
2yr-24hr-SCS	15:15:00	1.593
2yr-24hr-SCS	15:30:00	1.593
2yr-24hr-SCS	15:45:00	1.593
2yr-24hr-SCS	16:00:00	1.593
2yr-24hr-SCS	16:15:00	0.9558
2yr-24hr-SCS	16:30:00	0.9558
2yr-24hr-SCS	16:45:00	0.9558
2yr-24hr-SCS	17:00:00	0.9558
2yr-24hr-SCS	17:15:00	0.9558
2yr-24hr-SCS	17:30:00	0.9558
2yr-24hr-SCS	17:45:00	0.9558
2yr-24hr-SCS	18:00:00	0.9558
2yr-24hr-SCS	18:15:00	0.9558
2yr-24hr-SCS	18:30:00	0.9558
2yr-24hr-SCS	18:45:00	0.9558
2yr-24hr-SCS	19:00:00	0.9558
2yr-24hr-SCS	19:15:00	0.9558
2yr-24hr-SCS	19:30:00	0.9558
2yr-24hr-SCS	19:45:00	0.9558
2yr-24hr-SCS	20:00:00	0.9558
2yr-24hr-SCS	20:15:00	0.6372
2yr-24hr-SCS	20:30:00	0.6372
2yr-24hr-SCS	20:45:00	0.6372
2yr-24hr-SCS	21:00:00	0.6372
2yr-24hr-SCS	21:15:00	0.6372

2yr-24hr-SCS	21:30:00	0.6372
2yr-24hr-SCS	21:45:00	0.6372
2yr-24hr-SCS	22:00:00	0.6372
2yr-24hr-SCS	22:15:00	0.6372
2yr-24hr-SCS	22:30:00	0.6372
2yr-24hr-SCS	22:45:00	0.6372
2yr-24hr-SCS	23:00:00	0.6372
2yr-24hr-SCS	23:15:00	0.6372
2yr-24hr-SCS	23:30:00	0.6372
2yr-24hr-SCS	23:45:00	0.6372
2yr-24hr-SCS	24:00:00	0

5yr-24hr-SCS	0:00:00	0.7755
5yr-24hr-SCS	0:15:00	0.7755
5yr-24hr-SCS	0:30:00	0.7755
5yr-24hr-SCS	0:45:00	0.7755
5yr-24hr-SCS	1:00:00	0.7755
5yr-24hr-SCS	1:15:00	0.7755
5yr-24hr-SCS	1:30:00	0.7755
5yr-24hr-SCS	1:45:00	0.7755
5yr-24hr-SCS	2:00:00	0.7755
5yr-24hr-SCS	2:15:00	0.9165
5yr-24hr-SCS	2:30:00	0.9165
5yr-24hr-SCS	2:45:00	0.9165
5yr-24hr-SCS	3:00:00	0.9165
5yr-24hr-SCS	3:15:00	0.9165
5yr-24hr-SCS	3:30:00	0.9165
5yr-24hr-SCS	3:45:00	0.9165
5yr-24hr-SCS	4:00:00	0.9165
5yr-24hr-SCS	4:15:00	1.128
5yr-24hr-SCS	4:30:00	1.128
5yr-24hr-SCS	4:45:00	1.128
5yr-24hr-SCS	5:00:00	1.128
5yr-24hr-SCS	5:15:00	1.128
5yr-24hr-SCS	5:30:00	1.128
5yr-24hr-SCS	5:45:00	1.128
5yr-24hr-SCS	6:00:00	1.128
5yr-24hr-SCS	6:15:00	1.269
5yr-24hr-SCS	6:30:00	1.269
5yr-24hr-SCS	6:45:00	1.269
5yr-24hr-SCS	7:00:00	1.269
5yr-24hr-SCS	7:15:00	1.551
5yr-24hr-SCS	7:30:00	1.551
5yr-24hr-SCS	7:45:00	1.551
5yr-24hr-SCS	8:00:00	1.551
5yr-24hr-SCS	8:15:00	1.833
5yr-24hr-SCS	8:30:00	1.833
5yr-24hr-SCS	8:45:00	1.974
5yr-24hr-SCS	9:00:00	1.974
5yr-24hr-SCS	9:15:00	2.256
5yr-24hr-SCS	9:30:00	2.256
5yr-24hr-SCS	9:45:00	2.538
5yr-24hr-SCS	10:00:00	2.538
5yr-24hr-SCS	10:15:00	3.243
5yr-24hr-SCS	10:30:00	3.243
5yr-24hr-SCS	10:45:00	4.371
5yr-24hr-SCS	11:00:00	4.371
5yr-24hr-SCS	11:15:00	6.768
5yr-24hr-SCS	11:30:00	6.768
5yr-24hr-SCS	11:45:00	20.868
5yr-24hr-SCS	12:00:00	86.292
5yr-24hr-SCS	12:15:00	10.152
5yr-24hr-SCS	12:30:00	10.152
5yr-24hr-SCS	12:45:00	5.217
5yr-24hr-SCS	13:00:00	5.217
5yr-24hr-SCS	13:15:00	3.807
5yr-24hr-SCS	13:30:00	3.807
5yr-24hr-SCS	13:45:00	2.961
5yr-24hr-SCS	14:00:00	2.961
5yr-24hr-SCS	14:15:00	2.115

```
5yr-24hr-SCS                14:30:00   2.115
5yr-24hr-SCS                14:45:00   2.115
5yr-24hr-SCS                15:00:00   2.115
5yr-24hr-SCS                15:15:00   2.115
5yr-24hr-SCS                15:30:00   2.115
5yr-24hr-SCS                15:45:00   2.115
5yr-24hr-SCS                16:00:00   2.115
5yr-24hr-SCS                16:15:00   1.269
5yr-24hr-SCS                16:30:00   1.269
5yr-24hr-SCS                16:45:00   1.269
5yr-24hr-SCS                17:00:00   1.269
5yr-24hr-SCS                17:15:00   1.269
5yr-24hr-SCS                17:30:00   1.269
5yr-24hr-SCS                17:45:00   1.269
5yr-24hr-SCS                18:00:00   1.269
5yr-24hr-SCS                18:15:00   1.269
5yr-24hr-SCS                18:30:00   1.269
5yr-24hr-SCS                18:45:00   1.269
5yr-24hr-SCS                19:00:00   1.269
5yr-24hr-SCS                19:15:00   1.269
5yr-24hr-SCS                19:30:00   1.269
5yr-24hr-SCS                19:45:00   1.269
5yr-24hr-SCS                20:00:00   1.269
5yr-24hr-SCS                20:15:00   0.846
5yr-24hr-SCS                20:30:00   0.846
5yr-24hr-SCS                20:45:00   0.846
5yr-24hr-SCS                21:00:00   0.846
5yr-24hr-SCS                21:15:00   0.846
5yr-24hr-SCS                21:30:00   0.846
5yr-24hr-SCS                21:45:00   0.846
5yr-24hr-SCS                22:00:00   0.846
5yr-24hr-SCS                22:15:00   0.846
5yr-24hr-SCS                22:30:00   0.846
5yr-24hr-SCS                22:45:00   0.846
5yr-24hr-SCS                23:00:00   0.846
5yr-24hr-SCS                23:15:00   0.846
5yr-24hr-SCS                23:30:00   0.846
5yr-24hr-SCS                23:45:00   0.846
5yr-24hr-SCS                24:00:00   0

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

[TAGS]

[MAP]
DIMENSIONS       443473.66325     4938549.0987     443863.03575     4938913.2273
UNITS            Meters
```

Note: Coordinates, vertices, and polygons have been removed.

```
[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           07/23/2009
START_TIME           00:00:00
REPORT_START_DATE    07/23/2009
REPORT_START_TIME    00:00:00
END_DATE             07/25/2009
END_TIME             12:00:00
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              6

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

[RAINGAGES]
;;Name           Format    Interval SCF      Source
;;-------------- --------- -------- -------- ----------
RG1-SCS          INTENSITY 0:15     1.0      TIMESERIES 2yr-24hr-SCS
RG2-AES          INTENSITY 0:05     1.0      TIMESERIES 100yr-1hr-AES
RG3-Chicago      INTENSITY 0:10     1.0      TIMESERIES 25mm-Chicago

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

;;-------------- ---------------- ---------------- -------- -------- -------- -------- --------
----------------
C100A            RG1-SCS          C100A-S-Fut      1.01     64       776.923  2        0

C103AA           RG1-SCS          C103AA-S-Fut     0.96     57       738.462  2        0

C104AA           RG1-SCS          C104AA-S-Fut     0.64     57       492.308  2        0

C105A            RG1-SCS          C105A-S          0.51     71       318.75   2        0

C105B            RG1-SCS          C105B-S          0.2      57       181.818  2        0

;0.70
C109A            RG1-SCS          C109A-S          0.3      71       214.286  2        0

;0.40
C109B            RG1-SCS          C109B-S          0.18     29       180      2        0

C111A            RG1-SCS          C111A-S          0.12     50       70.588   2        0
```

```
C111B            RG1-SCS          C111B-S          0.1      50       55.556   2        0

POND             RG1-SCS          FOREBAY          0.42     29       280      20       0

;0.20
UNK-1            RG1-SCS          WestWatercourse2 0.05     0        83.333   2        0

;0.40
UNK-2            RG1-SCS          ParkedaleAvenue  0.01     29       16.667   2        0

UNK-3            RG1-SCS          WestWatercourse1 0.45     0        150      6.7      0

UNK-4            RG1-SCS          EastWatercourse1 0.49     0        163.333  8.1      0


[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
C100A            0.013      0.25       1.57       4.67       0          OUTLET
C103AA           0.013      0.25       1.57       4.67       0          OUTLET
C104AA           0.013      0.25       1.57       4.67       0          OUTLET
C105A            0.013      0.25       1.57       4.67       0          OUTLET
C105B            0.013      0.25       1.57       4.67       0          PERVIOUS   100
C109A            0.013      0.25       1.57       4.67       0          OUTLET
C109B            0.013      0.25       1.57       4.67       0          PERVIOUS   100
C111A            0.013      0.25       1.57       4.67       0          OUTLET
C111B            0.013      0.25       1.57       4.67       0          OUTLET
POND             0.013      0.25       1.57       4.67       0          OUTLET
UNK-1            0.013      0.25       1.57       4.67       0          PERVIOUS   100
UNK-2            0.013      0.25       1.57       4.67       0          OUTLET
UNK-3            0.013      0.25       1.57       4.67       0          PERVIOUS   100
UNK-4            0.013      0.25       1.57       4.67       0          PERVIOUS   100

[INFILTRATION]
;;Subcatchment   Param1     Param2     Param3     Param4     Param5
;;-------------- ---------- ---------- ---------- ---------- ----------
C100A            76.2       13.2       4.14       7          0
```



```
C103AA           76.2       13.2       4.14       7          0
C104AA           76.2       13.2       4.14       7          0
C105A            76.2       13.2       4.14       7          0
C105B            76.2       13.2       4.14       7          0
C109A            76.2       13.2       4.14       7          0
C109B            76.2       13.2       4.14       7          0
C111A            76.2       13.2       4.14       7          0
C111B            76.2       13.2       4.14       7          0
POND             76.2       13.2       4.14       7          0
UNK-1            76.2       13.2       4.14       7          0
UNK-2            76.2       13.2       4.14       7          0
UNK-3            76.2       13.2       4.14       7          0
UNK-4            76.2       13.2       4.14       7          0

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
EastWatercourse1 0          FREE                        NO
;Null Structure
EastWatercourse2 106.71     FREE                        NO
EastWatercourse3 106.99     FREE                        NO
ParkedaleAvenue  0          FREE                        NO
WestWatercourse1 0          FREE                        NO
WestWatercourse2 0          FREE                        NO

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve Name/Params            N/A      Fevap
Psi      Ksat     IMD
;;-------------- -------- ---------- ---------- ---------- ---------------------------- -------- --------
       -------- --------
;1500mm
100              106.64   2.23       0.36       FUNCTIONAL 1.13      0         0        0        0
;M-4
100A             106.62   1.7        0.38       FUNCTIONAL 1.13      0         0        0        0
;M-5.5
100D             106.45   1.56       0          FUNCTIONAL 1.13      0         0        0        0
;1800mm
101              106.7    2.94       0          FUNCTIONAL 1.13      0         0        0        0
```

```
;1500mm
102              106.96   2.86       0          FUNCTIONAL 1.13      0         0        0        0
;1500mm
103              107      3.06       0          FUNCTIONAL 1.13      0         0        0        0
103A             108.2    3          0          FUNCTIONAL 1.13      0         0        0        0
;1200mm
104              108.34   3.19       0          FUNCTIONAL 1.13      0         0        0        0
;Null Structure
104A             108.51   2.91       0          FUNCTIONAL 1.13      0         0        0        0
;1200mm
105              108.81   2.79       0          FUNCTIONAL 1.13      0         0        0        0
;1200mm
107              110.35   2.86       0          FUNCTIONAL 1.13      0         0        0        0
;1200mm
108              111.36   3.17       0          FUNCTIONAL 1.13      0         0        0        0
;1200mm
109              111.87   2.49       0          FUNCTIONAL 1.13      0         0        0        0
;1200mm
110              112.65   3.05       0          FUNCTIONAL 1.13      0         0        0        0
;1200mm
111              113.26   1.77       0          FUNCTIONAL 1.13      0         0        0        0
C100A-S-Fut      108.1    2.08       0          TABULAR    C100A                        0        0
C103AA-S-Fut     108.33   1.78       0          TABULAR    C103AA-V                     0        0
C104AA-S-Fut     109.85   1.78       0          TABULAR    C104AA-V                     0        0
C105A-S          109.93   1.78       0          TABULAR    C105A-V                      0        0
C105B-S          109.42   2.4        0          TABULAR    C105B-V                      0        0
C109A-S          112.91   1.78       0          TABULAR    C109A-V                      0        0
C109B-S          112.33   2.4        0          TABULAR    C109B-V                      0        0
C111A-S          113.57   1.78       0          TABULAR    C111A-V                      0        0
C111B-S          113.71   1.8        0          TABULAR    C111B-V                      0        0
FOREBAY          106      2          1          TABULAR    FOREBAY-V                    0        0
POND             106      2          1          TABULAR    MAIN_CELL-V                  0        0

[CONDUITS]
;;Name           From Node        To Node          Length     Roughness  InOffset   OutOffset  InitFlow
MaxFlow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ----------
----------
```



```
;825mm
100-100A         100              100A             18.7       0.013      106.94     106.92     0          0

;825mm
100A-FOREBAY     100A             FOREBAY          6.2        0.013      106.92     106.91     0          0

;600mm
100D-EastDrainage2 100D           EastWatercourse2 6.3        0.013      106.75     106.71     0          0

;825mm
101-100          101              100              25.9       0.013      107        106.97     0          0

;825mm
102-101          102              101              130.3      0.013      107.19     107.06     0          0

;750mm
103-102          103              102              13.99      0.013      107.3      107.26     0          0

;600mm
103A-103         103A             103              11.2       0.013      107.47     107.45     0          0

103AA-100A       C103AA-S-Fut     C100A-S-Fut      30.6       0.013      109.96     109.73     0          0

;525mm
104-103          104              103              68.18      0.013      108.64     107.52     0          0

;525mm
104A-104         104A             104              15.26      0.013      108.81     108.7      0          0

104AA-103AA      C104AA-S-Fut     C103AA-S-Fut     52.4       0.013      111.48     109.96     0          0

;525mm
105-104          105              104              49.77      0.013      109.1      108.7      0          0

105A-100A        C105A-S          C100A-S-Fut      58.6       0.013      111.43     109.73     0          0

;375mm
107-104          107              104              32.5       0.013      110.65     109.52     0          0
```

```
;375mm
108-107          108              107              27.9       0.013      111.66     110.68     0          0

;300mm
109-108          109              108              37         0.013      112.15     111.91     0          0

109A-105A        C109A-S          C105A-S          71         0.013      114.44     111.43     0          0

;300mm
110-108          110              108              25.4       0.013      112.95     112.06     0          0

;300mm
111-110          111              110              55.1       0.013      113.56     113.01     0          0

111B-104AA       C111B-S          C104AA-S-Fut     87         0.013      115.23     111.48     0          0

C100A-FOREBAY    C100A-S-Fut      FOREBAY          43.3       0.013      109.73     108        0          0

Overflow_Spillway POND            EastWatercourse3 10         0.013      107.84     106.99     0          0


[ORIFICES]
;;Name           From Node        To Node          Type         Offset     Qcoeff     Gated    CloseTime
;;-------------- ---------------- ---------------- ------------ ---------- ---------- -------- ----------
C100A-O-Fut      C100A-S-Fut      102              SIDE         108.1      0.572      NO       0
C103AA-O-Fut     C103AA-S-Fut     103A             SIDE         108.33     0.572      NO       0
C104AA-O-Fut     C104AA-S-Fut     104A             SIDE         109.85     0.572      NO       0
C105A-O1         C105A-S          105              SIDE         109.93     0.61       NO       0
C105A-O2         C105A-S          105              SIDE         109.93     0.61       NO       0
C105B-O          C105B-S          105              SIDE         109.42     0.61       NO       0
C109A-O1         C109A-S          109              SIDE         112.91     0.572      NO       0
C109A-O2         C109A-S          109              SIDE         112.91     0.572      NO       0
C111A-O          C111A-S          111              SIDE         113.57     0.572      NO       0
C111B-O          C111B-S          111              SIDE         113.71     0.572      NO       0
POND-O1          POND             100D             SIDE         107        0.61       NO       0

[WEIRS]
```

POST-DEVELOPMENT MODEL - 100Y 24H SCS

```
;;Name           From Node        To Node          Type         CrestHt    Qcoeff     Gated    EndCon
EndCoeff   Surcharge  RoadWidth  RoadSurf   Coeff. Curve
;;-------------- ---------------- ---------------- ------------ ---------- ---------- -------- --------
---------- ---------- ---------- ---------- ----------------
C105B-W          C105B-S          C105A-S          V-NOTCH      111.42     1.68       NO       0        0
       YES
C109B-W          C109B-S          C109A-S          V-NOTCH      114.47     1.68       NO       0        0
       YES
C111A-W          C111A-S          C111B-S          TRANSVERSE   115.25     1.68       NO       0        0
       YES
FOREBAY-W        FOREBAY          POND             TRAPEZOIDAL  106.7      1.68       NO       0        0
       YES
POND-O2          POND             100D             TRANSVERSE   107.34     1.68       NO       0        0
       YES

[OUTLETS]
;;Name           From Node        To Node          Offset     Type             QTable/Qcoeff    Qexpon
Gated
;;-------------- ---------------- ---------------- ---------- ---------------- ---------------- ----------
--------
C109B-O          C109B-S          109              112.33     FUNCTIONAL/DEPTH 1.35             0.51
NO

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels    Culvert
;;-------------- ------------ ---------------- ---------- ---------- ---------- ---------- ----------
100-100A         CIRCULAR     0.825            0          0          0          1
100A-FOREBAY     CIRCULAR     0.825            0          0          0          1
100D-EastDrainage2 CIRCULAR   0.6              0          0          0          1
101-100          CIRCULAR     0.825            0          0          0          1
102-101          CIRCULAR     0.825            0          0          0          1
103-102          CIRCULAR     0.75             0          0          0          1
103A-103         CIRCULAR     0.6              0          0          0          1
103AA-100A       IRREGULAR    7_Pavement_Half  0          0          0          1
104-103          CIRCULAR     0.525            0          0          0          1
104A-104         CIRCULAR     0.525            0          0          0          1
104AA-103AA      IRREGULAR    7_Pavement_Half  0          0          0          1
105-104          CIRCULAR     0.525            0          0          0          1
```

```
105A-100A        IRREGULAR    7_Pavement_Half  0          0          0          1
107-104          CIRCULAR     0.375            0          0          0          1
108-107          CIRCULAR     0.375            0          0          0          1
109-108          CIRCULAR     0.3              0          0          0          1
109A-105A        IRREGULAR    7_Pavement_Half  0          0          0          1
110-108          CIRCULAR     0.3              0          0          0          1
111-110          CIRCULAR     0.3              0          0          0          1
111B-104AA       IRREGULAR    7_Pavement_Half  0          0          0          1
C100A-FOREBAY    TRIANGULAR   0.07             3.5        0          0          1
Overflow_Spillway TRAPEZOIDAL 0.5              5          3          3          1
C100A-O-Fut      CIRCULAR     0.322            0          0          0
C103AA-O-Fut     CIRCULAR     0.308            0          0          0
C104AA-O-Fut     CIRCULAR     0.25             0          0          0
C105A-O1         CIRCULAR     0.2              0          0          0
C105A-O2         CIRCULAR     0.2              0          0          0
C105B-O          CIRCULAR     0.2              0          0          0
C109A-O1         CIRCULAR     0.152            0          0          0
C109A-O2         CIRCULAR     0.178            0          0          0
C111A-O          CIRCULAR     0.102            0          0          0
C111B-O          CIRCULAR     0.095            0          0          0
POND-O1          CIRCULAR     0.09             0          0          0
C105B-W          TRIANGULAR   0.5              3          0          0
C109B-W          TRIANGULAR   0.5              3          0          0
C111A-W          RECT_OPEN    0.15             12         0          0
FOREBAY-W        TRAPEZOIDAL  1.3              6.7        5          5
POND-O2          RECT_OPEN    0.51             1.1        0          0

[TRANSECTS]
;;Transect Data in HEC-2 format
;
NC 0.025    0.025    0.013
X1 11.6_ROW_1.3_X-Fall  7        -5.8     5.8      0.0      0.0      0.0      0.0      0.0
GR 0.198    -7.4     0.15     -5.8     0        -5.8     0.075    0        0.15     5.8
GR 0.3      5.8      0.349    7.4
;
NC 0.025    0.025    0.013
X1 14.75_ROW         7        1.5      10       0.0      0.0      0.0      0.0      0.0
GR 0.2      0        0.15     1.5      0        1.5      0.13     5.75     0        10
```



```
GR 0.15     10       0.35     14.75
;
NC 0.025    0.025    0.013
X1 18.00_ROW         7        4.75     13.25    0.0      0.0      0.0      0.0      0.0
GR 0.35     0        0.15     4.75     0        4.75     0.13     9        0        13.25
GR 0.15     13.25    0.35     18
;
NC 0.025    0.025    0.013
X1 18.00_ROW_LS      4        4.75     9        0.0      0.0      0.0      0.0      0.0
GR 0.35     0        0.15     4.75     0        4.75     0.13     9
;
NC 0.025    0.025    0.013
X1 6.40_ROW_0.6_X-Fall  5        -3.2     3.2      0.0      0.0      0.0      0.0      0.0
GR 0.15     -3.2     0        -3.2     0.02     0        0.04     3.2      0.19     3.2
;
NC 0.025    0.025    0.013
X1 6.40_ROW_1.2_X-Fall  5        -3.2     3.2      0.0      0.0      0.0      0.0      0.0
GR 0.15     -3.2     0        -3.2     0.04     0        0.08     3.2      0.23     3.2
;
NC 0.025    0.025    0.013
X1 6.40_ROW_1.4_X-Fall  7        -3.2     3.2      0.0      0.0      0.0      0.0      0.0
GR 0.213    -5.3     0.15     -3.2     0        -3.2     0.045    0        0.09     3.2
GR 0.24     3.2      0.288    4.8
;
NC 0.025    0.025    0.013
X1 6.40_ROW_1.6_X-Fall  5        -3.2     3.2      0.0      0.0      0.0      0.0      0.0
GR 0.15     -3.2     0        -3.2     0.05     0        0.1      3.2      0.25     3.2
;
NC 0.025    0.025    0.013
X1 6.40_ROW_2.0_X-Fall  7        -3.2     3.2      0.0      0.0      0.0      0.0      0.0
GR 0.216    -5.4     0.15     -3.2     0        -3.2     0.065    0        0.13     3.2
GR 0.28     3.2      0.328    4.8
;
NC 0.025    0.025    0.013
X1 6.40_ROW_2.3_X-Fall  7        -3.2     3.2      0.0      0.0      0.0      0.0      0.0
GR 0.267    -7.1     0.15     -3.2     0        -3.2     0.075    0        0.15     3.2
GR 0.3      3.2      0.417    7.1
;
```

```
NC 0.025    0.025    0.013
X1 7.9_ROW_1.4_X-Fall  5        -3.95    3.95     0.0      0.0      0.0      0.0      0.0
GR 0.15     -3.95    0        -3.95    0.055    0        0.11     3.95     0.26     3.95
;
NC 0.025    0.025    0.013
X1 7_Pavement_Half   5        -3.5     0.0      0.0      0.0      0.0      0.0      0.0
GR 0.242    -8.1     0.182    -5.1     0.15     -3.5     0        -3.5     0.07     0

[LOSSES]
;;Link           Kentry     Kexit      Kavg       Flap Gate  Seepage
;;-------------- ---------- ---------- ---------- ---------- ----------
100-100A         0          0.034      0          NO         0
101-100          0          0.503      0          NO         0
102-101          0          1.344      0          NO         0
103-102          0          0.042      0          NO         0
103A-103         0          0.042      0          NO         0
104-103          0          1.344      0          NO         0
104A-104         0          1.233      0          NO         0
105-104          0          1.344      0          NO         0
107-104          0          0.103      0          NO         0
108-107          0          0.199      0          NO         0
109-108          0          1.344      0          NO         0
110-108          0          0.157      0          NO         0
111-110          0          0.789      0          NO         0

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
P1-Q             Pump1      0          2
P1-Q                        1000       2

C100A            Storage    0          0.36
C100A                       1.38       0.36
C100A                       1.63       303
C100A                       1.78       303
C100A                       2.08       303

C103AA-V         Storage    0          0.36
```



```
C103AA-V                    1.38       0.36
C103AA-V                    1.63       288
C103AA-V                    1.78       288

C104AA-V         Storage    0          0.36
C104AA-V                    1.38       0.36
C104AA-V                    1.63       96
C104AA-V                    1.78       96

C105A-V          Storage    0          0.72
C105A-V                     1.38       0.72
C105A-V                     1.5        220
C105A-V                     1.78       220

C105B-V          Storage    0          0.36
C105B-V                     0.1        0.36
C105B-V                     0.2        0.36
C105B-V                     0.3        0.36
C105B-V                     0.4        0.36
C105B-V                     0.5        0.36
C105B-V                     0.6        0.36
C105B-V                     0.7        0.36
C105B-V                     0.8        0.36
C105B-V                     0.9        0.36
C105B-V                     1          0.43
C105B-V                     1.1        0.43
C105B-V                     1.2        4.53
C105B-V                     1.3        4.53
C105B-V                     1.4        45.43
C105B-V                     1.5        45.43
C105B-V                     1.6        45.43
C105B-V                     1.7        45.43
C105B-V                     1.8        45.43
C105B-V                     1.9        45.43
C105B-V                     2          45.43
C105B-V                     2.4        45.43

C109A-V          Storage    0          0.72
```

C109A-V		1.38	0.72
C109A-V		1.53	349
C109A-V		1.78	349
C109B-V	Storage	0	0.36
C109B-V		0.1	0.36
C109B-V		0.2	0.36
C109B-V		0.3	0.36
C109B-V		0.4	0.36
C109B-V		0.5	0.36
C109B-V		0.6	0.36
C109B-V		0.7	0.36
C109B-V		0.8	0.36
C109B-V		0.9	0.36
C109B-V		1	0.36
C109B-V		1.1	0.36
C109B-V		1.2	61.93
C109B-V		1.3	61.93
C109B-V		1.4	92.63
C109B-V		1.5	92.63
C109B-V		1.6	92.63
C109B-V		1.7	92.63
C109B-V		1.8	92.63
C109B-V		1.9	92.63
C109B-V		2	92.63
C109B-V		2.14	177.9
C109B-V		2.44	177.9
C111A-V	Storage	0	0.36
C111A-V		1.38	0.36
C111A-V		1.68	427.4
C111A-V		1.78	427.4
C111B-V	Storage	0	0.36
C111B-V		1.4	0.36
C111B-V		1.52	163.8
C111B-V		1.8	163.8

FOREBAY-V	Storage	0	75.36
FOREBAY-V		0.4	142.1
FOREBAY-V		0.7	245.03
FOREBAY-V		1	368.66
FOREBAY-V		1.6	580.32
FOREBAY-V		1.85	640.3
FOREBAY-V		2.15	711.85
MAIN_CELL-V	Storage	0	344.03
MAIN_CELL-V		0.4	521.71
MAIN_CELL-V		0.7	749.25
MAIN_CELL-V		1	1002.15
MAIN_CELL-V		1.6	1447.58
MAIN_CELL-V		1.85	1572.67
MAIN_CELL-V		2.15	1683.85

[TIMESERIES]

;;Name	Date	Time	Value
;;--------------	----------	----------	----------
100yr+20%-12hr-SCS		0:00:00	2.871
100yr+20%-12hr-SCS		0:15:00	2.871
100yr+20%-12hr-SCS		0:30:00	2.871
100yr+20%-12hr-SCS		0:45:00	2.871
100yr+20%-12hr-SCS		1:00:00	2.871
100yr+20%-12hr-SCS		1:15:00	2.871
100yr+20%-12hr-SCS		1:30:00	2.871
100yr+20%-12hr-SCS		1:45:00	2.871
100yr+20%-12hr-SCS		2:00:00	2.871
100yr+20%-12hr-SCS		2:15:00	3.4452
100yr+20%-12hr-SCS		2:30:00	3.4452
100yr+20%-12hr-SCS		2:45:00	3.4452
100yr+20%-12hr-SCS		3:00:00	3.4452
100yr+20%-12hr-SCS		3:15:00	4.5936
100yr+20%-12hr-SCS		3:30:00	4.5936
100yr+20%-12hr-SCS		3:45:00	4.5936
100yr+20%-12hr-SCS		4:00:00	4.5936
100yr+20%-12hr-SCS		4:15:00	6.8904
100yr+20%-12hr-SCS		4:30:00	6.8904

100yr+20%-12hr-SCS	4:45:00	9.1872
100yr+20%-12hr-SCS	5:00:00	9.1872
100yr+20%-12hr-SCS	5:15:00	13.7808
100yr+20%-12hr-SCS	5:30:00	13.7808
100yr+20%-12hr-SCS	5:45:00	55.1232
100yr+20%-12hr-SCS	6:00:00	151.5888
100yr+20%-12hr-SCS	6:15:00	20.6712
100yr+20%-12hr-SCS	6:30:00	20.6712
100yr+20%-12hr-SCS	6:45:00	9.1872
100yr+20%-12hr-SCS	7:00:00	9.1872
100yr+20%-12hr-SCS	7:15:00	6.8904
100yr+20%-12hr-SCS	7:30:00	6.8904
100yr+20%-12hr-SCS	7:45:00	6.8904
100yr+20%-12hr-SCS	8:00:00	6.8904
100yr+20%-12hr-SCS	8:15:00	4.0194
100yr+20%-12hr-SCS	8:30:00	4.0194
100yr+20%-12hr-SCS	8:45:00	4.0194
100yr+20%-12hr-SCS	9:00:00	4.0194
100yr+20%-12hr-SCS	9:15:00	4.0194
100yr+20%-12hr-SCS	9:30:00	4.0194
100yr+20%-12hr-SCS	9:45:00	4.0194
100yr+20%-12hr-SCS	10:00:00	4.0194
100yr+20%-12hr-SCS	10:15:00	2.2968
100yr+20%-12hr-SCS	10:30:00	2.2968
100yr+20%-12hr-SCS	10:45:00	2.2968
100yr+20%-12hr-SCS	11:00:00	2.2968
100yr+20%-12hr-SCS	11:15:00	2.2968
100yr+20%-12hr-SCS	11:30:00	2.2968
100yr+20%-12hr-SCS	11:45:00	2.2968
100yr+20%-12hr-SCS	12:00:00	2.2968

100yr+20%-1hr-AES	0:00:00	0
100yr+20%-1hr-AES	0:05:00	65.232
100yr+20%-1hr-AES	0:10:00	91.3248
100yr+20%-1hr-AES	0:15:00	110.8944
100yr+20%-1hr-AES	0:20:00	78.2784
100yr+20%-1hr-AES	0:25:00	91.3248
100yr+20%-1hr-AES	0:30:00	52.1856

100yr+20%-1hr-AES	0:35:00	71.7552
100yr+20%-1hr-AES	0:40:00	39.1392
100yr+20%-1hr-AES	0:45:00	26.0928
100yr+20%-1hr-AES	0:50:00	19.5696
100yr+20%-1hr-AES	0:55:00	6.5232
100yr+20%-1hr-AES	1:00:00	0

100yr+20%-24hr-SCS	0:00:00	1.55628
100yr+20%-24hr-SCS	0:15:00	1.55628
100yr+20%-24hr-SCS	0:30:00	1.55628
100yr+20%-24hr-SCS	0:45:00	1.55628
100yr+20%-24hr-SCS	1:00:00	1.55628
100yr+20%-24hr-SCS	1:15:00	1.55628
100yr+20%-24hr-SCS	1:30:00	1.55628
100yr+20%-24hr-SCS	1:45:00	1.55628
100yr+20%-24hr-SCS	2:00:00	1.55628
100yr+20%-24hr-SCS	2:15:00	1.83924
100yr+20%-24hr-SCS	2:30:00	1.83924
100yr+20%-24hr-SCS	2:45:00	1.83924
100yr+20%-24hr-SCS	3:00:00	1.83924
100yr+20%-24hr-SCS	3:15:00	1.83924
100yr+20%-24hr-SCS	3:30:00	1.83924
100yr+20%-24hr-SCS	3:45:00	1.83924
100yr+20%-24hr-SCS	4:00:00	1.83924
100yr+20%-24hr-SCS	4:15:00	2.26368
100yr+20%-24hr-SCS	4:30:00	2.26368
100yr+20%-24hr-SCS	4:45:00	2.26368
100yr+20%-24hr-SCS	5:00:00	2.26368
100yr+20%-24hr-SCS	5:15:00	2.26368
100yr+20%-24hr-SCS	5:30:00	2.26368
100yr+20%-24hr-SCS	5:45:00	2.26368
100yr+20%-24hr-SCS	6:00:00	2.26368
100yr+20%-24hr-SCS	6:15:00	2.54664
100yr+20%-24hr-SCS	6:30:00	2.54664
100yr+20%-24hr-SCS	6:45:00	2.54664
100yr+20%-24hr-SCS	7:00:00	2.54664
100yr+20%-24hr-SCS	7:15:00	3.11256
100yr+20%-24hr-SCS	7:30:00	3.11256

POST-DEVELOPMENT MODEL - 100Y 24H SCS

100yr+20%-24hr-SCS	7:45:00	3.11256
100yr+20%-24hr-SCS	8:00:00	3.11256
100yr+20%-24hr-SCS	8:15:00	3.67848
100yr+20%-24hr-SCS	8:30:00	3.67848
100yr+20%-24hr-SCS	8:45:00	3.96144
100yr+20%-24hr-SCS	9:00:00	3.96144
100yr+20%-24hr-SCS	9:15:00	4.52736
100yr+20%-24hr-SCS	9:30:00	4.52736
100yr+20%-24hr-SCS	9:45:00	5.09328
100yr+20%-24hr-SCS	10:00:00	5.09328
100yr+20%-24hr-SCS	10:15:00	6.50808
100yr+20%-24hr-SCS	10:30:00	6.50808
100yr+20%-24hr-SCS	10:45:00	8.77176
100yr+20%-24hr-SCS	11:00:00	8.77176
100yr+20%-24hr-SCS	11:15:00	13.58208
100yr+20%-24hr-SCS	11:30:00	13.58208
100yr+20%-24hr-SCS	11:45:00	41.87808
100yr+20%-24hr-SCS	12:00:00	173.17152
100yr+20%-24hr-SCS	12:15:00	20.37312
100yr+20%-24hr-SCS	12:30:00	20.37312
100yr+20%-24hr-SCS	12:45:00	10.46952
100yr+20%-24hr-SCS	13:00:00	10.46952
100yr+20%-24hr-SCS	13:15:00	7.63992
100yr+20%-24hr-SCS	13:30:00	7.63992
100yr+20%-24hr-SCS	13:45:00	5.94216
100yr+20%-24hr-SCS	14:00:00	5.94216
100yr+20%-24hr-SCS	14:15:00	4.2444
100yr+20%-24hr-SCS	14:30:00	4.2444
100yr+20%-24hr-SCS	14:45:00	4.2444
100yr+20%-24hr-SCS	15:00:00	4.2444
100yr+20%-24hr-SCS	15:15:00	4.2444
100yr+20%-24hr-SCS	15:30:00	4.2444
100yr+20%-24hr-SCS	15:45:00	4.2444
100yr+20%-24hr-SCS	16:00:00	4.2444
100yr+20%-24hr-SCS	16:15:00	2.54664
100yr+20%-24hr-SCS	16:30:00	2.54664
100yr+20%-24hr-SCS	16:45:00	2.54664
100yr+20%-24hr-SCS	17:00:00	2.54664

POST-DEVELOPMENT MODEL - 100Y 24H SCS

100yr+20%-24hr-SCS	17:15:00	2.54664
100yr+20%-24hr-SCS	17:30:00	2.54664
100yr+20%-24hr-SCS	17:45:00	2.54664
100yr+20%-24hr-SCS	18:00:00	2.54664
100yr+20%-24hr-SCS	18:15:00	2.54664
100yr+20%-24hr-SCS	18:30:00	2.54664
100yr+20%-24hr-SCS	18:45:00	2.54664
100yr+20%-24hr-SCS	19:00:00	2.54664
100yr+20%-24hr-SCS	19:15:00	2.54664
100yr+20%-24hr-SCS	19:30:00	2.54664
100yr+20%-24hr-SCS	19:45:00	2.54664
100yr+20%-24hr-SCS	20:00:00	2.54664
100yr+20%-24hr-SCS	20:15:00	1.69776
100yr+20%-24hr-SCS	20:30:00	1.69776
100yr+20%-24hr-SCS	20:45:00	1.69776
100yr+20%-24hr-SCS	21:00:00	1.69776
100yr+20%-24hr-SCS	21:15:00	1.69776
100yr+20%-24hr-SCS	21:30:00	1.69776
100yr+20%-24hr-SCS	21:45:00	1.69776
100yr+20%-24hr-SCS	22:00:00	1.69776
100yr+20%-24hr-SCS	22:15:00	1.69776
100yr+20%-24hr-SCS	22:30:00	1.69776
100yr+20%-24hr-SCS	22:45:00	1.69776
100yr+20%-24hr-SCS	23:00:00	1.69776
100yr+20%-24hr-SCS	23:15:00	1.69776
100yr+20%-24hr-SCS	23:30:00	1.69776
100yr+20%-24hr-SCS	23:45:00	1.69776
100yr+20%-24hr-SCS	24:00:00	0

100yr-12h-SCS	0:00:00	2.3925
100yr-12h-SCS	0:15:00	2.3925
100yr-12h-SCS	0:30:00	2.3925
100yr-12h-SCS	0:45:00	2.3925
100yr-12h-SCS	1:00:00	2.3925
100yr-12h-SCS	1:15:00	2.3925
100yr-12h-SCS	1:30:00	2.3925
100yr-12h-SCS	1:45:00	2.3925
100yr-12h-SCS	2:00:00	2.3925

100yr-12h-SCS	2:15:00	2.8710
100yr-12h-SCS	2:30:00	2.8710
100yr-12h-SCS	2:45:00	2.8710
100yr-12h-SCS	3:00:00	2.8710
100yr-12h-SCS	3:15:00	3.8280
100yr-12h-SCS	3:30:00	3.8280
100yr-12h-SCS	3:45:00	3.8280
100yr-12h-SCS	4:00:00	3.8280
100yr-12h-SCS	4:15:00	5.7420
100yr-12h-SCS	4:30:00	5.7420
100yr-12h-SCS	4:45:00	7.6560
100yr-12h-SCS	5:00:00	7.6560
100yr-12h-SCS	5:15:00	11.4840
100yr-12h-SCS	5:30:00	11.4840
100yr-12h-SCS	5:45:00	45.9360
100yr-12h-SCS	6:00:00	126.3240
100yr-12h-SCS	6:15:00	17.2260
100yr-12h-SCS	6:30:00	17.2260
100yr-12h-SCS	6:45:00	7.6560
100yr-12h-SCS	7:00:00	7.6560
100yr-12h-SCS	7:15:00	5.7420
100yr-12h-SCS	7:30:00	5.7420
100yr-12h-SCS	7:45:00	5.7420
100yr-12h-SCS	8:00:00	5.7420
100yr-12h-SCS	8:15:00	3.3495
100yr-12h-SCS	8:30:00	3.3495
100yr-12h-SCS	8:45:00	3.3495
100yr-12h-SCS	9:00:00	3.3495
100yr-12h-SCS	9:15:00	3.3495
100yr-12h-SCS	9:30:00	3.3495
100yr-12h-SCS	9:45:00	3.3495
100yr-12h-SCS	10:00:00	3.3495
100yr-12h-SCS	10:15:00	1.9140
100yr-12h-SCS	10:30:00	1.9140
100yr-12h-SCS	10:45:00	1.9140
100yr-12h-SCS	11:00:00	1.9140
100yr-12h-SCS	11:15:00	1.9140
100yr-12h-SCS	11:30:00	1.9140

100yr-12h-SCS	11:45:00	1.9140
100yr-12h-SCS	12:00:00	1.9140
100yr-1hr-AES	0:00:00	0.0000
100yr-1hr-AES	0:05:00	54.3600
100yr-1hr-AES	0:10:00	76.1040
100yr-1hr-AES	0:15:00	92.4120
100yr-1hr-AES	0:20:00	65.2320
100yr-1hr-AES	0:25:00	76.1040
100yr-1hr-AES	0:30:00	43.4880
100yr-1hr-AES	0:35:00	59.7960
100yr-1hr-AES	0:40:00	32.6160
100yr-1hr-AES	0:45:00	21.7440
100yr-1hr-AES	0:50:00	16.3080
100yr-1hr-AES	0:55:00	5.4360
100yr-1hr-AES	1:00:00	0.0000
100yr-24h-SCS	0:00:00	1.2969
100yr-24h-SCS	0:15:00	1.2969
100yr-24h-SCS	0:30:00	1.2969
100yr-24h-SCS	0:45:00	1.2969
100yr-24h-SCS	1:00:00	1.2969
100yr-24h-SCS	1:15:00	1.2969
100yr-24h-SCS	1:30:00	1.2969
100yr-24h-SCS	1:45:00	1.2969
100yr-24h-SCS	2:00:00	1.2969
100yr-24h-SCS	2:15:00	1.5327
100yr-24h-SCS	2:30:00	1.5327
100yr-24h-SCS	2:45:00	1.5327
100yr-24h-SCS	3:00:00	1.5327
100yr-24h-SCS	3:15:00	1.5327
100yr-24h-SCS	3:30:00	1.5327
100yr-24h-SCS	3:45:00	1.5327
100yr-24h-SCS	4:00:00	1.5327
100yr-24h-SCS	4:15:00	1.8864
100yr-24h-SCS	4:30:00	1.8864
100yr-24h-SCS	4:45:00	1.8864
100yr-24h-SCS	5:00:00	1.8864

POST-DEVELOPMENT MODEL - 100Y 24H SCS

100yr-24h-SCS	5:15:00	1.8864
100yr-24h-SCS	5:30:00	1.8864
100yr-24h-SCS	5:45:00	1.8864
100yr-24h-SCS	6:00:00	1.8864
100yr-24h-SCS	6:15:00	2.1222
100yr-24h-SCS	6:30:00	2.1222
100yr-24h-SCS	6:45:00	2.1222
100yr-24h-SCS	7:00:00	2.1222
100yr-24h-SCS	7:15:00	2.5938
100yr-24h-SCS	7:30:00	2.5938
100yr-24h-SCS	7:45:00	2.5938
100yr-24h-SCS	8:00:00	2.5938
100yr-24h-SCS	8:15:00	3.0654
100yr-24h-SCS	8:30:00	3.0654
100yr-24h-SCS	8:45:00	3.3012
100yr-24h-SCS	9:00:00	3.3012
100yr-24h-SCS	9:15:00	3.7728
100yr-24h-SCS	9:30:00	3.7728
100yr-24h-SCS	9:45:00	4.2444
100yr-24h-SCS	10:00:00	4.2444
100yr-24h-SCS	10:15:00	5.4234
100yr-24h-SCS	10:30:00	5.4234
100yr-24h-SCS	10:45:00	7.3098
100yr-24h-SCS	11:00:00	7.3098
100yr-24h-SCS	11:15:00	11.3184
100yr-24h-SCS	11:30:00	11.3184
100yr-24h-SCS	11:45:00	34.8984
100yr-24h-SCS	12:00:00	144.3096
100yr-24h-SCS	12:15:00	16.9776
100yr-24h-SCS	12:30:00	16.9776
100yr-24h-SCS	12:45:00	8.7246
100yr-24h-SCS	13:00:00	8.7246
100yr-24h-SCS	13:15:00	6.3666
100yr-24h-SCS	13:30:00	6.3666
100yr-24h-SCS	13:45:00	4.9518
100yr-24h-SCS	14:00:00	4.9518
100yr-24h-SCS	14:15:00	3.537
100yr-24h-SCS	14:30:00	3.537

POST-DEVELOPMENT MODEL - 100Y 24H SCS

100yr-24h-SCS	14:45:00	3.537
100yr-24h-SCS	15:00:00	3.537
100yr-24h-SCS	15:15:00	3.537
100yr-24h-SCS	15:30:00	3.537
100yr-24h-SCS	15:45:00	3.537
100yr-24h-SCS	16:00:00	3.537
100yr-24h-SCS	16:15:00	2.1222
100yr-24h-SCS	16:30:00	2.1222
100yr-24h-SCS	16:45:00	2.1222
100yr-24h-SCS	17:00:00	2.1222
100yr-24h-SCS	17:15:00	2.1222
100yr-24h-SCS	17:30:00	2.1222
100yr-24h-SCS	17:45:00	2.1222
100yr-24h-SCS	18:00:00	2.1222
100yr-24h-SCS	18:15:00	2.1222
100yr-24h-SCS	18:30:00	2.1222
100yr-24h-SCS	18:45:00	2.1222
100yr-24h-SCS	19:00:00	2.1222
100yr-24h-SCS	19:15:00	2.1222
100yr-24h-SCS	19:30:00	2.1222
100yr-24h-SCS	19:45:00	2.1222
100yr-24h-SCS	20:00:00	2.1222
100yr-24h-SCS	20:15:00	1.4148
100yr-24h-SCS	20:30:00	1.4148
100yr-24h-SCS	20:45:00	1.4148
100yr-24h-SCS	21:00:00	1.4148
100yr-24h-SCS	21:15:00	1.4148
100yr-24h-SCS	21:30:00	1.4148
100yr-24h-SCS	21:45:00	1.4148
100yr-24h-SCS	22:00:00	1.4148
100yr-24h-SCS	22:15:00	1.4148
100yr-24h-SCS	22:30:00	1.4148
100yr-24h-SCS	22:45:00	1.4148
100yr-24h-SCS	23:00:00	1.4148
100yr-24h-SCS	23:15:00	1.4148
100yr-24h-SCS	23:30:00	1.4148
100yr-24h-SCS	23:45:00	1.4148
100yr-24h-SCS	24:00:00	0

10yr-12h-SCS	0:00:00	1.6700
10yr-12h-SCS	0:15:00	1.6700
10yr-12h-SCS	0:30:00	1.6700
10yr-12h-SCS	0:45:00	1.6700
10yr-12h-SCS	1:00:00	1.6700
10yr-12h-SCS	1:15:00	1.6700
10yr-12h-SCS	1:30:00	1.6700
10yr-12h-SCS	1:45:00	1.6700
10yr-12h-SCS	2:00:00	1.6700
10yr-12h-SCS	2:15:00	2.0040
10yr-12h-SCS	2:30:00	2.0040
10yr-12h-SCS	2:45:00	2.0040
10yr-12h-SCS	3:00:00	2.0040
10yr-12h-SCS	3:15:00	2.6720
10yr-12h-SCS	3:30:00	2.6720
10yr-12h-SCS	3:45:00	2.6720
10yr-12h-SCS	4:00:00	2.6720
10yr-12h-SCS	4:15:00	4.0080
10yr-12h-SCS	4:30:00	4.0080
10yr-12h-SCS	4:45:00	5.3440
10yr-12h-SCS	5:00:00	5.3440
10yr-12h-SCS	5:15:00	8.0160
10yr-12h-SCS	5:30:00	8.0160
10yr-12h-SCS	5:45:00	32.0640
10yr-12h-SCS	6:00:00	88.1760
10yr-12h-SCS	6:15:00	12.0240
10yr-12h-SCS	6:30:00	12.0240
10yr-12h-SCS	6:45:00	5.3440
10yr-12h-SCS	7:00:00	5.3440
10yr-12h-SCS	7:15:00	4.0080
10yr-12h-SCS	7:30:00	4.0080
10yr-12h-SCS	7:45:00	4.0080
10yr-12h-SCS	8:00:00	4.0080
10yr-12h-SCS	8:15:00	2.3380
10yr-12h-SCS	8:30:00	2.3380
10yr-12h-SCS	8:45:00	2.3380
10yr-12h-SCS	9:00:00	2.3380

10yr-12h-SCS	9:15:00	2.3380
10yr-12h-SCS	9:30:00	2.3380
10yr-12h-SCS	9:45:00	2.3380
10yr-12h-SCS	10:00:00	2.3380
10yr-12h-SCS	10:15:00	1.3360
10yr-12h-SCS	10:30:00	1.3360
10yr-12h-SCS	10:45:00	1.3360
10yr-12h-SCS	11:00:00	1.3360
10yr-12h-SCS	11:15:00	1.3360
10yr-12h-SCS	11:30:00	1.3360
10yr-12h-SCS	11:45:00	1.3360
10yr-12h-SCS	12:00:00	1.3360
10yr-1hr-AES	0:00:00	0.0000
10yr-1hr-AES	0:05:00	37.9200
10yr-1hr-AES	0:10:00	53.0880
10yr-1hr-AES	0:15:00	64.4640
10yr-1hr-AES	0:20:00	45.5040
10yr-1hr-AES	0:25:00	53.0880
10yr-1hr-AES	0:30:00	30.3360
10yr-1hr-AES	0:35:00	41.7120
10yr-1hr-AES	0:40:00	22.7520
10yr-1hr-AES	0:45:00	15.1680
10yr-1hr-AES	0:50:00	11.3760
10yr-1hr-AES	0:55:00	3.7920
10yr-1hr-AES	1:00:00	0.0000
10yr-24h-SCS	0:00:00	0.902
10yr-24h-SCS	0:15:00	0.902
10yr-24h-SCS	0:30:00	0.902
10yr-24h-SCS	0:45:00	0.902
10yr-24h-SCS	1:00:00	0.902
10yr-24h-SCS	1:15:00	0.902
10yr-24h-SCS	1:30:00	0.902
10yr-24h-SCS	1:45:00	0.902
10yr-24h-SCS	2:00:00	0.902
10yr-24h-SCS	2:15:00	1.066
10yr-24h-SCS	2:30:00	1.066

POST-DEVELOPMENT MODEL - 100Y 24H SCS

10yr-24h-SCS	2:45:00	1.066
10yr-24h-SCS	3:00:00	1.066
10yr-24h-SCS	3:15:00	1.066
10yr-24h-SCS	3:30:00	1.066
10yr-24h-SCS	3:45:00	1.066
10yr-24h-SCS	4:00:00	1.066
10yr-24h-SCS	4:15:00	1.312
10yr-24h-SCS	4:30:00	1.312
10yr-24h-SCS	4:45:00	1.312
10yr-24h-SCS	5:00:00	1.312
10yr-24h-SCS	5:15:00	1.312
10yr-24h-SCS	5:30:00	1.312
10yr-24h-SCS	5:45:00	1.312
10yr-24h-SCS	6:00:00	1.312
10yr-24h-SCS	6:15:00	1.476
10yr-24h-SCS	6:30:00	1.476
10yr-24h-SCS	6:45:00	1.476
10yr-24h-SCS	7:00:00	1.476
10yr-24h-SCS	7:15:00	1.804
10yr-24h-SCS	7:30:00	1.804
10yr-24h-SCS	7:45:00	1.804
10yr-24h-SCS	8:00:00	1.804
10yr-24h-SCS	8:15:00	2.132
10yr-24h-SCS	8:30:00	2.132
10yr-24h-SCS	8:45:00	2.296
10yr-24h-SCS	9:00:00	2.296
10yr-24h-SCS	9:15:00	2.624
10yr-24h-SCS	9:30:00	2.624
10yr-24h-SCS	9:45:00	2.952
10yr-24h-SCS	10:00:00	2.952
10yr-24h-SCS	10:15:00	3.772
10yr-24h-SCS	10:30:00	3.772
10yr-24h-SCS	10:45:00	5.084
10yr-24h-SCS	11:00:00	5.084
10yr-24h-SCS	11:15:00	7.872
10yr-24h-SCS	11:30:00	7.872
10yr-24h-SCS	11:45:00	24.272
10yr-24h-SCS	12:00:00	100.368

POST-DEVELOPMENT MODEL - 100Y 24H SCS

10yr-24h-SCS	12:15:00	11.808
10yr-24h-SCS	12:30:00	11.808
10yr-24h-SCS	12:45:00	6.068
10yr-24h-SCS	13:00:00	6.068
10yr-24h-SCS	13:15:00	4.428
10yr-24h-SCS	13:30:00	4.428
10yr-24h-SCS	13:45:00	3.444
10yr-24h-SCS	14:00:00	3.444
10yr-24h-SCS	14:15:00	2.46
10yr-24h-SCS	14:30:00	2.46
10yr-24h-SCS	14:45:00	2.46
10yr-24h-SCS	15:00:00	2.46
10yr-24h-SCS	15:15:00	2.46
10yr-24h-SCS	15:30:00	2.46
10yr-24h-SCS	15:45:00	2.46
10yr-24h-SCS	16:00:00	2.46
10yr-24h-SCS	16:15:00	1.476
10yr-24h-SCS	16:30:00	1.476
10yr-24h-SCS	16:45:00	1.476
10yr-24h-SCS	17:00:00	1.476
10yr-24h-SCS	17:15:00	1.476
10yr-24h-SCS	17:30:00	1.476
10yr-24h-SCS	17:45:00	1.476
10yr-24h-SCS	18:00:00	1.476
10yr-24h-SCS	18:15:00	1.476
10yr-24h-SCS	18:30:00	1.476
10yr-24h-SCS	18:45:00	1.476
10yr-24h-SCS	19:00:00	1.476
10yr-24h-SCS	19:15:00	1.476
10yr-24h-SCS	19:30:00	1.476
10yr-24h-SCS	19:45:00	1.476
10yr-24h-SCS	20:00:00	1.476
10yr-24h-SCS	20:15:00	0.984
10yr-24h-SCS	20:30:00	0.984
10yr-24h-SCS	20:45:00	0.984
10yr-24h-SCS	21:00:00	0.984
10yr-24h-SCS	21:15:00	0.984
10yr-24h-SCS	21:30:00	0.984

10yr-24h-SCS	21:45:00	0.984
10yr-24h-SCS	22:00:00	0.984
10yr-24h-SCS	22:15:00	0.984
10yr-24h-SCS	22:30:00	0.984
10yr-24h-SCS	22:45:00	0.984
10yr-24h-SCS	23:00:00	0.984
10yr-24h-SCS	23:15:00	0.984
10yr-24h-SCS	23:30:00	0.984
10yr-24h-SCS	23:45:00	0.984
10yr-24h-SCS	24:00:00	0

25mm-Chicago	0:10	1.516088055
25mm-Chicago	0:20	1.749115351
25mm-Chicago	0:30	2.078715445
25mm-Chicago	0:40	2.583625152
25mm-Chicago	0:50	3.461716789
25mm-Chicago	1:00	5.394996968
25mm-Chicago	1:10	13.44811663
25mm-Chicago	1:20	56.72433275
25mm-Chicago	1:30	17.78358976
25mm-Chicago	1:40	9.131254948
25mm-Chicago	1:50	6.147712357
25mm-Chicago	2:00	4.655383456
25mm-Chicago	2:10	3.762897479
25mm-Chicago	2:20	3.169361772
25mm-Chicago	2:30	2.745825503
25mm-Chicago	2:40	2.428071751
25mm-Chicago	2:50	2.180598417
25mm-Chicago	3:00	1.982179574
25mm-Chicago	3:10	1.819403154
25mm-Chicago	3:20	1.683310546
25mm-Chicago	3:30	1.567742242
25mm-Chicago	3:40	1.468311255
25mm-Chicago	3:50	1.381797508
25mm-Chicago	4:00	1.305793328

2yr-12hr-SCS	0:00:00	1.0775
2yr-12hr-SCS	0:15:00	1.0775

2yr-12hr-SCS	0:30:00	1.0775
2yr-12hr-SCS	0:45:00	1.0775
2yr-12hr-SCS	1:00:00	1.0775
2yr-12hr-SCS	1:15:00	1.0775
2yr-12hr-SCS	1:30:00	1.0775
2yr-12hr-SCS	1:45:00	1.0775
2yr-12hr-SCS	2:00:00	1.0775
2yr-12hr-SCS	2:15:00	1.2930
2yr-12hr-SCS	2:30:00	1.2930
2yr-12hr-SCS	2:45:00	1.2930
2yr-12hr-SCS	3:00:00	1.2930
2yr-12hr-SCS	3:15:00	1.7240
2yr-12hr-SCS	3:30:00	1.7240
2yr-12hr-SCS	3:45:00	1.7240
2yr-12hr-SCS	4:00:00	1.7240
2yr-12hr-SCS	4:15:00	2.5860
2yr-12hr-SCS	4:30:00	2.5860
2yr-12hr-SCS	4:45:00	3.4480
2yr-12hr-SCS	5:00:00	3.4480
2yr-12hr-SCS	5:15:00	5.1720
2yr-12hr-SCS	5:30:00	5.1720
2yr-12hr-SCS	5:45:00	20.6880
2yr-12hr-SCS	6:00:00	56.8920
2yr-12hr-SCS	6:15:00	7.7580
2yr-12hr-SCS	6:30:00	7.7580
2yr-12hr-SCS	6:45:00	3.4480
2yr-12hr-SCS	7:00:00	3.4480
2yr-12hr-SCS	7:15:00	2.5860
2yr-12hr-SCS	7:30:00	2.5860
2yr-12hr-SCS	7:45:00	2.5860
2yr-12hr-SCS	8:00:00	2.5860
2yr-12hr-SCS	8:15:00	1.5085
2yr-12hr-SCS	8:30:00	1.5085
2yr-12hr-SCS	8:45:00	1.5085
2yr-12hr-SCS	9:00:00	1.5085
2yr-12hr-SCS	9:15:00	1.5085
2yr-12hr-SCS	9:30:00	1.5085
2yr-12hr-SCS	9:45:00	1.5085

2yr-12hr-SCS	10:00:00	1.5085
2yr-12hr-SCS	10:15:00	0.8620
2yr-12hr-SCS	10:30:00	0.8620
2yr-12hr-SCS	10:45:00	0.8620
2yr-12hr-SCS	11:00:00	0.8620
2yr-12hr-SCS	11:15:00	0.8620
2yr-12hr-SCS	11:30:00	0.8620
2yr-12hr-SCS	11:45:00	0.8620
2yr-12hr-SCS	12:00:00	0.8620
2yr-1hr-AES	0:00:00	0.0000
2yr-1hr-AES	0:05:00	24.4800
2yr-1hr-AES	0:10:00	34.2720
2yr-1hr-AES	0:15:00	41.6160
2yr-1hr-AES	0:20:00	29.3760
2yr-1hr-AES	0:25:00	34.2720
2yr-1hr-AES	0:30:00	19.5840
2yr-1hr-AES	0:35:00	26.9280
2yr-1hr-AES	0:40:00	14.6880
2yr-1hr-AES	0:45:00	9.7920
2yr-1hr-AES	0:50:00	7.3440
2yr-1hr-AES	0:55:00	2.4480
2yr-1hr-AES	1:00:00	0.0000
2yr-24hr-SCS	0:00:00	0.5841
2yr-24hr-SCS	0:15:00	0.5841
2yr-24hr-SCS	0:30:00	0.5841
2yr-24hr-SCS	0:45:00	0.5841
2yr-24hr-SCS	1:00:00	0.5841
2yr-24hr-SCS	1:15:00	0.5841
2yr-24hr-SCS	1:30:00	0.5841
2yr-24hr-SCS	1:45:00	0.5841
2yr-24hr-SCS	2:00:00	0.5841
2yr-24hr-SCS	2:15:00	0.6903
2yr-24hr-SCS	2:30:00	0.6903
2yr-24hr-SCS	2:45:00	0.6903
2yr-24hr-SCS	3:00:00	0.6903
2yr-24hr-SCS	3:15:00	0.6903

2yr-24hr-SCS	3:30:00	0.6903
2yr-24hr-SCS	3:45:00	0.6903
2yr-24hr-SCS	4:00:00	0.6903
2yr-24hr-SCS	4:15:00	0.8496
2yr-24hr-SCS	4:30:00	0.8496
2yr-24hr-SCS	4:45:00	0.8496
2yr-24hr-SCS	5:00:00	0.8496
2yr-24hr-SCS	5:15:00	0.8496
2yr-24hr-SCS	5:30:00	0.8496
2yr-24hr-SCS	5:45:00	0.8496
2yr-24hr-SCS	6:00:00	0.8496
2yr-24hr-SCS	6:15:00	0.9558
2yr-24hr-SCS	6:30:00	0.9558
2yr-24hr-SCS	6:45:00	0.9558
2yr-24hr-SCS	7:00:00	0.9558
2yr-24hr-SCS	7:15:00	1.1682
2yr-24hr-SCS	7:30:00	1.1682
2yr-24hr-SCS	7:45:00	1.1682
2yr-24hr-SCS	8:00:00	1.1682
2yr-24hr-SCS	8:15:00	1.3806
2yr-24hr-SCS	8:30:00	1.3806
2yr-24hr-SCS	8:45:00	1.4868
2yr-24hr-SCS	9:00:00	1.4868
2yr-24hr-SCS	9:15:00	1.6992
2yr-24hr-SCS	9:30:00	1.6992
2yr-24hr-SCS	9:45:00	1.9116
2yr-24hr-SCS	10:00:00	1.9116
2yr-24hr-SCS	10:15:00	2.4426
2yr-24hr-SCS	10:30:00	2.4426
2yr-24hr-SCS	10:45:00	3.2922
2yr-24hr-SCS	11:00:00	3.2922
2yr-24hr-SCS	11:15:00	5.0976
2yr-24hr-SCS	11:30:00	5.0976
2yr-24hr-SCS	11:45:00	15.7176
2yr-24hr-SCS	12:00:00	64.9944
2yr-24hr-SCS	12:15:00	7.6464
2yr-24hr-SCS	12:30:00	7.6464
2yr-24hr-SCS	12:45:00	3.9294

2yr-24hr-SCS	13:00:00	3.9294
2yr-24hr-SCS	13:15:00	2.8674
2yr-24hr-SCS	13:30:00	2.8674
2yr-24hr-SCS	13:45:00	2.2302
2yr-24hr-SCS	14:00:00	2.2302
2yr-24hr-SCS	14:15:00	1.593
2yr-24hr-SCS	14:30:00	1.593
2yr-24hr-SCS	14:45:00	1.593
2yr-24hr-SCS	15:00:00	1.593
2yr-24hr-SCS	15:15:00	1.593
2yr-24hr-SCS	15:30:00	1.593
2yr-24hr-SCS	15:45:00	1.593
2yr-24hr-SCS	16:00:00	1.593
2yr-24hr-SCS	16:15:00	0.9558
2yr-24hr-SCS	16:30:00	0.9558
2yr-24hr-SCS	16:45:00	0.9558
2yr-24hr-SCS	17:00:00	0.9558
2yr-24hr-SCS	17:15:00	0.9558
2yr-24hr-SCS	17:30:00	0.9558
2yr-24hr-SCS	17:45:00	0.9558
2yr-24hr-SCS	18:00:00	0.9558
2yr-24hr-SCS	18:15:00	0.9558
2yr-24hr-SCS	18:30:00	0.9558
2yr-24hr-SCS	18:45:00	0.9558
2yr-24hr-SCS	19:00:00	0.9558
2yr-24hr-SCS	19:15:00	0.9558
2yr-24hr-SCS	19:30:00	0.9558
2yr-24hr-SCS	19:45:00	0.9558
2yr-24hr-SCS	20:00:00	0.9558
2yr-24hr-SCS	20:15:00	0.6372
2yr-24hr-SCS	20:30:00	0.6372
2yr-24hr-SCS	20:45:00	0.6372
2yr-24hr-SCS	21:00:00	0.6372
2yr-24hr-SCS	21:15:00	0.6372
2yr-24hr-SCS	21:30:00	0.6372
2yr-24hr-SCS	21:45:00	0.6372
2yr-24hr-SCS	22:00:00	0.6372
2yr-24hr-SCS	22:15:00	0.6372

2yr-24hr-SCS	22:30:00	0.6372
2yr-24hr-SCS	22:45:00	0.6372
2yr-24hr-SCS	23:00:00	0.6372
2yr-24hr-SCS	23:15:00	0.6372
2yr-24hr-SCS	23:30:00	0.6372
2yr-24hr-SCS	23:45:00	0.6372
2yr-24hr-SCS	24:00:00	0

5yr-12hr-SCS	0:00:00	1.4325
5yr-12hr-SCS	0:15:00	1.4325
5yr-12hr-SCS	0:30:00	1.4325
5yr-12hr-SCS	0:45:00	1.4325
5yr-12hr-SCS	1:00:00	1.4325
5yr-12hr-SCS	1:15:00	1.4325
5yr-12hr-SCS	1:30:00	1.4325
5yr-12hr-SCS	1:45:00	1.4325
5yr-12hr-SCS	2:00:00	1.4325
5yr-12hr-SCS	2:15:00	1.7190
5yr-12hr-SCS	2:30:00	1.7190
5yr-12hr-SCS	2:45:00	1.7190
5yr-12hr-SCS	3:00:00	1.7190
5yr-12hr-SCS	3:15:00	2.2920
5yr-12hr-SCS	3:30:00	2.2920
5yr-12hr-SCS	3:45:00	2.2920
5yr-12hr-SCS	4:00:00	2.2920
5yr-12hr-SCS	4:15:00	3.4380
5yr-12hr-SCS	4:30:00	3.4380
5yr-12hr-SCS	4:45:00	4.5840
5yr-12hr-SCS	5:00:00	4.5840
5yr-12hr-SCS	5:15:00	6.8760
5yr-12hr-SCS	5:30:00	6.8760
5yr-12hr-SCS	5:45:00	27.5040
5yr-12hr-SCS	6:00:00	75.6360
5yr-12hr-SCS	6:15:00	10.3140
5yr-12hr-SCS	6:30:00	10.3140
5yr-12hr-SCS	6:45:00	4.5840
5yr-12hr-SCS	7:00:00	4.5840
5yr-12hr-SCS	7:15:00	3.4380

5yr-12hr-SCS	7:30:00	3.4380
5yr-12hr-SCS	7:45:00	3.4380
5yr-12hr-SCS	8:00:00	3.4380
5yr-12hr-SCS	8:15:00	2.0055
5yr-12hr-SCS	8:30:00	2.0055
5yr-12hr-SCS	8:45:00	2.0055
5yr-12hr-SCS	9:00:00	2.0055
5yr-12hr-SCS	9:15:00	2.0055
5yr-12hr-SCS	9:30:00	2.0055
5yr-12hr-SCS	9:45:00	2.0055
5yr-12hr-SCS	10:00:00	2.0055
5yr-12hr-SCS	10:15:00	1.1460
5yr-12hr-SCS	10:30:00	1.1460
5yr-12hr-SCS	10:45:00	1.1460
5yr-12hr-SCS	11:00:00	1.1460
5yr-12hr-SCS	11:15:00	1.1460
5yr-12hr-SCS	11:30:00	1.1460
5yr-12hr-SCS	11:45:00	1.1460
5yr-12hr-SCS	12:00:00	1.1460
5yr-1hr-AES	0:00:00	0.0000
5yr-1hr-AES	0:05:00	32.5200
5yr-1hr-AES	0:10:00	45.5280
5yr-1hr-AES	0:15:00	55.2840
5yr-1hr-AES	0:20:00	39.0240
5yr-1hr-AES	0:25:00	45.5280
5yr-1hr-AES	0:30:00	26.0160
5yr-1hr-AES	0:35:00	35.7720
5yr-1hr-AES	0:40:00	19.5120
5yr-1hr-AES	0:45:00	13.0080
5yr-1hr-AES	0:50:00	9.7560
5yr-1hr-AES	0:55:00	3.2520
5yr-1hr-AES	1:00:00	0.0000
5yr-24hr-SCS	0:00:00	0.7755
5yr-24hr-SCS	0:15:00	0.7755
5yr-24hr-SCS	0:30:00	0.7755
5yr-24hr-SCS	0:45:00	0.7755

5yr-24hr-SCS	1:00:00	0.7755
5yr-24hr-SCS	1:15:00	0.7755
5yr-24hr-SCS	1:30:00	0.7755
5yr-24hr-SCS	1:45:00	0.7755
5yr-24hr-SCS	2:00:00	0.7755
5yr-24hr-SCS	2:15:00	0.9165
5yr-24hr-SCS	2:30:00	0.9165
5yr-24hr-SCS	2:45:00	0.9165
5yr-24hr-SCS	3:00:00	0.9165
5yr-24hr-SCS	3:15:00	0.9165
5yr-24hr-SCS	3:30:00	0.9165
5yr-24hr-SCS	3:45:00	0.9165
5yr-24hr-SCS	4:00:00	0.9165
5yr-24hr-SCS	4:15:00	1.128
5yr-24hr-SCS	4:30:00	1.128
5yr-24hr-SCS	4:45:00	1.128
5yr-24hr-SCS	5:00:00	1.128
5yr-24hr-SCS	5:15:00	1.128
5yr-24hr-SCS	5:30:00	1.128
5yr-24hr-SCS	5:45:00	1.128
5yr-24hr-SCS	6:00:00	1.128
5yr-24hr-SCS	6:15:00	1.269
5yr-24hr-SCS	6:30:00	1.269
5yr-24hr-SCS	6:45:00	1.269
5yr-24hr-SCS	7:00:00	1.269
5yr-24hr-SCS	7:15:00	1.551
5yr-24hr-SCS	7:30:00	1.551
5yr-24hr-SCS	7:45:00	1.551
5yr-24hr-SCS	8:00:00	1.551
5yr-24hr-SCS	8:15:00	1.833
5yr-24hr-SCS	8:30:00	1.833
5yr-24hr-SCS	8:45:00	1.974
5yr-24hr-SCS	9:00:00	1.974
5yr-24hr-SCS	9:15:00	2.256
5yr-24hr-SCS	9:30:00	2.256
5yr-24hr-SCS	9:45:00	2.538
5yr-24hr-SCS	10:00:00	2.538
5yr-24hr-SCS	10:15:00	3.243

```
5yr-24hr-SCS                 10:30:00   3.243
5yr-24hr-SCS                 10:45:00   4.371
5yr-24hr-SCS                 11:00:00   4.371
5yr-24hr-SCS                 11:15:00   6.768
5yr-24hr-SCS                 11:30:00   6.768
5yr-24hr-SCS                 11:45:00   20.868
5yr-24hr-SCS                 12:00:00   86.292
5yr-24hr-SCS                 12:15:00   10.152
5yr-24hr-SCS                 12:30:00   10.152
5yr-24hr-SCS                 12:45:00   5.217
5yr-24hr-SCS                 13:00:00   5.217
5yr-24hr-SCS                 13:15:00   3.807
5yr-24hr-SCS                 13:30:00   3.807
5yr-24hr-SCS                 13:45:00   2.961
5yr-24hr-SCS                 14:00:00   2.961
5yr-24hr-SCS                 14:15:00   2.115
5yr-24hr-SCS                 14:30:00   2.115
5yr-24hr-SCS                 14:45:00   2.115
5yr-24hr-SCS                 15:00:00   2.115
5yr-24hr-SCS                 15:15:00   2.115
5yr-24hr-SCS                 15:30:00   2.115
5yr-24hr-SCS                 15:45:00   2.115
5yr-24hr-SCS                 16:00:00   2.115
5yr-24hr-SCS                 16:15:00   1.269
5yr-24hr-SCS                 16:30:00   1.269
5yr-24hr-SCS                 16:45:00   1.269
5yr-24hr-SCS                 17:00:00   1.269
5yr-24hr-SCS                 17:15:00   1.269
5yr-24hr-SCS                 17:30:00   1.269
5yr-24hr-SCS                 17:45:00   1.269
5yr-24hr-SCS                 18:00:00   1.269
5yr-24hr-SCS                 18:15:00   1.269
5yr-24hr-SCS                 18:30:00   1.269
5yr-24hr-SCS                 18:45:00   1.269
5yr-24hr-SCS                 19:00:00   1.269
5yr-24hr-SCS                 19:15:00   1.269
5yr-24hr-SCS                 19:30:00   1.269
5yr-24hr-SCS                 19:45:00   1.269
```



```
5yr-24hr-SCS                 20:00:00   1.269
5yr-24hr-SCS                 20:15:00   0.846
5yr-24hr-SCS                 20:30:00   0.846
5yr-24hr-SCS                 20:45:00   0.846
5yr-24hr-SCS                 21:00:00   0.846
5yr-24hr-SCS                 21:15:00   0.846
5yr-24hr-SCS                 21:30:00   0.846
5yr-24hr-SCS                 21:45:00   0.846
5yr-24hr-SCS                 22:00:00   0.846
5yr-24hr-SCS                 22:15:00   0.846
5yr-24hr-SCS                 22:30:00   0.846
5yr-24hr-SCS                 22:45:00   0.846
5yr-24hr-SCS                 23:00:00   0.846
5yr-24hr-SCS                 23:15:00   0.846
5yr-24hr-SCS                 23:30:00   0.846
5yr-24hr-SCS                 23:45:00   0.846
5yr-24hr-SCS                 24:00:00   0

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

[TAGS]
Node       EastWatercourse2 MN
Node       100              MN
Node       100A             MN
Node       100D             MN
Node       101              MN
Node       102              MN
Node       103              MN
Node       103A             MN
Node       104              MN
Node       104A             MN
Node       105              MN
```

```
Node       107             MN
Node       108             MN
Node       109             MN
Node       110             MN
Node       111             MN
Link       103AA-100A      MJ
Link       104AA-103AA     MJ
Link       105A-100A       MJ
Link       109A-105A       MJ
Link       111B-104AA      MJ
Link       C100A-FOREBAY   MJ
Link       Overflow_Spillway MJ

[MAP]
DIMENSIONS       443495.5969      4938549.13715    443831.4951      4938912.41985
UNITS            Meters

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
EastWatercourse1 443594.139         4938842.255
EastWatercourse2 443613.173         4938855.201
EastWatercourse3 443627.964         4938862.45
ParkedaleAvenue  443746.086         4938620.361
WestWatercourse1 443510.865         4938746.539
WestWatercourse2 443642.428         4938609.69
100              443741.259         4938869.941
100A             443722.662         4938868.137
100D             443638.867         4938824.646
101              443759.265         4938851.305
102              443659.198         4938767.921
103              443647.396         4938760.404
103A             443638.762         4938753.205
104              443686.801         4938704.766
104A             443675.163         4938694.897
105              443725.096         4938736.552
107              443697.388         4938674.085
108              443715.238         4938652.672
```



```
109              443743.633         4938676.345
110              443722.397         4938628.296
111              443680.006         4938593.068
C100A-S-Fut      443672.074         4938773.985
C103AA-S-Fut     443621.882         4938735.009
C104AA-S-Fut     443656.295         4938682.334
C105A-S          443714.566         4938735.315
C105B-S          443726.44          4938732.666
C109A-S          443740.858         4938666.557
C109B-S          443763.821         4938651.016
C111A-S          443678.936         4938596.336
C111B-S          443697.267         4938612.084
FOREBAY          443703.169         4938858.118
POND             443663.51          4938822.119

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
100A-FOREBAY     443712.46          4938866.484
103AA-100A       443625.212         4938745.532
103AA-100A       443662.901         4938776.001
104AA-103AA      443662.241         4938691.717
104AA-103AA      443681.942         4938708.266
104AA-103AA      443648.298         4938751.613
104AA-103AA      443631.9           4938739.929
105A-100A        443689.245         4938714.07
105A-100A        443656.349         4938757.848
105A-100A        443668.571         4938768.237
109A-105A        443726.714         4938660.832
109A-105A        443716.167         4938660.854
109A-105A        443702.352         4938676.883
109A-105A        443699.237         4938693.28
109A-105A        443693.989         4938706.891
109A-105A        443716.249         4938725.502
111B-104AA       443704.014         4938619.875
111B-104AA       443704.704         4938632.561
111B-104AA       443698.361         4938640.329
111B-104AA       443697.417         4938646.642
```

```
111B-104AA       443701.038        4938652.376
111B-104AA       443700.736        4938665.957
111B-104AA       443694.6          4938675.312
111B-104AA       443691.381        4938693.519
111B-104AA       443684.44         4938698.046
111B-104AA       443678.304        4938696.235
111B-104AA       443663.818        4938684.566
C100A-FOREBAY    443762.953        4938851.019
C100A-FOREBAY    443742.593        4938872.317
C100A-FOREBAY    443711.725        4938868.47
C100A-FOREBAY    443703.656        4938861.527
Overflow_Spillway 443648.755        4938834.679
C105A-O2         443719.694        4938738.035
C109A-O2         443740.425        4938671.288
C109B-W          443760.759        4938651.38
C109B-W          443745.538        4938670.479
POND-O2          443650.655        4938819.263

[POLYGONS]
;;Subcatchment   X-Coord            Y-Coord
;;-------------- ------------------ ------------------
C100A            443651.03          4938758.078
C100A            443640.854         4938771.606
C100A            443647.603         4938777.097
C100A            443662.817         4938794.153
C100A            443698.321         4938823.635
C100A            443722.484         4938840.249
C100A            443750.391         4938869.133
C100A            443794.7           4938847.622
C100A            443762.82          4938781.555
C100A            443769.891         4938768.127
C100A            443760.722         4938769.151
C100A            443751.824         4938769.954
C100A            443742.39          4938778.993
C100A            443682.46          4938729.944
C100A            443688.97          4938720.497
C100A            443685.155         4938712.408
C100A            443668.577         4938735.94
```



```
C100A            443651.03          4938758.078
C103AA           443636.738         4938776.309
C103AA           443640.854         4938771.606
C103AA           443651.03          4938758.078
C103AA           443668.577         4938735.94
C103AA           443685.155         4938712.408
C103AA           443670.289         4938719.463
C103AA           443626.464         4938682.324
C103AA           443650.432         4938654.301
C103AA           443636.111         4938642.494
C103AA           443620.41          4938658.184
C103AA           443612.096         4938673.243
C103AA           443604.257         4938687.805
C103AA           443536.784         4938630.554
C103AA           443525.467         4938649.231
C103AA           443565.205         4938721.447
C103AA           443627.289         4938773.214
C103AA           443634.54          4938779.267
C103AA           443636.738         4938776.309
C104AA           443725.867         4938627.834
C104AA           443717.92          4938625.664
C104AA           443704.002         4938622.111
C104AA           443695.149         4938627.524
C104AA           443686.653         4938620.44
C104AA           443687.628         4938619.27
C104AA           443683.66          4938615.962
C104AA           443680.254         4938613.122
C104AA           443679.278         4938614.292
C104AA           443672.616         4938608.738
C104AA           443657.373         4938606.635
C104AA           443655.118         4938609.34
C104AA           443636.111         4938642.494
C104AA           443650.432         4938654.301
C104AA           443626.464         4938682.324
C104AA           443670.289         4938719.463
C104AA           443685.155         4938712.408
C104AA           443695.998         4938693.48
C104AA           443696.028         4938693.384
```

POST-DEVELOPMENT MODEL - 100Y 24H SCS

C104AA	443696.057	4938693.288
C104AA	443696.086	4938693.192
C104AA	443696.115	4938693.096
C104AA	443696.143	4938693
C104AA	443696.172	4938692.904
C104AA	443696.2	4938692.808
C104AA	443696.228	4938692.711
C104AA	443696.256	4938692.615
C104AA	443696.284	4938692.519
C104AA	443696.312	4938692.422
C104AA	443696.339	4938692.326
C104AA	443696.367	4938692.229
C104AA	443696.394	4938692.133
C104AA	443696.421	4938692.036
C104AA	443696.448	4938691.939
C104AA	443696.474	4938691.843
C104AA	443696.501	4938691.746
C104AA	443696.527	4938691.649
C104AA	443696.554	4938691.552
C104AA	443696.58	4938691.455
C104AA	443696.606	4938691.358
C104AA	443696.631	4938691.261
C104AA	443696.657	4938691.164
C104AA	443696.682	4938691.067
C104AA	443696.708	4938690.97
C104AA	443696.733	4938690.873
C104AA	443696.758	4938690.776
C104AA	443696.783	4938690.679
C104AA	443696.807	4938690.581
C104AA	443696.832	4938690.484
C104AA	443696.856	4938690.387
C104AA	443696.88	4938690.289
C104AA	443696.904	4938690.192
C104AA	443696.928	4938690.094
C104AA	443696.952	4938689.997
C104AA	443696.975	4938689.899
C104AA	443696.998	4938689.802
C104AA	443697.021	4938689.704

POST-DEVELOPMENT MODEL - 100Y 24H SCS

C104AA	443697.044	4938689.607
C104AA	443697.067	4938689.509
C104AA	443697.09	4938689.411
C104AA	443697.113	4938689.313
C104AA	443697.135	4938689.216
C104AA	443697.157	4938689.118
C104AA	443697.179	4938689.02
C104AA	443697.201	4938688.922
C104AA	443697.223	4938688.824
C104AA	443697.244	4938688.726
C104AA	443697.266	4938688.628
C104AA	443697.287	4938688.53
C104AA	443697.308	4938688.432
C104AA	443697.329	4938688.334
C104AA	443697.349	4938688.235
C104AA	443697.37	4938688.137
C104AA	443697.39	4938688.039
C104AA	443697.411	4938687.941
C104AA	443697.431	4938687.842
C104AA	443697.451	4938687.744
C104AA	443697.47	4938687.646
C104AA	443697.49	4938687.547
C104AA	443697.509	4938687.449
C104AA	443697.529	4938687.35
C104AA	443697.548	4938687.252
C104AA	443697.567	4938687.153
C104AA	443697.585	4938687.055
C104AA	443697.604	4938686.956
C104AA	443697.622	4938686.858
C104AA	443697.641	4938686.759
C104AA	443697.659	4938686.66
C104AA	443697.677	4938686.562
C104AA	443697.694	4938686.463
C104AA	443697.712	4938686.364
C104AA	443697.729	4938686.265
C104AA	443697.747	4938686.166
C104AA	443697.764	4938686.068
C104AA	443697.781	4938685.969

POST-DEVELOPMENT MODEL - 100Y 24H SCS

C104AA	443697.798	4938685.87
C104AA	443697.814	4938685.771
C104AA	443697.831	4938685.672
C104AA	443697.847	4938685.573
C104AA	443697.863	4938685.474
C104AA	443697.879	4938685.375
C104AA	443697.895	4938685.276
C104AA	443697.91	4938685.177
C104AA	443697.926	4938685.077
C104AA	443697.941	4938684.978
C104AA	443697.956	4938684.879
C104AA	443697.971	4938684.78
C104AA	443697.986	4938684.681
C104AA	443698.001	4938684.581
C104AA	443698.015	4938684.482
C104AA	443698.03	4938684.383
C104AA	443698.044	4938684.283
C104AA	443698.058	4938684.184
C104AA	443698.072	4938684.085
C104AA	443698.085	4938683.985
C104AA	443698.099	4938683.886
C104AA	443698.112	4938683.786
C104AA	443698.125	4938683.687
C104AA	443698.138	4938683.587
C104AA	443698.151	4938683.488
C104AA	443698.164	4938683.388
C104AA	443698.176	4938683.289
C104AA	443698.188	4938683.189
C104AA	443698.201	4938683.09
C104AA	443698.213	4938682.99
C104AA	443698.224	4938682.89
C104AA	443698.236	4938682.791
C104AA	443698.248	4938682.691
C104AA	443698.259	4938682.591
C104AA	443698.27	4938682.492
C104AA	443698.281	4938682.392
C104AA	443698.292	4938682.292
C104AA	443698.303	4938682.193

POST-DEVELOPMENT MODEL - 100Y 24H SCS

C104AA	443698.313	4938682.093
C104AA	443698.323	4938681.993
C104AA	443698.334	4938681.893
C104AA	443698.344	4938681.793
C104AA	443698.353	4938681.693
C104AA	443698.363	4938681.594
C104AA	443698.373	4938681.494
C104AA	443698.382	4938681.394
C104AA	443698.391	4938681.294
C104AA	443698.4	4938681.194
C104AA	443698.409	4938681.094
C104AA	443698.418	4938680.994
C104AA	443698.426	4938680.894
C104AA	443698.434	4938680.794
C104AA	443698.443	4938680.694
C104AA	443698.451	4938680.594
C104AA	443698.459	4938680.494
C104AA	443698.466	4938680.394
C104AA	443698.474	4938680.294
C104AA	443698.481	4938680.194
C104AA	443698.488	4938680.094
C104AA	443698.495	4938679.994
C104AA	443698.502	4938679.894
C104AA	443698.509	4938679.794
C104AA	443698.515	4938679.693
C104AA	443698.522	4938679.593
C104AA	443698.528	4938679.493
C104AA	443698.534	4938679.393
C104AA	443698.54	4938679.293
C104AA	443698.545	4938679.193
C104AA	443698.551	4938679.093
C104AA	443698.556	4938678.992
C104AA	443698.561	4938678.892
C104AA	443698.566	4938678.792
C104AA	443698.571	4938678.692
C104AA	443698.576	4938678.591
C104AA	443698.58	4938678.491
C104AA	443698.585	4938678.391

POST-DEVELOPMENT MODEL - 100Y 24H SCS

C104AA	443698.589	4938678.291
C104AA	443698.593	4938678.191
C104AA	443700.611	4938674.147
C104AA	443718.122	4938653.117
C104AA	443722.297	4938638.948
C104AA	443732.538	4938627.133
C104AA	443731.547	4938623.052
C104AA	443725.867	4938627.834
C105A	443808.112	4938704.7
C105A	443794.357	4938694.358
C105A	443772.061	4938721.237
C105A	443770.216	4938733.854
C105A	443767.625	4938738.096
C105A	443772.062	4938740.807
C105A	443763.518	4938747.357
C105A	443735.407	4938723.918
C105A	443726.111	4938732.888
C105A	443732.827	4938721.767
C105A	443705.086	4938698.637
C105A	443706.397	4938695.173
C105A	443708.626	4938681.352
C105A	443709.697	4938678.061
C105A	443713.689	4938673.274
C105A	443722.298	4938661.372
C105A	443724.366	4938658.247
C105A	443718.122	4938653.117
C105A	443700.611	4938674.147
C105A	443698.593	4938678.191
C105A	443698.589	4938678.291
C105A	443698.585	4938678.391
C105A	443698.58	4938678.491
C105A	443698.576	4938678.591
C105A	443698.571	4938678.692
C105A	443698.566	4938678.792
C105A	443698.561	4938678.892
C105A	443698.556	4938678.992
C105A	443698.551	4938679.093
C105A	443698.545	4938679.193

POST-DEVELOPMENT MODEL - 100Y 24H SCS

C105A	443698.54	4938679.293
C105A	443698.534	4938679.393
C105A	443698.528	4938679.493
C105A	443698.522	4938679.593
C105A	443698.515	4938679.693
C105A	443698.509	4938679.794
C105A	443698.502	4938679.894
C105A	443698.495	4938679.994
C105A	443698.488	4938680.094
C105A	443698.481	4938680.194
C105A	443698.474	4938680.294
C105A	443698.466	4938680.394
C105A	443698.459	4938680.494
C105A	443698.451	4938680.594
C105A	443698.443	4938680.694
C105A	443698.434	4938680.794
C105A	443698.426	4938680.894
C105A	443698.418	4938680.994
C105A	443698.409	4938681.094
C105A	443698.4	4938681.194
C105A	443698.391	4938681.294
C105A	443698.382	4938681.394
C105A	443698.373	4938681.494
C105A	443698.363	4938681.594
C105A	443698.353	4938681.693
C105A	443698.344	4938681.793
C105A	443698.334	4938681.893
C105A	443698.323	4938681.993
C105A	443698.313	4938682.093
C105A	443698.303	4938682.193
C105A	443698.292	4938682.292
C105A	443698.281	4938682.392
C105A	443698.27	4938682.492
C105A	443698.259	4938682.591
C105A	443698.248	4938682.691
C105A	443698.236	4938682.791
C105A	443698.224	4938682.89
C105A	443698.213	4938682.99

POST-DEVELOPMENT MODEL - 100Y 24H SCS

C105A	443698.201	4938683.09
C105A	443698.188	4938683.189
C105A	443698.176	4938683.289
C105A	443698.164	4938683.388
C105A	443698.151	4938683.488
C105A	443698.138	4938683.587
C105A	443698.125	4938683.687
C105A	443698.112	4938683.786
C105A	443698.099	4938683.886
C105A	443698.085	4938683.985
C105A	443698.072	4938684.085
C105A	443698.058	4938684.184
C105A	443698.044	4938684.283
C105A	443698.03	4938684.383
C105A	443698.015	4938684.482
C105A	443698.001	4938684.581
C105A	443697.986	4938684.681
C105A	443697.971	4938684.78
C105A	443697.956	4938684.879
C105A	443697.941	4938684.978
C105A	443697.926	4938685.077
C105A	443697.91	4938685.177
C105A	443697.895	4938685.276
C105A	443697.879	4938685.375
C105A	443697.863	4938685.474
C105A	443697.847	4938685.573
C105A	443697.831	4938685.672
C105A	443697.814	4938685.771
C105A	443697.798	4938685.87
C105A	443697.781	4938685.969
C105A	443697.764	4938686.068
C105A	443697.747	4938686.166
C105A	443697.729	4938686.265
C105A	443697.712	4938686.364
C105A	443697.694	4938686.463
C105A	443697.677	4938686.562
C105A	443697.659	4938686.66
C105A	443697.641	4938686.759

POST-DEVELOPMENT MODEL - 100Y 24H SCS

C105A	443697.622	4938686.858
C105A	443697.604	4938686.956
C105A	443697.585	4938687.055
C105A	443697.567	4938687.153
C105A	443697.548	4938687.252
C105A	443697.529	4938687.35
C105A	443697.509	4938687.449
C105A	443697.49	4938687.547
C105A	443697.47	4938687.646
C105A	443697.451	4938687.744
C105A	443697.431	4938687.842
C105A	443697.411	4938687.941
C105A	443697.39	4938688.039
C105A	443697.37	4938688.137
C105A	443697.349	4938688.235
C105A	443697.329	4938688.334
C105A	443697.308	4938688.432
C105A	443697.287	4938688.53
C105A	443697.266	4938688.628
C105A	443697.244	4938688.726
C105A	443697.223	4938688.824
C105A	443697.201	4938688.922
C105A	443697.179	4938689.02
C105A	443697.157	4938689.118
C105A	443697.135	4938689.216
C105A	443697.113	4938689.313
C105A	443697.09	4938689.411
C105A	443697.067	4938689.509
C105A	443697.044	4938689.607
C105A	443697.021	4938689.704
C105A	443696.998	4938689.802
C105A	443696.975	4938689.899
C105A	443696.952	4938689.997
C105A	443696.928	4938690.094
C105A	443696.904	4938690.192
C105A	443696.88	4938690.289
C105A	443696.856	4938690.387
C105A	443696.832	4938690.484

POST-DEVELOPMENT MODEL - 100Y 24H SCS

C105A	443696.807	4938690.581
C105A	443696.783	4938690.679
C105A	443696.758	4938690.776
C105A	443696.733	4938690.873
C105A	443696.708	4938690.97
C105A	443696.682	4938691.067
C105A	443696.657	4938691.164
C105A	443696.631	4938691.261
C105A	443696.606	4938691.358
C105A	443696.58	4938691.455
C105A	443696.554	4938691.552
C105A	443696.527	4938691.649
C105A	443696.501	4938691.746
C105A	443696.474	4938691.843
C105A	443696.448	4938691.939
C105A	443696.421	4938692.036
C105A	443696.394	4938692.133
C105A	443696.367	4938692.229
C105A	443696.339	4938692.326
C105A	443696.312	4938692.422
C105A	443696.284	4938692.519
C105A	443696.256	4938692.615
C105A	443696.228	4938692.711
C105A	443696.2	4938692.808
C105A	443696.172	4938692.904
C105A	443696.143	4938693
C105A	443696.115	4938693.096
C105A	443696.086	4938693.192
C105A	443696.057	4938693.288
C105A	443696.028	4938693.384
C105A	443695.998	4938693.48
C105A	443685.155	4938712.408
C105A	443688.97	4938720.497
C105A	443682.46	4938729.944
C105A	443742.39	4938778.993
C105A	443751.824	4938769.954
C105A	443760.722	4938769.151
C105A	443769.891	4938768.127

C105A	443793.162	4938728.685
C105A	443808.112	4938704.7
C105B	443713.689	4938673.274
C105B	443709.697	4938678.061
C105B	443708.626	4938681.352
C105B	443706.397	4938695.173
C105B	443705.086	4938698.637
C105B	443732.827	4938721.767
C105B	443726.111	4938732.888
C105B	443735.407	4938723.918
C105B	443763.518	4938747.357
C105B	443772.062	4938740.807
C105B	443767.625	4938738.096
C105B	443770.216	4938733.854
C105B	443772.061	4938721.237
C105B	443713.689	4938673.274
C109A	443722.298	4938661.372
C109A	443713.689	4938673.274
C109A	443713.689	4938673.274
C109A	443772.061	4938721.237
C109A	443772.061	4938721.237
C109A	443794.357	4938694.358
C109A	443794.357	4938694.358
C109A	443756.244	4938661.48
C109A	443756.244	4938661.48
C109A	443748.352	4938668.137
C109A	443748.352	4938668.137
C109A	443753.572	4938659.252
C109A	443753.572	4938659.252
C109A	443732.332	4938641.543
C109A	443732.332	4938641.543
C109A	443729.181	4938636.264
C109A	443729.181	4938636.264
C109A	443737.053	4938626.699
C109A	443737.053	4938626.699
C109A	443732.538	4938627.133
C109A	443732.538	4938627.133
C109A	443722.297	4938638.948

POST-DEVELOPMENT MODEL - 100Y 24H SCS

C109A	443722.297	4938638.948
C109A	443718.122	4938653.117
C109A	443718.122	4938653.117
C109A	443724.366	4938658.247
C109A	443724.366	4938658.247
C109A	443722.298	4938661.372
C109B	443747.446	4938632.427
C109B	443740.138	4938626.781
C109B	443740.138	4938626.781
C109B	443737.053	4938626.699
C109B	443737.053	4938626.699
C109B	443729.181	4938636.264
C109B	443729.181	4938636.264
C109B	443732.332	4938641.543
C109B	443732.332	4938641.543
C109B	443753.572	4938659.252
C109B	443753.572	4938659.252
C109B	443748.352	4938668.137
C109B	443748.352	4938668.137
C109B	443756.244	4938661.48
C109B	443756.244	4938661.48
C109B	443794.357	4938694.358
C109B	443794.357	4938694.358
C109B	443808.112	4938704.7
C109B	443808.112	4938704.7
C109B	443816.227	4938690.326
C109B	443816.227	4938690.326
C109B	443781.793	4938662.267
C109B	443781.793	4938662.267
C109B	443783.832	4938658.795
C109B	443783.832	4938658.795
C109B	443755.3	4938635.005
C109B	443755.3	4938635.005
C109B	443747.446	4938632.427
C111A	443683.66	4938615.962
C111A	443703.524	4938591.837
C111A	443672.119	4938565.65
C111A	443664.858	4938578.651

POST-DEVELOPMENT MODEL - 100Y 24H SCS

C111A	443667.481	4938588.98
C111A	443663.413	4938595.108
C111A	443665.52	4938596.864
C111A	443657.373	4938606.635
C111A	443672.616	4938608.738
C111A	443679.278	4938614.292
C111A	443680.254	4938613.122
C111A	443683.66	4938615.962
C111B	443717.92	4938625.664
C111B	443725.867	4938627.834
C111B	443731.547	4938623.052
C111B	443732.493	4938616.711
C111B	443703.524	4938591.837
C111B	443683.66	4938615.962
C111B	443687.628	4938619.27
C111B	443686.653	4938620.44
C111B	443695.149	4938627.524
C111B	443704.002	4938622.111
C111B	443717.92	4938625.664
POND	443727.016	4938880.48
POND	443750.391	4938869.133
POND	443722.484	4938840.249
POND	443698.321	4938823.635
POND	443662.817	4938794.153
POND	443656.416	4938800.369
POND	443638.348	4938793.976
POND	443633.052	4938800.379
POND	443632.553	4938803.556
POND	443637.498	4938815.742
POND	443638.794	4938822.783
POND	443640.368	4938824.46
POND	443646.202	4938827.869
POND	443650.065	4938829.065
POND	443658.439	4938830.168
POND	443663.696	4938833.411
POND	443669.999	4938839.452
POND	443674.803	4938845.355
POND	443676.949	4938850.302

POST-DEVELOPMENT MODEL - 100Y 24H SCS

POND	443678.117	4938856.659
POND	443681.497	4938861.93
POND	443688.508	4938869.195
POND	443694.113	4938873.105
POND	443706.166	4938875.574
POND	443727.016	4938880.48
UNK-1	443620.41	4938658.184
UNK-1	443636.111	4938642.494
UNK-1	443636.111	4938642.494
UNK-1	443648.235	4938620.723
UNK-1	443648.235	4938620.723
UNK-1	443655.119	4938609.34
UNK-1	443655.119	4938609.34
UNK-1	443665.52	4938596.864
UNK-1	443665.52	4938596.864
UNK-1	443663.413	4938595.108
UNK-1	443663.413	4938595.108
UNK-1	443667.481	4938588.98
UNK-1	443667.481	4938588.98
UNK-1	443664.858	4938578.651
UNK-1	443664.858	4938578.651
UNK-1	443620.41	4938658.184
UNK-2	443731.547	4938623.052
UNK-2	443732.538	4938627.133
UNK-2	443732.538	4938627.133
UNK-2	443737.053	4938626.699
UNK-2	443737.053	4938626.699
UNK-2	443740.138	4938626.781
UNK-2	443740.138	4938626.781
UNK-2	443747.446	4938632.427
UNK-2	443747.446	4938632.427
UNK-2	443755.3	4938635.005
UNK-2	443755.3	4938635.005
UNK-2	443755.112	4938634.848
UNK-2	443755.112	4938634.848
UNK-2	443739.943	4938622.233
UNK-2	443739.943	4938622.233
UNK-2	443732.493	4938616.711

POST-DEVELOPMENT MODEL - 100Y 24H SCS

UNK-2	443732.493	4938616.711
UNK-2	443731.547	4938623.052
UNK-3	443618.381	4938765.786
UNK-3	443612.864	4938768.831
UNK-3	443609.255	4938774.378
UNK-3	443605.556	4938776.783
UNK-3	443600.331	4938777.661
UNK-3	443592.641	4938782.066
UNK-3	443587.244	4938778.679
UNK-3	443579.776	4938778.009
UNK-3	443574.351	4938775.429
UNK-3	443570.38	4938777.099
UNK-3	443565.488	4938775.485
UNK-3	443562.24	4938778.895
UNK-3	443555.939	4938778.797
UNK-3	443552.295	4938780.087
UNK-3	443535.456	4938711.147
UNK-3	443511.229	4938672.727
UNK-3	443525.467	4938649.231
UNK-3	443565.205	4938721.447
UNK-3	443618.381	4938765.786
UNK-4	443647.603	4938777.097
UNK-4	443640.854	4938771.606
UNK-4	443636.738	4938776.309
UNK-4	443634.54	4938779.267
UNK-4	443627.289	4938773.214
UNK-4	443618.381	4938765.786
UNK-4	443612.864	4938768.831
UNK-4	443609.255	4938774.378
UNK-4	443605.556	4938776.783
UNK-4	443600.331	4938777.661
UNK-4	443592.641	4938782.066
UNK-4	443587.244	4938778.679
UNK-4	443579.776	4938778.009
UNK-4	443574.351	4938775.429
UNK-4	443570.38	4938777.099
UNK-4	443565.488	4938775.485
UNK-4	443562.24	4938778.895

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UNK-4            443555.939         4938778.797
UNK-4            443552.295         4938780.087
UNK-4            443552.543         4938781.102
UNK-4            443598.502         4938814.247
UNK-4            443700.961         4938888.138
UNK-4            443695.239         4938895.907
UNK-4            443727.016         4938880.48
UNK-4            443706.166         4938875.574
UNK-4            443694.113         4938873.105
UNK-4            443688.508         4938869.195
UNK-4            443681.497         4938861.93
UNK-4            443678.117         4938856.659
UNK-4            443676.949         4938850.302
UNK-4            443674.803         4938845.355
UNK-4            443669.999         4938839.452
UNK-4            443663.696         4938833.411
UNK-4            443658.439         4938830.168
UNK-4            443650.065         4938829.065
UNK-4            443646.202         4938827.869
UNK-4            443640.368         4938824.46
UNK-4            443638.794         4938822.783
UNK-4            443637.498         4938815.742
UNK-4            443632.553         4938803.556
UNK-4            443632.576         4938803.405
UNK-4            443633.052         4938800.379
UNK-4            443638.348         4938793.976
UNK-4            443656.416         4938800.369
UNK-4            443662.817         4938794.153
UNK-4            443647.603         4938777.097

[SYMBOLS]
;;Gage           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
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C.3 SWM POND DESIGN CALCULATIONS

Project Name: Welling of Brockville - Site Servicing Plan
Project No.: 160401602

Water Quality Storage Requirements

SWMP ID	SWMP Type	Area (ha)	% Impervious	Protection Level	Unit Volume Requirements (m3/ha)			Specific Volume Requirements (m3)			Volume Provided (m3)	
					Total Unit Vol.	Permanent Pool	Extended Det.	Total Vol.	Permanent Pool	Extended Det.	Permanent Pool	Extended Det.
SWM Pond	Wet Pond	4.44	57.0%	Enhanced (80% TSS)	191.8	151.8	40.0	852	674	178	820	444

Water quality volume requirements per Table 3.2, Stormwater Management Planning & Design Manual (MOE, 2003)

Protection Level	SWMP Type	Storage Volume (m3/ha) for Impervious Level			
		35%	55%	70%	85%
Enhanced (80% TSS)	Infiltration	25	30	35	40
Enhanced (80% TSS)	Wetland	80	105	120	140
Enhanced (80% TSS)	Hybrid Wetlan	110	150	175	195
Enhanced (80% TSS)	Wet Pond	140	190	225	250
Normal (70% TSS)	Infiltration	20	20	25	30
Normal (70% TSS)	Wetland	60	70	80	90
Normal (70% TSS)	Hybrid Wetlan	75	90	105	120
Normal (70% TSS)	Wet Pond	90	110	130	150
Basic (60% TSS)	Infiltration	20	20	20	20
Basic (60% TSS)	Wetland	60	60	60	60
Basic (60% TSS)	Hybrid Wetlan	60	70	75	80
Basic (60% TSS)	Wet Pond	60	75	85	95
Basic (60% TSS)	Dry Pond	90	150	200	240

Project Name: Welling of Brockville - Site Servicing Plan
Project No.: 160401602

Extended Detention Drawdown Calculations

via falling head per Equation 4.10 of Stormwater Management Planning and Design Manual (MOE, 2003)

$$t = \left(h_1^{0.5} - h_0^{0.5}\right)\frac{2A_p}{CA_o(2g)^{0.5}}$$

where:
t = drawdown time (s)
h1 = starting water elevation above orifice (m)
h0 = ending water elevation above orifice (m)
Ap = pond surface area (m2) at h1
Ao = cross-sectional area of orifice (m2)
C = orifice discharge coefficient

h1 =	0.29 m			
h0 =	0.00 m			
Ap =	1688 m2			
Ao =	0.00636 m2			
C =	0.61			
t =	**29.4 hrs**		**Target**	**24-48 hrs**

via falling head per Equation 4.11 of Stormwater Management Planning and Design Manual (MOE, 2003)

$$t = \frac{0.66C_2h^{1.5} + 2C_3h^{0.5}}{2.75A_o}$$

where:
t = drawdown time (s)
C2 = slope coefficient from area-depth linear regression
C3 = intercept from area-depth linear regression
h = maximum water elevation above orifice (m)
Ao = cross-sectional area of orifice (m2)

C2 =	1095.2 m/m			
C3 =	1371.0 m2			
h =	0.29 m2			
Ao =	0.00636 m2			
t =	**25.2 hrs**		**Target**	**24-48 hrs**

Project Name: Welling of Brockville - Site Servicing Plan
Project No.: 160401602

Forebay Sizing Calculations

Settling Length per Equation 4.5 of Stormwater Management Planning and Design Manual (MOE, 2003)

$$Dist = \sqrt{\frac{rQp}{v_s}}$$

where:
Dist = Forebay Length (m)
r = Length-to-width ratio of forebay
Qp = Peak flow rate from the pond during design quality storm (m3/s)
Vs = Settling velocity (m/s)

r = 7.1 : 1
Qp = 0.009 m3/s
Vs = 0.0003 m/s
Dist = 14.3 m **Provided = 22.8 m**

Dispersion Length per Equation 4.6 of Stormwater Management Planning and Design Manual (MOE, 2003)

$$Dist = \frac{8Q}{dv_f}$$

where:
Dist = Forebay Length (m)
Q = Inlet flowrate during 5yr event (m3/s)
d = Depth of permanent pool in forebay less sediment depth
Vf = Desired forebay velocity (m/s)

Q = 0.898 m3/s
d = 0.65 m
Vf = 0.5 m/s
Dist = 22.1 m **Provided = 22.8 m**

Forebay Velocity

$$v = Q/A$$

where:
Q = Inlet flowrate during 5yr event (m3/s)
A = Forebay cross-sectional area (m2)
V = Desired forebay velocity (m/s)

Q = 0.898 m3/s
A = 6.931 m2
V = 0.13 m/s **Target <= 0.15 m/s**

Forebay Deep Zone Bottom Width per Equation 4.7 of Stormwater Management Planning and Design Manual (MOE, 2003)

$$width = Dist/8$$

where:
width = Minimum width of forebay (m)
Dist = Forebay length (m) per Equation 4.6, 4.7

Dist = 22.1 m
width = 2.8 m **Provided = 3.2 m**

Forebay Surface Area per Table 4.6 of Stormwater Management Planning and Design Manual (MOE, 2003)

$$S = SA_f/SA_{pp}$$

where:
SAf = Forebay surface area (m2) @ PP elevation
SApp = Permanent pool surface area (m2)
S = Target forebay size (%)

SAf = 369.0 m2
SApp = 1371.0 m2
S = 26.9 % **Target <= 33.3 %**

Cleanout Frequency (with reference to Table 6.3 of Stormwater Management Planning and Design Manual (MOE, 2003))

$$T_m = V_s/(L_s A_c P)$$

where:
Tm = Proposed SWMF maintenance timeframe (years)
Vs = Sediment storage volume (m3)
Ls = Sediment loading rate (m3/ha)
Ac = Pond catchment area (ha)
P = Removal efficiency = Level of Protection (%)

% Impervious	**35**	**55**	**70**	**80**
Loading (m3/ha)	0.6	1.9	2.8	3.8

Vs = 37 m3
I = 57.0% Contributing area imperviousness %
Ls = 2.068 m3/ha per year
Ac = 4.44 ha
P = 80% Enhanced (80% TSS)
Tm = 5.0 years **Target >= 5.0 years**

Project Name: Welling of Brockville - Site Servicing Plan
Project No.: 160401602

Stage Storage Calculations

Stage	Discharge	Active Storage		Depth	Forebay			Main Cell		
		Inc. Volume	Accum. Volume		Area	Inc. Volume	Accum. Volume	Area	Inc. Volume	Accum. Volume
(m)	(L/s)	(m3)	(m3)	(m)	(m2)	(m3)	(m3)	(m2)	(m3)	(m3)
106.00	0	0	0	0.00	75	0	0	344	0	0
106.10	0	0	0	0.10	92	8	8	388	37	37
106.20	0	0	0	0.20	109	10	18	433	41	78
106.30	0	0	0	0.30	125	12	30	477	46	123
106.40	0	0	0	0.40	142	13	43	522	50	173
106.50	0	0	0	0.50	176	16	59	598	56	229
106.60	0	0	0	0.60	211	19	79	673	64	293
106.70	0	0	0	0.70	245	23	102	749	71	364
106.80	0	0	0	0.80	286	27	128	834	79	443
106.90	0	0	0	0.90	327	31	159	918	88	531
107.00	0	0	0	1.00	369	35	194	1002	96	627
107.10	4	143	143	1.10	404	39	232	1076	104	730
107.20	7	154	296	1.20	439	42	274	1151	111	842
107.29	9	148	444	1.29	471	41	315	1217	107	948
107.30	9	17	461	1.30	474	5	320	1225	12	961
107.34	9	69	529	1.34	489	19	339	1255	50	1010
107.40	37	107	636	1.40	510	30	369	1299	77	1087
107.50	130	186	822	1.50	545	53	422	1373	134	1220
107.60	258	197	1020	1.60	580	56	478	1448	141	1361
107.70	413	206	1226	1.70	604	59	538	1498	147	1509
107.80	591	214	1440	1.80	628	62	599	1548	152	1661
107.84	669	88	1528	1.84	638	25	624	1568	62	1723
107.85	785	22	1550	1.85	640	6	631	1573	16	1739
107.90	0	111	1661	1.90	652	32	663	1591	79	1818
108.00	0	227	1889	2.00	676	66	730	1628	161	1979
108.10	0	233	2122	2.10	700	69	798	1665	165	2144
108.15	0	119	2241	2.15	712	35	834	1684	84	2227

Project Name: Welling of Brockville - Site Servicing Plan
Project No.: 160401602

Outlet Structure Discharge Calculations

Control ID	Control Type	Invert	Width/Dia.	Height	Coefficient	Side Slope	End Coefficient
1	Orifice (Circ.)	107.00	0.090		0.61		
2	Weir (Rect.)	107.34	1.100	0.510	1.68		
3	Weir (Trap.)	107.84	5.000	0.500	N/A	3.0	N/A

Elevation (m)	Control 1 (L/s)	Control 2 (L/s)	Control 3 (L/s)	Control 4 (L/s)	Control 5 (L/s)	Total Discharge (L/s)
107.00	0	0	0			0
107.10	4	0	0			4
107.20	7	0	0			7
107.29	9	0	0			9
107.30	9	0	0			9
107.34	9	0	0			9
107.40	10	27	0			37
107.50	12	118	0			130
107.60	13	245	0			258
107.70	14	399	0			413
107.80	15	577	0			591
107.84	15	653	0			669
107.85	15	673	97			785
107.90	16	774				
108.00	17	991				
108.10	18	1224				
108.15	18	1347				

* Calculated pond discharge rates do not consider elevated HGL at pond outlet

Appendix D – GEOTECHNICAL INVESTIGATION

Preliminary Geotechnical Investigation Report

Proposed Residential Subdivision (Wellings of Brockville)

Wellings of Brockville

3064 Parkedale Ave, Brockville, Ontario

Prepared for:
Nautical Lands General Contractors Inc. / Wellings 2019 Inc.
2962 Carp Road
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Project No. 160401602

March 2021

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1.0 INTRODUCTION

Nautical Lands General Contractors Inc. (NLGC Inc.), now Wellings 2019 Inc. has retained Stantec Consulting Ltd. (Stantec) to provide services including a geotechnical investigation and recommendations for the proposed residential subdivision (Wellings of Brockville) located at 3064 Parkedale Avenue in Brockville, Ontario.

This report presents the results of the geotechnical investigation and recommendations for design and construction of the proposed subdivision.

The work was carried out in general accordance with the scope of work for a geotechnical investigation as outlined in Stantec's proposal dated November 11, 2020.

This report has been prepared specifically and solely for the project described herein. It presents the factual results of the investigation and provides geotechnical recommendations for the design and construction for the proposed development.

Limitations associated with this report and its contents are provided in the statement of general conditions included in Appendix A.

2.0 PROJECT DESCRIPTION

2.1 PROPOSED DEVELOPMENT

The project site location is shown on the Key Plan, Drawing No. 1 in Appendix B.

The property boundaries, proposed site layout and configuration are shown on Drawing No. 2 in Appendix B which are based on the Conceptual Site Plan (dated June 2020). The proposed development includes 141 units. The development also includes a clubhouse in Phase 1. All units and the clubhouse are one-storey (without basements). The site layout also shows driveways, parking lots and a stormwater pond in the centre of the site. It is understood the site plan is in the process of being revised, the current version of the site plan proposes 148 units and the stormwater pond in the northwest corner of the site.

2.2 SITE DESCRIPTION AND BACKGROUND

The site is currently undeveloped with dense trees covering the eastern and western portion of the site. Topographic mapping was provided which indicates that the site generally slopes down towards the north. A swampy area was noted in the northwest corner of the site during the topographic survey.

Based on available information including surficial geology maps and a GEOCRES report (for Highway 401 CPR Overpass) as well as our previous project experience in the area, the stratigraphy is generally expected to consist of topsoil overlying a silty sand to sandy clay deposit overlying a sandy clay till. The depth to bedrock was found to be approximately 3 m to 6 m in the above-mentioned previous investigation.

XCG Environmental Engineers & Scientists completed a Phase I Environmental Site Assessment (dated September 8, 2020) and a Phase II Environmental Site Assessment (dated January 5, 2021). The two reports identified areas with fill materials within the western portion of the site, based on the 2003 Enhanced Phase I/II Environmental Site Assessment.

3.0 SCOPE OF WORK

The scope of work for this geotechnical investigation included the following:

- Advance nine boreholes throughout the site to characterize the subsurface conditions. Advanced boreholes to 5 m below ground surface or refusal, if shallower. If early refusal is encountered, core bedrock at two locations. If refusal is not encountered, complete dynamic cone penetration tests in two boreholes to 10 m depth. One borehole was cancelled on site due to site access.
- Complete 1 day of test pitting to delineate shallow subsurface soil and groundwater conditions at the site. Test pitting is being postponed.
- Two field percolation tests will be completed to estimate percolation rates of the soils.
- Install 7 monitoring wells.
- Characterize the soil and rock with laboratory testing.
- Prepare a Geotechnical Investigation Report for the development with a summary of the field investigation results and observations, laboratory test results, a borehole location plan, and geotechnical engineering recommendations for the design and construction o the project including:
  - Site preparation
  - Geotechnical bearing resistance values at ULS and SLS
  - Seismic design considerations including assessment of the Seismic Site classification
  - Estimated percolation rates based on the results of the percolation tests at the site
  - Frost protection recommendations
  - Excavation and backfill requirements

4.0 METHOD OF INVESTIGATION

4.1 GEOTECHNICAL FIELD INVESTIGATION

Prior to commencing the field work, public utility authorities were contacted to confirm the locations of underground utilities at the site.

Between January 12, 2021 and January 14, 2021, boreholes MW21-2 to MW21-9 were advanced, MW21-1 was cancelled on site due to site access issues. The approximate locations of the boreholes and monitoring wells are shown on Drawing No. 2 in Appendix B.

Dense trees cover the eastern and western portion of the site. Boreholes could not be advanced within the dense treed areas; borehole information is limited to the portion of the site that was accessible by drill rig.

The boreholes were advanced using a track-mounted CME drill rig. Soil samples were collected at regular intervals while conducting Standard Penetration Tests (SPT). The subsurface stratigraphy encountered in each hole was recorded in the field by Stantec personnel. A Dynamic Cone Penetration Test was carried out in borehole MW21-4. Bedrock was cored at two locations using NQ-size coring equipment. The boreholes were backfilled with auger cuttings and bentonite hole plug. Monitoring wells were installed at six locations (MW21-2, MW21-3, MW21-4, MW21-5, MW20-6 and MW21-9) to allow for the groundwater level to be measured.

All recovered soil samples and rock cores were transported to the Stantec Ottawa laboratory for detailed geotechnical classification and testing.

4.2 SURVEYING

Borehole and test pit locations were surveyed using a Trimble GPS unit with decimeter accuracy. Accuracy may be affected by satellite coverage at the time of survey. Ground surface elevations were obtained from the Survey plan by Stantec (dated December 3, 2020). Geodetic elevations at borehole and test pit locations are shown on the Borehole and Test Pit Records in Appendix C.

4.3 LABORATORY TESTING

All samples returned to the laboratory were subjected to detailed visual examination and classification by a geotechnical engineer. Selected samples were tested for moisture content and grain size analyses. Samples were submitted to Paracel Laboratories in Ottawa for pH, Sulphate content and Resistivity testing. One rock core sample were tested for intact rock core strength.

The results of the laboratory tests are discussed in the text of this report and are provided on the Borehole Records in Appendix C and the test results are provided in Appendix D.

Samples will be stored for a period of one (1) month after issuance of this report unless we are otherwise directed by the client.

5.0 RESULTS OF INVESTIGATION

5.1 SUBSURFACE INFORMATION

The subsurface profile generally consists of topsoil over silty sand to silty sand with gravel over limestone and sandstone bedrock. Possible fill was encountered at several borehole locations below the topsoil.

The subsurface conditions observed in the boreholes and test pits are presented in detail on the Borehole Records and Field Bedrock Core Logs provided in Appendix C. An explanation of the symbols and terms used to describe the Borehole Records is also provided in Appendix C.

A general overview of the soil, rock and groundwater conditions encountered in the boreholes is provided below.

5.1.1 Surficial Materials

Topsoil was encountered at ground surface in all the boreholes. The thickness of topsoil ranged from 125 mm to 600 mm. The table below outlines the topsoil thickness.

The moisture content of the topsoil ranged from 22% to 30%.

Table 5.1: Summary of Topsoil Thickness

Test Hole Location	Topsoil Thickness (mm)
MW21-2	600
MW21-3	175
MW21-4	600
MW21-5	175
MW21-6	600
BH21-7	175
BH21-8	125
MW21-9	600

5.1.2 FILL

A layer of yellow-brown to brown silty sand that was identified as possible fill material was encountered beneath the topsoil in MW21-4, MW21-5, MW21-6 and MW21-9. The thickness of the fill material ranged from 0.8 m to 1.9 m.

The Standard Penetration Test (SPT) N values from the fill ranged from 3 to 21 indicating a very loose to compact state.

The moisture content of the fill ranged from 12% to 24%.

One representative sample of the fill was selected for grain size analysis (hydrometer) testing and the results are summarized in the table below with the grain size distribution curve shown on Figure No. 1 in Appendix D.

Table 5.2: Summary of Grain Size Analysis of Fill

Borehole No.	Sample No.	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
MW21-9	SS-2	0.8 – 1.4	6	49	35	10

In accordance with the Unified Soil Classification System (USCS), the soil can be classified as a silty sand (SM).

5.1.3 Silty Sand / Silty Sand with Gravel

A layer of silty sand to silty sand with gravel was encountered in all boreholes below the topsoil or fill.

The thickness of the sand layer ranged from 1.5 m to 5.1 m.

The Standard Penetration Test (SPT) N values in the sand ranged from 2 to greater than 50 indicating a very loose to very dense compactness.

Occasional cobbles and boulders were inferred during drilling.

The moisture content of the sand ranged from 7% to 24%.

Seven representative samples of the sand were selected for grain size analysis (hydrometer) testing and the results are summarized in the table below with the grain size distribution curves are shown on Figure No. 2 in Appendix D.

Table 5.3: Summary of Grain Size Analysis of Clay

Borehole No.	Sample No.	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
MW21-2	SS-2	0.8 – 1.4	13	43	36	8
MW21-2	SS-5	3.0 – 3.6	15	43	34	8
MW21-3	SS-4	2.3 – 2.9	18	49	30	3
BH21-7	SS-2	0.8 – 1.4	6	47	35	12
BH21-7	SS-7	4.6 – 5.2	22	41	29	8
BH21-8	SS-2	0.8 – 1.4	10	49	35	6
MW21-9	SS-5	3.0 – 3.6	11	55	30	4

In accordance with the USCS, the soil can be classified as silty sand to silty sand with gravel (SM).

5.1.4 Till

A till material was encountered beneath the sand layer in MW21-5 and MW21-9. The thickness of the till encountered ranged from approximately 0.6 m to 1.4 m.

The till was described as silty sand to silty sand with gravel with occasional cobbles and boulders inferred. Glacial till deposits are often crowded with cobbles and boulders set in a matrix of finer-grained material (gravel, sand, silt and clay); large boulders in excess of 1.0 m are common.

The Standard Penetration Test (SPT) N values were greater than 50 indicating a very dense compactness.

The moisture content of the till ranged was 10%.

One representative sample of the till was tested for grain size analysis and the results are summarized in the table below and on Figure No. 3 in Appendix D.

Table 5.4: Summary of Grain Size Analysis of Till

Borehole No.	Sample No.	Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
MW21-5	SS-7	4.6 – 5.2	7	50	37	6

In accordance with the USCS, the till can be classified as silty sand (SM).

5.1.5 Bedrock

Bedrock was proven by coring in two boreholes. Auger refusal on inferred bedrock was encountered in one borehole.

Bedrock proven and inferred depths are provided in the table below. The bedrock consisted of grey limestone and sandstone.

The Total Core Recovery (TCR) was 92% to 100% and the Rock Quality Designation (RQD) ranged from 49% to 100% indicating a poor to excellent rock quality. Bedding joints were moderately spaced within the cored bedrock. The bedrock was typically slightly weathered. Photographs of the rock cores and the detailed field bedrock core logs are provided in Appendix C.

Table 5.5: Summary of Bedrock Depths

Borehole No.	Depth to Bedrock (m)	Depth to Refusal (m)	Comments
MW21-2	3.7	-	Bedrock proven by coring
MW21-3	3.4	-	Bedrock proven by coring
MW21-6		5.0	Refusal on inferred boulders or bedrock

One unconfined compressive strength test was carried out on a selected intact rock core. The result of the unconfined compressive strength test was 169 MPa indicating the bedrock is very strong.

5.2 GROUNDWATER

Monitoring wells were installed in six of the boreholes. The groundwater levels were measured on January 20, 2021. Additional groundwater information is provided in the Stantec Hydrogeological Report.

Table 5.6: Summary of Measured Groundwater Levels

Borehole Location	Groundwater Depth Below Ground Surface (m)
MW21-2	0.11
MW21-3	0.15
MW21-4	0.37
MW21-5	0.45
MW21-6	0.82
MW21-9	0.65

Fluctuations in the groundwater level due to seasonal variations or in response to a particular precipitation events should be anticipated.

6.0 DISCUSSION AND RECOMMENDATIONS

This section of the report provides geotechnical engineering input related to the proposed Wellings of Brockville residential subdivision at the site.

6.1 OVERVIEW OF SUBSURFACE CONDITIONS AND GEOTECHNICAL ISSUES

The subsurface soil conditions encountered at the site typically consist of topsoil over silty sand to silty sand with gravel over limestone and sandstone bedrock. Possible fill was encountered at several borehole locations below the topsoil. The topography of the site generally slopes from elevation 115.9 m at the south site boundary (Parkedale Avenue) down to 105.3 m at the northwest corner. Dense trees cover the eastern and western portion of the site. Boreholes could not be advanced within the dense treed areas; borehole information is limited to the portion of the site that was accessible by drill rig. A swampy area was noted in the northwest corner of the site during the topographic survey.

Based on the above conditions, the following is noted for the proposed development:

- The native soils are suitable to support moderate foundation loads using conventional spread footing foundations.
- Possible fill materials were noted in several boreholes to depths of up to 2.5 m below ground surface, these materials are not a suitable bearing surface and will need to fully be sub-excavated from

beneath the building floor slabs and from within the influence zone of the foundations and replaced with compacted Structural Fill.

- Groundwater was encountered at shallow depths in the monitoring wells.
- The soils on site include very dense material with inferred cobbles and boulders. Cobbles and boulders should be anticipated during excavation.

6.2 SITE GRADING

The groundwater level was near ground surface (less than 1 m below ground surface) at all locations. Site grading should include the excavation of perimeter ditches to improve surface drainage and to reduce ground disturbances from construction activities. Granular working pad may also be required to reduce ground disturbances from construction activities.

A grade raise restriction is not required for the site. The final grading plan should be reviewed by a geotechnical engineer.

6.3 SITE PREPARATION

6.3.1 Beneath Spread Footings and Slabs-on-Grade

Possible fill material was encountered beneath the topsoil in several boreholes. The removal of all existing fill, test pit backfill, topsoil/rootmat and other deleterious materials from beneath the building floor slabs and from within the influence zone of the foundations is recommended for this site. The influence zone is defined by a line drawn from the edges of the footings outward at 1H:1V and extending downward to native undisturbed soils.

Any soft or loose areas exposed must be removed and replaced with compacted Structural Fill as directed by geotechnical personnel. Any grade adjustments beneath foundations and floor slabs should be conducted using approved Structural Fill material.

If bedrock is encountered, exposed bedrock surfaces should be free of loose bedrock, soil, water, bedrock irregularities and sloping surfaces. Hand cleaning and pressure washing the rock bearing areas to remove any loose materials will be required to achieve the recommended bearing pressure.

Prepared subgrade surfaces should be inspected by experienced geotechnical personnel.

6.3.2 Beneath Roads and Driveways

All existing facilities or structures, test pit backfill, topsoil/rootmat, vegetation and organic soils must be entirely removed from proposed pavement areas (roads and parking areas). Exposed subgrades in proposed pavement areas should be surface compacted with a large vibratory roller and inspected by geotechnical personnel. Soft, loose or disturbed soils within pavement areas should be sub-excavated to 500 mm below the design subgrade line and backfilled with compacted Subgrade Fill. The slopes of the sub excavation should be no steeper than 3H:1V within 1.2 m of finished grade to minimize the effects of differential frost heave.

It is recommended that both subgrade and finished pavement surfaces be graded to direct water towards suitable drainage. A frost taper of 3H:1V must be incorporated into the subgrade surface as a transition between differing pavement structures. It is recommended that the lateral extent of the subbase and base layers not be terminated vertically behind curb lines a taper with a grade of 3H:1V is recommended in the subgrade line to minimize differential frost heave problems under curbs and sidewalks.

6.3.3 Construction Issues

Groundwater was encountered at shallow depths throughout the site, the silty sand may be disturbed by construction traffic and construction activities. The use of protective granular pads, mud mats and geotextiles will be required to protect subgrades from disturbances.

6.3.4 Structural Fill and Subgrade Fill

Structural Fill for use beneath the footings or concrete slabs-on-grade should consist of clean granular material such as OPSS Granular B Type I or OPSS Granular A. Structural Fill should be tested and approved by geotechnical personnel prior to placement. Structural Fill should be placed in lifts no thicker than 300 mm then compacted to a minimum of 100% Standard Proctor Maximum Dry Density (SPMDD).

Imported Subgrade Fill in paved areas, if required, should consist of materials meeting the requirements of OPSS Select Subgrade Material (SSM). Fill materials should be tested and approved by a Geotechnical Engineer prior to delivery to the site. Subgrade Fill should be placed in lifts no thicker than 300 mm then compacted using suitable equipment to a minimum of 95% SPMDD.

Re-use of site generated materials will be restricted to landscaping fill, the site soils are not suitable for re-use as subgrade fill, trench backfill, or exterior foundation wall backfill.

Note that construction techniques and weather conditions will influence the proportion of materials suitable for re-use.

Inspection and testing services will also be required to ensure that all fill is placed and compacted to the required degree.

6.4 SEISMIC SITE CLASS

Based on the soil conditions identified during the geotechnical investigation, the recommended site classification for seismic site response for this site is Site Class C in accordance with Table 4.1.8.4.A of the 2012 Ontario Building Code (OBC) with July 2019 amendments.

The site class is based on the SPT “N” values of the soil in the boreholes. Bedrock was not encountered at all locations, depth to bedrock varies from 3.4 m to greater than 5.3 m. The design parameters assumed for Seismic Site Classification are outlined in the table below.

Table 6.1: Parameters for Seismic Site Classification

Material/Depth Below Footings	N60 Value
Silty Sand (2 m – 3 m)	20
Silty Sand (3 m – 6 m)	50
Bedrock	100

Site-specific seismic data is presented in the Ministry of Municipal Affairs and Housing Building and Development Branch document titled "MMAH Supplementary Standard SB-1 Climatic and Seismic Data" updated January 15, 2019. Based on Table 3 in the reference, the PGA for the site is 0.164, which corresponds to Brockville. For the seismic design we recommend the following input values:

- PGA_{ref} = 0.131 (0.8 x PGA)
- Site Coefficient, F_s = 1.0

The site soils are not considered susceptible to liquefaction.

6.5 FOUNDATIONS

The soil conditions encountered are suitable for the use of conventional spread and strip footings for the support of structures.

6.5.1 Geotechnical Bearing Resistance for Foundations

Geotechnical Bearing Resistances are provided for design purposes. The resistances have been calculated assuming a footing width of 1.0 to 2.0 m.

Table 6.2: Geotechnical Bearing Resistance for Shallow Foundations

Footing Founding Material	ULS (kPa)	SLS (kPa)
Footings on sand	260	220

The Ultimate Limit State (ULS) bearing resistance includes a resistance factor of 0.5. The Serviceability Limit State (SLS) bearing resistance corresponds to total settlement of 25 mm. Differential settlements between footings are expected to be less than 19 mm.

All perimeter footings and interior footings located within 1 m from the exterior walls will require an equivalent minimum soil cover of 1.5 m for protection against frost action. Footings in unheated areas or exterior footings for unheated garages, signs, etc. should be founded at least 1.8 m below exterior grade to protect against frost action.

Where proposed footings have insufficient soil cover for frost protection, the use of insulation will be required. Where footings are placed on sound bedrock, the minimum soil cover can be reduced to 0.6 m.

The base of all footing excavations should be inspected by a geotechnical engineer prior to placing concrete to confirm the above design pressures and to ensure there is no loose material remaining on the subgrade surface. Any loose or disturbed material identified during the inspection will need to be removed.

Where construction is undertaken during winter conditions, footing subgrades should be protected from freezing and foundation walls and columns should be protected against heave due to soil adfreeze.

Footings and excavations should be protected from the detrimental effects of precipitation, seepage, surface run off, and frost.

6.5.2 Foundation Wall Backfill and Damp-Proofing

Foundation walls should be protected with damp-proofing and backfilled with free-draining granular material such as OPSS Granular B Type I. The zone of free-draining backfill should extend a horizontal distance of at least 500 mm out from the foundation wall.

Foundation backfill should be placed in lifts no thicker than 300 mm and compacted to 95% SPMDD. Care should be taken immediately adjacent to walls to avoid over compaction of the soil resulting in damage to the walls.

Perimeter drains are required at this site in accordance with the OBC 2012.

6.6 SLAB-ON-GRADE

A layer of free draining granular material such as OPSS Granular A at least 300 mm in thickness should be placed immediately beneath the floor slab for leveling and support purposes.

It is recommended that a perimeter drain and under slab drain be installed around the proposed buildings in cut areas and in all areas where the exterior grades are higher than the finished floor elevation or slope toward the structure. The drainage system should consist of a perforated drainage pipe backfilled with clear stone around the pipe and a non-woven geotextile separation between the clear stone and surrounding material. The drain configuration must be designed to allow positive drainage to a positive frost-free outlet. Pavement or landscaped areas should be sloped away from the structure to prevent ponding of water around the building.

The floor slab constructed as recommended above may be designed using a soil modulus of subgrade reaction, k, of 50 MPa/m.

On most projects there is a significant time lag between initial grading and the time when the contractor is ready to place the slab-on-grade. Environmental conditions and construction traffic often disturb previously prepared soils. Provisions should be made in the construction specifications for restoration of the material to a stable condition prior to placing the floor slab system.

Where construction is undertaken during winter conditions, floor slab fill should be protected from freezing. Alternatively, the floor slab fill should be completely thawed, and then proof rolled prior to placing concrete.

6.7 TEMPORARY EXCAVATIONS

The native soils are considered to be Type 3 soil in accordance with the Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects. Temporary excavations in the overburden may be supported or should be sloped at 1 horizontal to 1 vertical from the base of the excavation as per the requirement of OHSA.

Excavations should be inspected regularly for signs of instability and flattened as required. At locations where significant groundwater inflow is encountered, the soil would be classified as Type 4, excavations should be sloped no steeper than 3H:1V from the base of the excavation.

Based on OHSA requirements, the soil must be classified as the type with highest classification of the types of soils present if an excavation contains more than one soil type (i.e. if Type 3 and Type 4 soils are present, the excavation must be sloped or supported in accordance with the requirements for Type 4 soils).

The stability of the wall of the excavation can also be affected by:

- Surcharge loads
- Stockpiles
- Groundwater seepage conditions

Excavations in close proximity to existing structures or services should be reviewed by a Geotechnical Engineer.

Boulders may be encountered during excavation.

6.8 DEWATERING

The groundwater surface was measured between 0.1 m and 0.8 m below existing ground surface. Site grading should include the excavation of perimeter ditches to improve surface drainage and to reduce ground disturbances from construction activities. It is anticipated that excavations for utilities and structures may encounter groundwater and/or surface run-off. It is expected that groundwater and/or surface run-off may be controlled by sump and pump methods for excavations to as much as 2 m below ground surface. Excavation depths greater than 2 m below ground surface may require special dewatering techniques.

Basement floor slabs will likely be below the groundwater table and as such, perimeter and under slab drainage systems connected to a frost-free sump are recommended.

Site drainage should also be such that the run-off onto adjacent properties is controlled.

If dewatering activities are anticipated to exceed 50,000L/day, a Ministry of the Environment Permit to Take Water (PTTW) would be required. A hydrogeological assessment was completed and is reported separately with further detail on dewatering.

6.9 MUNICIPAL SERVICES

6.9.1 Bedding and Backfilling

Bedding for utilities should be placed in accordance with the pipe design and municipal requirements. It is recommended that a minimum of 300 mm of OPSS Granular A be placed below the pipe invert as bedding material. Bedding material should also be placed around the pipe with a minimum of 300 mm vertical cover. These materials should be compacted to at least 95% of SPMDD.

Backfill for service trenches in landscaped areas may consist of excavated material replaced and compacted in lifts. Where the service trenches extend below paved areas, the trench should be backfilled with Subgrade Fill material as defined in Section 6.3.3 from the top of the pipe cover to within 1.2 m of the proposed pavement surface, placed in lifts and compacted to at least 95% of SPMDD. The material used within the upper 1.2 m and below the subgrade line should be similar to that exposed in the trench walls to prevent differential frost heave, placed in lifts and compacted to at least 95% of SPMDD. Alternatively, where abutting materials within this zone are not similar a 3 horizontal to 1 vertical frost taper is required in order to minimize the effects of differential frost heaving.

Excavations for catch basins and manholes should be backfilled with OPSS Granular B Type I or II. A 3H:1V frost taper should be incorporated around catch basins and manholes within 1.2 m of finished grades. Joints between manhole and catch basin sections should be wrapped with a non-woven geotextile.

6.10 ROADS AND DRIVEWAYS

The subgrade in pavement areas should be prepared as described in Section 6.3.2. The recommend pavement structures presented below have been designed without detailed traffic data for the site. The pavement designs should be reviewed once the traffic data is available.

It has been assumed that the proposed local roads will have an annual average daily traffic volume of less than 1000 with no more than 2% commercial traffic and no city buses. The recommended minimum pavement designs are outlined in the tables below.

Table 6.3: Recommended Pavement Structure for Residential (local) Roads

Material	Roadway Pavement Structure (mm)
Superpave SP 12.5 Asphalt (PG 58-34, Traffic Level A)	40
Superpave SP 19 Asphalt (PG 58-34, Traffic Level A)	50
Granular A	150
Granular B Type II	300

Table 6.4: Recommended Pavement Structure for Collector Roads

Material	Roadway Pavement Structure (mm)
Superpave SP 12.5 Asphalt (PG 58-34, Traffic Level B)	50
Superpave SP 19 Asphalt (PG 58-34, Traffic Level B)	70
Granular A	150
Granular B Type II	500

It is estimated that the service life prior to major rehabilitation for the recommended pavement structures is 20 years provided it is properly maintained. It is recommended that both subgrade and finished pavement surfaces be graded to direct water towards suitable drainage.

All granular materials should be tested and approved by a geotechnical engineer prior to delivery to the site. Both base and subbase materials should be compacted to at least 100% SPMDD. Asphalt should be compacted to at least 97% Marshall Bulk density.

The subgrade may be easily disturbed, the placement of a geotextile over the subgrade can be used to protect the subgrade from disturbances.

A 3H:1V frost taper should be included along the subgrade line at the transition between abutting pavement structures.

It is recommended that the lateral extent of the subbase and base layers not be terminated in a vertical fashion immediately behind the curb line. A taper with a grade of 3H:1V is recommended in the subgrade line to minimize differential frost heave problems under curbs and sidewalks.

6.11 STORMWATER MANAGEMENT POND

It is understood the proposed development will include a stormwater management pond either in the centre or the northwest corner of the site. The proposed layout and sections for the pond will need to be reviewed once available, geotechnical input will be provided at that time.

Preliminary design considerations for the pond are provided below.

- The side slopes of the interior pond above the permanent water level should be vegetated as soon as practical after construction to minimize surface erosion.
- A 300 mm thick layer of rip-rap protection should be provided on the pond side slope and bottom at the location of the inlet and outlet structures. The rip-rap protection should be placed over a non-woven geotextile such as Terrafix 270R.
- Water retention structures have failed due to seepage and/or poor compaction of fill material around outlet structures. All outlet piping should incorporate anti-seepage collars at regular spacing; an anti-seepage collar should be incorporated into the liner system.

6.12 CEMENT TYPE AND CORROSION POTENTIAL

Two representative soil samples were submitted to Paracel Laboratories Limited in Ottawa, Ontario, for resistivity, pH, sulphate and chloride testing. The results of the testing are as follows:

Table 6.5: Results of Chemical Analysis

Borehole	Sample	Depth (m)	pH	Sulphate (µg/g)	Chloride (µg/g)	Resistivity (Ohm-m)
MW21-2	SS3	1.5 to 2.1	7.85	<5	<5	89.4
BH21-7	SS6	3.8 to 4.4	8.01	9	8	125

The concentration of soluble sulphate provides an indication of the degree of sulphate attack that is expected for concrete in contact with soil and groundwater at the site. Soluble sulphate concentrations less than 1000 µg/g generally indicate that a low degree of sulphate attack is expected for concrete in contact with soil and groundwater. Type GU Portland Cement should therefore be suitable for use in concrete at this site.

The pH, resistivity and chloride concentration provide an indication of the degree of corrosiveness of the sub-surface environment. The test results provided may be used to aid in the selection of coatings and corrosion protection systems for buried steel objects.

6.13 FUTURE INVESTIGATION

At the time of the field investigation, a portion of the site was covered with dense trees, which limited the borehole locations to the central portion of the site. It is recommended that additional test pits be excavated, after tree clearing has taken place and site access to the east and west limits is improved. The test pitting can be used to better delineate the fill material that was encountered during drilling.

7.0 CLOSURE

Use of this report is subject to the Statement of General Conditions provided in Appendix A. It is the responsibility of Nautical Lands General Contractors Inc (Wellings 2019 Inc). who is identified as "the Client" within the Statement of General Conditions, and its agents to review the conditions and to notify Stantec Consulting Ltd. should any of these not be satisfied. The Statement of General Conditions addresses the following:

- Use of the report
- Basis of the report
- Standard of care
- Interpretation of site conditions
- Varying or unexpected site conditions
- Planning, design or construction

This report has been prepared by Katurah Firdawsi and reviewed by Christopher McGrath.

Respectfully submitted,

STANTEC CONSULTING LTD.

Katurah Firdawsi, P.Eng.
Geotechnical Engineer

Christopher McGrath, P.Eng.
Senior Associate – Geotechnical Engineer

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Appendix E – FUNCTIONAL DESIGN SUBMISSION

Stantec

Memo

To:	Steve Allen	From:	Daniel Chochlinski, EIT
	City of Brockville		Stantec Consulting Ltd. 400-1331 Clyde Avenue Ottawa, ON K2C 3G4
File:	160401602	Date:	March 31, 2021

Reference: 160401602 – Wellings of Brockville – Functional Servicing and Stormwater Management Brief

INTRODUCTION

Nautical Lands Group has commissioned Stantec Consulting Ltd. (Stantec) to prepare the following Functional Servicing and Stormwater Management (SWM) Brief for its proposed Wellings of Brockville independent senior living development. The brief supports the rezoning application for the subject site, which is located in the City of Brockville approximately two kilometres northwest of the downtown core. The site is bound by Parkedale Avenue to the south, residential uses and undeveloped woodlot to the west and east, and undeveloped woodlot and watercourse immediately to the north. Access to the site is provided via frontage onto Parkedale Avenue to the south. The entire subject site is identified in **Figure 1** below with a pale orange dashed boundary, whereas the area of the proposed development, which excludes the existing environmental protection area, is shown with a solid orange hatch.

Figure 1: Key Map of the Wellings of Brockville Site

The existing property is undeveloped apart from two detached dwellings in the southeast corner of the site, located at municipal addresses 3064 and 3076 Parkedale Avenue. The undeveloped portion of the site is a mix of grassed land within its centre with a woodlot along its perimeter. The site drains to the north towards an existing unnamed watercourse, which appears to be tributary to Grants Creek.

The subject property occupies approximately 5.59 ha of land. The majority of the site is currently zoned as Mixed Use and Commercial per Schedule 1 of the City of Brockville's Official Plan. The northwest corner of the site (approximately 1.83 ha) is zoned as Parks and Open Space Area and will not be developed. The proposed development consists of 90 single-storey, slab-on-grade townhome units (44 1-bedroom units and 46 2-bedroom units), as shown in the conceptual site plan included in **Appendix D** and in **Figure 2** below. Background for the site was obtained through correspondence with City of Brockville staff (see correspondence in **Appendix E**).

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Legend

- PROPOSED WATERMAIN
- PROPOSED SANITARY SEWER
- PROPOSED FORCEMAIN
- PROPOSED STORM SEWER
- ALTERNATIVE WATERMAIN ROUTING
- ALTERNATIVE SANITARY SEWER ROUTING
- APPROX. LOCATION OF EX. WATERCOURSE
- PROPOSED SWM POND BLOCK
- PROPOSED PUMP STATION BLOCK

Client/Project
WELLINGS 2019 INC.
WELLINGS OF BROCKVILLE

Figure No.
2.0

Title
PROPOSED SITE SERVICING

POTABLE WATER SERVICING

BACKGROUND

The proposed development is located just outside of the City of Brockville's existing water distribution system. An existing 300 mm diameter watermain is located southeast of the subject site on Parkedale Avenue, terminating approximately 100 m east of the site near the intersection with Kent Boulevard. This watermain currently services the detached dwellings and businesses along this stretch of Parkedale Avenue. Refer to **Drawing OSSP-1** in **Appendix F**, which shows the existing watermain.

Hydrant flow testing at the nearest hydrant (H846) on Parkedale Avenue from 2018 was provided by the City of Brockville on September 22, 2020. The testing results indicated an available fire flow at 20 psi of 5,167 L/min and a static pressure of 70 psi. The hydrant testing results are provided in **Appendix A.3**.

PROPOSED WATERMAIN SIZING AND LAYOUT

Connections to Existing Infrastructure

The conceptual watermain alignment and sizing for the development is shown on **Drawing OSSP-1**. A 200 mm diameter watermain is proposed to follow the alignment of the private roads within the subject property. The 300 mm diameter watermain on Parkedale Avenue will need to be extended to the entrance of the subject site. Potential secondary watermain connections for looping are shown on **Drawing OSSP-1** to the existing 300 mm diameter watermain on Stewart Boulevard east of the subject site and to the existing 300 mm diameter watermain on Chelsea Street to the north of the subject site. Both potential secondary watermain connections cross land owned by others and as such will be subject to negotiation with the property owners, as well as approval from the City of Brockville and from the Cataraqui Conservation Authority for the connection to the north that would require crossing an existing watercourse.

The watermain network as shown on **Drawing OSSP-1** is preliminary and will be confirmed at the detailed stage once a hydraulic analysis is completed.

Domestic Water Demands

The proposed development contains 44 one-bedroom bungalow units and 46 two-bedroom bungalow units.

Water demands for the entire development were estimated using the City of Ottawa's Water Distribution Design Guidelines. For residential developments, the average day (AVDY) per capita water demand is 350 L/p/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 commercial areas, an average flow of 28,000 L/ha/d was used. For maximum day (MXDY) demand, AVDY was multiplied by a factor of 1.5 and for peak hour (PKHR) demand, MXDY was multiplied by a factor of 1.8. Refer to **Appendix A.1** for domestic water demand calculations. The calculated water consumption is represented in **Table 2-1**.

Table 2-1: Water Demands for Wellings of Brockville

Phase/Unit Type	Units	Persons/Unit	Population	AVDY (L/s)	MXDY (L/s)	PKHR (L/s)
1-bedroom bungalow units	44	1.4	62	0.25	0.62	1.37
2-bedroom bungalow units	46	2.1	97	0.39	0.98	2.15
1-storey clubhouse (628 m^2)	N/A	N/A	N/A	0.02	0.03	0.05
Total	**90**	**-**	**158**	**0.66**	**1.63**	**3.58**

1. Populations rounded to the nearest whole number.

Fire Flow Requirements

Fire flow requirement estimates were completed using the Office of the Fire Marshal (OFM) guidelines which meet the requirements of Section 3 of the Ontario Building Code (OBC). The results of the fire flow calculations are summarized in **Table 2-2** below. The detailed calculations are included in **Appendix A.2**.

Table 2-2: Fire Flow Calculations Using OFM/OBC Methodology

Unit Type	Description	Required Fire Flow Volume (L)	Min. Required Fire Flow (L/min)	Min. Required Fire Flow (L/s)
Six-unit block of bungalow units (Block 29)	Six-unit block of one-storey slab-on-grade units, no firewall, wood frame construction (Block 29), worst-case exposure distances	58,328	2,700	45
One-storey clubhouse	One-storey clubhouse with a 628 m^2 footprint	44,045	2,700	45

Based on the buildings proposed as part of the proposed development, using the OBC fire flow methodology, a minimum fire flow requirement of 2,700 L/min (45 L/s) and a required fire flow volume of 58,328 L will govern for the proposed development.

Based on hydrant flow testing conducted at the nearest hydrant (H846 on Parkedale Avenue) in 2018, the available fire flow at 20 psi is 5,167 L/min, which exceeds the required fire flow per the OBC calculation. The static pressure of 70 psi should also be adequate for all domestic water demand scenarios. As the subject site is at a lower elevation than Parkedale Avenue, the static pressures in the watermain system are expected to be higher than measured at this hydrant.

WASTEWATER SERVICING

BACKGROUND

The nearest sanitary sewer is a 200 mm diameter gravity sewer located along Parkedale Avenue, immediately south of the subject site. The existing sewer flows from west to east and covers the entire southern frontage of the site. An existing 200 mm diameter forcemain along Parkedale Avenue, used for leachate collection, discharges to this gravity sewer near the southwest corner of the site.

A 375 mm diameter gravity sanitary sewer also exists on Chelsea Street north of the subject site, terminating at a maintenance hole at the western limit of Chelsea Street. This sanitary sewer outlet is separated from the subject site by wooded lands owned by others, as well as an existing watercourse.

DESIGN CRITERIA

PROPOSED SANITARY SERVICING DESIGN

Sewage peak flows from the proposed site will be directed to a proposed sanitary pump station by gravity as shown on **Drawing OSSP-1**. The sanitary pump station to be located in the northeastern corner of the site, is required to service the subject site through the existing 200 mm diameter sanitary sewer along Parkedale Avenue. A proposed forcemain will outlet to an existing sanitary maintenance hole within the north shoulder of the Parkdale Avenue right-of-way, at the main entrance to the site.

The functional sanitary sewer layout for the subject site is shown in **Drawing OSSP-1** in **Appendix F**.

An alternate servicing layout consisting of a gravity outlet to the existing 375 mm diameter sanitary sewer on Chelsea Street is also shown on **Drawing OSSP-1**. This arrangement would require crossing the existing watercourse and the extension of the existing sewer on Chelsea Street. Additional topographic information for the watercourse will be required to confirm the cover over the sanitary sewer at the location of the creek crossing is adequate. This alternate servicing option is subject to negotiation with the property owner of the land separating the subject site from the Chelsea Street right-of-way, as well as approval from the Cataraqui Conservation Authority and from the City of Brockville.

A conceptual sanitary sewer design sheet for the entire site was prepared using the population estimates from the most recent conceptual site plan (dated March 2, 2021) and a 280 L/p/day average daily demand (per the City of Ottawa Sewer Design Guidelines (2012) and all subsequent technical bulletins). A 28,000 L/ha/day demand was attributed to the clubhouse, which has a total footprint of 628 m^2. The conceptual sanitary sewer design sheet is included in **Appendix B.1**. The peak flows from the proposed development are summarized in **Table 3-1** below.

Table 3-1: Sanitary Peak Flows from Wellings of Brockville

Source	Area (ha)	Population	Peak Flow (L/s)
44 1-br and 46 2-br Bungalow Townhomes	3.70	158	1.82
1-storey Clubhouse	0.06	-	0.03
Infiltration	3.76	-	1.24
Total:	**3.76**	**158**	**3.09**

1. Total area of the site considers only the portion of the site which will be developed (i.e., excludes the environmental protection area as shown on the conceptual site plan dated March 2, 2021).

The average daily demand of 280 L/p/d is conservative compared to an average daily demand of 197 L/unit/d, which was measured in the Wellings of Picton site in 2018 based on actual usage figures. The Wellings of Brockville development is expected to have similar sanitary release rates as both sites are the same type of independent living retirement community. The Wellings of Picton water/sanitary data is included in **Appendix B.2**.

The capacity of the existing sanitary sewer system will need to be confirmed by the City of Brockville. The preferred sanitary outlet will be determined as part of the detailed design process.

STORMWATER MANAGEMENT AND STORM SERVICING

EXISTING CONDITIONS

The existing 5.59 ha site consists mostly of meadow/grassed land in its centre with a mature woodlot around its perimeter. The only developed portion of the site is its southeast corner which contains two detached dwellings complete with gravel driveways fronting Parkedale Avenue. The site drains to the north towards an existing unnamed watercourse, which appears to be tributary to Grants Creek. Existing grades range between approximately 105.3 m and 116.1 m, with the lowest grades at the northwest corner of the site along the existing watercourse and the highest grades located on the south end of the site near Parkedale Avenue. Excluding the environmental protection area in the northwest corner of the site as shown on the conceptual site plan, the site measures approximately 3.76 ha in area and the lowest existing grade is approximately 106.8 m at the northeast corner of the site. The site falls within the Cataraqui Source Protection Area.

As the environmental protection area in the northwest corner of the site drains away from the subject site and will not be developed, only the remaining 3.76 ha area of the site is subject to all further stormwater management analysis. Refer to **Drawings OSSP-1 and OGP-1** for further details.

An initial assessment of existing (i.e., pre-development) 100-year peak flows from the subject site was completed using the rational method for a 3.76 ha area and a time of concentration of 14.6 minutes. The time of concentration was calculated using the Uplands Method for 262 m of overland sheet flow over a mix of pasture and woodlot. The time of concentration calculations are included in **Appendix C.1**. Environment Canada's IDF curve for Brockville Station 6100971 was used for the analysis. The calculation of the pre-development runoff coefficient is included in **Appendix C.2**. **Table 4-1** shows the pre-development 100-year peak flows from the site which will be used to estimate the 100-year volume requirements and approximate footprint of the proposed SWM wet pond.

Table 4-1: 100-Year Existing Condition Peak Flow

Drainage Area (ha)	Runoff Coefficient (C)	Time of Concentration (min)	100-Year Intensity (mm/hr)	100-Year Peak Flow (L/s)
3.76	0.21	14.6	129.14	**283.5**

The Ontario Ministry of Natural Resources and Forestry (MNRF) Ontario Flow Assessment Tool (OFAT) was used to analyze the watershed of which the Wellings of Brockville site forms part. Although provincial mapping does not indicate the upstream limit of the watercourse immediately north of the subject site, as-built mapping provided by the City of Brockville indicates that this watercourse passes north of the site and extends to the Stewart Boulevard right-of-way east of the site. Therefore, it is assumed that the watercourse forms parts of the OFAT-determined watershed. This assumption is to be verified via a survey of the watercourse, to be completed during the detailed design stage. A map of this watershed, including its outlet location, is provided in **Appendix C.2**.

Floodplain mapping for the existing watercourse north of the site, which appears to be tributary to Grants Creek and will serve as the stormwater outlet for the proposed stormwater management (SWM) wet pond, will need to be requested from Cataraqui Conservation.

PROPOSED CONDITIONS AND SWM DESIGN CRITERIA

The proposed development comprises of 90 slab-on-grade, bungalow townhome units, a sanitary pump station in the northeast corner of the site, a stormwater management (SWM) wet pond in the northeast corner of the site, and a one-storey clubhouse complete with associated parking area near the southwest corner. The proposed development has a C value (runoff coefficient) of approximately 0.61 (58.6% imperviousness). Calculations of the C value are included in **Appendix C.3**.

Post-development runoff from the proposed development will be restricted to pre-development levels for all storm events up to and including the 100-year storm (283.5 L/s). A SWM wet pond is proposed as an end-of-pipe SWM facility to provide ‘enhanced’ level of quality control (80% TSS removal per MECP guidelines) and to provide quantity control of runoff from the site prior to discharging to the existing watercourse north of the site via an engineered outlet channel.

The proposed stormwater management system for the development will consist of a dual drainage (minor and major) system. The minor system will consist of rear yard infiltration trenches (if soil conditions permit) drained by storm sewers ultimately discharging to the proposed SWM pond. The storm sewers will carry all runoff up to and including the 5-year storm event. The infiltration trenches will serve to provide additional quantity and quality control. The major system will consist of the proposed roads which will direct drainage overland to the proposed SWM wet pond. Storage throughout the site will be provided wherever possible so as to minimize flow depth on the streets.

Preliminary sizing indicates that an 825 mm diameter storm sewer at a grade of 0.25% will be required to accommodate the 5-year peak flows from the site, using a C of 0.65 for conservatism. The preliminary storm sewer design sheet is included in **Appendix C.4**.

The preliminary geotechnical investigation report for the project, prepared by Stantec Consulting Ltd. and dated March 23, 2021, recommends that perimeter drains and under slab drains be installed around the proposed slab-on-grade buildings in cut areas and in all areas where the exterior grades are higher than the finished floor elevation or slope toward the structure. These perimeter drains, where required, will be serviced by the proposed storm sewers and will be confirmed during the detailed design stage.

A culvert will need to be installed within the existing roadside ditch on the north side of Parkedale Avenue at the main entrance to the subject site, as shown on **Drawing OSSP-1**.

FUNCTIONAL ANALYSIS OF POST-DEVELOPMENT RUNOFF

The PCSWMM software package was used to estimate post-development runoff from the subject site with a conservative runoff coefficient of 0.65 in order to estimate the 100-year storage requirement in the proposed SWM pond to restrict post development peak flows to the 283.5 L/s pre-development 100-year peak flow. Sample PCSWMM input and output files have been included in **Appendix C.5** and **Appendix C.6**, respectively.

Based on available survey information and preliminary proposed grading, the conceptual SWM wet pond has been sized to provide a permanent pool elevation of 107.00 m and a 100-year water level of 108.15 m (see detailed calculations in **Appendix C.5**). The pond water levels are to be confirmed at the detailed design stage based on detailed survey of the existing outlet watercourse and available floodplain mapping.

The proposed SWM wet pond has been sized to provide 80% TSS removal as per MECP volumetric requirements as shown in the following table.

Table 4-2: Stormwater Quality Volumetric Requirements

Drainage Area (ha)	% Imp.	Volume Requirements		Volumes Provided		
		Permanent Pool (m^3)	Extended Detention (m^3)	Permanent Pool (m^3)	Extended Detention (m^3)	Total MECP Volume (m^3)
3.76	64.3	660	150	1,180	551	1,731

The preliminary hydraulic analysis shows that approximately 1,998 m^3 of active storage (above the permanent pool) are required in the proposed SWM wet pond to attenuate post development 100-year peak flows from the proposed site to pre-development levels. The footprint of the proposed SWM wet pond will be confirmed at the detailed design stage. **Drawing OSSP-1** in **Appendix F** shows the approximate size of the block required to accommodate the proposed SWM pond.

GRADING

Grading for the proposed site has been provided as shown on **Drawing OGP-1**. Site grading maintains the existing drainage outlet north of the site. Site regrading will be required in order to decrease the grade change across the site sufficiently to allow for the proposed buildings. The regrading works include up to approximately 1.5 m of grade raise in the northern portion of the site, with smaller regrading differences (cut and fill) required throughout the site. Retaining walls will be required along the eastern and northern property lines (extent and height to be confirmed during the detailed design stage).

The preliminary geotechnical investigation report for the project, prepared by Stantec Consulting Ltd. and dated March 23, 2021, does not recommend a grade raise restriction.

CONCLUSIONS

The results of the conceptual servicing assessment indicate that the proposed residential adult-living community can be serviced using the existing infrastructure as outlined in the sections above. Confirmation regarding residual sanitary sewer capacity in the existing system will be required from the City of Brockville.

It is of note that calculations for the proposed development concept are high-level estimates based on the latest concept plan. Detailed analysis will be required at a later stage to determine detailed infrastructure capacities and requirements.

Reference: 160401602 – Wellings of Brockville – Functional Servicing and Stormwater Management Brief

Stantec Consulting Ltd.

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Attachments: Appendices A through F

c. Eric Bays

APPENDICES

APPENDIX A - POTABLE WATER SERVICING

A.1 DOMESTIC WATER DEMAND CALCULATIONS

Wellings of Brockville - Domestic Water Demand Estimates
All Phases (Conceptual Design)

Last updated on 2021-03-22 based on Conceptual Site Plan from 2021-03-02 prepared by NLG

Population densities as per MECP/City of Ottawa Guidelines:

1 Bedroom Apt. (Bungalow)	1.4	ppu
2 Bedroom Apt. (Bungalow)	2.1	ppu

Demand conversion factors as per MECP Guidelines:

Residential	350	L/p/day
Institutional	28000	L/ha/day

Building ID	Area (m^2)	Number of Units[3]	Population	Daily Rate of Demand (L/m^2/day or L/p/day)	Avg. Day Demand		Max. Day Demand [1, 2]		Peak Hour Demand [1, 2]	
					(L/min)	(L/s)	(L/min)	(L/s)	(L/min)	(L/s)
Clubhouse (incl. future additions)	628	-	-	2.8	1.2	0.02	1.8	0.03	3.3	0.05
1 bedroom bungalows	-	44	62	350	15.0	0.25	37.4	0.62	82.3	1.37
2 bedroom bungalows	-	46	97	350	23.5	0.39	58.7	0.98	129.1	2.15
Total Site :	**628**	**90**	**158**		**39.7**	**0.66**	**98.0**	**1.63**	**214.8**	**3.58**

1 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
peak hour demand rate = 2.2 x maximum day demand rate

2 Water demand criteria used to estimate peak demand rates for commercial/amenity areas are as follows:
maximum day demand rate = 1.5 x average day demand rate
peak hour demand rate = 1.8 x maximum day demand rate

3 Residential unit counts include Block 26 (as shown on 2021-03-02 conceptual site plan) even though will likely need to remove Block 26 to accomodate sanitary PS and SWM pond.

A.2 FIRE FLOW DEMAND CALCULATIONS

Fire Flow Calculations as per OFM Guidelines (per Requirements of OBC, Section 3)

Project #	160401602 (Wellings of Brockville, Conceptual Design)	Designed by:	DJC
Date	2021-03-22	Checked by:	AMP
		Description:	6-unit Bungalow Towns, Block 29 *(Represents largest residential building with shortest exposure distances)*

$$Q = KVS_{tot}$$

Q = Volume of water required (L)

V = Total building volume (m3)

K = Water supply coefficient from Table 1

S_{tot} = Sotal of spatial coefficeint values from property line exposures on all sides as obtained from the formula

$S_{tot} = 1.0 + [S_{side1} + S_{side2} + S_{side3} + S_{side4}]$

1	Type of construction	Building Classification		Water Supply Coefficient
	combustible without Fire-Resistance Ratings	A-2, B-1, B-2, B-3, C, D		23
2	Area of one floor (m^2)	number of floors	height of ceiling (m)	Total Building Volume (m^3)
	445	1	2.85	1,268
3	Side	Exposure Distance (m)	Spatial Coefficient	Total Spatial Coeffiecient
	North	4	0.5	2
	East	29	0	
	South	4	0.5	
	West	24	0	
4	Established Fire Safety Plan?	Reduction in Volume (%)		Total Volume Reduction
	no	0%		0%
5				**Total Volume 'Q' (L)**
				58,328
				Minimum Required Fire Flow (L/min)
				2,700

1. Based on conceptual site plan by NLG dated 2021-03-02.

Fire Flow Calculations as per OFM Guidelines (per Requirements of OBC, Section 3)

Project #	160401602 (Wellings of Brockville, Conceptual Design)	Designed by:	DJC
Date	2021-03-22	Checked by:	AMP
		Description:	One-storey Clubhouse

$$Q = KVS_{tot}$$

Q = Volume of water required (L)
V = Total building volume (m3)
K = Water supply coefficient from Table 1
S_{tot} = Sotal of spatial coefficeint values from property line exposures on all sides as obtained from the formula
$S_{tot} = 1.0 + [S_{side1} + S_{side2} + S_{side3} + S_{side4}]$

1	Type of construction	Building Classification		Water Supply Coefficient
	combustible without Fire-Resistance Ratings	A-2, B-1, B-2, B-3, C, D		23
2	Area of one floor (m^2)	number of floors	height of ceiling (m)	Total Building Volume (m^3)
	628	1	3.05	1,915
3	Side	Exposure Distance (m)	Spatial Coefficient	Total Spatial Coeffiecient
	North	12	0	1
	East	46	0	
	South	31	0	
	West	13	0	
4	Established Fire Safety Plan?	Reduction in Volume (%)		Total Volume Reduction
	no	0%		0%
5				**Total Volume 'Q' (L)**
				44,045
				Minimum Required Fire Flow (L/min)
				2,700

1. Clubhouse to be one storey tall. Area as shown includes future additions.
2. Based on conceptual site plan by NLG dated 2021-03-02.

A.3 HYDRANT FLOW TEST RESULTS

Wellings of Brockville - Summary of Hydrant Fire Flow Results
Stantec Project No. 160401602
Last updated on 2021-03-22 based on data provided by City of Brockville on 2020-09-22

Hydrant ID	Static Pressure (psi)	Residual Pressure (psi)	Pitot Pressure (psi)	Total Flow (USGPM) at 20 psi	Total Flow (L/min) at 20 psi	Date Tested
H846	70	42	35	1365	5167	2018-05-08

Hydrant: H846

Flow Rate	
Main Size	
make	
Shut Off V	
Install Date	
Date Last	
Date next	
Active	1.00
STEAMER_CA	
QUICK_CONN	
Number	
Type	
Activity Id	419464996877
LastActivity	Fire Flow Test
DateStamp	5/8/2018, 8:00 PM
OpTime	13:32
OperatedBy	lcuthbert
Manufacturer	Mueller
HydrantType	
ModelId	
InstallYear	
StaticPsi	70
ResidPsi	42
Pitot	35
OrificeSize	2.5
FlowMin	13
ResidualLocation	Parkedale
Comments	Long key
BarrelDiameter	
FreeChlorine	1.22
Turbinity	2.78
Ph	7.60
HydrantColor	GREEN
Operator	Other,Other
AddressNumber	Pizza Hut
PumperPort	47A
FlowGpm	998
Flow20	1365
GalsUsed	12974
Address	Parkedale

Zoom to

APPENDIX B - WASTEWATER SERVICING CALCULATIONS

B.1 SANITARY SEWER DESIGN SHEET

SANITARY SEWER DESIGN SHEET

(City of Brockville/City of Ottawa/MECP Design Guidelines)

Stantec

PROJECT:

Wellings of Brockville
Conceptual Sanitary Calculations

DATE:	2021-03-23
REVISION:	1
DESIGNED BY:	DJC
CHECKED BY:	AMP

FILE NUMBER: 160401602

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/AMENITY SPACE	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 / 1 BR BUNGALOW UNIT	1.4	INSTITUTIONAL	28,000	L/ha/day	MINIMUM COVER	2.50	m
PERSONS / 2 BR BUNGALOW UNIT	2.1	INFILTRATION	0.33	L/s/ha	HARMON CORRECTION FACTOR	0.8	
PERSONS / TOWNHOME	2.7						

LOCATION			RESIDENTIAL AREA AND POPULATION									AMENITY (CLUBH.)	
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (ha)	1 BR BUNGALOWS	2 BR BUNGALOWS	TOWNHOME	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (L/s)	AREA (ha)	ACCU. AREA (ha)
Proposed site	Site	Pump Station	3.69	44	46	0	158	3.69	158	3.55	1.82	0.06	0.06

AREA ID NUMBER	INDUSTRIAL (L) AREA (ha)	INDUSTRIAL (L) ACCU. AREA (ha)	INDUSTRIAL (H) AREA (ha)	INDUSTRIAL (H) ACCU. AREA (ha)	INSTITUTIONAL AREA (ha)	INSTITUTIONAL ACCU. AREA (ha)	GREEN / UNUSED AREA (ha)	GREEN / UNUSED 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)
Proposed site	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	3.76	3.76	1.24	3.09

AREA ID NUMBER	PIPE LENGTH (m)	DIA (mm)	MATERIAL	CLASS	SLOPE (%)	CAP. (FULL) (l/s)	CAP. V PEAK FLOW (%)	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
Proposed site									

1. Residential average daily flow of 280 L/p/day used as per City of Ottawa Design Guidelines.
2. Per Conceptual Site Plan created by Nautical Lands Group, dated 2021-03-02.
2. Area used for infiltration calculations does not include environmentally protected lands as noted on the latest site plan.

B.2 HISTORICAL SANITARY WASTEWATER GENERATION FROM WELLINGS OF PICTON SITE (2018)

Wellings of Picton - Water/Sewer actual flow rates

Date	Current Read	Previous Read	Consumption - M3	Total # of Units	Occupancy	Prorated for 100%
Jan-18	6,983	6,775	208.0	88	39	469.3
Feb-18	7,199	6,983	216.0	88	39	487.4
Mar-18	7,422	7,199	223.0	88	39	503.2
Apr-18	7,637	7,422	215.0	88	44	430.0
May-18	7,896	7,637	259.0	88	47	484.9
Jun-18	8,188	7,896	292.0	88	47	546.7
Jul-18	10,428	8,188	2240.0	88	50	3942.4
Aug-18	11,525	10,428	1097.0	88	49	1970.1
Sep-18	12,607	11,525	1082.0	88	50	1904.3
Oct-18	12,952	12,607	345.0	88	52	583.8
Nov-18	13,344	12,952	392.0	88	53	650.9
Dec-18	13,738	13,344	394.0	88	58	597.8
Average Daily sanitary flow (CM)						17.4
Average Monthly sanitary flow (CM)						528.2
Annual sanitary flow (CM)						6338.8
L/D/Unit						197.3
L/S for the building						0.20

The blue hi-lighted months are well above average due to the lawn irigation which would not affect the sanitary flows. For that reason we have not used those months in this calculation but based it on the average of the other 9 months of that year.

This summary of actual consumption shows that WOP at 100% occupancy of the 88 units would produce an average sanitary output of 528.2 cm per month, 0.20 L/S, or 197.3 L/D/Unit.

APPENDIX C – STORMWATER MANAGEMENT

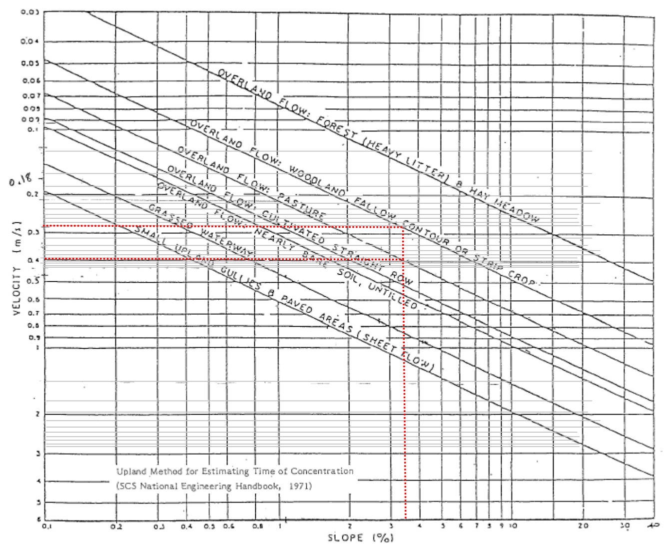
C.1 TABLES SUMMARIZING EXISTING CONDITION ASSUMPTIONS

160401602 - Wellings of Brockville - Functional Design
Model Input
Parameter Summary - Existing Conditions
Last updated on 2021-03-21

Existing Conditions												
Model Catchment ID	Description	Area (ha)	Gradient (%)		XIMP (%)	TIMP (%)	Length (m)		Velocity (m/s)		Tc (hrs)	Tp (hrs)
			Overland (Pasture)	Overland (Woodlot)			Overland (Pasture)	Overland (Woodlot)	Overland (Pasture)	Overland (Woodlot)		
SITE	Entire Site (All Phases), Pre-Development Condition *NB: excludes environmental protection area*	3.76	3.5%	3.5%	0.0%	0.0%	62	200	0.38	0.28	0.24	0.16
Total Area		3.76										
											Tc (min)	**Tp (min)**
											14.6	9.8

Existing Land Use Area (ha)							
Woodlot	Gravel	Lawns	Crop	Fallow	Pasture	Meadow	Residence (Impervious)
1.98	0.00	0.00	0.00	0.00	1.75	0.00	0.03

Uplands Method Velocity Determination



Pre-Development Weighted C (Runoff Coefficient) Calculations for Wellings of Brockville, Entire Site
Stantec Project No. 160401602
Last updated on 2021-03-21

	Area (m^2)	C
Pervious Area:	37226	0.2
Impervious Area:	344	0.9
	WEIGHTED C:	**0.21**
	TOTAL A (ha):	**3.76**

Notes:
1. Entire site area (3.76 ha) does not include the environmentally protected area which is not to be developed.

Impervious Area Breakdown:

Area ID	Area (m^2)
3064 Parkedale Avenue Building and Deck	118
3064 Parkedale Avenue Driveway	66
3076 Parkedale Avenue Building	94
3076 Parkedale Avenue Driveway	66
Total impervious area (m^2):	**344**

Wellings of Brockville - Rational Method Pre-Development Target Flow Calculation
Stantec Project No. 160401602
Last updated on 2021-03-26 by AMP

5 yr Intensity
City of Brockville IDF curve

$I = A*(T\ of\ C)^B$ A = 28.5, B = -0.685

t (min)	I (mm/hr)
10	97.25
15	73.66
30	45.82
40	37.62
50	32.29
60	28.50
70	25.64
80	23.40
90	21.59
100	20.09
110	18.82
120	17.73

IDF Curve from Environment Canada
(Brockville Station 6100971):

	1:2 yr	1:5 yr	1:10 yr	1:100 yr
A =	20.4	27.1	31.5	45.3
B =	-0.699	-0.699	-0.699	-0.699

Units: 'T of C' is in hours, 'I' is in mm/hr

5 YEAR Predevelopment Target Release from Site

Subdrainage Area: Predevelopment Tributary Area to Outlet
Area (ha): 3.76 *(Entire site excl. environmental protection area)*
C: 0.21 *(Refer to 2021-03-21_C_Calcs.xlsx)*

Time of concentration (tc) of 14.6 minutes calculated using Uplands Method. Refer to existing_2021-03-21_djc.xlsx

tc (min)	I (5 yr) (mm/hr)	Qtarget (L/s)
14.6	75.04	**164.7**

100 yr Intensity
City of Brockville IDF curve

$I = A*(T\ of\ C)^B$ A = 48.7, B = -0.690

t (min)	I (mm/hr)
10	167.67
15	126.75
30	78.57
40	64.42
50	55.23
60	48.70
70	43.79
80	39.93
90	36.82
100	34.23
110	32.05
120	30.19

100 YEAR Predevelopment Target Release from Site

Subdrainage Area: Predevelopment Tributary Area to Outlet
Area (ha): 3.76 *(Entire site excl. environmental protection area)*
C: 0.21 *(Refer to 2021-03-21_C_Calcs.xlsx)*

Time of concentration (tc) of 14.6 minutes calculated using Uplands Method. Refer to existing_2021-03-21_djc.xlsx

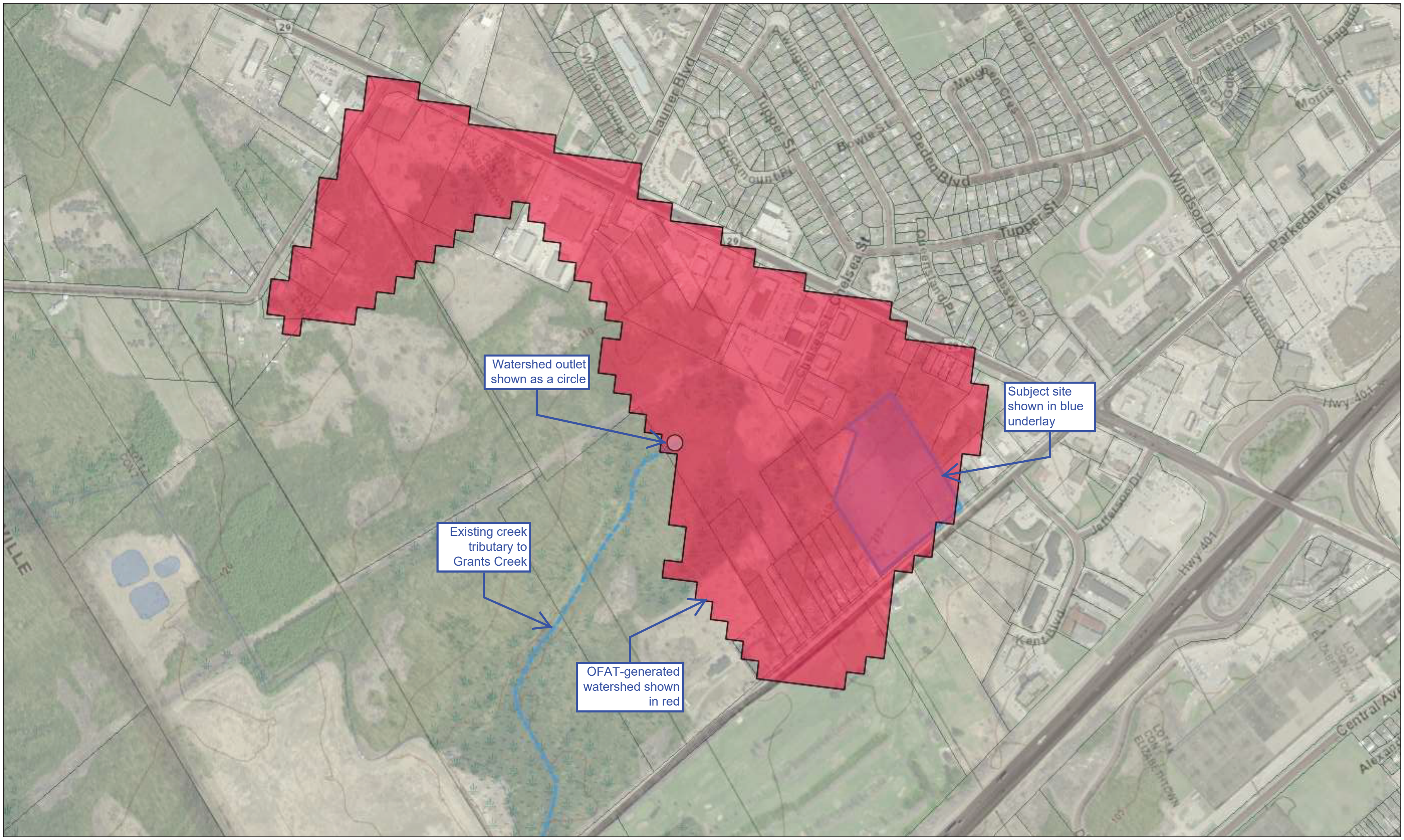
tc (min)	I (100 yr) (mm/hr)	Qtarget (L/s)
14.6	129.14	**283.5**

C.2 OFAT-GENERATED WATERSHED

Ontario MINISTRY OF NATURAL RESOURCES AND FORESTRY
Ontario Flow Assessment Tools

Wellings of Brockville - OFAT

Notes: OFAT figure generated on 2021-03-25 by Stantec Consulting Ltd.



Legend

- Assessment Parcel
- Secondary Watershed
- Tertiary Watershed
- Quaternary Watershed
- Great Lakes - St. Lawrence Basin
- Hudson - James Bay Basin
- Nelson River Basin
- Diversions
- Waterbody Outlet
- Conservation Authority Dam
- Provincial Dam
- Federal Dam
- OPG Dam
- Other Dam
- HYDAT Gauge
- HYDAT Gauge (RHBN)
- Virtual Flow Segment

Land Cover Compilation

- Other
- Cloud/Shadow
- Clear Open Water
- Turbid Water
- Shoreline
- Mudflats
- Marsh
- Swamp
- Fen
- Bog
- Heath
- Sparse Treed
- Treed Upland
- Deciduous Treed
- Mixed Treed
- Coniferous Treed
- Plantations - Treed Cultivated
- Hedge Rows
- Disturbance
- Open Cliff and Talus
- Alvar
- Sand Barren and Dune
- Open Tallgrass Prairie
- Tallgrass Savannah
- Tallgrass Woodland
- Sand/Gravel/Mine Tailings/Extraction
- Bedrock
- Community/Infrastructure
- Agriculture and Undifferentiated Rural Land Use

0.3 0 km 0.16 0.3

Scale: 1 : 6,428

Projection: Web Mercator

C.3 POST-DEVELOPMENT RUNOFF COEFFICIENT CALCULATIONS

Post-Development Weighted C (Runoff Coefficient) Calculations for Wellings of Brockville, Entire Site
Based on Conceptual Site Plan from 2021-03-02 Prepared by NLG, with Conceptual SWM Pond and SAN Pump Station Block Added
Stantec Project No. 160401602
Last updated on 2021-03-21

	Area (m^2)	C
Pervious Area:	15545	0.2
Impervious Area:	22025	0.9
	WEIGHTED C:	**0.61**
	TOTAL A (ha):	**3.76**

Notes:
1. Entire site area (3.76 ha) does not include the environmentally protected area which is not to be developed.
2. Entire SWM pond area considered to be impervious for the purpose of these calculations.
3. Sanitary pump station anticipated within current Block 26 footprint. Only Block 26 footprint used as an impervious areas for these calculations. Impervious areas have not been double counted.
4. There are no Blocks 11 through 22 per the latest site plan (dated 2021-03-02).

Impervious Area Breakdown:

Area ID	Area (m^2)
Roads and sidewalks throughout entire site:	8748
Block 1	609
Block 2	470
Block 3	477
Block 4	609
Block 5	468
Block 6	471
Block 7	462
Block 8	470
Block 9	609
Block 10	609
Block 23	467
Block 24	466
Block 25	467
Block 26 (will likely need to be eliminated to accommodate SWM pond and SAN pump station; impervious area calculation unaffected)	720
Block 27	610
Block 28	610
Block 29	667
Block 30	480
Block 31	474
Block 32	468
Clubhouse (incl. future additions)	628
All of SWM pond block conservatively assumed to be impervious	1966
Total impervious area (m^2):	**22025**

C.4 POND INLET SEWER DESIGN SHEET

Stantec	Wellings of Brockville		STORM SEWER DESIGN SHEET (City of Ottawa)
	DATE:	2021-03-26	
	REVISION:	0	
	DESIGNED BY:	AMP	FILE NUMBER: 160401602
	CHECKED BY:		Preliminary Storm Sewer Sizing

DESIGN PARAMETERS

$I = a / (t+b)^c$ (As per EC Station #6100971 for Brockville, ON)

	1:2 yr	1:5 yr	1:10 yr	1:100 yr			
a =	341.527	470.846	556.335	821.208	MANNING'S n =	0.013	BEDDING CLASS = B
b =	0.000	0.000	0.000	0.000	MINIMUM COVER:	2.00	m
c =	0.680	0.685	0.687	0.690	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) (-)
Site Area	STM	Pond Inlet	0.00	3.76	0.00	0.00	0.00	0.00	0.65	0.00	0.00

DRAINAGE AREA (continued)

AREA ID NUMBER	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)	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)
Site Area	0.000	0.000	2.444	2.444	0.000	0.000	0.000	0.000	10.00	71.36	97.25	114.38	167.67	0.00	0.0	660.2
									10.12							

PIPE SELECTION

AREA ID NUMBER	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)
Site Area	10.0	825	825	CIRCULAR	PVC	-	0.25	748.8	**88.17%**	1.36	1.37	0.12

C.5 POND SIZING CALCULATIONS

Job # 160401602 - Wellings of Brockville, Brockville ON

Stormwater Quality Volumetric Requirements

Pond	Drainage Area (ha)	Actual % Imp.	MOE Control Level	Water Quality Unit Volume Requirments			Water Quality Volume Requirements			Water Quality Volumes Provided			
				Total Unit Volume (m^3/ha)	Permanent Pool (m^3/ha)	Extended Detention (m^3/ha)	Permanent Pool (m^3)	Extended Detention (m^3)	Total MOE Volume	Permanent Pool (m^3)	Extended Detention (m^3)	Total MOE Volume	Actual Provided Unit Volume (m^3/ha)
Wet Pond	3.76	64.3	Enhanced - 80% TSS Removal	215	175.5	40	660	150	810	1,180	551	1,731	460

For use in Interpolation of above formulae

	Wetpond					Wetland			
%	0	35	55	70	85	35	55	70	85
Enhanced - 80% TSS Removal	0	140	190	225	250	80	105	120	140
Normal - 70% TSS Removal	0	90	110	130	150	60	70	80	90
Basic - 60% TSS Removal	0	60	75	85	95	60	60	60	60

Job # 160401602 - Wellings of Brockville, Brockville ON
Conceptual Stage-Storage-Discharge Summary

Stage	Discharge	Storage		Depth	Forebay			Main Cell			
		Active	Total*		Area	Incremental Volume	Accumulated Volume	Area	Incremental Volume	Accumulated Volume	
(m)	(m^3/s)	(m^3)	(m^3)	(m)	(m^2)	(m^3)	(m^3)	(m^2)	(m^3)	(m^3)	
105.50		0	0	0.00	137	0	0	319	0	0	
105.70		0	0	0.20	168	30	30	392	71	71	
106.10		0	279	0.60	230	80	110	537	186	257	
106.50		0	627	1.00	292	105	215	682	244	501	
107.00		0	1,180	1.50	370	166	380	864	387	887	Permanent Pool
107.00		0	1,180	1.50	0	0	380	1,234	0	887	
107.40		551	1,731	0.40	0	0	380	1,521	551	1,438	Ext. Det.
107.60		869	2,049	0.60	0	0	380	1,664	318	1,757	
107.80		1,216	2,396	0.80	0	0	380	1,807	347	2,104	
107.90		1,401	2,580	0.90	0	0	380	1,879	184	2,288	
108.00		1,592	2,772	1.00	0	0	380	1,950	191	2,479	
108.10		1,791	2,970	1.10	0	0	380	2,022	199	2,678	100yr
108.30		2,203	3,383	1.30	0	0	380	2,100	412	3,090	

* Total pond including forebay, excluding sediment storage (see forebay calculations)

Job # 160401602 - Wellings of Brockville, Brockville ON

Conceptual Outlet Structure Discharge Calculations

Elevation (m)	Discharge (m^3/s) Overflow Outlet	Spillway	Total	Piped Outlet Orifice 1	Orifice 2		Control	Weir 1	Total Discharge
105.50									
106.10									
106.50									
107.00									0.000
107.00		0.000	0.000	0.000	0.000		0.000	0.000	0.000
107.40		0.000	0.000	0.009	0.000		0.000	0.000	**0.009**
107.60		0.000	0.000	0.011	0.038		0.038	0.000	**0.049**
107.80		0.000	0.000	0.013	0.054		0.054	0.000	**0.067**
107.90		0.000	0.000	0.014	0.060		0.060	0.039	**0.112**
108.00		0.000	0.000	0.015	0.066		0.066	0.109	**0.189**
108.10		0.000	0.000	0.015	0.071		0.071	0.200	**0.286**
108.16		0.000	0.000	0.016	0.074		0.074	0.263	**0.353**
108.30		0.000	0.000	0.017	0.081		0.081	0.431	**0.528**

1. Outlet structure consists of orifice #1 (created by equivalent sluice gate orientation)
2. Secondary outlet is Weir#1 in weir wall inside structure

Parameters

Spillway Weir	Parameter	Value	Parameter	Value
	Orifice 1			
	Orifice Centre	107.0415 m	Perimeter	0.261 m
	Orifice Invert	107.00 m	Area	0.0054 m^2
	Orifice Diameter	83 mm	Orifice Coeff.	0.61
	Orientation	Vertical	Permanent Pool	107.00 m
Spillway Weir	**Orifice 2**			
Crest Elevation 108.3 m	Orifice Centre	107.5 m	Perimeter	0.628 m
Crest Width 5 m*	Orifice Invert	107.40 m	Area	0.0314 m^2
Weir Coeff. 1.740	Orifice Diameter	200 mm	Orifice Coeff.	0.61
	Orientation	Vertical		
	Weir 1			
	Top of Weir Structure	108.00 m	Max Perimeter	0.700 m
	Weir Crest Invert	107.80 m	Max Open Area	0.140 m^2
	Weir Dimensions (Height x Length)	0.20 m Height		0.70 m Len
	Side Walls	Vertical	Weir Coeff.	1.740

0.7 m long weir at inv. = 107.8
83 mm lowflow outlet at inv. = 107 m
200 mm outlet at inv. = 107.4 m

C.6 SAMPLE PCSWMM INPUT FILE

```
[TITLE]
;; 160401602 – Wellings of Brockville – PCSWMM Input File for 100-year 24-hour SCS Type II Storm


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

START_DATE           09/14/2011
START_TIME           00:00:00
REPORT_START_DATE    09/14/2011
REPORT_START_TIME    00:00:00
END_DATE             09/16/2011
END_TIME             00:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          00:01:00
WET_STEP             00:05:00
DRY_STEP             00:05:00
```

```
ROUTING_STEP         5
RULE_STEP            00:00:00

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  D-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              2

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

[RAINGAGES]
;;Name           Format    Interval SCF      Source
;;-------------- --------- -------- -------- ----------
RG1              INTENSITY 0:06     1.0      TIMESERIES 100yr_24hr_SCS_Brockville
```

```
[SUBCATCHMENTS]
;;Name           Rain Gage        Outlet           Area     %Imperv  Width    %Slope   CurbLen  SnowPack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- ----------------
Site             RG1              POND             3.76     64.286   846      3        0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
Site             0.013      0.25       1.57       4.67       0          OUTLET

[INFILTRATION]
;;Subcatchment   Param1     Param2     Param3     Param4     Param5
;;-------------- ---------- ---------- ---------- ---------- ----------
Site             76.2       13.2       4.17       7          0

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route To
;;-------------- ---------- ---------- ---------------- -------- ----------------
OF1              106.7      FREE                        NO

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve Name/Params            N/A      Fevap    Psi      Ksat     IMD
;;-------------- -------- ---------- ---------- ---------- ---------------------------- -------- --------          -------- --------
POND             105.5    2.8        1.5        TABULAR    pond                       0        0
S2               107      1.3        0          FUNCTIONAL 0         0         0        0        0
```

```
[CONDUITS]
;;Name           From Node        To Node          Length     Roughness  InOffset   OutOffset  InitFlow   MaxFlow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ---------- ----------
C1               S2               OF1              33         0.025      107        106.7      0          0

[ORIFICES]
;;Name           From Node        To Node          Type         Offset     Qcoeff     Gated    CloseTime
;;-------------- ---------------- ---------------- ------------ ---------- ---------- -------- ----------
OR2              POND             S2               SIDE         107.4      0.61       NO       0
QUAL-ORF         POND             S2               SIDE         107        0.61       NO       0

[WEIRS]
;;Name           From Node        To Node          Type         CrestHt    Qcoeff     Gated    EndCon   EndCoeff   Surcharge  RoadWidth  RoadSurf
Coeff. Curve
;;-------------- ---------------- ---------------- ------------ ---------- ---------- -------- -------- ---------- ---------- ---------- ----------
----------------
W1               POND             S2               TRANSVERSE   107.8      1.74       NO       0        0          YES

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels    Culvert
;;-------------- ------------ ---------------- ---------- ---------- ---------- ---------- ----------
C1               TRAPEZOIDAL  2                0.5        3          3          1
OR2              CIRCULAR     0.2              0          0          0
QUAL-ORF         CIRCULAR     0.083            0          0          0
W1               RECT_OPEN    0.2              0.7        0          0
```

```
[LOSSES]
;;Link           Kentry     Kexit      Kavg       Flap Gate  Seepage
;;-------------- ---------- ---------- ---------- ---------- ----------

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
pond             Storage    0          456
pond                        0.2        560
pond                        0.6        767
pond                        1          975
pond                        1.5        1234
pond                        1.9        1521
pond                        2.1        1664
pond                        2.3        1807
pond                        2.4        1879
pond                        2.5        1950
pond                        2.6        2022
pond                        2.8        2100

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------

100yr_24hr_SCS_Brockville            0:00       1.19079
```

```
100yr_24hr_SCS_Brockville        0:06      1.19079
100yr_24hr_SCS_Brockville        0:12      1.21437
100yr_24hr_SCS_Brockville        0:18      1.21437
100yr_24hr_SCS_Brockville        0:24      1.23795
100yr_24hr_SCS_Brockville        0:30      1.23795
100yr_24hr_SCS_Brockville        0:36      1.26153
100yr_24hr_SCS_Brockville        0:42      1.26153
100yr_24hr_SCS_Brockville        0:48      1.28511
100yr_24hr_SCS_Brockville        0:54      1.28511
100yr_24hr_SCS_Brockville        1:00      1.30869
100yr_24hr_SCS_Brockville        1:06      1.30869
100yr_24hr_SCS_Brockville        1:12      1.33227
100yr_24hr_SCS_Brockville        1:18      1.33227
100yr_24hr_SCS_Brockville        1:24      1.35585
100yr_24hr_SCS_Brockville        1:30      1.35585
100yr_24hr_SCS_Brockville        1:36      1.37943
100yr_24hr_SCS_Brockville        1:42      1.37943
100yr_24hr_SCS_Brockville        1:48      1.40301
100yr_24hr_SCS_Brockville        1:54      1.40301
100yr_24hr_SCS_Brockville        2:00      1.42659
100yr_24hr_SCS_Brockville        2:06      1.42659
100yr_24hr_SCS_Brockville        2:12      1.45017
100yr_24hr_SCS_Brockville        2:18      1.45017
100yr_24hr_SCS_Brockville        2:24      1.47375
100yr_24hr_SCS_Brockville        2:30      1.47375
100yr_24hr_SCS_Brockville        2:36      1.49733
```

100yr_24hr_SCS_Brockville	2:42	1.49733
100yr_24hr_SCS_Brockville	2:48	1.52091
100yr_24hr_SCS_Brockville	2:54	1.52091
100yr_24hr_SCS_Brockville	3:00	1.54449
100yr_24hr_SCS_Brockville	3:06	1.54449
100yr_24hr_SCS_Brockville	3:12	1.56807
100yr_24hr_SCS_Brockville	3:18	1.56807
100yr_24hr_SCS_Brockville	3:24	1.59165
100yr_24hr_SCS_Brockville	3:30	1.59165
100yr_24hr_SCS_Brockville	3:36	1.61523
100yr_24hr_SCS_Brockville	3:42	1.61523
100yr_24hr_SCS_Brockville	3:48	1.63881
100yr_24hr_SCS_Brockville	3:54	1.63881
100yr_24hr_SCS_Brockville	4:00	1.66239
100yr_24hr_SCS_Brockville	4:06	1.68597
100yr_24hr_SCS_Brockville	4:12	1.70955
100yr_24hr_SCS_Brockville	4:18	1.73313
100yr_24hr_SCS_Brockville	4:24	1.75671
100yr_24hr_SCS_Brockville	4:30	1.78029
100yr_24hr_SCS_Brockville	4:36	1.80387
100yr_24hr_SCS_Brockville	4:42	1.82745
100yr_24hr_SCS_Brockville	4:48	1.85103
100yr_24hr_SCS_Brockville	4:54	1.87461
100yr_24hr_SCS_Brockville	5:00	1.89819
100yr_24hr_SCS_Brockville	5:06	1.92177
100yr_24hr_SCS_Brockville	5:12	1.94535

100yr_24hr_SCS_Brockville	5:18	1.96893
100yr_24hr_SCS_Brockville	5:24	1.99251
100yr_24hr_SCS_Brockville	5:30	2.01609
100yr_24hr_SCS_Brockville	5:36	2.03967
100yr_24hr_SCS_Brockville	5:42	2.06325
100yr_24hr_SCS_Brockville	5:48	2.08683
100yr_24hr_SCS_Brockville	5:54	2.11041
100yr_24hr_SCS_Brockville	6:00	2.13399
100yr_24hr_SCS_Brockville	6:06	2.15757
100yr_24hr_SCS_Brockville	6:12	2.18115
100yr_24hr_SCS_Brockville	6:18	2.20473
100yr_24hr_SCS_Brockville	6:24	2.22831
100yr_24hr_SCS_Brockville	6:30	2.25189
100yr_24hr_SCS_Brockville	6:36	2.27547
100yr_24hr_SCS_Brockville	6:42	2.29905
100yr_24hr_SCS_Brockville	6:48	2.32263
100yr_24hr_SCS_Brockville	6:54	2.34621
100yr_24hr_SCS_Brockville	7:00	2.36979
100yr_24hr_SCS_Brockville	7:06	2.39337
100yr_24hr_SCS_Brockville	7:12	2.41695
100yr_24hr_SCS_Brockville	7:18	2.44053
100yr_24hr_SCS_Brockville	7:24	2.46411
100yr_24hr_SCS_Brockville	7:30	2.48769
100yr_24hr_SCS_Brockville	7:36	2.51127
100yr_24hr_SCS_Brockville	7:42	2.53485
100yr_24hr_SCS_Brockville	7:48	2.55843

```
100yr_24hr_SCS_Brockville           7:54       2.58201
100yr_24hr_SCS_Brockville           8:00       2.65275
100yr_24hr_SCS_Brockville           8:06       2.77065
100yr_24hr_SCS_Brockville           8:12       2.88855
100yr_24hr_SCS_Brockville           8:18       3.00645
100yr_24hr_SCS_Brockville           8:24       3.12435
100yr_24hr_SCS_Brockville           8:30       3.24225
100yr_24hr_SCS_Brockville           8:36       3.36015
100yr_24hr_SCS_Brockville           8:42       3.47805
100yr_24hr_SCS_Brockville           8:48       3.59595
100yr_24hr_SCS_Brockville           8:54       3.71385
100yr_24hr_SCS_Brockville           9:00       3.7728
100yr_24hr_SCS_Brockville           9:06       3.7728
100yr_24hr_SCS_Brockville           9:12       3.7728
100yr_24hr_SCS_Brockville           9:18       3.7728
100yr_24hr_SCS_Brockville           9:24       3.7728
100yr_24hr_SCS_Brockville           9:30       3.86712
100yr_24hr_SCS_Brockville           9:36       4.05576
100yr_24hr_SCS_Brockville           9:42       4.2444
100yr_24hr_SCS_Brockville           9:48       4.43304
100yr_24hr_SCS_Brockville           9:54       4.62168
100yr_24hr_SCS_Brockville           10:00      4.85748
100yr_24hr_SCS_Brockville           10:06      5.14044
100yr_24hr_SCS_Brockville           10:12      5.4234
100yr_24hr_SCS_Brockville           10:18      5.70636
100yr_24hr_SCS_Brockville           10:24      5.98932
```

100yr_24hr_SCS_Brockville	10:30	6.3666
100yr_24hr_SCS_Brockville	10:36	6.8382
100yr_24hr_SCS_Brockville	10:42	7.3098
100yr_24hr_SCS_Brockville	10:48	7.7814
100yr_24hr_SCS_Brockville	10:54	8.253
100yr_24hr_SCS_Brockville	11:00	9.05472
100yr_24hr_SCS_Brockville	11:06	10.18656
100yr_24hr_SCS_Brockville	11:12	11.3184
100yr_24hr_SCS_Brockville	11:18	12.45024
100yr_24hr_SCS_Brockville	11:24	13.58208
100yr_24hr_SCS_Brockville	11:30	28.10736
100yr_24hr_SCS_Brockville	11:36	56.02608
100yr_24hr_SCS_Brockville	11:42	90.11097
100yr_24hr_SCS_Brockville	11:48	161.6055
100yr_24hr_SCS_Brockville	11:54	112.1701
100yr_24hr_SCS_Brockville	12:00	22.35384
100yr_24hr_SCS_Brockville	12:06	19.66572
100yr_24hr_SCS_Brockville	12:12	16.9776
100yr_24hr_SCS_Brockville	12:18	14.28948
100yr_24hr_SCS_Brockville	12:24	11.60136
100yr_24hr_SCS_Brockville	12:30	9.95076
100yr_24hr_SCS_Brockville	12:36	9.33768
100yr_24hr_SCS_Brockville	12:42	8.7246
100yr_24hr_SCS_Brockville	12:48	8.11152
100yr_24hr_SCS_Brockville	12:54	7.49844
100yr_24hr_SCS_Brockville	13:00	7.02684

```
100yr_24hr_SCS_Brockville           13:06      6.69672
100yr_24hr_SCS_Brockville           13:12      6.3666
100yr_24hr_SCS_Brockville           13:18      6.03648
100yr_24hr_SCS_Brockville           13:24      5.70636
100yr_24hr_SCS_Brockville           13:30      5.4234
100yr_24hr_SCS_Brockville           13:36      5.1876
100yr_24hr_SCS_Brockville           13:42      4.9518
100yr_24hr_SCS_Brockville           13:48      4.716
100yr_24hr_SCS_Brockville           13:54      4.4802
100yr_24hr_SCS_Brockville           14:00      4.32693
100yr_24hr_SCS_Brockville           14:06      4.23261
100yr_24hr_SCS_Brockville           14:12      4.16187
100yr_24hr_SCS_Brockville           14:18      4.06755
100yr_24hr_SCS_Brockville           14:24      3.99681
100yr_24hr_SCS_Brockville           14:30      3.90249
100yr_24hr_SCS_Brockville           14:36      3.83175
100yr_24hr_SCS_Brockville           14:42      3.73743
100yr_24hr_SCS_Brockville           14:48      3.66669
100yr_24hr_SCS_Brockville           14:54      3.57237
100yr_24hr_SCS_Brockville           15:00      3.50163
100yr_24hr_SCS_Brockville           15:06      3.40731
100yr_24hr_SCS_Brockville           15:12      3.33657
100yr_24hr_SCS_Brockville           15:18      3.24225
100yr_24hr_SCS_Brockville           15:24      3.17151
100yr_24hr_SCS_Brockville           15:30      3.07719
100yr_24hr_SCS_Brockville           15:36      3.00645
```

100yr_24hr_SCS_Brockville	15:42	2.91213
100yr_24hr_SCS_Brockville	15:48	2.84139
100yr_24hr_SCS_Brockville	15:54	2.74707
100yr_24hr_SCS_Brockville	16:00	2.69991
100yr_24hr_SCS_Brockville	16:06	2.66454
100yr_24hr_SCS_Brockville	16:12	2.64096
100yr_24hr_SCS_Brockville	16:18	2.60559
100yr_24hr_SCS_Brockville	16:24	2.58201
100yr_24hr_SCS_Brockville	16:30	2.54664
100yr_24hr_SCS_Brockville	16:36	2.52306
100yr_24hr_SCS_Brockville	16:42	2.48769
100yr_24hr_SCS_Brockville	16:48	2.46411
100yr_24hr_SCS_Brockville	16:54	2.42874
100yr_24hr_SCS_Brockville	17:00	2.40516
100yr_24hr_SCS_Brockville	17:06	2.36979
100yr_24hr_SCS_Brockville	17:12	2.34621
100yr_24hr_SCS_Brockville	17:18	2.31084
100yr_24hr_SCS_Brockville	17:24	2.28726
100yr_24hr_SCS_Brockville	17:30	2.25189
100yr_24hr_SCS_Brockville	17:36	2.22831
100yr_24hr_SCS_Brockville	17:42	2.19294
100yr_24hr_SCS_Brockville	17:48	2.16936
100yr_24hr_SCS_Brockville	17:54	2.13399
100yr_24hr_SCS_Brockville	18:00	2.11041
100yr_24hr_SCS_Brockville	18:06	2.07504
100yr_24hr_SCS_Brockville	18:12	2.05146

100yr_24hr_SCS_Brockville	18:18	2.01609
100yr_24hr_SCS_Brockville	18:24	1.99251
100yr_24hr_SCS_Brockville	18:30	1.95714
100yr_24hr_SCS_Brockville	18:36	1.93356
100yr_24hr_SCS_Brockville	18:42	1.89819
100yr_24hr_SCS_Brockville	18:48	1.87461
100yr_24hr_SCS_Brockville	18:54	1.83924
100yr_24hr_SCS_Brockville	19:00	1.81566
100yr_24hr_SCS_Brockville	19:06	1.78029
100yr_24hr_SCS_Brockville	19:12	1.75671
100yr_24hr_SCS_Brockville	19:18	1.72134
100yr_24hr_SCS_Brockville	19:24	1.69776
100yr_24hr_SCS_Brockville	19:30	1.66239
100yr_24hr_SCS_Brockville	19:36	1.63881
100yr_24hr_SCS_Brockville	19:42	1.60344
100yr_24hr_SCS_Brockville	19:48	1.57986
100yr_24hr_SCS_Brockville	19:54	1.54449
100yr_24hr_SCS_Brockville	20:00	1.5327
100yr_24hr_SCS_Brockville	20:06	1.52091
100yr_24hr_SCS_Brockville	20:12	1.52091
100yr_24hr_SCS_Brockville	20:18	1.50912
100yr_24hr_SCS_Brockville	20:24	1.50912
100yr_24hr_SCS_Brockville	20:30	1.49733
100yr_24hr_SCS_Brockville	20:36	1.49733
100yr_24hr_SCS_Brockville	20:42	1.48554
100yr_24hr_SCS_Brockville	20:48	1.48554

```
100yr_24hr_SCS_Brockville           20:54      1.47375
100yr_24hr_SCS_Brockville           21:00      1.47375
100yr_24hr_SCS_Brockville           21:06      1.46196
100yr_24hr_SCS_Brockville           21:12      1.46196
100yr_24hr_SCS_Brockville           21:18      1.45017
100yr_24hr_SCS_Brockville           21:24      1.45017
100yr_24hr_SCS_Brockville           21:30      1.43838
100yr_24hr_SCS_Brockville           21:36      1.43838
100yr_24hr_SCS_Brockville           21:42      1.42659
100yr_24hr_SCS_Brockville           21:48      1.42659
100yr_24hr_SCS_Brockville           21:54      1.4148
100yr_24hr_SCS_Brockville           22:00      1.4148
100yr_24hr_SCS_Brockville           22:06      1.40301
100yr_24hr_SCS_Brockville           22:12      1.40301
100yr_24hr_SCS_Brockville           22:18      1.39122
100yr_24hr_SCS_Brockville           22:24      1.39122
100yr_24hr_SCS_Brockville           22:30      1.37943
100yr_24hr_SCS_Brockville           22:36      1.37943
100yr_24hr_SCS_Brockville           22:42      1.36764
100yr_24hr_SCS_Brockville           22:48      1.36764
100yr_24hr_SCS_Brockville           22:54      1.35585
100yr_24hr_SCS_Brockville           23:00      1.35585
100yr_24hr_SCS_Brockville           23:06      1.34406
100yr_24hr_SCS_Brockville           23:12      1.34406
100yr_24hr_SCS_Brockville           23:18      1.33227
100yr_24hr_SCS_Brockville           23:24      1.33227
```

```
100yr_24hr_SCS_Brockville            23:30      1.32048
100yr_24hr_SCS_Brockville            23:36      1.32048
100yr_24hr_SCS_Brockville            23:42      1.30869
100yr_24hr_SCS_Brockville            23:48      1.30869
100yr_24hr_SCS_Brockville            23:54      1.2969

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

[TAGS]
Subcatch   Site             post

[MAP]
DIMENSIONS       409174.5931      4997469.4735     409862.7289      4997774.8885
UNITS            Meters

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
OF1              409355.328         4997626.696
POND             409419.886         4997658.194
```

```
S2               409383.833         4997640.086


[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
OR2              409354.052         4997693.719
QUAL-ORF         409376.814         4997672.858
W1               409426.302         4997627.035
```

C.7 SAMPLE PCSWMM OUTPUT FILE

```
[TITLE]

;; 160401602 – Wellings of Brockville – PCSWMM Report File for 100-year 24-hour SCS Type II Storm

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

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

  *********************************************************

  NOTE: The summary statistics displayed in this report are

  based on results found at every computational time step,

  not just on results from each reporting time step.

  *********************************************************

  ****************

  Analysis Options

  ****************

  Flow Units ............... LPS

  Process Models:

    Rainfall/Runoff ........ YES

    RDII ................... NO

    Snowmelt ............... NO

    Groundwater ............ NO

    Flow Routing ........... YES

    Ponding Allowed ........ NO

    Water Quality .......... NO

  Infiltration Method ...... HORTON

  Flow Routing Method ...... DYNWAVE

  Surcharge Method ......... EXTRAN

  Starting Date ............ 09/14/2011 00:00:00
```

```
Ending Date .............. 09/16/2011 00:00:00

Antecedent Dry Days ...... 0.0

Report Time Step ......... 00:01:00

Wet Time Step ............ 00:05:00

Dry Time Step ............ 00:05:00

Routing Time Step ........ 5.00 sec

Variable Time Step ....... NO

Maximum Trials ........... 8

Number of Threads ........ 1

Head Tolerance ........... 0.001500 m



**************************        Volume         Depth

Runoff Quantity Continuity     hectare-m            mm

**************************     ---------       -------

Total Precipitation ......         0.443       117.900

Evaporation Loss .........         0.000         0.000

Infiltration Loss ........         0.113        29.950

Surface Runoff ...........         0.328        87.216

Final Storage ............         0.004         1.009

Continuity Error (%) .....        -0.234



**************************        Volume        Volume

Flow Routing Continuity        hectare-m      10^6 ltr

**************************     ---------     ---------
```

```
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.328         3.282
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.318         3.184
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.127         1.268
Final Stored Volume ......         0.137         1.365
Continuity Error (%) .....        -0.003


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


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     5.00 sec
Average Time Step           :     5.00 sec
Maximum Time Step           :     5.00 sec
```

```
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00
Percent 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
Site	117.90	0.00	0.00	29.95	74.90	12.32	87.22	3.28	1523.41	0.740

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

OF1	OUTFALL	0.04	0.20	106.90	0	12:09	0.20
POND	STORAGE	1.82	2.66	108.16	0	12:08	2.66
S2	STORAGE	0.05	0.22	107.22	0	12:09	0.22

****

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
OF1	OUTFALL	0.00	258.24	0 12:09	0	3.18	0.000
POND	STORAGE	1523.41	1523.41	0 11:54	3.28	4.55	0.000
S2	STORAGE	0.00	258.24	0 12:08	0	3.18	0.006

****

Node Surcharge Summary

****

No nodes were surcharged.

****

Node Flooding Summary

****

No nodes were flooded.

```
**********************
Storage Volume Summary
**********************


--------------------------------------------------------------------------------------------------
                       Average     Avg  Evap Exfil       Maximum     Max    Time of Max    Maximum
                        Volume    Pcnt  Pcnt  Pcnt        Volume    Pcnt     Occurrence    Outflow
Storage Unit           1000 m3    Full  Loss  Loss       1000 m3    Full    days hr:min        LPS
--------------------------------------------------------------------------------------------------
POND                     1.722      50     0     0         3.178      92       0  12:08     258.24
S2                       0.000       0     0     0         0.000       0       0  00:00     258.24


***********************
Outfall Loading Summary
***********************


-----------------------------------------------------------
                       Flow       Avg       Max       Total
                       Freq      Flow      Flow      Volume
Outfall Node           Pcnt       LPS       LPS    10^6 ltr
-----------------------------------------------------------
OF1                   96.56     19.08    258.24       3.184
-----------------------------------------------------------
System                96.56     19.08    258.24       3.184
```

****

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
C1	CONDUIT	258.24	0 12:09	1.06	0.01	0.11
OR2	ORIFICE	68.90	0 12:08			1.00
QUAL-ORF	ORIFICE	14.15	0 12:08			1.00
W1	WEIR	175.19	0 12:08			1.00

****

Flow Classification Summary

****

Conduit	Adjusted /Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
		---------- Fraction of Time in Flow Class ----------								
C1	1.00	0.03	0.00	0.00	0.97	0.00	0.00	0.00	0.00	0.00

****

Conduit Surcharge Summary

****

```
No conduits were surcharged.


Analysis begun on:  Fri Mar 26 14:41:02 2021

Analysis ended on:  Fri Mar 26 14:41:02 2021

Total elapsed time: < 1 sec
```

APPENDIX D – CONCEPTUAL SITE PLAN (MARCH 2, 2021)

LAND AREA & LOT COVERAGE SUMMARY

TOTAL LAND AREA = 55,863.5 SQM (13.8 ACRES) — TOTAL COVERAGE = 100.000%

PHASE 1 AREA = 28,581.8 SQM (7.1 ACRES) = 51.4%

PHASE 2 AREA = 5,039.9 SQM (1.3 ACRES) = 9.4%

PHASE 3 AREA = 4,532.7 SQM (1.1 ACRES) = 8.0%

O.P. E.P. ZONE = 17,709.1 SQM (4.4 ACRES) = 31.9%

AREA OF BLOCK OF 2 = 179.75 SQM (0.044 ACRES) x 0 UNITS = 000.00 SQM (0.00 ACRES) = 0.000%

AREA OF BLOCK OF 4 = 312.28 SQM (0.077 ACRES) x 12 UNITS = 3,747.36 SQM (0.93 ACRES) = 6.74%

AREA OF BLOCK OF 5 = 401.55 SQM (0.099 ACRES) x 6 UNITS = 2,409.3 SQM (0.59 ACRES) = 4.27%

AREA OF BLOCK OF 6 = 444.82 SQM (0.110 ACRES) x 2 UNITS = 889.64 SQM (0.22 ACRES) = 1.59%

AREA OF CLUBHOUSE = 546.20 SQM (0.135 ACRES) = 0.978%

TOTAL LOT COVERAGE BY ALL BUILDINGS (BLOCKS + CLUBHOUSE) = 7,592.5 SQM (1.875 ACRES) = 13.58%

PARKING SPACES:

CLUBHOUSE: 34 TOTAL SPACES + 4 ACCESSIBLE CLOSE TO BUILDING

RESIDENTIAL VISITOR PARKING:
P1: 7 SPACES
P2: 7 SPACES
P3: 7 SPACES
P6: 7 SPACES
P7: 5 SPACES
TOTAL: 33 PROVIDED (23 REQ'D BASED ON 0.25 SPACES PER UNIT)

RESIDENTIAL UNIT & TOTAL AREA COUNT SUMMARY

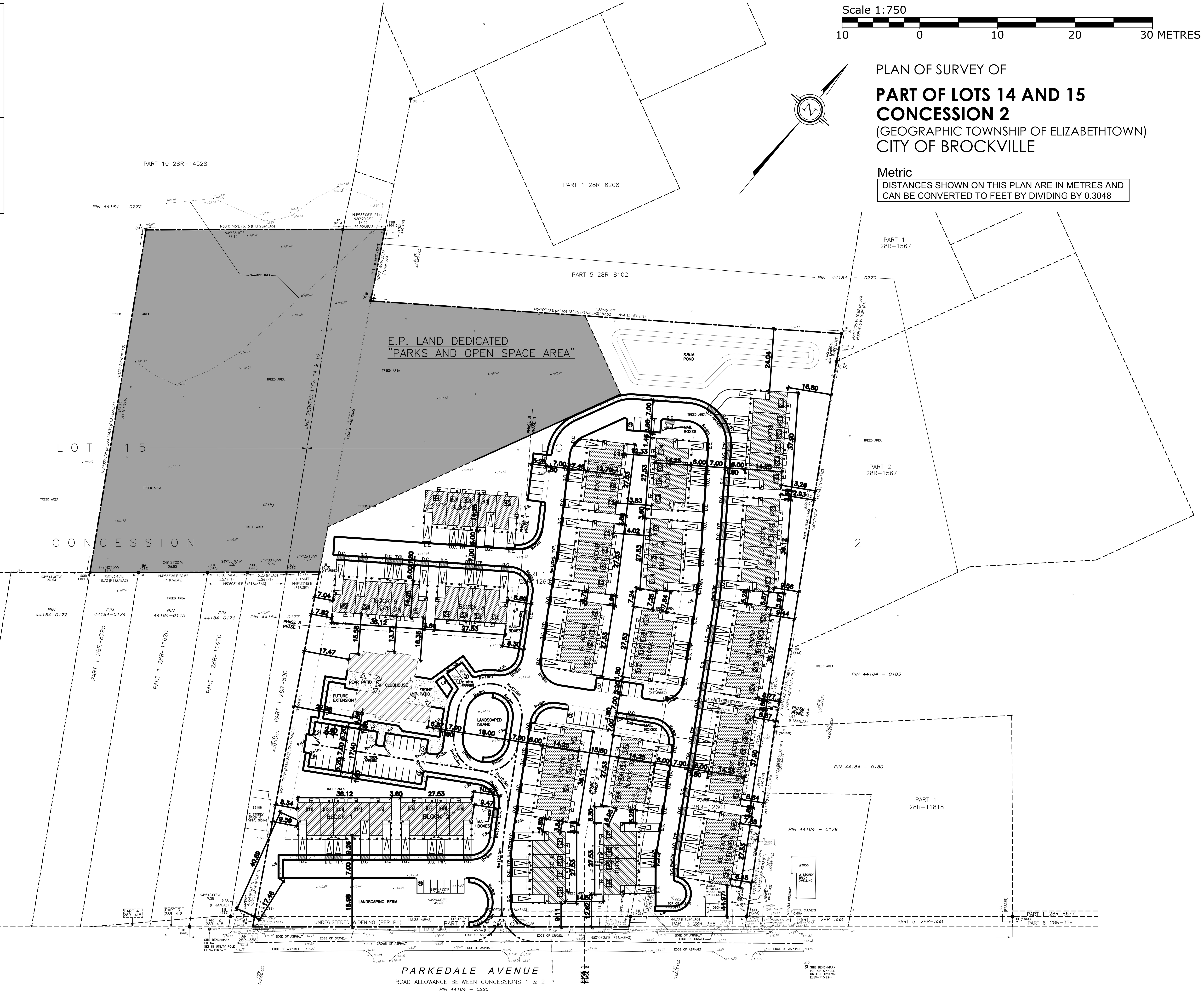
TOTAL RESIDENTIAL UNITS = 151 UNITS
44 = 1-BEDROOM = 48.8%
46 = 2-BEDROOM = 51.2%

CLUBHOUSE IN PHASE 1

ALL UNITS AND CLUBHOUSE ARE 1-STOREY

RESIDENTIAL UNIT BREAKDOWN

BLOCK #	1 BDRM	2 BDRM	TOTALS
BLOCK 1	2	3	5
BLOCK 2	2	2	4
BLOCK 3	2	2	4
BLOCK 4	2	3	5
BLOCK 5	2	2	4
BLOCK 6	2	2	4
BLOCK 7	2	2	4
BLOCK 8	2	2	4
BLOCK 9	2	3	5
BLOCK 10	2	3	5
BLOCK 23	2	2	4
BLOCK 24	2	2	4
BLOCK 25	2	2	4
BLOCK 26	4	2	6
BLOCK 27	2	3	5
BLOCK 28	2	3	5
BLOCK 29	4	2	6
BLOCK 30	2	2	4
BLOCK 31	2	2	4
BLOCK 32	2	2	4
TOTAL	44	46	90



G:\NLG Projects\NLG LOGOS\LATEST LOGOS\01 APR17'12\Wellings_Logo_FINAL.jpg

DEVELOPER INFORMATION:
NLGC Inc.
2962 Carp Road, Ottawa, ON., K0A 1L0

OWNER INFORMATION:

ARCHITECT'S INFORMATION:

REVISIONS		
1	ISSUED FOR CONCEPTUAL REVIEW	JAN15'21
2	ISSUED FOR CONCEPTUAL REVIEW	MAR2'21
3		
4		

PROJECT: WELLINGS OF BROCKVILLE

DRAWING: CONCEPTUAL SITE PLAN

ISSUE DATE: MAR 2020

SCALE 1:750

DRAWN BY M.W./T.S.L.

PROJECT NO. 1913

DRAWING NO. A101

APPENDIX E – CORRESPONDENCE WITH THE CITY OF BROCKVILLE

Chochlinski, Daniel

From: Moroz, Peter
Sent: Tuesday, March 9, 2021 11:01 AM
To: Johnson, Warren; Paerez, Ana; Chochlinski, Daniel
Cc: Bays, Eric
Subject: FW: Proposed Development - Parkedale Avenue
Attachments: 1969.pdf; 1976.pdf; 2177.pdf; 2540.pdf; 2546.pdf; 2547.pdf; 5482.pdf; 11243_10.pdf

Here is the background.

Peter

Peter Moroz P.Eng., MBA
Managing Principal, Community Development

Stantec
400 - 1331 Clyde Avenue Ottawa ON K2C 3G4

Phone: (613) 724-4082
Cell: (613) 294-2851

peter.moroz@stantec.com

From: Steve Allen <sallen@brockville.com>
Sent: Wednesday, September 23, 2020 2:41 PM
To: Bays, Eric <Eric.Bays@stantec.com>; Moroz, Peter <peter.moroz@stantec.com>
Cc: Jon Faurschou <jfaurschou@brockville.com>
Subject: RE: Proposed Development - Parkedale Avenue

Yes there is a gravity sanitary sewer in front of the property, see attached drawings. The site you are looking at has a lot of fall away from Parkdale Ave. which may result in having to pump on your site to the sewer. There is a possibility of tying into the sewers on Chelsea Street located north of your property depending on the development flows and outlet points.

I have attach some drawings as requested let me know if you require anything else.

As previously discussed you would have to extend the water main for the entire frontage of your site.

Steve

BROCKVILLE
CITY OF THE 1000 ISLANDS

Steven Allen C.E.T., Dipl.M.M.
Supervisor Engineering

City of Brockville
1 King Street West., Brockville, Ontario, K6V
7A5
613-342-8772 ext 3223
sallen@brockville.com
www.brockville.com

From: Bays, Eric <Eric.Bays@stantec.com>
Sent: September 22, 2020 1:52 PM
To: Steve Allen <sallen@brockville.com>; Moroz, Peter <peter.moroz@stantec.com>
Cc: Jon Faurschou <jfaurschou@brockville.com>
Subject: RE: Proposed Development - Parkedale Avenue

Hi Steve- just wanted to follow up and confirm.

Based on the sewer mapping you provided there is a sanitary gravity line in front of the property (see markup attached with property highlighted). Is this line not available for connection? It appears that the forcemain from the landfill ends before reaching the property.

There also appears to be a hydrant in front of 7700 Parkedale (old Pizza Hut)- I believe it's hydrant H846 on the plan. Based on this I do not think we would need to extend the water line any more than 100m.

Let me know your thoughts on this Steve- appreciate your feedback.
Eric

Eric A. Bays MCIP, RPP
Intermediate Planner

Direct: 613 724-4080
Mobile: 613 220-5705
Eric.Bays@stantec.com

Stantec
400 - 1331 Clyde Avenue
Ottawa ON K2C 3G4

From: Steve Allen <sallen@brockville.com>
Sent: Tuesday, September 22, 2020 10:28 AM
To: Moroz, Peter <peter.moroz@stantec.com>; Bays, Eric <Eric.Bays@stantec.com>
Cc: Jon Faurschou <jfaurschou@brockville.com>
Subject: RE: Proposed Development - Parkedale Avenue

Peter

The water main is located approximately 700 m east of the site and the sewer main is located approximately 600 m east of the site. Find the hydrant flow attached for the closest hydrant H846. The sewer lines shown going by the site are sanitary force mains from the old landfill site (leachate force mains).

Steve

Steven Allen C.E.T., Dipl.M.M.
Supervisor Engineering

City of Brockville
1 King Street West., Brockville, Ontario, K6V

7A5
613-342-8772 ext 3223
sallen@brockville.com
www.brockville.com

From: Moroz, Peter <peter.moroz@stantec.com>
Sent: September 22, 2020 9:50 AM
To: Steve Allen <sallen@brockville.com>; Bays, Eric <Eric.Bays@stantec.com>
Subject: RE: Proposed Development - Parkedale Avenue

Steve, thank you for forwarding the sewer and water plans for the area. Just for clarification, the email from Andrew McGinnis (attached) indicated that there is no services to the site. I am assuming, he is refereeing to service stubs to the property, not the sewers and watermains, which appear to be there? Further, do you have any as-built info for the water and sanitary sewers so that we can use it for our functional design, and fire flow test for the water to confirm fire flows and pressures? Also, are there any water and sewer capacity issues limiting the development for this site?

Peter

Peter Moroz P.Eng., MBA
Managing Principal, Community Development

Stantec
400 - 1331 Clyde Avenue Ottawa ON K2C 3G4

Phone: (613) 724-4082
Cell: (613) 294-2851

peter.moroz@stantec.com

From: Steve Allen <sallen@brockville.com>
Sent: Friday, September 11, 2020 2:53 PM
To: Bays, Eric <Eric.Bays@stantec.com>
Cc: Moroz, Peter <peter.moroz@stantec.com>
Subject: RE: Proposed Development - Parkedale Avenue

Eric

Find attached the sewer and water plates for the area you are asking about, contact me if you have any questions.

The westerly pumping station is at the old landfill with two leachate force mains.

Steve

....

BROCKVILLE
CITY OF THE 1000 ISLANDS

Steven Allen C.E.T., Dipl.M.M.
Supervisor Engineering

City of Brockville
1 King Street West., Brockville, Ontario, K6V 7A5
613-342-8772 ext 3223
sallen@brockville.com
www.brockville.com

....

From: Bays, Eric <Eric.Bays@stantec.com>
Sent: September 11, 2020 2:39 PM
To: Steve Allen <sallen@brockville.com>
Cc: Moroz, Peter <peter.moroz@stantec.com>
Subject: FW: Proposed Development - Parkedale Avenue

Hello Steve,
Could you provide us with available servicing information in proximity to 3076 Parkedale Avenue (across from the former Highland Gold Course)?
My colleague is hoping to review to get a better idea of the site's constraints and capacity for a proposed residential development (attached concept).
Thank you,

Eric A. Bays MCIP, RPP
Intermediate Planner

Direct: 613 724-4080
Mobile: 613 220-5705
Eric.Bays@stantec.com

Stantec
400 - 1331 Clyde Avenue
Ottawa ON K2C 3G4

Stantec

From: Jon Faurschou <jfaurschou@brockville.com>
Sent: Thursday, July 9, 2020 11:24 AM
To: Bays, Eric <Eric.Bays@stantec.com>; colinmcsweeney66@gmail.com; JAKE KRZYZANOWSKI (jk@nlgc.com) <jk@nlgc.com>
Cc: Steve Allen <sallen@brockville.com>; Matthew Locke <mlocke@brockville.com>; Janette Loveys <jloveys@brockville.com>; Robert Nolan <rnolan@brockville.com>; Andrew McGinnis <amcginnis@brockville.com>
Subject: Proposed Development - Parkedale Avenue

Good Morning,

Please accept this e-mail as follow-up to our virtual meeting of 08 July 2020 to discuss the attached concept plan.

Attached is the last contact with Angela Mariani addressing 3064 Parkedale Avenue, Brockville.

As discussed, the following is a list of various links to applicable information:

Employment Lands:
https://brockville.com/index.cfm?ID=987
This site contains Staff Reports, supporting studies, and the applicable OPA & ZBLA by-laws.

City of Brockville Official Plan:
https://brockville.com/index.cfm?ID=332

City of Brockville Zoning By-law 0505-2014, as amended:
https://brockville.com/zoning-bylaw

PPS 2020:
https://files.ontario.ca/mmah-provincial-policy-statement-2020-accessible-final-en-2020-02-14.pdf

Probable Supporting Studies:
Section 6.4.13, 5. of the Official Plan identifies the following in regard to potential supporting studies:

"5. During the pre-application consultation process for an Official Plan amendment, Zoning By-law amendment, draft plan of subdivision/condominium, or consent application, the City may identify that the applicant is required to submit any of the following supporting studies at the time of the submission of an application, in accordance with the policies outlined in this Plan and/or accepted professional standards and/or guidelines as applicable:

i. Retail Market Impact Study;
ii. Municipal Financial Impact Assessment;
iii. Urban Design Strategy;
iv. Land and/or Marine Archaeological Impact Assessment;
v. Hydrogeological Study;
vi. Groundwater Impact Assessment;
vii. Environmental Impact Study (EIS);
viii. Record of Site Condition (RSC);
ix. Phase I Environmental Site Assessment (ESA);
x. Site Screening Questionnaire, where a Phase 1 Environmental Site Assessment (ESA) is not required;
xi. Noise and/or Vibration Study;
xii. Transportation Impact Study;
xiii. Parking Study;
xiv. Servicing Options Report;
xv. Stormwater Management Plan;
xvi. Planning Rationale Report;
xvii. Built Heritage Impact Study;
xviii. Lighting Study;
xix. Architectural Design and Massing Drawings that address Signature Architecture and Tall Building Guidelines;
xx. Shadow Study; and/or
xxi. Other studies relevant to the development and lands

Commercial Impact Study – to support reduction of available commercial lands;

Industrial Impact Study – to assess the potential Impact of residential development adjacent to and in close proximity to Industrially designed and zoned lands.

Concept plan including, but not limited to: all dimensions (internal road width, lot areas by type of construction, grading, type of tenure (freehold/condominium), street parking dimensions and counts, Zone provision table by lot to ensue zoning compliance, Parkland, clubhouse details, stormwater details, etc.

Archaeological Assessment:
http://www.mtc.gov.on.ca/en/archaeology/archaeology_assessments.shtml

Once more details have been provided and discussed, the list of supporting studies may be refined.
Various supporting studies may be combined, particularly the environmental studies.

Site Plan Control:
Townhouse development containing more than three units requires Site Plan Approval.
Parking lots containing five (5) or more parking spaces requires Site Plan Approval.
https://brockville.com/index.cfm?ID=333

Concurrent Applications:
Application for Official Plan Amendment, Zoning By-law Amendment and Plan of Subdivision may be submitted concurrently.

Fee Schedule:
The current City of Brockville Fee schedule is available at the following link:
Building: https://brockville.com/UploadedFiles/2019%20Building%20Permit%20Fees.pdf
Planning: https://brockville.com/images/sitepicts/Planning/Planning%20Fees%20-%20User%20Fees%202019%20incl_%20CRCA%20fees.pdf

Fees should be confirmed prior to submitting application(s).

Development Charges:
https://brockville.com/index.cfm?ID=996

Servicing Data:
Servicing data is available by contacting Steve Allen, Supervisor of Engineering at 613-342-8772, ext. 3223 or sallen@brockville.com.

Traffic Data:
Traffic data is available by contacting Matt Locke, Supervisor of Transit Services, at 613-342-8772, ext. 3225 or mlocke@brockcille.com.
Note: MTO should be contacted as part of the Traffic Impact Study as MTO is planning long range improvements to various intersections on the 401 corridor.

Pre-Consultation:
Pre-Consultation is mandatory.
However, due to Covid 19 restrictions, in person meetings are not being undertaken at this time.

Once the above-noted information is available, the Planning Department will review and circulate the information for comment to ensure a complete application is received.
This circulation will also clarify the required supporting studies.

As discussed, the Planning Department is available for virtual meetings at your convenience throughout the process and especially during the pre-submission process.

Please contact the Planning Department should you require any additional information.

Jonathan

J. Faurschou, BA(H), MPl., MCIP, RPP
Planner
Interim Chief Planning Officer
City of Brockville
One King Street West
P.O. Box 5000
Brockville, Ontario
K6V 7A5
Fax (613) 498-2793
Tel (613) 342-8772, ext. 4449

March 31, 2021

APPENDIX F – CONCEPTUAL SERVICING AND GRADING DRAWINGS

Appendix F – DRAWINGS