South Nepean Town Centre (SNTC) Block 4 – Site Servicing and Stormwater Management Report

Project #160401085

April 30, 2020

Prepared for:

Caivan Development Corporation

Prepared by:

Stantec Consulting Ltd.

Revision	Description	Author		Quality Check	Independent Review
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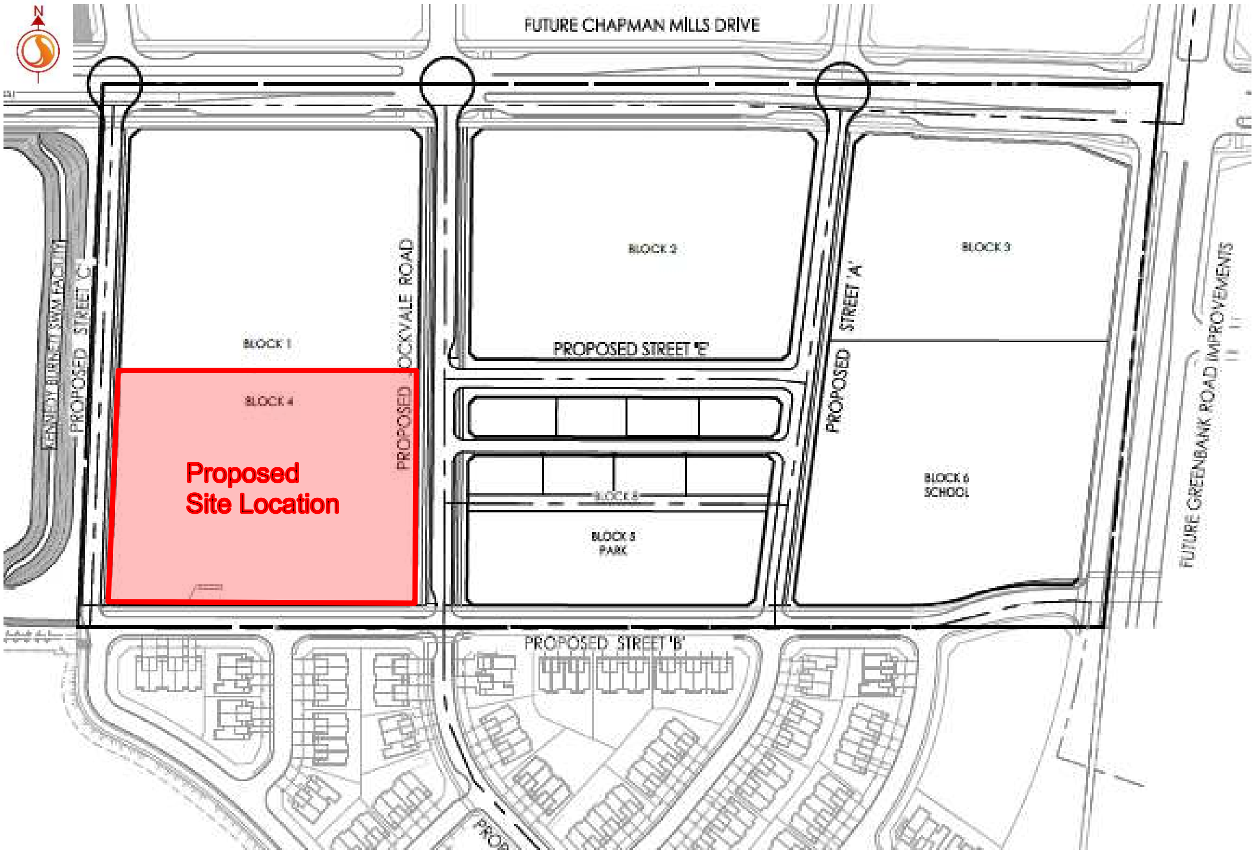
1.0 INTRODUCTION

Caivan Development Corporation has commissioned Stantec Consulting Ltd. to prepare the following Servicing and Stormwater Management Report for the South Nepean Town Centre (SNTC) Block 4. The subject property is located at the southwest quadrant of the SNTC subdivision, east of the Kennedy-Burnett Stormwater Management facility within the City of Ottawa, as indicated in **Figure 1.1.**The proposed residential development comprises approximately 1.59 ha of land, and consists of 116 back to back townhome units, associated private streets, and a parking area. The objective of this report is to provide a servicing scenario for the site that is free of conflicts, provides on-site servicing in accordance with City of Ottawa design guidelines, and utilizes the existing local infrastructure in accordance with the various background studies as well as the South Nepean Town Centre Site Servicing and Stormwater Management Report as outlined in **Section 2.0**.

Figure 1.1: Approximate Location of SNTC Block 4



2.0 REFERENCES

The following documents were referenced in the preparation of this report:

- South Nepean Town Centre(SNTC) Site Servicing and Stormwater Management Report, Stantec Consulting Ltd., February 2020
- South Nepean Town Centre (SNTC) – Functional Servicing Report, Stantec Consulting Ltd., October 2019
- Geotechnical Investigation – Proposed Residential Development – 3288 Greenbank Road, Paterson Group Inc., March 6, 2019
- City of Ottawa Design Guidelines – Water Distribution, Infrastructure Services Department, City of Ottawa, First Edition, July 2010
- City of Ottawa Sewer Design Guidelines, 2nd Ed., City of Ottawa, October 2012
- Technical Bulletin ISTB-2018-01 Revision to Ottawa Design Guidelines – Sewer, City of Ottawa, March 2018
- Technical Bulletin ISTB-2018-02 Revision to Ottawa Design Guidelines – Water Distribution, City of Ottawa, March 2018

3.0 POTABLE WATER

A detailed potable water servicing hydraulic analysis was completed as part of Stantec's SNTC Development Site Servicing and SWM Report (February 2020), which included the proposed Block 4 development.

3.1 BACKGROUND

The proposed site comprises 116 back to back townhome units, complete with associated infrastructure and access areas. The site will be serviced via two watermain connections to the 300mm and 200mm diameter watermains within Street B and Street C respectively (see **Drawing SSP-1**). The future watermains on Streets B and C will service 17 back-to-back townhomes fronting the ROWs. Services will be dropped off for each unit when Streets B and C are constructed. A district metering chamber will be installed on the water service connection at Street C in accordance with the Water Distribution Guidelines to facilitate leak detection within the private site by the City of Ottawa.

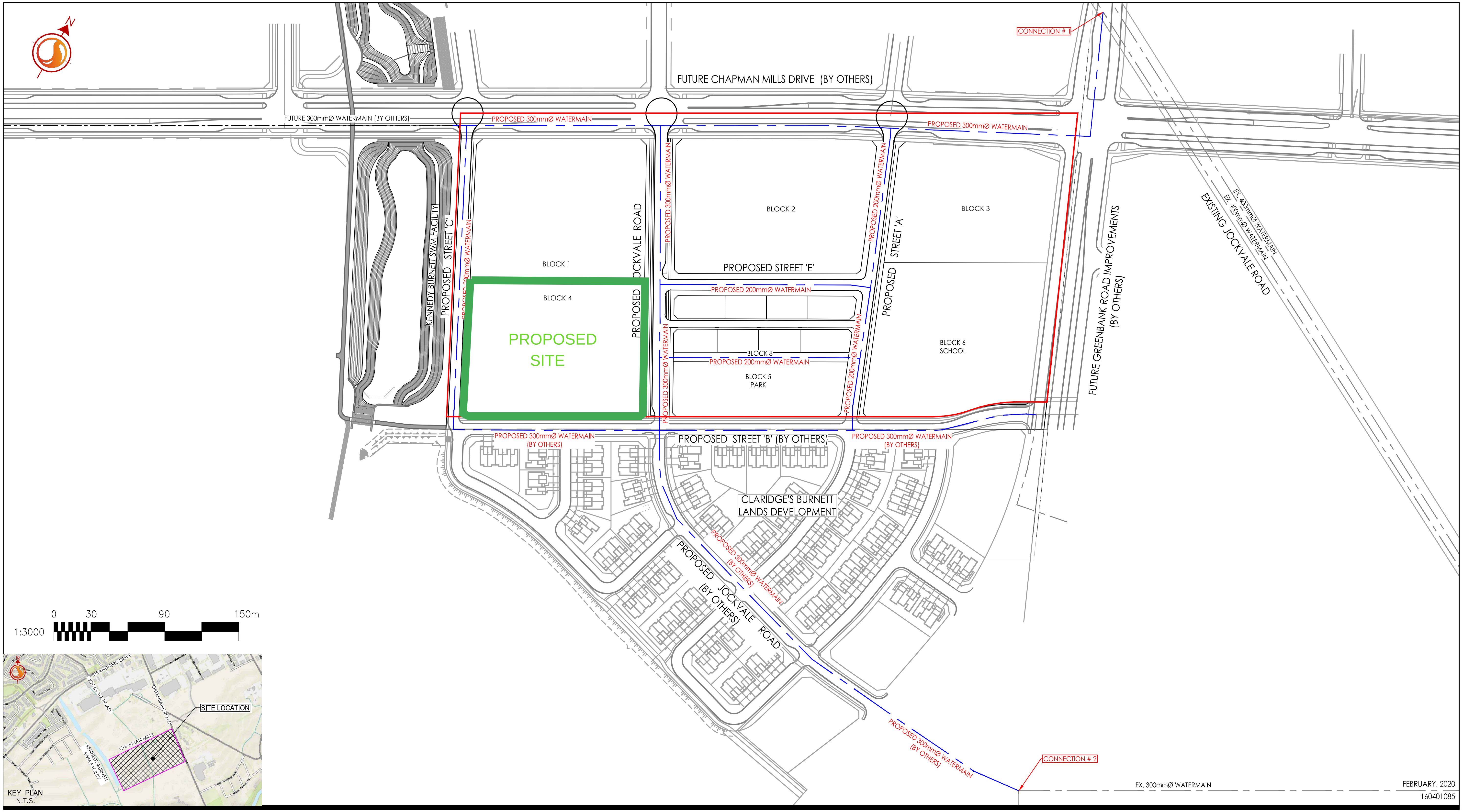
The SNTC development is currently located within Zone BARR of the City of Ottawa's water distribution system. This zone is fed by the Barrhaven Pump Station and Barrhaven Reservoir Pump Station, with the Moodie elevated storage tank providing balancing storage for peak flows and demands. The development is located within the future Zone 3C pressure zone reconfiguration which will be completed by the City of Ottawa in the future.

The overall development lies within the Nepean Town Centre lands (NTC). The Kennedy-Burnett Potable Water Master Servicing Study (MSS) completed by Stantec in March 2014 assessed the proposed water distribution system within the Kennedy-Burnett development and the NTC lands and provided servicing recommendations during the interim scenario with both development areas serviced by Zone BARR pressures and during future conditions with the NTC area converted to Zone 3C pressure zone.

3.2 PROPOSED WATERMAIN SIZING AND LAYOUT

The proposed watermain alignment and sizing for Block 4 is based on the proposed SNTC Development. Dual 400mm diameter watermains exist north of the subdivision lands at the intersection of Greenbank Road and Jockvale Road. Both the proposed Caivan SNTC Development and Claridge's Burnett Lands Development to the south require a 300mm watermain connection to be made at this location (Boundary Connection #1) which will require the extension of the distribution system along future Chapman Mills Drive and Greenbank Road. Looping for both developments will be provided through a second connection to an existing 300mm watermain stub located south of the Claridge lands at the intersection of Greenbank

Road and Bending Way (Boundary Connection #2). **Figure 3.1** shows the existing and proposed potable water distribution network required to service the proposed site.



FEBRUARY, 2020
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ORIGINAL SHEET - ANSI B

Stantec

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Legend

— · — · —	EXISTING WATERMAIN
— — —	PROPOSED WATERMAIN
—·—·—·—	FUTURE WATERMAIN
🟥	PROPOSED SNTC DEVELOPMENT BOUNDARY

Notes

Client/Project
NEPEAN TOWN CENTRE DEVELOPMENT CORPORATION
SNTC LANDS
OTTAWA, ON, CANADA

Figure No.
3.1

Title
EXISTING AND PROPOSED POTABLE
WATER DISTRIBUTION NETWORK

3.2.1 Water Demands

Water demands for the proposed site were estimated using the City of Ottawa Design Guidelines – Water Distribution (2010). A daily rate of 350 L/cap/day has been applied for the population of the proposed site. Population densities have been assumed as 2.7 pers./townhome unit. See **Appendix A** for detailed domestic water demand estimates.

The potable water analysis estimated for Block 4 in the overall SNTC development by Stantec assumed 140 units/ha resulting in 225 units with 2.7 pers./townhome, generating a total population of 608 persons. Excerpts from this report are included in **Appendix A** The proposed Block 4 consists of 116 units which results in a population of 313 persons.

The average day demand (AVDY) for the proposed site was determined to be 1.27 L/s. The maximum daily demand (MXDY) is 2.5 times the AVDY for residential areas, which results in 3.17 L/s. The peak hour demand (PKHR) is 2.2 times the MXDY for residential areas totaling 6.98 L/s. Each unit per block will be individually metered.

3.2.2 Fire Flow Requirements

Wood frame construction was considered in the assessment for fire flow requirements according to the FUS Guidelines. The FUS Guidelines indicate that low hazard occupancies include apartments, dwellings, dormitories, hotels, and schools, and as such, a low hazard occupancy / limited combustible building contents credit was applied. Based on calculations per the FUS Guidelines (**Appendix A**), the worst case required fire flows for this site occur at Blocks 10 and 11 with a required fire flow of 17,000 L/min (283 L/s).

As per the City's Technical Bulletin ISTB-2018-02, the maximum flow contribution from one given hydrant is 5,700 L/min (95 L/s) within a distance of 75 m, and 3,800 L/min (63 L/s) between 75 m and 150 m. As a result, hydrant placement in the vicinity of the townhome units within Block 10 and Block 11 was considered to ensure the maximum required fire flow of 17,000 L/min can be achieved.

3.2.3 Boundary Conditions

Boundary conditions for both existing and zone reconfiguration conditions were provided for the entire SNTC development from the City of Ottawa as included in **Appendix A.1** and summarized in **Table 3.4** and **Table 3.5**. As noted in the correspondence from the City included in **Appendix A.1**, the maximum day plus fire flow scenario assumed a fire flow requirement of 267 L/s. As a result, the boundary conditions for a maximum fire flow requirement of 283 L/s has been requested and will be used in the next submission.

Table 3.1: Hydraulic Analysis Existing Boundary Conditions

Connection	Maximum HGL (m)	Peak Hour HGL (m)	Max. Day plus Fire HGL (m) 267 L/s (16,000 L/min)	Ground Elevation (m)
Jockvale Road and Greenbank Road (Connection #1)	157.4	140.2	145.0	96.4
Greenbank road and Bending Way (Connection #2)	157.3	139.8	128.8	94.3

Table 3.2: Hydraulic Analysis Post SUC Zone Reconfiguration Boundary Conditions

Connection	Maximum HGL (m)	Peak Hour HGL (m)	Max. Day plus Fire HGL (m) 267 L/s (16,000 L/min)	Ground Elevation (m)
Jockvale Road and Greenbank Road (Connection #1)	147.8	145.3	144.2	96.4
Greenbank road and Bending Way (Connection #2)	147.6	144.5	128.3	94.3

3.3 HYDRAULIC ASSESSMENT

Level of Service

The City of Ottawa Water Distribution Design Guidelines state that the desired range of system pressures under normal demand conditions (i.e. basic day, maximum day and peak hour) should be in the range of 350 to 480 kPa (50 to 70 psi) and no less than 275 kPa (40 psi) at the ground elevation on the streets (i.e. at hydrant level). The maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way is 552 kPa (80 psi). As per the Ontario Building Code (OBC) & Guide for Plumbing, if pressures greater than 552 kPa (80 psi) are anticipated, pressure relief measures are required. The maximum pressure at any point in the distribution system in unoccupied areas shall not exceed 689 kPa (100 psi). Under emergency fire flow conditions, the minimum pressure objective in the distribution system is 138 kPa (20 psi).

Model Development

The proposed watermains within the Block 4 Development were added to the H2OMAP hydraulic model created for the entire SNTC Development (Stantec, February 2020) to simulate the proposed distribution system under both the existing and post reconfiguration conditions. Hazen-Williams coefficients ("C-Factors") were applied to the new watermain in accordance with the City of Ottawa's Water Distribution Design Guidelines (**Table 3.6**).

Table 3.3: Proposed Watermain C-Factors

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

3.4 HYDRAULIC MODEL RESULTS

The Kennedy-Burnett Potable Water MSS concluded that development that proceeds in the interim prior to the reconfiguration of Zone 3C will have to ensure pressure reducing valves are installed where required.

The H2OMAP model for the proposed site consists of both existing and post reconfiguration scenarios. The existing scenario assumes ultimate development conditions under existing Zone BARR conditions, and the post reconfiguration scenario assumes ultimate development conditions under SUC Zone reconfiguration (3C). The overall results can be found in **Appendix A.4.**

The results from the existing zone - ultimate development conditions analysis show that the maximum pressure modeled is approximately 90.7 psi (625 kPa) and the minimum pressure during the peak hour scenario was approximately 64.9 psi (447 kPa) within the proposed Block 4 development as shown in **Figure 3.2** and **Figure 3.3** respectively. These pressures are above the serviceable limit of 50 to 80 psi (345 to 552 kPa) and therefore all proposed units will require pressure reducing valves.

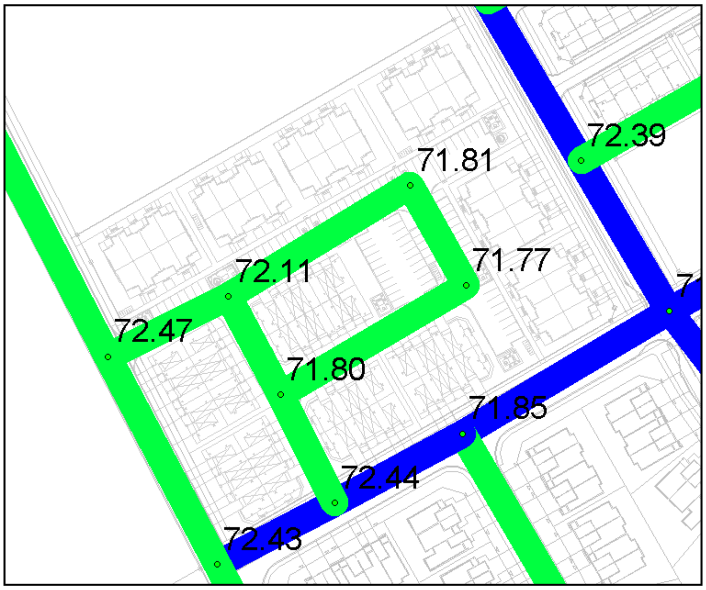
Figure 3.1: Existing Zone - Ultimate Condition AVDY Pressure Results (psi)

Figure 3.2: Existing Zone - Ultimate Condition PKHR Pressure Results (psi)

Post SUC zone reconfiguration under ultimate development conditions, the maximum pressure modeled was approximately 77.0 psi (530 kPa) and the minimum pressure during peak hour was approximately 71.8 psi (494 kPa) within the proposed SNTC development as shown in **Figure 3.4** and **Figure 3.5** respectively. These pressures are within the City of Ottawa allowable serviceable limits of 50 to 80 psi (345 to 552 kPa). Should the pressure zones be converted from Zone BARR to Zone 3C prior to construction, the dwellings will not require pressure reducing valves.

Figure 3.3: Post SUC Zone Reconfiguration - Ultimate Condition AVDY Pressure Results (psi)

Figure 3.4: Post SUC Zone Reconfiguration - Ultimate Condition PKHR Pressure Results (psi)

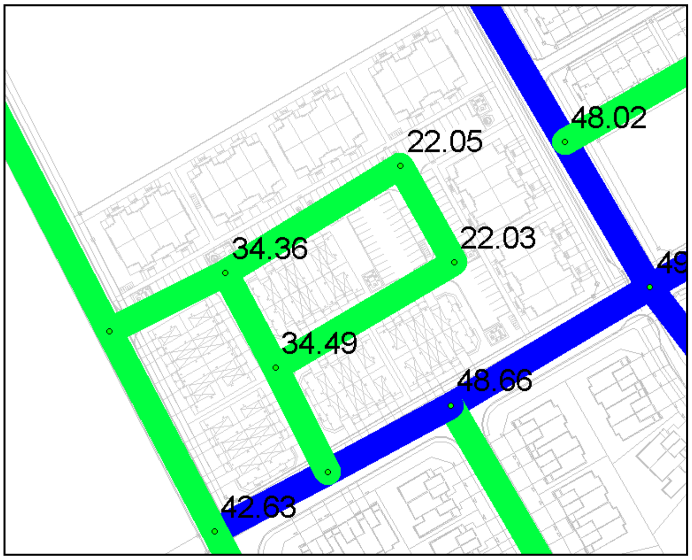


The hydraulic model was used to assess the fire flow conditions of the proposed site. The model was carried out to determine the anticipated amount of flow that could be provided under maximum day demands and a fire flow requirement of 283 L/s for Blocks 4 (back-to-back townhomes) on Street B and Street C (nodes 20 to 26). Boundary condition parameters for the overall SNTC Development model assumed a maximum day plus fire flow based on a fire flow demand of 267 L/s.

Results of the fire flow analysis indicate that flows in excess of 17.820 L/min (297 L/s) for the existing zone condition and 17,580 L/min (293 L/s) for the post reconfiguration zone condition can be delivered for the units that require 283 L/s while still maintaining a residual pressure of 140 kPa (20 psi).

Figure 3.5: Existing Zone - Ultimate Condition Fire Flow Results – Residual Pressure (psi)

Figure 3.6: Post SUC Zone Reconfiguration - Ultimate Condition Fire Flow Results – Residual Pressure (psi)



3.5 SUMMARY OF FINDINGS

Based on the findings of the report, pressure reducing valves will be required in all proposed units under existing BARR zone conditions to meet maximum pressure guidelines as per City of Ottawa standards under typical demand conditions (peak hour and average day conditions). If construction of the development occurs post SUC Zone reconfiguration, pressure reducing values will not be required.

The results indicate that sufficient fire flows are available within the proposed watermain network under emergency fire demand conditions (maximum day + fire flow) for both existing and post zone reconfiguration scenarios, while meeting the minimum pressure requirements as per City of Ottawa standards.

4.0 WASTEWATER SERVICING

4.1 BACKGROUND

As shown on **Drawing SA-1**, the proposed Block 4 will be serviced by the 200 mm diameter sanitary sewer on Street C with a connection to the existing 200mm stub dropped inside the property line. The network of 200mm diameter sanitary sewers is proposed along the private streets. Servicing requirements for Block 4 were outlined in Stantec's SNTC Site Servicing and Stormwater Management Report (February 2020) which included an estimated sanitary peak flow allocation for Block 4 of 7.1 L/s assuming high density residential land use with 140 units/ha and 2.7 person/unit for a total of 608 persons (Site Area = 1.59 ha).

The proposed site consists of eleven townhome blocks consists of 116 back-to-back townhome units with a population density of 313 persons. Nine units within Blocks 9 and 10 will be serviced through the sanitary sewer on Street C, and eight units within Block 7 and 8 will be serviced with individual service connections to Street B.

4.2 DESIGN CRITERIA

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

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

In addition, a residential peak factor based on Harmon's Equation in conjunction with a correction factor of 0.8 was used to determine the peak design flows.

4.3 PROPOSED SERVICING

The majority of the proposed site will be serviced by gravity sewers which will direct wastewater peak flows (approx. 3.5 L/s with allowance for infiltration) to the existing 200 mm diameter sanitary sewer stub. The proposed units within Blocks 7, 8, 9 and 10 that front Street B and Street C will be serviced through individual service connections to the sanitary sewers on Street C and Street B will generate a flow of approximately 0.6 L/s. Units within Blocks 1 to 6 and the units within Blocks 7-10 fronting the internal streets will be serviced through the private sanitary sewer system.

A sanitary sewer design sheets for the proposed sanitary sewers within the development and the sewer design sheet for the SNTC Subdivision are included in **Appendix B**.

Full port backwater valves are to be installed on all sanitary services within the site to prevent any surcharge from the downstream sewer main from impacting the proposed property.

5.0 STORMWATER MANAGEMENT

The following section describes the stormwater management (SWM) design for Block 4 in accordance with the background documents and governing criteria within the SNTC subdivision based on Stantec's Site Servicing and Stormwater Management Report (February 2020).

5.1 PROPOSED CONDITONS

The proposed 1.59 ha development is located within the southwestern quadrant of the SNTC subdivision and comprises 116 townhome units. The storm sewer collection system for the site will discharge to the 1200 mm diameter storm sewer on Street C that ultimately directs runoff to the Kennedy Burnett SWM Facility outlet channel. Quality control of stormwater runoff from the proposed Block 4 will be provided by hydrodynamic separator / Oil-Grit Separator (HDS) designed as part of Claridge's Development to the south to provide 'Enhanced' level of treatment (80% TSS Removal) prior to discharging into the outlet channel for the Kennedy-Burnett SWM Facility.

5.2 CRITERIA AND CONSTRAINTS

The overall approach for storm servicing and stormwater management for the proposed development was outlined in the Stantec SNTC Servicing and SWM Report (February 2020), excerpts can be found in **Appendix C.4**. The following summarizes the SWM criteria and constraints that will govern the detailed design of the proposed site as per the latest City of Ottawa Storm Sewer Guidelines as well as the conclusions made within the SNTC Servicing and SWM Report.

- Design using the dual drainage principle. (City)
- Minor system capture rate from Block 4 up to the 100-year storm to be restricted to 271 L/s. (Stantec - SNTC)
- Major system peak overflows to be controlled to a rate of 330 L/s during the 100-year storm event. (Stantec - SNTC)
- Size storm sewers to fully capture 2-year storm event under free-flow conditions (i.e. no ponding during 2-year storm event) using 2012 City of Ottawa Sewer Design Guidelines I-D-F parameters. (City)
- Separation of at least 0.3 m between the 100-year hydraulic grade line (HGL) and building under side of footing (USF) must be provided. (City)
- Maximum 'climate change' HGL to be lower than proposed basement elevations. (City)
- Inlet control devices (ICDs) to have a minimum orifice diameter of 83 mm. (City)
- Depth of flow may extend adjacent to the right-of-way provided that the water level does not touch any part of the building envelope and remains below the lowest building opening during the stress test event (100-year increased by 20%). (City)

- Total maximum depth of flow under static and dynamic conditions shall be less than 0.35 m. (City)
- 100-year hydraulic grade line (HGL) to be a minimum 0.30 m below lowest building underside of footing elevation. The proposed townhome units will not have basements due to grade raise restrictions and 100-year HGL elevations. (City)
- Design storm sewers along local and collector roadways to convey the 2-year and 5-year peak flow respectively under free-flow conditions using 2004 City of Ottawa I-D-F parameters and an inlet time of 10 minutes. (City)
- Assess impact of 2-year storm, 5-year storm, and the worst case 100-year storm events, and climate change scenarios with a 20% increase of rainfall intensity, on the major & minor drainage system. (City)
- Building openings to be above the 100-year water level. (City)
- There must be at least 30 cm of vertical clearance between the spill elevation on the private street and the lowest building opening that is in the proximity of the flow route or ponding area. (City)
- There must be at least 30 cm of vertical clearance between the spill elevation on rear yard swales and the ground elevation at the building envelope that is in the proximity of the flow route or ponding area. (City)
- Minimum swale grades at 1.5% (subgrade provided for grades < 1.5%). (City)
- Minimum roadway profile grades at 0.5%. (City)
- Minimum roadway slope of 0.1% from crest-to-crest for overland flow route. (City)
- Provide adequate emergency overflow conveyance off-site. (City)

5.3 DESIGN METHODOLOGY

The design methodology for the SWM component of the development is as follows:

- Create a PCSWMM model that generates major and minor system hydrographs and assesses the minor system hydraulic grade line and the major system flow depths.

- Size inlet control devices for the proposed catchbasins to avoid surface ponding during the 2-year storm while meeting the required 0.3m 100-year HGL to USF clearance and the 271 L/s minor system allowable release rate in the 100-year storm.

- Ensure that total dynamic and static surface ponding depths do not exceed 0.35 m during the 100-year storm scenario.

- Confirm that climate change storm simulation does not result in flooding of properties.

The site is designed using the “dual drainage” principle, whereby the minor (pipe) system is designed to convey the peak rate of runoff from the 2-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 appropriate outlet without impacting proposed or existing downstream properties.

In keeping with the minor system target peak outflow, Inlet Control Devices (ICDs) or orifice plates have been specified for all catchbasins to limit the inflow to the minor system which outlets to the 1200 mm diameter storm sewer on Street C. Restricted inlet rates to the sewer are necessary to meet the target peak outflows.

Drawing SD-1 outlines the proposed storm sewer alignment, ICD locations, drainage divides, and labels. The storm sewer design sheet is included in **Appendix C.1**.

5.4 MODELING RATIONALE

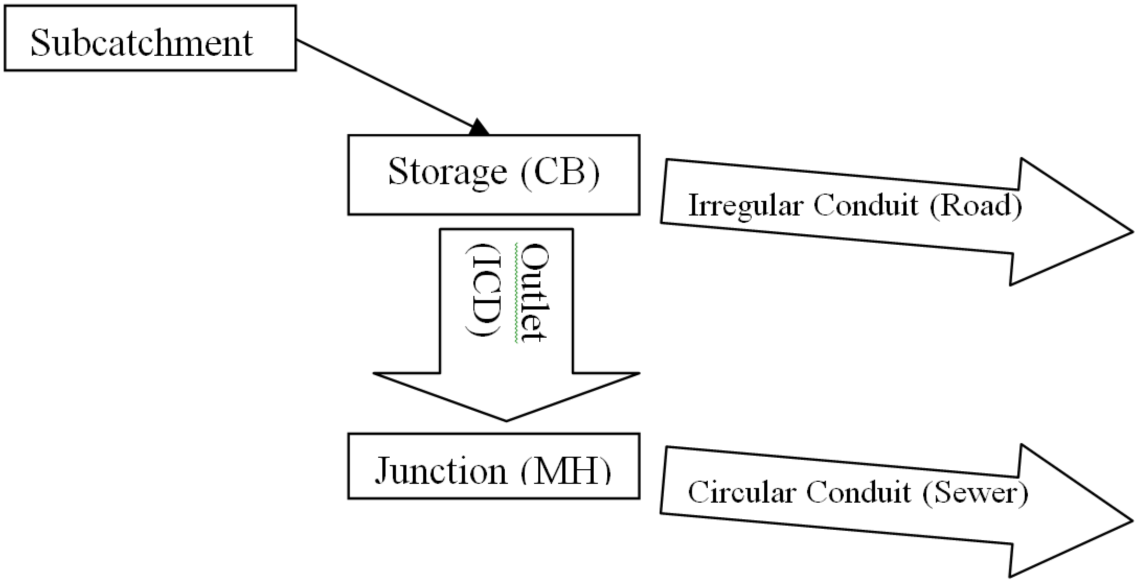
A comprehensive hydrologic modeling exercise was completed with PCSWMM, accounting for the estimated major and minor systems to evaluate the storm sewer infrastructure and major system segments. The use of PCSWMM for modeling of the site hydrology and hydraulics allowed for an analysis of the systems' response during various storm events. The following assumptions were applied to the detailed model:

- Hydrologic parameters as per Ottawa Sewer Design Guidelines, including Horton infiltration, Manning's 'n', and depression storage values.
- 3-hour Chicago Storm distribution for the 2-year, 5-year and 100-year analysis.
- To 'stress test' the system a 'climate change' scenario was created by adding 20% of the individual intensity values of the 100-year storm at their specified time step.
- Percent imperviousness calculated based on actual soft and hard surfaces for the proposed catchments and converted to equivalent Runoff Coefficient using the relationship C = (Imp. X 0.7) + 0.2.
- Subcatchment areas are defined from high-point to high-point where sags occur.
- Width parameter was taken as twice the length of the street/swale segment for two-sided catchments and as the length of the street/swale segment for one-sided catchments.
- Catchbasin inflow restricted with inlet-control devices (ICDs) as necessary to maintain the minor system target peak outflow.
- Surface storage in road sags calculated based on grading plans (**Drawing SD-1**).

5.4.1 SWMM Dual Drainage Methodology

The proposed development is modeled in one modeling program as a dual conduit system (see **Figure 5.1**), with: 1) circular conduits representing the sewers & storage nodes representing manholes; 2) irregular conduits using street-shaped cross-sections to represent the approximate overland road network and storage nodes representing catchbasins. The dual drainage systems are connected via outlet/orifice link objects from storage node (i.e. CB) to storage node (i.e. MH), and represent inlet control devices (ICDs). Subcatchments are linked to the storage node on the surface so that generated hydrographs are directed there firstly.

Figure 5.1: Schematic Representing Model Object Roles



Storage nodes are used in the model to represent catchbasins as well as major system junctions. For storage nodes representing catchbasins (CBs), the invert of the storage node represents the invert of the CB and the rim of the storage node represents the top of the CB plus an allowable flow depth on the segment. For the purpose of this SWM plan, CB inverts have been set 1.38 m below the top of the CB. The additional depth has been added to rim elevations to allow routing from one surface storage to the next. Storage nodes that represent catchbasins at sags, are surrounded by two transects that represent the road segments forming the sag. The storage value assigned to the storage node represents the available ponding volume above the catch basin. If the available storage volume in a storage node is exceeded, flows spill above the storage node and into the sag in the irregular conduits (representing roads). The volume stored within the road sags is represented as flood volume in the model and includes the total static volume and the ponded depth above the node representing the dynamic flow depth. Flow storage volumes exceeding the sag storage available in the transect (roadway) will spill at the downstream highpoint into the next sag and continue routing through the system until ultimately flows either re-enter the minor system or reach the outfall of the major system. Storage nodes representing high points are assigned an invert elevation equal to the transect invert (spill elevation at edge of pavement) and a rim elevation equal to the maximum allowable flow depth elevation above the storage node plus 0.35 m. A Storage value of 0 has been assigned to these nodes to disable linear volume calculations. No storage has been accounted for within storage nodes at high points. In this manner, storage will accumulate according to the actual ponding depths before spilling along the roadway conduit, and to the next downstream road conduit.

Inlet control devices, as represented by orifice links, have been used to represent the proposed vertical circular orifices sized to restrict minor system capture rates to the 2-year and 5-year rate for local streets, and collector roads (Jockvale Road) respectively. A minimum orifice diameter of 83 mm has been specified.

5.4.2 Design Storms

The 3-hour Chicago distribution was selected to estimate the 2-year capture rates for the proposed subcatchments, and to assess the 100-year HGL across the proposed development.

To 'stress test' the system a 'climate change' scenario was created by adding 20% of the individual intensity values of the 100-year storms at their specified time step.

5.4.3 Boundary Conditions

The detailed PCSWMM hydrology and the proposed storm sewers were used to assess the peak inflows and hydraulic grade line (HGL) in the proposed site. Fixed backwater elevations were obtained from Stantec's SNTC PCSWMM model (February 2020) from the stubbed outlet for Block 4 (Node 221) as 91.30 m 2-year storm, 91.32 m for the 5-year storm, 91.75 m for the 100-year storm and 91.76 m for the 100-year plus 20%.

5.4.4 Modeling Parameters

Table 5.1 presents the general subcatchment parameters used:

Table 5.1: General 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

Table 5.2 presents the individual parameters that vary for each of the subcatchments tributary to the storm outlet.

Table 5.2: Subcatchment Parameters

Area ID	Area (ha)	Width (m)	Slope (%)	% Impervious	Runoff Coefficient
L101A	0.37	370	3.0	88.57	0.82
L102A	0.16	116	3.0	87.14	0.81
L102B	0.42	314	3.0	84.29	0.79
L102C	0.09	40	3.0	91.43	0.84
L102D	0.12	54	3.0	88.57	0.82
L105A	0.11	56	3.0	87.14	0.81
UNC-1	0.14	321	2.0	60.00	0.62
UNC-3	0.12	305	3.0	42.86	0.50
UNC-4	0.03	200	3.0	42.86	0.50
UNC-2	0.03	200	3.0	42.86	0.50

Table 5.3 summarizes the storage node parameters used in the model. All catchbasins have been modeled as having an outlet invert as depicted on **Drawings SSP-1**. Static ponding depths, areas, and volumes within the proposed development area are as per **Drawings SD-1**.

Table 5.3: Storage Node Parameters

Storage Node	Invert Elevation (m)	Rim Elevation (m)	Total Depth (m)
L101A1-S	93.99	94.34	0.35
L101A-S	92.12	93.85	1.73
L101A-S1	93.65	94.00	0.35
L102A-S	92.29	94.02	1.73
L102A-S1	93.77	94.12	0.35
L102B-S	91.94	93.87	1.93
L102B-S1	93.87	94.22	0.35
L102B-S2	93.97	94.32	0.35
L102C-S	92.52	94.25	1.73
L102C-S1	94.10	94.45	0.35
L102D-S	92.26	93.99	1.73
L102D-S1	93.94	94.29	0.35
L105A-S	92.08	93.81	1.73
L105A-S1	93.91	94.26	0.35

*The rim of the storage node represents the maximum allowable flow depth elevation above the storage node (equal to the top of the CB plus an additional 0.35 m).

5.4.5 Hydraulic Parameters

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

Storm sewers were modeled to confirm flow capacities, assess hydraulic grade lines (HGLs) and to determine minor system peak outflows to the outlet. The detailed storm sewer design sheet is included in **Appendix C.1**.

The table below presents the parameters for the orifice link objects within the proposed residential blocks which represent ICDs. It should be noted that the proposed ICDs will consist of slide type vertical circular orifices. 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.

Table 5.4: Orifice Parameters for Proposed Catchments

Orifice Name	Catchbasin ID	Tributary Area ID	Minor System Node	ICD Type
L101A-IC	CB101A	L101A	STM-101	178mm Orifice
L102A-IC	CB102A	L102A	STM-101	108mm Orifice
L102B-IC	CB102B	L102B	STM-102	178mm Orifice
L102C-IC	CB102C	L102C	STM-102	94mm Orifice
L102D-IC	CB102D	L102D	STM-102	102mm Orifice
L105A-IC	CB105A	L105A	STM-105	94mm Orifice

5.5 MODELING RESULTS AND DISCUSSION

The following sections summarize the key hydrologic and hydraulic model results. For detailed model results or inputs please refer to the electronic model files on the enclosed CD.

5.5.1 Proposed Inlet Control Devices

Table 5.5 summarizes the orifice link maximum flow rates and heads across the proposed development.

Table 5.5: Proposed Phase Orifice Link Results

Orifice Name	Catchbasin ID	Tributary Area ID	ICD Type	2yr Head (m)	100yr Head (m)	2yr Flow (L/s)	100yr Flow (L/s)
L101A-IC	CB101A	L101A	178mm Orifice	1.35	1.58	70.91	76.88
L102A-IC	CB102A	L102A	108mm Orifice	1.41	1.54	27.07	28.27

Orifice Name	Catchbasin ID	Tributary Area ID	ICD Type	2yr Head (m)	100yr Head (m)	2yr Flow (L/s)	100yr Flow (L/s)
L102B-IC	CB102B	L102B	178mm Orifice	1.52	1.77	75.49	81.84
L102C-IC	CB102C	L102C	94mm Orifice	1.07	1.55	17.76	21.57
L102D-IC	CB102D	L102D	102mm Orifice	1.32	1.56	23.34	25.44
L105A-IC	CB105A	L105A	83mm Orifice	1.38	1.44	20.33	20.72

5.5.2 Proposed Development Hydraulic Grade Line Analysis

The 100-year hydraulic grade line (HGL) elevation across the proposed development and Street B and Street C in the adjacent Claridge development was estimated using the PCSWMM model for the 100-year, 3 hour Chicago storm and the climate change scenario. The 100 year HGL along storm sewers on Street B and C will service units within Blocks 7-10. The HGL values were obtained from Stantec's SNTC PCSWMM model (February 2020), excerpts of the stormwater management section can be found in **Appendix C.4**. **Table 5.6** below presents the clearance between the proposed storm sewer 100-year and 100-year + 20% HGL and the nearest proposed USF. The storm sewer design sheet is included in **Appendix C.1**.

Table 5.6: 100-Year HGL Results

STM MH	Prop. USF (m)	100-year, 3hr Chicago Storm		100-year+20%, 3hr Chicago Storm	
		HGL (m)	Prop. USF-HGL Clearance (m)	HGL (m)	Prop. USF-HGL Clearance (m)
101	92.12	91.82	0.30	91.83	0.29
102	92.43	92.00	0.43	92.01	0.42
103	92.85	91.84	1.01	91.85	1.00
104	92.43	91.85	0.58	91.86	0.57
105	92.85	91.87	0.98	91.88	0.97
218 (Street C)	92.12	91.67	0.45	91.67	0.45
EX 100 (Street B)	92.85	91.66	1.19	91.66	1.19

Detailed grading of the site has been completed to ensure that the maximum hydraulic grade line is kept at least 0.30 m below the underside-of-footing (USF) of the adjacent units connected to the storm sewer during the 100-year storm event and below proposed basement or first floor elevations during the 'climate change' event(Blocks 7- 11 do not have basements).

5.5.3 Overland Flow

Table 5.7 presents the maximum total surface water depths (static ponding depth + dynamic flow) above the top-of-grate of the proposed catchbasins for the 100-year, 3-hr Chicago storm and the 'climate change' storm. Based on the model results, the total ponding depth (static + dynamic) does not exceed the required 0.35 m maximum during the 100-year event. Tables summarizing the total surface water depths over the proposed catchbasins are included in **Appendix C.2**, which show that little to no ponding occurs over the proposed local streets during the 2-year storms events. Minimal ponding will occur in subcatchment area L102A in the 2-year storm, however if the ICD is increased to the next size up in keeping with the City of Ottawa approved ICD size, the 100-year HGL to USF clearance will not be met.

Table 5.7: Proposed Phase – Ultimate Maximum Static and Dynamic Surface Water Depths

Storage node ID	Structure ID	Top of Grate Elevation (m)	2-year, 3-hour Chicago		100-year, 3-hour Chicago		100-year, 3-hour Chicago+20%	
			Max HGL (m)	Total Surface Water Depth (m)	Max HGL (m)	Total Surface Water Depth (m)	Max HGL (m)	Total Surface Water Depth (m)
L101A-S	CB500	93.50	93.47	0.00	93.70	0.20	93.73	0.23
L102A-S	CB501	93.67	93.70	0.03	93.83	0.16	93.84	0.17
L102B-S	CB503	93.52	93.46	0.00	93.71	0.19	93.75	0.23
L102C-S	CB502	93.90	93.59	0.00	94.07	0.17	94.11	0.21
L102D-S	CB504	93.64	93.58	0.00	93.82	0.18	93.85	0.21
L105A-S	CB505	93.46	93.46	0.00	93.52	0.06	93.52	0.06

5.5.4 Minor and Major System Peak Outflows

Minor system peak flows from the site are directed to the 1200 mm diameter storm sewer on Street C. Based on the PCSWMM model for the proposed development the 100-year minor system peak outflow from the proposed site is equal to 254.6 L/s, meeting the 270.7 L/s minor system target for Block 4.

Similarly, major system peak flows from the site are directed to Street C. Due to grading restrictions, minor areas surrounding the site cannot be graded to enter the storm sewer system and will sheet flow uncontrolled to the adjacent Street B (UNC-2 & UNC-4), Street C (UNC-1), and Jockvale Road ROW (UNC-3). Peak discharges from uncontrolled areas have been considered in the overall SWM plan with 149.6 L/s being discharged in the 100-year storm. 100-year major system overflows from the proposed site onto Street C and Street B equal to 34.9 L/s and 37.9 L/s respectively, which results in 100-year overall overland peak flows of 222.4 L/s, well below the 330 L/s target.

6.0 GRADING

The proposed development site measures approximately 1.59 ha in area. The topography across the site under existing conditions is relatively flat and generally slopes towards the south west direction. The objective of the grading design strategy is to satisfy the stormwater management requirements, adhere to permissible grade raise restrictions as much as possible (see Section 10.0), and provide for minimum cover requirements for sewers. The grading plan has been provided for reference in **Appendix E**.

The grading design also follows the recommendations outlined in the SNTC Site Servicing and Stormwater Management Report (Stantec Consulting Ltd., February 2020) and directs overland drainage towards Street B and C ROW ultimately into the Kennedy Burnett SWM Facility.

The grading plan **(Drawing GP-1)** identifies grade raise restrictions identified in the geotechnical investigation. Areas where grades are expected to exceed the maximum permissible grade raise will be subject to either a pre-loading/surcharge program, or lightweight fill and/or other approved means outside of proposed rights-of-way to reduce the risks of unacceptable long-term post construction differential settlements.

7.0 UTILITIES

As the subject site lies within residential development community, Hydro, Bell, Gas and Cable servicing for the proposed site will be readily available within subsurface infrastructure within Street B and Street C ROW. Exact size, location and routing of hydro utilities will be finalized after design circulation.

8.0 APPROVALS

Ontario Ministry of Environment, Conservation and Parks (MECP) Environmental Compliance Approvals (ECAs, formerly Certificates of Approval (CofA)) under the Ontario Water Resources Act is not expected to be required for proposed site.

An MECP Permit to Take Water (PTTW) or reporting on the Environmental Activity and Sector Registry (EASR) may be required for the site as some of the proposed works may be below the groundwater elevation shown in the geotechnical report. The geotechnical consultant shall determine whether a PTTW or EASR reporting is required prior to construction.

9.0 EROSION CONTROL

Erosion and sediment controls must be in place during construction. The following recommendations to the contractor will be included in contract documents.

1. Implement best management practices to provide appropriate protection of the existing and proposed drainage system and the receiving water course(s).
2. Limit extent of 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 plastic or synthetic mulches.
6. Provide sediment traps and basins during dewatering.
7. Install sediment traps (such as SiltSack® by Terrafix) between catch basins and frames.
8. Plan construction at proper time to avoid flooding.

The contractor will, at every rainfall, complete inspections and guarantee proper performance. The inspection is to include:

9. Verification that water is not flowing under silt barriers.
10. Clean and change silt traps at catch basins.

Refer to Erosion and Sediment Control Plan included in **Appendix E** for the proposed location of silt fences, cutoff swales, temporary sediment basins and other erosion control structures.

10.0 GEOTECHNICAL INVESTIGATION

A geotechnical investigation for the development was completed by Paterson Group Inc. in March 2019. The report summarizes the existing soil conditions within the overall SNTC subdivision including the subject site and construction recommendations. For details which are not summarized below, please see the original Paterson report included in **Appendix D**.

Subsurface soil conditions within the subject area were determined through field investigations in February 2019 and October 2012. In total 4 boreholes were drilled, and 1 test pits excavated throughout the subject lands. In general soil stratigraphy consisted of topsoil and/or a silty clay deposit overlaying glacial till. Bedrock was estimated to occur between depths of 5-15m. The thickness of the existing topsoil ranged from 300 to 330mm.

Groundwater levels were encountered between 1.08m and 2.71m in depth. It is expected that construction may occur below the existing groundwater table and therefore a permit to take water may be required.

Based on the observed soil conditions, a grade raise restriction of between 1.4m and 2.0m above existing grade was recommended for housing / roadways. Areas where grades are expected to exceed the maximum permissible grade raise will be subject to either a pre-loading/surcharge program, or lightweight fill and/or other approved means outside of proposed rights-of-way to reduce the risks of unacceptable long-term post construction differential settlements.

The required pavement structure for the local roadways is outlined in **Table 10.1** and

Table 10.2 below.

Table 10.1: Recommended Pavement Structure – Car Parking Areas

Thickness (mm)	Material Description
50	Wear Course – HL 3 or Superpave 12.5 AC
150	Base - OPSS Granular ‘A’ crushed stone
300	Subbase - OPSS Granular ‘B’ Type II
	Subgrade – either fill, insitu soil or OPSS Granular B Type I or II material place over insitu soil or fill.

Table 10.2: Recommended Pavement Structure – Local Residential Roadways

Thickness (mm)	Material Description
40	Wear Course - Superpave 12.5 AC
50	Binder Course - Superpave 19.0 AC
150	Base – OPSS Granular A Crushed Stone
400	Subbase - OPSS Granular B Type II
	Subgrade – either fill, insitu soil or OPSS Granular B Type I or II material place over insitu soil or fill.

11.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the preceding information, the following conclusions are summarized below:

11.1 POTABLE WATER ANALYSIS

Based on the findings of the report, pressure reducing valves will be required in all proposed units under existing BARR zone conditions to meet maximum pressure guidelines as per City of Ottawa standards under typical demand conditions (peak hour and average day conditions). If construction of the development occurs post SUC Zone reconfiguration, pressure reducing values will not be required.

The results indicate that sufficient fire flows are available within the proposed watermain network under emergency fire demand conditions (maximum day + fire flow) for both existing and post zone reconfiguration scenarios, while meeting the minimum pressure requirements as per City of Ottawa standards.

11.2 WASTEWATER SERVICING

Block 4 will be serviced by a network of gravity sewers which will direct wastewater flows to the Street C. The proposed sanitary sewer design indicates a total estimated peak outflow of 3.5 L/s will be discharged to the Street C sewer. A total of 0.6 L/s will be generated by the units with direct service connections to the Street B and Street C sewers. The receiving sewer system has sufficient available capacity to receive the design flows. Design guidelines for slope and velocity have been met within the proposed sewers.

11.3 STORMWATER MANAGEMENT

- The proposed stormwater management plan is in compliance with the goals specified in the background reports and the 2012 City of Ottawa Sewer Guidelines.
- Inlet control devices will be proposed to limit inflow from the site area into the minor system to the 2-year storm (5-year for collector roads) event based on City of Ottawa IDF curves.
- All dynamic surface water depths are to be less than 0.35 m during all storm events up to the 100-year storm event.
- The storm sewer hydraulic grade line will be maintained at least 0.30 m below the underside of footing in the subdivision during design storm events.
- Minor system peak flows from the proposed site will be captured and directed to an HDS for quality control (designed by others) and will ultimately discharge into the outlet channel for the Kennedy-Burnett SWM Facility.
- The minor system target and major system peak outflow target have been met with the proposed design.

11.4 GRADING

A grading plan has been prepared taking into account required overland flow conveyance, cover over sewers, hydraulic grade line requirements, and grade raise restrictions as identified in the geotechnical investigation.

11.5 UTILITIES

Utility infrastructure exists in the general area of the subject site. Exact size, location and routing of utilities will be finalized at the detailed design stage.

APPENDICES

Appendix A POTABLE WATER ANALYSIS

A.1 BOUNDARY CONDITIONS

Boundary Conditions
South Nepean Town Centre

Provided Information

Scenario	Demand	
	L/min	L/s
Average Daily Demand	570.6	9.51
Maximum Daily Demand	1426.8	23.78
Peak Hour	3139.2	52.32
Fire Flow Demand	16020	267

Location

Results – Existing Conditions

Connection 1 - Jockvale Rd. (N20319)

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	157.4	86.8
Peak Hour	140.2	62.3
Max Day plus Fire	145.0	69.1

[1] Ground Elevation = 96.4 m

Connection 2 - Greenbank Rd. (N20084)

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	157.3	89.6
Peak Hour	139.8	64.7
Max Day plus Fire	128.8	49.0

[1] Ground Elevation = 94.3 m

Results – SUC Zone Reconfiguration

Connection 1 - Cambrian Rd. (N20319)

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.8	73.1
Peak Hour	145.3	69.6
Max Day plus Fire	144.2	68.0

[1] Ground Elevation = 96.4 m

Connection 2 - Greenbank Rd. (N20084)

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.6	75.8
Peak Hour	144.5	71.4
Max Day plus Fire	128.3	48.3

[1] Ground Elevation = 94.3 m

Notes:

1. As per the Ontario Building Code in areas that may be occupied, the static pressure at any fixture shall not exceed 552 kPa (80 psi.) Pressure control measures to be considered are as follows, in order of preference:
   a. If possible, systems to be designed to residual pressures of 345 to 552 kPa (50 to 80 psi) in all occupied areas outside of the public right-of-way without special pressure control equipment.
   b. Pressure reducing valves to be installed immediately downstream of the isolation valve in the home/ building, located downstream of the meter so it is owner maintained.
2. Under Existing Condition BARR PUMP #3 had to be turned on during Fire Hours.

Disclaimer

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

A.2 WATER DEMAND CALCULATIONS

SNTC Lands Block 4 - Domestic Water Demand Estimates

- Based on Proposed Site Plan (160401085)

Densities as per City Guidelines:

B2B units 2.7 ppu

Building ID	Units	Population [1]	Daily Rate of Demand [2] (L/m^2/day)	Avg Day Demand		Max Day Demand [3]		Peak Hour Demand [3]	
				(L/min)	(L/s)	(L/min)	(L/s)	(L/min)	(L/s)
Area 1 - Junction 23	39	105.3	350	25.6	0.43	64.0	1.07	140.8	2.35
Area 2 - Junction 24	8	21.6	350	5.3	0.09	13.1	0.22	28.9	0.48
Area 3 - Junction 25	36	97.2	350	23.6	0.39	59.1	0.98	129.9	2.17
Area 4 - Junction 26	16	43.2	350	10.5	0.18	26.3	0.44	57.8	0.96
Area 7 - Junction 7	17	45.9	350	11.2	0.19	27.9	0.46	61.4	1.02
Total Site :		**313.2**		**76.1**	**1.27**	**190.3**	**3.17**	**418.7**	**6.98**

1 Population counts based on a conversion factor of 2.7 persons/back-toback townhome unit

2 Average day water demand for residential areas equal to 350 L/cap/d

3 The City of Ottawa water demand criteria used to estimate peak demand rates for residential areas are as follows:

maximum day demand rate = 2.5 x average day demand rate

peak hour demand rate = 2.2 x maximum day demand rate

Referenced from the City of Ottawa Design Guidelines: Water Distribution (July 2010)

A.3 FUS CALCULATIONS

Stantec

FUS Fire Flow Calculation Sheet

Stantec Project #: 160401085
Project Name: Nepean Town Centre Development Corporation - SNTC Lands Block 4
Date: 4/30/2020
Fire Flow Calculation #: 1
Description: Residential Back to Back Townhome Units (Block 5)

Notes: Worst case townhome units

<table>
<tr><th>Step</th><th>Task</th><th colspan="6">Notes</th><th>Value Used</th><th>Req'd Fire Flow (L/min)</th></tr>
<tr><td>1</td><td>Determine Type of Construction</td><td colspan="6">Wood Frame</td><td>1.5</td><td>-</td></tr>
<tr><td rowspan="2">2</td><td>Determine Ground Floor Area of One Unit</td><td colspan="6">-</td><td>456.0</td><td>-</td></tr>
<tr><td>Determine Number of Adjoining Units</td><td colspan="6">Includes adjacent wood frame structures separated by 3m or less</td><td>1</td><td>-</td></tr>
<tr><td>3</td><td>Determine Height in Storeys</td><td colspan="6">Does not include floors >50% below grade or open attic space</td><td>3</td><td>-</td></tr>
<tr><td>4</td><td>Determine Required Fire Flow</td><td colspan="6">(F = 220 x C x A$^{1/2}$). Round to nearest 1000 L/min</td><td>-</td><td>12000</td></tr>
<tr><td>5</td><td>Determine Occupancy Charge</td><td colspan="6">Limited Combustible</td><td>-15%</td><td>10200</td></tr>
<tr><td rowspan="4">6</td><td rowspan="4">Determine Sprinkler Reduction</td><td colspan="6">None</td><td>0%</td><td rowspan="4">0</td></tr>
<tr><td colspan="6">Non-Standard Water Supply or N/A</td><td>0%</td></tr>
<tr><td colspan="6">Not Fully Supervised or N/A</td><td>0%</td></tr>
<tr><td colspan="6">% Coverage of Sprinkler System</td><td>0%</td></tr>
<tr><td rowspan="5">7</td><td rowspan="5">Determine Increase for Exposures (Max. 75%)</td><td>Direction</td><td>Exposure Distance (m)</td><td>Exposed Length (m)</td><td>Exposed Height (Stories)</td><td>Length-Height Factor (m x stories)</td><td>Construction of Adjacent Wall</td><td>-</td><td>-</td></tr>
<tr><td>North</td><td>20.1 to 30</td><td>14</td><td>3</td><td>31-60</td><td>Wood Frame or Non-Combustible</td><td>8%</td><td rowspan="4">3672</td></tr>
<tr><td>East</td><td>30.1 to 45</td><td>28</td><td>3</td><td>61-90</td><td>Wood Frame or Non-Combustible</td><td>5%</td></tr>
<tr><td>South</td><td>3.1 to 10</td><td>14</td><td>3</td><td>31-60</td><td>Wood Frame or Non-Combustible</td><td>18%</td></tr>
<tr><td>West</td><td>30.1 to 45</td><td>28</td><td>3</td><td>61-90</td><td>Wood Frame or Non-Combustible</td><td>5%</td></tr>
<tr><td rowspan="4">8</td><td rowspan="4">Determine Final Required Fire Flow</td><td colspan="7">Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min</td><td>14000</td></tr>
<tr><td colspan="7">Total Required Fire Flow in L/s</td><td>233.3</td></tr>
<tr><td colspan="7">Required Duration of Fire Flow (hrs)</td><td>3.00</td></tr>
<tr><td colspan="7">Required Volume of Fire Flow (m^3)</td><td>2520</td></tr>
</table>

Stantec

FUS Fire Flow Calculation Sheet

Stantec Project #: 160401085
Project Name: Nepean Town Centre Development Corporation - SNTC Lands Block 4
Date: 4/30/2020
Fire Flow Calculation #: 2
Description: Residential Back to Back Townhome Units (Block 11)

Notes: Worst case townhome units

<table>
<tr><th>Step</th><th>Task</th><th colspan="6">Notes</th><th>Value Used</th><th>Req'd Fire Flow (L/min)</th></tr>
<tr><td>1</td><td>Determine Type of Construction</td><td colspan="6">Wood Frame</td><td>1.5</td><td>-</td></tr>
<tr><td rowspan="2">2</td><td>Determine Ground Floor Area of One Unit</td><td colspan="6">-</td><td>58.0</td><td>-</td></tr>
<tr><td>Determine Number of Adjoining Units</td><td colspan="6">Includes adjacent wood frame structures separated by 3m or less</td><td>10</td><td>-</td></tr>
<tr><td>3</td><td>Determine Height in Storeys</td><td colspan="6">Does not include floors >50% below grade or open attic space</td><td>3</td><td>-</td></tr>
<tr><td>4</td><td>Determine Required Fire Flow</td><td colspan="6">(F = 220 x C x A$^{1/2}$). Round to nearest 1000 L/min</td><td>-</td><td>14000</td></tr>
<tr><td>5</td><td>Determine Occupancy Charge</td><td colspan="6">Limited Combustible</td><td>-15%</td><td>11900</td></tr>
<tr><td rowspan="4">6</td><td rowspan="4">Determine Sprinkler Reduction</td><td colspan="6">None</td><td>0%</td><td rowspan="4">0</td></tr>
<tr><td colspan="6">Non-Standard Water Supply or N/A</td><td>0%</td></tr>
<tr><td colspan="6">Not Fully Supervised or N/A</td><td>0%</td></tr>
<tr><td colspan="6">% Coverage of Sprinkler System</td><td>0%</td></tr>
<tr><td rowspan="5">7</td><td rowspan="5">Determine Increase for Exposures (Max. 75%)</td><td>Direction</td><td>Exposure Distance (m)</td><td>Exposed Length (m)</td><td>Exposed Height (Stories)</td><td>Length-Height Factor (m x stories)</td><td>Construction of Adjacent Wall</td><td>-</td><td>-</td></tr>
<tr><td>North</td><td>20.1 to 30</td><td>33</td><td>3</td><td>91-120</td><td>Wood Frame or Non-Combustible</td><td>10%</td><td rowspan="4">5117</td></tr>
<tr><td>East</td><td>30.1 to 45</td><td>20</td><td>3</td><td>31-60</td><td>Wood Frame or Non-Combustible</td><td>5%</td></tr>
<tr><td>South</td><td>10.1 to 20</td><td>33</td><td>3</td><td>91-120</td><td>Wood Frame or Non-Combustible</td><td>15%</td></tr>
<tr><td>West</td><td>10.1 to 20</td><td>20</td><td>3</td><td>31-60</td><td>Wood Frame or Non-Combustible</td><td>13%</td></tr>
<tr><td rowspan="4">8</td><td rowspan="4">Determine Final Required Fire Flow</td><td colspan="7">Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min</td><td>17000</td></tr>
<tr><td colspan="7">Total Required Fire Flow in L/s</td><td>283.3</td></tr>
<tr><td colspan="7">Required Duration of Fire Flow (hrs)</td><td>3.50</td></tr>
<tr><td colspan="7">Required Volume of Fire Flow (m^3)</td><td>3570</td></tr>
</table>

Stantec

FUS Fire Flow Calculation Sheet

Stantec Project #: 160401085
Project Name: Nepean Town Centre Development Corporation - SNTC Lands Block 4
Date: 4/30/2020
Fire Flow Calculation #: 3
Description: Residential Back to Back Townhome Units (Block 10)

Notes: Worst case townhome units

<table>
<tr><th>Step</th><th>Task</th><th colspan="6">Notes</th><th>Value Used</th><th>Req'd Fire Flow (L/min)</th></tr>
<tr><td>1</td><td>Determine Type of Construction</td><td colspan="6">Wood Frame</td><td>1.5</td><td>-</td></tr>
<tr><td rowspan="2">2</td><td>Determine Ground Floor Area of One Unit</td><td colspan="6">-</td><td>58.0</td><td>-</td></tr>
<tr><td>Determine Number of Adjoining Units</td><td colspan="6">Includes adjacent wood frame structures separated by 3m or less</td><td>10</td><td>-</td></tr>
<tr><td>3</td><td>Determine Height in Storeys</td><td colspan="6">Does not include floors >50% below grade or open attic space</td><td>3</td><td>-</td></tr>
<tr><td>4</td><td>Determine Required Fire Flow</td><td colspan="6">(F = 220 x C x A$^{1/2}$). Round to nearest 1000 L/min</td><td>-</td><td>14000</td></tr>
<tr><td>5</td><td>Determine Occupancy Charge</td><td colspan="6">Limited Combustible</td><td>-15%</td><td>11900</td></tr>
<tr><td rowspan="4">6</td><td rowspan="4">Determine Sprinkler Reduction</td><td colspan="6">None</td><td>0%</td><td rowspan="4">0</td></tr>
<tr><td colspan="6">Non-Standard Water Supply or N/A</td><td>0%</td></tr>
<tr><td colspan="6">Not Fully Supervised or N/A</td><td>0%</td></tr>
<tr><td colspan="6">% Coverage of Sprinkler System</td><td>0%</td></tr>
<tr><td rowspan="5">7</td><td rowspan="5">Determine Increase for Exposures (Max. 75%)</td><td>Direction</td><td>Exposure Distance (m)</td><td>Exposed Length (m)</td><td>Exposed Height (Stories)</td><td>Length-Height Factor (m x stories)</td><td>Construction of Adjacent Wall</td><td>-</td><td>-</td></tr>
<tr><td>North</td><td>20.1 to 30</td><td>20</td><td>3</td><td>31-60</td><td>Wood Frame or Non-Combustible</td><td>8%</td><td rowspan="4">4879</td></tr>
<tr><td>East</td><td>10.1 to 20</td><td>33</td><td>3</td><td>91-120</td><td>Wood Frame or Non-Combustible</td><td>15%</td></tr>
<tr><td>South</td><td>3.1 to 10</td><td>20</td><td>3</td><td>31-60</td><td>Wood Frame or Non-Combustible</td><td>18%</td></tr>
<tr><td>West</td><td>> 45</td><td>33</td><td>3</td><td>91-120</td><td>Wood Frame or Non-Combustible</td><td>0%</td></tr>
<tr><td rowspan="4">8</td><td rowspan="4">Determine Final Required Fire Flow</td><td colspan="7">Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min</td><td>17000</td></tr>
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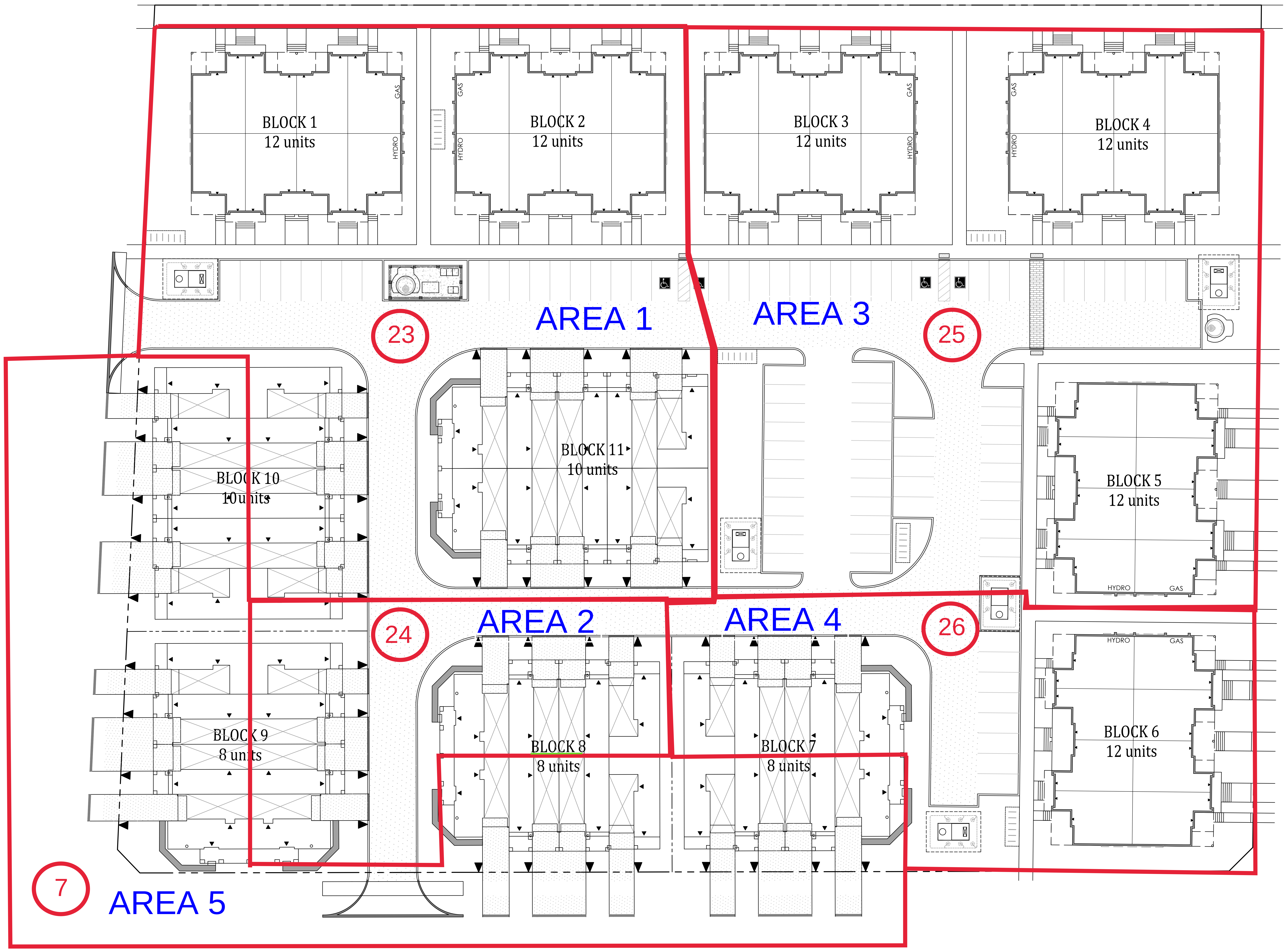
<tr><td colspan="7">Required Volume of Fire Flow (m^3)</td><td>3570</td></tr>
</table>

A.3 HYDRAULIC ANALYSIS


BLOCK 1
12 units
BLOCK 2
12 units
BLOCK 3
12 units
BLOCK 4
12 units
GAS
HYDRO
AREA 1
AREA 3
23
25
BLOCK 11
10 units
BLOCK 10
10 units
BLOCK 5
12 units
AREA 2
AREA 4
24
26
BLOCK 6
12 units
BLOCK 9
8 units
BLOCK 8
8 units
BLOCK 7
8 units
7
AREA 5

EXISTING CONDITIONS

Hydraulic Model Results - Average Day Analysis

Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(Kpa)
7	0.19	93.51	157.31	90.69	625.29
20	0.00	93.48	157.31	90.74	625.63
21	0.00	93.50	157.31	90.71	625.43
23	0.43	93.73	157.31	90.38	623.15
24	0.09	93.95	157.31	90.07	621.01
25	0.39	93.94	157.31	90.08	621.08
26	0.18	93.97	157.31	90.04	620.81

Pipe Results

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)		(L/s)	(m/s)
20	7	21	43.26	297.00	120	0.18	0.00
50	20	7	76.79	204.00	110	0.74	0.02
54	25	23	72.20	204.00	110	-0.32	0.01
56	23	20	40.00	204.00	110	-1.02	0.03
58	25	26	32.20	204.00	110	-0.07	0.00
60	26	24	72.20	204.00	110	-0.25	0.01
62	23	24	32.20	204.00	110	0.27	0.01
64	24	21	47.60	204.00	110	-0.07	0.00

Hydraulic Model Results -Peak Hour Analysis

Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(Kpa)
7	1.02	93.51	139.66	65.61	452.37
20	0.00	93.48	139.66	65.65	452.64
21	0.00	93.50	139.66	65.62	452.44
23	2.35	93.73	139.66	65.29	450.16
24	0.48	93.95	139.66	64.98	448.02
25	2.17	93.94	139.65	64.99	448.09
26	0.96	93.97	139.65	64.94	447.75

Pipe Results

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)		(L/s)	(m/s)
20	7	21	43.26	297.00	120	-1.82	0.03
50	20	7	76.79	204.00	110	-1.89	0.06
54	25	23	72.20	204.00	110	-1.48	0.05
56	23	20	40.00	204.00	110	-2.59	0.08
58	25	26	32.20	204.00	110	-0.69	0.02
60	26	24	72.20	204.00	110	-1.65	0.05
62	23	24	32.20	204.00	110	-1.24	0.04
64	24	21	47.60	204.00	110	-3.37	0.10

Hydraulic Model Results -Fire Flow Analysis 283 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)
7	0.46	58.52	403.48	134.67	283.00	43.42	299.37	504.88	20	137.90
23	1.07	58.34	402.24	134.77	283.00	35.15	242.35	386.44	20	137.90
24	0.22	57.99	399.83	134.74	283.00	35.28	243.25	388.44	20	137.90
25	0.98	58.02	400.04	134.75	283.00	22.84	157.48	297.81	20	137.90
26	0.44	57.97	399.69	134.75	283.00	22.83	157.41	297.21	20	137.90

RECONFIGURATION CONDITIONS

Hydraulic Model Results - Average Day Analysis

Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(Kpa)
7	0.19	93.51	147.63	76.94	530.49
20	0.00	93.48	147.63	76.98	530.76
21	0.00	93.50	147.63	76.95	530.55
23	0.43	93.73	147.63	76.63	528.35
24	0.09	93.95	147.63	76.31	526.14
25	0.39	93.94	147.63	76.33	526.28
26	0.18	93.97	147.63	76.28	525.94

Pipe Results

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)		(L/s)	(m/s)
20	7	21	43.26	297.00	120.00	0.36	0.01
50	20	7	76.79	204.00	110.00	1.29	0.04
54	25	23	72.20	204.00	110.00	-0.46	0.01
56	23	20	40.00	204.00	110.00	-1.59	0.05
58	25	26	32.20	204.00	110.00	0.07	0.00
60	26	24	72.20	204.00	110.00	-0.11	0.00
62	23	24	32.20	204.00	110.00	0.69	0.02
64	24	21	47.60	204.00	110.00	0.50	0.02

Hydraulic Model Results -Peak Hour Analysis

Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(Kpa)
7	1.02	93.51	144.46	72.43	499.39
20	0.00	93.48	144.46	72.47	499.67
21	0.00	93.50	144.46	72.44	499.46
23	2.35	93.73	144.46	72.11	497.18
24	0.48	93.95	144.46	71.80	495.05
25	2.17	93.94	144.45	71.81	495.12
26	0.96	93.97	144.45	71.77	494.84

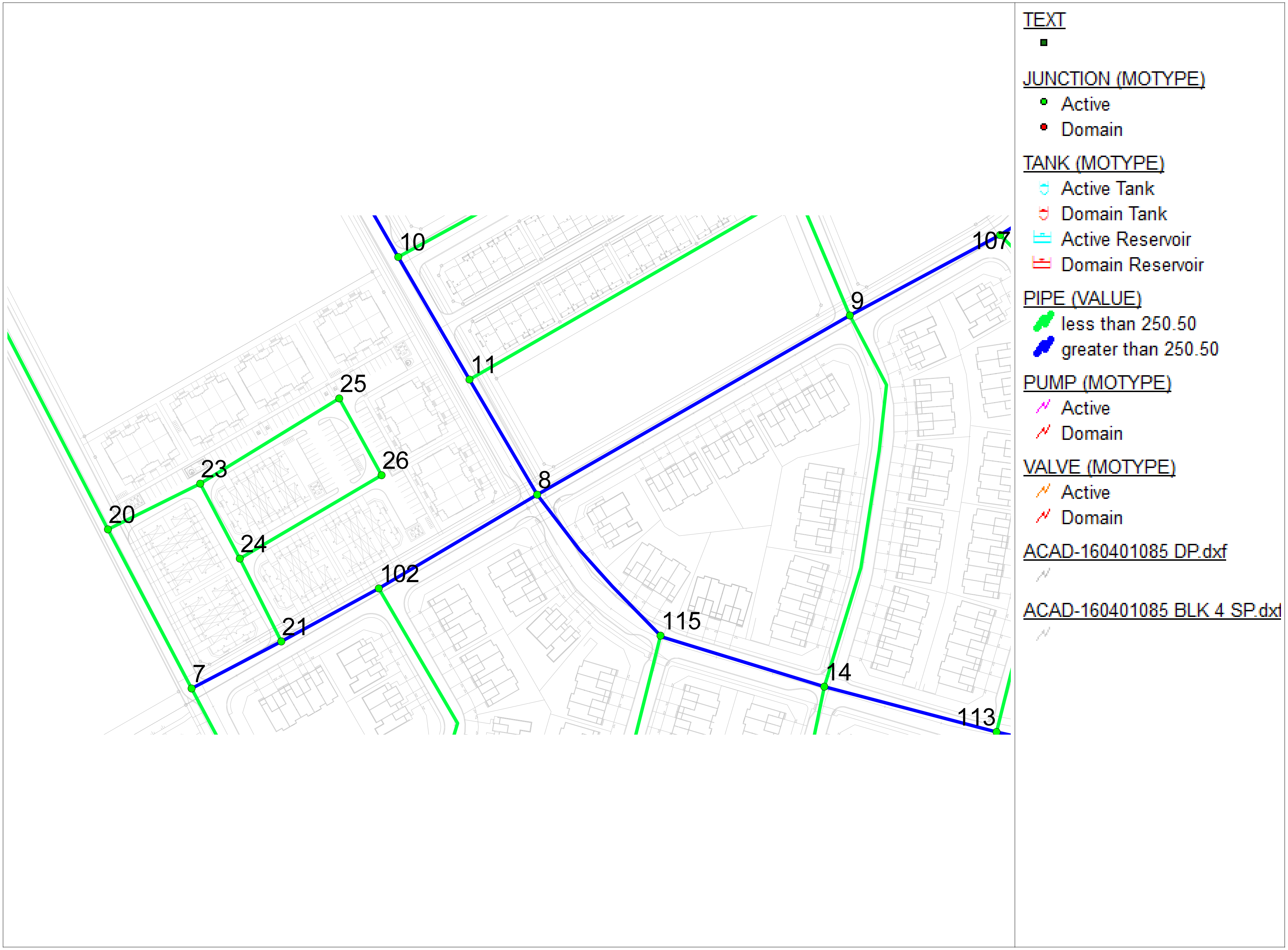
Pipe Results

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)		(L/s)	(m/s)
20	7	21	43.26	297.00	120.00	-0.72	0.01
50	20	7	76.79	204.00	110.00	-0.26	0.01
54	25	23	72.20	204.00	110.00	-1.55	0.05
56	23	20	40.00	204.00	110.00	-3.14	0.10
58	25	26	32.20	204.00	110.00	-0.62	0.02
60	26	24	72.20	204.00	110.00	-1.58	0.05
62	23	24	32.20	204.00	110.00	-0.76	0.02
64	24	21	47.60	204.00	110.00	-2.82	0.09

Hydraulic Model Results -Fire Flow Analysis 283 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)
7	0.46	57.64	397.42	134.05	283	42.63	293.93	498.53	20	137.90
23	1.07	57.46	396.18	134.15	283	34.36	236.91	381.54	20	137.90
24	0.22	57.10	393.69	134.12	283	34.49	237.80	383.46	20	137.90
25	0.98	57.14	393.97	134.13	283	22.05	152.03	293.98	20	137.90
26	0.44	57.09	393.62	134.13	283	22.03	151.89	293.37	20	137.90

160401085_SNTC_BLOCK4-JUNCTION ID



Prepared By:

Date: Thursday, April 30, 2020

160401085_SNTC_BLOCK4-PIPE ID

TEXT
▪

JUNCTION (MOTYPE)
● Active
● Domain

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

PIPE (VALUE)
🟩 less than 250.50
🟦 greater than 250.50

PUMP (MOTYPE)
Active
Domain

VALVE (MOTYPE)
Active
Domain

ACAD-160401085 DP.dxf

ACAD-160401085 BLK 4 SP.dxf

Prepared By:

Date: 4/30/2020 1:03:32 PM

160401085_SNTC_BLOCK4-PIPE ID

TEXT
■

JUNCTION (MOTYPE)
- ● Active
- ● Domain

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

PIPE (VALUE)
- 🟩 less than 250.50
- 🟦 greater than 250.50

PUMP (MOTYPE)
- Active
- Domain

VALVE (MOTYPE)
- Active
- Domain

ACAD-160401085 DP.dxf

ACAD-160401085 BLK 4 SP.dxf

Prepared By:

Date: 4/30/2020 2:07:00 PM

A.5 BACKGROUND REPORT EXCERPTS

3.2.1 Ground Elevations

The proposed ground elevations of the development range from approximately 95.50m to 93.30m. Proposed grading and elevations have been determined for the site and are included on **Drawing GP-1** and **Drawing GP-2**.

3.2.2 Water Demands

The current subdivision plan for the development consists of four public roadways with two rows of rear-lane townhomes, 4 blocks intended for future residential development, a community park block and a school block. The residential blocks lie within CDP areas noted as mid-rise residential and mid-rise mixed-use areas (2-4 and 4-6 storeys buildings), as well as high density mixed-use areas. Net unit density targets have been applied to each block to develop estimated domestic demand rates for the region in consideration with an average townhouse unit population density of 2.7ppu and average apartment population density of 1.8ppu.

The contributing area was assessed at a residential density of 100 units/ha for mid-rise 2-4 storey residential areas (Block 2), 200 units/ha for mid-rise 4-6 storey residential areas, and 250 units/ha for high-rise residential areas (Block 3). A residential density of 140 units/ha was assumed for Blocks 1 and 4.

Water demands for the 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/cap/day. 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 and institutional use, the AVDY is based on the area of land use at 28,000 L/ha/day as shown in the following tables. For institutional use, AVDY was multiplied by a factor of 1.5 for MXDY demand and MXDY was multiplied by a factor of 1.8 for PKHR demand (see detailed calculations in **Appendix A.2**). The calculated domestic water consumption for the proposed SNTC Development is represented in **Table 3.1** and **Table 3.2**.

A 300mm watermain connection through Claridge's Burnett Lands located to the south of the site is required to maintain looping. As such, water demands for Claridge's development to the south have also been included in the hydraulic model. The water demands for Claridge's Burnett Lands Development were taken from the latest Novatech Site Servicing and Stormwater Management Report completed in May 2019(see **Appendix A.5**). Claridge's domestic demands are represented in **Table 3.3.**

Table 3.1: SNTC Development Residential Water Demands

Area ID	Units	Person/Unit	Population	AVDY (L/s)	MXDY (L/s)	PKHR (L/s)
Block 1	225	2.7	608	2.46	6.15	13.54
Block 2	172	2.7	464	1.88	4.70	10.35

Area ID	Units	Person/Unit	Population	AVDY (L/s)	MXDY (L/s)	PKHR (L/s)
Block 3	310	1.8	558	2.26	5.65	12.43
Block 4	225	2.7	608	2.46	6.15	13.54
Block 9-16	42	2.7	113	0.46	1.15	2.53
		Total	**2,351**	**9.52**	**23.80**	**52.39**

Table 3.2: SNTC Development Institutional Water Demands

Area ID	Area (ha)	Demand (L/ha/day)	AVDY (L/s)	MXDY (L/s)	PKHR (L/s)
Block 5	0.62	28,000	0.20	0.30	0.54
Block 6	1.62	28,000	0.52	0.79	1.42
		Total	**0.72**	**1.09**	**1.96**

Table 3.3: Claridge's Burnett Lands Water Demands

Area ID	AVDY (L/s)	MXDY (L/s)	PKHR (L/s)
Claridge Homes (3370 Greenbank Road)	4.53	11.33	24.93

3.2.3 Fire Flow Requirements

As part of the Kennedy-Burnett Potable Water Master Servicing Study, an assessment using the City's 2013 Water Master Plan Update model was carried out. The MSS analysis concluded that under both pre and post zone reconfiguration, available fire flows in the NTC lands are projected to be greater than 15,000 L/min along all the larger diameter watermain (305mm and greater). Background report excerpts are included in **Appendix A.5**.

A maximum fire flow of 16,000 L/min (267 L/s) was estimated for the worst-case townhome units (Block 10) within the proposed Blocks 9 to 16. FUS calculations can be found in **Appendix A.3.** A fire flow requirement of 10,000 L/min has been assumed for the future development blocks. However, it is recommended that the maximum fire flow requirement assumption be revisited at the detailed design stage of each block as development proceeds to ensure sufficient fire flows are available within the adjacent watermains.

As per the City's Technical Bulletin ISTB-2018-02, the maximum flow contribution from one given hydrant is 5,700 L/min (95 L/s) within a distance of 75 m, and 3,800 L/min (63 L/s) between 75 m and 150 m. As a result, hydrant placement in the vicinity of the townhome units within Block 10 was considered to ensure the maximum required fire flow of 16,000 L/min can be achieved.

From: Bougadis, John
To: Rathnasooriya, Thakshika
Subject: Re: Hydraulic Boundary Conditions - South Nepean Town Centre (SNTC)
Date: Friday, February 14, 2020 5:22:44 PM
Attachments: image001.png

No, the bcs did not include the claridge lands to the south or future development to the north. The 305 mm watermain was sized in past master planning studies (kevin Alemany did the work as part of the kB water servicing update).

Fire demands govern the sizing of local water mains that you will be designing. Also, the domestic demands from claridge and your development are relatively small compared to the entire pressure zone (hgls will not significantly decease during peak hour).

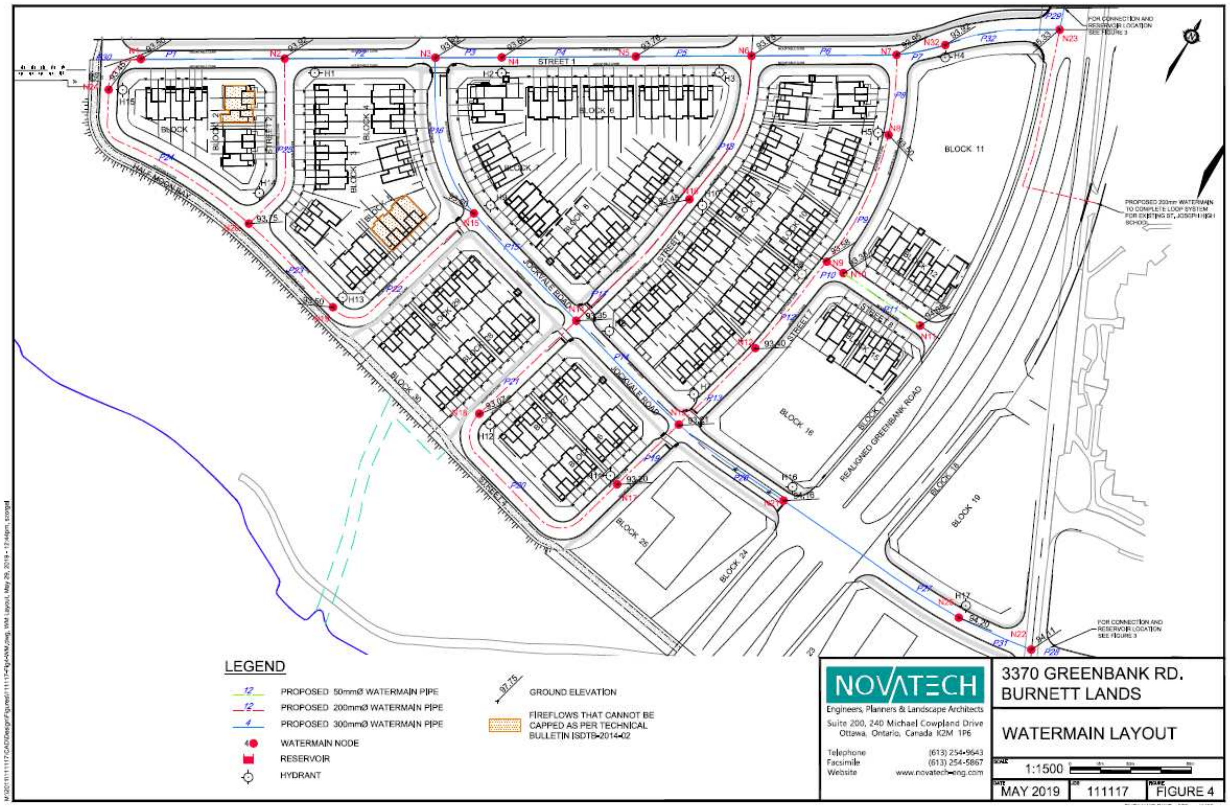
John

Get Outlook for iOS

From: Rathnasooriya, Thakshika <Thakshika.Rathnasooriya@stantec.com>
Sent: Friday, February 14, 2020 3:15:03 PM
To: Bougadis, John <John.Bougadis@ottawa.ca>
Subject: RE: Hydraulic Boundary Conditions - South Nepean Town Centre (SNTC)

Hi John,

To clarify, did the boundary conditions provided include demands from the development to the south, Burnett Lands (3370 Greenbank Road)?



Thanks,

Shika Rathnasooriya , P.Eng.

Direct: 613 724-4081
Thakshika.Rathnasooriya@stantec.com

Stantec
400 - 1331 Clyde Avenue
Ottawa ON K2C 3G4

From: Bougadis, John <John.Bougadis@ottawa.ca>
Sent: Wednesday, February 12, 2020 12:31 PM
To: Rathnasooriya, Thakshika <Thakshika.Rathnasooriya@stantec.com>
Cc: Shillington, Jeffrey <jeff.shillington@ottawa.ca>; Simard, Lyndsey <lyndsey.simard@ottawa.ca>
Subject: RE: Hydraulic Boundary Conditions - South Nepean Town Centre (SNTC)

Hi Shika,

I have attached boundary conditions for the SNTC development.

Thanks

John
x14990

From: Rathnasooriya, Thakshika <Thakshika.Rathnasooriya@stantec.com>
Sent: February 04, 2020 10:16 AM
To: Shillington, Jeffrey <jeff.shillington@ottawa.ca>
Subject: RE: Hydraulic Boundary Conditions - South Nepean Town Centre (SNTC)

Hi Jeff,

As per my voice mail, we are leaning towards going with conservative population counts which were used during draft plan. If revising the demands will trigger an additional 2 weeks wait, please continue to use the values provided in the previous request.

The connection locations and pipes diameters will remain the same, however, the demands have increased. Please see revised domestic demands below:

Estimated domestic demands and fire flow requirements for the site are as follows:
Average Day Demand – 9.51L/s
Max Day Demand - 23.78 L/s
Peak Hour Demand - 52.32L/s
Fire Flow Requirement per FUS for townhome units - 267 L/s

Thank you,

Shika Rathnasooriya , P.Eng.

Direct: 613 724-4081
Thakshika.Rathnasooriya@stantec.com

Stantec
400 - 1331 Clyde Avenue
Ottawa ON K2C 3G4

From: Rathnasooriya, Thakshika
Sent: Friday, January 31, 2020 2:36 PM
To: Shillington, Jeffrey <jeff.shillington@ottawa.ca>
Subject: RE: Hydraulic Boundary Conditions - South Nepean Town Centre (SNTC)

Good afternoon Jeff,

Could you please provide me with a statues update of the boundary conditions request for South Nepean Town Centre.

Thank you,

Shika Rathnasooriya , P.Eng.

Direct: 613 724-4081
Thakshika.Rathnasooriya@stantec.com

Stantec
400 - 1331 Clyde Avenue
Ottawa ON K2C 3G4

From: Rathnasooriya, Thakshika
Sent: Wednesday, January 22, 2020 1:35 PM
To: Shillington, Jeffrey <jeff.shillington@ottawa.ca>
Cc: Paerez, Ana <Ana.Paerez@stantec.com>
Subject: Hydraulic Boundary Conditions - South Nepean Town Centre (SNTC)

Hi Jeff,

I am looking for watermain hydraulic boundary conditions for theSouth Nepean Town Centre. The development is located southwest of the intersection of future extension of Chapman Mills Drive and Greenbank Road. The development consists of townhomes, back-to back units, apartment buildings, a school and a park.

We anticipate connecting to the existing twinning 400mm watermains on Jockvale Road south of the intersection with Greenbank Road(connection 1), and a 300mm diameter main exits at the intersection of Bending Way and Greenbank Road to maintain looping(connection 2). The development for Burnett Lands by Claridge to the south will require the extension of the Jockvale Road realignment (stated as "proposed Jockvale Rd" in proposed connection plan) to Street B.

Greenbank Road is proposed to be widened within the near future and minimal construction of the road prior to the widening is recommended through pre-consultation meetings with the City.

Estimated domestic demands and fire flow requirements for the site are as follows:
Average Day Demand – 7.07L/s

South Nepean Town Centre - Domestic Water Demand Estimates

Densities as per City Guidelines:

Apartments	1.8	ppu
Townhomes	2.7	ppu
Mid-Rise (2-4)	100	units/ha
Mid-Rise (4-6)	200	units/ha
High Density	250	units/ha
Block 1 & 4	140	units/ha

Area ID	Residential Area	# of Units	Population	Institutional Area (ha)	Daily Rate of Demand (L/cap/day)	Daily Rate of Demand (L/ha/day)	Avg Day Demand		Max Day Demand [1]		Peak Hour Demand [2]	
							(L/min)	(L/s)	(L/min)	(L/s)	(L/min)	(L/s)
Block 1	1.60	225	608	0.00	350	0	147.7	2.46	369.1	6.15	812.1	13.54
Block 2	1.72	172	464	0.00	350	0	112.9	1.88	282.2	4.70	620.8	10.35
Block 3	1.24	310	558	0.00	350	0	135.6	2.26	339.1	5.65	745.9	12.43
Block 4	1.59	225	608	0.00	350	0	147.7	2.46	369.1	6.15	812.1	13.54
Block 7	0.00	0	0	0.00	350	0	0.0	0.00	0.0	0.00	0.0	0.00
Block 8	0.00	0	0	0.00	350	0	0.0	0.00	0.0	0.00	0.0	0.00
Block 9-16	0.78	42	113	0.00	350	0	27.6	0.46	68.9	1.15	151.6	2.53
Block 5	0.00	0	0	0.62	0	28000	12.1	0.20	18.1	0.30	32.6	0.54
Block 6	0.00	0	0	1.62	0	28000	31.5	0.52	47.2	0.79	85.0	1.42
Claridge Homes (3370 Greenbank Road)								4.53		11.33		24.93
Total Site :			**2351**				**615**	**14.78**	**1494**	**36.23**	**3260**	**79.27**

Average day water demand for residential areas: 350 L/cap/d

The City of Ottawa water demand criteria used to estimate peak demand rates for residential areas are as follows:

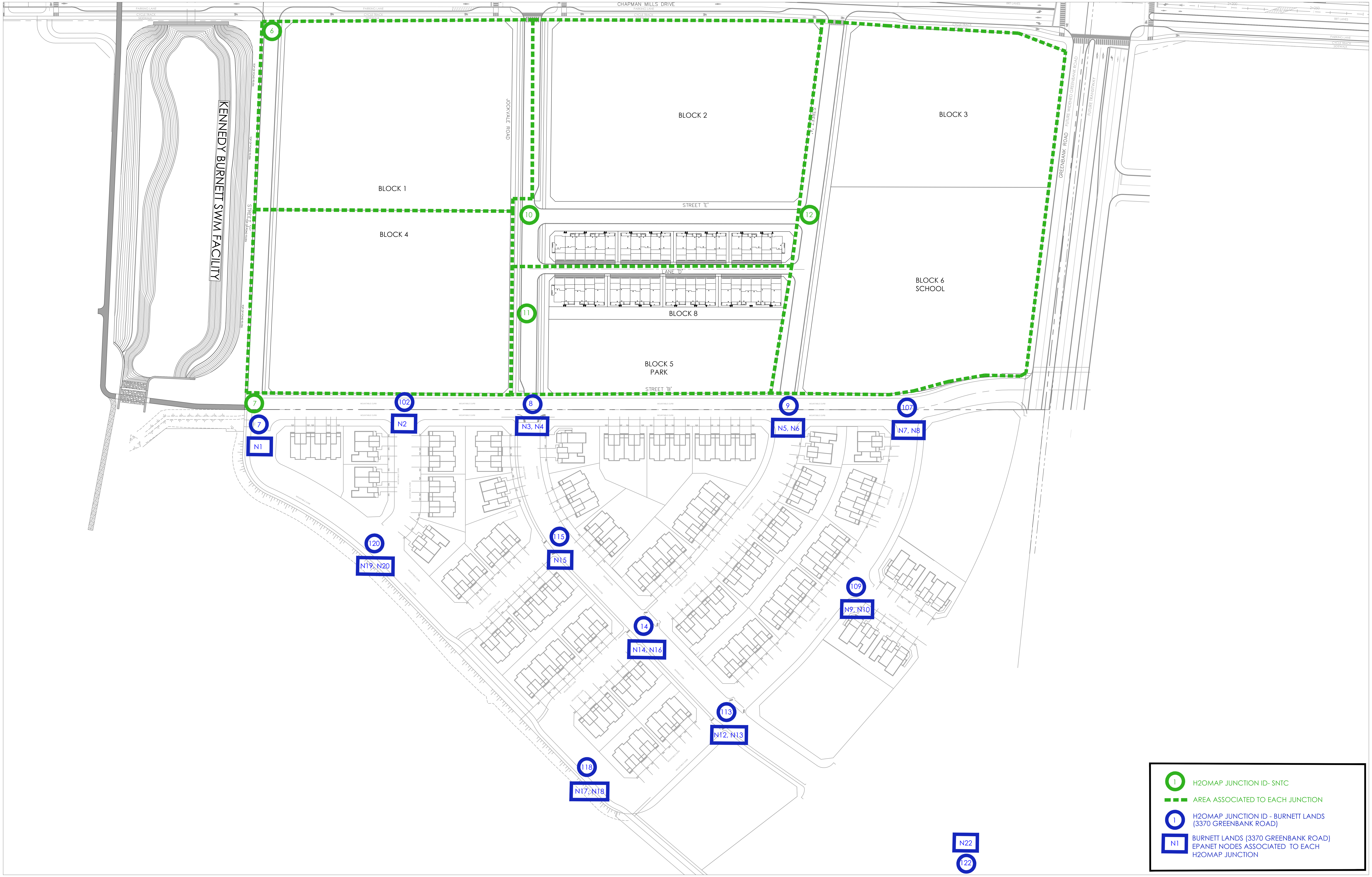
1 maximum day demand rate = 2.5 x average day demand rate for residential

2 peak hour demand rate = 2.2 x maximum day demand rate for residential

Water demand criteria used to estimate peak demand rates for commercial/institutional areas are as follows:

1 maximum day demand rate = 1.5 x average day demand rate

2 peak hour demand rate = 1.8 x maximum day demand rate


CHAPMAN MILLS DRIVE
KENNEDY BURNETT SWM FACILITY
JOCKVALE ROAD
GREENBANK ROAD
FUTURE TRANSITWAY
BLOCK 1
BLOCK 2
BLOCK 3
BLOCK 4
BLOCK 5
PARK
BLOCK 6
SCHOOL
BLOCK 8
STREET 'E'
LANE 'D'
STREET 'B'
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102
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N3, N4
N5, N6
N7, N8
N9, N10
N12, N13
N14, N16
N15
N17, N18
N19, N20
N22
H2OMAP JUNCTION ID- SNTC
AREA ASSOCIATED TO EACH JUNCTION
H2OMAP JUNCTION ID - BURNETT LANDS (3370 GREENBANK ROAD)
BURNETT LANDS (3370 GREENBANK ROAD) EPANET NODES ASSOCIATED TO EACH H2OMAP JUNCTION

EXISTING CONDITIONS
Hydraulic Model Results - Average Day Analysis

Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(Kpa)
3	0.00	94.78	157.38	88.99	613.57
4	0.00	94.21	157.34	89.74	618.74
5	0.00	93.15	157.31	91.21	628.87
6	2.46	93.93	157.31	90.10	621.22
7	2.52	93.51	157.30	90.69	625.29
8	0.15	93.82	157.30	90.25	622.26
9	0.15	93.74	157.30	90.36	623.01
10	2.11	93.67	157.31	90.47	623.77
11	0.43	93.54	157.31	90.65	625.01
12	2.78	94.07	157.31	89.90	619.84
13	0.00	93.85	157.31	90.21	621.98
14	0.43	93.35	157.30	90.91	626.81
15	0.00	95.33	157.30	88.10	607.43
102	0.08	93.92	157.30	90.11	621.29
107	0.38	93.95	157.30	90.06	620.95
109	0.23	93.58	157.30	90.59	624.60
113	1.13	93.21	157.30	91.11	628.19
115	0.20	93.60	157.30	90.56	624.39
118	0.15	92.82	157.30	91.67	632.05
120	0.20	93.75	157.30	90.35	622.95
122	1.39	94.11	157.30	89.83	619.36

Pipe Results

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)
10	14	113	76.07	297	120	2.56	0.04
11	8	115	80.12	297	120	2.56	0.04
12	9	14	165.53	204	110	0.83	0.03
13	11	8	57.06	297	120	4.79	0.07
14	10	11	60.55	297	120	5.02	0.07
15	5	10	125.25	297	120	6.71	0.1
16	4	12	128.8	204	110	5.12	0.16
17	12	13	57.59	204	110	1.91	0.06
18	13	9	57.74	204	110	1.72	0.05
19	6	7	243.82	204	110	1.66	0.05
20	7	102	90.67	297	120	-1.01	0.01
21	6	5	158.01	297	120	-4.12	0.06
22	4	5	186.77	297	120	10.83	0.16
23	9	8	153.93	297	120	-0.59	0.01
24	3	4	146.18	297	120	15.95	0.23
25	1000	3	92.09	297	120	15.95	0.23
26	10	12	170.91	204	110	-0.42	0.01
27	11	13	161.29	204	110	-0.2	0.01
28	9	107	72.78	297	120	1.32	0.02
30	102	8	78.61	297	120	-1.49	0.02
32	115	14	73.28	297	120	2.72	0.04
34	122	113	199.82	297	120	-2.55	0.04
36	107	15	78.35	297	120	0	0
38	113	109	106.78	204	110	-0.71	0.02
39	109	107	116.92	204	110	-0.94	0.03
41	118	113	114.97	204	110	0.41	0.01
42	14	118	109.64	204	110	0.56	0.02
43	7	120	128.07	204	110	0.16	0
44	120	102	92.43	204	110	-0.4	0.01
46	120	115	154.08	204	110	0.36	0.01
48	122	1001	10	297	120	1.16	0.02

Hydraulic Model Results -Peak Hour Analysis

Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(Kpa)
3	0.00	94.78	140.04	64.35	443.68
4	0.00	94.21	139.80	64.81	446.85
5	0.00	93.15	139.64	66.09	455.68
6	13.54	93.93	139.60	64.92	447.61
7	13.85	93.51	139.59	65.51	451.68
8	0.85	93.82	139.61	65.09	448.78
9	0.80	93.74	139.61	65.21	449.61
10	11.61	93.67	139.61	65.31	450.30
11	1.79	93.54	139.61	65.49	451.54
12	13.85	94.07	139.61	64.74	446.37
13	0.00	93.85	139.61	65.05	448.51
14	2.36	93.35	139.62	65.78	453.54
15	0.00	95.33	139.61	62.95	434.03
102	0.42	93.92	139.60	64.94	447.75
107	2.07	93.95	139.61	64.91	447.54
109	1.25	93.58	139.62	65.45	451.26
113	6.27	93.21	139.64	66.01	455.13
115	1.09	93.60	139.61	65.41	450.99
118	0.85	92.82	139.63	66.55	458.85
120	1.09	93.75	139.60	65.18	449.40
122	7.62	94.11	139.79	64.94	447.75

Pipe Results

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)		(L/s)	(m/s)
10	14	113	76.07	297	120	-14.23	0.21
11	8	115	80.12	297	120	-7.03	0.10
12	9	14	165.53	204	110	-2.88	0.09
13	11	8	57.06	297	120	1.77	0.03
14	10	11	60.55	297	120	2.97	0.04
15	5	10	125.25	297	120	14.66	0.21
16	4	12	128.80	204	110	13.69	0.42
17	12	13	57.59	204	110	-0.08	0.00
18	13	9	57.74	204	110	-0.67	0.02
19	6	7	243.82	204	110	1.84	0.06
20	7	102	90.67	297	120	-9.41	0.14
21	6	5	158.01	297	120	-15.38	0.22
22	4	5	186.77	297	120	30.04	0.43
23	9	8	153.93	297	120	2.45	0.04
24	3	4	146.18	297	120	43.74	0.63
25	1000	3	92.09	297	120	43.74	0.63
26	10	12	170.91	204	110	0.08	0.00
27	11	13	161.29	204	110	-0.59	0.02
28	9	107	72.78	297	120	-1.04	0.01
30	102	8	78.61	297	120	-10.41	0.15
32	115	14	73.28	297	120	-11.23	0.16
34	122	113	199.82	297	120	27.95	0.40
36	107	15	78.35	297	120	0.00	0.00
38	113	109	106.78	204	110	4.36	0.13
39	109	107	116.92	204	110	3.11	0.10
41	118	113	114.97	204	110	-3.09	0.09
42	14	118	109.64	204	110	-2.24	0.07
43	7	120	128.07	204	110	-2.60	0.08
44	120	102	92.43	204	110	-0.58	0.02
46	120	115	154.08	204	110	-3.11	0.10
48	122	1001	10.00	297	120	-35.57	0.51

Hydraulic Model Results -Fire Flow Analysis 267 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)
3	0.00	67.94	468.43	142.57	167	62.10	428.17	1025.85	20	137.90
4	0.00	63.26	436.17	138.71	167	53.93	371.84	730.12	20	137.90
5	0.00	61.36	423.06	136.31	167	52.04	358.81	631.39	20	137.90
6	6.15	59.97	413.48	136.11	167	48.14	331.92	458.68	20	137.90
7	6.29	58.29	401.90	134.51	167	48.99	337.78	506.86	20	137.90
8	0.38	57.81	398.59	134.49	167	50.30	346.81	660.25	20	137.90
9	0.36	57.80	398.52	134.40	167	49.93	344.26	589.46	20	137.90
12	6.44	59.13	407.69	135.67	167	48.88	337.02	475.20	20	137.90
13	0.00	58.47	403.14	134.98	167	48.88	337.02	492.71	20	137.90
14	1.08	56.97	392.80	133.42	167	50.62	349.01	670.63	20	137.90
15	0.00	55.43	382.18	134.32	167	44.22	304.89	393.11	20	137.90
102	0.19	57.67	397.62	134.49	167	49.23	339.43	556.64	20	137.90
107	0.95	57.39	395.69	134.32	167	48.43	333.92	503.45	20	137.90
109	0.56	56.71	391.00	133.47	167	44.21	304.82	348.72	20	137.90
113	2.83	56.16	387.21	132.71	167	50.74	349.84	718.67	20	137.90
115	0.50	57.47	396.24	134.03	167	50.33	347.02	639.82	20	137.90
118	0.38	57.22	394.52	133.07	167	45.02	310.40	357.63	20	137.90
120	0.49	57.81	398.59	134.42	167	46.80	322.68	421.20	20	137.90
122	3.46	49.57	341.78	128.98	167	49.31	339.98	2289.55	20	137.90
10	5.27	59.39	409.48	135.45	267	48.41	333.78	629.07	20	137.90
11	0.87	58.89	406.03	134.96	267	48.73	335.98	640.25	20	137.90

RECONFIGURATION CONDITIONS
Hydraulic Model Results - Average Day Analysis

Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(Kpa)
3	0.00	94.78	147.76	75.31	519.25
4	0.00	94.21	147.69	76.03	524.21
5	0.00	93.15	147.65	77.47	534.14
6	2.46	93.93	147.64	76.36	526.49
7	2.52	93.51	147.63	76.93	530.42
8	0.15	93.82	147.63	76.49	527.38
9	0.15	93.74	147.63	76.60	528.14
10	2.11	93.67	147.64	76.72	528.97
11	0.43	93.54	147.63	76.89	530.14
12	2.78	94.07	147.64	76.15	525.04
13	0.00	93.85	147.63	76.45	527.11
14	0.43	93.35	147.62	77.15	531.93
15	0.00	95.33	147.63	74.34	512.56
102	0.08	93.92	147.63	76.35	526.42
107	0.38	93.95	147.63	76.30	526.07
109	0.23	93.58	147.62	76.82	529.66
113	1.13	93.21	147.62	77.34	533.24
115	0.20	93.60	147.62	76.80	529.52
118	0.15	92.82	147.62	77.90	537.10
120	0.20	93.75	147.63	76.59	528.07
122	1.39	94.11	147.60	76.04	524.28

Pipe Results

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)		(L/s)	(m/s)
10	14	113	76.07	297	120	6.43	0.09
11	8	115	80.12	297	120	5.41	0.08
12	9	14	165.53	204	110	1.84	0.06
13	11	8	57.06	297	120	8.23	0.12
14	10	11	60.55	297	120	8.34	0.12
15	5	10	125.25	297	120	9.58	0.14
16	4	12	128.80	204	110	6.98	0.21
17	12	13	57.59	204	110	3.33	0.10
18	13	9	57.74	204	110	3.02	0.09
19	6	7	243.82	204	110	2.67	0.08
20	7	102	90.67	297	120	-0.43	0.01
21	6	5	158.01	297	120	-5.13	0.07
22	4	5	186.77	297	120	14.71	0.21
23	9	8	153.93	297	120	-1.43	0.02
24	3	4	146.18	297	120	21.69	0.31
25	1000	3	92.09	297	120	21.69	0.31
26	10	12	170.91	204	110	-0.87	0.03
27	11	13	161.29	204	110	-0.31	0.01
28	9	107	72.78	297	120	2.46	0.04
30	102	8	78.61	297	120	-1.23	0.02
32	115	14	73.28	297	120	6.31	0.09
34	122	113	199.82	297	120	-8.29	0.12
36	107	15	78.35	297	120	0.00	0.00
38	113	109	106.78	204	110	-1.85	0.06
39	109	107	116.92	204	110	-2.08	0.06
41	118	113	114.97	204	110	1.15	0.04
42	14	118	109.64	204	110	1.30	0.04
43	7	120	128.07	204	110	0.58	0.02
44	120	102	92.43	204	110	-0.72	0.02
46	120	115	154.08	204	110	1.10	0.03
48	122	1001	10.00	297	120	6.90	0.10

Hydraulic Model Results -Peak Hour Analysis

Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(Kpa)
3	0.00	94.78	145.07	71.49	492.91
4	0.00	94.21	144.71	71.79	494.98
5	0.00	93.15	144.48	72.97	503.11
6	13.54	93.93	144.43	71.79	494.98
7	13.85	93.51	144.41	72.35	498.84
8	0.85	93.82	144.42	71.93	495.94
9	0.80	93.74	144.42	72.05	496.77
10	11.61	93.67	144.43	72.16	497.53
11	1.79	93.54	144.43	72.34	498.77
12	13.85	94.07	144.43	71.59	493.60
13	0.00	93.85	144.43	71.90	495.74
14	2.36	93.35	144.42	72.61	500.63
15	0.00	95.33	144.42	69.79	481.19
102	0.42	93.92	144.41	71.78	494.91
107	2.07	93.95	144.42	71.75	494.70
109	1.25	93.58	144.42	72.28	498.36
113	6.27	93.21	144.43	72.81	502.01
115	1.09	93.60	144.42	72.25	498.15
118	0.85	92.82	144.43	73.36	505.80
120	1.09	93.75	144.41	72.02	496.56
122	7.62	94.11	144.49	71.62	493.81

Pipe Results

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)
10	14	113	76.07	297	120	-7.53	0.11
11	8	115	80.12	297	120	-1.56	0.02
12	9	14	165.53	204	110	-1.04	0.03
13	11	8	57.06	297	120	7.22	0.10
14	10	11	60.55	297	120	8.52	0.12
15	5	10	125.25	297	120	19.85	0.29
16	4	12	128.80	204	110	17.03	0.52
17	12	13	57.59	204	110	2.89	0.09
18	13	9	57.74	204	110	2.41	0.07
19	6	7	243.82	204	110	3.38	0.10
20	7	102	90.67	297	120	-8.27	0.12
21	6	5	158.01	297	120	-16.92	0.24
22	4	5	186.77	297	120	36.77	0.53
23	9	8	153.93	297	120	1.62	0.02
24	3	4	146.18	297	120	53.80	0.78
25	1000	3	92.09	297	120	53.80	0.78
26	10	12	170.91	204	110	-0.28	0.01
27	11	13	161.29	204	110	-0.49	0.01
28	9	107	72.78	297	120	1.03	0.01
30	102	8	78.61	297	120	-9.55	0.14
32	115	14	73.28	297	120	-5.08	0.07
34	122	113	199.82	297	120	17.89	0.26
36	107	15	78.35	297	120	0.00	0.00
38	113	109	106.78	204	110	2.29	0.07
39	109	107	116.92	204	110	1.04	0.03
41	118	113	114.97	204	110	-1.79	0.05
42	14	118	109.64	204	110	-0.94	0.03
43	7	120	128.07	204	110	-2.20	0.07
44	120	102	92.43	204	110	-0.86	0.03
46	120	115	154.08	204	110	-2.43	0.07
48	122	1001	10.00	297	120	-25.51	0.37

Hydraulic Model Results -Peak Hour Analysis

Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(Kpa)
3	0.00	94.78	145.07	71.49	492.91
4	0.00	94.21	144.71	71.79	494.98
5	0.00	93.15	144.48	72.97	503.11
6	13.54	93.93	144.43	71.79	494.98
7	13.85	93.51	144.41	72.35	498.84
8	0.85	93.82	144.42	71.93	495.94
9	0.80	93.74	144.42	72.05	496.77
10	11.61	93.67	144.43	72.16	497.53
11	1.79	93.54	144.43	72.34	498.77
12	13.85	94.07	144.43	71.59	493.60
13	0.00	93.85	144.43	71.90	495.74
14	2.36	93.35	144.42	72.61	500.63
15	0.00	95.33	144.42	69.79	481.19
102	0.42	93.92	144.41	71.78	494.91
107	2.07	93.95	144.42	71.75	494.70
109	1.25	93.58	144.42	72.28	498.36
113	6.27	93.21	144.43	72.81	502.01
115	1.09	93.60	144.42	72.25	498.15
118	0.85	92.82	144.43	73.36	505.80
120	1.09	93.75	144.41	72.02	496.56
122	7.62	94.11	144.49	71.62	493.81

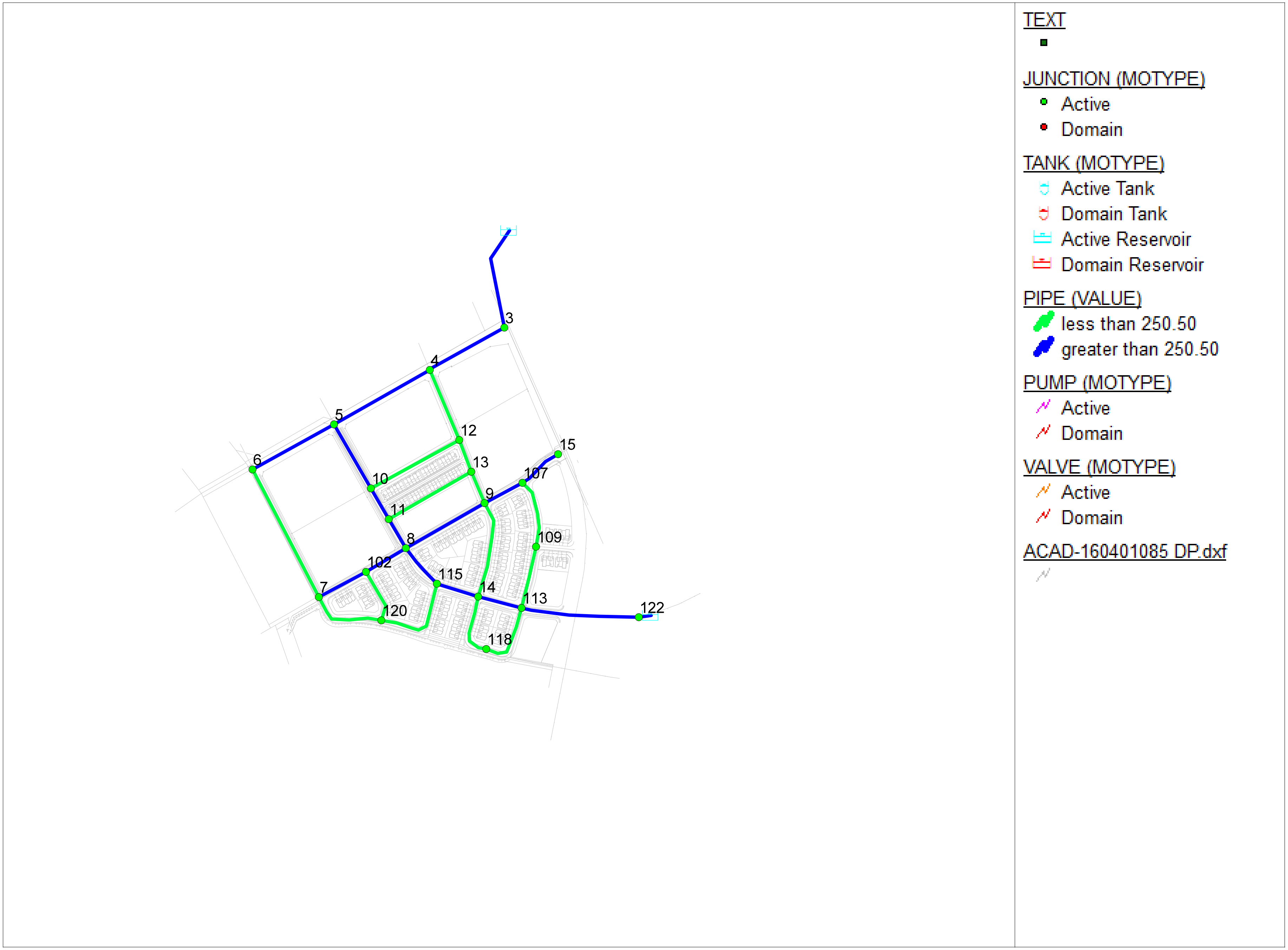
Pipe Results

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)		(L/s)	(m/s)
10	14	113	76.07	297	120	-7.53	0.11
11	8	115	80.12	297	120	-1.56	0.02
12	9	14	165.53	204	110	-1.04	0.03
13	11	8	57.06	297	120	7.22	0.10
14	10	11	60.55	297	120	8.52	0.12
15	5	10	125.25	297	120	19.85	0.29
16	4	12	128.80	204	110	17.03	0.52
17	12	13	57.59	204	110	2.89	0.09
18	13	9	57.74	204	110	2.41	0.07
19	6	7	243.82	204	110	3.38	0.10
20	7	102	90.67	297	120	-8.27	0.12
21	6	5	158.01	297	120	-16.92	0.24
22	4	5	186.77	297	120	36.77	0.53
23	9	8	153.93	297	120	1.62	0.02
24	3	4	146.18	297	120	53.80	0.78
25	1000	3	92.09	297	120	53.80	0.78
26	10	12	170.91	204	110	-0.28	0.01
27	11	13	161.29	204	110	-0.49	0.01
28	9	107	72.78	297	120	1.03	0.01
30	102	8	78.61	297	120	-9.55	0.14
32	115	14	73.28	297	120	-5.08	0.07
34	122	113	199.82	297	120	17.89	0.26
36	107	15	78.35	297	120	0.00	0.00
38	113	109	106.78	204	110	2.29	0.07
39	109	107	116.92	204	110	1.04	0.03
41	118	113	114.97	204	110	-1.79	0.05
42	14	118	109.64	204	110	-0.94	0.03
43	7	120	128.07	204	110	-2.20	0.07
44	120	102	92.43	204	110	-0.86	0.03
46	120	115	154.08	204	110	-2.43	0.07
48	122	1001	10.00	297	120	-25.51	0.37

Hydraulic Model Results -Fire Flow Analysis 267 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)
3	0.00	66.86	460.99	141.81	167	61.06	421.00	1012.96	20	137.90
4	0.00	62.28	429.41	138.02	167	53.03	365.63	720.86	20	137.90
5	0.00	60.43	416.65	135.66	167	51.23	353.22	623.57	20	137.90
6	6.15	59.05	407.14	135.47	167	47.32	326.26	452.88	20	137.90
7	6.29	57.41	395.83	133.89	167	48.21	332.40	500.51	20	137.90
8	0.38	56.93	392.52	133.87	167	49.53	341.50	651.79	20	137.90
9	0.36	56.92	392.45	133.78	167	49.15	338.88	581.95	20	137.90
12	6.44	58.22	401.42	135.03	167	48.07	331.43	469.18	20	137.90
14	1.08	56.12	386.94	132.83	167	49.87	343.84	662.19	20	137.90
15	0.00	54.56	376.18	133.71	167	43.44	299.51	387.76	20	137.90
102	0.19	56.79	391.56	133.87	167	48.46	334.12	549.48	20	137.90
107	0.95	56.52	389.69	133.71	167	47.66	328.61	496.99	20	137.90
109	0.56	55.86	385.14	132.87	167	43.45	299.58	344.31	20	137.90
113	2.83	55.33	381.49	132.13	167	50.00	344.74	709.69	20	137.90
115	0.50	56.60	390.25	133.42	167	49.58	341.84	631.69	20	137.90
118	0.38	56.38	388.73	132.48	167	44.27	305.23	353.24	20	137.90
120	0.49	56.94	392.59	133.80	167	46.02	317.30	415.84	20	137.90
122	3.46	48.85	336.81	128.48	167	48.60	335.09	2259.54	20	137.90
10	5.27	58.49	403.28	134.81	267	47.62	328.33	621.14	20	137.90
11	0.87	58.00	399.90	134.34	267	47.95	330.61	632.16	20	137.90

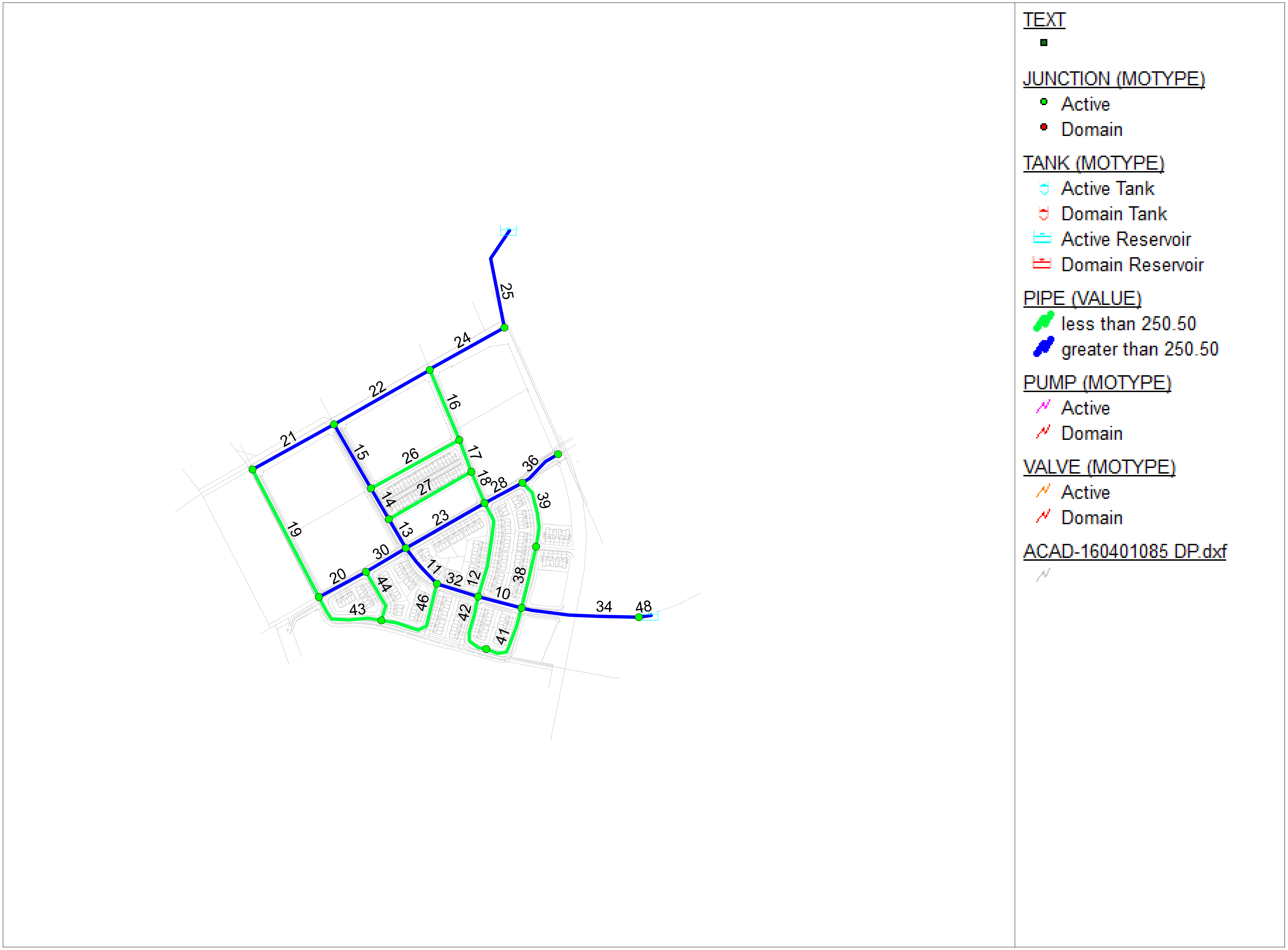
160401085-2020-02-06-JUNCTION ID



Prepared By:

Date: 2/14/2020 11:56:53 AM

160401085-2020-02-06-PIPE ID



Prepared By:

Date: 2/14/2020 11:57:35 AM

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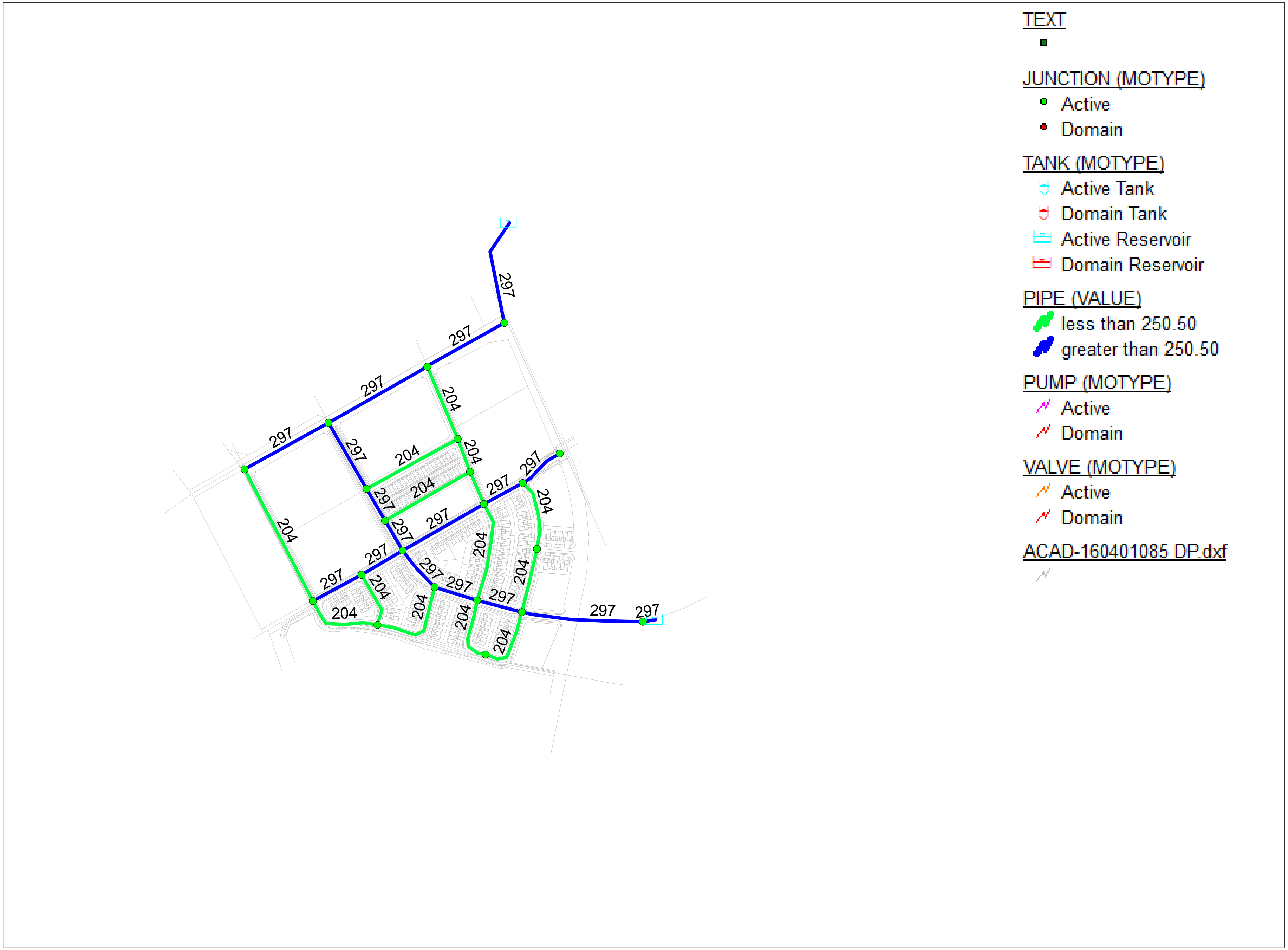

Prepared By:

Date: 2/13/2020 2:07:55 PM

3370 Greenbank Raod
Hydraulic Analysis

Table 1
Watermain Demand Calculations

Node	Number of Units		Pop.	Demand (L/s)		
	Town	Apartment Condo		High Pres.	Max Daily	Peak Hour
1	5		14	0.06	0.14	0.31
2	7		19	0.08	0.19	0.42
3	10		27	0.11	0.27	0.60
4	4		11	0.04	0.11	0.25
5	7		19	0.08	0.19	0.42
6	6		17	0.07	0.17	0.38
7	16		44	0.18	0.45	0.98
8	18		49	0.20	0.50	1.09
9	8		22	0.09	0.22	0.49
10	6		17	0.07	0.17	0.38
11	6		17	0.07	0.17	0.38
12	9	60	133	0.54	1.35	2.96
13	4	75	146	0.59	1.48	3.25
14	20		54	0.22	0.55	1.20
15	18		49	0.20	0.50	1.09
16	19		52	0.21	0.53	1.16
17	4		11	0.04	0.11	0.25
18	10		27	0.11	0.27	0.60
19	8		22	0.09	0.22	0.49
20	10		27	0.11	0.27	0.60
21			0	0.00	0.00	0.00
22		190	342	1.39	3.46	7.62
23			0	0.00	0.00	0.00
				4.53	**11.33**	**24.93**

1. Residential Population density: 2.7 people/town, 2.1 people/apartment
2. Residential High Pressure demand = 350L/s/p/d
3. Residential Maximum Daily demand = 2.5 x High Pressure Demand
4. Residential Peak Hour Demand = 2.2 x Maximum Daily Demand

Prepared By:
NOVATECH
Date: January 12, 2018

M:\2011\111117\DATA\Calculations\Sewer Calcs\Water\20180106\Unit Count.xls

Table 2
Pipe Data

Pipe	Length (m)	Diameter (mm)	Roughness
1	87	300	120
2	75	300	120
3	44	300	120
4	55	300	120
5	59	300	120
6	72	300	120
7	80	300	120
8	38	200	110
9	74	200	110
10	10	200	110
11	45	50	100
12	56	200	110
13	54	200	110
14	74	300	120
15	74	300	120
16	81	300	120
17	84	200	110
18	79	200	110
19	83	200	110
20	68	200	110
21	76	200	110
22	80	200	110
23	72	200	110
24	120	200	110
25	89	200	110
26	75	300	120
27	130	300	120
28	610	300	120
29	330	300	120

Prepared By:
NOVATECH
Date: January 12, 2018

EXECUTIVE SUMMARY

The following report identifies and evaluates the proposed water distribution system for a development located in the southern area of the City of Ottawa. The proposed Kennedy-Burnett (KB) development and the Nepean Town Centre (NTC) are located south of Strandherd Drive and are bound by Longfields Drive to the east, Cedarview Road to the west and the Jock River to the south (Figure 1-1). The area is currently serviced by the Zone BARR pressure zone within the City of Ottawa water distribution system.

A hydraulic assessment was performed using the City's 2013 Water Master Plan Update model for existing conditions and future conditions. Since this development is located in close proximity to the future 3C boundary, the hydraulic assessment reviewed scenarios in which the development is built in existing conditions, interim conditions, and future network configurations.

In the interim, both development areas are to be serviced by Zone BARR pressures. Based on the evaluation presented herein, it is recommended for the future that the KB area remain within Zone BARR and the NTC area be converted to the Zone 3C pressure zone post zone reconfiguration.

The proposed servicing plan recommends that the KB area will be fed by the existing small diameter Zone Barr watermain that currently feeds a small development in this area and/or by the future Strandherd 406mm diameter watermain. It is recommended that the NTC area continue to be fed by the 762mm diameter watermain along Greenbank and converted to Zone 3C pressures as previously planned. This configuration eliminates the need to connect the two developments with looping watermain across the future Kennedy-Burnett stormwater facilities – a savings of potentially $2.847 million.

Under pre zone reconfiguration conditions, certain areas within both the KB lands and the NTC lands experience maximum pressures greater than 80psi. Per the Ontario Building Code, services with pressures greater than 80 psi require pressure mitigation measures to be implemented, in most cases this involves a pressure reduction valve (PRV) on the individual service lines. Any development that proceeds in the interim prior to zone reconfiguration will have to ensure pressure reduction measures are in place as required depending on ground elevations. Under post zone reconfiguration conditions, lands within the KB area remain in the higher pressure zone and will continue to require pressure reduction measures accordingly. Lands within NTC will be located within a lower operating pressure zone and according to the results, maximum pressures are not anticipated to exceed 80 psi and therefore would likely not require pressure reduction measures – the requirement for PRVs in the NTC lands post zone reconfigurations will ultimately be decided once the final zone reconfiguration hydraulics are confirmed and implemented.

With respect to minimum pressure constraints, the results are similar for both areas under pre and post zone reconfiguration. The KB lands are anticipated to maintain minimum pressures greater than 60psi. This value is greater than the City's Design Guideline minimum pressure objective whereas the minimum pressures in NTC are anticipated to be maintained greater than 50psi at the highest ground elevations. This value is greater than the 40 psi minimum allowable pressure per the design guidelines.

A fire flow assessment under maximum day demand conditions was carried out. Under both pre and post zone reconfiguration, available fire flows in the NTC lands are projected to be greater than 15,000L/min along all the larger diameter watermain (305mm and greater). A hydraulic analysis for individual developments will still be required to determine the fire flow requirements and capabilities of the local watermain to provide the necessary fire flow amounts.

Under pre zone reconfiguration conditions, fire flows in the KB lands are limited by the small diameter watermains that feed the area. Available fire flows are limited to approximately 10,080L/min at a residual pressure of 20 psi. As development grows in the KB area, a third connection across Strandherd to an existing watermain along Frasier Fields will help to increase fire flows to a minimum of 12,120L/min along the larger diameter pipe network. Under future network conditions if and when the KB lands connect directly to the future 406mm diameter watermain along Strandherd, the available fire flows in the KB lands are expected to increase significantly and will be capable of providing greater than 15,000L/min.

Scenario 1A:

- Entire study area serviced by Zone BARR with no direct connections between KB and NTC;
- Represents a scenario where KB is developed independently of NTC (Figure 2-3);
- Existing (2012) demands under existing network conditions;
- KB area connected to existing development north of Strandherd;

Scenario 1B:

- Entire study area serviced by Zone BARR with no direct connections between KB and NTC;
- Represents a scenario where KB is developed independently of NTC (Figure 2-3);
- Existing (2012) demands under existing conditions;
- KB area connected to existing development north of Strandherd and a new watermain connection to the existing 254mm diameter pipe on Fraser Fields Way (for additional fire flow support);

Scenario 1C:

- Study area serviced by Zone BARR with direct connections between KB and NTC;
- Represents a scenario where both areas are developed concurrently (Figure 2-4);
- Existing (2012) demands under existing conditions;
- KB area connected to existing development north of Strandherd and two new 305mm diameter watermains connections across the future stormwater facilities to the NTC lands.

Model results are summarized in Table 2-3. Under existing network conditions, 100% of the nodes in the KB & NTC lands exceed the 80 psi threshold requiring pressure reduction measures per the Ontario Building/Plumbing Code.

With respect to minimum pressures under peak demand conditions, all pressures at nodes in the NTC lands remain greater than 51 psi whereas the minimum pressure in the KB lands is 64psi. These minimum pressure values are within acceptable guideline ranges.

Available fire flow to the KB lands is restricted by existing smaller diameter watermain, as shown in Scenario 1A, the minimum fire flow observed is 10,080L/min. With a third connection along Fraser Fields, the fire flow increases to 12,120. If the KB lands were connected to the NTC lands (Scenario 1C) the available fire flow would exceed 15,000L/min.

Table 2-3: Pre Zone Reconfiguration - Results Under Various Scenarios

		AVDY (psi)	PKHR (psi)	Available Fire Flow (L/min) @ 20 psi
Scenario & Area	Zone	Max	Min	
Scenario 1A: KB	BARR	99-102	64-67	10,080
Scenario 1A: NTC	BARR	82-103	51-72	> 15,000
Scenario 1B: KB	BARR	99-102	66-69	12,120
Scenario 1B: NTC	BARR	82-103	51-72	> 15,000
Scenario 1C: KB	BARR	99-102	67-70	> 15,000
Scenario 1C: NTC	BARR	82-103	51-72	> 15,000

* Pressures greater than 80psi exceed the allowable range as per the OBC

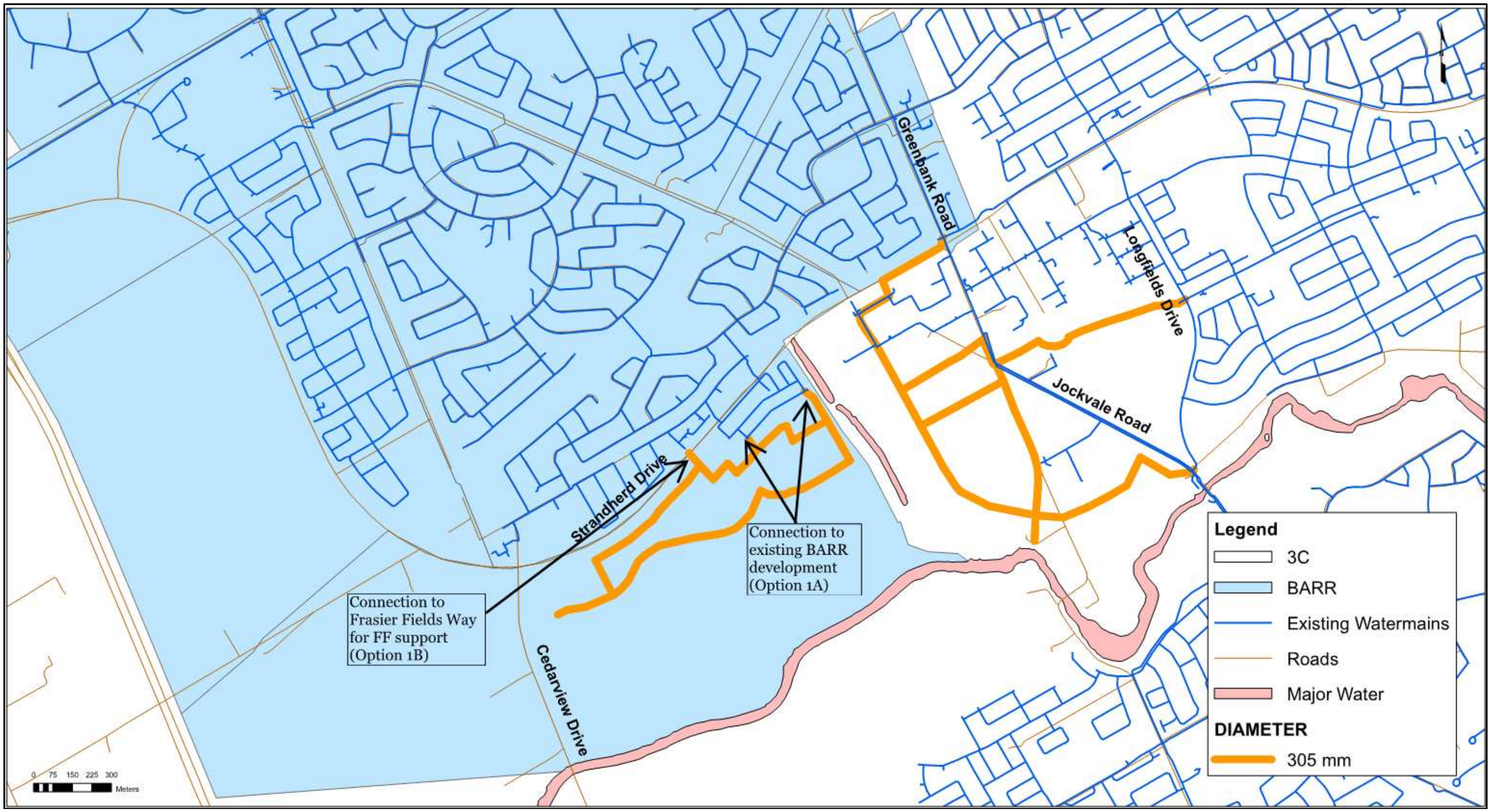

Figure 2-3: Proposed Pipe Layout Pre Zone Reconfiguration – Scenarios 1A and 1B

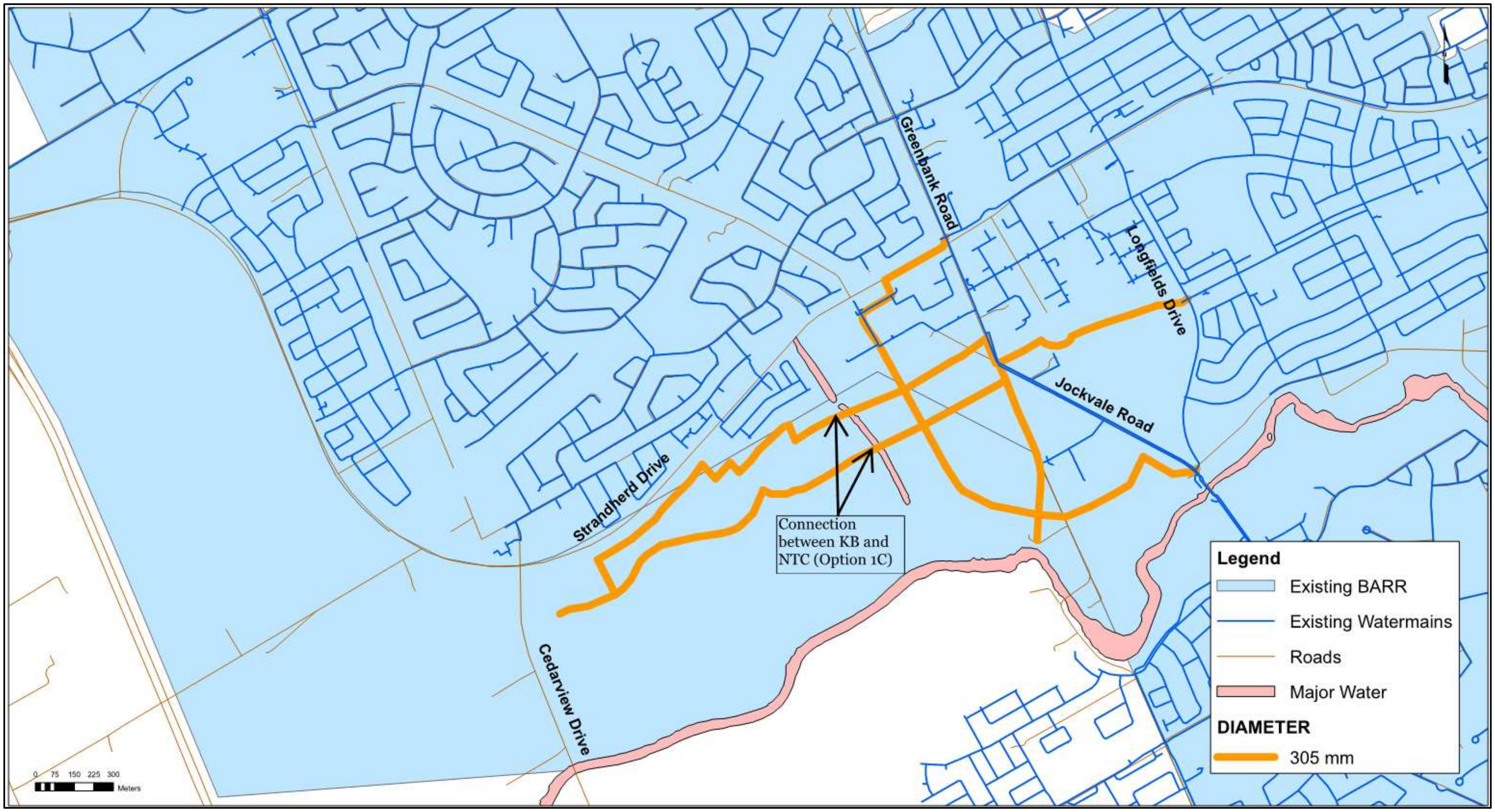

Figure 2-4: Proposed Pipe Layout Pre Zone Reconfiguration – Scenario 1C

2.7.2 Post Zone Reconfiguration – Future Demand Conditions

Scenario 2A: Prior to 406mm diameter watermain along Strandherd

- Represents scenario where KB operates at BARR pressure (*blue*) and NTC operates at 3C pressure (*white*) post zone reconfiguration (Figure 2-5);
- 2031 demands under 2031 network conditions;
- KB area connected to existing development north of Strandherd and a new watermain connection to the existing 254mm diameter pipe on Fraser Fields Way;

Scenario 2B: Post construction of 406mm watermain along Strandherd

- Represents scenario where KB operates at BARR pressure (*blue*) and NTC operates at 3C pressure (*white*) post zone reconfiguration (Figure 2-6);
- 2031 demands under 2031 network conditions;
- KB area connected to existing development north of Strandherd and to a future BARR 406mm diameter watermain along Strandherd;

Scenario 3: KB and NTC both serviced by Zone 3C

- Represents scenario where study area operates at 3C pressure (*white*) post zone reconfiguration (Figure 2-7);
- 2031 demands under 2031 network conditions;
- Two 305mm diameter watermains connecting KB and NTC across future stormwater facilities;
- KB area not connected to existing development along Strandherd.

Model results are summarized in Table 2-4. As shown in Scenario2A and 2B, keeping the KB lands in Zone Barr results in maximum pressures exceeding the 80 psi threshold and would require pressure reduction measures per the Ontario Building/Plumbing Code (similar to existing development conditions). If the KB development is switched to Zone 3C post reconfiguration, the maximum pressures drop below the threshold. For all scenarios, the maximum pressures within the NTC lands remain just below the maximum pressures threshold and therefore would not require pressure reduction measures.

Available fire flow to the KB lands is restricted by existing smaller diameter watermain in the development to the north. In order for fire flows to increase to greater than 15,000 L/min, connections to a new larger diameter watermain along Strandherd would be required. Similarly, if the KB lands were to be directly connected to the NTC lands and disconnected from Zone Barr, this alternative would also increase fire flows to KB lands to greater than 15,000L/min.

Table 2-4: Post Zone Reconfiguration - Results Under Various Scenarios

		AVDY (psi)	PKHR (psi)	Available Fire Flow (L/min) @ 20 psi
Scenario & Area	Zone	Max	Min	
Scenario 2A: KB	BARR	95-98	78-81	10,980
Scenario 2A: NTC	3C	59-80	51-70	> 15,000
Scenario 2B: KB	BARR	91-94	80-83	> 15,000
Scenario 2B: NTC	3C	59-80	51-70	> 15,000
Scenario 3: KB	3C	76-79	66-69	> 15,000
Scenario 3: NTC	3C	59-80	51-70	> 15,000

* Pressures greater than 80psi exceeds the allowable maximum pressure per the OBC

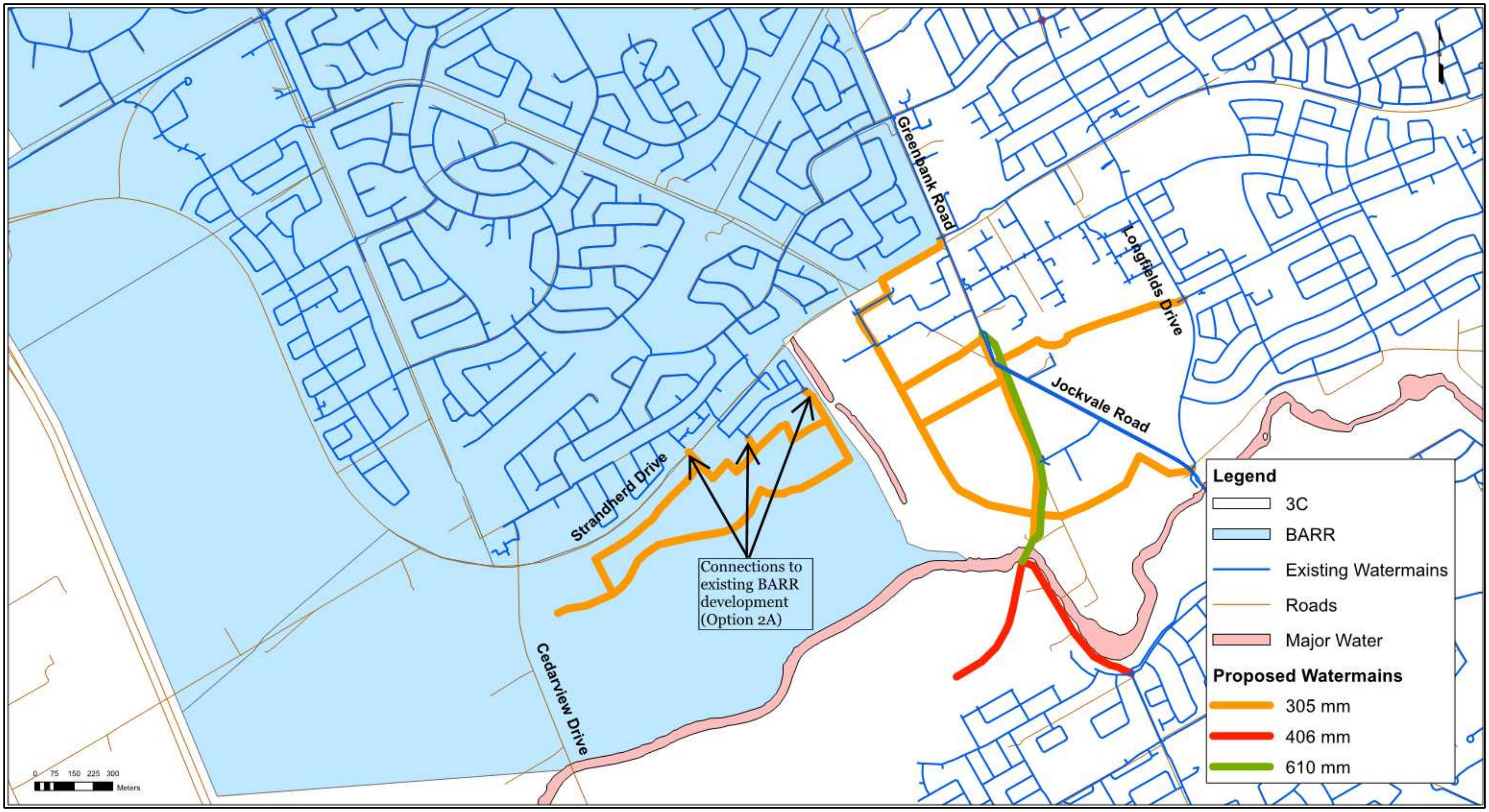

Figure 2-5: Proposed Pipe Layout Post Zone Reconfiguration – Scenario 2A

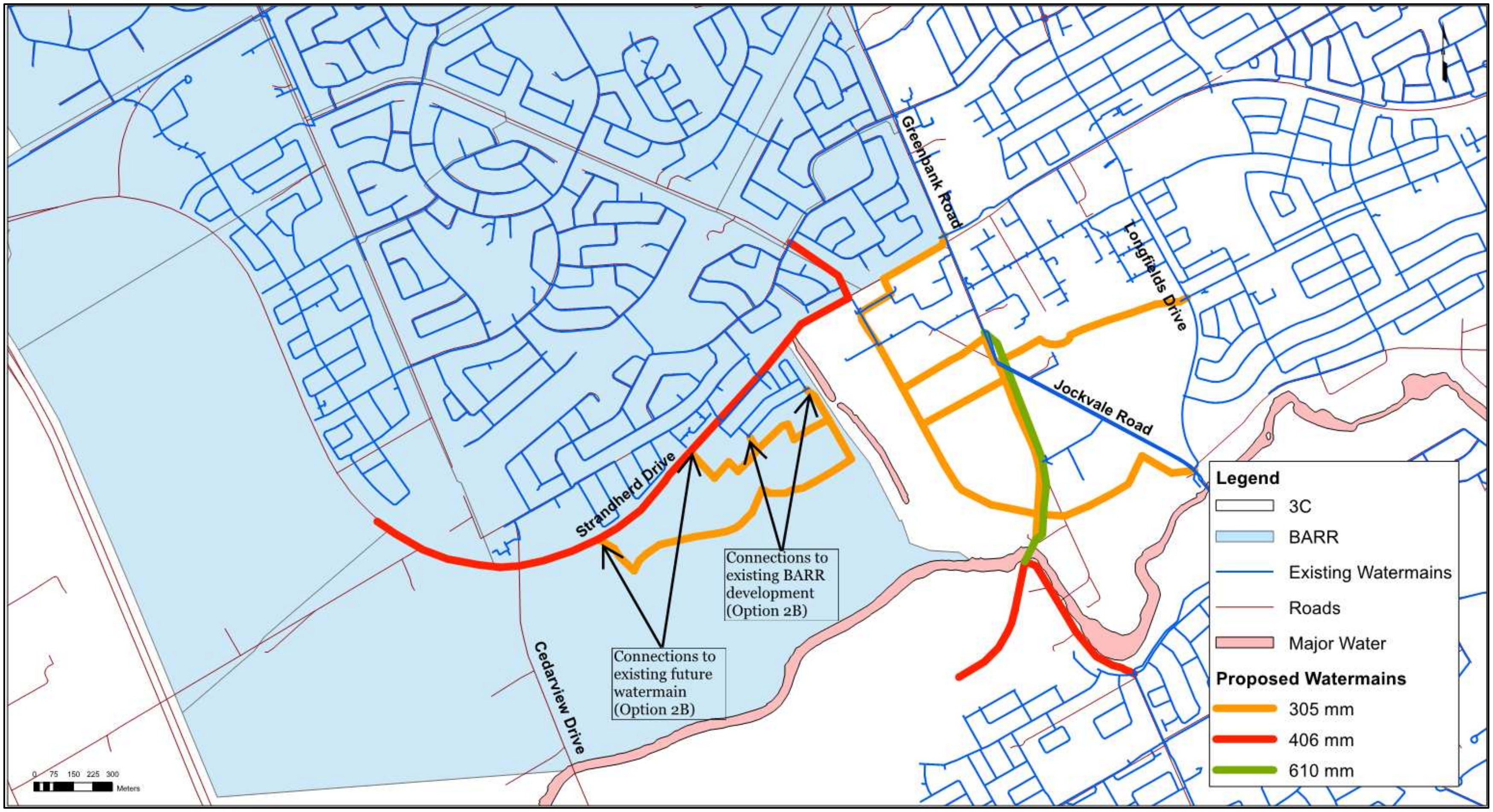

Figure 2-6: Proposed Pipe Layout Post Zone Reconfiguration – Scenario 2B

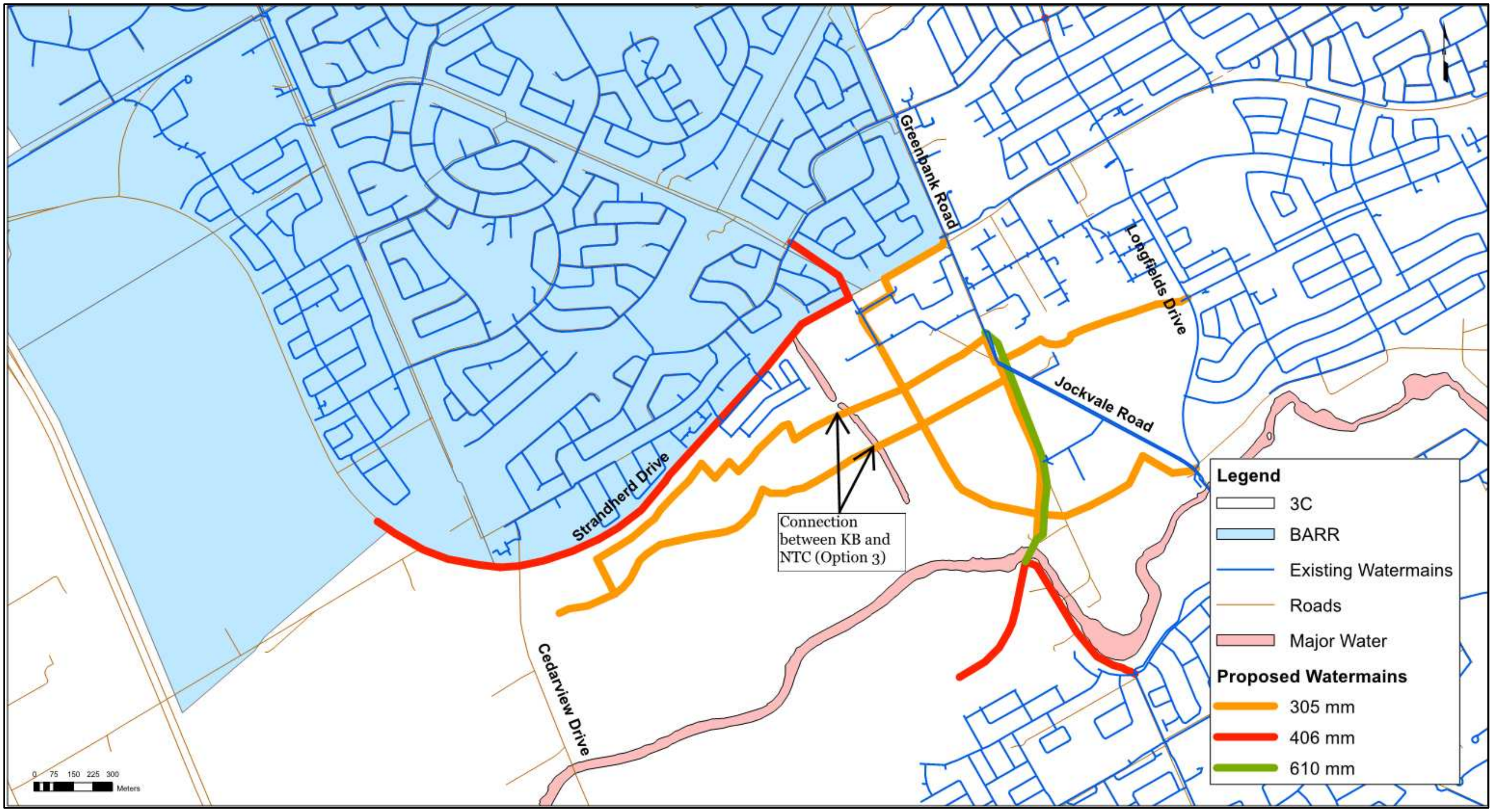

Figure 2-7: Proposed Pipe Layout Post Zone Reconfiguration – Scenario 3

Appendix B SANITARY SEWER CALCULATIONS

B.1 SANITARY SEWER DESIGN SHEET

Stantec

SUBDIVISION:

SNTC Lands - Block 4

DATE: 4/30/2020
REVISION: 1
DESIGNED BY: TR
CHECKED BY: AMP

FILE NUMBER: 160401085

SANITARY SEWER DESIGN SHEET
(City of Ottawa)

DESIGN PARAMETERS

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

LOCATION			RESIDENTIAL AREA AND POPULATION									COMMERCIAL		INDUSTRIAL (L)		INDUSTRIAL (H)		INSTITUTIONAL		GREEN / UNUSED		C+I+I	INFILTRATION			TOTAL	PIPE								
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (ha)	SINGLE	UNITS TOWN	APT	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (L/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	FLOW (L/s)	LENGTH (m)	DIA (mm)	MATERIAL	CLASS	SLOPE (%)	CAP. (FULL) (L/s)	CAP. V PEAK FLOW (%)	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
R4A	4	3	0.19	0	12	0	32	0.19	32	3.68	0.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.19	0.19	0.1	0.4	31.2	200	PVC	SDR 35	1.00	33.4	**1.34%**	1.05	0.30
R5A	5	3	0.17	0	12	0	32	0.17	32	3.68	0.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.17	0.17	0.1	0.4	30.2	200	PVC	SDR 35	1.00	33.4	**1.33%**	1.05	0.30
R3A	3	2	0.37	0	29	0	78	0.73	143	3.56	1.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.37	0.73	0.2	1.9	71.8	200	PVC	SDR 35	0.40	21.1	**8.94%**	0.67	0.34
R7A	7	6	0.08	0	4	0	11	0.08	11	3.73	0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.08	0.08	0.0	0.2	28.7	200	PVC	SDR 35	0.65	27.0	**0.58%**	0.85	0.18
R9A	9	8	0.18	0	12	0	32	0.18	32	3.68	0.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.18	0.18	0.1	0.4	23.0	200	PVC	SDR 35	1.00	33.4	**1.33%**	1.05	0.30
R8A	8	6	0.20	0	13	0	35	0.38	68	3.63	0.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.20	0.38	0.1	0.9	71.4	200	PVC	SDR 35	0.40	21.1	**4.34%**	0.67	0.27
R6A	6	2	0.08	0	5	0	14	0.54	92	3.60	1.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.08	0.54	0.2	1.3	38.3	200	PVC	SDR 35	0.40	21.1	**5.91%**	0.67	0.30
R2A	2	STUB 1	0.14	0	12	0	32	1.41	267	3.48	3.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.14	1.41	0.5	3.5	29.5	200	PVC	SDR 35	0.40	21.1	**16.45%**	0.67	0.41
																												200							
EXT-1	EX101	EX105	0.08	0	8	0	22	0.08	22	3.70	0.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.08	0.08	0.0	0.3									
EXT-2	EX.115	EX101	0.10	0	9	0	24	0.10	24	3.69	0.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.10	0.10	0.0	0.3									

B.2 BACKGROUND REPORT EXCERPTS

Stantec

SUBDIVISION:

SNTC LANDS

DATE: 2/20/2020
REVISION: 1
DESIGNED BY: WAJ
CHECKED BY: AMP

SANITARY SEWER DESIGN SHEET
(City of Ottawa)

FILE NUMBER: 160401085

DESIGN PARAMETERS

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

LOCATION			RESIDENTIAL AREA AND POPULATION									COMMERCIAL		INDUSTRIAL (L)		INDUSTRIAL (H)		INSTITUTIONAL		GREEN / UNUSED		C+I+I	INFILTRATION			TOTAL	PIPE								
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (ha)	UNITS SINGLE	UNITS TOWN	UNITS APT	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (L/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (L/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (L/s)	FLOW (L/s)	LENGTH (m)	DIA (mm)	MATERIAL	CLASS	SLOPE (%)	CAP. (FULL) (l/s)	CAP. V PEAK FLOW (%)	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
R106A	106	105	1.24	0	0	310	558	1.24	558	3.36	6.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	1.24	1.24	0.4	6.5	11.2	200	PVC	SDR 35	0.40	21.1	**30.7%**	0.67	0.49
G105A	105	104	0.00	0	0	0	0	1.24	558	3.36	6.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.21	0.0	0.21	1.45	0.5	6.6	23.7	200	PVC	SDR 35	0.40	21.1	**31.0%**	0.67	0.49
I107A	107	104	0.00	0	0	0	0	0.00	0	3.80	0.0	0.00	0.00	0.00	0.00	0.00	0.00	1.61	1.61	0.00	0.00	0.8	1.61	1.61	0.5	1.3	11.0	200	PVC	SDR 35	0.40	21.1	**6.2%**	0.67	0.31
G104A, R104A	104	103	0.16	0	5	0	14	1.40	572	3.35	6.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.61	0.19	0.40	0.8	0.35	3.42	1.1	8.1	48.1	200	PVC	SDR 35	0.40	21.1	**38.4%**	0.67	0.52
R111A	111	103	1.72	0	172	0	464	1.72	464	3.39	5.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	1.72	1.72	0.6	5.7	11.1	200	PVC	SDR 35	0.40	21.1	**26.8%**	0.67	0.47
R103A	103	102	0.26	0	10	0	27	3.38	1063	3.23	11.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.61	0.00	0.40	0.8	0.26	5.40	1.8	13.7	64.1	200	PVC	SDR 35	0.40	21.1	**64.7%**	0.67	0.61
R102A	102	101	0.21	0	6	0	16	3.59	1079	3.22	11.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.61	0.00	0.40	0.8	0.21	5.60	1.8	13.9	60.1	200	PVC	SDR 35	0.40	21.1	**65.7%**	0.67	0.62
	101	100	0.00	0	0	0	0	3.59	1079	3.22	11.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.61	0.00	0.40	0.8	0.00	5.60	1.8	13.9	35.0	200	PVC	SDR 35	0.40	21.1	**65.7%**	0.67	0.62
R110A	110	109	0.24	0	11	0	30	0.24	30	3.68	0.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.24	0.24	0.1	0.4	76.8	200	PVC	SDR 35	0.40	21.1	**2.1%**	0.67	0.22
R109A	109	108	0.20	0	10	0	27	0.44	57	3.64	0.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.20	0.44	0.1	0.8	76.8	200	PVC	SDR 35	0.40	21.1	**3.9%**	0.67	0.26
G113A	113	112	0.00	0	0	0	0	0.00	0	3.80	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.62	0.00	0.00	0.3	0.62	0.62	0.2	0.5	15.1	150	PVC	DR 28	1.00	15.3	**3.3%**	0.86	0.33
G112A	112	108	0.00	0	0	0	0	0.00	0	3.80	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.12	0.12	0.3	0.12	0.74	0.2	0.5	26.1	200	PVC	SDR 35	1.00	33.4	**1.6%**	1.05	0.32
G108A	108	100	0.00	0	0	0	0	0.44	57	3.64	0.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.05	0.17	0.3	0.05	1.24	0.4	1.4	22.2	200	PVC	SDR 35	0.40	21.1	**6.5%**	0.67	0.31
G100A	100	23	0.00	0	0	0	0	4.04	1136	3.21	11.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.23	0.35	0.92	1.1	0.35	7.19	2.4	15.3	2.7	250	PVC	SDR 35	1.32	69.7	**21.9%**	1.40	0.94
			4.04	0	214	310	1136					0.00		0.00		0.00		2.23		0.92			7.19												
R117A	117	116	1.60	0	225	0	608	1.60	608	3.34	6.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	1.60	1.60	0.5	7.1	10.3	200	PVC	SDR 35	0.40	21.1	**33.6%**	0.67	0.51
R116A	116	115	0.00	0	0	0	0	1.60	608	3.34	6.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.22	0.0	0.22	1.82	0.6	7.2	76.1	200	PVC	SDR 35	0.40	21.1	**34.0%**	0.67	0.51
R118A	118	115	1.59	0	225	0	608	1.59	608	3.34	6.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	1.59	1.59	0.5	7.1	10.0	200	PVC	SDR 35	0.40	21.1	**33.6%**	0.67	0.51
G115A	115	114	0.00	0	0	0	0	3.19	1215	3.20	12.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.32	0.0	0.10	3.52	1.2	13.7	67.2	200	PVC	SDR 35	0.40	21.1	**65.0%**	0.67	0.61
																												200							
			3.19	0	450	0	1215					0.00		0.00		0.00		0.00		0.32			3.52												

Appendix C STORMWATER MANAGEMENT CALCULATIONS

C.1 STORM SEWER DESIGN SHEET

Stantec

SNTC Lands - Block 4

DATE: 2020-04-30
REVISION: 1
DESIGNED BY: TR
CHECKED BY: AMP

STORM SEWER DESIGN SHEET
(City of Ottawa)

FILE NUMBER: 160401085

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

	1:2 yr	1:5 yr	1:10 yr	1:100 yr
a =	732.951	998.071	1174.184	1735.688
b =	6.199	6.053	6.014	6.014
c =	0.810	0.814	0.816	0.820

MANNING'S n = 0.013
BEDDING CLASS = B
MINIMUM COVER: 2.00 m
TIME OF ENTRY 10 min

LOCATION			**DRAINAGE AREA**																									**PIPE SELECTION**											
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)	T of C (min)	$I_{2\text{-YEAR}}$ (mm/h)	$I_{5\text{-YEAR}}$ (mm/h)	$I_{10\text{-YEAR}}$ (mm/h)	$I_{100\text{-YEAR}}$ (mm/h)	$Q_{CONTROL}$ (L/s)	ACCUM. $Q_{CONTROL}$ (L/s)	Q_{ACT} (CIA/360) (L/s)	LENGTH (m)	PIPE WIDTH OR DIAMETE (mm)	PIPE HEIGHT (mm)	PIPE SHAPE (-)	MATERIAL (-)	CLASS (-)	SLOPE %	Q_{CAP} (FULL) (L/s)	% FULL (-)	VEL. (FULL) (m/s)	VEL. (ACT) (m/s)	TIME OF FLOW (min)
Block 4 Foundation Drainage	Stub	102	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	0.0	11.8	200	200	CIRCULAR	PVC	-	1.00	33.3	**0.0%**	1.05	0.00	0.00
																				10.00																			
Block 5 Foundation Drainage	Stub	102	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	0.0	9.9	200	200	CIRCULAR	PVC	-	1.00	33.3	**0.0%**	1.05	0.00	0.00
																				10.00																			
L102C	CB102C	102	0.09	0.00	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.077	0.077	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	16.5	12.2	200	200	CIRCULAR	PVC	-	1.00	33.3	**49.4%**	1.05	0.90	0.23
																				10.23																			
L102D	CB102D	102	0.12	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.102	0.102	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	21.7	20.1	200	200	CIRCULAR	PVC	-	1.00	33.3	**65.3%**	1.05	0.97	0.34
																				10.34																			
L102B	CB102B	102	0.42	0.00	0.00	0.00	0.00	0.79	0.00	0.00	0.00	0.329	0.329	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	70.2	20.0	375	375	CIRCULAR	PVC	-	1.00	110.5	**63.5%**	1.05	0.97	0.34
																				10.34																			
L102A	102	101	0.16	0.00	0.00	0.00	0.00	0.81	0.00	0.00	0.00	0.126	0.634	0.000	0.000	0.000	0.000	0.000	0.000	10.34	75.51	102.41	120.04	175.47	0.0	0.0	133.1	82.2	450	450	CIRCULAR	CONCRETE	-	0.40	188.1	**70.7%**	1.15	1.09	1.26
																				11.60																			
Block 6 Foundation Drainage	Stub	104	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	0.0	18.7	200	200	CIRCULAR	PVC	-	1.00	33.3	**0.0%**	1.05	0.00	0.00
	104	103	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	0.0	68.2	300	300	CIRCULAR	PVC	-	0.40	60.8	**0.0%**	0.86	0.00	0.00
																				10.00																			
L105A	CB105A	105	0.11	0.00	0.00	0.00	0.00	0.81	0.00	0.00	0.00	0.090	0.090	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	19.2	4.3	200	200	CIRCULAR	PVC	-	1.00	33.3	**57.7%**	1.05	0.94	0.08
	105	103	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.090	0.000	0.000	0.000	0.000	0.000	0.000	10.08	76.51	103.79	121.67	177.86	0.0	0.0	19.1	26.3	300	300	CIRCULAR	PVC	-	0.50	68.0	**28.1%**	0.97	0.70	0.63
																				10.70																			
	103	101	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.090	0.000	0.000	0.000	0.000	0.000	0.000	10.70	74.20	100.61	117.92	172.36	0.0	0.0	18.6	41.3	300	300	CIRCULAR	PVC	-	0.40	60.8	**30.5%**	0.86	0.64	1.08
																				11.78																			
Blcok 1 Foundation Drainage	Stub	101	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	0.0	11.2	200	200	CIRCULAR	PVC	-	1.00	33.3	**0.0%**	1.05	0.00	0.00
																				10.00																			
L101A	101	Stub	0.37	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.305	1.029	0.000	0.000	0.000	0.000	0.000	0.000	11.78	70.58	95.64	112.06	163.76	0.0	0.0	201.8	25.2	675	675	CIRCULAR	CONCRETE	-	0.30	480.3	**42.0%**	1.30	1.06	0.40
																				12.18									675	675									

C.2 PCSWMM MODEL INPUT

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[TITLE]
160401085 - SNTC Lands Assessment
Detailed Design Block 4, located north of the Jock River and west of Greenbank Road.


[OPTIONS]
;;Options            Value
;;------------------ ------------
FLOW_UNITS           LPS
INFILTRATION         HORTON
FLOW_ROUTING         DYNWAVE
LINK_OFFSETS         ELEVATION
MIN_SLOPE            0
ALLOW_PONDING        YES
SKIP_STEADY_STATE    NO
START_DATE           01/02/2018
START_TIME           00:00:00
REPORT_START_DATE    01/02/2018
REPORT_START_TIME    00:00:00
END_DATE             01/03/2018
END_TIME             00:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          00:01:00
WET_STEP             00:01:00
DRY_STEP             00:01:00
ROUTING_STEP         2
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]
;;Type          Parameters
;;------------- ----------
CONSTANT     0.0
DRY_ONLY     NO
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[RAINGAGES]
;;               Rain      Time   Snow   Data      
;;Name           Type      Intrvl Catch  Source    
;;-------------- --------- ------ ------ ----------
Raingage         INTENSITY 0:10   1.0    TIMESERIES Chicago100y_3h_10m_City

[SUBCATCHMENTS]
;;                                                 Total    Pcnt.             Pcnt.    Curb     Snow    
;;Name           Raingage         Outlet           Area     Imperv   Width    Slope    Length   Pack    
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- --------
L101A            Raingage         L101A-S          0.371714 88.571   370      3        0                        

L102A            Raingage         L102A-S          0.155965 87.143   116      3        0                        

L102B            Raingage         L102B-S          0.416519 84.286   314      3        0                        

L102C            Raingage         L102C-S          0.091812 91.429   40       3        0                        

L102D            Raingage         L102D-S          0.124257 88.571   54       3        0                        

L105A            Raingage         L105A-S          0.111158 87.143   56       3        0                        

UNC-1            Raingage         OF1              0.142651 60       321      2        0                        

UNC-2            Raingage         OF2              0.03007  42.857   200      3        0                        

UNC-3            Raingage         OF3              0.1184   42.857   305      3        0                        

UNC-4            Raingage         OF4              0.02893  42.857   200      3        0                        


[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted 
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
L101A            0.013      0.25       1.57       4.67       0          OUTLET    
L102A            0.013      0.25       1.57       4.67       0          OUTLET    
L102B            0.013      0.25       1.57       4.67       0          OUTLET    
L102C            0.013      0.25       1.57       4.67       0          OUTLET    
L102D            0.013      0.25       1.57       4.67       0          OUTLET    
L105A            0.013      0.25       1.57       4.67       0          OUTLET    
UNC-1            0.013      0.25       1.57       4.67       0          PERVIOUS   90        
UNC-2            0.013      0.25       1.57       4.67       0          PERVIOUS   70        
UNC-3            0.013      0.25       1.57       4.67       0          PERVIOUS   95        
UNC-4            0.013      0.25       1.57       4.67       0          PERVIOUS   90        

[INFILTRATION]
;;Subcatchment   MaxRate    MinRate    Decay      DryTime    MaxInfil  
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L101A            76.2       13.2       4.14       7          0
L102A            76.2       13.2       4.14       7          0
L102B            76.2       13.2       4.14       7          0
L102C            76.2       13.2       4.14       7          0
L102D            76.2       13.2       4.14       7          0
L105A            76.2       13.2       4.14       7          0
UNC-1            76.2       13.2       4.14       7          0
UNC-2            76.2       13.2       4.14       7          0
UNC-3            76.2       13.2       4.14       7          0
UNC-4            76.2       13.2       4.14       7          0

[OUTFALLS]
;;               Invert     Outfall      Stage/Table      Tide
;;Name           Elev.      Type         Time Series      Gate Route To
;;-------------- ---------- ------------ ---------------- ---- ----------------
218              89.827     FIXED        91.75            NO
MAJ-1            93.33      FREE                          NO
MAJ-2            93.24      FREE                          NO
OF1              0          FREE                          NO
OF2              0          FREE                          NO
OF3              93.52      FREE                          NO
OF4              93.44      FREE                          NO

[STORAGE]
;;               Invert   Max.     Init.    Storage    Curve                                Evap.
;;Name           Elev.    Depth    Depth    Curve      Params                               Frac.
Infiltration parameters
;;-------------- -------- -------- -------- ---------- -------- -------- -------- -------- --------
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L101A1-S         93.99    0.35     0        FUNCTIONAL 0        0        0        0        0
L101A-S          92.12    1.73     0        TABULAR    L101A-V                    0        0
L101A-S1         93.65    0.35     0        FUNCTIONAL 0        0        0        0        0
L102A-S          92.29    1.73     0        TABULAR    L102A-V                    0        0
L102A-S1         93.77    0.35     0        FUNCTIONAL 0        0        0        0        0
L102B-S          91.94    1.93     0        TABULAR    L102B-V                    0        0
L102B-S1         93.87    0.35     0        FUNCTIONAL 0        0        0        0        0
L102B-S2         93.97    0.35     0        FUNCTIONAL 0        0        0        0        0
L102C-S          92.52    1.73     0        TABULAR    102C-V                     0        0
L102C-S1         94.1     0.35     0        FUNCTIONAL 0        0        0        0        0
L102D-S          92.26    1.73     0        TABULAR    L102D-V                    0        0
L102D-S1         93.94    0.35     0        FUNCTIONAL 0        0        0        0        0
L105A-S          92.08    1.73     0        FUNCTIONAL 0        0        0        0        0
L105A-S1         93.91    0.35     0        FUNCTIONAL 0        0        0        0        0
STM-101          90.606   3.105    1.144    FUNCTIONAL 0        0        0        0        0
STM-102          91.16    2.977    0.59     FUNCTIONAL 0        0        0        0        0
STM-103          91.071   2.863    0.599    FUNCTIONAL 0        0        0        0        0
STM-104          91.404   2.583    0.346    FUNCTIONAL 0        0        0        0        0
STM-105          91.232   2.306    0.518    FUNCTIONAL 0        0        0        0        0
```

```
[CONDUITS]
;;               Inlet            Outlet                      Manning    Inlet      Outlet     Init.
Max.
;;Name           Node             Node             Length     N          Offset     Offset     Flow
Flow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ----------
----------
C1               L105A-S1         L105A-S          29.884     0.013      93.91      93.46      0          0

C10              L102D-S          L102D-S1         18.031     0.013      93.64      93.94      0          0

C11              L102B-S2         L102D-S          10.552     0.013      93.97      93.64      0          0

C12              L102B-S2         L102B-S          21.381     0.013      93.97      93.52      0          0

C13              L102D-S1         L102B-S1         24.144     0.013      93.94      93.87      0          0

C14              L101A1-S         L101A-S          75.133     0.013      93.99      93.5       0          0

C15              L101A1-S         L102B-S          31.108     0.013      93.99      93.52      0          0

C16              L101A-S1         MAJ-1            18.852     0.013      93.65      93.33      0          0

C17              L105A-S          MAJ-2            9.672      0.013      93.46      93.24      0          0

C3               L101A-S          L101A-S1         14.841     0.013      93.5       93.65      0          0

C4               L102A-S1         L101A-S          18.287     0.013      93.77      93.5       0          0

C5               L102A-S          L102A-S1         18.719     0.013      93.67      93.77      0          0

C6               L102B-S1         L102A-S          20.072     0.013      93.87      93.67      0          0

C7               L102C-S          L102C-S1         10.31      0.013      93.9       94.1       0          0

C8               L102C-S1         L102B-S1         46.399     0.013      94.1       93.87      0          0

C9               L102B-S          L102B-S1         21.768     0.013      93.52      93.87      0          0

Pipe_3           STM-102          STM-101          82.253     0.013      91.46      91.131     0          0

Pipe_4           STM-103          STM-101          41.48      0.013      91.371     91.206     0          0

Pipe_46          STM-101          218              40.4       0.013      90.906     90.83      0          0

Pipe_5           STM-104          STM-103          68.185     0.013      91.704     91.431     0          0
```

```
Pipe_6           STM-105          STM-103          26.256     0.013      91.532     91.401     0          0


[ORIFICES]
;;               Inlet            Outlet           Orifice      Crest      Disch.     Flap Open/Close
;;Name           Node             Node             Type         Height     Coeff.     Gate Time      
;;-------------- ---------------- ---------------- ------------ ---------- ---------- ---- ----------
L101A-IC         L101A-S          STM-101          SIDE         92.12      0.572      NO   0         
L102A-IC         L102A-S          STM-101          SIDE         92.29      0.572      NO   0         
L102B-IC         L102B-S          STM-102          SIDE         91.94      0.572      NO   0         
L102C-IC         L102C-S          STM-102          SIDE         92.52      0.572      NO   0         
L102D-IC         L102D-S          STM-102          SIDE         92.26      0.572      NO   0         
L105A-IC         L105A-S          STM-105          SIDE         92.08      0.572      NO   0         

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels   
;;-------------- ------------ ---------------- ---------- ---------- ---------- ----------
C1               IRREGULAR    Half-12m-MC      0          0          0          1
C10              IRREGULAR    Half-17m-MC      0          0          0          1
C11              IRREGULAR    Half-17m-MC      0          0          0          1
C12              IRREGULAR    Half-17m-MC      0          0          0          1
C13              IRREGULAR    Half-17m-MC      0          0          0          1
C14              IRREGULAR    Half-12m-MC      0          0          0          1
C15              IRREGULAR    Half-17m-MC      0          0          0          1
C16              IRREGULAR    Half-17m-MC      0          0          0          1
C17              IRREGULAR    Half-8.5mROW     0          0          0          1
C3               IRREGULAR    Half-17m-MC      0          0          0          1
C4               IRREGULAR    Half-17m-MC      0          0          0          1
C5               IRREGULAR    Half-17m-MC      0          0          0          1
C6               IRREGULAR    Half-17m-MC      0          0          0          1
C7               IRREGULAR    Half-17m-MC      0          0          0          1
C8               IRREGULAR    Half-17m-MC      0          0          0          1
C9               IRREGULAR    Half-17m-MC      0          0          0          1
Pipe_3           CIRCULAR     0.45             0          0          0          1
Pipe_4           CIRCULAR     0.3              0          0          0          1
Pipe_46          CIRCULAR     0.675            0          0          0          1
Pipe_5           CIRCULAR     0.3              0          0          0          1
Pipe_6           CIRCULAR     0.3              0          0          0          1
L101A-IC         CIRCULAR     0.178            0          0          0
L102A-IC         CIRCULAR     0.108            0          0          0
L102B-IC         CIRCULAR     0.178            0          0          0
L102C-IC         CIRCULAR     0.094            0          0          0
L102D-IC         CIRCULAR     0.102            0          0          0
L105A-IC         CIRCULAR     0.094            0          0          0

[TRANSECTS]

;Full street, width = 8.5m, curb = 0.15m , cross-slope = 0.03m/m, bank-slope = 0.02m/m, bank-height = 
```

```
0.245m.
NC 0.025    0.025    0.013   
X1 18mROW           7        10       18.5     0.0       0.0       0.0      0.0      0.0     
GR 0.35     0        0.15     10       0        10       0.13     14.25    0        18.5    
GR 0.15     18.5     0.35     28.5    

;Full street, width = 11m, curb = 0.15m , cross-slope = 0.016m/m, bank-slope = 0.02m/m, bank-height = 0.23m.
NC 0.025    0.025    0.013   
X1 24mROW           7        10       21       0.0       0.0       0.0      0.0      0.0     
GR 0.35     0        0.15     10       0        10       0.165    15.5     0        21      
GR 0.15     21       0.35     31      

;Full street, width = 5.5m, curb = 0.15m , cross-slope = 0.03m/m, bank-slope = 0.02m/m, bank-height = 0.23m.
NC 0.025    0.025    0.013   
X1 8.5m-ROW         7        10       15.5     0.0       0.0       0.0      0.0      0.0     
GR 0.35     0        0.15     10       0        10       0.13     12.75    0        15.5    
GR 0.15     15.5     0.35     25.5    

NC 0.013    0.025    0.013   
X1 Half-12m-MC      6        3        9        0.0       0.0       0.0      0.0      0.0     
GR 0.17     0        0.11     3        0.06     3        0        9        0.05     9       
GR 0.11     12      

NC 0.013    0.025    0.013   
X1 Half-17m-MC      6        3        14       0.0       0.0       0.0      0.0      0.0     
GR 0.36     0        0.27     3        0.22     3        0        14       0.05     14      
GR 0.14     17      

NC 0.013    0.025    0.013   
X1 Half-18mROW      5        0.0      4.25     0.0       0.0       0.0      0.0      0.0     
GR 0.13     0        0        4.25     0.15     4.25     0.35     10       0.4      12.5    

NC 0.013    0.025    0.013   
X1 Half-8.5mROW     5        0.0      2.75     0.0       0.0       0.0      0.0      0.0     
GR 0.13     0        0        2.75     0.15     2.75     0.35     10       0.4      12.5    

[LOSSES]
;;Link           Inlet      Outlet     Average    Flap Gate  SeepageRate
;;-------------- ---------- ---------- ---------- ---------- ----------
Pipe_4           0          1.32       0          NO         0         
Pipe_46          0.02       1.32       0          NO         0         
Pipe_5           0          1.32       0          NO         0         
Pipe_6           0          0.02       0          NO         0         

[CURVES]
;;Name           Type       X-Value    Y-Value   
;;-------------- ---------- ---------- ----------
C202A-Q          Rating     0          0         
```

```
C202A-Q                     1.38       116.6
C202A-Q                     1.73       128.3
C202A-Q                     2.08       130.6

L201A-Q          Rating     0          0
L201A-Q                     1.38       79.8
L201A-Q                     1.73       87.8
L201A-Q                     2.08       89.4

L201C-Q          Rating     0          0
L201C-Q                     1.38       27.6
L201C-Q                     1.73       30.4
L201C-Q                     2.08       30.9

L202B-Q          Rating     0          0
L202B-Q                     1.38       127
L202B-Q                     1.73       139.7
L202B-Q                     2.08       142.2

L202C-Q          Rating     0          0
L202C-Q                     1.38       20.3
L202C-Q                     1.68       22.3

L203A-Q          Rating     0          0
L203A-Q                     1.38       52.3
L203A-Q                     1.73       57.5
L203A-Q                     2.08       58.6

L204A-Q          Rating     0          0
L204A-Q                     1.38       246.7
L204A-Q                     1.73       271.4
L204A-Q                     2.08       276.3

L205AA-Q         Rating     0          0
L205AA-Q                    1.38       88.2
L205AA-Q                    1.73       97

L205A-Q          Rating     0          0
L205A-Q                     1.38       208.6
L205A-Q                     1.73       229.5
L205A-Q                     2.08       233.6

L205C-Q          Rating     0          0
L205C-Q                     1.38       123.6
L205C-Q                     1.73       136
L205C-Q                     2.08       138.4

L215A-Q          Rating     0          0
```

```
L215A-Q                     1.38       262.8
L215A-Q                     1.73       289.1
L215A-Q                     2.08       294.3

L216A-Q          Rating     0          0
L216A-Q                     2.3        76
L216A-Q                     2.6        83.6
L216A-Q                     2.9        85.12

L218A-Q          Rating     0          0
L218A-Q                     1.38       60.3
L218A-Q                     1.73       66.3
L218A-Q                     2.08       67.5

L221A-Q          Rating     0          0
L221A-Q                     1.38       243.5
L221A-Q                     1.73       267.9
L221A-Q                     2.08       272.7

L222A-Q          Rating     0          0
L222A-Q                     1.38       245.1
L222A-Q                     1.73       269.6
L222A-Q                     2.08       274.5

102C-V           Storage    0          0
102C-V                      1.38       0
102C-V                      1.58       115
102C-V                      1.581      0
102C-V                      1.73       0

C202A-V          Storage    0          0
C202A-V                     1.38       0
C202A-V                     1.73       933
C202A-V                     1.731      0
C202A-V                     2.08       0

C300A-V          Storage    0          0
C300A-V                     1.38       0
C300A-V                     1.39       1
C300A-V                     1.4        0
C300A-V                     1.73       0

C302A-V          Storage    0          0
C302A-V                     1.38       0
C302A-V                     1.39       1
C302A-V                     1.4        0
C302A-V                     1.73       0
```

```
L101A-V          Storage    0          0
L101A-V                     1.38       0
L101A-V                     1.53       61
L101A-V                     1.531      0
L101A-V                     1.73       0

L102A-V          Storage    0          0
L102A-V                     1.38       0
L102A-V                     1.48       44
L102A-V                     1.481      0
L102A-V                     1.73       0

L102B-V          Storage    0          0
L102B-V                     1.58       0
L102B-V                     1.93       600
L102B-V                     1.931      0

L102D-V          Storage    0          0
L102D-V                     1.38       0
L102D-V                     1.68       138
L102D-V                     1.681      0
L102D-V                     1.73       0

L201A-V          Storage    0          0
L201A-V                     1.38       0
L201A-V                     1.73       88
L201A-V                     1.731      0
L201A-V                     2.08       0

L201C-V          Storage    0          0
L201C-V                     1.38       0
L201C-V                     1.73       44
L201C-V                     1.731      0
L201C-V                     2.08       0

L203A-V          Storage    0          0
L203A-V                     1.38       0
L203A-V                     1.73       78
L203A-V                     1.731      0
L203A-V                     2.08       0

L204AA-V         Storage    0          0
L204AA-V                    1.38       0
L204AA-V                    1.73       116
L204AA-V                    1.731      0
L204AA-V                    2.08       0

L204A-V          Storage    0          0
```

```
L204A-V                     1.38       0
L204A-V                     1.73       1700
L204A-V                     1.731      0
L204A-V                     2.08       0

L205AA-V         Storage    0          0
L205AA-V                    1.38       0
L205AA-V                    1.73       693

L205A-V          Storage    0          0
L205A-V                     1.38       0
L205A-V                     1.73       1130
L205A-V                     1.731      0
L205A-V                     2.08       0

L205C-V          Storage    0          0
L205C-V                     1.38       0
L205C-V                     1.73       180
L205C-V                     1.731      0
L205C-V                     2.08       0

L215A-V          Storage    0          0
L215A-V                     1.38       0
L215A-V                     1.73       487
L215A-V                     1.731      0
L215A-V                     2.08       0

L216A-V          Storage    0          0
L216A-V                     2.3        0
L216A-V                     2.6        22000
L216A-V                     2.601      0
L216A-V                     2.9        0

L221A-V          Storage    0          0
L221A-V                     1.38       0
L221A-V                     1.73       452
L221A-V                     1.731      0
L221A-V                     2.08       0

L222A-V          Storage    0          0
L222A-V                     1.38       0
L222A-V                     1.73       458
L222A-V                     1.731      0
L222A-V                     2.08       0

L400A-V          Storage    0          0
L400A-V                     1.38       0
L400A-V                     1.39       1
```

```
L400A-V                     1.4        0
L400A-V                     1.73       0

L402A-V          Storage    0          0
L402A-V                     1.38       0
L402A-V                     1.39       4700
L402A-V                     1.4        0
L402A-V                     1.73       0

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
;100yr - 4hr Chicago Design Storm - City of Ottawa IDF Data (1967-1997)
C100yr-4hr                  0:00       0.00
C100yr-4hr                  0:10       4.39
C100yr-4hr                  0:20       5.07
C100yr-4hr                  0:30       6.05
C100yr-4hr                  0:40       7.54
C100yr-4hr                  0:50       10.16
C100yr-4hr                  1:00       15.97
C100yr-4hr                  1:10       40.65
C100yr-4hr                  1:20       178.56
C100yr-4hr                  1:30       54.05
C100yr-4hr                  1:40       27.32
C100yr-4hr                  1:50       18.24
C100yr-4hr                  2:00       13.74
C100yr-4hr                  2:10       11.06
C100yr-4hr                  2:20       9.29
C100yr-4hr                  2:30       8.02
C100yr-4hr                  2:40       7.08
C100yr-4hr                  2:50       6.35
C100yr-4hr                  3:00       5.76
C100yr-4hr                  3:10       5.28
C100yr-4hr                  3:20       4.88
C100yr-4hr                  3:30       4.54
C100yr-4hr                  3:40       4.25
C100yr-4hr                  3:50       3.99
C100yr-4hr                  4:00       3.77

;100yr +20% - 4hr Chicago Design Storm - City of Ottawa IDF Data (1967-1997)
C100yr-4hr+20%              0:00       0.00
C100yr-4hr+20%              0:10       5.27
C100yr-4hr+20%              0:20       6.08
C100yr-4hr+20%              0:30       7.26
C100yr-4hr+20%              0:40       9.05
C100yr-4hr+20%              0:50       12.19
C100yr-4hr+20%              1:00       19.16
C100yr-4hr+20%              1:10       48.78
```

```
C100yr-4hr+20%              1:20       214.27
C100yr-4hr+20%              1:30       64.86
C100yr-4hr+20%              1:40       32.78
C100yr-4hr+20%              1:50       21.89
C100yr-4hr+20%              2:00       16.49
C100yr-4hr+20%              2:10       13.27
C100yr-4hr+20%              2:20       11.15
C100yr-4hr+20%              2:30       9.62
C100yr-4hr+20%              2:40       8.50
C100yr-4hr+20%              2:50       7.62
C100yr-4hr+20%              3:00       6.91
C100yr-4hr+20%              3:10       6.34
C100yr-4hr+20%              3:20       5.86
C100yr-4hr+20%              3:30       5.45
C100yr-4hr+20%              3:40       5.10
C100yr-4hr+20%              3:50       4.79
C100yr-4hr+20%              4:00       4.52

;25mm - 4hr Chicago Design Storm - City of Ottawa IDF Data (1967-1997)
C25mm-4hr                   0:00       0.00
C25mm-4hr                   0:10       1.51
C25mm-4hr                   0:20       1.75
C25mm-4hr                   0:30       2.07
C25mm-4hr                   0:40       2.58
C25mm-4hr                   0:50       3.46
C25mm-4hr                   1:00       5.39
C25mm-4hr                   1:10       13.44
C25mm-4hr                   1:20       56.67
C25mm-4hr                   1:30       17.77
C25mm-4hr                   1:40       9.12
C25mm-4hr                   1:50       6.14
C25mm-4hr                   2:00       4.65
C25mm-4hr                   2:10       3.76
C25mm-4hr                   2:20       3.17
C25mm-4hr                   2:30       2.74
C25mm-4hr                   2:40       2.43
C25mm-4hr                   2:50       2.18
C25mm-4hr                   3:00       1.98
C25mm-4hr                   3:10       1.81
C25mm-4hr                   3:20       1.68
C25mm-4hr                   3:30       1.56
C25mm-4hr                   3:40       1.47
C25mm-4hr                   3:50       1.38
C25mm-4hr                   4:00       1.31

;2yr - 4hr Chicago Design Storm - City of Ottawa IDF Data (1967-1997)
C2yr-4hr                    0:00       0.00
C2yr-4hr                    0:10       2.05
```

```
C2yr-4hr                    0:20       2.37
C2yr-4hr                    0:30       2.81
C2yr-4hr                    0:40       3.50
C2yr-4hr                    0:50       4.69
C2yr-4hr                    1:00       7.30
C2yr-4hr                    1:10       18.21
C2yr-4hr                    1:20       76.81
C2yr-4hr                    1:30       24.08
C2yr-4hr                    1:40       12.36
C2yr-4hr                    1:50       8.32
C2yr-4hr                    2:00       6.30
C2yr-4hr                    2:10       5.09
C2yr-4hr                    2:20       4.29
C2yr-4hr                    2:30       3.72
C2yr-4hr                    2:40       3.29
C2yr-4hr                    2:50       2.95
C2yr-4hr                    3:00       2.68
C2yr-4hr                    3:10       2.46
C2yr-4hr                    3:20       2.28
C2yr-4hr                    3:30       2.12
C2yr-4hr                    3:40       1.99
C2yr-4hr                    3:50       1.87
C2yr-4hr                    4:00       1.77

;5yr - 4hr Chicago Design Storm - City of Ottawa IDF Data (1967-1997)
C5yr-4hr                    0:00       0.00
C5yr-4hr                    0:10       2.68
C5yr-4hr                    0:20       3.10
C5yr-4hr                    0:30       3.68
C5yr-4hr                    0:40       4.58
C5yr-4hr                    0:50       6.15
C5yr-4hr                    1:00       9.61
C5yr-4hr                    1:10       24.17
C5yr-4hr                    1:20       104.19
C5yr-4hr                    1:30       32.04
C5yr-4hr                    1:40       16.34
C5yr-4hr                    1:50       10.96
C5yr-4hr                    2:00       8.29
C5yr-4hr                    2:10       6.69
C5yr-4hr                    2:20       5.63
C5yr-4hr                    2:30       4.87
C5yr-4hr                    2:40       4.30
C5yr-4hr                    2:50       3.86
C5yr-4hr                    3:00       3.51
C5yr-4hr                    3:10       3.22
C5yr-4hr                    3:20       2.98
C5yr-4hr                    3:30       2.77
C5yr-4hr                    3:40       2.60
```

```
C5yr-4hr                    3:50       2.44
C5yr-4hr                    4:00       2.31

Chicago_2yr_3hr_10m_ottawa            0:10       2.81459
Chicago_2yr_3hr_10m_ottawa            0:20       3.49824
Chicago_2yr_3hr_10m_ottawa            0:30       4.68718
Chicago_2yr_3hr_10m_ottawa            0:40       7.30485
Chicago_2yr_3hr_10m_ottawa            0:50       18.20881
Chicago_2yr_3hr_10m_ottawa            1:00       76.805
Chicago_2yr_3hr_10m_ottawa            1:10       24.07906
Chicago_2yr_3hr_10m_ottawa            1:20       12.36376
Chicago_2yr_3hr_10m_ottawa            1:30       8.32403
Chicago_2yr_3hr_10m_ottawa            1:40       6.30341
Chicago_2yr_3hr_10m_ottawa            1:50       5.09498
Chicago_2yr_3hr_10m_ottawa            2:00       4.29133
Chicago_2yr_3hr_10m_ottawa            2:10       3.71786
Chicago_2yr_3hr_10m_ottawa            2:20       3.28762
Chicago_2yr_3hr_10m_ottawa            2:30       2.95254
Chicago_2yr_3hr_10m_ottawa            2:40       2.68388
Chicago_2yr_3hr_10m_ottawa            2:50       2.46348
Chicago_2yr_3hr_10m_ottawa            3:00       2.27921

Chicago_5y_3h_10m_City            0:00       3.68223
Chicago_5y_3h_10m_City            0:10       4.58232
Chicago_5y_3h_10m_City            0:20       6.15055
Chicago_5y_3h_10m_City            0:30       9.6141
Chicago_5y_3h_10m_City            0:40       24.17035
Chicago_5y_3h_10m_City            0:50       104.193
Chicago_5y_3h_10m_City            1:00       32.03692
Chicago_5y_3h_10m_City            1:10       16.3375
Chicago_5y_3h_10m_City            1:20       10.96479
Chicago_5y_3h_10m_City            1:30       8.28693
Chicago_5y_3h_10m_City            1:40       6.68897
Chicago_5y_3h_10m_City            1:50       5.6279
Chicago_5y_3h_10m_City            2:00       4.87167
Chicago_5y_3h_10m_City            2:10       4.30483
Chicago_5y_3h_10m_City            2:20       3.8637
Chicago_5y_3h_10m_City            2:30       3.51028
Chicago_5y_3h_10m_City            2:40       3.22046
Chicago_5y_3h_10m_City            2:50       2.97831

Chicago100y_3h_10m_City            00:00      6.04573
Chicago100y_3h_10m_City            00:10      7.54219
Chicago100y_3h_10m_City            00:20      10.15880
Chicago100y_3h_10m_City            00:30      15.96889
Chicago100y_3h_10m_City            00:40      40.65497
Chicago100y_3h_10m_City            00:50      178.55900
Chicago100y_3h_10m_City            01:00      54.04853
```

```
Chicago100y_3h_10m_City           01:10      27.31870
Chicago100y_3h_10m_City           01:20      18.24039
Chicago100y_3h_10m_City           01:30      13.73692
Chicago100y_3h_10m_City           01:40      11.05876
Chicago100y_3h_10m_City           01:50      9.28521
Chicago100y_3h_10m_City           02:00      8.02389
Chicago100y_3h_10m_City           02:10      7.08022
Chicago100y_3h_10m_City           02:20      6.34698
Chicago100y_3h_10m_City           02:30      5.76029
Chicago100y_3h_10m_City           02:40      5.27978
Chicago100y_3h_10m_City           02:50      4.87871

Chicago100y+20%_3h_10m_City           00:00      7.255
Chicago100y+20%_3h_10m_City           00:10      9.051
Chicago100y+20%_3h_10m_City           00:20      12.191
Chicago100y+20%_3h_10m_City           00:30      19.163
Chicago100y+20%_3h_10m_City           00:40      48.786
Chicago100y+20%_3h_10m_City           00:50      214.271
Chicago100y+20%_3h_10m_City           01:00      64.858
Chicago100y+20%_3h_10m_City           01:10      32.782
Chicago100y+20%_3h_10m_City           01:20      21.888
Chicago100y+20%_3h_10m_City           01:30      16.484
Chicago100y+20%_3h_10m_City           01:40      13.271
Chicago100y+20%_3h_10m_City           01:50      11.142
Chicago100y+20%_3h_10m_City           02:00      9.629
Chicago100y+20%_3h_10m_City           02:10      8.496
Chicago100y+20%_3h_10m_City           02:20      7.616
Chicago100y+20%_3h_10m_City           02:30      6.912
Chicago100y+20%_3h_10m_City           02:40      6.336
Chicago100y+20%_3h_10m_City           02:50      5.854

;100yr - 12hr SCS Design Storm - City of Ottawa IDF Data (1967-1997)
S100yr-12hr                 0:00       0.00
S100yr-12hr                 0:30       2.82
S100yr-12hr                 1:00       1.31
S100yr-12hr                 1:30       2.44
S100yr-12hr                 2:00       2.44
S100yr-12hr                 2:30       3.19
S100yr-12hr                 3:00       2.82
S100yr-12hr                 3:30       3.76
S100yr-12hr                 4:00       3.76
S100yr-12hr                 4:30       5.07
S100yr-12hr                 5:00       6.39
S100yr-12hr                 5:30       10.14
S100yr-12hr                 6:00       80.38
S100yr-12hr                 6:30       20.47
S100yr-12hr                 7:00       9.02
S100yr-12hr                 7:30       6.01
```

```
S100yr-12hr                 8:00       5.26
S100yr-12hr                 8:30       4.13
S100yr-12hr                 9:00       4.32
S100yr-12hr                 9:30       2.82
S100yr-12hr                 10:00      2.25
S100yr-12hr                 10:30      3.19
S100yr-12hr                 11:00      2.07
S100yr-12hr                 11:30      1.88
S100yr-12hr                 12:00      1.88

;2yr - 12hr SCS Design Storm - City of Ottawa IDF Data (1967-1997)
S2yr-12hr                   0:00       0.00
S2yr-12hr                   0:30       1.27
S2yr-12hr                   1:00       0.59
S2yr-12hr                   1:30       1.10
S2yr-12hr                   2:00       1.10
S2yr-12hr                   2:30       1.44
S2yr-12hr                   3:00       1.27
S2yr-12hr                   3:30       1.69
S2yr-12hr                   4:00       1.69
S2yr-12hr                   4:30       2.29
S2yr-12hr                   5:00       2.88
S2yr-12hr                   5:30       4.57
S2yr-12hr                   6:00       36.24
S2yr-12hr                   6:30       9.23
S2yr-12hr                   7:00       4.06
S2yr-12hr                   7:30       2.71
S2yr-12hr                   8:00       2.37
S2yr-12hr                   8:30       1.86
S2yr-12hr                   9:00       1.95
S2yr-12hr                   9:30       1.27
S2yr-12hr                   10:00      1.02
S2yr-12hr                   10:30      1.44
S2yr-12hr                   11:00      0.93
S2yr-12hr                   11:30      0.85
S2yr-12hr                   12:00      0.85

;5yr - 12hr SCS Design Storm - City of Ottawa IDF Data (1967-1997)
S5yr-12hr                   0:00       0.00
S5yr-12hr                   0:30       1.69
S5yr-12hr                   1:00       0.79
S5yr-12hr                   1:30       1.46
S5yr-12hr                   2:00       1.46
S5yr-12hr                   2:30       1.91
S5yr-12hr                   3:00       1.69
S5yr-12hr                   3:30       2.25
S5yr-12hr                   4:00       2.25
S5yr-12hr                   4:30       3.03
```

```
S5yr-12hr                   5:00       3.82
S5yr-12hr                   5:30       6.07
S5yr-12hr                   6:00       48.08
S5yr-12hr                   6:30       12.25
S5yr-12hr                   7:00       5.39
S5yr-12hr                   7:30       3.60
S5yr-12hr                   8:00       3.15
S5yr-12hr                   8:30       2.47
S5yr-12hr                   9:00       2.58
S5yr-12hr                   9:30       1.69
S5yr-12hr                   10:00      1.35
S5yr-12hr                   10:30      1.91
S5yr-12hr                   11:00      1.24
S5yr-12hr                   11:30      1.12
S5yr-12hr                   12:00      1.12

[REPORT]
INPUT      YES
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]
Node       218              MH-C
Node       L101A-S          CB
Node       L102A-S          CB
Node       L102B-S          CB
Node       L102C-S          CB
Node       L102D-S          CB
Node       L105A-S          CB
Node       STM-101          MH-C
Node       STM-102          MH-C
Node       STM-103          MH-C
Node       STM-104          MH-C
Node       STM-105          MH-C
Link       C1               MAJ
Link       C10              MAJ
Link       C11              MAJ
Link       C12              MAJ
Link       C13              MAJ
Link       C14              MAJ
Link       C15              MAJ
Link       C16              MAJ
Link       C17              MAJ
Link       C3               MAJ
Link       C4               MAJ
Link       C5               MAJ
```

```
Link       C6               MAJ
Link       C7               MAJ
Link       C8               MAJ
Link       C9               MAJ
Link       Pipe_3           STM
Link       Pipe_4           STM
Link       Pipe_46          STM
Link       Pipe_5           STM
Link       Pipe_6           STM
Link       L101A-IC         RoadCB
Link       L102A-IC         RoadCB
Link       L102B-IC         RoadCB
Link       L102C-IC         RoadCB
Link       L102D-IC         RoadCB
Link       L105A-IC         RoadCB

[MAP]
DIMENSIONS       363780.9547      5013769.74325    363974.0113      5013954.18575
UNITS            Meters

[COORDINATES]
;;Node           X-Coord          Y-Coord
;;-------------- ---------------- ----------------
218              363797.507       5013838.233
MAJ-1            363801.696       5013833.174
MAJ-2            363872.589       5013785.283
OF1              363815.06        5013801.877
OF2              363927.001       5013812.438
OF3              363935.684       5013936.112
OF4              363951.599       5013825.948
L101A1-S         363885.226       5013841.386
L101A-S          363830.675       5013850.347
L101A-S1         363817.757       5013843.042
L102A-S          363859.441       5013857.072
L102A-S1         363850.337       5013854.166
L102B-S          363890.759       5013864.523
L102B-S1         363873.778       5013871.118
L102B-S2         363911.787       5013860.656
L102C-S          363915.2         5013903
L102C-S1         363904.9         5013903.432
L102D-S          363910.176       5013871.083
L102D-S1         363900.795       5013886.481
L105A-S          363868.4         5013794
L105A-S1         363848.35        5013816.157
STM-101          363833.3         5013856
STM-102          363904.6         5013897
STM-103          363853.9         5013820
STM-104          363913           5013854
```

C.3 PCSWMM MODEL OUTPUT

```
  EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.013)
  ---------------------------------------------------------------

  160401085 - SNTC Lands Assessment
  Detailed Design Block 4, located north of the Jock River and west of Greenbank Road.


  *************
  Element Count
  *************
  Number of rain gages ...... 1
  Number of subcatchments ... 10
  Number of nodes ........... 26
  Number of links ........... 27
  Number of pollutants ...... 0
  Number of land uses ....... 0


  ****************
  Raingage Summary
  ****************
                                                       Data       Recording
  Name                 Data Source                     Type       Interval
  -------------------------------------------------------------------------
  Raingage             Chicago100y_3h_10m_City         INTENSITY   10 min.


  ********************
  Subcatchment Summary
  ********************
  Name                       Area     Width   %Imperv    %Slope Rain Gage            Outlet

------------------------------------------------------------------------------------------------------------
  L101A                      0.37    370.00     88.57    3.0000 Raingage             L101A-S
  L102A                      0.16    116.00     87.14    3.0000 Raingage             L102A-S
  L102B                      0.42    314.00     84.29    3.0000 Raingage             L102B-S
  L102C                      0.09     40.00     91.43    3.0000 Raingage             L102C-S
  L102D                      0.12     54.00     88.57    3.0000 Raingage             L102D-S
  L105A                      0.11     56.00     87.14    3.0000 Raingage             L105A-S
  UNC-1                      0.14    321.00     60.00    2.0000 Raingage             OF1
  UNC-2                      0.03    200.00     42.86    3.0000 Raingage             OF2
  UNC-3                      0.12    305.00     42.86    3.0000 Raingage             OF3
  UNC-4                      0.03    200.00     42.86    3.0000 Raingage             OF4


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

```
  ************
                                            Invert      Max.    Ponded    External
  Name                 Type                  Elev.     Depth      Area    Inflow
  --------------------------------------------------------------------------------
  218                  OUTFALL               89.83      1.68       0.0
  MAJ-1                OUTFALL               93.33      0.36       0.0
  MAJ-2                OUTFALL               93.24      0.40       0.0
  OF1                  OUTFALL                0.00      0.00       0.0
  OF2                  OUTFALL                0.00      0.00       0.0
  OF3                  OUTFALL               93.52      0.00       0.0
  OF4                  OUTFALL               93.44      0.00       0.0
  L101A1-S             STORAGE               93.99      0.35       0.0
  L101A-S              STORAGE               92.12      1.73       0.0
  L101A-S1             STORAGE               93.65      0.35       0.0
  L102A-S              STORAGE               92.29      1.73       0.0
  L102A-S1             STORAGE               93.77      0.35       0.0
  L102B-S              STORAGE               91.94      1.93       0.0
  L102B-S1             STORAGE               93.87      0.35       0.0
  L102B-S2             STORAGE               93.97      0.35       0.0
  L102C-S              STORAGE               92.52      1.73       0.0
  L102C-S1             STORAGE               94.10      0.35       0.0
  L102D-S              STORAGE               92.26      1.73       0.0
  L102D-S1             STORAGE               93.94      0.35       0.0
  L105A-S              STORAGE               92.08      1.73       0.0
  L105A-S1             STORAGE               93.91      0.35       0.0
  STM-101              STORAGE               90.61      3.10       0.0
  STM-102              STORAGE               91.16      2.98       0.0
  STM-103              STORAGE               91.07      2.86       0.0
  STM-104              STORAGE               91.40      2.58       0.0
  STM-105              STORAGE               91.23      2.31       0.0


  ************
  Link Summary
  ************
  Name             From Node        To Node          Type            Length    %Slope Roughness
  ---------------------------------------------------------------------------------------------
  C1               L105A-S1         L105A-S          CONDUIT           29.9    1.5060    0.0130
  C10              L102D-S          L102D-S1         CONDUIT           18.0   -1.6640    0.0130
  C11              L102B-S2         L102D-S          CONDUIT           10.6    3.1289    0.0130
  C12              L102B-S2         L102B-S          CONDUIT           21.4    2.1051    0.0130
  C13              L102D-S1         L102B-S1         CONDUIT           24.1    0.2899    0.0130
  C14              L101A1-S         L101A-S          CONDUIT           75.1    0.6522    0.0130
  C15              L101A1-S         L102B-S          CONDUIT           31.1    1.5110    0.0130
  C16              L101A-S1         MAJ-1            CONDUIT           18.9    1.6977    0.0130
  C17              L105A-S          MAJ-2            CONDUIT            9.7    2.2752    0.0130
  C3               L101A-S          L101A-S1         CONDUIT           14.8   -1.0108    0.0130
  C4               L102A-S1         L101A-S          CONDUIT           18.3    1.4766    0.0130
```

```
C5               L102A-S          L102A-S1         CONDUIT           18.7   -0.5342    0.0130
C6               L102B-S1         L102A-S          CONDUIT           20.1    0.9965    0.0130
C7               L102C-S          L102C-S1         CONDUIT           10.3   -1.9402    0.0130
C8               L102C-S1         L102B-S1         CONDUIT           46.4    0.4957    0.0130
C9               L102B-S          L102B-S1         CONDUIT           21.8   -1.6081    0.0130
Pipe_3           STM-102          STM-101          CONDUIT           82.3    0.4000    0.0130
Pipe_4           STM-103          STM-101          CONDUIT           41.5    0.3978    0.0130
Pipe_46          STM-101          218              CONDUIT           40.4    0.1881    0.0130
Pipe_5           STM-104          STM-103          CONDUIT           68.2    0.4004    0.0130
Pipe_6           STM-105          STM-103          CONDUIT           26.3    0.4989    0.0130
L101A-IC         L101A-S          STM-101          ORIFICE
L102A-IC         L102A-S          STM-101          ORIFICE
L102B-IC         L102B-S          STM-102          ORIFICE
L102C-IC         L102C-S          STM-102          ORIFICE
L102D-IC         L102D-S          STM-102          ORIFICE
L105A-IC         L105A-S          STM-105          ORIFICE


*********************
Cross Section Summary
*********************
                                      Full     Full     Hyd.     Max.   No. of     Full
Conduit          Shape               Depth     Area     Rad.    Width  Barrels     Flow
---------------------------------------------------------------------------------------
C1               Half-12m-MC          0.17     1.20     0.08    12.00        1  2179.29
C10              Half-17m-MC          0.36     3.68     0.18    17.00        1 11600.04
C11              Half-17m-MC          0.36     3.68     0.18    17.00        1 15906.50
C12              Half-17m-MC          0.36     3.68     0.18    17.00        1 13047.26
C13              Half-17m-MC          0.36     3.68     0.18    17.00        1  4841.99
C14              Half-12m-MC          0.17     1.20     0.08    12.00        1  1434.14
C15              Half-17m-MC          0.36     3.68     0.18    17.00        1 11053.93
C16              Half-17m-MC          0.36     3.68     0.18    17.00        1 11716.73
C17              Half-8.5mROW         0.40     2.07     0.14    12.50        1  6338.51
C3               Half-17m-MC          0.36     3.68     0.18    17.00        1  9040.74
C4               Half-17m-MC          0.36     3.68     0.18    17.00        1 10927.31
C5               Half-17m-MC          0.36     3.68     0.18    17.00        1  6572.65
C6               Half-17m-MC          0.36     3.68     0.18    17.00        1  8976.55
C7               Half-17m-MC          0.36     3.68     0.18    17.00        1 12525.80
C8               Half-17m-MC          0.36     3.68     0.18    17.00        1  6331.27
C9               Half-17m-MC          0.36     3.68     0.18    17.00        1 11403.33
Pipe_3           CIRCULAR             0.45     0.16     0.11     0.45        1   180.33
Pipe_4           CIRCULAR             0.30     0.07     0.07     0.30        1    60.99
Pipe_46          CIRCULAR             0.68     0.36     0.17     0.68        1   364.61
Pipe_5           CIRCULAR             0.30     0.07     0.07     0.30        1    61.19
Pipe_6           CIRCULAR             0.30     0.07     0.07     0.30        1    68.31
```

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

Transect 18mROW
Area:
            0.0004     0.0014     0.0033     0.0058     0.0091
            0.0130     0.0177     0.0232     0.0293     0.0362
            0.0438     0.0522     0.0612     0.0710     0.0815
            0.0927     0.1047     0.1174     0.1307     0.1441
            0.1576     0.1712     0.1859     0.2016     0.2185
            0.2364     0.2555     0.2757     0.2970     0.3194
            0.3429     0.3675     0.3932     0.4201     0.4480
            0.4770     0.5072     0.5385     0.5708     0.6043
            0.6389     0.6746     0.7114     0.7493     0.7883
            0.8284     0.8697     0.9120     0.9554     1.0000
Hrad:
            0.0226     0.0452     0.0679     0.0905     0.1131
            0.1357     0.1583     0.1810     0.2036     0.2262
            0.2488     0.2715     0.2941     0.3167     0.3393
            0.3619     0.3846     0.4072     0.4392     0.4836
            0.5279     0.5717     0.6114     0.6466     0.6779
            0.7058     0.7307     0.7531     0.7733     0.7916
            0.8083     0.8236     0.8378     0.8510     0.8633
            0.8748     0.8858     0.8962     0.9062     0.9158
            0.9251     0.9341     0.9428     0.9514     0.9598
            0.9680     0.9762     0.9842     0.9921     1.0000
Width:
            0.0161     0.0321     0.0482     0.0642     0.0803
            0.0964     0.1124     0.1285     0.1445     0.1606
            0.1767     0.1927     0.2088     0.2248     0.2409
            0.2570     0.2730     0.2891     0.2982     0.2982
            0.2982     0.3123     0.3368     0.3614     0.3860
            0.4105     0.4351     0.4596     0.4842     0.5088
            0.5333     0.5579     0.5825     0.6070     0.6316
            0.6561     0.6807     0.7053     0.7298     0.7544
            0.7789     0.8035     0.8281     0.8526     0.8772
            0.9018     0.9263     0.9509     0.9754     1.0000

Transect 24mROW
Area:
            0.0003     0.0013     0.0030     0.0053     0.0083
            0.0119     0.0162     0.0211     0.0268     0.0330
            0.0400     0.0476     0.0558     0.0648     0.0744
            0.0846     0.0955     0.1071     0.1193     0.1322
            0.1457     0.1601     0.1760     0.1936     0.2122
            0.2318     0.2524     0.2740     0.2966     0.3202
            0.3448     0.3703     0.3969     0.4244     0.4530
```

```
            0.4825     0.5130     0.5445     0.5770     0.6105
            0.6450     0.6805     0.7170     0.7544     0.7929
            0.8323     0.8727     0.9142     0.9566     1.0000
Hrad:
            0.0220     0.0439     0.0659     0.0879     0.1099
            0.1318     0.1538     0.1758     0.1978     0.2197
            0.2417     0.2637     0.2857     0.3076     0.3296
            0.3516     0.3735     0.3955     0.4175     0.4395
            0.4614     0.4831     0.5016     0.5262     0.5600
            0.5912     0.6202     0.6471     0.6723     0.6958
            0.7179     0.7388     0.7585     0.7773     0.7952
            0.8122     0.8286     0.8443     0.8594     0.8740
            0.8881     0.9018     0.9152     0.9281     0.9408
            0.9531     0.9652     0.9770     0.9886     1.0000
Width:
            0.0151     0.0301     0.0452     0.0602     0.0753
            0.0903     0.1054     0.1204     0.1355     0.1505
            0.1656     0.1806     0.1957     0.2108     0.2258
            0.2409     0.2559     0.2710     0.2860     0.3011
            0.3161     0.3441     0.3817     0.4129     0.4355
            0.4581     0.4806     0.5032     0.5258     0.5484
            0.5710     0.5935     0.6161     0.6387     0.6613
            0.6839     0.7065     0.7290     0.7516     0.7742
            0.7968     0.8194     0.8419     0.8645     0.8871
            0.9097     0.9323     0.9548     0.9774     1.0000

Transect 8.5m-ROW
Area:
            0.0003     0.0012     0.0026     0.0046     0.0073
            0.0105     0.0142     0.0186     0.0235     0.0291
            0.0352     0.0418     0.0491     0.0569     0.0654
            0.0744     0.0840     0.0941     0.1048     0.1156
            0.1264     0.1374     0.1497     0.1633     0.1783
            0.1947     0.2125     0.2316     0.2521     0.2740
            0.2973     0.3219     0.3479     0.3752     0.4040
            0.4341     0.4656     0.4985     0.5327     0.5683
            0.6053     0.6437     0.6834     0.7245     0.7670
            0.8108     0.8561     0.9027     0.9507     1.0000
Hrad:
            0.0273     0.0546     0.0819     0.1092     0.1365
            0.1638     0.1911     0.2184     0.2458     0.2731
            0.3004     0.3277     0.3550     0.3823     0.4096
            0.4369     0.4642     0.4915     0.5300     0.5831
            0.6360     0.6880     0.7322     0.7685     0.7980
            0.8220     0.8415     0.8574     0.8704     0.8813
            0.8905     0.8984     0.9053     0.9116     0.9173
            0.9228     0.9280     0.9331     0.9382     0.9432
            0.9484     0.9536     0.9589     0.9643     0.9699
```

```
            0.9756     0.9815     0.9875     0.9937     1.0000
Width:
            0.0116     0.0232     0.0348     0.0465     0.0581
            0.0697     0.0813     0.0929     0.1045     0.1161
            0.1278     0.1394     0.1510     0.1626     0.1742
            0.1858     0.1974     0.2090     0.2157     0.2157
            0.2157     0.2314     0.2588     0.2863     0.3137
            0.3412     0.3686     0.3961     0.4235     0.4510
            0.4784     0.5059     0.5333     0.5608     0.5882
            0.6157     0.6431     0.6706     0.6980     0.7255
            0.7529     0.7804     0.8078     0.8353     0.8627
            0.8902     0.9176     0.9451     0.9725     1.0000

Transect Half-12m-MC
Area:
            0.0005     0.0019     0.0043     0.0077     0.0120
            0.0173     0.0236     0.0308     0.0390     0.0482
            0.0583     0.0694     0.0814     0.0944     0.1084
            0.1237     0.1405     0.1586     0.1774     0.1967
            0.2165     0.2368     0.2576     0.2788     0.3005
            0.3227     0.3454     0.3686     0.3922     0.4163
            0.4409     0.4660     0.4916     0.5177     0.5442
            0.5712     0.5987     0.6267     0.6551     0.6841
            0.7135     0.7434     0.7738     0.8047     0.8360
            0.8679     0.9002     0.9330     0.9662     1.0000
Hrad:
            0.0199     0.0397     0.0596     0.0795     0.0993
            0.1192     0.1391     0.1589     0.1788     0.1987
            0.2185     0.2384     0.2583     0.2781     0.2980
            0.3167     0.3343     0.3577     0.3924     0.4261
            0.4588     0.4905     0.5213     0.5513     0.5805
            0.6089     0.6366     0.6635     0.6899     0.7155
            0.7406     0.7651     0.7779     0.7855     0.7942
            0.8040     0.8146     0.8261     0.8381     0.8508
            0.8641     0.8778     0.8919     0.9064     0.9213
            0.9365     0.9520     0.9678     0.9838     1.0000
Width:
            0.0283     0.0567     0.0850     0.1133     0.1417
            0.1700     0.1983     0.2267     0.2550     0.2833
            0.3117     0.3400     0.3683     0.3967     0.4292
            0.4717     0.5142     0.5467     0.5608     0.5750
            0.5892     0.6033     0.6175     0.6317     0.6458
            0.6600     0.6742     0.6883     0.7025     0.7167
            0.7308     0.7450     0.7592     0.7733     0.7875
            0.8017     0.8158     0.8300     0.8442     0.8583
            0.8725     0.8867     0.9008     0.9150     0.9292
            0.9433     0.9575     0.9717     0.9858     1.0000
```

```
Transect Half-17m-MC
Area:
             0.0004     0.0014     0.0032     0.0056     0.0088
             0.0127     0.0173     0.0228     0.0295     0.0374
             0.0465     0.0567     0.0681     0.0807     0.0945
             0.1094     0.1255     0.1428     0.1613     0.1808
             0.2011     0.2221     0.2439     0.2663     0.2894
             0.3132     0.3378     0.3630     0.3890     0.4156
             0.4429     0.4703     0.4977     0.5251     0.5524
             0.5798     0.6072     0.6347     0.6625     0.6909
             0.7197     0.7489     0.7787     0.8089     0.8396
             0.8707     0.9023     0.9344     0.9670     1.0000
Hrad:
             0.0196     0.0393     0.0589     0.0785     0.0982
             0.1178     0.1374     0.1551     0.1703     0.1844
             0.1980     0.2114     0.2248     0.2383     0.2518
             0.2653     0.2790     0.2927     0.3065     0.3218
             0.3389     0.3565     0.3745     0.3929     0.4115
             0.4304     0.4494     0.4686     0.4879     0.5073
             0.5330     0.5665     0.6000     0.6334     0.6669
             0.7002     0.7336     0.7602     0.7800     0.7999
             0.8198     0.8398     0.8597     0.8797     0.8997
             0.9198     0.9398     0.9599     0.9799     1.0000
Width:
             0.0212     0.0424     0.0635     0.0847     0.1059
             0.1271     0.1490     0.1843     0.2196     0.2549
             0.2902     0.3255     0.3608     0.3961     0.4314
             0.4667     0.5020     0.5373     0.5725     0.6000
             0.6212     0.6424     0.6635     0.6847     0.7059
             0.7271     0.7482     0.7694     0.7906     0.8118
             0.8235     0.8235     0.8235     0.8235     0.8235
             0.8235     0.8235     0.8306     0.8447     0.8588
             0.8729     0.8871     0.9012     0.9153     0.9294
             0.9435     0.9576     0.9718     0.9859     1.0000

Transect Half-18mROW
Area:
             0.0004     0.0018     0.0040     0.0071     0.0111
             0.0160     0.0218     0.0285     0.0361     0.0445
             0.0539     0.0641     0.0753     0.0873     0.1002
             0.1140     0.1285     0.1429     0.1574     0.1725
             0.1884     0.2050     0.2224     0.2406     0.2596
             0.2793     0.2999     0.3212     0.3433     0.3662
             0.3899     0.4144     0.4396     0.4657     0.4925
             0.5201     0.5484     0.5776     0.6076     0.6383
             0.6698     0.7021     0.7352     0.7691     0.8042
             0.8406     0.8784     0.9176     0.9581     1.0000
Hrad:
```

```
             0.0212     0.0424     0.0637     0.0849     0.1061
             0.1273     0.1486     0.1698     0.1910     0.2122
             0.2334     0.2547     0.2759     0.2971     0.3183
             0.3395     0.3757     0.4165     0.4571     0.4959
             0.5317     0.5649     0.5957     0.6244     0.6512
             0.6763     0.6998     0.7219     0.7428     0.7625
             0.7812     0.7990     0.8159     0.8321     0.8476
             0.8624     0.8767     0.8904     0.9037     0.9165
             0.9289     0.9410     0.9527     0.9633     0.9708
             0.9777     0.9840     0.9897     0.9951     1.0000
Width:
             0.0209     0.0418     0.0628     0.0837     0.1046
             0.1255     0.1465     0.1674     0.1883     0.2092
             0.2302     0.2511     0.2720     0.2929     0.3138
             0.3348     0.3400     0.3400     0.3446     0.3630
             0.3814     0.3998     0.4182     0.4366     0.4550
             0.4734     0.4918     0.5102     0.5286     0.5470
             0.5654     0.5838     0.6022     0.6206     0.6390
             0.6574     0.6758     0.6942     0.7126     0.7310
             0.7494     0.7678     0.7862     0.8080     0.8400
             0.8720     0.9040     0.9360     0.9680     1.0000

Transect Half-8.5mROW
Area:
             0.0003     0.0013     0.0029     0.0052     0.0082
             0.0118     0.0160     0.0209     0.0265     0.0327
             0.0395     0.0471     0.0552     0.0641     0.0735
             0.0837     0.0943     0.1049     0.1155     0.1270
             0.1396     0.1533     0.1681     0.1841     0.2011
             0.2193     0.2386     0.2590     0.2806     0.3032
             0.3270     0.3519     0.3779     0.4051     0.4333
             0.4627     0.4932     0.5249     0.5576     0.5915
             0.6264     0.6625     0.6998     0.7381     0.7779
             0.8192     0.8621     0.9065     0.9525     1.0000
Hrad:
             0.0281     0.0561     0.0842     0.1122     0.1403
             0.1683     0.1964     0.2245     0.2525     0.2806
             0.3086     0.3367     0.3647     0.3928     0.4209
             0.4489     0.4959     0.5488     0.6012     0.6488
             0.6890     0.7232     0.7521     0.7768     0.7979
             0.8161     0.8320     0.8460     0.8585     0.8697
             0.8800     0.8894     0.8983     0.9067     0.9147
             0.9224     0.9298     0.9371     0.9443     0.9514
             0.9584     0.9655     0.9725     0.9787     0.9825
             0.9861     0.9896     0.9931     0.9965     1.0000
Width:
             0.0135     0.0271     0.0406     0.0542     0.0677
             0.0812     0.0948     0.1083     0.1218     0.1354
```

```
          0.1489     0.1625     0.1760     0.1895     0.2031
          0.2166     0.2200     0.2200     0.2258     0.2490
          0.2722     0.2954     0.3186     0.3418     0.3650
          0.3882     0.4114     0.4346     0.4578     0.4810
          0.5042     0.5274     0.5506     0.5738     0.5970
          0.6202     0.6434     0.6666     0.6898     0.7130
          0.7362     0.7594     0.7826     0.8080     0.8400
          0.8720     0.9040     0.9360     0.9680     1.0000


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

****************
Analysis Options
****************
Flow Units ............... LPS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... HORTON
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 01/02/2018 00:00:00
Ending Date .............. 01/03/2018 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:01:00
Dry Time Step ............ 00:01:00
Routing Time Step ........ 2.00 sec
Variable Time Step ....... NO
Maximum Trials ........... 8
Number of Threads ........ 6
Head Tolerance ........... 0.001500 m


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         0.114        71.665
```

```
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.015         9.663
Surface Runoff ...........         0.097        60.875
Final Storage ............         0.002         1.252
Continuity Error (%) .....        -0.175


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.097         0.969
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.001         0.012
External Outflow .........         0.098         0.981
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.003         0.033
Final Stored Volume ......         0.003         0.033
Continuity Error (%) .....         0.029


*************************
Highest Continuity Errors
*************************
Node STM-103 (1.50%)


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


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     2.00 sec
Average Time Step           :     2.00 sec
Maximum Time Step           :     2.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00
Percent Not Converging      :     0.01


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

```
  Subcatchment Runoff Summary
  ***************************

------------------------------------------------------------------------------------------------------------
------------------
                            Total      Total      Total      Total     Imperv       Perv      Total
Total     Peak  Runoff
                           Precip      Runon       Evap      Infil     Runoff     Runoff     Runoff
Runoff   Runoff   Coeff
  Subcatchment                 mm         mm         mm         mm         mm         mm         mm    10^6
ltr      LPS
------------------------------------------------------------------------------------------------------------
------------------
  L101A                     71.66       0.00       0.00       5.00      62.19       3.21      65.40
0.24    181.43   0.913
  L102A                     71.66       0.00       0.00       5.63      61.19       3.60      64.79
0.10     75.95   0.904
  L102B                     71.66       0.00       0.00       6.89      59.18       4.39      63.57
0.26    201.97   0.887
  L102C                     71.66       0.00       0.00       3.76      64.18       2.40      66.58
0.06     44.98   0.929
  L102D                     71.66       0.00       0.00       5.02      62.17       3.19      65.36
0.08     60.61   0.912
  L105A                     71.66       0.00       0.00       5.64      61.18       3.59      64.77
0.07     54.11   0.904
  UNC-1                     71.66       0.00       0.00      21.56      42.10      45.08      49.29
0.07     67.67   0.688
  UNC-2                     71.66       0.00       0.00      28.09      30.06      34.14      43.16
0.01     13.86   0.602
  UNC-3                     71.66       0.00       0.00      28.93      30.06      40.69      42.20
0.05     54.67   0.589
  UNC-4                     71.66       0.00       0.00      28.72      30.06      39.43      42.44
0.01     13.36   0.592


  ******************
  Node Depth Summary
  ******************

  ---------------------------------------------------------------------------------
                                 Average  Maximum  Maximum  Time of Max    Reported
                                   Depth    Depth      HGL   Occurrence   Max Depth
  Node                 Type       Meters   Meters   Meters  days hr:min      Meters
  ---------------------------------------------------------------------------------
  218                  OUTFALL      1.92     1.92    91.75     0  00:00        1.92
  MAJ-1                OUTFALL      0.00     0.04    93.37     0  01:01        0.04
```

```
  MAJ-2                OUTFALL      0.00     0.06    93.30     0  01:00        0.06
  OF1                  OUTFALL      0.00     0.00     0.00     0  00:00        0.00
  OF2                  OUTFALL      0.00     0.00     0.00     0  00:00        0.00
  OF3                  OUTFALL      0.00     0.00    93.52     0  00:00        0.00
  OF4                  OUTFALL      0.00     0.00    93.44     0  00:00        0.00
  L101A1-S             STORAGE      0.00     0.00    93.99     0  00:00        0.00
  L101A-S              STORAGE      0.05     1.58    93.70     0  01:01        1.58
  L101A-S1             STORAGE      0.00     0.04    93.69     0  01:01        0.04
  L102A-S              STORAGE      0.04     1.54    93.83     0  01:00        1.54
  L102A-S1             STORAGE      0.00     0.05    93.82     0  01:00        0.05
  L102B-S              STORAGE      0.06     1.77    93.71     0  01:01        1.77
  L102B-S1             STORAGE      0.00     0.00    93.87     0  00:00        0.00
  L102B-S2             STORAGE      0.00     0.00    93.97     0  00:00        0.00
  L102C-S              STORAGE      0.04     1.55    94.07     0  01:01        1.55
  L102C-S1             STORAGE      0.00     0.00    94.10     0  00:00        0.00
  L102D-S              STORAGE      0.05     1.56    93.82     0  01:01        1.56
  L102D-S1             STORAGE      0.00     0.00    93.94     0  00:00        0.00
  L105A-S              STORAGE      0.03     1.44    93.52     0  01:00        1.44
  L105A-S1             STORAGE      0.00     0.00    93.91     0  00:00        0.00
  STM-101              STORAGE      1.15     1.22    91.82     0  01:01        1.22
  STM-102              STORAGE      0.60     0.84    92.00     0  00:51        0.83
  STM-103              STORAGE      0.68     0.78    91.86     0  00:54        0.78
  STM-104              STORAGE      0.35     0.46    91.86     0  00:53        0.46
  STM-105              STORAGE      0.52     0.64    91.87     0  00:54        0.64


  *******************
  Node Inflow Summary
  *******************

  -------------------------------------------------------------------------------------------------
                                  Maximum  Maximum                  Lateral       Total        Flow
                                  Lateral    Total  Time of Max      Inflow      Inflow     Balance
                                   Inflow   Inflow   Occurrence      Volume      Volume       Error
  Node                 Type           LPS      LPS  days hr:min    10^6 ltr    10^6 ltr     Percent
  -------------------------------------------------------------------------------------------------
  218                  OUTFALL       0.00   254.58      0  01:02           0       0.818       0.000
  MAJ-1                OUTFALL       0.00    34.92      0  01:01           0      0.0126       0.000
  MAJ-2                OUTFALL       0.00    33.33      0  01:00           0       0.017       0.000
  OF1                  OUTFALL      67.67    67.67      0  01:00      0.0703      0.0703       0.000
  OF2                  OUTFALL      13.86    13.86      0  01:00       0.013       0.013       0.000
  OF3                  OUTFALL      54.67    54.67      0  01:00        0.05        0.05       0.000
  OF4                  OUTFALL      13.36    13.36      0  01:00      0.0123      0.0123       0.000
  L101A1-S             STORAGE       0.00     0.00      0  00:00           0           0       0.000 ltr
  L101A-S              STORAGE     181.43   224.06      0  01:00       0.243        0.26      -0.161
  L101A-S1             STORAGE       0.00    36.94      0  01:00           0      0.0128       0.643
  L102A-S              STORAGE      75.95    75.95      0  01:00       0.101       0.101      -0.279
  L102A-S1             STORAGE       0.00    44.47      0  01:00           0      0.0166      -1.622
```

```
L102B-S              STORAGE     201.97   201.97     0  01:00       0.265       0.265       0.035
L102B-S1             STORAGE       0.00     0.00     0  00:00           0           0       0.000 ltr
L102B-S2             STORAGE       0.00     0.00     0  00:00           0           0       0.000 ltr
L102C-S              STORAGE      44.98    44.98     0  01:00      0.0611      0.0611       0.070
L102C-S1             STORAGE       0.00     0.00     0  00:00           0           0       0.000 ltr
L102D-S              STORAGE      60.61    60.61     0  01:00      0.0812      0.0812       0.087
L102D-S1             STORAGE       0.00     0.00     0  00:00           0           0       0.000 ltr
L105A-S              STORAGE      54.11    54.11     0  01:00       0.072       0.072       0.046
L105A-S1             STORAGE       0.00     0.00     0  00:00           0           0       0.000 ltr
STM-101              STORAGE       0.00   254.55     0  01:02           0       0.821       0.004
STM-102              STORAGE       0.00   128.85     0  01:01           0       0.417       0.001
STM-103              STORAGE       0.00    35.87     0  00:00           0      0.0689       1.526
STM-104              STORAGE       0.00    10.70     0  00:52           0     0.00545      -3.669
STM-105              STORAGE       0.00    22.54     0  00:00           0       0.058       0.009


**********************
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
--------------------------------------------------------------------------------------------------
L101A1-S                 0.000       0     0     0         0.000       0       0  00:00       0.00
L101A-S                  0.000       2     0     0         0.005     100       0  00:57     113.80
L101A-S1                 0.000       0     0     0         0.000       0       0  00:00      34.92
L102A-S                  0.000       2     0     0         0.002     100       0  00:53      72.74
L102A-S1                 0.000       0     0     0         0.000       0       0  00:00      43.37
L102B-S                  0.000       0     0     0         0.032      30       0  01:01      81.84
L102B-S1                 0.000       0     0     0         0.000       0       0  00:00       0.00
L102B-S2                 0.000       0     0     0         0.000       0       0  00:00       0.00
L102C-S                  0.000       1     0     0         0.008      73       0  01:01      21.57
```

```
L102C-S1                 0.000       0     0     0         0.000       0       0  00:00       0.00
L102D-S                  0.000       1     0     0         0.007      36       0  01:01      25.44
L102D-S1                 0.000       0     0     0         0.000       0       0  00:00       0.00
L105A-S                  0.000       0     0     0         0.000       0       0  00:00      54.05
L105A-S1                 0.000       0     0     0         0.000       0       0  00:00       0.00
STM-101                  0.000       0     0     0         0.000       0       0  00:00     254.58
STM-102                  0.000       0     0     0         0.000       0       0  00:00     128.86
STM-103                  0.000       0     0     0         0.000       0       0  00:00      24.63
STM-104                  0.000       0     0     0         0.000       0       0  00:00       6.10
STM-105                  0.000       0     0     0         0.000       0       0  00:00      21.29


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

-----------------------------------------------------------
                       Flow       Avg       Max       Total
                       Freq      Flow      Flow      Volume
Outfall Node           Pcnt       LPS       LPS   10^6 ltr
-----------------------------------------------------------
218                   94.11     10.06    254.58       0.818
MAJ-1                  1.64      8.84     34.92       0.013
MAJ-2                  0.87     22.66     33.33       0.017
OF1                   11.60      7.02     67.67       0.070
OF2                   11.53      1.30     13.86       0.013
OF3                   11.45      5.05     54.67       0.050
OF4                    7.78      1.82     13.36       0.012
-----------------------------------------------------------
System                19.85     56.76     13.36       0.994


********************
Link Flow Summary
********************

-----------------------------------------------------------------------------
                               Maximum  Time of Max   Maximum   Max/     Max/
                                |Flow|   Occurrence   |Veloc|   Full     Full
Link                 Type          LPS  days hr:min     m/sec   Flow    Depth
-----------------------------------------------------------------------------
C1                   CHANNEL      0.00      0  00:00      0.00   0.00     0.16
C10                  CHANNEL      0.00      0  00:00      0.00   0.00     0.25
C11                  CHANNEL      0.00      0  00:00      0.00   0.00     0.25
C12                  CHANNEL      0.00      0  00:00      0.00   0.00     0.27
C13                  CHANNEL      0.00      0  00:00      0.00   0.00     0.00
C14                  CHANNEL      0.00      0  00:00      0.00   0.00     0.50
C15                  CHANNEL      0.00      0  00:00      0.00   0.00     0.27
```

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C16                  CHANNEL     34.92     0  01:01      0.76    0.00    0.12
C17                  CHANNEL     33.33     0  01:00      1.03    0.01    0.14
C3                   CHANNEL     36.94     0  01:00      0.09    0.00    0.33
C4                   CHANNEL     43.37     0  01:00      0.11    0.00    0.34
C5                   CHANNEL     44.47     0  01:00      0.14    0.01    0.28
C6                   CHANNEL      0.00     0  00:00      0.00    0.00    0.22
C7                   CHANNEL      0.00     0  00:00      0.00    0.00    0.24
C8                   CHANNEL      0.00     0  00:00      0.00    0.00    0.00
C9                   CHANNEL      0.00     0  00:00      0.00    0.00    0.27
Pipe_3               CONDUIT    128.86     0  01:01      0.81    0.71    1.00
Pipe_4               CONDUIT     23.89     0  00:54      0.34    0.39    1.00
Pipe_46              CONDUIT    254.58     0  01:02      0.71    0.70    1.00
Pipe_5               CONDUIT     10.70     0  00:52      0.21    0.17    0.77
Pipe_6               CONDUIT     22.54     0  00:00      0.36    0.33    1.00
L101A-IC             ORIFICE     76.88     0  01:01                      1.00
L102A-IC             ORIFICE     28.27     0  01:00                      1.00
L102B-IC             ORIFICE     81.84     0  01:01                      1.00
L102C-IC             ORIFICE     21.57     0  01:01                      1.00
L102D-IC             ORIFICE     25.44     0  01:01                      1.00
L105A-IC             ORIFICE     20.72     0  01:00                      1.00


***************************
Flow Classification Summary
***************************

-------------------------------------------------------------------------------------
                    Adjusted    ---------- Fraction of Time in Flow Class ----------
                     /Actual         Up    Down  Sub   Sup   Up    Down  Norm  Inlet
Conduit               Length    Dry  Dry   Dry   Crit  Crit  Crit  Crit  Ltd   Ctrl
-------------------------------------------------------------------------------------
C1                      1.00   0.99  0.01  0.00  0.00  0.00  0.00  0.00  0.00  0.00
C10                     1.00   0.98  0.02  0.00  0.00  0.00  0.00  0.00  0.00  0.00
C11                     1.00   0.98  0.02  0.00  0.00  0.00  0.00  0.00  0.00  0.00
C12                     1.00   0.97  0.03  0.00  0.00  0.00  0.00  0.00  0.00  0.00
C13                     1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
C14                     1.00   0.97  0.03  0.00  0.00  0.00  0.00  0.00  0.00  0.00
C15                     1.00   0.97  0.03  0.00  0.00  0.00  0.00  0.00  0.00  0.00
C16                     1.00   0.04  0.00  0.00  0.90  0.06  0.00  0.00  0.02  0.00
C17                     1.00   0.99  0.00  0.00  0.00  0.01  0.00  0.00  0.00  0.00
C3                      1.00   0.04  0.00  0.00  0.02  0.00  0.00  0.94  0.01  0.00
C4                      1.00   0.04  0.00  0.00  0.02  0.00  0.00  0.94  0.02  0.00
C5                      1.00   0.04  0.00  0.00  0.02  0.00  0.00  0.95  0.01  0.00
C6                      1.00   0.98  0.02  0.00  0.00  0.00  0.00  0.00  0.00  0.00
C7                      1.00   0.98  0.02  0.00  0.00  0.00  0.00  0.00  0.00  0.00
C8                      1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
C9                      1.00   0.97  0.03  0.00  0.00  0.00  0.00  0.00  0.00  0.00
Pipe_3                  1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00
```

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Pipe_4                  1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00
Pipe_46                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00
Pipe_5                  1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00
Pipe_6                  1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00  0.00


*************************
Conduit Surcharge Summary
*************************

----------------------------------------------------------------------------
                                                         Hours        Hours
                       --------- Hours Full --------   Above Full   Capacity
Conduit                Both Ends  Upstream  Dnstream   Normal Flow   Limited
----------------------------------------------------------------------------
Pipe_3                      0.56      0.56     24.00      0.01         0.01
Pipe_4                     24.00     24.00     24.00      0.01         0.01
Pipe_46                    24.00     24.00     24.00      0.01         0.01
Pipe_5                      0.01      0.01     23.99      0.01         0.01
Pipe_6                      0.34      0.34     24.00      0.01         0.01


Analysis begun on:  Thu Apr 30 12:18:58 2020
Analysis ended on:  Thu Apr 30 12:18:59 2020
Total elapsed time: 00:00:01
```

C.4 BACKGROUND REPORT EXCERPTS

SNTC Lands

DATE: 2020-02-20
REVISION: 1
DESIGNED BY: MJS
CHECKED BY: AMP

STORM SEWER DESIGN SHEET
(City of Ottawa)

FILE NUMBER: 160401085

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

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

LOCATION			DRAINAGE AREA																									PIPE SELECTION											
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)	T of C (min)	$I_{2\text{-YEAR}}$ (mm/h)	$I_{5\text{-YEAR}}$ (mm/h)	$I_{10\text{-YEAR}}$ (mm/h)	$I_{100\text{-YEAR}}$ (mm/h)	$Q_{CONTROL}$ (L/s)	ACCUM. $Q_{CONTROL}$ (L/s)	Q_{ACT} (CIA/360) (L/s)	LENGTH (m)	PIPE WIDTH OR DIAMETEI (mm)	PIPE HEIGHT (mm)	PIPE SHAPE (-)	MATERIAL (-)	CLASS (-)	SLOPE %	Q_{CAP} (FULL) (L/s)	% FULL (-)	VEL. (FULL) (m/s)	VEL. (ACT) (m/s)	TIME OF FLOW (min)
L220A	220	219	0.06	0.00	0.00	0.00	0.00	0.73	0.00	0.00	0.00	0.043	0.043	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	9.1	71.5	375	375	CIRCULAR	PVC	-	0.50	116.6	**7.8%**	1.11	0.55	2.18
																				12.18																			
L222A	222	219	1.60	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	1.121	1.121	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	239.2	11.8	600	600	CIRCULAR	CONCRETE	-	0.30	350.8	**68.2%**	1.20	1.13	0.17
																				10.17																			
L219A	219	218	0.09	0.00	0.00	0.00	0.00	0.73	0.00	0.00	0.00	0.063	1.226	0.000	0.000	0.000	0.000	0.000	0.000	12.18	69.35	93.95	110.08	160.84	0.0	0.0	236.3	76.2	750	750	CIRCULAR	CONCRETE	-	0.15	449.8	**52.5%**	0.99	0.86	1.48
																				13.65																			
L221A	221	218	1.59	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	1.114	1.114	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	237.6	12.5	600	600	CIRCULAR	CONCRETE	-	0.30	350.8	**67.7%**	1.20	1.13	0.19
																				10.19																			
L218A, L218B	218	10000	0.18	0.00	0.00	0.00	0.00	0.73	0.00	0.00	0.00	0.133	2.473	0.000	0.000	0.000	0.000	0.000	0.000	13.65	65.14	88.17	103.28	150.86	0.0	0.0	447.5	81.5	1200	1200	CIRCULAR	CONCRETE	-	0.10	1286.2	**34.8%**	1.10	0.85	1.60
																				15.26									1200	1200									
L108A, L108B, L110A	108	106	0.37	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.223	0.223	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	47.5	85.4	675	675	CIRCULAR	CONCRETE	-	0.20	392.2	**12.1%**	1.06	0.59	2.40
																				12.40																			
L203B, L203A	203	202	0.15	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.00	0.100	0.100	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	21.3	88.4	450	450	CIRCULAR	CONCRETE	-	0.30	162.9	**13.1%**	0.99	0.57	2.60
																				12.60																			
L205A	205	202	1.24	0.00	0.00	0.00	0.00	0.75	0.00	0.00	0.00	0.930	0.930	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	198.3	12.8	525	525	CIRCULAR	CONCRETE	-	0.30	245.7	**80.7%**	1.10	1.08	0.20
																				10.20																			
	202	201	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	1.030	0.000	0.000	0.000	0.000	0.000	0.000	12.60	68.07	92.19	108.01	157.80	0.0	0.0	194.7	22.8	750	750	CIRCULAR	CONCRETE	-	0.10	367.3	**53.0%**	0.81	0.70	0.54
																				13.15																			
L204A	204	201	1.62	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	1.132	1.132	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	241.6	14.6	600	600	CIRCULAR	CONCRETE	-	0.30	350.9	**68.9%**	1.20	1.13	0.21
																				10.21																			
L201A, L201B	201	106	0.32	0.00	0.00	0.00	0.00	0.62	0.00	0.00	0.00	0.202	2.364	0.000	0.000	0.000	0.000	0.000	0.000	13.15	66.52	90.07	105.51	154.14	0.0	0.0	436.9	118.4	1200	1200	CIRCULAR	CONCRETE	-	0.10	1286.5	**34.0%**	1.10	0.84	2.36
																				15.51																			
L106A	106	104	0.23	0.00	0.00	0.00	0.00	0.73	0.00	0.00	0.00	0.165	2.752	0.000	0.000	0.000	0.000	0.000	0.000	15.51	60.60	81.96	95.97	140.14	0.0	0.0	463.3	105.8	1200	1200	CIRCULAR	CONCRETE	-	0.11	1369.9	**33.8%**	1.17	0.89	1.98
L104B, L104A	104	102	0.40	0.00	0.00	0.00	0.00	0.56	0.00	0.00	0.00	0.222	2.975	0.000	0.000	0.000	0.000	0.000	0.000	17.48	56.46	76.30	89.32	130.38	0.0	0.0	466.5	50.4	1200	1200	CIRCULAR	CONCRETE	-	0.12	1403.7	**33.2%**	1.20	0.91	0.92
																				18.40																			
C210A	210	209	0.00	0.18	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	0.107	0.107	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	31.0	111.5	450	450	CIRCULAR	CONCRETE	-	0.20	133.0	**23.3%**	0.81	0.55	3.37
																				13.37																			
L214A	214	213	0.24	0.00	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.152	0.152	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	32.3	26.6	375	375	CIRCULAR	PVC	-	0.30	90.3	**35.8%**	0.86	0.66	0.67
																				10.67																			
L215A	215	213	1.72	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	1.202	1.202	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	256.5	8.6	600	600	CIRCULAR	CONCRETE	-	0.30	350.8	**73.1%**	1.20	1.16	0.12
																				10.12																			
L213A	213	212	0.17	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.111	1.465	0.000	0.000	0.000	0.000	0.000	0.000	10.67	74.31	100.76	118.10	172.62	0.0	0.0	302.5	64.4	675	675	CIRCULAR	CONCRETE	-	0.17	361.6	**83.7%**	0.98	0.98	1.10
L212A	212	209	0.19	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.125	1.590	0.000	0.000	0.000	0.000	0.000	0.000	11.78	70.60	95.67	112.10	163.81	0.0	0.0	311.8	60.6	750	750	CIRCULAR	CONCRETE	-	0.15	449.8	**69.3%**	0.99	0.93	1.09
																				12.86																			
C209A	209	208	0.00	0.12	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.000	1.590	0.073	0.180	0.000	0.000	0.000	0.000	13.37	65.90	89.21	104.51	152.66	0.0	0.0	335.7	34.5	1200	1200	CIRCULAR	CONCRETE	-	0.10	1286.2	**26.1%**	1.10	0.77	0.74
																				14.12																			
L223A	223	211	0.04	0.00	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.035	0.035	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	7.6	69.2	375	375	CIRCULAR	PVC	-	0.30	90.3	**8.4%**	0.86	0.44	2.65
L211A, L211B	211	208	0.15	0.00	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.130	0.165	0.000	0.000	0.000	0.000	0.000	0.000	12.65	67.94	92.02	107.80	157.50	0.0	0.0	31.2	88.0	375	375	CIRCULAR	PVC	-	0.30	90.3	**34.6%**	0.86	0.66	2.23
																				14.88																			
C208A, L208B	208	207	0.18	0.22	0.00	0.00	0.00	0.50	0.65	0.00	0.00	0.088	1.843	0.144	0.324	0.000	0.000	0.000	0.000	14.88	62.06	83.95	98.32	143.58	0.0	0.0	393.3	49.3	1200	1200	CIRCULAR	CONCRETE	-	0.10	1286.2	**30.6%**	1.10	0.82	1.01
																				15.89																			
L216A	216	207	0.62	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.372	0.372	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	79.3	18.0	300	300	CIRCULAR	PVC	-	1.00	96.2	**82.5%**	1.37	1.36	0.22
																				10.22																			
C207A	207	102	0.00	0.06	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	2.215	0.033	0.357	0.000	0.000	0.000	0.000	15.89	59.75	80.80	94.61	138.14	0.0	0.0	447.8	33.6	1200	1200	CIRCULAR	CONCRETE	-	0.10	1286.6	**34.8%**	1.10	0.85	0.66
																				16.55																			
L102A, L102C, L102D, L102B	102	100	0.49	0.00	0.00	0.00	0.00	0.62	0.00	0.00	0.00	0.300	5.489	0.000	0.357	0.000	0.000	0.000	0.000	18.40	54.75	73.96	86.57	126.34	0.0	0.0	908.2	142.6	1920	1220	ELLIPTICAL	CONCRETE	-	0.11	2434.5	**37.3%**	1.32	1.03	2.31
L100A	100	10000	0.10	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00	0.058	5.547	0.000	0.357	0.000	0.000	0.000	0.000	20.71	50.91	68.72	80.41	117.32	0.0	0.0	852.6	22.2	1920	1220	ELLIPTICAL	CONCRETE	-	0.11	2410.3	**35.4%**	1.31	1.01	0.37
																				21.08																			
	10000	10002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	8.020	0.000	0.357	0.000	0.000	0.000	0.000	21.08	50.35	67.96	79.52	116.01	0.0	0.0	1189.3	9.8	1920	1220	ELLIPTICAL	CONCRETE	-	0.30	3988.9	**29.8%**	2.17	1.58	0.10
																				21.18									1920	1220									
			11.74	0.58	0.00	0.00	0.00					8.02		0.36		0.00		0.00																					

Notes:

1. Existing storm sewers from MH108 to MH10002 were designed by Novatech as part of the development to the south through coordination with Stantec.

Project No. 160401085
SNTC Development
Runoff Coefficient Calculations

Runoff Coeeficient for Hard Areas, C=0.90
Runoff Coeeficient for Soft Areas, C=0.20

ID	Total Area (m^2)	Hard Area (m^2)	Soft Area (m^2)	C-Value
C207A	600	334.28	265.72	0.59
C208A	2200	1414.29	785.71	0.65
C209A	1224	699.20	524.39	0.60
C210A	1815	1011.09	803.70	0.59
L201A	666	456.59	209.27	0.68
L201B	2600	1522.85	1077.15	0.61
L203A	700	450.00	250.00	0.65
L203B	800	548.57	251.43	0.68
L204A	16200	11571.50	4628.50	0.70
L205A	12399	9742.25	2657.04	0.75
L208B	1758	753.48	1004.65	0.50
L211A	476	442.31	34.02	0.85
L211B	1064	973.07	91.22	0.84
L212A	1916	1231.84	684.35	0.65
L213A	1713	1101.00	611.66	0.65
L214A	2408	1478.93	928.62	0.63
L215A	17171	12265.15	4905.96	0.70
L216A	6193	3538.83	2654.10	0.60
L218A	1400	1060.00	340.00	0.73
L218B	400	302.86	97.14	0.73
L219A	900	681.43	218.57	0.73
L220A	584	441.92	141.75	0.73
L221A	15912	11365.79	4546.22	0.70
L222A	16017	11440.75	4576.20	0.70
L223A	394	393.92	0.00	0.90

Total Surface Flow Depth Summary

Storage node ID		Top of Grate Elevation (m)		Rim Elevation (m)	2 year, 3 hour Chicago		5 year, 3 hour Chicago		100 year, 3 hour Chicago		100 year, 3 hour Chicago +20%	
	Drainage Area		Lowest Adjacent Building Opening (m)		Max Surface HGL (m)	Total Surface Ponding Depth (m)	Max Surface HGL (m)	Total Surface Ponding Depth (m)	Max Surface HGL (m)	Total Surface Ponding Depth (m)	Max Surface HGL (m)	Total Surface Ponding Depth (m)
C207A-S	C207A	93.49	N/A	93.89	92.23	0.00	92.35	0.00	93.71	0.22	93.77	0.28
C208A-S	C208A	93.48	N/A	93.88	92.54	0.00	93.49	0.01	93.72	0.24	93.78	0.30
C209A-S	C209A	93.61	94.00	94.01	92.62	0.00	93.12	0.00	93.83	0.22	93.88	0.27
C210A-S	C210A	92.95	N/A	93.35	92.02	0.00	92.58	0.00	93.04	0.09	93.05	0.10
L201A-S	L201A	93.90	N/A	94.30	93.10	0.00	93.71	0.00	94.01	0.11	94.18	0.28
L201B-S	L201B	93.37	N/A	93.77	93.05	0.00	93.43	0.06	93.56	0.19	93.66	0.29
L203A-S	L203A	94.03	N/A	94.43	92.82	0.00	93.00	0.00	93.79	-0.24	94.07	0.04
L203B-S	L203B	94.16	N/A	94.56	93.01	0.00	93.24	0.00	94.17	0.01	94.30	0.14
L208B-S	L208B	93.74	N/A	94.14	93.44	0.00	93.78	0.04	93.81	0.07	93.82	0.08
L211A-S	L211A	94.14	94.28	94.54	93.20	0.00	93.55	0.00	94.17	0.03	94.18	0.04
L211B-S	L211B	93.69	93.94	94.09	93.35	0.00	93.76	0.07	93.83	0.14	93.85	0.16
L212A-S	L212A	93.48	94.00	93.88	93.07	0.00	93.54	0.06	93.83	0.35	93.87	0.39
L213A-S	L213A	93.58	94.02	93.98	92.95	0.00	93.60	0.02	93.74	0.16	93.90	0.32
L214A-S	L214A	93.70	94.12	94.10	93.70	0.00	93.80	0.10	93.93	0.23	93.99	0.29
L218A-S	L218A	93.32	N/A	93.72	92.40	0.00	92.86	0.00	93.58	0.26	93.65	0.33
L218B-S	L218B	93.26	N/A	93.66	91.98	0.00	92.05	0.00	93.58	0.32	93.64	0.38
L219A-S	L219A	93.59	N/A	93.99	92.54	0.00	92.86	0.00	93.86	0.27	93.91	0.32
L220A-S	L220A	93.76	N/A	94.16	92.54	0.00	92.68	0.00	93.24	-0.52	93.61	-0.15
L223A-S	L223A	94.08	94.31	94.48	93.03	0.00	93.27	0.00	94.09	0.01	94.11	0.03

Detailed grading of the future blocks should be done based on the above results to assess the feasibility of accommodating basements in residential units while ensuring that a minimum clearance of 0.3 m is provided between all under side of footings (USFs) and the 100-year HGL, and that no basement flooding occurs in the climate change scenario.

5.3.3 Overland Flow

Due to the site configuration and grading constraints, major flows from the proposed development will be directed to Street B within the adjacent Claridge Development to the South.

Based on grading plans and plan and profiles obtained from Novatech for Street B, there are three major system outlets to the adjacent Claridge Subdivision streets and a fourth major system outlet that discharges to the storm outlet channel at the downstream end of Street B.

Table 5.10: 100-Year Major System Overflows

Major System Outlet	100-Year Major System Overflow (L/s)
Claridge Street 7	3.3
Claridge Street 5	3.5
Claridge Jockvale Road	5.6
Outlet Channel	0.0

Table 5.11 presents the maximum total surface water depths (static ponding depth + dynamic flow) above the top-of-grate of the proposed catchbasins for the 100-year, 3-hr Chicago storm and the 'climate change' storm. Based on the model results, the total ponding depth (static + dynamic) does not exceed the required 0.35 m maximum during the 100-year event. Tables summarizing the total surface water depths over the proposed catchbasins are included in **Appendix C.3**, which show that no ponding occurs over the proposed local streets and collector roads during the 2-year and 5-year storms respectively.

Table 5.11: Proposed Phase – Ultimate Maximum Static and Dynamic Surface Water Depths

Storage node ID	Top of Grate Elevation (m)	Lowest Adjacent Building Opening (m)	100-year, 3-hour Chicago		100-year, 3-hour Chicago+20%	
			Max HGL (m)	Total Surface Water Depth (m)	Max HGL (m)	Total Surface Water Depth (m)
107A-S(1)	97.59	98.26	97.80	0.21	97.87	0.28
109A-S	97.58	98.23	97.75	0.17	97.90	0.32

Storage node ID	Top of Grate Elevation (m)	Lowest Adjacent Building Opening (m)	100-year, 3-hour Chicago		100-year, 3-hour Chicago+20%	
			Max HGL (m)	Total Surface Water Depth (m)	Max HGL (m)	Total Surface Water Depth (m)
109B-S	97.59	98.25	97.68	0.09	97.76	0.17
110A-S	97.75	98.45	97.88	0.13	97.92	0.17
C207A-S	93.49	N/A	93.71	0.22	93.77	0.28
C208A-S	93.48	N/A	93.72	0.24	93.78	0.30
C209A-S	93.61	94.00	93.83	0.22	93.88	0.27
C210A-S	92.95	N/A	93.04	0.09	93.05	0.10
CB69-70	93.32	N/A	92.70	0.00	93.48	0.16
CB39-40	93.27	N/A	93.48	0.21	93.62	0.35
CB41-42	93.44	N/A	93.63	0.19	93.74	0.30
CB43-44	93.40	N/A	93.61	0.21	93.72	0.32
CB45-46	93.41	N/A	93.63	0.22	93.66	0.25
CB47-48	93.47	N/A	93.64	0.17	93.66	0.19
CB49-50	93.67	N/A	93.84	0.17	93.85	0.18
L201A-S	93.90	N/A	94.01	0.11	94.18	0.28
L201B-S	93.37	N/A	93.56	0.19	93.66	0.29
L203A-S	94.03	N/A	93.79	0.00	94.07	0.04
L203B-S	94.16	N/A	94.17	0.01	94.30	0.14
L208B-S	93.74	N/A	93.81	0.07	93.82	0.08
L211A-S	94.14	94.28	94.17	0.03	94.18	0.04
L211B-S	93.69	93.94	93.83	0.14	93.85	0.16
L212A-S	93.48	94.00	93.83	0.35	93.87	0.39
L213A-S	93.58	94.02	93.74	0.16	93.90	0.32
L214A-S	93.70	94.12	93.93	0.23	93.99	0.29
L218A-S	93.32	N/A	93.58	0.26	93.65	0.33
L218B-S	93.26	N/A	93.58	0.32	93.64	0.38
L219A-S	93.59	N/A	93.86	0.27	93.91	0.32
L220A-S	93.76	N/A	93.24	0.00	93.61	0.00
L223A-S	94.08	94.31	94.09	0.01	94.11	0.03

5.3.4 Future Development Blocks SWM Criteria

Table 5.12 below presents the parameters for the outlet link objects in the model, which represent the minor system capture rate for the future private blocks within the SNTC Development.

Appendix D GEOTECHNICAL INVESTIGATION

patersongroup

Geotechnical
Engineering

Environmental
Engineering

Hydrogeology

Geological
Engineering

Materials Testing

Building Science

Archaeological Studies

Geotechnical Investigation
Proposed Residential Development
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Report: PG2743-2

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Appendices

Appendix 1	Soil Profile and Test Data Sheets Symbols and Terms Record of Borehole by Others Consolidation Test Sheets Atterberg Test Results Sheets
Appendix 2	Figure 1 - Key Plan Drawing PG2743-2 - Permissible Grade Raise Areas - Housing Drawing PG2743-3 - Permissible Grade Raise Areas - Apartment Buildings Drawing PG2743-4 - Test Hole Location Plan

1.0 Introduction

Paterson Group (Paterson) was commissioned by Caivan Communities to conduct a geotechnical investigation for the proposed residential development to be located at 3288 Greenbank Road, in the City of Ottawa (refer to Figure 1 - Key Plan presented in Appendix 2).

The objective of the investigation was to:

- ☐ determine the subsoil and groundwater conditions at this site by means of test holes.
- ☐ provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect the design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. The report contains our findings and includes geotechnical recommendations pertaining to the design and construction of the proposed development as understood at the time of this report.

Investigating the presence or potential presence of contamination on the proposed development was not part of the scope of work. Therefore, the present report does not address environmental issues.

2.0 Proposed Development

It is understood that the proposed development consists of townhouse style housing blocks and multi-storey apartment buildings. Local roadways, car parking and landscaped areas are further anticipated for the proposed development.

3.0 Method of Investigation

3.1 Field Investigation

The field program for our investigation was carried out in February 2019 and October 2012. As part of our investigations, eleven (11) boreholes and 8 test pits were completed across the subject site extending to a maximum 10 m depth. The test hole location was placed in a manner to provide general coverage of the subject site taking into account existing test holes completed by others. The test hole locations are illustrated on Drawing PG2743-4 - Test Hole Location Plan presented in Appendix 2.

The boreholes were completed using a track-mounted auger drill rig operated by a two person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer from the geotechnical division. The testing procedure consisted of augering to the required depths and at the selected locations sampling the overburden.

Sampling and In Situ Testing

Soil samples were collected from the borehole using a 50 mm diameter split-spoon (SS) sampler, using 73 mm diameter thin walled (TW) Shelby tubes in conjunction with a piston sampler, or from the auger flights. All soil samples were visually inspected and initially classified on site. The split-spoon samples were placed in sealed plastic bags and the Shelby tubes were sealed at both ends on site. All samples were transported to the our laboratory for examination and classification. The depths at which the split-spoon, Shelby tube and auger samples were recovered from the test holes are shown as SS, TW and AU, respectively, on the Soil Profile and Test Data sheets presented in Appendix 1.

The Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split-spoon samples. The SPT results are recorded as “N” values on the Soil Profile and Test Data sheets. The “N” value is the number of blows required to drive the split-spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

Undrained shear strength testing was conducted in cohesive soils using a field vane apparatus.

The overburden thickness was evaluated by a dynamic cone penetration testing (DCPT) at BH 6, BH 8 and BH 10. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at the tip, using a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment.

The subsurface conditions observed at the test hole locations were recorded in detail in the field. The soil profiles are presented on the Soil Profile and Test Data sheets in Appendix 1 of this report.

Groundwater

Flexible standpipes were installed in the boreholes to monitor the groundwater level subsequent to the completion of the sampling program. The groundwater observations are noted on the Soil Profile and Test Data sheets presented in Appendix 1.

Sample Storage

All samples will be stored in the laboratory for a period of one month after issuance of the report. They will then be discarded unless we are otherwise directed.

3.2 Field Survey

The test holes were located in the field by JD Barnes. It is understood that the elevations are referenced to a geodetic datum. The ground surface elevation and location of the test holes are presented on Drawing PG2743-4 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

The soil samples recovered from the field investigation were examined in our laboratory to review field notes and soil samples.

Seven (7) Shelby tube samples were submitted for unidimensional consolidation and one (1) sample submitted for Atterberg limit testing from our test holes completed during our investigation. Eight (8) additional soil samples were submitted for atterberg limit testing as part of our current investigation.

The results of the consolidation testing are presented on the Consolidation Test sheets presented in Appendix 1 and are further discussed in Sections 4 and 5.

4.0 Observations

4.1 Surface Conditions

Currently, the subject site consists of agricultural lands and associated farmhouse and outbuildings. The majority of the ground surface across the subject site is relatively flat and slopes gradually downwards to the south.

4.2 Subsurface Profile

Generally, the soil conditions encountered at the test hole locations consist of a cultivated topsoil/organic layer followed by a stiff, brown silty clay deposit overlying a glacial till layer. Practical refusal to augering or DCPT was encountered at BH 1, BH 6, BH 8 and BH 10 at depths varying between 8.2 and 14.8 m. It should be noted that BH 2 was terminated due to damage of drilling augers on dense till material at a 5.3 m depth. Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for specific details of the soil profiles encountered at each test hole location.

Based on available geological mapping, the bedrock in this area mostly consists of interbedded limestone and dolomite of the Gull River formation with an overburden drift thickness of 5 to 15 m depth.

4.3 Groundwater

Groundwater levels (GWL) were measured in the piezometers installed in the boreholes and results are summarized in Table 1. It should be noted that surface water can become perched within a backfilled borehole, which can lead to higher than normal groundwater level readings. The long-term groundwater level can also be estimated based on moisture levels and colour of the recovered soil samples. Based on these observations, the long-term groundwater table is expected between 1.5 to 2.5 m below original ground surface. It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater levels could vary at the time of construction.

Table 1 - Summary of Groundwater Level Readings

Borehole Number	Ground Surface Elevation (m)	Groundwater Level (m)	Groundwater Elevation (m)	Recording Date
BH 1	92.89	1.30	91.59	November 7, 2012
BH 2	92.37	1.08	91.29	November 7, 2012
BH 3	92.66	0.55	92.11	November 7, 2012
BH 4	92.81	1.76	91.05	November 7, 2012
BH 5	92.06	-	92.06	November 7, 2012
BH 6	92.19	1.08	91.11	November 7, 2012
BH 7	92.38	2.71	89.67	November 7, 2012
BH 8	92.88	1.35	91.53	November 7, 2012
BH 9	92.64	3.32	89.32	November 7, 2012
BH 10	92.40	1.63	90.77	November 7, 2012
BH 11	92.19	1.08	91.11	November 7, 2012

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is adequate for the proposed residential development. However, due to the presence of the sensitive silty clay layer, the proposed development will be subjected to grade raise restrictions.

Our permissible grade raise recommendations are discussed in Subsection 5.3 and the recommended permissible grade raise areas for housing are presented in Drawing PG2743-2 - Permissible Grade Raise Areas - Housing in Appendix 2. Also, the recommended permissible grade raise areas for apartment buildings are presented in Drawing PG2743-3 - Permissible Grade Raise Areas - Apartment Buildings in Appendix 2. If higher than permissible grade raises are required, preloading with or without a surcharge, lightweight fill and/or other measures should be investigated to reduce the risks of unacceptable long-term post construction total and differential settlements.

The above and other considerations are further discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing organic materials, should be stripped from under any buildings, paved areas, pipe bedding and other settlement sensitive structures.

Fill Placement

Fill used for grading beneath the building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. Granular material should be tested and approved prior to delivery to the site. The fill should be placed in lifts of 300 mm thick or less and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the building areas should be compacted to at least 98% of the Standard Proctor Maximum Dry Density (SPMDD).

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill and beneath parking areas where settlement of the ground surface is of minor concern. In landscaped areas, these materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of the SPMDD. Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

5.3 Foundation Design

Bearing Resistance Values

Strip footings, up to 2.5 m wide, and pad footings, up to 5 m wide, placed on an undisturbed, stiff silty clay bearing surface can be designed using a bearing resistance value at SLS of **100 kPa** and a factored bearing resistance value at ULS of **200 kPa**. Footings designed using the bearing resistance value at SLS given above will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively.

The bearing resistance values are provided on the assumption that the footings will be placed on undisturbed soil bearing surfaces. An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to the in-situ bearing medium soils above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Settlement/Grade Raise

Consideration must be given to potential settlements which could occur due to the presence of the silty clay deposit and the combined loads from the proposed footings, any groundwater lowering effects, and grade raise fill. The foundation loads to be considered for the settlement case are the continuously applied loads which consist of the unfactored dead loads and the portion of the unfactored live load that is considered to be continuously applied. For dwellings, a minimum value of 50% of the live load is recommended by Paterson.

Generally, the potential long term settlement is evaluated based on the compressibility characteristics of the silty clay. These characteristics are estimated in the laboratory by conducting unidimensional consolidation tests on undisturbed soil samples collected using Shelby tubes in conjunction with a piston sampler. Seven (7) site specific consolidation tests were conducted. The results of the consolidation tests are presented in Table 2 and in Appendix 1.

The value for p'_c is the preconsolidation pressure and p'_o is the effective overburden pressure of the test samples. The difference between these values is the available preconsolidation. The increase in stress on the soil due to the cumulative effects of the fill surcharge, the footing pressures, the slab loadings and the lowering of the groundwater should not exceed the available preconsolidation if unacceptable settlements are to be avoided.

The values for C_{cr} and C_c are the recompression and compression indices, respectively. These soil parameters are a measure of the compressibility due to stress increases below and above the preconsolidation pressures. The higher values for the C_c, as compared to the C_{cr}, illustrate the increased settlement potential above, as compared to below, the preconsolidation pressure.

Table 2 - Summary of Consolidation Test Results

Borehole	Sample	Elevation	p'_c	p'_o	C_{cr}	C_c	Q
BH 3	TW 4	88.45	104	50	0.021	2.253	A
BH 4	TW 4	88.53	103	55	0.019	2.146	A
BH 6	TW 3	87.16	119	63	0.022	1.064	A
BH 7	TW 3	87.35	113	68	0.016	1.683	A
BH 8	TW 3	87.78	111	62	0.015	2.000	A
BH 11	TW 1	88.41	119	58	0.014	1.253	A

* - Q - Quality assessment of sample - G: Good A: Acceptable P: Likely disturbed

The values of p'_c, p'_o, C_{cr} and C_c are determined using standard engineering testing procedures and are estimates only. Natural variations within the soil deposit will affect the results. The p'_o parameter is directly influenced by the groundwater level. Groundwater levels were measured during the site investigation. Groundwater levels vary seasonally which has an impact on the available preconsolidation. Lowering the groundwater level increases the p'_o and therefore reduces the available preconsolidation. Unacceptable settlements could be induced by a significant lowering of the groundwater level. The p'_o values for the consolidation tests during the investigation are based on the long term groundwater level being at 0.5 m below the existing groundwater table. The groundwater level is based on the colour and undrained shear strength profile of the silty clay.

The total and differential settlements will be dependent on characteristics of the proposed buildings. For design purposes, the total and differential settlements are estimated to be 25 and 20 mm, respectively. A post-development groundwater lowering of 0.5 m was assumed.

The potential post construction total and differential settlements are dependent on the position of the long term groundwater level when building are situated over deposits of compressible silty clay. Efforts can be made to reduce the impacts of the proposed development on the long term groundwater level by placing clay dykes in the service trenches, reducing the sizes of paved areas, leaving green spaces to allow for groundwater recharge or limiting planting of trees to areas away from the buildings. However, it is not economically possible to control the groundwater level.

To reduce potential long term liabilities, consideration should be given to accounting for a larger groundwater lowering and to provide means to reduce long term groundwater lowering (e.g. clay dykes, restriction on planting around the dwellings, etc). Buildings on silty clay deposits increases the likelihood of movements and therefore of cracking. The use of steel reinforcement in foundations placed at key structural locations will tend to reduce foundation cracking compared to unreinforced foundations.

Based on the consolidation testing results and subsurface profile encountered at the borehole locations, a permissible grade raise restriction was calculated for loadings associated with housing and for loadings associated with a 4 storey apartment building with an underground parking level. The recommended permissible grade raise areas for housing and apartment buildings are defined in Drawing PG2743-2 - Permissible Grade Raise Areas - Housing and Drawing PG2743-3 - Permissible Grade Raise Areas - Apartment Buildings in Appendix 2.

If higher grade raises and/or higher loading conditions are required, post construction settlements can be reduced by several methods. The following options can be considered and are further discussed in Subsection 5.4:

- ☐ preloading and surcharging
- ☐ lightweight fill (LWF)

Bearing resistance values for footing designs should be determined on a per lot basis at the time of construction.

5.4 Foundation Options

Based on the above discussion, several options could be considered for the foundation support of the proposed buildings:

Scenario A

Where the grade raise is close to, but below, the maximum permissible grade raise, consideration should be given to using more reinforcement in the design of the foundation (footings and walls) to reduce the risks of cracking in the concrete foundation. The use of control joints within the brick work between the garage and basement area should also be considered.

Scenario B

Where the grade raise cannot be accommodated with soil fill, the following options could be used alone or in combination.

Option 1 - Use of Lightweight Fill

Lightweight fill (LWF) can be used, consisting of EPS (expanded polystyrene) Type 19 or 22 blocks or other light weight materials which allow for raising the grade without adding a significant load to the underlying soils. However, these materials are expensive and, in the case of the EPS, are more difficult to use under the groundwater level, as they are buoyant, and must be protected against potential hydrocarbon spills. Use lightweight fill within the interior of the garage and porch areas to reduce the fill-related loads.

As an alternative to lightweight fill in the interior of the garage and porch, a structural slab can be designed to create a void beneath the floor slab and therefore reduce fill-related loads. Additional information can be provided once the design of the buildings is known.

Option 2 - Preloading or Surcharging

It is possible to preload or surcharge the proposed site in localized areas provided sufficient time is available to achieve the desired settlements based on theoretical values from the settlement analysis. If this option is considered, a monitoring program using settlement plates and electronic piezometers will have to be implemented. This program will determine the amount of settlement in the preloaded or surcharged areas. Obviously, preloading to proposed finished grades will allow for consolidation of the underlying clays over a longer time period. Surcharging the site with additional fill above the proposed finished grade will add additional load to the underlying clays accelerating the consolidation process and allowing for accelerated settlements. Once the desired settlements are achieved, the site can be unloaded and the fill can be used elsewhere on site.

With both the preloading and surcharging methods, the loading period can be reduced by installing vertical wick drains or sand drains in the silty clay layer to promote the movement of groundwater towards the ground surface. However, vertical drains are expensive for this type of residential project.

Underground Utilities

The underground services may be subjected to unacceptable total or differential settlements. In particular, the joints at the interface building/soil may be subjected to excessive stress if the differential settlements between the building and the services are excessive. This should be considered in the design of the underground services.

Once the required grade raises are established, the above options could be further discussed along with further recommendations on specific requirements.

5.5 Design for Earthquakes

A seismic site response **Class D** is applicable for foundations designed for the subject site according to the OBC 2012. A higher site class, such as Class C, may be applicable for foundations constructed within the east portion of the subject site. However, the higher site class should be confirmed by a site specific shear wave velocity test. The soils underlying the site are not susceptible to liquefaction.

5.6 Basement Slab

With the removal of all topsoil and deleterious fill, containing organic matter, within the footprints of the proposed buildings, undisturbed native soil surface will be considered acceptable subgrade on which to commence backfilling for floor slab construction. Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab. It is recommended that the upper 200 mm of sub-slab fill consist of 19 mm clear crushed stone.

5.7 Pavement Structure

For design purposes, the pavement structure presented in the following tables could be used for the design of car parking areas and access lanes/local residential streets. These guidelines should be reviewed once the details of the development are known.

Table 4 - Recommended Pavement Structure - Car Parking Areas	
Thickness (mm)	**Material Description**
50	**Wear Course** - HL 3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 5 - Recommended Pavement Structure - Local Residential Roadways	
Thickness (mm)	**Material Description**
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
400	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil	

Table 6 - Recommended Pavement Structure - Roadways with Bus Traffic	
Thickness mm	**Material Description**
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete
50	**Upper Binder Course** - Superpave 19.0 Asphaltic Concrete
50	**Lower Binder Course** - Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
600	**SUBBASE** - OPSS Granular B Type II
	SUBGRADE - Either in situ soil or OPSS Granular B Type II material placed over in situ soil

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type I or II material. Weak subgrade conditions may be experienced over service trench fill materials. This may require the use of a geotextile, thicker subbase or other measures that can be recommended at the time of construction as part of the field observation program.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on the contact zone between the subgrade material and the base stone in a dry condition. Failure to provide adequate drainage under conditions of heavy wheel loading can result in the fine subgrade soil being pumped into the voids in the stone subbase, thereby reducing load carrying capacity.

Due to the low permeability of the subgrade materials consideration should be given to installing subdrains during the pavement construction as per City of Ottawa standards. The subdrain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be crowned to promote water flow to the drainage lines.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

A perimeter foundation drainage system is recommended for proposed structures. The system should consist of a 100 to 150 mm diameter, geotextile-wrapped, perforated, corrugated, plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Backfill against the exterior sides of the foundation walls should consist of free-draining, non frost susceptible granular materials. The site materials will be frost susceptible and, as such, are not recommended for re-use as backfill unless a composite drainage system (such as system Platon or Miradrain G100N) connected to a drainage system is provided.

6.2 Protection Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effect of frost action. A minimum 1.5 m thick soil cover (or equivalent) should be provided in this regard.

A minimum of 2.1 m thick soil cover (or equivalent) should be provided for other exterior unheated footings.

6.3 Excavation Side Slopes

The excavation for the current phase of the proposed development will be mostly through sandy silt and/or clayey silt/silty clay. Above the groundwater level, for excavations to depths of approximately 3 m, the excavation side slopes should be stable in the short term at 1H:1V. Flatter slopes could be required for deeper excavations or for excavation below the groundwater level. Where such side slopes are not permissible or practical, temporary shoring should be used. The subsoil at this site is considered to be mainly a Type 2 or 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

The slope cross-sections recommended above are for temporary slopes. Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by “cut and cover” methods and excavations will not be left open for extended periods of time.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications and Standard Detail Drawings from the City of Ottawa.

The pipe bedding for sewer and water pipes should consist of at least 150 mm of OPSS Granular A material. Where the bedding is located within the firm grey silty clay, the thickness of the bedding material should be increased to a minimum of 300 mm. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD. The bedding material should extent at least to the spring line of the pipe.

The cover material, which should consist of OPSS Granular A, should extend from the spring line of the pipe to at least 300 mm above the obvert of the pipe. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of its SPMDD.

Generally, it should be possible to re-use the moist (not wet) brown silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. Wet silty clay materials will be difficult to re-use, as the high water contents make compacting impractical without an extensive drying period.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material’s SPMDD.

To reduce long-term lowering of the groundwater level at this site, clay seals should be provided in the service trenches. The seals should be at least 1.5 m long (in the trench direction) and should extend from trench wall to trench wall. The seals should extend from the frost line and fully penetrate the bedding, subbedding and cover material. The barriers should consist of relatively dry and compactable brown silty clay placed in maximum 225 mm thick loose layers and compacted to a minimum of 95% of the SPMDD. The clay seals should be placed at the site boundaries and at strategic locations at no more than 60 m intervals in the service trenches.

6.5 Groundwater Control

Due to the relatively impervious nature of the silty clay materials, it is anticipated that groundwater infiltration into the excavations should be low and controllable using open sumps. A perched groundwater condition may be encountered within the silty sand/sandy silt deposit which may produce significant temporary groundwater infiltration levels. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations.

A temporary MOE permit to take water (PTTW) will be required for this project if more than 50,000 L/day are to be pumped during the construction phase. At least 3 to 4 months should be allowed for completion of the application and issuance of the permit by the MOE.

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

6.6 Winter Construction

The subsurface conditions at this site mostly consist of frost susceptible materials. In presence of water and freezing conditions ice could form within the soil mass. Heaving and settlement upon thawing could occur. Precautions should be taken if winter construction is considered for this project.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw, propane heaters, tarpaulins or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

The trench excavations should be constructed in a manner that will avoid the introduction of frozen materials into the trenches. As well, pavement construction is difficult during winter. The subgrade consists of frost susceptible soils which will experience total and differential frost heaving as the work takes place. In addition, the introduction of frost, snow or ice into the pavement materials, which is difficult to avoid, could adversely affect the performance of the pavement structure. Additional information could be provided, if required.

6.7 Landscaping Considerations

Tree Planting Restrictions

In accordance with the City of Ottawa Tree Planting in Sensitive Marine Clay Soils (2017 Guidelines), Paterson completed a soils review of the site to determine applicable tree planting setbacks. Atterberg limits testing was completed for recovered silty clay samples at selected locations throughout the subject site. A shrinkage limit test and sieve analysis testing was also completed on selected soil samples. The shrinkage limit testing indicates a shrinkage limit of 21% with a shrinkage ratio of 1.78. The results of our atterberg limit and sieve testing are presented in Appendix 1.

During our field investigation, it was noted that the silty clay deposit across the site consists of a brown, stiff to very stiff silty clay, which is not considered to be a sensitive marine clay soil. Therefore, the Tree Planting Guidelines not required to be followed for the subject site. **Based on our review of the silty clay deposit, a tree planting setback limit of 4.5 m for small (mature tree height up to 7.5m) and medium size trees (mature tree height 7.5 m to 14 m) is recommended across the subject site provided that the following conditions are met.**

☐ The underside of footing (USF) is 2.1 m or greater below the lowest finished grade must be satisfied for footings within 10 m from the tree, as measured from the centre of the tree trunk and verified by means of the Grading Plan as indicated procedural changes below.

☐ A small tree must be provided with a minimum of 25 m^3 of available soil volume while a medium tree must be provided with a minimum of 30 m^3 of available soil volume, as determined by the Landscape Architect. The developer is to ensure that the soil is generally un-compacted when backfilling in street tree planting locations.

- ❑ The tree species must be small (mature tree height up to 7.5 m) to medium size (mature tree height 7.5 m to 14 m) as confirmed by the Landscape Architect. The foundation walls are to be reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall).

- ❑ Grading surround the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree), as noted on the subdivision Grading Plan.

Swimming Pools

The in-situ soils are considered to be acceptable for swimming pools. Above ground swimming pools must be placed at least 4 m away from the residence foundation and neighbouring foundations. Otherwise, pool construction is considered routine, and can be constructed in accordance with the manufacturer`s requirements.

Aboveground Hot Tubs

If consideration is given to construction of an aboveground hot tub, a geotechnical consultant should be retained by the homeowner to review the site conditions. Additional grading around the hot tub should not exceed permissible grade raises. Otherwise, hot tub construction is considered routine, and can be constructed in accordance with the manufacturer’s specifications.

Installation of Decks or Additions

If consideration is given to construction of a deck or addition, a geotechnical consultant should be retained by the homeowner to review the site conditions. Additional grading around proposed deck or addition should not exceed permissible grade raises. Otherwise, standard construction practices are considered acceptable.

7.0 Recommendations

It is recommended that the following be completed once the master plan and site development are determined:

❏ Review detailed grading plan(s) from a geotechnical perspective.

❏ Observation of all bearing surfaces prior to the placement of concrete.

❏ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.

❏ Observation of all subgrades prior to placing backfilling materials.

❏ Field density tests to ensure that the specified level of compaction has been achieved.

❏ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that these works have been conducted in general accordance with Paterson's recommendations could be issued upon request, following the completion of a satisfactory material testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

The recommendations made in this report are in accordance with Paterson's present understanding of the project. Paterson requests permission to review the grading plan once available. Paterson's recommendations should be reviewed when the drawings and specifications are complete.

The client should be aware that any information pertaining to soils and the test hole log are furnished as a matter of general information only. Test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests to be notified immediately in order to permit reassessment of the recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Caivan Communities or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

March 12, 2019

Joey R Villeneuve, M.A.Sc, EIT.

LICENSED PROFESSIONAL ENGINEER
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

David J. Gilbert, P.Eng.

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEET

SYMBOLS AND TERMS

RECORDS OF BOREHOLE BY OTHERS

CONSOLIDATION TEST RESULTS

ATTERBERG LIMITS' TESTING RESULTS

GRAIN SIZE DISTRIBUTION RESULTS

patersongroup Consulting Engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 3288 Greenbank Rd.
Ottawa, Ontario

DATUM Ground surface elevations at borehole locations provided by J.D. Barnes Limited.

REMARKS

BORINGS BY CME 850X Power Auger

DATE October 15, 2012

FILE NO. PG2743

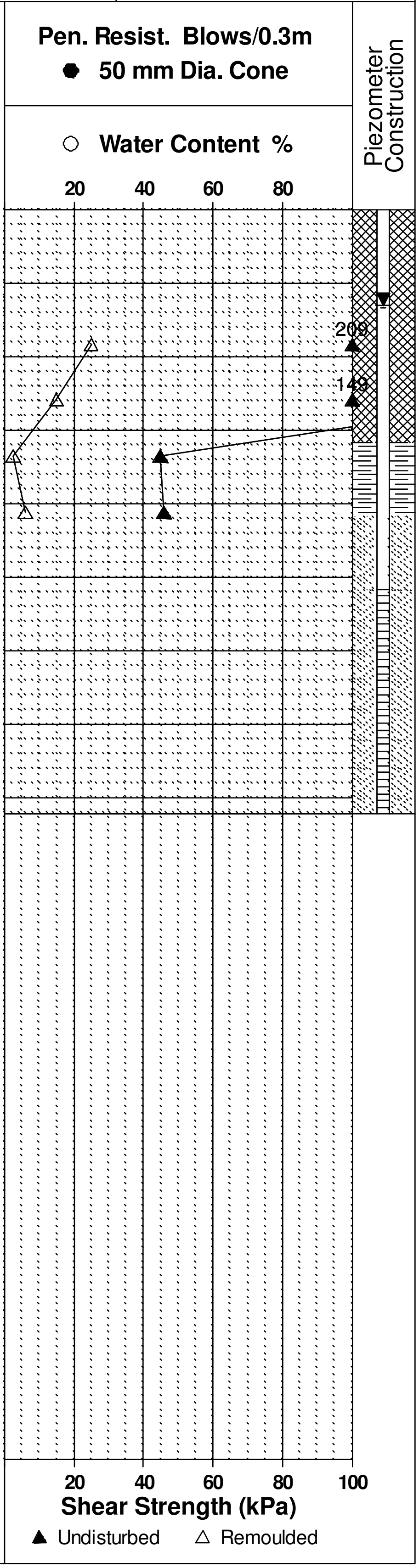
HOLE NO. BH 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	92.89
TOPSOIL 0.30		AU	1				
		AU	2				
Hard to very stiff, brown **SILTY CLAY** - firm by 2.8m depth		SS	3	100	10	1	91.89
						2	90.89
						3	89.89
4.34						4	88.89
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, boulders		SS	4	100	4	5	87.89
		SS	5	12	2	6	86.89
		SS	6	17	2	7	85.89
		SS	7	100	3		
8.21		SS	8	73	50+	8	84.89

End of Borehole

Practical refusal to augering at 8.21m depth

(GWL @ 1.30m-Nov. 7, 2012)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 3288 Greenbank Rd.
Ottawa, Ontario

DATUM Ground surface elevations at borehole locations provided by J.D. Barnes Limited.

FILE NO. **PG2743**

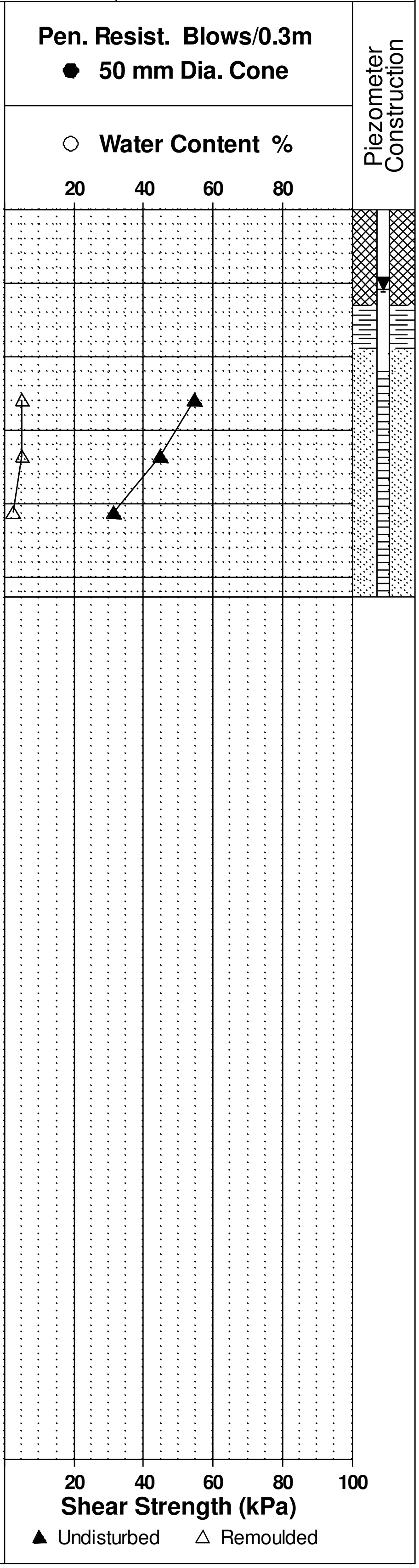
REMARKS

HOLE NO. **BH 2**

BORINGS BY CME 850X Power Auger

DATE October 16, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.37
TOPSOIL 0.30		AU	1				
		AU	2				
		SS	3	100	10	1	91.37
Very stiff to stiff, brown **SILTY CLAY**		SS	4	100	5		
						2	90.37
- firm by 2.8m depth							
						3	89.37
4.34						4	88.37
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, boulders		SS	5	38	50+		
5.26						5	87.37
End of Borehole							
(GWL @ 1.08m-Nov. 7, 2012)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 3288 Greenbank Rd.
Ottawa, Ontario

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FILE NO. **PG2743**

REMARKS

HOLE NO. **BH 3**

BORINGS BY CME 850X Power Auger

DATE October 16, 2012

SOIL DESCRIPTION

GROUND SURFACE

TOPSOIL 0.25

Very stiff to stiff, brown **SILTY CLAY**

- firm and grey by 2.8m depth

5.87

GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, boulders

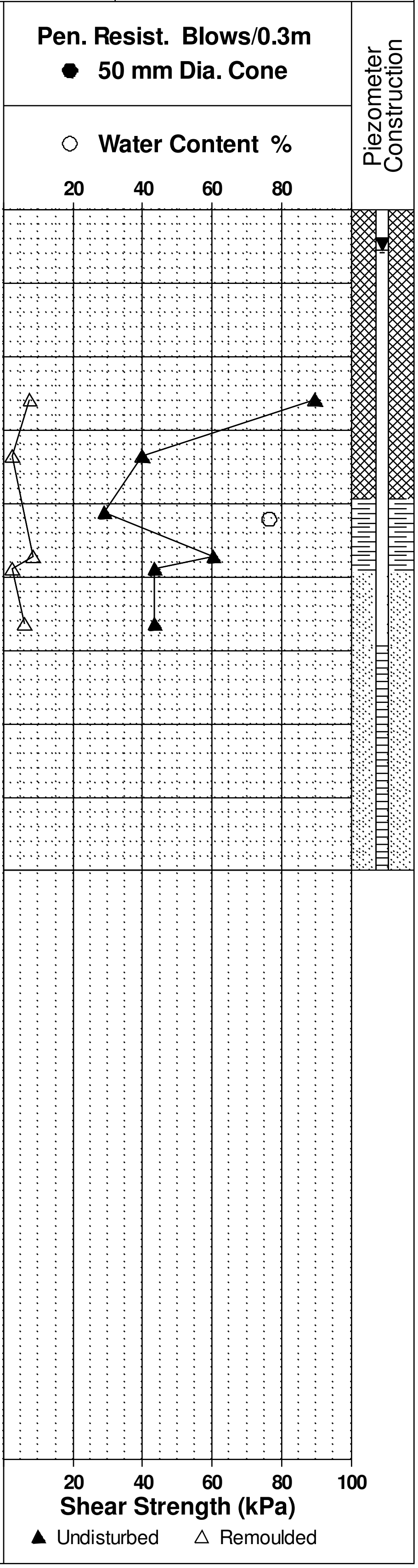
8.99

End of Borehole

(GWL @ 0.55m-Nov. 7, 2012)

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	100	10
SS	3	100	4
TW	4	100	
SS	5	0	4
SS	6	0	6
SS	7	83	8
SS	8	67	38

DEPTH (m)	ELEV. (m)
0	92.66
1	91.66
2	90.66
3	89.66
4	88.66
5	87.66
6	86.66
7	85.66
8	84.66



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 3288 Greenbank Rd.
Ottawa, Ontario

DATUM Ground surface elevations at borehole locations provided by J.D. Barnes Limited.

FILE NO. PG2743

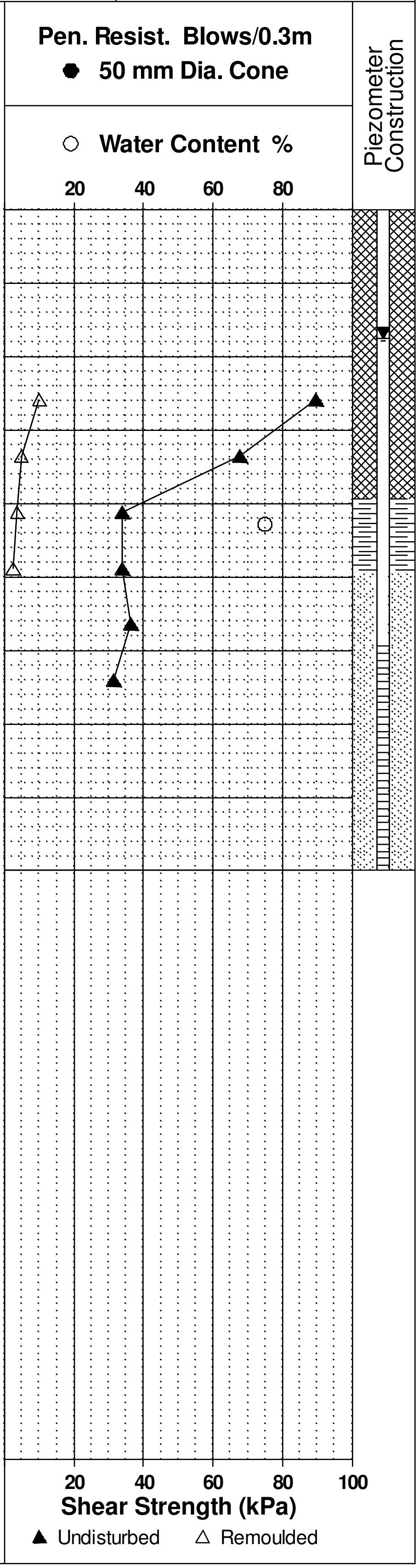
REMARKS

HOLE NO. BH 4

BORINGS BY CME 850X Power Auger

DATE October 16, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.81
TOPSOIL 0.30		AU	1				
		SS	2	100	12	1	91.81
		SS	3	100	4	2	90.81
Very stiff to stiff, brown **SILTY CLAY**						3	89.81
- firm and grey by 3.6m depth		TW	4			4	88.81
						5	87.81
						6	86.81
7.54		TW	5	83		7	85.81
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, boulders		SS	6	83	7	8	84.81
8.99		SS	7	67	12		
End of Borehole (GWL @ 1.76m-Nov. 7, 2012)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 3288 Greenbank Rd.
Ottawa, Ontario

DATUM Ground surface elevations at borehole locations provided by J.D. Barnes Limited.

FILE NO. **PG2743**

REMARKS

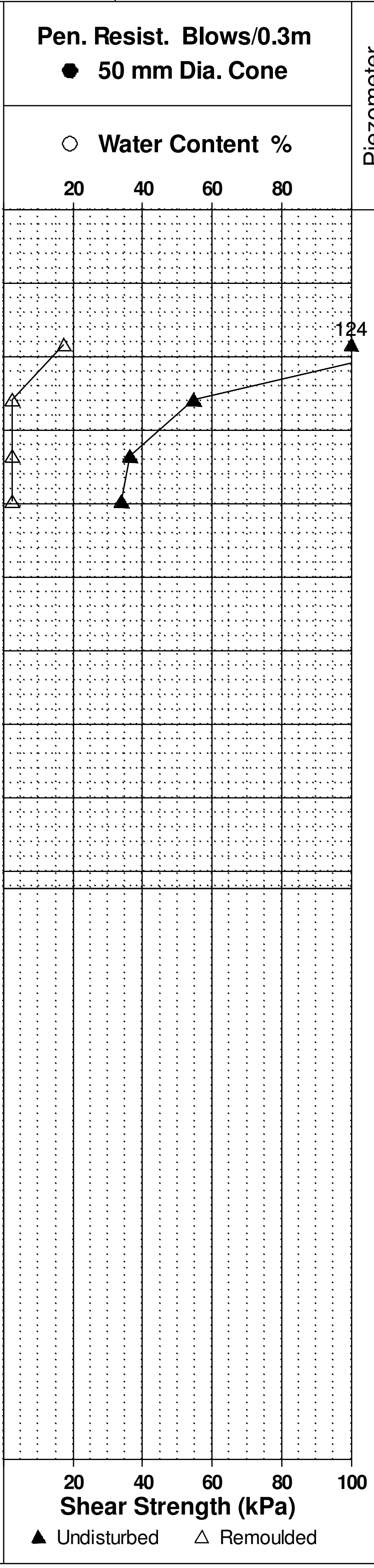
HOLE NO. **BH 5**

BORINGS BY CME 850X Power Auger

DATE October 16, 2012

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	92.06
TOPSOIL 0.28	AU	1				
	SS	2		12	1	91.06
Very stiff to stiff, brown **SILTY CLAY**					2	90.06
- firm and grey by 2.8m depth					3	89.06
	TW	3	100			
4.27	TW	4	46		4	88.06
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, boulders	SS	5	50	8	5	87.06
	SS	6	50	3	6	86.06
	SS	7	50	15		
7.16					7	85.06
Loose, grey **SAND**	SS	8	42	9	8	84.06
9.24					9	83.06
End of Borehole						

Piezometer Construction



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 3288 Greenbank Rd.
Ottawa, Ontario

DATUM Ground surface elevations at borehole locations provided by J.D. Barnes Limited.

FILE NO. **PG2743**

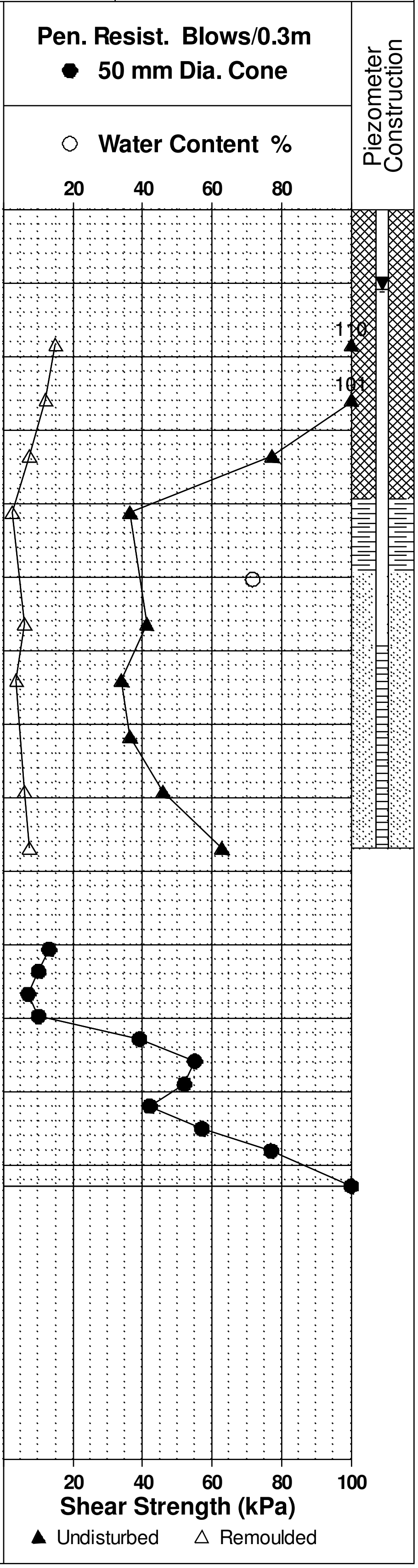
REMARKS

HOLE NO. **BH 6**

BORINGS BY CME 850X Power Auger

DATE October 17, 2012

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						
TOPSOIL 0.33	AU	1			0	92.19
	SS	2	100	9	1	91.19
					2	90.19
Very stiff to stiff, brown **SILTY CLAY**					3	89.19
- firm and grey 3.6m depth					4	88.19
	TW	3	100		5	87.19
					6	86.19
					7	85.19
8.69					8	84.19
Dynamic Cone Penetration Test commenced at 8.69m depth. Cone pushed to 10.0m depth.					9	83.19
					10	82.19
					11	81.19
					12	80.19
13.28					13	79.19
End of Borehole Practical cone refusal at 13.28m depth (GWL @ 1.08m-Nov. 7, 2012)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 3288 Greenbank Rd.
Ottawa, Ontario

DATUM Ground surface elevations at borehole locations provided by J.D. Barnes Limited.

FILE NO. PG2743

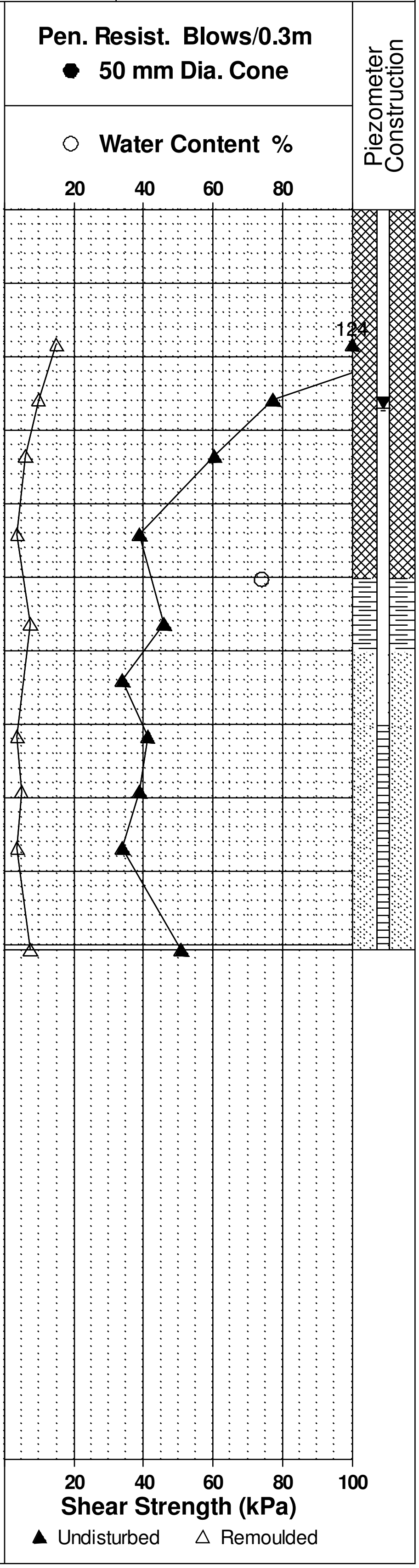
REMARKS

HOLE NO. BH 7

BORINGS BY CME 850X Power Auger

DATE October 17, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.38
TOPSOIL 0.30		AU	1				
		SS	2	100	8	1	91.38
						2	90.38
Very stiff to stiff, brown **SILTY CLAY**						3	89.38
- firm and grey by 3.6m depth						4	88.38
		TW	3	83		5	87.38
						6	86.38
						7	85.38
						8	84.38
						9	83.38
		TW	4	100			
10.06						10	82.38
End of Borehole							
(GWL @ 2.71m-Nov. 7, 2012)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 3288 Greenbank Rd.
Ottawa, Ontario

DATUM Ground surface elevations at borehole locations provided by J.D. Barnes Limited.

FILE NO. **PG2743**

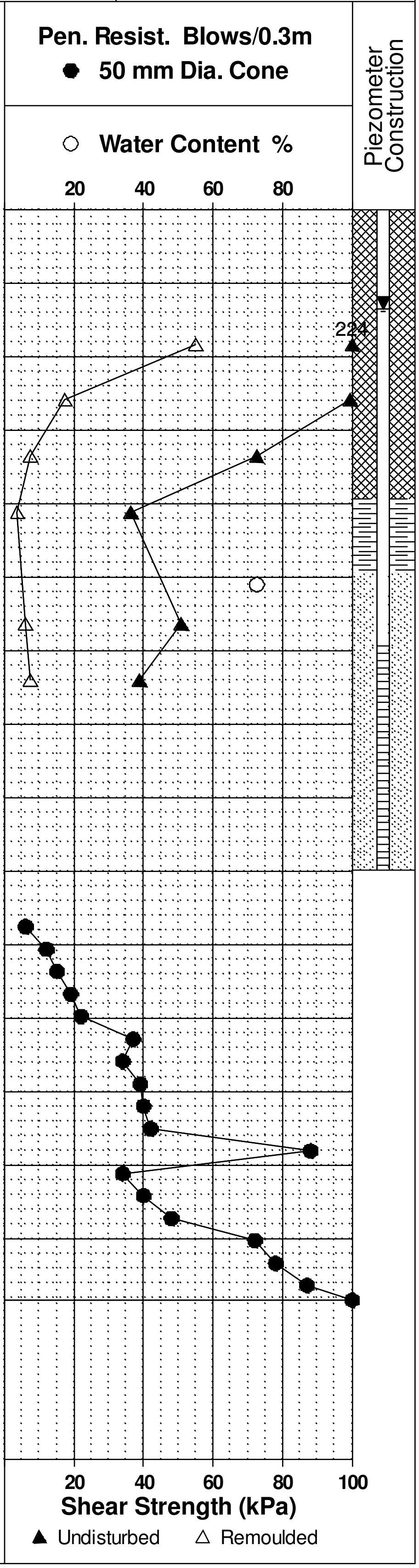
REMARKS

HOLE NO. **BH 8**

BORINGS BY CME 850X Power Auger

DATE October 17, 2012

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	92.88
TOPSOIL 0.30	AU	1				
	SS	2	100	10	1	91.88
					2	90.88
Hard to stiff, brown **SILTY CLAY**					3	89.88
- firm and grey by 3.6m depth					4	88.88
	TW	3	100		5	87.88
					6	86.88
7.16	TW	4	58		7	85.88
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, boulders	SS	5	42	8	8	84.88
9.00	SS	6	33	6	9	83.88
Dynamic Cone Penetration Test commenced at 9.00m depth.					10	82.88
					11	81.88
					12	80.88
					13	79.88
					14	78.88
14.83						
End of Borehole Practical refusal to augering at 14.83m depth. (GWL @ 1.35m-Nov. 7, 2012)						



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 3288 Greenbank Rd.
Ottawa, Ontario

DATUM Ground surface elevations at borehole locations provided by J.D. Barnes Limited.

FILE NO. **PG2743**

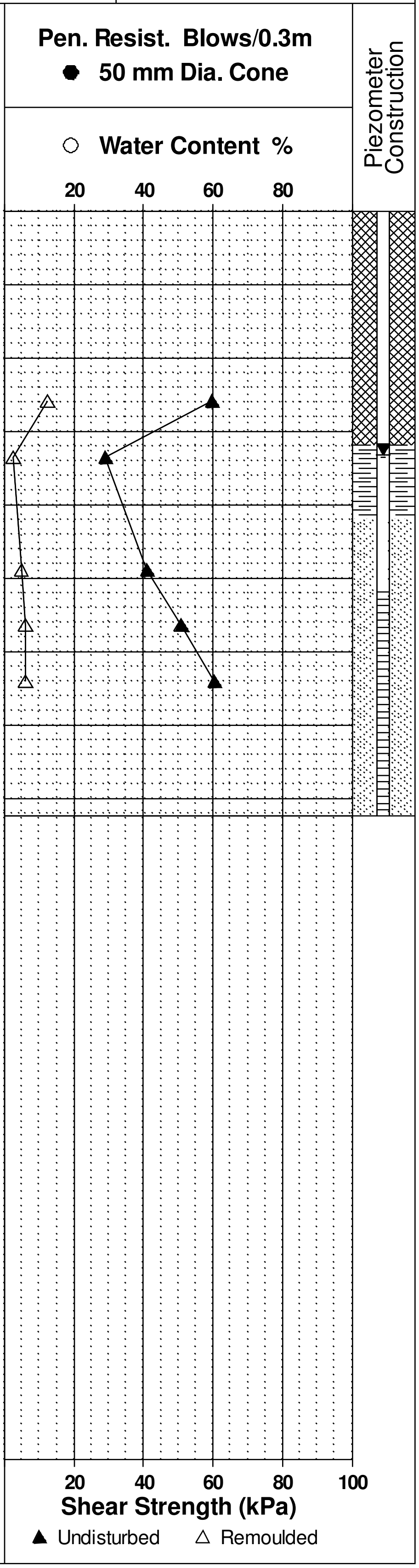
REMARKS

HOLE NO. **BH 9**

BORINGS BY CME 850X Power Auger

DATE October 18, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.64
TOPSOIL 0.30		AU	1				
		SS	2	100	13	1	91.64
Very stiff to stiff, brown **SILTY CLAY**		SS	3	100	7	2	90.64
- firm and grey by 2.8m depth						3	89.64
		TW	4				
		TW	5	100		4	88.64
- stiff and grey-brown by 5.1m depth						5	87.64
6.63						6	86.64
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, boulders		SS	6	42	50	7	85.64
8.23		SS	7	8	14	8	84.64
End of Borehole							
(GWL @ 3.32m-Nov. 7, 2012)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 3288 Greenbank Rd.
Ottawa, Ontario

DATUM Ground surface elevations at borehole locations provided by J.D. Barnes Limited.

FILE NO. **PG2743**

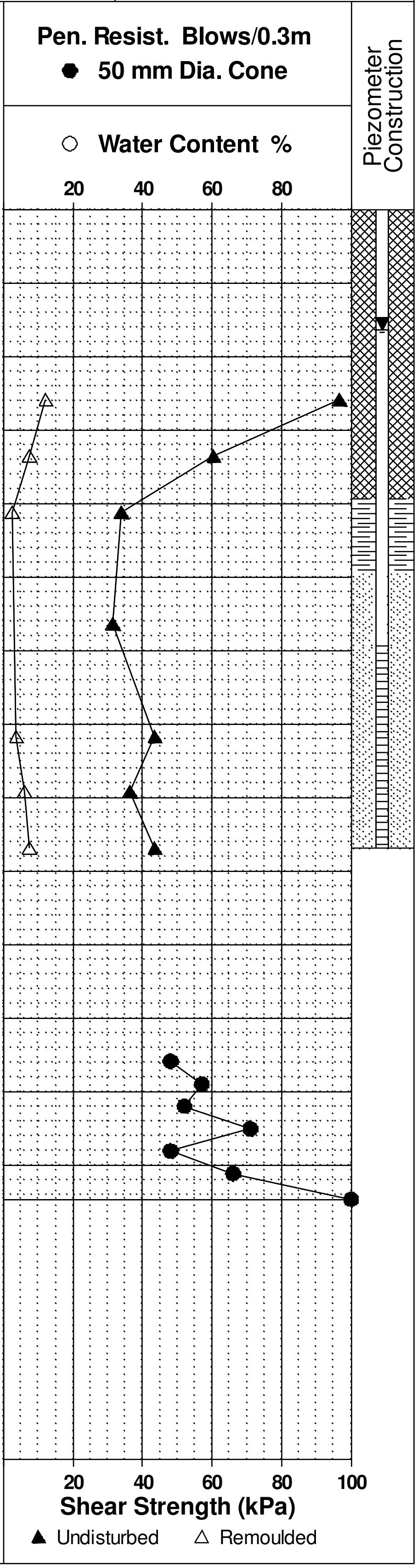
REMARKS

HOLE NO. **BH10**

BORINGS BY CME 850X Power Auger

DATE October 18, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.40
TOPSOIL 0.30		AU	1				
Stiff, brown **SILTY CLAY** - firm and grey-brown by 3.6m depth		SS	2	100	7	1	91.40
		SS	3	100	3	2	90.40
						3	89.40
						4	88.40
		TW	4	100		5	87.40
						6	86.40
		TW	5	100			
						7	85.40
						8	84.40
8.69							
Dynamic Cone Penetration Test commenced at 8.69m depth. Cone pushed to 11.5m depth.						9	83.40
						10	82.40
						11	81.40
						12	80.40
						13	79.40
13.46							
End of Borehole Practical cone refusal at 13.46m depth. (GWL @ 1.63m-Nov. 7, 2012)							



patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - 3288 Greenbank Rd.
Ottawa, Ontario

DATUM Ground surface elevations at borehole locations provided by J.D. Barnes Limited.

FILE NO. **PG2743**

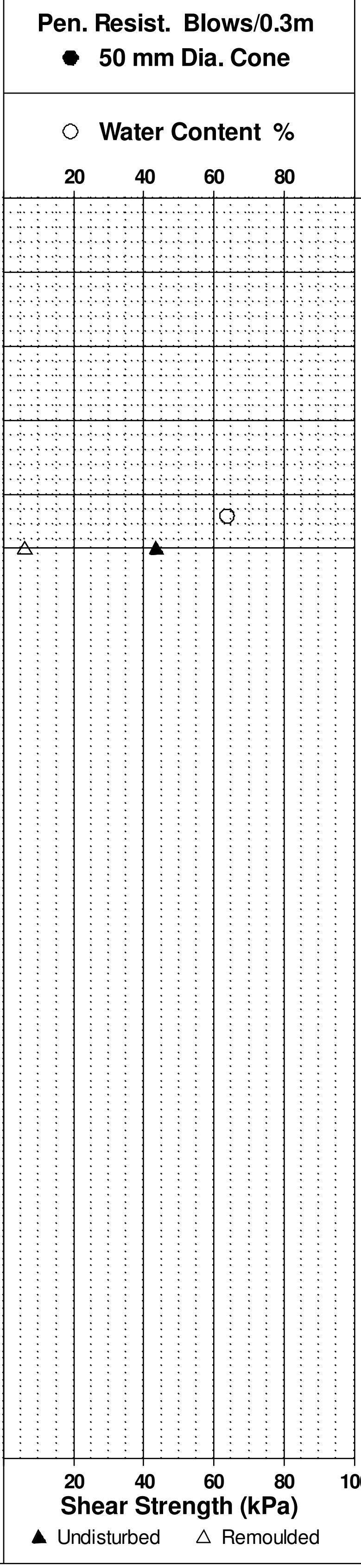
REMARKS

HOLE NO. **BH11**

BORINGS BY CME 850X Power Auger

DATE October 18, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	92.70	
TOPSOIL 0.30								
						1	91.70	
Firm, grey **SILTY CLAY**						2	90.70	
						3	89.70	
		TW	1	100		4	88.70	
4.72								
End of Borehole								



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
2388 Greenbank Road
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

REMARKS

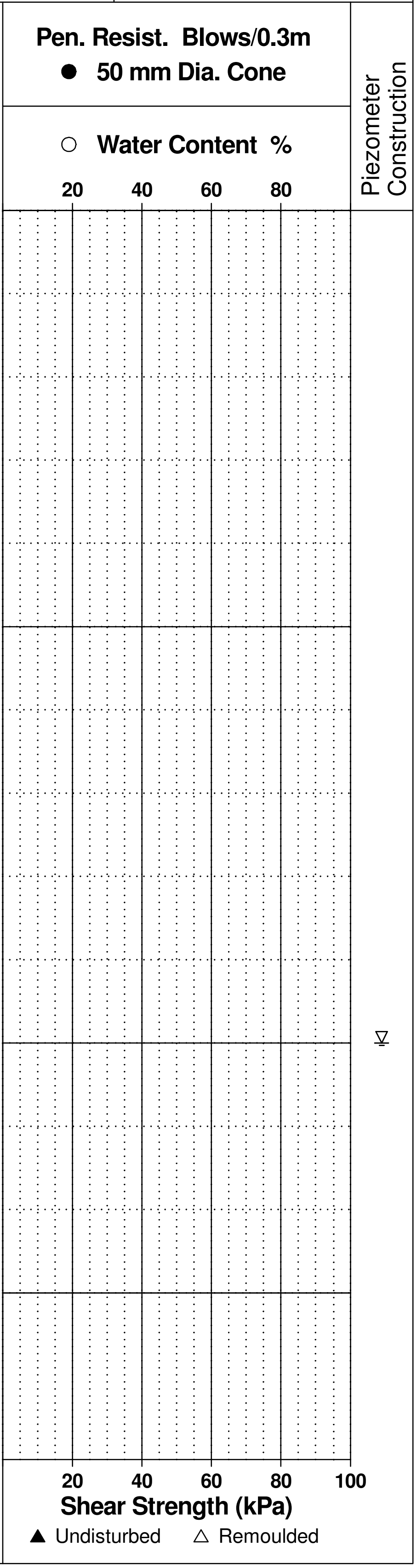
BORINGS BY Excavator

DATE February 19, 2019

FILE NO. PG2743

HOLE NO. TP 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	93.85
TOPSOIL 0.20							
Brown **SILTY SAND** with clay 0.40							
Stiff, brown **CLAYEY SILT**						1	92.85
		G	1				
1.80							
GLACIAL TILL: Brown clayey silt with sand, gravel, cobbles and boulders		G	2			2	91.85
		G	3				
2.60							
End of Test Pit (GWL @ 2.0m depth based on field observations)							



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
2388 Greenbank Road
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

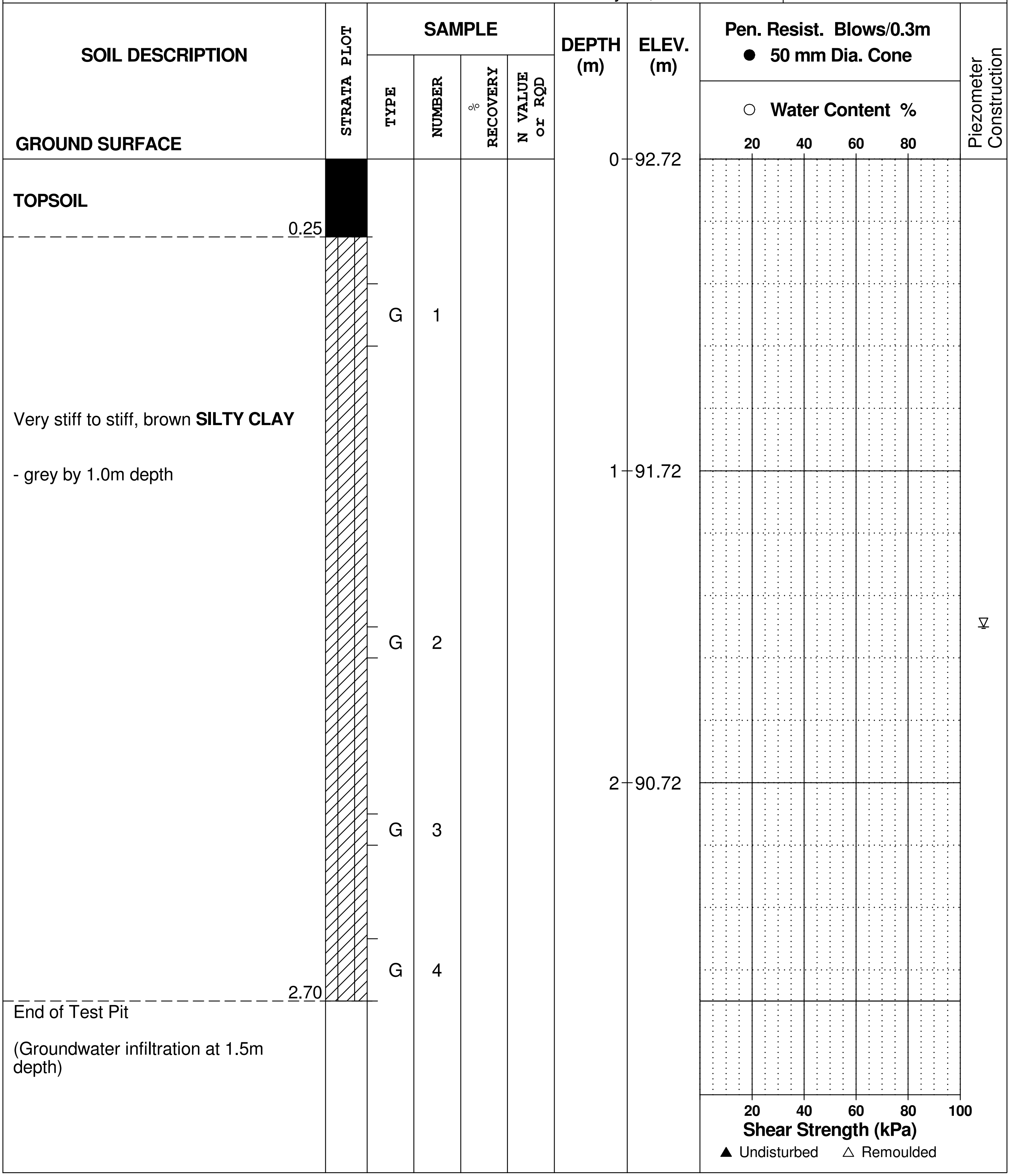
REMARKS

BORINGS BY Excavator

DATE February 19, 2019

FILE NO. PG2743

HOLE NO. TP 2



SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.72
TOPSOIL 0.25							
Very stiff to stiff, brown **SILTY CLAY** - grey by 1.0m depth		G	1				
						1	91.72
		G	2				
						2	90.72
		G	3				
2.70		G	4				
End of Test Pit (Groundwater infiltration at 1.5m depth)							

patersongroup Consulting Engineers

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
2388 Greenbank Road
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

REMARKS

BORINGS BY Excavator

DATE February 19, 2019

FILE NO. PG2743

HOLE NO. TP 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	92.90		
TOPSOIL 0.30									
		G	1						
Very stiff to stiff, brown **SILTY CLAY**									
- grey by 1.0m depth						1	91.90		
		G	2						
									∇
		G	3			2	90.90		
2.50		G	4						
End of Test Pit									
(Groundwater infiltration at 1.8m depth)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
2388 Greenbank Road
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

FILE NO. **PG2743**

REMARKS

HOLE NO. **TP 4**

BORINGS BY Excavator **DATE** February 19, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	92.95		
TOPSOIL 0.25	■								
Very stiff, brown **CLAYEY SILT/SILTY CLAY** 1.00	▨					1	91.95		
Very stiff, brown **SILTY CLAY**	▨	G	1						
	▨								∇
	▨	G	2			2	90.95		
2.60	▨	G	3						
End of Test Pit (Groundwater infiltration at 1.9m depth)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
2388 Greenbank Road
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

REMARKS

BORINGS BY Excavator

DATE February 19, 2019

FILE NO. PG2743

HOLE NO. TP 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	92.40		
TOPSOIL 0.30	■								
	▨					1	91.40		
Stiff, brown **SILTY CLAY**	▨								
	▨	G	1						
	▨								▽
	▨					2	90.40		
	▨	G	2						
2.60	▨	G	3						
End of Test Pit (Groundwater infiltration at 1.7m depth)								20 40 60 80 100 **Shear Strength (kPa)** ▲ Undisturbed △ Remoulded	

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
2388 Greenbank Road
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

FILE NO. PG2743

REMARKS

HOLE NO. TP 6

BORINGS BY Excavator

DATE February 19, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	92.48		
TOPSOIL 0.20	■								
Very stiff, brown **SILTY CLAY** with sand	▨	G	1			1	91.48		
1.40									
Stiff, grey-brown **SILTY CLAY** - grey by 1.7m depth	▨	G	2						▽
	▨	G	3			2	90.48		
2.60	▨	G	4						
End of Test Pit (Groundwater infiltration at 1.8m depth)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
2388 Greenbank Road
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

FILE NO. PG2743

REMARKS

HOLE NO. TP 7

BORINGS BY Excavator

DATE February 19, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	92.63		
TOPSOIL — 0.40									
Very stiff, brown **SILTY CLAY** with sand — 1.00		G	1						
						1	91.63		
Stiff, brown **SILTY CLAY**		G	2						
						2	90.63		
— 2.40		G	3						∇
End of Test Pit (Groundwater infiltration at 1.5m depth)									

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
2388 Greenbank Road
Ottawa, Ontario

DATUM Ground surface elevations provided by J.D. Barnes Limited.

REMARKS

BORINGS BY Excavator

DATE February 19, 2019

FILE NO. PG2743

HOLE NO. TP 8

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	93.20		
TOPSOIL — 0.30	■								
Very stiff, brown **SILTY CLAY** with sand — 1.10	▨					1	92.20		
Very stiff, brown **SILTY CLAY**	▨	G	1						∇
	▨	G	2			2	91.20		
— 2.60	▨	G	3						
End of Test Pit (Groundwater infiltration at 1.6m depth)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) ‘N’ value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

Relative Density	‘N’ Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

Consistency	Undrained Shear Strength (kPa)	‘N’ Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NXL size core. However, it can be used on smaller core sizes, such as BX, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	**ROCK QUALITY**
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC% - Natural moisture content or water content of sample, %
LL - Liquid Limit, % (water content above which soil behaves as a liquid)
PL - Plastic limit, % (water content above which soil behaves plastically)
PI - Plasticity index, % (difference between LL and PL)

Dxx - Grain size which xx% of the soil, by weight, is of finer grain sizes
These grain size descriptions are not used below 0.075 mm grain size
D10 - Grain size at which 10% of the soil is finer (effective grain size)
D60 - Grain size at which 60% of the soil is finer

Cc - Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu - Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay (more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

p'_o - Present effective overburden pressure at sample depth
p'_c - Preconsolidation pressure of (maximum past pressure on) sample
Ccr - Recompression index (in effect at pressures below p'_c)
Cc - Compression index (in effect at pressures above p'_c)

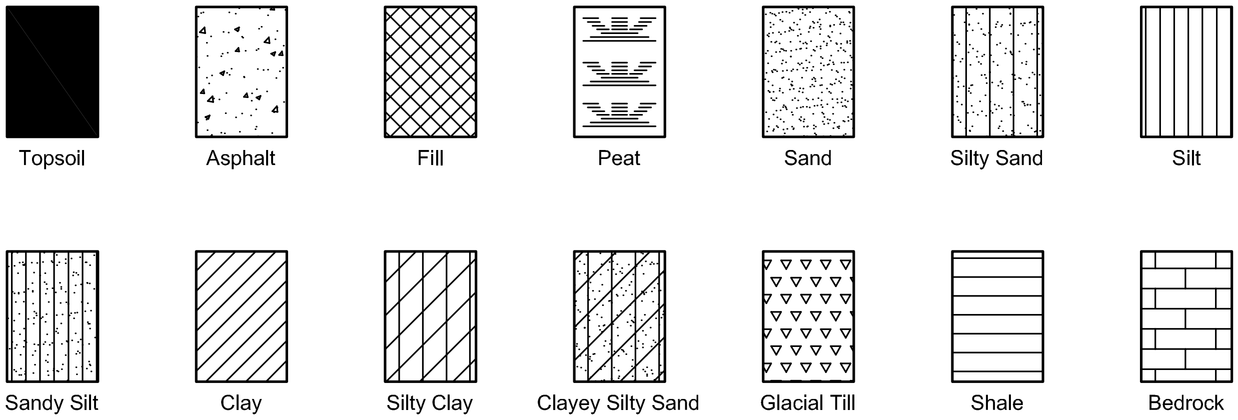
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

k - Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

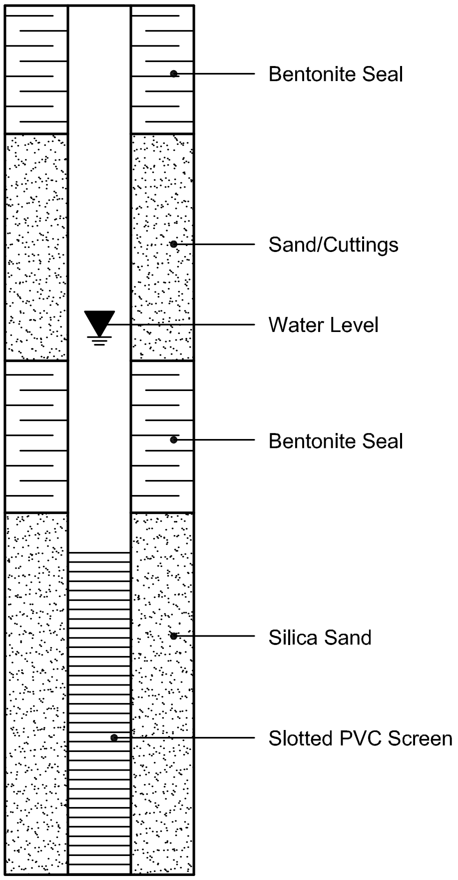
SYMBOLS AND TERMS (continued)

STRATA PLOT

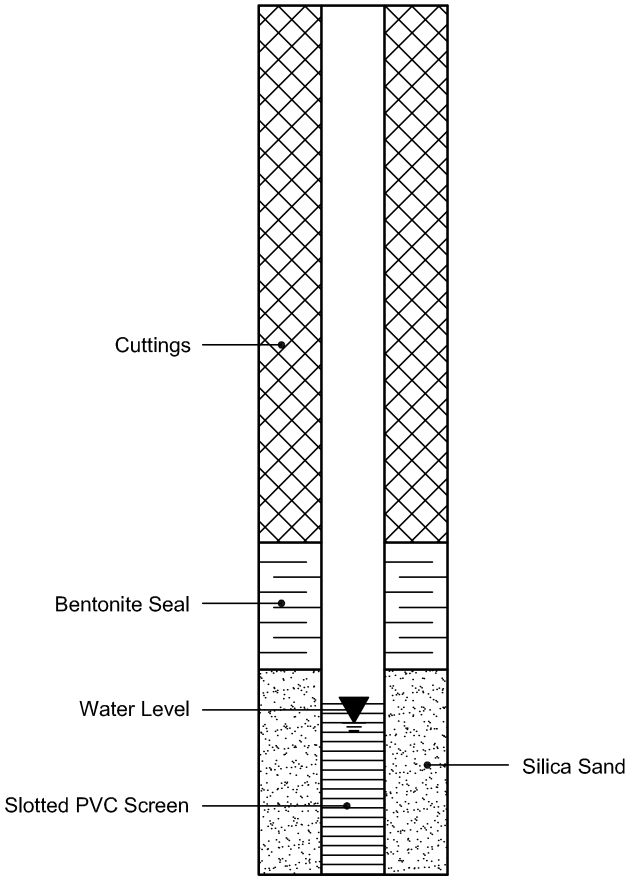


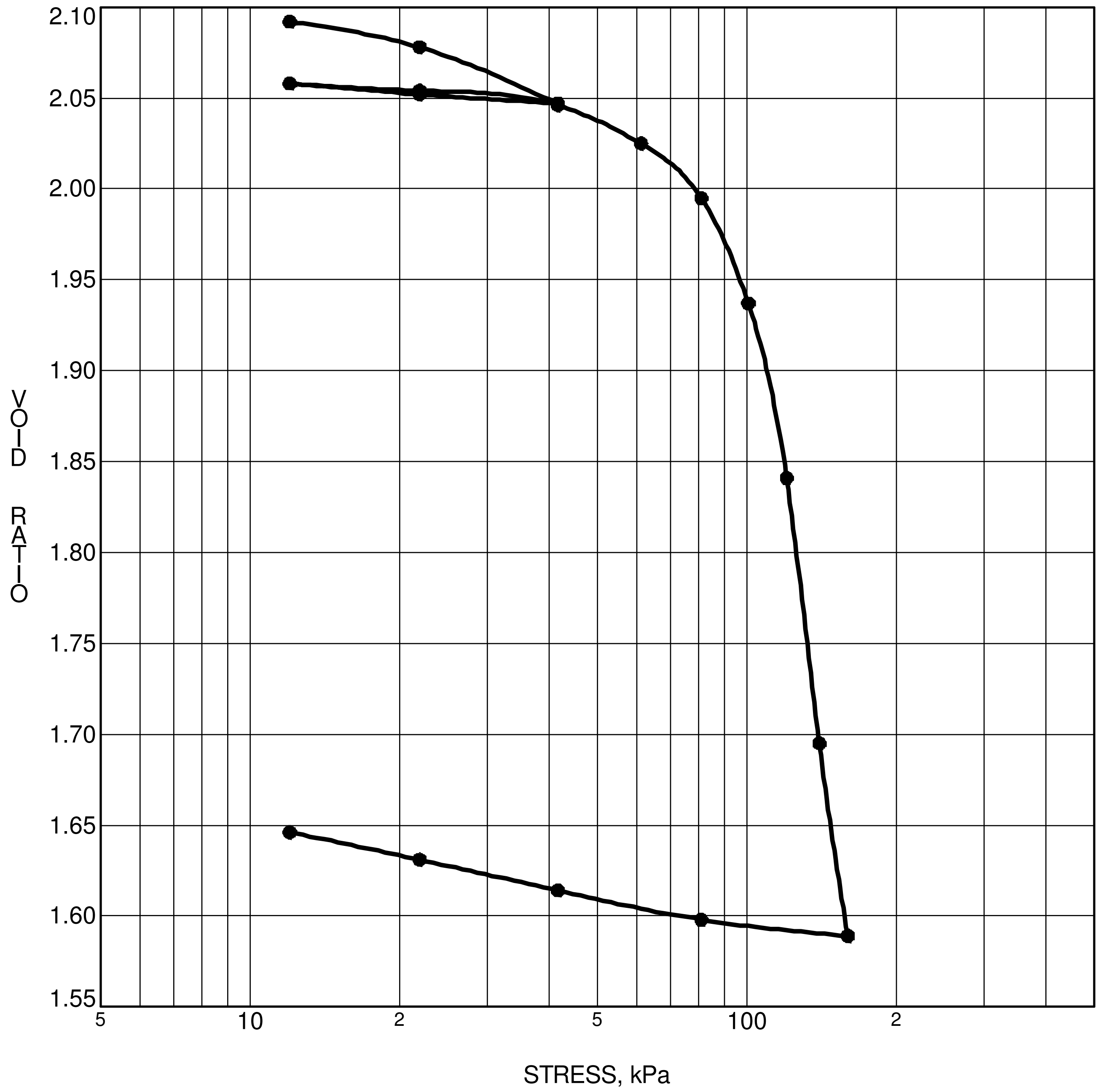
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION





CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 3	p'$_o$	50 kPa	Ccr	0.021
Sample No.	TW 4	p'$_c$	104 kPa	Cc	2.253
Sample Depth	4.21 m	OC Ratio	2.1	Wo	76.5 %
Sample Elev.	88.45 m	Void Ratio	2.103	Unit Wt.	15.8 kN/m ^{3}

CLIENT **Mattamy Homes**

FILE NO. **PG2743**

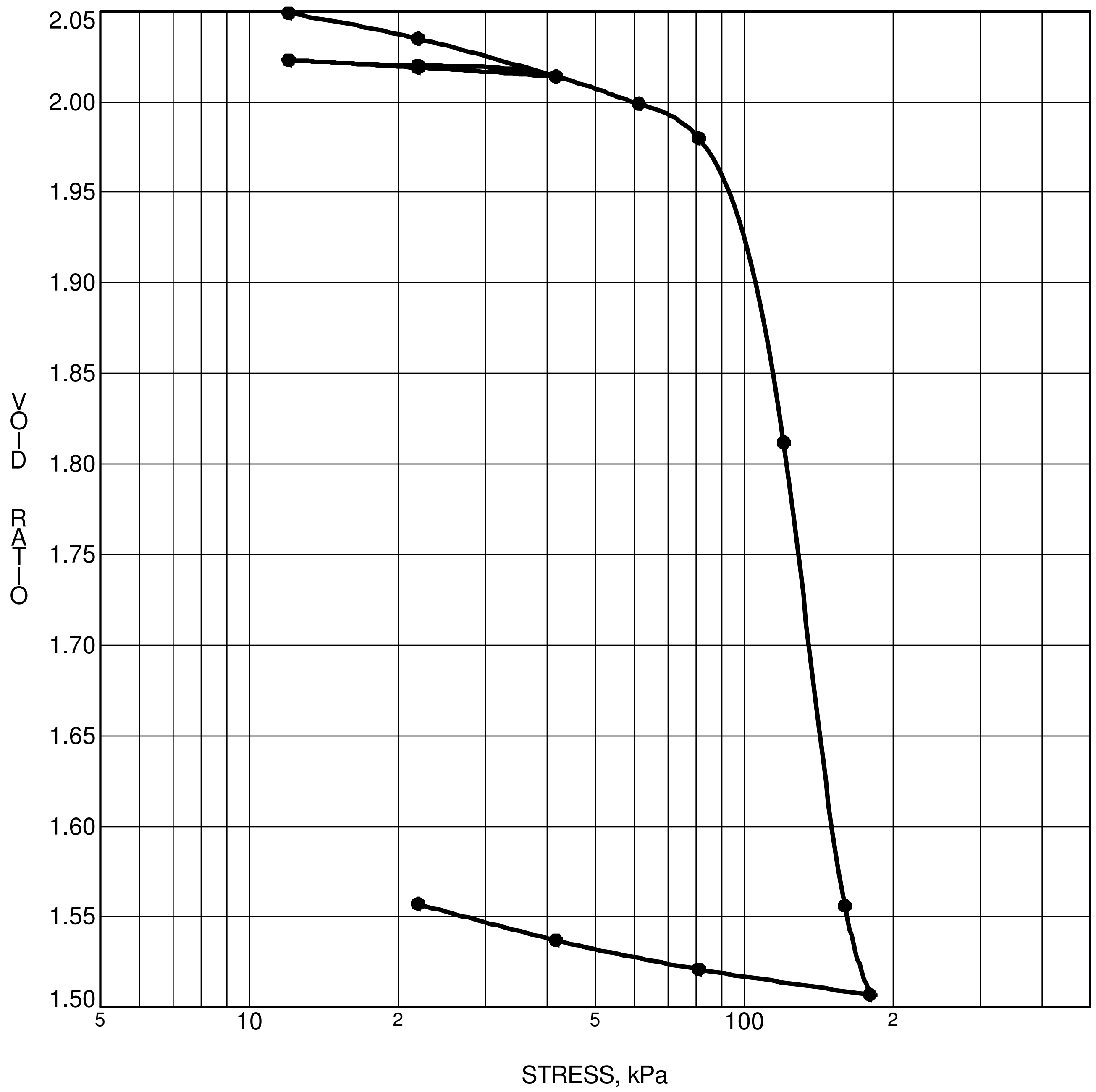
PROJECT **Geotechnical Investigation - Prop. Residential Development - 3288 Greenbank Rd.**

DATE **26/10/2012**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 4**	p'_o	**55** kPa	Ccr	**0.019**
Sample No.	**TW 4**	p'_c	**103** kPa	Cc	**2.146**
Sample Depth	**4.28** m	OC Ratio	**1.9**	Wo	**74.9** %
Sample Elev.	**88.53** m	Void Ratio	**2.061**	Unit Wt.	**15.8** kN/m^3

CLIENT **Mattamy Homes**

FILE NO. **PG2743**

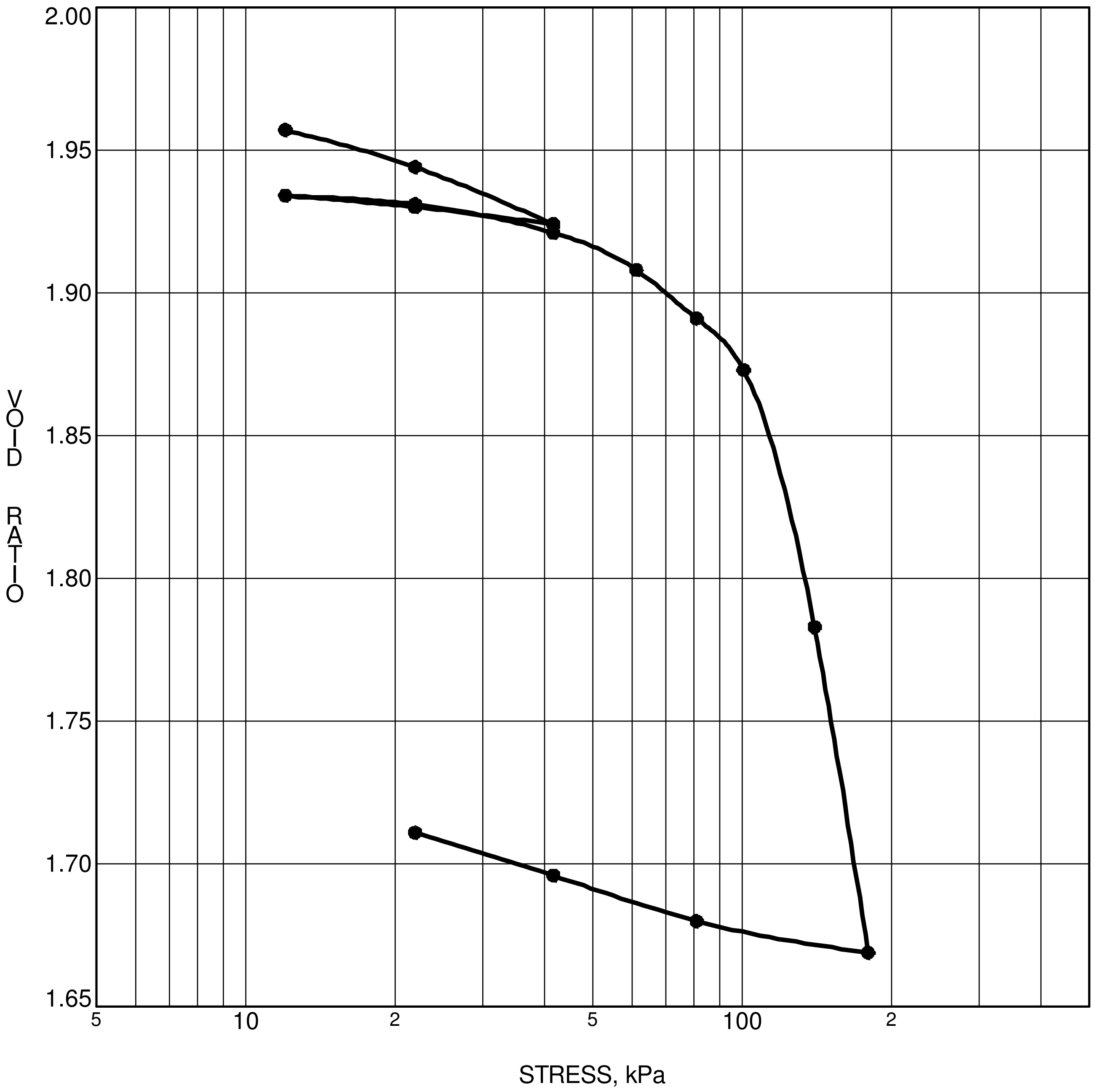
PROJECT **Geotechnical Investigation - Prop. Residential Development - 3288 Greenbank Rd.**

DATE **22/10/2012**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 6**	p'o	**63** kPa	Ccr	**0.022**
Sample No.	**TW 3**	p'c	**119** kPa	Cc	**1.064**
Sample Depth	**5.03** m	OC Ratio	**1.9**	Wo	**71.7** %
Sample Elev.	**87.16** m	Void Ratio	**1.971**	Unit Wt.	**16.0** kN/m ^{3}

CLIENT **Mattamy Homes**

FILE NO. **PG2743**

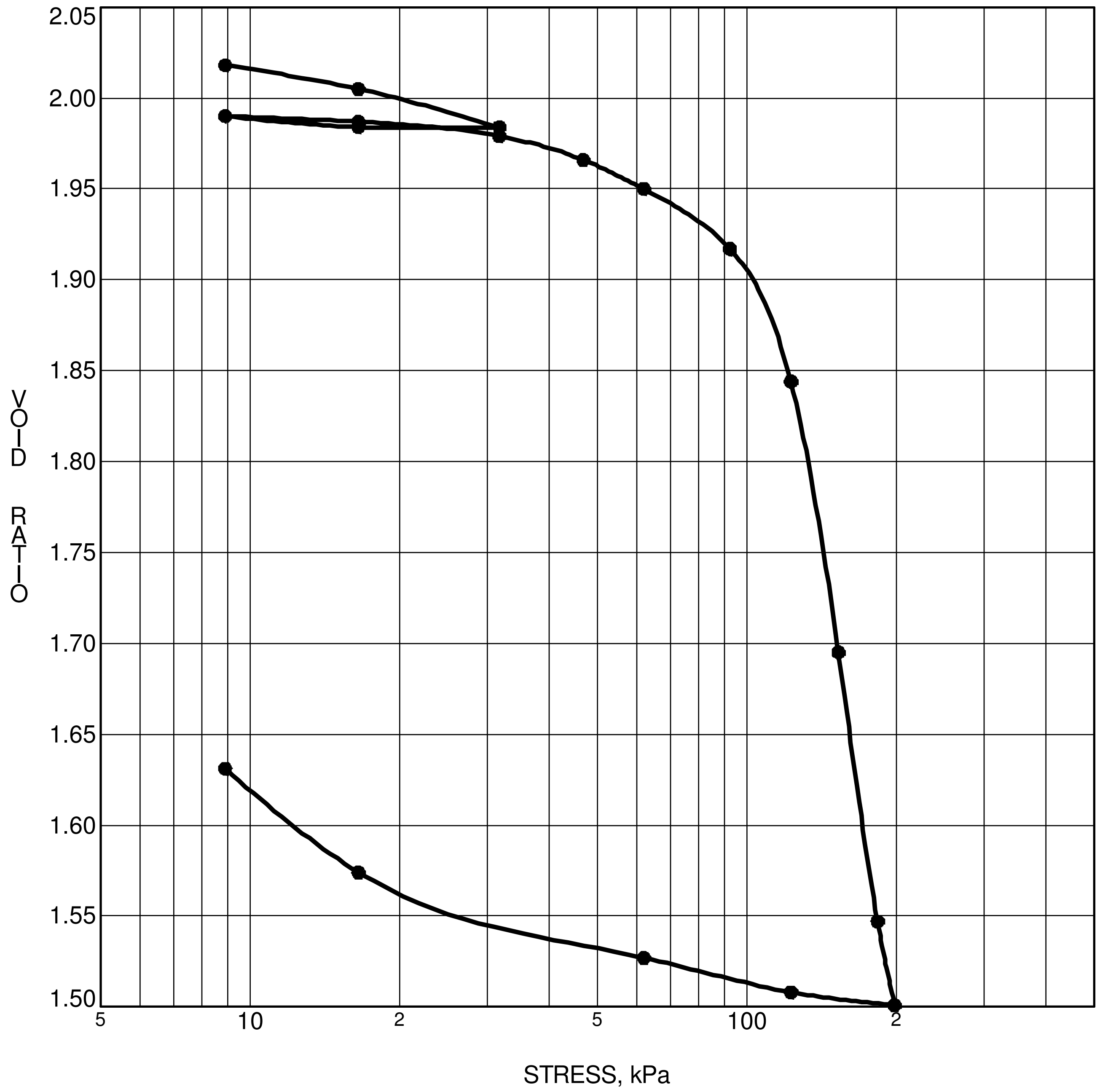
PROJECT **Geotechnical Investigation - Prop. Residential Development - 3288 Greenbank Rd.**

DATE **22/12/2012**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 7**	p'o	**68** kPa	Ccr	**0.016**
Sample No.	**TW 3**	p'c	**113** kPa	Cc	**1.683**
Sample Depth	**5.03** m	OC Ratio	**1.7**	Wo	**74.0** %
Sample Elev.	**87.35** m	Void Ratio	**2.034**	Unit Wt.	**15.8** kN/m ^{3}

CLIENT **Mattamy Homes**

FILE NO. **PG2743**

PROJECT **Geotechnical Investigation - Prop. Residential Development - 3288 Greenbank Rd.**

DATE **29/10/2012**

patersongroup **Consulting Engineers**

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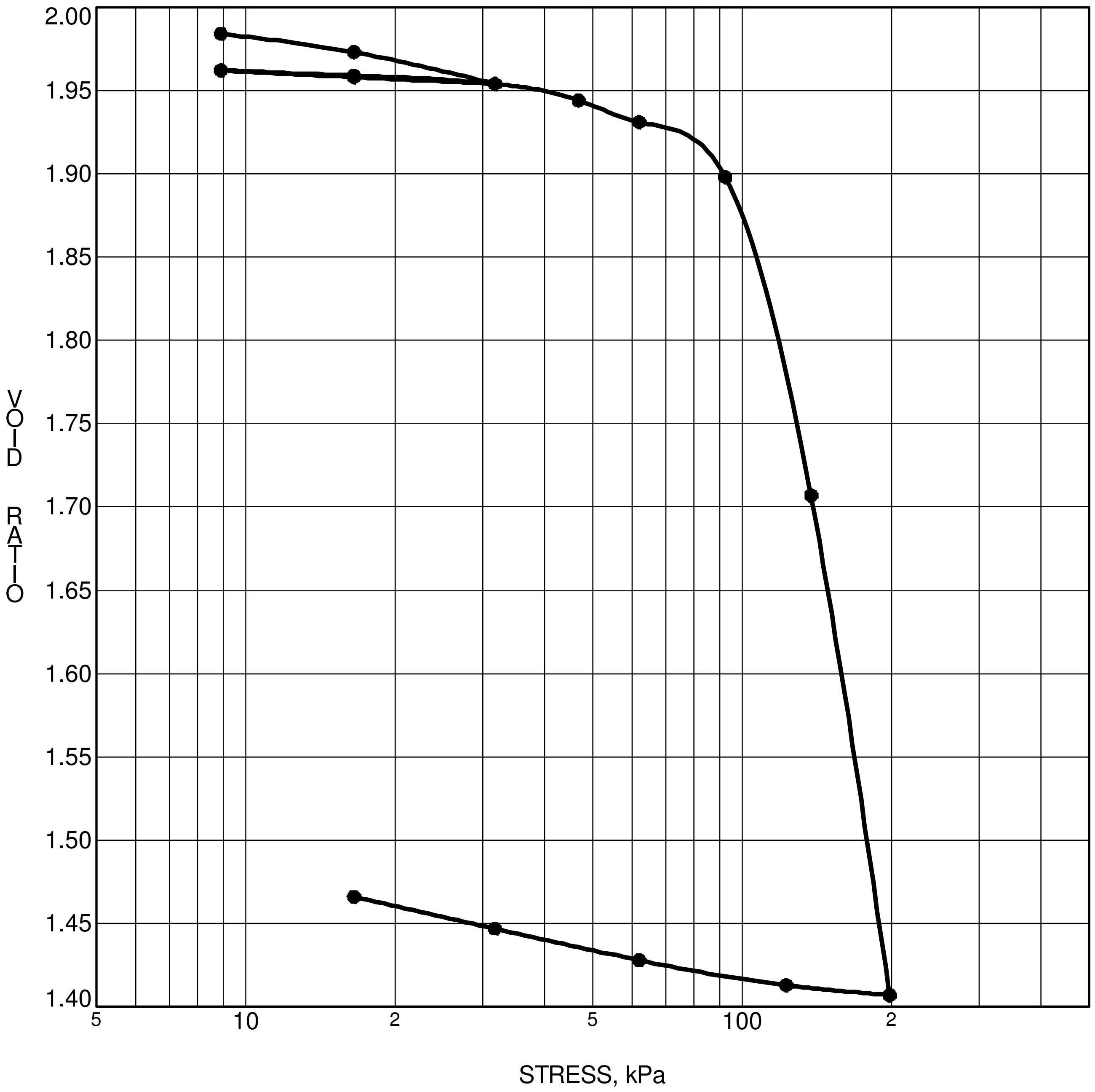
CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 8**	p'$_o$	**62** kPa	Ccr	**0.015**
Sample No.	**TW 3**	p'$_c$	**111** kPa	Cc	**2.000**
Sample Depth	**5.10** m	OC Ratio	**1.8**	Wo	**72.6** %
Sample Elev.	**87.78** m	Void Ratio	**1.996**	Unit Wt.	**15.9** kN/m ^{3}

CLIENT **Mattamy Homes**

FILE NO. **PG2743**

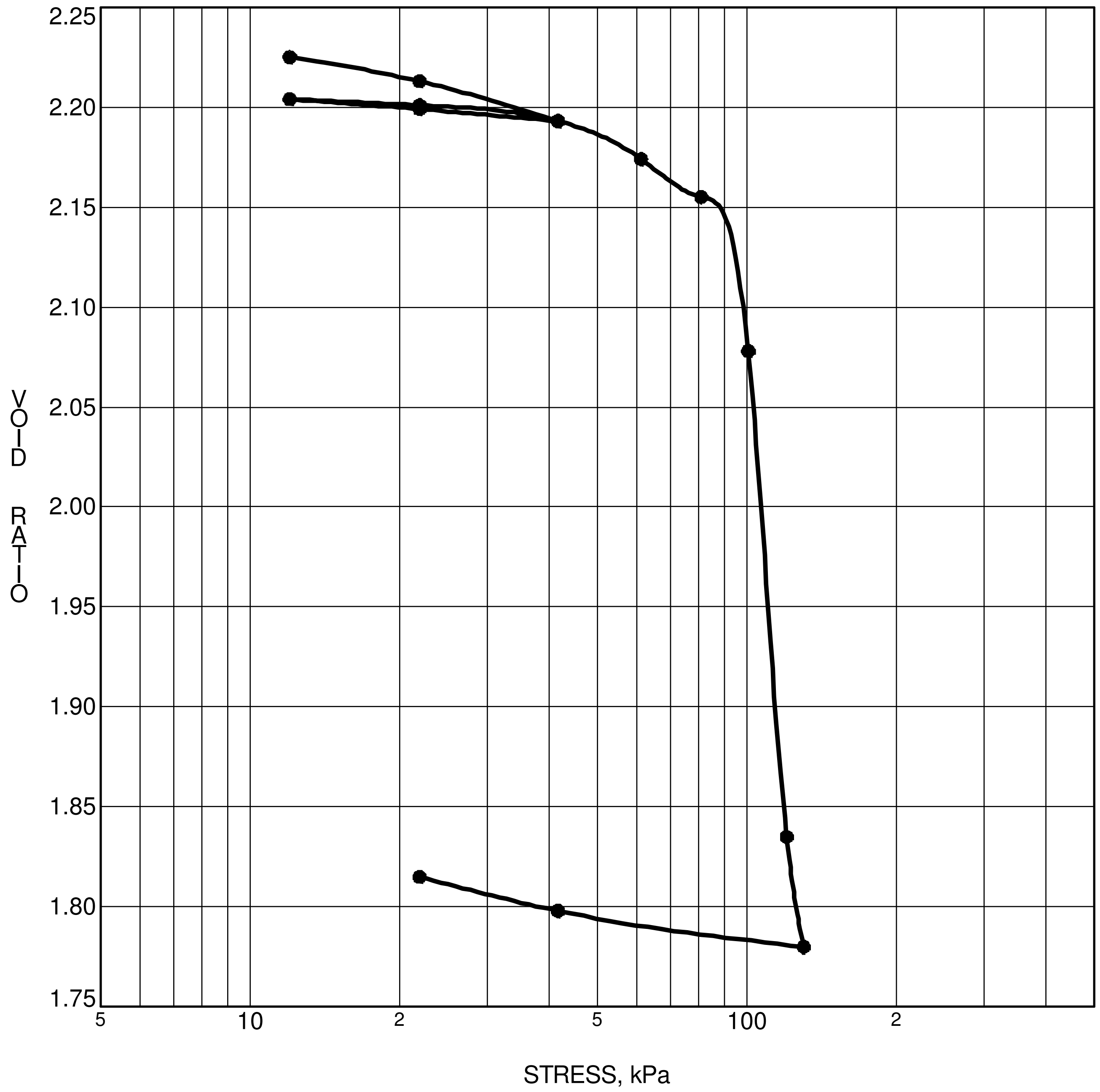
PROJECT **Geotechnical Investigation - Prop. Residential Development - 3288 Greenbank Rd.**

DATE **22/10/2012**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	BH 9	p'_o	54 kPa	Ccr	0.022
Sample No.	TW 5	p'_c	97 kPa	Cc	3.224
Sample Depth	4.32 m	OC Ratio	1.8	Wo	81.4 %
Sample Elev.	88.32 m	Void Ratio	2.237	Unit Wt.	15.5 kN/m ^{3}

CLIENT **Mattamy Homes**

FILE NO. **PG2743**

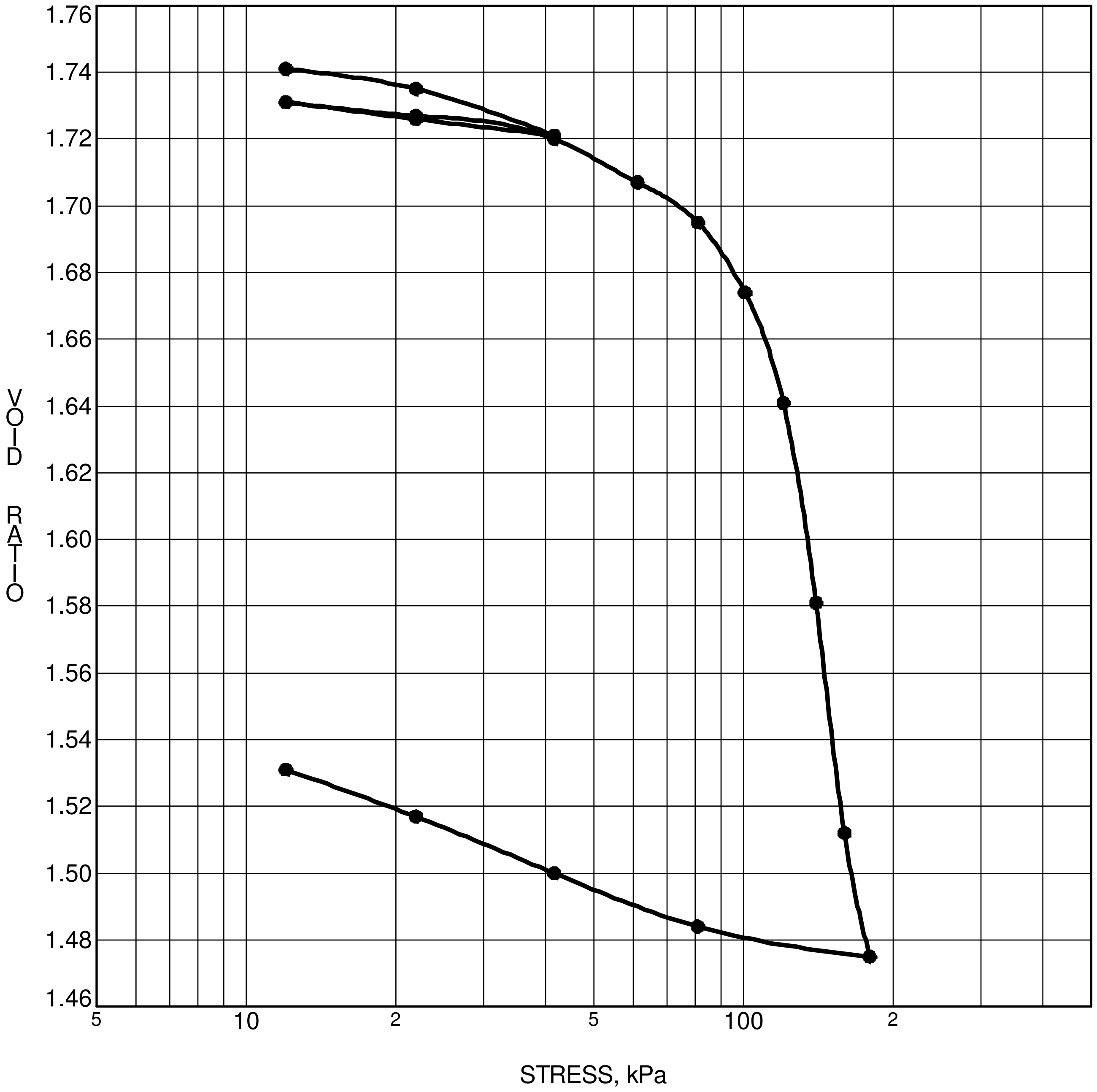
PROJECT **Geotechnical Investigation - Prop. Residential Development - 3288 Greenbank Rd.**

DATE **12/11/2012**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH11**	p'$_o$	**58** kPa	Ccr	**0.014**
Sample No.	**TW 1**	p'$_c$	**119** kPa	Cc	**1.253**
Sample Depth	**4.29** m	OC Ratio	**2.1**	Wo	**63.7** %
Sample Elev.	**88.41** m	Void Ratio	**1.753**	Unit Wt.	**16.4** kN/m^3

CLIENT **Mattamy Homes**

FILE NO. **PG2743**

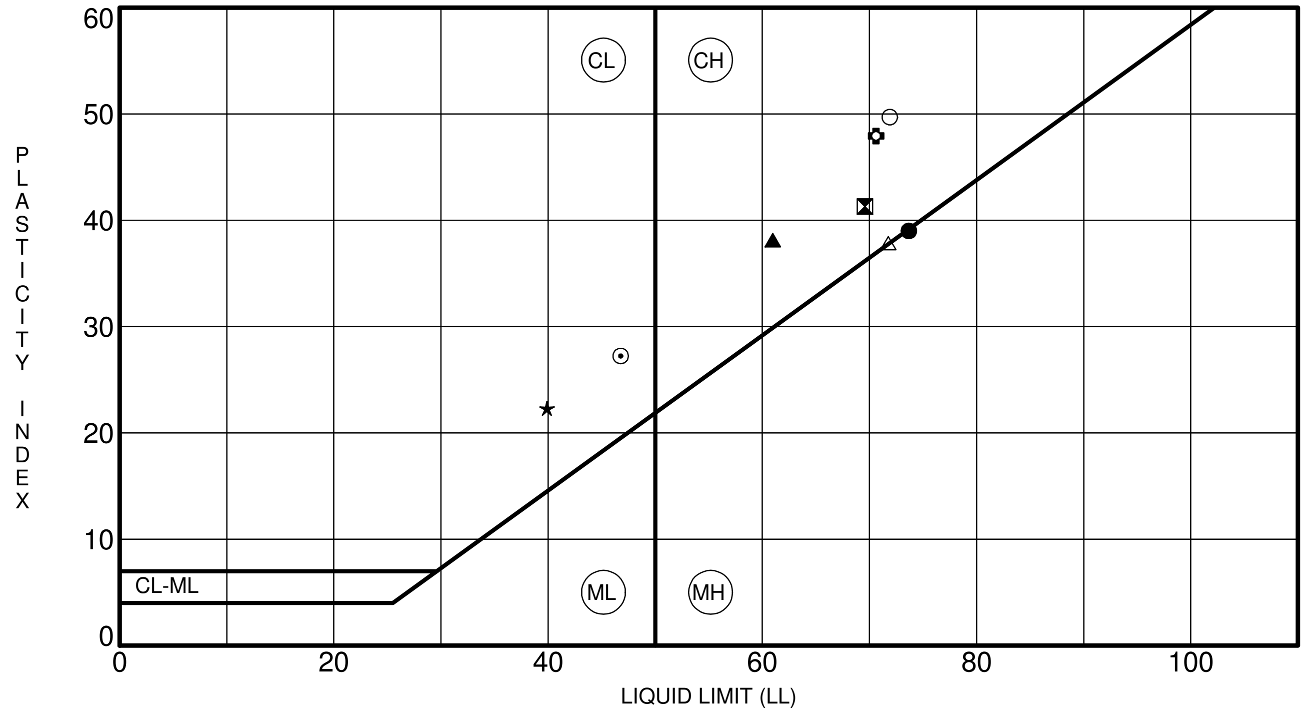
PROJECT **Geotechnical Investigation - Prop. Residential Development - 3288 Greenbank Rd.**

DATE **29/10/2012**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



Specimen Identification			LL	PL	PI	Fines	Classification
●	**TP 1**	**G 1**	**74**	**35**	**39**		**CH - Inorganic clays of high plasticity**
⧗	**TP 2**	**G 3**	**70**	**28**	**41**		**CH - Inorganic clays of high plasticity**
▲	**TP 3**	**G 3**	**61**	**23**	**38**		**CH - Inorganic clays of high plasticity**
★	**TP 4**	**G 2**	**40**	**18**	**22**		**CL - Inorganic clays of low plasticity**
⊙	**TP 5**	**G 2**	**47**	**20**	**27**		**CL - Inorganic clays of low plasticity**
✿	**TP 6**	**G 3**	**71**	**23**	**48**		**CH - Inorganic clays of high plasticity**
○	**TP 7**	**G 3**	**72**	**22**	**50**		**CH - Inorganic clays of high plasticity**
△	**TP 8**	**G 2**	**72**	**34**	**38**		**CH - Inorganic clays of high plasticity**

CLIENT **Caivan Communities**

PROJECT **Geotechnical Investigation - 2388 Greenbank Road**

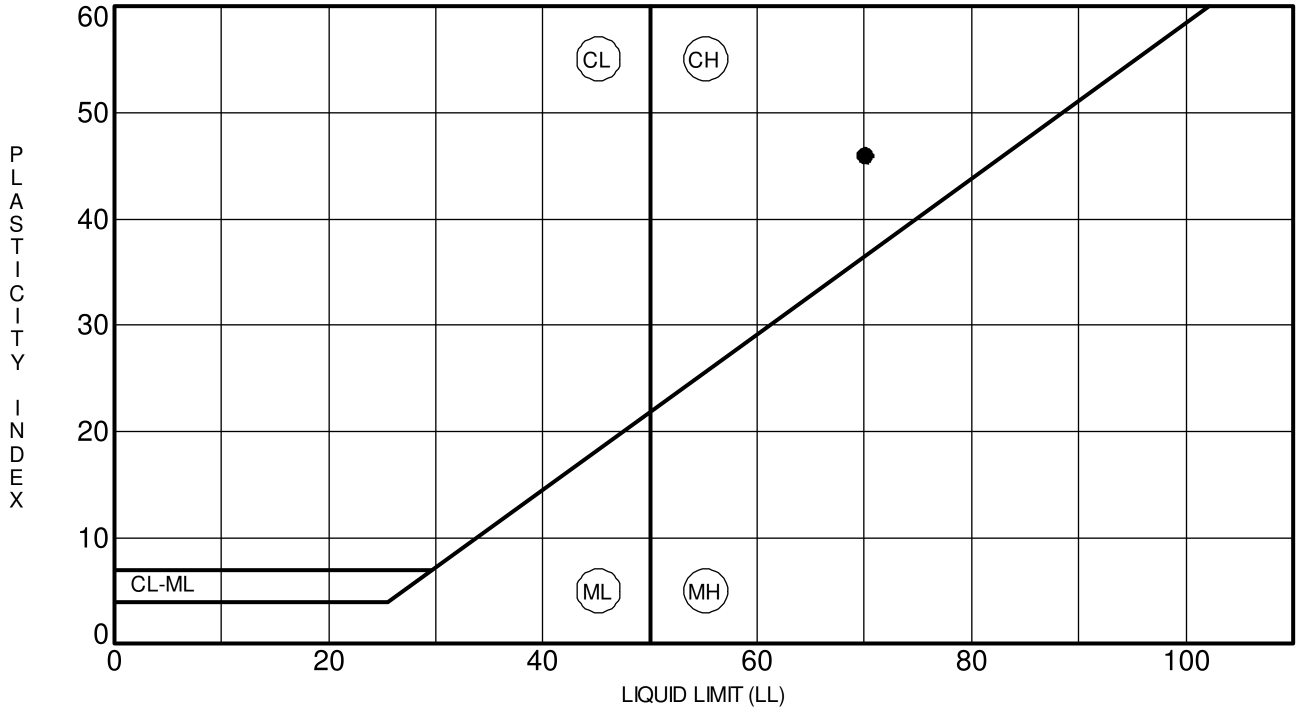
FILE NO. **PG2743**

DATE **19 Feb 19**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**BH 6**	**TW 3**	**70**	**24**	**46**		**Inorganic clay of high plasticity**

CLIENT **Mattamy Homes**

FILE NO. **PG2743**

PROJECT **Geotechnical Investigation - Prop. Residential Development - 3288 Greenbank Rd.**

DATE **17 Oct 12**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG2743-2 - PERMISSIBLE GRADE RAISE AREAS - HOUSING

DRAWING PG2743-3 - PERMISSIBLE GRADE RAISE AREAS - APARTMENT BLDG.

DRAWING PG2743-4 - TEST HOLE LOCATION PLAN

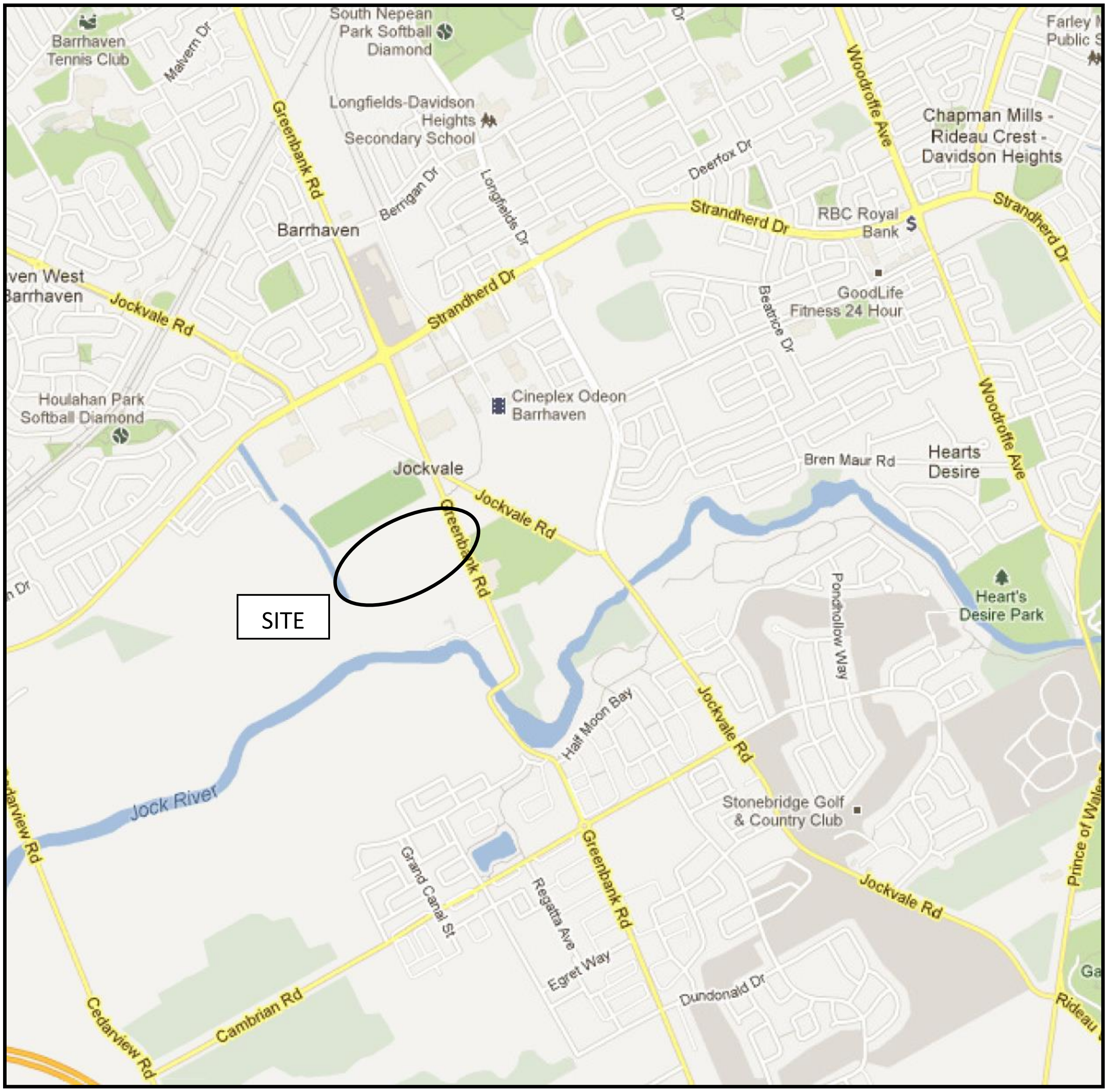
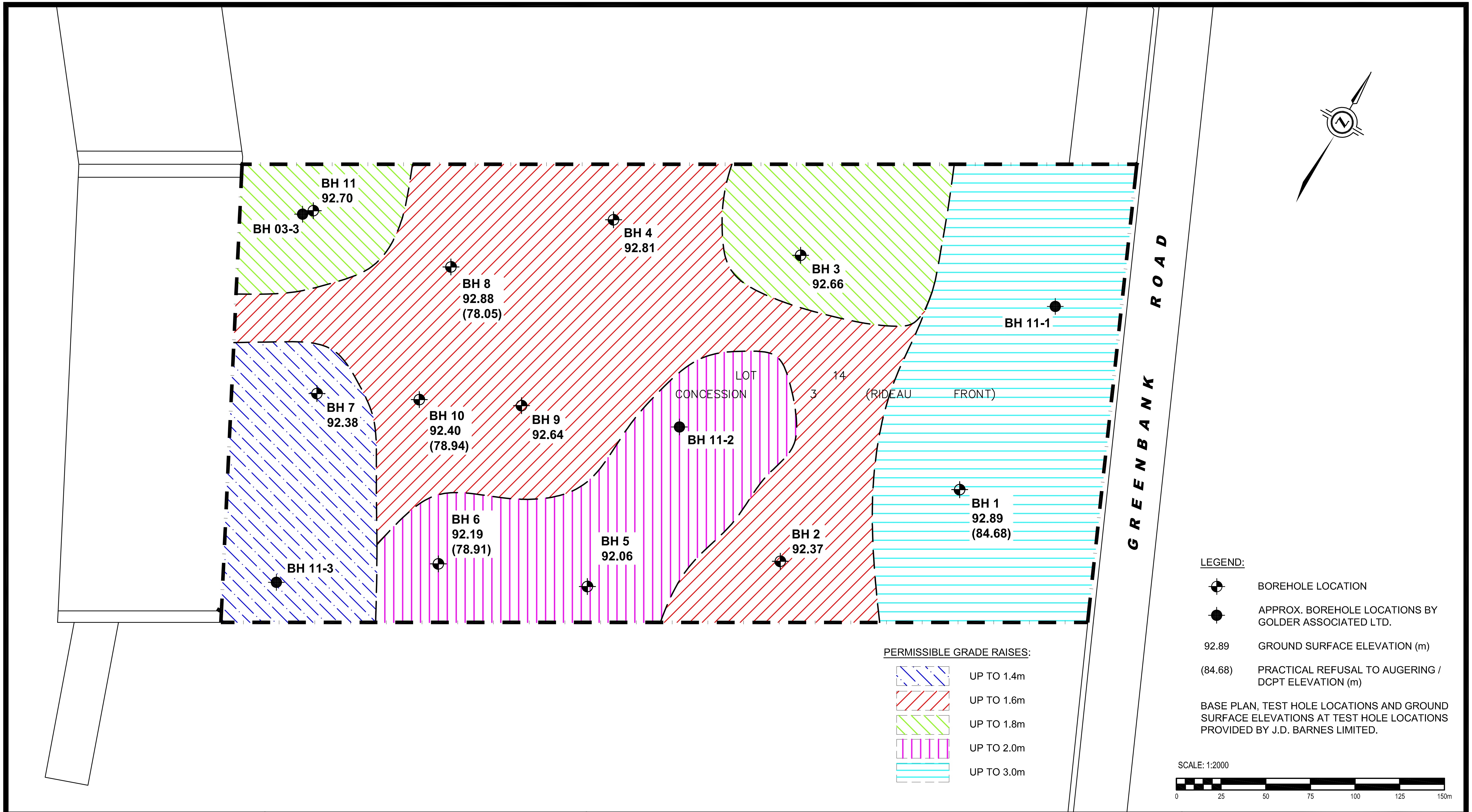


FIGURE 1

KEY PLAN



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NO.	REVISIONS	DATE	INITIAL

CAIVAN COMMUNITIES
GEOTECHNICAL INVESTIGATION
PROP. RESIDENTIAL DEVELOPMENT - 2388 GREENBANK ROAD
OTTAWA, ONTARIO

Title:
PERMISSIBLE GRADE RAISE PLAN - HOUSING

Scale: 1:2000
Date: 11/2012
Drawn by: MPG
Report No.: PG2743-1
Checked by: DJG
Approved by: DJG

PG2743-2

Revision No.:

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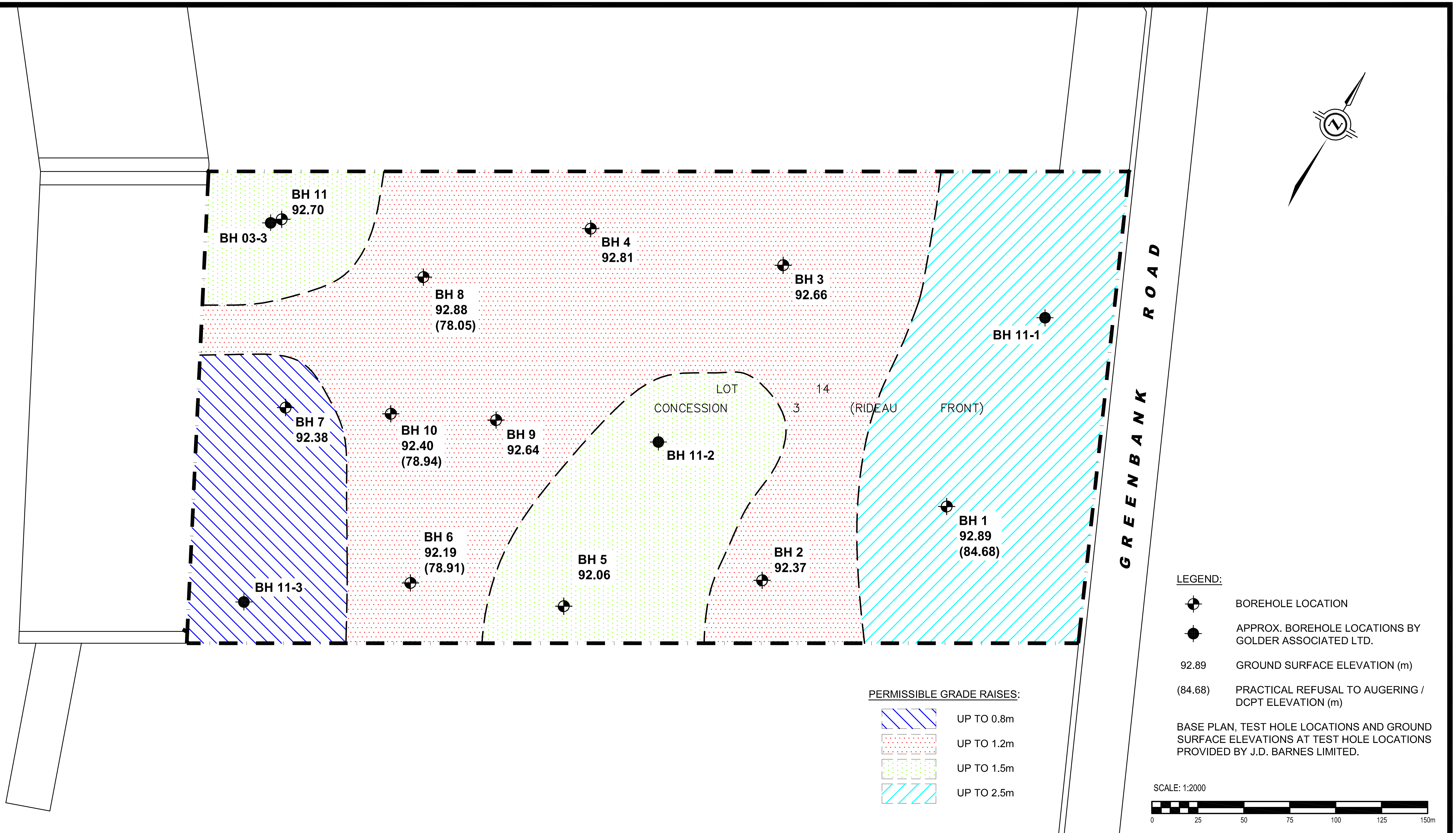

PERMISSIBLE GRADE RAISES:

▧	UP TO 0.8m
▨	UP TO 1.2m
▨	UP TO 1.5m
▨	UP TO 2.5m

LEGEND:

⊕	BOREHOLE LOCATION
●	APPROX. BOREHOLE LOCATIONS BY GOLDER ASSOCIATED LTD.
92.89	GROUND SURFACE ELEVATION (m)
(84.68)	PRACTICAL REFUSAL TO AUGERING / DCPT ELEVATION (m)

BASE PLAN, TEST HOLE LOCATIONS AND GROUND SURFACE ELEVATIONS AT TEST HOLE LOCATIONS PROVIDED BY J.D. BARNES LIMITED.

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NO.	REVISIONS	DATE	INITIAL

CAIVAN COMMUNITIES

GEOTECHNICAL INVESTIGATION
PROP. RESIDENTIAL DEVELOPMENT - 2388 GREENBANK ROAD
OTTAWA, ONTARIO

Title:
PERMISSIBLE GRADE RAISE PLAN - APARTMENT BLDG.

Scale: 1:2000	Date: 11/2012
Drawn by: MPG	Report No.: PG2743-1
Checked by: DJG	**PG2743-3**
Approved by: DJG	Revision No.:

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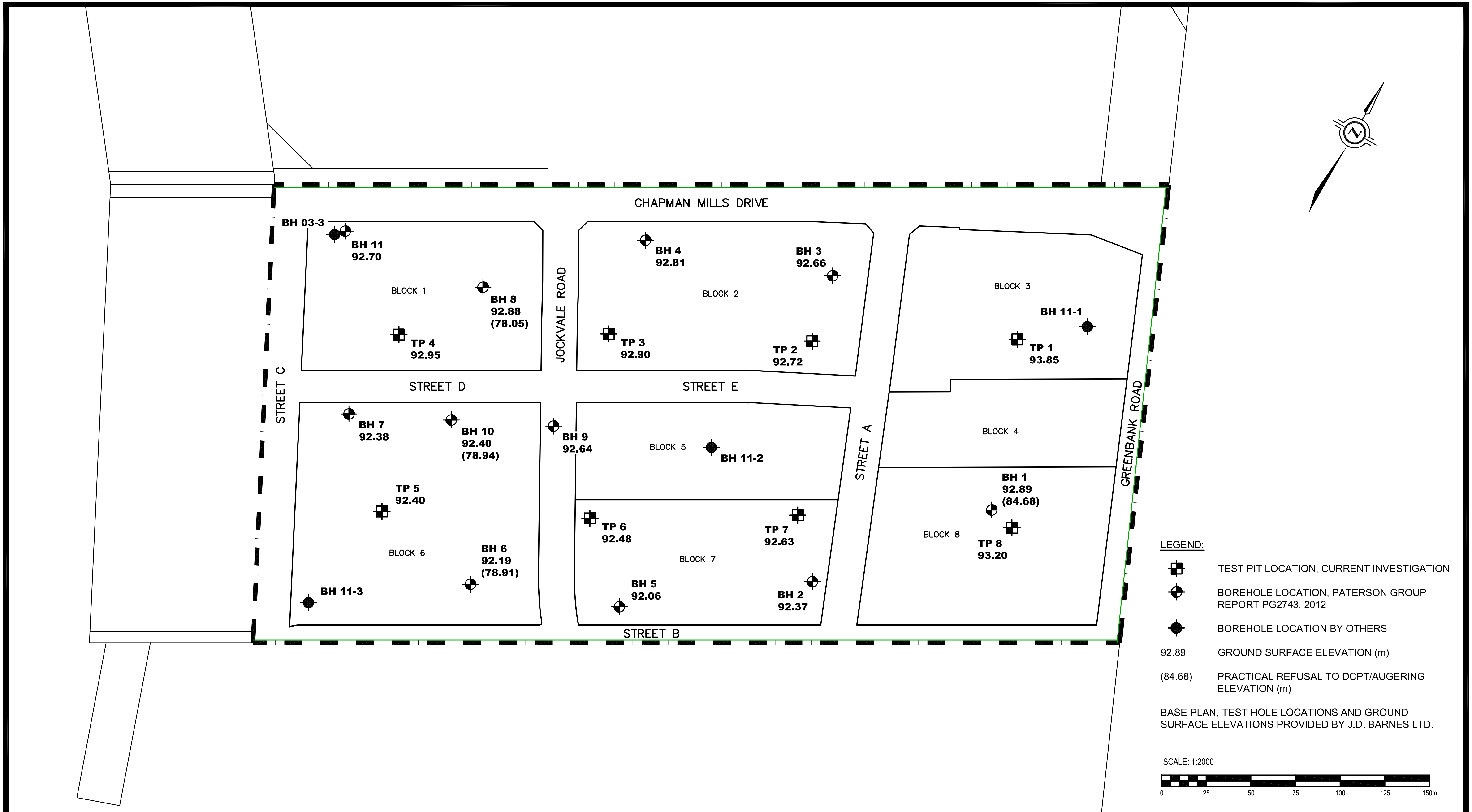

LEGEND:

▣	TEST PIT LOCATION, CURRENT INVESTIGATION
⊕	BOREHOLE LOCATION, PATERSON GROUP REPORT PG2743, 2012
●	BOREHOLE LOCATION BY OTHERS
92.89	GROUND SURFACE ELEVATION (m)
(84.68)	PRACTICAL REFUSAL TO DCPT/AUGERING ELEVATION (m)

BASE PLAN, TEST HOLE LOCATIONS AND GROUND SURFACE ELEVATIONS PROVIDED BY J.D. BARNES LTD.

SCALE: 1:2000

patersongroup
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NO.	REVISIONS	DATE	INITIAL

CAIVAN COMMUNITIES

GEOTECHNICAL INVESTIGATION
PROP. RESIDENTIAL DEVELOPMENT - 2388 GREENBANK ROAD

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:2000
Date: 03/2019
Drawn by: MPG
Report No.: PG2743
Checked by: JV
Approved by: DJG

PG2743-4

Revision No.:

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Appendix E **DRAWINGS**