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

Project #160401085

August 7, 2020

Prepared for:

Caivan Development Corporation

Prepared by:

Stantec Consulting Ltd.

Revision	Description	Author		Quality Check	Independent Review
0	Site Servicing and SWM Report	T.Rathnasooriya	Apr 30, 2020	A. Paerez	K. Smadella
1	Site Servicing and SWM Report	T.Rathnasooriya	August 4, 2020	A. Paerez	K. Smadella

This document entitled South Nepean Town Centre (SNTC) Block 4 – Site Servicing and Stormwater Management Report was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Caivan Development Corporation (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by ______________________
(signature)

Thakshika Rathnasooriya, P.Eng.

LICENSED PROFESSIONAL ENGINEER
T.K. RATHNASOORIYA
100225159
2020-08-07
PROVINCE OF ONTARIO

Reviewed by ______________________
(signature)

Ana M. Paerez, P.Eng.

Reviewed by K Smadella
(signature)

Karin Smadella, P.Eng.

Table of Contents

LIST OF TABLES

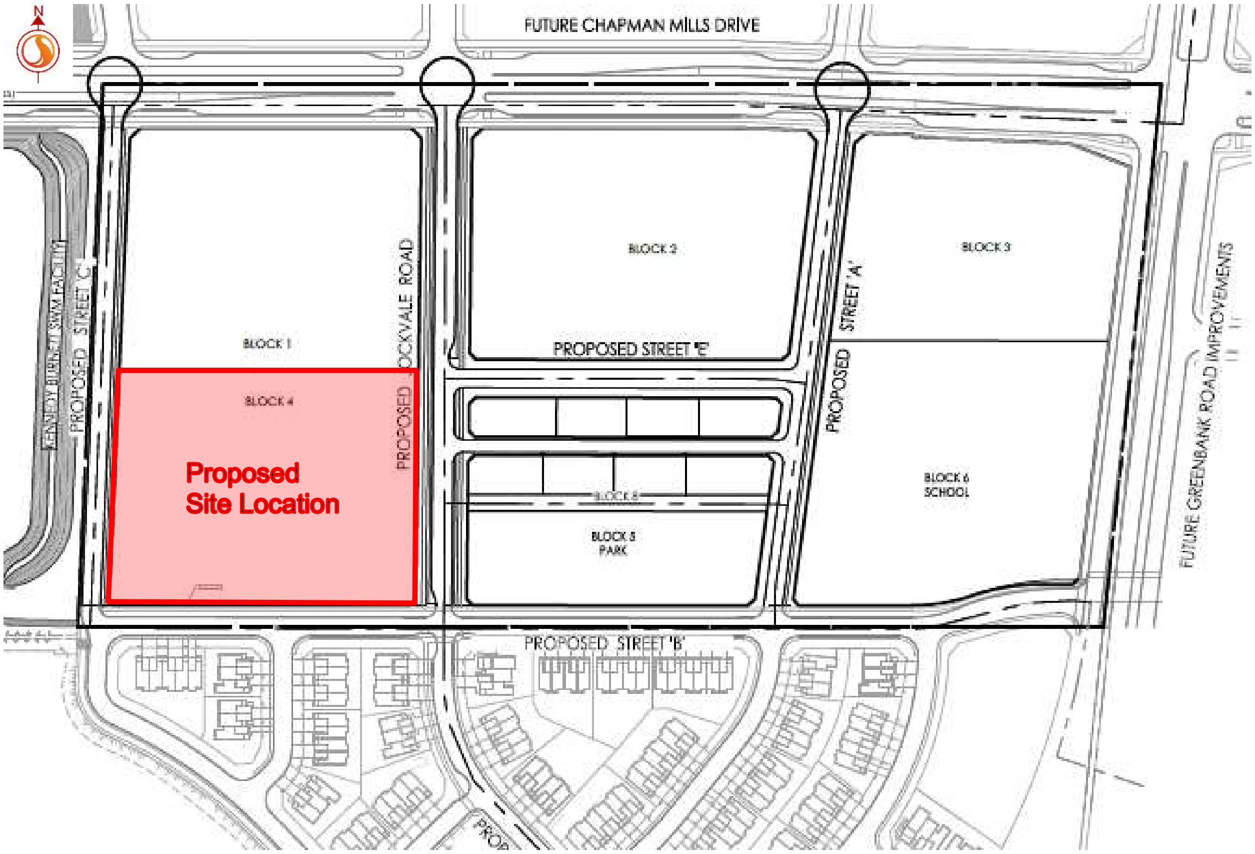
LIST OF FIGURES

LIST OF APPENDICES

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., July 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 200mm diameter watermains within Street B and Street C (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.

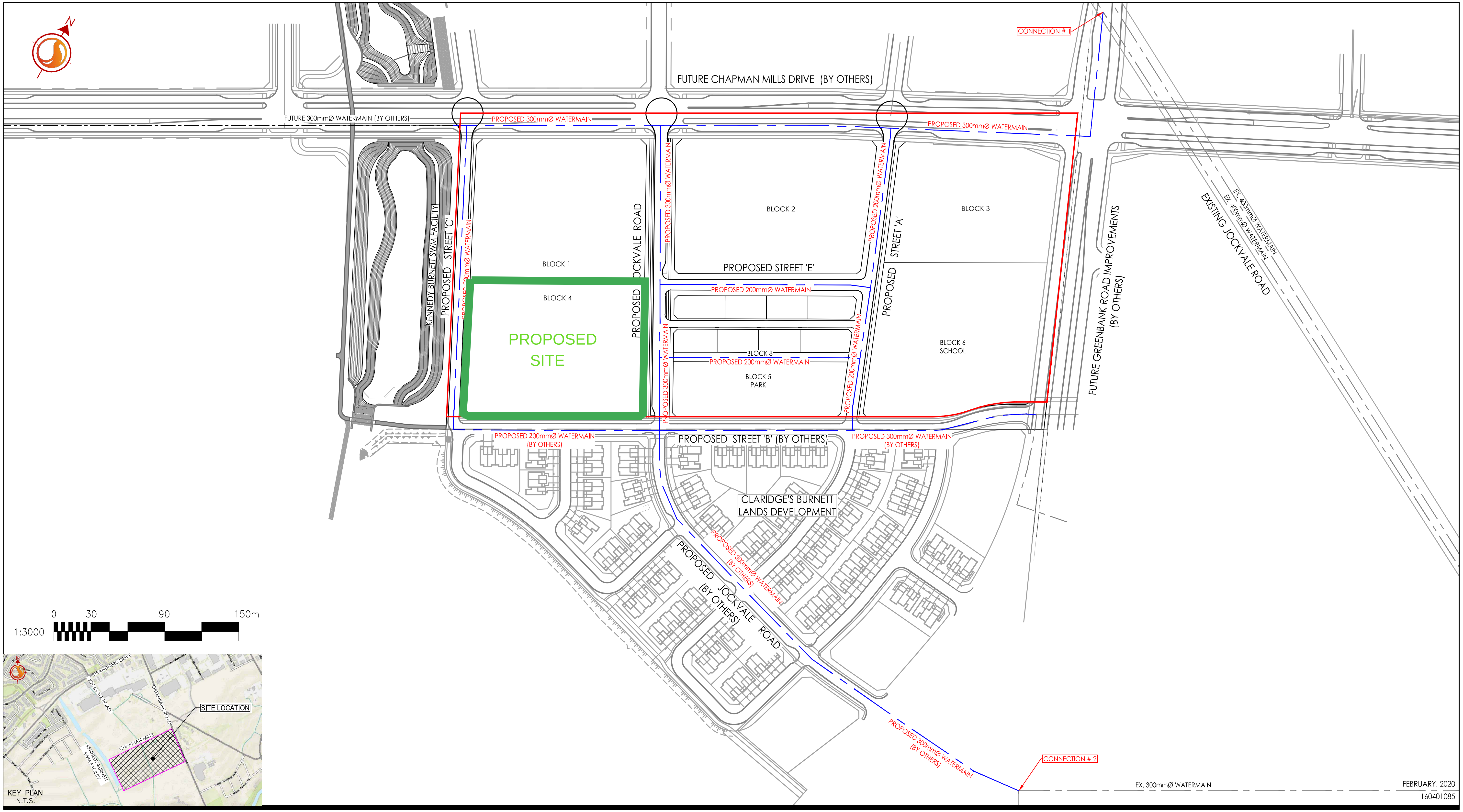
The overall development lies within the Nepean Town Centre lands (NTC). The Kennedy-Burnett Potable Water Master Servicing Study (MSS) completed by Stantec in March 2014 assessed the proposed water distribution system within the Kennedy-Burnett development and the NTC lands and provided servicing recommendations 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.

V:\01-604\active\160401085_Cavian_SNTC Lands\design\drawing\DETAILED DESIGN\Detailed Draft Plan Design\FIG 3.1.dwg
2020/02/20 9:08 AM By: Sharp, Mike



FEBRUARY, 2020
160401085

ORIGINAL SHEET - ANSI B

Stantec

Stantec Consulting Ltd.
400 - 1331 Clyde Avenue
Ottawa ON
Tel. 613.722.4420
www.stantec.com

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 Block 5 with a required fire flow of 14,000 L/min (233 L/s).

Fire separation walls are required for Blocks 10 and 11 to reduce maximum fire flows requirements in order to obtain minimum residual pressures of 20 psi.

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 5 was considered to ensure the maximum required fire flow of 14,000 L/min can be achieved.

On site fire protection will be provided by private hydrants located with a maximum of 90m spacing and within 90m of all building entrances. The internal private streets have been designed with a fire route providing access to all hydrants and residential units. The fire route is shown on the proposed site plan prepared by Korsiak.

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 3.1** and **Table 3.2**. These boundary conditions have been used to evaluate the level of service based on domestic design flows.

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. The Burnett Subdivision watermain sizing for Street B has since been updated which directly impacts the fire flow analysis for Block 4. Boundary conditions for a fire flow requirement of 233 L/s have been interpolated from the boundary conditions provided for the Burnett Subdivision scenario 2 (Appendix A.1). These have been summarized in **Table 3.3** below. Updated boundary conditions have been requested from the City to confirm the interpolated values.

Table 3.1: Hydraulic Analysis Existing Boundary Conditions (SNTC Subdivision)

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 (SNTC Subdivision)

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

Table 3.3: Maximum Day + Fire Flow Boundary Conditions (Burnett Lands Subdivision)

	Connection	Max. Day plus Fire HGL (m) 200 L/s (12,000 L/min)	Max. Day plus Fire HGL (m) 250 L/s (15,000 L/min)	Max. Day plus Fire HGL (m) 233 L/s (14,000 L/min)	Ground Elevation (m)
PRE-Configuration	Jockvale Road and Greenbank Road (Connection #1)	138.2	133.70	135.23	112.7
	Jockvale Road and Bending Way (Connection #2)	136.8	131.80	133.50	108.2
POST-Configuration	Jockvale Road and Greenbank Road (Connection #1)	146.4	146.30	146.35	112.7
	Jockvale Road and Bending Way (Connection #2)	145.4	144.90	145.07	108.2

*300mm watermain along Bending Way from Greenbank Road to Jockvale Road was included in MXDY + Fire Flow modeling analysis

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 3.4**).

Table 3.4: 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 3.1** and **Figure 3.2** 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 3.3** and **Figure 3.4** 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 233 L/s for Blocks 4 (back-to-back townhomes) on Street B and Street C (nodes 20 to 26). As boundary condition parameters for the overall SNTC Development model only assessed a maximum day plus fire flow based on a fire flow demand of 267 L/s, the Burnett Lands boundary conditions were assumed to analysis the maximum day plus fire flow scenario.

Scenario 2 was considered, for both pre and post configuration. A fire flow of 233L/s was interpolated as detailed in section 3.2.3 above.

Results of the fire flow analysis indicate that flows in excess of 15.000 L/min (250 L/s) for the existing zone condition and 18,350 L/min (306 L/s) for the post reconfiguration zone c condition can be delivered for the units that require 233 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)

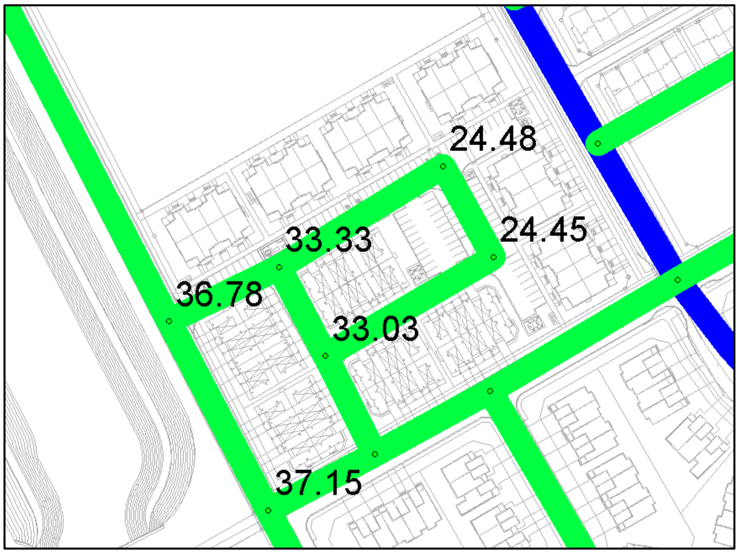
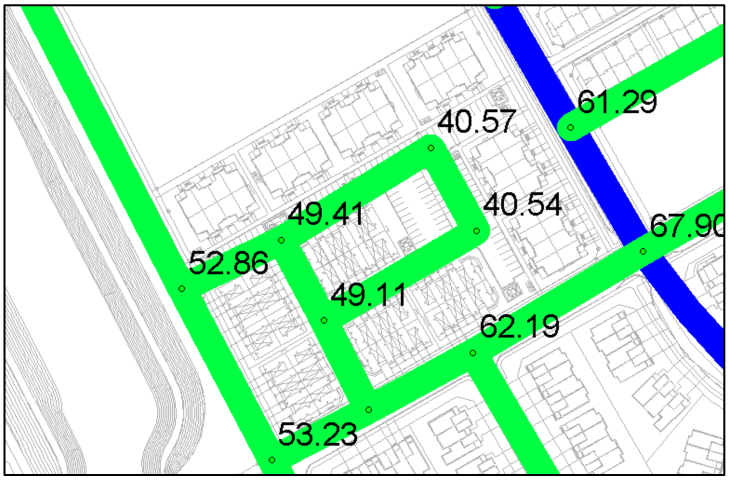


Figure 3.6: Post SUC Zone Reconfiguration - Ultimate Condition Fire Flow Results – Residual Pressure (psi)



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. Fire walls are required for Blocks 10 and 11.

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.5**. 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 215 L/s. (Stantec - SNTC)
- Major system peak overflows to be controlled to a rate of 369 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 214.6 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

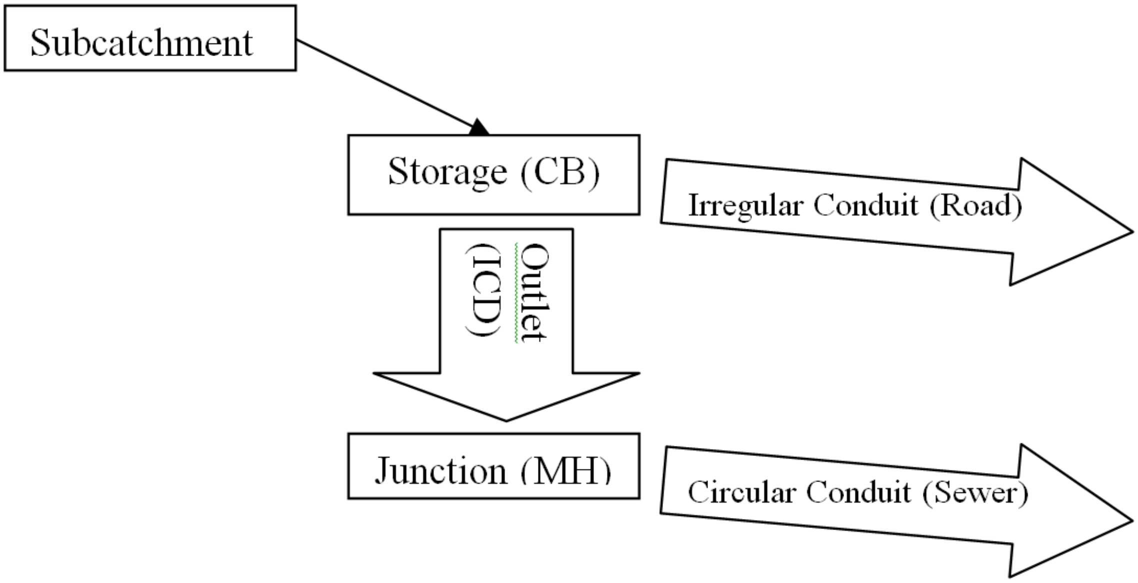
A comprehensive hydrologic modeling exercise was completed with PCSWMM, accounting for the estimated major and minor systems to evaluate the storm sewer infrastructure and major system segments. The use of PCSWMM for modeling of the site hydrology and hydraulics allowed for an analysis of the systems' 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 elevation was obtained from Stantec's SNTC PCSWMM model (July 2020) from the stubbed outlet for Block 4 (Node 221) as 91.10 m 2-year storm.

As requested by City of Ottawa staff, the following scenarios have been used for the subject site to demonstrate compliance with City Guidelines:

- 5-year runoff with 100-year Jock River spring freshet boundary condition (91.90 m). Increased release rates to the minor system from Block 4 were required in order to minimize ponding during the 2-year event as the imperviousness assumed for Block 4 in the subdivision design is lower than that of the proposed Block 4 site plan. The revised Block 4 discharge rates were modeled in the overall SNTC subdivision for the worst case 100-year event. As the 5-year runoff with 100-year boundary condition provides the worse HGL results, the new boundary condition (from PCSWMM storage node ID-DICB221) generated from the revised subdivision model, was then used to model the Block 4 site plan.
- 100-year runoff with 5-year Jock River spring freshet boundary condition (91.36 m)

A stress test scenario using the 100-year rainfall intensities with 20% increase and the 5-year Jock River boundary condition should be assessed to ensure the maximum surface water level is below the proposed building openings. If the 5-year rainfall event with the 100-year boundary condition results in the governing hydraulic grade line (HGL), an additional climate change scenario based on the 5-year rainfall intensities with 20% increase should be assessed with the

100-year Jock River boundary condition to ensure the HGL does not touch the proposed under side of footings (USFs).

- 5-year +20% runoff with 100-year Jock River spring freshet boundary condition (91.92 m)
- 100-year + 20% runoff with 5-year Jock River spring freshet boundary condition (91.38 m)

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-2	0.03	200	3.0	42.86	0.50
UNC-3	0.12	305	3.0	42.86	0.50
UNC-4	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	93.69	94.04	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	83mm Orifice
L102D-IC	CB102D	L102D	STM-102	102mm Orifice
L105A-IC	CB105A	L105A	STM-105	83mm 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.

To allow for minimal ponding during the 2-year storm event, ICD sizes were maximized resulting in higher release rates during the worst case 100-year condition (100 year runoff using 5 year boundary conditions).

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 Runoff-5-yr BC Head (m)	2yr Flow (L/s)	100yr Runoff 5-yr BC Flow (L/s)
L101A-IC	CB101A	L101A	178mm Orifice	1.35	1.58	70.91	76.90
L102A-IC	CB102A	L102A	108mm Orifice	1.41	1.54	27.07	28.27
L102B-IC	CB102B	L102B	178mm Orifice	1.52	1.77	75.49	81.84
L102C-IC	CB102C	L102C	83mm Orifice	1.41	1.57	16.06	16.96
L102D-IC	CB102D	L102D	102mm Orifice	1.32	1.56	23.34	25.44
L105A-IC	CB105A	L105A	83mm Orifice	1.41	1.44	16.02	16.20

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 worst-case HGL using the 3 hour Chicago storm for the 5-year runoff with the 100-year Jock River water level as boundary condition and the 100-year runoff with the 5-year Jock River water level as boundary condition. The 5-year runoff with 100year boundary conditions is based on the SNTC subdivision model adjusted values to account for a worst case minor system peak outflow of 245 L/s as detailed in section 5.5.4 below.

The climate change scenario was assessed using the 5-year runoff intensities (worst-case HGL) increased by 20% with the 100-year Jock River water level as a boundary condition. 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 (July 2020), excerpts of the stormwater management section can be found in **Appendix C.5**. **Table 5.6** below presents the clearance between the proposed storm sewers worst cade 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	USF (m)	Worst-Case 100-Year HGL				5-year+20%, 3hr Chicago Storm	
		100-year Runoff HGL (m)	5-year Runoff HGL (m)	Worst-Case HGL (m)	Prop. Grade/USF-HGL Clearance (m)	Climate Change HGL (m)	Prop. Grade/USF -HGL Clearance (m)
101	92.27	91.41	91.95	91.95	0.32	91.97	0.30
102	92.43	91.73	92.09	92.09	0.34	92.12	0.31
103	92.85	91.48	91.98	91.98	0.87	92.00	0.85
104	92.43	91.40	91.99	91.99	0.44	92.02	0.41
105	92.85	91.63	91.99	91.99	0.86	92.01	0.84
218 (Street C)	92.24	91.33	91.85	91.85	0.39	91.89	0.35
EX 100 (Street B)	92.85	91.36	91.87	91.87	0.98	91.91	0.94

The model results indicate that there is sufficient clearance between the worst-case HGL and the proposed USFs within Block 4. 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 worst case 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 event, with minimal ponding in subcatchment areas L102A and L102C.

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	CB101A	93.50	93.47	0.00	93.70	0.20	93.74	0.24
L102A-S	CB102A	93.67	93.70	0.03	93.83	0.16	93.84	0.17
L102B-S	CB102B	93.52	93.46	0.00	93.71	0.19	93.75	0.23
L102C-S	CB102C	93.90	93.93	0.03	94.09	0.19	94.11	0.21
L102D-S	CB102D	93.64	93.58	0.00	93.82	0.18	93.85	0.21
L105A-S	CB105A	93.46	93.46	0.00	93.52	0.06	93.52	0.06

5.5.4 Minor and Major System Peak Outflows and Deviations

Maximizing ICD sizes to allow for minimal ponding in the 2-year storm event resulted in greater minor system release rates during the 100-year storm event than targeted in the SNTC – Site Servicing and Stormwater Management Report (Stantec July 2020). The assumed imperviousness for Block 4 in the subdivision design was 71%, while the current site plan indicated 88%. As the SNTC subdivision plan at this time is under detail design approval, minor system alterations to Block 4's outflow rate will need to be reflected in the subdivision SWM model prior to final submission.

An analysis was completed on the overall SNTC subdivision model applying updated minor system discharge rates provided in **Table 5.8**. The PCSWMM modeling results and HGL comparison table can be found in **Appendix C.4**. Based on the overall model, the slight increase in minor system peak flows from Block 4 is negligible and will not have a significant impact on the downstream system as Block 4 is within close proximity to the outlet channel for the Kennedy-

Burnett SWMF. A 0.29m clearance to USF during the 5-year runoff with 100-year boundary conditions can be provided across the subdivision with the increased peak flow from Block 4.

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 worst case 100-year minor system peak outflow from the proposed site is equal to 245.5 L/s, 30 L/s greater than the 215.2 L/s minor system target for Block 4. The increase had minimal effect on the downstream water levels.

Table 5.8: Minor System Runoffs Results

Storm Event	Required Minor System Release Rate	Boundary Condition (DICB221)	Minor System Release Rate Target
2-year Chicago Storm	228.1	91.10	190.0
5-year runoff with 100-year Boundary Conditions Chicago Storm	237.3	91.90	214.5
100-year runoff with 5-year Boundary Conditions Chicago Storm	245.5	91.36	215.2
5-year+20%, 3hr Chicago Storm	238.8	91.92	219.5
100-year+20%, 3hr Chicago Storm	252.73	91.38	215.7

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 not been considered in the overall SWM plan for Block 4. The uncontrolled areas within Block 4 have been included as part of the SNTC subdivision plan and sheet drain to the adjacent streets (subcatchments L102A, L102C, L208A, L209A, L218A, L218B and L219C). The overall uncontrolled discharge rate for the proposed site is 149.6 L/s. Major system outflows from the proposed site onto Street C and Street B equal to 0 L/s and 37.9 L/s respectively, well below the 369 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. Fire separation walls are required to reduce maximum fire flows for Blocks 10 and 11.

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 outflow is greater than the proposed target by 30 L/s. The increased discharge rate has been modeled through PCSWMM and generates minimal impact to the downstream storm sewers.
- 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.

Appendix A Potable Water analysis

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.

Boundary Conditions 3370 Greenbank Road (Burnett Lands)

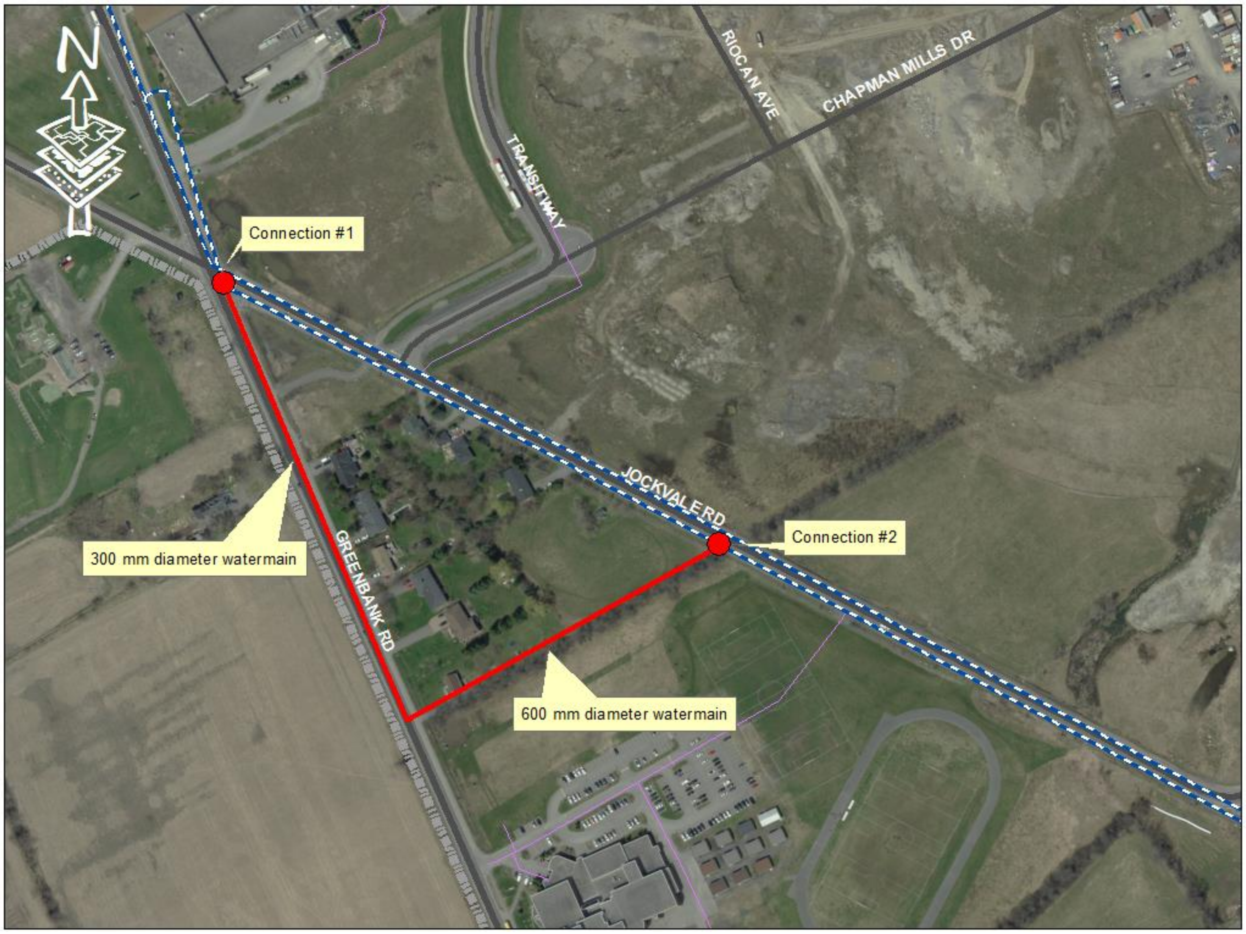
Information Provided

Date provided: 27 December 2017

Scenario	Demand	
	L/min	L/s
Average Daily Demand	348.6	5.81
Maximum Daily Demand	871.2	14.52
Peak Hour	1917	32.0
Fire Flow Demand # 1	12000	200.0
Fire Flow Demand # 2	15000	250.0
Fire Flow Demand # 3	18000	300.0

# of connections	2

Connection Location Scenario 1



Connection Location Scenario 2

Results

SCENARIO 1

PRE-configured Zone

Connection 1 - Greenbank Road and Jockvale Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	157.2	97.2
Peak Hour	141.2	62.6
Max Day plus Fire (12,000 l/min)	138.2	58.4
Max Day plus Fire (15,000 l/min)	133.7	52.0
Max Day plus Fire (18,000 l/min)	129.3	45.6

[1] Ground Elevation = 112.7 m

Connection 2 - Jockvale Road and Private Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	153.0	95.0
Peak Hour	140.9	60.2
Max Day plus Fire (12,000 l/min)	137.1	54.8
Max Day plus Fire (15,000 l/min)	132.2	47.8
Max Day plus Fire (18,000 l/min)	127.3	40.8

[1] Ground Elevation = 108.2 m

SCENARIO 2

PRE-configured Zone

Connection 1 - Greenbank Road and Jockvale Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	157.2	97.2
Peak Hour	141.2	62.6
Max Day plus Fire (12,000 l/min)	138.2	58.4
Max Day plus Fire (15,000 l/min)	133.7	52.0
Max Day plus Fire (18,000 l/min)	129.2	45.6

[1] Ground Elevation = 112.7 m

Connection 2 - Jockvale Road and Bren-Maur Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	157.2	104.1
Peak Hour	140.5	69.0
Max Day plus Fire (12,000 l/min)	136.8	63.7
Max Day plus Fire (15,000 l/min)	131.8	56.7
Max Day plus Fire (18,000 l/min)	126.9	49.7

[1] Ground Elevation = 108.2 m

SCENARIO 1

POST-configured Zone

Connection 1 - Greenbank Road and Jockvale Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.7	72.1
Peak Hour	146.3	70.0
Max Day plus Fire (12,000 l/min)	146.4	70.2
Max Day plus Fire (15,000 l/min)	146.2	69.9
Max Day plus Fire (18,000 l/min)	145.9	69.5

[1] Ground Elevation = 112.7 m

Connection 2 - Jockvale Road and Private Road

Demand Scenario	Head (m)	Pressure¹ (psi)
Maximum HGL	147.7	70.0
Peak Hour	146.0	67.5
Max Day plus Fire (12,000 l/min)	145.2	66.5
Max Day plus Fire (15,000 l/min)	144.6	65.5
Max Day plus Fire (18,000 l/min)	143.8	64.5

[1] Ground Elevation = 108.2 m

SCENARIO 2

POST-configured Zone

Connection 1 - Greenbank Road and Jockvale Road

Demand Scenario	Head (m)	Pressure¹ (psi)
Maximum HGL	147.7	72.1
Peak Hour	146.3	70.0
Max Day plus Fire (12,000 l/min)	146.4	70.2
Max Day plus Fire (15,000 l/min)	146.3	69.9
Max Day plus Fire (18,000 l/min)	145.9	69.5

[1] Ground Elevation = 112.7 m

Connection 2 - Jockvale Road and Bren-Maur Road

Demand Scenario	Head (m)	Pressure¹ (psi)
Maximum HGL	147.7	79.2
Peak Hour	145.7	76.2
Max Day plus Fire (12,000 l/min)	145.4	75.9
Max Day plus Fire (15,000 l/min)	144.9	75.1
Max Day plus Fire (18,000 l/min)	144.3	74.2

[1] Ground Elevation = 108.2 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.

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: 7/30/2020
Fire Flow Calculation #: 2
Description: Residential Back to Back Townhome Units (Block 5)

Notes: Worst case townhome units

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

Stantec

FUS Fire Flow Calculation Sheet

Stantec Project #: 160401085
Project Name: Nepean Town Centre Development Corporation - SNTC Lands Block 4
Date: 7/30/2020
Fire Flow Calculation #: 5
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>6</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>11000</td></tr>
<tr><td>5</td><td>Determine Occupancy Charge</td><td colspan="6">Limited Combustible</td><td>-15%</td><td>9350</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">2151</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>Ordinary or Fire Resistive (Blank Wall)</td><td>0%</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>12000</td></tr>
<tr><td colspan="7">Total Required Fire Flow in L/s</td><td>200.0</td></tr>
<tr><td colspan="7">Required Duration of Fire Flow (hrs)</td><td>2.50</td></tr>
<tr><td colspan="7">Required Volume of Fire Flow (m^3)</td><td>1800</td></tr>
</table>

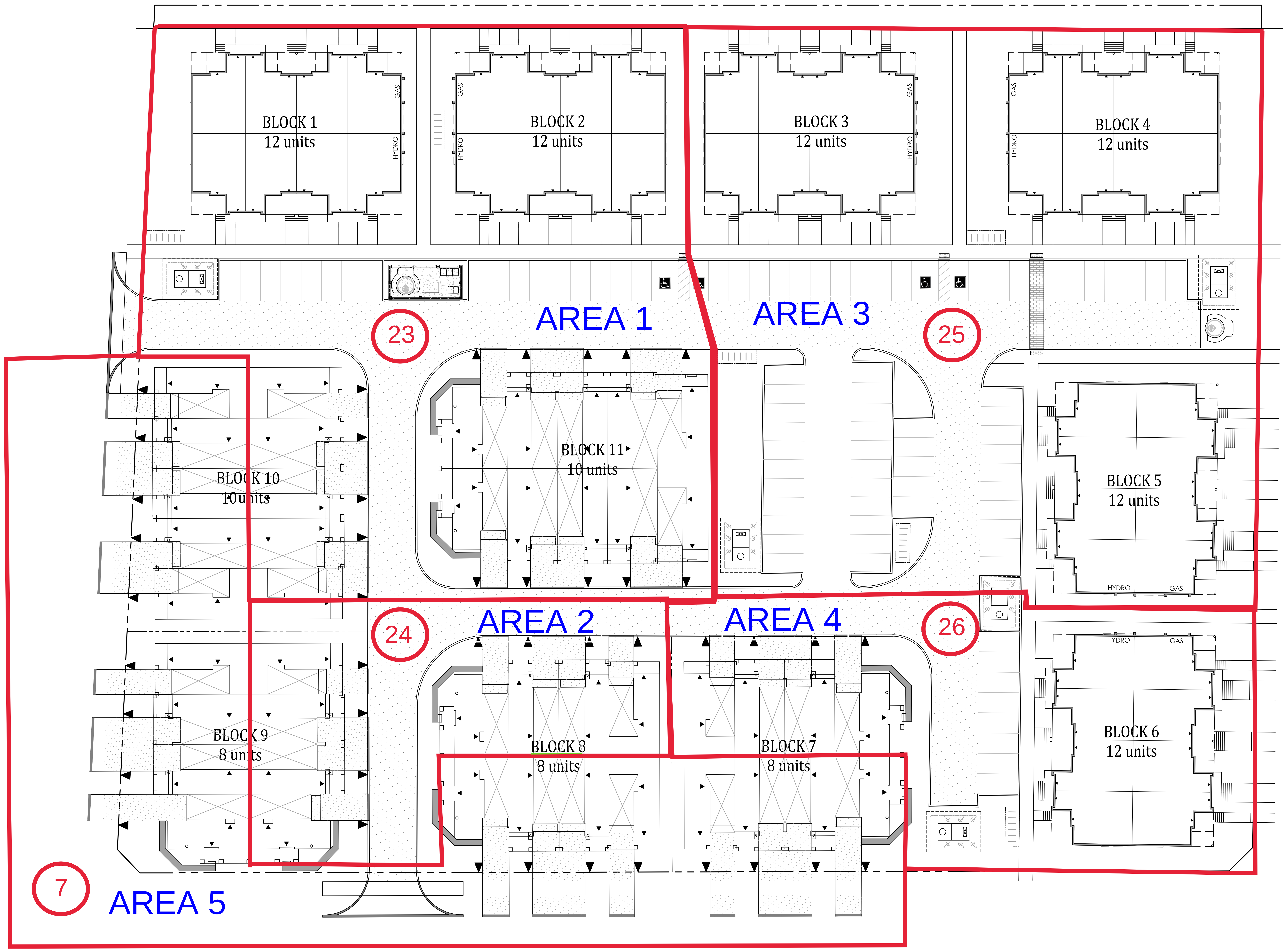
FUS Fire Flow Calculation Sheet

Stantec Project #: 160401085
Project Name: Nepean Town Centre Development Corporation - SNTC Lands Block 4
Date: 7/30/2020
Fire Flow Calculation #: 1
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>6</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>11000</td></tr>
<tr><td>5</td><td>Determine Occupancy Charge</td><td colspan="6">Limited Combustible</td><td>-15%</td><td>9350</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">2805</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>Ordinary or Fire Resistive (Blank Wall)</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>12000</td></tr>
<tr><td colspan="7">Total Required Fire Flow in L/s</td><td>200.0</td></tr>
<tr><td colspan="7">Required Duration of Fire Flow (hrs)</td><td>2.50</td></tr>
<tr><td colspan="7">Required Volume of Fire Flow (m^3)</td><td>1800</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	43.3	204	110	0.16	0.00
50	20	7	76.8	204	110	0.73	0.02
54	25	23	72.2	204	110	-0.32	0.01
56	23	20	40.0	204	110	-1.02	0.03
58	25	26	32.2	204	110	-0.07	0.00
60	26	24	72.2	204	110	-0.25	0.01
62	23	24	32.2	204	110	0.28	0.01
64	24	21	47.6	204	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	139.65	65.59	452.23
20	0.00	93.48	139.65	65.63	452.51
21	0.00	93.50	139.65	65.61	452.37
23	2.35	93.73	139.65	65.27	450.02
24	0.48	93.95	139.65	64.96	447.89
25	2.17	93.94	139.64	64.97	447.96
26	0.96	93.97	139.64	64.93	447.68

Pipe Results

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)		(L/s)	(m/s)
20	7	21	43.26	204	110	-0.32	0.01
50	20	7	76.79	204	110	-1.30	0.04
54	25	23	72.20	204	110	-1.52	0.05
56	23	20	40.00	204	110	-2.88	0.09
58	25	26	32.20	204	110	-0.65	0.02
60	26	24	72.20	204	110	-1.61	0.05
62	23	24	32.20	204	110	-0.99	0.03
64	24	21	47.60	204	110	-3.08	0.09

Hydraulic Model Results -Fire Flow Analysis 233L/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	57.69	397.76	134.09	233	37.15	256.14	327.08	20	137.90
20	0.00	57.74	398.11	134.10	233	36.78	253.59	323.2	20	137.90
23	1.07	57.38	395.62	134.09	233	33.33	229.80	298.78	20	137.90
24	0.22	57.06	393.42	134.09	233	33.03	227.74	296.59	20	137.90
25	0.98	57.08	393.56	134.09	233	24.48	168.78	251.19	20	137.90
26	0.44	57.03	393.21	134.09	233	24.45	168.58	250.54	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	76.29	526.00

Pipe Results

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)		(L/s)	(m/s)
20	7	21	43.26	204	110	0.26	0.01
50	20	7	76.79	204	110	1.25	0.04
54	25	23	72.20	204	110	-0.46	0.01
56	23	20	40.00	204	110	-1.57	0.05
58	25	26	32.20	204	110	0.07	0.00
60	26	24	72.20	204	110	-0.11	0.00
62	23	24	32.20	204	110	0.68	0.02
64	24	21	47.60	204	110	0.48	0.01

Hydraulic Model Results -Peak Hour Analysis

Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(Kpa)
7	1.02	93.51	144.45	72.42	499.32
20	0.00	93.48	144.45	72.46	499.60
21	0.00	93.50	144.45	72.43	499.39
23	2.35	93.73	144.45	72.10	497.12
24	0.48	93.95	144.45	71.79	494.98
25	2.17	93.94	144.45	71.80	495.05
26	0.96	93.97	144.45	71.76	494.77

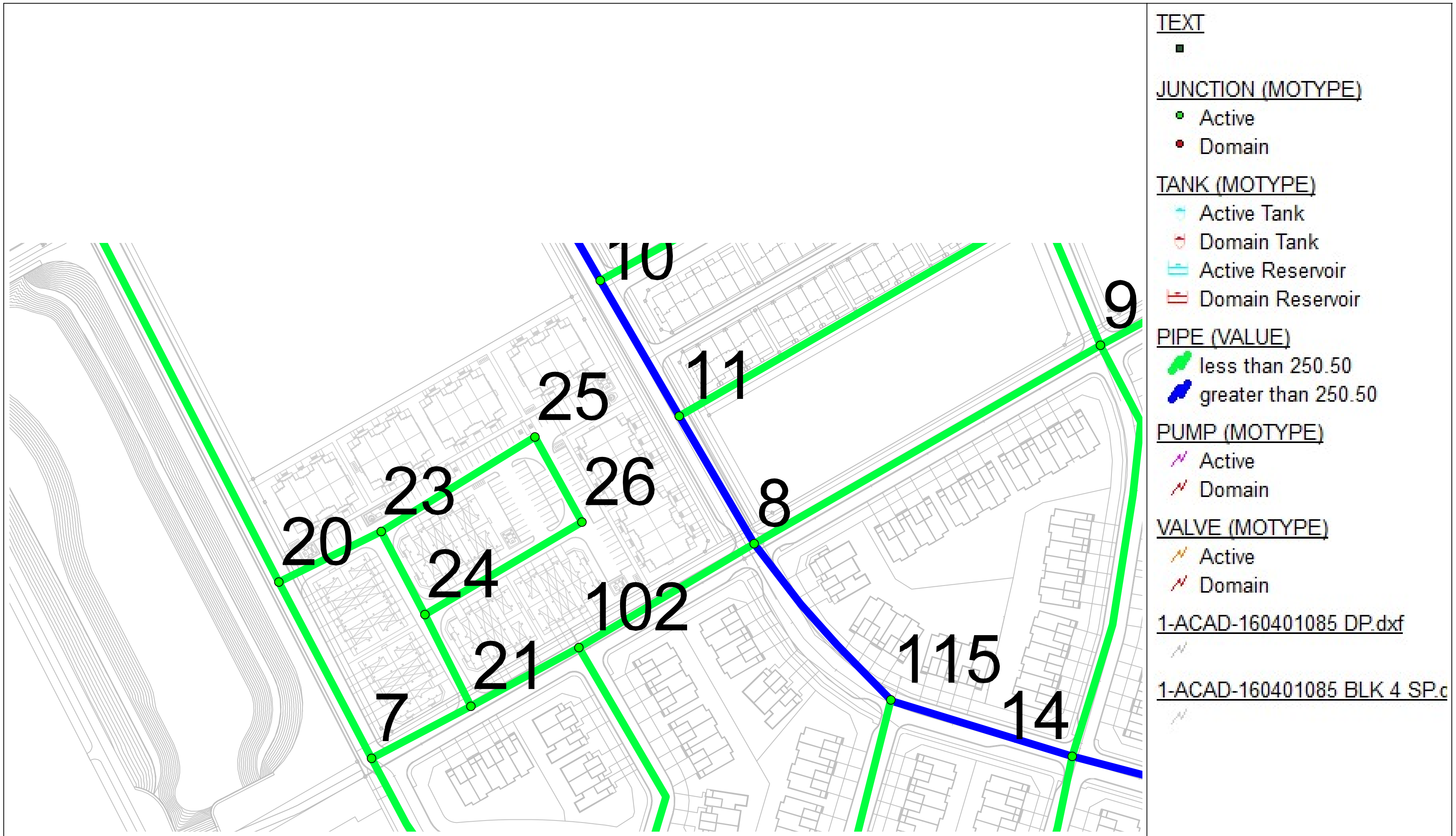
Pipe Results

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)		(L/s)	(m/s)
20	7	21	43.26	204	110	0.39	0.01
50	20	7	76.79	204	110	0.07	0.00
54	25	23	72.20	204	110	-1.55	0.05
56	23	20	40.00	204	110	-3.18	0.10
58	25	26	32.20	204	110	-0.62	0.02
60	26	24	72.20	204	110	-1.58	0.05
62	23	24	32.20	204	110	-0.72	0.02
64	24	21	47.60	204	110	-2.78	0.08

Hydraulic Model Results -Fire Flow Analysis 233 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	73.82	141.33	145.44	233	53.23	367.01	398.09	20	137.90
20	0.00	73.87	141.39	145.44	233	52.86	364.46	393.39	20	137.90
23	1.07	73.51	141.36	145.44	233	49.41	340.67	363.97	20	137.90
24	0.22	73.19	141.35	145.44	233	49.11	338.60	361.99	20	137.90
25	0.98	73.21	141.35	145.44	233	40.57	279.72	306.21	20	137.90
26	0.44	73.16	141.35	145.44	233	40.54	279.52	305.58	20	137.90

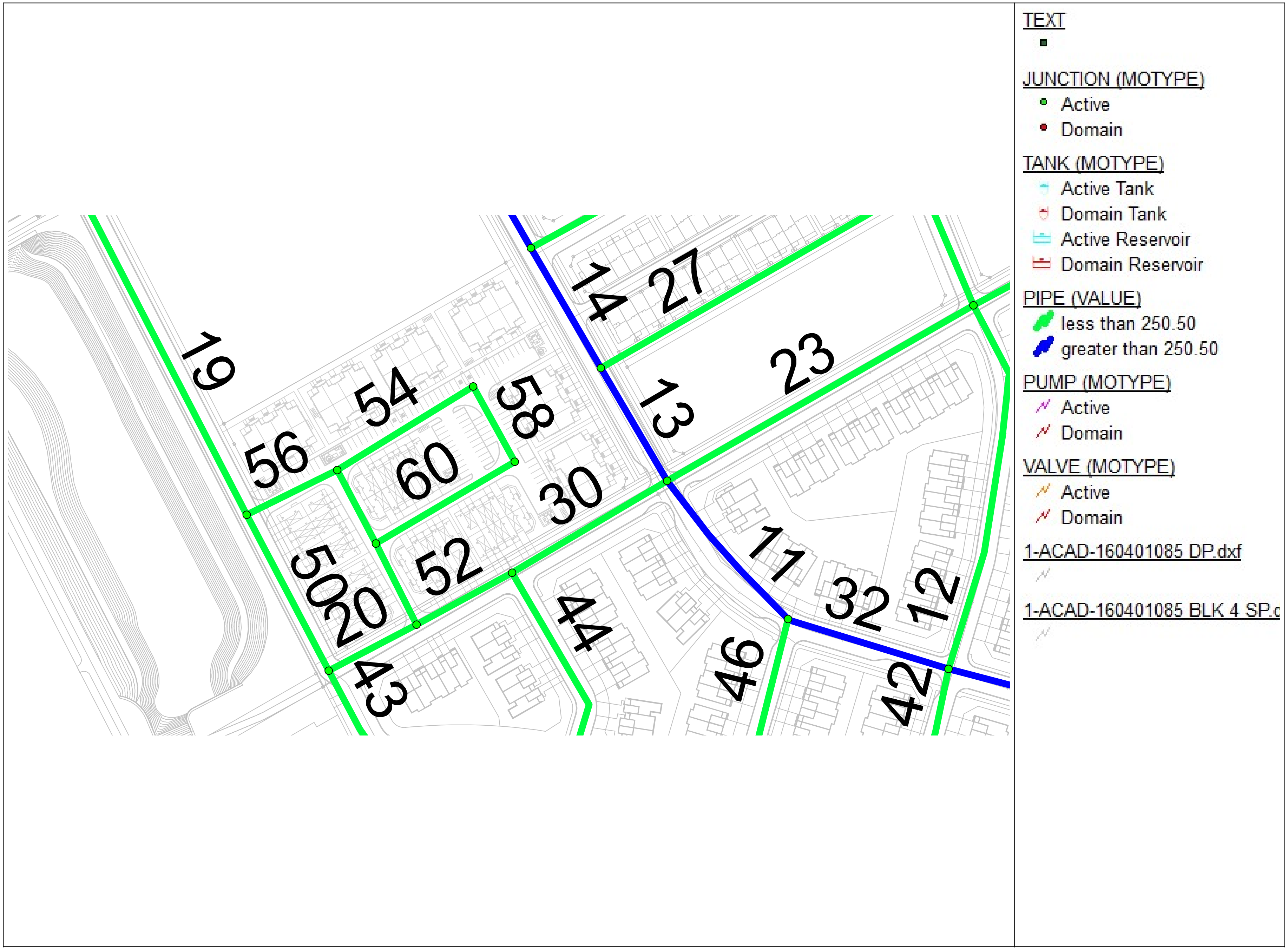
160401085_SNTC_Block4-2020-07-30- JUNCTION ID



Prepared By:

Date: 8/5/2020 7:02:27 AM

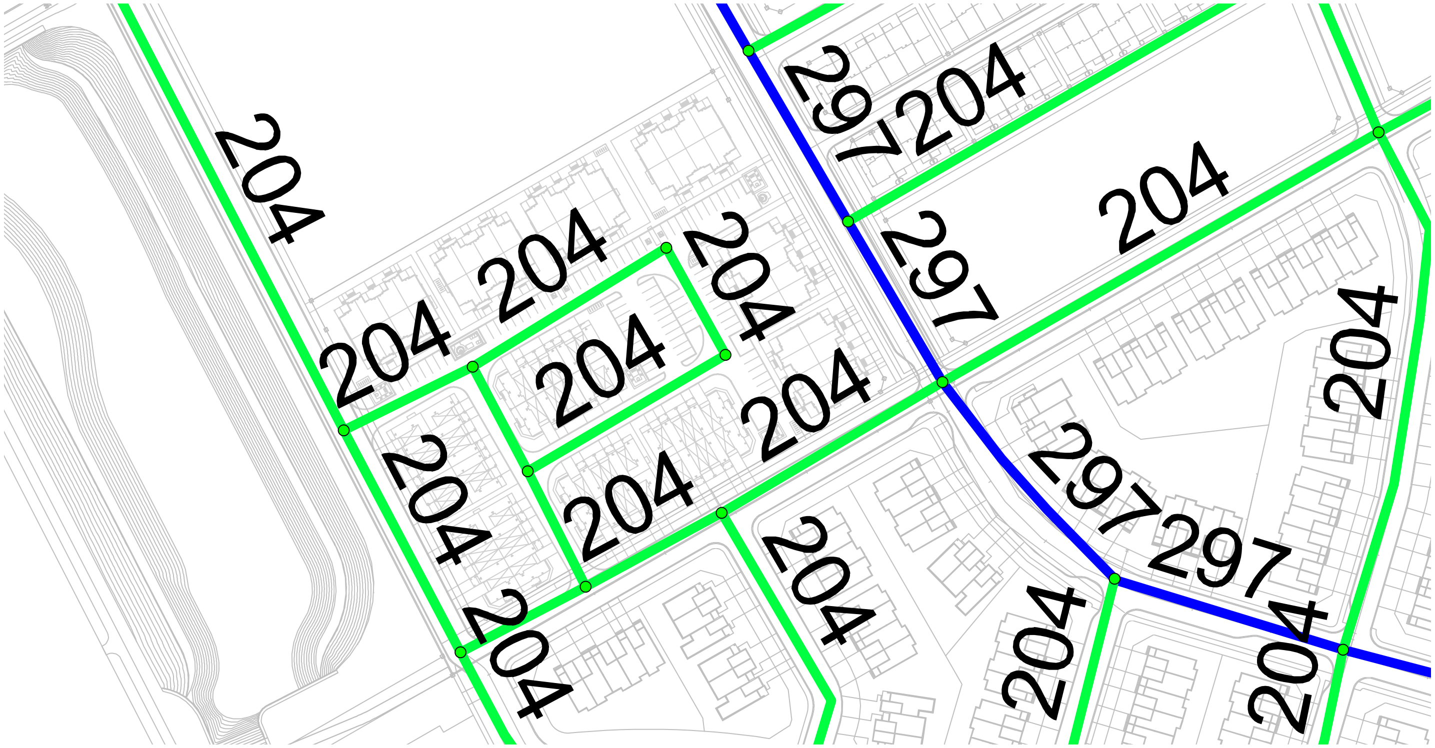
160401085_SNTC_Block4-2020-07-30-PIPE ID



Prepared By:

Date: 8/5/2020 7:03:22 AM

160401085_SNTC_Block4-2020-07-30-PIPE DIAMETER



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

1-ACAD-160401085 DP.dxf

1-ACAD-160401085 BLK 4 SP.c

Prepared By:

Date: 8/5/2020 7:04:04 AM

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 3. Detailed design for Block 4 is currently under review at the City of Ottawa and as such, the actual unit count of 116 townhomes was used in the calculations in accordance with the proposed site plan.

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 June 2020(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

Area ID	Units	Person/Unit	Population	AVDY (L/s)	MXDY (L/s)	PKHR (L/s)
Block 2	172	2.7	464	1.88	4.70	10.35
Block 3	310	1.8	558	2.26	5.65	12.43
Block 4	116	2.7	313	1.27	3.17	6.98
Block 8-15	42	2.7	113	0.46	1.15	2.53
		Total	**2,056**	**8.33**	**20.82**	**45.83**

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 8 to 15. 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

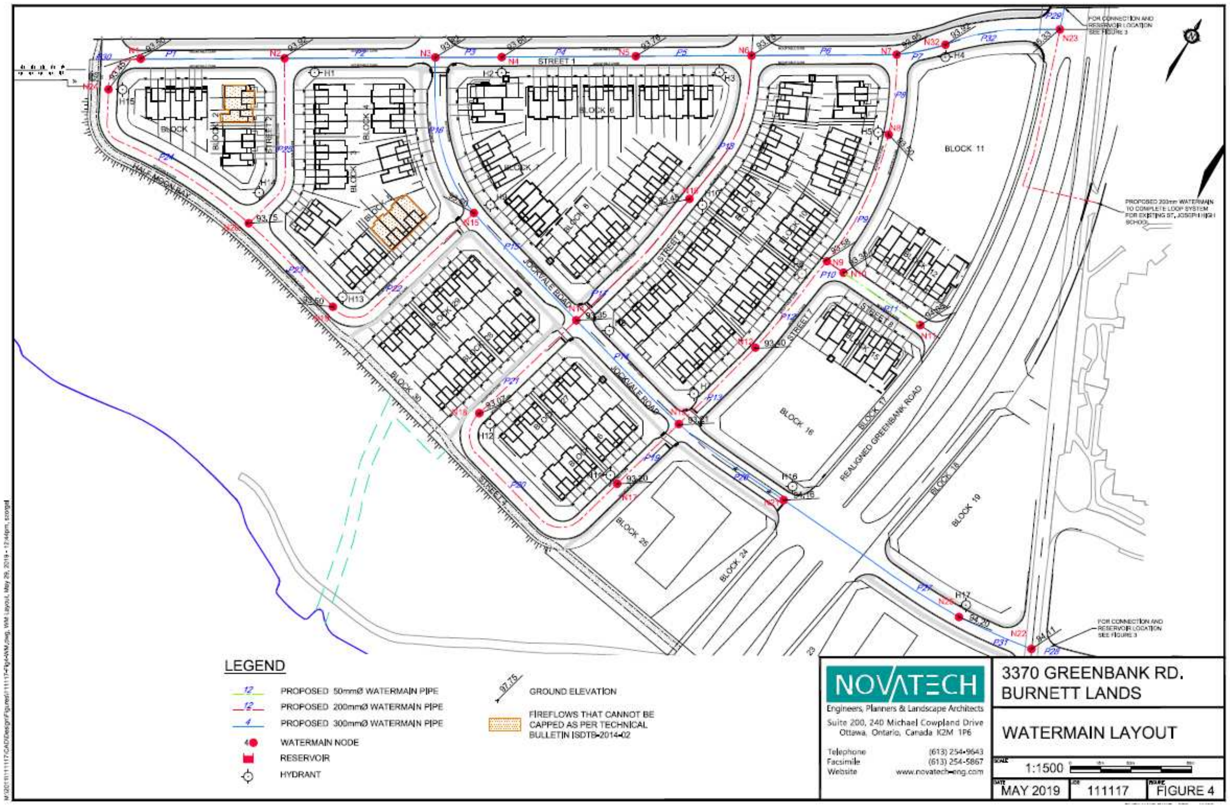
From: Rathnasooriya, Thakshika <Thakshika.Rathnasooriya@stantec.com>
Sent: Friday, February 14, 2020 3:15:03 PM
To: Bougadis, John <John.Bougadis@ottawa.ca>
Subject: RE: Hydraulic Boundary Conditions - South Nepean Town Centre (SNTC)

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

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

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)

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

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

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

Max Day Demand	- 16.95L/s
Peak Hour Demand	- 36.85L/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

'

'

'

This e-mail originates from the City of Ottawa e-mail system. Any distribution, use or copying of this e-mail or the information it contains by other than the intended recipient(s) is unauthorized. Thank you.

Le présent courriel a été expédié par le système de courriels de la Ville d'Ottawa. Toute distribution, utilisation ou reproduction du courriel ou des renseignements qui s'y trouvent par une personne autre que son destinataire prévu est interdite. Je vous remercie de votre collaboration.

'

A.2 WATER DEMAND CALCULATIONS

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	116	313	0.00	350	0	76.1	1.27	190.3	3.17	418.7	6.98
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 :			**2057**				**543**	**13.59**	**1315**	**33.25**	**2867**	**72.71**

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

A.3 FUS CALCULATIONS

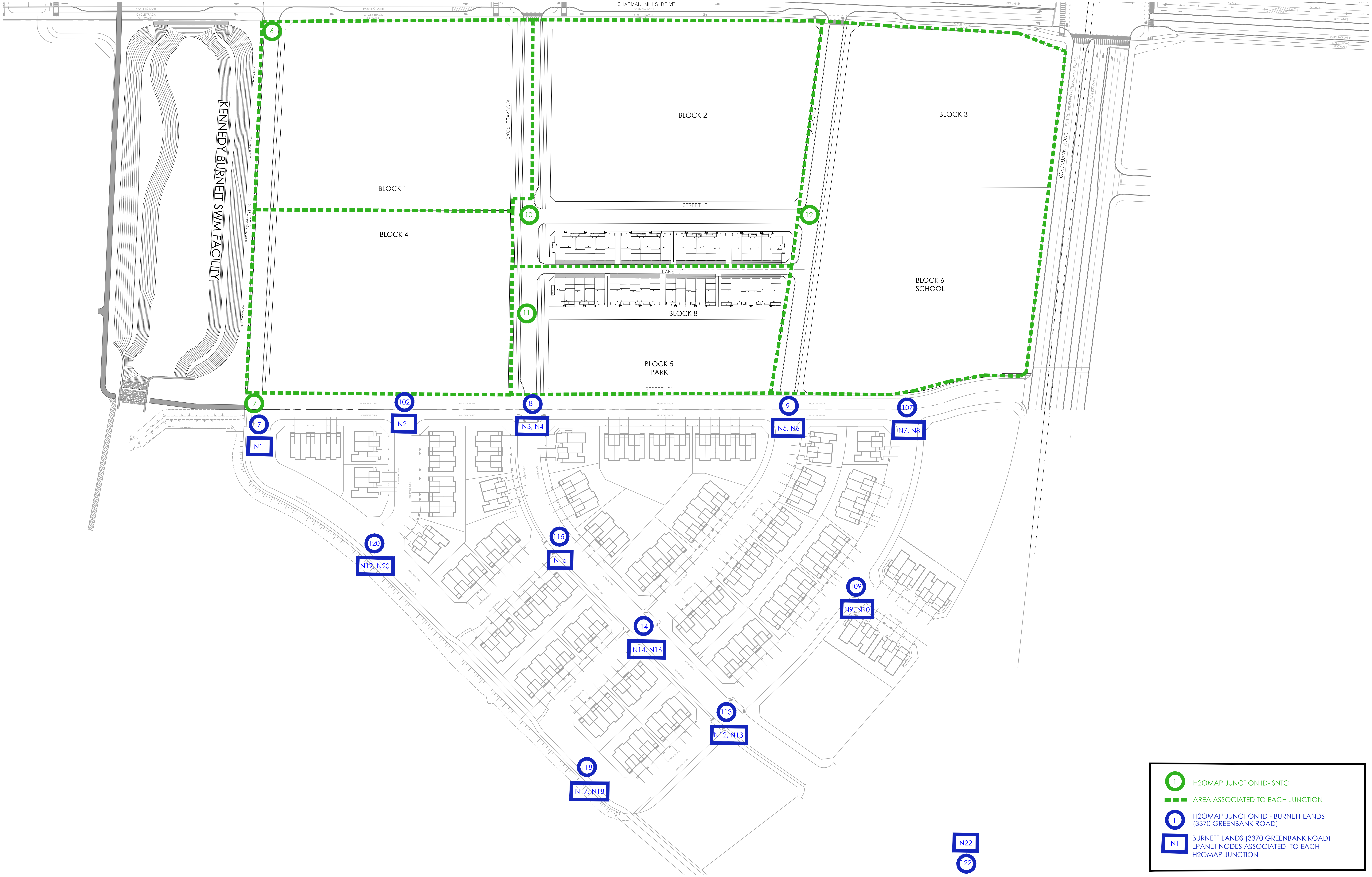
FUS Fire Flow Calculation Sheet

Stantec Project #: 160401085
Project Name: Nepean Town Centre Development Corporation
Date: 2/19/2020
Fire Flow Calculation #: 1
Description: Residential Townhome Units (Block 10)

Notes: Worst case townhome units

Step	Task	Notes						Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Wood Frame						1.5	-
2	Determine Ground Floor Area of One Unit	-						447.6	-
	Determine Number of Adjoining Units	Includes adjacent wood frame structures separated by 3m or less						1	-
3	Determine Height in Storeys	Does not include floors >50% below grade or open attic space						3	-
4	Determine Required Fire Flow	(F = 220 x C x $A^{1/2}$). Round to nearest 1000 L/min						-	12000
5	Determine Occupancy Charge	Limited Combustible						-15%	10200
6	Determine Sprinkler Reduction	None						0%	0
		Non-Standard Water Supply or N/A						0%	
		Not Fully Supervised or N/A						0%	
		% Coverage of Sprinkler System						0%	
7	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall	-	-
		North	20.1 to 30	30	3	61-90	Wood Frame or Non-Combustible	9%	6018
		East	3.1 to 10	12	3	31-60	Wood Frame or Non-Combustible	18%	
		South	10.1 to 20	30	3	61-90	Wood Frame or Non-Combustible	14%	
		West	3.1 to 10	12	3	31-60	Wood Frame or Non-Combustible	18%	
8	Determine Final Required Fire Flow	Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min							16000
		Total Required Fire Flow in L/s							266.7
		Required Duration of Fire Flow (hrs)							3.50
		Required Volume of Fire Flow (m^3)							3360

A.4 ULTIMATE CONDITIONS HYDRAULIC ANALYSIS RESULTS


CHAPMAN MILLS DRIVE
KENNEDY BURNETT SWM FACILITY
JOCKVALE ROAD
GREENBANK ROAD
STREET 'E'
LANE 'D'
STREET 'B'
BLOCK 1
BLOCK 2
BLOCK 3
BLOCK 4
BLOCK 5
PARK
BLOCK 6
SCHOOL
BLOCK 8
6
7
8
9
10
11
12
7
102
107
109
113
115
118
120
122
14
N1
N2
N3, N4
N5, N6
N7, N8
N9, N10
N12, N13
N14, N16
N15
N17, N18
N19, N20
N22
1 H2OMAP JUNCTION ID- SNTC
AREA ASSOCIATED TO EACH JUNCTION
1 H2OMAP JUNCTION ID - BURNETT LANDS (3370 GREENBANK ROAD)
N1 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	95.10	157.38	88.53	610.40
4	0.00	94.21	157.34	89.74	618.74
5	0.00	93.15	157.32	91.22	628.94
6	2.46	93.93	157.31	90.10	621.22
7	0.19	93.51	157.31	90.69	625.29
8	0.15	93.82	157.31	90.25	622.26
9	0.15	93.74	157.31	90.36	623.01
10	2.11	93.82	157.31	90.26	622.32
11	0.43	93.61	157.31	90.55	624.32
12	2.78	94.11	157.31	89.84	619.43
13	0.00	93.99	157.31	90.01	620.60
14	0.43	93.35	157.30	90.92	626.88
15	0.00	95.33	157.30	88.10	607.43
20	0.00	93.48	157.31	90.74	625.63
21	0.00	93.50	157.31	90.71	625.43
102	0.08	93.92	157.31	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	157.31	90.56	624.39
118	0.15	92.82	157.30	91.67	632.05
120	0.20	93.75	157.31	90.35	622.95
122	1.39	94.11	157.30	89.83	619.36

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	3.46	0.05
11	8	115	80.12	297	120	3.25	0.05
12	9	14	165.53	204	110	0.96	0.03
13	11	8	57.06	297	120	4.38	0.06
14	10	11	60.55	297	120	4.77	0.07
15	5	10	125.25	297	120	6.48	0.09
16	4	12	128.80	204	110	5.03	0.15
17	12	13	57.59	204	110	1.85	0.06
18	13	9	57.74	204	110	1.81	0.06
19	6	20	167.03	204	110	1.76	0.05
20	7	21	43.26	204	110	0.16	0.00
21	6	5	158.01	297	120	-4.22	0.06
22	4	5	186.77	297	120	10.70	0.15
23	9	8	153.93	204	110	-0.57	0.02
24	3	4	146.18	297	120	15.73	0.23
25	1000	3	92.09	297	120	15.73	0.23
26	10	12	170.91	204	110	-0.40	0.01
27	11	13	161.29	204	110	-0.04	0.00
28	9	107	72.78	204	110	1.27	0.04
30	102	8	78.61	204	110	-0.42	0.01
32	115	14	73.28	297	120	3.66	0.05
34	122	113	199.82	297	120	-3.57	0.05
36	107	15	78.35	204	110	0.00	0.00
38	113	109	106.78	204	110	-0.66	0.02
39	109	107	116.92	204	110	-0.89	0.03
41	118	113	114.97	204	110	0.58	0.02
42	14	118	109.64	204	110	0.73	0.02
43	7	120	128.07	204	110	0.38	0.01
44	120	102	92.43	204	110	-0.43	0.01
46	120	115	154.08	204	110	0.61	0.02
48	122	1001	10.00	297	120	2.18	0.03
50	20	7	76.79	204	110	0.73	0.02
52	21	102	47.41	204	110	0.10	0.00

Hydraulic Model Results -Peak Hour Analysis

Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(Kpa)
3	0.00	95.10	140.06	63.91	440.65
4	0.00	94.21	139.83	64.86	447.20
5	0.00	93.15	139.69	66.16	456.16
6	13.54	93.93	139.65	65.00	448.16
7	1.02	93.51	139.65	65.59	452.23
8	0.85	93.82	139.67	65.18	449.40
9	0.80	93.74	139.67	65.29	450.16
10	11.61	93.82	139.67	65.18	449.40
11	1.79	93.61	139.67	65.47	451.40
12	13.85	94.11	139.67	64.76	446.51
13	0.00	93.99	139.67	64.93	447.68
14	2.36	93.35	139.68	65.86	454.09
15	0.00	95.33	139.67	63.03	434.58
20	0.00	93.48	139.65	65.63	452.51
21	0.00	93.50	139.65	65.61	452.37
102	0.42	93.92	139.66	65.02	448.30
107	2.07	93.95	139.67	64.99	448.09
109	1.25	93.58	139.67	65.53	451.82
113	6.27	93.21	139.69	66.07	455.54
115	1.09	93.60	139.67	65.49	451.54
118	0.85	92.82	139.68	66.61	459.26
120	1.09	93.75	139.66	65.26	449.95
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	-11.16	0.16
11	8	115	80.12	297	120	-4.33	0.06
12	9	14	165.53	204	110	-2.06	0.06
13	11	8	57.06	297	120	-0.09	0.00
14	10	11	60.55	297	120	1.45	0.02
15	5	10	125.25	297	120	13.41	0.19
16	4	12	128.80	204	110	12.94	0.40
17	12	13	57.59	204	110	-0.56	0.02
18	13	9	57.74	204	110	-0.81	0.02
19	6	20	167.03	204	110	1.58	0.05
20	7	21	43.26	204	110	-0.32	0.01
21	6	5	158.01	297	120	-15.12	0.22
22	4	5	186.77	297	120	28.53	0.41
23	9	8	153.93	204	110	0.55	0.02
24	3	4	146.18	297	120	41.47	0.60
25	1000	3	92.09	297	120	41.47	0.60
26	10	12	170.91	204	110	0.35	0.01
27	11	13	161.29	204	110	-0.25	0.01
28	9	107	72.78	204	110	-0.10	0.00
30	102	8	78.61	204	110	-3.93	0.12
32	115	14	73.28	297	120	-8.39	0.12
34	122	113	199.82	297	120	23.35	0.34
36	107	15	78.35	204	110	0.00	0.00
38	113	109	106.78	204	110	3.42	0.10
39	109	107	116.92	204	110	2.17	0.07
41	118	113	114.97	204	110	-2.50	0.08
42	14	118	109.64	204	110	-1.65	0.05
43	7	120	128.07	204	110	-2.00	0.06
44	120	102	92.43	204	110	-0.11	0.00
46	120	115	154.08	204	110	-2.97	0.09
48	122	1001	10.00	297	120	-30.97	0.45
50	20	7	76.79	204	110	-1.30	0.04
52	21	102	47.41	204	110	-3.40	0.10

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	67.54	465.67	142.61	167	61.71	425.48	1020.86	20	137.90
4	0.00	63.40	437.13	138.81	167	54.04	372.59	731.07	20	137.90
5	0.00	61.54	424.31	136.44	167	52.14	359.49	631.84	20	137.90
6	6.15	60.13	414.58	136.23	167	48.29	332.95	460.82	20	137.90
8	0.38	58.16	401.00	134.73	167	50.33	347.02	640.93	20	137.90
9	0.36	57.89	399.14	134.46	167	49.05	338.19	505.95	20	137.90
10	5.27	59.42	409.69	135.62	267	48.17	332.12	625.67	20	137.90
11	0.87	59.06	407.21	135.16	267	48.55	334.74	634.00	20	137.90
12	6.44	59.30	408.86	135.83	167	48.93	337.36	474.54	20	137.90
13	0.00	58.52	403.48	135.15	167	48.75	336.12	483.88	20	137.90
14	1.08	57.15	394.04	133.55	167	50.66	349.29	674.29	20	137.90
15	0.00	55.01	379.28	134.03	167	24.71	170.37	183.01	20	137.90
102	0.19	58.08	400.45	134.77	183	45.49	313.64	409.70	20	137.90
107	0.95	56.97	392.80	134.03	167	43.17	297.65	331.50	20	137.90
109	0.56	56.56	389.97	133.36	167	42.70	294.41	322.03	20	137.90
113	2.83	56.26	387.90	132.78	167	50.76	349.98	720.12	20	137.90
115	0.50	57.76	398.24	134.23	200	49.90	344.05	639.17	20	137.90
118	0.38	57.36	395.49	133.17	167	45.09	310.89	358.29	20	137.90
120	0.49	58.24	401.55	134.71	167	45.70	315.09	376.85	20	137.90
122	3.46	49.57	341.78	128.98	167	49.31	339.98	2290.76	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	95.10	147.76	74.86	516.14
4	0.00	94.21	147.69	76.03	524.21
5	0.00	93.15	147.65	77.48	534.21
6	2.46	93.93	147.65	76.36	526.49
7	0.19	93.51	147.63	76.94	530.49
8	0.15	93.82	147.63	76.5	527.45
9	0.15	93.74	147.63	76.61	528.21
10	2.11	93.82	147.64	76.51	527.52
11	0.43	93.61	147.64	76.8	529.52
12	2.78	94.11	147.64	76.1	524.69
13	0.00	93.99	147.64	76.26	525.80
14	0.43	93.35	147.62	77.16	532.00
15	0.00	95.33	147.63	74.34	512.56
20	0.00	93.48	147.63	76.98	530.76
21	0.00	93.50	147.63	76.95	530.55
102	0.08	93.92	147.63	76.36	526.49
107	0.38	93.95	147.63	76.31	526.14
109	0.23	93.58	147.62	76.83	529.73
113	1.13	93.21	147.62	77.35	533.31
115	0.20	93.60	147.63	76.81	529.59
118	0.15	92.82	147.62	77.91	537.17
120	0.20	93.75	147.63	76.6	528.14
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	7.35	0.11
11	8	115	80.12	297	120	6.20	0.09
12	9	14	165.53	204	110	1.91	0.06
13	11	8	57.06	297	120	7.52	0.11
14	10	11	60.55	297	120	7.94	0.11
15	5	10	125.25	297	120	9.22	0.13
16	4	12	128.80	204	110	6.84	0.21
17	12	13	57.59	204	110	3.23	0.10
18	13	9	57.74	204	110	3.22	0.10
19	6	20	167.03	204	110	2.82	0.09
20	7	21	43.26	204	110	0.26	0.01
21	6	5	158.01	297	120	-5.28	0.08
22	4	5	186.77	297	120	14.50	0.21
23	9	8	153.93	204	110	-1.08	0.03
24	3	4	146.18	297	120	21.34	0.31
25	1000	3	92.09	297	120	21.34	0.31
26	10	12	170.91	204	110	-0.83	0.03
27	11	13	161.29	204	110	-0.01	0.00
28	9	107	72.78	204	110	2.25	0.07
30	102	8	78.61	204	110	-0.08	0.00
32	115	14	73.28	297	120	7.35	0.11
34	122	113	199.82	297	120	-9.18	0.13
36	107	15	78.35	204	110	0.00	0.00
38	113	109	106.78	204	110	-1.64	0.05
39	109	107	116.92	204	110	-1.87	0.06
41	118	113	114.97	204	110	1.32	0.04
42	14	118	109.64	204	110	1.47	0.05
43	7	120	128.07	204	110	0.80	0.02
44	120	102	92.43	204	110	-0.75	0.02
46	120	115	154.08	204	110	1.35	0.04
48	122	1001	10.00	297	120	7.79	0.11
50	20	7	76.79	204	110	1.25	0.04
52	21	102	47.41	204	110	0.74	0.02

Hydraulic Model Results -Peak Hour Analysis

Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(Kpa)
3	0.00	95.10	145.08	71.05	489.88
4	0.00	94.21	144.73	71.82	495.18
5	0.00	93.15	144.52	73.02	503.46
6	13.54	93.93	144.47	71.85	495.39
7	1.02	93.51	144.45	72.42	499.32
8	0.85	93.82	144.46	71.99	496.36
9	0.80	93.74	144.46	72.11	497.18
10	11.61	93.82	144.47	72.00	496.43
11	1.79	93.61	144.47	72.30	498.49
12	13.85	94.11	144.47	71.59	493.60
13	0.00	93.99	144.47	71.76	494.77
14	2.36	93.35	144.46	72.66	500.98
15	0.00	95.33	144.46	69.84	481.53
20	0.00	93.48	144.45	72.46	499.60
21	0.00	93.50	144.45	72.43	499.39
102	0.42	93.92	144.46	71.84	495.32
107	2.07	93.95	144.46	71.81	495.12
109	1.25	93.58	144.46	72.33	498.70
113	6.27	93.21	144.46	72.86	502.36
115	1.09	93.60	144.46	72.31	498.56
118	0.85	92.82	144.46	73.41	506.15
120	1.09	93.75	144.46	72.08	496.98
122	7.62	94.11	144.50	71.63	493.87

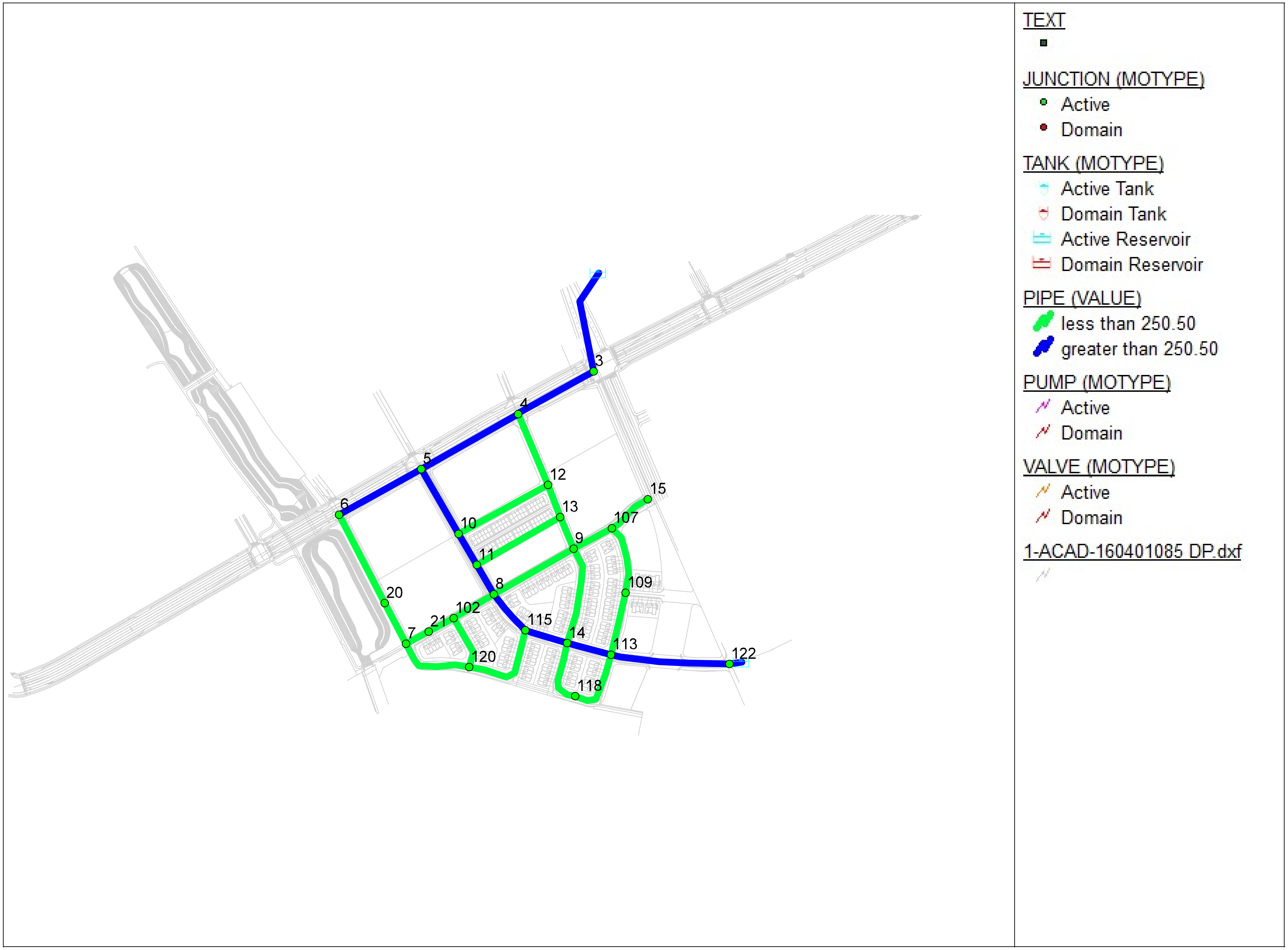
Pipe Results

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)		(L/s)	(m/s)
10	14	113	76.07	297	120	-3.46	0.05
11	8	115	80.12	297	120	1.91	0.03
12	9	14	165.53	204	110	0.11	0.00
13	11	8	57.06	297	120	6.18	0.09
14	10	11	60.55	297	120	7.64	0.11
15	5	10	125.25	297	120	19.11	0.28
16	4	12	128.80	204	110	16.59	0.51
17	12	13	57.59	204	110	2.61	0.08
18	13	9	57.74	204	110	2.28	0.07
19	6	20	167.03	204	110	3.26	0.10
20	7	21	43.26	204	110	0.39	0.01
21	6	5	158.01	297	120	-16.80	0.24
22	4	5	186.77	297	120	35.91	0.52
23	9	8	153.93	204	110	-0.31	0.01
24	3	4	146.18	297	120	52.50	0.76
25	1000	3	92.09	297	120	52.50	0.76
26	10	12	170.91	204	110	-0.13	0.00
27	11	13	161.29	204	110	-0.33	0.01
28	9	107	72.78	204	110	1.67	0.05
30	102	8	78.61	204	110	-3.12	0.10
32	115	14	73.28	297	120	-1.30	0.02
34	122	113	199.82	297	120	12.32	0.18
36	107	15	78.35	204	110	0.00	0.00
38	113	109	106.78	204	110	1.65	0.05
39	109	107	116.92	204	110	0.40	0.01
41	118	113	114.97	204	110	-0.94	0.03
42	14	118	109.64	204	110	-0.09	0.00
43	7	120	128.07	204	110	-1.34	0.04
44	120	102	92.43	204	110	-0.31	0.01
46	120	115	154.08	204	110	-2.12	0.06
48	122	1001	10.00	297	120	-19.94	0.29
50	20	7	76.79	204	110	0.07	0.00
52	21	102	47.41	204	110	-2.39	0.07

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	66.46	458.23	141.85	167	60.67	418.31	1007.92	20	137.90
4	0.00	62.42	430.37	138.12	167	53.14	366.39	721.82	20	137.90
5	0.00	60.62	417.96	135.79	167	51.33	353.91	624.04	20	137.90
6	6.15	59.21	408.24	135.58	167	47.47	327.30	455.00	20	137.90
8	0.38	57.28	394.93	134.11	167	49.56	341.71	632.76	20	137.90
9	0.36	57.02	393.14	133.85	167	48.27	332.81	499.53	20	137.90
10	5.27	58.51	403.41	134.98	267	47.38	326.68	617.77	20	137.90
11	0.87	58.17	401.07	134.53	267	47.77	329.36	626.00	20	137.90
12	6.44	58.39	402.59	135.18	167	48.11	331.71	468.53	20	137.90
13	0.00	57.63	397.35	134.53	167	47.96	330.67	477.69	20	137.90
14	1.08	56.30	388.18	132.95	167	49.91	344.12	665.84	20	137.90
15	0.00	54.15	373.35	133.42	167	23.94	165.06	180.49	20	137.90
102	0.19	57.19	394.31	134.15	183	44.72	308.34	404.45	20	137.90
107	0.95	56.11	386.87	133.42	167	42.40	292.34	327.25	20	137.90
109	0.56	55.71	384.11	132.77	167	41.93	289.10	317.95	20	137.90
113	2.83	55.43	382.18	132.20	167	50.02	344.88	711.16	20	137.90
115	0.50	56.89	392.25	133.62	200	49.17	339.02	631.09	20	137.90
118	0.38	56.52	389.69	132.58	167	44.34	305.72	353.90	20	137.90
120	0.49	57.35	395.42	134.09	167	44.91	309.65	372.06	20	137.90
122	3.46	48.86	336.88	128.48	167	48.60	335.09	2260.76	20	137.90

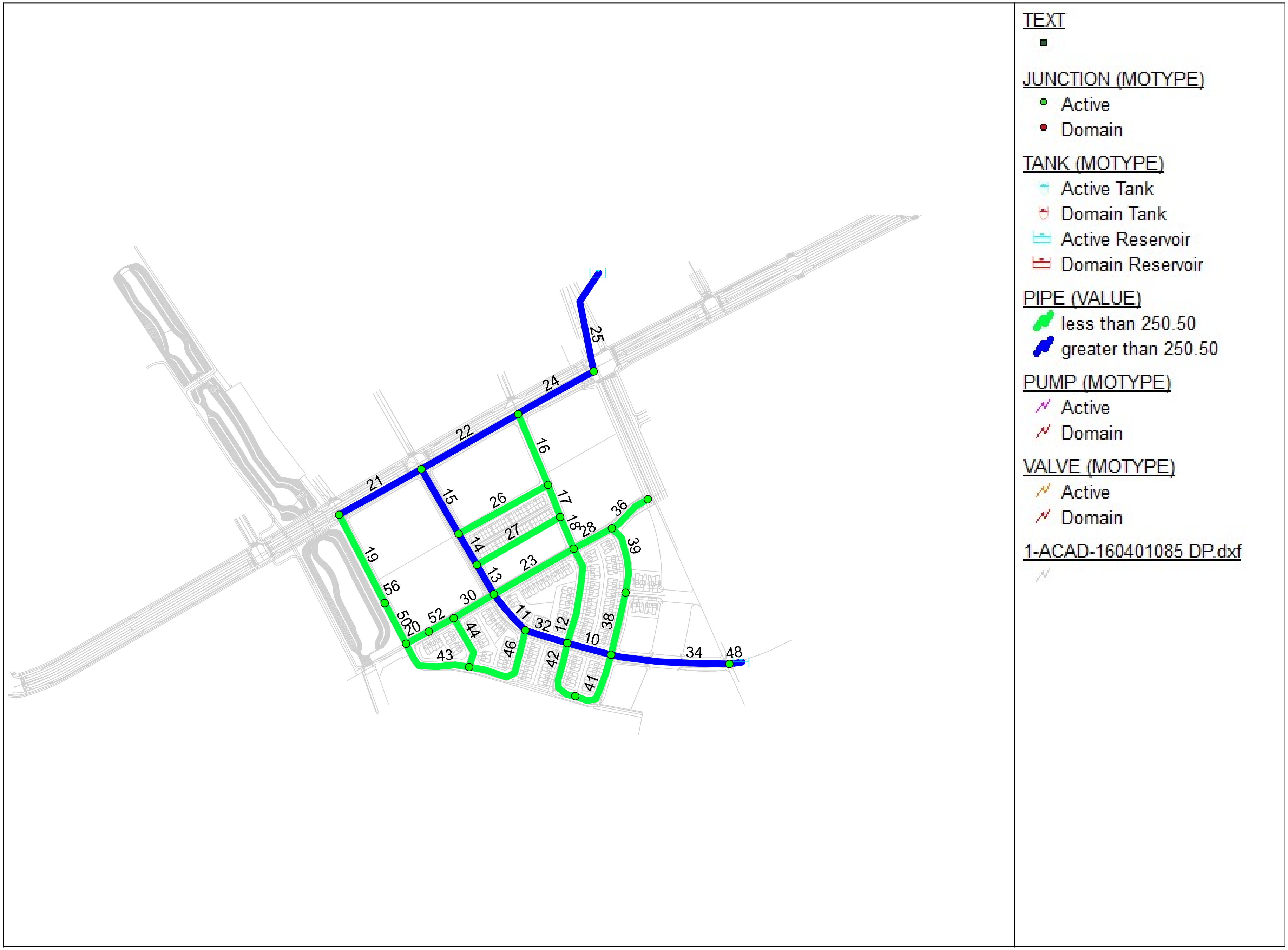
160401085_SNTC-2020-06-2-Ultimate-JUNCTION ID



Prepared By:

Date: 7/8/2020 11:48:09 AM

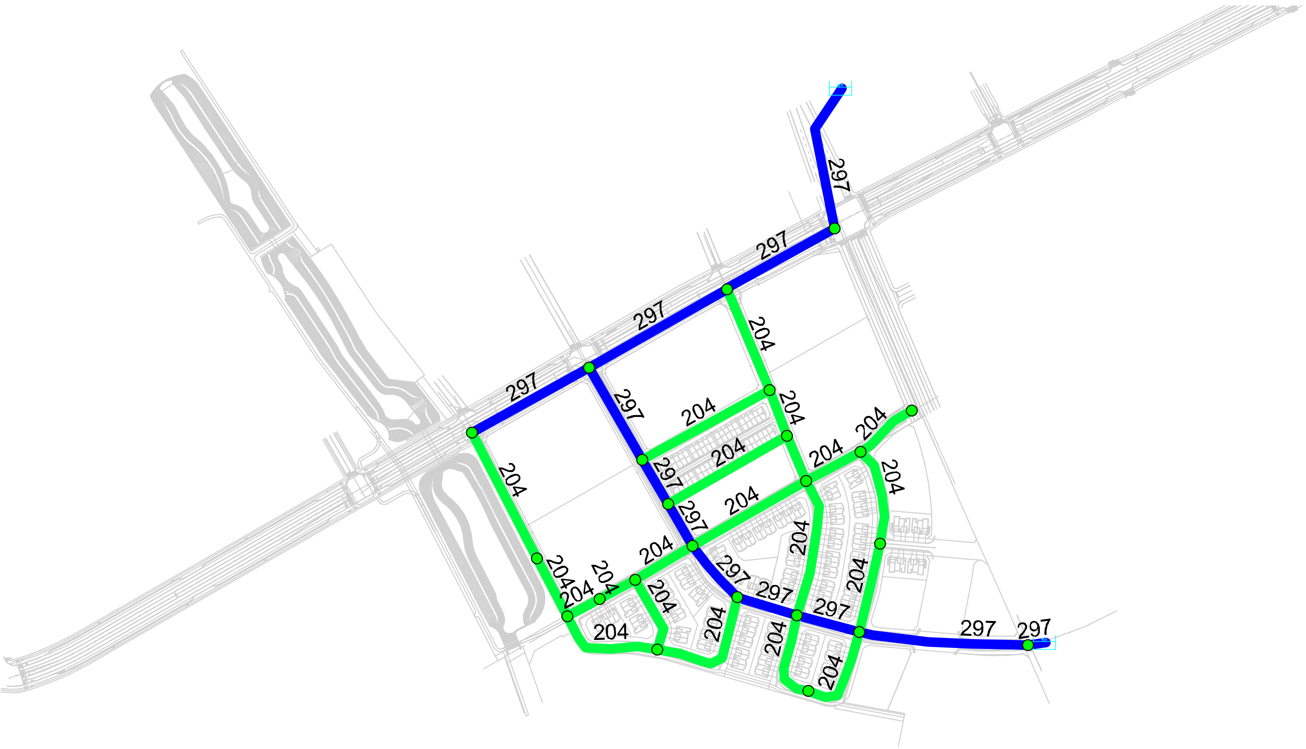
160401085_SNTC-2020-06-2-Ultimate - PIPE ID



Prepared By:

Date: 7/8/2020 11:48:39 AM

160401085_SNTC-2020-06-2-Ultimate - PIPE DIAMTER



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

1-ACAD-160401085 DP.dxf

Prepared By:

Date: 7/8/2020 11:49:16 AM

A.5 HYDRAULIC ANALYSIS RESULTS – SINGLE FEED OPTION

EXISTING CONDITIONS
Hydraulic Model Results - Average Day Analysis

Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(Kpa)
3	0.00	95.10	157.39	88.55	610.53
4	0.00	94.21	157.38	89.80	619.15
5	0.00	93.15	157.37	91.30	629.50
6	2.46	93.93	157.37	90.19	621.84
7	0.19	93.51	157.37	90.79	625.98
8	0.15	93.82	157.37	90.35	622.95
9	0.15	93.74	157.37	90.46	623.70
10	2.11	93.82	157.37	90.35	622.95
11	0.43	93.61	157.37	90.64	624.94
12	2.78	94.11	157.37	89.93	620.05
13	0.00	93.99	157.37	90.10	621.22
20	0.00	93.60	157.37	90.66	625.08

Pipe Results

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)		(L/s)	(m/s)
13	11	8	57.06	297	120	0.15	0.00
14	10	11	60.55	297	120	0.70	0.01
15	5	10	125.25	297	120	3.00	0.04
16	4	12	128.80	204	110	2.62	0.08
17	12	13	57.59	204	110	0.03	0.00
18	13	9	57.74	204	110	0.15	0.00
19	6	20	167.03	204	110	0.19	0.01
21	6	5	158.01	297	120	-2.65	0.04
22	4	5	186.77	297	120	5.65	0.08
24	3	4	146.18	297	120	8.27	0.12
25	1000	3	92.09	297	120	8.27	0.12
26	10	12	170.91	204	110	0.19	0.01
27	11	13	161.29	204	110	0.12	0.00
50	20	7	76.79	204	110	0.19	0.01

Hydraulic Model Results -Peak Hour Analysis

Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(Kpa)
3	0.00	95.10	140.05	63.89	440.51
4	0.00	94.21	139.80	64.81	446.85
5	0.00	93.15	139.65	66.10	455.75
6	13.54	93.93	139.61	64.94	447.75
7	1.02	93.51	139.61	65.53	451.82
8	0.85	93.82	139.62	65.10	448.85
9	0.80	93.74	139.62	65.22	449.68
10	11.61	93.82	139.62	65.10	448.85
11	1.79	93.61	139.62	65.40	450.92
12	13.85	94.11	139.62	64.69	446.02
13	0.00	93.99	139.62	64.86	447.20
20	0.00	93.60	139.61	65.41	450.99

Pipe Results

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)		(L/s)	(m/s)
13	11	8	57.06	297	120	0.85	0.01
14	10	11	60.55	297	120	2.98	0.04
15	5	10	125.25	297	120	15.21	0.22
16	4	12	128.80	204	110	13.69	0.42
17	12	13	57.59	204	110	0.46	0.01
18	13	9	57.74	204	110	0.80	0.02
19	6	20	167.03	204	110	1.02	0.03
21	6	5	158.01	297	120	-14.56	0.21
22	4	5	186.77	297	120	29.77	0.43
24	3	4	146.18	297	120	43.46	0.63
25	1000	3	92.09	297	120	43.46	0.63
26	10	12	170.91	204	110	0.62	0.02
27	11	13	161.29	204	110	0.34	0.01
50	20	7	76.79	204	110	1.02	0.03

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	70.89	488.77	144.96	167	67.67	466.57	804.23	20	137.90
4	0.00	72.07	496.91	144.91	167	63.76	439.61	479.92	20	137.90
5	0.00	73.52	506.91	144.87	167	61.46	423.75	394.30	20	137.90
6	6.15	72.40	499.18	144.86	167	55.47	382.45	324.94	20	137.90
8	0.38	72.56	500.29	144.86	167	56.35	388.52	327.35	20	137.90
9	0.36	72.67	501.05	144.86	167	41.49	286.07	224.23	20	137.90
10	5.27	72.56	500.29	144.86	267	42.23	291.17	370.29	20	137.90
11	0.87	72.86	502.36	144.86	267	40.07	276.27	350.89	20	137.90
12	6.44	72.15	497.46	144.86	167	56.57	390.04	340.06	20	137.90
13	0.00	72.32	498.63	144.86	167	53.35	367.84	297.03	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	95.10	147.79	74.91	516.49
4	0.00	94.21	147.78	76.16	525.11
5	0.00	93.15	147.77	77.65	535.38
6	2.46	93.93	147.77	76.54	527.73
7	0.19	93.51	147.77	77.14	531.86
8	0.15	93.82	147.77	76.70	528.83
9	0.15	93.74	147.77	76.81	529.59
10	2.11	93.82	147.77	76.70	528.83
11	0.43	93.61	147.77	77.00	530.90
12	2.78	94.11	147.77	76.29	526.00
13	0.00	93.99	147.77	76.46	527.18
20	0.00	93.60	147.77	77.01	530.97

Pipe Results

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)		(L/s)	(m/s)
13	11	8	57.06	297	120	0.15	0.00
14	10	11	60.55	297	120	0.70	0.01
15	5	10	125.25	297	120	3.00	0.04
16	4	12	128.80	204	110	2.62	0.08
17	12	13	57.59	204	110	0.03	0.00
18	13	9	57.74	204	110	0.15	0.00
19	6	20	167.03	204	110	0.19	0.01
21	6	5	158.01	297	120	-2.65	0.04
22	4	5	186.77	297	120	5.65	0.08
24	3	4	146.18	297	120	8.27	0.12
25	1000	3	92.09	297	120	8.27	0.12
26	10	12	170.91	204	110	0.19	0.01
27	11	13	161.29	204	110	0.12	0.00
50	20	7	76.79	204	110	0.19	0.01

Hydraulic Model Results -Peak Hour Analysis

Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(Kpa)
3	0.00	95.10	145.15	71.14	490.50
4	0.00	94.21	144.90	72.06	496.84
5	0.00	93.15	144.75	73.35	505.73
6	13.54	93.93	144.71	72.19	497.74
7	1.02	93.51	144.71	72.78	501.80
8	0.85	93.82	144.72	72.35	498.84
9	0.80	93.74	144.72	72.47	499.67
10	11.61	93.82	144.72	72.35	498.84
11	1.79	93.61	144.72	72.65	500.91
12	13.85	94.11	144.72	71.94	496.01
13	0.00	93.99	144.72	72.11	497.18
20	0.00	93.60	144.71	72.66	500.98

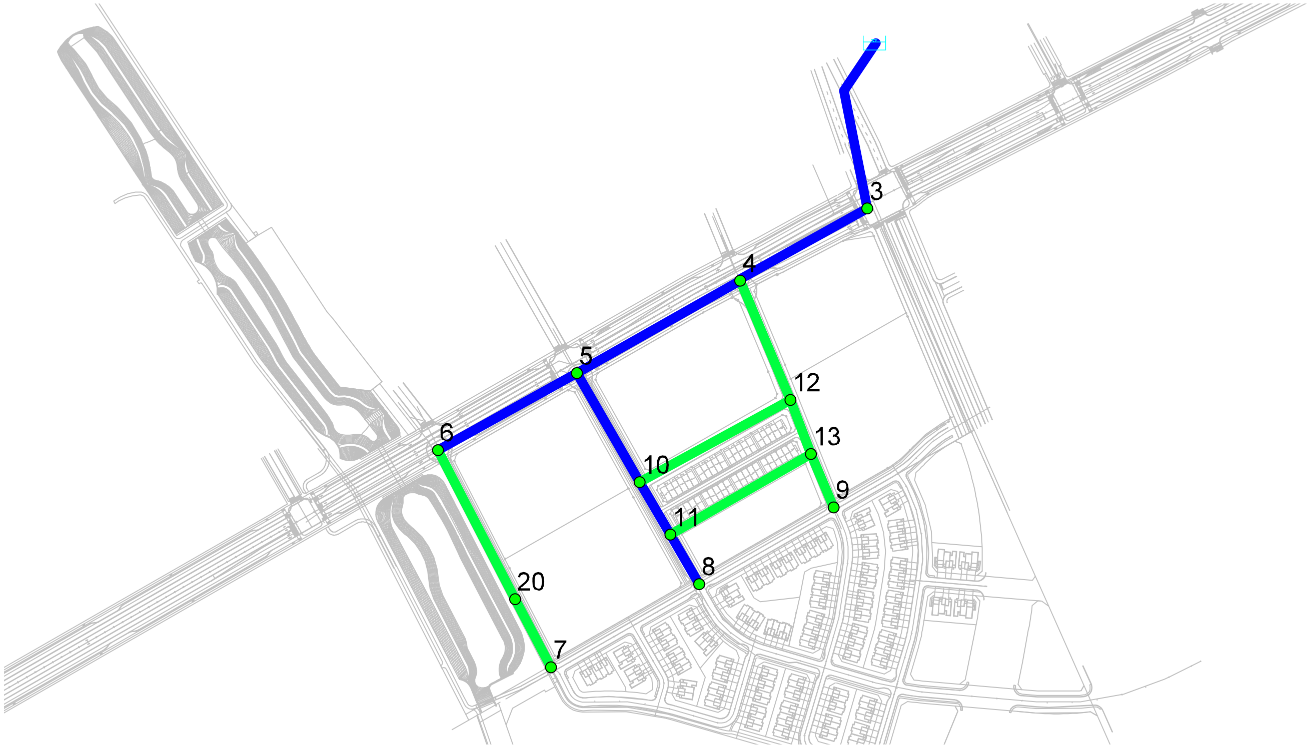
Pipe Results

ID	From Node	To Node	Length	Diameter	Roughness	Flow	Velocity
			(m)	(mm)		(L/s)	(m/s)
13	11	8	57.06	297	120	0.85	0.01
14	10	11	60.55	297	120	2.98	0.04
15	5	10	125.25	297	120	15.21	0.22
16	4	12	128.80	204	110	13.69	0.42
17	12	13	57.59	204	110	0.46	0.01
18	13	9	57.74	204	110	0.80	0.02
19	6	20	167.03	204	110	1.02	0.03
21	6	5	158.01	297	120	-14.56	0.21
22	4	5	186.77	297	120	29.77	0.43
24	3	4	146.18	297	120	43.46	0.63
25	1000	3	92.09	297	120	43.46	0.63
26	10	12	170.91	204	110	0.62	0.02
27	11	13	161.29	204	110	0.34	0.01
50	20	7	76.79	204	110	1.02	0.03

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	69.75	480.91	144.16	167	66.54	458.78	794.24	20	137.90
4	0.00	70.93	489.05	144.11	167	62.62	431.75	474.01	20	137.90
5	0.00	72.39	499.11	144.07	167	60.32	415.89	389.55	20	137.90
6	6.15	71.27	491.39	144.06	167	54.33	374.59	321.02	20	137.90
8	0.38	71.42	492.43	144.06	167	55.21	380.66	323.35	20	137.90
9	0.36	71.54	493.25	144.06	167	40.36	278.27	221.53	20	137.90
10	5.27	71.42	492.43	144.06	267	41.10	283.38	365.81	20	137.90
11	0.87	71.72	494.50	144.06	267	38.93	268.41	346.62	20	137.90
12	6.44	71.01	489.60	144.06	167	55.43	382.18	335.94	20	137.90
13	0.00	71.18	490.77	144.06	167	52.21	359.98	293.39	20	137.90

160401085_SNTC-2020-06-2-JUNCTION 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

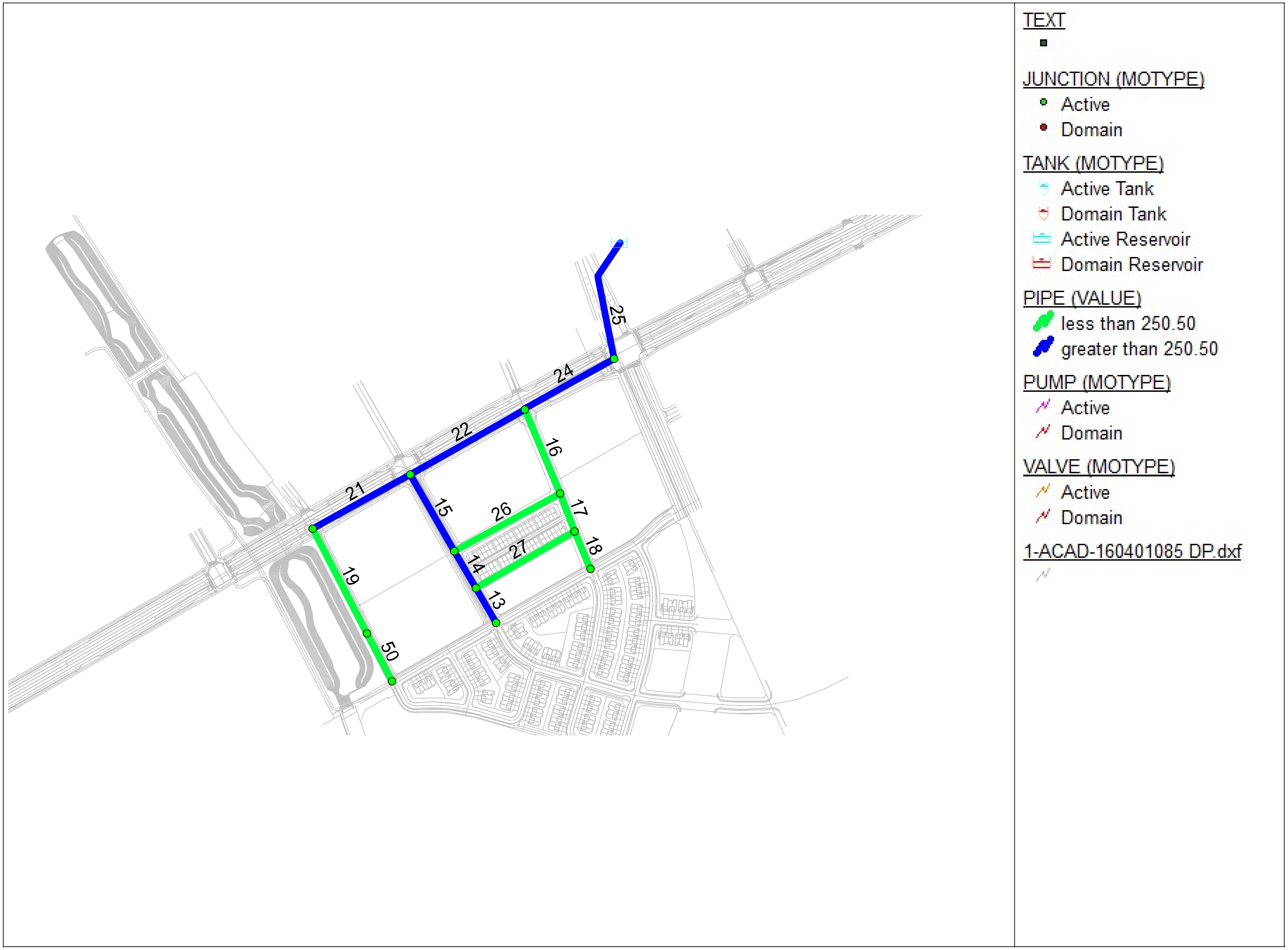
VALVE (MOTYPE)
Active
Domain

1-ACAD-160401085 DP.dxf

Prepared By:

Date: 7/8/2020 11:50:05 AM

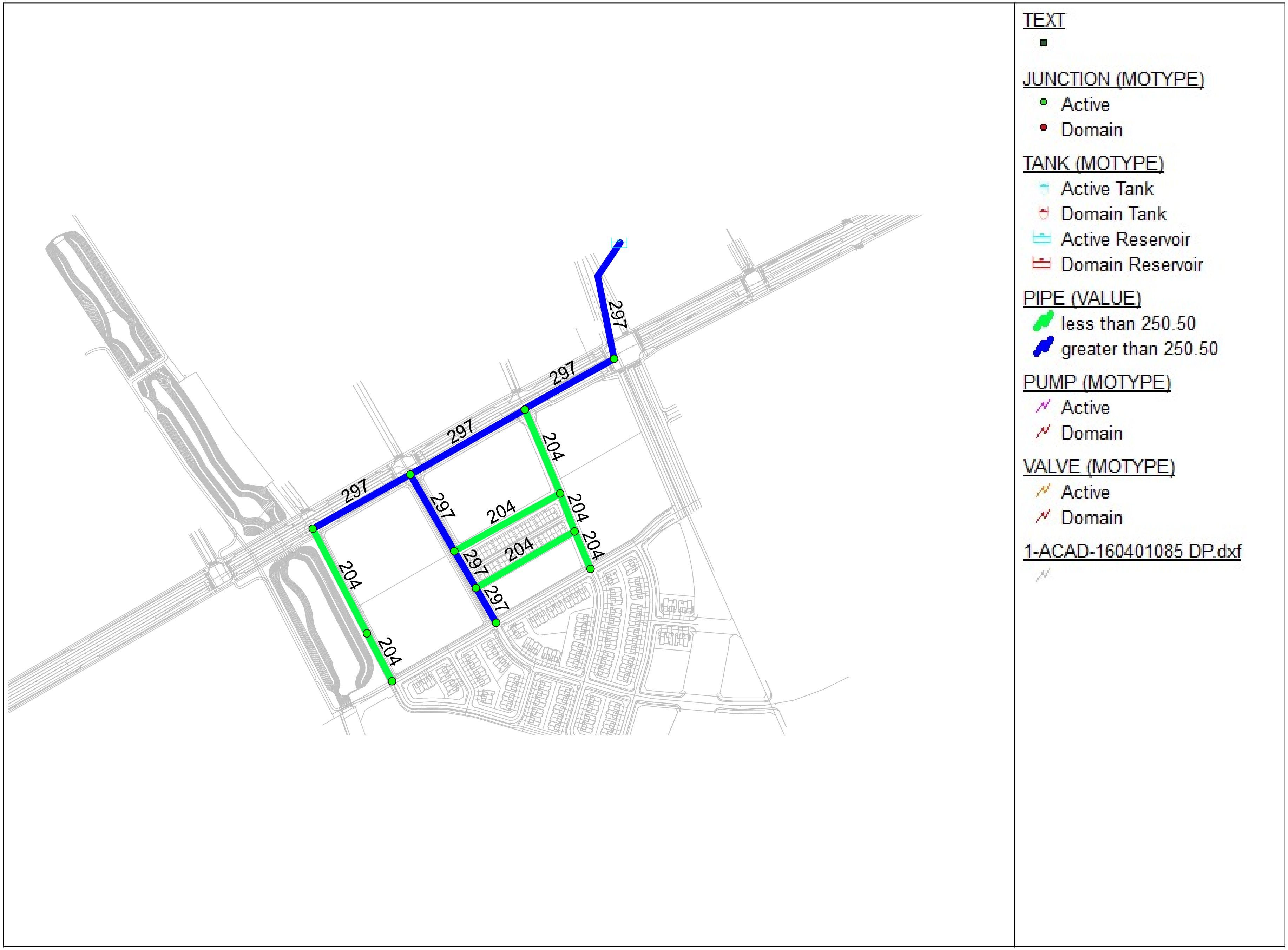
160401085_SNTC-2020-06-2-PIPE ID



Prepared By:

Date: 7/8/2020 11:50:31 AM

160401085_SNTC-2020-06-2- PIPE DIAMETER



Prepared By:

Date: 7/8/2020 11:51:55 AM

4.0 WATERMAIN

4.1 Previous Studies

Stantec consulting was retained to analyze the regional-level impact of developments in the area including the Burnett Lands. Their report, *Kennedy-Burnett Potable Water Master Servicing Study* (April 29, 2014) proposed 3 connections for the Burnett Lands development. At the northeast limits, the watermain will connect to a 300 mm watermain to be located in the realigned Greenbank Road at the Street 1 intersection. At the southeast limits, the watermain will connect to a future 300mm watermain (by others) located within Jockvale Road and current Greenbank Road. At the northwest limits of the site, the watermain will connect to a future watermain located at the Street 1 / Jockvale Road intersection.

4.2 Proposed Watermain System

The ultimate watermain connections and backbone watermain (300mm) throughout the development are consistent with Stantec's *Kennedy-Burnett Potable Water Master Servicing Study* (April 29, 2014) and have not been constructed to date. It has been noted by the City that the southeast and northern connections (by others) should advance and be constructed prior to development of the Burnett Lands. These two connections will serve as a backbone loop system for the proposed Burnett development until such time Greenbank Road is realigned and the 3rd connection can be established as per the ultimate condition of the development.

Since the construction of realigned Greenbank Road is unknown at this time, alternative looping and servicing will be provided through the lands to the north. In addition to the 300mm connection to the north, two connections to 200mm watermains are proposed to the lands to the north at two separate intersections.

The Burnett Lands will be serviced with a combination of 50mm, 200mm and 300 mm looped watermain with three connections to the site to the north and one connection at the southeast limits of the site. Refer to the following figures:

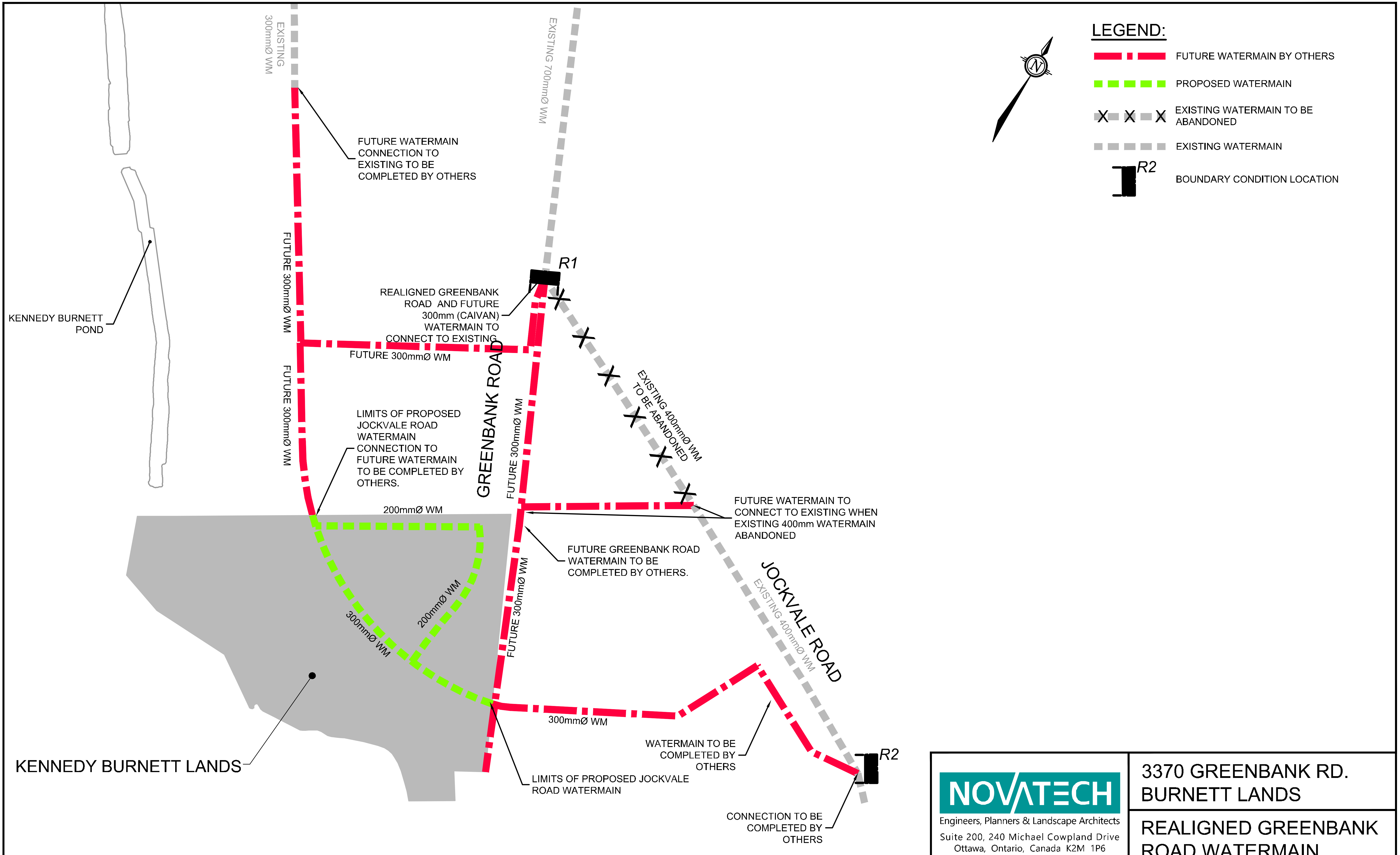
- **Figure 3 –** Realigned Greenbank Road Watermain
- **Figure 4A –** Watermain Layout
- **Figure 4B –** Watermain Layout – Offsite (By Others)

4.3 Design Criteria

It is noted the proposed watermain works are located in a future Zone 3C pressure zone. The realignment of the pressure zone will be completed by the City of Ottawa and once complete will alter the boundary conditions for the development. Timing for the realignment is unknown at this time. The City of Ottawa has provided boundary conditions for the pre and post-realignment conditions. This report considers both conditions.

Boundary conditions were provided at the intersection of current Greenbank Road and Jockvale Road as well as the intersection of Jockvale Raod and Bren-Maur Road. These two connections were utilized and modelled, however, since the connection to Jockvale Road / Greenbank Road occurs through the site to the north, demand and the proposed pipe network were also taken into account and modelled. Boundary conditions do not take into account the demand from the site to the north, however, it is anticipated the demand will have minimal impact on the hydraulic results.

Fire flow demands have been calculated as per the Fire Underwriter's Survey (FUS) and are included in **Appendix C**. However as per the City of Ottawa's technical bulletin ISDTB-2014-02 (Revisions to Ottawa Design Guidelines – Water), the majority of the townhouse fireflows have



M:\2011\111117\CAD\Design\Figures\111117-Fig3-RealignedWM.dwg, Fig3-RealignedWM, Jun 22, 2020 - 1:22pm, szorgel

NOVATECH
Engineers, Planners & Landscape Architects
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada K2M 1P6

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

3370 GREENBANK RD.
BURNETT LANDS

REALIGNED GREENBANK
ROAD WATERMAIN

SCALE
NOT TO SCALE

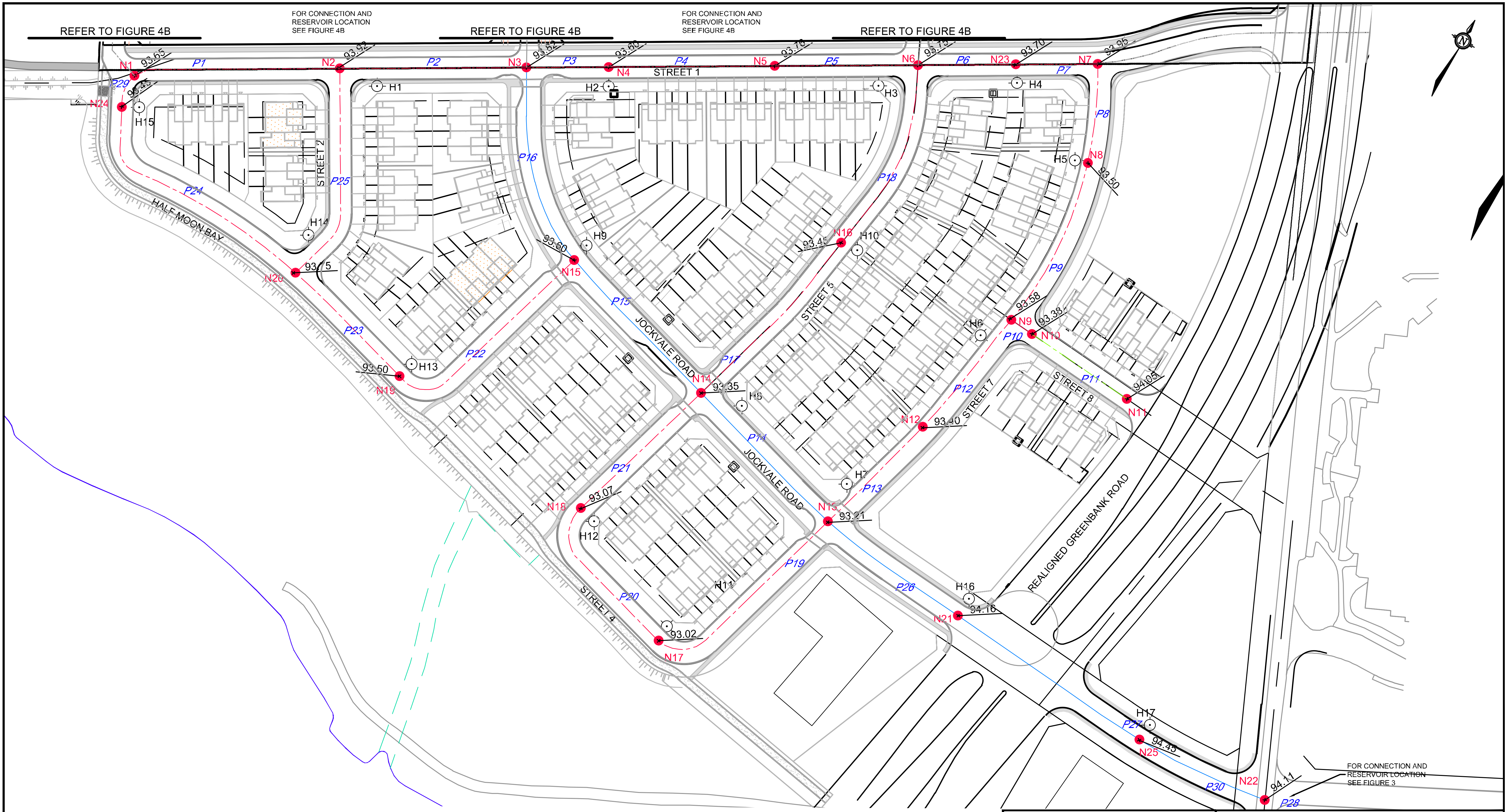
DATE
JUNE 2020

JOB
111117

FIGURE
FIGURE 3

SHT11X17.DWG - 279mmX432mm

M:\2011\111117\CAD\Design\Figures\111117-Fig4-WM.dwg, WM Layout, Jun 22, 2020 - 1:24pm, szorgel



LEGEND

P12	PROPOSED 50mmØ WATERMAIN PIPE
P12	PROPOSED 200mmØ WATERMAIN PIPE
P4	PROPOSED 300mmØ WATERMAIN PIPE
OP4 300mmØ	OFFSITE WATERMAIN PIPE ID AND SIZE (BY OTHERS)
N4 ●	WATERMAIN NODE - ONSITE
ON4 ●	WATERMAIN NODE - OFFSITE
■	RESERVOIR
⊙	HYDRANT
97.75	GROUND ELEVATION
▨	FIREFLOWS THAT CANNOT BE CAPPED AS PER TECHNICAL BULLETIN ISDTB-2014-02

NOVATECH
Engineers, Planners & Landscape Architects
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada K2M 1P6

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

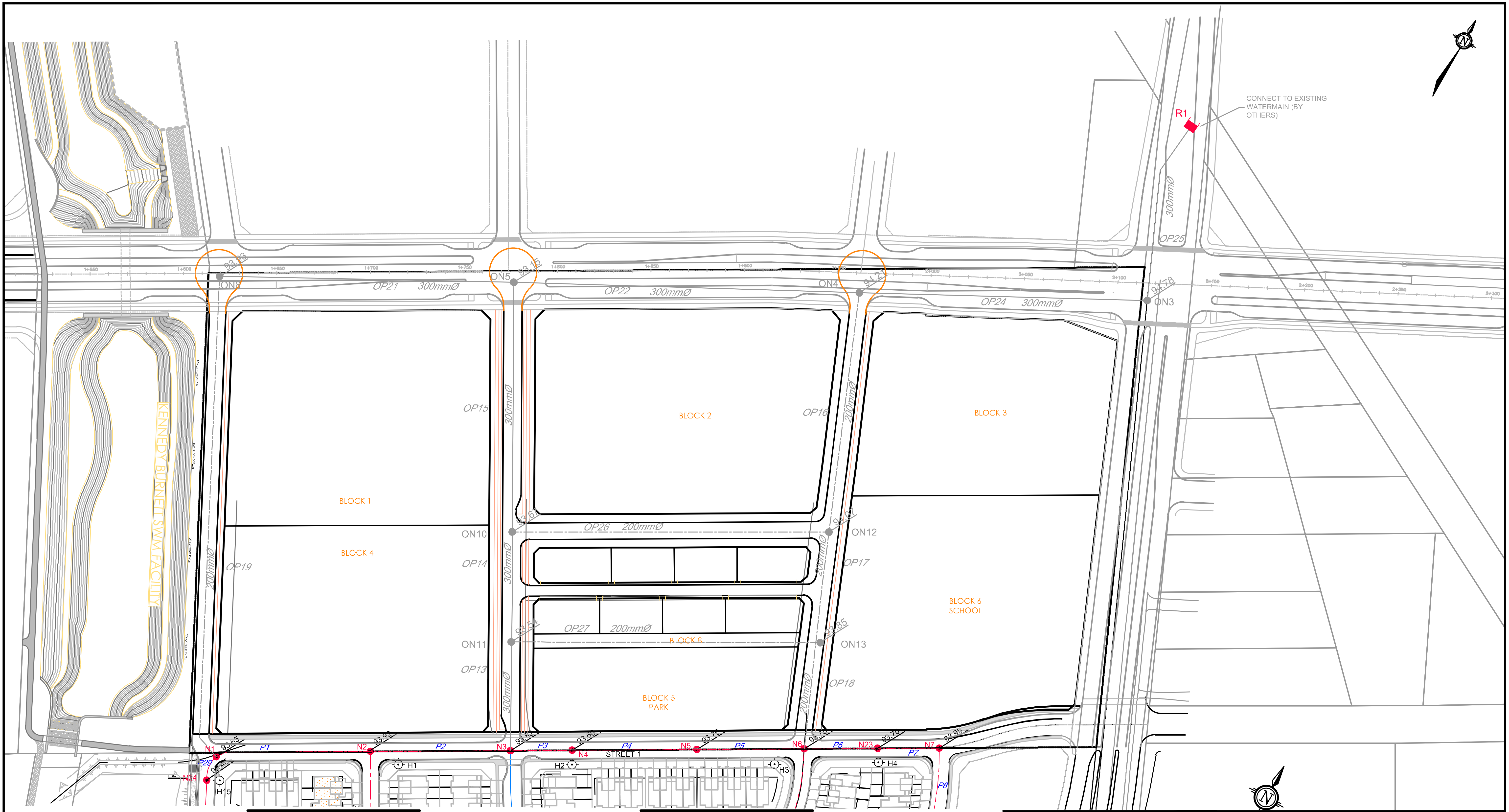
3370 GREENBANK RD.
BURNETT LANDS

WATERMAIN LAYOUT

SCALE 1:1500 (0 15m 30m 60m)

DATE JUNE 2020
JOB 111117
FIGURE FIGURE 4A

SHT11X17.DWG - 279mmX432mm



LEGEND

P12	PROPOSED 50mmØ WATERMAIN PIPE
P12	PROPOSED 200mmØ WATERMAIN PIPE
P4	PROPOSED 300mmØ WATERMAIN PIPE
OP4 300mmØ	OFFSITE WATERMAIN PIPE ID AND SIZE (BY OTHERS)
N4 ●	WATERMAIN NODE - ONSITE
ON4 ●	WATERMAIN NODE - OFFSITE
🟥	RESERVOIR
⨀	HYDRANT
97.75	GROUND ELEVATION
▨	FIREFLOWS THAT CANNOT BE CAPPED AS PER TECHNICAL BULLETIN ISDTB-2014-02

NOVATECH
Engineers, Planners & Landscape Architects

Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada K2M 1P6

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

3370 GREENBANK RD.
BURNETT LANDS

WATERMAIN LAYOUT - OFFSITE (BY OTHERS)

SCALE 1 : 2000 0 20 40 60 80

DATE JUNE 2020
JOB 111117
FIGURE FIGURE 4B

M:\2011\111117\CAD\Design\Figures\111117-Fig4-WM.dwg, WM Layout -Offsite, Apr 01, 2020 - 3:39pm, szorgel

SHT11X17.DWG - 279mmX432mm

been capped at 10,000 L/min (167 L/s). Fireflows that cannot be capped are highlighted in **Figure 4A – Watermain Layout**. Watermain analysis was completed based on the following criteria:

Demands:

Townhouse Density	2.7 persons/unit
Condo/Apartment Density	1.8 persons/unit
Average Daily Demand	350 L/capita/day
Max. Daily Demand	2.5 x Average Daily Demand
Peak Hour Demand	2.2 x Maximum Daily Demand
Fire Flow Demand	Fire Underwriters Survey

System Requirements:

Max. Pressure (Unoccupied Areas)	690 kPa (100 psi)
Max. Pressure (Occupied Areas)	552 kPa (80 psi)
Min. Pressure	276 kPa (40 psi) excluding fire flows
Min. Pressure (Fire)	138 kPa (20 psi) including fire flows
Max. Age (Quality)	192 hours (onsite)

Friction Factors:

Watermain Size	C-Factor
50mm	100
200-250 mm	110
300-400 mm	120

4.4 Watermain Analysis

Hydraulic modelling of the proposed 3370 Greenbank Road was completed using EPANET 2.0. EPANET is public domain software capable of modeling municipal water distribution systems by performing simulations of the water movement within a pressurized system. EPANET utilized the Hazen-Williams equation to predict the performance of the proposed watermain and considered the following input parameters: water demand, pipe length, pipe diameter, pipe roughness, and pipe elevation. Table 1 (Water Demand Calculations) in Appendix C confirms the water demands at each node in the system. Table 2 (Pipe Data) in Appendix C confirms the length, diameter, and roughness of each pipe in the system. Tables 3 to 8 in Appendix C confirms the elevation of each node in the system.

The high pressure condition (average daily demand) was analyzed to ensure the system meets the design criteria for maximum pressure and quality. The maximum daily demand plus fire flow and peak hour conditions were analyzed to ensure the system meets the design criteria for maximum flow and minimum pressure.

The hydraulic modelling results for the development prior to the City reconfiguring the watermain are listed in **Table 4.1.**

Table 4.1: Water Demand Summary (Pre-Watermain Reconfiguration)

Condition	Demand (L/s)	Fire Flow (L/s)	Allowable Max/Min Pressure (kPa/psi)	Max/Min Pressure (kPa/psi)	Time (hrs)
High Pressure	4.53	N/A	690/100 (Max)	626.7/90.9	22.5
Maximum Daily Demand	11.33	167, 183, 200	138/20 (Min)	303.4/44.0 (167L/s at N10)	N/A
Peak Hour	24.93	N/A	276/40 (Min)	447.7/64.9	N/A

The analysis confirms the proposed watermain can service the Burnett Lands prior to the site being included into the realigned Zone 3C pressure zone. It is noted that pressure in the main is greater than 552 kPa/80psi for the entire development. Since the timing for the realignment and reconfiguration is unknown at this time, the use of pressure reducing values will be required throughout the entire development.

The hydraulic modelling results for the development after the watermain realignment of the watermain are listed in **Table 4.2**.

Table 4.2: Water Demand Summary (Post Watermain Reconfiguration)

Condition	Demand (L/s)	Fire Flow (L/s)	Allowable Max/Min Pressure (kPa/psi)	Max/Min Pressure (kPa/psi)	Time (hrs)
High Pressure	4.53	N/A	690/100 (Max)	533.7/77.4	22.5
Maximum Daily Demand	11.33	167, 183, 200	138/20 (Min)	385.4/55.9 (167L/s at N10)	N/A
Peak Hour	24.93	N/A	276/40 (Min)	497.8/72.2	N/A

The analysis confirms the proposed watermain can service the Burnett Lands after the realigned Zone 3C pressure zone under all operating conditions.

A copy of the boundary conditions provided by the City of Ottawa, fire flow calculations, detailed hydraulic analysis results, and watermain layout figure are included in **Appendix C**.

Deviations from the City of Ottawa Design Guidelines – Water Distribution (2010) include:

- As per discussions with the City of Ottawa, Jockvale Road has a 22.0m ROW with a 9.5m wide roadway, with servicing including a sanitary trunk sewer, local sanitary sewer, storm sewer and watermain. A collector road typically has a 24.0m ROW with a 11.0m wide roadway.
  - Due to the geometry (bend, curb bump outs) of Jockvale Road and following the existing sanitary trunk sewer while maintaining sufficient offsets, a portion of the watermain is located under curb. Additionally, hydrant shut off valves cannot be located within the roadway and will be located under the sidewalk along Jockvale

Road. This deviation is a result of reducing the roadway width to 9.5m as per City comments.

- A specific cross section has been developed for Street 1 (shared road) based on comments received from utilities and to accommodate large elliptical storm sewers within the roadway.
- A specific cross section has been developed for all other roadway based on comments received from utilities.
- Isolation valves are to be located 2.0m away from the intersection, from the point where the projection of the property line intersects the watermain. This distance has been increased to accommodate intersection narrowing along the collector road to improve pedestrian crossings and to ensure a valve chamber is not located under curb and located within the roadway. This occurs in several intersections along Jockvale Road.

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.

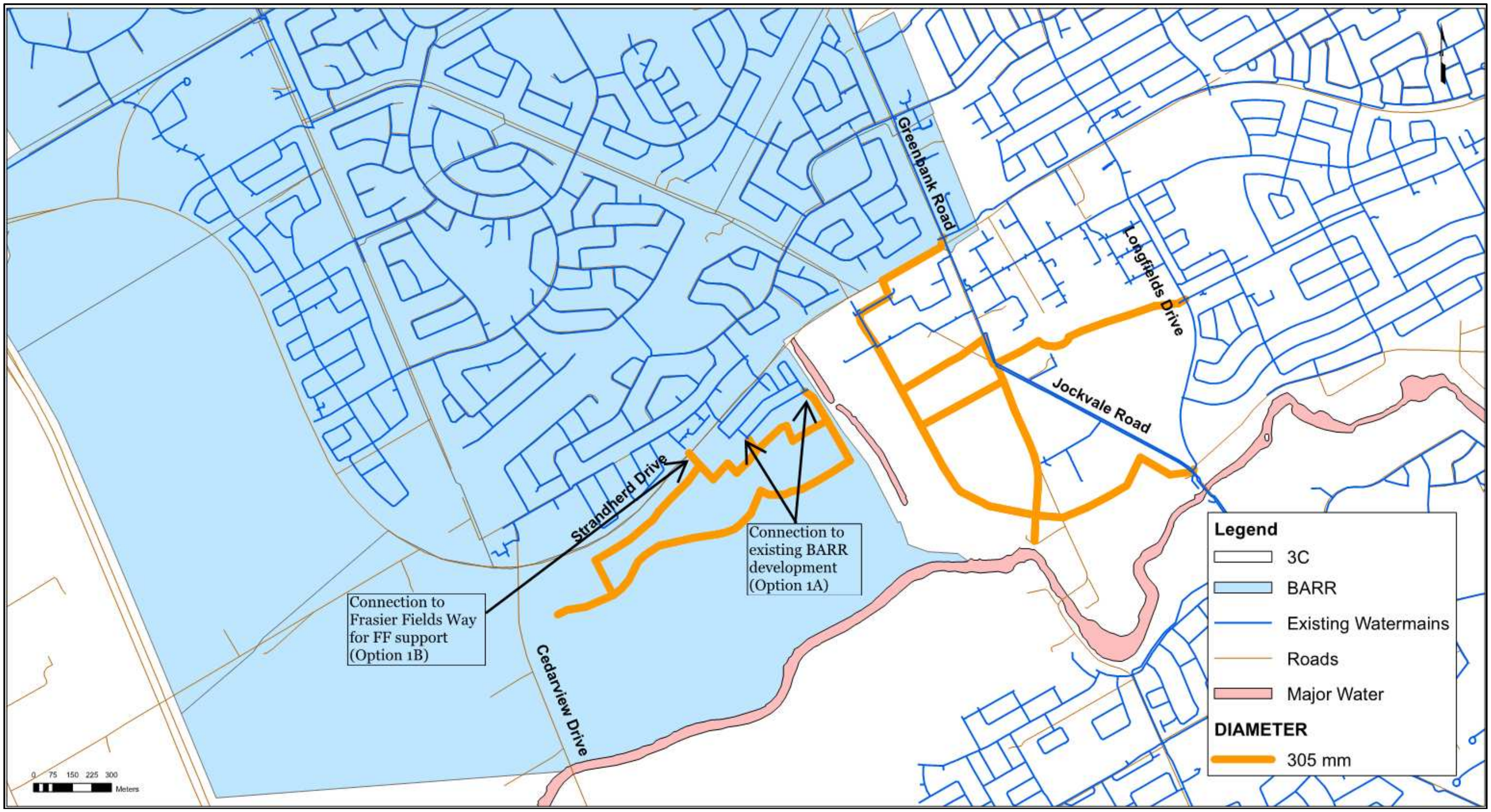
With respect to minimum pressures under peak demand conditions, all pressures at nodes in the NTC lands remain greater than 51 psi whereas the minimum pressure in the KB lands is 64psi. These minimum pressure values are within acceptable guideline ranges.

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

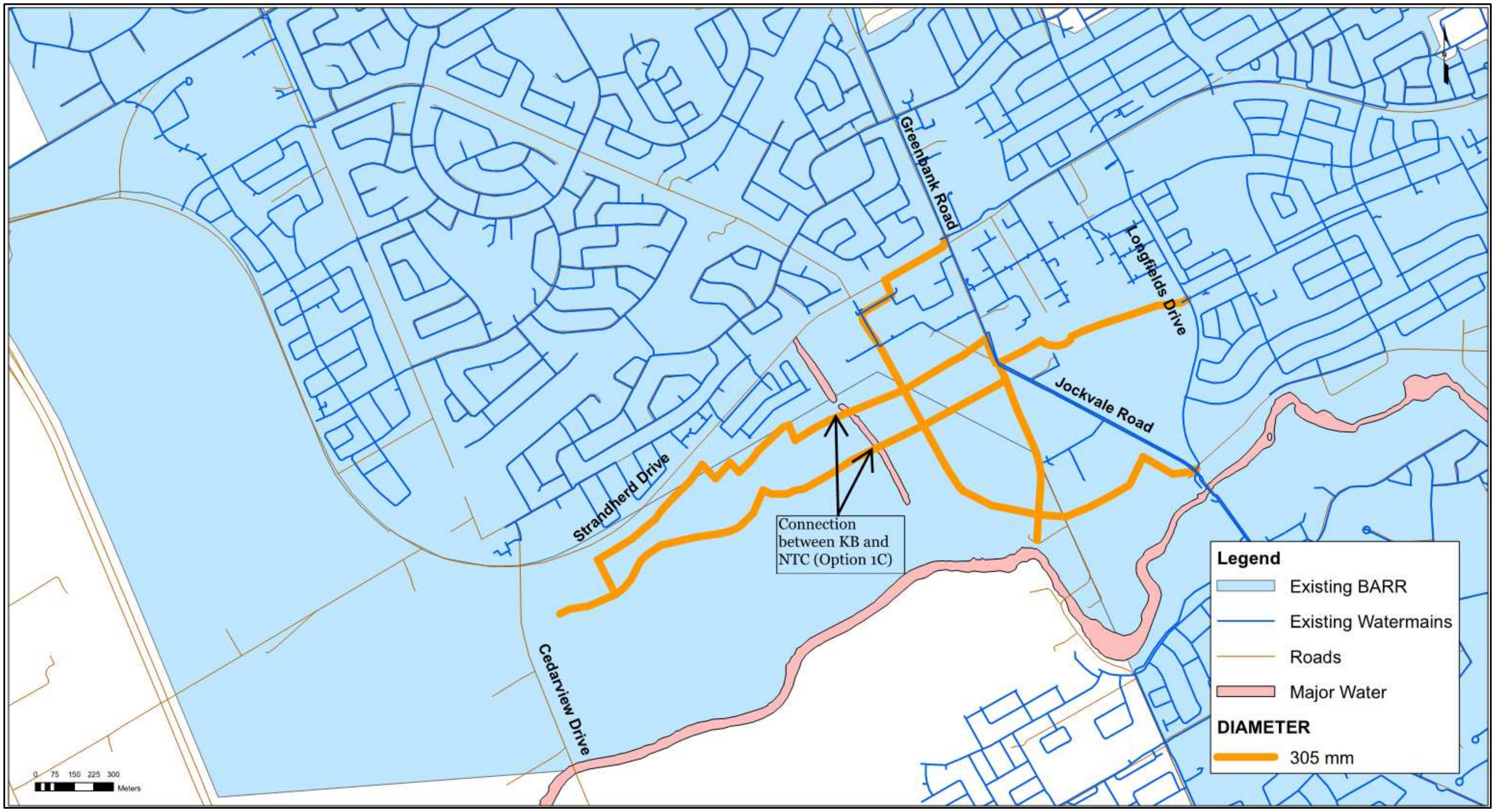
* Pressures greater than 80psi exceed the allowable range as per the OBC



Connection to existing BARR development (Option 1A)

Connection to Frasier Fields Way for FF support (Option 1B)

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



Connection between KB and NTC (Option 1C)

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

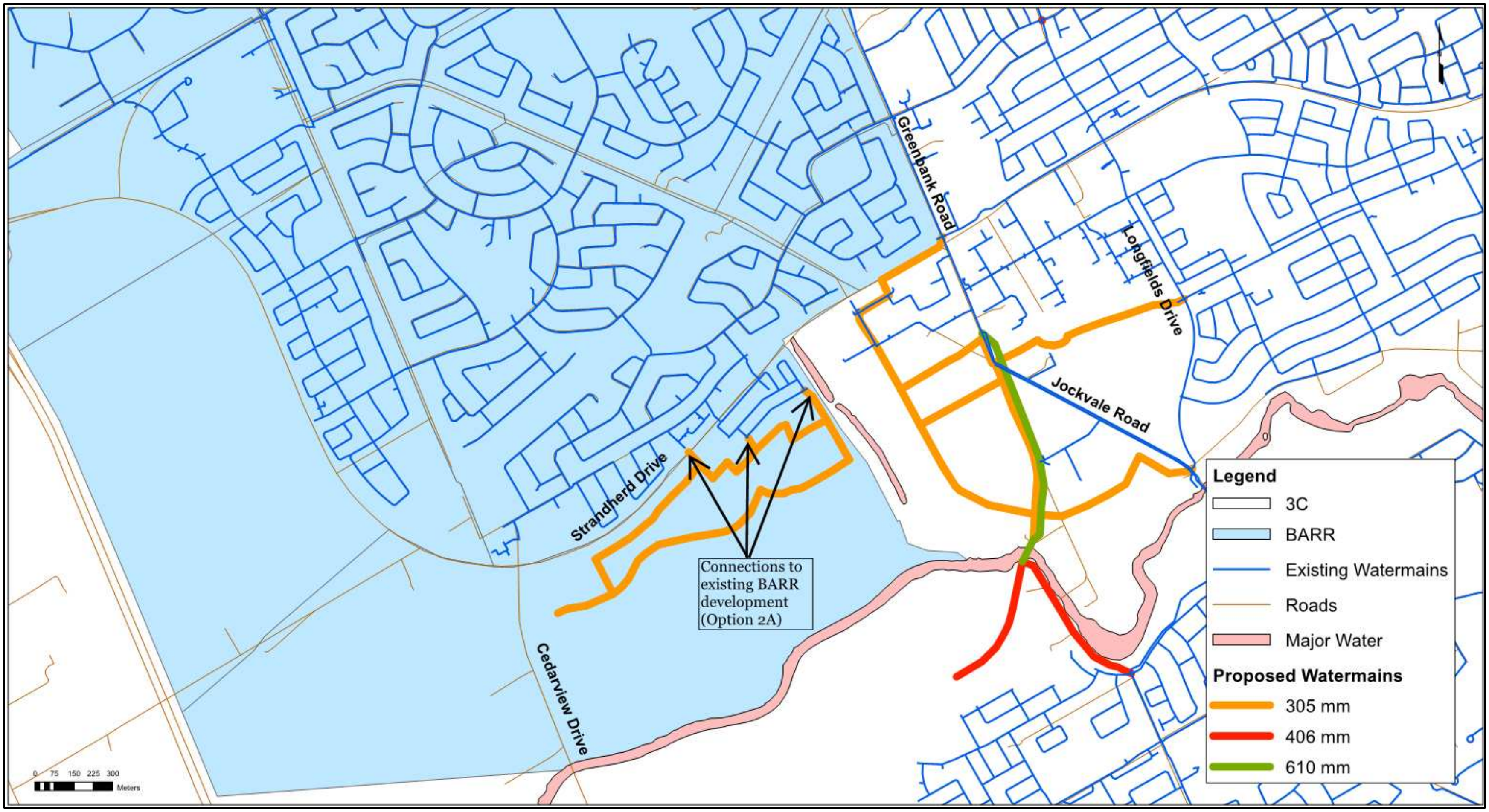
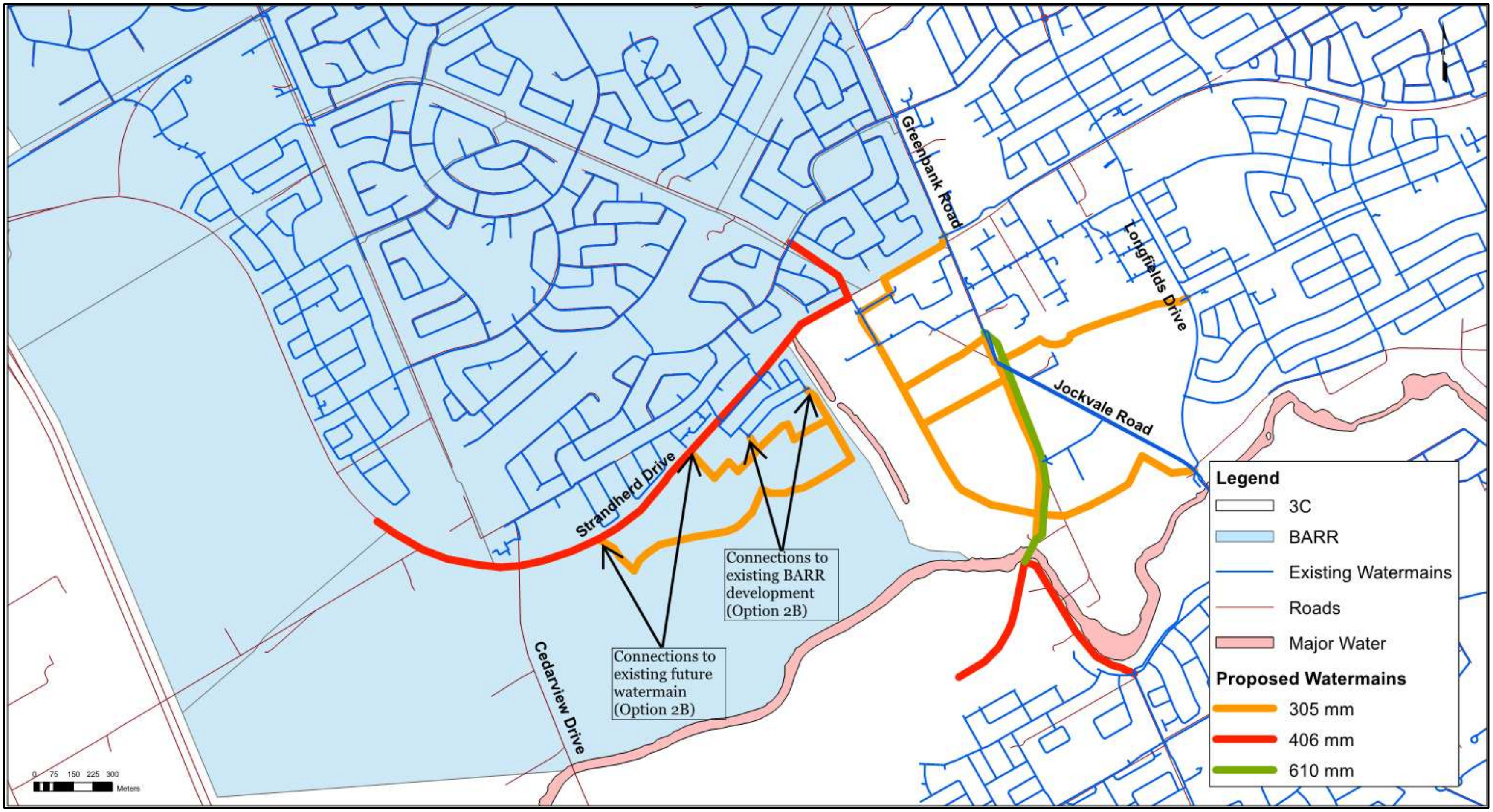


Figure 2-5: Proposed Pipe Layout Post Zone Reconfiguration – Scenario 2A



Connections to existing BARR development (Option 2B)

Connections to existing future watermain (Option 2B)

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

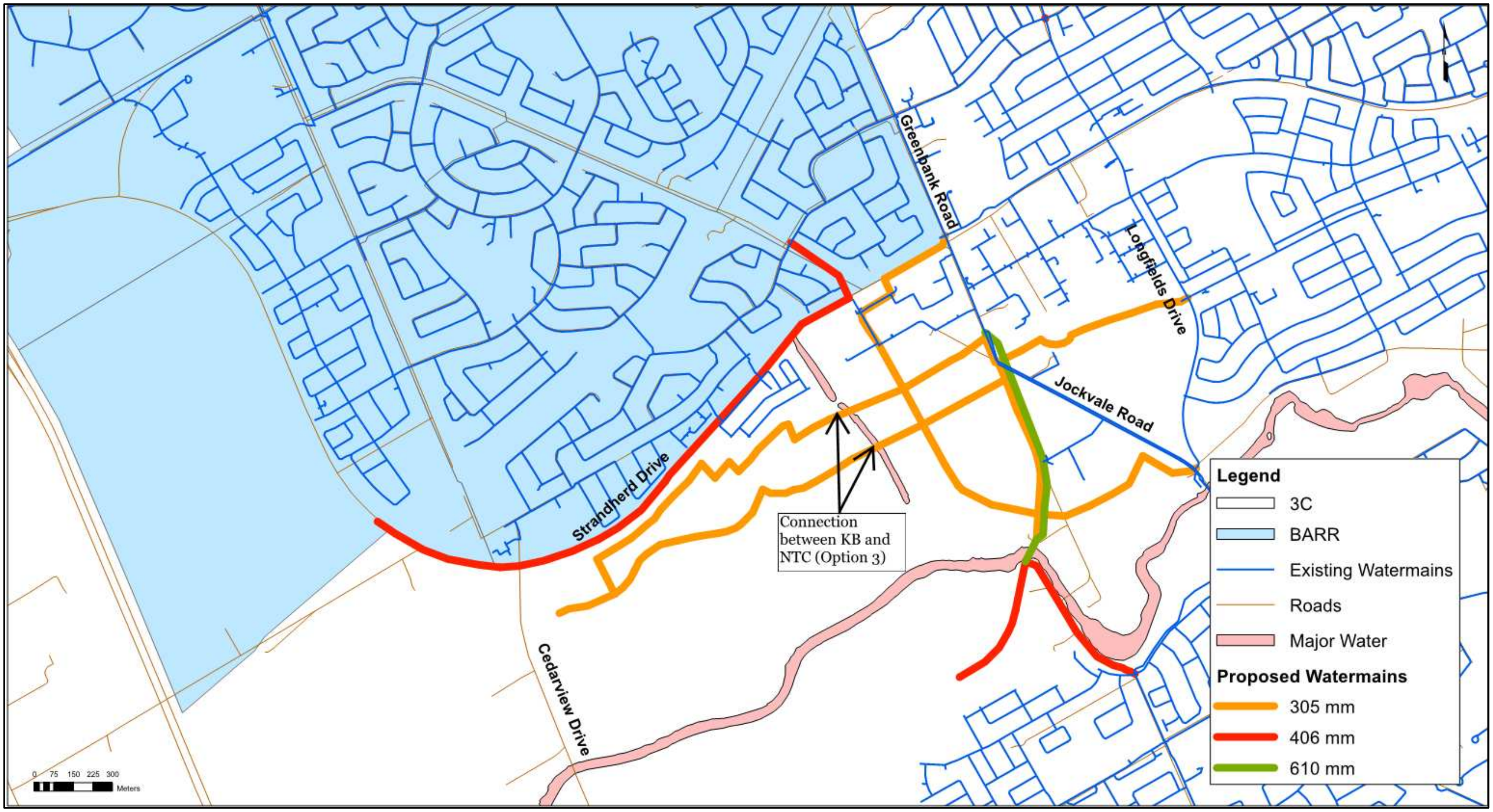


Figure 2-7: Proposed Pipe Layout Post Zone Reconfiguration – Scenario 3

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

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)	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								
				UNITS				CUMULATIVE																											
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (ha)	SINGLE	TOWN	APT	POP.	AREA (ha)	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
MINIMUM COVER: 2.00 m
TIME OF ENTRY 10 min
BEDDING CLASS = B

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-YEAR} (mm/h)	I_{5-YEAR} (mm/h)	$I_{10-YEAR}$ (mm/h)	$I_{100-YEAR}$ (mm/h)	$Q_{CONTROL}$ (L/s)	ACCUM. $Q_{CONTROL}$ (L/s)	Q_{ACT} (CIA/360) (L/s)	LENGTH (m)	PIPE WIDTH OR 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

```
[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
```

```
[RAINGAGES]
;;               Rain      Time   Snow   Data
;;Name           Type      Intrvl Catch  Source
;;-------------- --------- ------ ------ ----------
Raingage         INTENSITY 0:10   1.0    TIMESERIES Chicago_5y_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
;;-------------- ---------- ---------- ---------- ---------- ----------
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
;;-------------- ---------- ------------ ---------------- ---- ----------------
DICB221          90.72      FIXED        91.9             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
;;-------------- -------- -------- -------- ---------- -------- -------- --------
-------- -------- -----------------------
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         93.69    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          90.496   3.214    1.404    FUNCTIONAL 0        0        0        0
       0
STM-102          91.16    2.977    0.74     FUNCTIONAL 0        0        0        0
       0
STM-103          91.071   2.863    0.829    FUNCTIONAL 0        0        0        0
       0
STM-104          91.404   2.583    0.496    FUNCTIONAL 0        0        0        0
       0
STM-105          91.232   2.306    0.668    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      93.69
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
93.69      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          DICB221          25.2       0.013      90.8
90.72      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
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
```

```
L103B-IC         L102B-S          STM-102          SIDE         91.94      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
L102C-IC         CIRCULAR     0.083            0          0          0
L102D-IC         CIRCULAR     0.102            0          0          0
L103B-IC         CIRCULAR     0.178            0          0          0
L105A-IC         CIRCULAR     0.083            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                     1.57       105
L101A-V                     1.571      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       DICB221          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       L102C-IC         RoadCB
Link       L102D-IC         RoadCB
Link       L103B-IC         RoadCB
Link       L105A-IC         RoadCB

[MAP]
DIMENSIONS       363780.9547      5013769.74325    363974.0113      5013954.18575
```

```
UNITS            Meters

[COORDINATES]
;;Node           X-Coord          Y-Coord
;;-------------- ---------------- ----------------
DICB221          363809.615       5013844.287
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
STM-105          363866.9         5013798

[VERTICES]
;;Link           X-Coord          Y-Coord
;;-------------- ---------------- ----------------
C14              363850.866       5013819.484
C14              363846.381       5013820.418
C15              363897.883       5013851.268
C8               363889.802       5013891.91
C9               363886.162       5013871.512
C9               363880.374       5013873.874

[POLYGONS]
;;Subcatchment   X-Coord          Y-Coord
;;-------------- ---------------- ----------------
L101A            363824.67        5013885.528
L101A            363827.444       5013886.934
```

```
L101A           363827.444      5013886.934
L101A           363835.034      5013873.662
L101A           363835.034      5013873.662
L101A           363843.407      5013862.561
L101A           363843.407      5013862.561
L101A           363848.277      5013858.427
L101A           363848.277      5013858.427
L101A           363855.956      5013845.052
L101A           363855.956      5013845.052
L101A           363876.545      5013856.872
L101A           363876.545      5013856.872
L101A           363884.203      5013843.532
L101A           363884.203      5013843.532
L101A           363891.025      5013831.652
L101A           363891.025      5013831.652
L101A           363889.68       5013830.88
L101A           363889.68       5013830.88
L101A           363898.703      5013815.164
L101A           363898.703      5013815.164
L101A           363895.839      5013813.52
L101A           363895.839      5013813.52
L101A           363895.586      5013813.961
L101A           363895.586      5013813.961
L101A           363892.811      5013812.367
L101A           363892.811      5013812.367
L101A           363893.007      5013812.026
L101A           363893.007      5013812.026
L101A           363890.308      5013810.476
L101A           363890.308      5013810.476
L101A           363890.004      5013811.005
L101A           363890.004      5013811.005
L101A           363884.299      5013807.73
L101A           363884.299      5013807.73
L101A           363884.602      5013807.201
L101A           363884.602      5013807.201
L101A           363881.904      5013805.652
L101A           363881.904      5013805.652
L101A           363881.297      5013806.709
L101A           363881.297      5013806.709
L101A           363878.795      5013805.273
L101A           363878.795      5013805.273
L101A           363869.724      5013821.065
L101A           363869.724      5013821.065
L101A           363866.6        5013826.504
L101A           363866.6        5013826.504
L101A           363853.592      5013819.03
L101A           363853.592      5013819.03
L101A           363843.731      5013813.398
```

```
L101A           363843.731      5013813.398
L101A           363842.663      5013815.246
L101A           363842.663      5013815.246
L101A           363839.177      5013813.243
L101A           363839.177      5013813.243
L101A           363830.126      5013808.042
L101A           363830.126      5013808.042
L101A           363828.481      5013810.905
L101A           363828.481      5013810.905
L101A           363828.921      5013811.158
L101A           363828.921      5013811.158
L101A           363827.327      5013813.933
L101A           363827.327      5013813.933
L101A           363825.347      5013816.589
L101A           363825.347      5013816.589
L101A           363822.246      5013821.985
L101A           363822.246      5013821.985
L101A           363822.775      5013822.288
L101A           363822.775      5013822.288
L101A           363819.497      5013827.992
L101A           363819.497      5013827.992
L101A           363818.969      5013827.689
L101A           363818.969      5013827.689
L101A           363817.419      5013830.386
L101A           363817.419      5013830.386
L101A           363817.759      5013830.585
L101A           363817.759      5013830.585
L101A           363816.164      5013833.36
L101A           363816.164      5013833.36
L101A           363815.724      5013833.107
L101A           363815.724      5013833.107
L101A           363814.079      5013835.97
L101A           363814.079      5013835.97
L101A           363819.989      5013839.365
L101A           363819.989      5013839.365
L101A           363815.759      5013846.754
L101A           363815.759      5013846.754
L101A           363811.72       5013852.739
L101A           363811.72       5013852.739
L101A           363805.735      5013856.908
L101A           363805.735      5013856.908
L101A           363798.145      5013870.18
L101A           363798.145      5013870.18
L101A           363800.151      5013871.327
L101A           363800.151      5013871.327
L101A           363800          5013871.592
L101A           363800          5013871.592
L101A           363801.764      5013872.6
```

L101A	363801.764	5013872.6
L101A	363800.554	5013874.717
L101A	363800.554	5013874.717
L101A	363805.051	5013877.289
L101A	363805.051	5013877.289
L101A	363806.261	5013875.172
L101A	363806.261	5013875.172
L101A	363808.036	5013876.187
L101A	363808.036	5013876.187
L101A	363813.14	5013879.106
L101A	363813.14	5013879.106
L101A	363811.93	5013881.222
L101A	363811.93	5013881.222
L101A	363816.427	5013883.794
L101A	363816.427	5013883.794
L101A	363817.637	5013881.678
L101A	363817.637	5013881.678
L101A	363819.401	5013882.686
L101A	363819.401	5013882.686
L101A	363819.552	5013882.422
L101A	363819.552	5013882.422
L101A	363821.559	5013883.569
L101A	363821.559	5013883.569
L101A	363823.107	5013884.635
L101A	363823.107	5013884.635
L101A	363824.67	5013885.528
L102A	363851.651	5013898.935
L102A	363855.954	5013901.396
L102A	363855.954	5013901.396
L102A	363862.748	5013889.51
L102A	363862.748	5013889.51
L102A	363867.398	5013882.261
L102A	363867.398	5013882.261
L102A	363872.957	5013872.538
L102A	363872.957	5013872.538
L102A	363875.408	5013868.257
L102A	363875.408	5013868.257
L102A	363880.606	5013859.203
L102A	363880.606	5013859.203
L102A	363876.545	5013856.872
L102A	363876.545	5013856.872
L102A	363855.956	5013845.052
L102A	363855.956	5013845.052
L102A	363848.277	5013858.427
L102A	363848.277	5013858.427
L102A	363843.407	5013862.561
L102A	363843.407	5013862.561
L102A	363835.034	5013873.662

L102A	363835.034	5013873.662
L102A	363827.444	5013886.934
L102A	363827.444	5013886.934
L102A	363829.45	5013888.082
L102A	363829.45	5013888.082
L102A	363829.299	5013888.346
L102A	363829.299	5013888.346
L102A	363831.063	5013889.355
L102A	363831.063	5013889.355
L102A	363829.852	5013891.471
L102A	363829.852	5013891.471
L102A	363834.35	5013894.043
L102A	363834.35	5013894.043
L102A	363835.56	5013891.927
L102A	363835.56	5013891.927
L102A	363842.439	5013895.86
L102A	363842.439	5013895.86
L102A	363841.229	5013897.976
L102A	363841.229	5013897.976
L102A	363845.726	5013900.548
L102A	363845.726	5013900.548
L102A	363846.936	5013898.432
L102A	363846.936	5013898.432
L102A	363848.7	5013899.44
L102A	363848.7	5013899.44
L102A	363848.851	5013899.176
L102A	363848.851	5013899.176
L102A	363850.858	5013900.323
L102A	363850.858	5013900.323
L102A	363851.651	5013898.935
L102B	363885.061	5013918.04
L102B	363889.722	5013920.706
L102B	363889.722	5013920.706
L102B	363896.518	5013908.822
L102B	363896.518	5013908.822
L102B	363898.524	5013909.969
L102B	363898.524	5013909.969
L102B	363898.676	5013909.704
L102B	363898.676	5013909.704
L102B	363900.439	5013910.713
L102B	363900.439	5013910.713
L102B	363901.65	5013908.596
L102B	363901.65	5013908.596
L102B	363903.565	5013905.243
L102B	363903.565	5013905.243
L102B	363904.723	5013903.601
L102B	363904.723	5013903.601
L102B	363910.282	5013893.878

L102B	363910.282	5013893.878
L102B	363906.9	5013891.83
L102B	363906.9	5013891.83
L102B	363897.182	5013883.324
L102B	363897.182	5013883.324
L102B	363894.808	5013881.989
L102B	363894.808	5013881.989
L102B	363904.068	5013865.403
L102B	363904.068	5013865.403
L102B	363909.654	5013861.144
L102B	363909.654	5013861.144
L102B	363921.1	5013858.279
L102B	363921.1	5013858.279
L102B	363931.902	5013864.012
L102B	363931.902	5013864.012
L102B	363938.576	5013867.739
L102B	363938.576	5013867.739
L102B	363945.251	5013871.467
L102B	363945.251	5013871.467
L102B	363946.378	5013869.449
L102B	363946.378	5013869.449
L102B	363946.654	5013869.585
L102B	363946.654	5013869.585
L102B	363947.634	5013867.824
L102B	363947.634	5013867.824
L102B	363949.763	5013869.012
L102B	363949.763	5013869.012
L102B	363952.289	5013864.489
L102B	363952.289	5013864.489
L102B	363950.165	5013863.303
L102B	363950.165	5013863.303
L102B	363954.024	5013856.382
L102B	363954.024	5013856.382
L102B	363956.153	5013857.571
L102B	363956.153	5013857.571
L102B	363958.679	5013853.048
L102B	363958.679	5013853.048
L102B	363956.55	5013851.859
L102B	363956.55	5013851.859
L102B	363957.541	5013850.085
L102B	363957.541	5013850.085
L102B	363957.275	5013849.936
L102B	363957.275	5013849.936
L102B	363958.402	5013847.919
L102B	363958.402	5013847.919
L102B	363945.053	5013840.464
L102B	363945.053	5013840.464
L102B	363943.929	5013842.483

L102B	363943.929	5013842.483
L102B	363943.66	5013842.333
L102B	363943.66	5013842.333
L102B	363942.67	5013844.107
L102B	363942.67	5013844.107
L102B	363940.541	5013842.918
L102B	363940.541	5013842.918
L102B	363938.164	5013842.488
L102B	363938.164	5013842.488
L102B	363936.591	5013841.609
L102B	363936.591	5013841.609
L102B	363932.242	5013838.731
L102B	363932.242	5013838.731
L102B	363922.288	5013833.174
L102B	363922.288	5013833.174
L102B	363924.202	5013829.841
L102B	363924.202	5013829.841
L102B	363921.075	5013828.045
L102B	363921.075	5013828.045
L102B	363920.423	5013829.179
L102B	363920.423	5013829.179
L102B	363917.472	5013827.483
L102B	363917.472	5013827.483
L102B	363918.079	5013826.426
L102B	363918.079	5013826.426
L102B	363915.381	5013824.876
L102B	363915.381	5013824.876
L102B	363915.078	5013825.405
L102B	363915.078	5013825.405
L102B	363909.373	5013822.128
L102B	363909.373	5013822.128
L102B	363909.677	5013821.599
L102B	363909.677	5013821.599
L102B	363906.978	5013820.049
L102B	363906.978	5013820.049
L102B	363906.782	5013820.39
L102B	363906.782	5013820.39
L102B	363904.007	5013818.796
L102B	363904.007	5013818.796
L102B	363904.26	5013818.356
L102B	363904.26	5013818.356
L102B	363901.397	5013816.711
L102B	363901.397	5013816.711
L102B	363892.37	5013832.424
L102B	363892.37	5013832.424
L102B	363891.025	5013831.652
L102B	363891.025	5013831.652
L102B	363884.203	5013843.532

L102B	363884.203	5013843.532
L102B	363876.545	5013856.872
L102B	363876.545	5013856.872
L102B	363880.606	5013859.203
L102B	363880.606	5013859.203
L102B	363875.408	5013868.257
L102B	363875.408	5013868.257
L102B	363872.957	5013872.538
L102B	363872.957	5013872.538
L102B	363867.398	5013882.261
L102B	363867.398	5013882.261
L102B	363862.748	5013889.51
L102B	363862.748	5013889.51
L102B	363855.954	5013901.396
L102B	363855.954	5013901.396
L102B	363855.161	5013902.783
L102B	363855.161	5013902.783
L102B	363857.167	5013903.93
L102B	363857.167	5013903.93
L102B	363857.016	5013904.195
L102B	363857.016	5013904.195
L102B	363858.78	5013905.203
L102B	363858.78	5013905.203
L102B	363857.57	5013907.32
L102B	363857.57	5013907.32
L102B	363862.068	5013909.891
L102B	363862.068	5013909.891
L102B	363863.278	5013907.774
L102B	363863.278	5013907.774
L102B	363868.036	5013910.495
L102B	363868.036	5013910.495
L102B	363870.157	5013911.707
L102B	363870.157	5013911.707
L102B	363868.947	5013913.823
L102B	363868.947	5013913.823
L102B	363873.445	5013916.394
L102B	363873.445	5013916.394
L102B	363874.655	5013914.278
L102B	363874.655	5013914.278
L102B	363876.419	5013915.286
L102B	363876.419	5013915.286
L102B	363876.57	5013915.021
L102B	363876.57	5013915.021
L102B	363878.576	5013916.168
L102B	363878.576	5013916.168
L102B	363879.367	5013914.785
L102B	363879.367	5013914.785
L102B	363885.061	5013918.04

L102C	363912.342	5013935.483
L102C	363919.932	5013922.21
L102C	363919.932	5013922.21
L102C	363917.925	5013921.063
L102C	363917.925	5013921.063
L102C	363918.077	5013920.799
L102C	363918.077	5013920.799
L102C	363917.371	5013920.395
L102C	363917.371	5013920.395
L102C	363920.497	5013914.924
L102C	363920.497	5013914.924
L102C	363921.391	5013913.361
L102C	363921.391	5013913.361
L102C	363924.785	5013909.312
L102C	363924.785	5013909.312
L102C	363928.855	5013902.193
L102C	363928.855	5013902.193
L102C	363929.539	5013899.609
L102C	363929.539	5013899.609
L102C	363916.19	5013892.157
L102C	363916.19	5013892.157
L102C	363910.282	5013893.878
L102C	363910.282	5013893.878
L102C	363904.723	5013903.601
L102C	363904.723	5013903.601
L102C	363903.565	5013905.243
L102C	363903.565	5013905.243
L102C	363901.65	5013908.596
L102C	363901.65	5013908.596
L102C	363900.439	5013910.713
L102C	363900.439	5013910.713
L102C	363898.676	5013909.704
L102C	363898.676	5013909.704
L102C	363898.524	5013909.969
L102C	363898.524	5013909.969
L102C	363896.518	5013908.822
L102C	363896.518	5013908.822
L102C	363889.722	5013920.706
L102C	363889.722	5013920.706
L102C	363888.929	5013922.094
L102C	363888.929	5013922.094
L102C	363890.935	5013923.241
L102C	363890.935	5013923.241
L102C	363890.783	5013923.506
L102C	363890.783	5013923.506
L102C	363892.547	5013924.514
L102C	363892.547	5013924.514
L102C	363891.337	5013926.631

L102C	363891.337	5013926.631
L102C	363895.834	5013929.202
L102C	363895.834	5013929.202
L102C	363897.045	5013927.086
L102C	363897.045	5013927.086
L102C	363903.923	5013931.019
L102C	363903.923	5013931.019
L102C	363902.713	5013933.136
L102C	363902.713	5013933.136
L102C	363907.211	5013935.708
L102C	363907.211	5013935.708
L102C	363908.421	5013933.591
L102C	363908.421	5013933.591
L102C	363910.185	5013934.6
L102C	363910.185	5013934.6
L102C	363910.336	5013934.335
L102C	363910.336	5013934.335
L102C	363912.342	5013935.483
L102D	363938.576	5013867.739
L102D	363931.902	5013864.012
L102D	363931.902	5013864.012
L102D	363921.1	5013858.279
L102D	363921.1	5013858.279
L102D	363909.654	5013861.144
L102D	363909.654	5013861.144
L102D	363904.068	5013865.403
L102D	363904.068	5013865.403
L102D	363894.808	5013881.989
L102D	363894.808	5013881.989
L102D	363897.182	5013883.324
L102D	363897.182	5013883.324
L102D	363906.9	5013891.83
L102D	363906.9	5013891.83
L102D	363910.282	5013893.878
L102D	363910.282	5013893.878
L102D	363916.19	5013892.157
L102D	363916.19	5013892.157
L102D	363929.539	5013899.609
L102D	363929.539	5013899.609
L102D	363930.666	5013897.591
L102D	363930.666	5013897.591
L102D	363930.932	5013897.74
L102D	363930.932	5013897.74
L102D	363931.922	5013895.966
L102D	363931.922	5013895.966
L102D	363934.051	5013897.154
L102D	363934.051	5013897.154
L102D	363936.577	5013892.63

L102D	363936.577	5013892.63
L102D	363934.448	5013891.442
L102D	363934.448	5013891.442
L102D	363938.31	5013884.523
L102D	363938.31	5013884.523
L102D	363940.44	5013885.712
L102D	363940.44	5013885.712
L102D	363942.965	5013881.188
L102D	363942.965	5013881.188
L102D	363940.836	5013879.999
L102D	363940.836	5013879.999
L102D	363941.826	5013878.225
L102D	363941.826	5013878.225
L102D	363941.561	5013878.077
L102D	363941.561	5013878.077
L102D	363942.686	5013876.059
L102D	363942.686	5013876.059
L102D	363936.012	5013872.332
L102D	363936.012	5013872.332
L102D	363938.576	5013867.739
L105A	363874.339	5013795.992
L105A	363868.693	5013792.758
L105A	363868.693	5013792.758
L105A	363862.862	5013792.927
L105A	363862.862	5013792.927
L105A	363844.803	5013782.55
L105A	363844.803	5013782.55
L105A	363843.006	5013785.677
L105A	363843.006	5013785.677
L105A	363844.14	5013786.329
L105A	363844.14	5013786.329
L105A	363842.444	5013789.28
L105A	363842.444	5013789.28
L105A	363841.387	5013788.673
L105A	363841.387	5013788.673
L105A	363839.837	5013791.371
L105A	363839.837	5013791.371
L105A	363840.366	5013791.674
L105A	363840.366	5013791.674
L105A	363837.088	5013797.378
L105A	363837.088	5013797.378
L105A	363836.56	5013797.075
L105A	363836.56	5013797.075
L105A	363835.009	5013799.773
L105A	363835.009	5013799.773
L105A	363835.35	5013799.969
L105A	363835.35	5013799.969
L105A	363833.756	5013802.744

```
L105A           363833.756      5013802.744
L105A           363833.315      5013802.491
L105A           363833.315      5013802.491
L105A           363831.67       5013805.354
L105A           363831.67       5013805.354
L105A           363844.208      5013812.558
L105A           363844.208      5013812.558
L105A           363843.731      5013813.398
L105A           363843.731      5013813.398
L105A           363853.592      5013819.03
L105A           363853.592      5013819.03
L105A           363866.6        5013826.504
L105A           363866.6        5013826.504
L105A           363869.724      5013821.065
L105A           363869.724      5013821.065
L105A           363878.795      5013805.273
L105A           363878.795      5013805.273
L105A           363878.345      5013805.015
L105A           363878.345      5013805.015
L105A           363878.996      5013803.88
L105A           363878.996      5013803.88
L105A           363875.868      5013802.085
L105A           363875.868      5013802.085
L105A           363874.339      5013795.992
UNC-1           363815.724      5013833.107
UNC-1           363816.164      5013833.36
UNC-1           363816.164      5013833.36
UNC-1           363817.759      5013830.585
UNC-1           363817.759      5013830.585
UNC-1           363817.419      5013830.386
UNC-1           363817.419      5013830.386
UNC-1           363818.969      5013827.689
UNC-1           363818.969      5013827.689
UNC-1           363819.497      5013827.992
UNC-1           363819.497      5013827.992
UNC-1           363822.775      5013822.288
UNC-1           363822.775      5013822.288
UNC-1           363822.246      5013821.985
UNC-1           363822.246      5013821.985
UNC-1           363825.347      5013816.589
UNC-1           363825.347      5013816.589
UNC-1           363827.327      5013813.933
UNC-1           363827.327      5013813.933
UNC-1           363828.921      5013811.158
UNC-1           363828.921      5013811.158
UNC-1           363828.481      5013810.905
UNC-1           363828.481      5013810.905
UNC-1           363830.126      5013808.042
```

```
UNC-1           363830.126      5013808.042
UNC-1           363839.177      5013813.243
UNC-1           363839.177      5013813.243
UNC-1           363842.663      5013815.246
UNC-1           363842.663      5013815.246
UNC-1           363843.731      5013813.398
UNC-1           363843.731      5013813.398
UNC-1           363844.208      5013812.558
UNC-1           363844.208      5013812.558
UNC-1           363831.67       5013805.354
UNC-1           363831.67       5013805.354
UNC-1           363833.315      5013802.491
UNC-1           363833.315      5013802.491
UNC-1           363833.756      5013802.744
UNC-1           363833.756      5013802.744
UNC-1           363835.35       5013799.969
UNC-1           363835.35       5013799.969
UNC-1           363835.009      5013799.773
UNC-1           363835.009      5013799.773
UNC-1           363836.56       5013797.075
UNC-1           363836.56       5013797.075
UNC-1           363837.088      5013797.378
UNC-1           363837.088      5013797.378
UNC-1           363840.366      5013791.674
UNC-1           363840.366      5013791.674
UNC-1           363839.837      5013791.371
UNC-1           363839.837      5013791.371
UNC-1           363841.387      5013788.673
UNC-1           363841.387      5013788.673
UNC-1           363842.444      5013789.28
UNC-1           363842.444      5013789.28
UNC-1           363844.14       5013786.329
UNC-1           363844.14       5013786.329
UNC-1           363843.006      5013785.677
UNC-1           363843.006      5013785.677
UNC-1           363844.803      5013782.55
UNC-1           363844.803      5013782.55
UNC-1           363862.862      5013792.927
UNC-1           363862.862      5013792.927
UNC-1           363868.693      5013792.758
UNC-1           363868.693      5013792.758
UNC-1           363843.215      5013778.127
UNC-1           363843.215      5013778.127
UNC-1           363839.241      5013779.3
UNC-1           363839.241      5013779.3
UNC-1           363789.73       5013875.495
UNC-1           363789.73       5013875.495
UNC-1           363863.823      5013917.865
```

```
UNC-1            363863.823       5013917.865
UNC-1            363868.036       5013910.495
UNC-1            363868.036       5013910.495
UNC-1            363863.278       5013907.774
UNC-1            363863.278       5013907.774
UNC-1            363862.068       5013909.891
UNC-1            363862.068       5013909.891
UNC-1            363857.57        5013907.32
UNC-1            363857.57        5013907.32
UNC-1            363858.78        5013905.203
UNC-1            363858.78        5013905.203
UNC-1            363857.016       5013904.195
UNC-1            363857.016       5013904.195
UNC-1            363857.167       5013903.93
UNC-1            363857.167       5013903.93
UNC-1            363855.161       5013902.783
UNC-1            363855.161       5013902.783
UNC-1            363855.954       5013901.396
UNC-1            363855.954       5013901.396
UNC-1            363851.651       5013898.935
UNC-1            363851.651       5013898.935
UNC-1            363850.858       5013900.323
UNC-1            363850.858       5013900.323
UNC-1            363848.851       5013899.176
UNC-1            363848.851       5013899.176
UNC-1            363848.7         5013899.44
UNC-1            363848.7         5013899.44
UNC-1            363846.936       5013898.432
UNC-1            363846.936       5013898.432
UNC-1            363845.726       5013900.548
UNC-1            363845.726       5013900.548
UNC-1            363841.229       5013897.976
UNC-1            363841.229       5013897.976
UNC-1            363842.439       5013895.86
UNC-1            363842.439       5013895.86
UNC-1            363835.56        5013891.927
UNC-1            363835.56        5013891.927
UNC-1            363834.35        5013894.043
UNC-1            363834.35        5013894.043
UNC-1            363829.852       5013891.471
UNC-1            363829.852       5013891.471
UNC-1            363831.063       5013889.355
UNC-1            363831.063       5013889.355
UNC-1            363829.299       5013888.346
UNC-1            363829.299       5013888.346
UNC-1            363829.45        5013888.082
UNC-1            363829.45        5013888.082
UNC-1            363827.444       5013886.934
```

```
UNC-1            363827.444       5013886.934
UNC-1            363824.67        5013885.528
UNC-1            363824.67        5013885.528
UNC-1            363823.107       5013884.635
UNC-1            363823.107       5013884.635
UNC-1            363821.559       5013883.569
UNC-1            363821.559       5013883.569
UNC-1            363819.552       5013882.422
UNC-1            363819.552       5013882.422
UNC-1            363819.401       5013882.686
UNC-1            363819.401       5013882.686
UNC-1            363817.637       5013881.678
UNC-1            363817.637       5013881.678
UNC-1            363816.427       5013883.794
UNC-1            363816.427       5013883.794
UNC-1            363811.93        5013881.222
UNC-1            363811.93        5013881.222
UNC-1            363813.14        5013879.106
UNC-1            363813.14        5013879.106
UNC-1            363808.036       5013876.187
UNC-1            363808.036       5013876.187
UNC-1            363806.261       5013875.172
UNC-1            363806.261       5013875.172
UNC-1            363805.051       5013877.289
UNC-1            363805.051       5013877.289
UNC-1            363800.554       5013874.717
UNC-1            363800.554       5013874.717
UNC-1            363801.764       5013872.6
UNC-1            363801.764       5013872.6
UNC-1            363800           5013871.592
UNC-1            363800           5013871.592
UNC-1            363800.151       5013871.327
UNC-1            363800.151       5013871.327
UNC-1            363798.145       5013870.18
UNC-1            363798.145       5013870.18
UNC-1            363805.735       5013856.908
UNC-1            363805.735       5013856.908
UNC-1            363811.72        5013852.739
UNC-1            363811.72        5013852.739
UNC-1            363815.759       5013846.754
UNC-1            363815.759       5013846.754
UNC-1            363819.989       5013839.365
UNC-1            363819.989       5013839.365
UNC-1            363814.079       5013835.97
UNC-1            363814.079       5013835.97
UNC-1            363815.724       5013833.107
UNC-2            363917.402       5013826.037
UNC-2            363919.785       5013822.096
```

UNC-2	363874.339	5013795.992
UNC-2	363875.868	5013802.085
UNC-2	363878.996	5013803.88
UNC-2	363878.345	5013805.015
UNC-2	363878.795	5013805.273
UNC-2	363881.297	5013806.709
UNC-2	363881.904	5013805.652
UNC-2	363884.602	5013807.201
UNC-2	363884.299	5013807.73
UNC-2	363890.004	5013811.005
UNC-2	363890.308	5013810.476
UNC-2	363893.007	5013812.026
UNC-2	363892.811	5013812.367
UNC-2	363895.586	5013813.961
UNC-2	363895.839	5013813.52
UNC-2	363898.703	5013815.164
UNC-2	363889.68	5013830.88
UNC-2	363891.025	5013831.652
UNC-2	363892.37	5013832.424
UNC-2	363901.397	5013816.711
UNC-2	363904.26	5013818.356
UNC-2	363904.007	5013818.796
UNC-2	363906.782	5013820.39
UNC-2	363906.978	5013820.049
UNC-2	363909.677	5013821.599
UNC-2	363909.373	5013822.128
UNC-2	363915.078	5013825.405
UNC-2	363915.381	5013824.876
UNC-2	363917.402	5013826.037
UNC-3	363964.106	5013847.567
UNC-3	363958.387	5013847.945
UNC-3	363957.275	5013849.936
UNC-3	363957.541	5013850.085
UNC-3	363956.55	5013851.859
UNC-3	363958.679	5013853.048
UNC-3	363956.153	5013857.571
UNC-3	363954.024	5013856.382
UNC-3	363950.165	5013863.303
UNC-3	363952.289	5013864.489
UNC-3	363949.763	5013869.012
UNC-3	363947.634	5013867.824
UNC-3	363946.654	5013869.585
UNC-3	363946.378	5013869.449
UNC-3	363945.251	5013871.467
UNC-3	363938.576	5013867.739
UNC-3	363936.012	5013872.332
UNC-3	363942.686	5013876.059
UNC-3	363941.561	5013878.077

UNC-3	363941.826	5013878.225
UNC-3	363940.836	5013879.999
UNC-3	363942.965	5013881.188
UNC-3	363940.44	5013885.712
UNC-3	363938.31	5013884.523
UNC-3	363934.448	5013891.442
UNC-3	363936.577	5013892.63
UNC-3	363934.051	5013897.154
UNC-3	363931.922	5013895.966
UNC-3	363930.932	5013897.74
UNC-3	363930.666	5013897.591
UNC-3	363929.539	5013899.609
UNC-3	363928.855	5013902.193
UNC-3	363924.785	5013909.312
UNC-3	363921.391	5013913.361
UNC-3	363920.497	5013914.924
UNC-3	363917.371	5013920.395
UNC-3	363918.077	5013920.799
UNC-3	363917.925	5013921.063
UNC-3	363919.932	5013922.21
UNC-3	363912.342	5013935.483
UNC-3	363910.336	5013934.335
UNC-3	363910.185	5013934.6
UNC-3	363908.421	5013933.591
UNC-3	363907.211	5013935.708
UNC-3	363902.713	5013933.136
UNC-3	363903.923	5013931.019
UNC-3	363897.045	5013927.086
UNC-3	363895.834	5013929.202
UNC-3	363891.337	5013926.631
UNC-3	363892.547	5013924.514
UNC-3	363890.783	5013923.506
UNC-3	363890.935	5013923.241
UNC-3	363888.929	5013922.094
UNC-3	363889.722	5013920.706
UNC-3	363885.061	5013918.04
UNC-3	363879.367	5013914.785
UNC-3	363878.576	5013916.168
UNC-3	363876.57	5013915.021
UNC-3	363876.419	5013915.286
UNC-3	363874.655	5013914.278
UNC-3	363873.445	5013916.394
UNC-3	363868.947	5013913.823
UNC-3	363870.157	5013911.707
UNC-3	363868.036	5013910.495
UNC-3	363863.823	5013917.865
UNC-3	363912.677	5013945.802
UNC-3	363926.744	5013920.609

```
UNC-3            363932.862       5013909.651
UNC-3            363965.236       5013851.67
UNC-3            363964.106       5013847.567
UNC-4            363919.785       5013822.096
UNC-4            363917.402       5013826.037
UNC-4            363918.079       5013826.426
UNC-4            363917.472       5013827.483
UNC-4            363920.423       5013829.179
UNC-4            363921.075       5013828.045
UNC-4            363924.202       5013829.841
UNC-4            363922.288       5013833.174
UNC-4            363932.242       5013838.731
UNC-4            363936.591       5013841.609
UNC-4            363938.164       5013842.488
UNC-4            363940.541       5013842.918
UNC-4            363942.67        5013844.107
UNC-4            363943.66        5013842.333
UNC-4            363943.929       5013842.483
UNC-4            363945.053       5013840.464
UNC-4            363958.402       5013847.919
UNC-4            363958.387       5013847.945
UNC-4            363964.106       5013847.567
UNC-4            363964.101       5013847.55
UNC-4            363919.785       5013822.096

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

```
[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
```

```
[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
;;-------------- ---------- ---------- ---------- ---------- ----------
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
;;-------------- ---------- ------------ ---------------- ---- ----------------
DICB221          90.72      FIXED        91.36            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
;;-------------- -------- -------- -------- ---------- -------- -------- --------
-------- -------- -----------------------
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         93.69    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          90.496   3.214    0.864    FUNCTIONAL 0        0        0        0
       0
STM-102          91.16    2.977    0.2      FUNCTIONAL 0        0        0        0
       0
STM-103          91.071   2.863    0.289    FUNCTIONAL 0        0        0        0
       0
STM-104          91.404   2.583    0        FUNCTIONAL 0        0        0        0
       0
STM-105          91.232   2.306    0.128    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      93.69
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
93.69      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          DICB221          25.2       0.013      90.8
90.72      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     0.083            0          0          0
L102D-IC         CIRCULAR     0.102            0          0          0
L105A-IC         CIRCULAR     0.083            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                     1.57       105
L101A-V                     1.571      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       DICB221          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
;;-------------- ---------------- ----------------
DICB221          363809.615       5013844.287
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
STM-105          363866.9         5013798

[VERTICES]
;;Link           X-Coord          Y-Coord
;;-------------- ---------------- ----------------
C14              363850.866       5013819.484
C14              363846.381       5013820.418
C15              363897.883       5013851.268
C8               363889.802       5013891.91
C9               363886.162       5013871.512
C9               363880.374       5013873.874

[POLYGONS]
;;Subcatchment   X-Coord          Y-Coord
;;-------------- ---------------- ----------------
L101A            363824.67        5013885.528
L101A            363827.444       5013886.934
```

```
L101A           363827.444       5013886.934
L101A           363835.034       5013873.662
L101A           363835.034       5013873.662
L101A           363843.407       5013862.561
L101A           363843.407       5013862.561
L101A           363848.277       5013858.427
L101A           363848.277       5013858.427
L101A           363855.956       5013845.052
L101A           363855.956       5013845.052
L101A           363876.545       5013856.872
L101A           363876.545       5013856.872
L101A           363884.203       5013843.532
L101A           363884.203       5013843.532
L101A           363891.025       5013831.652
L101A           363891.025       5013831.652
L101A           363889.68        5013830.88
L101A           363889.68        5013830.88
L101A           363898.703       5013815.164
L101A           363898.703       5013815.164
L101A           363895.839       5013813.52
L101A           363895.839       5013813.52
L101A           363895.586       5013813.961
L101A           363895.586       5013813.961
L101A           363892.811       5013812.367
L101A           363892.811       5013812.367
L101A           363893.007       5013812.026
L101A           363893.007       5013812.026
L101A           363890.308       5013810.476
L101A           363890.308       5013810.476
L101A           363890.004       5013811.005
L101A           363890.004       5013811.005
L101A           363884.299       5013807.73
L101A           363884.299       5013807.73
L101A           363884.602       5013807.201
L101A           363884.602       5013807.201
L101A           363881.904       5013805.652
L101A           363881.904       5013805.652
L101A           363881.297       5013806.709
L101A           363881.297       5013806.709
L101A           363878.795       5013805.273
L101A           363878.795       5013805.273
L101A           363869.724       5013821.065
L101A           363869.724       5013821.065
L101A           363866.6         5013826.504
L101A           363866.6         5013826.504
L101A           363853.592       5013819.03
L101A           363853.592       5013819.03
L101A           363843.731       5013813.398
```

```
L101A           363843.731       5013813.398
L101A           363842.663       5013815.246
L101A           363842.663       5013815.246
L101A           363839.177       5013813.243
L101A           363839.177       5013813.243
L101A           363830.126       5013808.042
L101A           363830.126       5013808.042
L101A           363828.481       5013810.905
L101A           363828.481       5013810.905
L101A           363828.921       5013811.158
L101A           363828.921       5013811.158
L101A           363827.327       5013813.933
L101A           363827.327       5013813.933
L101A           363825.347       5013816.589
L101A           363825.347       5013816.589
L101A           363822.246       5013821.985
L101A           363822.246       5013821.985
L101A           363822.775       5013822.288
L101A           363822.775       5013822.288
L101A           363819.497       5013827.992
L101A           363819.497       5013827.992
L101A           363818.969       5013827.689
L101A           363818.969       5013827.689
L101A           363817.419       5013830.386
L101A           363817.419       5013830.386
L101A           363817.759       5013830.585
L101A           363817.759       5013830.585
L101A           363816.164       5013833.36
L101A           363816.164       5013833.36
L101A           363815.724       5013833.107
L101A           363815.724       5013833.107
L101A           363814.079       5013835.97
L101A           363814.079       5013835.97
L101A           363819.989       5013839.365
L101A           363819.989       5013839.365
L101A           363815.759       5013846.754
L101A           363815.759       5013846.754
L101A           363811.72        5013852.739
L101A           363811.72        5013852.739
L101A           363805.735       5013856.908
L101A           363805.735       5013856.908
L101A           363798.145       5013870.18
L101A           363798.145       5013870.18
L101A           363800.151       5013871.327
L101A           363800.151       5013871.327
L101A           363800           5013871.592
L101A           363800           5013871.592
L101A           363801.764       5013872.6
```

```
L101A            363801.764       5013872.6
L101A            363800.554       5013874.717
L101A            363800.554       5013874.717
L101A            363805.051       5013877.289
L101A            363805.051       5013877.289
L101A            363806.261       5013875.172
L101A            363806.261       5013875.172
L101A            363808.036       5013876.187
L101A            363808.036       5013876.187
L101A            363813.14        5013879.106
L101A            363813.14        5013879.106
L101A            363811.93        5013881.222
L101A            363811.93        5013881.222
L101A            363816.427       5013883.794
L101A            363816.427       5013883.794
L101A            363817.637       5013881.678
L101A            363817.637       5013881.678
L101A            363819.401       5013882.686
L101A            363819.401       5013882.686
L101A            363819.552       5013882.422
L101A            363819.552       5013882.422
L101A            363821.559       5013883.569
L101A            363821.559       5013883.569
L101A            363823.107       5013884.635
L101A            363823.107       5013884.635
L101A            363824.67        5013885.528
L102A            363851.651       5013898.935
L102A            363855.954       5013901.396
L102A            363855.954       5013901.396
L102A            363862.748       5013889.51
L102A            363862.748       5013889.51
L102A            363867.398       5013882.261
L102A            363867.398       5013882.261
L102A            363872.957       5013872.538
L102A            363872.957       5013872.538
L102A            363875.408       5013868.257
L102A            363875.408       5013868.257
L102A            363880.606       5013859.203
L102A            363880.606       5013859.203
L102A            363876.545       5013856.872
L102A            363876.545       5013856.872
L102A            363855.956       5013845.052
L102A            363855.956       5013845.052
L102A            363848.277       5013858.427
L102A            363848.277       5013858.427
L102A            363843.407       5013862.561
L102A            363843.407       5013862.561
L102A            363835.034       5013873.662
```

```
L102A            363835.034       5013873.662
L102A            363827.444       5013886.934
L102A            363827.444       5013886.934
L102A            363829.45        5013888.082
L102A            363829.45        5013888.082
L102A            363829.299       5013888.346
L102A            363829.299       5013888.346
L102A            363831.063       5013889.355
L102A            363831.063       5013889.355
L102A            363829.852       5013891.471
L102A            363829.852       5013891.471
L102A            363834.35        5013894.043
L102A            363834.35        5013894.043
L102A            363835.56        5013891.927
L102A            363835.56        5013891.927
L102A            363842.439       5013895.86
L102A            363842.439       5013895.86
L102A            363841.229       5013897.976
L102A            363841.229       5013897.976
L102A            363845.726       5013900.548
L102A            363845.726       5013900.548
L102A            363846.936       5013898.432
L102A            363846.936       5013898.432
L102A            363848.7         5013899.44
L102A            363848.7         5013899.44
L102A            363848.851       5013899.176
L102A            363848.851       5013899.176
L102A            363850.858       5013900.323
L102A            363850.858       5013900.323
L102A            363851.651       5013898.935
L102B            363885.061       5013918.04
L102B            363889.722       5013920.706
L102B            363889.722       5013920.706
L102B            363896.518       5013908.822
L102B            363896.518       5013908.822
L102B            363898.524       5013909.969
L102B            363898.524       5013909.969
L102B            363898.676       5013909.704
L102B            363898.676       5013909.704
L102B            363900.439       5013910.713
L102B            363900.439       5013910.713
L102B            363901.65        5013908.596
L102B            363901.65        5013908.596
L102B            363903.565       5013905.243
L102B            363903.565       5013905.243
L102B            363904.723       5013903.601
L102B            363904.723       5013903.601
L102B            363910.282       5013893.878
```

```
L102B            363910.282      5013893.878
L102B            363906.9        5013891.83
L102B            363906.9        5013891.83
L102B            363897.182      5013883.324
L102B            363897.182      5013883.324
L102B            363894.808      5013881.989
L102B            363894.808      5013881.989
L102B            363904.068      5013865.403
L102B            363904.068      5013865.403
L102B            363909.654      5013861.144
L102B            363909.654      5013861.144
L102B            363921.1        5013858.279
L102B            363921.1        5013858.279
L102B            363931.902      5013864.012
L102B            363931.902      5013864.012
L102B            363938.576      5013867.739
L102B            363938.576      5013867.739
L102B            363945.251      5013871.467
L102B            363945.251      5013871.467
L102B            363946.378      5013869.449
L102B            363946.378      5013869.449
L102B            363946.654      5013869.585
L102B            363946.654      5013869.585
L102B            363947.634      5013867.824
L102B            363947.634      5013867.824
L102B            363949.763      5013869.012
L102B            363949.763      5013869.012
L102B            363952.289      5013864.489
L102B            363952.289      5013864.489
L102B            363950.165      5013863.303
L102B            363950.165      5013863.303
L102B            363954.024      5013856.382
L102B            363954.024      5013856.382
L102B            363956.153      5013857.571
L102B            363956.153      5013857.571
L102B            363958.679      5013853.048
L102B            363958.679      5013853.048
L102B            363956.55       5013851.859
L102B            363956.55       5013851.859
L102B            363957.541      5013850.085
L102B            363957.541      5013850.085
L102B            363957.275      5013849.936
L102B            363957.275      5013849.936
L102B            363958.402      5013847.919
L102B            363958.402      5013847.919
L102B            363945.053      5013840.464
L102B            363945.053      5013840.464
L102B            363943.929      5013842.483
```

```
L102B            363943.929      5013842.483
L102B            363943.66       5013842.333
L102B            363943.66       5013842.333
L102B            363942.67       5013844.107
L102B            363942.67       5013844.107
L102B            363940.541      5013842.918
L102B            363940.541      5013842.918
L102B            363938.164      5013842.488
L102B            363938.164      5013842.488
L102B            363936.591      5013841.609
L102B            363936.591      5013841.609
L102B            363932.242      5013838.731
L102B            363932.242      5013838.731
L102B            363922.288      5013833.174
L102B            363922.288      5013833.174
L102B            363924.202      5013829.841
L102B            363924.202      5013829.841
L102B            363921.075      5013828.045
L102B            363921.075      5013828.045
L102B            363920.423      5013829.179
L102B            363920.423      5013829.179
L102B            363917.472      5013827.483
L102B            363917.472      5013827.483
L102B            363918.079      5013826.426
L102B            363918.079      5013826.426
L102B            363915.381      5013824.876
L102B            363915.381      5013824.876
L102B            363915.078      5013825.405
L102B            363915.078      5013825.405
L102B            363909.373      5013822.128
L102B            363909.373      5013822.128
L102B            363909.677      5013821.599
L102B            363909.677      5013821.599
L102B            363906.978      5013820.049
L102B            363906.978      5013820.049
L102B            363906.782      5013820.39
L102B            363906.782      5013820.39
L102B            363904.007      5013818.796
L102B            363904.007      5013818.796
L102B            363904.26       5013818.356
L102B            363904.26       5013818.356
L102B            363901.397      5013816.711
L102B            363901.397      5013816.711
L102B            363892.37       5013832.424
L102B            363892.37       5013832.424
L102B            363891.025      5013831.652
L102B            363891.025      5013831.652
L102B            363884.203      5013843.532
```

L102B	363884.203	5013843.532
L102B	363876.545	5013856.872
L102B	363876.545	5013856.872
L102B	363880.606	5013859.203
L102B	363880.606	5013859.203
L102B	363875.408	5013868.257
L102B	363875.408	5013868.257
L102B	363872.957	5013872.538
L102B	363872.957	5013872.538
L102B	363867.398	5013882.261
L102B	363867.398	5013882.261
L102B	363862.748	5013889.51
L102B	363862.748	5013889.51
L102B	363855.954	5013901.396
L102B	363855.954	5013901.396
L102B	363855.161	5013902.783
L102B	363855.161	5013902.783
L102B	363857.167	5013903.93
L102B	363857.167	5013903.93
L102B	363857.016	5013904.195
L102B	363857.016	5013904.195
L102B	363858.78	5013905.203
L102B	363858.78	5013905.203
L102B	363857.57	5013907.32
L102B	363857.57	5013907.32
L102B	363862.068	5013909.891
L102B	363862.068	5013909.891
L102B	363863.278	5013907.774
L102B	363863.278	5013907.774
L102B	363868.036	5013910.495
L102B	363868.036	5013910.495
L102B	363870.157	5013911.707
L102B	363870.157	5013911.707
L102B	363868.947	5013913.823
L102B	363868.947	5013913.823
L102B	363873.445	5013916.394
L102B	363873.445	5013916.394
L102B	363874.655	5013914.278
L102B	363874.655	5013914.278
L102B	363876.419	5013915.286
L102B	363876.419	5013915.286
L102B	363876.57	5013915.021
L102B	363876.57	5013915.021
L102B	363878.576	5013916.168
L102B	363878.576	5013916.168
L102B	363879.367	5013914.785
L102B	363879.367	5013914.785
L102B	363885.061	5013918.04

L102C	363912.342	5013935.483
L102C	363919.932	5013922.21
L102C	363919.932	5013922.21
L102C	363917.925	5013921.063
L102C	363917.925	5013921.063
L102C	363918.077	5013920.799
L102C	363918.077	5013920.799
L102C	363917.371	5013920.395
L102C	363917.371	5013920.395
L102C	363920.497	5013914.924
L102C	363920.497	5013914.924
L102C	363921.391	5013913.361
L102C	363921.391	5013913.361
L102C	363924.785	5013909.312
L102C	363924.785	5013909.312
L102C	363928.855	5013902.193
L102C	363928.855	5013902.193
L102C	363929.539	5013899.609
L102C	363929.539	5013899.609
L102C	363916.19	5013892.157
L102C	363916.19	5013892.157
L102C	363910.282	5013893.878
L102C	363910.282	5013893.878
L102C	363904.723	5013903.601
L102C	363904.723	5013903.601
L102C	363903.565	5013905.243
L102C	363903.565	5013905.243
L102C	363901.65	5013908.596
L102C	363901.65	5013908.596
L102C	363900.439	5013910.713
L102C	363900.439	5013910.713
L102C	363898.676	5013909.704
L102C	363898.676	5013909.704
L102C	363898.524	5013909.969
L102C	363898.524	5013909.969
L102C	363896.518	5013908.822
L102C	363896.518	5013908.822
L102C	363889.722	5013920.706
L102C	363889.722	5013920.706
L102C	363888.929	5013922.094
L102C	363888.929	5013922.094
L102C	363890.935	5013923.241
L102C	363890.935	5013923.241
L102C	363890.783	5013923.506
L102C	363890.783	5013923.506
L102C	363892.547	5013924.514
L102C	363892.547	5013924.514
L102C	363891.337	5013926.631

L102C	363891.337	5013926.631
L102C	363895.834	5013929.202
L102C	363895.834	5013929.202
L102C	363897.045	5013927.086
L102C	363897.045	5013927.086
L102C	363903.923	5013931.019
L102C	363903.923	5013931.019
L102C	363902.713	5013933.136
L102C	363902.713	5013933.136
L102C	363907.211	5013935.708
L102C	363907.211	5013935.708
L102C	363908.421	5013933.591
L102C	363908.421	5013933.591
L102C	363910.185	5013934.6
L102C	363910.185	5013934.6
L102C	363910.336	5013934.335
L102C	363910.336	5013934.335
L102C	363912.342	5013935.483
L102D	363938.576	5013867.739
L102D	363931.902	5013864.012
L102D	363931.902	5013864.012
L102D	363921.1	5013858.279
L102D	363921.1	5013858.279
L102D	363909.654	5013861.144
L102D	363909.654	5013861.144
L102D	363904.068	5013865.403
L102D	363904.068	5013865.403
L102D	363894.808	5013881.989
L102D	363894.808	5013881.989
L102D	363897.182	5013883.324
L102D	363897.182	5013883.324
L102D	363906.9	5013891.83
L102D	363906.9	5013891.83
L102D	363910.282	5013893.878
L102D	363910.282	5013893.878
L102D	363916.19	5013892.157
L102D	363916.19	5013892.157
L102D	363929.539	5013899.609
L102D	363929.539	5013899.609
L102D	363930.666	5013897.591
L102D	363930.666	5013897.591
L102D	363930.932	5013897.74
L102D	363930.932	5013897.74
L102D	363931.922	5013895.966
L102D	363931.922	5013895.966
L102D	363934.051	5013897.154
L102D	363934.051	5013897.154
L102D	363936.577	5013892.63

L102D	363936.577	5013892.63
L102D	363934.448	5013891.442
L102D	363934.448	5013891.442
L102D	363938.31	5013884.523
L102D	363938.31	5013884.523
L102D	363940.44	5013885.712
L102D	363940.44	5013885.712
L102D	363942.965	5013881.188
L102D	363942.965	5013881.188
L102D	363940.836	5013879.999
L102D	363940.836	5013879.999
L102D	363941.826	5013878.225
L102D	363941.826	5013878.225
L102D	363941.561	5013878.077
L102D	363941.561	5013878.077
L102D	363942.686	5013876.059
L102D	363942.686	5013876.059
L102D	363936.012	5013872.332
L102D	363936.012	5013872.332
L102D	363938.576	5013867.739
L105A	363874.339	5013795.992
L105A	363868.693	5013792.758
L105A	363868.693	5013792.758
L105A	363862.862	5013792.927
L105A	363862.862	5013792.927
L105A	363844.803	5013782.55
L105A	363844.803	5013782.55
L105A	363843.006	5013785.677
L105A	363843.006	5013785.677
L105A	363844.14	5013786.329
L105A	363844.14	5013786.329
L105A	363842.444	5013789.28
L105A	363842.444	5013789.28
L105A	363841.387	5013788.673
L105A	363841.387	5013788.673
L105A	363839.837	5013791.371
L105A	363839.837	5013791.371
L105A	363840.366	5013791.674
L105A	363840.366	5013791.674
L105A	363837.088	5013797.378
L105A	363837.088	5013797.378
L105A	363836.56	5013797.075
L105A	363836.56	5013797.075
L105A	363835.009	5013799.773
L105A	363835.009	5013799.773
L105A	363835.35	5013799.969
L105A	363835.35	5013799.969
L105A	363833.756	5013802.744

L105A	363833.756	5013802.744
L105A	363833.315	5013802.491
L105A	363833.315	5013802.491
L105A	363831.67	5013805.354
L105A	363831.67	5013805.354
L105A	363844.208	5013812.558
L105A	363844.208	5013812.558
L105A	363843.731	5013813.398
L105A	363843.731	5013813.398
L105A	363853.592	5013819.03
L105A	363853.592	5013819.03
L105A	363866.6	5013826.504
L105A	363866.6	5013826.504
L105A	363869.724	5013821.065
L105A	363869.724	5013821.065
L105A	363878.795	5013805.273
L105A	363878.795	5013805.273
L105A	363878.345	5013805.015
L105A	363878.345	5013805.015
L105A	363878.996	5013803.88
L105A	363878.996	5013803.88
L105A	363875.868	5013802.085
L105A	363875.868	5013802.085
L105A	363874.339	5013795.992
UNC-1	363815.724	5013833.107
UNC-1	363816.164	5013833.36
UNC-1	363816.164	5013833.36
UNC-1	363817.759	5013830.585
UNC-1	363817.759	5013830.585
UNC-1	363817.419	5013830.386
UNC-1	363817.419	5013830.386
UNC-1	363818.969	5013827.689
UNC-1	363818.969	5013827.689
UNC-1	363819.497	5013827.992
UNC-1	363819.497	5013827.992
UNC-1	363822.775	5013822.288
UNC-1	363822.775	5013822.288
UNC-1	363822.246	5013821.985
UNC-1	363822.246	5013821.985
UNC-1	363825.347	5013816.589
UNC-1	363825.347	5013816.589
UNC-1	363827.327	5013813.933
UNC-1	363827.327	5013813.933
UNC-1	363828.921	5013811.158
UNC-1	363828.921	5013811.158
UNC-1	363828.481	5013810.905
UNC-1	363828.481	5013810.905
UNC-1	363830.126	5013808.042

UNC-1	363830.126	5013808.042
UNC-1	363839.177	5013813.243
UNC-1	363839.177	5013813.243
UNC-1	363842.663	5013815.246
UNC-1	363842.663	5013815.246
UNC-1	363843.731	5013813.398
UNC-1	363843.731	5013813.398
UNC-1	363844.208	5013812.558
UNC-1	363844.208	5013812.558
UNC-1	363831.67	5013805.354
UNC-1	363831.67	5013805.354
UNC-1	363833.315	5013802.491
UNC-1	363833.315	5013802.491
UNC-1	363833.756	5013802.744
UNC-1	363833.756	5013802.744
UNC-1	363835.35	5013799.969
UNC-1	363835.35	5013799.969
UNC-1	363835.009	5013799.773
UNC-1	363835.009	5013799.773
UNC-1	363836.56	5013797.075
UNC-1	363836.56	5013797.075
UNC-1	363837.088	5013797.378
UNC-1	363837.088	5013797.378
UNC-1	363840.366	5013791.674
UNC-1	363840.366	5013791.674
UNC-1	363839.837	5013791.371
UNC-1	363839.837	5013791.371
UNC-1	363841.387	5013788.673
UNC-1	363841.387	5013788.673
UNC-1	363842.444	5013789.28
UNC-1	363842.444	5013789.28
UNC-1	363844.14	5013786.329
UNC-1	363844.14	5013786.329
UNC-1	363843.006	5013785.677
UNC-1	363843.006	5013785.677
UNC-1	363844.803	5013782.55
UNC-1	363844.803	5013782.55
UNC-1	363862.862	5013792.927
UNC-1	363862.862	5013792.927
UNC-1	363868.693	5013792.758
UNC-1	363868.693	5013792.758
UNC-1	363843.215	5013778.127
UNC-1	363843.215	5013778.127
UNC-1	363839.241	5013779.3
UNC-1	363839.241	5013779.3
UNC-1	363789.73	5013875.495
UNC-1	363789.73	5013875.495
UNC-1	363863.823	5013917.865

UNC-1	363863.823	5013917.865
UNC-1	363868.036	5013910.495
UNC-1	363868.036	5013910.495
UNC-1	363863.278	5013907.774
UNC-1	363863.278	5013907.774
UNC-1	363862.068	5013909.891
UNC-1	363862.068	5013909.891
UNC-1	363857.57	5013907.32
UNC-1	363857.57	5013907.32
UNC-1	363858.78	5013905.203
UNC-1	363858.78	5013905.203
UNC-1	363857.016	5013904.195
UNC-1	363857.016	5013904.195
UNC-1	363857.167	5013903.93
UNC-1	363857.167	5013903.93
UNC-1	363855.161	5013902.783
UNC-1	363855.161	5013902.783
UNC-1	363855.954	5013901.396
UNC-1	363855.954	5013901.396
UNC-1	363851.651	5013898.935
UNC-1	363851.651	5013898.935
UNC-1	363850.858	5013900.323
UNC-1	363850.858	5013900.323
UNC-1	363848.851	5013899.176
UNC-1	363848.851	5013899.176
UNC-1	363848.7	5013899.44
UNC-1	363848.7	5013899.44
UNC-1	363846.936	5013898.432
UNC-1	363846.936	5013898.432
UNC-1	363845.726	5013900.548
UNC-1	363845.726	5013900.548
UNC-1	363841.229	5013897.976
UNC-1	363841.229	5013897.976
UNC-1	363842.439	5013895.86
UNC-1	363842.439	5013895.86
UNC-1	363835.56	5013891.927
UNC-1	363835.56	5013891.927
UNC-1	363834.35	5013894.043
UNC-1	363834.35	5013894.043
UNC-1	363829.852	5013891.471
UNC-1	363829.852	5013891.471
UNC-1	363831.063	5013889.355
UNC-1	363831.063	5013889.355
UNC-1	363829.299	5013888.346
UNC-1	363829.299	5013888.346
UNC-1	363829.45	5013888.082
UNC-1	363829.45	5013888.082
UNC-1	363827.444	5013886.934

UNC-1	363827.444	5013886.934
UNC-1	363824.67	5013885.528
UNC-1	363824.67	5013885.528
UNC-1	363823.107	5013884.635
UNC-1	363823.107	5013884.635
UNC-1	363821.559	5013883.569
UNC-1	363821.559	5013883.569
UNC-1	363819.552	5013882.422
UNC-1	363819.552	5013882.422
UNC-1	363819.401	5013882.686
UNC-1	363819.401	5013882.686
UNC-1	363817.637	5013881.678
UNC-1	363817.637	5013881.678
UNC-1	363816.427	5013883.794
UNC-1	363816.427	5013883.794
UNC-1	363811.93	5013881.222
UNC-1	363811.93	5013881.222
UNC-1	363813.14	5013879.106
UNC-1	363813.14	5013879.106
UNC-1	363808.036	5013876.187
UNC-1	363808.036	5013876.187
UNC-1	363806.261	5013875.172
UNC-1	363806.261	5013875.172
UNC-1	363805.051	5013877.289
UNC-1	363805.051	5013877.289
UNC-1	363800.554	5013874.717
UNC-1	363800.554	5013874.717
UNC-1	363801.764	5013872.6
UNC-1	363801.764	5013872.6
UNC-1	363800	5013871.592
UNC-1	363800	5013871.592
UNC-1	363800.151	5013871.327
UNC-1	363800.151	5013871.327
UNC-1	363798.145	5013870.18
UNC-1	363798.145	5013870.18
UNC-1	363805.735	5013856.908
UNC-1	363805.735	5013856.908
UNC-1	363811.72	5013852.739
UNC-1	363811.72	5013852.739
UNC-1	363815.759	5013846.754
UNC-1	363815.759	5013846.754
UNC-1	363819.989	5013839.365
UNC-1	363819.989	5013839.365
UNC-1	363814.079	5013835.97
UNC-1	363814.079	5013835.97
UNC-1	363815.724	5013833.107
UNC-2	363917.402	5013826.037
UNC-2	363919.785	5013822.096

UNC-2	363874.339	5013795.992
UNC-2	363875.868	5013802.085
UNC-2	363878.996	5013803.88
UNC-2	363878.345	5013805.015
UNC-2	363878.795	5013805.273
UNC-2	363881.297	5013806.709
UNC-2	363881.904	5013805.652
UNC-2	363884.602	5013807.201
UNC-2	363884.299	5013807.73
UNC-2	363890.004	5013811.005
UNC-2	363890.308	5013810.476
UNC-2	363893.007	5013812.026
UNC-2	363892.811	5013812.367
UNC-2	363895.586	5013813.961
UNC-2	363895.839	5013813.52
UNC-2	363898.703	5013815.164
UNC-2	363889.68	5013830.88
UNC-2	363891.025	5013831.652
UNC-2	363892.37	5013832.424
UNC-2	363901.397	5013816.711
UNC-2	363904.26	5013818.356
UNC-2	363904.007	5013818.796
UNC-2	363906.782	5013820.39
UNC-2	363906.978	5013820.049
UNC-2	363909.677	5013821.599
UNC-2	363909.373	5013822.128
UNC-2	363915.078	5013825.405
UNC-2	363915.381	5013824.876
UNC-2	363917.402	5013826.037
UNC-3	363964.106	5013847.567
UNC-3	363958.387	5013847.945
UNC-3	363957.275	5013849.936
UNC-3	363957.541	5013850.085
UNC-3	363956.55	5013851.859
UNC-3	363958.679	5013853.048
UNC-3	363956.153	5013857.571
UNC-3	363954.024	5013856.382
UNC-3	363950.165	5013863.303
UNC-3	363952.289	5013864.489
UNC-3	363949.763	5013869.012
UNC-3	363947.634	5013867.824
UNC-3	363946.654	5013869.585
UNC-3	363946.378	5013869.449
UNC-3	363945.251	5013871.467
UNC-3	363938.576	5013867.739
UNC-3	363936.012	5013872.332
UNC-3	363942.686	5013876.059
UNC-3	363941.561	5013878.077

UNC-3	363941.826	5013878.225
UNC-3	363940.836	5013879.999
UNC-3	363942.965	5013881.188
UNC-3	363940.44	5013885.712
UNC-3	363938.31	5013884.523
UNC-3	363934.448	5013891.442
UNC-3	363936.577	5013892.63
UNC-3	363934.051	5013897.154
UNC-3	363931.922	5013895.966
UNC-3	363930.932	5013897.74
UNC-3	363930.666	5013897.591
UNC-3	363929.539	5013899.609
UNC-3	363928.855	5013902.193
UNC-3	363924.785	5013909.312
UNC-3	363921.391	5013913.361
UNC-3	363920.497	5013914.924
UNC-3	363917.371	5013920.395
UNC-3	363918.077	5013920.799
UNC-3	363917.925	5013921.063
UNC-3	363919.932	5013922.21
UNC-3	363912.342	5013935.483
UNC-3	363910.336	5013934.335
UNC-3	363910.185	5013934.6
UNC-3	363908.421	5013933.591
UNC-3	363907.211	5013935.708
UNC-3	363902.713	5013933.136
UNC-3	363903.923	5013931.019
UNC-3	363897.045	5013927.086
UNC-3	363895.834	5013929.202
UNC-3	363891.337	5013926.631
UNC-3	363892.547	5013924.514
UNC-3	363890.783	5013923.506
UNC-3	363890.935	5013923.241
UNC-3	363888.929	5013922.094
UNC-3	363889.722	5013920.706
UNC-3	363885.061	5013918.04
UNC-3	363879.367	5013914.785
UNC-3	363878.576	5013916.168
UNC-3	363876.57	5013915.021
UNC-3	363876.419	5013915.286
UNC-3	363874.655	5013914.278
UNC-3	363873.445	5013916.394
UNC-3	363868.947	5013913.823
UNC-3	363870.157	5013911.707
UNC-3	363868.036	5013910.495
UNC-3	363863.823	5013917.865
UNC-3	363912.677	5013945.802
UNC-3	363926.744	5013920.609

```
UNC-3            363932.862       5013909.651
UNC-3            363965.236       5013851.67
UNC-3            363964.106       5013847.567
UNC-4            363919.785       5013822.096
UNC-4            363917.402       5013826.037
UNC-4            363918.079       5013826.426
UNC-4            363917.472       5013827.483
UNC-4            363920.423       5013829.179
UNC-4            363921.075       5013828.045
UNC-4            363924.202       5013829.841
UNC-4            363922.288       5013833.174
UNC-4            363932.242       5013838.731
UNC-4            363936.591       5013841.609
UNC-4            363938.164       5013842.488
UNC-4            363940.541       5013842.918
UNC-4            363942.67        5013844.107
UNC-4            363943.66        5013842.333
UNC-4            363943.929       5013842.483
UNC-4            363945.053       5013840.464
UNC-4            363958.402       5013847.919
UNC-4            363958.387       5013847.945
UNC-4            363964.106       5013847.567
UNC-4            363964.101       5013847.55
UNC-4            363919.785       5013822.096

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

Appendix C Stormwater Management Calculations

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            Chicago_5y_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
  -------------------------------------------------------------------------------
  DICB221              OUTFALL              90.72      0.68       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              93.69      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              90.50      3.21       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
1.9100    0.0130
  C17               L105A-S          MAJ-2            CONDUIT            9.7
2.2752    0.0130
  C3                L101A-S          L101A-S1         CONDUIT           14.8
-1.2803    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          DICB221          CONDUIT           25.2
0.3175    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
  L102C-IC          L102C-S          STM-102          ORIFICE
  L102D-IC          L102D-S          STM-102          ORIFICE
  L103B-IC          L102B-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
12427.71
  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
10175.17
  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
473.65
  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 ......         0.068        42.514
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.013         8.229
Surface Runoff ...........         0.053        33.110
Final Storage ............         0.002         1.252
Continuity Error (%) .....        -0.179


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.053         0.527
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.004
External Outflow .........         0.053         0.532
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.003         0.031
Final Stored Volume ......         0.003         0.031
Continuity Error (%) .....         0.000


********************************
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    :     0.02


  ***************************
  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                      42.51       0.00       0.00       4.11      36.32
0.76      37.09       0.14   103.53   0.872
  L102A                      42.51       0.00       0.00       4.63      35.74
0.84      36.58       0.06    43.08   0.860
  L102B                      42.51       0.00       0.00       5.67      34.56
1.02      35.58       0.15   113.49   0.837
  L102C                      42.51       0.00       0.00       3.09      37.48
0.56      38.04       0.03    25.74   0.895
  L102D                      42.51       0.00       0.00       4.13      36.31
0.73      37.04       0.05    34.31   0.871
  L105A                      42.51       0.00       0.00       4.65      35.73
0.82      36.55       0.04    30.53   0.860
  UNC-1                      42.51       0.00       0.00      19.25      24.60
20.00      22.46       0.03    37.41   0.528
  UNC-2                      42.51       0.00       0.00      24.10      17.55
12.59      17.86       0.01     7.37   0.420
  UNC-3                      42.51       0.00       0.00      25.16      17.56
15.91      16.79       0.02    29.16   0.395
  UNC-4                      42.51       0.00       0.00      24.90      17.56
15.36      17.11       0.00     7.16   0.403


  ******************
  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
  --------------------------------------------------------------------------------
  DICB221              OUTFALL     1.18     1.18    91.90     0  00:00        1.18
  MAJ-1                OUTFALL     0.00     0.00    93.33     0  00:00        0.00
  MAJ-2                OUTFALL     0.00     0.04    93.28     0  01:00        0.04
  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     0.03     1.46    93.58     0  01:00        1.46
  L101A-S1             STORAGE     0.00     0.00    93.69     0  00:00        0.00
  L102A-S              STORAGE     0.03     1.48    93.77     0  01:00        1.48
  L102A-S1             STORAGE     0.00     0.00    93.77     0  01:01        0.00
  L102B-S              STORAGE     0.03     1.68    93.62     0  01:00        1.67
  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     0.03     1.48    94.00     0  01:00        1.48
  L102C-S1             STORAGE     0.00     0.00    94.10     0  00:00        0.00
  L102D-S              STORAGE     0.02     1.46    93.72     0  01:00        1.46
  L102D-S1             STORAGE     0.00     0.00    93.94     0  00:00        0.00
  L105A-S              STORAGE     0.02     1.42    93.50     0  01:00        1.42
  L105A-S1             STORAGE     0.00     0.00    93.91     0  00:00        0.00
  STM-101              STORAGE     1.40     1.45    91.95     0  00:53        1.45
  STM-102              STORAGE     0.74     0.93    92.09     0  01:00        0.93
  STM-103              STORAGE     0.83     0.91    91.98     0  00:53        0.90
  STM-104              STORAGE     0.50     0.59    92.00     0  00:52        0.59
  STM-105              STORAGE     0.67     0.76    91.99     0  00:53        0.75


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

----------------------------------------------------------------------------------
--------------
  DICB221              OUTFALL       0.00   237.33     0  00:54           0
0.468       0.000
  MAJ-1                OUTFALL       0.00     0.00     0  00:00           0
  0       0.000 ltr
  MAJ-2                OUTFALL       0.00    14.14     0  01:00           0
0.00586       0.000
  OF1                  OUTFALL      37.41    37.41     0  01:00       0.032
0.032       0.000
  OF2                  OUTFALL       7.37     7.37     0  01:00     0.00537
0.00537       0.000
  OF3                  OUTFALL      29.16    29.16     0  01:00      0.0199
0.0199       0.000
  OF4                  OUTFALL       7.16     7.16     0  01:00     0.00495
0.00495       0.000
  L101A1-S             STORAGE       0.00     0.00     0  00:00           0
  0       0.000 ltr
  L101A-S              STORAGE     103.53   103.53     0  01:00       0.138
0.138      -0.127
  L101A-S1             STORAGE       0.00     0.00     0  00:00           0
  0       0.000 ltr
  L102A-S              STORAGE      43.08    43.08     0  01:00       0.057
0.0571      -0.034
  L102A-S1             STORAGE       0.00     2.02     0  01:00           0
8.76e-05     117.870
  L102B-S              STORAGE     113.49   113.49     0  01:00       0.148
0.148      -0.059
  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      25.74    25.74     0  01:00      0.0349
0.0349       0.053
  L102C-S1             STORAGE       0.00     0.00     0  00:00           0
  0       0.000 ltr
  L102D-S              STORAGE      34.31    34.31     0  01:00       0.046
0.046       0.069
  L102D-S1             STORAGE       0.00     0.00     0  00:00           0
  0       0.000 ltr
  L105A-S              STORAGE      30.53    30.53     0  01:00      0.0406
0.0406       0.035
  L105A-S1             STORAGE       0.00     0.00     0  00:00           0
  0       0.000 ltr
  STM-101              STORAGE       0.00   236.81     0  00:53           0
0.469       0.000
```

```
  STM-102             STORAGE       0.00   118.86     0  01:00           0
0.232       0.000
  STM-103             STORAGE       0.00    19.59     0  00:53           0
0.0417      -0.001
  STM-104             STORAGE       0.00     8.08     0  00:52           0
0.00327      -0.076
  STM-105             STORAGE       0.00    16.10     0  01:00           0
0.0355      -0.002


  **********************
  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       0     0     0         0.002      18       0
01:00      73.88
  L101A-S1                 0.000       0     0     0         0.000       0       0
00:00       0.00
  L102A-S                  0.000       1     0     0         0.002     100       0
01:00      29.77
```

```
  L102A-S1                 0.000       0     0     0         0.000       0       0
00:00       0.06
  L102B-S                  0.000       0     0     0         0.008       7       0
01:00      77.82
  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       0     0     0         0.003      24       0
01:00      16.43
  L102C-S1                 0.000       0     0     0         0.000       0       0
00:00       0.00
  L102D-S                  0.000       0     0     0         0.002       8       0
01:00      24.61
  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      30.24
  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     237.33
  STM-102                  0.000       0     0     0         0.000       0       0
00:00     118.89
  STM-103                  0.000       0     0     0         0.000       0       0
00:00      20.53
  STM-104                  0.000       0     0     0         0.000       0       0
00:00       3.96
  STM-105                  0.000       0     0     0         0.000       0       0
00:00      16.77


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

  -----------------------------------------------------------
                      Flow       Avg       Max       Total
                      Freq      Flow      Flow      Volume
  Outfall Node        Pcnt       LPS       LPS    10^6 ltr
  -----------------------------------------------------------
  DICB221            84.50      6.41    237.33       0.468
  MAJ-1               0.00      0.00      0.00       0.000
  MAJ-2               0.71      9.57     14.14       0.006
  OF1                11.04      3.36     37.41       0.032
  OF2                10.95      0.57      7.37       0.005
  OF3                 8.19      2.80     29.16       0.020
  OF4                 4.87      1.16      7.16       0.005
```

```
  -----------------------------------------------------------
  System              17.18     23.86      7.33       0.536


  ********************
  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    0.12
  C10                  CHANNEL      0.00     0  00:00      0.00    0.00    0.12
  C11                  CHANNEL      0.00     0  00:00      0.00    0.00    0.12
  C12                  CHANNEL      0.00     0  00:00      0.00    0.00    0.13
  C13                  CHANNEL      0.00     0  00:00      0.00    0.00    0.00
  C14                  CHANNEL      0.00     0  00:00      0.00    0.00    0.24
  C15                  CHANNEL      0.00     0  00:00      0.00    0.00    0.13
  C16                  CHANNEL      0.00     0  00:00      0.00    0.00    0.00
  C17                  CHANNEL     14.14     0  01:00      0.83    0.00    0.10
  C3                   CHANNEL      0.00     0  00:00      0.00    0.00    0.11
  C4                   CHANNEL      0.04     0  01:01      0.08    0.00    0.12
  C5                   CHANNEL      2.02     0  01:00      0.03    0.00    0.15
  C6                   CHANNEL      0.00     0  00:00      0.00    0.00    0.14
  C7                   CHANNEL      0.00     0  00:00      0.00    0.00    0.14
  C8                   CHANNEL      0.00     0  00:00      0.00    0.00    0.00
  C9                   CHANNEL      0.00     0  00:00      0.00    0.00    0.13
  Pipe_3               CONDUIT    118.89     0  01:00      0.75    0.66    1.00
  Pipe_4               CONDUIT     20.53     0  00:53      0.29    0.34    1.00
  Pipe_46              CONDUIT    237.33     0  00:54      0.66    0.50    1.00
  Pipe_5               CONDUIT      8.08     0  00:52      0.12    0.13    0.99
  Pipe_6               CONDUIT     16.77     0  00:54      0.24    0.25    1.00
  L101A-IC             ORIFICE     73.88     0  01:00                      1.00
  L102A-IC             ORIFICE     27.75     0  01:00                      1.00
  L102C-IC             ORIFICE     16.43     0  01:00                      1.00
  L102D-IC             ORIFICE     24.61     0  01:00                      1.00
  L103B-IC             ORIFICE     77.82     0  01:00                      1.00
  L105A-IC             ORIFICE     16.10     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   0.99  0.01  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  C11                     1.00   0.99  0.01  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  C12                     1.00   0.99  0.01  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   0.99  0.01  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  C15                     1.00   0.99  0.01  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  C16                     1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
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   0.99  0.01  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  C4                      1.00   0.04  0.01  0.00  0.00  0.00  0.00  0.95  0.00
0.00
  C5                      1.00   0.04  0.01  0.00  0.01  0.00  0.00  0.95  0.01
0.00
  C6                      1.00   0.99  0.01  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  C7                      1.00   0.99  0.01  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   0.99  0.01  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
  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                    0.53      0.53     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     24.00      0.01         0.01
  Pipe_6                   24.00     24.00     24.00      0.01         0.01


  Analysis begun on:  Fri Aug  7 12:31:32 2020
  Analysis ended on:  Fri Aug  7 12:31:36 2020
  Total elapsed time: 00:00:04
```

```
  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
 -------------------------------------------------------------------------------
 DICB221              OUTFALL              90.72      0.68       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              93.69      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              90.50      3.21       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
1.9100    0.0130
  C17               L105A-S          MAJ-2            CONDUIT            9.7
2.2752    0.0130
  C3                L101A-S          L101A-S1         CONDUIT           14.8
-1.2803    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          DICB221          CONDUIT           25.2
0.3175    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
12427.71
  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
10175.17
  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
473.65
  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 ..........         0.000         0.004
External Outflow .........         0.097         0.973
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.001         0.012
Final Stored Volume ......         0.001         0.013
Continuity Error (%) .....        -0.107


********************************
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
  --------------------------------------------------------------------------------
  DICB221          OUTFALL     0.64     0.64    91.36     0  00:00        0.64
  MAJ-1            OUTFALL     0.00     0.01    93.34     0  01:01        0.01
  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  01:02        1.58
  L101A-S1         STORAGE     0.00     0.01    93.70     0  01:01        0.01
  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     0.05     1.57    94.09     0  01:02        1.57
  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     0.04     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     0.87     0.92    91.41     0  01:01        0.92
  STM-102          STORAGE     0.31     0.57    91.73     0  01:02        0.57
  STM-103          STORAGE     0.31     0.41    91.48     0  01:00        0.41
  STM-104          STORAGE     0.00     0.00    91.40     0  00:00        0.00
  STM-105          STORAGE     0.30     0.40    91.63     0  01:00        0.40


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

----------------------------------------------------------------------------------
--------------
  DICB221          OUTFALL      0.00   245.45     0  01:01           0
0.811      0.000
  MAJ-1            OUTFALL      0.00     0.21     0  01:01           0
8.55e-05      0.000
  MAJ-2            OUTFALL      0.00    37.85     0  01:00           0
0.0208      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   224.09     0  01:00       0.243
0.26      -0.112
  L101A-S1         STORAGE      0.00     5.82     0  01:01           0
0.000204      36.454
  L102A-S          STORAGE     75.95    75.95     0  01:00       0.101
0.101      -0.280
  L102A-S1         STORAGE      0.00    44.47     0  01:00           0
0.0165      -2.156
  L102B-S          STORAGE    201.97   201.97     0  01:00       0.265
0.265      0.033
  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      -0.006
  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      0.039
  L105A-S1         STORAGE      0.00     0.00     0  00:00           0
  0      0.000 ltr
  STM-101          STORAGE      0.00   245.43     0  01:01           0
0.807      0.019
```

```
  STM-102             STORAGE       0.00   124.24     0  01:01           0
0.407       0.029
  STM-103             STORAGE       0.00    16.20     0  01:00           0
0.0509       0.023
  STM-104             STORAGE       0.00     0.00     0  00:00           0
  0       0.000 ltr
  STM-105             STORAGE       0.00    16.20     0  01:00           0
0.0511       0.389


  **********************
  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         0.010     100       0
01:00      82.66
  L101A-S1                 0.000       0     0     0         0.000       0       0
00:00       0.39
  L102A-S                  0.000       2     0     0         0.002     100       0
00:53      72.75
```

```
  L102A-S1                 0.000       0     0     0         0.000       0       0
00:00      43.40
  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       2     0     0         0.011      91       0
01:02      16.96
  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      54.06
  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     245.45
  STM-102                  0.000       0     0     0         0.000       0       0
00:00     124.23
  STM-103                  0.000       0     0     0         0.000       0       0
00:00      16.20
  STM-104                  0.000       0     0     0         0.000       0       0
00:00       0.00
  STM-105                  0.000       0     0     0         0.000       0       0
00:00      16.20


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

  -----------------------------------------------------------
                         Flow       Avg       Max       Total
                         Freq      Flow      Flow      Volume
  Outfall Node           Pcnt       LPS       LPS    10^6 ltr
  -----------------------------------------------------------
  DICB221               89.98     10.43    245.45       0.811
  MAJ-1                  0.89      0.09      0.21       0.000
  MAJ-2                  1.34     17.95     37.85       0.021
  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              19.22     43.66     13.86       0.977


  ********************
  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    0.17
  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
  C16                  CHANNEL    0.21     0  01:01      0.24    0.00    0.02
  C17                  CHANNEL   37.85     0  01:00      1.06    0.01    0.15
  C3                   CHANNEL    5.82     0  01:01      0.02    0.00    0.28
  C4                   CHANNEL   43.40     0  01:00      0.12    0.00    0.33
  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    0.27
  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  124.23     0  01:02      1.22    0.69    0.62
  Pipe_4               CONDUIT   16.20     0  01:00      0.44    0.27    0.52
  Pipe_46              CONDUIT  245.45     0  01:01      0.71    0.52    0.93
  Pipe_5               CONDUIT    0.00     0  00:00      0.00    0.00    0.08
  Pipe_6               CONDUIT   16.20     0  01:00      0.81    0.24    0.33
  L101A-IC             ORIFICE   76.90     0  01:02                      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   16.96     0  01:02                      1.00
  L102D-IC             ORIFICE   25.44     0  01:01                      1.00
  L105A-IC             ORIFICE   16.20     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  0.91  0.05  0.00  0.00  0.01
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  0.01  0.00  0.02  0.00  0.00  0.94  0.02
0.00
  C4                      1.00   0.04  0.00  0.00  0.03  0.00  0.00  0.94  0.03
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   0.97  0.03  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  0.20  0.00  0.80  0.00  0.00  0.00  0.98
0.00
  Pipe_4                  1.00   0.00  0.39  0.00  0.61  0.00  0.00  0.00  0.99
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   0.97  0.03  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  Pipe_6                  1.00   0.01  0.00  0.00  0.00  0.00  0.00  0.99  0.00
0.00


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

  No conduits were surcharged.


  Analysis begun on:  Fri Aug  7 12:49:29 2020
  Analysis ended on:  Fri Aug  7 12:49:35 2020
  Total elapsed time: 00:00:06
```

C.4 REVISED SNTC SUBDIVISION PCSWMM MODEL AND HGL COMPARISON TABLE

```
[TITLE]
160401085 - SNTC Lands Assessment
Detailed Design Blocks 8 to 15, 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

[FILES]
USE HOTSTART "C:\2020\1085 - Block 4\2020-07-30\SNTC PCWMM\Submitted\5CHI-HGL.HSF"

[EVAPORATION]
;;Type          Parameters
```

```
;;------------- ----------
CONSTANT     0.0
DRY_ONLY     NO

[RAINGAGES]
;;               Rain      Time   Snow   Data
;;Name           Type      Intrvl Catch  Source
;;-------------- --------- ------ ------ ----------
Raingage         INTENSITY 0:10   1.0    TIMESERIES Chicago_5y_3h_10m_City

[SUBCATCHMENTS]
;;                                                Total    Pcnt.             Pcnt.
   Curb     Snow
;;Name           Raingage         Outlet           Area     Imperv   Width    Slope
   Length   Pack
;;-------------- ---------------- ---------------- -------- -------- --------
-------- -------- --------
;0.65
C208A            Raingage         C208A-S          0.331731 75.714   195      3
   0
;0.60
C209A            Raingage         C209A-S          0.251315 61.429   142.8    5
   0
;0.59
C210A            Raingage         C210A-S          0.215972 75.714   90       4
   0
;0.59
C210B            Raingage         C210B-S          0.250004 72.857   104      4
   0
CM1              Raingage         GREENBANK        0.59     85.714   136.9    2
   0
CM2              Raingage         LP               0.7      85.714   204      2
   0
CM3              Raingage         STREETC          0.83     85.714   146      2
   0
;C=0.6
L100A            Raingage         CB69-70          0.1      57.1     57.074   1.4
   0
;C=0.69
L102A            Raingage         CB39-40          0.23     70       96.201   5.5
   0
;C=0.47
L102B            Raingage         RYCB-01          0.03     38.6     20.515   1.8
   0
;C=0.62
L102C            Raingage         CB41-42          0.1825   60       120.041  0.7
   0
;C=0.49
```

```
L102D            Raingage         RYT-01           0.11     41.4     31.402   1.5
   0
;C=0.68
L104A            Raingage         CB43-44          0.2      68.6     85.721   4.7
   0
;C=0.42
L104B            Raingage         RYT-05           0.2      31.4     41.287   2
   0
;C=0.73
L106A            Raingage         CB45-46          0.23     75.7     103.091  4.5
   0
;C=0.45
L106B            Raingage         RYT-11           0.08     35.7     28.135   1.6
   0
;C=0.62
L108A            Raingage         CB47-48          0.15     60       119.261  0.8
   0
;C=0.62
L118A            Raingage         CB49-50          0.14     60       150.602  2.8
   0
;0.68
L201A            Raingage         L201A-S          0.054236 78.571   40.5     2
   0
;0.68
L201B            Raingage         L201B-S          0.059995 92.857   47.6     6
   0
;0.68
L201C            Raingage         L201C-S          0.153167 47.143   111.1    3
   0
;0.68
L202A            Raingage         L202A-S          0.354367 68.571   142.3    4.5
   0
;0.65
L203A            Raingage         L203A-S          0.0657   74.286   49.5     3
   0
;0.70
L204A            Raingage         L204A-S          1.556739 71.429   742.8    2
   0
;0.70
L205A            Raingage         L205A-S          1.102616 71.429   523      2
   0
;0.85
L211A            Raingage         L211A-S          0.047633 90       35.5     5
   0
;0.84
L211B            Raingage         L211B-S          0.106429 91.429   79.4     6
   0
;0.65
```

```
L212A            Raingage         L212A-S          0.245866 72.857   119      3.5
   0
;0.65
L213A            Raingage         L213A-S          0.245087 72.857   117.4    3.5
   0
;0.63
L214A            Raingage         L214A-S          0.245928 62.857   178.5    4.5
   0
;0.70
L215A            Raingage         L215A-S          1.14885  71.429   547      1
   0
;0.60
L216A            Raingage         L216A-S          0.619558 25       111.8    0.5
   0
;0.70
L216B            Raingage         L216A-S          0.240143 50       143.7    2.5
   0
;0.73
L218A            Raingage         L218A-S          0.087369 75.714   45       4
   0
;0.73
L218B            Raingage         L218B-S          0.044699 74.286   21       4
   0
;0.73
L219A            Raingage         L219A-S          0.23166  72.857   92       4
   0
;0.70
L219B            Raingage         L219B-S          1.061507 71.428   506      1
   0
;0.73
L219C            Raingage         L219C-S          0.300748 75.714   135      3
   0
;0.73
L220A            Raingage         L220A-S          0.074565 90       36       2
   0
;0.70
L221A            Raingage         L221A-S          1.271426 87.857   635      1
   0
;0.90
L223A            Raingage         L223A-S          0.039392 95.714   29.4     4.5
   0
;0.70
UNC-1            Raingage         STREETC          0.102069 71.429   125      3
   0
;0.70
UNC-2            Raingage         LP               0.15082  71.429   160      3
   0
;0.70
```

```
UNC-3            Raingage         GREENBANK        0.104615 71.429   111.11   3
   0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo
PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ----------
----------
C208A            0.013      0.25       1.57       4.67       15         IMPERVIOUS
100
C209A            0.013      0.25       1.57       4.67       50         IMPERVIOUS
100
C210A            0.013      0.25       1.57       4.67       40         IMPERVIOUS
100
C210B            0.013      0.25       1.57       4.67       40         IMPERVIOUS
100
CM1              0.013      0.25       1.57       4.67       0          IMPERVIOUS
100
CM2              0.013      0.25       1.57       4.67       0          IMPERVIOUS
100
CM3              0.013      0.25       1.57       4.67       0          IMPERVIOUS
100
L100A            0.013      0.25       1.57       4.67       0          IMPERVIOUS
100
L102A            0.013      0.25       1.57       4.67       15         IMPERVIOUS
100
L102B            0.013      0.25       1.57       4.67       100        PERVIOUS
100
L102C            0.013      0.25       1.57       4.67       0          IMPERVIOUS
100
L102D            0.013      0.25       1.57       4.67       100        PERVIOUS
100
L104A            0.013      0.25       1.57       4.67       15         IMPERVIOUS
100
L104B            0.013      0.25       1.57       4.67       100        PERVIOUS
100
L106A            0.013      0.25       1.57       4.67       25         IMPERVIOUS
100
L106B            0.013      0.25       1.57       4.67       100        PERVIOUS
100
L108A            0.013      0.25       1.57       4.67       0          IMPERVIOUS
100
L118A            0.013      0.25       1.57       4.67       0          IMPERVIOUS
100
L201A            0.013      0.25       1.57       4.67       0          IMPERVIOUS
100
L201B            0.013      0.25       1.57       4.67       60         IMPERVIOUS
100
```

```
L201C            0.013      0.25       1.57       4.67       0          IMPERVIOUS
100
L202A            0.013      0.25       1.57       4.67       30         IMPERVIOUS
100
L203A            0.013      0.25       1.57       4.67       0          IMPERVIOUS
100
L204A            0.013      0.25       1.57       4.67       50         IMPERVIOUS
100
L205A            0.013      0.25       1.57       4.67       50         IMPERVIOUS
100
L211A            0.013      0.25       1.57       4.67       60         IMPERVIOUS
100
L211B            0.013      0.25       1.57       4.67       60         IMPERVIOUS
100
L212A            0.013      0.25       1.57       4.67       40         IMPERVIOUS
100
L213A            0.013      0.25       1.57       4.67       40         IMPERVIOUS
100
L214A            0.013      0.25       1.57       4.67       40         IMPERVIOUS
100
L215A            0.013      0.25       1.57       4.67       50         IMPERVIOUS
100
L216A            0.013      0.25       1.57       4.67       25         IMPERVIOUS
100
L216B            0.013      0.25       1.57       4.67       100        PERVIOUS
100
L218A            0.013      0.25       1.57       4.67       0          IMPERVIOUS
100
L218B            0.013      0.25       1.57       4.67       0          IMPERVIOUS
100
L219A            0.013      0.25       1.57       4.67       15         IMPERVIOUS
100
L219B            0.013      0.25       1.57       4.67       50         IMPERVIOUS
100
L219C            0.013      0.25       1.57       4.67       50         IMPERVIOUS
100
L220A            0.013      0.25       1.57       4.67       0          IMPERVIOUS
100
L221A            0.013      0.25       1.57       4.67       50         IMPERVIOUS
100
L223A            0.013      0.25       1.57       4.67       60         IMPERVIOUS
100
UNC-1            0.013      0.25       1.57       4.67       100        IMPERVIOUS
100
UNC-2            0.013      0.25       1.57       4.67       100        IMPERVIOUS
100
UNC-3            0.013      0.25       1.57       4.67       100        IMPERVIOUS
100
```

```
[INFILTRATION]
;;Subcatchment   MaxRate    MinRate    Decay      DryTime    MaxInfil
;;-------------- ---------- ---------- ---------- ---------- ----------
C208A            76.2       13.2       4.14       7          0
C209A            76.2       13.2       4.14       7          0
C210A            76.2       13.2       4.14       7          0
C210B            76.2       13.2       4.14       7          0
CM1              76.2       13.2       4.14       7          0
CM2              76.2       13.2       4.14       7          0
CM3              76.2       13.2       4.14       7          0
L100A            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
L104A            76.2       13.2       4.14       7          0
L104B            76.2       13.2       4.14       7          0
L106A            76.2       13.2       4.14       7          0
L106B            76.2       13.2       4.14       7          0
L108A            76.2       13.2       4.14       7          0
L118A            76.2       13.2       4.14       7          0
L201A            76.2       13.2       4.14       7          0
L201B            76.2       13.2       4.14       7          0
L201C            76.2       13.2       4.14       7          0
L202A            76.2       13.2       4.14       7          0
L203A            76.2       13.2       4.14       7          0
L204A            76.2       13.2       4.14       7          0
L205A            76.2       13.2       4.14       7          0
L211A            76.2       13.2       4.14       7          0
L211B            76.2       13.2       4.14       7          0
L212A            76.2       13.2       4.14       7          0
L213A            76.2       13.2       4.14       7          0
L214A            76.2       13.2       4.14       7          0
L215A            76.2       13.2       4.14       7          0
L216A            76.2       13.2       4.14       7          0
L216B            76.2       13.2       4.14       7          0
L218A            76.2       13.2       4.14       7          0
L218B            76.2       13.2       4.14       7          0
L219A            76.2       13.2       4.14       7          0
L219B            76.2       13.2       4.14       7          0
L219C            76.2       13.2       4.14       7          0
L220A            76.2       13.2       4.14       7          0
L221A            76.2       13.2       4.14       7          0
L223A            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
```

```
[JUNCTIONS]
;;               Invert     Max.       Init.      Surcharge  Ponded
;;Name           Elev.      Depth      Depth      Depth      Area
;;-------------- ---------- ---------- ---------- ---------- ----------
1+010            93.47      0.35       0          0          0
1+096            93.79      0.35       0          0          0
1+173            93.61      0.35       0          0          0
1+250            93.79      0.35       0          0          0
1+329            93.57      0.36       0          0          0
1+400            93.76      0.35       0          0          0
1+466            94.97      0.35       0          0          0
3+057            93.71      0.35       0          0          0
;T/G = 93.27
CB39-40          91.49      2.13       0          0.3        0
;T/G = 93.44
CB41-42          91.75      2.04       0          0          0
;T/G = 93.4
CB43-44          91.72      2.03       0          0          0
;T/G = 93.41
CB45-46          91.73      2.03       0          0          0
;T/G = 93.47
CB47-48          91.79      2.03       0          0          0
;T/G = 93.68
CB49-50          91.97      2.06       0          0          0
;T/G = 93.32
CB69-70          91.52      2.15       0          0          0
HP-RYCB01        93.75      0.3        0          0          0
HP-RYCB04        93.83      0.24       0          0          0
HP-RYT01         93.85      0.3        0          0          0
HP-RYT05         93.85      0.3        0          0          0
HP-RYT11         93.74      0.3        0          0          0
J4               93.53      0.42       0          0          0
;T/G = 93.53
RYCB-72          91.42      2.41       0          0.3        0
;T/G = 93.51
RYCB-73          91.79      2.02       0          0.3        0
;T/G = 93.55
RYCB-76          91.62      2.23       0          0          0

[OUTFALLS]
;;               Invert     Outfall      Stage/Table      Tide
;;Name           Elev.      Type         Time Series      Gate Route To
;;-------------- ---------- ------------ ---------------- ---- ----------------
400              89.7       FIXED        91.94            NO
;T/G = 93.33
CB09             91.66      FREE                          NO
;T/G = 93.3
```

```
CB13-14          91.62      FREE                          NO
;T/G = 93.35
CB37-38          91.67      FREE                          NO
;NWL = 89.90, 2-year WL = 90.55
;5-year WL = 90.93, 100-year WL = 91.58
HW-02            89.87      FIXED        91.58            NO
MAJ-OUT2         93.4       NORMAL                        NO

[STORAGE]
;;               Invert   Max.     Init.    Storage    Curve
       Evap.
;;Name           Elev.    Depth    Depth    Curve      Params
       Frac.    Infiltration parameters
;;-------------- -------- -------- -------- ---------- -------- -------- --------
-------- -------- ----------------------
;Mcon MH - Concentric
10000            90.04    3.38     0        FUNCTIONAL 1.13     0        0        0
       0
102              89.956   3.806    0        FUNCTIONAL 0        0        1.13     0
       0
106              90.139   3.686    0        FUNCTIONAL 0        0        1.13     0
       0
200              90.51    2.9      0        FUNCTIONAL 0        0        0        0
       0
201              90.321   3.701    0        FUNCTIONAL 0        0        1.13     0
       0
201A-S(2)        94.03    0.4      0        FUNCTIONAL 0        0        0        0
       0
201B-S(1)        94.08    0.4      0        FUNCTIONAL 0        0        0        0
       0
202              90.794   3.226    0        FUNCTIONAL 0        0        1.13     0
       0
202A-S(1)        93.96    0.4      0        FUNCTIONAL 0        0        0        0
       0
203              91.359   2.807    0        FUNCTIONAL 0        0        1.13     0
       0
203A-S(1)        94.31    0.4      0        FUNCTIONAL 0        0        0        0
       0
206              90.33    3.24     0        FUNCTIONAL 0        0        0        0
       0
207              90.053   3.359    0        FUNCTIONAL 0        0        1.13     0
       0
208              90.105   3.675    0        FUNCTIONAL 0        0        1.13     0
       0
209              90.142   3.573    0        FUNCTIONAL 0        0        1.13     0
       0
209A-S(1)        93.76    0.4      0        FUNCTIONAL 0        0        0        0
       0
```

```
210              91.115   1.922    0        FUNCTIONAL 0        0        1.13     0
       0
210A-S(1)        93.91    0.4      0        FUNCTIONAL 0        0        0        0
       0
210B-S(1)        93.83    0.4      0        FUNCTIONAL 0        0        0        0
       0
211              91.194   2.96     0        FUNCTIONAL 0        0        1.13     0
       0
212              90.683   3.205    0        FUNCTIONAL 0        0        1.13     0
       0
212A-S(1)        93.64    0.4      0        FUNCTIONAL 0        0        0        0
       0
213              90.868   3.096    0        FUNCTIONAL 0        0        1.13     0
       0
213A-S(1)        93.87    0.4      0        FUNCTIONAL 0        0        0        0
       0
214              91.248   2.567    0        FUNCTIONAL 0        0        1.13     0
       0
214A-S(1)        93.93    0.4      0        FUNCTIONAL 0        0        0        0
       0
215A             91.31    3.09     0        FUNCTIONAL 0        0        1.13     0
       0
216              91.132   2.308    0        FUNCTIONAL 0        0        1.13     0
       0
217              90.08    3.22     0        FUNCTIONAL 0        0        0        0
       0
218              89.88    3.726    0        FUNCTIONAL 0        0        1.13     0
       0
218A-S(1)        93.67    0.4      0        FUNCTIONAL 0        0        0        0
       0
218B-S(1)        93.55    0.4      0        FUNCTIONAL 0        0        0        0
       0
219              90.446   3.28     0        FUNCTIONAL 0        0        1.13     0
       0
219A-S(1)        93.95    0.4      0        FUNCTIONAL 0        0        0        0
       0
219B             91.18    3.12     0        FUNCTIONAL 0        0        1.13     0
       0
219C-S(1)        93.6     0.4      0        FUNCTIONAL 0        0        0        0
       0
220              91.179   2.704    0        FUNCTIONAL 0        0        1.13     0
       0
221A             90.81    3.31     0        FUNCTIONAL 0        0        1.13     0
       0
223              91.411   2.683    0        FUNCTIONAL 0        0        1.13     0
       0
402              90       3.5      0        FUNCTIONAL 0        0        0        0
       0
```

```
404              90.2     3.94     0        FUNCTIONAL 0        0        0        0
       0
406              90.5     5.08     0        FUNCTIONAL 0        0        0        0
       0
C208A-S          91.97    1.78     0        FUNCTIONAL 0        0        0        0
       0
C209A-S          92.23    1.78     0        FUNCTIONAL 0        0        0        0
       0
C210A-S          92.12    1.78     0        FUNCTIONAL 0        0        0        0
       0
C210B-S          92.36    1.78     0        FUNCTIONAL 0        0        0        0
       0
DICB204          91.27    2.95     0        FUNCTIONAL 0        0        0        0
       0
DICB205          91.366   2.854    0        FUNCTIONAL 0        0        0        0
       0
DICB215          91.279   2.881    0        FUNCTIONAL 0        0        0        0
       0
DICB221          90.751   2.949    0        FUNCTIONAL 0        0        0        0
       0
DICB222          90.942   2.938    0        FUNCTIONAL 0        0        0        0
       0
GREENBANK        93.765   2.4      0        FUNCTIONAL 0        0        0        0
       0
L201A-S          92.52    1.78     0        FUNCTIONAL 0        0        0        0
       0
L201B-S          92.69    1.78     0        FUNCTIONAL 0        0        0        0
       0
L201B-S(1)       94.12    0.4      0        FUNCTIONAL 0        0        0        0
       0
L201C-S          92.03    1.78     0        FUNCTIONAL 0        0        0        0
       0
L202A-S          92.51    1.78     0        FUNCTIONAL 0        0        0        0
       0
L203A-S          92.41    1.78     0        FUNCTIONAL 0        0        0        0
       0
L204A-S          92.62    2.08     0        TABULAR    L204A-V                    0
       0
L205A-S          92.88    2.08     0        TABULAR    L205A-V                    0
       0
L211A-S          92.68    1.78     0        FUNCTIONAL 0        0        0        0
       0
L211B-S          92.32    1.78     0        FUNCTIONAL 0        0        0        0
       0
L212A-S          92.12    1.78     0        FUNCTIONAL 0        0        0        0
       0
L213A-S          92.35    1.78     0        FUNCTIONAL 0        0        0        0
       0
```

```
L214A-S          92.37    1.78     0        FUNCTIONAL 0        0        0        0
       0
L215A-S          92.67    2.08     0        TABULAR    L215A-V                    0
       0
L216A-S          91.43    2.9      0        TABULAR    L216A-V                    0
       0
L218A-S          92.06    1.78     0        FUNCTIONAL 0        0        0        0
       0
L218B-S          91.92    1.78     0        FUNCTIONAL 0        0        0        0
       0
L219A-S          92.21    1.78     0        FUNCTIONAL 0        0        0        0
       0
L219B-S          92.57    2.08     0        TABULAR    L219B-V                    0
       0
L219C-S          92.09    1.78     0        FUNCTIONAL 0        0        0        0
       0
L220A-S          92.38    1.78     0        FUNCTIONAL 0        0        0        0
       0
L221A-S          92.39    2.08     0        TABULAR    L221A-V                    0
       0
L223A-S          92.71    1.78     0        FUNCTIONAL 0        0        0        0
       0
LP               91.56    2.4      0        FUNCTIONAL 0        0        0        0
       0
;Mcon MH - Concentric
MH-100           90.1     3.34     0        FUNCTIONAL 1.13     0        0        0
       0
;Mcon MH - Concentric
MH-104           90.32    3.28     0        FUNCTIONAL 1.13     0        0        0
       0
;Mcon MH - Concentric
MH-108           91.4     2.43     0        FUNCTIONAL 1.13     0        0        0
       0
;Mcon MH - Concentric
MH-110           91.47    3.04     0        FUNCTIONAL 1.13     0        0        0
       0
;Mcon MH - Concentric
MH-x10002        89.99    3.62     0        FUNCTIONAL 1.13     0        0        0
       0
;Mcon MH - Concentric
MH-x10004        89.97    3.58     0        FUNCTIONAL 1.13     0        0        0
       0
;Mcon MH - Concentric
MH-x10006        89.88    3.28     0        FUNCTIONAL 1.13     0        0        0
       0
OF2              93.94    0.4      0        FUNCTIONAL 0        0        0        0
       0
;T/G = 93.65
```

```
RYCB-01          92       1.95     0       FUNCTIONAL 0.1      0        0        0
       0
;T/G = 93.72
RYT-01           91.55    2.47     0       FUNCTIONAL 0.1      0        0        0
       0
;T/G = 93.7
RYT-05           91.92    2.08     0       FUNCTIONAL 0.1      0        0        0
       0
;T/G = 93.58
RYT-11           91.7     2.18     0       FUNCTIONAL 0.1      0        0        0
       0
STM-430          90       2.9      0       FUNCTIONAL 1.13     0        0        0
       0
STREETC          91.9     2.4      0       FUNCTIONAL 0        0        0        0
       0

[CONDUITS]
;;               Inlet            Outlet                      Manning    Inlet
Outlet     Init.      Max.
;;Name           Node             Node             Length     N          Offset
Offset     Flow       Flow
;;-------------- ---------------- ---------------- ---------- ---------- ----------
---------- ---------- ----------
200-201          221A             DICB221          166        0.013      91.09
90.82      0          0
C1               CB69-70          MAJ-OUT2         23.864     0.035      93.61
93.53      0          0
C10              201A-S(2)        L214A-S          26         0.013      94.03
93.75      0          0
C11              203A-S(1)        L203A-S          30.62      0.016      94.31
93.79      0          0
C12              L203A-S          OF2              2          0.016      93.79
93.94      0          0
C13              L214A-S          214A-S(1)        26.18      0.013      93.75
93.93      0          0
C14              214A-S(1)        L213A-S          34.07      0.013      93.93
93.73      0          0
C15              L213A-S          213A-S(1)        25.3       0.013      93.73
93.87      0          0
C16              213A-S(1)        L212A-S          43.76      0.013      93.87
93.5       0          0
C17              L212A-S          212A-S(1)        13.5       0.013      93.5
93.63      0          0
C18              C210A-S          210A-S(1)        53         0.016      93.5
93.91      0          0
C19              LP               C210A-S          16.4       0.013      93.56
93.5       0          0
C2               L219C-S          219C-S(1)        27.05      0.013      93.47
```

```
93.6       0          0
C20              C210B-S          210B-S(1)        18         0.013      93.74
93.83      0          0
C21              212A-S(1)        C209A-S          3.5        0.013      93.63
93.61      0          0
C22              C209A-S          209A-S(1)        14.8       0.013      93.61
93.76      0          0
C23              209A-S(1)        C208A-S          41.3       0.013      93.76
93.35      0          0
C24              C208A-S          1+173            42.6       0.013      93.35
93.61      0          0
C25              OF2              LP               15         0.013      93.94
93.56      0          0
C26              202A-S(1)        L214A-S          21.2       0.013      93.96
93.75      0          0
C27              L223A-S          L211B-S          76.8       0.013      94.09
93.7       0          0
C28              L211B-S          209A-S(1)        4          0.013      93.7
93.76      0          0
C29              L211A-S          C208A-S          112        0.013      94.06
93.35      0          0
C3               215A             DICB215          160        0.013      91.59
91.27      0          0
C30              L201B-S(1)       L201A-S          30.4       0.013      94.12
93.9       0          0
C32              219A-S(1)        L220A-S          12.9       0.013      93.95
93.76      0          0
C33              L220A-S          STREETC          14.5       0.013      93.76
93.9       0          0
C34              219A-S(1)        L219A-S          71.4       0.013      93.95
93.59      0          0
C35              L219A-S          218A-S(1)        14.5       0.013      93.59
93.67      0          0
C36              218A-S(1)        L219C-S          63.3       0.013      93.67
93.47      0          0
C37              L218A-S          218B-S(1)        15.6       0.013      93.44
93.55      0          0
C38              218B-S(1)        L218B-S          14.4       0.013      93.55
93.3       0          0
C39              L218B-S          1+010            10         0.016      93.3
93.47      0          0
C4               L205A-S          L202A-S          51         0.016      94.61
93.89      0          0
C40              L219B-S          L219A-S          142        0.016      94.3
93.59      0          0
C41              219C-S(1)        L218A-S          27.9       0.013      93.6
93.44      0          0
C42              217              10000            12.9       0.013      90.08
```

```
90.07      0          0
C43              210A-S(1)        C210B-S          34.3       0.013      93.91
93.74      0          0
C44              210B-S(1)        212A-S(1)        42.7       0.013      93.83
93.63      0          0
C45              L201B-S          201B-S(1)        3          0.013      94.07
94.08      0          0
C46              201B-S(1)        201A-S(2)        23         0.013      94.08
94.03      0          0
C47              L201C-S          J4               18.7       0.013      93.41
93.53      0          0
C5               L201B-S(1)       L201C-S          56.9       0.013      94.12
93.41      0          0
C6               L201C-S          1+329            23.05      0.016      93.37
93.57      0          0
C7               203A-S(1)        L202A-S          84.2       0.013      94.31
93.89      0          0
C8               219B             DICB222          149        0.013      91.18
90.94      0          0
C9               L201A-S          201A-S(2)        4.25       0.016      93.9
94.03      0          0
CM1              406              404              175        0.013      90.72
90.54      0          0
CM2              404              402              140        0.013      90.54
90.4       0          0
CM3              402              400              150        0.013      90.18
90.03      0          0
CM4              STREETC          LP               68         0.013      93.9
93.56      0          0
CM6              GREENBANK        LP               235.036    0.013      95.765
93.56      0          0
L201B-W          L221A-S          L218A-S          135        0.013      94.12
93.44      0          0
L203C-W          L216A-S          C208A-S          10         0.025      94.03
93.68      0          0
L204B-M          L215A-S          L214A-S          131        0.016      94.4
93.75      0          0
L205B-W          L202A-S          202A-S(1)        10.2       0.013      93.89
93.96      0          0
L205D-W          L204A-S          L201A-S          51         0.016      94.35
93.9       0          0
;CONC. 50-D
MH10000-MH10002  10000            MH-x10002        9.8        0.013      90.04
90.02      0          0
;PVC DR 35
MH10002-STM430   MH-x10002        STM-430          5          0.013      90.01
90         0          0
;CONC. 50-D
```

```
MH10004-MH10006  MH-x10004        MH-x10006        40.3       0.013      89.97
89.91      0          0
;CONC. 50-D
MH10006-STM469   MH-x10006        HW-02            7.3        0.013      89.88
89.87      0          0
;CONC. 50-D
MH100-MH10000    MH-100           10000            22.2       0.013      90.1
90.07      0          0
;CONC. 50-D
MH102-MH100      102              MH-100           142.6      0.013      90.26
90.1       0          0
;CONC. 50-D
MH104-MH102      MH-104           102              50.4       0.013      90.32
90.26      0          0
;CONC. 50-D
MH106-MH104      106              MH-104           105.8      0.013      90.44
90.32      0          0
;CONC. 50-D
MH108-MH106      MH-108           106              85.4       0.013      91.4
90.96      0          0
;CONC. 50-D
MH110-MH108      MH-110           MH-108           37.4       0.013      91.47
91.4       0          0
OVF-HP-RYCB01    HP-RYCB01        CB39-40          3          0.035      93.75
93.27      0          0
OVF-HP-RYCB04    HP-RYCB04        RYT-01           3          0.035      93.83
93.72      0          0
OVF-HP-RYT01     HP-RYT01         CB41-42          3          0.035      93.85
93.44      0          0
OVF-HP-RYT05     HP-RYT05         CB43-44          3          0.035      93.85
93.4       0          0
OVF-HP-RYT11     HP-RYT11         CB47-48          3          0.035      93.74
93.47      0          0
OVF-RYCB01       HP-RYCB01        RYCB-01          3          0.035      93.75
93.65      0          0
OVF-RYT01        HP-RYT01         RYT-01           3          0.035      93.85
93.72      0          0
OVF-RYT05        HP-RYT05         RYT-05           3          0.035      93.85
93.7       0          0
OVF-RYT11        HP-RYT11         RYT-11           3          0.035      93.74
93.58      0          0
Pipe_28          201              200              105.988    0.013      90.621
90.515     0          0
Pipe_29          202              201              22.766     0.013      91.094
91.071     0          0
Pipe_30          203              202              88.399     0.013      91.659
91.394     0          0
Pipe_31          DICB204          201              16.519     0.013      91.27
```

```
91.221     0          0
Pipe_32          DICB205          202              15.788     0.013      91.366
91.319     0          0
Pipe_33          207              206              21.63      0.013      90.353
90.331     0          0
Pipe_34          208              207              49.292     0.013      90.405
90.356     0          0
Pipe_35          209              208              34.456     0.013      90.442
90.408     0          0
Pipe_36          210              209              111.526    0.013      91.415
91.192     0          0
Pipe_37          211              208              88.049     0.013      91.494
91.23      0          0
Pipe_37_(1)      223              211              69.187     0.013      91.731
91.523     0          0
Pipe_38          212              209              60.649     0.013      90.983
90.892     0          0
Pipe_39          213              212              64.432     0.013      91.168
91.058     0          0
Pipe_40          214              213              26.61      0.013      91.548
91.468     0          0
Pipe_41          DICB215          213              12.061     0.013      91.279
91.243     0          0
Pipe_42          216              207              17.974     0.013      91.432
91.253     0          0
Pipe_43          218              217              67.08      0.013      90.15
90.083     0          0
Pipe_44          219              218              77.639     0.013      90.716
90.6       0          0
Pipe_45          220              219              71.543     0.013      91.449
91.091     0          0
Pipe_46          DICB221          218              15.248     0.013      90.721
90.675     0          0
Pipe_47          DICB222          219              13.971     0.013      90.912
90.87      0          0
Pipe_58          206              102              11.964     0.013      90.328
90.316     0          0
Pipe_59          200              106              12.27      0.013      90.512
90.499     0          0
;Ipex PVC DR 35
RYT01-RYCB72     RYT-01           RYCB-72          14         0.013      91.55
91.42      0          0
;Ipex PVC DR 35
RYT02-RYCB73     RYT-05           RYCB-73          14.9       0.013      91.92
91.79      0          0
;Ipex PVC DR 35
RYT11-RYCB76     RYT-11           RYCB-76          9.5        0.013      91.7
91.62      0          0
```

```
ST01-01          1+010            CB69-70          5.2        0.016      93.47
93.32      0          0
ST01-02          1+010            CB39-40          21.2       0.016      93.47
93.27      0          0
ST01-03          1+096            CB39-40          59.9       0.016      93.79
93.27      0          0
ST01-04          1+096            CB41-42          51.3       0.016      93.79
93.44      0          0
ST01-05          1+173            CB41-42          25.4       0.016      93.61
93.44      0          0
ST01-06          1+173            CB43-44          28.7       0.016      93.61
93.4       0          0
ST01-07          1+250            CB43-44          50.4       0.016      93.79
93.4       0          0
ST01-08          1+250            CB45-46          50.2       0.016      93.79
93.41      0          0
ST01-09_1        J4               1+329            9.88       0.016      93.53
93.57      0          0
ST01-09_2        J4               CB45-46          18.32      0.016      93.533
93.41      0          0
ST01-10          1+329            CB47-48          28.4       0.016      93.57
93.47      0          0
ST01-11          1+400            CB47-48          46.6       0.016      93.76
93.47      0          0
ST01-12          1+400            CB49-50          18.3       0.016      93.76
93.68      0          0
ST01-13          1+466            CB49-50          46.4       0.016      94.97
93.68      0          0
ST03-01          3+057            CB69-70          25.7       0.016      93.71
93.32      0          0
ST05-01          1+329            CB13-14          32         0.016      93.57
93.3       0          0
ST06-01          1+173            CB09             35.3       0.016      93.61
93.33      0          0
ST07-01          1+400            CB37-38          36.9       0.016      93.76
93.35      0          0
;PVC DR 35
STM431-MH10004   STM-430          MH-x10004        5          0.013      90
89.99      0          0

[ORIFICES]
;;               Inlet            Outlet           Orifice      Crest      Disch.
  Flap Open/Close
;;Name           Node             Node             Type         Height     Coeff.
  Gate Time
;;-------------- ---------------- ---------------- ------------ ----------
---------- ---- ----------
C208A-IC1        C208A-S          208              SIDE         91.97      0.61
```

```
  NO   0
C208A-IC2        C208A-S          208              SIDE         91.97      0.61
  NO   0
C209A-IC1        C209A-S          209              SIDE         92.23      0.61
  NO   0
C209A-IC2        C209A-S          209              SIDE         92.23      0.61
  NO   0
C210A-IC1        C210A-S          210              SIDE         92.12      0.61
  NO   0
C210A-IC2        C210A-S          210              SIDE         92.12      0.61
  NO   0
C210B-IC1        C210B-S          210              SIDE         92.36      0.61
  NO   0
C210B-IC2        C210B-S          210              SIDE         92.36      0.61
  NO   0
L201A-IC         L201A-S          201              SIDE         92.52      0.61
  NO   0
L201B-IC1        L201B-S          201              SIDE         92.69      0.61
  NO   0
L201C-IC1        L201C-S          201              SIDE         92.03      0.61
  NO   0
L201C-IC2        L201C-S          201              SIDE         92.03      0.61
  NO   0
L202A-IC1        L202A-S          202              SIDE         92.51      0.61
  NO   0
L202A-IC2        L202A-S          202              SIDE         92.51      0.61
  NO   0
L203A-IC1        L203A-S          203              SIDE         92.41      0.61
  NO   0
L203A-IC2        L203A-S          203              SIDE         92.41      0.61
  NO   0
L211A-IC         L211A-S          211              SIDE         92.68      0.61
  NO   0
L211B-IC         L211B-S          211              SIDE         92.13      0.61
  NO   0
L212A-IC1        L212A-S          212              SIDE         92.12      0.61
  NO   0
L212A-IC2        L212A-S          212              SIDE         92.12      0.61
  NO   0
L213A-IC1        L213A-S          213              SIDE         92.35      0.61
  NO   0
L213A-IC2        L213A-S          213              SIDE         92.35      0.61
  NO   0
L214A-IC1        L214A-S          214              SIDE         92.37      0.61
  NO   0
L214A-IC2        L214A-S          214              SIDE         92.37      0.61
  NO   0
L216A-IC1        L216A-S          216              SIDE         91.43      0.61
```

```
  NO   0
L218A-IC1        L218A-S          218              SIDE         92.06      0.61
  NO   0
L218A-IC2        L218A-S          218              SIDE         92.06      0.61
  NO   0
L218B-IC1        L218B-S          218              SIDE         91.92      0.61
  NO   0
L218B-IC2        L218B-S          218              SIDE         91.92      0.61
  NO   0
L219A-IC1        L219A-S          219              SIDE         92.21      0.61
  NO   0
L219A-IC2        L219A-S          219              SIDE         92.21      0.61
  NO   0
L219C-IC1        L219C-S          219              SIDE         92.09      0.61
  NO   0
L219C-IC2        L219C-S          219              SIDE         92.09      0.61
  NO   0
L220A-IC1        L220A-S          220              SIDE         92.38      0.61
  NO   0
L220A-IC2        L220A-S          220              SIDE         92.38      0.61
  NO   0
L223A-IC         L223A-S          223              SIDE         92.71      0.61
  NO   0
OCB-39           CB39-40          MH-100           SIDE         91.49      0.61
  NO   0
OCB-40           CB39-40          MH-100           SIDE         91.49      0.61
  NO   0
OCB-41           CB41-42          102              SIDE         91.75      0.61
  NO   0
OCB-42           CB41-42          102              SIDE         91.75      0.61
  NO   0
OCB-43           CB43-44          MH-104           SIDE         91.72      0.61
  NO   0
OCB-44           CB43-44          MH-104           SIDE         91.72      0.61
  NO   0
OCB-45           CB45-46          106              SIDE         91.73      0.61
  NO   0
OCB-46           CB45-46          106              SIDE         91.73      0.61
  NO   0
OCB-47           CB47-48          MH-108           SIDE         91.79      0.61
  NO   0
OCB-48           CB47-48          MH-108           SIDE         91.79      0.61
  NO   0
OCB-49           CB49-50          MH-110           SIDE         91.97      0.61
  NO   0
OCB-50           CB49-50          MH-110           SIDE         91.97      0.61
  NO   0
OCB-69           CB69-70          10000            SIDE         91.52      0.61
```

```
  NO   0
OCB-70           CB69-70          10000            SIDE         91.52      0.61
  NO   0
ORYCB-01         RYCB-01          102              SIDE         92         0.61
  NO   0
ORYCB-72         RYCB-72          102              SIDE         91.42      0.61
  NO   0
ORYCB-73         RYCB-73          MH-104           SIDE         91.79      0.61
  NO   0
ORYCB-76         RYCB-76          MH-108           SIDE         91.62      0.61
  NO   0

[WEIRS]
;;               Inlet            Outlet           Weir         Crest      Disch.
  Flap End      End
;;Name           Node             Node             Type         Height     Coeff.
  Gate Con.     Coeff.     Surcharge  RoadWidth  RoadSurf   Coeff. Curve
;;-------------- ---------------- ---------------- ------------ ----------
---------- ---- -------- ---------- ---------- ---------- ----------
----------------
;CONC. 50-D
MH10002-MH10004  MH-x10002        MH-x10004        TRANSVERSE   90.68      1.84
  NO   0        0          YES

[OUTLETS]
;;               Inlet            Outlet           Outflow    Outlet
Qcoeff/                    Flap
;;Name           Node             Node             Height     Type
QTable           Qexpon     Gate
;;-------------- ---------------- ---------------- ---------- ----------------
---------------- ---------- ----
CM-1             GREENBANK        406              93.765     TABULAR/HEAD     S1-S
                       NO
CM-2             LP               404              91.56      TABULAR/HEAD     S2-S
                       NO
CM-3             STREETC          402              91.9       TABULAR/HEAD     S3-S
                       NO
L204A-O          L204A-S          DICB204          92.62      TABULAR/DEPTH
L204A-Q                    NO
L205A-O          L205A-S          DICB205          92.88      TABULAR/DEPTH
L205A-Q                    NO
L215A-O          L215A-S          215A             92.67      TABULAR/DEPTH
L215A-Q                    NO
L219B-O          L219B-S          219B             92.57      TABULAR/DEPTH
L219B-Q                    NO
L221A-O          L221A-S          221A             92.39      TABULAR/DEPTH
L221A-Q                    NO
```

```
[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4
Barrels
;;-------------- ------------ ---------------- ---------- ---------- ----------
----------
200-201          CIRCULAR     0.6              0          0          0          1

C1               TRIANGULAR   0.3              1.8        0          0          1

C10              IRREGULAR    Half-18mROW      0          0          0          1

C11              IRREGULAR    18mROW           0          0          0          1

C12              IRREGULAR    18mROW           0          0          0          1

C13              IRREGULAR    Street-E-18m-ROW 0          0          0          1

C14              IRREGULAR    Street-E-18m-ROW 0          0          0          1

C15              IRREGULAR    Street-E-18m-ROW 0          0          0          1

C16              IRREGULAR    18mROW           0          0          0          1

C17              IRREGULAR    18mROW           0          0          0          1

C18              IRREGULAR    Jockvale         0          0          0          1

C19              IRREGULAR    Jockvale         0          0          0          1

C2               IRREGULAR    Street-C-mount-14m-ROW 0    0          0          1

C20              IRREGULAR    Jockvale         0          0          0          1

C21              IRREGULAR    Jockvale         0          0          0          1

C22              IRREGULAR    Jockvale         0          0          0          1

C23              IRREGULAR    Jockvale         0          0          0          1

C24              IRREGULAR    Jockvale         0          0          0          1

C25              IRREGULAR    Street-A-18mROW  0          0          0          1

C26              IRREGULAR    Half-18mROW      0          0          0          1

C27              IRREGULAR    Half-LaneD-8.5mROW 0        0          0          1

C28              IRREGULAR    Half-LaneD-8.5mROW 0        0          0          1
```

```
C29              IRREGULAR    Half-LaneD-8.5mROW 0        0          0          1
C3               CIRCULAR     0.6              0          0          0          1
C30              IRREGULAR    Half-18mROW      0          0          0          1
C32              IRREGULAR    Street-C-14m-ROW 0          0          0          1
C33              IRREGULAR    Street-C-14m-ROW 0          0          0          1
C34              IRREGULAR    Street-C-14m-ROW 0          0          0          1
C35              IRREGULAR    Street-C-14m-ROW 0          0          0          1
C36              IRREGULAR    Street-C-mount-14m-ROW 0    0          0          1
C37              IRREGULAR    Street-C-mount-14m-ROW 0    0          0          1
C38              IRREGULAR    Street-C-mount-14m-ROW 0    0          0          1
C39              IRREGULAR    18mROW           0          0          0          1
C4               IRREGULAR    18mROW           0          0          0          1
C40              IRREGULAR    8.5m-ROW         0          0          0          1
C41              IRREGULAR    Street-C-mount-14m-ROW 0    0          0          1
C42              CIRCULAR     1.2              0          0          0          1
C43              IRREGULAR    Jockvale         0          0          0          1
C44              IRREGULAR    Jockvale         0          0          0          1
C45              IRREGULAR    Half-LaneD-8.5mROW 0        0          0          1
C46              IRREGULAR    Half-18mROW      0          0          0          1
C47              IRREGULAR    Street-A-18mROW  0          0          0          1
C5               IRREGULAR    Street-A-18mROW  0          0          0          1
C6               IRREGULAR    18mROW           0          0          0          1
C7               IRREGULAR    Street-A-18mROW  0          0          0          1
C8               CIRCULAR     0.6              0          0          0          1
```

```
C9               IRREGULAR    Half-18mROW      0          0          0          1
CM1              CIRCULAR     1.05             0          0          0          1
CM2              CIRCULAR     1.05             0          0          0          1
CM3              HORIZ_ELLIPSE 10              0          0          0          1
CM4              IRREGULAR    ChapmanMills     0          0          0          1
CM6              IRREGULAR    ChapmanMills     0          0          0          1
L201B-W          IRREGULAR    8.5m-ROW         0          0          0          1
L203C-W          TRIANGULAR   0.3              1.8        0          0          1
L204B-M          IRREGULAR    8.5m-ROW         0          0          0          1
L205B-W          IRREGULAR    Street-A-18mROW  0          0          0          1
L205D-W          IRREGULAR    8.5m-ROW         0          0          0          1
MH10000-MH10002  HORIZ_ELLIPSE 1.219           1.93       0          0          1
MH10002-STM430   CIRCULAR     1.219            0          0          0          1
MH10004-MH10006  HORIZ_ELLIPSE 1.219           1.93       0          0          1
MH10006-STM469   HORIZ_ELLIPSE 1.219           1.93       0          0          1
MH100-MH10000    HORIZ_ELLIPSE 1.219           1.93       0          0          1
MH102-MH100      HORIZ_ELLIPSE 1.219           1.93       0          0          1
MH104-MH102      CIRCULAR     1.219            0          0          0          1
MH106-MH104      CIRCULAR     1.219            0          0          0          1
MH108-MH106      CIRCULAR     0.686            0          0          0          1
MH110-MH108      CIRCULAR     0.686            0          0          0          1
OVF-HP-RYCB01    TRIANGULAR   0.3              1.8        0          0          1
OVF-HP-RYCB04    TRIANGULAR   0.3              1.8        0          0          1
OVF-HP-RYT01     TRIANGULAR   0.3              1.8        0          0          1
```

```
OVF-HP-RYT05     TRIANGULAR   0.3              1.8        0          0          1
OVF-HP-RYT11     TRIANGULAR   0.3              1.8        0          0          1
OVF-RYCB01       TRIANGULAR   0.3              1.8        0          0          1
OVF-RYT01        TRIANGULAR   0.3              1.8        0          0          1
OVF-RYT05        TRIANGULAR   0.3              1.8        0          0          1
OVF-RYT11        TRIANGULAR   0.3              1.8        0          0          1
Pipe_28          CIRCULAR     1.2              0          0          0          1
Pipe_29          CIRCULAR     0.75             0          0          0          1
Pipe_30          CIRCULAR     0.45             0          0          0          1
Pipe_31          CIRCULAR     0.6              0          0          0          1
Pipe_32          CIRCULAR     0.525            0          0          0          1
Pipe_33          CIRCULAR     1.2              0          0          0          1
Pipe_34          CIRCULAR     1.2              0          0          0          1
Pipe_35          CIRCULAR     1.2              0          0          0          1
Pipe_36          CIRCULAR     0.45             0          0          0          1
Pipe_37          CIRCULAR     0.375            0          0          0          1
Pipe_37_(1)      CIRCULAR     0.375            0          0          0          1
Pipe_38          CIRCULAR     0.75             0          0          0          1
Pipe_39          CIRCULAR     0.675            0          0          0          1
Pipe_40          CIRCULAR     0.375            0          0          0          1
Pipe_41          CIRCULAR     0.6              0          0          0          1
Pipe_42          CIRCULAR     0.3              0          0          0          1
Pipe_43          CIRCULAR     1.2              0          0          0          1
Pipe_44          CIRCULAR     0.75             0          0          0          1
```

```
Pipe_45          CIRCULAR     0.375            0          0          0          1
Pipe_46          CIRCULAR     0.675            0          0          0          1
Pipe_47          CIRCULAR     0.6              0          0          0          1
Pipe_58          CIRCULAR     1.2              0          0          0          1
Pipe_59          CIRCULAR     1.2              0          0          0          1
RYT01-RYCB72     CIRCULAR     0.25             0          0          0          1
RYT02-RYCB73     CIRCULAR     0.25             0          0          0          1
RYT11-RYCB76     CIRCULAR     0.25             0          0          0          1
ST01-01          IRREGULAR    8.5m_ROW         0          0          0          1
ST01-02          IRREGULAR    8.5m_ROW         0          0          0          1
ST01-03          IRREGULAR    8.5m_ROW         0          0          0          1
ST01-04          IRREGULAR    8.5m_ROW         0          0          0          1
ST01-05          IRREGULAR    8.5m_ROW         0          0          0          1
ST01-06          IRREGULAR    8.5m_ROW         0          0          0          1
ST01-07          IRREGULAR    8.5m_ROW         0          0          0          1
ST01-08          IRREGULAR    8.5m_ROW         0          0          0          1
ST01-09_1        IRREGULAR    8.5m_ROW         0          0          0          1
ST01-09_2        IRREGULAR    8.5m_ROW         0          0          0          1
ST01-10          IRREGULAR    8.5m_ROW         0          0          0          1
ST01-11          IRREGULAR    8.5m_ROW         0          0          0          1
ST01-12          IRREGULAR    8.5m_ROW         0          0          0          1
ST01-13          IRREGULAR    8.5m_ROW         0          0          0          1
ST03-01          IRREGULAR    8.5m_ROW         0          0          0          1
ST05-01          IRREGULAR    8.5m_ROW         0          0          0          1
```

```
ST06-01          IRREGULAR    9.5m_ROW         0          0          0          1

ST07-01          IRREGULAR    8.5m_ROW         0          0          0          1

STM431-MH10004   CIRCULAR     1.219            0          0          0          1

C208A-IC1        CIRCULAR     0.127            0          0          0
C208A-IC2        CIRCULAR     0.127            0          0          0
C209A-IC1        CIRCULAR     0.127            0          0          0
C209A-IC2        CIRCULAR     0.127            0          0          0
C210A-IC1        CIRCULAR     0.102            0          0          0
C210A-IC2        CIRCULAR     0.102            0          0          0
C210B-IC1        CIRCULAR     0.127            0          0          0
C210B-IC2        CIRCULAR     0.127            0          0          0
L201A-IC         CIRCULAR     0.083            0          0          0
L201B-IC1        CIRCULAR     0.083            0          0          0
L201C-IC1        CIRCULAR     0.094            0          0          0
L201C-IC2        CIRCULAR     0.094            0          0          0
L202A-IC1        CIRCULAR     0.108            0          0          0
L202A-IC2        CIRCULAR     0.108            0          0          0
L203A-IC1        CIRCULAR     0.083            0          0          0
L203A-IC2        CIRCULAR     0.083            0          0          0
L211A-IC         CIRCULAR     0.083            0          0          0
L211B-IC         CIRCULAR     0.094            0          0          0
L212A-IC1        CIRCULAR     0.094            0          0          0
L212A-IC2        CIRCULAR     0.094            0          0          0
L213A-IC1        CIRCULAR     0.094            0          0          0
L213A-IC2        CIRCULAR     0.094            0          0          0
L214A-IC1        CIRCULAR     0.094            0          0          0
L214A-IC2        CIRCULAR     0.094            0          0          0
L216A-IC1        CIRCULAR     0.152            0          0          0
L218A-IC1        CIRCULAR     0.094            0          0          0
L218A-IC2        CIRCULAR     0.094            0          0          0
L218B-IC1        CIRCULAR     0.083            0          0          0
L218B-IC2        CIRCULAR     0.083            0          0          0
L219A-IC1        CIRCULAR     0.094            0          0          0
L219A-IC2        CIRCULAR     0.094            0          0          0
L219C-IC1        CIRCULAR     0.108            0          0          0
L219C-IC2        CIRCULAR     0.108            0          0          0
L220A-IC1        CIRCULAR     0.094            0          0          0
L220A-IC2        CIRCULAR     0.094            0          0          0
L223A-IC         CIRCULAR     0.083            0          0          0
OCB-39           CIRCULAR     0.083            0          0          0
OCB-40           CIRCULAR     0.083            0          0          0
OCB-41           CIRCULAR     0.083            0          0          0
OCB-42           CIRCULAR     0.083            0          0          0
OCB-43           CIRCULAR     0.083            0          0          0
```

```
OCB-44           CIRCULAR     0.083            0          0          0
OCB-45           CIRCULAR     0.083            0          0          0
OCB-46           CIRCULAR     0.083            0          0          0
OCB-47           CIRCULAR     0.083            0          0          0
OCB-48           CIRCULAR     0.083            0          0          0
OCB-49           CIRCULAR     0.083            0          0          0
OCB-50           CIRCULAR     0.083            0          0          0
OCB-69           CIRCULAR     0.083            0          0          0
OCB-70           CIRCULAR     0.083            0          0          0
ORYCB-01         CIRCULAR     0.083            0          0          0
ORYCB-72         CIRCULAR     0.102            0          0          0
ORYCB-73         CIRCULAR     0.127            0          0          0
ORYCB-76         CIRCULAR     0.083            0          0          0
MH10002-MH10004  RECT_OPEN    1                2.4        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

;NOVATECH
NC 0.016    0.016    0.016
X1 8.5m_ROW         9        5        15.5     0.0       0.0       0.0      0.0
 0.0
GR 0.35     0        0.16     5        0.15     6        0        6.01     0.13
10.25
GR 0        14.49    0.15     14.5     0.16     15.5     0.35     20.5

;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 0.01     0.01     0.01
X1 9.5m_ROW         9        5        16.5     0.0       0.0       0.0       0.0
 0.0
GR 0.35     0        0.16     5        0.15     6        0        6.01     0.14
10.75
GR 0        15.49    0.15     15.5     0.16     16.5     0.35     21.5

;41mROW
NC 0.025    0.025    0.013
X1 ChapmanMills     16       6        35       0.0       0.0       0.0       0.0
 0.0
GR 0.27     0        0.17     4.8      0.15     6        0        6        0.18
12
GR 0.23     12       0.22     16.5     0.17     16.5     0.29     20.5     0.17
24.5
GR 0.22     24.5     0.23     29       0.18     29       0        35       0.15
35
GR 0.27     41

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

NC 0.013    0.013    0.013
X1 Half-LaneD-8.5mROW 4        0.0      0.0      0.0       0.0       0.0      0.0
   0.0
GR 0.07     0        0        2.75     0.05     2.75     0.1      4.25

;Full street, width = 9.5m, curb = 0.15m , cross-slope = 3%, bank-slope = 1.8-2.6%,
bank-height = 0.20m.
NC 0.025    0.025    0.013
X1 Jockvale         11       2.7      26.7     0.0       0.0       0.0       0.0
 0.0
GR 0.35     0        0.28     2.7      0.23     5.45     0.15     9.95     0
9.95
GR 0.13     14.7     0        19.45    0.15     19.45    0.23     23.95    0.28
```

```
26.7
GR 0.35     29.4

NC 0.016    0.016    0.016
X1 novatech-8.5m_ROW 9        5        15.5     0.0       0.0       0.0      0.0
  0.0
GR 0.35     0        0.16     5        0.15     6        0        6.01     0.13
10.25
GR 0        14.49    0.15     14.5     0.16     15.5     0.35     20.5

;Full street, width = 8.5m, curb = 0.15m , cross-slope = 0.03m/m, bank-slope =
2-3%, bank-height = 0.19m.
NC 0.025    0.025    0.013
X1 Street-A-18mROW  10       7.65     17.65    0.0       0.0       0.0      0.0
 0.0
GR 0.34     0        0.25     2.9      0.15     7.65     0        7.65     0.13
11.9
GR 0        16.15    0.15     16.15    0.18     17.65    0.25     20.9     0.34
23.8

;Barier Curb, 8.5m-wide pavement, 1.8m-sidewalk on one side, 1.5m-wide boulevard on
the other side, followed by K-B SWMF
NC 0.025    0.025    0.013
X1 Street-C-14m-ROW 8        1.5      11.8     0.0       0.0       0.0      0.0
 0.0
GR 0.18     0        0.15     1.5      0        1.5      0.13     5.75     0
10
GR 0.15     10       0.19     11.8     0.23     14

;Barier/Mountable Curb, 8.5m-wide pavement, 1.8m-sidewalk on one side, 1.5m-wide
boulevard on the other side, followed by K-B SWMF
NC 0.025    0.025    0.013
X1 Street-C-mount-14m-ROW 9        1.5      11.8     0.0       0.0       0.0
0.0      0.0
GR 0.18     0        0.15     1.5      0        1.5      0.13     5.75     0
10
GR 0.05     10       0.09     11.8     0.13     14       0.23     18.8

;Full street, width = 8.5m, curb = 0.15m , cross-slope = 0.03m/m, bank-slope =
0.027m/m, bank-height = 0.13m.
NC 0.025    0.025    0.013
X1 Street-E-18m-ROW 7        4.75     13.25    0.0       0.0       0.0      0.0
 0.0
GR 0.28     0        0.15     4.75     0        4.75     0.13     9        0
13.25
GR 0.15     13.25    0.28     18

[LOSSES]
```

```
;;Link           Inlet      Outlet     Average    Flap Gate  SeepageRate
;;-------------- ---------- ---------- ---------- ---------- ----------
200-201          0          1.26       0          NO         0
C3               0          0.02       0          NO         0
C42              0          0.02       0          NO         0
C8               0          0.02       0          NO         0
CM1              0          0.06       0          NO         0
CM2              0          0.06       0          NO         0
MH10000-MH10002  0.5        0.39       0          NO         0
MH10004-MH10006  0.5        0.39       0          NO         0
MH10006-STM469   0.5        1          0.5        NO         0
MH100-MH10000    0.5        0.39       0          NO         0
MH102-MH100      0.5        0          0          NO         0
MH104-MH102      0.5        1.32       0          NO         0
MH106-MH104      0.5        0          0          NO         0
MH108-MH106      0.5        0          0          NO         0
MH110-MH108      0.5        0.09       0          NO         0
Pipe_28          0          0.06       0          NO         0
Pipe_29          0          0.06       0          NO         0
Pipe_30          0          0.06       0          NO         0
Pipe_31          0          0.02       0          NO         0
Pipe_32          0          1.32       0          NO         0
Pipe_33          0          0.06       0          NO         0
Pipe_34          0          0.06       0          NO         0
Pipe_35          0          0.06       0          NO         0
Pipe_36          0          0.06       0          NO         0
Pipe_37          0          1.32       0          NO         0
Pipe_37_(1)      0          0.06       0          NO         0
Pipe_38          0          1.32       0          NO         0
Pipe_39          0          0.06       0          NO         0
Pipe_40          0          0.06       0          NO         0
Pipe_41          0          1.32       0          NO         0
Pipe_42          0          1.32       0          NO         0
Pipe_43          0          0.06       0          NO         0
Pipe_44          0          0.06       0          NO         0
Pipe_45          0          0.06       0          NO         0
Pipe_46          0          1.32       0          NO         0
Pipe_47          0          0.02       0          NO         0
RYT01-RYCB72     0.5        1.32       0          NO         0
RYT02-RYCB73     0.5        1.32       0          NO         0
RYT11-RYCB76     0.5        1.32       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       237
L204A-Q                     1.73       261
L204A-Q                     2.08       265

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       168
L205A-Q                     1.73       185
L205A-Q                     2.08       188

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       175
L215A-Q                     1.73       193
```

```
L215A-Q                     2.08       196

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

L219B-Q          Rating     0          0
L219B-Q                     1.38       162
L219B-Q                     1.73       178
L219B-Q                     2.08       181

L221A-Q          Rating     0          0
L221A-Q                     1.38       230
L221A-Q                     1.73       245
L221A-Q                     2.08       250

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

S1-S             Rating     0          0
S1-S                        2          292
S1-S                        2.2        453
S1-S                        2.4        498

S2-S             Rating     0          0
S2-S                        2          327
S2-S                        2.2        495
S2-S                        2.4        544

S3-S             Rating     0          0
S3-S                        2          296
S3-S                        2.2        457
S3-S                        2.4        502

BLOCK11          Storage    0          0.36
BLOCK11                     1.4        0.36
BLOCK11                     1.75       320

BLOCK16          Storage    0          0.36
BLOCK16                     1.4        0.36
```

```
BLOCK16                     1.75       230

BLOCK19          Storage    0          0.36
BLOCK19                     1.4        0.36
BLOCK19                     1.75       250

BLOCK20          Storage    0          0.36
BLOCK20                     1.4        0.36
BLOCK20                     1.75       515

BLOCK25          Storage    0          0.36
BLOCK25                     1.4        0.36
BLOCK25                     1.75       350

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

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       326        
L215A-V                     1.731      0          
L215A-V                     2.08       0          

L216A-V          Storage    0          0          
L216A-V                     2.3        0          
L216A-V                     2.6        1000       
L216A-V                     2.601      0          
L216A-V                     2.9        0          

L219B-V          Storage    0          0          
L219B-V                     1.38       0          
L219B-V                     1.73       304        
L219B-V                     1.731      0          
L219B-V                     2.08       0          
```

```
L221A-V          Storage    0          0          
L221A-V                     1.38       0          
L221A-V                     1.73       360        
L221A-V                     1.731      0          
L221A-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     
;;-------------- ---------- ---------- ----------
;25mm - 4hr Chicago Design Storm - City of Ottawa IDF Data (1967-1997)
01-C25mm-4                  0:00       0.00      
01-C25mm-4                  0:10       1.51      
01-C25mm-4                  0:20       1.75      
01-C25mm-4                  0:30       2.07      
01-C25mm-4                  0:40       2.58      
01-C25mm-4                  0:50       3.46      
01-C25mm-4                  1:00       5.39      
01-C25mm-4                  1:10       13.44     
01-C25mm-4                  1:20       56.67     
01-C25mm-4                  1:30       17.77     
01-C25mm-4                  1:40       9.12      
01-C25mm-4                  1:50       6.14      
01-C25mm-4                  2:00       4.65      
01-C25mm-4                  2:10       3.76      
01-C25mm-4                  2:20       3.17      
01-C25mm-4                  2:30       2.74      
01-C25mm-4                  2:40       2.43      
01-C25mm-4                  2:50       2.18      
01-C25mm-4                  3:00       1.98      
01-C25mm-4                  3:10       1.81      
01-C25mm-4                  3:20       1.68      
01-C25mm-4                  3:30       1.56      
01-C25mm-4                  3:40       1.47      
01-C25mm-4                  3:50       1.38      
01-C25mm-4                  4:00       1.31      
```

UNC-1	363857.006	5014032.4
UNC-1	363857.006	5014032.4
UNC-1	363852.804	5014037.995
UNC-1	363852.804	5014037.995
UNC-1	363843.736	5014032.93
UNC-1	363843.736	5014032.93
UNC-1	363834.667	5014027.864
UNC-1	363834.667	5014027.864
UNC-1	363838.491	5014019.091
UNC-1	363838.491	5014019.091
UNC-1	363831.471	5014015.06
UNC-1	363831.471	5014015.06
UNC-1	363826.734	5014023.308
UNC-1	363826.734	5014023.308
UNC-1	363803.345	5014009.875
UNC-1	363803.345	5014009.875
UNC-1	363808.518	5014000.868
UNC-1	363808.518	5014000.868
UNC-1	363802.072	5013997.166
UNC-1	363802.072	5013997.166
UNC-1	363796.899	5014006.173
UNC-1	363796.899	5014006.173
UNC-1	363773.51	5013992.741
UNC-1	363773.51	5013992.741
UNC-1	363776.103	5013988.226
UNC-1	363776.103	5013988.226
UNC-1	363764.209	5013981.528
UNC-1	363764.209	5013981.528
UNC-1	363762.222	5013985.39
UNC-1	363762.222	5013985.39
UNC-1	363752.985	5013980.639
UNC-1	363752.985	5013980.639
UNC-1	363752.985	5013980.639
UNC-1	363752.985	5013980.639
UNC-1	363743.748	5013975.887
UNC-1	363743.748	5013975.887
UNC-1	363750.733	5013962.31
UNC-1	363750.733	5013962.31
UNC-1	363746.283	5013960.021
UNC-1	363746.283	5013960.021
UNC-1	363743.995	5013964.428
UNC-1	363743.995	5013964.428
UNC-1	363739.473	5013973.14
UNC-1	363739.473	5013973.14
UNC-1	363741.52	5013980.076
UNC-2	363883.585	5014047.135
UNC-2	363879.867	5014053.793
UNC-2	363879.867	5014053.793

UNC-2	363881.765	5014060.65
UNC-2	363881.765	5014060.65
UNC-2	363986.826	5014121.009
UNC-2	363986.826	5014121.009
UNC-2	364015.507	5014135.958
UNC-2	364015.507	5014135.958
UNC-2	364021.861	5014133.652
UNC-2	364021.861	5014133.652
UNC-2	364027.07	5014121.039
UNC-2	364027.07	5014121.039
UNC-2	364023.349	5014119.509
UNC-2	364023.349	5014119.509
UNC-2	364021.671	5014123.542
UNC-2	364021.671	5014123.542
UNC-2	364020.804	5014123.181
UNC-2	364020.804	5014123.181
UNC-2	364019.135	5014127.191
UNC-2	364019.135	5014127.191
UNC-2	364009.544	5014123.199
UNC-2	364009.544	5014123.199
UNC-2	363999.955	5014119.209
UNC-2	363999.955	5014119.209
UNC-2	364000.756	5014114.838
UNC-2	364000.756	5014114.838
UNC-2	364001.587	5014112.842
UNC-2	364001.587	5014112.842
UNC-2	363999.199	5014111.849
UNC-2	363999.199	5014111.849
UNC-2	363991.114	5014108.182
UNC-2	363991.114	5014108.182
UNC-2	363987.142	5014115.097
UNC-2	363987.142	5014115.097
UNC-2	363952.39	5014095.138
UNC-2	363952.39	5014095.138
UNC-2	363962.736	5014077.123
UNC-2	363962.736	5014077.123
UNC-2	363959.998	5014073.533
UNC-2	363959.998	5014073.533
UNC-2	363958.437	5014072.636
UNC-2	363958.437	5014072.636
UNC-2	363953.956	5014072.081
UNC-2	363953.956	5014072.081
UNC-2	363943.609	5014090.096
UNC-2	363943.609	5014090.096
UNC-2	363908.857	5014070.136
UNC-2	363908.857	5014070.136
UNC-2	363919.203	5014052.121
UNC-2	363919.203	5014052.121

```
UNC-2            363914.369       5014047.327
UNC-2            363914.369       5014047.327
UNC-2            363912.798       5014046.45
UNC-2            363912.798       5014046.45
UNC-2            363900.452       5014065.023
UNC-2            363900.452       5014065.023
UNC-2            363891.383       5014059.958
UNC-2            363891.383       5014059.958
UNC-2            363882.314       5014054.892
UNC-2            363882.314       5014054.892
UNC-2            363883.612       5014050.643
UNC-2            363883.612       5014050.643
UNC-2            363885.098       5014047.981
UNC-2            363885.098       5014047.981
UNC-2            363883.585       5014047.135
UNC-3            364156.658       5014197.145
UNC-3            364163.863       5014180.004
UNC-3            364163.863       5014180.004
UNC-3            364161.003       5014178.76
UNC-3            364161.003       5014178.76
UNC-3            364155.936       5014190.813
UNC-3            364155.936       5014190.813
UNC-3            364153.764       5014189.914
UNC-3            364153.764       5014189.914
UNC-3            364152.685       5014192.521
UNC-3            364152.685       5014192.521
UNC-3            364150.263       5014193.524
UNC-3            364150.263       5014193.524
UNC-3            364080.679       5014164.705
UNC-3            364080.679       5014164.705
UNC-3            364074.599       5014162.187
UNC-3            364074.599       5014162.187
UNC-3            364081.162       5014146.342
UNC-3            364081.162       5014146.342
UNC-3            364062.664       5014138.681
UNC-3            364062.664       5014138.681
UNC-3            364056.773       5014152.904
UNC-3            364056.773       5014152.904
UNC-3            364047.484       5014149.057
UNC-3            364047.484       5014149.057
UNC-3            364047.112       5014149.953
UNC-3            364047.112       5014149.953
UNC-3            364043.773       5014148.57
UNC-3            364043.773       5014148.57
UNC-3            364042.877       5014146.961
UNC-3            364042.877       5014146.961
UNC-3            364041.09        5014142.033
UNC-3            364041.09        5014142.033
```

```
UNC-3            364046.469       5014129.045
UNC-3            364046.469       5014129.045
UNC-3            364043.718       5014127.905
UNC-3            364043.718       5014127.905
UNC-3            364037.882       5014142.003
UNC-3            364037.882       5014142.003
UNC-3            364040.396       5014148.93
UNC-3            364040.396       5014148.93
UNC-3            364060.249       5014159.278
UNC-3            364060.249       5014159.278
UNC-3            364060.711       5014158.391
UNC-3            364060.711       5014158.391
UNC-3            364126.131       5014192.489
UNC-3            364126.131       5014192.489
UNC-3            364156.658       5014197.145

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

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

  160401085 - SNTC Lands Assessment
  Detailed Design Blocks 8 to 15, located north of the Jock River and west of
Greenbank Road.


  *************
  Element Count
  *************
  Number of rain gages ...... 1
  Number of subcatchments ... 44
  Number of nodes ........... 120
  Number of links ........... 184
  Number of pollutants ...... 0
  Number of land uses ....... 0


  ****************
  Raingage Summary
  ****************
                                                 Data       Recording
  Name                 Data Source               Type       Interval
  ------------------------------------------------------------------------
  Raingage             Chicago_5y_3h_10m_City    INTENSITY   10 min.


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

--------------------------------------------------------------------------------
------------------------
  C208A                      0.33    195.00     75.71    3.0000 Raingage
 C208A-S
  C209A                      0.25    142.80     61.43    5.0000 Raingage
 C209A-S
  C210A                      0.22     90.00     75.71    4.0000 Raingage
 C210A-S
  C210B                      0.25    104.00     72.86    4.0000 Raingage
 C210B-S
  CM1                        0.59    136.90     85.71    2.0000 Raingage
 GREENBANK
  CM2                        0.70    204.00     85.71    2.0000 Raingage
```

```
 LP
  CM3                        0.83    146.00     85.71    2.0000 Raingage
 STREETC
  L100A                      0.10     57.07     57.10    1.4000 Raingage
 CB69-70
  L102A                      0.23     96.20     70.00    5.5000 Raingage
 CB39-40
  L102B                      0.03     20.52     38.60    1.8000 Raingage
 RYCB-01
  L102C                      0.18    120.04     60.00    0.7000 Raingage
 CB41-42
  L102D                      0.11     31.40     41.40    1.5000 Raingage
 RYT-01
  L104A                      0.20     85.72     68.60    4.7000 Raingage
 CB43-44
  L104B                      0.20     41.29     31.40    2.0000 Raingage
 RYT-05
  L106A                      0.23    103.09     75.70    4.5000 Raingage
 CB45-46
  L106B                      0.08     28.14     35.70    1.6000 Raingage
 RYT-11
  L108A                      0.15    119.26     60.00    0.8000 Raingage
 CB47-48
  L118A                      0.14    150.60     60.00    2.8000 Raingage
 CB49-50
  L201A                      0.05     40.50     78.57    2.0000 Raingage
 L201A-S
  L201B                      0.06     47.60     92.86    6.0000 Raingage
 L201B-S
  L201C                      0.15    111.10     47.14    3.0000 Raingage
 L201C-S
  L202A                      0.35    142.30     68.57    4.5000 Raingage
 L202A-S
  L203A                      0.07     49.50     74.29    3.0000 Raingage
 L203A-S
  L204A                      1.56    742.80     71.43    2.0000 Raingage
 L204A-S
  L205A                      1.10    523.00     71.43    2.0000 Raingage
 L205A-S
  L211A                      0.05     35.50     90.00    5.0000 Raingage
 L211A-S
  L211B                      0.11     79.40     91.43    6.0000 Raingage
 L211B-S
  L212A                      0.25    119.00     72.86    3.5000 Raingage
 L212A-S
  L213A                      0.25    117.40     72.86    3.5000 Raingage
 L213A-S
  L214A                      0.25    178.50     62.86    4.5000 Raingage
```

```
L214A-S
 L215A                     1.15    547.00     71.43    1.0000 Raingage
L215A-S
 L216A                     0.62    111.80     25.00    0.5000 Raingage
L216A-S
 L216B                     0.24    143.70     50.00    2.5000 Raingage
L216A-S
 L218A                     0.09     45.00     75.71    4.0000 Raingage
L218A-S
 L218B                     0.04     21.00     74.29    4.0000 Raingage
L218B-S
 L219A                     0.23     92.00     72.86    4.0000 Raingage
L219A-S
 L219B                     1.06    506.00     71.43    1.0000 Raingage
L219B-S
 L219C                     0.30    135.00     75.71    3.0000 Raingage
L219C-S
 L220A                     0.07     36.00     90.00    2.0000 Raingage
L220A-S
 L221A                     1.27    635.00     87.86    1.0000 Raingage
L221A-S
 L223A                     0.04     29.40     95.71    4.5000 Raingage
L223A-S
 UNC-1                     0.10    125.00     71.43    3.0000 Raingage
STREETC
 UNC-2                     0.15    160.00     71.43    3.0000 Raingage
LP
 UNC-3                     0.10    111.11     71.43    3.0000 Raingage
GREENBANK


 ************
 Node Summary
 ************
                                         Invert      Max.    Ponded    External
 Name                 Type                Elev.     Depth      Area    Inflow  
 -------------------------------------------------------------------------------
 1+010                JUNCTION            93.47      0.35       0.0
 1+096                JUNCTION            93.79      0.35       0.0
 1+173                JUNCTION            93.61      0.35       0.0
 1+250                JUNCTION            93.79      0.35       0.0
 1+329                JUNCTION            93.57      0.36       0.0
 1+400                JUNCTION            93.76      0.35       0.0
 1+466                JUNCTION            94.97      0.35       0.0
 3+057                JUNCTION            93.71      0.35       0.0
 CB39-40              JUNCTION            91.49      2.13       0.0
 CB41-42              JUNCTION            91.75      2.04       0.0
 CB43-44              JUNCTION            91.72      2.03       0.0
```

```
 CB45-46              JUNCTION            91.73      2.03       0.0
 CB47-48              JUNCTION            91.79      2.03       0.0
 CB49-50              JUNCTION            91.97      2.06       0.0
 CB69-70              JUNCTION            91.52      2.39       0.0
 HP-RYCB01            JUNCTION            93.75      0.30       0.0
 HP-RYCB04            JUNCTION            93.83      0.30       0.0
 HP-RYT01             JUNCTION            93.85      0.30       0.0
 HP-RYT05             JUNCTION            93.85      0.30       0.0
 HP-RYT11             JUNCTION            93.74      0.30       0.0
 J4                   JUNCTION            93.53      0.42       0.0
 RYCB-72              JUNCTION            91.42      2.41       0.0
 RYCB-73              JUNCTION            91.79      2.02       0.0
 RYCB-76              JUNCTION            91.62      2.23       0.0
 400                  OUTFALL             89.70      1.42       0.0
 CB09                 OUTFALL             91.66      2.02       0.0
 CB13-14              OUTFALL             91.62      2.03       0.0
 CB37-38              OUTFALL             91.67      2.03       0.0
 HW-02                OUTFALL             89.87      1.22       0.0
 MAJ-OUT2             OUTFALL             93.40      0.43       0.0
 10000                STORAGE             90.04      3.38       0.0
 102                  STORAGE             89.96      3.81       0.0
 106                  STORAGE             90.14      3.69       0.0
 200                  STORAGE             90.51      2.90       0.0
 201                  STORAGE             90.32      3.70       0.0
 201A-S(2)            STORAGE             94.03      0.40       0.0
 201B-S(1)            STORAGE             94.08      0.40       0.0
 202                  STORAGE             90.79      3.23       0.0
 202A-S(1)            STORAGE             93.96      0.40       0.0
 203                  STORAGE             91.36      2.81       0.0
 203A-S(1)            STORAGE             94.31      0.40       0.0
 206                  STORAGE             90.33      3.24       0.0
 207                  STORAGE             90.05      3.36       0.0
 208                  STORAGE             90.10      3.67       0.0
 209                  STORAGE             90.14      3.57       0.0
 209A-S(1)            STORAGE             93.76      0.40       0.0
 210                  STORAGE             91.11      1.92       0.0
 210A-S(1)            STORAGE             93.91      0.40       0.0
 210B-S(1)            STORAGE             93.83      0.40       0.0
 211                  STORAGE             91.19      2.96       0.0
 212                  STORAGE             90.68      3.20       0.0
 212A-S(1)            STORAGE             93.64      0.40       0.0
 213                  STORAGE             90.87      3.10       0.0
 213A-S(1)            STORAGE             93.87      0.40       0.0
 214                  STORAGE             91.25      2.57       0.0
 214A-S(1)            STORAGE             93.93      0.40       0.0
 215A                 STORAGE             91.31      3.09       0.0
 216                  STORAGE             91.13      2.31       0.0
 217                  STORAGE             90.08      3.22       0.0
```

```
  218                  STORAGE              89.88      3.73       0.0
  218A-S(1)            STORAGE              93.67      0.40       0.0
  218B-S(1)            STORAGE              93.55      0.40       0.0
  219                  STORAGE              90.45      3.28       0.0
  219A-S(1)            STORAGE              93.95      0.40       0.0
  219B                 STORAGE              91.18      3.12       0.0
  219C-S(1)            STORAGE              93.60      0.40       0.0
  220                  STORAGE              91.18      2.70       0.0
  221A                 STORAGE              90.81      3.31       0.0
  223                  STORAGE              91.41      2.68       0.0
  402                  STORAGE              90.00      3.50       0.0
  404                  STORAGE              90.20      3.94       0.0
  406                  STORAGE              90.50      5.08       0.0
  C208A-S              STORAGE              91.97      1.78       0.0
  C209A-S              STORAGE              92.23      1.78       0.0
  C210A-S              STORAGE              92.12      1.78       0.0
  C210B-S              STORAGE              92.36      1.78       0.0
  DICB204              STORAGE              91.27      2.95       0.0
  DICB205              STORAGE              91.37      2.85       0.0
  DICB215              STORAGE              91.28      2.88       0.0
  DICB221              STORAGE              90.75      2.95       0.0
  DICB222              STORAGE              90.94      2.94       0.0
  GREENBANK            STORAGE              93.77      2.40       0.0
  L201A-S              STORAGE              92.52      1.78       0.0
  L201B-S              STORAGE              92.69      1.78       0.0
  L201B-S(1)           STORAGE              94.12      0.40       0.0
  L201C-S              STORAGE              92.03      1.78       0.0
  L202A-S              STORAGE              92.51      1.78       0.0
  L203A-S              STORAGE              92.41      1.78       0.0
  L204A-S              STORAGE              92.62      2.08       0.0
  L205A-S              STORAGE              92.88      2.08       0.0
  L211A-S              STORAGE              92.68      1.78       0.0
  L211B-S              STORAGE              92.32      1.78       0.0
  L212A-S              STORAGE              92.12      1.78       0.0
  L213A-S              STORAGE              92.35      1.78       0.0
  L214A-S              STORAGE              92.37      1.78       0.0
  L215A-S              STORAGE              92.67      2.08       0.0
  L216A-S              STORAGE              91.43      2.90       0.0
  L218A-S              STORAGE              92.06      1.78       0.0
  L218B-S              STORAGE              91.92      1.78       0.0
  L219A-S              STORAGE              92.21      1.78       0.0
  L219B-S              STORAGE              92.57      2.08       0.0
  L219C-S              STORAGE              92.09      1.78       0.0
  L220A-S              STORAGE              92.38      1.78       0.0
  L221A-S              STORAGE              92.39      2.08       0.0
  L223A-S              STORAGE              92.71      1.78       0.0
  LP                   STORAGE              91.56      2.40       0.0
  MH-100               STORAGE              90.10      3.34       0.0
```

```
  MH-104               STORAGE              90.32      3.28       0.0
  MH-108               STORAGE              91.40      2.43       0.0
  MH-110               STORAGE              91.47      3.04       0.0
  MH-x10002            STORAGE              89.99      3.62       0.0
  MH-x10004            STORAGE              89.97      3.58       0.0
  MH-x10006            STORAGE              89.88      3.28       0.0
  OF2                  STORAGE              93.94      0.40       0.0
  RYCB-01              STORAGE              92.00      1.95       0.0
  RYT-01               STORAGE              91.55      2.47       0.0
  RYT-05               STORAGE              91.92      2.08       0.0
  RYT-11               STORAGE              91.70      2.18       0.0
  STM-430              STORAGE              90.00      2.90       0.0
  STREETC              STORAGE              91.90      2.40       0.0


  ************
  Link Summary
  ************
  Name             From Node        To Node          Type             Length
%Slope Roughness

------------------------------------------------------------------------------------
----------
  200-201          221A             DICB221          CONDUIT           166.0
0.1627    0.0130
  C1               CB69-70          MAJ-OUT2         CONDUIT            23.9
0.3352    0.0350
  C10              201A-S(2)        L214A-S          CONDUIT            26.0
1.0770    0.0130
  C11              203A-S(1)        L203A-S          CONDUIT            30.6
1.6985    0.0130
  C12              L203A-S          OF2              CONDUIT             2.0
-7.5212    0.0130
  C13              L214A-S          214A-S(1)        CONDUIT            26.2
-0.6876    0.0130
  C14              214A-S(1)        L213A-S          CONDUIT            34.1
0.5870    0.0130
  C15              L213A-S          213A-S(1)        CONDUIT            25.3
-0.5534    0.0130
  C16              213A-S(1)        L212A-S          CONDUIT            43.8
0.8456    0.0130
  C17              L212A-S          212A-S(1)        CONDUIT            13.5
-1.0371    0.0130
  C18              C210A-S          210A-S(1)        CONDUIT            53.0
-0.7736    0.0130
  C19              LP               C210A-S          CONDUIT            16.4
0.3659    0.0130
  C2               L219C-S          219C-S(1)        CONDUIT            27.0
```

```
-0.4806    0.0130
  C20              C210B-S          210B-S(1)        CONDUIT              18.0
-0.5000    0.0130
  C21              212A-S(1)        C209A-S          CONDUIT               3.5
0.8572    0.0130
  C22              C209A-S          209A-S(1)        CONDUIT              14.8
-1.0136    0.0130
  C23              209A-S(1)        C208A-S          CONDUIT              41.3
0.9928    0.0130
  C24              C208A-S          1+173            CONDUIT              42.6
-0.6103    0.0130
  C25              OF2              LP               CONDUIT              15.0
2.5341    0.0130
  C26              202A-S(1)        L214A-S          CONDUIT              21.2
0.9906    0.0130
  C27              L223A-S          L211B-S          CONDUIT              76.8
0.5078    0.0130
  C28              L211B-S          209A-S(1)        CONDUIT               4.0
-1.5002    0.0130
  C29              L211A-S          C208A-S          CONDUIT             112.0
0.6339    0.0130
  C3               215A             DICB215          CONDUIT             160.0
0.1944    0.0130
  C30              L201B-S(1)       L201A-S          CONDUIT              30.4
0.7237    0.0130
  C32              219A-S(1)        L220A-S          CONDUIT              12.9
1.4730    0.0130
  C33              L220A-S          STREETC          CONDUIT              14.5
-0.9656    0.0130
  C34              219A-S(1)        L219A-S          CONDUIT              71.4
0.5042    0.0130
  C35              L219A-S          218A-S(1)        CONDUIT              14.5
-0.5517    0.0130
  C36              218A-S(1)        L219C-S          CONDUIT              63.3
0.3160    0.0130
  C37              L218A-S          218B-S(1)        CONDUIT              15.6
-0.7051    0.0130
  C38              218B-S(1)        L218B-S          CONDUIT              14.4
1.7364    0.0130
  C39              L218B-S          1+010            CONDUIT              10.0
-1.7002    0.0130
  C4               L205A-S          L202A-S          CONDUIT              51.0
1.4119    0.0130
  C40              L219B-S          L219A-S          CONDUIT             142.0
0.5000    0.0130
  C41              219C-S(1)        L218A-S          CONDUIT              27.9
0.5735    0.0130
  C42              217              10000            CONDUIT              12.9
```

```
0.0775    0.0130
  C43              210A-S(1)        C210B-S          CONDUIT              34.3
0.4956    0.0130
  C44              210B-S(1)        212A-S(1)        CONDUIT              42.7
0.4450    0.0130
  C45              L201B-S          201B-S(1)        CONDUIT               3.0
-0.3333    0.0130
  C46              201B-S(1)        201A-S(2)        CONDUIT              23.0
0.2174    0.0130
  C47              L201C-S          J4               CONDUIT              18.7
-0.6417    0.0130
  C5               L201B-S(1)       L201C-S          CONDUIT              56.9
1.2479    0.0130
  C6               L201C-S          1+329            CONDUIT              23.1
-0.8677    0.0130
  C7               203A-S(1)        L202A-S          CONDUIT              84.2
0.4988    0.0130
  C8               219B             DICB222          CONDUIT             149.0
0.1597    0.0130
  C9               L201A-S          201A-S(2)        CONDUIT               4.3
-3.0603    0.0130
  CM1              406              404              CONDUIT             175.0
0.1029    0.0130
  CM2              404              402              CONDUIT             140.0
0.1000    0.0130
  CM3              402              400              CONDUIT             150.0
0.1000    0.0130
  CM4              STREETC          LP               CONDUIT              68.0
0.5000    0.0130
  CM6              GREENBANK        LP               CONDUIT             235.0
0.9382    0.0130
  L201B-W          L221A-S          L218A-S          CONDUIT             135.0
0.5037    0.0130
  L203C-W          L216A-S          C208A-S          CONDUIT              10.0
3.5021    0.0250
  L204B-M          L215A-S          L214A-S          CONDUIT             131.0
0.4962    0.0130
  L205B-W          L202A-S          202A-S(1)        CONDUIT              10.2
-0.6863    0.0130
  L205D-W          L204A-S          L201A-S          CONDUIT              51.0
0.8824    0.0130
  MH10000-MH10002  10000            MH-x10002        CONDUIT               9.8
0.2041    0.0130
  MH10002-STM430   MH-x10002        STM-430          CONDUIT               5.0
0.2000    0.0130
  MH10004-MH10006  MH-x10004        MH-x10006        CONDUIT              40.3
0.1489    0.0130
  MH10006-STM469   MH-x10006        HW-02            CONDUIT               7.3
```

```
0.1370    0.0130
  MH100-MH10000    MH-100           10000            CONDUIT             22.2
0.1351    0.0130
  MH102-MH100      102              MH-100           CONDUIT            142.6
0.1122    0.0130
  MH104-MH102      MH-104           102              CONDUIT             50.4
0.1190    0.0130
  MH106-MH104      106              MH-104           CONDUIT            105.8
0.1134    0.0130
  MH108-MH106      MH-108           106              CONDUIT             85.4
0.5152    0.0130
  MH110-MH108      MH-110           MH-108           CONDUIT             37.4
0.1872    0.0130
  OVF-HP-RYCB01    HP-RYCB01        CB39-40          CONDUIT              3.0
16.2088    0.0350
  OVF-HP-RYCB04    HP-RYCB04        RYT-01           CONDUIT              3.0
3.6691    0.0350
  OVF-HP-RYT01     HP-RYT01         CB41-42          CONDUIT              3.0
13.7961    0.0350
  OVF-HP-RYT05     HP-RYT05         CB43-44          CONDUIT              3.0
15.1717    0.0350
  OVF-HP-RYT11     HP-RYT11         CB47-48          CONDUIT              3.0
9.0367    0.0350
  OVF-RYCB01       HP-RYCB01        RYCB-01          CONDUIT              3.0
3.3352    0.0350
  OVF-RYT01        HP-RYT01         RYT-01           CONDUIT              3.0
4.3374    0.0350
  OVF-RYT05        HP-RYT05         RYT-05           CONDUIT              3.0
5.0063    0.0350
  OVF-RYT11        HP-RYT11         RYT-11           CONDUIT              3.0
5.3409    0.0350
  Pipe_28          201              200              CONDUIT            106.0
0.1000    0.0130
  Pipe_29          202              201              CONDUIT             22.8
0.1010    0.0130
  Pipe_30          203              202              CONDUIT             88.4
0.2998    0.0130
  Pipe_31          DICB204          201              CONDUIT             16.5
0.2966    0.0130
  Pipe_32          DICB205          202              CONDUIT             15.8
0.2977    0.0130
  Pipe_33          207              206              CONDUIT             21.6
0.1017    0.0130
  Pipe_34          208              207              CONDUIT             49.3
0.0994    0.0130
  Pipe_35          209              208              CONDUIT             34.5
0.0987    0.0130
  Pipe_36          210              209              CONDUIT            111.5
```

```
0.2000    0.0130
  Pipe_37          211              208              CONDUIT             88.0
0.2998    0.0130
  Pipe_37_(1)      223              211              CONDUIT             69.2
0.3006    0.0130
  Pipe_38          212              209              CONDUIT             60.6
0.1500    0.0130
  Pipe_39          213              212              CONDUIT             64.4
0.1707    0.0130
  Pipe_40          214              213              CONDUIT             26.6
0.3006    0.0130
  Pipe_41          DICB215          213              CONDUIT             12.1
0.2985    0.0130
  Pipe_42          216              207              CONDUIT             18.0
0.9959    0.0130
  Pipe_43          218              217              CONDUIT             67.1
0.0999    0.0130
  Pipe_44          219              218              CONDUIT             77.6
0.1494    0.0130
  Pipe_45          220              219              CONDUIT             71.5
0.5004    0.0130
  Pipe_46          DICB221          218              CONDUIT             15.2
0.4984    0.0130
  Pipe_47          DICB222          219              CONDUIT             14.0
0.5154    0.0130
  Pipe_58          206              102              CONDUIT             12.0
0.1170    0.0130
  Pipe_59          200              106              CONDUIT             12.3
0.1059    0.0130
  RYT01-RYCB72     RYT-01           RYCB-72          CONDUIT             14.0
0.9286    0.0130
  RYT02-RYCB73     RYT-05           RYCB-73          CONDUIT             14.9
0.8725    0.0130
  RYT11-RYCB76     RYT-11           RYCB-76          CONDUIT              9.5
0.8421    0.0130
  ST01-01          1+010            CB69-70          CONDUIT              5.2
2.8858    0.0160
  ST01-02          1+010            CB39-40          CONDUIT             21.2
0.9434    0.0160
  ST01-03          1+096            CB39-40          CONDUIT             59.9
0.8681    0.0160
  ST01-04          1+096            CB41-42          CONDUIT             51.3
0.6823    0.0160
  ST01-05          1+173            CB41-42          CONDUIT             25.4
0.6693    0.0160
  ST01-06          1+173            CB43-44          CONDUIT             28.7
0.7317    0.0160
  ST01-07          1+250            CB43-44          CONDUIT             50.4
```

```
0.7738    0.0160
  ST01-08         1+250           CB45-46         CONDUIT           50.2
0.7570    0.0160
  ST01-09_1       J4              1+329           CONDUIT            9.9
-0.4049    0.0160
  ST01-09_2       J4              CB45-46         CONDUIT           18.3
0.6714    0.0160
  ST01-10         1+329           CB47-48         CONDUIT           28.4
0.3521    0.0160
  ST01-11         1+400           CB47-48         CONDUIT           46.6
0.6223    0.0160
  ST01-12         1+400           CB49-50         CONDUIT           18.3
0.4372    0.0160
  ST01-13         1+466           CB49-50         CONDUIT           46.4
2.7812    0.0160
  ST03-01         3+057           CB69-70         CONDUIT           25.7
1.5177    0.0160
  ST05-01         1+329           CB13-14         CONDUIT           32.0
0.8438    0.0160
  ST06-01         1+173           CB09            CONDUIT           35.3
0.7932    0.0100
  ST07-01         1+400           CB37-38         CONDUIT           36.9
1.1112    0.0160
  STM431-MH10004  STM-430         MH-x10004       CONDUIT            5.0
0.2000    0.0130
  C208A-IC1       C208A-S         208             ORIFICE
  C208A-IC2       C208A-S         208             ORIFICE
  C209A-IC1       C209A-S         209             ORIFICE
  C209A-IC2       C209A-S         209             ORIFICE
  C210A-IC1       C210A-S         210             ORIFICE
  C210A-IC2       C210A-S         210             ORIFICE
  C210B-IC1       C210B-S         210             ORIFICE
  C210B-IC2       C210B-S         210             ORIFICE
  L201A-IC        L201A-S         201             ORIFICE
  L201B-IC1       L201B-S         201             ORIFICE
  L201C-IC1       L201C-S         201             ORIFICE
  L201C-IC2       L201C-S         201             ORIFICE
  L202A-IC1       L202A-S         202             ORIFICE
  L202A-IC2       L202A-S         202             ORIFICE
  L203A-IC1       L203A-S         203             ORIFICE
  L203A-IC2       L203A-S         203             ORIFICE
  L211A-IC        L211A-S         211             ORIFICE
  L211B-IC        L211B-S         211             ORIFICE
  L212A-IC1       L212A-S         212             ORIFICE
  L212A-IC2       L212A-S         212             ORIFICE
  L213A-IC1       L213A-S         213             ORIFICE
  L213A-IC2       L213A-S         213             ORIFICE
  L214A-IC1       L214A-S         214             ORIFICE
```

```
  L214A-IC2       L214A-S         214             ORIFICE
  L216A-IC1       L216A-S         216             ORIFICE
  L218A-IC1       L218A-S         218             ORIFICE
  L218A-IC2       L218A-S         218             ORIFICE
  L218B-IC1       L218B-S         218             ORIFICE
  L218B-IC2       L218B-S         218             ORIFICE
  L219A-IC1       L219A-S         219             ORIFICE
  L219A-IC2       L219A-S         219             ORIFICE
  L219C-IC1       L219C-S         219             ORIFICE
  L219C-IC2       L219C-S         219             ORIFICE
  L220A-IC1       L220A-S         220             ORIFICE
  L220A-IC2       L220A-S         220             ORIFICE
  L223A-IC        L223A-S         223             ORIFICE
  OCB-39          CB39-40         MH-100          ORIFICE
  OCB-40          CB39-40         MH-100          ORIFICE
  OCB-41          CB41-42         102             ORIFICE
  OCB-42          CB41-42         102             ORIFICE
  OCB-43          CB43-44         MH-104          ORIFICE
  OCB-44          CB43-44         MH-104          ORIFICE
  OCB-45          CB45-46         106             ORIFICE
  OCB-46          CB45-46         106             ORIFICE
  OCB-47          CB47-48         MH-108          ORIFICE
  OCB-48          CB47-48         MH-108          ORIFICE
  OCB-49          CB49-50         MH-110          ORIFICE
  OCB-50          CB49-50         MH-110          ORIFICE
  OCB-69          CB69-70         10000           ORIFICE
  OCB-70          CB69-70         10000           ORIFICE
  ORYCB-01        RYCB-01         102             ORIFICE
  ORYCB-72        RYCB-72         102             ORIFICE
  ORYCB-73        RYCB-73         MH-104          ORIFICE
  ORYCB-76        RYCB-76         MH-108          ORIFICE
  MH10002-MH10004 MH-x10002       MH-x10004       WEIR
  CM-1            GREENBANK       406             OUTLET
  CM-2            LP              404             OUTLET
  CM-3            STREETC         402             OUTLET
  L204A-O         L204A-S         DICB204         OUTLET
  L205A-O         L205A-S         DICB205         OUTLET
  L215A-O         L215A-S         215A            OUTLET
  L219B-O         L219B-S         219B            OUTLET
  L221A-O         L221A-S         221A            OUTLET


  *********************
  Cross Section Summary
  *********************
                                        Full     Full     Hyd.     Max.   No. of
Full
  Conduit         Shape                Depth     Area     Rad.    Width  Barrels
```

```
 Flow

-------------------------------------------------------------------------------------
----
  200-201          CIRCULAR             0.60     0.28     0.15     0.60        1
247.65
  C1               TRIANGULAR           0.30     0.27     0.14     1.80        1
121.75
  C10              Half-18mROW          0.40     2.35     0.18    12.50        1
6023.64
  C11              18mROW               0.35     4.42     0.15    28.50        1
12487.10
  C12              18mROW               0.35     4.42     0.15    28.50        1
26276.91
  C13              Street-E-18m-ROW     0.28     2.45     0.15    18.00        1
4405.97
  C14              Street-E-18m-ROW     0.28     2.45     0.15    18.00        1
4071.16
  C15              Street-E-18m-ROW     0.28     2.45     0.15    18.00        1
3952.68
  C16              18mROW               0.35     4.42     0.15    28.50        1
8810.51
  C17              18mROW               0.35     4.42     0.15    28.50        1
9757.53
  C18              Jockvale             0.35     4.86     0.18    29.40        1
10563.86
  C19              Jockvale             0.35     4.86     0.18    29.40        1
7264.70
  C2               Street-C-mount-14m-ROW     0.23     2.29     0.12    18.80
 1  2944.07
  C20              Jockvale             0.35     4.86     0.18    29.40        1
8492.78
  C21              Jockvale             0.35     4.86     0.18    29.40        1
11119.80
  C22              Jockvale             0.35     4.86     0.18    29.40        1
12091.72
  C23              Jockvale             0.35     4.86     0.18    29.40        1
11967.13
  C24              Jockvale             0.35     4.86     0.18    29.40        1
9383.14
  C25              Street-A-18mROW      0.34     3.93     0.16    23.80        1
14467.20
  C26              Half-18mROW          0.40     2.35     0.18    12.50        1
5777.05
  C27              Half-LaneD-8.5mROW     0.10     0.22     0.05     4.25        1
 160.30
  C28              Half-LaneD-8.5mROW     0.10     0.22     0.05     4.25        1
 275.51
```

```
  C29              Half-LaneD-8.5mROW     0.10     0.22     0.05     4.25        1
 179.10
  C3               CIRCULAR             0.60     0.28     0.15     0.60        1
270.72
  C30              Half-18mROW          0.40     2.35     0.18    12.50        1
4937.81
  C32              Street-C-14m-ROW     0.23     1.65     0.13    14.00        1
3926.52
  C33              Street-C-14m-ROW     0.23     1.65     0.13    14.00        1
3179.02
  C34              Street-C-14m-ROW     0.23     1.65     0.13    14.00        1
2297.25
  C35              Street-C-14m-ROW     0.23     1.65     0.13    14.00        1
2403.07
  C36              Street-C-mount-14m-ROW     0.23     2.29     0.12    18.80
 1  2387.11
  C37              Street-C-mount-14m-ROW     0.23     2.29     0.12    18.80
 1  3566.13
  C38              Street-C-mount-14m-ROW     0.23     2.29     0.12    18.80
 1  5596.02
  C39              18mROW               0.35     4.42     0.15    28.50        1
12493.58
  C4               18mROW               0.35     4.42     0.15    28.50        1
11385.02
  C40              8.5m-ROW             0.35     3.57     0.12    25.50        1
4767.52
  C41              Street-C-mount-14m-ROW     0.23     2.29     0.12    18.80
 1  3216.03
  C42              CIRCULAR             1.20     1.13     0.30     1.20        1
1085.56
  C43              Jockvale             0.35     4.86     0.18    29.40        1
8455.56
  C44              Jockvale             0.35     4.86     0.18    29.40        1
8011.75
  C45              Half-LaneD-8.5mROW     0.10     0.22     0.05     4.25        1
 129.87
  C46              Half-18mROW          0.40     2.35     0.18    12.50        1
2706.30
  C47              Street-A-18mROW      0.34     3.93     0.16    23.80        1
7280.19
  C5               Street-A-18mROW      0.34     3.93     0.16    23.80        1
10152.16
  C6               18mROW               0.35     4.42     0.15    28.50        1
8925.22
  C7               Street-A-18mROW      0.34     3.93     0.16    23.80        1
6418.59
  C8               CIRCULAR             0.60     0.28     0.15     0.60        1
245.41
```

```
  C9               Half-18mROW          0.40      2.35      0.18     12.50         1
10153.89
  CM1              CIRCULAR             1.05      0.87      0.26      1.05         1
875.83
  CM2              CIRCULAR             1.05      0.87      0.26      1.05         1
863.58
  CM3              HORIZ_ELLIPSE        1.09      1.54      0.34      1.73         1
1817.19
  CM4              ChapmanMills         0.29      4.44      0.09     41.00         1
5020.25
  CM6              ChapmanMills         0.29      4.44      0.09     41.00         1
6876.77
  L201B-W          8.5m-ROW             0.35      3.57      0.12     25.50         1
4785.15
  L203C-W          TRIANGULAR           0.30      0.27      0.14      1.80         1
550.92
  L204B-M          8.5m-ROW             0.35      3.57      0.12     25.50         1
4749.29
  L205B-W          Street-A-18mROW      0.34      3.93      0.16     23.80         1
7528.74
  L205D-W          8.5m-ROW             0.35      3.57      0.12     25.50         1
6333.37
  MH10000-MH10002  HORIZ_ELLIPSE        1.22      1.89      0.37      1.93         1
3397.04
  MH10002-STM430   CIRCULAR             1.22      1.17      0.30      1.22         1
1818.27
  MH10004-MH10006  HORIZ_ELLIPSE        1.22      1.89      0.37      1.93         1
2901.49
  MH10006-STM469   HORIZ_ELLIPSE        1.22      1.89      0.37      1.93         1
2783.15
  MH100-MH10000    HORIZ_ELLIPSE        1.22      1.89      0.37      1.93         1
2764.28
  MH102-MH100      HORIZ_ELLIPSE        1.22      1.89      0.37      1.93         1
2518.83
  MH104-MH102      CIRCULAR             1.22      1.17      0.30      1.22         1
1402.82
  MH106-MH104      CIRCULAR             1.22      1.17      0.30      1.22         1
1369.27
  MH108-MH106      CIRCULAR             0.69      0.37      0.17      0.69         1
629.99
  MH110-MH108      CIRCULAR             0.69      0.37      0.17      0.69         1
379.70
  OVF-HP-RYCB01    TRIANGULAR           0.30      0.27      0.14      1.80         1
846.59
  OVF-HP-RYCB04    TRIANGULAR           0.30      0.27      0.14      1.80         1
402.79
  OVF-HP-RYT01     TRIANGULAR           0.30      0.27      0.14      1.80         1
781.04
```

```
  OVF-HP-RYT05     TRIANGULAR           0.30      0.27      0.14      1.80         1
819.06
  OVF-HP-RYT11     TRIANGULAR           0.30      0.27      0.14      1.80         1
632.12
  OVF-RYCB01       TRIANGULAR           0.30      0.27      0.14      1.80         1
384.02
  OVF-RYT01        TRIANGULAR           0.30      0.27      0.14      1.80         1
437.94
  OVF-RYT05        TRIANGULAR           0.30      0.27      0.14      1.80         1
470.49
  OVF-RYT11        TRIANGULAR           0.30      0.27      0.14      1.80         1
485.97
  Pipe_28          CIRCULAR             1.20      1.13      0.30      1.20         1
1233.03
  Pipe_29          CIRCULAR             0.75      0.44      0.19      0.75         1
353.88
  Pipe_30          CIRCULAR             0.45      0.16      0.11      0.45         1
156.11
  Pipe_31          CIRCULAR             0.60      0.28      0.15      0.60         1
334.43
  Pipe_32          CIRCULAR             0.53      0.22      0.13      0.53         1
234.66
  Pipe_33          CIRCULAR             1.20      1.13      0.30      1.20         1
1243.46
  Pipe_34          CIRCULAR             1.20      1.13      0.30      1.20         1
1229.30
  Pipe_35          CIRCULAR             1.20      1.13      0.30      1.20         1
1224.78
  Pipe_36          CIRCULAR             0.45      0.16      0.11      0.45         1
127.50
  Pipe_37          CIRCULAR             0.38      0.11      0.09      0.38         1
96.01
  Pipe_37_(1)      CIRCULAR             0.38      0.11      0.09      0.38         1
96.14
  Pipe_38          CIRCULAR             0.75      0.44      0.19      0.75         1
431.26
  Pipe_39          CIRCULAR             0.68      0.36      0.17      0.68         1
347.34
  Pipe_40          CIRCULAR             0.38      0.11      0.09      0.38         1
96.14
  Pipe_41          CIRCULAR             0.60      0.28      0.15      0.60         1
335.48
  Pipe_42          CIRCULAR             0.30      0.07      0.07      0.30         1
96.51
  Pipe_43          CIRCULAR             1.20      1.13      0.30      1.20         1
1232.23
  Pipe_44          CIRCULAR             0.75      0.44      0.19      0.75         1
430.35
```

```
  Pipe_45          CIRCULAR             0.38      0.11      0.09      0.38         1
124.03
  Pipe_46          CIRCULAR             0.68      0.36      0.17      0.68         1
593.49
  Pipe_47          CIRCULAR             0.60      0.28      0.15      0.60         1
440.82
  Pipe_58          CIRCULAR             1.20      1.13      0.30      1.20         1
1333.75
  Pipe_59          CIRCULAR             1.20      1.13      0.30      1.20         1
1269.11
  RYT01-RYCB72     CIRCULAR             0.25      0.05      0.06      0.25         1
57.31
  RYT02-RYCB73     CIRCULAR             0.25      0.05      0.06      0.25         1
55.55
  RYT11-RYCB76     CIRCULAR             0.25      0.05      0.06      0.25         1
54.58
  ST01-01          8.5m_ROW             0.35      3.76      0.18     20.50         1
12745.74
  ST01-02          8.5m_ROW             0.35      3.76      0.18     20.50         1
7287.65
  ST01-03          8.5m_ROW             0.35      3.76      0.18     20.50         1
6990.80
  ST01-04          8.5m_ROW             0.35      3.76      0.18     20.50         1
6197.42
  ST01-05          8.5m_ROW             0.35      3.76      0.18     20.50         1
6138.23
  ST01-06          8.5m_ROW             0.35      3.76      0.18     20.50         1
6418.08
  ST01-07          8.5m_ROW             0.35      3.76      0.18     20.50         1
6600.16
  ST01-08          8.5m_ROW             0.35      3.76      0.18     20.50         1
6527.95
  ST01-09_1        8.5m_ROW             0.35      3.76      0.18     20.50         1
4774.02
  ST01-09_2        8.5m_ROW             0.35      3.76      0.18     20.50         1
6147.88
  ST01-10          8.5m_ROW             0.35      3.76      0.18     20.50         1
4452.18
  ST01-11          8.5m_ROW             0.35      3.76      0.18     20.50         1
5918.90
  ST01-12          8.5m_ROW             0.35      3.76      0.18     20.50         1
4960.81
  ST01-13          8.5m_ROW             0.35      3.76      0.18     20.50         1
12512.68
  ST03-01          8.5m_ROW             0.35      3.76      0.18     20.50         1
9243.18
  ST05-01          8.5m_ROW             0.35      3.76      0.18     20.50         1
6892.00
```

```
  ST06-01          9.5m_ROW             0.35      4.00      0.18     21.50         1
11475.53
  ST07-01          8.5m_ROW             0.35      3.76      0.18     20.50         1
7909.02
  STM431-MH10004   CIRCULAR             1.22      1.17      0.30      1.22         1
1818.27


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

```
  CM4                     1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  CM6                     1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  L201B-W                 1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  L203C-W                 1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  L204B-M                 1.00   0.99  0.01  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  L205B-W                 1.00   0.04  0.01  0.00  0.01  0.00  0.00  0.95  0.00
0.00
  L205D-W                 1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  MH10000-MH10002         1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  MH10002-STM430          1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  MH10004-MH10006         1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  MH10006-STM469          1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  MH100-MH10000           1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  MH102-MH100             1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  MH104-MH102             1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  MH106-MH104             1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  MH108-MH106             1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  MH110-MH108             1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  OVF-HP-RYCB01           1.00   0.99  0.01  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  OVF-HP-RYCB04           1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  OVF-HP-RYT01            1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  OVF-HP-RYT05            1.00   0.99  0.01  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  OVF-HP-RYT11            1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  OVF-RYCB01              1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  OVF-RYT01               1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
```

```
  OVF-RYT05               1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  OVF-RYT11               1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  Pipe_28                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  Pipe_29                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  Pipe_30                 1.00   0.00  0.58  0.00  0.42  0.00  0.00  0.00  0.99
0.00
  Pipe_31                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  Pipe_32                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  Pipe_33                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  Pipe_34                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  Pipe_35                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  Pipe_36                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  Pipe_37                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  Pipe_37_(1)             1.00   0.00  0.60  0.00  0.40  0.00  0.00  0.00  0.99
0.00
  Pipe_38                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  Pipe_39                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  Pipe_40                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.07
0.00
  Pipe_41                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  Pipe_42                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  Pipe_43                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  Pipe_44                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  Pipe_45                 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_47                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  Pipe_58                 1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
```

```
  Pipe_59               1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  RYT01-RYCB72          1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.00
0.00
  RYT02-RYCB73          1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.04
0.00
  RYT11-RYCB76          1.00   0.00  0.00  0.00  1.00  0.00  0.00  0.00  0.97
0.00
  ST01-01               1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  ST01-02               1.00   0.99  0.01  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  ST01-03               1.00   0.99  0.01  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  ST01-04               1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  ST01-05               1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  ST01-06               1.00   0.99  0.01  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  ST01-07               1.00   0.99  0.01  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  ST01-08               1.00   0.99  0.01  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  ST01-09_1             1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  ST01-09_2             1.00   0.99  0.01  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  ST01-10               1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  ST01-11               1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  ST01-12               1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  ST01-13               1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  ST03-01               1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  ST05-01               1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  ST06-01               1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  ST07-01               1.00   1.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
0.00
  STM431-MH10004        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
----------------------------------------------------------------------------
200-201                       0.38      0.38     24.00       0.01         0.23
C3                            0.17      0.17      0.30       0.01         0.01
C42                          24.00     24.00     24.00       0.01         0.20
C8                            0.31      0.31     24.00       0.01         0.01
CM1                          24.00     24.00     24.00       0.01         0.01
CM2                          24.00     24.00     24.00       0.01         0.01
CM3                          24.00     24.00     24.00       0.01         0.01
MH10000-MH10002              24.00     24.00     24.00       0.01        21.64
MH10002-STM430               24.00     24.00     24.00       0.01         1.48
MH10004-MH10006              24.00     24.00     24.00       0.01         0.20
MH10006-STM469               24.00     24.00     24.00       0.01         0.50
MH100-MH10000                24.00     24.00     24.00       0.01         0.09
MH102-MH100                  24.00     24.00     24.00       0.01         0.01
MH104-MH102                  24.00     24.00     24.00       0.01         0.01
MH106-MH104                   0.39      0.39     24.00       0.01         0.01
MH108-MH106                   0.01      0.01      0.40       0.01         0.01
Pipe_28                       0.28      0.28      0.36       0.01         0.01
Pipe_29                       0.28      0.28      0.28       0.01         0.01
Pipe_30                       0.01      0.01      0.28       0.01         0.01
Pipe_31                       0.27      0.27      0.28       0.01         0.01
Pipe_32                       0.27      0.28      0.28       0.01         0.27
Pipe_33                      24.00     24.00     24.00       0.01         0.01
Pipe_34                       0.82      0.82     24.00       0.01         0.01
Pipe_35                       0.39      0.39      0.78       0.01         0.01
Pipe_36                       0.28      0.28      0.39       0.01         0.01
Pipe_37                       0.26      0.26      0.82       0.01         0.01
Pipe_37_(1)                   0.01      0.01      0.20       0.01         0.01
Pipe_38                       0.34      0.34      0.39       0.01         0.05
Pipe_39                       0.31      0.31      0.34       0.01         0.01
Pipe_40                       0.28      0.28      0.31       0.01         0.01
Pipe_41                       0.30      0.30      0.31       0.01         0.15
Pipe_42                       0.40      0.40     24.00       0.01         0.01
Pipe_43                      24.00     24.00     24.00       0.01         0.01
Pipe_44                      24.00     24.00     24.00       0.01         0.01
Pipe_45                       0.24      0.24     24.00       0.01         0.01
Pipe_46                      24.00     24.00     24.00       0.01         0.01
Pipe_47                      24.00     24.00     24.00       0.01         0.01
Pipe_58                      24.00     24.00     24.00       0.01         0.01
Pipe_59                       0.36      0.36      0.36       0.01         0.01
```

```
RYT01-RYCB72                0.35      0.35      0.45      0.01         0.01
RYT02-RYCB73                0.20      0.20      0.27      0.01         0.01
RYT11-RYCB76                0.30      0.30      0.34      0.01         0.01
STM431-MH10004             24.00     24.00     24.00      0.01         7.48


Analysis begun on:  Thu Aug  6 10:09:29 2020
Analysis ended on:  Thu Aug  6 10:09:43 2020
Total elapsed time: 00:00:14
```

			Worst-Case 100-Year HGL			
STM MH	**Prop. Grade (m)**	**USF (m)**	**100-year Runoff HGL (m)**	**5-year Runoff HGL (m)**	**Worst-Case HGL (m)**	**Prop. Grade/USF-HGL Clearance (m)**
200	93.41	N/A	91.54	92.02	92.02	1.39
201	94.02	N/A	91.56	92.04	92.04	1.98
202	94.02	N/A	91.59	92.05	92.05	1.97
203	94.17	N/A	91.8	92.06	92.06	2.11
DICB204	94.22	N/A	91.64	92.07	92.07	2.15
DICB205	94.22	N/A	91.8	92.12	92.12	2.1
206	93.57	N/A	91.44	91.94	91.94	1.63
207	93.41	N/A	91.45	91.95	91.95	1.46
208	93.78	92.45	91.46	91.96	91.96	0.49
209	93.72	92.48	91.47	91.96	91.96	0.52
210	93.04	N/A	91.81	92.13	92.13	0.91
211	94.15	92.45	91.73	92.02	92.02	0.43
212	93.89	92.48	91.59	92.04	92.04	0.44
213	93.96	92.61	91.67	92.12	92.12	0.49
214	93.82	92.61	91.74	92.13	92.13	0.48
DICB215	94.16	N/A	91.74	92.16	92.16	2
216	93.44	N/A	91.69	92.09	92.09	1.35
217	93.3	92.85	91.32	91.85	91.85	1
218	93.61	92.24	91.34	91.86	91.86	0.38
219	93.73	N/A	91.4	91.91	91.91	1.82
220	93.88	N/A	91.61	91.91	91.91	1.97
DICB221	93.7	N/A	91.38	91.9	91.9	1.8
DICB222	93.88	N/A	91.41	91.92	91.92	1.96
223	94.09	92.79	91.84	92.02	92.02	0.77
215A	94.4	N/A	91.97	92.31	92.31	2.09
219B	94.3	N/A	91.57	92.04	92.04	2.26
221A	94.12	N/A	91.64	92.19	92.19	1.93
Claridge Burnett Lands Subdivision – Novatech June 2020 Submission						
102	93.76	N/A	91.44	91.94	91.94	1.82
MH-100	93.44	92.21	91.36	91.88	91.88	0.33
MH-104	93.6	92.31	91.5	91.99	91.99	0.32
106	93.83	92.31	91.54	92.02	92.02	0.29

MH-108	93.83	N/A	91.58	92.03	92.03	1.8
MH-110	94.51	N/A	91.63	92.04	92.04	2.47

C.5 BACKGROUND REPORT EXCERPTS

Table 5.12: V x D Summary

Storage Node ID	Drainage Area ID	Conduit 100-yr V (m/s)	Conduit Depth (m)	VxD (m^2/s)
C208A-S	C208A	0.16	0.14	0.02
C209A-S	C209A	0.53	0.17	0.09
C210A-S	C210A	0.24	0.08	0.02
C210B-S	C210B	0.18	0.13	0.02
L201A-S	L201A	0.64	0.10	0.06
L201B-S	L201B	0.46	0.07	0.03
L201C-S	L201C	0.26	0.11	0.03
L202A-S	L202A	0.17	0.15	0.03
L203A-S	L203A	0.00	0.00	0.00
L211A-S	L211A	0.05	0.03	0.00
L211B-S	L211B	0.32	0.12	0.04
L212A-S	L212A	0.15	0.27	0.04
L213A-S	L213A	0.18	0.21	0.04
L214A-S	L214A	0.16	0.26	0.04
L218A-S	L218A	0.24	0.20	0.05
L218B-S	L218B	0.77	0.23	0.18
L219A-S	L219A	0.33	0.19	0.06
L219C-S	L219C	0.19	0.20	0.04
L220A-S	L220A	0.19	0.21	0.04
L223A-S	L223A	0.01	0.01	0.00

5.3.4 Future Development Blocks SWM Criteria

Table 5.13 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 Caivan SNTC Development.

Table 5.13: SWM Criteria of Future Blocks

Storm Drainage Area	Description	Minor System Outlet	100-Year Minor System Capture (L/s)	Major System Flow Direction	100-Year Major System Overflows (L/s)
L204A	Block6-School	STM201	259.0	100-yr on-site storage. Emergency overland to Street A.	N/A
L205A	Block3-HD-RES	STM202	184.1	100-yr on-site storage. Emergency overland to Street A.	N/A

Storm Drainage Area	Description	Minor System Outlet	100-Year Minor System Capture (L/s)	Major System Flow Direction	100-Year Major System Overflows (L/s)
L215A	Block2-B2BTH	STM213	194.1	50m^3/ha on-site storage. Major Flow to Street E.	328
L219B	Block1-RL-TH	STM219	179.1	50m^3/ha on-site storage. Major Flow to Street C.	309
L221A	Block4-RL-TH	STM218	214.6	50m^3/ha on-site storage. Major Flow to Street C.	369
L216A	Block5-Park	STM207	74.2	100-yr on-site storage. Emergency overland to Jockvale/Street A.	N/A

5.4 QUALITY CONTROL

Street 1 is a shared road between the Claridge Burnett Lands Development and the Caivan SNTC Lands Development which will be constructed as a part of the Burnett Lands Development. Approximately 1.59 ha of the Burnett Lands development and all of the Caivan Lands will drain to Street 1, the K-B SWMF outlet channel, and ultimately to the Fraser Clarke Drain that discharges into the Jock River.

Storm runoff from the proposed Caivan SNTC Lands Development and Street 1 will be directed to the outlet channel for the Kennedy-Burnett SWMF by a shared storm sewer. An Enhanced (80% TSS removal) level of water quality control will be provided by using a hydrodynamic separator (HDS) (i.e. Vortechs units or approved equivalent) upstream of the storm outfall as designed by Novatech in their *Stormwater Management Report Burnett Lands – 3370 Greenbank Road* submitted in June 2020 and summarized as follows.

- A total drainage area of 12.34 ha at 70% imperviousness was used to size the HDS unit as shown in excerpts from Novatech's SWM Report for Burnett Lands included in **Appendix C.5**.
- Storm runoff from Street 1 and the proposed Caivan SNTC Development will be treated by an Off-line Vortechs Model PC1421 unit located upstream of the outfall to the Kennedy-Burnett SWM Facility outlet channel as shown on **Drawing SD-1**.

5.5 INTERIM CONDITION EXTERNAL DRAINAGE MANAGEMENT

The existing Burnett Municipal Drain, which is tributary to the Jock River bisects the site from north to south. The drain consists primarily of an open channel between the Barrhaven Town Centre

Stantec

SNTC SUBDIVISION

DATE: 2020-07-10
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
b =	6.199	6.053	6.014	6.014
c =	0.810	0.814	0.816	0.820

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

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-YEAR} (mm/h)	I_{5-YEAR} (mm/h)	$I_{10-YEAR}$ (mm/h)	$I_{100-YEAR}$ (mm/h)	$Q_{CONTROL}$ (L/s)	ACCUM. $Q_{CONTROL}$ (L/s)	Q_{ACT} (CIA/360) (L/s)	LENGTH (m)	PIPE WIDTH OR DIAMETEI (mm)	PIPE HEIGHT (mm)	PIPE SHAPE (-)	MATERIAL (-)	CLASS (-)	SLOPE %	Q_{CAP} (FULL) (L/s)	% FULL (-)	VEL. (FULL) (m/s)	VEL. (ACT) (m/s)	TIME OF FLOW (min)
L110A (Claridge)	110	108	0.00	0.14	0.00	0.00	0.00	0.00	0.62	0.00	0.00	0.000	0.000	0.087	0.087	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	25.1	37.4	675	675	CIRCULAR	CONCRETE	-	0.20	392.2	**6.41%**	1.06	0.50	1.25
L108A, L106B (Claridge)	108	106	0.00	0.23	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.000	0.000	0.135	0.222	0.000	0.000	0.000	0.000	11.25	72.31	98.01	114.86	167.87	0.0	0.0	60.4	84.4	675	675	CIRCULAR	CONCRETE	-	0.51	626.3	**9.64%**	1.70	0.88	1.59
																				12.84																			
L203A	203	202	0.07	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.047	0.047	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	10.1	88.4	450	450	CIRCULAR	CONCRETE	-	0.30	162.9	**6.19%**	0.99	0.45	3.26
																				13.26																			
L205A	TEMP 205	202	1.11	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.777	0.777	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	165.8	15.8	525	525	CIRCULAR	CONCRETE	-	0.30	245.7	**67.46%**	1.10	1.03	0.26
																				10.26																			
L202A	202	201	0.35	0.00	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.241	1.065	0.000	0.000	0.000	0.000	0.000	0.000	13.26	66.20	89.62	104.99	153.37	0.0	0.0	195.9	22.8	750	750	CIRCULAR	CONCRETE	-	0.10	367.3	**53.32%**	0.81	0.70	0.54
																				13.80																			
L204A	TEMP 204	201	1.56	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	1.092	1.092	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	233.0	16.5	600	600	CIRCULAR	CONCRETE	-	0.30	350.8	**66.40%**	1.20	1.12	0.25
																				10.25																			
L201A, L201C, L201B	201	106	0.27	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.173	2.330	0.000	0.000	0.000	0.000	0.000	0.000	13.80	64.74	87.63	102.65	149.93	0.0	0.0	419.0	118.3	1200	1200	CIRCULAR	CONCRETE	-	0.10	1294.0	**32.38%**	1.11	0.83	2.37
																				16.18																			
L106A (Claridge)	106	104	0.00	0.23	0.00	0.00	0.00	0.00	0.73	0.00	0.00	0.000	2.330	0.168	0.390	0.000	0.000	0.000	0.000	16.18	59.13	79.94	93.60	136.66	0.0	0.0	469.2	106.8	1200	1200	CIRCULAR	CONCRETE	-	0.11	1363.4	**34.42%**	1.17	0.89	2.01
L104A, L104B (Claridge)	104	102	0.00	0.40	0.00	0.00	0.00	0.00	0.55	0.00	0.00	0.000	2.330	0.220	0.610	0.000	0.000	0.000	0.000	18.18	55.15	74.51	87.21	127.29	0.0	0.0	483.1	50.4	1200	1200	CIRCULAR	CONCRETE	-	0.12	1403.7	**34.42%**	1.20	0.91	0.92
																				19.10																			
C210A, C210B	210	209	0.00	0.47	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.000	0.000	0.337	0.337	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	97.7	111.5	450	450	CIRCULAR	CONCRETE	-	0.20	133.0	**73.43%**	0.81	0.78	2.39
																				12.39																			
L214A	214	213	0.25	0.00	0.00	0.00	0.00	0.64	0.00	0.00	0.00	0.157	0.157	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	33.6	26.6	375	375	CIRCULAR	PVC	-	0.30	90.3	**37.19%**	0.86	0.67	0.67
																				10.67																			
L215A	TEMP 215	213	1.15	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.805	0.805	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	171.7	12.1	600	600	CIRCULAR	CONCRETE	-	0.30	350.8	**48.95%**	1.20	1.02	0.20
																				10.20																			
L213A	213	212	0.25	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.174	1.136	0.000	0.000	0.000	0.000	0.000	0.000	10.67	74.34	100.80	118.15	172.69	0.0	0.0	234.7	64.4	675	675	CIRCULAR	CONCRETE	-	0.17	361.6	**64.90%**	0.98	0.90	1.19
L212A	212	209	0.25	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.175	1.311	0.000	0.000	0.000	0.000	0.000	0.000	11.86	70.35	95.32	111.69	163.21	0.0	0.0	256.2	60.6	750	750	CIRCULAR	CONCRETE	-	0.15	449.8	**56.95%**	0.99	0.87	1.16
																				13.01																			
C209A	209	208	0.00	0.25	0.00	0.00	0.00	0.00	0.63	0.00	0.00	0.000	1.311	0.158	0.496	0.000	0.000	0.000	0.000	13.01	66.90	90.58	106.12	155.03	0.0	0.0	368.4	34.5	1200	1200	CIRCULAR	CONCRETE	-	0.10	1286.2	**28.64%**	1.10	0.79	0.72
																				13.73																			
L223A	223	211	0.04	0.00	0.00	0.00	0.00	0.87	0.00	0.00	0.00	0.034	0.034	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	7.3	69.2	375	375	CIRCULAR	PVC	-	0.30	90.3	**8.10%**	0.86	0.42	2.72
L211B, L211A	211	208	0.15	0.00	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.129	0.163	0.000	0.000	0.000	0.000	0.000	0.000	12.72	67.74	91.74	107.48	157.03	0.0	0.0	30.7	88.0	375	375	CIRCULAR	PVC	-	0.30	90.3	**34.01%**	0.86	0.65	2.26
																				14.97																			
C208A	208	207	0.00	0.33	0.00	0.00	0.00	0.00	0.73	0.00	0.00	0.000	1.474	0.242	0.738	0.000	0.000	0.000	0.000	14.97	61.83	83.64	97.95	143.03	0.0	0.0	424.6	49.3	1200	1200	CIRCULAR	CONCRETE	-	0.10	1286.2	**33.01%**	1.10	0.83	0.99
																				15.97																			
L216B, L216A	216	207	0.86	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00	0.504	0.504	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	107.5	18.0	375	375	CIRCULAR	PVC	-	1.00	164.8	**65.21%**	1.56	1.45	0.21
																				10.21																			
	207	102	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	1.978	0.000	0.738	0.000	0.000	0.000	0.000	15.97	59.57	80.55	94.32	137.71	0.0	0.0	492.4	33.6	1200	1200	CIRCULAR	CONCRETE	-	0.10	1286.6	**38.27%**	1.10	0.87	0.65
																				16.62																			
L102C, L102A, L102B, L102D (Claridge)	102	100	0.54	0.00	0.00	0.00	0.00	0.62	0.00	0.00	0.00	0.337	4.645	0.000	1.348	0.000	0.000	0.000	0.000	19.10	53.52	72.28	84.60	123.45	0.0	0.0	961.1	142.6	1920	1220	ELLIPTICAL	CONCRETE	-	0.11	2434.5	**39.48%**	1.32	1.05	2.26
	100	10000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	4.645	0.000	1.348	0.000	0.000	0.000	0.000	21.36	49.94	67.40	78.86	115.04	0.0	0.0	896.7	22.2	1920	1220	ELLIPTICAL	CONCRETE	-	0.14	2673.0	**33.55%**	1.45	1.10	0.34
																				21.69																			
L220A	220	219	0.07	0.00	0.00	0.00	0.00	0.83	0.00	0.00	0.00	0.062	0.062	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	13.2	71.5	375	375	CIRCULAR	PVC	-	0.50	116.6	**11.32%**	1.11	0.60	1.98
																				11.98																			
L219B	TEMP 222	219	1.06	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.742	0.742	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	158.3	14.0	600	600	CIRCULAR	CONCRETE	-	0.30	350.8	**45.12%**	1.20	1.00	0.23
																				10.23																			
L219C, L219A	219	218	0.53	0.00	0.00	0.00	0.00	0.73	0.00	0.00	0.00	0.389	1.193	0.000	0.000	0.000	0.000	0.000	0.000	11.98	69.97	94.80	111.08	162.32	0.0	0.0	231.8	77.6	750	750	CIRCULAR	CONCRETE	-	0.15	449.8	**51.53%**	0.99	0.85	1.52
																				13.50																			
L221A	TEMP 221	218	1.27	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.889	0.889	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	189.7	15.2	675	675	CIRCULAR	CONCRETE	-	0.30	480.3	**39.49%**	1.30	1.03	0.25
																				10.25																			
L218B, L218A	218	10000	0.13	0.00	0.00	0.00	0.00	0.73	0.00	0.00	0.00	0.096	2.177	0.000	0.000	0.000	0.000	0.000	0.000	13.50	65.56	88.76	103.97	151.87	0.0	0.0	396.6	80.0	1200	1200	CIRCULAR	CONCRETE	-	0.10	1286.2	**30.83%**	1.10	0.82	1.64
																				15.13																			
L100A (Claridge)	10000	10002	0.10	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.060	6.882	0.000	1.348	0.000	0.000	0.000	0.000	21.69	49.46	66.74	78.08	113.90	0.0	0.0	1195.3	9.8	1920	1220	ELLIPTICAL	CONCRETE	-	0.16	2907.0	**41.12%**	1.58	1.27	0.13
																				21.82									1920	1220									

Summary of Subcatchment Parameters - Proposed Development Areas

Area ID	Area (ha)	Width (m)	Slope (%)	%IMP	Runoff Coefficient	Subarea Routing	% Routed		Minor System Capture (L/s)	STORAGE- (cu.m)
C208A	0.33	195.0	3.0	75.7%	0.73	IMPERVIOUS	100	Jockvale	82.3	-
C209A	0.25	142.8	5.0	61.4%	0.63	IMPERVIOUS	100	Jockvale	55.2	-
C210A	0.22	90.0	4.0	75.7%	0.73	IMPERVIOUS	100	Jockvale	52.9	-
C210B	0.25	104.0	4.0	72.9%	0.71	IMPERVIOUS	100	Jockvale	59.4	-
L100A	0.10	57.1	1.4	57.1%	0.60	IMPERVIOUS	100	CLARIDGE-RD	12.2	-
L102A	0.23	96.2	5.5	70.0%	0.69	IMPERVIOUS	100	CLARIDGE-RD	34.4	-
L102B	0.03	20.5	1.8	38.6%	0.47	PERVIOUS	100	CLARIDGE-RY	2.8	-
L102C	0.18	120.0	0.7	60.0%	0.62	IMPERVIOUS	100	CLARIDGE-RD	23.4	-
L102D	0.11	31.4	1.5	41.4%	0.49	PERVIOUS	100	CLARIDGE-RY	5.9	-
L104A	0.20	85.7	4.7	68.6%	0.68	IMPERVIOUS	100	CLARIDGE-RD	29.3	-
L104B	0.20	41.3	2.0	31.4%	0.42	PERVIOUS	100	CLARIDGE-RY	5.4	-
L106A	0.23	103.1	4.5	75.7%	0.73	IMPERVIOUS	100	CLARIDGE-RD	37.2	-
L106B	0.08	28.1	1.6	35.7%	0.45	PERVIOUS	100	CLARIDGE-RY	3.9	-
L108A	0.15	119.3	0.8	60.0%	0.62	IMPERVIOUS	100	CLARIDGE-RD	19.2	-
L118A	0.14	150.6	2.8	60.0%	0.62	IMPERVIOUS	100	CLARIDGE-RD	17.9	-
L201A	0.05	40.5	2.0	78.6%	0.75	IMPERVIOUS	100	Street-A	9.1	-
L201B	0.06	47.6	6.0	92.9%	0.85	IMPERVIOUS	100	Lane-D	11.9	-
L201C	0.15	111.1	3.0	47.1%	0.53	IMPERVIOUS	100	Street-A	15.4	-
L202A	0.35	142.3	4.5	68.6%	0.68	IMPERVIOUS	100	Street-A	51.9	-
L203A	0.07	49.5	3.0	74.3%	0.72	IMPERVIOUS	100	Street-A	10.4	-
L204A	1.56	742.8	2.0	71.4%	0.70	IMPERVIOUS	100	Block6-School	237.3	250
L205A	1.10	523.0	2.0	71.4%	0.70	IMPERVIOUS	100	Block3-HD-RES	168.1	177
L211A	0.05	35.5	5.0	90.0%	0.83	IMPERVIOUS	100	Lane-D	9.2	-
L211B	0.11	79.4	6.0	91.4%	0.84	IMPERVIOUS	100	Lane-D	20.8	-
L212A	0.25	119.0	3.5	72.9%	0.71	IMPERVIOUS	100	Street-E	38.2	-
L213A	0.25	117.4	3.5	72.9%	0.71	IMPERVIOUS	100	Street-E	38.1	-
L214A	0.25	178.5	4.5	62.9%	0.64	IMPERVIOUS	100	Street-E	33.0	-
L215A	1.15	547.0	1.0	71.4%	0.70	IMPERVIOUS	100	Block2-B2BTH	175.1	57
L216A	0.62	111.8	0.5	25.0%	0.38	IMPERVIOUS	100	Block5-Park	65.7	104
L216B	0.24	143.7	2.5	50.0%	0.55	PERVIOUS	100	Block-7	32.6	-
L218A	0.09	45.0	4.0	75.7%	0.73	IMPERVIOUS	100	Street-C	14.1	-
L218B	0.04	21.0	4.0	74.3%	0.72	IMPERVIOUS	100	Street-C	7.1	-
L219A	0.23	92.0	4.0	72.9%	0.71	IMPERVIOUS	100	Street-C	36.0	-
L219B	1.06	506.0	1.0	71.4%	0.70	IMPERVIOUS	100	Block1-RL-TH	161.8	53
L219C	0.30	135.0	3.0	75.7%	0.73	IMPERVIOUS	100	Street-C	48.6	-
L220A	0.07	36.0	2.0	90.0%	0.83	IMPERVIOUS	100	StreetC	14.3	-
L221A	1.27	635.0	1.0	71.4%	0.70	IMPERVIOUS	100	Block4-RL-TH	193.8	64
L223A	0.04	29.4	4.5	95.7%	0.87	IMPERVIOUS	100	Lane-D	8.1	-
UNC-1	0.10	125.0	3.0	71.4%	0.70	IMPERVIOUS	100	UNC-CM	0.0	-
UNC-2	0.15	160.0	3.0	71.4%	0.70	IMPERVIOUS	100	UNC-CM	0.0	-
UNC-3	0.10	111.1	3.0	71.4%	0.70	IMPERVIOUS	100	UNC-CM	0.0	-
	12.06	**ha - Total Sewershed Area**		**67.1%**	**0.67**					
	10.76	**ha - Total Proposed Site**		**68.6%**	**0.68**					

Total Surface Flow Depth Summary

					2 year, 3 hour Chicago		5 year, 3 hour Chicago		100 year, 3 hour Chicago		100 year, 3 hour Chicago +20%	
Storage node ID	Drainage Area	Top of Grate Elevation (m)	Lowest Adjacent Building Opening (m)	Rim Elevation (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)
C208A-S	C208A	93.35	93.95	93.75	92.78	0.00	93.37	**0.02**	93.49	0.14	93.66	0.31
C209A-S	C209A	93.61	93.98	94.01	92.63	0.00	93.11	0.00	93.78	0.17	93.86	0.25
C210A-S	C210A	93.61	N/A	93.90	92.90	0.00	93.52	0.00	93.69	0.08	93.75	0.14
C210B-S	C210B	93.74	N/A	94.14	92.82	0.00	93.29	0.00	93.87	0.13	93.89	0.15
L201A-S	L201A	93.90	N/A	94.30	93.00	0.00	93.46	0.00	94.00	0.10	94.14	0.24
L201B-S	L201B	94.07	94.26	94.47	93.43	0.00	94.03	0.00	94.14	0.07	94.14	0.07
L201C-S	L201C	93.41	N/A	93.81	92.35	0.00	92.83	0.00	93.52	0.11	93.59	0.18
L202A-S	L202A	93.89	N/A	94.29	93.88	0.00	93.96	0.07	94.04	0.15	94.08	0.19
L203A-S	L203A	93.79	N/A	94.19	92.61	0.00	92.81	0.00	93.61	0.00	93.84	0.05
L211A-S	L211A	94.06	94.15	94.46	93.15	0.00	93.54	0.00	94.09	0.03	94.09	0.03
L211B-S	L211B	93.70	93.95	94.10	93.67	0.00	93.77	0.07	93.82	**0.12**	93.84	0.14
L212A-S	L212A	93.50	93.87	93.90	93.39	0.00	93.59	0.09	93.77	0.27	93.86	**0.36**
L213A-S	L213A	93.73	94.00	94.13	93.61	0.00	93.82	0.09	93.94	0.21	94.00	0.27
L214A-S	L214A	93.75	94.07	94.15	93.48	0.00	93.80	0.05	94.01	0.26	94.07	0.32
L218A-S	L218A	93.44	93.80	93.84	92.28	0.00	92.49	0.00	93.64	0.20	93.67	0.23
L218B-S	L218B	93.30	94.05	93.70	92.03	0.00	92.12	0.00	93.53	**0.23**	93.67	**0.37**
L219A-S	L219A	93.59	93.81	93.99	93.32	0.00	93.63	0.04	93.78	0.19	93.81	0.22
L219C-S	L219C	93.47	94.00	93.87	93.26	0.00	93.54	0.07	93.67	0.20	93.71	0.24
L220A-S	L220A	93.76	N/A	94.16	92.59	0.00	92.74	0.00	93.97	0.21	93.99	0.23
L223A-S	L223A	94.09	94.31	94.49	93.07	0.00	93.34	0.00	94.10	0.01	94.12	0.03
CB69-70	L100A	93.32	93.90	93.67	91.78	0.00	92.08	0.00	93.52	0.20	93.68	**0.36**
CB39-40	L102A	93.27	93.90	93.62	93.14	0.00	93.35	0.08	93.50	0.23	93.69	**0.42**
CB41-42	L102C	93.44	94.04	93.79	92.52	0.00	93.43	0.00	93.58	0.14	93.63	0.19
CB43-44	L104A	93.40	94.15	93.75	92.94	0.00	93.45	**0.05**	93.58	0.18	93.63	0.23
CB45-46	L106A	93.41	94.05	93.76	93.43	0.02	93.51	**0.10**	93.59	0.18	93.60	0.19
CB47-48	L108A	93.47	94.09	93.82	92.35	0.00	93.04	0.00	93.58	0.11	93.61	0.14
CB49-50	L118A	93.68	N/A	94.03	92.57	0.00	93.35	0.00	93.79	0.11	93.81	0.13

Appendix D GEOTECHNICAL INVESTIGATION

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Studies

patersongroup

Geotechnical Investigation

Proposed Residential Development
3288 Greenbank Road - Ottawa

Prepared For

Caivan Communities

March 6, 2019

Report: PG2743-2

Paterson Group Inc.
Consulting Engineers
154 Colonnade Road South
Ottawa (Nepean), Ontario
Canada K2E 7J5

Tel: (613) 226-7381
Fax: (613) 226-6344
www.patersongroup.ca

Tables of Contents

Appendices

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.

LICENSED PROFESSIONAL ENGINEER
March 12, 2019
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

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

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.

FILE NO. PG2743

REMARKS

HOLE NO. BH 1

BORINGS BY CME 850X Power Auger **DATE** October 15, 2012

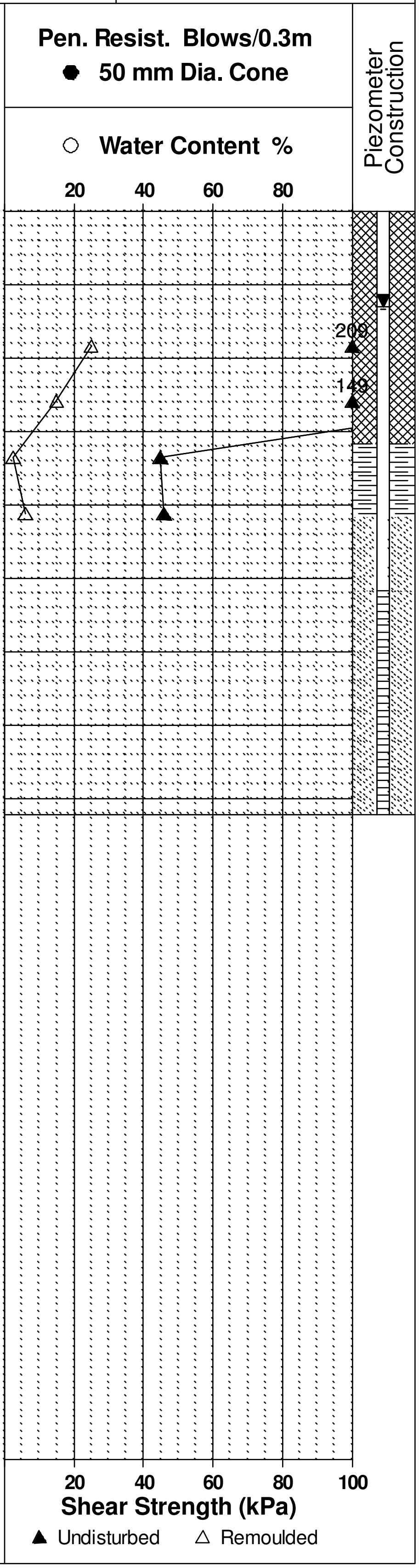
SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
TOPSOIL 0.30	AU	1		
	AU	2		
Hard to very stiff, brown **SILTY CLAY** - firm by 2.8m depth 4.34	SS	3	100	10
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, boulders	SS	4	100	4
	SS	5	12	2
	SS	6	17	2
	SS	7	100	3
8.21	SS	8	73	50+

DEPTH (m)	ELEV. (m)
0	92.89
1	91.89
2	90.89
3	89.89
4	88.89
5	87.89
6	86.89
7	85.89
8	84.89

End of Borehole

Practical refusal to augering at 8.21m depth

(GWL @ 1.30m-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. **BH 2**

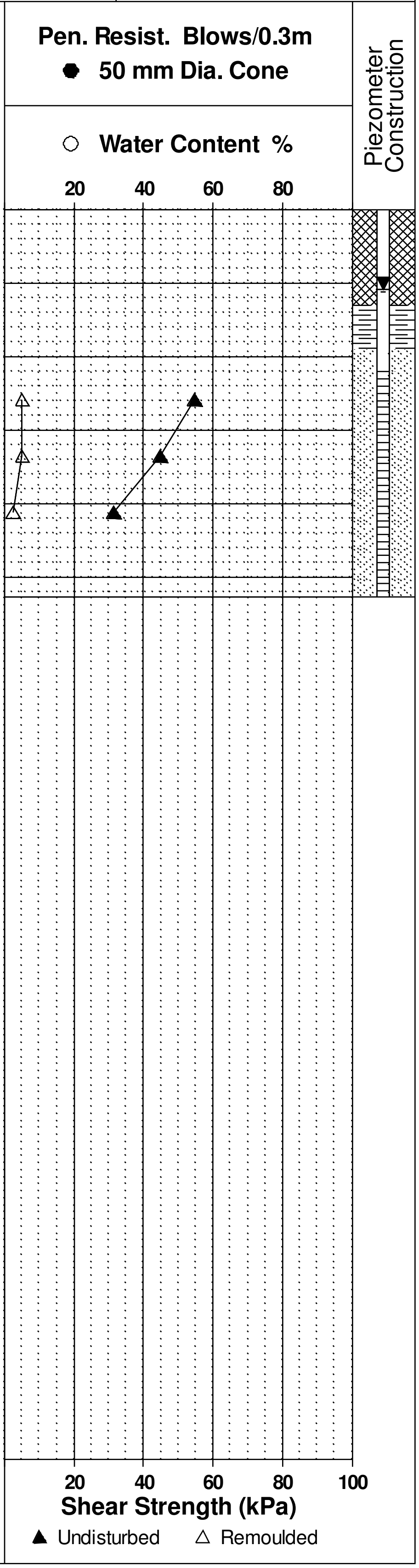
BORINGS BY CME 850X Power Auger

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	87.37
5.26							

End of Borehole

(GWL @ 1.08m-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

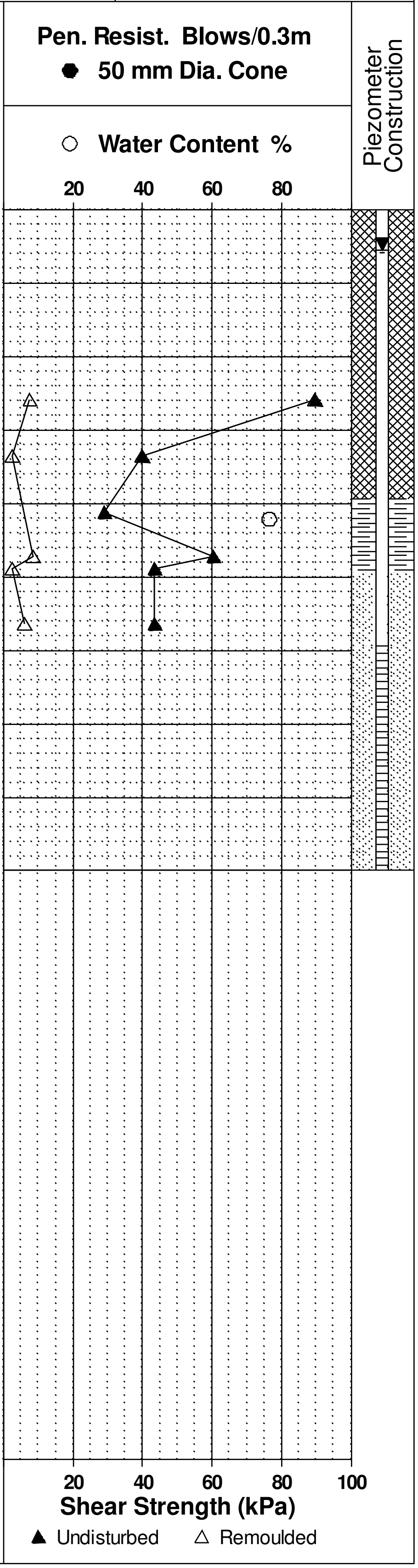
REMARKS

HOLE NO. BH 3

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	92.66
TOPSOIL 0.25		AU	1				
		SS	2	100	10	1	91.66
Very stiff to stiff, brown **SILTY CLAY**		SS	3	100	4	2	90.66
- firm and grey by 2.8m depth						3	89.66
		TW	4	100		4	88.66
5.87						5	87.66
		SS	5	0	4	6	86.66
GLACIAL TILL: Grey silty clay with sand, gravel, cobbles, boulders		SS	6	0	6	7	85.66
		SS	7	83	8	8	84.66
8.99		SS	8	67	38		
End of Borehole							
(GWL @ 0.55m-Nov. 7, 2012)							



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

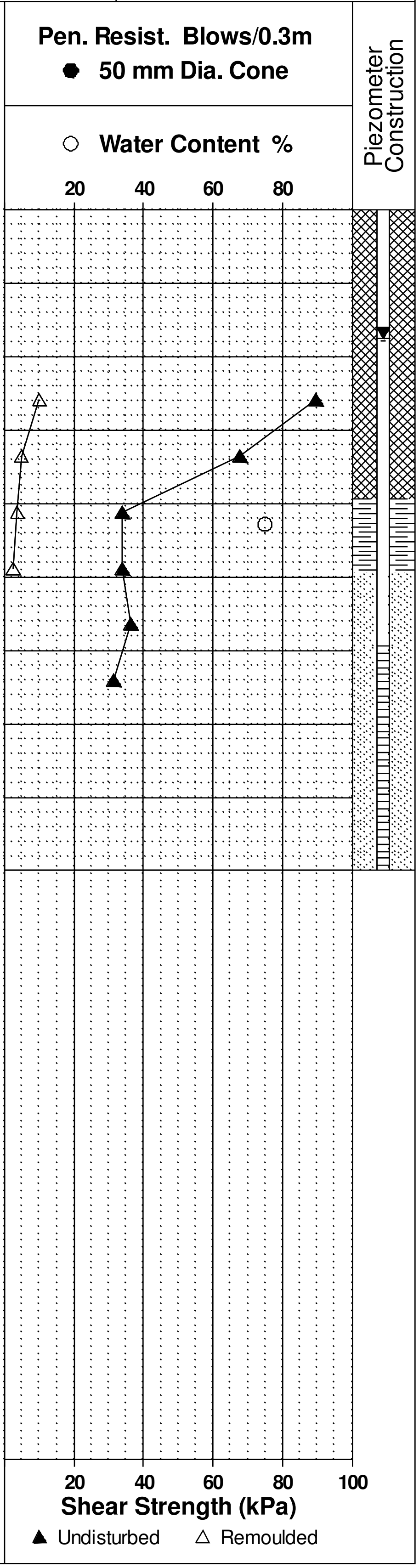
BORINGS BY CME 850X Power Auger

DATE October 16, 2012

FILE NO. PG2743

HOLE NO. BH 4

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						
TOPSOIL 0.30	AU	1			0	92.81
	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)						



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**

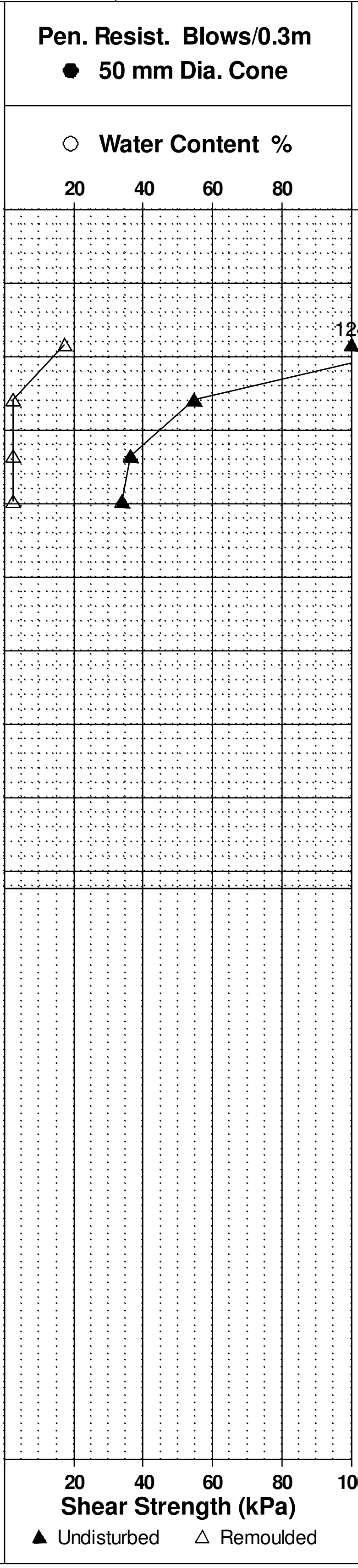
REMARKS

HOLE NO. **BH 5**

BORINGS BY CME 850X Power Auger

DATE October 16, 2012

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
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

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.

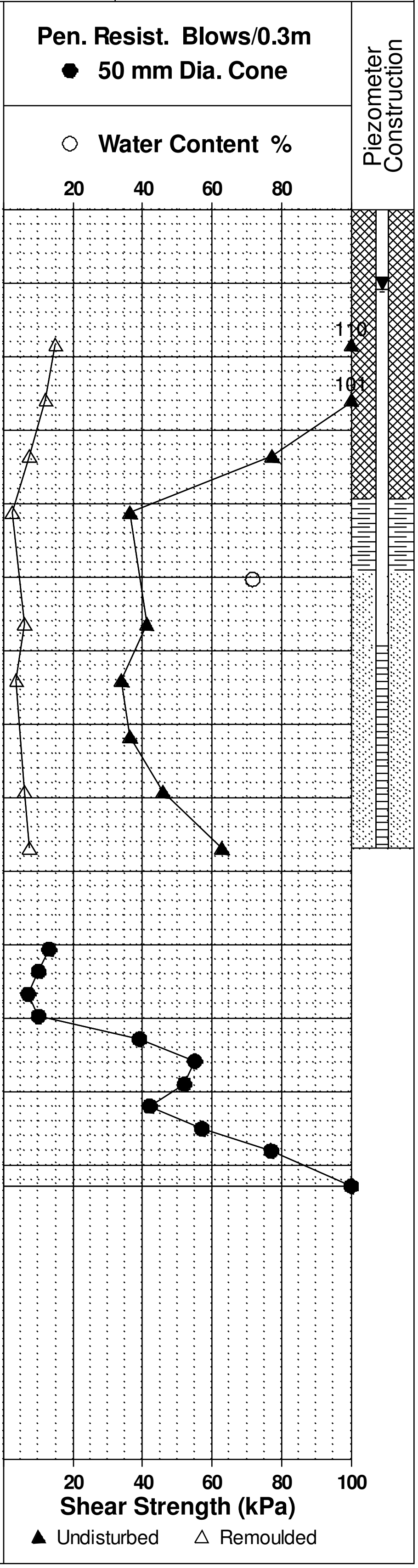
FILE NO. PG2743

REMARKS

HOLE NO. BH 6

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	92.19
TOPSOIL 0.33		AU	1				
		SS	2	100	9	1	91.19
						2	90.19
Very stiff to stiff, brown **SILTY CLAY** - firm and grey 3.6m depth						3	89.19
						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)							



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

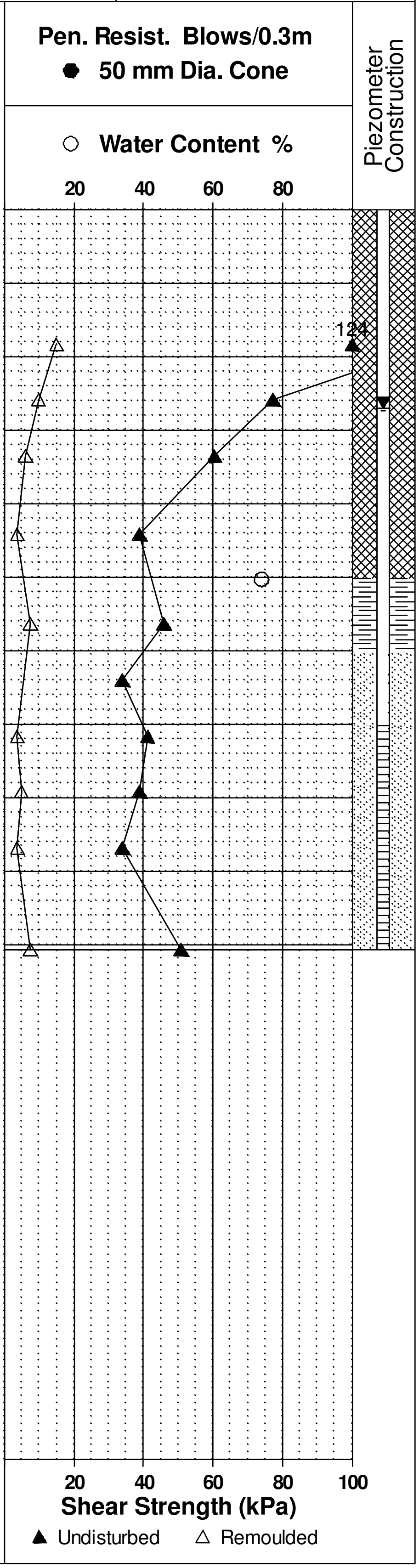
REMARKS

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)							



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 17, 2012

FILE NO. PG2743

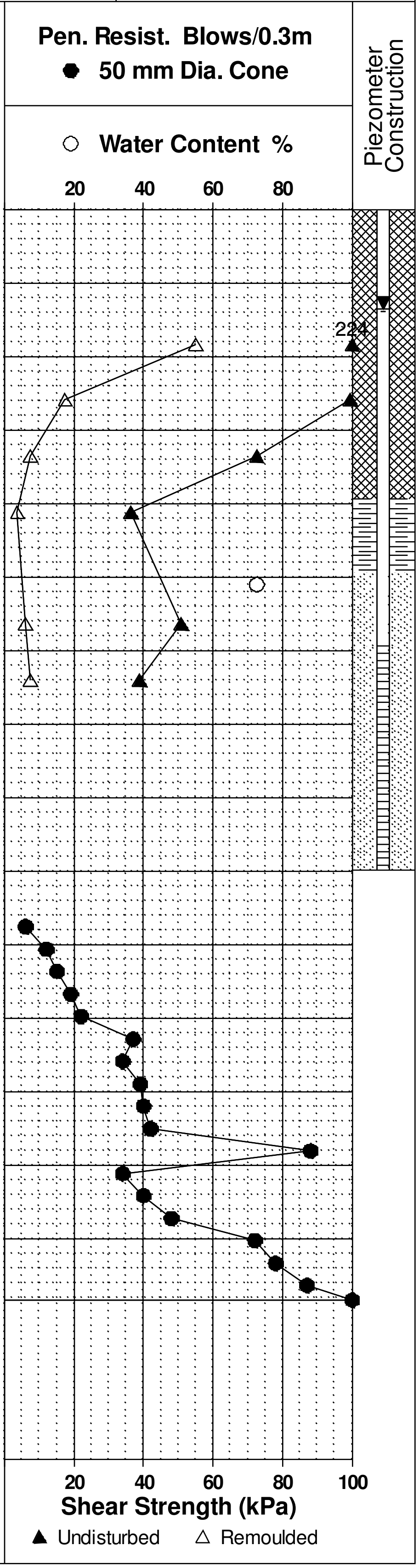
HOLE NO. BH 8

SOIL DESCRIPTION	SAMPLE 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)



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. **BH 9**

BORINGS BY CME 850X Power Auger

DATE October 18, 2012

SOIL DESCRIPTION

GROUND SURFACE

TOPSOIL 0.30

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

- firm and grey by 2.8m depth

- stiff and grey-brown by 5.1m depth

6.63

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

8.23

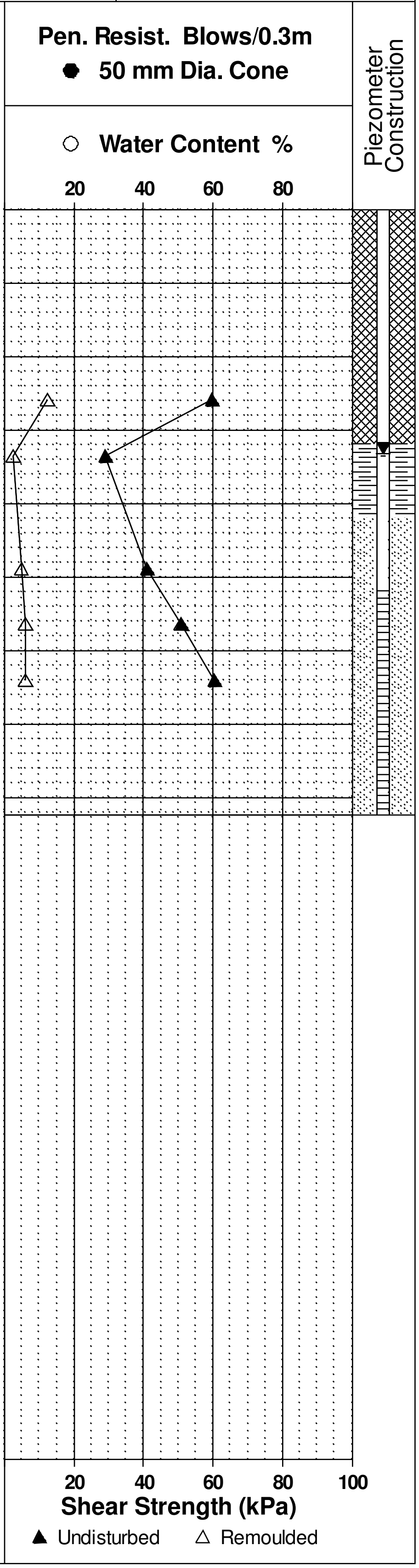
End of Borehole

(GWL @ 3.32m-Nov. 7, 2012)

SAMPLE

TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	100	13
SS	3	100	7
TW	4		
TW	5	100	
SS	6	42	50
SS	7	8	14

DEPTH (m)	ELEV. (m)
0	92.64
1	91.64
2	90.64
3	89.64
4	88.64
5	87.64
6	86.64
7	85.64
8	84.64



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**

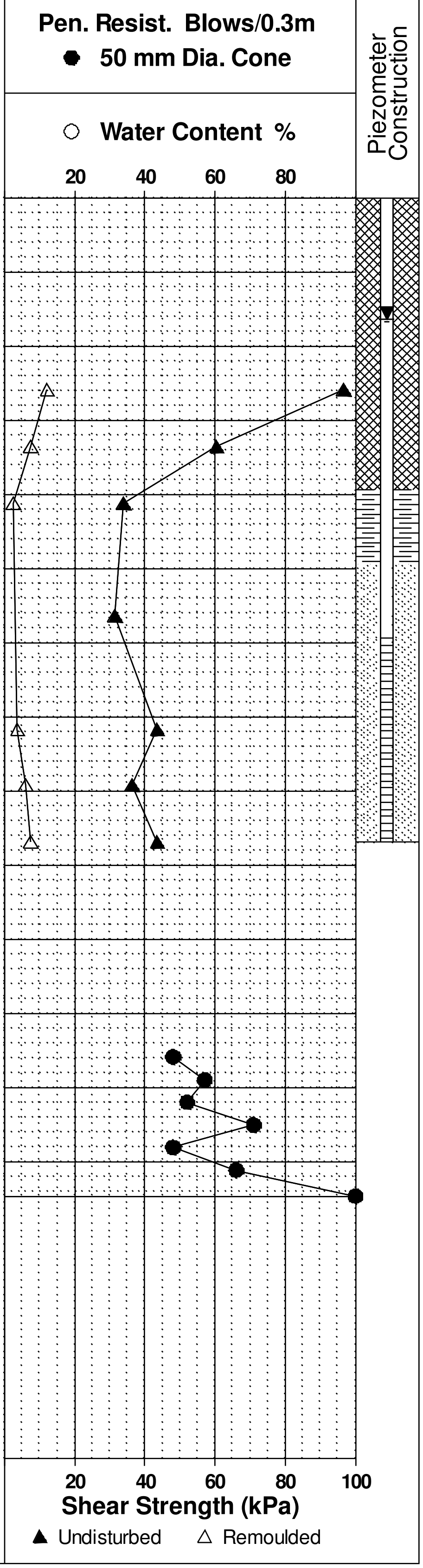
REMARKS

HOLE NO. **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
8.69						8	84.40
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
13.46						13	79.40
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

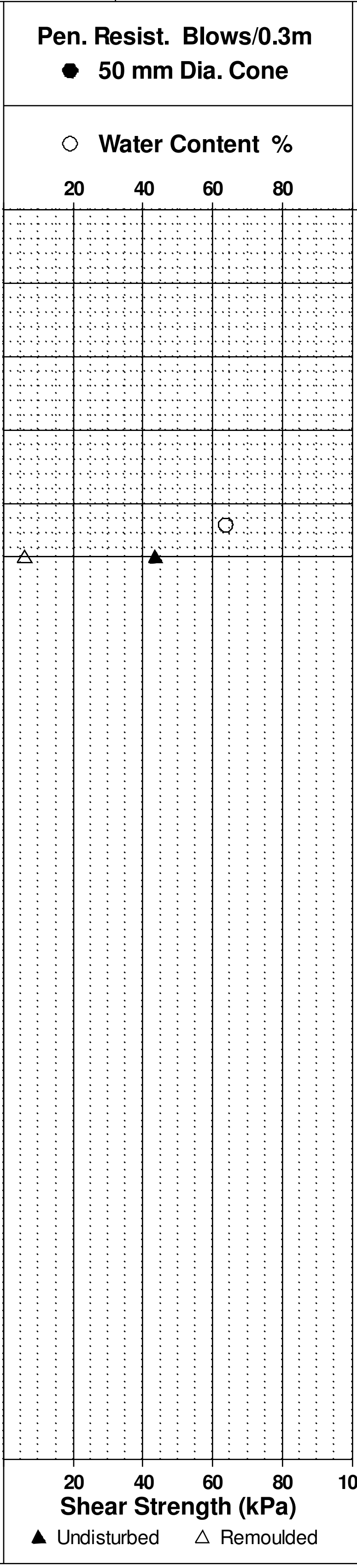
HOLE NO. **BH11**

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
GROUND SURFACE					
TOPSOIL 0.30					
Firm, grey **SILTY CLAY** 4.72		TW	1	100	
End of Borehole					

DEPTH (m)	ELEV. (m)
0	92.70
1	91.70
2	90.70
3	89.70
4	88.70



Piezometer Construction

patersongroup Consulting Engineers
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.

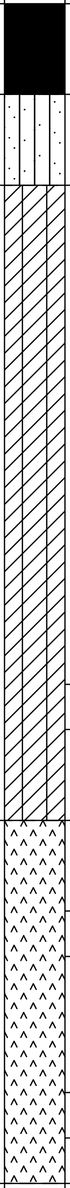
REMARKS

BORINGS BY Excavator

DATE February 19, 2019

FILE NO. PG2743

HOLE NO. TP 1



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

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

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	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	92.72		
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)									

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

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

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
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	DEPTH (m)
GROUND SURFACE	
TOPSOIL	0.30
Very stiff to stiff, brown **SILTY CLAY** - grey by 1.0m depth	2.50
End of Test Pit (Groundwater infiltration at 1.8m depth)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
G	1		
G	2		
G	3		
G	4		

DEPTH (m)	ELEV. (m)
0	92.90
1	91.90
2	90.90

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %
20 40 60 80

Piezometer Construction

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

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 4**

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	92.95		
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)									

Water Content % scale: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
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	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	92.40
TOPSOIL 0.30						
					1	91.40
Stiff, brown **SILTY CLAY**	G	1				
	G	2			2	90.40
2.60	G	3				
End of Test Pit (Groundwater infiltration at 1.7m depth)						

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

∇

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

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

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
2388 Greenbank Road
Ottawa, Ontario

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

REMARKS

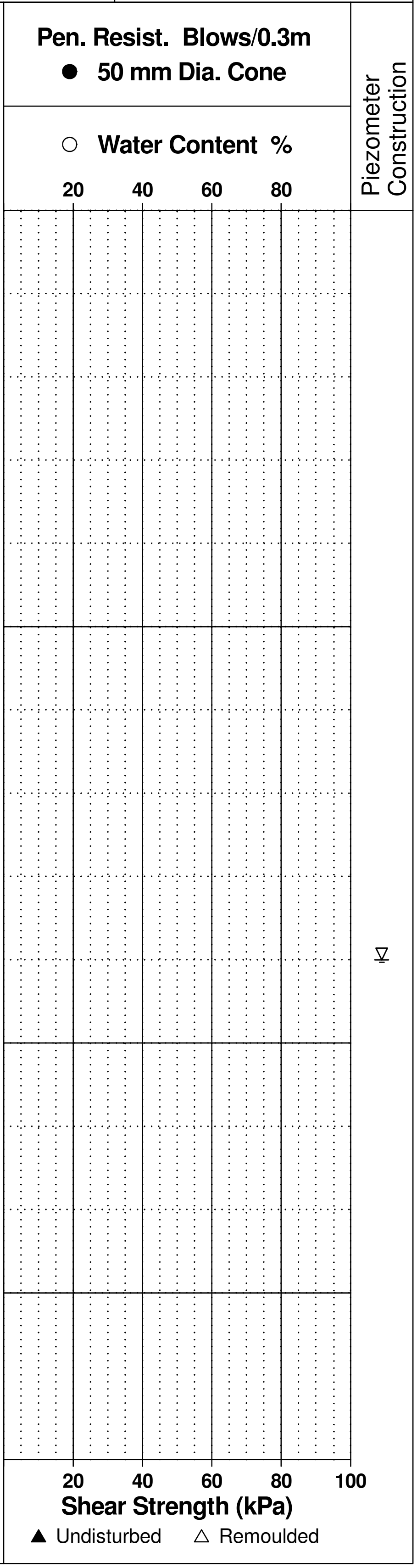
BORINGS BY Excavator

DATE February 19, 2019

FILE NO. PG2743

HOLE NO. TP 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.48
TOPSOIL 0.20							
Very stiff, brown **SILTY CLAY** with sand 1.40		G	1				
						1	91.48
Stiff, grey-brown **SILTY CLAY** - grey by 1.7m depth		G	2				
						2	90.48
		G	3				
2.60		G	4				
End of Test Pit (Groundwater infiltration at 1.8m depth)							



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

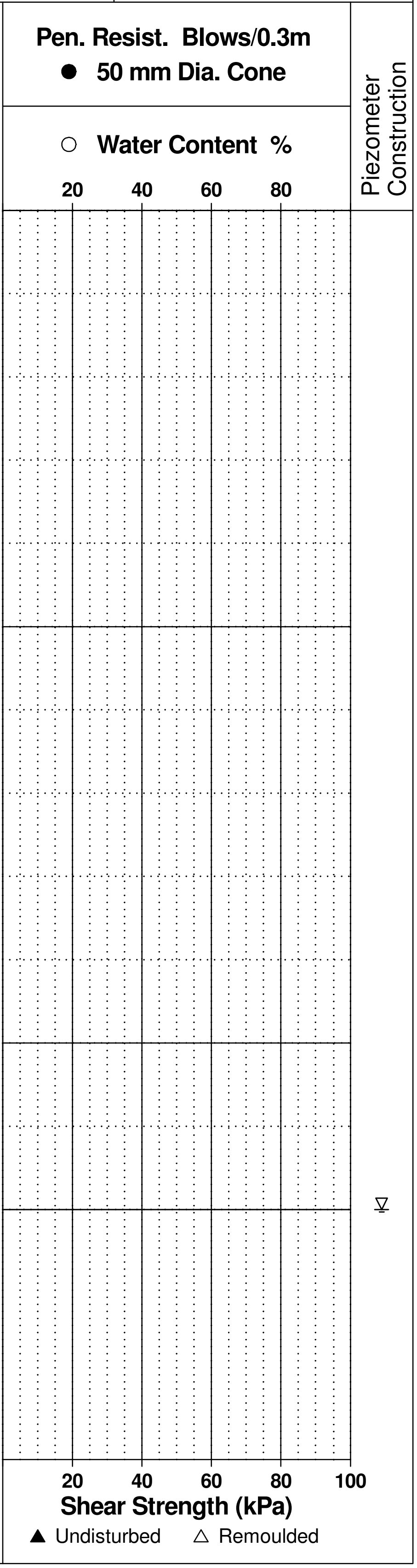
SOIL PROFILE AND TEST DATA

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 7

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.63
TOPSOIL (to 0.40)	■						
Very stiff, brown **SILTY CLAY** with sand (0.40 to 1.00)	▨	G	1				
						1	91.63
Stiff, brown **SILTY CLAY** (1.00 to 2.40)	▨	G	2				
						2	90.63
	▨	G	3				
End of Test Pit (2.40)							

(Groundwater infiltration at 1.5m depth)



patersongroup Consulting Engineers

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 8**

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	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)

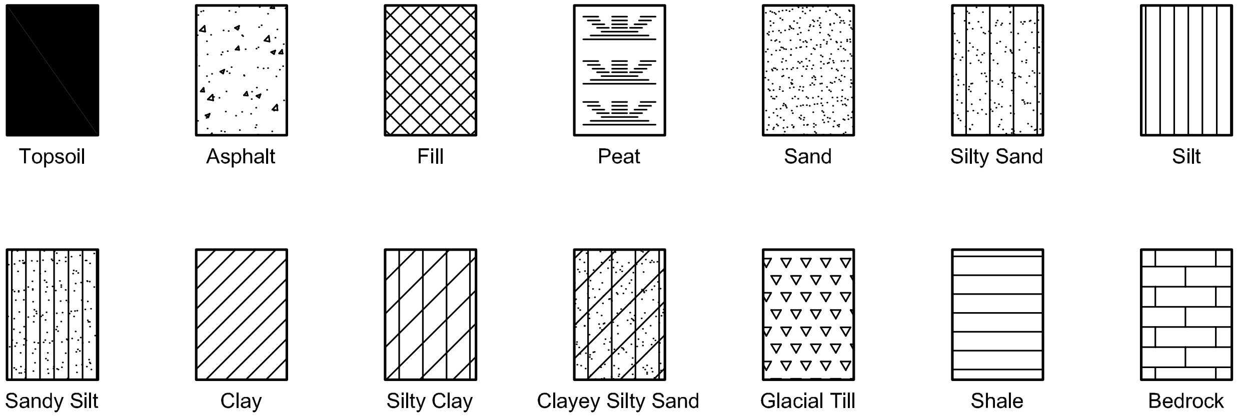
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

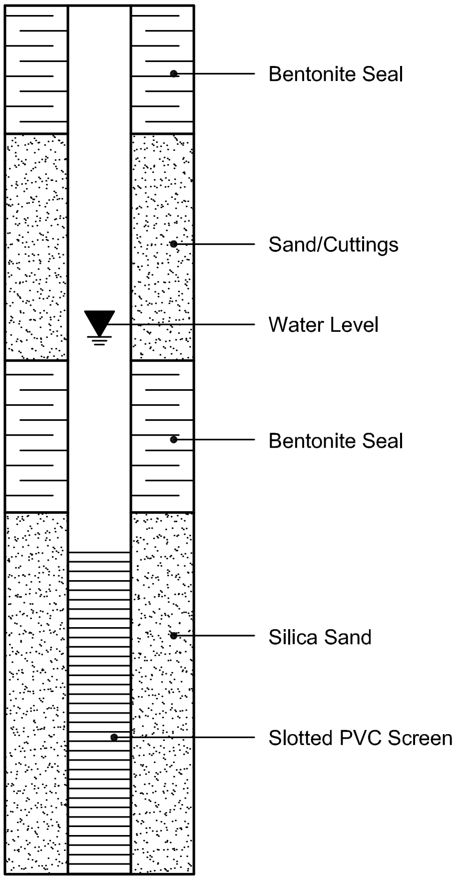
SYMBOLS AND TERMS (continued)

STRATA PLOT

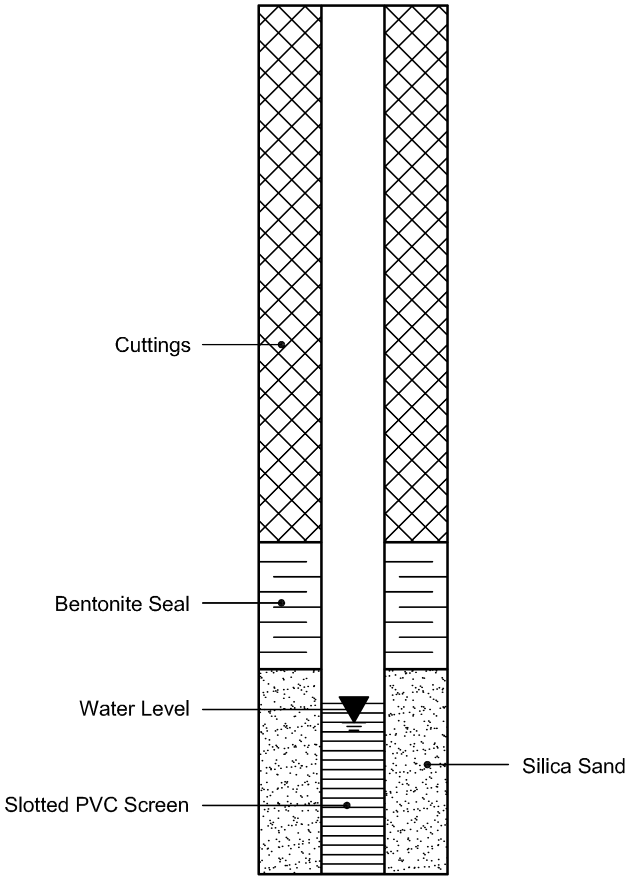


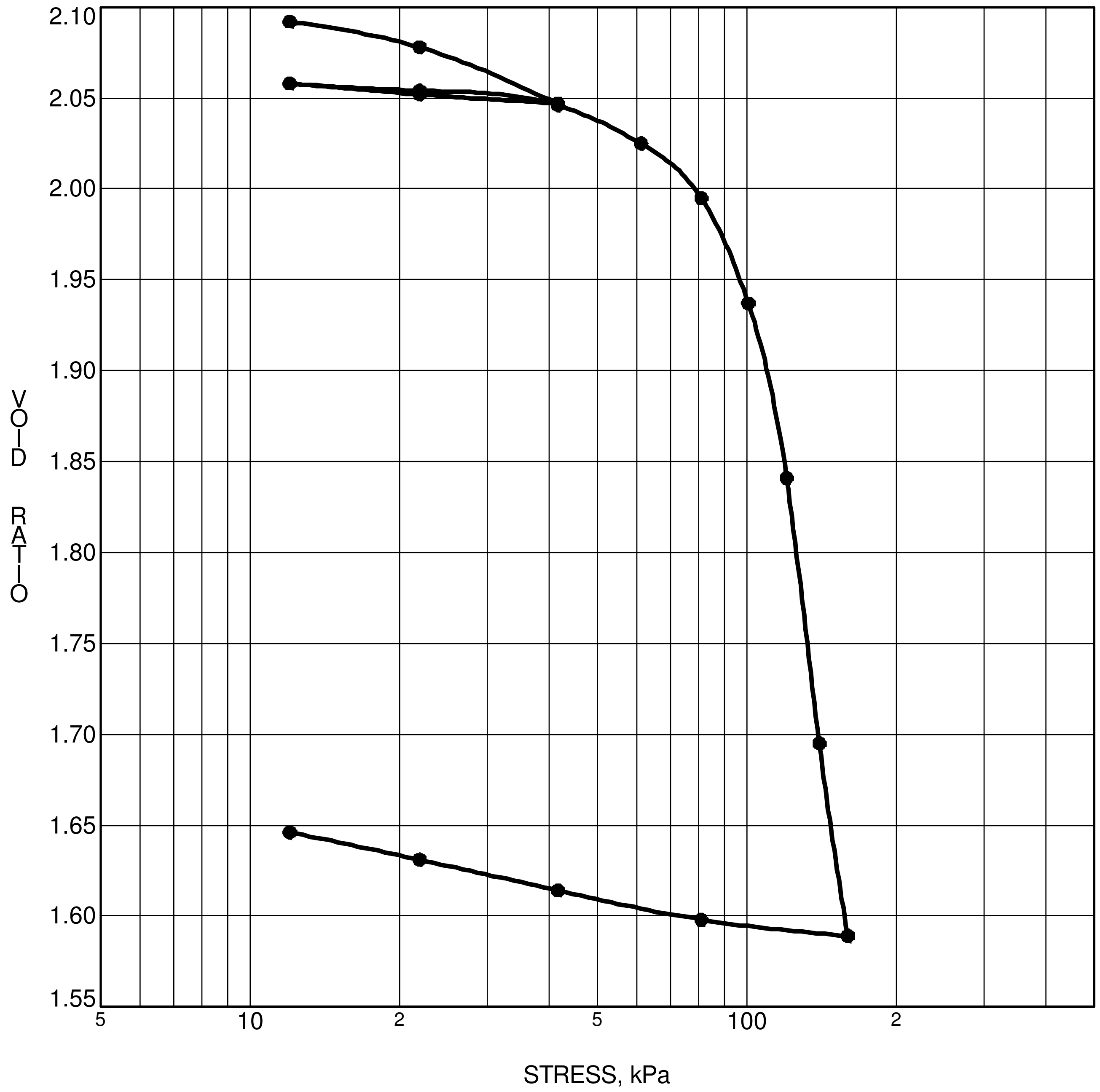
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION





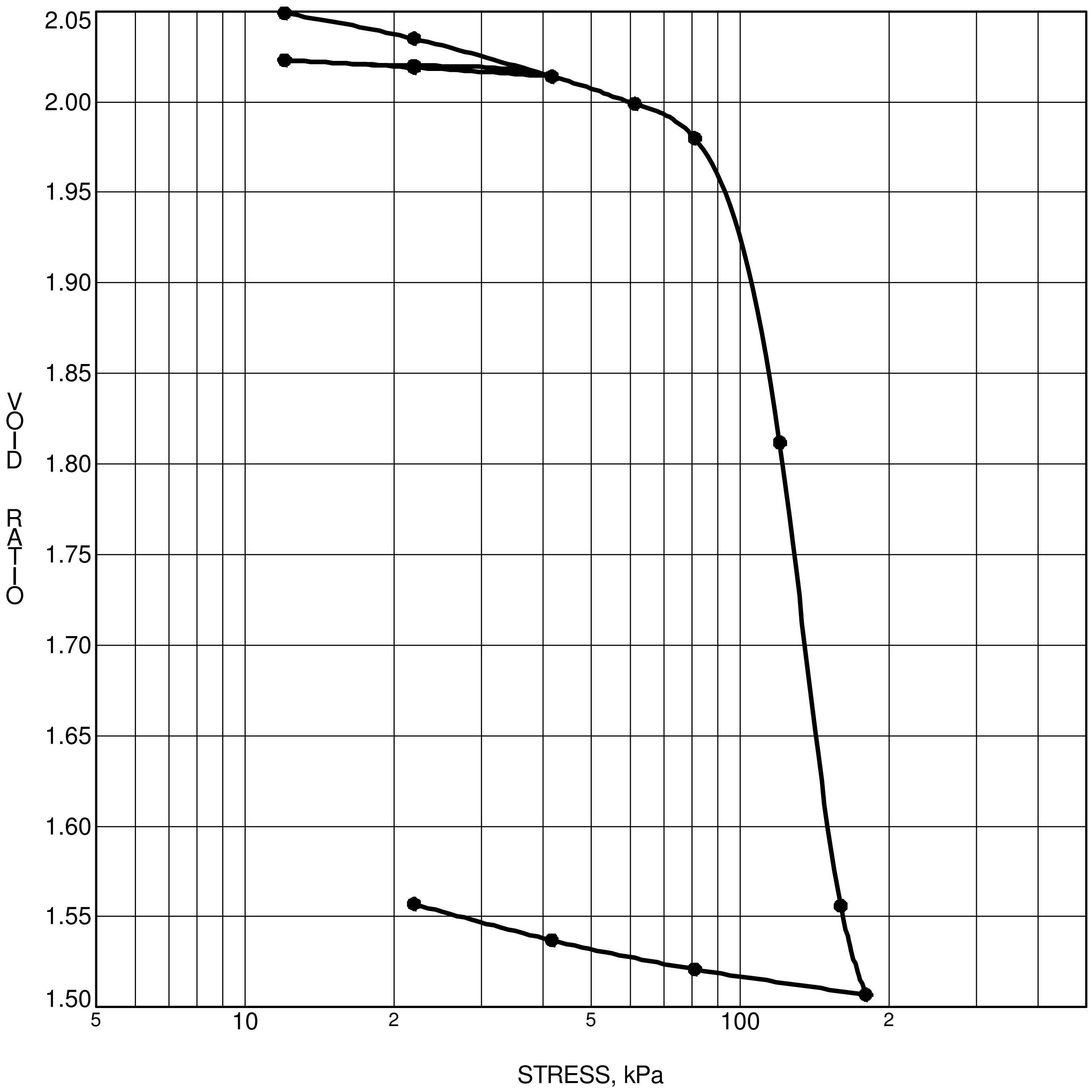
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 3**	p'_o	**50** kPa	Ccr	**0.021**
Sample No.	**TW 4**	p'_c	**104** kPa	Cc	**2.253**
Sample Depth	**4.21** m	OC Ratio	**2.1**	Wo	**76.5** %
Sample Elev.	**88.45** m	Void Ratio	**2.103**	Unit Wt.	**15.8** kN/m ^{3}

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**

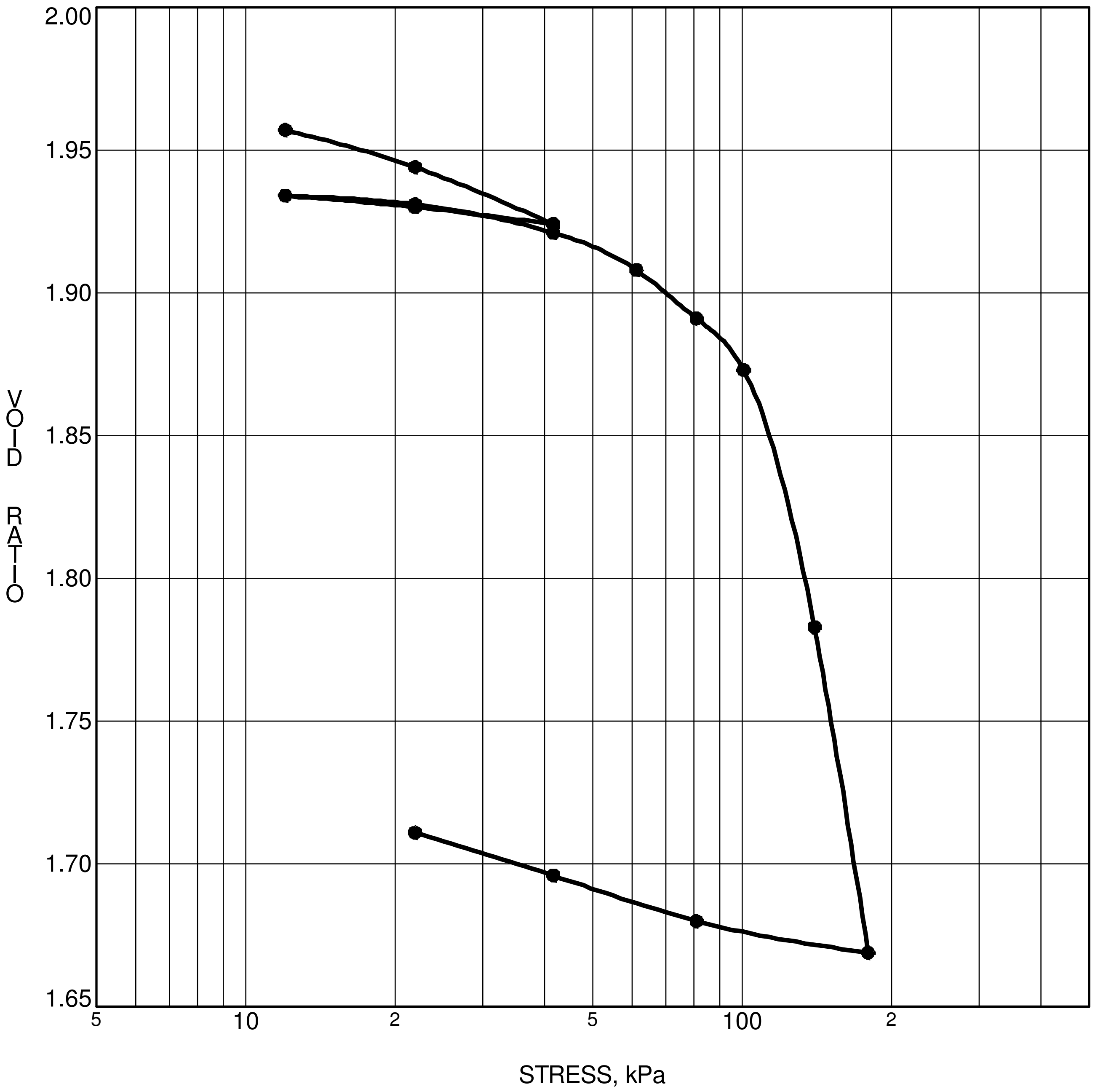
PROJECT **Geotechnical Investigation - Prop. Residential Development - 3288 Greenbank Rd.**

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**

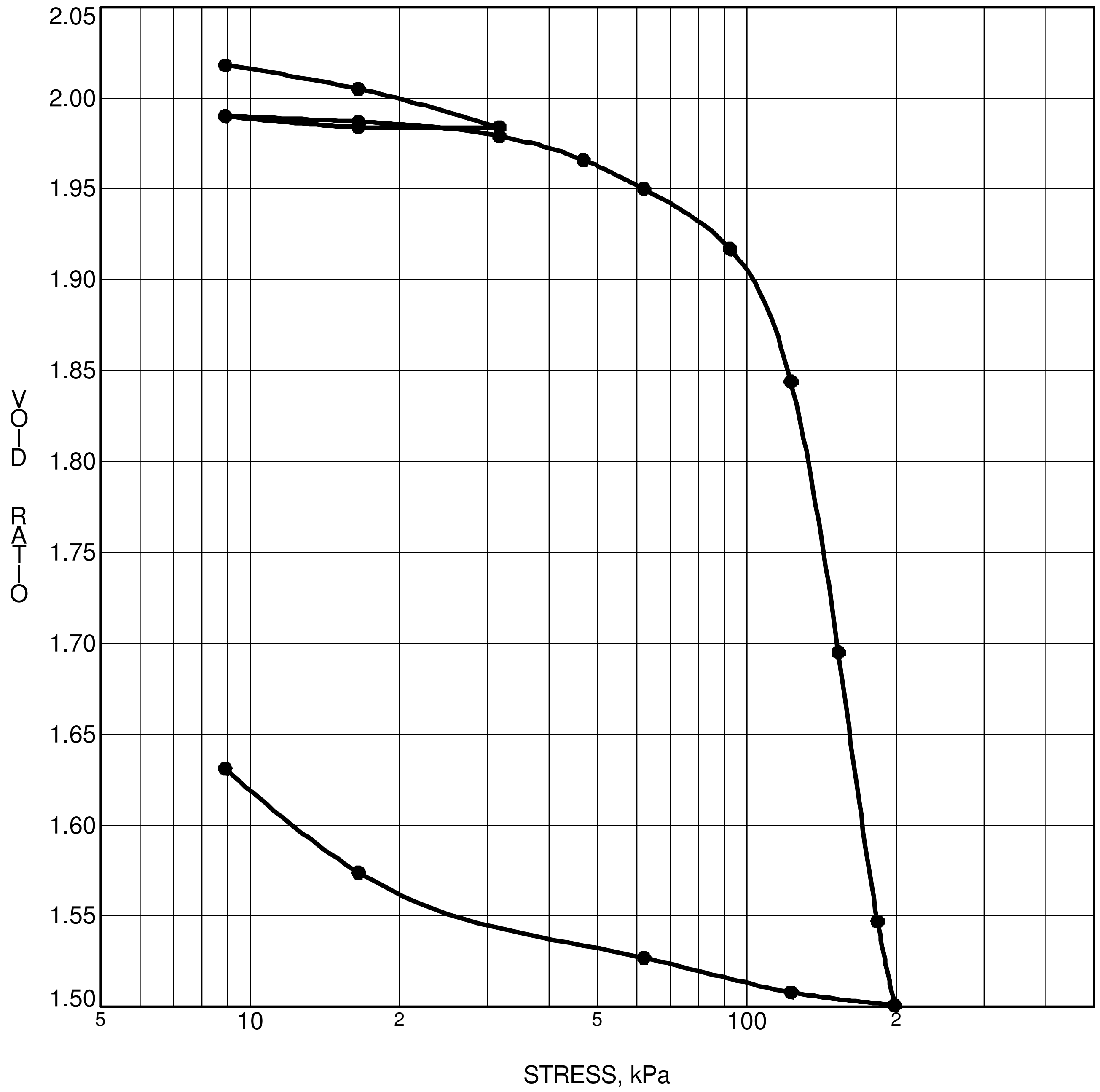
PROJECT **Geotechnical Investigation - Prop. Residential Development - 3288 Greenbank Rd.**

DATE **22/12/2012**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



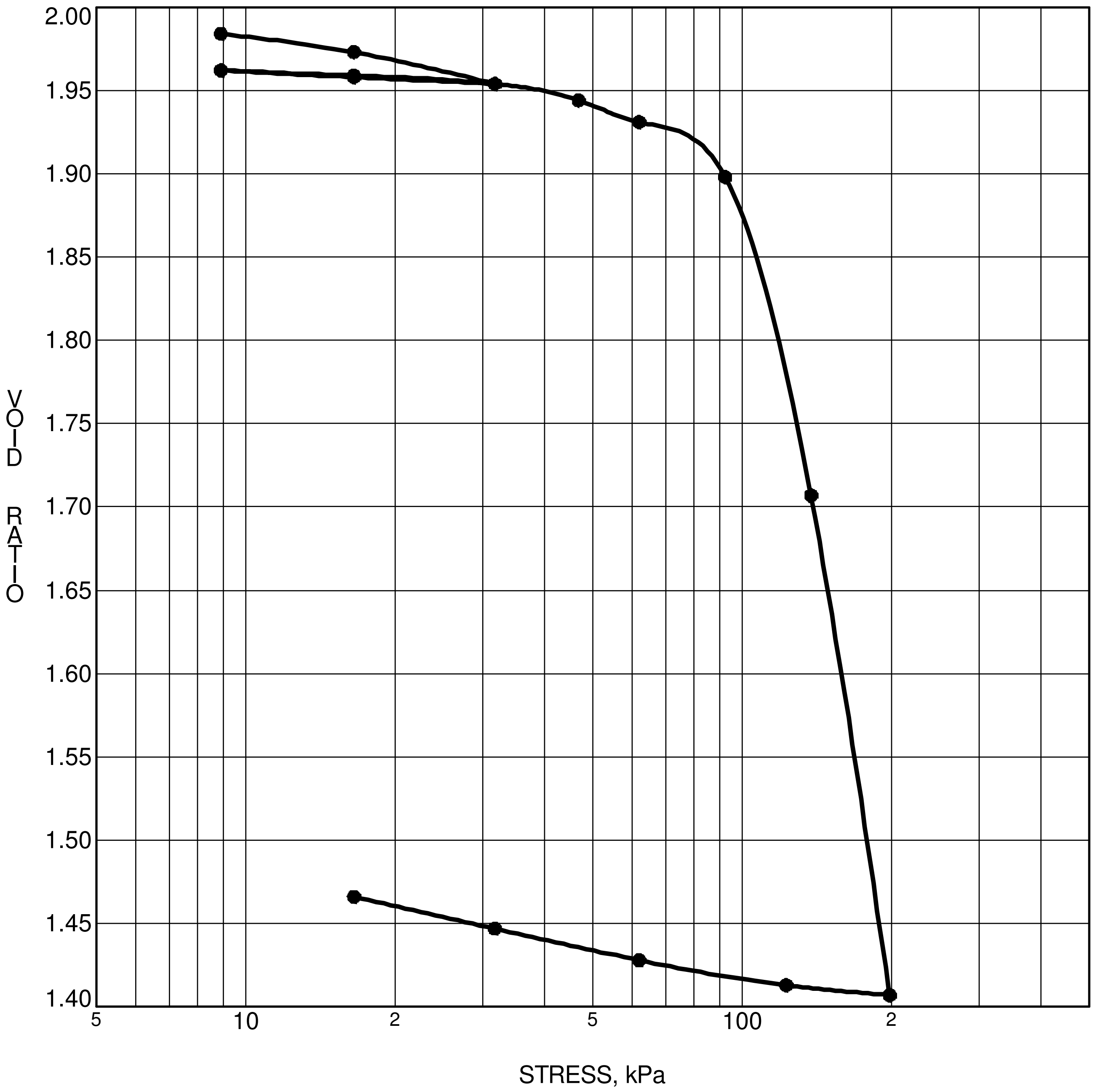
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 7**	p'_o	**68** kPa	Ccr	**0.016**
Sample No.	**TW 3**	p'_c	**113** kPa	Cc	**1.683**
Sample Depth	**5.03** m	OC Ratio	**1.7**	Wo	**74.0** %
Sample Elev.	**87.35** m	Void Ratio	**2.034**	Unit Wt.	**15.8** kN/m ^{3}

CLIENT	**Mattamy Homes**	FILE NO.	**PG2743**
PROJECT	**Geotechnical Investigation - Prop. Residential Development - 3288 Greenbank Rd.**	DATE	**29/10/2012**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

CONSOLIDATION TEST



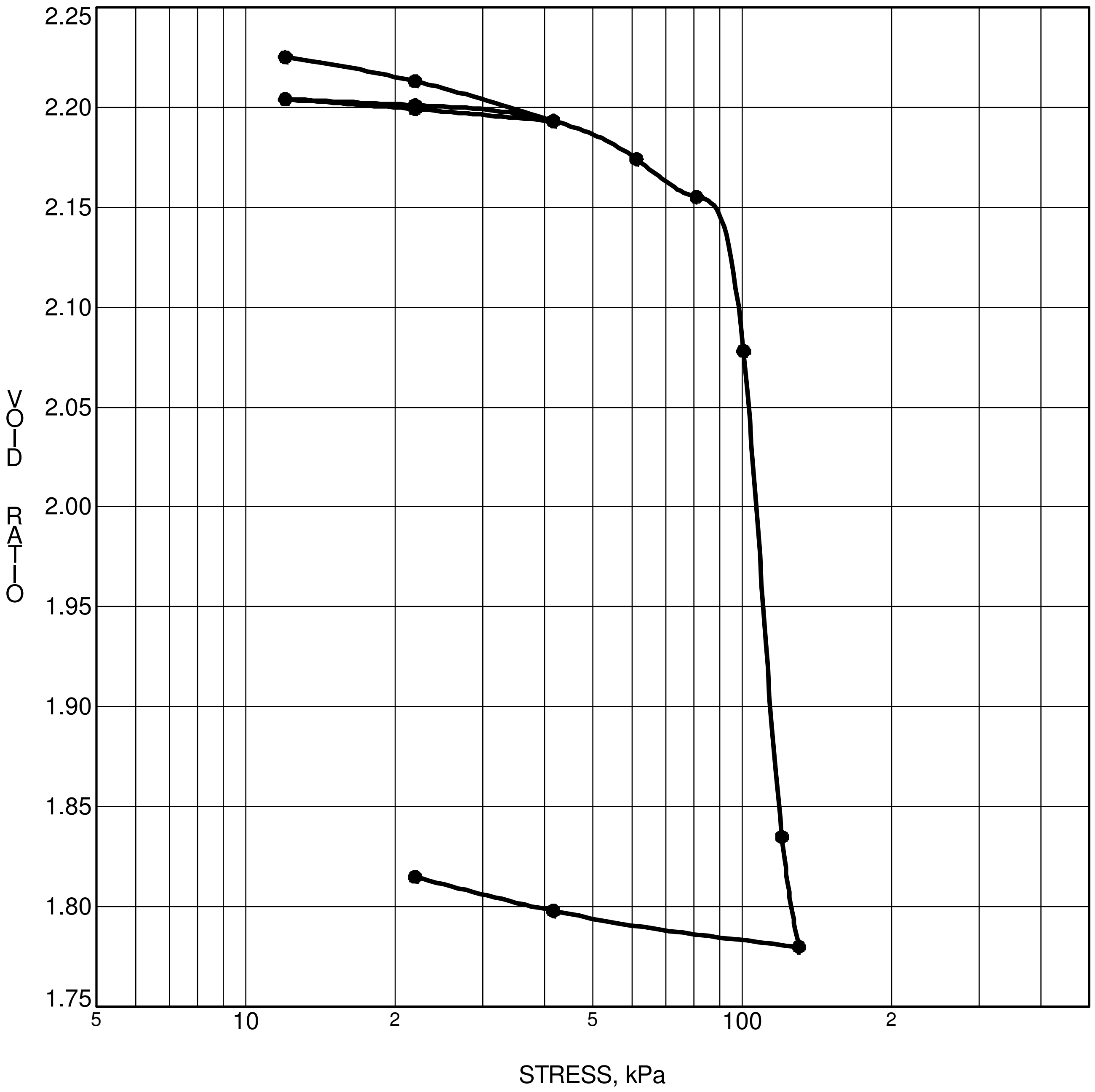
CONSOLIDATION TEST DATA SUMMARY					
Borehole No.	**BH 8**	p'$_o$	**62** kPa	Ccr	**0.015**
Sample No.	**TW 3**	p'$_c$	**111** kPa	Cc	**2.000**
Sample Depth	**5.10** m	OC Ratio	**1.8**	Wo	**72.6** %
Sample Elev.	**87.78** m	Void Ratio	**1.996**	Unit Wt.	**15.9** kN/m ^{3}

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**

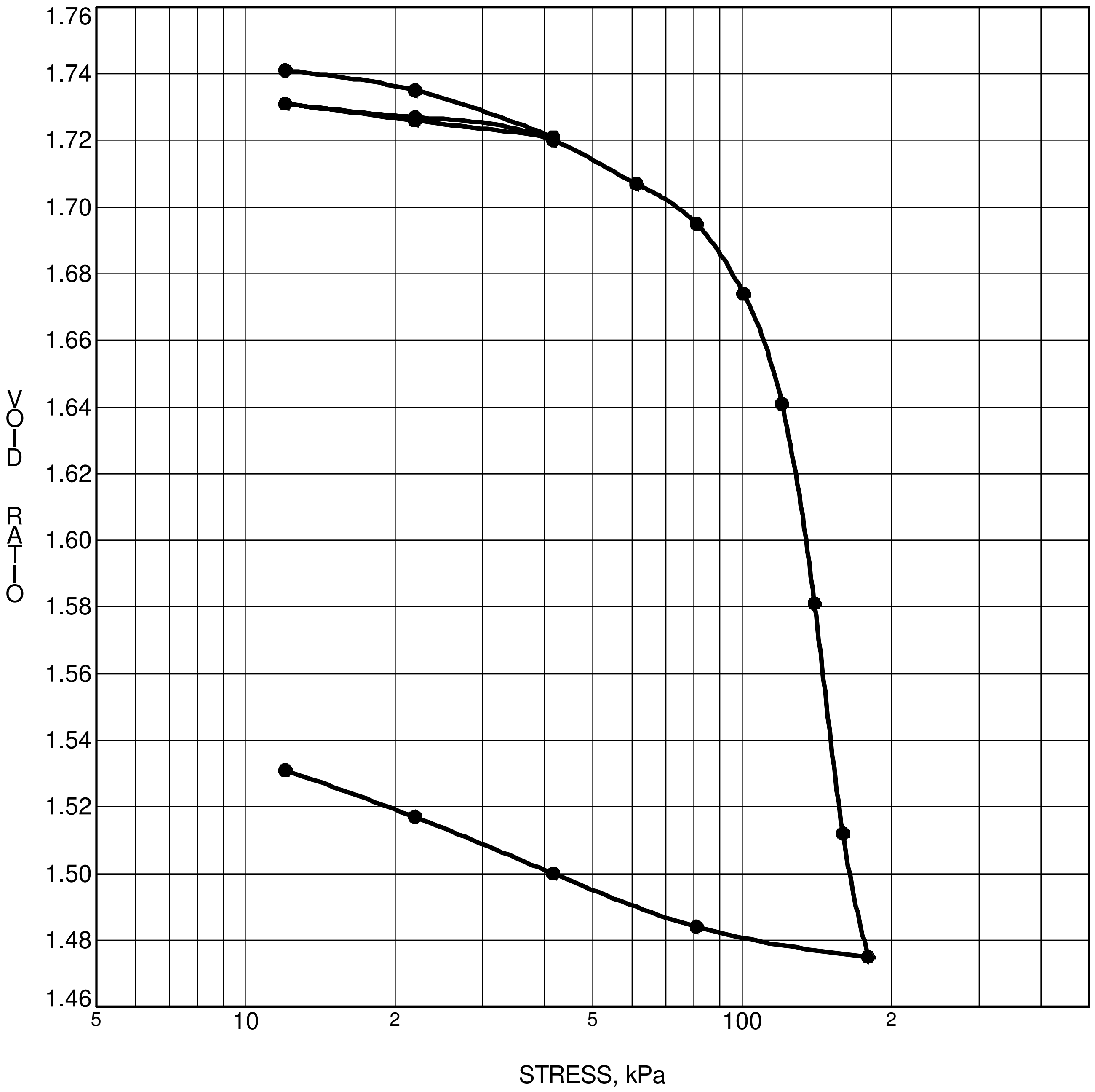
PROJECT **Geotechnical Investigation - Prop. Residential Development - 3288 Greenbank Rd.**

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**

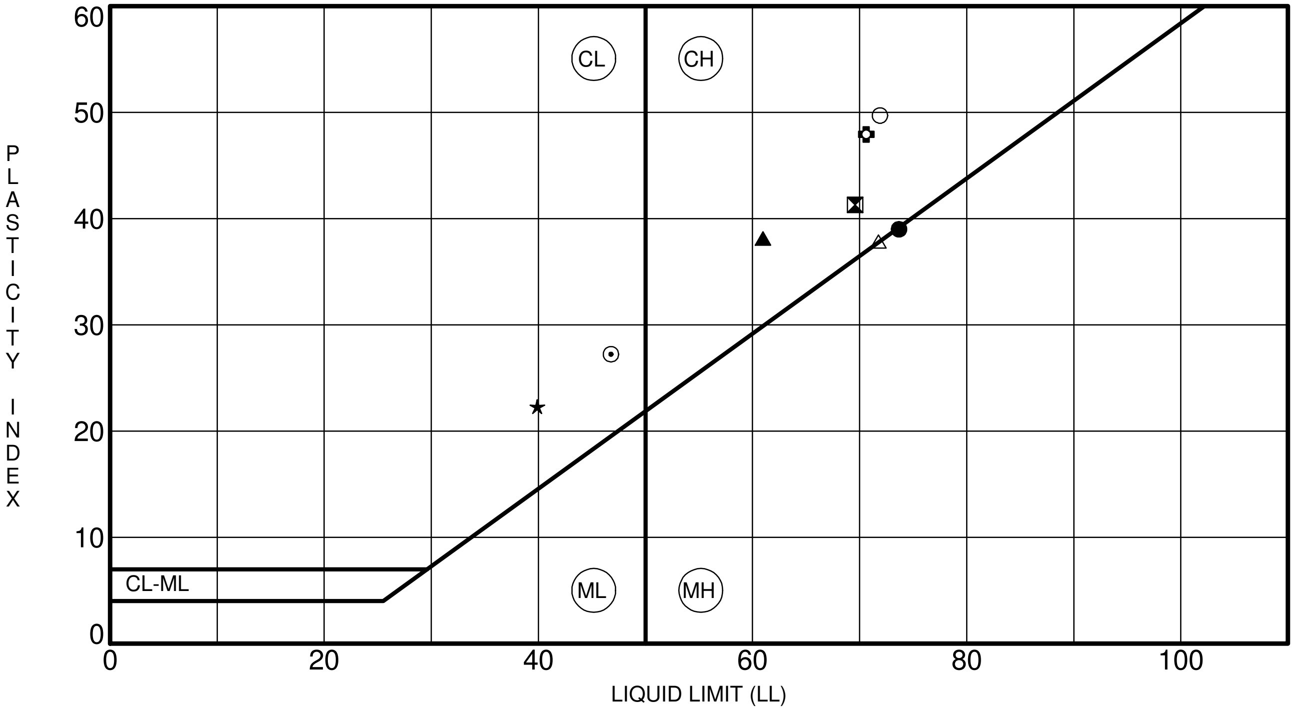
PROJECT **Geotechnical Investigation - Prop. Residential Development - 3288 Greenbank Rd.**

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**

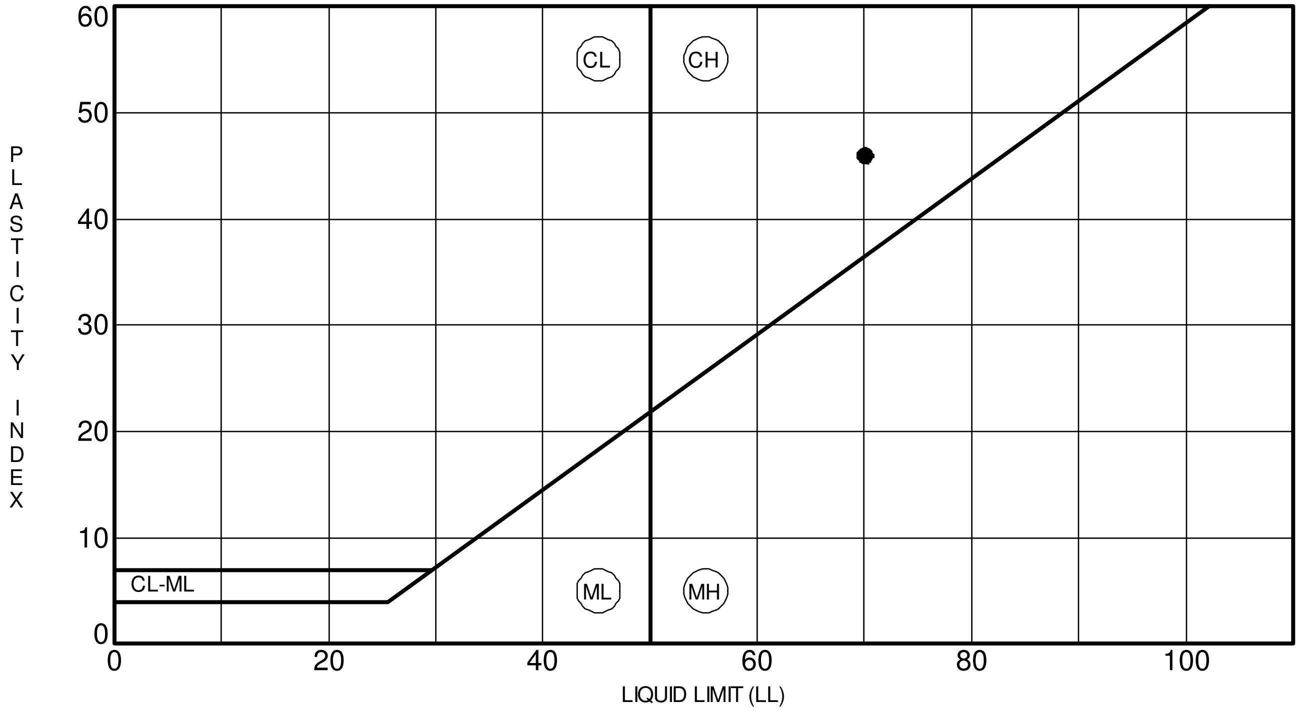
FILE NO. **PG2743**

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

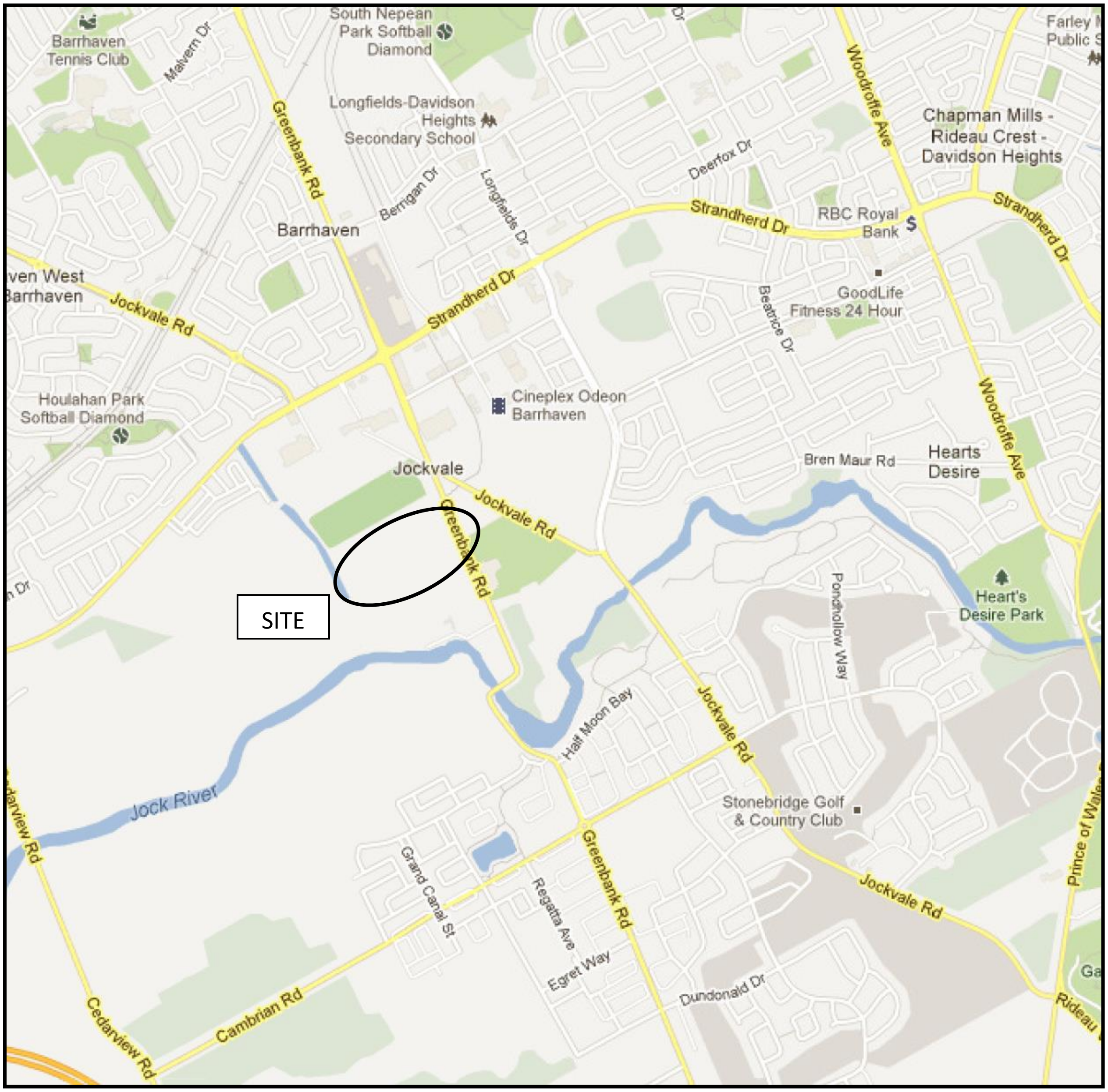
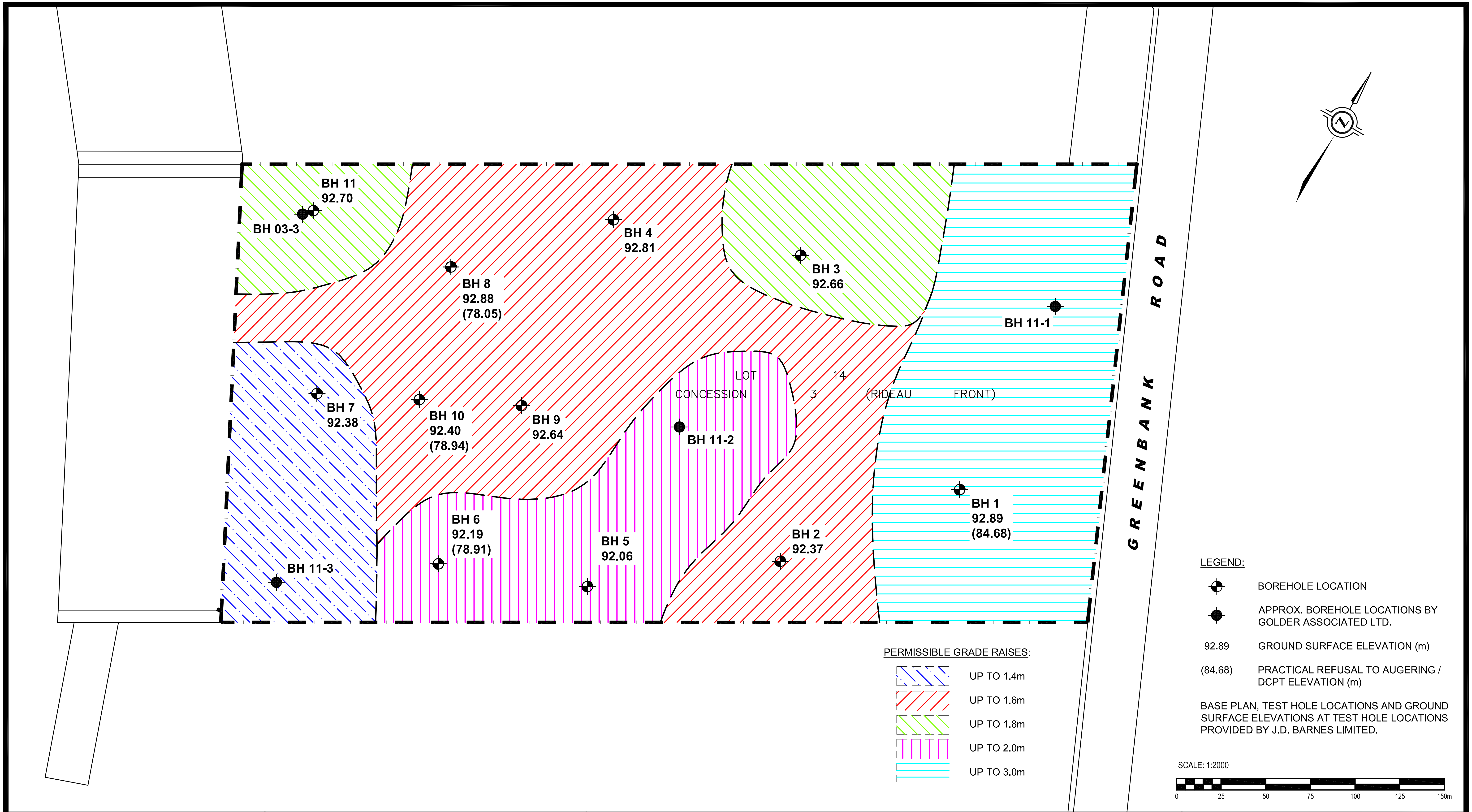


FIGURE 1

KEY PLAN



patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

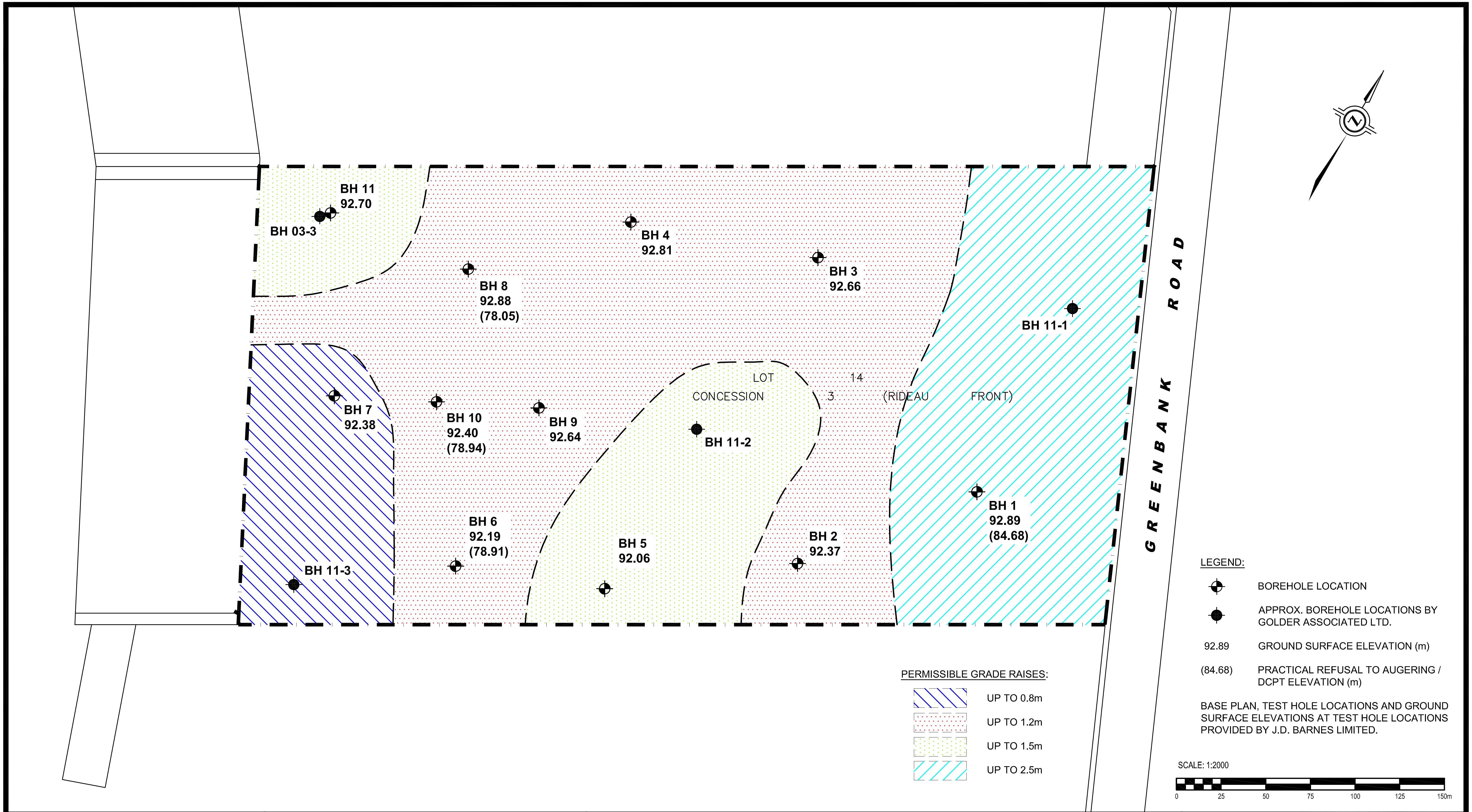
NO.	REVISIONS	DATE	INITIAL

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
PG2743-2
Approved by: DJG
Revision No.:

p:\autocad drawings\geotechnical\pg27xx\pg2743\pg2743-1 rev1.dwg



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.

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

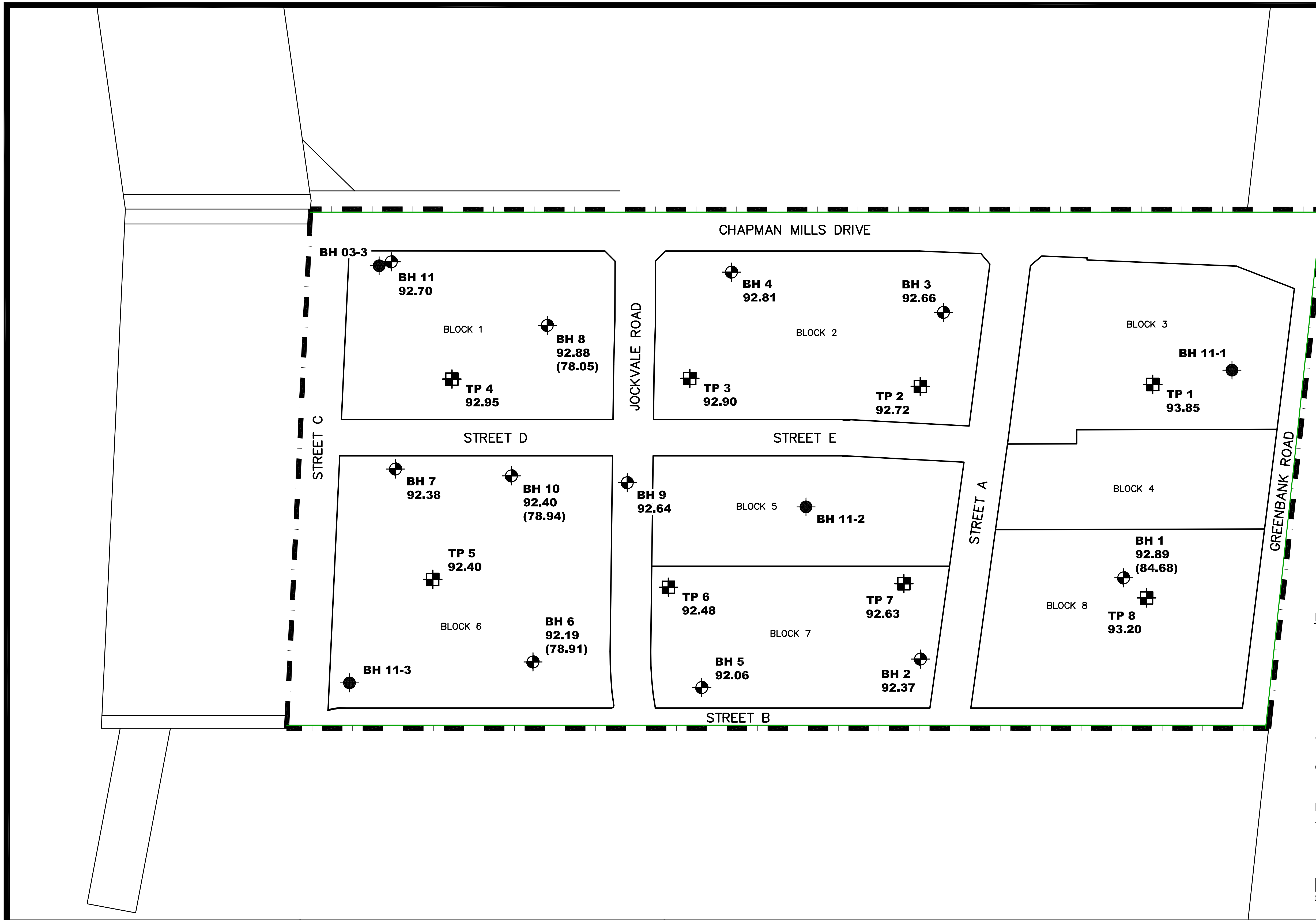
NO.	REVISIONS	DATE	INITIAL

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.:

p:\autocad drawings\geotechnical\pg27xx\pg2743\pg2743-1 rev1.dwg



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.

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

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	PG2743-4
Approved by: DJG	Revision No.:

p:\autocad drawings\geotechnical\pg27xx\pg2743\pg2743-4 thlp.dwg

Appendix E **DRAWINGS**