Site Servicing and Stormwater Management Report – Orleans II Draft Plan of Subdivision

Project # 160401419

Prepared for:
Innes Shopping Centres Limited

Prepared by:
Stantec Consulting Ltd.

April 12, 2018

Sign-off Sheet

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Dustin Thiffault, P.Eng.

Reviewed by ______________________________
(signature)

Karin Smadella, P.Eng.

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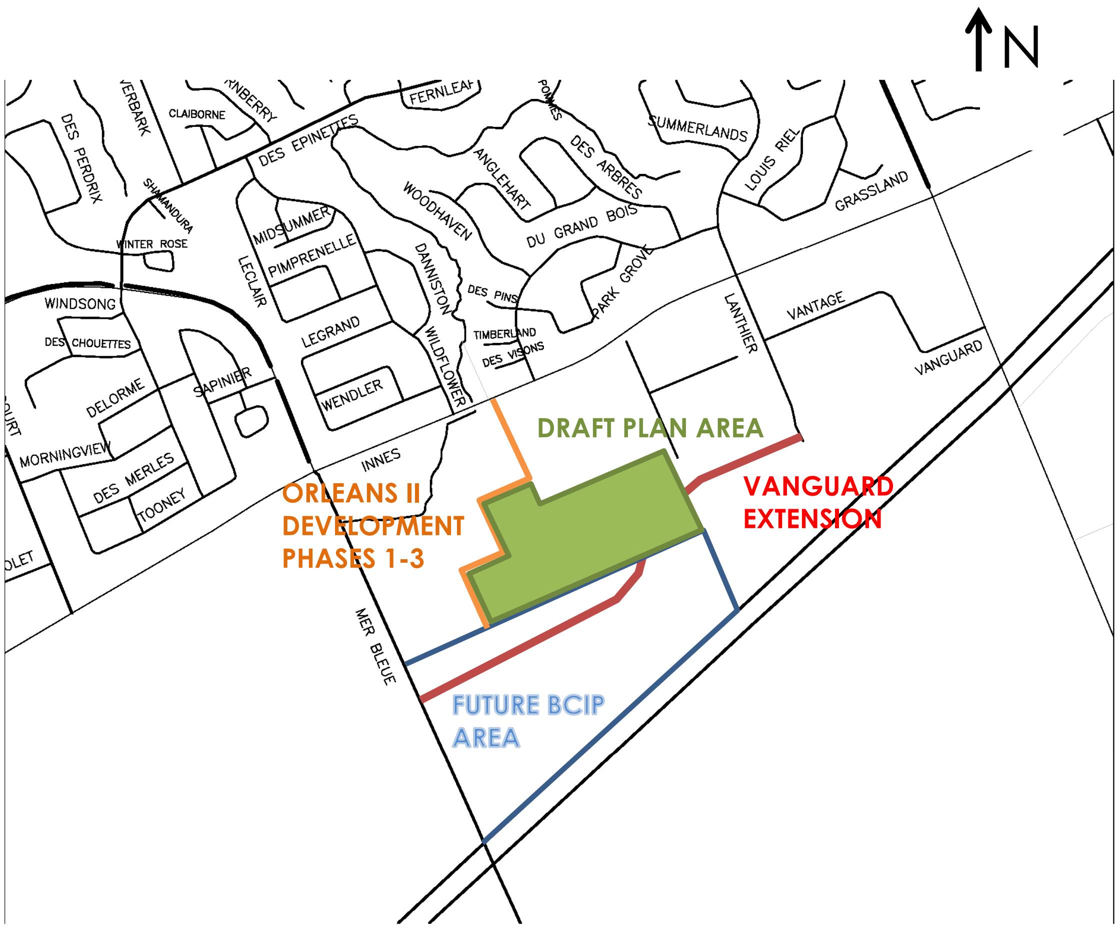
1.0 INTRODUCTION

Stantec Consulting Ltd. has been commissioned by Innes Shopping Centres Limited to prepare a servicing study in support of the plan of subdivision for the property located at 4200 Innes Road forming part of the Orleans II Commercial Development. The site is situated southeast of the intersection of Innes Road and Mer Bleue Road within the City of Ottawa as indicated in **Figure 1**. The proposed development comprises approximately 11.3 ha of land within the Bilberry Creek Industrial Park (BCIP), and is currently zoned AM (arterial mainstreet) and IG (general industrial). The intent 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 background studies noted in **Section 2.0**, and as per consultation with City of Ottawa staff.

Numerous infrastructure projects have recently taken place in the surrounding area that will provide servicing and transportation connections to the subdivision lands. In the summer of 2006, the City of Ottawa completed the design and construction of Innes Road improvements and associated servicing. Innes Road was widened to a four-lane divided arterial and a large diameter storm trunk sewer was constructed which is tributary to Bilberry Creek. Roadway improvements to Mer Bleue Road from Innes Road south to Renaud Road have also been completed and Vanguard Drive has been extended from Trim Road to Lanthier Drive. A sanitary sewer was extended from Lanthier Drive through an easement within the development lands to service the site plan developments along Mer Bleue Road south of Innes Road. Site plan works include between Innes Road and the subdivision lands include the extension of the municipal services along new roadways that will provide servicing and transportation connections to the subdivision lands from Mer Bleue Road and Innes Road. Access will be available from Vanguard Drive in the future when the roadway is extended from its existing terminus at Lanthier Drive.

Figure 1: Location Plan



2.0 BACKGROUND

In October 2006 (and later re-assessed in 2012 and 2016 for rezoning of the property) Stantec prepared a serviceability report entitled "Pharand Lands Serviceability Report". This report outlined a general servicing scheme for the proposed development site. It was shown that adequate servicing could be provided to support the development.

In July 2006 Stantec prepared a report entitled "Gloucester and Cumberland East Urban Community Expansion Area and Bilberry Creek Industrial Park Master Servicing Update". The objective of the report was to consolidate recent reports and to update the Gloucester and Cumberland East Urban Community Master Servicing reports. It also included updated basemaps to include existing and proposed trunk storm (900mm and larger), sanitary (375mm and greater) and watermains (300mm and larger).

In April 2006 Paterson Group completed a report for the proposed lands entitled "Preliminary Geotechnical Investigation: Proposed Commercial Development (Pharand Lands) Innes Road at Mer Bleue Road – Ottawa". The investigation included a series of 34 test pits as well as eight boreholes ranging in depth from 0.3m to 13.9m. Generally, the report indicated that the site consists of topsoil overlying silty clay and/or glacial till. The site was generally found to be vacant with only two buildings and one well. A rock outcrop exists in the centre of the site. Groundwater levels were found to range from the ground surface to 3m below the surface. The report indicated that shallow foundations over silty clay would require some means of reducing settlement.

In April 2006 Paterson Group completed a Phase 1 Environmental Assessment for the proposed lands. The purpose was to research the past use of the site and identify and any concerns associated with the site. It was their opinion that a Phase II Environmental Site Assessment would not be required for the subject property.

Serviceability for the development lands was reassessed in December 2016 to permit rezoning of the subject lands. To this end, a Stage 1 and 2 Archaeological Assessment as well as an Environmental Impact Statement with Headwaters Assessment was produced for the property. The Archeological Assessment did not identify any potential archaeological sites requiring further assessment, whereas the EIS recommended mitigation measures relating to spill management, erosion and sediment control, and construction timing to ensure the proposed development would not result in adverse environmental effects.

Documents referenced in preparation of the design for the Orleans II Draft Plan of Subdivison include:

- Geotechnical Investigation – Proposed Pharand Lands-Commercial Developments – Innes Road, Patersongroup Consulting Engineers, April 24, 2006.
- Phase 1 Environmental Site Assessment, Proposed Commercial Property, Pharand Lands – Innes Road at Mer Bleue Road, Patersongroup Consulting Engineers, April 28, 2006.
- City of Ottawa Sewer Design Guidelines, City of Ottawa, October 2012.
- City of Ottawa Design Guidelines – Water Distribution, City of Ottawa, July 2010.
- Gloucester and Cumberland East Urban Community Expansion Area and Bilberry Creek Industrial Park Master Servicing Update, Stantec Consulting Ltd., July 2006.
- Pharand Lands, Innes Shopping Centres Limited – City of Ottawa, Stantec Consulting Ltd., February 22, 2012.
- Stage 1 and 2 Archaeological Assessment for Site Plan Application at 4100 Innes Rd/2025 Mer Bleue Rd, Stantec Consulting Ltd., July 2016.
- Environmental Impact Statement with Headwaters Assessment for 4100 Innes Road/2025 Mer Bleue Road, Stantec Consulting Ltd., December 2016.
- Site Servicing and Stormwater Management Report – Orleans II Development Rezoning, Stantec Consulting Ltd., December 2016.
- Site Servicing and Stormwater Management Report – Orleans II Development – 2025 Mer Bleue Road – Phase 1, Stantec Consulting Ltd., March 2017.
- Site Servicing and Stormwater Management Report – Orleans II Development – 2025 Mer Bleue Road – Phase 2, Stantec Consulting Ltd., March 2018.

3.0 WATER SUPPLY SERVICING

3.1 BACKGROUND

The proposed development comprises six development blocks, three of which are light industrial/non-residential sites, with the remaining three having zoning permitting mid-rise apartment dwellings. The subdivision will be serviced via the existing 305mm watermain constructed as part of the site plan developments to the north, which is fed from the 406mm watermain within Mer Bleue Road and the 610mm watermain on Innes Road. Additional connection points are anticipated in the future with the extension of the 305mm watermain within Vanguard Drive. The property is located within the City's Pressure Zone 2E. Proposed ground elevations of the site vary from approximately 88.3m to 89.2m.

3.2 WATERMAIN LAYOUT

A 305mm watermain has been proposed to extend through the internal roadway network from the Orleans II Development to the north (extension of Wildflower Drive) to the future proposed location of Vanguard Road as per findings of the Gloucester and Cumberland East Urban Community Expansion Area and Bilberry Creek Industrial Park Master Servicing Update, and Pharand Lands, Innes Shopping Centres Limited reports. A 200mm watermain has been proposed adjacent to Blocks 1 and 3 in anticipation of future looping to the future Vanguard watermain extension (see **Drawing WM-1** for details).

3.3 HYDRAULIC ANALYSIS

A hydraulic model for the proposed subdivision was prepared during preparation of the Site Servicing and Stormwater Management Report – Orleans II Development Rezoning. The analysis considered several high rise apartment dwellings with a mixed use component on ground floors within blocks 1 and 3, as well as senior housing complexes within blocks 2 and 4, which produce domestic and fire flow demands that suit a wide range of permissible uses under the current zoning arrangement for the development. Additionally, the model was created under the assumption that watermains within Vanguard would not be constructed in the interim, providing and additional level of conservatism to the design. Results of the modeling indicated that the required demands could be met while maintaining the appropriate residual pressures at all areas prior to construction of the Vanguard watermain.

As such, it is assumed that the analysis is adequate in assessing the viability of the current development plan, and that a detailed hydraulic analysis with boundary condition at Vanguard be required for detailed design. Description of the original hydraulic analysis has been included below, with results tabulated within **Appendix A**.

3.3.1 Water Demands

Water demands for the development were estimated using the Ministry of Environment's Design Guidelines for Drinking Water Systems (2008). A daily rate of 5 L/m^2 of commercial space was used for the proposed site, a rate of 3.5 L/m^2 has been assumed for industrial use spaces, and a rate of 350 L/cap/day has been applied to residential populations, with an assumed apartment density of 1.8 persons/unit. It is predicted that commercial/industrial facilities will be operated 12 hours per day. See **Appendix A.1** for detailed domestic water demand estimates.

Maximum daily demand peaking factors used were 1.5 for commercial/industrial property and 2.5 for residential areas. Peak hour demand peaking factors were 1.8 for commercial/industrial property and 2.2 for residential uses.

The average day demand (AVDY) for the entire site was determined to be 14.27 L/s. The maximum daily demand (MXDY) totals 33.74 L/s. The peak hour demand (PKHR) totals 73.07 L/s.

Ordinary construction was considered for commercial buildings and non-combustible construction for industrial buildings and residential towers for assessment for fire flow requirements according to the FUS Guidelines. All buildings save one were considered to be fully equipped with automatic sprinkler systems conforming to NFPA 13. Based on calculations per the FUS Guidelines (**Appendix A.2**), the maximum required fire flows for the development were assumed to be 183 L/s.

3.3.2 Hydraulic Model Results

A hydraulic model of the water supply system was created by Stantec based on boundary conditions provided for detailed design of the Phase 1 Orleans II Site Plan to the north to assess the proposed watermain layout under the above demands and during fire flow scenarios. Headloss for boundary conditions was extrapolated based on the estimated demands for the entire site as noted in the sections above. Results of the hydraulic modeling demonstrate that adequate flows are available for the subject site, with on-site pressures ranging from **53 psi** to **60 psi** under normal operating conditions. These values are within the normal operating pressure range as defined by MOECC and City of Ottawa design guidelines (desired 50 to 70 psi and not less than 40 psi). Results of the hydraulic model analysis can be found in **Appendix A.4.**

A fire flow analysis was carried out using the hydraulic model to determine the anticipated amount of flow that could be provided for the proposed development under maximum day demands and fire flow requirements per the FUS methodology. Results of the modeling analysis indicate that flows in excess of 11,000L/min (183 l/sec) can be delivered while still maintaining a residual pressure of 140 kPa (20 psi) under interim conditions prior to looping of the proposed 300mm watermain to the Vanguard Drive extension. In the future, looping may be provided by a 300mm connection to the Vanguard Drive/Lanthier Drive watermain, and connection to the 400mm watermain along Mer Bleue Road. Results of the hydraulic modeling are included for reference in **Appendix A.4**.

4.0 WASTEWATER SERVICING

4.1 BACKGROUND

The subdivision will be serviced by an existing 375mm diameter sanitary sewer located at the southeast corner of the lands in an existing easement within the future Vanguard Drive extension. The sewer directs flow to an existing 525mm diameter sanitary sewer at the intersection of Lanthier Drive and Vanguard Drive, and ultimately to the Tenth Line Road pumping station. A 250mm sewer was previously installed through blocks 2 and 4 of the proposed subdivision to service earlier phases of the Orleans II site plan development (see **Drawing SA-1**). It is proposed to make an new connection to the 375mm sewer and extend the sanitary sewer along the proposed municipal roadways within the subdivision to the existing sanitary manhole (Ex. SAN 14) immediately north of the subdivision lands. The new sewer will provide a sanitary outlet for all of the proposed subdivision blocks. Once the new sanitary sewer has been commissioned, the existing 250mm sewer running through blocks 2 and 4 will be abandoned. The subdivision lands and proposed land uses form part of the previously approved drainage area to the existing Tenth Line Road Pump Station.

For detailed information regarding the wastewater servicing and pump station improvements for the area, please refer to the *Gloucester and Cumberland East Urban Community Expansion Area and Bilberry Creek Industrial Park Master Servicing Update* (Stantec, July 2006).

4.2 DESIGN CRITERIA

It is assumed that areas zoned Arterial Mainstreet may comprise of low-mid rise apartment dwellings that will provide the bulk of domestic sanitary sewer contribution for the development. As such, development blocks within this zoning blanket have been considered to contain 200 typical apartment units per hectare of land as a conservative value (based on an intermediate value between low density and medium density apartments within Table 4.1 of the 2004 version of the Sewer Design Guidelines).

Future tributary areas to the 375mm sanitary main forming the remainder of the Bilberry Creek Industrial Park (BCIP) have been assessed as entirely light industrial area with the exception of lands attributed to the future Vanguard Drive extension ROW.

As outlined in the recently updated City of Ottawa Sewer Design Guidelines and the MOECC's Design Guidelines for Sewage Works, the following criteria were used to calculate estimated wastewater flow rates and to size the sanitary sewers:

- Minimum Velocity – 0.6 m/s (0.8 m/s for upstream sections)

- Maximum Velocity – 3.0 m/s
- Manning roughness coefficient for all smooth wall pipes – 0.013
- Minimum size – 200mm dia. for residential areas, 250mm for commercial areas
- Average Wastewater Generation – 28,000L/ha/day (Commercial)
- Average Wastewater Generation – 35,000L/ha/day (Light Industrial)
- Average Wastewater Generation – 280 L/pers/day (Residential)
- Peak Factor – 1.5 (Commercial >20% of development)
- Peak Factor – per Harmon's equation and correction factor of 0.8 (Residential)
- Peak Factor – per Sewer Design Guidelines Appendix 4-B (Industrial)
- Average Apartment Unit Density – 1.8ppu
- Extraneous Flow Allowance – 0.33 l/s/ha
- Manhole Spacing – 120 m
- Minimum Cover – 2.5m

4.3 PROPOSED SERVICING

The proposed site will be serviced by gravity sewers which will direct the wastewater flows (approx. 66.9 L/s with allowance for infiltration) to the existing 375mm diameter sanitary sewer at the northeast corner of the subdivision. The proposed drainage pattern is detailed on **Drawing SA-1**. A sanitary sewer design sheet for the proposed and existing downstream sewers is included in **Appendix B.1**. External downstream sewers and flow contributions have been input based on the Overall Sanitary Drainage Area Plan for the Tenth Line Road Pump Station as prepared by David Schaeffer Engineering Ltd. to incorporate additional urban expansion area to the pump station. Full port backwater valves are to be installed on all sanitary services within the site to prevent any potential surcharge from the downstream sanitary sewer from impacting developments within the proposed property.

5.0 STORMWATER MANAGEMENT

5.1 OBJECTIVES

The objective of this stormwater management plan is to determine the measures necessary to control the quantity/quality of stormwater released from the proposed development to criteria established by the *Pharand Lands – Innes Shopping Centres Limited – Serviceability Study* (Stantec, February 2012) and the *Gloucester and Cumberland East Urban Community Expansion Area and Bilberry Creek Industrial Park Master Servicing Update* for the region, and to provide sufficient detail for draft plan approval of the subject site.

5.2 SWM CRITERIA AND CONSTRAINTS

Criteria were established by combining current design practices outlined by the City of Ottawa Design Guidelines (2012), those presented in the Pharand Lands Serviceability Study and other background reports listed in **Section 2.0**, and through consultation with City of Ottawa staff. The following summarizes the criteria, with the source of each criterion indicated in brackets:

General

- Use of the dual drainage principle (City of Ottawa).
- Wherever feasible and practical, site-level measures should be used to reduce and control the volume and rate of runoff. (City of Ottawa).
- Assess impact of 100 year event outlined in the City of Ottawa Sewer Design Guidelines on major & minor drainage system (City of Ottawa).
- Enhanced quality control (80% TSS removal) to be provided on-site for the development.

Storm Sewer & Inlet Controls

- Proposed development to discharge the existing 1350mm diameter storm sewer stub at the northern boundary of the subject site (City of Ottawa).
- Proposed storm sewers to be sized to service existing and future commercial/light industrial developments to the south and east of the subject site as per background reports (Pharand Lands Serviceability Study).
- Minor system inflow to be restricted for all privately owned contributing areas to 50L/s/ha (Pharand Lands Serviceability Study).
- Minor system inflow for municipal ROW contributing areas to be limited to 100L/s/ha (Pharand Lands Serviceability Study).
- 100-year HGL boundary condition at the site outlet sewer of 81.342m (BCIP Report, Appendix I for node W19).

- 100-year Storm HGL to be a minimum of 0.30 m below building foundation footing (City of Ottawa).

Surface Storage & Overland Flow

- Building openings to be a minimum of 0.30m above the 100-year water level (City of Ottawa).
- No overland flow is to be permitted from internal sites to the municipal ROW (Pharand Lands Serviceability Study).
- Sites to provide minimum storage of 200 m^3/ha or sufficient storage to contain 100-year storm event on-site, whichever is greater (Pharand Lands Serviceability Study).
- Road storage to be maximized where possible to provide 130 m^3/ha of storage (Pharand Lands Serviceability Study).
- Maximum depth of flow under either static or dynamic conditions shall be less than 0.35m (City of Ottawa)
- Provide adequate emergency overflow conveyance off-site (City of Ottawa)

5.3 STORMWATER MANAGEMENT

5.3.1 Allowable Release Rate

Based on background information, the peak post-development discharge from the subject site to the minor system is to be limited to 50L/s/ha of contributing area. Peak post-development discharge from municipal Rights-of-Way within the development are to be limited to 100L/s/ha. Peak release rates for the current phase, existing tributary areas and future developments are summarized in **Table 1** below:

Table 1: Target Release Rates

Development Site	Area (ha)	Target Flow Rate (L/s)
Proposed Development - Private	9.570	478.5
Proposed Development - Public	1.757	175.7
Future – Private	14.611	730.6
Future – Public	1.724	172.4
Total	**27.632**	**1557.2**

The total target flow rate lies slightly above that determined for the previous Pharand Lands study, and is likely due to the assessment of additional length of public roads both on-site and within the external tributary BCIP area. The downstream 1350mm sewer on Wildflower Drive has capacity to accept the increase in flows based on drainage area plans and design sheets created by Delcan for construction of the storm sewer and widening of Innes Road (capacity of 2784.1L/s including downstream existing phases of development, see **Appendix C.2**). It is of note that the tributary area to the Wildflower Drive outlet has not changed, and peak post-development discharge targets of 100L/s/ha and 50L/s/ha for public ROWs and private developments has been carried from targets listed in the BCIP Master Servicing Update.

5.3.2 Water Quantity Control

The development will require restrictive quantity control measures to meet stormwater release criteria. Per hectare storage rates have been estimated via the Modified Rational Method. Peak flow rates have been calculated as follows:

$Q = 2.78\ CiA$
Where: Q = peak flow rate, L/s
A = drainage area, ha
I = rainfall intensity, mm/hr (per Ottawa IDF curves)
C = site runoff coefficient

Based on a conservative time of concentration of 10 minutes for a given development parcel, and an estimated runoff coefficient C of 0.80 for private sites (increased by 25% to a maximum of 1.00 for post-development 100-year storm events based on MTO Drainage Manual recommendations), it is anticipated that private developments will require approximately 385m^3/ha of storage to meet the required release rate. It is likely that individual sites within the development will be required to provide dry ponds, subsurface tanks or cisterns in addition to rooftop and surface storage within paved areas to meet restrictive stormwater criteria. Infiltration measures are not anticipated to be effective given a thick layer of clay (or bedrock outcrop) underlying the proposed development area.

Municipal roads releasing at 100L/s/ha will be required to provide approximately 230 m^3/ha of surface storage in order to meet the required release rate. This storage requirement is feasible given the relatively flat grading of the proposed development, and the ability to store water up to a maximum depth of 0.35m per recent revisions to the City stormwater management guidelines (see calculation sheet as part of **Appendix C**). Ponding is anticipated during 5-year storm events and above in order to meet the 100L/s/ha restriction.

It is assumed that no major system spillage will occur from private sites to municipal rights-of-way within the development, and no major system spillage is to occur to Innes Road or downstream segments of Vanguard Drive during design storm events up to the 100-year event. Further dual-drainage modeling will be required at time of detailed design to confirm HGLs in the receiving sewer and to ensure the 0.35m maximum water depth is being achieved.

Drawing SD-1 summarizes the discretized subcatchments used in the analysis of the proposed site, and outlines the major overland flow paths. Conceptual grading plans are also enclosed for review.

Storm sewers were designed using Rational Method calculations to confirm flow capacities in the ultimate condition with consideration of flow contributions from future areas. The detailed storm sewer design sheet is included in **Appendix C1**.

5.4 WATER QUALITY CONTROL

On-site quality control measures are expected for the proposed development sites per section 3.1.2.5.2 of the Gloucester Cumberland EUC & BCIP Servicing Update. It is assumed that enhanced protection (80% removal of suspended solids for the downstream Bilberry Creek) will be required for all development parcels similar to existing areas of the BCIP. The downstream SWMF additionally provides quality control to normal protection criteria (70% TSS removal).

6.0 GRADING AND DRAINAGE

The proposed development site measures approximately 11.3 ha in area. The topography across the site is relatively flat, and currently drains from west to east. A conceptual grading plan (see **Drawing GP-1**) has been provided to satisfy the stormwater management requirements, adhere to permissible grade raise restrictions (see **Section 9.0**) for the site, and provide for minimum cover requirements for storm and sanitary sewers where possible. Site grading has been established to provide emergency overland flow routes required for stormwater management in accordance with City of Ottawa requirements.

The subject site maintains emergency overland flow routes for flows deriving from storm events in excess of the maximum design event to the proposed municipal rights-of-way at the southern and eastern boundaries of the phase 1 development, and ultimately to the future Vanguard Drive extension as depicted in **Drawing GP-1.** Future development areas to the south within the BCIP are anticipated to maintain overland flow routes to the future Vanguard Road extension.

7.0 UTILITIES

As the subject site is bound to the north and west by an existing commercial business park, and by an existing right-of-way to the north, Hydro, Bell, Gas and Cable servicing for the proposed development should be readily available. It is anticipated that existing infrastructure will be sufficient to provide a means of distribution for the proposed site. Exact size, location and routing of utilities, along with determination of transformer locations and any off-site works required for development, will be finalized upon detailed design of the individual site plans within the development.

8.0 EROSION CONTROL DURING CONSTRUCTION

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.

9.0 GEOTECHNICAL INVESTIGATION AND ENVIRONMENTAL ASSESSMENT

A geotechnical Investigation Report was prepared by Patersongroup on April 24, 2006. The report summarizes the existing soil conditions within the subject area and construction recommendations. For details which are not summarized below, please see the original Paterson report.

Subsurface soil conditions within the subject area were determined from 8 boreholes and 34 test pits distributed across the proposed site. In general soil stratigraphy consisted of topsoil underlain silty clay and/or glacial till. Bedrock/inferred bedrock elevations range from depths of 0.3 to 13.9m below ground surface.

Groundwater Levels were measured and vary in elevation from ground surface to a depth of 3m.

The required pavement structure for proposed hard surfaced areas are outlined in **Tables 1 and 2** below:

Table 2: Pavement Structure – Car only Parking Areas

Thickness (mm)	Material Description
50	Wear Course – HL 3 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 bedrock.

Table 3: Pavement Structure – Access Lanes and Heavy Truck Parking Areas

Thickness (mm)	Material Description
40	Wear Course – HL-3 Asphaltic Concrete
50	Binder Course – HL-8 Asphaltic Concrete
150	Base – OPSS Granular A Crushed Stone
450	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 bedrock.

10.0 CONCLUSIONS

10.1 WATER SERVICING

Based on previously assessed watermain hydraulic model prepared for rezoning of the subject lands utilizing the supplied boundary conditions for existing watermains and estimated domestic and fire flow demands for the subject site, it is anticipated that the proposed servicing in this development will provide sufficient capacity to sustain the required domestic demands and emergency fire flow demands for the area. Fire flows greater than those required per the FUS Guidelines are available for this development.

10.2 SANITARY SERVICING

The proposed sanitary sewer network is sufficiently sized to provide gravity drainage of the site. The proposed site will be serviced by a network of gravity sewers which will direct wastewater flows to the existing 375mm dia. sanitary sewer situated within the future Vanguard Drive extension to Lanthier Drive. The proposed drainage outlet to the east has sufficient capacity to receive sanitary discharge from the site based on the findings of the Gloucester and Cumberland EUC Master Servicing Update, and through assessment of the tributary area to the downstream Tenth Line Pumping Station.

10.3 STORMWATER SERVICING

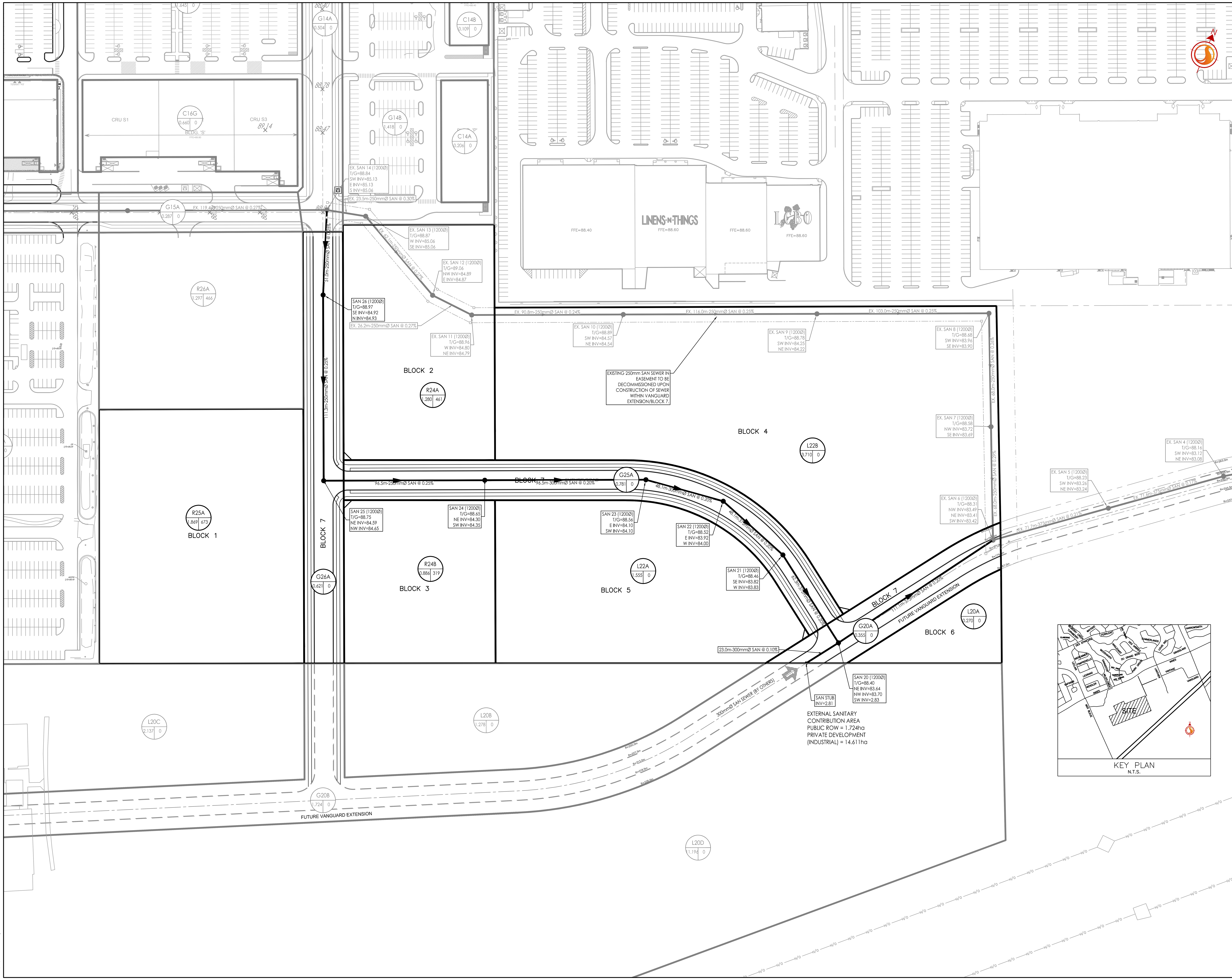
The proposed stormwater management plan is in compliance with the goals specified through consultation with the City of Ottawa. On-site catchbasins and connected ICDs will be proposed to limit peak storm sewer inflows to downstream storm sewers to 50L/s/ha for privately owned areas and 100L/s/ha for municipal ROWs as determined by background reports. The downstream receiving sewer has sufficient capacity to receive runoff volumes from the site based on the findings of the Gloucester and Cumberland EUC Master Servicing Update, and as detailed during design for Innes Road widening.

10.4 GRADING

Grading for the site has been designed to provide an emergency overland flow route as per City requirements and reflects the recommendations made in the Geotechnical Investigation Report prepared by Patersongroup and the Gloucester and Cumberland EUC Master Servicing Update. Erosion and sediment control measures will be implemented during construction to reduce the impact on existing facilities.

10.5 UTILITIES

Utility infrastructure exists within neighbouring developments and roadways. It is anticipated that existing infrastructure will be sufficient to provide a means of distribution for the proposed site. Exact size, location and routing of utilities will be finalized after detailed design of the individual sites within the development.



Stantec

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Legend

PROPOSED TRUNK SANITARY SEWER
EXISTING TRUNK SANITARY SEWER
SANITARY DRAINAGE BOUNDARY
EXISTING SANITARY DRAINAGE BOUNDARY

G17A / 0.50 / 50

SANITARY DRAINAGE AREA ID
G = GREEN SPACE OR INFILTRATION
C = COMMERCIAL AREA
L = LIGHT INDUSTRIAL AREA
R = RESIDENTIAL AREA

POPULATION

SANITARY DRAINAGE AREA (ha)

Notes

1	ISSUED FOR DRAFT PLAN OF SUBDIVISION	DT	KS	18.04.11
Revision		By	Appd.	YY.MM.DD

File Name: 160401242-D8	DT	KS	DT	18.04.09
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Permit-Seal

Client/Project

INNES SHOPPING CENTRES LIMITED

ORLEANS II
DRAFT PLAN OF SUBDIVISION
Ottawa, ON

Title

OVERALL SANITARY SEWER LAYOUT

Project No. 160401419

Scale 1:1000 (0 10 30 50m)

Drawing No. SA-1

Sheet 1 of 4

Revision 1

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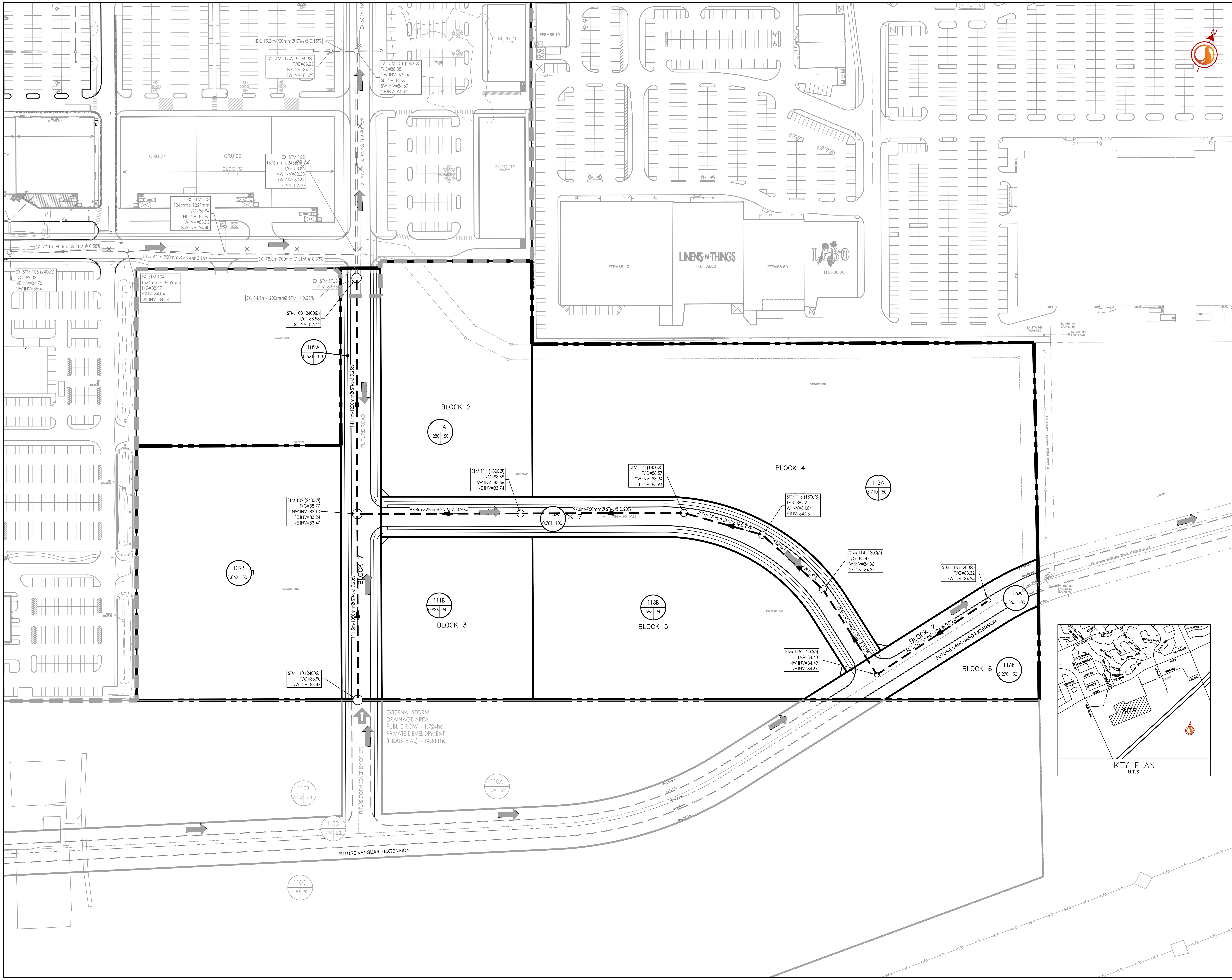

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Legend

- TRUNK STORM SEWER
- EXISTING TRUNK STORM SEWER
- FUTURE TRUNK STORM SEWER
- MAJOR OVERLAND FLOW ROUTE
- 305A / 1.00 / 100: DRAINAGE AREA No.; CONTROLLED RELEASE RATE (L/s); STORM DRAINAGE AREA (ha)
- STORM DRAINAGE BOUNDARY
- FUTURE STORM DRAINAGE BOUNDARY
- MAJOR SYSTEM DIVIDE

Notes

1	ISSUED FOR DRAFT PLAN OF SUBDIVISION	DT	KS	18.04.11
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Permit-Seal

Client/Project

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DRAFT PLAN OF SUBDIVISION
Ottawa, ON

Title

OVERALL STORM SEWER LAYOUT

Project No. 160401419

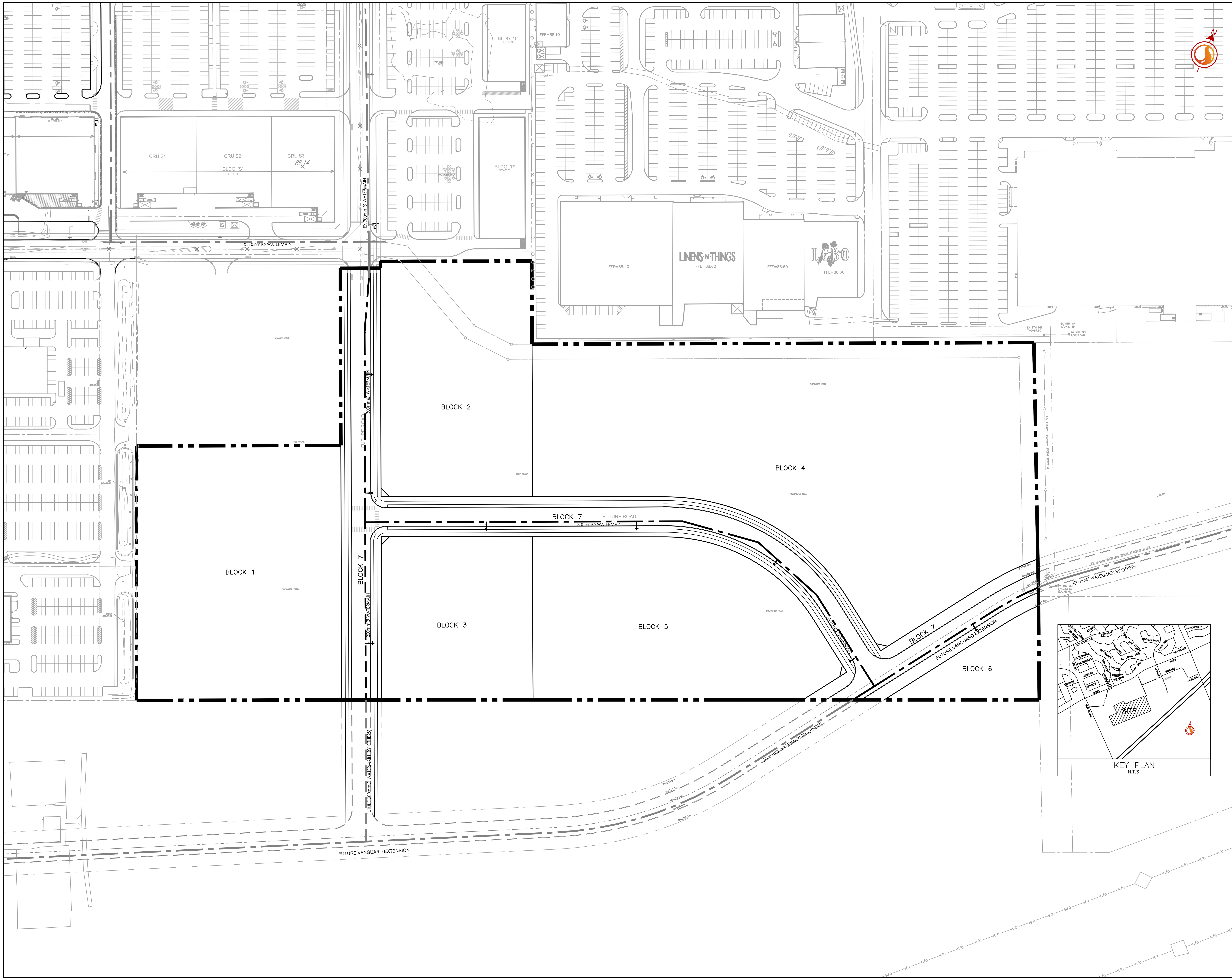
Scale 1:1000 (0 10 30 50m)

Drawing No. SD-1

Sheet 2 of 4

Revision 1

ORIGINAL SHEET - ARCH D



ORIGINAL SHEET - ARCH D

Stantec

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

Legend

406mmØ WATERMAIN
305mmØ WATERMAIN
203mmØ WATERMAIN

EX. 406mmØ WATERMAIN
EX. 305mmØ WATERMAIN
EX. 203mmØ WATERMAIN

FUT. 406mmØ WATERMAIN
FUT. 305mmØ WATERMAIN
FUT. 203mmØ WATERMAIN

Notes

1	ISSUED FOR DRAFT PLAN OF SUBDIVISION	DT	KS	18.04.11
Revision		By	Appd.	YY.MM.DD

File Name: 160401242-DB	DT	KS	DT	18.04.09
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

Client/Project

INNES SHOPPING CENTRES LIMITED

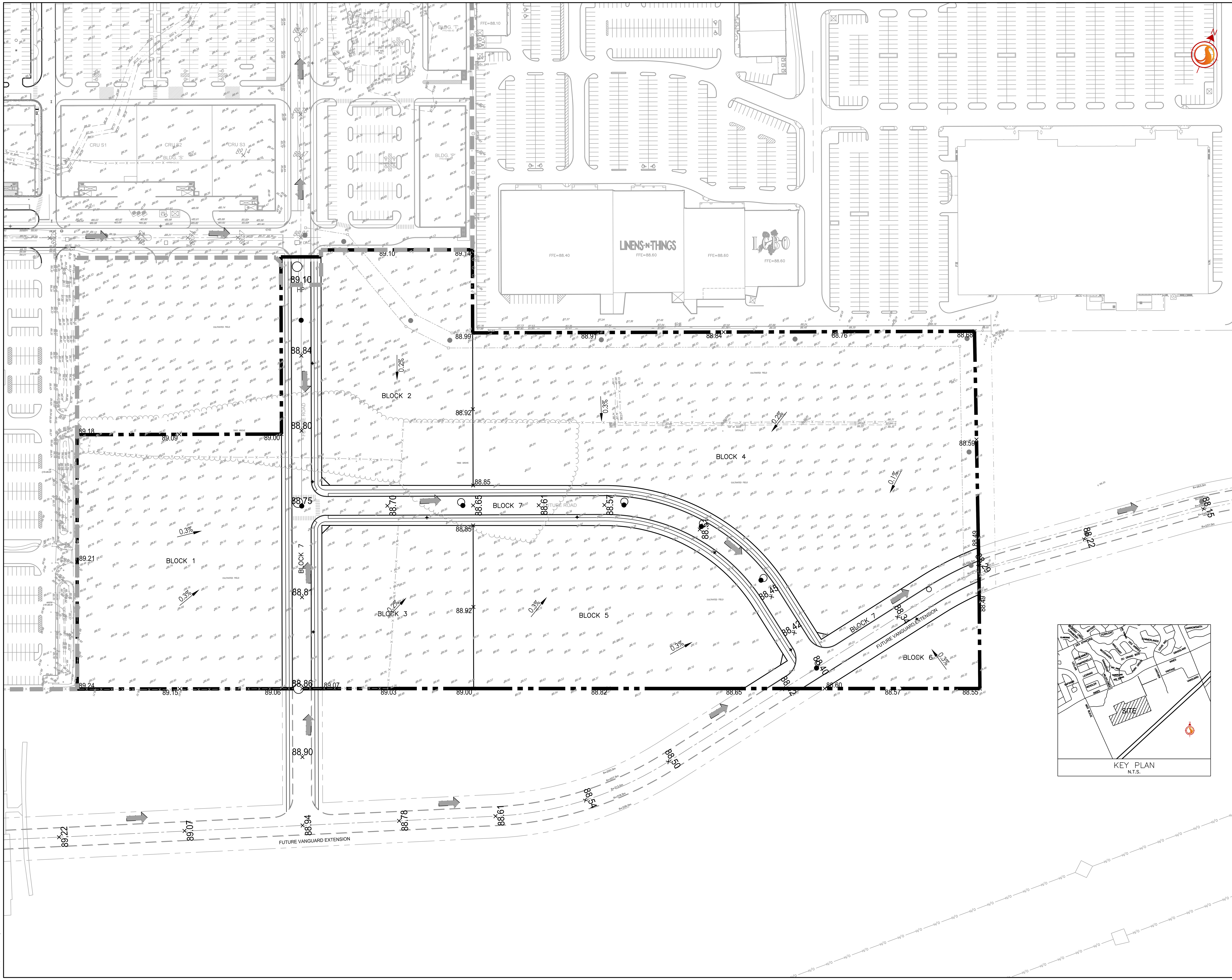
ORLEANS II
DRAFT PLAN OF SUBDIVISION
Ottawa, ON

Title

OVERALL WATERMAIN LAYOUT

Project No.	Scale
160401419	1:1000 (0 10 30 50m)

Drawing No.	Sheet	Revision
WM-1	3 of 4	1



KEY PLAN
N.T.S.

Stantec

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Legend

× 87.65	EXISTING ELEVATION
89.40 ×	PROPOSED ELEVATION
89.14 ×	EXISTING DESIGN ELEVATION
(arrow)	MAJOR OVERLAND FLOW ROUTE
(dashed line)	MAJOR SYSTEM DIVIDE

Notes

1	ISSUED FOR DRAFT PLAN OF SUBDIVISION	DT	KS	18.04.11
Revision		By	Appd.	YY.MM.DD

File Name: 160401242-DB	DT	KS	DT	18.04.09
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

Client/Project
INNES SHOPPING CENTRES LIMITED

ORLEANS II
DRAFT PLAN OF SUBDIVISION
Ottawa, ON

Title

OVERALL GRADING PLAN

Project No. 160401419
Scale 1:1000 (0 10 30 50m)
Drawing No. GP-1
Sheet 4 of 4
Revision 1

ORIGINAL SHEET - ARCH D

Appendix A WATER SUPPLY SERVICING

A.1 DOMESTIC WATER DEMAND ESTIMATE

2025 Mer Bleue Road - Domestic Water Demand Estimates
- Based on Alcaide Webster Architects Site Plan 11/2016 (160401242)

Building ID	Area (m^2)	Population	Daily Rate of Demand [1] ($L/m^2/day$)	Avg Day Demand [2,3]		Max Day Demand [2,3]		Peak Hour Demand [2,3]	
				(L/min)	(L/s)	(L/min)	(L/s)	(L/min)	(L/s)
BLDG J	743	0	5	2.6	0.04	3.9	0.06	7.0	0.12
BLDG K	604	0	5	2.1	0.03	3.1	0.05	5.7	0.09
BLDG N	484	0	5	1.7	0.03	2.5	0.04	4.5	0.08
BLDG H	6521	0	5	22.6	0.38	34.0	0.57	61.1	1.02
BLDG S	7262	0	5	25.2	0.42	37.8	0.63	68.1	1.13
BLDG M	836	0	5	2.9	0.05	4.4	0.07	7.8	0.13
BLDG L	929	0	5	3.2	0.05	4.8	0.08	8.7	0.15
BLDG Q	465	0	5	1.6	0.03	2.4	0.04	4.4	0.07
BLDG R	465	0	5	1.6	0.03	2.4	0.04	4.4	0.07
BLDG T	1040	0	5	3.6	0.06	5.4	0.09	9.8	0.16
BLDG L	1997	0	5	6.9	0.12	10.4	0.17	18.7	0.31
LOT 1 T1C	1210	0	5	4.2	0.07	6.3	0.11	11.3	0.19
LOT 1 T1R	-	720	350	175.0	2.92	437.5	7.29	962.5	16.04
LOT 1 T2C	1210	0	5	4.2	0.07	6.3	0.11	11.3	0.19
LOT 1 T2R	-	720	350	175.0	2.92	437.5	7.29	962.5	16.04
LOT 2	-	630	350	153.1	2.55	382.8	6.38	842.2	14.04
LOT 3	5480	0	3.5	13.3	0.22	20.0	0.33	36.0	0.60
LOT 4	-	256	350	62.2	1.04	155.6	2.59	342.2	5.70
LOT 5	-	720	350	175.0	2.92	437.5	7.29	962.5	16.04
LOT 6	5443	0	3.5	13.2	0.22	19.8	0.33	35.7	0.60
LAND SALE	2705	0	3.5	6.6	0.11	9.9	0.16	17.8	0.30
Total Site :				**856.0**	**14.27**	**2024.3**	**33.74**	**4384.1**	**73.07**

1 For the purpose of this study it is predicted that commercial facilities will be operated 12 hours per day.

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

3 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
maximum hour demand rate = 2.2 x maximum day demand rate

A.2 FIRE FLOW REQUIREMENTS PER FUS

FUS Fire Flow Calculations Summary

Stantec Project #: 160401242
Project Name: 2025 Mer Bleue Road
Date: 04/01/17

Data input by: Dustin Thiffault

Building Reference	Building Name	Floor Space m2	FF (L/min)	FF (L/s)	Duration (hrs)	Volume (m3)
1	BLDG J	743	5,000	83	1.75	525
2	BLDG K	604	4,000	67	1.50	360
3	BLDG N	484	6,000	100	2.00	720
4	BLDG H	6,521	11,000	183	2.25	1,485
5	BLDG S	5,132	10,000	167	2.00	1,200
6	BLDG M	836	5,000	83	1.75	525
7	BLDG L	929	5,000	83	1.75	525
8	BLDG Q	465	4,000	67	1.50	360
9	BLDG R	465	5,000	83	1.75	525
10	BLDG T	1,041	7,000	117	2.25	945
11	BLDG P	1,997	7,000	117	2.25	945
12	Lot 1 South Tower	2,945	6,000	100	2.00	720
13	Lot 1 North Tower	2,945	9,000	150	1.75	945
14	Lot 2	4,041	7,000	117	2.25	945
15	Lot 3	5,480	10,000	167	2.00	1,200
16	Lot 4	4,365	8,000	133	2.00	960
17	Lot 5	2,945	9,000	150	1.75	945
18	Lot 6	5,443	10,000	167	2.00	1,200

FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 160401148
Project Name: 2025 Mer Bleue Road
Date: January 4, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 1
Building Type/Description/Name: BLDG J

Notes:
Building Classification A Div. 2

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Ordinary construction	1	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	# of Storeys	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	Enter Ground Floor Area of One Unit	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			743 Square Metres (m2)	743	Area in Square Meters (m^2)	
4	Obtain Required Fire Flow without Reductions	Required Fire Flow (without reductions or increases per FUS) ($F = 220 * C * \sqrt{A}$) Round to nearest 1000L/min						6,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Combustible	0	N/A	6,000
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	-1,800
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	-600
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	0
			Sprinkler not fully supervised or N/A	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	45.1m or greater	0	0.15	m	900
			East Side	10.1 to 20.0m	0.15			
			South Side	45.1m or greater	0			
			West Side	45.1m or greater	0			
6	Obtain Required Fire Flow, Duration & Volume	***Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:***						**5,000**
		Total Required Fire Flow (above) in L/s:						**83**
		Required Duration of Fire Flow (hrs)						**1.75**
		Required Volume of Fire Flow (m^3)						**525**

FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 160401148
Project Name: 2025 Mer Bleue Road
Date: January 4, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 2
Building Type/Description/Name: BLDG K

Notes:
Building Classification A Div. 2

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Ordinary construction	1	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	# of Storeys	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	Enter Ground Floor Area of One Unit	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			604 Square Metres (m2)	604	Area in Square Meters (m^2)	
4	Obtain Required Fire Flow without Reductions	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						5,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Combustible	0	N/A	5,000
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	-1,500
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	-500
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	0
			Sprinkler not fully supervised or N/A	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	45.1m or greater	0	0.2	m	1,000
			East Side	30.1 to 45.0m	0.05			
			South Side	45.1m or greater	0			
			West Side	10.1 to 20.0m	0.15			
6	Obtain Required Fire Flow, Duration & Volume	*Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:*						**4,000**
		Total Required Fire Flow (above) in L/s:						**67**
		Required Duration of Fire Flow (hrs)						**1.50**
		Required Volume of Fire Flow (m^3)						**360**

Stantec

FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 160401148
Project Name: 2025 Mer Bleue Road
Date: January 4, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 3
Building Type/Description/Name: BLDG N

Notes:
Building Classification E

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Ordinary construction	1	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	# of Storeys	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	Enter Ground Floor Area of One Unit	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			484 Square Metres (m2)	484	Area in Square Meters (m^2)	
4	Obtain Required Fire Flow without Reductions	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						5,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Combustible	0	N/A	5,000
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	None	0	N/A	0
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is not standard or N/A	0	N/A	0
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	0
			Sprinkler not fully supervised or N/A	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	45.1m or greater	0	0.15	m	750
			East Side	20.1 to 30.1m	0.1			
			South Side	45.1m or greater	0			
			West Side	30.1 to 45.0m	0.05			
6	Obtain Required Fire Flow, Duration & Volume	***Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:***						**6,000**
		Total Required Fire Flow (above) in L/s:						**100**
		Required Duration of Fire Flow (hrs)						**2.00**
		Required Volume of Fire Flow (m^3)						**720**

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FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 160401148
Project Name: 2025 Mer Bleue Road
Date: January 4, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 4
Building Type/Description/Name: BLDG H

Notes:
Building Classification E

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Non-combustible construction	0.8	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	# of Storeys	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	Enter Ground Floor Area of One Unit	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			6,521 Square Metres (m2)	6,521	Area in Square Meters (m^2)	
4	Obtain Required Fire Flow without Reductions	Required Fire Flow (without reductions or increases per FUS) ($F = 220 * C * \sqrt{A}$) Round to nearest 1000L/min						14,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Combustible	0	N/A	14,000
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	-4,200
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	-1,400
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	0
			Sprinkler not fully supervised or N/A	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	45.1m or greater	0	0.15	m	2,100
			East Side	10.1 to 20.0m	0.15			
			South Side	45.1m or greater	0			
			West Side	45.1m or greater	0			
6	Obtain Required Fire Flow, Duration & Volume	***Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:***						**11,000**
		Total Required Fire Flow (above) in L/s:						**183**
		Required Duration of Fire Flow (hrs)						**2.25**
		Required Volume of Fire Flow (m^3)						**1,485**

FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 160401148
Project Name: 2025 Mer Bleue Road
Date: January 4, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 5
Building Type/Description/Name: BLDG S

Notes:
Building Classification E, 2hr Fire Separation considered between Units S1, S2. Unit S2 considered as worst case.

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	**Choose Frame Used for Construction of Unit**	Coefficient related to type of construction (C)	Wood Frame	1.5	Non-combustible construction	0.8	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	**Choose Type of Housing (if TH, Enter Number of Units Per TH Block)**	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	**# of Storeys**	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	**Enter Ground Floor Area of One Unit**	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			5,132 Square Metres (m2)	5,132	Area in Square Meters (m^2)	
4	**Obtain Required Fire Flow without Reductions**	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						**13,000**
5	**Apply Factors Affecting Burning**	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	**Choose Combustibility of Building Contents**	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Combustible	0	N/A	**13,000**
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	**Choose Reduction Due to Presence of Sprinklers**	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	**-3,900**
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	**-1,300**
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	**0**
			Sprinkler not fully supervised or N/A	0				
5.3	**Choose Separation Distance Between Units**	Exposure Distance Between Units	North Side	45.1m or greater	0	0.15	m	**1,950**
			East Side	45.1m or greater	0			
			South Side	30.1 to 45.0m	0.05			
			West Side	Fire Wall	0.1			
6	**Obtain Required Fire Flow, Duration & Volume**	***Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:***						**10,000**
		Total Required Fire Flow (above) in L/s:						**167**
		Required Duration of Fire Flow (hrs)						**2.00**
		Required Volume of Fire Flow (m^3)						**1,200**

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FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 160401148
Project Name: 2025 Mer Bleue Road
Date: January 4, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 6
Building Type/Description/Name: BLDG M

Notes:
Building Classification A Div. 2

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Ordinary construction	1	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	# of Storeys	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	Enter Ground Floor Area of One Unit	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			836 Square Metres (m2)	836	Area in Square Meters (m^2)	
4	Obtain Required Fire Flow without Reductions	Required Fire Flow (without reductions or increases per FUS) ($F = 220 * C * \sqrt{A}$) Round to nearest 1000L/min						6,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Combustible	0	N/A	6,000
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	-1,800
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	-600
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	0
			Sprinkler not fully supervised or N/A	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	45.1m or greater	0	0.15	m	900
			East Side	30.1 to 45.0m	0.05			
			South Side	45.1m or greater	0			
			West Side	20.1 to 30.1m	0.1			
6	Obtain Required Fire Flow, Duration & Volume	*Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:*						**5,000**
		Total Required Fire Flow (above) in L/s:						**83**
		Required Duration of Fire Flow (hrs)						**1.75**
		Required Volume of Fire Flow (m^3)						**525**

FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 160401148
Project Name: 2025 Mer Bleue Road
Date: January 4, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 7
Building Type/Description/Name: BLDG L

Notes:
Building Classification A Div. 2

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Ordinary construction	1	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	# of Storeys	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	Enter Ground Floor Area of One Unit	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			929 Square Metres (m2)	929	Area in Square Meters (m^2)	
4	Obtain Required Fire Flow without Reductions	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						7,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Combustible	0	N/A	7,000
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	-2,100
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	-700
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	0
			Sprinkler not fully supervised or N/A	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	45.1m or greater	0	0.1	m	700
			East Side	30.1 to 45.0m	0.05			
			South Side	45.1m or greater	0			
			West Side	30.1 to 45.0m	0.05			
6	Obtain Required Fire Flow, Duration & Volume	***Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:***						**5,000**
		Total Required Fire Flow (above) in L/s:						**83**
		Required Duration of Fire Flow (hrs)						**1.75**
		Required Volume of Fire Flow (m^3)						**525**

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FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 160401148
Project Name: 2025 Mer Bleue Road
Date: January 4, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 8
Building Type/Description/Name: BLDG Q

Notes:
Building Classification A Div. 2

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Ordinary construction	1	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	# of Storeys	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	Enter Ground Floor Area of One Unit	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			465 Square Metres (m2)	465	Area in Square Meters (m^2)	
4	Obtain Required Fire Flow without Reductions	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						5,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Combustible	0	N/A	5,000
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	-1,500
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	-500
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	0
			Sprinkler not fully supervised or N/A	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	45.1m or greater	0	0.1	m	500
			East Side	30.1 to 45.0m	0.05			
			South Side	45.1m or greater	0			
			West Side	30.1 to 45.0m	0.05			
6	Obtain Required Fire Flow, Duration & Volume	***Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:***						**4,000**
		Total Required Fire Flow (above) in L/s:						**67**
		Required Duration of Fire Flow (hrs)						**1.50**
		Required Volume of Fire Flow (m^3)						**360**

FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 160401148
Project Name: 2025 Mer Bleue Road
Date: January 4, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 9
Building Type/Description/Name: BLDG R

Notes:
Building Classification A Div. 2

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Ordinary construction	1	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	# of Storeys	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	Enter Ground Floor Area of One Unit	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			465 Square Metres (m2)	465	Area in Square Meters (m^2)	
4	Obtain Required Fire Flow without Reductions	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						5,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Combustible	0	N/A	5,000
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	-1,500
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	-500
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	0
			Sprinkler not fully supervised or N/A	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	45.1m or greater	0	0.35	m	1,750
			East Side	3.1 to 10.0m	0.2			
			South Side	20.1 to 30.1m	0.1			
			West Side	30.1 to 45.0m	0.05			
6	Obtain Required Fire Flow, Duration & Volume	*Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:*						**5,000**
		Total Required Fire Flow (above) in L/s:						**83**
		Required Duration of Fire Flow (hrs)						**1.75**
		Required Volume of Fire Flow (m^3)						**525**

FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 160401148
Project Name: 2025 Mer Bleue Road
Date: January 4, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 10
Building Type/Description/Name: BLDG T

Notes:
Building Classification A Div. 2

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	**Choose Frame Used for Construction of Unit**	Coefficient related to type of construction (C)	Wood Frame	1.5	Ordinary construction	1	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	**Choose Type of Housing (if TH, Enter Number of Units Per TH Block)**	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	**# of Storeys**	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	**Enter Ground Floor Area of One Unit**	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			1,041 Square Metres (m2)	1,041	Area in Square Meters (m^2)	
4	**Obtain Required Fire Flow without Reductions**	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						**7,000**
5	**Apply Factors Affecting Burning**	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	**Choose Combustibility of Building Contents**	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Combustible	0	N/A	**7,000**
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	**Choose Reduction Due to Presence of Sprinklers**	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	**-2,100**
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	**-700**
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	**0**
			Sprinkler not fully supervised or N/A	0				
5.3	**Choose Separation Distance Between Units**	Exposure Distance Between Units	North Side	20.1 to 30.1m	0.1	0.45	m	**3,150**
			East Side	3.1 to 10.0m	0.2			
			South Side	10.1 to 20.0m	0.15			
			West Side	45.1m or greater	0			
6	**Obtain Required Fire Flow, Duration & Volume**	***Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:***						**7,000**
		Total Required Fire Flow (above) in L/s:						**117**
		Required Duration of Fire Flow (hrs)						**2.25**
		Required Volume of Fire Flow (m^3)						**945**

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FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 160401148
Project Name: 2025 Mer Bleue Road
Date: January 4, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 11
Building Type/Description/Name: BLDG P

Notes:
Building Classification E

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Non-combustible construction	0.8	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	# of Storeys	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	Enter Ground Floor Area of One Unit	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			1,997 Square Metres (m2)	1,997	Area in Square Meters (m^2)	
4	Obtain Required Fire Flow without Reductions	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						8,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Combustible	0	N/A	8,000
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	-2,400
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	-800
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	0
			Sprinkler not fully supervised or N/A	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	10.1 to 20.0m	0.15	0.25	m	2,000
			East Side	20.1 to 30.1m	0.1			
			South Side	45.1m or greater	0			
			West Side	45.1m or greater	0			
6	Obtain Required Fire Flow, Duration & Volume	*Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:*						**7,000**
		Total Required Fire Flow (above) in L/s:						**117**
		Required Duration of Fire Flow (hrs)						**2.25**
		Required Volume of Fire Flow (m^3)						**945**

FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 160401148
Project Name: 2025 Mer Bleue Road
Date: January 4, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 12
Building Type/Description/Name: Lot 1 South Tower

Notes:
Building Classification C per 3.2.2.42

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	**Choose Frame Used for Construction of Unit**	Coefficient related to type of construction (C)	Wood Frame	1.5	Non-combustible construction	0.8	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	**Choose Type of Housing (if TH, Enter Number of Units Per TH Block)**	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	**# of Storeys**	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	**Enter Ground Floor Area of One Unit**	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			2,945 Square Metres (m2)	2,945	Area in Square Meters (m^2)	
4	**Obtain Required Fire Flow without Reductions**	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						**10,000**
5	**Apply Factors Affecting Burning**	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	**Choose Combustibility of Building Contents**	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Limited combustible	-0.15	N/A	**8,500**
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	**Choose Reduction Due to Presence of Sprinklers**	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	**-2,550**
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	**-850**
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	**0**
			Sprinkler not fully supervised or N/A	0				
5.3	**Choose Separation Distance Between Units**	Exposure Distance Between Units	North Side	30.1 to 45.0m	0.05	0.15	m	**1,275**
			East Side	45.1m or greater	0			
			South Side	Fire Wall	0.1			
			West Side	45.1m or greater	0			
6	**Obtain Required Fire Flow, Duration & Volume**	***Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:***						**6,000**
		Total Required Fire Flow (above) in L/s:						**100**
		Required Duration of Fire Flow (hrs)						**2.00**
		Required Volume of Fire Flow (m^3)						**720**

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FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 160401148
Project Name: 2025 Mer Bleue Road
Date: January 4, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 13
Building Type/Description/Name: Lot 1 North Tower

Notes:
Building Classification C per 3.2.2.42

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Non-combustible construction	0.8	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	# of Storeys	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	Enter Ground Floor Area of One Unit	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			2,945 Square Metres (m2)	2,945	Area in Square Meters (m^2)	
4	Obtain Required Fire Flow without Reductions	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						10,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Limited combustible	-0.15	N/A	8,500
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	-2,550
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	-850
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	0
			Sprinkler not fully supervised or N/A	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	Fire Wall	0.1	0.45	m	3,825
			East Side	10.1 to 20.0m	0.15			
			South Side	3.1 to 10.0m	0.2			
			West Side	45.1m or greater	0			
6	Obtain Required Fire Flow, Duration & Volume	***Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:***						**9,000**
		Total Required Fire Flow (above) in L/s:						**150**
		Required Duration of Fire Flow (hrs)						**1.75**
		Required Volume of Fire Flow (m^3)						**945**

FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 160401148
Project Name: 2025 Mer Bleue Road
Date: January 4, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 14
Building Type/Description/Name: Lot 2

Notes:
Building Classification C per 3.2.2.42

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	**Choose Frame Used for Construction of Unit**	Coefficient related to type of construction (C)	Wood Frame	1.5	Non-combustible construction	0.8	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	**Choose Type of Housing (if TH, Enter Number of Units Per TH Block)**	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	**# of Storeys**	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	**Enter Ground Floor Area of One Unit**	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			4,041 Square Metres (m2)	4,041	Area in Square Meters (m^2)	
4	**Obtain Required Fire Flow without Reductions**	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						**11,000**
5	**Apply Factors Affecting Burning**	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	**Choose Combustibility of Building Contents**	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Limited combustible	-0.15	N/A	**9,350**
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	**Choose Reduction Due to Presence of Sprinklers**	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	**-2,805**
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	**-935**
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	**0**
			Sprinkler not fully supervised or N/A	0				
5.3	**Choose Separation Distance Between Units**	Exposure Distance Between Units	North Side	45.1m or greater	0	0.1	m	**935**
			East Side	20.1 to 30.1m	0.1			
			South Side	45.1m or greater	0			
			West Side	45.1m or greater	0			
6	**Obtain Required Fire Flow, Duration & Volume**	***Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:***						**7,000**
		Total Required Fire Flow (above) in L/s:						**117**
		Required Duration of Fire Flow (hrs)						**2.25**
		Required Volume of Fire Flow (m^3)						**945**

FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 160401148
Project Name: 2025 Mer Bleue Road
Date: January 4, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 15
Building Type/Description/Name: Lot 3

Notes:
Building Classification F-3

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Non-combustible construction	0.8	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	# of Storeys	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	Enter Ground Floor Area of One Unit	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			5,480 Square Metres (m2)	5,480	Area in Square Meters (m^2)	
4	Obtain Required Fire Flow without Reductions	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						13,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Combustible	0	N/A	13,000
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	-3,900
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	-1,300
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	0
			Sprinkler not fully supervised or N/A	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	20.1 to 30.1m	0.1	0.2	m	2,600
			East Side	45.1m or greater	0			
			South Side	45.1m or greater	0			
			West Side	20.1 to 30.1m	0.1			
6	Obtain Required Fire Flow, Duration & Volume	*Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:*						**10,000**
		Total Required Fire Flow (above) in L/s:						**167**
		Required Duration of Fire Flow (hrs)						**2.00**
		Required Volume of Fire Flow (m^3)						**1,200**

FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 160401148
Project Name: 2025 Mer Bleue Road
Date: January 4, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 16
Building Type/Description/Name: Lot 4

Notes:
Building Classification C per 3.2.2.42

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Non-combustible construction	0.8	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	# of Storeys	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	Enter Ground Floor Area of One Unit	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			4,365 Square Metres (m2)	4,365	Area in Square Meters (m^2)	
4	Obtain Required Fire Flow without Reductions	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						12,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Limited combustible	-0.15	N/A	10,200
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	-3,060
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	-1,020
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	0
			Sprinkler not fully supervised or N/A	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	45.1m or greater	0	0.2	m	2,040
			East Side	10.1 to 20.0m	0.15			
			South Side	30.1 to 45.0m	0.05			
			West Side	45.1m or greater	0			
6	Obtain Required Fire Flow, Duration & Volume	*Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:*						**8,000**
		Total Required Fire Flow (above) in L/s:						**133**
		Required Duration of Fire Flow (hrs)						**2.00**
		Required Volume of Fire Flow (m^3)						**960**

FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 160401148
Project Name: 2025 Mer Bleue Road
Date: January 4, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 17
Building Type/Description/Name: Lot 5

Notes:
Building Classification C per 3.2.2.42

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Non-combustible construction	0.8	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	# of Storeys	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	Enter Ground Floor Area of One Unit	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			2,945 Square Metres (m2)	2,945	Area in Square Meters (m^2)	
4	Obtain Required Fire Flow without Reductions	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						**10,000**
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Limited combustible	-0.15	N/A	**8,500**
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	**-2,550**
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	**-850**
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	**0**
			Sprinkler not fully supervised or N/A	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	45.1m or greater	0	0.45	m	**3,825**
			East Side	20.1 to 30.1m	0.1			
			South Side	3.1 to 10.0m	0.2			
			West Side	10.1 to 20.0m	0.15			
6	Obtain Required Fire Flow, Duration & Volume	***Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:***						**9,000**
		Total Required Fire Flow (above) in L/s:						**150**
		Required Duration of Fire Flow (hrs)						**1.75**
		Required Volume of Fire Flow (m^3)						**945**

FUS Fire Flow Calculation

Calculations based on: "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey, 1999

Stantec Project #: 160401148
Project Name: 2025 Mer Bleue Road
Date: January 4, 2017
Data input by: Dustin Thiffault

Fire Flow Calculation #: 18
Building Type/Description/Name: Lot 6

Notes:
Building Classification F-3

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Non-combustible construction	0.8	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (> 3 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, Apt etc.)	1	Units	
			Townhouse - indicate # of units	8				
			Other (Comm, Ind, Apt etc.)	1				
2.2	# of Storeys	Number of Floors/Storeys in the Unit (do not include basement):			1	1	Storeys	
3	Enter Ground Floor Area of One Unit	Average Floor Area (A) based on fire resistive building design when vertical openings are inadequately protected:			5,443 / Square Metres (m2)	5,443	Area in Square Meters (m^2)	
4	Obtain Required Fire Flow without Reductions	Required Fire Flow (without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						13,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Combustible	0	N/A	13,000
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Adequate Sprinkler conforms to NFPA13	-0.3	Adequate Sprinkler conforms to NFPA13	-0.3	N/A	-3,900
			None	0				
		Water Supply Credit	Water supply is standard for sprinkler and fire dept. hose line	-0.1	Water supply is standard for sprinkler and fire dept. hose line	-0.1	N/A	-1,300
			Water supply is not standard or N/A	0				
		Sprinkler Supervision Credit	Sprinkler system is fully supervised	-0.1	Sprinkler not fully supervised or N/A	0	N/A	0
			Sprinkler not fully supervised or N/A	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	45.1m or greater	0	0.2	m	2,600
			East Side	45.1m or greater	0			
			South Side	20.1 to 30.1m	0.1			
			West Side	20.1 to 30.1m	0.1			
6	Obtain Required Fire Flow, Duration & Volume	*Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:*						**10,000**
		Total Required Fire Flow (above) in L/s:						**167**
		Required Duration of Fire Flow (hrs)						**2.00**
		Required Volume of Fire Flow (m^3)						**1,200**

A.3 BOUNDARY CONDITIONS

Boundary Conditions at 2025 Mer Bleue

Information Provided:

Date provided: 07 July, 2016

Criteria	Demand (L/s)
Average Demand	0.49
Maximum Daily Demand	0.87
Peak Hourly Demand	1.31
Fire Flow Demand	83, 100, 183
Maximum Daily + Fire Flow Demand	83.87, 100.87, 183.87

Location:

-

Results

Connection:

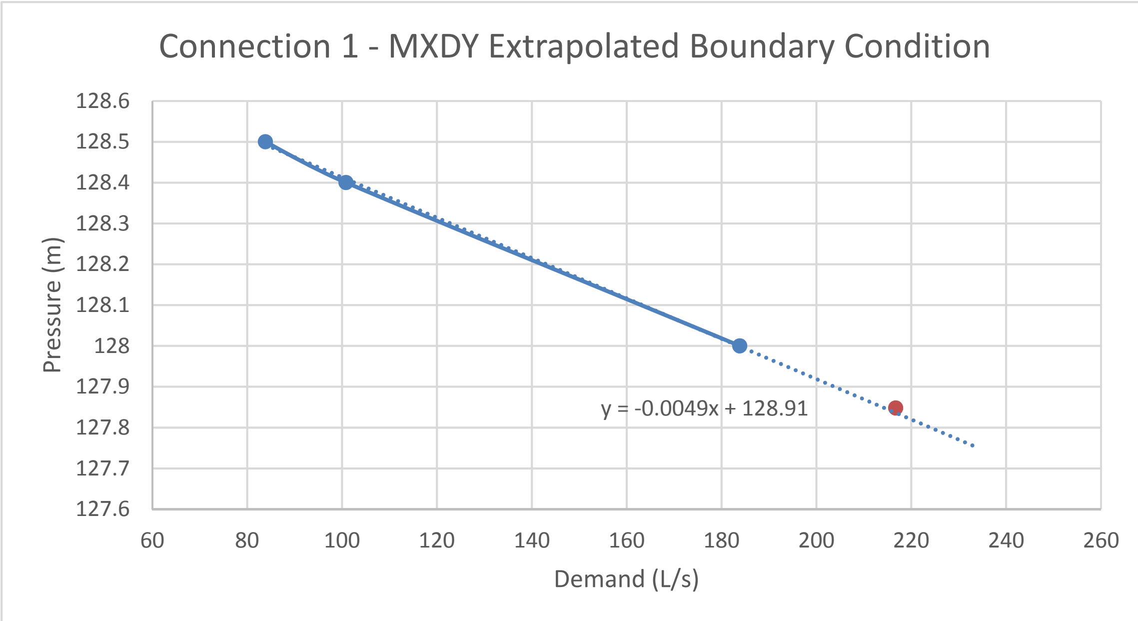
Criteria	Head (m)	Pressure (psi)
Max HGL	130.8	60.0
PKHR	128.2	56.3
MXDY + Fire Flow (83.87 L/s)	128.4	56.6
MXDY + Fire Flow (100.87 L/s)	128.5	56.9
MXDY + Fire Flow (183.87 L/s)	128.0	56.2

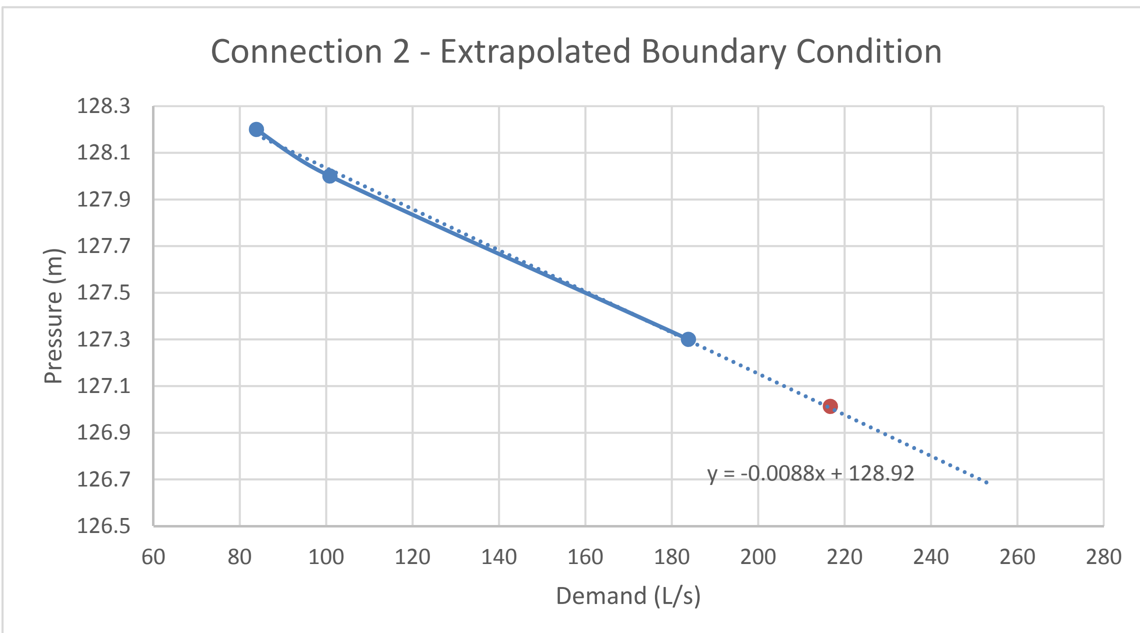
Connection:

Criteria	Head (m)	Pressure (psi)
Max HGL	130.6	60.5
PKHR	127.3	55.8
MXDY + Fire Flow (83.87 L/s)	128.0	56.8
MXDY + Fire Flow (100.87 L/s)	128.2	57.1
MXDY + Fire Flow (183.87 L/s)	127.3	55.8

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.


Connection 1 - MXDY Extrapolated Boundary Condition
128.6
128.5
128.4
128.3
128.2
128.1
128
127.9
127.8
127.7
127.6
Pressure (m)
y = -0.0049x + 128.91
60
80
100
120
140
160
180
200
220
240
260
Demand (L/s)


Connection 2 - Extrapolated Boundary Condition
128.3
128.1
127.9
127.7
127.5
127.3
127.1
126.9
126.7
126.5
Pressure (m)
y = -0.0088x + 128.92
60
80
100
120
140
160
180
200
220
240
260
280
Demand (L/s)

A.4 HYDRAULIC ANALYSIS RESULTS

7001
14
11
16
13
22
9
20
7008
26
15
28
17
30
19
32
21

Hydraulic Model Estimated Water Demands

Node ID	AVDY (L/s)	MXDY (L/s)	PKHR (L/s)
9	0.48	0.73	1.31
11	0.64	0.95	1.72
13	0.12	0.17	0.31
15	11.44	28.47	62.54
17	0.44	0.66	1.19
19	1.04	2.59	5.70
21	0.11	0.16	0.30
Total	14.27	33.74	73.07

AVDY - Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(Kpa)
11	0.64	88.69	130.61	59.59	410.86
13	0.12	88.87	130.62	59.35	409.21
15	11.44	88.82	130.59	59.39	409.48
17	0.44	88.46	130.59	59.90	413.00
19	1.04	88.26	130.59	60.18	414.93
21	0.11	88.40	130.59	59.98	413.55
9	0.48	89.05	130.70	59.21	408.24

AVDY - Pipe Results

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)
14	11	7001	55.5	300	120	9.78	0.14
16	13	11	150.4	300	120	10.42	0.15
20	7008	9	185.3	300	120	24.05	0.34
22	9	13	153.8	300	120	23.57	0.33
26	13	15	162.3	300	120	13.03	0.18
28	15	17	165.3	300	120	1.59	0.02
30	17	19	102.7	300	120	1.15	0.02
32	19	21	77.9	300	120	0.11	0.00

PKHR - Junction Results

ID	Demand	Elevation	Head	Pressure	
	(L/s)	(m)	(m)	(psi)	(Kpa)
11	1.72	88.69	126.66	53.97	372.11
13	0.31	88.87	126.65	53.71	370.32
15	62.54	88.82	126.03	52.90	364.73
17	1.19	88.46	126.02	53.40	368.18
19	5.7	88.26	126.02	53.68	370.11
21	0.3	88.40	126.02	53.48	368.73
9	1.31	89.05	127.18	54.21	373.77

PKHR - Pipe Results

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)
14	11	7001	55.5	300	120	-6.03	0.09
16	13	11	150.4	300	120	-4.31	0.06
20	7008	9	185.3	300	120	67.04	0.95
22	9	13	153.8	300	120	65.73	0.93
26	13	15	162.3	300	120	69.73	0.99
28	15	17	165.3	300	120	7.19	0.10
30	17	19	102.7	300	120	6.00	0.08
32	19	21	77.9	300	120	0.30	0.00

MXDY + FF - Model Results

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)
11	0.95	54.5	375.77	127.03	183	53.34	367.77	1,161.32	20.01	137.96
13	0.17	54.33	374.59	127.09	183	51.55	355.43	753.56	20.01	137.96
15	28.47	54.19	373.63	126.94	183	44.53	307.03	412.41	20.00	137.90
17	0.66	54.7	377.15	126.94	183	39.49	272.28	294.45	20.00	137.90
19	2.59	54.98	379.08	126.94	183	36.35	250.63	264.6	20.00	137.90
21	0.16	54.78	377.70	126.94	183	33.62	231.80	242.67	20.00	137.90
9	0.73	54.56	376.18	127.43	183	51.89	357.77	781.81	20.01	137.96

Appendix B WASTEWATER SERVICING

B.1 SANITARY SEWER DESIGN SHEET

Stantec

SUBDIVISION:

Orleans II Draft Plan of Subdivision

DATE: 12/4/2018
REVISION: 1
DESIGN BY: DT
CHECKED BY: KS

SANITARY SEWER DESIGN SHEET
(City of Ottawa)

FILE NUMBER: 160401419

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):	Varies	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: AREA ID NUMBER	LOCATION: FROM M.H.	LOCATION: TO M.H.	RESIDENTIAL: AREA (ha)	RESIDENTIAL: UNITS SINGLE	RESIDENTIAL: UNITS TOWN	RESIDENTIAL: UNITS APT	RESIDENTIAL: POP.	RESIDENTIAL: CUMULATIVE AREA (ha)	RESIDENTIAL: CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	COMMERCIAL: AREA (ha)	COMMERCIAL: ACCU. AREA (ha)	INDUSTRIAL (L): AREA (ha)	INDUSTRIAL (L): ACCU. AREA (ha)	INDUSTRIAL (H): AREA (ha)	INDUSTRIAL (H): ACCU. AREA (ha)	INSTITUTIONAL: AREA (ha)	INSTITUTIONAL: ACCU. AREA (ha)	GREEN / UNUSED: AREA (ha)	GREEN / UNUSED: ACCU. AREA (ha)	C+I+I: PEAK FLOW (l/s)	INFILTRATION: TOTAL AREA (ha)	INFILTRATION: ACCU. AREA (ha)	INFILTRATION: INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	PIPE: LENGTH (m)	PIPE: DIA (mm)	PIPE: MATERIAL	PIPE: CLASS	PIPE: SLOPE (%)	PIPE: CAP. (FULL) (l/s)	PIPE: CAP. V PEAK FLOW (%)	PIPE: VEL. (FULL) (m/s)	PIPE: VEL. (ACT.) (m/s)
E16A, C16A-G, G16A-C	16	15	0.00	0	0	0	0	0.00	0	3.80	0.0	5.85	5.85	0.00	0.00	0.00	0.00	0.00	0.00	4.10	4.10	2.8	9.95	9.95	3.3	6.1	90.6	250	PVC	SDR 35	0.26	31.2	**19.63%**	0.63	0.41
G15A	15	14	0.00	0	0	0	0	0.00	0	3.80	0.0	0.00	5.85	0.00	0.00	0.00	0.00	0.00	0.00	0.29	4.38	2.8	0.29	10.23	3.4	6.2	119.4	250	PVC	SDR 35	0.27	31.4	**19.82%**	0.63	0.41
G14A-B, C14A-D	14	26	0.00	0	0	0	0	0.00	0	3.80	0.0	0.41	6.26	0.00	0.00	0.00	0.00	0.00	0.00	1.92	6.31	3.0	2.33	12.56	4.1	7.2	51.0	250	PVC	SDR 35	0.25	30.3	**23.71%**	0.61	0.42
G26A, R26A	26	25	1.30	0	0	259	466	1.30	466	3.39	5.1	0.00	6.26	0.00	0.00	0.00	0.00	0.00	0.00	0.62	6.93	3.0	1.92	14.48	4.8	12.9	111.3	250	PVC	SDR 35	0.25	30.3	**42.70%**	0.61	0.50
G25A, R25A	25	24	1.87	0	0	374	673	3.17	1139	3.21	11.9	0.00	6.26	0.00	0.00	0.00	0.00	0.00	0.00	0.78	7.71	3.0	2.65	17.13	5.7	20.5	96.5	250	PVC	SDR 35	0.25	30.3	**67.78%**	0.61	0.57
R24A, R24B	24	23	2.17	0	0	433	779	5.33	1919	3.08	19.2	0.00	6.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.71	3.0	2.17	19.30	6.4	28.6	96.5	300	PVC	SDR 35	0.20	42.9	**66.51%**	0.61	0.57
	23	22	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	6.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.71	3.0	0.00	19.30	6.4	28.6	48.1	300	PVC	SDR 35	0.20	42.9	**66.51%**	0.61	0.57
L22A, L22B	22	21	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	6.26	5.27	5.27	0.00	0.00	0.00	0.00	0.00	7.71	13.7	5.27	24.56	8.1	41.0	48.1	375	PVC	SDR 35	0.20	72.6	**56.43%**	0.69	0.61
	21	20	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	6.26	0.00	5.27	0.00	0.00	0.00	0.00	0.00	7.71	13.7	0.00	24.56	8.1	41.0	62.3	375	PVC	SDR 35	0.20	72.6	**56.43%**	0.69	0.61
L20B, L20C, G20B, L20D	STUB	20	0.00	0	0	0	0	0.00	0	3.80	0.0	0.00	0.00	14.61	14.61	0.00	0.00	0.00	0.00	1.72	1.72	23.7	16.33	16.33	5.4	29.1	23.0	300	PVC	SDR 35	0.20	42.9	**67.69%**	0.61	0.57
L20A, G20A	20	6	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	6.26	0.27	20.15	0.00	0.00	0.00	0.00	0.35	9.79	34.1	0.62	41.52	13.7	66.9	111.1	375	PVC	SDR 35	0.20	72.6	**92.17%**	0.69	0.71
	6	5	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	6.26	0.00	20.15	0.00	0.00	0.00	0.00	0.00	9.79	34.1	0.00	41.52	13.7	66.9	71.7	375	PVC	SDR 35	0.21	74.3	**90.10%**	0.70	0.72
	5	4	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	6.26	0.00	20.15	0.00	0.00	0.00	0.00	0.00	9.79	34.1	0.00	41.52	13.7	66.9	71.6	375	PVC	SDR 35	0.17	66.4	**100.72%**	0.63	0.66
	4	3	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	6.26	0.00	20.15	0.00	0.00	0.00	0.00	0.00	9.79	34.1	0.00	41.52	13.7	66.9	61.8	375	PVC	SDR 35	0.23	77.3	**86.61%**	0.73	0.74
	3	2	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	6.26	0.00	20.15	0.00	0.00	0.00	0.00	0.00	9.79	34.1	0.00	41.52	13.7	66.9	61.7	375	PVC	SDR 35	0.18	68.5	**97.65%**	0.65	0.68
	2	1	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	6.26	0.00	20.15	0.00	0.00	0.00	0.00	0.00	9.79	34.1	0.00	41.52	13.7	66.9	7.2	375	PVC	SDR 35	0.28	85.4	**78.31%**	0.81	0.79
																												375							
BCIP	1	MHVG2	0.00	0	0	0	0	5.33	1919	3.08	19.2	29.98	36.24	12.68	32.82	0.00	0.00	0.00	0.00	0.00	9.79	62.8	42.66	84.18	27.8	109.7	115.0	525	CONCRETE	-	0.19	197.6	**55.53%**	0.88	0.78
	MHVG2	MHVG3	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	36.24	0.00	32.82	0.00	0.00	0.00	0.00	0.00	9.79	62.8	0.00	84.18	27.8	109.7	120.0	525	CONCRETE	-	0.20	202.8	**54.12%**	0.91	0.80
	MHVG3	MHVG4	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	36.24	0.00	32.82	0.00	0.00	0.00	0.00	0.00	9.79	62.8	0.00	84.18	27.8	109.7	90.0	525	CONCRETE	-	0.20	202.8	**54.12%**	0.91	0.80
	MHVG4	MHVG5	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	36.24	0.00	32.82	0.00	0.00	0.00	0.00	0.00	9.79	62.8	0.00	84.18	27.8	109.7	115.0	525	CONCRETE	-	0.20	202.8	**54.12%**	0.91	0.80
	MHVG5	MH EX1	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	36.24	0.00	32.82	0.00	0.00	0.00	0.00	0.00	9.79	62.8	0.00	84.18	27.8	109.7	36.0	525	CONCRETE	-	0.22	212.7	**51.60%**	0.95	0.82
	MH EX1	MH1	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	36.24	0.00	32.82	0.00	0.00	0.00	0.00	0.00	9.79	62.8	0.00	84.18	27.8	109.7	92.0	525	CONCRETE	-	0.09	136.0	**80.68%**	0.61	0.60
	MH1	MH2	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	36.24	0.00	32.82	0.00	0.00	0.00	0.00	0.00	9.79	62.8	0.00	84.18	27.8	109.7	135.0	525	CONCRETE	-	0.18	192.4	**57.05%**	0.86	0.76
	MH2	MH3	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	36.24	0.00	32.82	0.00	0.00	0.00	0.00	0.00	9.79	62.8	0.00	84.18	27.8	109.7	120.0	525	CONCRETE	-	0.20	202.8	**54.12%**	0.91	0.80
	MH3	MH4	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	36.24	0.00	32.82	0.00	0.00	0.00	0.00	0.00	9.79	62.8	0.00	84.18	27.8	109.7	120.0	525	CONCRETE	-	0.20	202.8	**54.12%**	0.91	0.80
	MH4	MH5	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	36.24	0.00	32.82	0.00	0.00	0.00	0.00	0.00	9.79	62.8	0.00	84.18	27.8	109.7	120.0	525	CONCRETE	-	0.20	202.8	**54.12%**	0.91	0.80
	MH5	MH6	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	36.24	0.00	32.82	0.00	0.00	0.00	0.00	0.00	9.79	62.8	0.00	84.18	27.8	109.7	120.0	525	CONCRETE	-	0.20	202.8	**54.12%**	0.91	0.80
	MH6	MH7	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	36.24	0.00	32.82	0.00	0.00	0.00	0.00	0.00	9.79	62.8	0.00	84.18	27.8	109.7	120.0	525	CONCRETE	-	0.20	202.8	**54.12%**	0.91	0.80
	MH7	MH8	0.00	0	0	0	0	5.33	1919	3.08	19.2	0.00	36.24	0.00	32.82	0.00	0.00	0.00	0.00	0.00	9.79	62.8	0.00	84.18	27.8	109.7	63.0	525	CONCRETE	-	0.29	244.2	**44.95%**	1.09	0.91
EX. CHAPERAL	MH8	MH9	51.51	0	0	0	4070	56.84	5989	2.74	53.1	14.97	51.21	0.00	32.82	0.00	0.00	0.00	0.00	1.67	11.46	70.1	68.15	152.33	50.3	173.5	29.6	600	CONCRETE	-	0.20	289.5	**59.92%**	0.99	0.89
	MH9	MH10	0.00	0	0	0	0	56.84	5989	2.74	53.1	0.00	51.21	0.00	32.82	0.00	0.00	0.00	0.00	0.00	11.46	70.1	0.00	152.33	50.3	173.5	105.0	600	CONCRETE	-	0.20	289.5	**59.92%**	0.99	0.89
	MH10	MH10A	0.00	0	0	0	0	56.84	5989	2.74	53.1	0.00	51.21	0.00	32.82	0.00	0.00	0.00	0.00	0.00	11.46	70.1	0.00	152.33	50.3	173.5	18.0	600	CONCRETE	-	0.22	303.6	**57.14%**	1.04	0.93
	MH10A	MH10B	0.00	0	0	0	0	56.84	5989	2.74	53.1	0.00	51.21	0.00	32.82	0.00	0.00	0.00	0.00	0.00	11.46	70.1	0.00	152.33	50.3	173.5	71.0	600	CONCRETE	-	0.20	289.5	**59.92%**	0.99	0.89
	MH10B	MH11	0.00	0	0	0	0	56.84	5989	2.74	53.1	0.00	51.21	0.00	32.82	0.00	0.00	0.00	0.00	0.00	11.46	70.1	0.00	152.33	50.3	173.5	31.0	600	CONCRETE	-	0.19	282.2	**61.48%**	0.97	0.88
	MH11	MH12	0.00	0	0	0	0	56.84	5989	2.74	53.1	0.00	51.21	0.00	32.82	0.00	0.00	0.00	0.00	0.00	11.46	70.1	0.00	152.33	50.3	173.5	120.0	600	CONCRETE	-	0.20	289.5	**59.92%**	0.99	0.89
	MH12	MH15166	0.00	0	0	0	0	56.84	5989	2.74	53.1	0.00	51.21	0.00	32.82	0.00	0.00	0.00	0.00	0.00	11.46	70.1	0.00	152.33	50.3	173.5	107.0	600	CONCRETE	-	0.22	303.6	**57.14%**	1.04	0.93
AVALON WEST	MH15166	MH10128	62.10	0	0	0	4501	118.94	10490	2.55	86.6	20.93	72.14	0.00	32.82	0.00	0.00	0.00	0.00	0.00	11.46	80.3	83.03	235.36	77.7	244.5	36.0	675	CONCRETE	-	0.24	434.2	**56.32%**	1.18	1.04
PROP. MINTO	A1	A2	22.91	0	0	0	1720	22.91	1720	3.11	17.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	22.91	22.91	7.6	24.9	250.0	675	CONCRETE	-	0.10	280.3	**8.88%**	0.76	0.39
PROP. AREA 10 (OPT 2)	A2	MH514	45.57	0	0	0	5008	68.48	6728	2.70	58.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	45.57	68.48	22.6	81.4	250.0	675	CONCRETE	-	0.10	280.3	**29.06%**	0.76	0.55
AVALON SOUTH	MH514	MH55A	93.85	0	0	0	6740	162.33	13468	2.46	107.4	0.77	0.77	0.00	0.00	0.00	0.00	13.40	13.40	1.43	1.43	4.6	109.45	177.93	58.7	170.7	75.5	675	CONCRETE	-	0.15	343.2	**49.73%**	0.93	0.79
PROP. MATTAMY BISSON	MH55A	MH10128	30.04	0	0	0	2434	192.37	15902	2.40	123.8	0.00	0.77	0.00	0.00	0.00	0.00	0.00	13.40	1.83	3.26	4.6	31.87	209.80	69.2	197.6	19.0	675	CONCRETE	-	0.16	354.5	**55.75%**	0.96	0.85
	MH10128	TLPS	0.00	0	0	0	0	311.31	26392	2.23	190.4	55.17	128.08	12.18	45.00	0.00	0.00	0.00	13.40	0.00	14.72	127.1	67.35	512.51	169.1	486.6	52.3	675	CONCRETE	-	0.28	469.0	**103.76%**	1.27	1.34

B.2 BACKGROUND REPORT EXCERPTS (SANITARY DRAINAGE)

DSEL
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TENTH LINE ROAD PUMP STATION

OVERALL SANITARY DRAINAGE AREA PLAN

PROJECT No. :	12-609
SCALE:	1:5000
DATE:	MAY 2015
Fig No.	1

Memo

To:	Bob Wingate / Demetrius Yannoulopoulos IBI Group, Ottawa	From:	Marc Telmosse Stantec, Ottawa
File:	1634-01269	Date:	August 26, 2016

Reference: Mer Bleue Community Design Plan – Tenth Line PS & Wastewater Servicing: Pump Station Capacity Assessment

The existing capacity of the Tenth Line pumping station (TLPS) was previously reviewed and presented in a memo dated October 10, 2014. That memo considered the findings of the 2013 Infrastructure Master Plan (IMP) and provided a discussion on the capacity available under existing and future (2031 and 2060 buildout) conditions at the TLPS and downstream sanitary collection system. The original memo was resubmitted on March 2, 2015. The current version of the memo encompasses further revisions based on City review comments on the March 2, 2015 submission.

A meeting was subsequently held with the City where the peak existing wet weather flow rate was discussed. Higher flows were seen at the TLPS during the June 24-25, 2014 rainfall event than were reported in the 2013 IMP report and the City requested that these be considered. This memo documents the findings of the flow analysis completed and also presents the influence of these on the Mer Bleue and TLPS flow projections.

An assessment of the pump station upgrade capacity was completed and a summary of our findings is included.

BACKGROUND

An update to the community design plan (CDP) for the TLPS servicing area was provided and this was used as a basis to develop updated flow projections. The differences between the 2013 IMP and updated CDP under the 2031 scenario are shown in **Table 1**.

Table 1: Growth Comparison - 2031

Area	Gross Growth Area (ha)	2013 IMP		2016 CDP Update	
		Growth Population (ppl)	Growth ICI	Growth Population (ppl)	Growth ICI
Mer Bleue (10A, 10B, 10C)	213	9,639	607 employees	10,840	17ha school
Minto (10D, 10E)	28	1,276	7 employees	1,819	7 employees
Existing	169	7,624	2,573 employees	7,624	2,573 employees
Total Growth	410	18,539	3,187 employees	20,774	2,580 employees + 1 school

Reference: Mer Bleue Community Design Plan – Tenth Line PS & Wastewater Servicing: Pump Station Capacity Assessment

The 2013 IMP also included a 2060 scenario which included growth areas beyond the City's current official plan (OP). The 2060 scenario had a reduction in population for the "existing" area. For these reasons, only the 2031 scenario is considered without consideration for areas outside the existing OP (see **Figure 1**).

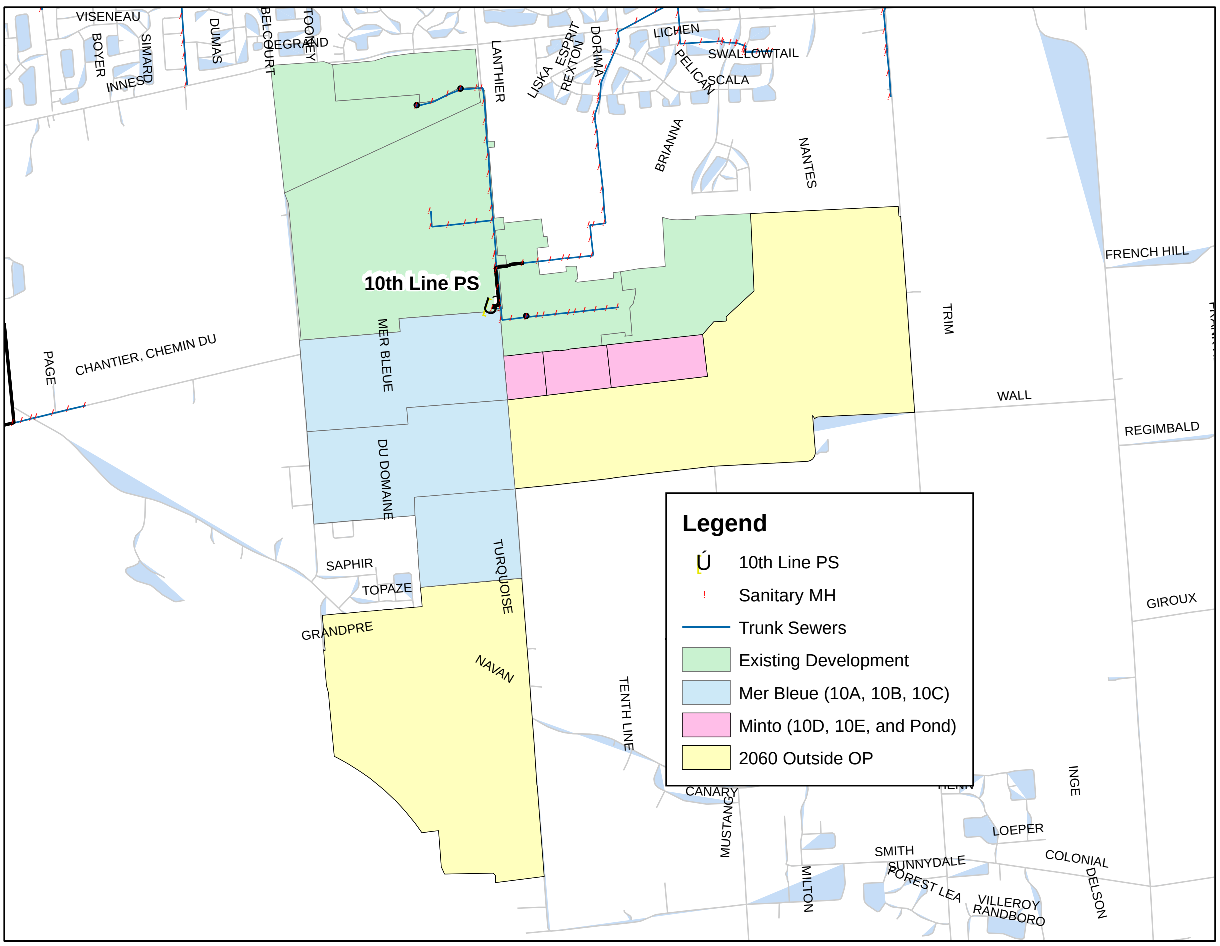

Figure 1: TLPS Servicing Area

Results from the 2013 IMP using the 100 year design storm were considered for the existing flows at the TLPS. This result showed a projected peak wet weather flow of 86L/s. This modeled flow is less than the peak wet weather flow of 108L/s seen at the TLPS during the June 24-25th, 2014 event and the City requested that the higher flow be considered. All design event scenarios are estimates as they are not based on actual system responses. With this consideration in mind, more emphasis was placed on the June 24-25th, 2014 event that was recorded.

Reference: Mer Bleue Community Design Plan – Tenth Line PS & Wastewater Servicing: Pump Station Capacity Assessment

REVISED FLOW ANALYSIS

The City provided water consumption and flow monitoring data which were used in conjunction with landuse area shapefiles to assess the flows observed at the TLPS. The assessment focused on quantifying and qualifying the I/I observed at the TLPS.

As per Section 4.4 of the Ottawa Sewer Design Guidelines, we adopted the approach suggested in the guidelines:

- Standard Peak Flow Design Parameters: Applied for establishing peak design capacity (used for the design of sewers and pumping stations)
    - (i.e. for Growth related flows)
- Operational Flow Parameters: Derived from monitoring data and used for establishing the range of operational flows (used in sewer analysis and pumping station design)
    - (i.e. for Existing flows using the June 24-25 2014 event flow)

However, in addition to this approach, we also considered the scenario where the City's standard peak flow parameters were applied to existing development.

Dry Weather Flow Analysis

The 2014 water consumption records were assessed and compared to the dry weather flow monitoring data recorded at the TLPS. The goal of this analysis was to confirm that these two data sets were comparable, as well as establish the quantity of ground water infiltration seen in the system.

The annual water consumption data was provided and it was determined that 535,252 m^3 was consumed in 2014 and equates to an approximate average flow rate of 17L/s. The flow monitoring data was also assessed and showed that an approximate average flow of 20L/s was seen during the DWF in June of 2014 as illustrated on

Figure 2. A peak DWF rate of approximately 32L/s was also seen during this same period.

The 3L/s difference between the water consumption records and flow monitoring data average DWF findings is assumed to be the result of dry weather groundwater infiltration (GWI). Taken over the existing 201ha of development, this 3L/s corresponds to a gross unit rate of 0.015L/ha/s. This rate is representative of a new developed area with limited dry weather flow conditions inflow and is also less than the City of Ottawa Design Guideline Operational GWI rate of 0.05-0.08L/ha/s.

Wet Weather Flow Analysis

A wet weather flow analysis was completed on the flow monitoring data collected during the June 24-25 2014 rainfall event. As shown on **Figure 3**, the peak flow seen during the event was approximately 108L/s, with a rainfall derived inflow/infiltration (RDII) component of 81L/s. This rate corresponds to a gross area flow of approximately 0.40L/ha/s over the 201 ha gross area currently serviced by the TLPS.

The corresponding operational design RDII flow can be also approximated as 53L/s using the servicing area (201ha) and City's design guideline rate of 0.265L/ha/s (0.28L/ha/s – 0.015L/ha/s). This 53L/s represents the WWF contribution that was considered in developing the flow projection scenarios as the "design/operational" existing WWF.

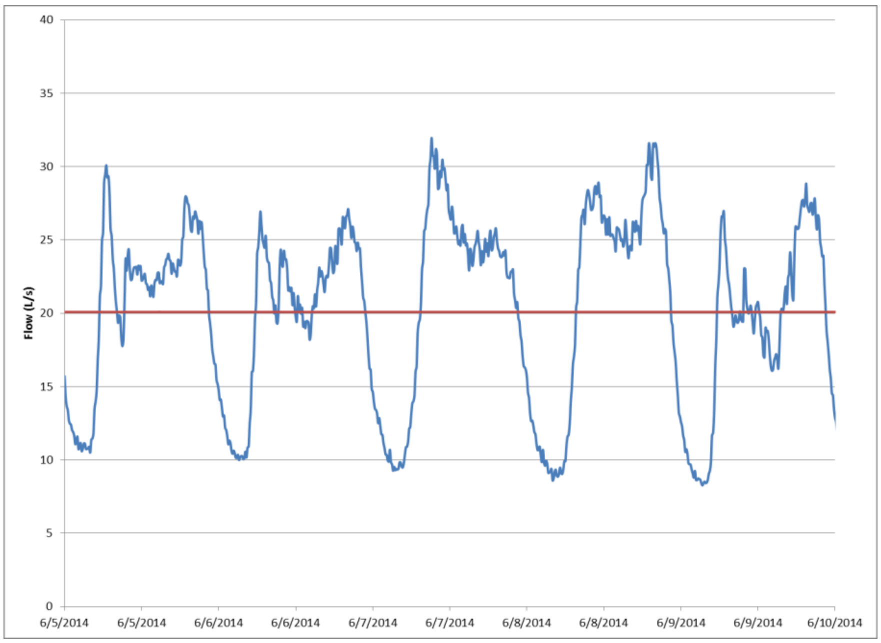

Figure 2: June 2014 TLPS Dry Weather Flow

Reference: Mer Bleue Community Design Plan – Tenth Line PS & Wastewater Servicing: Pump Station Capacity Assessment

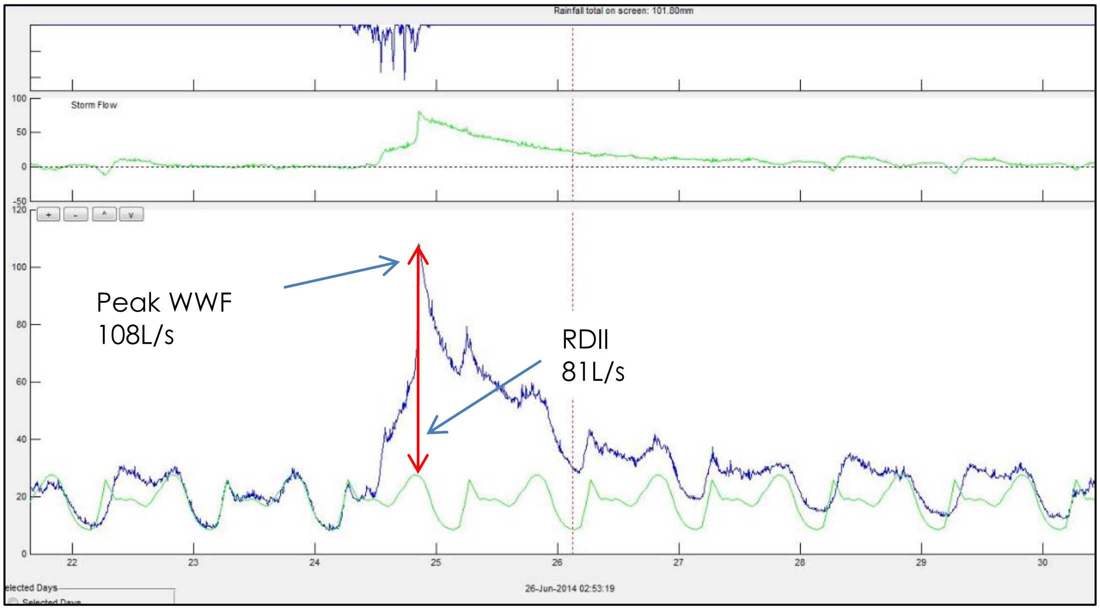

Figure 3: June 24-25, 2014 TLPS Flow

Reference: Mer Bleue Community Design Plan – Tenth Line PS & Wastewater Servicing: Pump Station Capacity Assessment

Discussion

The RDII rate observed during the June 24-25, 2014 event is significantly higher than the 0.265 L/ha/s operational/design I/I rate specified in the City of Ottawa Sewer Design Guidelines. This high RDII rate is not expected in a newer developed area such as that serviced by the TLPS. This result was discussed with the City and it was agreed that the RDII seen was irregularly high. Several possibilities were suggested as being responsible for such a high rate:

- Foundation excavations of partially constructed houses may have drained to the sanitary collection system through un-capped service laterals. This has occurred in other areas in the City during construction of newer developments.
- The storm water collection system could have influenced the sanitary system. This is unlikely as it is our understanding that backflow preventers (duckbills) are in place.

Although the RDII rate seen is considered irregularly high, it was requested that it be considered in our flow projections as it may be representative of future interim flows.

REVISED TENTH LINE PS PROJECTED FLOWS

The City requested that both design and observed conditions be considered in the TLPS flow projections. Four (4) scenarios were therefore considered involving a combination of observed, operational/design, and design flow conditions.

EXISTING FLOWS

The existing flows were considered based on the flow monitored data provided and considered both the June 24-25, 2014 event and the City's Sewer Design Guideline parameters. The DWF was taken as the 32 L/s observed during the peak overall wet weather flow of the June 24-25, 2014 event for all scenarios. This 32 L/s includes the 0.015 L/ha/s GWI estimated from the flow monitoring data.

The WWF projections considered the peak 108 L/s of which 81 L/s is considered to be due to RDII sources, as well as an Operational/Design Guideline rate approach where a 53 L/s RDII (201 ha x 0.265 L/ha/s) is used and added to the observed peak DWF of 32 L/s for a total of 85 L/s.

GROWTH FLOWS

The growth flows were considered based on the design and operational rates provided in the City's Design Guidelines. Considering both of these sets of parameters provides a range of possible flows and identifies the sensitivity of the area to these parameters. We have adopted these parameters with the exception of using an employee generation rate of 83 L/employee/day for growth in existing areas (taken from the 2013 IMP), as well as maintaining a "K" value of 1 for use with the Harmon equation for all scenarios.

From the City of Ottawa Sewer Design Guidelines:

Peak Flow Design Parameters Summary

AVERAGE WASTEWATER FLOWS:

Residential Average Flow: 350 L/c/day

Commercial/Institutional Flow: 50,000 L/gross ha/d

PEAKING FACTORS:

Residential Peak factor: Harmon Equation

$$P.F. = 1 + \left(\frac{14}{4 + \left(\frac{P}{1000}\right)^{\frac{1}{2}}}\right) * K$$

Where: P = Population

K = Correction Factor = 1

Commercial/Institutional Peak factor: 1.5

PEAK EXTRANEOUS FLOWS: (design event)

Infiltration Allowance: 0.28 L/s/effective gross ha (for all areas)

Operational Parameters Summary (Example)

AVERAGE WASTEWATER FLOWS:

Residential Average Flow: 300 L/c/day

Commercial Flow: 17,000 L/gross ha/d

Institutional Flow: 10,000 L/gross ha/d

PEAKING FACTORS:

Residential Peak factor: Harmon Equation

$$P.F. = 1 + \left(\frac{14}{4 + \left(\frac{P}{1000}\right)^{\frac{1}{2}}}\right) * K$$

Where: P = Population

K = Correction Factor = 0.4 to 0.6

Commercial/Institutional Peak factor: 1 (non-coincident peak)

Reference: Mer Bleue Community Design Plan – Tenth Line PS & Wastewater Servicing: Pump Station Capacity Assessment

EXTRANEOUS FLOWS: (Typical values for separated sewers)

Dry Weather Groundwater infiltration:	0.05-0.08 L/s/gross ha (example range)
Wet Weather Extraneous Flow:	0.15-0.2 L/s/ gross ha (typical events)
(includes Dry weather GWI)	0.28 L/s/effective gross ha (large event – typical of annual event)
	0.30-0.50 L/s/gross ha (extreme event)

ASSESSMENT FINDINGS

The flow projection scenarios were considered using the various flow generation components for existing and growth areas as described above. The various spreadsheets used in the assessment are provided as an attachment to this document, while the overall findings are summarized in **Table 2**, and show that a flow range between 381 L/s and 447 L/s is expected.

Table 2: TLPS Flow Projections (2031) - Scenario Summaries

Scenario	Description	Existing Flow	Growth Flow	Total Flow
A	Existing – June 24-25, 2014 Growth – Operational	108 L/s	296 L/s	404 L/s
B	Existing – Operational/Design Guidelines Growth – Operational	85 L/s	296 L/s	381 L/s
C	Existing – June 24-25, 2014 Growth – Design Guidelines	108 L/s	339 L/s	447 L/s
D	Existing – Operational/Design Guidelines Growth – Design Guidelines	85 L/s	339 L/s	424 L/s

TLPS CAPACITY

The TLPS currently has a firm capacity of approximately 290 L/s and was originally designed for an ultimate peak flow of 425 L/s. The forcemain was extended during construction however and this resulted in the peak ultimate firm capacity being reduced to 405 L/s.

The maximum flow that could be sent through the existing 300/400 mm forcemains is limited to 445 L/s based on keeping velocities under 2.5 m/s. Higher flow would require larger or additional forcemains.

A pump selection of three (3) Xylem NP 3301 MT 3~ 636 pumps (2 duty / 1 standby) would provide 445 L/s at 17.9 m TDH. These MT pumps would replace the existing LT pumps and would fit in the wet well without modification to the benching. An adapter on the pump outlet would be required due to the difference in outlet size (300 mm to 250 mm).

Reference: Mer Bleue Community Design Plan – Tenth Line PS & Wastewater Servicing: Pump Station Capacity Assessment

Electrical Considerations

The new MT pumps would each require a power input of 52.7 kW for a total of 105.4 kW for two pumps running. Additional electrical considerations are as follows:

- The pump softstarter manufacturer (Benshaw) confirms that the existing two existing 60 HP softstarters internal components are suitable for the proposed larger 70 HP pumps. Some programmed parameters will need to be modified in the softstarter control module to reflect the new pump motor nameplate data. The thermal trip setting on the stoftstarter disconnect switch breaker will also need to be adjusted.

- The existing Distribution Panel 100 A feeder breakers (2) and power cables are suitable for the new larger 70 HP pumps.

- The existing power factor correction capacitors (2) will not be perfectly matched to the proposed larger 70 HP pumps, but will still correct the power factor to above 0.9 which is acceptable to Hydro Ottawa and will still avoid utility billing penalty charges.

- The existing 230 kW standby power generator is sized to feed the existing station base electrical loads and will allow operation of two proposed 70 HP pumps simultaneously (in a 2 duty / 1 standby configuration), without the need for any modifications to the emergency power system.

- The station currently has two sewage pumps. The installation of the third 70 HP sewage pump will require a new softstarter, new capacitor bank, new feeder breaker, new power wiring, and new control/monitoring wiring back to the station RPU.

- The existing station RPU control panel has reserved spare I/O points for the future third sewage pump, and therefore would not require any additional I/O modules.

- During the station upgrade's construction and testing phase, the City SCADA programmers will need to make programming changes to the pump station RPU control panel, as well as on the SCADA HMI pump duty table.

Additional Storage Considerations

The highest flow projected in our flow assessment is 447 L/s from Scenario C and is 2L/s beyond the upgrade conveyance capacity established for the TLPS. Since increasing the conveyance could not be established without essentially replacing the entire pump station and forcemains, the remaining alternative is to add a storage component to offset this conveyance need.

We have assumed the same hydrograph distribution as the June 24-25, 2014 event to estimate this storage volume requirement while maintaining the upgraded conveyance rate at 445 L/s. The required volume is then obtained by calculating the difference between the Scenario C hydrograph and the TLPS conveyance and is estimated as 4 m^3 (see **Figure 4**).

Reference: Mer Bleue Community Design Plan – Tenth Line PS & Wastewater Servicing: Pump Station Capacity Assessment

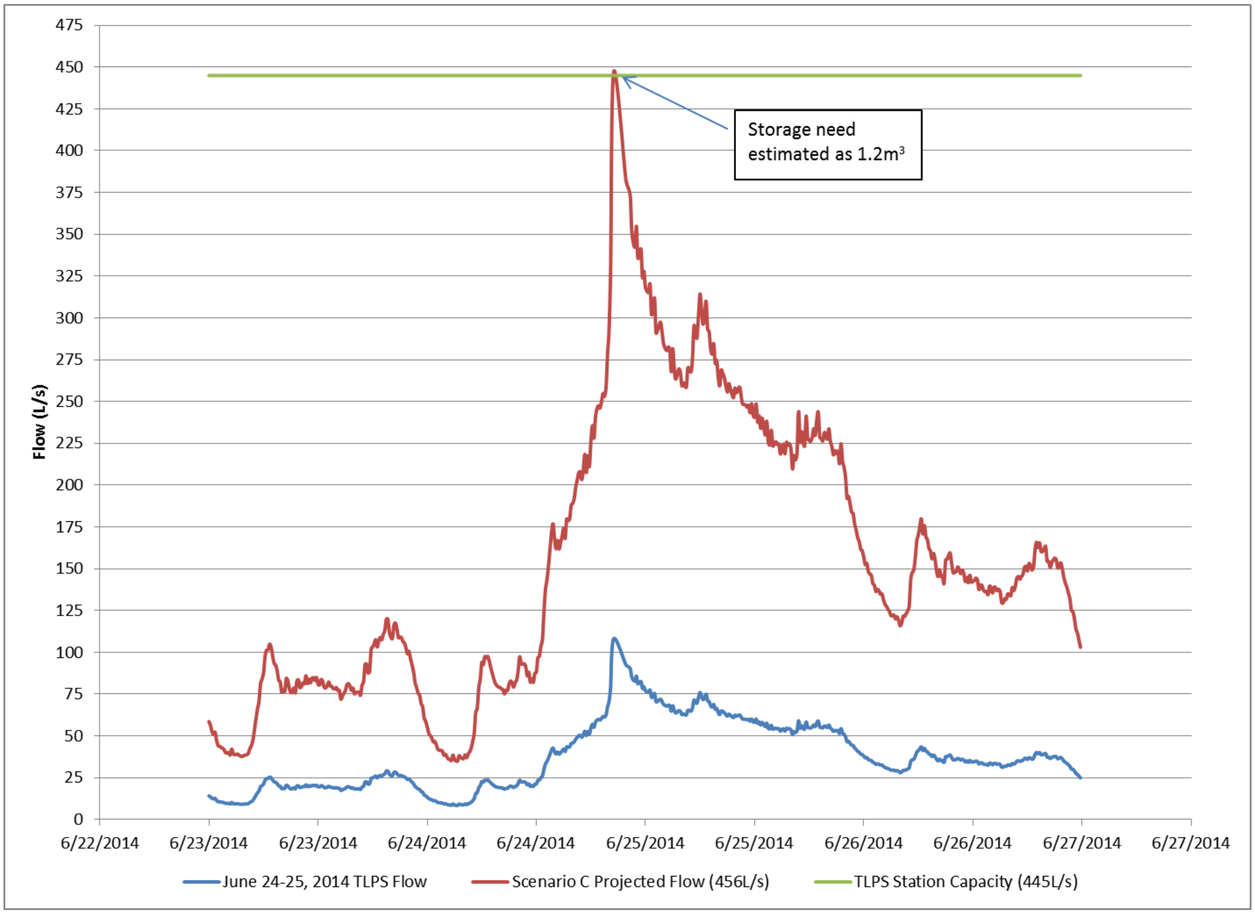

Figure 4: TLPS Estimated Storage Upgrade Need

This storage need is negligibly small and it is assumed that the upstream collection system could handle the backwater condition that could occur without adding additional storage at the TLPS.

SUMMARY & RECOMMENDATIONS

A revision to the flow projections for the TLPS was completed following a meeting with the City. This revision was requested because the monitored peak existing flows into the pump station during the June 24-25, 2014 event were greater than the 100-year design flows previously used and obtained from the City's 2013 IMP wastewater model. We also reviewed the TLPS upgrade potential and identified that a capacity increase to approximately 445 L/s could be achieved by replacing the existing pumps and modifying some electrical components.

The findings of this revision showed that the RDII rate observed during the June 24-25, 2014 event was higher than that provided in the City's Sewer Design Guidelines. We suspect this high rate was due to inflow caused by partially constructed homes where sewer laterals may not have been

Reference: Mer Bleue Community Design Plan – Tenth Line PS & Wastewater Servicing: Pump Station Capacity Assessment

capped. This high RDII rate is not considered to be reflective of normal system responses; however the rate was still considered in our revised flow projections to provide a range of expected flows.

The revised flow projections considered the June 24-25, 2014 event and design rates for existing development and operational and design rates (from the City of Ottawa Sewer Design Guidelines) for growth. A range of flows between 381-447 L/s was obtained using this approach, with the highest estimated flow corresponding to the RDII rates observed during the June 24-25, 2014 event. We have estimated that a negligibly small amount of storage (1.2m^3) could be needed should this highest flow projection be attained while maintaining the 445 L/s capacity at the TLPS. We reiterate that we suspect irregular inflow conditions were responsible for the June 24-25, 2014 event and that the high RDII seen is not typical for newer developments.

Nonetheless, we recommend that a flow monitoring analysis be completed on the TLPS flow data once 50% of the anticipated growth is in place to confirm RDII rates and the projected conveyance and/or storage upgrade needs. This amount of growth corresponds to an additional flow of 170 L/s for a total wet weather flow of 278 L/s (108 L/s+170 L/s) and is within the stations existing capacity of 290 L/s. This flow monitoring analysis will help identify when and confirm what type of upgrades will be needed at the TLPS.

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Attach: TLPS Scenario Summaries

SCENARIO A

FLOW PROJECTION

Interest	Area	IMP Catch ID	Catchment Area (GIS)	2031 Population	Growth	2031 ICI (ha)	Growth	2031 Employees	Growth	2031 Area (ha)	Growth	Res (300L/c/d)	PF (Harmon)	P_RES	Emp (83L/emp/d)	PF	P_Emp	I/I (90% of area)	Total Growth Flow	
Existing	NW	568	28	0	0	22.3	0	1046	0	28	0	0.0	4.00	0.0	0.0	1	0.0	0.0	0.0	
Existing	NE	601	59.4	1236	1199	0	0	0	0	59.4	18.4	4.2	3.75	15.6	0.0	1	0.0	4.6	20.2	
Existing	NE	602	55.4	2442	-227	0	0	5	0	55.4	0.1	-0.8	#NUM!	0.0	0.0	1	0.0	0.0	0.0	
Existing	NW	603	60.9	8	-1	35.4	35.4	2080	2073	60.9	35.4	0.0	#NUM!	0.0	2.0	1	2.0	8.9	10.9	
Existing	NW	604	177.9	7098	6653	0.1	0	508	500	177.9	115.2	23.1	3.13	72.3	0.5	1	0.5	29.0	101.8	
MER BLEUE	10A	632	88.5		10840	17	17	0	0	78.7	78.7	37.6	2.92	109.9	3.3	1	3.3	19.8	133.1	
	10B	633	88.8			0	0	0	0	79.8	79.8	0.0	4.00	0.0	0.0	1	0.0	20.1	20.1	
	10C	634	44			0	0	0	0	54.6	54.6	0.0	4.00	0.0	0.0	1	0.0	13.8	13.8	
MINTO	10D	635	8.3		1819	0	0	7	7	8.3	8.3	6.3	3.62	22.8	0.0	1	0.0	2.1	24.9	
	POND	636	13.4			0	0	0	0	13.4	0	0.0	4.00	0.0	0.0	1	0.0	0.0	0.0	
	10E	637	19.9			0	0	0	0	19.9	19.9	0.0	4.00	0.0	0.0	1	0.0	5.0	5.0	
Outside OP	S - 2060	647	232.9	86	-9	0	0	90	0	0	0	0.0	#NUM!	0.0	0.0	1	0.0	0.0	0.0	
Outside OP	E - 2060	648	286.4	0	0	0	0	26	0	0	0	0.0	4.00	0.0	0.0	1	0.0	0.0	0.0	Including 108L/s from Existing
		TOTAL	**1,163.80**	**21,855**	**20,274**	**57.7**	**52**	**4,401**	**2,580**	**636.2**	**410**	**70.4**	**2.65**	**186.3**	**5.8**	**1**	**5.8**	**103.4**	**295.5**	**404**

RESIDENTIAL RATE 300 L/c/d
COMMERCIAL RATE 17000 L/ha/d or 83L/emp/d
I/I RATE 0.28 L/s/ha

RESIDENTIAL PEAK FACTOR Harmon (K=1)
COMMERCIAL PEAK FACTOR 1

SCENARIO B FLOW PROJECTION

Interest	Area	IMP Catch ID	Catchment Area (GIS)	2031 Population	Growth	2031 ICI (ha)	Growth	2031 Employees	Growth	2031 Area (ha)	Growth	Res (300L/c/d)	PF (Harmon)	P_RES	Emp (83L/emp/d)	PF	P_Emp	I/I (90% of area)	Total Growth Flow	
Existing	NW	568	28	0	0	22.3	0	1046	0	28	0	0.0	4.00	0.0	0.0	1	0.0	0.0	0.0	
Existing	NE	601	59.4	1236	1199	0	0	0	0	59.4	18.4	4.2	3.75	15.6	0.0	1	0.0	4.6	20.2	
Existing	NE	602	55.4	2442	-227	0	0	5	0	55.4	0.1	-0.8	#NUM!	0.0	0.0	1	0.0	0.0	0.0	
Existing	NW	603	60.9	8	-1	35.4	35.4	2080	2073	60.9	35.4	0.0	#NUM!	0.0	2.0	1	2.0	8.9	10.9	
Existing	NW	604	177.9	7098	6653	0.1	0	508	500	177.9	115.2	23.1	3.13	72.3	0.5	1	0.5	29.0	101.8	
MER BLEUE	10A	632	88.5		10840	17	17	0	0	78.7	78.7	37.6	2.92	109.9	3.3	1	3.3	19.8	133.1	
	10B	633	88.8			0	0	0	0	79.8	79.8	0.0	4.00	0.0	0.0	1	0.0	20.1	20.1	
	10C	634	44			0	0	0	0	54.6	54.6	0.0	4.00	0.0	0.0	1	0.0	13.8	13.8	
MINTO	10D	635	8.3		1819	0	0	7	7	8.3	8.3	6.3	3.62	22.8	0.0	1	0.0	2.1	24.9	
	POND	636	13.4			0	0	0	0	13.4	0	0.0	4.00	0.0	0.0	1	0.0	0.0	0.0	
	10E	637	19.9			0	0	0	0	19.9	19.9	0.0	4.00	0.0	0.0	1	0.0	5.0	5.0	
Outside OP	S - 2060	647	232.9	86	-9	0	0	90	0	0	0	0.0	#NUM!	0.0	0.0	1	0.0	0.0	0.0	
Outside OP	E - 2060	648	286.4	0	0	0	0	26	0	0	0	0.0	4.00	0.0	0.0	1	0.0	0.0	0.0	Including 85L/s from Existing
		TOTAL	**1,163.80**	**21,855**	**20,274**	**57.7**	**52**	**4,401**	**2,580**	**636.2**	**410**	**70.4**	**2.65**	**186.3**	**5.8**	**1**	**5.8**	**103.4**	**295.5**	**381**

RESIDENTIAL RATE 300 L/c/d
COMMERCIAL RATE 17000 L/ha/d or 83L/emp/d
I/I RATE 0.28 L/s/ha

RESIDENTIAL PEAK FACTOR Harmon (K=1)
COMMERCIAL PEAK FACTOR 1

SCENARIO C FLOW PROJECTION

Interest	Area	IMP Catch ID	Catchment Area (GIS)	2031 Population	Growth	2031 ICI (ha)	Growth	2031 Employees	Growth	2031 Area (ha)	Growth	Res (350L/c/d)	PF (Harmon)	P_RES	Emp (83L/emp/d)	PF	P_Emp	I/I (90% of area)	Total Growth Flow	
Existing	NW	568	28	0	0	22.3	0	1046	0	28	0	0.0	4.00	0.0	0.0	1.5	0.0	0.0	0.0	
Existing	NE	601	59.4	1236	1199	0	0	0	0	59.4	18.4	4.9	3.75	18.2	0.0	1.5	0.0	4.6	22.8	
Existing	NE	602	55.4	2442	-227	0	0	5	0	55.4	0.1	-0.9	#NUM!	0.0	0.0	1.5	0.0	0.0	0.0	
Existing	NW	603	60.9	8	-1	35.4	35.4	2080	2073	60.9	35.4	0.0	#NUM!	0.0	2.0	1.5	3.0	8.9	11.9	
Existing	NW	604	177.9	7098	6653	0.1	0	508	500	177.9	115.2	27.0	3.13	84.3	0.5	1.5	0.7	29.0	114.0	
MER BLEUE	10A	632	88.5		10840	17	17	0	0	78.7	78.7	43.9	2.92	128.2	9.8	1.5	14.8	19.8	162.8	
	10B	633	88.8			0	0	0	0	79.8	79.8	0.0	4.00	0.0	0.0	1.5	0.0	20.1	20.1	
	10C	634	44			0	0	0	0	54.6	54.6	0.0	4.00	0.0	0.0	1.5	0.0	13.8	13.8	
MINTO	10D	635	8.3		1819	0	0	7	7	8.3	8.3	7.4	3.62	26.7	0.0	1.5	0.0	2.1	28.8	
	POND	636	13.4			0	0	0	0	13.4	0	0.0	4.00	0.0	0.0	1.5	0.0	0.0	0.0	
	10E	637	19.9			0	0	0	0	19.9	19.9	0.0	4.00	0.0	0.0	1.5	0.0	5.0	5.0	
Outside OP	S - 2060	647	232.9	86	-9	0	0	90	0	0	0	0.0	#NUM!	0.0	0.0	1.5	0.0	0.0	0.0	
Outside OP	E - 2060	648	286.4	0	0	0	0	26	0	0	0	0.0	4.00	0.0	0.0	1.5	0.0	0.0	0.0	Including 108L/s from Existing
		TOTAL	**1,163.80**	**21,855**	**20,274**	**57.7**	**52**	**4,401**	**2,580**	**636.2**	**410**	**82.1**	**2.65**	**217.4**	**12.3**	**1.5**	**18.5**	**103.4**	**339.3**	**447**

RESIDENTIAL RATE	350 L/c/d	
COMMERCIAL RATE	50000 L/ha/d	or 83L/emp/d
I/I RATE	0.28 L/s/ha	

RESIDENTIAL PEAK FACTOR	Harmon (K=1)
COMMERCIAL PEAK FACTOR	1.5

SCENARIO D FLOW PROJECTION

Interest	Area	IMP Catch ID	Catchment Area (GIS)	2031 Population	Growth	2031 ICI (ha)	Growth	2031 Employees	Growth	2031 Area (ha)	Growth	Res (350L/c/d)	PF (Harmon)	P_RES	Emp (83L/emp/d)	PF	P_Emp	I/I (90% of area)	Total Growth Flow	
Existing	NW	568	28	0	0	22.3	0	1046	0	28	0	0.0	4.00	0.0	0.0	1.5	0.0	0.0	0.0	
Existing	NE	601	59.4	1236	1199	0	0	0	0	59.4	18.4	4.9	3.75	18.2	0.0	1.5	0.0	4.6	22.8	
Existing	NE	602	55.4	2442	-227	0	0	5	0	55.4	0.1	-0.9	#NUM!	0.0	0.0	1.5	0.0	0.0	0.0	
Existing	NW	603	60.9	8	-1	35.4	35.4	2080	2073	60.9	35.4	0.0	#NUM!	0.0	2.0	1.5	3.0	8.9	11.9	
Existing	NW	604	177.9	7098	6653	0.1	0	508	500	177.9	115.2	27.0	3.13	84.3	0.5	1.5	0.7	29.0	114.0	
MER BLEUE	10A	632	88.5		10840	17	17	0	0	78.7	78.7	43.9	2.92	128.2	9.8	1.5	14.8	19.8	162.8	
	10B	633	88.8			0	0	0	0	79.8	79.8	0.0	4.00	0.0	0.0	1.5	0.0	20.1	20.1	
	10C	634	44			0	0	0	0	54.6	54.6	0.0	4.00	0.0	0.0	1.5	0.0	13.8	13.8	
MINTO	10D	635	8.3		1819	0	0	7	7	8.3	8.3	7.4	3.62	26.7	0.0	1.5	0.0	2.1	28.8	
	POND	636	13.4			0	0	0	0	13.4	0	0.0	4.00	0.0	0.0	1.5	0.0	0.0	0.0	
	10E	637	19.9			0	0	0	0	19.9	19.9	0.0	4.00	0.0	0.0	1.5	0.0	5.0	5.0	
Outside OP	S - 2060	647	232.9	86	-9	0	0	90	0	0	0	0.0	#NUM!	0.0	0.0	1.5	0.0	0.0	0.0	
Outside OP	E - 2060	648	286.4	0	0	0	0	26	0	0	0	0.0	4.00	0.0	0.0	1.5	0.0	0.0	0.0	Including 85L/s from Existing
		TOTAL	**1,163.80**	**21,855**	**20,274**	**57.7**	**52**	**4,401**	**2,580**	**636.2**	**410**	**82.1**	**2.65**	**217.4**	**12.3**	**1.5**	**18.5**	**103.4**	**339.3**	**424**

RESIDENTIAL RATE	350 L/c/d	
COMMERCIAL RATE	50000 L/ha/d	or 83L/emp/d
I/I RATE	0.28 L/s/ha	
RESIDENTIAL PEAK FACTOR	Harmon (K=1)	
COMMERCIAL PEAK FACTOR	1.5	

Appendix C STORMWATER MANAGEMENT

C.1 STORM SEWER DESIGN SHEET

Stantec

Orleans II - Draft Plan of Subdivision	
DATE:	2018-04-12
REVISION:	1
DESIGNED BY:	DT
CHECKED BY:	KS

STORM SEWER DESIGN SHEET (City of Ottawa)

FILE NUMBER: **160401419**

DESIGN PARAMETERS

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

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

MANNING'S n = 0.013 BEDDING CLASS = B

MINIMUM COVER: 2.00 m

TIME OF ENTRY 10 min

LOCATION			DRAINAGE AREA																									PIPE SELECTION											
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (2-YEAR) (ha)	AREA (5-YEAR) (ha)	AREA (10-YEAR) (ha)	AREA (100-YEAR) (ha)	AREA (ROOF) (ha)	C (2-YEAR) (-)	C (5-YEAR) (-)	C (10-YEAR) (-)	C (100-YEAR) (-)	A x C (2-YEAR) (ha)	ACCUM AxC (2YR) (ha)	A x C (5-YEAR) (ha)	ACCUM. AxC (5YR) (ha)	A x C (10-YEAR) (ha)	ACCUM. AxC (10YR) (ha)	A x C (100-YEAR) (ha)	ACCUM. AxC (100YR) (ha)	T of C (min)	I_{2-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)
110A, 110B	110	109	14.61	1.72	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	903.0	903.0	903.0	111.5	1050	1050	CIRCULAR	CONCRETE	-	0.20	1274.0	**70.87%**	1.43	1.35	1.37
																				11.37																			
116A, 116B	116	115	0.36	0.27	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	44.8	44.8	44.8	80.2	375	375	CIRCULAR	PVC	-	0.25	82.4	**54.30%**	0.78	0.69	1.95
115A	115	114	0.00	0.78	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	11.95	70.06	94.93	111.23	162.53	78.1	122.9	122.9	60.5	525	525	CIRCULAR	CONCRETE	-	0.20	200.6	**61.23%**	0.90	0.82	1.24
	114	113	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	13.18	66.42	89.93	105.35	153.90	0.0	122.9	122.9	48.8	525	525	CIRCULAR	CONCRETE	-	0.20	200.6	**61.23%**	0.90	0.82	1.00
113A, 113B	113	112	5.27	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	14.18	63.77	86.30	101.08	147.64	263.3	386.1	386.1	48.9	750	750	CIRCULAR	CONCRETE	-	0.20	519.4	**74.34%**	1.14	1.10	0.74
	112	111	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	14.92	61.95	83.81	98.14	143.32	0.0	386.1	386.1	97.8	750	750	CIRCULAR	CONCRETE	-	0.20	519.4	**74.34%**	1.14	1.10	1.49
111A, 111B	111	109	2.17	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	16.41	58.63	79.26	92.80	135.48	108.3	494.4	494.4	97.8	825	825	CIRCULAR	CONCRETE	-	0.20	669.7	**73.82%**	1.21	1.17	1.40
																				17.81																			
109A, 109B	109	108	1.87	0.62	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	17.81	55.85	75.47	88.34	128.94	155.6	1552.9	1552.9	141.4	1200	1200	CIRCULAR	CONCRETE	-	0.25	2033.7	**76.36%**	1.74	1.70	1.39
																				19.20									1200	1200									

C.2 BACKGROUND REPORT EXCERPTS (STORM DRAINAGE)

Innes Road Widening
Wildflower Outlet - Loblaws Route
Rational Method - Innes Road 10yr, BCIP Roads 5yr+ 750 L/s from Tenth Line
Fixed Flow Controls for Billberry Creek Industrial Park
New City 5 and 10 yr,

Project SO1137EON

Revised 6/7/2004

IDF equation
I = a/(b+D)^c (see data dict tab)
I = Rainfall Intensity (mm/hr)

	5 yr	10 yr
Return Period (t	5.00	10.00
Constant 'a'	998.07	1174.18
Constant 'b'	6.05	6.01
Constant 'c'	0.81	0.82
Initial Tc	20.00	20.00

n= 0.013

Areas (Ha) (5 Year Design: BCIP Roads, North Innes, North Innes; 10 Year Design) — Weighted Runoff R

Street	From	To	0.59 (BCIP Roads)	0.5 (North Innes)	0.35 (North Innes)	0.20	0.46	0.50	0.64	0.73	0.74	0.76	0.78	0.79	0.80	0.81	0.82	0.83	0.84
Tenth Line Rd	Pond N2	OU3																	
Vanguard Dr	OU3	STMH I12	0.01																
Vanguard Dr	STMH I12	STMH I10	0.26																
Vanguard Dr	STMH I10	STMH I9	0.23																
Vanguard Dr	STMH I9	STMH I8	0.28																
Vanguard Dr	STMH I8	STMH I7	0.3																
Vanguard Dr	STMH I7	STMH I6	0.27																
Vanguard Dr	STMH I6	STMH I5	0.43																
Loblaws	STMH I5	STMH I3																	
Loblaws	STMH I3	STMH I2																	
Loblaws	STMH I2	STMH I1																	
Loblaws	STMH I1	STMH F47																	
Innes Rd	STMH F75	STMH F67			0.80	0.04			0.19										0.31
Innes Rd	STMH F67	STMH F60			0.72											0.40			
Innes Rd	STMH F60	STMH F53			0.43														0.34
Innes Rd	STMH F53	STMH F47A												0.27					
Innes Rd	STMH F47A	STMH F47																	
Innes Rd	STMH F47	STMH F38									0.70								
Innes Rd	STMH F38	STMH F30												0.52					
BCIP	P1	P2	0.54																
BCIP	P2	P3	0.7																
BCIP	P4	P3	0.63																
BCIP	P3	P5	0.31																
BCIP	P5	P6	0.5																
BCIP	P7	P6	0.77																
BCIP	P6	STMH F30	0																
			3.45																
Wildflower Dr.	STMH F30	EX 19																	
Mer Bleue Rd	STMH F12	STMH F9										0.38							
Mer Bleue Rd	STMH F9	STMH F3					0.87									0.29			0.33
Mer Bleue Rd	STMH F3	STMH F13																	0.19
Innes Rd	STMH F13	STMH F20															0.54		
Innes Rd	STMH F20	STMH F28									0.56								
Innes Rd	STMH F28	STMH F29A																	
Innes Rd	STMH F29A	EXIST																	
Innes Rd	STMH F29A	EXIST																	
Wildflower Dr.	EX 19	EX 18																	
Wildflower Dr.	EX 18	EX 17																	
Wildflower Dr.	EX 17	EX 16																	
Wildflower Dr.	EX 16	EX 14																	
Wildflower Dr.	EX 14	EX 13																	
Wildflower Dr.	EX 13	EX 12																	
EASEMENT	EX 12	OUTLET																	
PRESTWICK OUTLET																			
Innes Road	STMH H3	STMH H10		0.31												0.44			

Rational Method / **Fixed Flow Rate (FFR) Tenth Line Road and BCIP Lots**

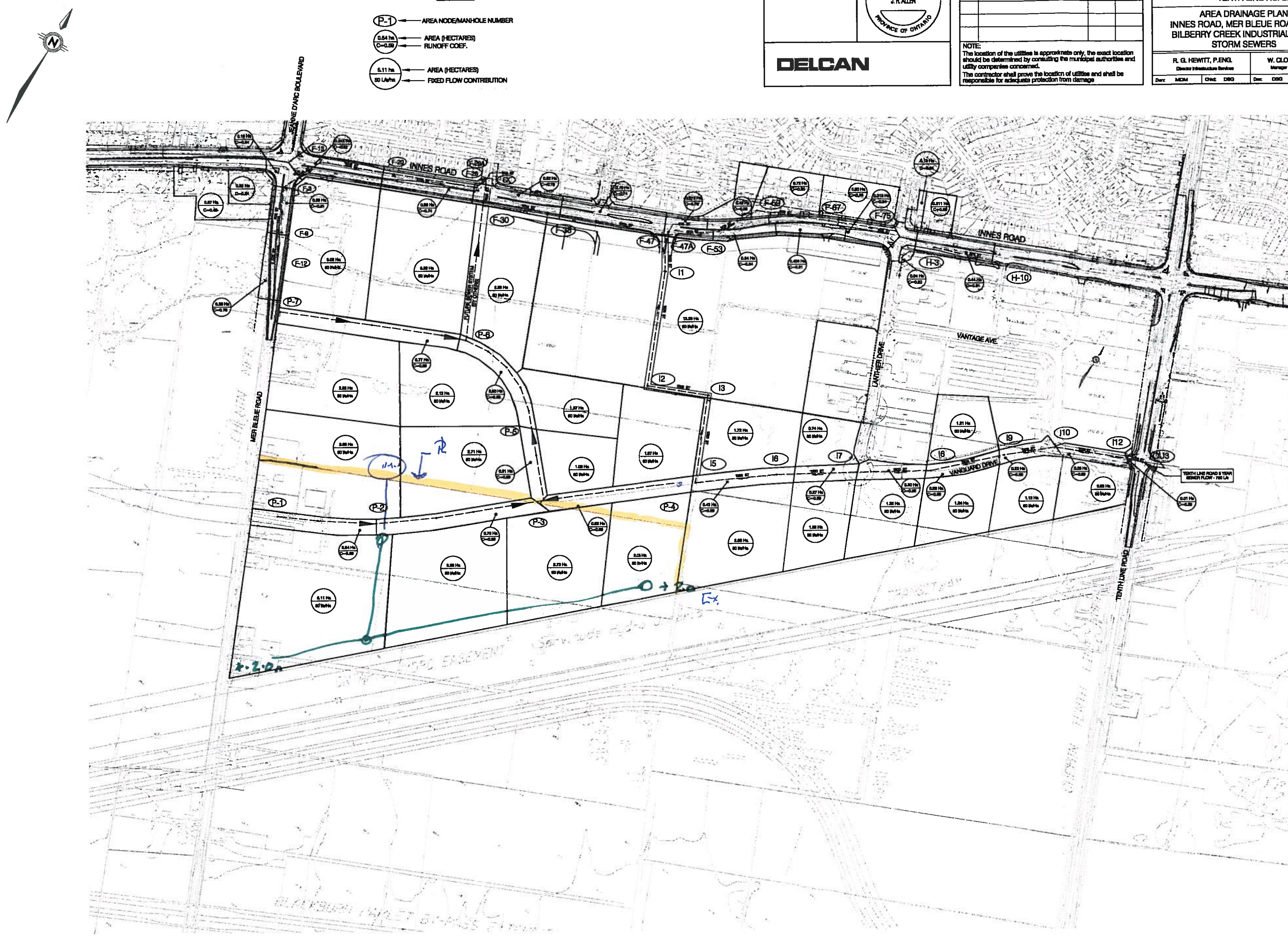
Street	From	To	5 Year Design Indiv. 2.78AR	5 Year Design Accum. 2.78 AR	10 Year Design Indiv. 2.78AR	10 Year Design Accum. 2.78 AR	Time of Conc. (min)	5 yr Rainfall Intensity (mm/hr) (I)	10 yr Rainfall Intensity (mm/hr) (I)	5 yr Rational Flow Q (L/sec)	10 yr Rational Flow Q (L/sec)	Total Rational Flow Q (L/sec)	Future Lot Area FFR 50 Area (Ha)	Cardinal Farm FFR 90 Area (Ha)	Tenth Line Road Q (L/sec)	Fixed Rate Flows Indiv. Q (L/sec)	Fixed Rate Flows Accum. Q (L/sec)	Peak Flow Q (L/sec)
Tenth Line Rd	Pond N2	OU3											0.00		750	0.00	750.00	750.00
Vanguard Dr	OU3	STMH I12	0.02	0.02	0.00	0.00	20.00	70.25		1.15		1.15	0			0.00	750.00	751.15
Vanguard Dr	STMH I12	STMH I10	0.43	0.44	0.00	0.00	20.47	69.24		30.66		30.66	0.93			48.50	796.50	827.16
Vanguard Dr	STMH I10	STMH I9	0.38	0.82	0.00	0.00	22.55	65.11		53.40		53.40	1.12			56.00	852.50	905.90
Vanguard Dr	STMH I9	STMH I8	0.46	1.28	0.00	0.00	23.90	62.71		80.23		80.23	2.45			122.50	975.00	1055.23
Vanguard Dr	STMH I8	STMH I7	0.49	1.77	0.00	0.00	25.80	59.65		105.66		105.66	1.32			66.00	1041.00	1148.66
Vanguard Dr	STMH I7	STMH I6	0.44	2.21	0.00	0.00	27.70	56.90		125.99		125.99	2.09			104.50	1145.50	1271.49
Vanguard Dr	STMH I6	STMH I5	0.71	2.92	0.00	0.00	29.62	54.39		158.81		158.81	4.28			214.00	1359.50	1518.31
Loblaws	STMH I5	STMH I3	0.00	2.92	0.00	0.00	31.54	52.12		152.17		152.17	0			0.00	1359.50	1511.67
Loblaws	STMH I3	STMH I2	0.00	2.92	0.00	0.00	33.60	49.91		145.71		145.71	0			0.00	1359.50	1505.21
Loblaws	STMH I2	STMH I1	0.00	2.92	0.00	0.00	35.07	48.45		141.45		141.45	0			0.00	1359.50	1500.95
Loblaws	STMH I1	STMH F47	0.00	2.92	0.00	0.00	37.87	45.92		134.07		134.07	13.29			664.50	2024.00	2158.07
Innes Rd	STMH F75	STMH F67	0.78	0.78	1.08	1.08	15.00	83.56	97.85	65.04	106.09	171.13	0.00			0.00	0.00	171.13
Innes Rd	STMH F67	STMH F60	0.70	1.48	0.91	1.99	16.44	79.18	92.70	117.10	184.84	301.94	0.00			0.00	0.00	301.94
Innes Rd	STMH F60	STMH F53	0.42	1.90	0.79	2.79	17.51	76.24	89.24	144.65	248.81	393.45	0.00			0.00	0.00	393.45
Innes Rd	STMH F53	STMH F47A	0.00	1.90	0.60	3.39	18.15	74.59	87.31	141.53	295.76	437.29	0.00			0.00	0.00	437.29
Innes Rd	STMH F47A	STMH F47	0.00	1.90	0.00	3.39	18.90	72.76	85.16	138.05	288.48	426.53	0.00			0.00	0.00	426.53
Innes Rd	STMH F47	STMH F38	0.00	4.82	1.43	4.82	38.70	45.23	52.84	217.85	254.55	472.40	0.00			0.00	2024.00	2496.40
Innes Rd	STMH F38	STMH F30	0.00	4.82	1.14	5.96	40.64	43.69	51.04	210.45	304.17	514.62	0.00			0.00	2024.00	2538.62
BCIP	P1	P2	0.89	0.89	0.00	0.00	20.00	70.25		62.22		62.22	8.77			438.50	438.50	500.72
BCIP	P2	P3	1.15	2.03	0.00	0.00	22.10	65.96		134.14		134.14	3.38			169.00	607.50	741.64
BCIP	P4	P3	1.03	1.03	0.00	0.00	20.00	70.25		72.59		72.59	6.75			337.50	337.50	410.09
BCIP	P3	P5	0.51	3.58	0.00	0.00	25.24	60.52		216.38		216.38	3.91			195.50	1140.50	1356.88
BCIP	P5	P6	0.82	4.40	0.00	0.00	26.48	58.63		257.73		257.73	6.08			304.00	1444.50	1702.23
BCIP	P7	P6	1.26	1.26	0.00	0.00	20.00	70.25		88.72		88.72	9.32			466.00	466.00	554.72
BCIP	P6	STMH F30	0.00	5.66	0.00	0.00	28.27	56.13		317.62		317.62	0.00			0.00	1910.50	2228.12
Wildflower Dr.	STMH F30	EX 19	0.00	10.48	0.00	5.96	42.58	42.27	49.37	442.77	294.22	736.99	0.00			0.00	3934.50	4671.49
Mer Bleue Rd	STMH F12	STMH F9			0.80	0.80	10.00		122.14		98.06	98.06	0.00			0.00	0.00	98.06
Mer Bleue Rd	STMH F9	STMH F3			2.54	3.34	10.83		117.21		391.38	391.38	0.00			0.00	0.00	391.36
Mer Bleue Rd	STMH F3	STMH F13			0.44	3.78	11.73		112.33		424.93	424.93	0.00			0.00	0.00	424.93
Innes Rd	STMH F13	STMH F20			1.24	5.02	12.32		109.38		549.12	549.12	0.00			0.00	0.00	549.12
Innes Rd	STMH F20	STMH F28			1.15	6.17	13.31		104.78		646.77	646.77	0.00			0.00	0.00	646.77
Innes Rd	STMH F28	STMH F29A			0.00	6.17	14.42		100.11		617.95	617.95	0.00			0.00	0.00	617.95
Innes Rd	STMH F29A	EXIST			0.00	5.17	14.53		99.67		615.25	615.25	0.00			0.00	0.00	615.25
Innes Rd	STMH F29A	EXIST															500.00	500.00
Wildflower Dr.	EX 19	EX 18	0.00	10.48	0.00	5.96	42.85	42.08	49.15	440.78	292.89	733.67				0.00	4434.50	5168.17
Wildflower Dr.	EX 18	EX 17	0.00	10.48	0.00	5.96	43.11	41.90	48.94	438.88	291.63	730.51		5.03		452.70	4887.20	5617.71
Wildflower Dr.	EX 17	EX 16	0.00	10.48	0.00	5.96	43.75	41.46	48.42	434.28	288.57	722.85				0.00	4887.20	5610.05
Wildflower Dr.	EX 16	EX 14	0.00	10.48	0.00	5.96	44.32	41.07	47.98	430.28	285.90	716.18		2.89		260.10	5147.30	5863.46
Wildflower Dr.	EX 14	EX 13	0.00	10.48	0.00	5.96	44.85	40.73	47.57	426.83	283.46	710.09		4.11		369.90	5517.20	6227.29
Wildflower Dr.	EX 13	EX 12	0.00	10.48	0.00	5.96	45.44	40.35	47.12	422.65	280.81	703.45		1.41		126.90	5644.10	6347.55
EASEMENT	EX 12	OUTLET	0.00	10.48	0.00	5.96	45.79	40.12	46.86	420.32	279.26	699.58		4.80		432.00	6076.10	6775.68
PRESTWICK OUTLET																		
Innes Road	STMH H3	STMH H10	0.43	0.43	1.00	1.00	20.00	70.25	82.21	30.27	82.01	112.28						112.28

SEWER DATA

Street	From	To	Type of Pipe	Diameter (mm) (nom.)	Diameter (act.)	Slope (%)	Length (m)	Capacity (L/sec)	Velocity (m/sec)	Time of Flow (min)	REMARKS
Tenth Line Rd	Pond N2	OU3									
Vanguard Dr	OU3	STMH I12	Conc	1050	1067	0.09	27	854.64	0.96	0.47	
Vanguard Dr	STMH I12	STMH I10	Conc	1050	1067	0.09	120	854.64	0.96	2.08	
Vanguard Dr	STMH I10	STMH I9	Conc	1200	1219	0.09	85	1220.19	1.05	1.35	
Vanguard Dr	STMH I9	STMH I8	Conc	1200	1219	0.09	120	1220.19	1.05	1.90	
Vanguard Dr	STMH I8	STMH I7	Conc	1200	1219	0.09	120	1220.19	1.05	1.90	
Vanguard Dr	STMH I7	STMH I6	Conc	1350	1372	0.09	130	1670.48	1.13	1.92	
Vanguard Dr	STMH I6	STMH I5	Conc	1350	1372	0.09	130	1670.46	1.13	1.92	
Loblaws	STMH I5	STMH I3	Conc	1350	1372	0.09	140	1670.48	1.13	2.06	
Loblaws	STMH I3	STMH I2	Conc	1350	1372	0.09	100	1670.46	1.13	1.47	
Loblaws	STMH I2	STMH I1	Conc	1350	1372	0.09	190	1670.46	1.13	2.80	
Loblaws	STMH I1	STMH F47	Conc	1500	1524	0.09	60	2212.36	1.21	0.83	
Innes Rd	STMH F75	STMH F67	Conc	525	533	0.40	110	283.76	1.27	1.44	
Innes Rd	STMH F67	STMH F60	Conc	900	914	0.40	117	1194.45	1.82	1.07	
Innes Rd	STMH F60	STMH F53	Conc	900	914	0.40	70	1194.45	1.82	0.64	
Innes Rd	STMH F53	STMH F47A	Conc	900	914	0.40	82	1194.45	1.82	0.75	
Innes Rd	STMH F47A	STMH F47	Conc	675	686	0.40	6	554.62	1.50	0.07	
Innes Rd	STMH F47	STMH F38	Conc	1650	1676	0.09	150	2852.57	1.29	1.94	
Innes Rd	STMH F38	STMH F30	Conc	1650	1676	0.09	150	2852.57	1.29	1.94	
BCIP	P1	P2	Conc	750	762	0.25	180	580.71	1.27	2.10	
BCIP	P2	P3	Conc	900	914	0.25	271	944.29	1.44	3.14	
BCIP	P4	P3	Conc	675	886	0.25	216	438.47	1.19	3.03	
BCIP	P3	P5	Conc	1050	1067	0.25	118	1424.40	1.59	1.24	
BCIP	P5	P6	Conc	1200	1219	0.25	187	2033.66	1.74	1.79	
BCIP	P7	P6	Conc	750	762	0.25	320	580.71	1.27	4.20	
BCIP	P6	STMH F30	Conc	1350	1372	0.25	220	2784.10	1.88	1.95	
Wildflower Dr.	STMH F30	EX 19	Conc	1800	1829	0.24	36	5874.75	2.24	0.27	
Mer Bleue Rd	STMH F12	STMH F9	Conc	375	381	0.40	50	115.68	1.01	0.83	
Mer Bleue Rd	STMH F9	STMH F3	Conc	600	610	0.40	75	405.13	1.39	0.90	
Mer Bleue Rd	STMH F3	STMH F13	Conc	1050	1067	0.40	72	1801.74	2.02	0.59	
Innes Rd	STMH F13	STMH F20	Conc	1050	1067	0.40	120	1801.74	2.02	0.99	
Innes Rd	STMH F20	STMH F28	Conc	1050	1067	0.40	135	1801.74	2.02	1.11	
Innes Rd	STMH F28	STMH F29A	Conc	1050	1067	0.40	14	1801.74	2.02	0.11	
Innes Rd	STMH F29A	EXIST	Conc	600	610	2.00	6	905.89	3.10	0.03	
Innes Rd	STMH F29A	EXIST									MAX CONTROLLED FLOW
Wildflower Dr.	EX 19	EX 18	Conc	1800	1829	0.37	43.2	7294.32	2.78	0.26	
Wildflower Dr.	EX 18	EX 17	Conc	1950	1981	0.25	92.8	7422.55	2.41	0.64	
Wildflower Dr.	EX 17	EX 16	Conc	1950	1981	0.31	91.0	8265.40	2.68	0.57	
Wildflower Dr.	EX 16	EX 14	Conc	1950	1981	0.27	79.7	7713.74	2.50	0.53	
Wildflower Dr.	EX 14	EX 13	Conc	1950	1981	0.20	75.7	6638.93	2.15	0.59	
Wildflower Dr.	EX 13	EX 12	Conc	1950	1981	0.35	60.2	8782.48	2.85	0.35	
EASEMENT	EX 12	OUTLET	Conc	1950	1981	0.30	73.1	8131.00	2.64	0.46	
PRESTWICK OUTLET											
Innes Road	STMH H3	STMH H10	PVC	375	381	0.50	120.0	129.34	1.13	1.77	

LEGEND

P-1 — AREA NODE/MANHOLE NUMBER
0.54 ha / C=0.59 — AREA (HECTARES) / RUNOFF COEF.
5.11 ha / 50 L/s/ha — AREA (HECTARES) / FIXED FLOW CONTRIBUTION



J. R. ALLEN
LICENSED PROFESSIONAL ENGINEER
PROVINCE OF ONTARIO

DELCAN

NO.	REVISIONS	BY	DATE

NOTE:
The location of the utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned.
The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage

INNES ROAD WIDENING
ORLEANS BLVD
TO
TENTH LINE ROAD

AREA DRAINAGE PLAN
INNES ROAD, MER BLEUE ROAD AND
BILBERRY CREEK INDUSTRIAL PARK
STORM SEWERS

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CONTRACT NO.
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DWG. NO.
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SHEET 1 OF 1
Date: JULY 2004
Scale: 1:3000 HORIZONTAL
0m 60 120 m

Line/Vanguard Intersection (that controls the flow from the N2 pond and the Tenth Line road interconnect).

The release rate from the BCIP was determined by providing a 5 year level of service for the road corridors and controlling the flow from the development parcels. Accounting for the 10 year flow contribution from the Innes and Mer Bleue road corridors and flow contributions from the remainder of the tributary area, it was found that new developments within the BCIP would have to be controlled to 50L/s/ha.

Tributary areas and peak flow contributions to the Wildflower Drive trunk sewer at Innes Road are summarized in **Table 3-1**.

TABLE 3-1
Tributary Areas and Peak Flow Contributions to the Wildflower Trunk Sewer at Innes Road – Major Flows

Tributary Area	Area (ha)	Controlled Flow Rate	
		L/s/ha	Total (L/s)
The BCIP development: • Future Lots (Phases 1 & 2) • Roads (Exist & Future)	 63.8 5.19	 50 100	 3190 519
Innes Road	3.7	235*	869.5
Mer Bleue Road	0.86	111	95.5
Existing Urban Block (south west corner of Innes and Mer Bleue Roads)	1.20	111	133.2
Existing Urban area north of Innes Road west of Prestwick Drive	2.14	150	321
The outflow from N2 SWM pond and Tenth Line Road storm sewer at Vanguard Drive	N/A	N/A	820
Total	**76.89**		**5948**

The total peak flow contribution to the Wildflower storm trunk at Innes Road of 5948L/s, shown in **Table 3-1**, represents the 100 year storm condition. For a 5 year storm, the peak flow contribution as shown in the Rational Method calculation provided in **Appendix G** is 5663L/s, which is less than the allowable flow of 5948L/s.

Areas and flow contributions to the BCIP – Innes Road trunk sewer between Tenth Line Road and Wildflower Drive are summarized in **Table 3-2**.

The required BCIP/Innes Road storm trunk size is a 1200mm diameter at Tenth Line Road and increases to a 1650mm on Innes Road at the outlet to Wildflower Drive trunk sewer. The sewer depth varies from 6.0m at Tenth Line Road to 7.2m at Wildflower Drive. The routing of the storm sewers through the BCIP for the preferred concept plan is shown on **Figure 3-3**.

TABLE 3-2
Tributary Areas and Peak Flow Contributions to the BCIP

Tributary Area	Area (ha)	Controlled Flow Rate	
		L/s/ha	Total (L/s)
The BCIP development:			
• Future Lots (Phase 1) Including Loblaws Site	25.7	50	1285
• Roads (Exist & Future Phase 1)	1.74	100	174
Innes Road Prestwick Dr. to Wildflower Dr.	1.88	235	441.8
Existing Urban area north of Innes Road west of Prestwick Drive	2.14	150	321
The outflow from N2 SWM pond and Tenth Line Road storm sewer at Vanguard Drive	N/A	N/A	820
Total	**31.46**		**3042**

3.1.2.4 Major System

The developments within the BCIP are required to provide onsite storage to reduce the 100 year storm flow to 50L/s/ha. The onsite storage volume requirement for the 100 year storm is 310m^3/ha based on the release rate of 50L/s/ha and an imperviousness ratio of 0.7.

The roads within the BCIP are to be designed to maximize the amount of storage that can be provided at sag points to a maximum of 130m^3/ha. The effective road slopes should be designed to allow major system flow to overflow towards Innes Road or Mer Bleue Road. Inlet control devices are required on catch basins to control sewer flows to the 5 year level of 100L/s/ha. Given that the major system flow from the BCIP area cannot flow across Innes Road, it is proposed to store excess volume in the ditches south of Innes Road and east of Mer Bleue Road. A DDSWMM assessment of the BCIP roadway drainage system was undertaken and it was found that approximately 1330m^3 of excess runoff would be generated during the July 1st, 1979 storm event. If 130m^3/ha of storage is provided in the sag points, 900m^3 of storage will be provided along the 6.93ha of internal roads. The remaining 430m^3 will therefore need to be stored in the ditches south of Innes Road.

The City's current design guidelines, published in November 2004, dictate that the minor system within arterial roads be designed to handle the 10 year peak flow and the flow from residential developments to the minor system be restricted to 85L/s/ha. (Refer to **Appendix H** for a copy of the technical memo explaining the basis for the 85L/s/ha.) As the BCIP storm flows were approved prior to the release of the November 2004 guidelines, the criteria used in sizing the collection system do not match the current guidelines. In addition, as it is intended to upgrade

Mer Bleue Road in 2008, the detailed design of the minor system along Mer Bleue must account for the proposed upgrade.

3.1.2.5 Downstream Impacts

3.1.2.5.1 Cardinal Farm Developments

The Hydraulic Gradeline (HGL) elevations in the Wildflower Drive trunk, which services the Cardinal Farm development, were calculated to determine the impact of major storm flow contributions from the sewershed south of and including Innes Road. The allowable release rates in **Table 3-1** were applied in calculating the flows and HGL elevations in XPSWMM. Peak flows from the Cardinal Farm development, which is tributary to the sewer system, were increased by 20 % for the 5 year event to account for the increased catch basin capture rates during the 100 year storm.

The results of the HGL analysis indicated there is no significant sewer surcharge during the 100 year storm. The maximum flow contribution to the Wildflower trunk from the catchment area south of and including Innes Road is $5.9m^3/s$ (major storm), which is close to the 5 year allowable flow of $6.16m^3/s$. (Refer to **Appendix I** for modeling details.)

3.1.2.5.2 Bilberry Creek

The existing SWM pond at Avenue Des Epinettes, constructed in 1986 was sized to control the flows from the BCIP and the Cardinal Farm development, as well as address erosion and flooding concerns in Bilberry Creek. Therefore, no negative impacts to Bilberry Creek are expected.

Similar to the existing properties within Phase 1 of the BCIP, water quality control measures are to be implemented as part of the City's development site plan control process. It is also of note that the N2 SWM pond provides additional treatment to allow areas downstream of the pond to be released untreated. Therefore, water quality control measures for the section of Innes Road draining to Wildflower and Prestwick trunks are not required.

3.1.2.6 Cost Apportionment – BCIP/Innes Road Storm Trunk

The cost sharing analysis for the BCIP / Innes Road trunk sewer was completed to delineate the costs associated between both the Innes Road and BCIP drainage catchments. The cost sharing considers not only the areas draining directly to the BCIP / Innes Road trunk but also the lands that were allocated capacity in the Prestwick Drive trunk, with the construction of the BCIP / Innes Road trunk. The cost sharing is assessed based on the peak flow contribution from the tributary areas considering the allowable flow to the Prestwick Drive trunk and the total flow from the areas directly tributary to the BCIP – Innes Road trunk sewer. The allowable flow to the Prestwick Drive trunk sewer is 2.6 m^3/s and the total flow contribution to the BCIP – Innes Road trunk sewer is 3.65 m^3/s. Flow contributions from the Innes Road (including Tenth Line Road) and the existing and proposed developments are summarized in **Table 3-3**.

4.0 Storm Drainage

4.1 STORM SEWER CRITERIA

Criteria were established by combining current design practices outlined by the City of Ottawa guidelines (2004) and the supporting servicing studies for the Pharand Lands and Bilberry Creek industrial Park (BCIP). Where the criteria conflicted, the BCIP & Pharand Lands report criteria were given precedence. The following summarizes the criteria, with the source of each criterion indicated in italics:

General

- Use of the dual drainage principle *(City of Ottawa)*
- Wherever feasible and practical, site-level measures should be used to reduce and control the volume and rate of runoff *(City of Ottawa)*
- Assess impact of 5 and 100 year storm (using 3-hour Chicago Storm distribution and City of Ottawa IDF parameters) (*City of Ottawa, Pharand/BCIP Reports*)

Storm Sewer & Inlet Controls

- Size storm sewers to convey 5 year storm event under free-flow conditions using 2004 City of Ottawa I-D-F parameters *(City of Ottawa)*
- 100 year Hydraulic Grade Line (HGL) analysis to be conducted using the boundary condition at outlet of 81.342 m (from BCIP report, Appendix I for node W19) *(Pharand/BCIP Reports)*
- Overall inlet rate to sewer to be restricted to 50 L/s/ha *(Pharand/BCIP Reports)*
- Sewer inlet rate for roads within the BCIP to be restricted to 100 L/s/ha *(Pharand/BCIP Reports)*

Surface Storage & Overland Flow

- No overland flow is allowed from internal sites, however overland flow is expected to occur along roadways
- Maximum 100 year ponding depth of 0.30 m *(City of Ottawa)*
- Sites to provide minimum storage of 200 m^3/ha or sufficient storage to contain 100 year storm on-site, whichever of the two is greater (*Pharand/BCIP Reports*)
- Road storage to be maximized where possible to provide up to 130 m^3/ha of storage (*Pharand/BCIP Reports*)

- Standing water depths at road sags not to cause surface flooding in any building or structure *(City of Ottawa)*
- Maximum ponding spill point elevation to be at least 0.30m below adjacent at-units grades *(City of Ottawa)*
- Subdrains required in swales where longitudinal gradient is less than 1.5% *(City of Ottawa)*
- Provide adequate emergency overflow conveyance off-site (*City of Ottawa*)

4.2 STORMWATER MANAGEMENT

The following sections describe the stormwater management (SWM) design for the Pharand Lands Development in the context of the background documents and governing criteria.

4.2.1 Proposed Conditions

The proposed development will consist of commercial buildings complete with associated transportation and servicing infrastructure. The various commercial blocks are bisected by the proposed internal roadways which connect to the intersection of Wildflower Drive and Innes Road.

The overall drainage area to the proposed outlet sewer is 41.2 ha: Future Development Lands (16.8 ha), Area Tributary to Proposed Dry Pond (9.6 ha), Development block STOR168 (4.3 ha), Remaining Site Area (10.4 ha). At the required rate of 50 L/s/ha, the peak allowable rate at the outlet is 2,060 L/s.

Future development areas (future blocks) have been considered for the purposes of this stormwater management analysis. The previous Stantec Pharand Lands report quantified this future area to the South as 15.2 ha, however using more detailed CAD areas it has been found that this area is actually 16.83 ha in size. For location and extent of this future development block, refer to excerpts of the previous Stantec report in **Appendix D.1**. The future development block will be serviced through the storm sewer trunk at upstream manhole MH200.

It is expected that development designs for these future blocks will be submitted to the City of Ottawa under separate applications. Stormwater Management criteria for the future blocks remain the same as in the BCIP and Pharand lands reports: sites are to provide minimum 200 m^3/ha of active storage in the 100 year event or sufficient storage to contain the 100 year storm on-site, whichever of the two criteria is greater. Inflow rates to the minor system are not to exceed 50 L/s/ha. Precise ponding volumes and final ICD sizes should be determined at the detailed design stage.

It is proposed that a portion of the proposed site drain unrestricted to a storm sewer, which is connected by reverse sloped pipe to a dry pond. An orifice will be placed on the sewer at MH110, causing water to back-up into the proposed dry pond. The orifice will not be in-line with the main trunk that runs from the Future Development Lands in the south to the intersection of Innes Road and Wildflower Drive. See **Figure 4.1** below, showing the proposed site subcatchments, with the proposed area which is tributary to the dry pond highlighted in blue.

The previous storm sewer design included conveying a portion of the Vanguard Road stormwater (drainage areas 132 and 139) through the site. At the City's request this design has been modified to convey these flows to the existing manhole in Vanguard Road. Analysis of the existing storm sewer design indicated that the downstream system (existing nodes 15 to 13) has capacity for 1671L/s and the proposed design would result in an actual flow rate of 1591 L/s. Therefore, there is sufficient capacity within the existing system to accommodate the additional flows from Vanguard Road.

Figure 4.1: PCSWMM Model Subcatchments in light green (area in blue is tributary to the proposed dry pond, area = 9.6 ha)

4.2.2 Design Methodology

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

- Restrict inflows to the sewer to a rate of 50 L/s/ha or less for sites via orifices
- Road CBs to be interconnected and controlled with a 100 mm circular diameter orifice per catchbasin pair, except in areas upstream of MH110 (these areas are tributary to the dry pond and should not have inlet restrictors)
- Produce a combined hydrologic/hydraulic model to provide minor system hydrographs and to model the storm sewer system
- Provide a preliminary volume total for the proposed dry pond based on the proposed outline
- Identify criteria and constraints for development blocks

The roadways are designed using the “dual drainage” principle, whereby the minor (pipe) system is designed to convey the peak rate of runoff from the 5 year design storm and runoff from larger events is to be conveyed by both minor (pipe) and major (overland) channels, such as roadways and walkways, safely off site without impacting proposed or existing downstream properties. A separate DDSWMM model was prepared as part of the BCIP report, dealing with major system flows from the internal roadways in the BCIP. Inlet and storage rates in the roadways should meet BCIP criteria; overflows should be directed to Innes Road, where they are to be stored in roadside ditches. See the BCIP report excerpts included in **Appendix D** for more information. Since the inlet rates for roadways are being met (and exceeded) in this analysis, and that an overland flow model for the roadways has been dealt with by others, the overland routes and downstream off-site storage have not been modeled in this analysis.

Solid covers should be installed on all manholes located in ponding areas to limit inflows to the minor system to that of the ICD.

Drawing SD-1 outlines the proposed storm sewer alignment, ICD locations, drainage divides and labels. The major flow from most of the site is contained within each block; right-of-ways are allowed to have major system flow beyond the five year event. Regardless, all areas will be graded to safely convey extreme flows off-site via engineered (overland) channels such as roadways and walkways. The majority of the site is graded to overflow to Innes Road, however some portions in the east will be directed to Vanguard Extension.

4.2.3 Building Storm Service Surcharging

Because the proposed buildings are slab-on-grade and will not have any basements, flooding will not be an issue. However, the City has expressed concerns regarding building storm services that are attached to the sewer which surcharges into the proposed dry pond. We have agreed to perform SWM modeling using several different storms to determine the maximum HGL (excluding the initial wave pulse). The pipe surcharge is due to water accumulating in the dry pond and is not permanent – the dry pond drains down over several hours. Six storm distributions were run at the 100 year return period: 3, 6, and 12 hour Chicago storms, and 6, 12, and 24 hour SCS storms. The HGLs from the 6 hour SCS storm were used to set the minimum storm service inverts for buildings S and A. HGL for the services to buildings S and A were 86.94 m and 87.14 m for building S and building A, respectively. It is therefore proposed that the storm services to these buildings have inverts not lower than these values and that a similar approach be taken for any future buildings proposed at the detailed design stage, unless these buildings are to have underground parking, in which case they will need to be sump pumped. Any parking garages will be fitted with backflow preventers and pumps, as is standard practice in the City of Ottawa. See **Appendix B.4** for the results of the SWM analysis, or the SWM modeling files that have been included on the CD attached to this report.

4.3 HYDROLOGY / HYDRAULICS

A preliminary integrated hydrologic/hydraulic modeling exercise was completed with PCSWMM, accounting for the sites area and future lands to the south.

Surface storage amounts based on the Pharand and BCIP reports were originally 200 m^3/ha for sites, 130 m^3/ha for right-of-ways. Because the criteria in this report is to provide either these above rates or sufficient storage to contain the 100 year storm on-site, these rates were multiplied by three (an arbitrary number). It is intended that if storage greater than 200 m^3/ha occurs, this preliminary overestimate of storage will allow the total quantity of stored volume to be identified. Actual per hectare rates of required storage are reported later in this report.

The following assumptions were applied to the preliminary PCSWMM 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 5 & 100 Year Analysis; July 1, 1979 City of Ottawa Historical Storm used to assess impact of major storm
- Imperviousness assumed as 100% for all site areas excluding the proposed pond and vacant strip of land to its north (these areas were assumed to have 0% imperviousness)
- Subcatchment areas and segment lengths defined from conceptual grading.
- Subcatchment width equal to catchment area divided by subcatchment flow length. Site inflows restricted with inlet-control devices (ICDs) as necessary to meet inlet rate criterion.
- Storage amounts over-predicted to ensure capture of total 'actual storage' volume

Drawing SD-1 presents the proposed subcatchments used in the analysis of the proposed development. The preliminary grading plans are also enclosed for review.

For the purposes of this analysis, the Future Development Lands to the south and the development block in storm area ST168 are considered to be self contained. Hydrographs for area ST168 were generated and routed through that site's storage, with a flow restriction at 50 L/s/ha. The Future Development Land to the south was represented by a static constant inflow of 841.6 L/s at node 200 (i.e. 16.833 ha at 50 L/s/ha).

Zurn Flo-Control Roof Drains are proposed for the flat roofs of the buildings on-site. A brief modified rational method analysis was used to calculate the number of drains required for the buildings, see **Appendix B** for the results. The stage versus flow and storage curves calculated in this analysis were input into the PCSWMM model. Water depths on roofs during the 100 year storm do not exceed 75 mm.

The BCIP proposed inlet restriction rate for the roadways is 100 L/s/ha. It was found that for most road catchments, this could be achieved using a 100 mm circular orifice. In order to meet the criterion for some smaller catchments however, an orifice smaller than the minimum allowable City size would be required; this was not considered to be a viable option. For simplification of construction installation, it is proposed to use this ICD size in all interconnected roadway CBs. Any over-contribution of flow has been offset by reducing the flow from the dry pond tributary area.

The list of proposed inlet control devices is presented below in **Table 4.1**.

Table 4.1: Preliminary Inlet Control Device Schedule

Tributary Area IDs	Located in Structure:	Install Type	Orifice Size, Circular Diameter (mm)	Peak Flow Rate (L/s)
Control for areas to pond	110	PLUG	200	216
ST170, ST174, RF181, RF179, RF176, RF177	167 (on u/s inv. to STM170)	FRAME	175	125
ST199	206	PLUG	100	39
ST167	184	PLUG	100	34
ST197	208	PLUG	100	39
ST188	193	PLUG	100	31
ST190	191	PLUG	100	45
ST106B	228	PLUG	100	37
ST106	226	PLUG	100	35
ST165	212	PLUG	100	34
CB203	201	PLUG	95	36
CB215	214	PLUG	95	33

Tributary Area IDs	Located in Structure:	Install Type	Orifice Size, Circular Diameter (mm)	Peak Flow Rate (L/s)
ST230	230	PLUG	75	32
ST109	217	PLUG	75	30
ST106A	225	PLUG	75	18
CB223, CB224, ST219, CB222, RF220	218	PLUG	150	102

Table 4.2 summarizes the subcatchment areas, node outlets, and peak runoff rates for the proposed development during the 100 year, 3-hour Chicago storm, as well as maximum required storage rates. **Appendix B** summarizes the modeling results for the subject area for the 100 year storm.

Table 4.2: PCSWMM Results (100 Year Storm)

Area Group	Name	Area (ha)	Peak Runoff (L/s)	Outlet	Storage Node	Maximum Storage (cu.m)	Orifice Size, Circular Diameter (mm)	Peak Flow Rate (L/s)
ROW	ST106B	0.088	43	228	228	3	100	37
	ST106	0.324	156	226	226	84	100	35
	ST199	0.369	169	206	206	89	100	39
	ST197	0.385	175	208	208	99	100	39
	ST190	0.108	53	191	191	2	100	45
	ST188	0.383	174	193	193	110	100	31
	ST167	0.341	150	184	184	88	100	34
	ST165	0.483	225	212	212	157	100	34
To_Pond	ST154	0.783	366	154	143	2635	0	0
	CB156	0.479	234	156				
	ST151	0.148	73	151				
	ST135A	0.932	441	136				
	ST132	1.912	907	140				
	ST128A	1.793	849	146				
	ST128	0.137	62	128				
	ST123	0.604	272	123				

<table>
<tr><th>Area Group</th><th>Name</th><th>Area (ha)</th><th>Peak Runoff (L/s)</th><th>Outlet</th><th>Storage Node</th><th>Maximum Storage (cu.m)</th><th>Orifice Size, Circular Diameter (mm)</th><th>Peak Flow Rate (L/s)</th></tr>
<tr><td rowspan="16">Parcels</td><td>ST118</td><td>0.375</td><td>173</td><td>118</td><td rowspan="4"></td><td rowspan="4"></td><td rowspan="7"></td><td rowspan="7"></td></tr>
<tr><td>CB160</td><td>0.076</td><td>37</td><td>160</td></tr>
<tr><td>POND</td><td>0.549</td><td>68</td><td>143</td></tr>
<tr><td>FREE_1</td><td>0.175</td><td>47</td><td>POND</td></tr>
<tr><td>RF150A</td><td>0.271</td><td>133</td><td>STOR150</td><td rowspan="2">STOR150</td><td rowspan="2">559</td></tr>
<tr><td>RF150</td><td>0.886</td><td>430</td><td>STOR150</td></tr>
<tr><td>RF114</td><td>0.178</td><td>88</td><td>STOR114</td><td>STOR114</td><td>87</td></tr>
<tr><td>ST109</td><td>0.419</td><td>206</td><td>217</td><td>217</td><td>138</td><td>75</td><td>30</td></tr>
<tr><td>ST230</td><td>0.401</td><td>190</td><td>230</td><td>230</td><td>122</td><td>75</td><td>32</td></tr>
<tr><td>ST106A</td><td>0.325</td><td>156</td><td>225</td><td>225</td><td>116</td><td>75</td><td>18</td></tr>
<tr><td>RF231</td><td>0.030</td><td>15</td><td>STOR231</td><td>STOR231</td><td>15</td><td>Zurn</td><td>1</td></tr>
<tr><td>RF211</td><td>0.419</td><td>208</td><td>STOR211</td><td>STOR211</td><td>204</td><td>Zurn</td><td>16</td></tr>
<tr><td>RF210</td><td>0.046</td><td>23</td><td>STOR210</td><td>STOR210</td><td>23</td><td>Zurn</td><td>2</td></tr>
<tr><td>RF195</td><td>0.289</td><td>143</td><td>STOR195</td><td>STOR195</td><td>141</td><td>Zurn</td><td>11</td></tr>
<tr><td>CB215</td><td>0.782</td><td>350</td><td>214</td><td>214</td><td>309</td><td>95</td><td>33</td></tr>
<tr><td>CB203</td><td>0.996</td><td>414</td><td>201</td><td>201</td><td>406</td><td>95</td><td>36</td></tr>
<tr><td>Future</td><td>ST168</td><td>4.328</td><td>1700</td><td>STOR1</td><td>STOR1</td><td>1546</td><td>TBD</td><td>216</td></tr>
<tr><td rowspan="6">NW corner of site, controlled at MH174</td><td>ST174</td><td>1.159</td><td>558</td><td>172</td><td rowspan="2">169</td><td rowspan="2">771</td><td rowspan="6">0</td><td rowspan="6">0</td></tr>
<tr><td>ST170</td><td>0.983</td><td>472</td><td>170</td></tr>
<tr><td>RF181</td><td>0.310</td><td>154</td><td>STOR181</td><td>STOR181</td><td>151</td></tr>
<tr><td>RF179</td><td>0.035</td><td>17</td><td>STOR179</td><td>STOR179</td><td>17</td></tr>
<tr><td>RF177</td><td>0.046</td><td>23</td><td>STOR177</td><td>STOR177</td><td>23</td></tr>
<tr><td>RF176</td><td>0.067</td><td>33</td><td>STOR176</td><td>STOR176</td><td>33</td></tr>
<tr><td rowspan="5">NE corner of site, controlled at MH218</td><td>RF220</td><td>0.237</td><td>117</td><td>STOR220</td><td>STOR220</td><td>115</td><td rowspan="5">0</td><td rowspan="5">0</td></tr>
<tr><td>ST219</td><td>0.234</td><td>114</td><td>219</td><td rowspan="4">218</td><td rowspan="4">454</td></tr>
<tr><td>CB224</td><td>0.198</td><td>98</td><td>224</td></tr>
<tr><td>CB223</td><td>0.338</td><td>166</td><td>223</td></tr>
<tr><td>CB222</td><td>0.614</td><td>301</td><td>222</td></tr>
</table>

Tot. Area: **24.035** **ha**

Max Storage: **8497.52** **cu.m**
Max. Storage per ha: **353.5** **cu.m/ha**

Total Peak Runoff: **10785** **L/s**
Total peak runoff per hectare: **448.7** **L/s/ha**

Maximum Inflow (L/s): **841.6**
Maximum Inflow per ha (L/s/ha): **35.0**

Maximum ICD Inflow from Site (L/s):	**936**	**L/s**
External Flow From Industrial Lands to South (L/s):	**842**	**L/s**
Peak Maximum Inflow with ICDs & External:	**1777**	**L/s**
Actual Peak Flow at outlet from model:	**1946**	**L/s**
Allowable flow:	**2060**	**L/s**
Amount that actual peak flow is below allowable flow:	**114**	**L/s**

As can be seen from the table, the expected required storage rate per hectare for the proposed site is higher than previously estimated (310 m^3/ha from BCIP report versus 354 cu.m/ha). This is mostly due to the change in imperviousness: the subject sites were previously anticipated to be 70% impervious, but now are effectively 100% impervious. Some sites may not be able to contain all of the proposed runoff in surface storage. In these cases, either underground storage or volume reduction methods would be required to meet the criterion.

The proposed dry pond peaks at 0.76 m in depth during the 100 year 3 hour Chicago storm event (2,635 cu.m). This is below the 2.0 m allowable maximum depth the Ministry of the Environment specifies. A detailed pond design should be prepared at the detailed design stage. A preliminary area and depth has been shown on **Drawing GP-1**, which was used in this analysis.

In future, further storage could be gained by placing inlet controls on sites within the dry pond tributary area. Standard practice in the City of Ottawa is to avoid inlet control devices in series such as this, however because the potential storage volumes are at different elevations, ICDs in series would be necessary to take advantage of all of the available storage. Storing more runoff on the individual sites within the dry pond tributary area would reduce the size of the dry pond.

Table 4.3 below presents the peak outflow rates to the trunk sewer on Innes Road for each of the modeled scenarios. During all scenarios, the peak flow rate is below the allowable rate of 2,060 L/s.

Table 4.3: Scenario Peak Outflow Rates

	100 Year, 3 Hour Chicago Storm	5 Year, 3 Hour Chicago Storm	July 1, 1979 Historical Storm
Peak Outflow Rate (L/s) to Innes Road	1946	1834	1905

Peak Outlet Rate per Hectare (L/s/ha)	48	45	47

The City of Ottawa normally requires that during the major storm event, the maximum hydraulic grade line (HGL) be kept at least 0.30 m below the underside-of-footing (USF) of any adjacent units connected to the storm sewer. There are no units with USFs proposed in this commercial development.

Appendix B summarizes the results of the hydraulic modeling and output files for the subject site area during the 100 year storm event. All modeling files and results are contained on the CD enclosed with this report.

Appendix D GEOTECHNICAL INVESTIGATION

patersongroup

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Preliminary Geotechnical Investigation

Pharand Lands-Commercial Developments
Innes Road
Ottawa, Ontario

Prepared For

SmartCentres

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Report No. PG0811-1

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APPENDICES

1.0 INTRODUCTION

Paterson Group (Paterson) was commissioned by SmartCentres to conduct a preliminary geotechnical investigation for a proposed commercial development to be located at the southeast intersection of Innes Road and Mer Bleue Road (Pharand Lands), in the City of Ottawa, Ontario (refer to Figure 1, Key Plan in Appendix 2 of this report).

The objectives of the current investigation were to:

- ❑ determine the subsoil and groundwater conditions at this site by of a series of test pits and eight (8) boreholes; and
- ❑ based on the results of the test holes, provide preliminary geotechnical recommendations pertaining to the design of the proposed commercial development including construction considerations that may affect its design.

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

Investigating the presence or potential presence of contamination on the subject property was not part of the scope of work of this present investigation. Therefore, the present report does not address environmental issues.

A Phase I Environmental Site Assessment (ESA) was completed by Paterson concurrently with the present investigation. The findings and recommendations of the Phase I ESA are presented under separate cover.

2.0 PROPOSED DEVELOPMENT

The proposed development is to be located in the southeast quadrant of the intersection of Innes Road and Mer Bleue Road. The subject site is bordered by commercial development to the east, agricultural lands to the south, Mer Bleue Road to the west and Innes Road to the north. The property is known as the Pharand Lands and covers an area of about 24.5 hectares.

It is understood that a commercial development, including several buildings, paved access lanes and parking areas, is being considered. Also, it is understood that the proposed buildings are to be one-storey slab-on-grade construction. Further details of the development were not known at the time of writing this report.

3.0 METHOD OF INVESTIGATION

3.1 Field Investigation

The fieldwork program for the preliminary investigation was carried out on April 5 and 12, 2006. At that time eight (8) boreholes (BHs 1 to 8) and 34 test pits (TPs 1 to 34) were advanced to depths ranging from 0.3 to 13.9 m. The test holes locations were spaced across the site to provide full coverage of the subject site. The locations of the test holes are shown on Drawing PG0811-1, Test Hole Location Plan, included in Appendix 2.

The boreholes were put down using a track-mounted auger drill rig operated by a crew of two. The drilling procedure consisted of augering to the required depths at the selected locations, and sampling and testing the overburden.

The test pits were excavated using a rubber tired back-hoe supplied and operated by a local contractor. The test pit operations consisted of excavating to the required depths at the selected locations, and sampling and testing the overburden. The test pits were loosely backfilled upon completion. The purpose of the test pits was to better delineate the shallow bedrock encountered at this site.

All fieldwork was conducted under the full-time supervision of personnel from Paterson's geotechnical division under the direction of a senior engineer.

Sampling and In Situ Testing

In the boreholes, soil samples were recovered from the auger flights and using a 50 mm diameter split-spoon sampler. The depths at which the auger and split-spoon samples were recovered from the boreholes are depicted as AU and SS, respectively, on the Soil Profile and Test Data sheets 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.

Soil samples were recovered from the base and side walls of the test pits. The depths at which the samples were recovered in the test pits are depicted as G on the Soil Profile and Test Data sheets in Appendix 1.

The soil samples were logged on site, placed in sealed plastic bags and transported to our laboratory.

The thickness of the overburden was evaluated during the course of the investigation by dynamic cone penetration testing (DCPT) at BH 2. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at its 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 in the test holes were recorded in detail in the field. The soil profiles are logged on the Soil Profile and Test Data sheets presented in Appendix 1 of this report.

Groundwater

A flexible standpipe was installed in all boreholes except BH 6 to permit monitoring of the groundwater levels subsequent to the completion of the sampling program.

Sample Storage

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

3.2 Field Survey

The test hole locations were determined by Paterson personnel and were located and surveyed in the field by Stantec Consulting Limited (Stantec). The locations of the test hole and the ground surface at each test hole locations are presented on Drawing PG0811-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

A total of 35 soil samples were recovered from the subject site and examined in our laboratory to review the results of the field logging.

3.4 Analytical Testing

One (1) soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The sample was submitted to determine the concentration of sulphate and chloride, the resistivity and the pH of the soil. The results were not available at the time of writing this report. They will be provided as soon as they become available.

4.0 OBSERVATIONS

4.1 Surface Conditions

The subject site is currently vacant except for a few buildings and a well. The ground surface is relatively flat except for a bedrock outcrop, which is higher than the remainder of the site and located in the central portion of the subject site.

Generally, the ground surface is covered with grass and a few trees except for the bedrock outcrop mentioned earlier.

4.2 Subsurface Profile

The soil profile underlying the site consists primarily of a topsoil overlying silty clay and/or glacial till. Fill extending to depths of 1.1 and 0.2 m was encountered at TPs 1 and 2, respectively. Shallow bedrock was observed in the northwest and central portions of the site. All test holes, except BHs 2, 4, 5, 7 and 8, and TPs 8 to 11, 13, 16, 17, 23, 24 and 29 were terminated on bedrock/inferred bedrock, at depths ranging from 0.3 to 13.9 m. Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for the details of the soil profile encountered at each test hole.

Topsoil

Topsoil was encountered at ground surface at all test hole locations except TP 2. The apparent thickness of this layer ranges from 80 to 600 mm.

Fill

At BH 1 and TP 1, fill consisting of silty clay with trace of organic matter and/or gravel was encountered below the topsoil. The fill extends to a depth of 1.1 m. Fill, consisting of crushed stone and extending to a depth of 0.2 m, was encountered at ground surface at TP 2.

Silty Sand/Sandy Silt

Silty sand or sandy silt was encountered below the topsoil or crushed stone at TPs 2 and 3. This layer extends to 2.1 m at TP 2 and to 0.9 m at TP 3. Based on visual observations, the state of compactness of this layer is estimated to be loose to compact.

Silty Clay/Clayey Silt

Silty clay/clayey silt was encountered beneath the topsoil, silty sand, sandy silt and/or fill at all test hole locations except TPs 2, 4 and 12. Boreholes 4, 5, 7, and 8, and TPs 8, 11, 13, 16, 17, 23, 24 and 29 were terminated within the silty clay.

The upper portion of the silty clay has been weathered to a stiff to very stiff brown crust or red-brown crust. The crust extends to approximate depths varying between 2.0 and 3.2 m.

Two (2) in situ shear vane field testing carried out in the lower portion of the weathered crust yielded undrained shear strength values of approximately 85 and 55 kPa. Based on the undrained shear strength values and the SPT N values, the consistency of the weathered silty crust is estimated to range from stiff to very stiff.

Grey silty clay was encountered below the weathered crust at BHs 2, 4, 5, 7 and 8, and at TPs 8, 11, 13, 16, 17, 23, 24 and 29.

In situ shear vane field testing carried out within the grey silty clay yielded undrained shear strength values ranging from approximately 20 to 45 kPa. These values are indicative of a soft to firm consistency.

Silty Sand/Sandy Silt

Silty sand/sandy silt was encountered below the topsoil and/or fill at TPs 2 and 3. This layer, which was encountered at depth of 0.2 m, has a thickness of 0.9 and 2.1 m at TPs 3 and 2, respectively.

Glacial Till

Glacial till, which consists of a fine soil matrix mixed with gravel, cobbles and boulders, was encountered below the silty clay at BHs 1 and 3, and at TPs 1, 5 to 7, 9 and 10. It was also encountered below the topsoil at TPs 4 and 12. The fine soil matrix consists of silty sand, sandy silt or clayey silt with sand. The glacial till was encountered at depths ranging from 0.2 to 3.3 m.

Based on visual observations, the state of compactness of the glacial till is estimated to be compact to dense.

Bedrock/Inferred Bedrock

Bedrock/inferred bedrock was encountered at all test pits except BHs 4, 5, 7 and 8, and at TPs 8 to 11, 13, 16, 17, 23, 24 and 29. The bedrock/inferred bedrock surface was encountered at depths ranging from 0.3 m at TP 12 to 13.9 m at BH 2.

Based on available geological mapping, the bedrock in the area consists of limestone and dolomite interbedded of the Gull River formation. Also based on available geological mapping, the overburden thickness is expected to range from 1 to 25 m.

4.3 Groundwater

Groundwater levels were measured in the standpipe placed in the boreholes (except BH 6) and in the open test pits prior to backfilling. The measured groundwater levels range from ground surface to a depth of 3 m. The measured groundwater level (GWL) readings are presented in Table 1.

It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater level could be higher at the time of construction.

Table 1
Summary of Groundwater Levels

Borehole Number	Measured Groundwater Level, m	Recording Date	Borehole Number	Measured Groundwater Level, m	Recording Date
	Depth			Depth	
BH 1	Dry	April 12, 2006	TP 15	1.00	April 12, 2006
BH 2	0.60		TP 16	1.80	
BH 3	0.45		TP 17	1.00	
BH 4	0.40		TP 18	1.10	
BH 5	0.21		TP 19	Dry	
BH 7	Ground surface		TP 20	Dry	
BH 8	Ground surface		TP 21	Dry	
TP 1	1.20		TP 22	Dry	
TP 2	1.30		TP 23	2.00	
TP 3	1.40		TP 24	1.40	
TP 4	1.10		TP 25	1.60	
TP 5	1.20		TP 26	Dry	
TP 6	Dry		TP 27	1.20	
TP 7	Dry		TP 28	Dry	
TP 8	3.00		TP 29	Dry	
TP 9	2.90		TP 30	Dry	
TP 10	2.40		TP 31	Dry	
TP 11	1.60		TP 32	Dry	
TP 12	1.60		TP 33	Dry	
TP 13	1.50		TP 34	Dry	
TP 14	Dry				

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 Geotechnical Assessment

Based on the information provided, the proposed development is to consist of several commercial buildings of slab-on-grade construction, paved parking areas and access lanes.

For the most part, the subsurface conditions at this site consist of silty clay and/or glacial till overlying bedrock, which was encountered at shallow depths in the northwest and central portions of the subject property. Glacial till, silty sand or sandy silt were encountered at shallow depths at a few locations.

Buildings could be founded on footings placed on shallow silty sand, glacial till and bedrock. Where silty clay is encountered at or below the founding levels, routine shallow footing foundation will be possible only where the grade raise are within a permissible range and if the allowable bearing pressures are sufficient for the footing loads. Deep foundation, such as piles or caissons founded on the bedrock surface could be used as an alternative where the anticipated settlements at the buildings will not be acceptable. Alternatively, lightweight fill and/or surcharging could be used to reduce the potential post-construction total and differential settlements and, possibly, permit the construction of routine shallow footing foundations. Additional testing is required to determine the permissible grade raise in the area of deep silty clay. Areas of deep silty clay are considered to be:

- ❏ the eastern 2/3 of the northern half of the property (i.e. north of TP 25 and east of TPs 7 and 15)
- ❏ a deep silty clay trough may also exist at TPs 10 and 11, and may extend to the east
- ❏ the southwest corner of the subject site (east of TP 33)
- ❏ possibly, along the western half of the south property limit (i.e. south of TPs 30and 33)
- ❏ the southeast corner of the southern half of the property (i.e. east of BHs 4, and 6 and TPs 24, 25, 26, and 30).

Bedrock removal will likely be required for the construction of the building foundations and/or underground service trenches.

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. If encountered, existing foundation walls and other construction debris should be entirely removed from within the building perimeters. Under paved areas, existing construction remnants such as foundation walls should be excavated to a minimum of 1 m below final grade.

Bedrock Removal

Bedrock removal could be carried out by hoe-ramming where only small quantities of bedrock need to be removed. Otherwise, line drilling and controlled blasting could be used. However, prior to considering blasting, the blasting effects and potential damage to existing adjacent structures should be addressed.

As a general guideline, peak particle velocities of 50 mm/sec (measured at the structures) should not be exceeded during the blasting program to reduce the risks of damage to the existing structures.

The blasting operations should be planned and carried out under the supervision of a licensed professional engineer who is also a blasting expert.

A pre-blast or preconstructing survey of the existing surrounding structures should be carried out prior to commencing site blasting activities. The extent of the survey should be determined by the blasting consultant and should be sufficient to respond to any inquiries/claims related to the blasting operations.

Fill Placement

Fill used for grading beneath the buildings, between footings and foundation walls, and under the base and subbase layers of paved areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular B Type I or II. These materials should be tested and approved prior to delivery to the site. The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the buildings and paved areas should be compacted to at least 95% of its standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to reduce 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 their respective 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.

If excavated rock is to be used as fill, it should be suitably fragmented to produce a well-graded material with a maximum particle size of 300 mm. This material should be used structurally only to build up the subgrade for pavements. Where the fill is open-graded, a blinding layer of finer granular fill and/or a woven geotextile may be required to prevent adjacent finer materials from migrating into the voids, with associated loss of ground and settlements. This can be assessed at the time of construction.

5.3 Foundation Design

Preliminary Allowable Bearing Pressures - Shear Failure

Founding conditions at the site are generally considered suitable for the construction of commercial buildings provided that the grade raise are within permissible range. These restrictions apply only in areas of deep silty clay.

Based on the subsurface profile encountered at the site, it is expected that silty clay, silty sand/sandy silt, glacial till and/or bedrock will be encountered at the founding levels.

For preliminary design proposes footings placed on surface-sounded bedrock bearing media can be designed using a preliminary allowable bearing pressure of 1,000 kPa. On undisturbed glacial till or silty sand/sandy silt, the footings can be designed using an allowable bearing pressure of 150 and 100 kPa, respectively.

For preliminary design purposes, the allowable bearing pressure against shear failure in silty clay can be taken as presented in Tables 2 and 3. It should be noted that the allowable bearing pressures must also be checked for acceptable settlements. Further investigation is recommended for settlement analysis.

Table 2
Preliminary Allowable Bearing Pressure for Strip Footings on Silty Clay, kPa

Founding Depth below OGS* (m)	Footing Width (m)			
	0.6	1	1.5	2
1	150	135	100	85
1.5	150	115	90	75
2	130	95	75	70

* Original Ground Surface

Table 3
Preliminary Allowable Bearing Pressure for Square Footings on Silty Clay, kPa

Founding Depth below OGS* (m)	Footing Dimension (m by m)			
	1.5 by 1.5	2.0 by 2.0	2.5 by 2.5	3.0 by 3.0
1	125	100	85	70
1.5	105	85	75	65
2	85	75	65	60

*Original Ground Surface

The bearing pressures 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. In bedrock, the footing beds should be free of soil and loose materials.

Where fill is required to raise the grade below the footing level, the fill located within the zones of influence of the footings should consist of engineered fill. The engineered fill should consist of OPSS Granular A (crushed stone) or Granular B Type II materials and should be placed in maximum 300 mm thick loose lifts compacted to a minimum of 98% of its SPMDD.

The zone of influence of the footing is considered to extend out from the edges of the footing at a slope of 1H:1V, or flatter, and out to the in situ soil. for preliminary design purpose, the allowable bearing pressures for footings placed on engineered fill should be taken as that of the soil over which it is placed (e.g. 150 kPa if placed over glacial till and 100 kPa if placed over silty sand) taking the depth of the underside of the footing as input to Tables 2 and 3 if placed over silty clay.

The allowable bearing pressures should be confirmed by the geotechnical consultant at the time of construction. Reduction in allowable bearing pressure may be required to address settlement concerns at some locations.

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 a stiff to very stiff silty clay, glacial till, silty sand/sandy silt 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. A 1H:6V plane, or flatter, should be used for sound bedrock. For weathered/fractured bedrock a 1H:1V plane, or flatter, should be used.

Potential Post Construction Settlements/Grade Raises

In addition to the shear failure case, consideration must be given to potential post construction settlements when determining the allowable bearing pressures for footings placed on deep silty clay deposits. The amount of settlement will depend on the footing loads, the grade raise at the building and the long term lowering of the groundwater level.

Footings placed on undisturbed silty sand, glacial till bearing media and designed using the allowable bearing pressures provided herein will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively. Footings placed on engineered placed over the native silty sand or glacial till (both over bedrock) and designed using the allowable bearing pressures provided herein will also be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively. Footings placed on bedrock bearing media and designed using the allowable bearing pressure provided herein will be subjected to negligible settlement.

It should be noted that the total settlement for footing placed on a soil bearing medium will be differential with respect to a footing founded on a bedrock bearing medium. Therefore, it is not recommended to found a building on both soil and bedrock unless means to accommodate such differential settlements are provided.

Based on the results of the field vane testing completed at this site, undrained shear strength values as low as 20 kPa were observed at this site. Based on preliminary calculations, it is considered that a shallow footing foundation over silty clay would not be possible at this site without means to reduce the settlements as the loading of the silty clay resulting from the footings and grade raise will likely be to great and would result in excessive potential post-construction settlements (e.g. no grade raise would be permissible for a 1 m wide footing loaded with a continuously applied pressure). Additional testing is recommended to delineate the thickness of the silty clay at the buildings in areas of deep silty clay and to determine the compressibility characteristics of the silty clay.

5.4 Pavement

Car only parking areas and heavy traffic access areas are expected at this site. The subgrade material will consist of native soil, fill and possibly bedrock. The proposed pavement structures are presented in Tables 4 and 5.

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.

Table 4
Recommended Pavement Structure, Car Only Parking Areas

Thickness mm	Material Description
50	**WEAR COURSE -** HL 3 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
	SUBGRADE - Either in situ soil or OPSS Granular B Type I or II material placed over in situ soil or bedrock

Table 5
Recommended Pavement Structure, Access Lanes and Heavy Truck Parking Areas

Thickness mm	Material Description
40	**WEAR COURSE -** HL 3 Asphaltic Concrete
50	**BINDER COURSE -** HL 8 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
	SUBGRADE - Either in situ soil or OPSS Granular B Type I or II material placed over in situ soil or bedrock

If bedrock is encountered at the subgrade level, the total thickness of the pavement granular materials (base and subbase) could be reduced to 300 mm. Care should be exercised to ensure that the bedrock subgrade does not have depressions that will trap water.

The pavement granulars (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 compaction equipment.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on keeping 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 its load carrying capacity.

Due to the impervious nature of the subgrade materials consideration should be given to installing subdrains during the pavement construction. These drains should be installed at each catch basin, be at least 3 m long and should extend in four orthogonal directions or longitudinally when placed along a curb. 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 Pipe Bedding and Backfill

At least 150 mm of OPSS Granular A should be used for pipe bedding for sewer and water pipes. Where the invert of the excavation is below the stiff crust and into the grey silty clay the thickness of the bedding should be increased to 300 mm. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe should consist of OPSS Granular A. The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to a minimum of 95% of the material's SPMDD.

It should generally be possible to re-use the upper portion of the silty clay crust, silty sand and the glacial till above the cover material if the excavation and filling operations are carried out in dry weather conditions. Due to its high natural water content, the wet grey silty clay will be difficult, if not impractical, to compact 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 reduce potential 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 clay seals should be as per Standard Drawing No. S8 of the Department of Transportation, Utilities and Public Works - Infrastructure Services Branch (TUPW - ISB) of the City of Ottawa. The seals should be at least 1.5 m long (in the trench direction), as compared to the 1 m minimum in the detail, and should extend from trench wall to trench wall. Generally, 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 compacted to a minimum of 95% of the material's 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.

6.2 Groundwater Control

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.

The rate of flow of groundwater into the excavation through the overburden should be low to moderate. It is anticipated that pumping from open sumps will be sufficient to control the groundwater influx through the sides of the excavations (with flatter excavation slopes when being used below groundwater level).

6.3 Corrosion Potential and Sulphate

One (1) sample was submitted for testing. The analytical test results were not received at the time of writing this report. The results will be provided once available.

7.0 RECOMMENDATIONS

This geotechnical investigation is preliminary in nature and should be used for preliminary design only. It is recommended that the following be carried out once the details of the proposed development are determined:

- ❏ Carry out a detailed geotechnical investigation.
- ❏ Undertake settlement analyses for the proposed buildings and associated grading.
- ❏ Review the detailed grading plan from a geotechnical perspective.
- ❏ Suggest foundation alternatives based on the potential long term total and differential settlements.

8.0 STATEMENT OF LIMITATIONS

The recommendations provided herein are preliminary in nature and are in accordance with our present understanding of the project. We recommend that a detailed geotechnical investigation and settlement analyses be carried out for the proposed development of the subject property.

The client should be aware that any information pertaining to soils and all test hole logs are furnished as a matter of general information only and 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, we request that we be notified immediately in order to permit reassessment of our 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 SmartCentres or their agent(s) is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

PATERSON GROUP INC.

Glenn Collins, P.Eng

Carlos P. Da Silva, P.Eng

LICENSED PROFESSIONAL ENGINEER
C. P. DA SILVA
PROVINCE OF ONTARIO

Report Distribution:

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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

REMARKS

BORINGS BY CME 75 Power Auger **DATE** 5 Apr 06

FILE NO. PG0811

HOLE NO. BH 1

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.41
TOPSOIL	0.08						
FILL: Brown silty clay, some gravel	0.20						
Very stiff, brown **SILTY CLAY**	1.42	SS	1	50	17	1	88.41
GLACIAL TILL: Dense, brown silty sand with clay, gravel, cobbles and boulders	2.03	SS	2	44	50+	2	87.41

End of Borehole

Practical refusal to augering @ 2.03m depth

(BH dry-Apr. 12/06)

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

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

REMARKS

BORINGS BY CME 75 Power Auger

DATE 5 Apr 06

FILE NO. PG0811

HOLE NO. BH 2

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.23	AU	1		
Very stiff to stiff, brown **SILTY CLAY**		SS	2	58	22
		SS	3	100	11
		SS	4	100	5
- firm and grey by 3.2m depth	4.88	SS	5	100	2
Dynamic Cone Penetration Test commenced @ 4.88m depth Inferred **SILTY CLAY**	13.94				
End of Borehole DCPT refusal @ 13.94m depth (GWL @ 0.60m-Apr. 12/06)					

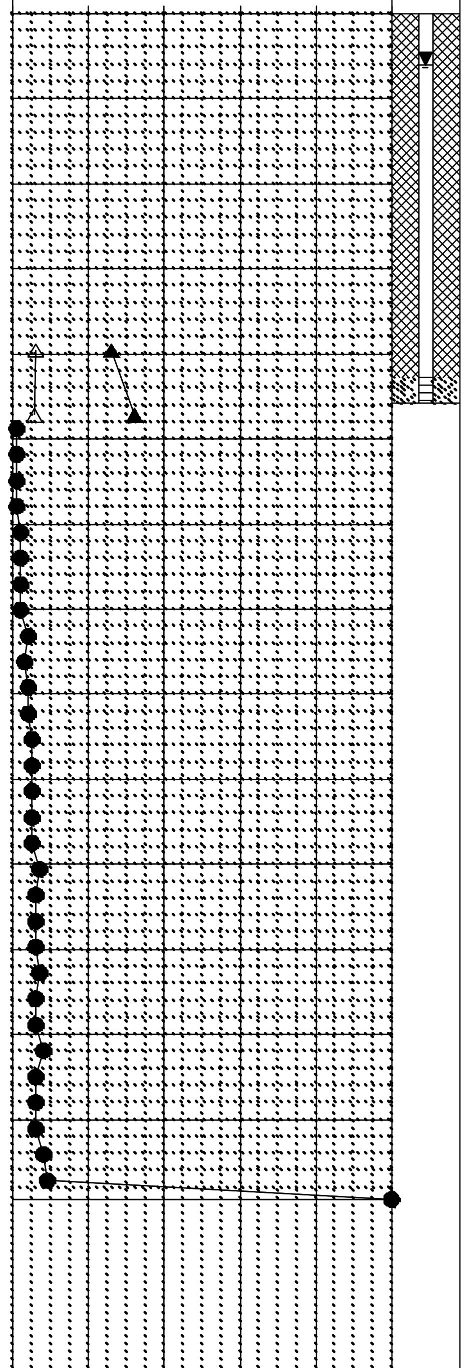
DEPTH (m)	ELEV. (m)
0	87.81
1	86.81
2	85.81
3	84.81
4	83.81
5	82.81
6	81.81
7	80.81
8	79.81
9	78.81
10	77.81
11	76.81
12	75.81
13	74.81

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

○ Water Content %

20 40 60 80

Piezometer Construction



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

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

REMARKS

BORINGS BY CME 75 Power Auger **DATE** 5 Apr 06

FILE NO. PG0811

HOLE NO. BH 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	89.00		
TOPSOIL 0.23									
Very stiff, brown **SILTY CLAY** 0.76									
GLACIAL TILL: Dense, brown silty sand with clay, gravel, cobbles and boulders 1.19		SS	1	67	50+	1	88.00		
End of Borehole									
Practical refusal to augering @ 1.19m depth									
(GWL @ 0.45m-Apr. 12/06)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

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REMARKS

BORINGS BY CME 75 Power Auger

DATE 5 Apr 06

FILE NO. PG0811

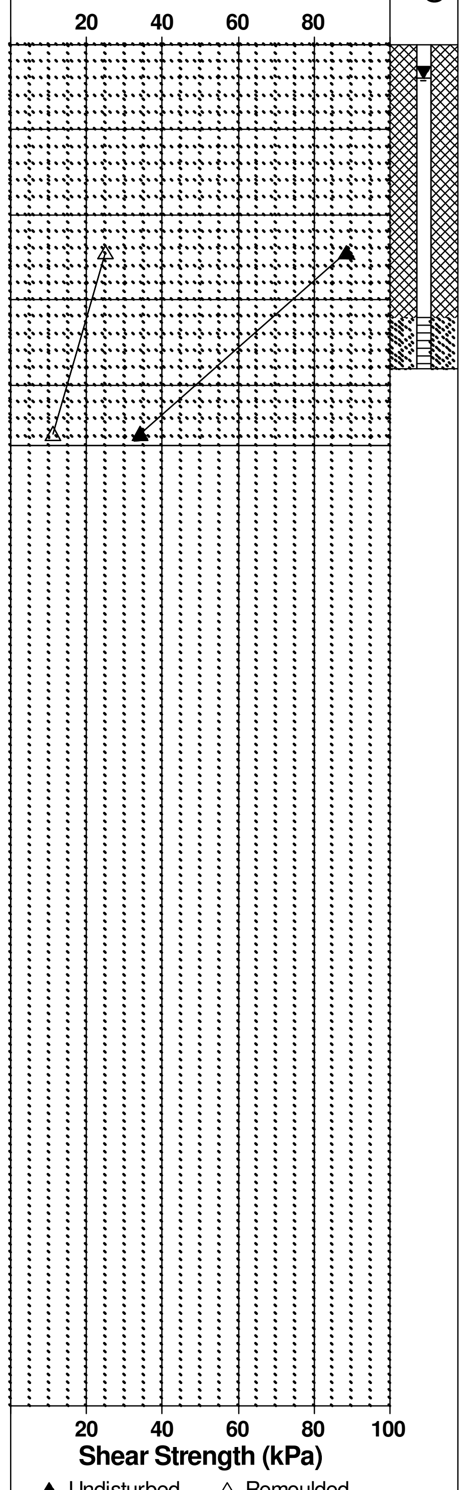
HOLE NO. BH 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.38
TOPSOIL 0.23							
Very stiff to stiff, brown **SILTY CLAY**		SS	1	62	12	1	87.38
		SS	2	100	8	2	86.38
- stiff to firm and grey by 2.6m depth						3	85.38
		SS	3	100	1		
4.72		SS	4	100	1	4	84.38
End of Borehole							
(GWL @ 0.40m-Apr. 12/06)							

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

○ Water Content %

Piezometer Construction



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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

FILE NO. PG0811

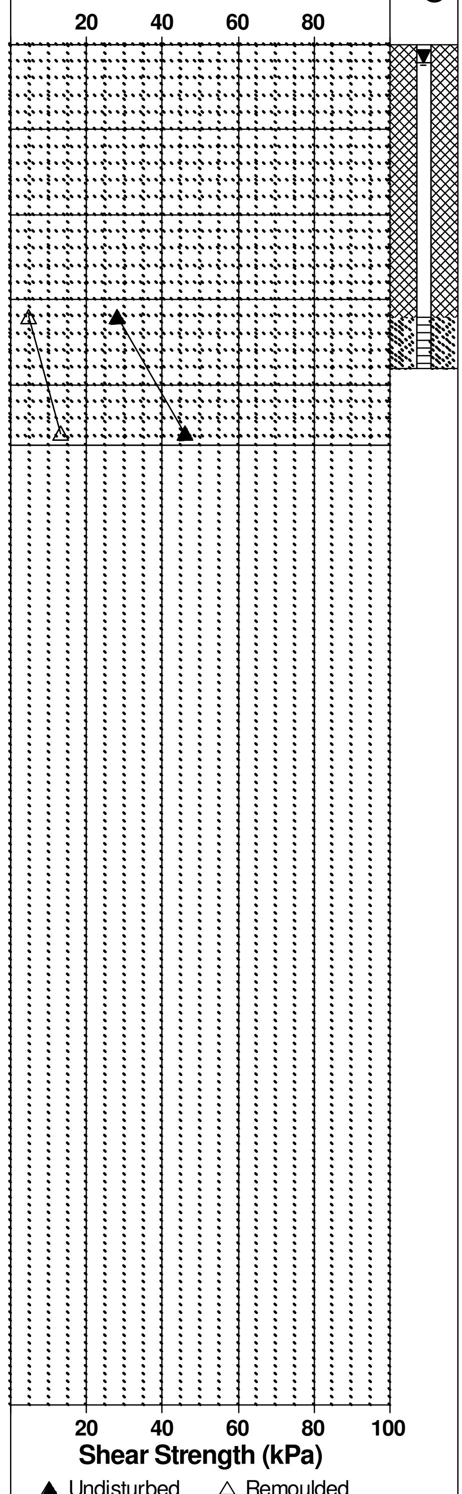
REMARKS

HOLE NO. BH 5

BORINGS BY CME 75 Power Auger **DATE** 5 Apr 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.46
TOPSOIL 0.10							
Brown **CLAYEY SILT**, trace sand 0.60							
		SS	1	75	12	1	87.46
Stiff, brown **SILTY CLAY**		SS	2	83	7	2	86.46
		SS	3	100	4		
- firm and grey by 2.9m depth						3	85.46
		SS	4	100	1	4	84.46
4.72							
End of Borehole							
(GWL @ 0.21m-Apr. 12/06)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
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REMARKS

BORINGS BY CME 75 Power Auger **DATE** 5 Apr 06

FILE NO. PG0811

HOLE NO. BH 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	89.47		
TOPSOIL 0.25									
Brown **SILTY CLAY**, trace sand 0.76		AU	1						
End of Borehole Practical refusal to augering @ 0.76m depth									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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Pharand Lands - Innes Road at Mer Bleeu Road
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REMARKS

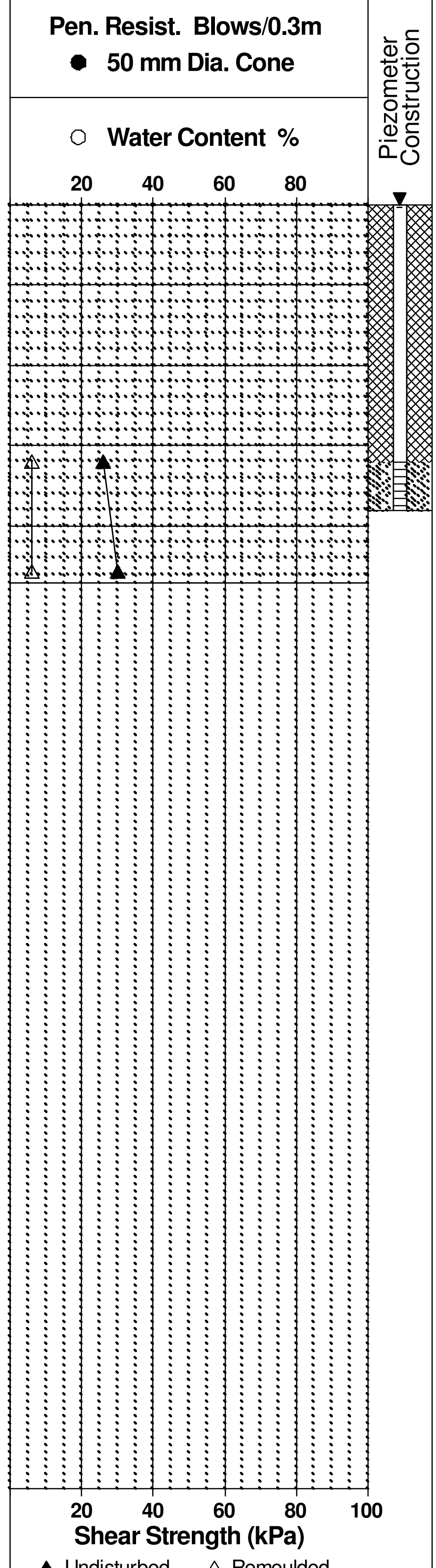
BORINGS BY CME 75 Power Auger

DATE 5 Apr 06

FILE NO. PG0811

HOLE NO. BH 7

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.20
TOPSOIL 0.23							
Very stiff to stiff, red-brown **SILTY CLAY**, trace sand		SS	1	75	9	1	87.20
		SS	2	100	4	2	86.20
- firm and brown by 2.1m depth		SS	3	100	3	3	85.20
- grey by 2.7m depth						4	84.20
4.72		SS	4	100	1		
End of Borehole							
(GWL @ ground surface - April 12/06)							



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SOIL PROFILE AND TEST DATA

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Pharand Lands - Innes Road at Mer Bleeu Road
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REMARKS

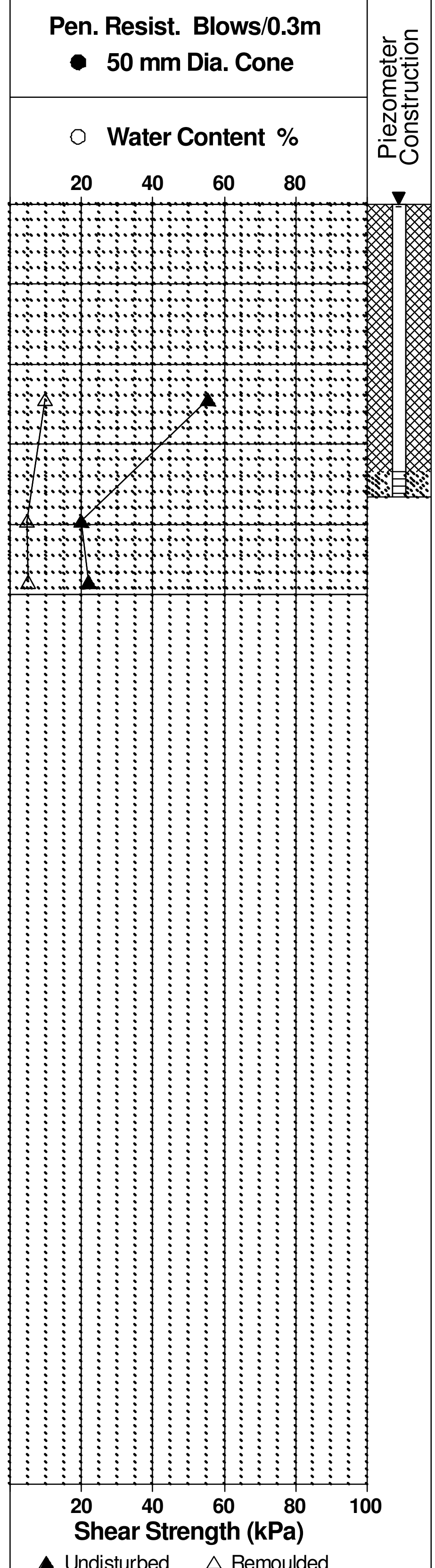
BORINGS BY CME 75 Power Auger

DATE 5 Apr 06

FILE NO. PG0811

HOLE NO. BH 8

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.28
TOPSOIL 0.19							
Very stiff to stiff, brown to red-brown **SILTY CLAY**		SS	1	50	11	1	87.28
		SS	2	75	7	2	86.28
- firm to soft and grey by 2.6m depth						3	85.28
		SS	3	100	1	4	84.28
4.88							
End of Borehole							
(GWL @ ground surface - April 12/06)							



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
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REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE						0	89.57		
TOPSOIL — 0.15									
FILL: Dark brown silty clay, trace organic matter — 1.10		G	1			1	88.57		⊻
Very stiff to stiff, grey-brown **SILTY CLAY** — 2.10		G	2			2	87.57		
GLACIAL TILL: Grey-brown sandy silt with gravel, cobbles and boulders — 2.40		G	3						
End of Borehole									

TP terminated on bedrock surface @ 2.40m depth

(Open hole GWL @ 1.2m depth)

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

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

FILE NO. PG0811

REMARKS

HOLE NO. TP 2

BORINGS BY Backhoe **DATE** 12 Apr 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	89.83		
FILL: Crushed gravel — 0.15									
Brown **SILTY SAND**		G	1						
		G	2			1	88.83		
- grey-brown by 1.3m depth									∇
		G	3			2	87.83		
2.10									
End of Test Pit TP terminated on bedrock surface @ 2.10m depth (Open hole GWL @ 1.3m depth)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

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REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP 3

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	89.34		
TOPSOIL — 0.20									
Brown **SANDY SILT** — 0.90						1	88.34		
Very stiff to stiff, grey-brown **SILTY CLAY** — 2.90						2	87.34		▽
End of Test Pit TP terminated on bedrock surface @ 2.90m depth (Open hole GWL @ 1.4m depth)									

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

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
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REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	89.54		
TOPSOIL 0.30									
GLACIAL TILL: Brown sandy silt with gravel, cobbles and boulders 2.20						1	88.54		∇
						2	87.54		
End of Test Pit TP terminated on bedrock surface @ 2.20m depth (Open hole GWL @ 1.1m depth)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

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REMARKS

BORINGS BY Backhoe **DATE** 12 Apr 06

FILE NO. PG0811

HOLE NO. TP 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	88.89		
TOPSOIL 0.20									
Stiff, brown **SILTY CLAY**		G	1			1	87.89		∇
1.40									
GLACIAL TILL: Brown clayey silt with sand, gravel, cobbles and boulders		G	2			2	86.89		
2.70									
End of Test Pit TP terminated on bedrock surface @ 2.70m depth (Open hole GWL @ 1.2m depth)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

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Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

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REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	88.81		
TOPSOIL 0.20									
Grey-brown **SILTY CLAY** 1.20						1	87.81		
GLACIAL TILL: Brown clayey silt with sand, gravel, cobbles and boulders 2.00						2	86.81		
End of Test Pit TP terminated on bedrock surface @ 2.00m depth (TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP 7

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	88.71		
TOPSOIL — 0.20									
Very stiff to stiff, brown **SILTY CLAY** — 1.40						1	87.71		
GLACIAL TILL: Brown clayey silt with sand, gravel, cobbles and boulders — 2.20						2	86.71		
End of Test Pit TP terminated on bedrock surface @ 2.20m depth (TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

FILE NO. PG0811

REMARKS

HOLE NO. TP 8

BORINGS BY Backhoe **DATE** 12 Apr 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	88.02		
TOPSOIL 0.25									
						1	87.02		
Very stiff to stiff, brown **SILTY CLAY**						2	86.02		
- grey by 3.0m depth						3	85.02		▽
		G	1						
3.40									
End of Test Pit (Open hole GWL @ 3.0m depth)									

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

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

FILE NO. PG0811

REMARKS

HOLE NO. TP 9

BORINGS BY Backhoe

DATE 12 Apr 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	88.12		
TOPSOIL (to 0.20)									
Very stiff to stiff, grey-brown **SILTY CLAY** (0.20 to 2.00)						1	87.12		
GLACIAL TILL: Grey-brown clayey silt with sand, gravel, cobbles and boulders (2.00 to 3.20)						2	86.12		∇
						3	85.12		
End of Test Pit (3.20) (Open hole GWL @ 2.9m depth)									

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

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

FILE NO. PG0811

REMARKS

HOLE NO. TP10

BORINGS BY Backhoe

DATE 12 Apr 06

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	89.08		
TOPSOIL 0.60									
						1	88.08		
Very stiff to stiff, grey-brown **SILTY CLAY**						2	87.08		
3.30						3	86.08		
End of Test Pit TP terminated on Glacial Till @ 3.30 m depth (Open hole GWL @ 2.4m depth)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

FILE NO. PG0811

REMARKS

HOLE NO. TP11

BORINGS BY Backhoe

DATE 12 Apr 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	88.57		
TOPSOIL 0.30									
						1	87.57		
Very stiff to stiff, grey-brown **SILTY CLAY**									∇
						2	86.57		
- firm and grey by 2.5m depth									
						3	85.57		
3.50									
End of Test Pit (Open hole GWL @ 1.6m depth)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
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REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	88.95		
TOPSOIL 0.20									
GLACIAL TILL: Brown silty clay with sand, gravel and boulders 1.70						1	87.95		▽
End of Test Pit Bedrock @ 1.7m depth, east of test pit and 0.3m depth at west of test pit (Open hole GWL @ 1.6m depth)									

Water Content % axis: 20, 40, 60, 80

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
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REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP13

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	88.79		
TOPSOIL 0.30									
Very stiff to stiff, brown to grey-brown **SILTY CLAY**						1	87.79		∇
						2	86.79		
3.60						3	85.79		
End of Test Pit (Open hole GWL @ 1.5m depth)									

Water Content % scale: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

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Pharand Lands - Innes Road at Mer Bleeu Road
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REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP14

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	89.06		
TOPSOIL (to 0.30)									
Stiff, brown **SILTY CLAY** (to 1.00)						1	88.06		
End of Test Pit TP terminated on bedrock surface @ 1.00m depth (TP dry upon completion)									

Water Content % scale: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
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REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	88.63		
TOPSOIL 0.15									
Very stiff, grey-brown **SILTY CLAY**		G	1						
1.10						1	87.63		∇
End of Test Pit TP terminated on bedrock surface @ 1.10m depth (Open hole GWL @ 1.0m depth)									

Water Content % scale: 20, 40, 60, 80

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
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REMARKS

BORINGS BY Backhoe **DATE** 12 Apr 06

FILE NO. PG0811

HOLE NO. TP16

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	88.48		
TOPSOIL — 0.15									
						1	87.48		
Very stiff to stiff, grey-brown **SILTY CLAY**									∇
						2	86.48		
						3	85.48		
— 3.10									
End of Test Pit (Open hole GWL @ 1.8m depth)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP17

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	88.47		
TOPSOIL (to 0.30)									
Stiff, grey-brown **SILTY CLAY** (0.30 to 3.20)						1	87.47		∇
						2	86.47		
						3	85.47		
End of Test Pit (3.20) (Open hole GWL @ 1.0m depth)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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REMARKS

BORINGS BY Backhoe **DATE** 12 Apr 06

FILE NO. PG0811

HOLE NO. TP18

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	89.14		
TOPSOIL 0.30									
Stiff, brown to grey-brown **SILTY CLAY**						1	88.14		
1.10 End of Test Pit									
TP terminated on bedrock surface @ 1.10m depth									
(Open hole GWL @ 1.1m depth)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP19

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	89.26		
TOPSOIL 0.30									
Brown **SILTY CLAY** 0.60									
End of Test Pit TP terminated on bedrock surface @ 0.60m depth									

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

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FILE NO. PG0811

HOLE NO. TP20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	88.94		
TOPSOIL — 0.30									
Stiff, brown **SILTY CLAY** — 1.00						1	87.94		
End of Test Pit TP terminated on bedrock surface @ 1.00m depth (TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	88.53		
TOPSOIL 0.30									
Stiff, grey-brown **SILTY CLAY** 1.70						1	87.53		
End of Test Pit TP terminated on bedrock surface @ 1.70m depth (TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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REMARKS

BORINGS BY Backhoe **DATE** 12 Apr 06

FILE NO. PG0811

HOLE NO. TP22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	88.78		
TOPSOIL 0.30									
Stiff, grey-brown **SILTY CLAY** 1.40						1	87.78		
End of Test Pit TP terminated on bedrock surface @ 1.40m depth (TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP23

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	88.49		
TOPSOIL (to 0.30)									
Stiff, brown to grey-brown **SILTY CLAY** (0.30 to 3.30)						1	87.49		
						2	86.49		∇
						3	85.49		
End of Test Pit (Open hole GWL @ 2.0m depth)									

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Backhoe **DATE** 12 Apr 06

FILE NO. PG0811

HOLE NO. TP24

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	88.71		
TOPSOIL 0.30									
						1	87.71		
Stiff, grey-brown **SILTY CLAY**									▽ (approx. 1.4 m)
						2	86.71		
						3	85.71		
3.30 End of Test Pit									
(Open hole GWL @ 1.4m depth)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Backhoe **DATE** 12 Apr 06

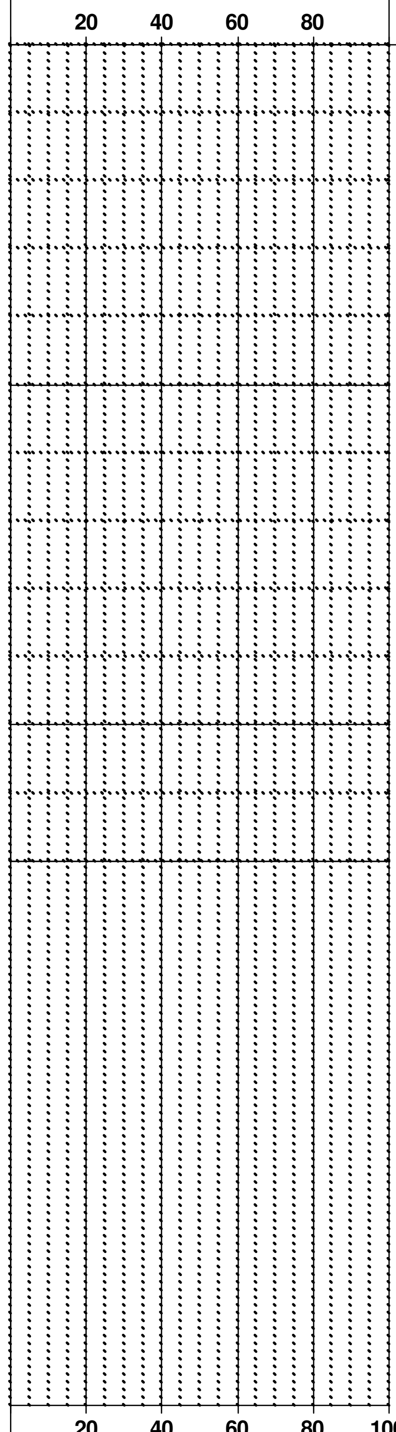
FILE NO. PG0811

HOLE NO. TP25

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.82
TOPSOIL (to 0.40)							
Stiff, grey-brown **SILTY CLAY** (0.40 to 2.40)						1	87.82
						2	86.82
End of Test Pit TP terminated on bedrock surface @ 2.40m depth (Open hole GWL @ 1.6m depth)							

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

○ Water Content %



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
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REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP26

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	89.48		
TOPSOIL 0.30									
Stiff, brown **SILTY CLAY** 0.70									
End of Test Pit TP terminated on bedrock surface @ 0.70m depth (TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Backhoe **DATE** 12 Apr 06

FILE NO. PG0811

HOLE NO. TP27

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	88.54		
TOPSOIL 0.30									
Stiff, grey-brown **SILTY CLAY**						1	87.54		∇
2.30						2	86.54		
End of Test Pit TP terminated on bedrock surface @ 2.30m depth (Open hole GWL @ 1.2m depth)									

Water Content % axis: 20, 40, 60, 80

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP28

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	88.15		
TOPSOIL 0.30									
Stiff, grey-brown **SILTY CLAY** 2.40						1	87.15		
						2	86.15		
End of Test Pit TP terminated on bedrock surface @ 2.40m depth (Open hole GWL @ 1.3m depth)									

Water Content % axis: 20, 40, 60, 80

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Backhoe **DATE** 12 Apr 06

FILE NO. PG0811

HOLE NO. TP29

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	88.12		
TOPSOIL 0.30									
		G	1			1	87.12		
Stiff, grey-brown **SILTY CLAY**									
- grey by 1.8m depth						2	86.12		
3.20						3	85.12		
End of Test Pit									
(TP dry upon completion)									

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

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SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
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REMARKS

BORINGS BY Backhoe **DATE** 12 Apr 06

FILE NO. PG0811

HOLE NO. TP30

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	89.09		
TOPSOIL 0.20									
Stiff, brown **SILTY CLAY** 1.10						1	88.09		
End of Test Pit TP terminated on bedrock surface @ 1.10m depth (TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP31

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	88.63		
TOPSOIL 0.30									
						1	87.63		
Stiff, grey-brown **SILTY CLAY**									
						2	86.63		
2.50									
End of Test Pit TP terminated on bedrock surface @ 2.50m depth (TP dry upon completion)									

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

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Backhoe **DATE** 12 Apr 06

FILE NO. PG0811

HOLE NO. TP32

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	89.18		
TOPSOIL — 0.30									
Stiff, brown **SILTY CLAY** — 0.80									
End of Test Pit TP terminated on bedrock surface @ 0.80m depth (TP dry upon completion)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP33

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	88.99		
TOPSOIL 0.30									
Stiff, grey-brown **SILTY CLAY**						1	87.99		
- some boulders by 1.2m depth 1.40									
End of Test Pit TP terminated on bedrock surface @ 1.40m depth (TP dry upon completion)									

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

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SOIL PROFILE AND TEST DATA

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REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP34

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	88.49		
TOPSOIL 0.30									
Stiff, grey-brown **SILTY CLAY**						1	87.49		
2.30						2	86.49		
End of Test Pit TP terminated on bedrock surface @ 2.30m depth (TP dry upon completion)									

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ 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

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

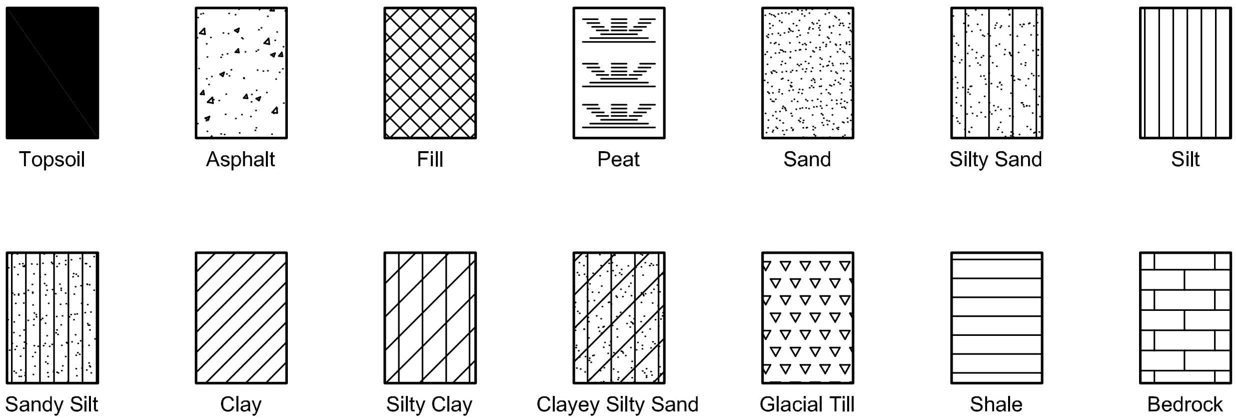
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void 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.

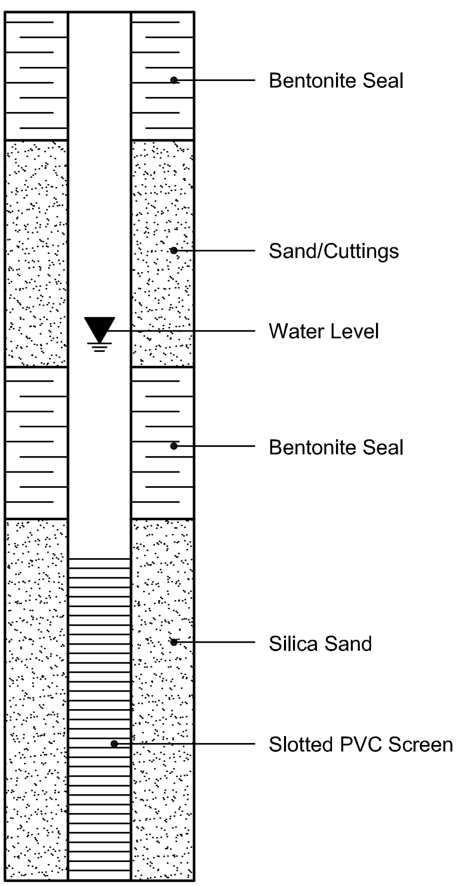
SYMBOLS AND TERMS (continued)

STRATA PLOT

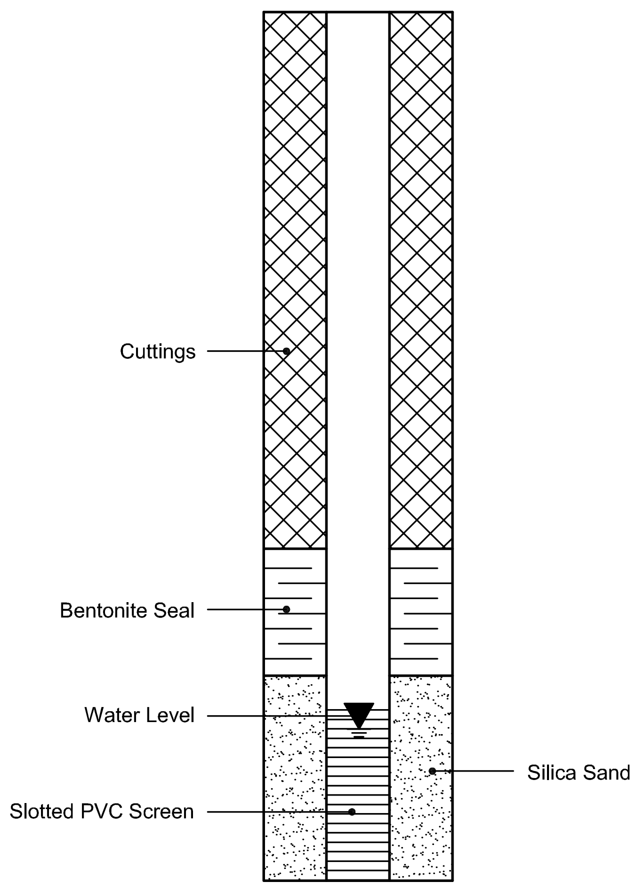


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG0811-1- TEST HOLE LOCATION PLAN

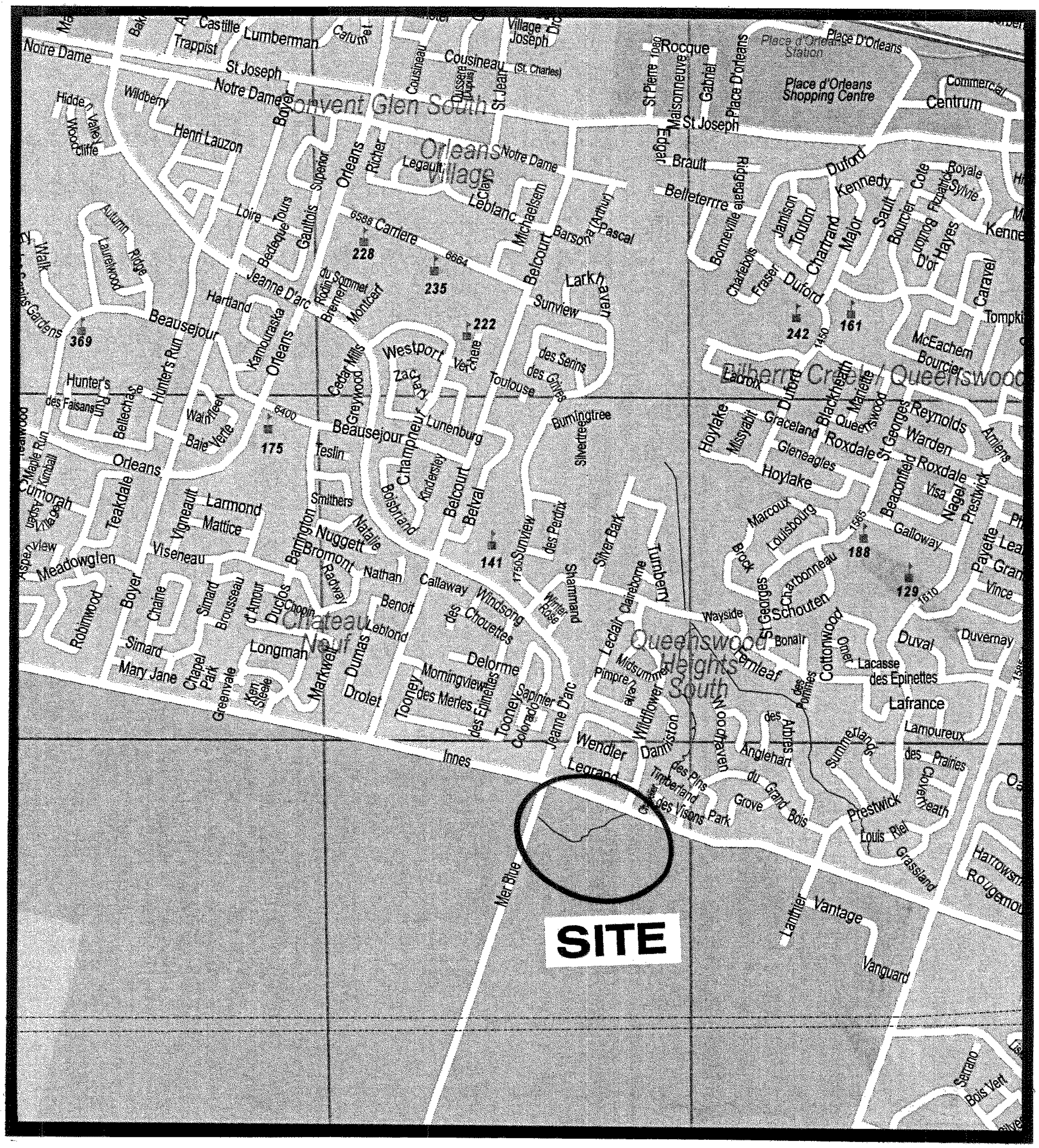


FIGURE 1

KEY PLAN

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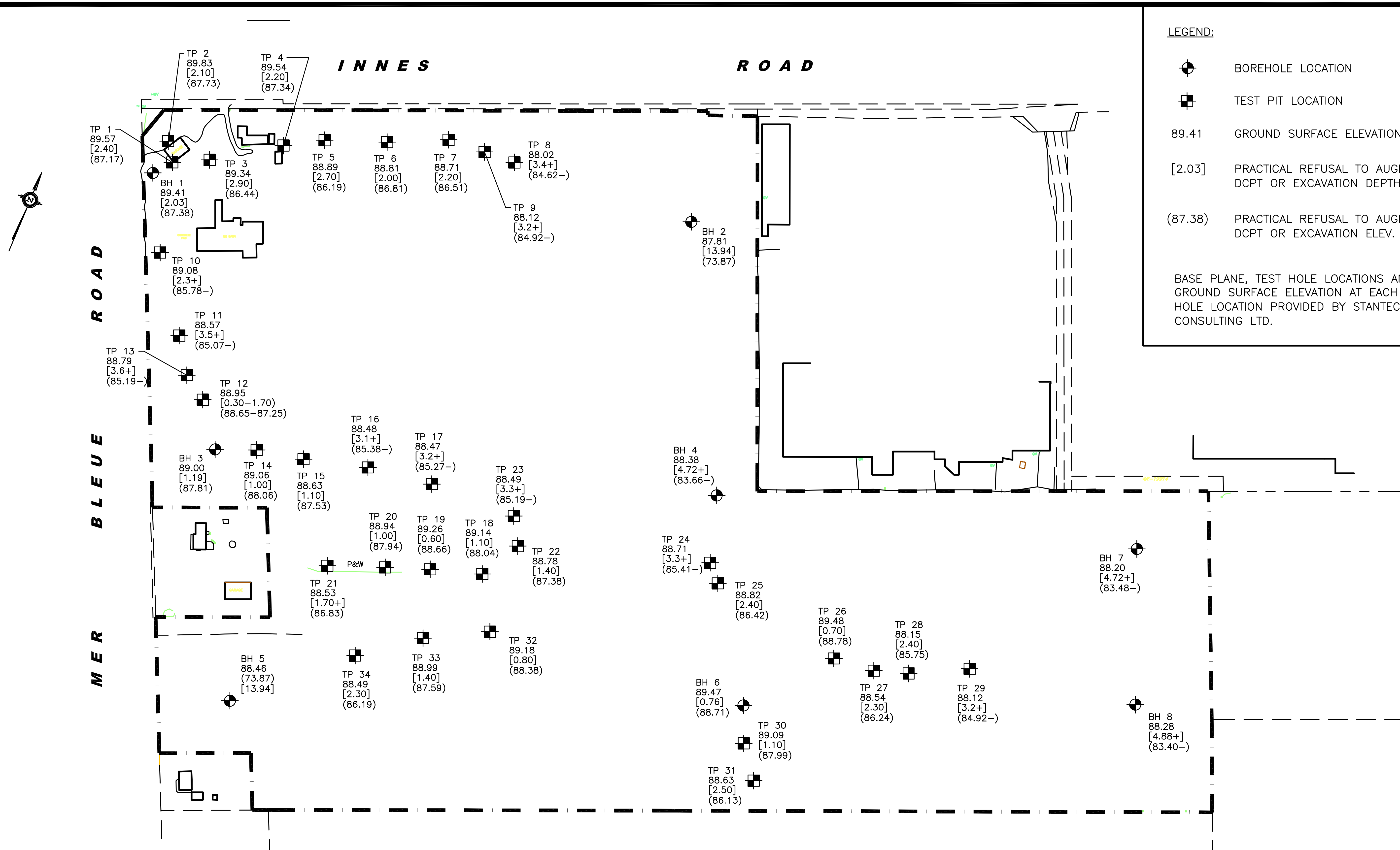

LEGEND:

⊕	BOREHOLE LOCATION
▣	TEST PIT LOCATION
89.41	GROUND SURFACE ELEVATION (m)
[2.03]	PRACTICAL REFUSAL TO AUGERING, DCPT OR EXCAVATION DEPTH (m)
(87.38)	PRACTICAL REFUSAL TO AUGERING, DCPT OR EXCAVATION ELEV. (m)

BASE PLANE, TEST HOLE LOCATIONS AND GROUND SURFACE ELEVATION AT EACH TEST HOLE LOCATION PROVIDED BY STANTEC CONSULTING LTD.

paterson group
consulting engineers
28 Concourse Gate, Unit 1, Ottawa, Ontario K2E 7T7

Scale: 1:2500
Des.:
Dwn: MPG
Chkd: GC

FIRST PRO SHOPPING CENTRES
PRELIMINARY GEOTECHNICAL INVESTIGATION
INNES ROAD AT MER BLEUE ROAD
OTTAWA, ONTARIO

TEST HOLE LOCATION PLAN

Dwg. No. PG0811-1
Report No.: PG0811-1
Date: 04/2006

patersongroup

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

Geotechnical Investigation

Proposed Commercial Development - Phase 1
Innes Road at Mer Bleue Road
Ottawa, Ontario

Prepared For

SmartReit

December 5, 2016

Report: PG0811-2

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Table of Contents

Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by SmartReit to conduct a geotechnical investigation for the current phase of the proposed commercial development to be located at the southeast corner of Innes Road and Mer Bleue Road, in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan in Appendix 2).

The objectives of the current investigation were:

❏ to determine the subsurface soil and groundwater conditions by means of boreholes,

❏ to provide geotechnical recommendations pertaining to 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 the geotechnical findings and recommendations pertaining to the design and construction of the subject development as understood at the time of writing this report.

Investigating the presence or potential presence of contamination on the subject property was not part of the scope of work of this present investigation. Therefore, the present report does not address environmental issues.

2.0 Proposed Development

It is understood that the current phase of the proposed development will consist of several commercial buildings of slab-on-grade construction along with associated car parking areas, access lanes and landscaped areas. It is further understood that the site will be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current geotechnical investigation was carried out between November 9 and 11, 2016. At that time, seven (7) boreholes were drilled to a maximum depth of 6.6 m and eleven (11) probeholes were drilled to a maximum depth of 7.6 m below existing ground surface. A previous investigation was conducted by this firm within the subject site during April 2006. The relevant test holes within the subject site from the current and previous investigations are presented on Drawing PG0811-1 - Test Hole Location Plan in Appendix 2. The test hole locations were determined in the field by Paterson personnel taking into consideration site features and underground services.

The test holes were completed with 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 our geotechnical department. The test pits completed during the previous geotechnical investigation consisted of excavating to the required depths at the selected locations and sampling and testing the overburden.

Sampling and In Situ Testing

Soil samples were recovered from the auger flights or a 50 mm diameter split-spoon sampler. The soil from the auger flights and split-spoon samples were classified on site and placed in sealed plastic bags. All samples were transported to our laboratory. The depths at which the auger flight and , split-spoon samples were recovered from the boreholes are depicted as AU and SS, respectively, on the Soil Profile and Test Data sheets 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, using a vane apparatus, was conducted at regular intervals of depth in cohesive soils.

The subsurface conditions observed in the test holes were recorded in detail in the field. The soil profiles are logged on the Soil Profile and Test Data sheets in Appendix 1.

Groundwater

Flexible PVC standpipes were installed in all boreholes to permit monitoring of the groundwater levels subsequent to the completion of the sampling program.

Sample Storage

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

3.2 Field Survey

The test hole locations were located in the field by Paterson personnel. The test hole locations and ground surface elevation at the test hole locations were provided by Stantec Geomatics. The ground surface elevations are understood to be referenced to a geodetic datum. The test hole locations and ground surface elevations of the test hole locations are presented on Drawing PG0811-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

The soil samples recovered from the subject site were examined in our laboratory to review the results of the field logging.

3.4 Analytical Testing

One soil sample from the subject site was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The analytical test results are presented in Appendix 1 and discussed in Subsection 6.7.

4.0 Observations

4.1 Surface Conditions

At the time of our field program, the subject site consisted of agricultural fields with some mature trees and a grassed area within the northwest corner of the site. It should be noted that two existing ditches were observed within the current phase of the proposed development. The subject site is relatively flat and slightly lower than Innes Road and Mer Bleue Road.

4.2 Subsurface Profile

Generally, the soil conditions encountered at the test hole locations consist of topsoil overlying very stiff to stiff brown silty clay crust layer and followed by a firm grey silty clay deposit. A thin layer of fill overtop of the silty clay crust was encountered at BH 1-16 and BH 5-16. Glacial till was encountered below the firm grey silty clay deposit at BH 1-16, BH 2-16, BH 3-16 and BH 5-16. Practical refusal to augering was encountered at depths ranging from 2 m to 7.6 m. Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for the details of the soil profile encountered at each test hole location.

Based on available geological mapping, the bedrock consists of interbedded limestone and dolomite of the Lindsay Formation and is expected to be encountered at depths ranging from 5 to 15 m.

4.3 Groundwater

Groundwater levels were noted at the test hole locations at the time of drilling and the results are summarized in Table 1. It is important to note that groundwater readings at the piezometers can be influenced by water perched within the borehole backfill material. Long-term groundwater conditions can also be estimated based on the observed colour, moisture levels and consistency of the recovered soil samples. Based on these observations, it is estimated that the long-term groundwater level can be expected between 2 to 3 m below existing 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 - Measured Groundwater Levels

Test Hole Number	Ground Surface Elevation (m)	Water Level		Date
		Depth (m)	Elevation (m)	
Current Investigation				
BH 1-16	89.78	1.17	88.61	November 24, 2016
BH 2-16	88.54	1.50	87.04	November 24, 2016
BH 3-16	88.52	1.33	87.19	November 24, 2016
BH 4-16	88.38	0.97	87.41	November 24, 2016
BH 5-16	89.62	2.13	87.49	November 24, 2016
BH 6-16	89.32	Damaged	n/a	November 24, 2016
BH 7-16	88.73	Damaged	Surface	November 24, 2016
PH 6-16	88.59	Damaged	n/a	November 24, 2016
PH 7-16	89.48	2.01	87.47	November 24, 2016
Previous Investigation				
BH 1	89.41	Dry	n/a	April 12, 2006
BH 2	87.81	0.60	87.21	April 12, 2006
BH 3	89.00	0.45	88.55	April 12, 2006

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered adequate for the proposed commercial development. It is expected that the proposed buildings can be founded by conventional style shallow foundations placed on an undisturbed, stiff brown silty clay bearing surface.

Due to the presence of a silty clay deposit underlying the subject site, a permissible grade raise restriction will be required.

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. Sideslopes of the existing ditch should be shaped to provide maximum 500 mm high steps to improve the quality of the compaction work during the backfilling program.

Fill Placement

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

Non-specified existing fill along with site-excavated soil could be placed as general landscaping fill where settlement is a minor concern. These materials should be spread in maximum lift thickness of 300 mm and at a minimum compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be placed to increase the subgrade level for areas to be paved, the backfill 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 placement as backfill against foundation walls, unless a geocomposite drainage membrane is installed, such as Miradrain G100N or Delta Drain 6000. Consideration should also be given to placing a non-frost susceptible, granular fill against the exterior side of the foundation walls to limit frost heave issues for sensitive areas, such as perimeter sidewalks or exterior entrance slabs.

Bedrock Removal

If bedrock removal is required, consideration should be given to hoe-ramming or controlled blasting. In areas of weathered bedrock and where only a small quantity of bedrock is to be removed, bedrock removal may be possible by hoe-ramming.

Prior to considering blasting operations, the blasting effects on the existing services, buildings and other structures should be addressed. A pre-blast or pre-construction survey of the existing structures located in proximity of the blasting operations should be carried out prior to commencing site activities. The extent of the survey should be determined by the blasting consultant and should be sufficient to respond to any inquiries/claims related to the blasting operations.

As a general guideline, peak particle velocities (measured at the structures) should not exceed 25 mm per second during the blasting program to reduce the risks of damage to the existing structures.

The blasting operations should be planned and conducted under the supervision of a licensed professional engineer who is also an experienced blasting consultant.

Vibration Considerations

Construction operations are also the cause of vibrations, and possibly, sources of nuisance to the community. Therefore, means to reduce the vibration levels as much as possible should be incorporated in the construction operations to maintain, as much as possible, a cooperative environment with the residents.

5.3 Foundation Design

Conventional Shallow Foundations

Strip footings, up to 2 m wide, and pad footings, up to 5 m wide, founded on an undisturbed, stiff silty clay, glacial till or engineered fill bearing surface can be designed using the bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **225 kPa**.

Footings designed using the above-noted bearing resistance values, founded on undisturbed, stiff silty clay bearing surface or engineered fill placed on an undisturbed, stiff silty clay will be subjected to potential post-construction total and differential settlements of 25 and 20 mm, respectively.

An undisturbed soil bearing surface consists of a surface from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

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 a silty clay above the groundwater table when a plane extending horizontally and vertically from the footing perimter at a minimum of 1.5H:1V, passing 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.

Due to the silty clay underlying the subject site, a permissible grade raise of **2 m** is recommended for grading within 6 m of the building footprint. A permissible grade raise restriction of **2.5 m** is recommended for the parking areas and access lanes. It should be noted that the permissible grade raise values noted above are measured from the **original ground surface**, below any existing fill observed at select locations on site.

Generally, the potential long term settlement is evaluated based on the compressibility characteristics 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.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C** for footings placed over a silty clay bearing surface. The soils underlying the proposed shallow foundations are not susceptible to liquefaction. Reference should be made to the latest revision of the 2012 Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Slab on Grade Construction

The in situ soils, approved granular fill or lean concrete mudslab will be considered to be an acceptable subgrade on which to commence backfilling for floor slab construction.

The upper 200 mm of sub-slab backfill is recommended to consist of 19 mm clear crushed stone. All backfill material within the proposed building footprint should be placed in maximum 300 mm thick loose layers and compacted to a minimum of 98% of the SPMDD.

Any soft areas should be removed and backfilled with appropriate backfill material prior to placing any additional backfill. OPSS Granular A or Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab. All backfill material within the footprint of the proposed building should be placed in maximum 300 mm thick loose layers and compacted to a minimum of 98% of the SPMDD.

5.6 Pavement Structure

For design purposes, the pavement structures presented in the following tables could be used for the design of car only parking areas, heavy truck parking areas and access lanes.

Table 2 - Recommended Pavement Structure - Car Only Parking Areas

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

Table 3 - Recommended Pavement Structure
Heavy Truck Parking Areas and Access Lanes

Thickness (mm)	Material Description
40	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either in situ soil, fill or OPSS Granular B Type I or 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.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 98% of the SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on keeping 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 the load bearing capacity.

Where silty clay is anticipated at subgrade level, consideration should be given to installing sub-drains at the catch basin locations during the pavement construction. The sub-drain inverts should be approximately 300 mm below subgrade level and extend 3 m along the curblines in both directions. 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

It is recommended that a perimeter foundation drainage system be provided for the proposed structures. The system should consist of a 150 mm diameter 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 greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls where frost heave sensitive structures, such as a concrete sidewalk, will be placed. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material may be used for this purpose. A composite drainage system, such as Delta Drain 6000, Miradrain G100 or equivalent, should be placed against the foundation wall to promote drainage toward the perimeter drainage pipe.

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 of 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 side slopes of excavations in the soil and fill overburden materials should be either cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is assumed that sufficient room will be available for the greater part of the excavation to be undertaken by open-cut methods (i.e. unsupported excavations).

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or flatter. The flatter slope is required for excavation below groundwater level. The subsoil at this site is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

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

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

6.4 Pipe Bedding and Backfill

The pipe bedding for sewer and water pipes should consist of at least 150 mm of OPSS Granular A crushed stone. Where the bedding is located within the firm grey silty clay or directly over the bedrock surface, 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 extend 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 the SPMDD.

It should generally 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 SPMDD.

It is recommended that the subgrade medium be inspected in the field to determine how steeply the bedrock surface, where encountered, drops off. A transition treatment should be provided where the bedrock slopes at more than 3H:1V. At these locations, the bedrock should be excavated and extra bedding be placed to provide a 3H:1V (or flatter) transition from the bedrock subgrade towards the soil subgrade. This treatment reduces the propensity for bending stress to occur in the service pipes.

To reduce long-term lowering of the groundwater level at this site, clay seals should be provided in the service trenches where services are installed within the silty clay deposit. The seals should be at least 1.5 m long (in the trench direction) and should extend from trench wall to trench wall. Generally, 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

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

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

For typical ground or surface water volumes, being pumped during the construction phase, between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MOECC review of the PTTW application.

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 Corrosion Potential and Sulphate

The analytical test results are presented in Table 4 along with industry standards for the applicable threshold values. The results are indicative that Type 10 Portland cement can be used at the subject site.

Table 4 - Corrosion Potential

Parameter	Laboratory Results BH 2 - SS3	Threshold	Commentary
Chloride	16 µg/g	Chloride content less than 400 mg/g	Negligible concern
pH	7.432	pH value less than 5.0	Neutral Soil
Resistivity	86 ohm.m	Resistivity greater than 1,500 ohm.cm	Low Corrosion Potential
Sulphate	35 µg/g	Sulphate value greater than 1 mg/g	Negligible Concern

7.0 Recommendations

It is a requirement for the foundation design data provided herein to be applicable that a materials testing and observation services program including the following aspects be performed by the geotechnical consultant.

- ❏ Review the master grading plan from a geotechnical perspective, once available.
- ❏ Observation of all bearing surfaces prior to the placement of concrete.
- ❏ Sampling and testing of the concrete and granular fill materials used.
- ❏ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- ❏ Observation of all subgrades prior to backfilling.
- ❏ Field density tests to determine the level of compaction achieved.
- ❏ Sampling and testing of the bituminous concrete including mix design reviews.

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

8.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. We request that we be permitted to review the grading plan once available. Also, our recommendations should be reviewed when the project drawings and specifications are complete.

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, we request that we be notified immediately in order to permit reassessment of our 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 SmartReit 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.

Faisal I. Abou-Seido, P.Eng.

David J. Gilbert, P.Eng.

Report Distribution:

- ❏ SmartReit (3 copies)
- ❏ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Dev. - Innes at Mer Bleue Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG0811

REMARKS

HOLE NO. BH 1-16

BORINGS BY CME 55 Power Auger **DATE** November 9, 2016

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
TOPSOIL	0.20				
FILL: Brown silty clay, trace sand and gravel	0.91	AU	1		
GLACIAL TILL: Brown silty clay, trace sand, gravel, cobbles and boulders	4.01	SS	2	54	13
		SS	3	17	39
		SS	4	38	31
		SS	5	29	50+
		SS	6	50	50+

DEPTH (m)	ELEV. (m)
0	89.78
1	88.78
2	87.78
3	86.78
4	85.78

End of Borehole

Practical refusal to augering at 4.01m depth

(GWL @ 1.17m - Nov. 24, 2016)

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
Prop. Commercial Dev. - Innes at Mer Bleue Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE November 10, 2016

FILE NO. PG0811

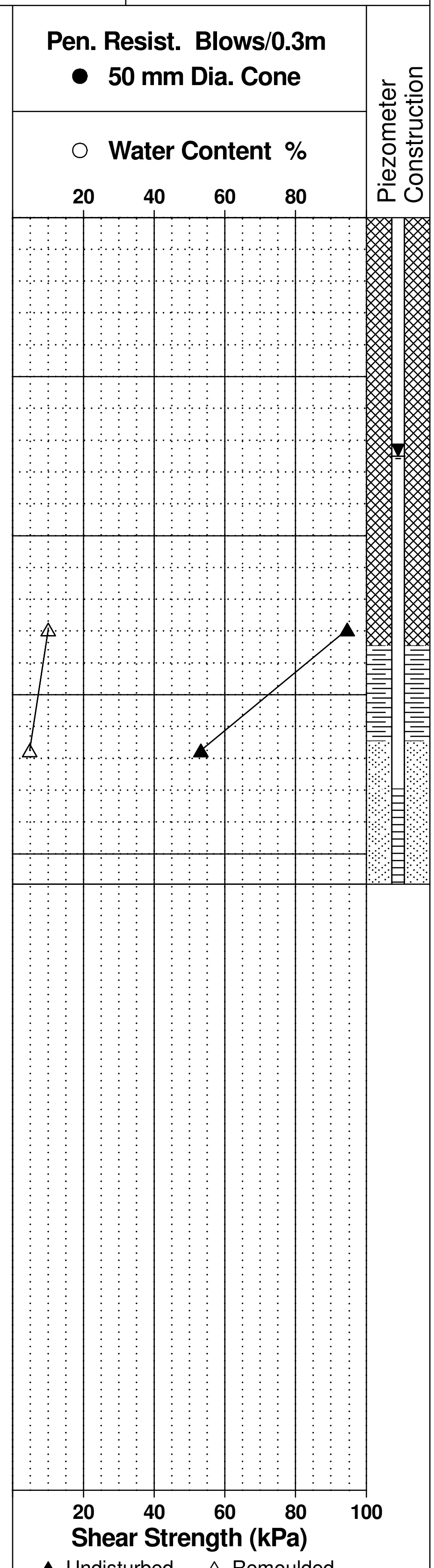
HOLE NO. BH 2-16

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.54
TOPSOIL (to 0.35)		AU	1				
		SS	2	100	9	1	87.54
Very stiff to stiff, brown **SILTY CLAY,** trace sand		SS	3	100	6	2	86.54
- grey by 3.0m depth (to 3.50)						3	85.54
GLACIAL TILL: Grey silty clay, trace sand, gravel, cobbles and boulders (to 4.19)		SS	4	31	50+	4	84.54

End of Borehole

Practical refusal to augering at 4.19m depth

(GWL @ 1.50m - Nov. 24, 2016)



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Dev. - Innes at Mer Bleue Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG0811

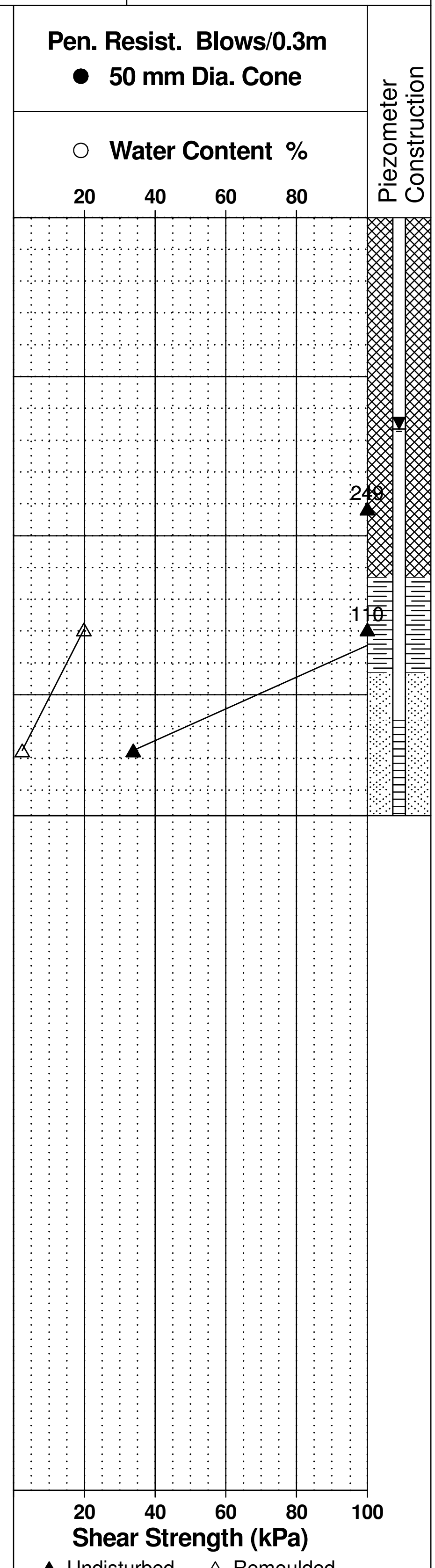
REMARKS

HOLE NO. BH 3-16

BORINGS BY CME 55 Power Auger

DATE November 10, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.52
TOPSOIL (to 0.35)		AU	1				
Hard to very stiff, brown **SILTY CLAY,** trace sand		SS	2	100	13	1	87.52
						2	86.52
- stiff to firm and grey by 3.0m depth (to 3.50)						3	85.52
GLACIAL TILL: Grey silty clay, trace sand, gravel, cobbles and boulders (to 3.76)							
End of Borehole							
Practical refusal to augering at 3.76m depth							
(GWL @ 1.33m - Nov. 24, 2016)							



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Dev. - Innes at Mer Bleue Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG0811

REMARKS

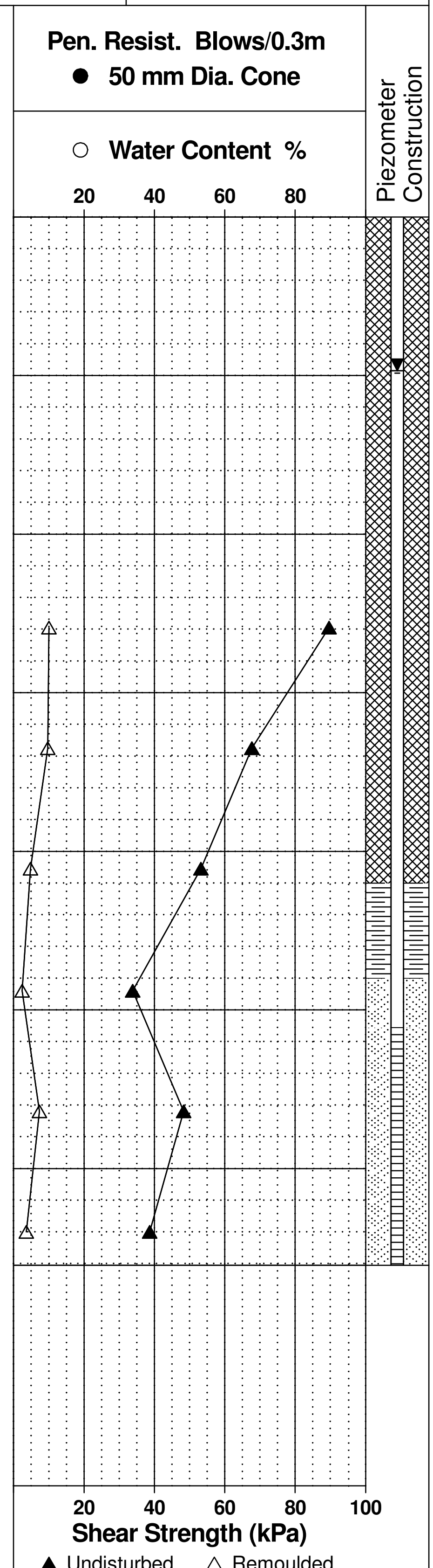
HOLE NO. BH 4-16

BORINGS BY CME 55 Power Auger **DATE** November 10, 2016

SOIL DESCRIPTION	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	88.38
TOPSOIL 0.30	AU	1				
	SS	2	100	10	1	87.38
	SS	3	100	8	2	86.38
Very stiff to stiff, brown **SILTY CLAY,** trace sand					3	85.38
					4	84.38
- firm and grey by 4.6m depth					5	83.38
6.61					6	82.38
End of Borehole						

Practical refusal to augering at 6.61m depth

(GWL @ 0.97m - Nov. 24, 2016)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Dev. - Innes at Mer Bleue Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger **DATE** November 9, 2016

FILE NO. PG0811

HOLE NO. BH 5-16

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.62
TOPSOIL 0.18							
FILL: Brown silty clay, trace gravel 0.53		AU	1				
Compact, brown **SILTY SAND,** trace clay 1.07		SS	2	67	15	1	88.62
Very stiff, brown **SILTY CLAY** 1.60		SS	3	100	50+		
GLACIAL TILL: Brown silty sand with clay, gravel, cobbles and boulders 2.84		SS	4	83	23	2	87.62
End of Borehole							
Practical refusal to augering at 2.84m depth							
(GWL @ 2.13m - Nov. 24, 2016)							

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

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Dev. - Innes at Mer Bleue Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG0811

REMARKS

HOLE NO. BH 6-16

BORINGS BY CME 55 Power Auger **DATE** November 9, 2016

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. / Water Content / Shear Strength
GROUND SURFACE						0	89.32	
TOPSOIL	0.20							
FILL: Brown silty clay, trace sand, gravel, cobbles and asphalt	0.89	AU	1					
Very stiff to stiff, brown **SILTY CLAY,** trace sand	3.66	SS	2	0	13	1	88.32	
		SS	3	100	10	2	87.32	
		SS	4	100	7	3	86.32	
		SS	5	100				▲ Undisturbed ~60 kPa; △ Remoulded ~8 kPa
End of Borehole (BH dry - Nov. 24, 2016)								

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone
○ Water Content %
20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Piezometer Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Dev. - Innes at Mer Bleue Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG0811

REMARKS

HOLE NO. BH 7-16

BORINGS BY CME 55 Power Auger

DATE November 9, 2016

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	88.75		
TOPSOIL (to 0.30)		AU	1						
Very stiff, brown **SILTY CLAY,** trace sand (to 2.03)		SS	2	100	11	1	87.75	121 ▲	
End of Borehole						2	86.75		

End of Borehole

Practical refusal to augering at 2.03m depth

(Piezometer damaged - Nov. 24, 2016)

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Dev. - Innes at Mer Bleue Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG0811

REMARKS

HOLE NO. PH 1-16

BORINGS BY CME 55 Power Auger

DATE November 10, 2016

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	89.19		
						1	88.19		
						2	87.19		
OVERBURDEN									
						3	86.19		
						4	85.19		
4.57									
End of Probehole									

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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Dev. - Innes at Mer Bleue Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG0811

REMARKS

HOLE NO. PH 2-16

BORINGS BY CME 55 Power Auger **DATE** November 10, 2016

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	88.64		
						1	87.64		
OVERBURDEN						2	86.64		
3.28						3	85.64		
End of Probehole Practical refusal to augering at 3.28m depth									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Dev. - Innes at Mer Bleue Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG0811

REMARKS

HOLE NO. PH 3-16

BORINGS BY CME 55 Power Auger **DATE** November 11, 2016

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	88.96		
OVERBURDEN						1	87.96		
2.80						2	86.96		
End of Probehole Practical refusal to augering at 2.80m depth									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Dev. - Innes at Mer Bleue Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG0811**

REMARKS

HOLE NO. **PH 4-16**

BORINGS BY CME 55 Power Auger

DATE November 11, 2016

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	88.28		
						1	87.28		
OVERBURDEN						2	86.28		
						3	85.28		
						4	84.28		
4.57									
End of Probehole									

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Dev. - Innes at Mer Bleue Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE November 11, 2016

FILE NO. PG0811

HOLE NO. PH 5-16

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	88.36		
						1	87.36		
OVERBURDEN						2	86.36		
						3	85.36		
						4	84.36		
4.57									
End of Probehole									

Water Content % scale: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Dev. - Innes at Mer Bleue Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG0811

REMARKS

HOLE NO. PH 6-16

BORINGS BY CME 55 Power Auger **DATE** November 10, 2016

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	88.59
OVERBURDEN						1	87.59
						2	86.59
2.13							
End of Probehole Practical refusal to augering at 2.13m 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

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Dev. - Innes at Mer Bleue Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger **DATE** November 10, 2016

FILE NO. PG0811

HOLE NO. PH 7-16

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	89.48		
						1	88.48		
						2	87.48		
OVERBURDEN						3	86.48		
						4	85.48		
4.72									

End of Probehole

Practical refusal to augering at 4.72m depth

(GWL @ 2.01m - Nov. 24, 2016)

Pen. Resist. / Water Content scale: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Dev. - Innes at Mer Bleue Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE November 10, 2016

FILE NO. PG0811

HOLE NO. PH 8-16

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	88.53		
						1	87.53		
						2	86.53		
						3	85.53		
OVERBURDEN						4	84.54		
						5	83.53		
						6	82.53		
						7	81.53		
7.62									
End of Probehole									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Dev. - Innes at Mer Bleue Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. PG0811

REMARKS

HOLE NO. PH 9-16

BORINGS BY CME 55 Power Auger **DATE** November 10, 2016

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	88.23		
						1	87.23		
OVERBURDEN						2	86.23		
						3	85.23		
4.27						4	84.23		
End of Probehole Practical refusal to augering at 4.27m depth									

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Dev. - Innes at Mer Bleue Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE November 11, 2016

FILE NO. PG0811

HOLE NO. PH10-16

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	88.42		
						1	87.42		
OVERBURDEN						2	86.42		
						3	85.42		
3.58									
End of Probehole Practical refusal to augering at 3.58m depth									

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Dev. - Innes at Mer Bleue Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

FILE NO. **PG0811**

REMARKS

HOLE NO. **PH11-16**

BORINGS BY CME 55 Power Auger

DATE November 11, 2016

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	88.36		
						1	87.36		
OVERBURDEN									
						2	86.36		
						3	85.36		
3.15									
End of Probehole Practical refusal to augering at 3.15m depth									

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

REMARKS

BORINGS BY CME 75 Power Auger

DATE 5 Apr 06

FILE NO. PG0811

HOLE NO. BH 1

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	89.41
TOPSOIL	0.08						
FILL: Brown silty clay, some gravel	0.20						
Very stiff, brown **SILTY CLAY**	1.42	SS	1	50	17	1	88.41
GLACIAL TILL: Dense, brown silty sand with clay, gravel, cobbles and boulders	2.03	SS	2	44	50+	2	87.41

End of Borehole

Practical refusal to augering @ 2.03m depth

(BH dry-Apr. 12/06)

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

○ Water Content %

20 40 60 80

Shear Strength (kPa)
20 40 60 80 100

▲ Undisturbed △ Remoulded

Piezometer Construction

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

FILE NO. PG0811

REMARKS

HOLE NO. TP 1

BORINGS BY Backhoe

DATE 12 Apr 06

SOIL DESCRIPTION	Depth to base (m)	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							0	89.57
TOPSOIL	0.15							
FILL: Dark brown silty clay, trace organic matter	1.10		G	1			1	88.57
Very stiff to stiff, grey-brown **SILTY CLAY**	2.10		G	2			2	87.57
GLACIAL TILL: Grey-brown sandy silt with gravel, cobbles and boulders	2.40		G	3				

End of Borehole

TP terminated on bedrock surface @ 2.40m depth

(Open hole GWL @ 1.2m depth)

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

○ Water Content %

20 40 60 80

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

Piezometer Construction

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	89.83		
FILL: Crushed gravel — 0.15									
Brown **SILTY SAND**		G	1						
		G	2			1	88.83		
- grey-brown by 1.3m depth									∇
		G	3			2	87.83		
2.10									
End of Test Pit TP terminated on bedrock surface @ 2.10m depth (Open hole GWL @ 1.3m depth)									

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

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

FILE NO. PG0811

REMARKS

HOLE NO. TP 3

BORINGS BY Backhoe

DATE 12 Apr 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	89.34		
TOPSOIL 0.20									
Brown **SANDY SILT** 0.90						1	88.34		
Very stiff to stiff, grey-brown **SILTY CLAY** 2.90						2	87.34		▽ (1.4m)
End of Test Pit TP terminated on bedrock surface @ 2.90m depth (Open hole GWL @ 1.4m depth)									

Water Content % axis: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	89.54		
TOPSOIL 0.30									
GLACIAL TILL: Brown sandy silt with gravel, cobbles and boulders						1	88.54		∇
2.20						2	87.54		
End of Test Pit TP terminated on bedrock surface @ 2.20m depth (Open hole GWL @ 1.1m depth)									

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

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

FILE NO. PG0811

REMARKS

HOLE NO. TP 5

BORINGS BY Backhoe

DATE 12 Apr 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE						0	88.89		
TOPSOIL — 0.20									
Stiff, brown **SILTY CLAY** — 1.40		G	1			1	87.89		∇
GLACIAL TILL: Brown clayey silt with sand, gravel, cobbles and boulders — 2.70		G	2			2	86.89		
End of Test Pit									

TP terminated on bedrock surface @ 2.70m depth

(Open hole GWL @ 1.2m depth)

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	88.81		
TOPSOIL — 0.20									
Grey-brown **SILTY CLAY** — 1.20						1	87.81		
GLACIAL TILL: Brown clayey silt with sand, gravel, cobbles and boulders — 2.00						2	86.81		
End of Test Pit TP terminated on bedrock surface @ 2.00m depth (TP dry upon completion)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP 7

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	88.71		
TOPSOIL (0.20)									
Very stiff to stiff, brown **SILTY CLAY** (1.40)						1	87.71		
GLACIAL TILL: Brown clayey silt with sand, gravel, cobbles and boulders (2.20)						2	86.71		
End of Test Pit TP terminated on bedrock surface @ 2.20m depth (TP dry upon completion)									

Water Content % axis: 20, 40, 60, 80

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

FILE NO. **PG0811**

REMARKS

HOLE NO. **TP 8**

BORINGS BY Backhoe

DATE 12 Apr 06

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	88.02		
TOPSOIL 0.25									
						1	87.02		
Very stiff to stiff, brown **SILTY CLAY**									
						2	86.02		
- grey by 3.0m depth						3	85.02		⊻
		G	1						
End of Test Pit 3.40									
(Open hole GWL @ 3.0m depth)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP 9

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	88.12		
TOPSOIL 0.20									
Very stiff to stiff, grey-brown **SILTY CLAY**						1	87.12		
2.00						2	86.12		
GLACIAL TILL: Grey-brown clayey silt with sand, gravel, cobbles and boulders						3	85.12		∇
3.20									
End of Test Pit (Open hole GWL @ 2.9m depth)									

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

FILE NO. PG0811

REMARKS

HOLE NO. TP10

BORINGS BY Backhoe **DATE** 12 Apr 06

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	89.08		
TOPSOIL (to 0.60)									
Very stiff to stiff, grey-brown **SILTY CLAY** (0.60 to 3.30)						1	88.08		
						2	87.08		
						3	86.08		
End of Test Pit TP terminated on Glacial Till @ 3.30 m depth (Open hole GWL @ 2.4m depth)									

Water content scale: 20, 40, 60, 80

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

FILE NO. PG0811

REMARKS

HOLE NO. TP11

BORINGS BY Backhoe

DATE 12 Apr 06

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	88.57		
TOPSOIL 0.30									
						1	87.57		
Very stiff to stiff, grey-brown **SILTY CLAY**									∇
						2	86.57		
- firm and grey by 2.5m depth									
						3	85.57		
3.50									
End of Test Pit (Open hole GWL @ 1.6m depth)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

REMARKS

BORINGS BY Backhoe

DATE 12 Apr 06

FILE NO. PG0811

HOLE NO. TP12

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	88.95		
TOPSOIL — 0.20									
GLACIAL TILL: Brown silty clay with sand, gravel and boulders — 1.70						1	87.95		∇
End of Test Pit									
Bedrock @ 1.7m depth, east of test pit and 0.3m depth at west of test pit									
(Open hole GWL @ 1.6m depth)									

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Preliminary Geotechnical Investigation
Pharand Lands - Innes Road at Mer Bleeu Road
Ottawa, Ontario

DATUM Geodetic, as provided by Stantec Consulting Ltd.

REMARKS

BORINGS BY Backhoe **DATE** 12 Apr 06

FILE NO. PG0811

HOLE NO. TP13

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	88.79		
TOPSOIL 0.30									
Very stiff to stiff, brown to grey-brown **SILTY CLAY** 3.60						1	87.79		∇
						2	86.79		
						3	85.79		
End of Test Pit (Open hole GWL @ 1.5m depth)									

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ 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

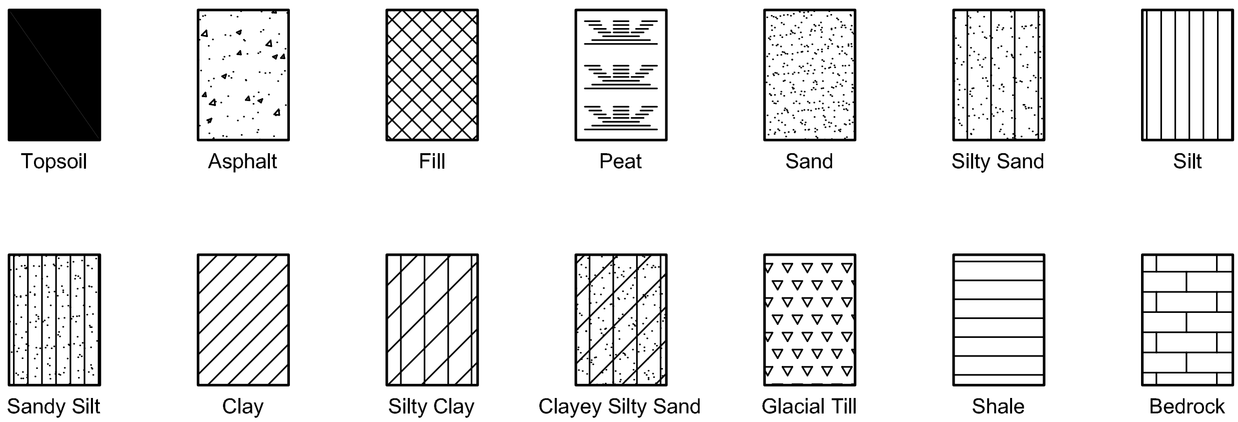
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void 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.

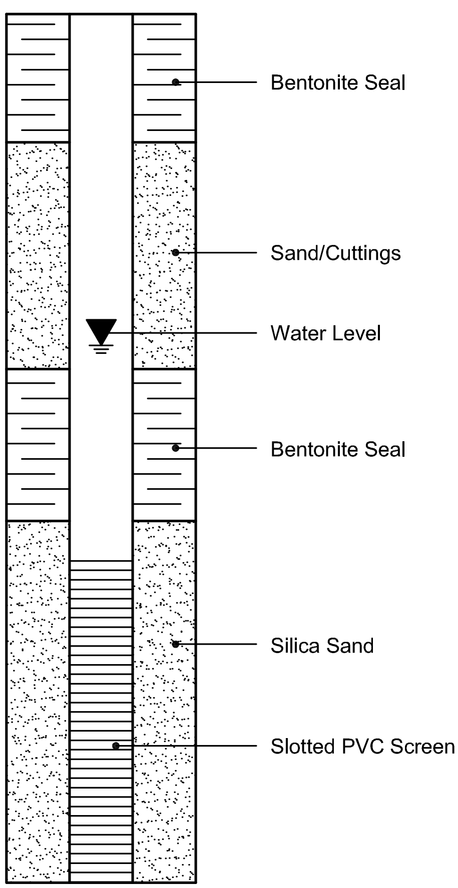
SYMBOLS AND TERMS (continued)

STRATA PLOT

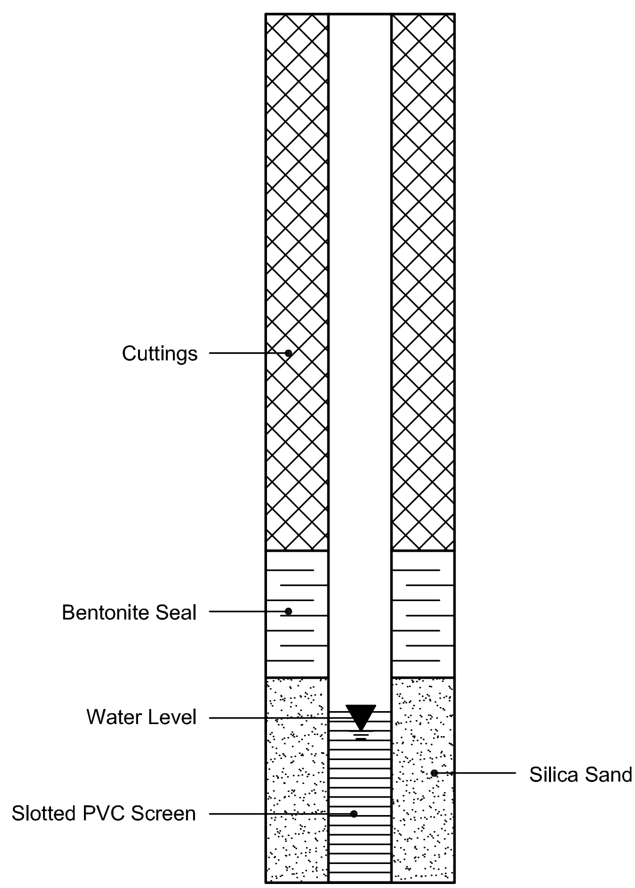


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



PARACEL LABORATORIES LTD.

Order #: 1647058

Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 21264

Report Date: 17-Nov-2016

Order Date: 14-Nov-2016

Project Description: PG0811

	Client ID:	BH2-16 SS3	-	-	-
	Sample Date:	10-Nov-16	-	-	-
	Sample ID:	1647058-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	65.1	-	-	-
General Inorganics					
pH	0.05 pH Units	7.32	-	-	-
Resistivity	0.10 Ohm.m	86.0	-	-	-
Anions					
Chloride	5 ug/g dry	16	-	-	-
Sulphate	5 ug/g dry	41	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG0811-1 - TEST HOLE LOCATION PLAN

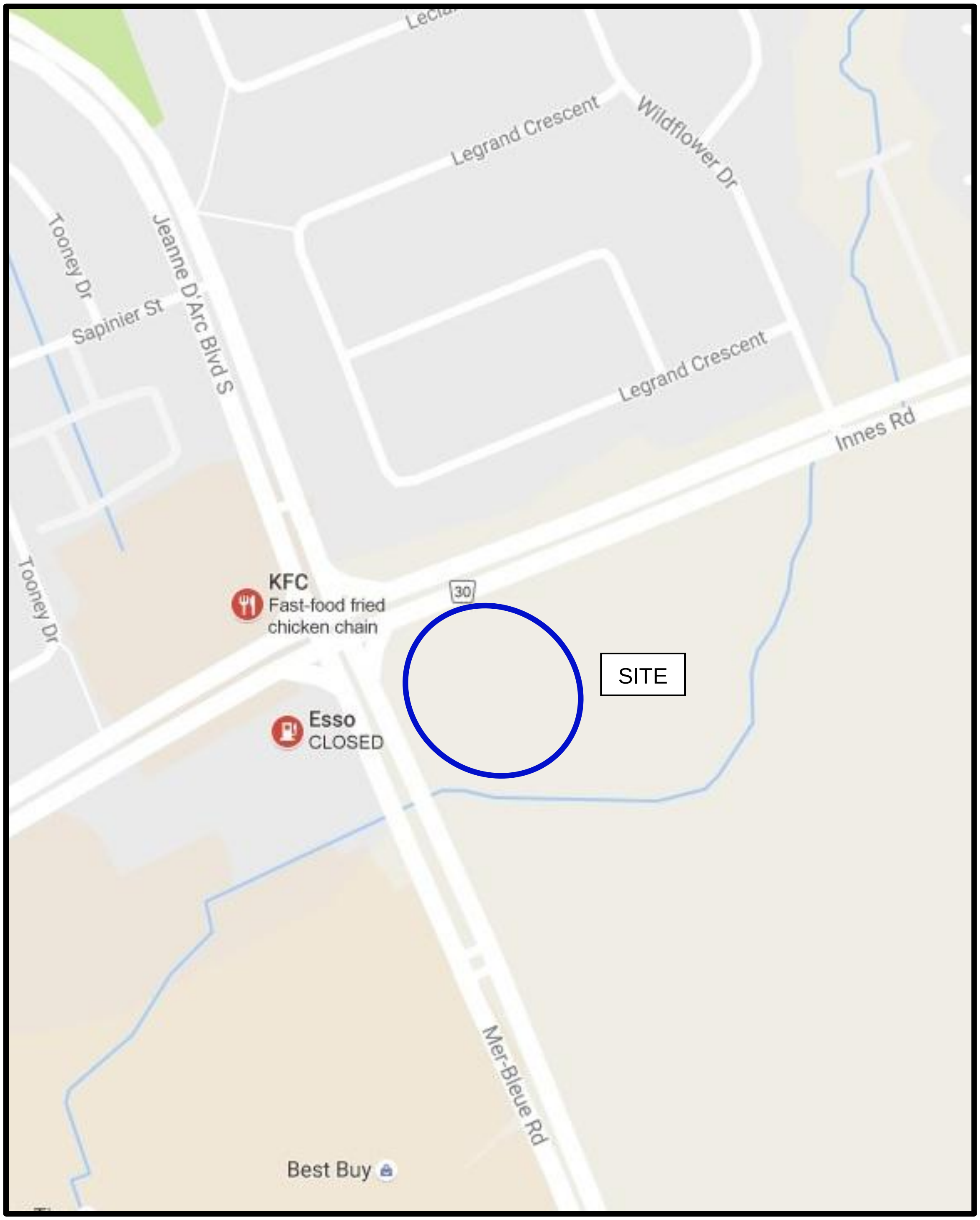
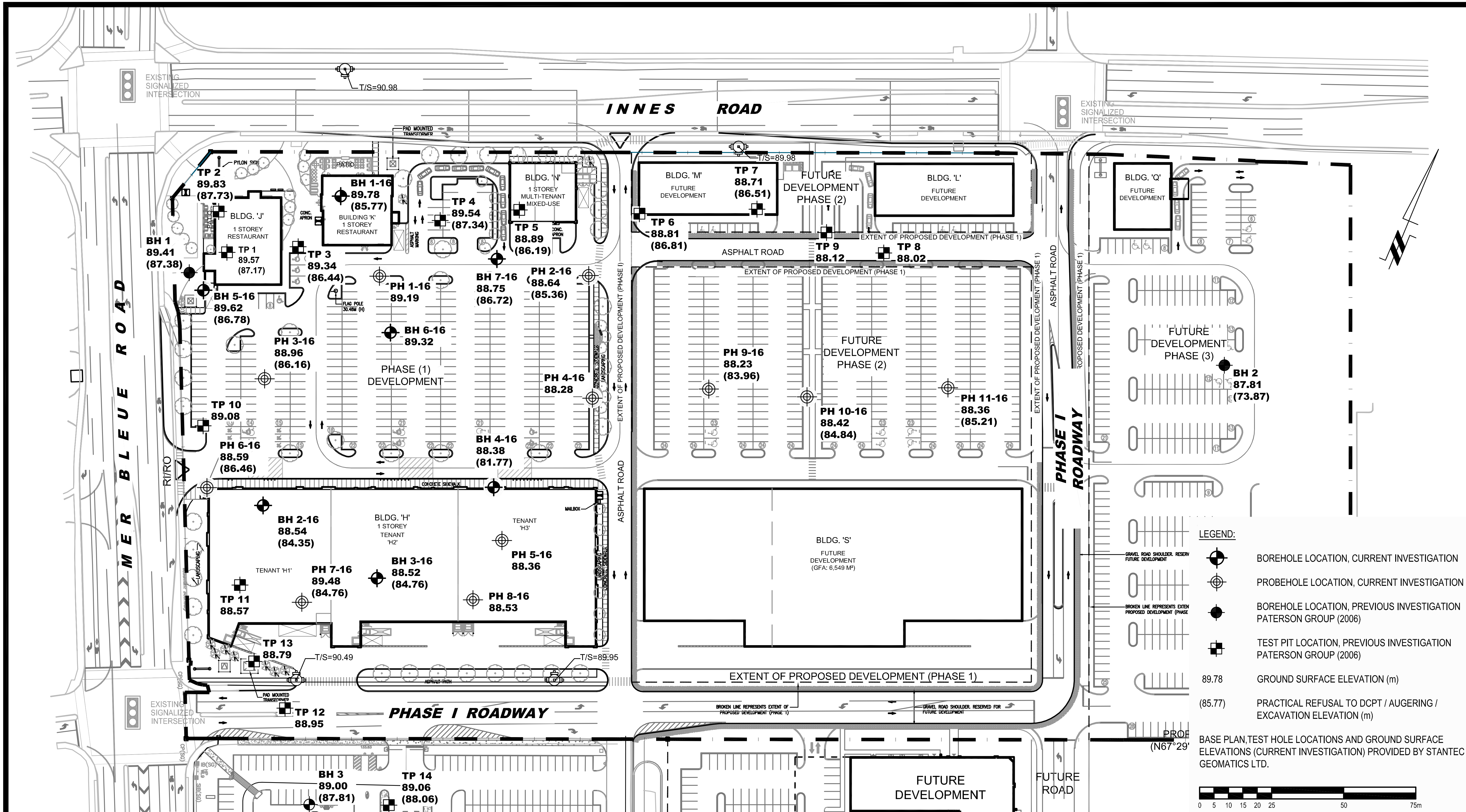


FIGURE 1

KEY PLAN

patersongroup



LEGEND:

- BOREHOLE LOCATION, CURRENT INVESTIGATION
- PROBEHOLE LOCATION, CURRENT INVESTIGATION
- BOREHOLE LOCATION, PREVIOUS INVESTIGATION PATERSON GROUP (2006)
- TEST PIT LOCATION, PREVIOUS INVESTIGATION PATERSON GROUP (2006)
- 89.78 GROUND SURFACE ELEVATION (m)
- (85.77) PRACTICAL REFUSAL TO DCPT / AUGERING / EXCAVATION ELEVATION (m)

BASE PLAN,TEST HOLE LOCATIONS AND GROUND SURFACE ELEVATIONS (CURRENT INVESTIGATION) PROVIDED BY STANTEC GEOMATICS LTD.

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
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NO.	REVISIONS	DATE	INITIAL
1	BASE PLAN UPDATED, PROBEHOLES AND BOREHOLES ADDED	29/11/2016	FA

SMART REIT

PROPOSED COMMERCIAL DEVELOPMENT - BUILDING H,J,K & N - PHASE I
MER BLEUE ROAD AND INNES ROAD

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1250	Date: 11/2016
Drawn by: RCG	Report No.: PG0811
Checked by: FA	Dwg. No.: PG0811-1
Approved by: DJG	Revision No.: 1

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Appendix E DRAWINGS