DCR/PHOENIX GROUP OF COMPANIES

ADEQUACY OF PUBLIC SERVICING REPORT
109575-5.2.2.1

1208 OLD MONTREAL ROAD

CITY OF OTTAWA

IBI

Prepared for DCR/PHOENIX HOMES
by IBI Group
January 8, 2018

Table of Contents

Table of Contents (continued)

Table of Contents (continued)

1 INTRODUCTION

1.1 Objective

IBI Professional Services Inc. (hereinafter referred to as IBI, or IBI Group) has been retained by DCR/PHOENIX Group of Companies to prepare this Adequacy of Public Services Report in support of Draft Plan approval for its **5.37ha** properties located at 1154, 1176, 1180 and 1208 Old Montreal Road. The draft plan has been prepared to demonstrate functionality of the subject lands including the property of 1172 Old Montreal Road. At the time of writing this report, DCR/Phoenix was in acquisition discussions with the property owner of 1172 Old Montreal Road. Should those discussions fail, this report also demonstrates the functionality of the subject lands excluding 1172 Old Montreal Road. This report will provide stakeholders with functional level design constraints in support of the proposed development sufficient to prepare draft conditions for the Plan of Subdivision.

1.2 Location

The subject properties are located in the City of Ottawa, within the former Cumberland Township and within the Cardinal Creek Village (CCV) CDP. It is bound to the north by Old Montreal Road, to the east by vacant agricultural/future development lands, to the south by a tributary branch of the Cardinal Creek, and to the west by existing rural development lands. The site is located opposite of de la Famille-Laporte Avenue, constructed by Tamarack Homes as part of the CCV development. Refer to **Figure 1.1** below for key map.

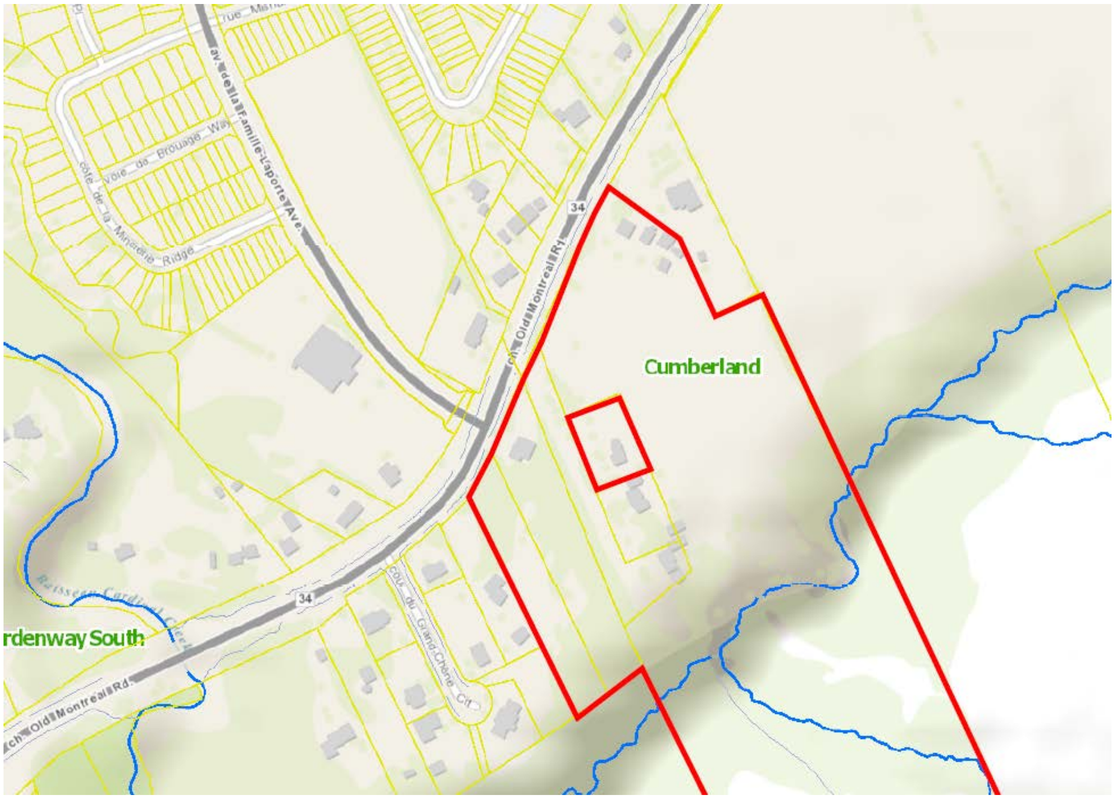


Figure 1.1 – Key Map of Subject Lands

The subject lands are inclusive in the Cardinal Creek Village Master Servicing Study.

1.3 Proposed Development

DCR/Phoenix is proposing to develop the subject lands with a mix of medium and high density development. The proposed site would combine stacked townhouse condominiums, semi-detached homes and freehold townhouses on municipal right of ways and private streets.

Parking for the semi-detached and freehold townhouses is provided for with standard construction single car garages, driveways and residual on-street parking. Parking for the stacked condominiums is provided by a combination of surface parking lot, on-street parking and below ground parking.

Due to the uncertainty of the land acquisition deal for 1172 Old Montreal Road, 2 draft plans have been prepared to support development with or without this property. Refer to **Appendix A** for each draft plan. The table below illustrates the unit counts for each plan.

PLAN	UNIT TYPE	NUMBER OF UNITS
Draft Plan 1 Excluding 1172 Old Montreal	Semis/Freehold Townhouse	20
	Condominium Unit/Apartment	462
TOTAL		**482**
Draft Plan 2 Including 1172 Old Montreal	Semis/Freehold Townhouse	28
	Condominium Unit/Apartment	510
TOTAL		**538**

This report has been prepared to demonstrate adequate servicing for the ultimate build out plan, therefore Draft Plan 2 will be used for all supporting calculations.

1.4 Previous Studies

In approving the CCV CDP, the City of Ottawa required the CDP lands undergo a number of studies and reports to support various development activities in the area. With respect to the provision of the three principle infrastructure services of water distribution, wastewater disposal and stormwater management, the following is a short list of the pertinent approved studies:

Master Servicing Study

"Master Servicing Study for Tamarack (Queen Street) Corporation, Cardinal Creek Village, City of Ottawa", prepared by DSEL, dated July 2013.

Design Brief

"Design Brief for Cardinal Creek Village Phase 1A & 1B, Tamarack (Cardinal Creek) Corporation, City of Ottawa", prepared by DSEL, dated May 2014.

Stormwater Management Report

"Stormwater Management Report for Phase 1 of Cardinal Creek Village", prepare by JFSA, updated May 2014).

1.5 Constraints to Development

There are 2 major constraints to the development of the site.

The primary major constraint to development is the substantial changes in existing topography across the site which impacts road slopes which further complicates stormwater management.

The secondary major constraint to development of the plan is the land acquisition of 1172 Old Montreal Road. This parcel is virtually centered within the development, while development can occur around the parcel, grade change between the retained and developed lands will need to be addressed.

1.6 Pre-Consultation

The draft plans presented in **Appendix A** have been presented to the City on two separate occasions (July 26, 2017 and November 10, 2017). The pre-consultation meetings focused on road profiles and site grading. Site servicing was discussed, however given the Cardinal Creek Village Master Servicing Study was just recently approved, water distribution, wastewater and stormwater sewers are all sized based on current standards to accommodate this development and are all located within close proximity to the subject site.

From the pre-consultation meeting, the following criteria were established as starting points.

- A reasonable approach slope to Old Montreal Road must be provided.
- Municipal Road, centerline slope may exceed minimum (6.0% slope) where sidewalks are not located parallel to the road, maximum road slope of 12% for straight sections without entrances/sidewalk locations
- Easements for public sidewalks through the development may be required
- At least 1 barrier free sidewalk to the upper plateau of the site, and may include switchback sections
- Public sidewalk in an easement may include stairs, which will be closed during the winter months
- City of Ottawa will require special ice prevention schedule for steep roads, particularly the roads connecting to Old Montreal Road.

1.7 Geotechnical Consideration

As part of the master servicing study, Paterson Group performed a high level Geotechnical Investigation in support of the overall community design plan.

Subsequently, EXP Services Inc., has been retained by DCR/Phoenix Homes to provide a more detailed geotechnical investigation for the subject lands. The preliminary geotechnical investigation found “that beneath 25 mm to 200 mm of topsoil, silty sand or fill extends to 0.7 m to 2.3 m depth. The silty sand/fill are underlain by clay, which extends to the entire depth investigated of 7.3 m to 8.6 m” and “18.9m to 20.9m”.

The preliminary investigation also assumed traditionally built 1 and 2 storey residential dwellings would be built on site, and that excavations would not exceed a maximum depth of 3m. At detail design stage, the geotechnical investigation will need to refine its findings specific to the intended grading plan and final building/unit types. Building excavations will exceed 3m from both existing ground, and from pre-grade in many locations, and as such shoring may be required.

A slope stability analysis of the existing ravine was undertaken, and revealed that the slope is stable and that a geotechnical setback is not required for the majority of the site. There is one area where a 24m setback has been established, and this is reflected in the draft plan, and is identified in the geotechnical report as the limits of hazardous land.

A copy of the report is included in **Appendix D**.

2 WATER DISTRIBUTION

2.1 Existing Conditions

The subject site is located within Pressure Zone 2E of the City of Ottawa's water distribution system. An existing 406mm watermain is located within the Old Montreal Road ROW.

2.2 Design Criteria

2.2.1 Water Demands

As previously noted, the development consists of twelve condominium buildings of 4 or more storeys, with a total of 510 units, 12 townhouse units and 16 semi-detached units. Populations by unit were taken from Table 4.1 of the City Design Guidelines. A watermain demand calculation sheet is included in **Appendix A** and the total water demands are summarized as follows:

Average Day	4.03 l/s
Maximum Day	10.06 l/s
Peak Hour	22.14 l/s

2.2.2 System Pressure

The 2010 City of Ottawa Water Distribution Guidelines states that the preferred practice for design of a new distribution system is to have normal operating pressures range between 345 kPa (50 psi) and 552 kPa (80 psi) under maximum daily flow conditions. Other pressure criteria identified in the guidelines are as follows:

Minimum Pressure	Minimum system pressure under peak hour demand conditions shall not be less than 276 kPa (40 psi)
Fire Flow	During the period of maximum day demand, the system pressure shall not be less than 140 kPa (20 psi) during a fire flow event.
Maximum Pressure	Maximum pressure at any point in the distribution system shall not exceed 689 kPa (100 psi). In accordance with the Ontario Building/Plumbing Code, the maximum pressure should not exceed 552 kPa (80 psi). Pressure reduction controls may be required for buildings where it is not possible/feasible to maintain the system pressure below 552 kPa.

2.2.3 Fire Flow Rate

As per the Ottawa Design Guidelines, the fire flow rate has been calculated using the Fire Underwriters Survey (FUS) method. The FUS method takes into account the type of building construction, the building occupancy, the use of sprinklers and the exposures to adjacent structures. Calculations were performed for Blocks 2, 5 & 12. Assuming ordinary building construction and a sprinkler system, a fire flow rate of 15,000 l/min (250l/s) was calculated for the condominium buildings and 10,000 l/min (167l/s) was calculated for the townhouses and semi-detached units. A copy of the calculations is included in **Appendix A**.

2.2.4 Boundary Conditions

Boundary conditions for two scenarios were obtained from the City – Existing Conditions and Future Conditions. Existing Conditions are used in this analysis because Future Conditions were calculated assuming a 406 mm watermain to the north of Old Montreal Road which has yet to be installed.

The two boundary conditions for the analysis obtained from the City are:

1. Old Montreal Road at Famille-Laporte Avenue
2. Old Montreal Road near Cartographe Street

A copy is also included in **Appendix A**, and they are summarized as follows:

BOUNDARY CONDITIONS		
SCENARIO	**HGL (m) Famille-Laporte Avenue**	**HGL (m) Cartographe Street**
Maximum HGL	130.2	130.2
Minimum HGL (Peak Hour)	124.8	124.8
Max Day + Fire Flow (10,000 l/min	122.3	121.6
Max Day + Fire Flow (15,000 l/min)	116.9	115.5

2.2.5 Hydraulic Model

A computer model for the site has been developed using the H$_2$0 map version 6.0 program produced by MWH Soft. The two boundary conditions (which represent the two connections to the existing watermain) have been incorporated into the model.

2.2.5 Modeling Results

The hydraulic model was run under basic day, maximum day with fire flows and under peak hour conditions. Water pipes are sized to provide sufficient pressure under peak hour conditions and provide the required fire flows under maximum day conditions. Results of the hydraulic model are included in **Appendix A** and summarized as follows:

Results of the hydraulic analysis are summarized as follows:

SCENARIO	
Basic Day (Max HGL) Pressure (kPa)	431.0 – 581.8
Peak Hour Pressure (kPa)	274.9 – 528.8
Minimum Design Fire Flow @140 kPa and 10,000 l/s Residual Pressure (l/s) (Townhouses and Semi-detached)	383.9
Minimum Design Fire Flow @140 kPa and 15,000 l/s Residual Pressure (l/s) (Condominium Buildings)	334.1

A comparison of the results and the design criteria is summarized as follows:

Maximum Pressure:	In low areas near Old Montreal Road, some nodes in the basic day HGL analysis have pressure greater than 552 kPa, therefore some pressure reducing control will be required for this development.
Minimum Pressure:	Minimum pressure was tested at all the buildings' top floors. Most nodes in the peak hour analysis have pressures greater than the required 276 kPa. However, a water pump may be required in areas of higher elevation.
Fire Flow:	Under the fire flow analysis all nodes exceed the required 15,000 l/min (250 l/s) flow for the condominium buildings and 10,000 l/min (167 l/s) flow for the townhouses and semi-detached units.

2.2.6 Watermain Layout

The proposed watermain layout for this development is shown on **Figure 2.1** in **Appendix A.** Two connections to the existing 406mm watermain on Old Montreal Road are proposed. A 250mm watermain is required to meet the fire flows for the condominium buildings in the southeast portion of the site and a 204mm watermain is required to meet the fire flows for Blocks 1 through 8. A 250mm watermain is proposed for the main loop throughout the site and a 204mm watermain is proposed for the connecting run through Blocks 1 to 8. Based on the above, the existing municipal infrastructure is suitably sized to accommodate the proposed draft plan.

3 WASTEWATER DISPOSAL

3.1 Existing Conditions and Previous Studies

The subject lands are located within the study limits of the Cardinal Creek Village Master Servicing Study (DSEL 2013). The Cardinal Creek Village Phase 1A and 1B sewers have been designed, approved and constructed with adequate capacity to service the subject lands. The Cardinal Creek Trunk wastewater disposal system is tributary to the Trim Road Collector, Cumberland Collector and ultimately received by the R. O. Pickard Wastewater Treatment Facility.

Construction of Phases 1A and 1B of Cardinal Creek Village included installing sanitary sewers in de la Famille Laporte Avenue. These sewers have been installed to provide service for the subject lands.

The subject lands form part of two tributary areas in the Cardinal Creek Village Trunk sewer network. The subject lands development limits vary slightly from the assumed areas identified within the Cardinal Creek Village Servicing Brief (DSEL 2014) an analysis of ultimate area and population follows.

An excerpt from the Cardinal Creek Village External Sanitary Drainage Plan 63A (DSEL, May 2014) has been provided below in **Figure 3.1** below. The full plan has been included in **Appendix B.**

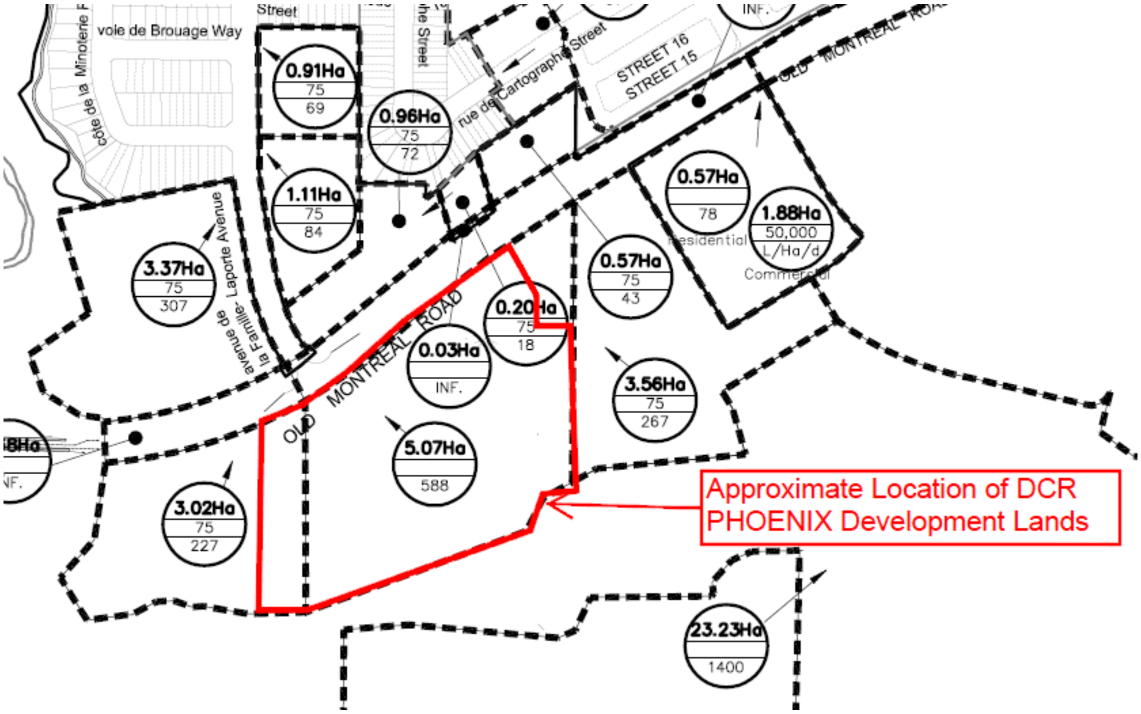


Figure 3.1 – DCR/Phoenix Lands location on DSEL External Sanitary Drainage Areas

The two areas tributary to the main trunk on de la Famille Laporte Avenue are identified in the **Table 3.1a** below.

DRAINAGE AREA	AREA (HA)	POPULATION
1	3.02	227
2	5.07	588

Table 3.1a – Summary of relevant areas from Cardinal Creek Phase 1A & 1B (DSEL 2014)

Of drainage area 1, noted in **Table 3.1a** above, the DCR lands represent a total development area of **0.49ha**. This is **16.2%** of the total sanitary drainage area. Therefore, 16.2% of the design population of 227, results in a population allowance of **36.8** for the DCR lands.

Of drainage area 2, noted in **Table 3.1a** above, the DCR lands represent a total development area of **4.88ha**. This is **96.2%** of the total sanitary drainage area. Therefore, 96.2% of the design population of 588, results in a population allowance of **565.7** for the DCR lands.

Therefore, the total allocated population for the DCR/Phoenix development lands are demonstrated in **Table 3.1b** below.

DRAINAGE AREA	AREA (HA)	POPULATION
1	0.49	36.8
2	4.88	565.7
TOTAL	**5.37**	**602.5**

Table 3.1b – Summary of total allocated population from Cardinal Creek Phase 1A&1B (DSEL 2014)

3.2 Design Criteria

The sanitary flows for the subject lands are determined based on current City of Ottawa design criteria, which includes, but is not limited to the following:

3.2.1 Design Flow:

Average Residential Flow	-	350 l/cap/day
Average Commercial/Institution Flow	-	50,000 l/Ha/day
Peak Residential Factor	-	Harmon Formula
Peak Commercial/Institution Factor	-	1.5
Infiltration Allowance	-	0.28 l/sec/Ha

3.2.2 Population Density:

Single Family	-	3.4 person/unit
Townhouse Units	-	2.7 person/unit
Apartment Units	-	1.8 person/unit
External Low Density Land	-	120 units/gross Ha

3.3 Proposed Wastewater Disposal System

As previously noted, the proposed wastewater disposal system within the study limits of the Cardinal Creek Master Servicing plan (DSEL, 2013) and the Cardinal Creek Village Phase 1A and 1B Design Brief (DSEL, 2014). All downstream sewers have been sized for sanitary flows generated from the subject lands. As previously noted, a population allowance of **602.5** has been carried through the previous studies.

3.3.1 Proposed Population Calculations

As previously noted, the ultimate development plan (Draft Plan 2) proposes 28 semidetached/townhouse units and 510 condominiums/apartment units, the total design population is indicated below.

UNIT TYPE	# OF UNITS	POPULATION DENSITY	POPULATION
Semi/Townhouse	28	2.7 pp/unit	75.6
Condo/Apartment	510	1.8 pp/unit	918
TOTAL	**538**	**-**	**993.6**

The proposed population exceeds the assumed population noted in the MSS for the subject lands.

3.3.2 Residual Capacity in downstream sewers

Upon investigating the residual capacity in downstream sewers, it was discovered that the allocated 227 people (area 3.02ha south of Old Montreal Road) on the external drainage area plan prepared by DSEL was omitted from the detail design sheets population. An initial investigation was completed to verify the increase in flows generated by the omitted 227 people. IBI has prepared a partial sewer design sheet summary for the external sewer in Cardinal Creek Village Phase 1A & 1B, manhole 115A to 116A. The result is an increase in flow of **3.22l/s**, refer to IBI Group **Sanitary Sewer Design Sheet** in **Appendix B**. Capacity in all downstream sewers to the Cardinal Creek Phase 1A/1B outlet were verified to be adequate for the omitted population, by comparing the design flow to the sewer capacities identified on the DSEL Sanitary Sewer Design Sheets (May 2014), included in **Appendix B** with all relevant sewer runs highlighted.

Subsequently, the same methodology was used to verify capacity for the additional population from the proposed DCR/Phoenix development lands with intensified density. The additional population can be calculated by subtracting the population allocation of **602.5** from the total proposed population of **993.6**. The resulting increase in population is **391.1**. IBI has prepared a partial sewer design sheet summary for the external sewer to Cardinal Creek Village Phase 1A & 1B, manhole 115A to 116A. The result is a total increase in flow to the trunk sewer of **8.59l/s**, which includes the omitted population flows of **3.22l/s** noted above, refer to IBI Group **Sanitary Sewer Design Sheet** in **Appendix B**. Therefore, the net increase in flow to the trunk sewer system generated from the increased population density is **5.37l/s**. Capacity in all downstream sewers to the Cardinal Creek Phase 1A/1B outlet were verified to be adequate for the omitted population and the increased population density of the subject lands, by comparing the design flow to the sewer capacities identified on the DSEL Sanitary Sewer Design Sheets (May 2014), included in **Appendix B** with all relevant sewer runs highlighted. Hence the downstream infrastructure is suitably sized to accommodate the proposed draft plan.

3.3.3 Proposed Wastewater Plan

As previously noted, downstream sewers have adequate capacity to service the subject lands. The proposed development will require extension of existing sewers from de la Famille Laporte Avenue onto and crossing Old Montreal Road. The public sanitary sewer system proposed will extend along Old Montreal Road to the East with 1 private sewer connection for Block 1 & 2. Townhouse blocks built into the stacked condo blocks will be serviced from within (i.e. 1 sanitary service to each building). The public sanitary sewer will also be extended into the proposed development through the proposed municipal road opposite of de la Famille Laporte Avenue.

Within the proposed development, the public sanitary sewer will follow the alignment of the proposed municipal road to provide service to the south-eastern limits of the development. Private sanitary sewers will connect to the public sewer are various locations to provide servicing for the condominium/apartment blocks.

There are no external lands contributing to the internal sanitary sewers. The sanitary sewers on Old Montreal Road will be designed for all external areas established in the MSS.

Due to existing topography, the subject lands will be designed with steeper than typical gradient roadways. As such, the sanitary sewer network will be constructed in such a fashion to limit sewage velocities within the pipe network. This will require the use of flattened pipes relative to the road slope and several sanitary sewer manholes with external drop structures.

4 STORMWATER MANAGEMENT

4.1 Existing Conditions and Previous Studies

The subject lands are tributary to Cardinal Creek, a tributary of the Ottawa River. The Cardinal Creek Village Master Servicing Study (DSEL June 2013) and Cardinal Creek Phase 1A & 1B Design Brief (DSEL May 2014) establish the stormwater management plan for the subject lands. The stormwater solution presented in the MSS consists of using site controls, dual drainage design and end of pipe stormwater management facility. Minor system flows are tributary to the Ottawa River, through the existing SWM facility (DSEL Figure 17, June 2013). Major system flow from the subject lands are tributary to the North Tributary of Cardinal Creek (DSEL Figure 18, June 2013). The subject lands are inclusive in the design of the Phase 1 trunk storm sewer network and are tributary to the Cardinal Creek Village interim pond #1. Additionally, the trunk sewer system for Phase 1 of the Cardinal Creek Village has provided capacity for the 100 year capture for lands south of Old Montreal Road (DSEL Section 5.3.2, May 2014). Design Sheets and Drainage area plans from Cardinal Creek Village Phase 1A & 1B Design Brief (DSEL May 2014) have been included in **Appendix C**.

The end of pipe stormwater management facility discharges directly to the Ottawa River, and is designed to provide an enhanced level of service (80% removal of TSS)

Downstream sewers have been modelled using XPSWMM program based on the 100 year 3-hour Chicago and 24-hour SCS design storms, and for the July 1st 1979, August 4th, 1988 and August 8th, 1996 historical events, Refer for DSEL Design Brief May 2014 and JFSA Stormwater Management Report for Phase 1 of Cardinal Creek Village (JFSA, May 2014).

4.2 Dual Drainage Design

The subject lands will be designed to be consistent with the findings of the MSS, downstream detail design brief, City of Ottawa sewer design Guidelines (OSDG October 2012), the OSDG guidelines of September 2016 Technical Bulletin PIEDTB-2016-01, and the February 2014 Technical Bulletin ISDTP-2014-1.

The site will be designed with dual drainage features, accommodating minor and major system flows. During frequent storm events, the effective runoff of a catchment area is directly released via catch basin inlets to the network of storm sewers, called the minor system. During less frequent storm events, the balance of the flow (in excess of the minor flow) is accommodated by a system of street segments, and in some cases oversized storm sewers, called the major system.

The street within the subject lands consist of a mix of sawtooth and continuous grade profiles. In several instances the road profiles would steeper than typical roads. Where possible, sawtoothing has been implemented to facilitate capture and storage. Inlet control devices (ICD's) are proposed across the site to maximize the use of available on-site storage and control surcharge to the minor system.

The final design of the subject lands will demonstrate that minor system capture and major flow conveyance is consistent with the findings of the MSS, Design Brief and Stormwater Management report for Phase 1 of Cardinal Creek Village.

On-site stormwater management will restrict flow to the minor system to the 100 year capture rate at the designed area and run-off coefficient, as identified in the previous studies for lands south of Old Montreal Road. The intent for 100 year capture is to limit ponding and major flow crossing of an arterial road. This will involve the sizing of onsite sewers to a minimum of the 2 year rational pipe sizes, or of a minimum size modelled to convey the designed flow.

Should the area and run-off coefficient of the final draft plan exceed the allocation in the MSS/SWM Report, or modelled flows exceed the allocated flows, then on-site stormwater management measures will be required. On-site stormwater management measures may include maximizing surface ponding, rooftop ponding or providing underground storage.

4.3 Proposed Stormwater Management Plan

As previously noted, downstream infrastructure was designed to provide capacity and treatment of stormwater runoff from the subject lands. The proposed development will require extension of the existing storm sewers from de la Famille Laporte Avenue onto and crossing Old Montreal Road. The public storm sewer system proposed will extend along Old Montreal Road to the East with one private sewer connection for Block 1 & 2, and the landscaping areas between the Old Montreal Road Right-of-Way and the facads of the two buildings, it will also be extended up the eastern municipal roadway within the development site. The public storm sewer will also be extended into the proposed development through the proposed municipal road opposite of de la Famille Laporte Avenue.

Within the proposed development, the public storm sewer will follow the alignment of the proposed municipal road to provide service to the south-eastern limits of the development. Private storm sewers will connect to the public sewer are various locations to provide servicing for the condominium/apartment blocks, a schematic of the proposed sewers is provided on **Figure 4.1** in **Appendix C.**

There are no external lands contributing to the internal storm sewers. The storm sewers on Montreal Road will be designed for all external areas established in the MSS.

Due to existing topography, the subject lands are designed with steep gradient roadways. As such, the storm sewer network will be constructed in such a fashion to limit sewage velocities within the pipe network. This will require the use of flattened pipes relative to the road slope and several storm sewer manholes.

It is anticipated that approach capture for roadside catchbasins will be a challenge on the steep segments of road. Flared curbs and additional inlet structures will be implemented as a means to increase capture into the storm sewer system.

4.4 Old Montreal Road

The storm sewer network will be extended from the existing manhole on de la Famille Laporte Avenue, easterly along Old Montreal Road. This sewer will be designed to capture the 10 year storm event of the Old Montreal Road drainage area. The MSS and Phase 1 of the Cardinal Creek Village were intended to capture a large area of Old Montreal Road, east of de la Famille Laporte Avenue. Subsequently, the Cardinal Creek Village Phase 2 design included a portion of Old Montreal Road which was originally tributary to Phase 1 / de la Famille Laporte Avenue. Therefore, the area has been reduced, and the existing sewers have more than adequate capacity to service the revised area. The revised area has been demonstrated on **Figure 4.2** in **Appendic C.**

5 ROADS AND GRADING

5.1 Site Grading

The existing grades within portions of the proposed development lands are 12-17m greater than the existing road centerline of Old Montreal Road. The existing topography suggests that during the construction of Old Montreal Road (former Highway 17), aggressive excavations into the escarpment were made. The existing embankment appears to be cut at approximately 1:1 slope.

The ultimate configuration of Old Montreal Road consists of a 4 lane arterial road cross section, which has yet to be designed. In absence of this information, it is being assumed that the ultimate road profile will closely follow that of the existing road centerline.

The site is currently occupied by low density rural residences and agricultural land, whose driveways are also cut into the embankment at slopes of approximately 15%.

The site plateaus, and is relatively flat to the southern limits of development, where the grade falls off sharply due to the northern banks of a tributary branch of the Cardinal Creek.

The proposed site grading would involve a major earth excavation undertaking. In order to best manage resources, on-site grading will consist of steep road ways, unique condominium buildings with 2 levels of underground parking (no internal ramps), retaining walls, terracing and walkout style traditional townhomes.

A macro grading plan has been prepared for the interim and ultimate build out of the development site to demonstrate the proposed grades, see **figures 5.1 and 5.2** in **Appendix D**.

5.2 Road Network

The draft plan(s) delineates the proposed road pattern for the development which is a mix of public and private roads. The proposed municipal roads within the development are all to be designed to City of Ottawa Standard 18.0m ROW. The private road within the condo site has 8.5m asphalt road width with designated street parking on the north side. Private entrances vary in width from 6.0m to 7.5m.

As previously noted, the existing topography has lead to some very unique grading. During preconsultation meetings with the City of Ottawa, the Project Manager and Senior Traffic Engineer agreed to entertain roadway slopes of up to 12.0% in areas where sidewalks can be rerouted away from the public road.

To assist in the capturing of major storm runoff prior to reaching Old Montreal Road a low point has been proposed at each of the intersections with Old Montreal Road. The low points are located approximately 15.0m south of the existing road centerline. The eastern road connection grading transition consists of 15.0m of 3.0% followed by 30.0m of 6.0%. The main entrance to the site, opposite of de la Famille Laporte, which will eventually be signalized and widened, consists of a longer approach of 30.0m at 3.0%, followed by approximately 70m of 5.0%. While these slopes are steeper than typically used for an approach to an arterial road, they have been minimized as much as feasibly possible.

Conceptual road profiles have been provided on **Figures 5.3, 5.4, 5.5, and 5.6** in **Appendix D**.

The public sidewalk is to be kept barrier free, accessible and must provide a reasonable level of service to the residences at the southern limits of the site. The main pedestrian access will be by a public sidewalk through private land within an easement. The sidewalk will maintain a 5.0% continuous slope without handrails, or an 8.3% slope with handrails and intermittent landings as required by the Ontario Building Code. Condo buildings will be serviced by private sidewalks meeting the sloping requirements noted above, and may also include several steps.

5.3 Municipal Consent

Municipal consent application will be required for works along the ROW of Old Montreal Road. Intersection improvements as per the Traffic Impact Study and extension of deep servicing infrastructure will require comment and review.

6 SOURCE CONTROLS

6.1 General

Since an end of pipe treatment facility is provided for the development lands, stormwater site management for the subject lands will focus on site level or source control management of runoff. Such controls or mitigative measures are proposed for this development not only for final development but also during construction and build out. Some of these measures are:

- flat site grading where possible;
- vegetation planting; and
- groundwater recharge in landscaped areas.

6.2 Lot Grading

Where possible, all of the proposed blocks within the development will make use gentle surface slopes on hard surfaces such as asphalt and concrete. In accordance with local municipal standards, all grading will be between 0.5 and 12.0 percent for hard surfaces and 2.0 and 6.0 percent for all landscaped areas. Significant grade changes will be accomplished through the use of terracing (3:1 max slope) or retaining walls. All street and parking lot catchbasins shall be equipped with 3.0m subdrains on opposite sides of a curbside catchbasin running parallel to the curb, and with 3.0m subdrains extending out from all 4 sides of parking lot catchbasins.

6.3 Vegetation

As with most subdivision agreements, the developer will be required to complete a vegetation and planting program. Vegetation throughout the development including planting along roadsides and within the individual blocks provides opportunities to re-create lost vegetation.

6.4 Groundwater Recharge

Perforated sub-drain systems will be implemented at capture locations in all vegetated areas. Roof leaders for pitched roofs are to direct runoff to landscaped areas. This will promote increased infiltration during low flow events before water is collected by the storm sewer system.

7 CONVEYANCE CONTROLS

7.1 General

Besides source controls, the development also proposes to use several conveyance control measures to improve runoff quality. These will include:

- vegetated swales; and
- catchbasin sumps.

7.2 Vegetated Swales

All rearyards within the proposed development make use of relatively vegetated swales. These swales generally employ saw-toothing at regular intervals and encourage infiltration and runoff treatment.

7.3 Catchbasins and Maintenance Hole Sumps

All catchbasins within the development, either rear yard or street, will be constructed with minimum 600 mm deep sumps. These sumps trap pollutants, sand, grit and debris which can be mechanically removed prior to being flushed into the minor pipe system. Both rear yard and street catchbasins will be to OPSD 705.02. All storm sewer maintenance holes serving local sewers less than 900 mm diameter shall be constructed with a 300 mm sump as per City standards.

8 SEDIMENT AND EROSION CONTROL PLAN

8.1 General

During construction, existing stream and conveyance systems can be exposed to significant sediment loadings. Although construction is only a temporary situation, it is proposed to introduce a number of mitigative construction techniques to reduce unnecessary construction sediment loadings. These will include:

- groundwater in trench will be pumped into a filter mechanism prior to release to the environment;
- bulkhead barriers will be installed at the nearest downstream manhole in each sewer which connects to an existing downstream sewer;
- seepage barriers will be constructed in any temporary drainage ditches;
- filter cloths will remain on open surface structure such as manholes and catchbasins until these structures are commissioned and put into use; and
- Silt fence on the site perimeter.

8.2 Trench Dewatering

Although little groundwater is expected during construction of municipal services, any trench dewatering using pumps will be discharged into a filter trap made up of geotextile filters and straw bales similar in design to the OPSD 219.240 Dewatering Trap. These will be constructed in a bowl shape with the fabric forming the bottom and the straw bales forming the sides. Any pumped groundwater will be filtered prior to release to the existing surface runoff. The contractor will inspect and maintain the filters as needed including sediment removal and disposal and material replacement as needed.

8.3 Bulkhead Barriers

At the first new manhole constructed within the development that is immediately upstream of an existing sewer a temporary ½ diameter bulkhead will be constructed over the lower half of the outletting sewer. This bulkhead will trap any sediment carrying flows thus preventing any construction-related contamination of existing sewers. The bulkheads will be inspected and maintained including periodic sediment removal as needed and removed prior to top course asphalt being laid.

8.4 Seepage Barriers

The presence of road side ditches along Old Montreal Road and the proximity of the Cardinal Creek necessitate the installation of seepage barriers. These barriers will consist of both the Light Duty Straw Bale Barrier as per OPSD 219.100 or the Light Duty Silt Fence Barrier as per OPSD 219.110. The barriers are typically made of layers of straw bales or geotextile fabric staked in place. All seepage barriers will be inspected and maintained as needed.

8.5 Surface Structure Filters

All catchbasins, and to a lesser degree manholes, convey surface water to sewers. However, until the surrounding surface has been completed these structures should be covered in some fashion to prevent sediment from entering the minor storm sewer system. Until rearyards are sodded or until streets are asphalted and curbed, catchbasins and manholes will be constructed with geotextile filter bags or a geotextile filter fabric located between the structure frame and cover respectively. These will stay in place and be maintained during construction and build until it is appropriate to remove same.

8.6 Stockpile Management

During construction of any development similar to that proposed by the Owner, both imported and native soils are stockpiled. Mitigative measures and proper management to prevent these materials entering the sewer systems is needed. Significant excess material will be generated from the subject lands, and will need to be disposed of off-site in a manner consistent with all MOECC regulations.

During construction of the deeper municipal services, water, sewers and service connections, imported granular bedding materials are temporarily stockpiled on site. These materials are however quickly used up and generally before any catchbasins are installed. Street catchbasins are installed at the time of roadway construction and rearyard catchbasins are usually installed after base course asphalt is placed.

Contamination of the environment as a result of stockpiling of imported construction materials is generally not a concern provided the above noted seepage barriers are installed. These materials are quickly used and the mitigative measures stated previously, especially the ½ diameter sewer bulkheads and filter fabric in catchbasins and manholes help to manage these concerns.

The roadway granular materials are not stockpiled on site. They are immediately placed in the roadway and have little opportunity of contamination. Lot grading sometimes generates stockpiles of native materials. However, this is only a temporary event since the materials are quickly moved off site.

To assist in the control of transporting sediment off-site into municipal roads, mud matts will be employed at the construction entrances.

9 CONCLUSIONS

Water, wastewater and stormwater systems required to accommodate the orderly development of the DCR Phoenix 1208 Old Montreal Road lands are available to the subject site. The attached drawings and supporting analysis illustrate the lands can be developed in an orderly and effective manner and in accordance with the City of Ottawa's current level of service requirements.

The use of lot level controls, conveyance controls and end of pipe controls outlined in the report will result in effective treatment of surface stormwater runoff from the site. Adherence to the proposed sediment and erosion control plan during construction will minimize harmful impacts on surface water.

This report outlined conceptual servicing scheme to support the proposed development. The servicing schemes are subject to various governmental approvals prior to construction, including but not limited to the following:

- Certificate of Authorization (C of A) for sewers and SWM: Ministry of Environment;
- Commence Work Order: City of Ottawa;
- Municipal Consent: City of Ottawa.

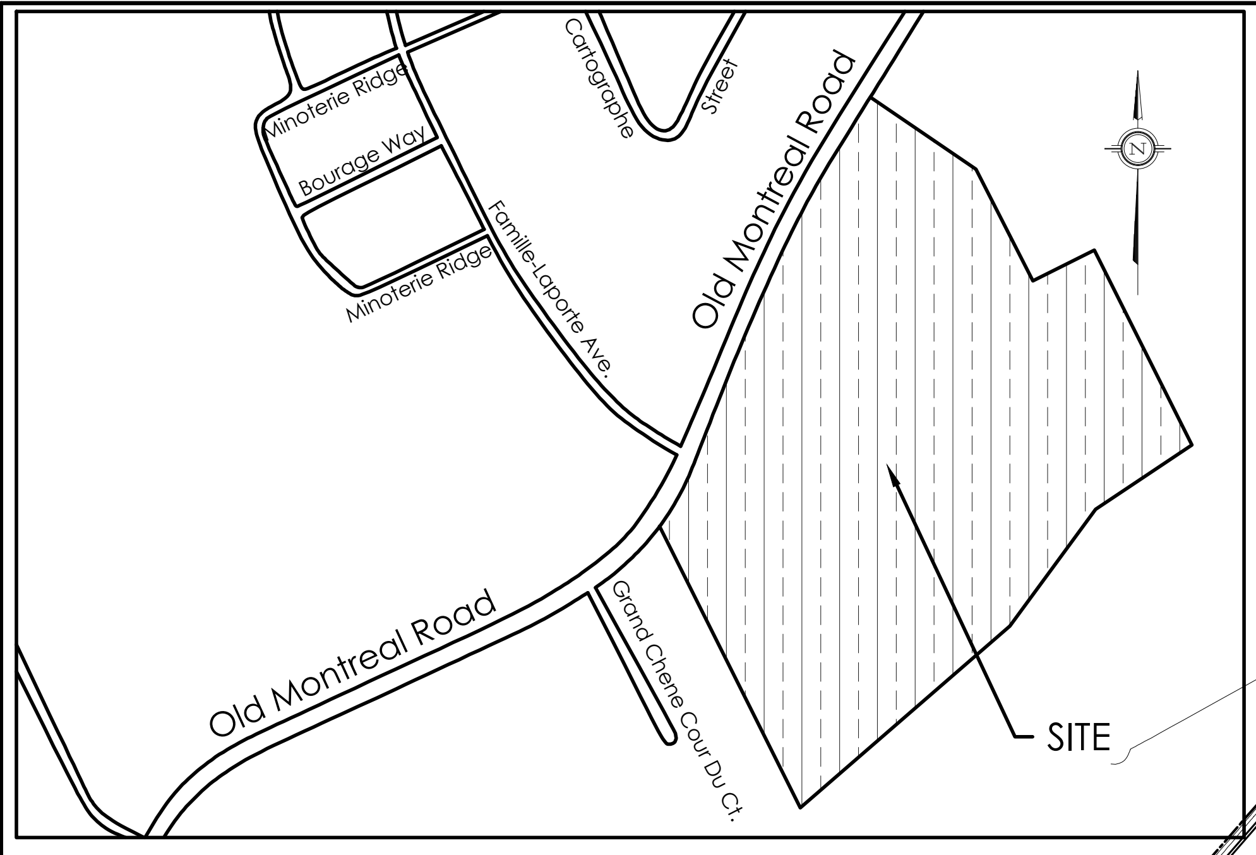
Report Prepared By:

LICENSED PROFESSIONAL ENGINEER
D.G. Yannoulopoulos
PROVINCE OF ONTARIO

Demetrius Yannoulopoulos, P. Eng.

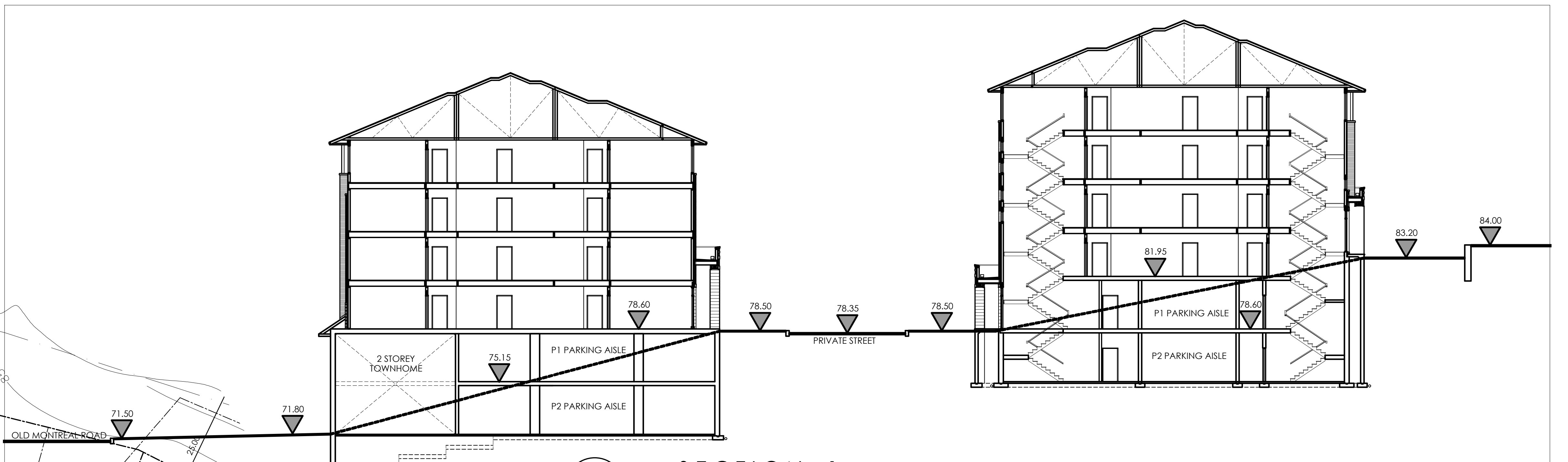
Ryan Magladry, C.E.T.

APPENDIX A



2 SP1 KEY PLAN

n.t.s.



1 SP1 SECTION 1

n.t.s.

5 20 50 100m
0 10 30 75

TERRACE FLATS & TOWNS		FLATS	TOWNS
BLOCK 1 =	TERRACE FLATS / TWO STOREY TOWNS	48 UNITS	8 UNITS
BLOCK 2 =	TERRACE FLATS / TWO STOREY TOWNS	40 UNITS	7 UNITS
BLOCK 3 =	TERRACE FLATS / TWO STOREY TOWNS	40 UNITS	7 UNITS
BLOCK 4 =	TERRACE FLATS / TWO STOREY TOWNS	48 UNITS	8 UNITS
BLOCK 5 =	TERRACE FLATS	56 UNITS	
BLOCK 7 =	TERRACE FLATS	24 UNITS	
BLOCK 8 =	TERRACE FLATS	48 UNITS	
BLOCK 9 =	TERRACE FLATS	24 UNITS	
BLOCK 10 =	TERRACE FLATS	24 UNITS	
BLOCK 11 =	TERRACE FLATS	40 UNITS	
BLOCK 12 =	TERRACE FLATS	40 UNITS	
TOTAL =		432 UNITS	30 UNITS
SEMI-DETACHED			
SEMI-DETACHED =		16 UNITS	
TOWNHOMES			
TOWNHOMES =		4 UNITS	
TOTAL ALL UNITS =		482 UNITS	

M. David Blakely
Architect Inc.
2200 Prince of Wales Dr. - Suite 101
Ottawa, Ontario K2E 6Z9
Phone (613) 226-8811 Fax (613) 226-7942

GENERAL NOTES:

1. THE CONTRACTOR IS RESPONSIBLE FOR CHECKING AND VERIFYING ALL DIMENSIONS, ANY DISCREPANCY MUST BE REPORTED TO M. DAVID BLAKELY ARCHITECT INC.
2. ALL WORK AND MATERIALS TO BE IN COMPLIANCE WITH ALL CODES, REGULATIONS, AND BY-LAWS.
3. ADDITIONAL DRAWINGS MAY BE ISSUED FOR CLARIFICATION TO ASSIST THE PROPER EXECUTION OF WORK. SUCH DRAWINGS WILL HAVE THE SAME MEANING AND INTENT AS IF THEY WERE INCLUDED WITH THE PLANS IN CONTRACT DOCUMENTS.
4. DO NOT SCALE DRAWINGS.
5. THIS DRAWING SHALL NOT BE USED FOR PERMIT OR CONSTRUCTION UNLESS THE DRAWING BEARS THE ARCHITECT'S SEAL AND SIGNATURE.
6. THIS REPRODUCTION SHALL NOT BE ALTERED

CONSTRUCTION NORTH

No.	DATE	DESCRIPTION	INIT.
10.			
9.			
8.			
7.	04/01/18	REVISED BLOCK LOCATIONS	SM
6.	28/09/17	REVISED SITE BOUNDARIES	SM
5.	20/09/17	REVISED SITE LAYOUT	SM
4.	05/07/17	REVISED UNIT TYPES	SM
3.	13/04/17	REVISED SITE LAYOUT	SM
2.	21/12/16	REVISED 36 UNIT BLOCK LAYOUT	SM
1.	30/11/16	FOR REVIEW	SM

REVISIONS

No.	DATE	DESCRIPTION	INIT.
20.			
19.			
18.			
17.			
16.			
15.			
14.			
13.			
12.			
11.			

REVISIONS

A
B | C

A - DETAIL NUMBER
B - SHEET NUMBER (DETAIL REQUIRED)
C - SHEET NUMBER (DETAIL LOCATION)

SEAL

PROJECT
PROPOSED SUBDIVISION
OLD MONTREAL ROAD
OTTAWA, ONTARIO.

DRAWING TITLE
PRELIMINARY DEVELOPMENT PLAN

CLIENT
PHOENIX HOMES

DATE: NOV., 2016.
SCALE: 1 : 500
DRAWN BY: SBM
CHECKED: MDB
SHEET No. SP-1

\\Jon-pc\f\2018 PROJECTS\Phoenix Homes\Old Montreal Road\Site Plans\Montreal Road Site Plan SP-1 180104-Rev07.dwg, 04/01/2018 12:14:47 PM

\\Jon-pc\f\2018 PROJECTS\Phoenix Homes\Old Montreal Road\Site Plans\Montreal Road Site Plan 180102-Rev07.dwg, 02/01/2018 4:11:54 PM

TERRACE FLATS & TOWNS		FLATS	TOWNS
BLOCK 1 =	TERRACE FLATS / TWO STOREY TOWNS	48 UNITS	8 UNITS
BLOCK 2 =	TERRACE FLATS / TWO STOREY TOWNS	40 UNITS	7 UNITS
BLOCK 3 =	TERRACE FLATS / TWO STOREY TOWNS	40 UNITS	7 UNITS
BLOCK 4 =	TERRACE FLATS / TWO STOREY TOWNS	48 UNITS	8 UNITS
BLOCK 5 =	TERRACE FLATS	56 UNITS	
BLOCK 6 =	TERRACE FLATS	48 UNITS	
BLOCK 7 =	TERRACE FLATS	24 UNITS	
BLOCK 8 =	TERRACE FLATS	48 UNITS	
BLOCK 9 =	TERRACE FLATS	24 UNITS	
BLOCK 10 =	TERRACE FLATS	24 UNITS	
BLOCK 11 =	TERRACE FLATS	40 UNITS	
BLOCK 12 =	TERRACE FLATS	40 UNITS	
TOTAL =		480 UNITS	30 UNITS
SEMI-DETACHED			
SEMI-DETACHED =		16 UNITS	
TOWNHOMES			
TOWNHOMES =		12 UNITS	
TOTAL ALL UNITS =		538 UNITS	

M. David Blakely
Architect Inc.
2200 Prince of Wales Dr. - Suite 101
Ottawa, Ontario K2E 6Z9
Phone (613) 226-8811 Fax (613) 226-7942

GENERAL NOTES:

1. THE CONTRACTOR IS RESPONSIBLE FOR CHECKING AND VERIFYING ALL DIMENSIONS, ANY DISCREPANCY MUST BE REPORTED TO M. DAVID BLAKELY ARCHITECT INC.
2. ALL WORK AND MATERIALS TO BE IN COMPLIANCE WITH ALL CODES, REGULATIONS, AND BY-LAWS.
3. ADDITIONAL DRAWINGS MAY BE ISSUED FOR CLARIFICATION TO ASSIST THE PROPER EXECUTION OF WORK. SUCH DRAWINGS WILL HAVE THE SAME MEANING AND INTENT AS IF THEY WERE INCLUDED WITH THE PLANS IN CONTRACT DOCUMENTS.
4. DO NOT SCALE DRAWINGS.
5. THIS DRAWING SHALL NOT BE USED FOR PERMIT OR CONSTRUCTION UNLESS THE DRAWING BEARS THE ARCHITECT'S SEAL AND SIGNATURE.
6. THIS REPRODUCTION SHALL NOT BE ALTERED

CONSTRUCTION NORTH

No.	DATE	DESCRIPTION	INIT.
10.			
9.			
8.			
7.	02/01/18	REVISED BLOCK LOCATIONS	SM
6.	28/09/17	REVISED SITE BOUNDARIES	SM
5.	20/09/17	REVISED SITE LAYOUT	SM
4.	05/07/17	REVISED UNIT TYPES	SM
3.	13/04/17	REVISED SITE LAYOUT	SM
2.	21/12/16	REVISED 36 UNIT BLOCK LAYOUT	SM
1.	30/11/16	FOR REVIEW	SM

REVISIONS

No.	DATE	DESCRIPTION	INIT.
20.			
19.			
18.			
17.			
16.			
15.			
14.			
13.			
12.			
11.			

REVISIONS

A - DETAIL NUMBER
B - SHEET NUMBER (DETAIL REQUIRED)
C - SHEET NUMBER (DETAIL LOCATION)

SEAL

PROJECT
PROPOSED SUBDIVISION
OLD MONTREAL ROAD
OTTAWA, ONTARIO.

DRAWING TITLE
PRELIMINARY
DEVELOPMENT PLAN

CLIENT
PHOENIX HOMES

DATE: NOV., 2016.
SCALE: 1 : 500
SHEET No.: SP-2
DRAWN BY: SBM
CHECKED: MDB

WATERMAIN DEMAND CALCULATION SHEET

IBI GROUP
333 PRESTON STREET
OTTAWA, ONTARIO
K1S 5N4

PROJECT : **OLD MONTREAL ROAD**
CLIENT : **DCR PHOENIX**

FILE: 109575-5.7
DATE PRINTED: 2018-01-12
DESIGN: MB
PAGE: 1 OF 1

	RESIDENTIAL				NON-RESIDENTIAL (ICI)			AVERAGE DAILY DEMAND (l/s)			MAXIMUM DAILY DEMAND (l/s)			MAXIMUM HOURLY DEMAND (l/s)			
NODE	SINGLE FAMILY UNITS	TOWNHOUSE / SEMI-DETACHED UNITS	MEDIUM DENSITY UNITS	POPULATION	INDUST. (ha)	COMM. (ha)	INSTIT. (ha)	RESIDENTIAL	ICI	TOTAL	RESIDENTIAL	ICI	TOTAL	RESIDENTIAL	ICI	TOTAL	FIRE DEMAND (l/min)
Blocks 1 & 8			104	187.20				0.76		0.76	1.90		1.90	4.17		4.17	15,000
Blocks 2 & 7			71	127.80				0.52		0.52	1.29		1.29	2.85		2.85	15,000
Blocks 3 & 6			95	171.00				0.69		0.69	1.73		1.73	3.81		3.81	15,000
Blocks 4 & 5			112	201.60				0.82		0.82	2.04		2.04	4.49		4.49	15,000
Townhouses 2		14		37.80				0.15		0.15	0.38		0.38	0.84		0.84	10,000
Townhouses 1		14		37.80				0.15		0.15	0.38		0.38	0.84		0.84	10,000
Block 12			40	72.00				0.29		0.29	0.73		0.73	1.60		1.60	15,000
Blocks 9 to 11			88	158.40				0.64		0.64	1.60		1.60	3.53		3.53	15,000
Total		**28**	**510**	**993.60**				**4.03**		**4.03**	**10.06**		**10.06**	**22.14**		**22.14**	

POPULATION DENSITY

Single Family	3.4 persons/unit
Semi Detached & Townhouse	2.7 persons/unit
Medium Density	1.8 persons/unit

WATER DEMAND RATES

Residential	350 l/cap/day

PEAKING FACTORS

Maximum Daily Residential	2.5 x avg. day
Maximum Hourly Residential	2.2 x max. day

FIRE DEMANDS

Single Family	10,000 l/min (166.7 l/s)
Semi Detached & Townhouse	10,000 l/min (166.7 l/s)
Medium Density	15,000 l/min (250 l/s)

109575 - Old Montreal Road Fire Flow Requirement from Fire Underwriters Survey

Block 2

Floor Area (1 & 2)	1,800	m^2
Floor Area (3 to 5)	2,700	m^2
Total Floor Area	4,500	m^2

$F = 220C\sqrt{A}$

C	1.0	
A	4,500	m^2
F	14,758	l/min
use	15,000	l/min

C =

1.5	wood frame
1.0	ordinary
0.8	non-combustible
0.6	fire-resistive

Occupancy Adjustment

Use	-15%	
Adjustment	-2250	l/min
Fire flow	12,750	l/min

-25%	non-combustible
-15%	limited combustible
0%	combustible
+15%	free burning
+25%	rapid burning

Sprinkler Adjustment

Use	-30%	
Adjustment	-3825	l/min

-30%	system conforming to NFPA 13
-50%	complete automatic system

Exposure Adjustment

Building Face	Separation	Charge
north	15	15%
east	15	15%
south	15	15%
west	45	5%
Total		50%

Separation	Charge
0 to 3m	+25%
3.1 to 10m	+20%
10.1 to 20m	+15%
20.1 to 30m	+10%
30.1 to 45m	+5%

Adjustment	6,375	l/min
Fire flow	15,300	l/min
Use	**15,000**	**l/min**
	250	**l/s**

109575 - Old Montreal Road Fire Flow Requirement from Fire Underwriters Survey

Block 5

Floor Area (1 & 2)	2,400	m^2
Floor Area (3 & 4)	2,400	m^2
Total Floor Area	4,800	m^2

$F = 220C\sqrt{A}$

C	1.0	
A	4,800	m^2
F	15,242	l/min
use	15,500	l/min

C =	
1.5	wood frame
1.0	ordinary
0.8	non-combustible
0.6	fire-resistive

Occupancy Adjustment

-25%	non-combustible
-15%	limited combustible
0%	combustible
+15%	free burning
+25%	rapid burning

Use	-15%	
Adjustment	-2325	l/min
Fire flow	13,175	l/min

Sprinkler Adjustment

-30%	system conforming to NFPA 13
-50%	complete automatic system

Use	-30%	
Adjustment	-3953	l/min

Exposure Adjustment

Separation	Charge
0 to 3m	+25%
3.1 to 10m	+20%
10.1 to 20m	+15%
20.1 to 30m	+10%
30.1 to 45m	+5%

Building Face	Separation	Charge
north	25	10%
east	15	15%
south	50	5%
west	27	10%
Total		40%

Adjustment	5,270	l/min
Fire flow	14,493	l/min
Use	**15,000**	**l/min**
	250	**l/s**

109575 - Old Montreal Road Fire Flow Requirement from Fire Underwriters Survey

Block 12

Floor Area (1 & 2)	1,700	m^2
Floor Area (3 & 4)	1,700	m^2
Total Floor Area	3,400	m^2

$F = 220C\sqrt{A}$

C	1.0	
A	3,400	m^2
F	12,828	l/min
use	13,000	l/min

C =	1.5	wood frame
	1.0	ordinary
	0.8	non-combustible
	0.6	fire-resistive

Occupancy Adjustment

Use	-15%	
Adjustment	-1950	l/min
Fire flow	11,050	l/min

-25%	non-combustible
-15%	limited combustible
0%	combustible
+15%	free burning
+25%	rapid burning

Sprinkler Adjustment

Use	-30%	
Adjustment	-3315	l/min

-30%	system conforming to NFPA 13
-50%	complete automatic system

Exposure Adjustment

Building Face	Separation	Charge
north	45	5%
east	45	5%
south	17	15%
west	29	10%
Total		35%

Separation	Charge
0 to 3m	+25%
3.1 to 10m	+20%
10.1 to 20m	+15%
20.1 to 30m	+10%
30.1 to 45m	+5%

Adjustment	3,868	l/min
Fire flow	11,603	l/min
Use	**12,000**	**l/min**
	200	**l/s**

Michael Black

From: White, Joshua (Planning) <Joshua.White@ottawa.ca>
Sent: Friday, October 27, 2017 10:02 AM
To: Ryan Magladry
Subject: FW: 1208 Old Montreal Road - Boundary Condition Request
Attachments: 1208MontrealRoad_Boundary Conditions_05Oct2017.docx

Here are the boundary conditions for this site

I have provided two scenarios:

- Existing conditions – one 406 mm feed on Old Montreal
- Future conditions – the additional of the 2nd 406 mm feed at Dairy.

From: Ryan Magladry [mailto:]
Sent: Wednesday, October 04, 2017 1:15 PM
To: White, Joshua (Planning) <Joshua.White@ottawa.ca>
Subject: RE: 1208 Old Montreal Road - Boundary Condition Request

See attached. Locations are approximate, but should be sufficient for this exercise.
Thx

Ryan Magladry

IBI GROUP
400-333 Preston Street
Ottawa ON K1S 5N4 Canada
tel +1 613 225 1311 fax +1 613 225 9868

Defining the cities of tomorrow
ibigroup.com

From: White, Joshua (Planning) [mailto:Joshua.White@ottawa.ca]
Sent: Wednesday, October 04, 2017 12:07 PM
To: Ryan Magladry <rmagladry@IBIGroup.com>
Subject: RE: 1208 Old Montreal Road - Boundary Condition Request

If you could show where the connections are going on this screen shot.

Josh

From: Ryan Magladry [mailto:rmagladry@IBIGroup.com]
Sent: Friday, September 22, 2017 9:26 AM
To: White, Joshua (Planning) <Joshua.White@ottawa.ca>
Cc: Demetrius Yannoulopoulos <dyannoulopoulos@IBIGroup.com>
Subject: 1208 Old Montreal Road - Boundary Condition Request

Good morning Josh,
Subsequent to your preliminary design meeting with Demetrius a few weeks back, we are proceeding with draft plan for the DCR development at 1208 Old Montreal Road. Could we please receive watermain boundary conditions for the proposed development? Attached preliminary demand calculations.

Thanks,

Ryan Magladry

IBI GROUP
400-333 Preston Street
Ottawa ON K1S 5N4 Canada
tel +1 613 225 1311 fax +1 613 225 9868

Defining the cities of tomorrow
ibigroup.com

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

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

'

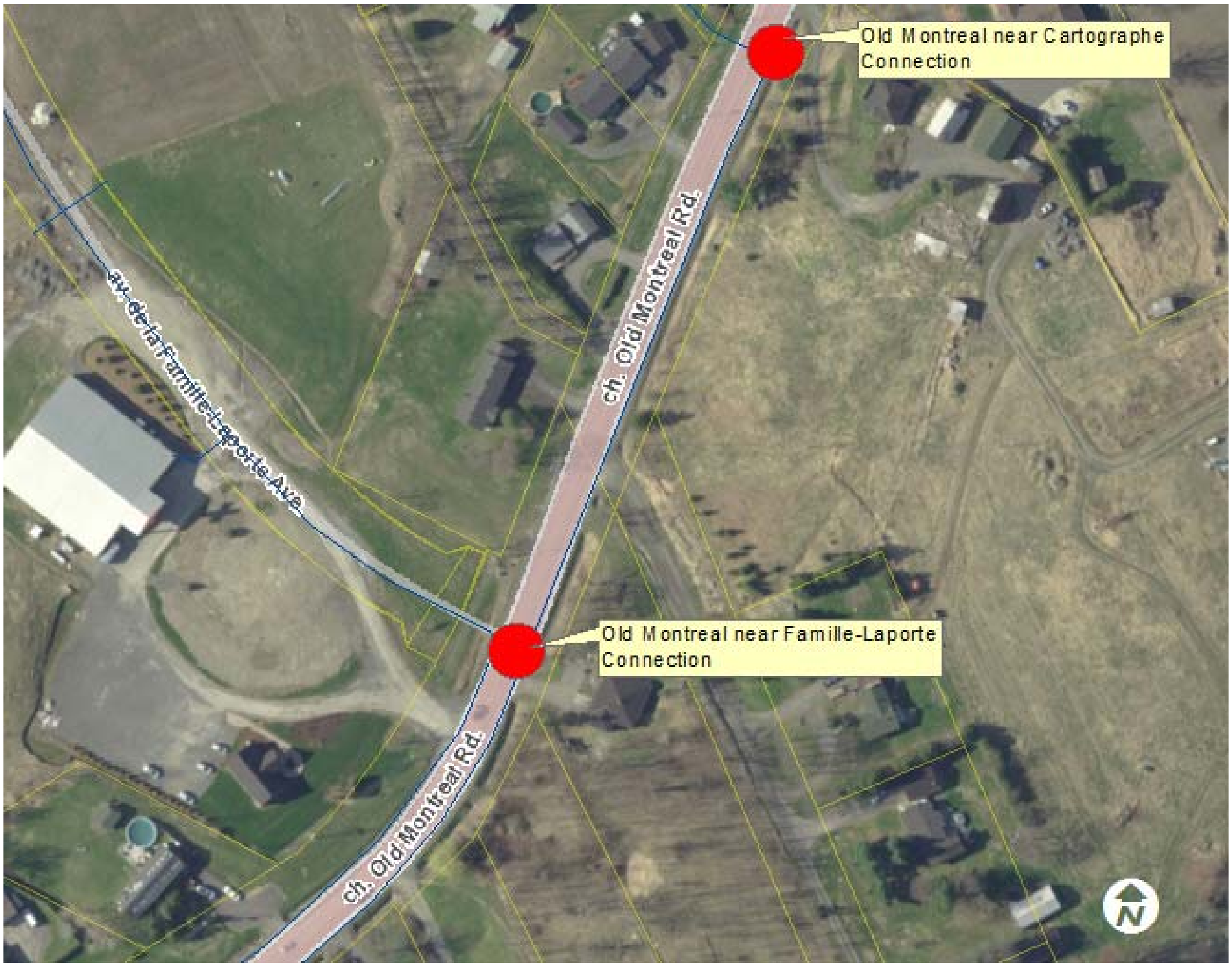
Boundary Conditions 1208 Montreal Road

Information Provided

Date provided: September 2017

Scenario	Demand	
	L/min	L/s
Average Daily Demand	241.8	4.03
Maximum Daily Demand	603.6	10.06
Peak Hour	1328.4	22.1
Fire Flow Demand # 1	10000	166.7
Fire Flow Demand # 2	15000	250.0

Scenario 1: Existing Conditions



Results

Connection 1 - Old Montreal near Famille-Laporte

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	130.2	84.4
Peak Hour	124.8	76.8
Max Day plus Fire (10,000 l/min)	122.3	73.2
Max Day plus Fire (15,000 l/min)	116.9	65.6

[1] Ground Elevation = 70.8 m

Connection 2 - Old Montreal near Cartographe

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	130.2	80.6
Peak Hour	124.8	72.9
Max Day plus Fire (10,000 l/min)	121.6	68.4
Max Day plus Fire (15,000 l/min)	115.5	59.8

[1] Ground Elevation = 73.5 m

Scenario 2: Future Conditions (2nd 406 mm watermain)

Results

Connection 1 - Old Montreal near Famille-Laporte

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	130.2	84.4
Peak Hour	124.8	76.8
Max Day plus Fire (10,000 l/min)	123.6	75.0
Max Day plus Fire (15,000 l/min)	119.6	69.4

[1] Ground Elevation = 70.8 m

Connection 2 - Old Montreal near Cartographe

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	130.2	80.6
Peak Hour	124.8	73.0
Max Day plus Fire (10,000 l/min)	123.2	70.7
Max Day plus Fire (15,000 l/min)	118.9	64.5

[1] Ground Elevation = 73.5 m

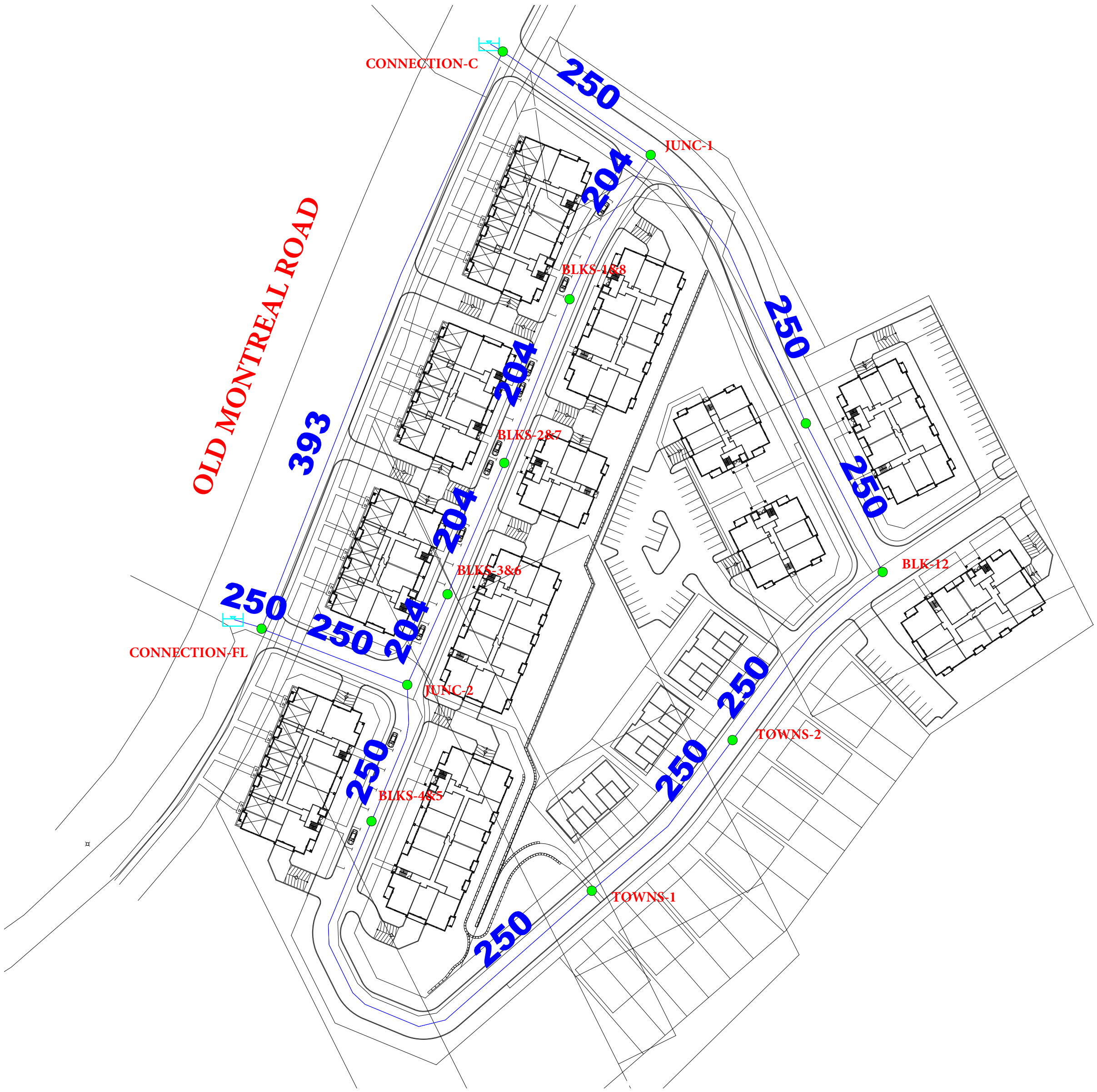
Notes:

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

Disclaimer

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

Pipe Sizes and Node IDs



Max HGL (Average Daily Demand) - Junction Report

	ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (kPa)
▭	BLK-12	0.29	86.22	130.20	430.96
▭	BLKS-1&8	0.76	74.50	130.20	545.80
▭	BLKS-2&7	0.52	73.28	130.20	557.76
▭	BLKS-3&6	0.69	72.36	130.20	566.77
▭	BLKS-4&5	0.82	73.34	130.20	557.17
▭	BLKS-9&10&11	0.64	84.81	130.20	444.77
▭	CONNECTION-C	0.00	74.09	130.20	549.83
▭	CONNECTION-FL	0.00	70.83	130.20	581.78
▭	JUNC-1	0.00	75.43	130.20	536.69
▭	JUNC-2	0.00	71.94	130.20	570.89
▭	TOWNS-1	0.15	84.95	130.20	443.40
▭	TOWNS-2	0.15	85.92	130.20	433.90

Peak Hour HGL (Maximum Hourly Demand) - Junction Report

	ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (kPa)
☐	BLK-12	1.60	96.72	124.77	274.87
☐	BLKS-1&8	4.17	85.00	124.77	389.69
☐	BLKS-2&7	2.85	83.78	124.77	401.64
☐	BLKS-3&6	3.81	82.86	124.77	410.67
☐	BLKS-4&5	4.49	85.34	124.77	386.41
☐	BLKS-9&10&11	3.53	95.31	124.77	288.70
☐	CONNECTION-C	0.00	74.09	124.80	496.90
☐	CONNECTION-FL	0.00	70.83	124.80	528.84
☐	JUNC-1	0.00	85.93	124.78	380.70
☐	JUNC-2	0.00	82.44	124.78	414.88
☐	TOWNS-1	0.84	88.45	124.77	355.91
☐	TOWNS-2	0.84	89.42	124.77	346.41

Peak Hour HGL - Pipe Report

	ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/km)
▤	1	CONNECTION-C	JUNC-1	56.51	250.00	110.00	10.34	0.21	0.02	0.32
▤	10	TOWNS-2	BLK-12	70.94	250.00	110.00	-0.08	0.00	0.00	0.00
▤	11B	BLK-12	BLKS-9&10&11	52.39	250.00	110.00	-1.68	0.03	0.000	0.01
▤	12A	JUNC-1	BLKS-9&10&11	97.98	250.00	110.00	5.21	0.11	0.01	0.09
▤	2	JUNC-1	BLKS-1&8	51.99	204.00	110.00	5.13	0.16	0.01	0.23
▤	3	BLKS-1&8	BLKS-2&7	55.19	204.00	110.00	0.96	0.03	0.000	0.01
▤	4	BLKS-2&7	BLKS-3&6	44.81	204.00	110.00	-1.89	0.06	0.00	0.04
▤	5	BLKS-3&6	JUNC-2	31.00	204.00	110.00	-5.70	0.17	0.01	0.28
▤	6	CONNECTION-FL	JUNC-2	48.89	250.00	110.00	11.79	0.24	0.02	0.41
▤	7	JUNC-2	BLKS-4&5	44.97	250.00	110.00	6.09	0.12	0.01	0.12
▤	8	BLKS-4&5	TOWNS-1	151.36	250.00	110.00	1.60	0.03	0.00	0.01
▤	9	TOWNS-1	TOWNS-2	64.98	250.00	110.00	0.76	0.02	0.000	0.00
▤	CONNECTION-C	CARTOGRAPHE	CONNECTION-C	4.44	250.00	110.00	12.76	0.26	0.00	0.47
▤	CONNECTION-FL	FAMILLE-LAPORTE	CONNECTION-FL	9.39	250.00	110.00	9.37	0.19	0.00	0.27
▤	EXISTING-406MM	CONNECTION-FL	CONNECTION-C	195.97	393.00	120.00	-2.43	0.02	0.000	0.00

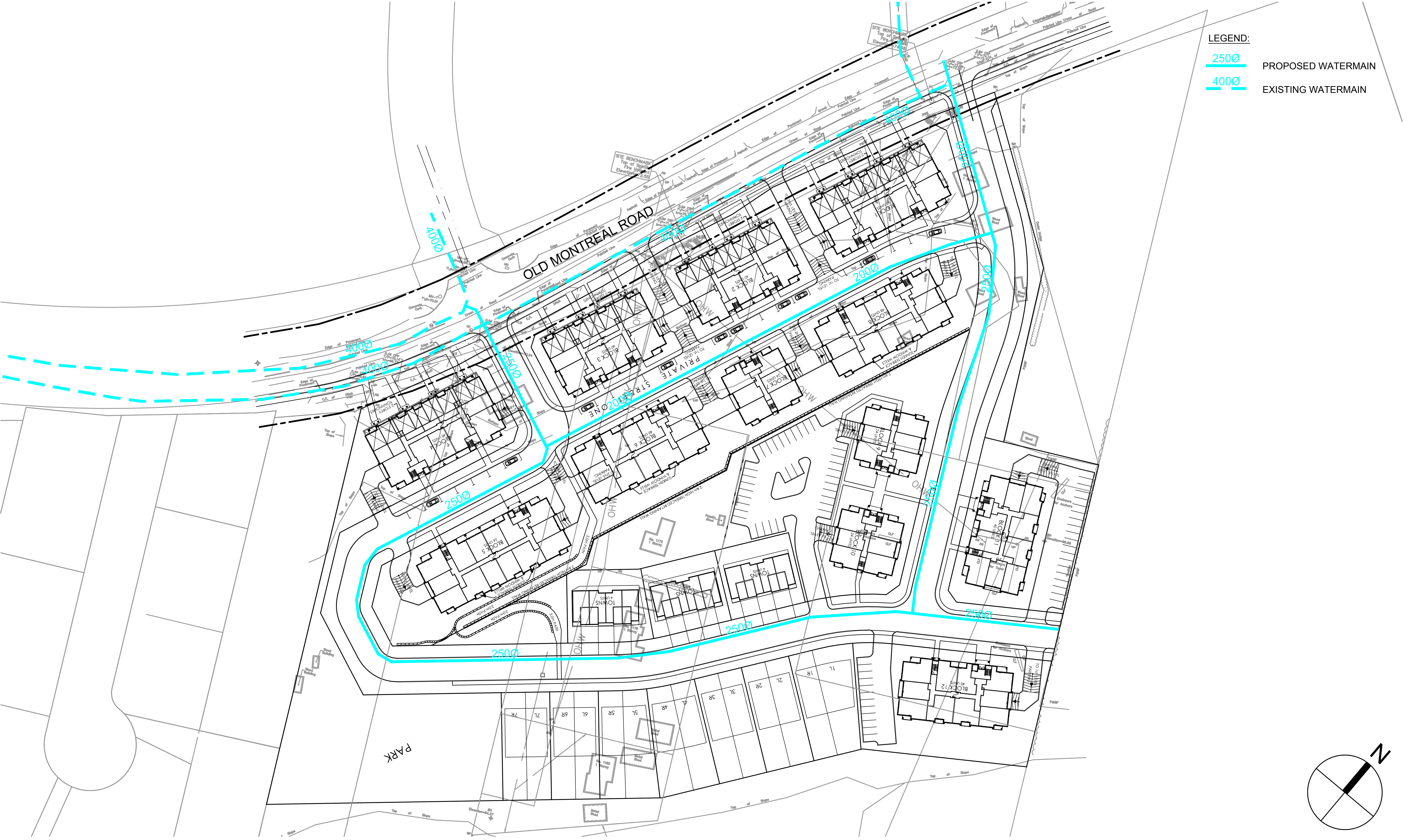
Max Day + Fire HGL (Townhouses & Semis - 10,000 l/min) - Fireflow Design Report

	ID	Total Demand (L/s)	Critical Node 1 ID	Critical Node 1 Pressure (kPa)	Critical Node 1 Head (m)	Adjusted Fire-Flow (L/s)	Available Flow @Hydrant (L/s)	Critical Node 2 ID	Critical Node 2 Pressure (kPa)	Critcal Node 2 Head (m)	Adjusted Available Flow (L/s)	Design Flow (L/s)
▤	BLK-12	250.73	BLK-12	259.44	112.70	398.55	398.55	BLK-12	139.96	100.50	398.56	398.55
▤	BLKS-1&8	251.90	BLK-12	327.39	107.91	883.89	510.29	BLKS-1&8	139.96	88.78	510.29	510.29
▤	BLKS-2&7	251.29	BLK-12	328.93	106.85	919.16	493.05	BLKS-2&7	139.96	87.56	493.05	493.05
▤	BLKS-3&6	251.73	BLK-12	329.87	106.02	955.23	589.90	BLKS-3&6	139.97	86.64	589.90	589.90
▤	BLKS-4&5	252.04	TOWNS-2	315.63	105.55	668.37	666.53	TOWNS-1	113.09	84.88	626.26	626.26
▤	BLKS-9&10&11	251.60	BLK-12	279.87	113.37	460.60	448.37	BLKS-9&10&11	139.96	99.09	448.38	448.38
▤	JUNC-1	250.00	BLK-12	322.73	108.36	785.31	864.04	BLKS-9&10&11	90.60	84.68	774.74	774.74
▤	JUNC-2	250.00	BLK-12	330.92	105.71	992.81	947.29	TOWNS-1	104.83	82.64	874.12	874.12
▤	TOWNS-1	167.38	TOWNS-2	313.87	116.98	431.75	397.14	TOWNS-1	139.96	99.23	397.14	397.14
▤	TOWNS-2	167.38	TOWNS-2	305.12	117.06	383.93	383.94	TOWNS-2	139.96	100.20	383.94	383.93

Max Day + Fire HGL (Condominiums - 15,000 l/min) - Fireflow Design Report

	ID	Total Demand (L/s)	Critical Node 1 ID	Critical Node 1 Pressure (kPa)	Critical Node 1 Head (m)	Adjusted Fire-Flow (L/s)	Available Flow @Hydrant (L/s)	Critical Node 2 ID	Critical Node 2 Pressure (kPa)	Critcal Node 2 Head (m)	Adjusted Available Flow (L/s)	Design Flow (L/s)
▤	BLK-12	250.73	BLK-12	201.50	106.78	334.09	334.09	BLK-12	139.96	100.50	334.09	334.09
▤	BLKS-1&8	251.90	BLK-12	269.35	101.99	741.83	458.81	BLKS-1&8	139.96	88.78	458.81	458.81
▤	BLKS-2&7	251.29	BLK-12	270.96	100.93	771.71	445.01	BLKS-2&7	139.96	87.56	445.02	445.02
▤	BLKS-3&6	251.73	BLK-12	271.55	100.07	801.54	534.14	BLKS-3&6	139.97	86.64	534.14	534.14
▤	BLKS-4&5	252.04	TOWNS-2	257.31	99.60	562.06	602.13	TOWNS-1	97.88	83.33	531.34	531.34
▤	BLKS-9&10&11	251.60	BLK-12	222.03	107.47	386.44	380.92	BLKS-9&10&11	139.96	99.09	380.92	380.92
▤	JUNC-1	250.00	BLK-12	265.05	102.48	659.58	774.50	BLKS-9&10&11	82.89	83.89	658.79	658.79
▤	JUNC-2	250.00	BLK-12	272.32	99.73	832.00	860.19	TOWNS-1	89.14	81.04	742.12	742.12
▤	TOWNS-1	167.38	TOWNS-2	255.79	111.05	362.81	336.78	TOWNS-1	139.96	99.23	336.78	336.78
▤	TOWNS-2	167.38	TOWNS-2	247.13	111.14	322.71	322.71	TOWNS-2	139.96	100.20	322.71	322.71

J:\109575_OldMontrealRd\5.9 Drawings\59civil\current\Serviceability\Layout\109575-FIG 2.1 - WATERMAIN.dwg Layout Name: 24x36 Plan Plot Style: ---- Plot Scale: 1:4.526 Plotted At: 1/11/2018 12:08 PM
Last Saved By: chris.cormier Last Saved At: Jan. 5, 18

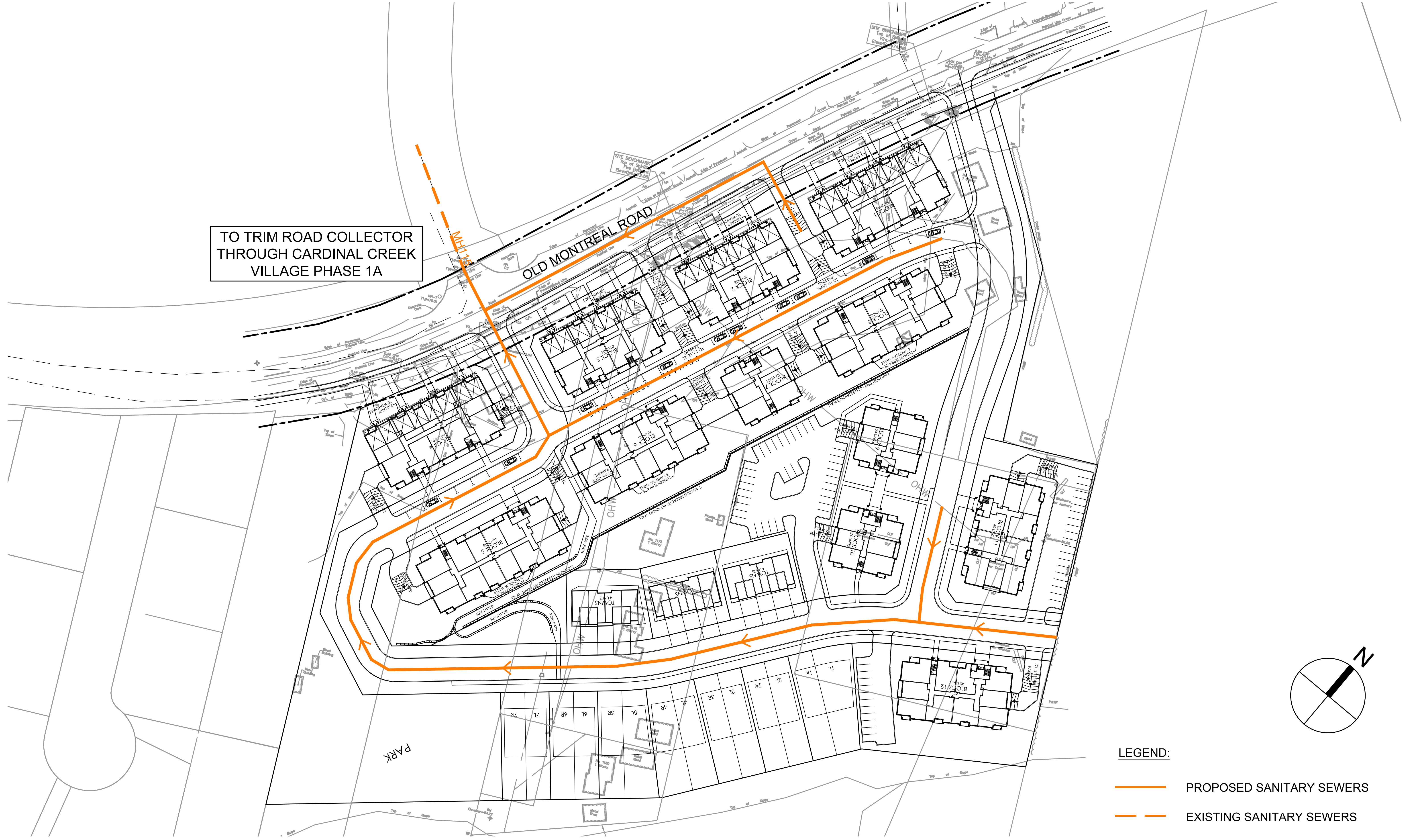


Scale	Project Title	Drawing Title	Sheet No.
N.T.S.	DCR / PHOENIX 1208 OLD MONTREAL ROAD	CONCEPTUAL WATER DISTRIBUTION SYSTEM	FIG. 2.1

IBI

APPENDIX B

J:\109575_OldMontrealRd\5.9 Drawings\59civil\current\Serviceability\Layout\109575-FIG 3.1 - SANITARY.dwg Layout Name: 24x36 Plan Plot Style: ---- Plot Scale: 1:4.526 Plotted At: 1/11/2018 12:08 PM
Last Saved By: chris.cormier Last Saved At: Jan. 5, 18



Scale

N.T.S.

Project Title

DCR / PHOENIX
1208 OLD MONTREAL ROAD

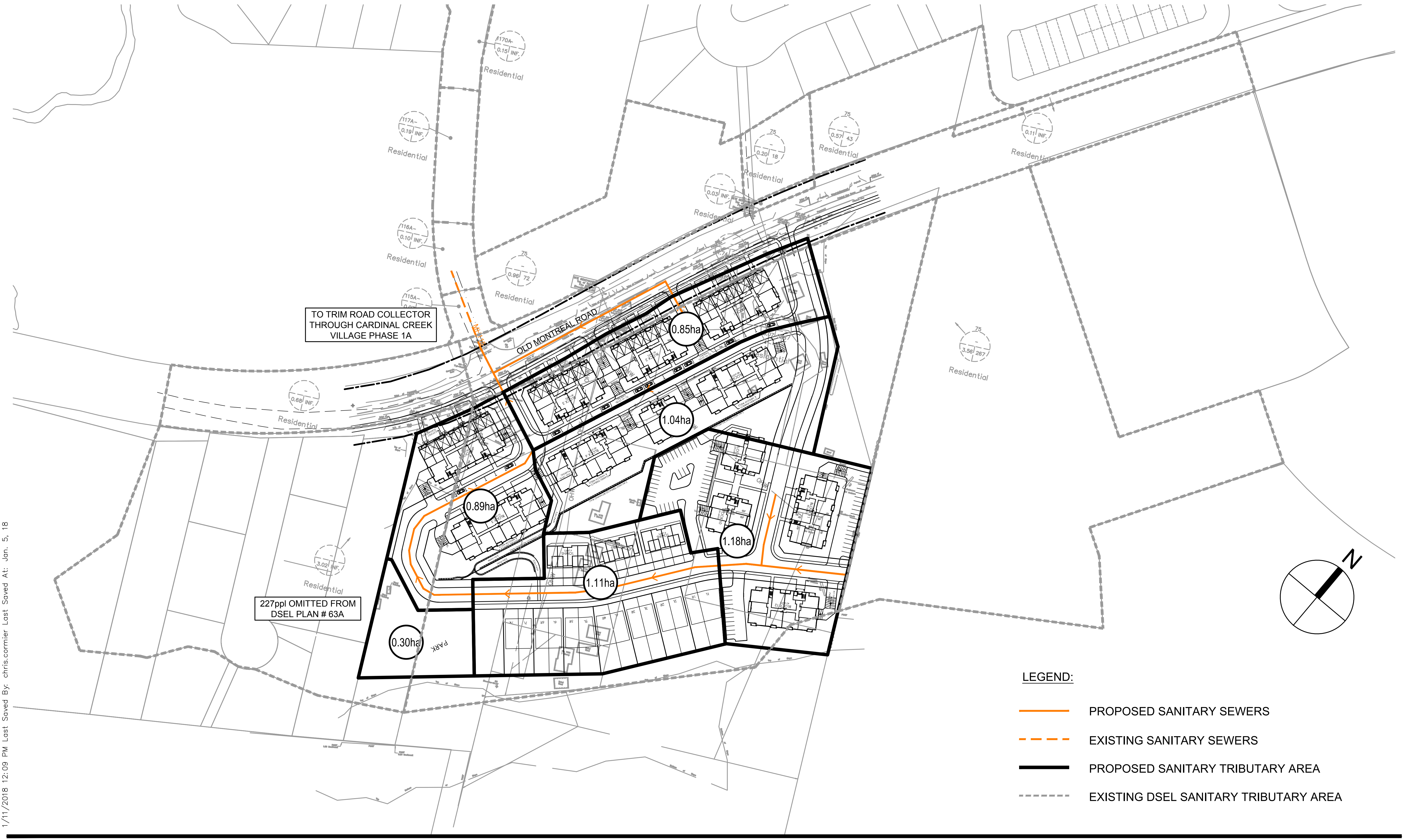
Drawing Title

CONCEPTUAL WASTEWATER
DISPOSAL SYSTEM

Sheet No.

FIG. 3.1

J:\109575_OldMontrealRd\5.9 Drawings\59civil\current\Serviceability\Layout\109575-FIG 3.2 - SANITARY DRAINAGE PLAN.dwg Layout Name: 24x36 Plan Plot Style: ---- Plot Scale: 1:4.526 Plotted At:
1/11/2018 12:09 PM Last Saved By: chris.cormier Last Saved At: Jan. 5, 18



IBI

Scale

N.T.S.

Project Title

DCR / PHOENIX
1208 OLD MONTREAL ROAD

Drawing Title

CONCEPTUAL SANITARY
DRAINAGE AREA

Sheet No.

FIG. 3.2

IBI GROUP
400-333 Preston Street
Ottawa, Ontario K1S 5N4 Canada
tel 613 225 1311 fax 613 225 9868
ibigroup.com

SANITARY SEWER DESIGN SHEET

1208 OLD MONTREAL ROAD
CITY OF OTTAWA
DCR/Phoenix Homes

LOCATION				RESIDENTIAL										ICI AREAS							INFILTRATION ALLOWANCE			FIXED FLOW (L/s)		TOTAL FLOW	PROPOSED SEWER DESIGN						
STREET	AREA ID	FROM MH	TO MH	AREA w/ Units (Ha)	UNIT TYPES				AREA w/o Units (Ha)	POPULATION		PEAK FACTOR	PEAK FLOW (L/s)	AREA (Ha)						PEAK FLOW (L/s)	AREA (Ha)		FLOW (L/s)			(L/s)	CAPACITY (L/s)	LENGTH (m)	DIA (mm)	SLOPE (%)	VELOCITY (full) (m/s)	AVAILABLE CAPACITY	
					SF	SD	TH	APT		IND	CUM			INSTITUTIONAL		COMMERCIAL		INDUSTRIAL			IND	CUM		IND	CUM								
														IND	CUM	IND	CUM	IND	CUM													L/s	(%)
VERIFICATION OF RESIDUAL CAPACITY IN DOWNSTREAM SEWERS																																	
FUTURE RES									3.56	267.0	267.0				NOTES:																		
FUTURE RES									**5.07**	**588.0**	**588.0**				1. Population counts extracted directly from MOECC and City																		
FUTURE RES									0.57	43.0	43.0				Design by DSEL (2014)																		
FUTURE RES									0.96	72.0	72.0				2. DSEL external drainage area plan shows a population of																		
EXTERNAL									1.74	0.0	0.0				227 for the arae measuring 3.02Ha. This population was																		
EXTERNAL									0.11	0.0	0.0				omitted from DSEL's design sheet.																		
EXTERNAL									0.03	0.0	0.0																						
EXTERNAL									0.68	0.0	0.0																						
EXTERNAL									0.20	18.0	18.0																						
FUTURE RES (DSEL MISSING 227)									**3.02**	**227.0**	**227.0**																						
		115A	116A	0.07					**15.94**	956.4	2171.4	3.56	31.29		0.00		0.00		0.00	0.00	31.95	31.95	8.95		0.00	40.24	35.89	53.00	200	1.10	1.107	-4.35	-12.13%
																								DSEL TOTAL Q		19.69							
																								INCREASED Q_{pop}		**20.55**							
FUTURE RES									3.56	267.0	267.0				NOTES:																		
FUTURE RES (DSEL AREA SPLIT - EXTERNAL)									**0.19**	**22.3**	**22.3**				1. Population counts extracted directly from MOECC and City																		
FUTURE RES (DSEL AREA SPLIT - DCR/PHOENIX SHARE)									**4.88**	**565.7**	**565.7**				of Ottawa approved Cardinal Creek Village Phase 1A & 1B																		
FUTURE RES (Additional Intensification Population)									**0.00**	**391.1**	**391.1**				Design by DSEL (2014)																		
FUTURE RES									0.57	43.0	43.0				2. DSEL external drainage area plan shows a population of																		
FUTURE RES									0.96	72.0	72.0				227 for the arae measuring 3.02Ha. This population was																		
EXTERNAL									1.74	0.0	0.0				omitted from DSEL's design sheet.																		
EXTERNAL									0.11	0.0	0.0				3. Due to intensification, DCR/Phoenix lands population																		
EXTERNAL									0.03	0.0	0.0				exceeds the original design estimate.																		
EXTERNAL									0.68	0.0	0.0																						
EXTERNAL									0.20	18.0	18.0																						
FUTURE RES (DSEL AREA SPLIT - EXTERNAL)									**2.53**	**190.2**	**190.2**																						
FUTURE RES (DSEL AREA SPLIT - DCR/PHOENIX SHARE)									**0.49**	**36.8**	**36.8**																						
		115A	116A	0.07					**15.94**	956.4	2562.5	3.50	36.33		0.00		0.00		0.00	0.00	31.95	31.95	8.95		0.00	45.27	35.89	53.00	200	1.10	1.107	-9.39	-26.16%
																								DSEL TOTAL Q		19.69							
																								INCREASED Q		**25.58**							
																								less omitted pop		20.55							
																								INCREASED Q_{DCR}		**5.03**							

Design Parameters:

Residential			ICI Areas			
						Peak Factor
SF	3.4	p/p/u				
TH/SD	2.7	p/p/u	INST	50,000	L/Ha/day	1.5
APT	1.8	p/p/u	COM	50,000	L/Ha/day	1.5
Other	60	p/p/Ha	IND	35,000	L/Ha/day	MOE Chart
				17000	L/Ha/day	

Notes:
1. Mannings coefficient (n) = 0.013
2. Demand (per capita): 350 L/day 300 L/day
3. Infiltration allowance: 0.28 L/s/Ha
4. Residential Peaking Factor:
Harmon Formula = 1+(14/(4+P^0.5))
where P = population in thousands

Designed: RM

Checked: DY

Dwg. Reference: 109575-FIG 3.3

No.	Revision	Date
1.	Adequacy of Public Services - Submission No. 1	2017-12-21

File Reference:	Date:	Sheet No:
109575.5.7.1	2017-12-21	1 of 1

SANITARY SEWER CALCULATION SHEET

Ottawa

Manning's n=0.013

LOCATION STREET	FROM M.H.	TO M.H.	RESIDENTIAL AREA AND POPULATION AREA (ha)	UNITS	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	COMM AREA (ha)	ACCU. AREA (ha)	INDUST AREA (ha)	ACCU. AREA (ha)	INSTIT AREA (ha)	ACCU. AREA (ha)	C+I+I PEAK FLOW (l/s)	INFILTRATION TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	PIPE DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)
rue de Cartographe Street																										
Contribution From rue de Cartographe Street (Future Phase), Pipe MH 150A -151A						0.68	56.7										0.68									
	151A	152A	0.58	14	37.8	1.26	94.5	4.00	1.53								0.58	1.26	0.35	1.88	81.5	200	2.50	51.86	0.04	1.65
	152A	1520A	0.19	3	8.1	1.45	102.6	4.00	1.66								0.19	1.45	0.41	2.07	10.5	200	2.20	48.65	0.04	1.55
	1520A	153A	0.21	4	10.8	1.47	105.3	4.00	1.71								0.21	1.47	0.41	2.12	15.5	200	2.20	48.65	0.04	1.55
	153A	154A	0.88	28	75.6	2.33	178.2	4.00	2.89								0.88	2.33	0.65	3.54	116.0	200	1.50	40.17	0.09	1.28
To rue de Cartographe Street, Pipe 154A - 207A						2.33	178.2											2.33								
rue Mishawashkode Street																										
Contribution From rue de Cartographe Street (Future Phase), Pipe MH 222A -155A						0.63	37.8										0.63									
	155A	154A	0.07			0.70	37.8	4.00	0.61								0.07	0.70	0.20	0.81	30.5	200	3.20	58.67	0.01	1.87
To rue de Cartographe Street, Pipe 154A - 207A						0.70	37.8											0.70								
			0.06			0.06	0.0										0.06	0.06								
	120A	121A	0.15	4	10.8	0.21	10.8	4.00	0.18								0.15	0.21	0.06	0.24	23.5	200	4.50	69.58	0.00	2.21
																	Splash Pad 5.0 L/s Flow Allowance			5.00						
Contribution from BLOCK 141 (Park)														1.29	1.29	0.14	1.29	1.29	0.36	5.50	11.0	200	1.00	32.80	0.17	1.04
	121A	113A	0.36	8	21.6	0.57	32.4	4.00	0.53						1.29	0.14	0.36	1.86	0.52	6.19	79.0	200	3.00	56.81	0.11	1.81
To côte de la Minoterie Ridge, Pipe 113A - 114A						0.57	32.4							1.29				1.86		5.00						
rue de Cartographe Street																										
Contribution From rue Mishawashkode Street, Pipe 155A -154A						0.70	37.8										0.70									
Contribution From rue de Cartographe Street, Pipe 153A -154A						2.33	178.2										2.33									
	154A	207A	0.36	5	17.0	3.39	233.0	4.00	3.78								0.36	3.39	0.95	4.73	87.0	200	1.20	35.93	0.13	1.14
	207A	208A	0.21	3	10.2	3.60	243.2	4.00	3.94								0.21	3.60	1.01	4.95	30.5	200	1.20	35.93	0.14	1.14
	208A	209A	0.20	3	10.2	3.80	253.4	4.00	4.11								0.20	3.80	1.06	5.17	28.5	200	2.10	47.53	0.11	1.51
			0.01			3.81	253.4	2.00	2.05								0.01	3.81								
	209A	1			6.8	3.97	260.2	4.00	4.22								0.16	3.97	1.11	5.33	38.5	200	0.80	29.34	0.18	0.93
To rue de la Baie-des-Castors Street, Pipe 144A - 145A						3.97	260.2											3.97								
avenue de la Famille-Laporte Avenue																										
Contribution From FUTURE RESIDENTIAL			3.56	-	207.0	3.56	207.0										3.56	3.56								
Contribution From FUTURE RESIDENTIAL			5.07	-	588.0	5.07	588.0										5.07	5.07								
Contribution From FUTURE RESIDENTIAL			0.57		43	0.57	43.0										0.57	0.57								
Contribution From FUTURE RESIDENTIAL			0.96	-	72	0.96	72.0										0.96	0.96								
Contribution From EXTERNAL			1.74			1.74											1.74	1.74								
Contribution From EXTERNAL			0.11			0.11											0.11	0.11								
Contribution From EXTERNAL			0.03			0.03											0.03	0.03								
Contribution From EXTERNAL			0.68			0.68											0.68	0.68								
Contribution From EXTERNAL			0.20	-	18.0	0.20	18.0										0.20	0.20								
Contribution From FUTURE RESIDENTIAL			3.02			3.02	0.0										3.02	3.02								
	115A	116A	0.07			16.01	988.0	3.80	15.21								0.07	16.01	4.48	19.69	53.0	200	1.10	34.40	0.57	1.09
	116A	117A	0.10			16.11	988.0	3.80	15.21								0.10	16.11	4.51	19.72	41.5	200	1.10	34.40	0.57	1.09
	117A	1170A	0.19			16.30	988.0	3.80	15.21								0.19	16.30	4.56	19.77	81.0	200	1.90	45.21	0.44	1.44

Population 227 omitted from design sheet

Portion of DCR/ Phoenix Lands

Portion of DCR/ Phoenix Lands

Residual Capacity exceeds **8.59l/s**, refer to IBI sewer design sheet for calculations

LICENSED PROFESSIONAL ENGINEER
Z. LI
PROVINCE OF ONTARIO

DESIGN PARAMETERS

Average Daily Flow =	350	l/p/day	Industrial Peak Factor = as per MOE Graph		
Commercial/Institution Flow =	50000	L/ha/da	Extraneous Flow =	0.280	L/s/ha
Industrial Flow =	35000	L/ha/da	Minimum Velocity =	0.760	m/s
Max Res. Peak Factor =	4.00		Manning's n =	0.013	
Commercial/Institution peak Factor =	1.50		Townhouse/Semi coeff=	2.7	
Park Average Flow =	9300	L/ha/da	Single house coeff=	3.4	

Designed: K.M.

Checked: Z.L.

Dwg. Reference: Sanitary Drainage Plan, Dwg. No. 57 - 58

PROJECT: **CARDINAL CREEK VILLLAGE PHASE 1**

LOCATION: **City of Ottawa**

File Ref: 11-513B-1

Date: May, 2014

Sheet No. 1 of 5

513 san3.xls

SANITARY SEWER CALCULATION SHEET

Ottawa

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION							COMM		INDUST		INSTIT		C+I+I	INFILTRATION				PIPE					
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)
Contribution From FUTURE RESIDENTIAL			1.11	-	84.0	1.11	84.0	4.00	1.36								1.11	1.11	0.31	1.67	12.5	200	1.00	32.80	0.05	1.04
Contribution From FUTURE RESIDENTIAL			3.37	-	534.0	3.37	534.0	3.96	8.57								3.37	3.37	0.94	9.51	14.0	200	1.00	32.80	0.29	1.04
	1170A	118A	0.15			20.93	1606.0	3.66	23.81								0.15	20.93	5.86	29.67	57.5	250	1.00	59.47	0.50	1.21
	118A	119A	0.19			21.12	1606.0	3.66	23.81								0.19	21.12	5.91	29.72	78.5	250	1.20	65.14	0.46	1.33
Contribution From FUTURE RESIDENTIAL			0.91	-	69.0	0.91	69.0	4.00	1.12								0.91	0.91	0.25	1.37	14.5	200	1.00	32.80	0.04	1.04
To voie de Brouage Way, Pipe 119A - 109A						22.03	1675.0											22.03								
	110A	111A	0.22	2	6.8	0.22	6.8	4.00	0.11								0.22	0.22	0.06	0.17	48.0	200	1.20	35.93	0.00	1.14
	111A	112A	0.37	5	17.0	0.59	23.8	4.00	0.39								0.37	0.59	0.17	0.56	66.0	200	2.80	54.88	0.01	1.75
			0.17	3	10.2	0.76	34.0	2.00	0.28								0.17	0.76								
			0.11	2	5.4	0.87	39.4	2.00	0.32								0.11	0.87								
	112A	113A	0.09	2	5.4	0.96	44.8	4.00	0.73								0.09	0.96	0.27	1.00	64.0	200	2.50	51.86	0.02	1.65
To côte de la Minoterie Ridge, Pipe 113A - 114A						0.96	44.8							0.00				0.96								
Contribution From STREET 2 (Future Phase), Pipe MH 211A - 212A						71.92	4768.6			1.88				12.69			86.49			5.00						
	212A	144A	0.26	3	10.2	72.18	4778.8	3.26	63.11		1.88				12.69	10.81	0.26	86.75	24.29	108.21	57.0	375	1.70	228.60	0.47	2.07
To rue de la Baie-des-Castors Street, Pipe 144A - 145A						72.18	4778.8				1.88				12.69			86.75		5.00						
voie de Brouage Way																										
Contribution From avenue de la Famille-Laporte Avenue, Pipe118A - 119A						22.03	1675.0										22.03									
	119A	109A	0.42	11	29.7	22.45	1704.7	3.64	25.14								0.42	22.45	6.29	31.43	65.0	250	1.00	59.47	0.53	1.21
			0.33	9	24.3	22.78	1729.0	2.00	14.01								0.33	22.78								
	109A	105A	0.19	2	6.8	22.97	1735.8	3.63	25.52								0.19	22.97	6.43	31.95	65.0	250	2.50	94.03	0.34	1.92
To côte de la Minoterie Ridge, Pipe 104A - 105A						22.97	1735.8											22.97								
côte de la Minoterie Ridge																										
	100A	101A	0.95	27	72.9	0.95	72.9	4.00	1.18								0.95	0.95	0.27	1.45	93.5	200	3.30	59.58	0.02	1.90
	101A	102A	0.11	1	2.7	1.06	75.6	4.00	1.23								0.11	1.06	0.30	1.53	10.5	200	2.90	55.85	0.03	1.78
	102A	103A	0.29	4	13.6	1.35	89.2	4.00	1.45								0.29	1.35	0.38	1.83	42.0	200	2.70	53.89	0.03	1.72
	104A	105A	0.22	3	10.2	1.57	99.4	4.00	1.61								0.22	1.57	0.44	2.05	33.0	200	2.10	47.53	0.04	1.51
Contribution From voie de Brouage Way, Pipe 109A - 105A						22.97	1735.8										22.97									
	105A	106A	0.48	5	17.0	25.02	1852.2	3.61	27.09								0.48	25.02	7.01	34.10	67.5	250	1.00	59.47	0.57	1.21
	106A	107A	0.12	1	3.4	25.14	1855.6	3.61	27.14								0.12	25.14	7.04	34.18	15.5	250	0.80	53.19	0.64	1.08
	107A	108A	0.29	5	17.0	25.43	1872.6	3.61	27.38								0.29	25.43	7.12	34.50	32.5	250	0.80	53.19	0.65	1.08
To STREET 22, Pipe 108A - 200A						25.43	1872.6											25.43								

Z. LI

Residual Capacity exceeds **8.59l/s**, refer to IBI sewer design sheet for calculations

DESIGN PARAMETERS

Average Daily Flow = 350 l/p/day
Commercial/Institution Flow = 50000 L/ha/da
Industrial Flow = 35000 L/ha/da
Max Res. Peak Factor = 4.00
Commercial/Institution peak Factor = 1.50
Park Average Flow = 9300 L/ha/da

Industrial Peak Factor = as per MOE Graph
Extraneous Flow = 0.280 L/s/ha
Minimum Velocity = 0.760 m/s
Manning's n = 0.013
Townhouse/Semi coeff= 2.7
Single house coeff= 3.4

Designed: K.M.

Checked: Z.L.

Dwg. Reference: Sanitary Drainage Plan, Dwg. No. 57 - 58

PROJECT: **CARDINAL CREEK VILLLAGE PHASE 1**

LOCATION: **City of Ottawa**

File Ref: 11-513B-1

Date: May, 2014

Sheet No. 2 of 5

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION							COMM		INDUST		INSTIT		C+I+I	INFILTRATION				PIPE					
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)
Contribution From avenue de la Famille-Laporte Avenue, Pipe 112A - 113A						0.96	44.8							0.00			0.96									
Contribution From rue Mishawashkode Street, Pipe 121A - 113A						0.57	32.4							1.29			1.86			5.00						
						1.53	77.2	2.00	0.63						1.29		0.00	2.82								
			0.17			1.70																				
	113A	114A	0.12	2	5.4	1.82	82.6	4.00	1.34						1.29	0.14	0.12	2.94	0.82	7.30	34.0	200	0.40	20.74	0.35	0.66
	114A	108A	0.22	3	10.2	2.04	92.8	4.00	1.50						1.29	0.14	0.22	3.16	0.88	7.52	50.0	200	0.40	20.74	0.36	0.66
To STREET 22, Pipe 108A - 200A						2.04	92.8							1.29				3.16		5.00						
STREET 22																										
Contribution From côte de la Minoterie Ridge, Pipe 107A - 108A						25.43	1872.6										25.43									
Contribution From côte de la Minoterie Ridge, Pipe 114A - 108A						2.04	92.8							1.29			3.16			5.00						
			0.01			27.48	1965.4	2.00	15.92						1.29	0.14	0.01	28.60	8.01	29.07						
	108A	200A	0.17	2	6.8	27.65	1972.2	3.59	28.68						1.29	0.14	0.17	28.77	8.06	41.88	42.0	250	0.90	56.42	0.74	1.15
	200A	201A	0.65	5	17.0	28.30	1989.2	3.59	28.93						1.29	0.14	0.65	29.42	8.24	42.31	38.5	250	0.90	56.42	0.75	1.15
	201A	202A	0.33	5	17.0	28.63	2006.2	3.59	29.18						1.29	0.14	0.33	29.75	8.33	42.65	42.0	250	0.90	56.42	0.76	1.15
	202A	203A	0.26	2	6.8	28.89	2013.0	3.58	29.19						1.29	0.14	0.26	30.01	8.40	42.73	13.0	250	0.90	56.42	0.76	1.15
To BLOCK 402 (SERVICING), Pipe 203A - 204A						28.89	2013.0							1.29				30.01		5.00						
BLOCK 402 (SERVICING)																										
Contribution From STREET 22 (Future Phase), Pipe 206A - 203A						1.58	64.6										1.58									
Contribution From STREET 22, Pipe 202A - 203A						28.89	2013.0							1.29			30.01			5.00						
	203A	204A	0.07			30.54	2077.6	3.57	30.65						1.29	0.14	0.07	31.66	8.86	44.05	54.5	300	0.35	57.21	0.77	0.81
	204A	146A	0.72			31.26	2077.6	3.57	30.65						1.29	0.14	0.72	32.38	9.07	44.26	76.5	300	0.35	57.21	0.77	0.81
To rue de la Baie-des-Castors Street, Pipe 146A - 147A						31.26	2077.6							1.29				32.38		5.00						
avenue Mashkig Avenue																										
Contribution From avenue Mashkig Avenue (Future Phase), Pipe MH 804A - 1420A						3.55	207.1										3.55									
	1420A	142A	0.17	3	10.2	3.72	217.3	4.00	3.52								0.17	3.72	1.04	4.56	16.5	200	1.80	44.00	0.10	1.40
	142A	143A	0.48	9	30.6	4.20	247.9	4.00	4.02								0.48	4.20	1.18	5.20	61.5	200	4.80	71.86	0.07	2.29
	143A	147A	0.52	8	27.2	4.72	275.1	4.00	4.46								0.52	4.72	1.32	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.08	2.33
To rue de la Baie-des-Castors Street, Pipe 147A - 148A						4.72	275.1											4.72								
rue de la Baie-des-Castors Street																										
Contribution From rue de la Baie-des-Castors Street (Future Phase), Pipe MH 709A - 1220A						4.38	231.2							3.97			8.35									
	Plug	122A				4.38	231.2	4.00	3.75						3.97	0.43	0.00	8.35	2.34	16.52	19.5	200	1.20	35.93	0.46	1.14
	122A	123A	0.57	11	37.4	4.95	268.6	4.00	4.35						3.97	0.43	0.57	8.92	2.50	17.28	64.0	200	3.50	61.36	0.28	1.95
	123A	124A	0.46	8	27.2	5.41	295.8	4.00	4.79						3.97	0.43	0.46	9.38	2.63	17.85	60.0	200	3.40	60.48	0.30	1.93
	124A	125A	0.53	9	30.6	5.94	326.4	4.00	5.29						3.97	0.43	0.53	9.91	2.77	18.49	70.5	200	3.50	61.36	0.30	1.95
To BLOCK 256 (SERVICING), Pipe 125A - 126A						5.94	326.4							3.97				9.91		10.00						

Residual Capacity exceeds **8.59l/s**, refer to IBI sewer design sheet for calculations

LICENSED PROFESSIONAL ENGINEER
Z. LI
PROVINCE OF ONTARIO

DESIGN PARAMETERS

Average Daily Flow =	350	l/p/day	Industrial Peak Factor = as per MOE Graph		
Commercial/Institution Flow =	50000	L/ha/da	Extraneous Flow =	0.280	L/s/ha
Industrial Flow =	35000	L/ha/da	Minimum Velocity =	0.760	m/s
Max Res. Peak Factor =	4.00		Manning's n =	0.013	
Commercial/Institution peak Factor =	1.50		Townhouse/Semi coeff=	2.7	
Park Average Flow =	9300	L/ha/da	Single house coeff=	3.4	

Designed: K.M.

PROJECT: **CARDINAL CREEK VILLLAGE PHASE 1**

Checked: Z.L.

LOCATION: **City of Ottawa**

Dwg. Reference: Sanitary Drainage Plan, Dwg. No. 57 - 58

File Ref: 11-513B-1

Date: May, 2014

Sheet No. 3 of 5

SANITARY SEWER CALCULATION SHEET

Ottawa

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION							COMM		INDUST		INSTIT		C+I+I	INFILTRATION				PIPE					
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)
Contribution From avenue de la Famille-Laporte Avenue, Pipe 212A -144A						72.18	4778.8			1.88				12.69			86.75			5.00						
Contribution From rue de Cartographe Street, Pipe 209A -144A						3.97	260.2										3.97									
	144A	145A	0.03			76.18	5039.0	3.24	66.14		1.88				12.69	10.81	0.03	90.75	25.41	107.36	21.5	375	1.00	175.33	0.61	1.59
	145A	146A	0.17			76.35	5039.0	3.24	66.14		1.88				12.69	10.81	0.17	90.92	25.46	107.41	88.5	375	2.00	247.95	0.43	2.25
Contribution From BLOCK 402 (SERVICING), Pipe 204A -146A						31.26	2077.6							1.29			32.38			5.00						
	146A	147A	0.23	4	13.6	107.84	7130.2	3.10	89.54		1.88				13.98	10.95	0.23	123.53	34.59	145.08	59.5	450	0.90	270.48	0.54	1.70
Contribution From avenue Mashkig Avenue, Pipe 143A -147A						4.72	275.1										4.72									
	147A	148A	0.37	5	17.0	112.93	7422.3	3.08	92.61		1.88				13.98	10.95	0.37	128.62	36.01	149.57	66.5	450	0.90	270.48	0.55	1.70
	148A	125A	0.07			113.00	7422.3	3.08	92.61		1.88				13.98	10.95	0.07	128.69	36.03	149.59	15.5	450	0.90	270.48	0.55	1.70
To BLOCK 256 (SERVICING), Pipe 125A - 126A						113.00	7422.3			1.88				13.98				128.69		10.00						
BLOCK 256 (SERVICING)																										
Contribution from rue de la Baie-des-Castors Street, Pipe 124A -125A						5.94	326.4							3.97			9.91			10.00						
Contribution from rue de la Baie-des-Castors Street, Pipe 148A -125A						113.00	7422.3			1.88				13.98			128.69			10.00						
	125A	126A				118.94	7748.7	3.06	96.05		1.88				17.95	11.37	0.00	138.60	38.81	166.23	10.0	450	0.90	270.48	0.61	1.70
	126A	127A	0.06			119.00	7748.7	3.06	96.05		1.88				17.95	11.37	0.06	138.66	38.82	166.24	32.5	450	0.90	270.48	0.61	1.70
	127A	128A	0.05			119.05	7748.7	3.06	96.05		1.88				17.95	11.37	0.05	138.71	38.84	166.26	39.0	450	2.70	468.48	0.35	2.95
To SAN TRUNK 1 - 12.0m EASEMENT, Pipe 128A - 129A						119.05	7748.7			1.88				17.95				138.71		20.00						
SAN TRUNK 1 - 12.0m EASEMENT																										
Contribution From SAN TRUNK (Future Phase), Pipe MH 10160A - 128A						30.05	2240.2			9.07				4.17			43.29			5.00						
Contribution from BLOCK 256 (SERVICING), Pipe 127A - 128A						119.05	7748.7			1.88				17.95			138.71			20.00						
	128A	129A	0.02			149.12	9988.9	2.96	119.77		10.95				22.12	21.95	0.02	182.02	50.97	217.69	23.5	675	0.12	291.19	0.75	0.81
	129A	130A	0.14			149.26	9988.9	2.96	119.77		10.95				22.12	21.95	0.14	182.16	51.00	217.72	115.0	675	0.12	291.19	0.75	0.81
	130A	131A	0.04			149.30	9988.9	2.96	119.77		10.95				22.12	21.95	0.04	182.20	51.02	217.74	36.5	675	0.12	291.19	0.75	0.81
	131A	132A	0.04			149.34	9988.9	2.96	119.77		10.95				22.12	21.95	0.04	182.24	51.03	217.75	35.5	675	0.12	291.19	0.75	0.81
	132A	133A	0.05			149.39	9988.9	2.96	119.77		10.95				22.12	21.95	0.05	182.29	51.04	217.76	41.5	675	0.12	291.19	0.75	0.81
	133A	134A	0.06			149.45	9988.9	2.96	119.77		10.95				22.12	21.95	0.06	182.35	51.06	217.78	52.5	675	0.12	291.19	0.75	0.81

Residual Capacity exceeds **8.59l/s**, refer to IBI sewer design sheet for calculations

Z. LI

APR 27 2014

Average Daily Flow =	350	l/p/day	Industrial Peak Factor = as per MOE Graph		
Commercial/Institution Flow =	50000	L/ha/da	Extraneous Flow =	0.280	L/s/ha
Industrial Flow =	35000	L/ha/da	Minimum Velocity =	0.760	m/s
Max Res. Peak Factor =	4.00		Manning's n =	0.013	
Commercial/Institution peak Factor =	1.50		Townhouse/Semi coeff=	2.7	
Park Average Flow =	9300	L/ha/da	Single house coeff=	3.4	

K.M.	**CARDINAL CREEK VILLLAGE PHASE 1**		
Checked: Z.L.	LOCATION: **City of Ottawa**		
Dwg. Reference: Sanitary Drainage Plan, Dwg. No. 57 - 58	File Ref: 11-513B-1	Date: May, 2014	Sheet No. 4 of 5

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION							COMM		INDUST		INSTIT		C+I+I	INFILTRATION				PIPE					
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)
	134A	135A	0.10			149.55	9988.9	2.96	119.77		10.95				22.12	21.95	0.10	182.45	51.09	217.81	82.0	675	0.12	291.19	0.75	0.81
	135A	136A	0.11			149.66	9988.9	2.96	119.77		10.95				22.12	21.95	0.11	182.56	51.12	217.84	96.0	675	0.12	291.19	0.75	0.81
	136A	137A	0.10			149.76	9988.9	2.96	119.77		10.95				22.12	21.95	0.10	182.66	51.14	217.86	105.0	675	0.12	291.19	0.75	0.81
	137A	1105A (B.O.)	0.11			149.87	9988.9	2.96	119.77		10.95				22.12	21.95	0.11	182.77	51.18	217.90	120.5	675	0.12	291.19	0.75	0.81
	1105A (B.O.)	1104A (B.O.)	0.05			149.92	9988.9	2.96	119.77		10.95				22.12	21.95	0.05	182.82	51.19	217.91	55.0	675	0.12	291.19	0.75	0.81
	1104A (B.O.)	1103A (B.O.)	0.04			149.96	9988.9	2.96	119.77		10.95				22.12	21.95	0.04	182.86	51.20	217.92	42.9	675	0.12	291.19	0.75	0.81
	1103A (B.O.)	1102A (B.O.)	0.05			150.01	9988.9	2.96	119.77		10.95				22.12	21.95	0.05	182.91	51.21	217.93	56.9	675	0.12	291.19	0.75	0.81
	1102A (B.O.)	1101A (B.O.)	0.09			150.10	9988.9	2.96	119.77		10.95				22.12	21.95	0.09	183.00	51.24	217.96	109.0	675	0.12	291.19	0.75	0.81
	1101A (B.O.)	1100A (B.O.)				150.10	9988.9	2.96	119.77		10.95				22.12	21.95	0.00	183.00	51.24	217.96	12.5	675	0.12	291.19	0.75	0.81
To EXISTING SANITARY, Pipe 1100A (B.O.) - 30A						150.10	9988.9			10.95				22.12				183.00								

Residual Capacity exceeds **8.59l/s**, refer to IBI sewer design sheet for calculations

LICENSED PROFESSIONAL ENGINEER
Z. LI
MAY-27-2014
PROVINCE OF ONTARIO

DESIGN PARAMETERS

Average Daily Flow =	350	l/p/day	Industrial Peak Factor = as per MOE Graph		
Commercial/Institution Flow =	50000	L/ha/da	Extraneous Flow =	0.280	L/s/ha
Industrial Flow =	35000	L/ha/da	Minimum Velocity =	0.760	m/s
Max Res. Peak Factor =	4.00		Manning's n =	0.013	
Commercial/Institution peak Factor =	1.50		Townhouse/Semi coeff=	2.7	
Park Average Flow =	9300	L/ha/da	Single house coeff=	3.4	

Designed: K.M.

Checked: Z.L.

Dwg. Reference: Sanitary Drainage Plan, Dwg. No. 57 - 58

PROJECT: **CARDINAL CREEK VILLLAGE PHASE 1**

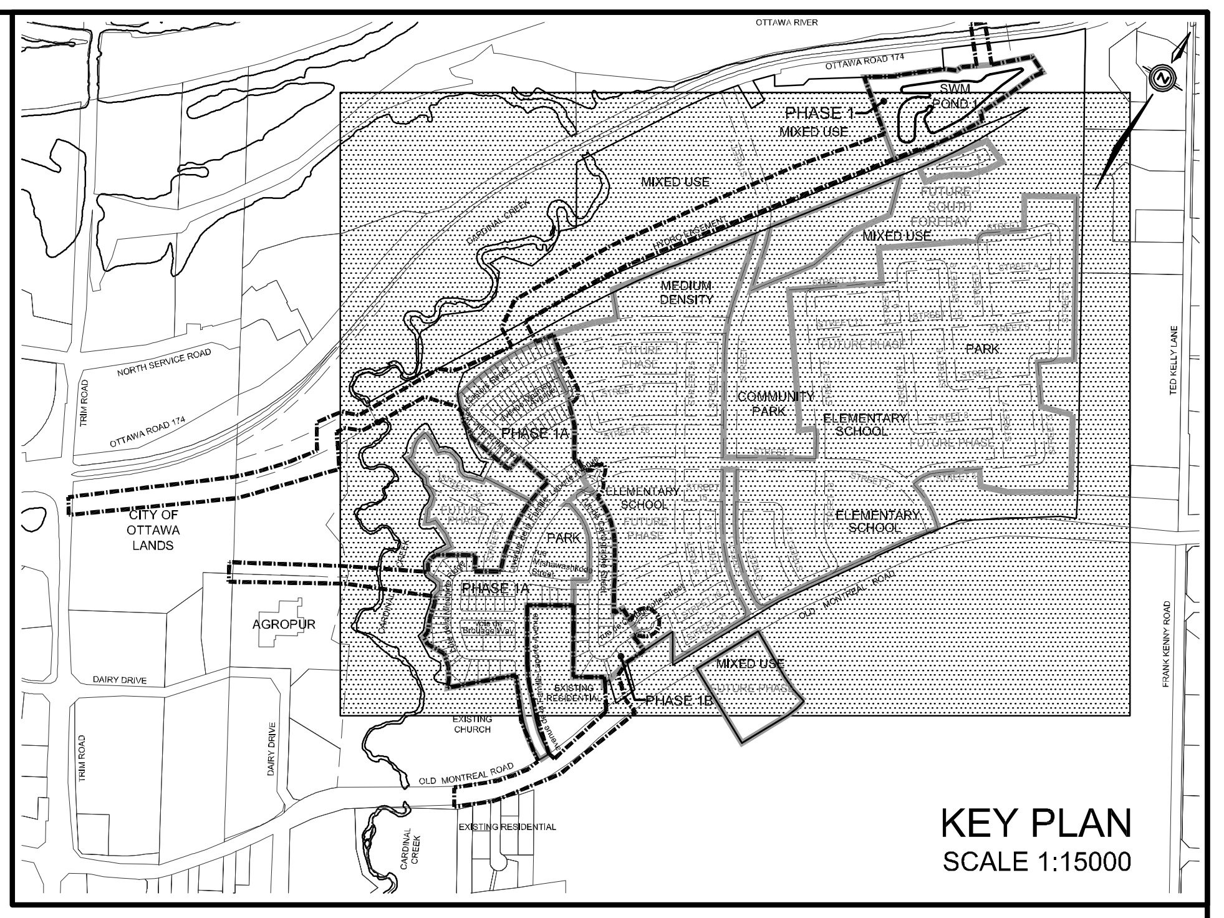
LOCATION: **City of Ottawa**

File Ref: 11-513B-1

Date: May, 2014

Sheet No. 5 of 5

EXTERNAL SANITARY DRAINAGE PLAN



KEY PLAN
SCALE 1:15000

LEGEND

0.82Ha	AREA IN HECTARES
135	POPULATION DENSITY (PERSONS PER HECTARE)
111	POPULATION
Residential	
▬ ▬ ▬	EXTERNAL SANITARY TRIBUTARY BOUNDARY

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY STANTEC GEOMATICS LTD, PROJECT No. 161611900–111 RECEIVED ON JULY 6, 2012 AND PROJECT No. 16162924–111 RECEIVED ON OCTOBER 24, 2013 AND NOVEMBER 29, 2013

LEGAL INFORMATION

CALCULATED M–PLAN PROVIDED BY STANTEC GEOMATICS LTD, PROJECT No. 161613098–132 RECEIVED ON APRIL 23, 2014.

2nd SUBMISSION 14–05–01

NOT FOR CONSTRUCTION

ELEVATION NOTE

ELEVATIONS HEREON ARE GEODETIC AND ARE DERIVED FROM THE CAN–NET VRS NETWORK.

2.	14–05–01	Z.L.	2nd SUBMISSION	
1.	14–02–07	Z.L.	1st SUBMISSION	
No.	DATE	BY	DESCRIPTION	BY

Ottawa CITY OF OTTAWA

PROJECT No. 11–513 B–1

LICENSED PROFESSIONAL ENGINEER
Z. LI
14-05-01
PROVINCE OF ONTARIO

EXTERNAL SANITARY DRAINAGE PLAN

TAMARACK
(CARDINAL CREEK)
CORPORATION

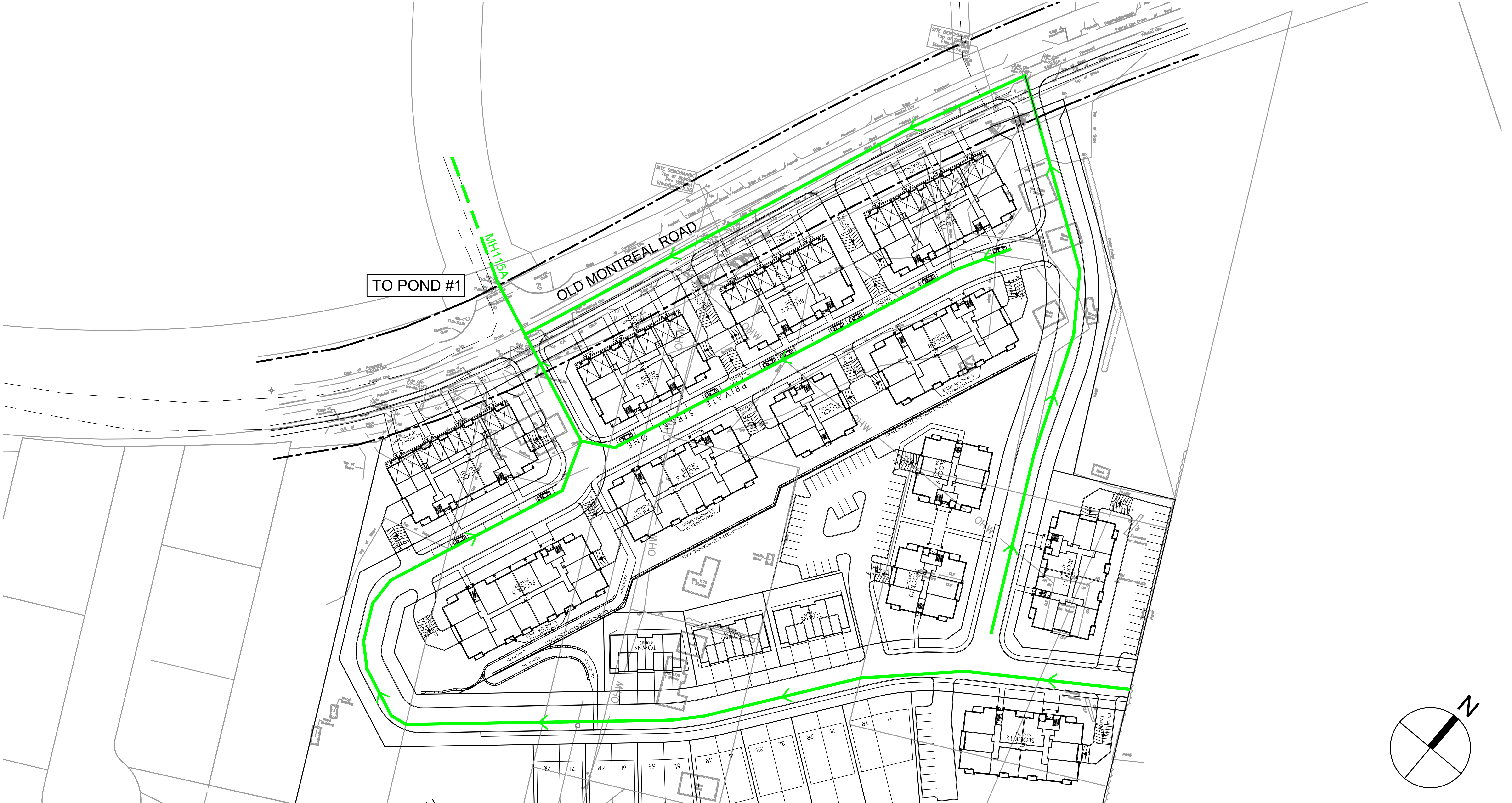
CARDINAL CREEK
VILLAGE PHASE 1

DSEL
david schaeffer engineering ltd
120 Iber Road, Unit 203
Stittsville, ON K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

DRAWN BY: W.L./H.P.	CHECKED BY: K.M.	DRAWING NO.	SHEET NO.
DESIGNED BY: K.M.	CHECKED BY: Z.L.		63A
SCALE: 1:4000	DATE: FEBRUARY 2014		

APPENDIX C

J:\109575_OldMontrealRd\5.9 Drawings\59civil\current\Serviceability\Layout\109575-FIG 4.1 – STORM.dwg Layout Name: 24x36 Plan Plot Style: ---- Plot Scale: 1:4.526 Plotted At: 1/11/2018 12:09 PM
Last Saved By: chris.cormier Last Saved At: Dec. 20, 17



LEGEND:

━ PROPOSED STORM SEWERS

╍ EXISTING STORM SEWERS

IBI

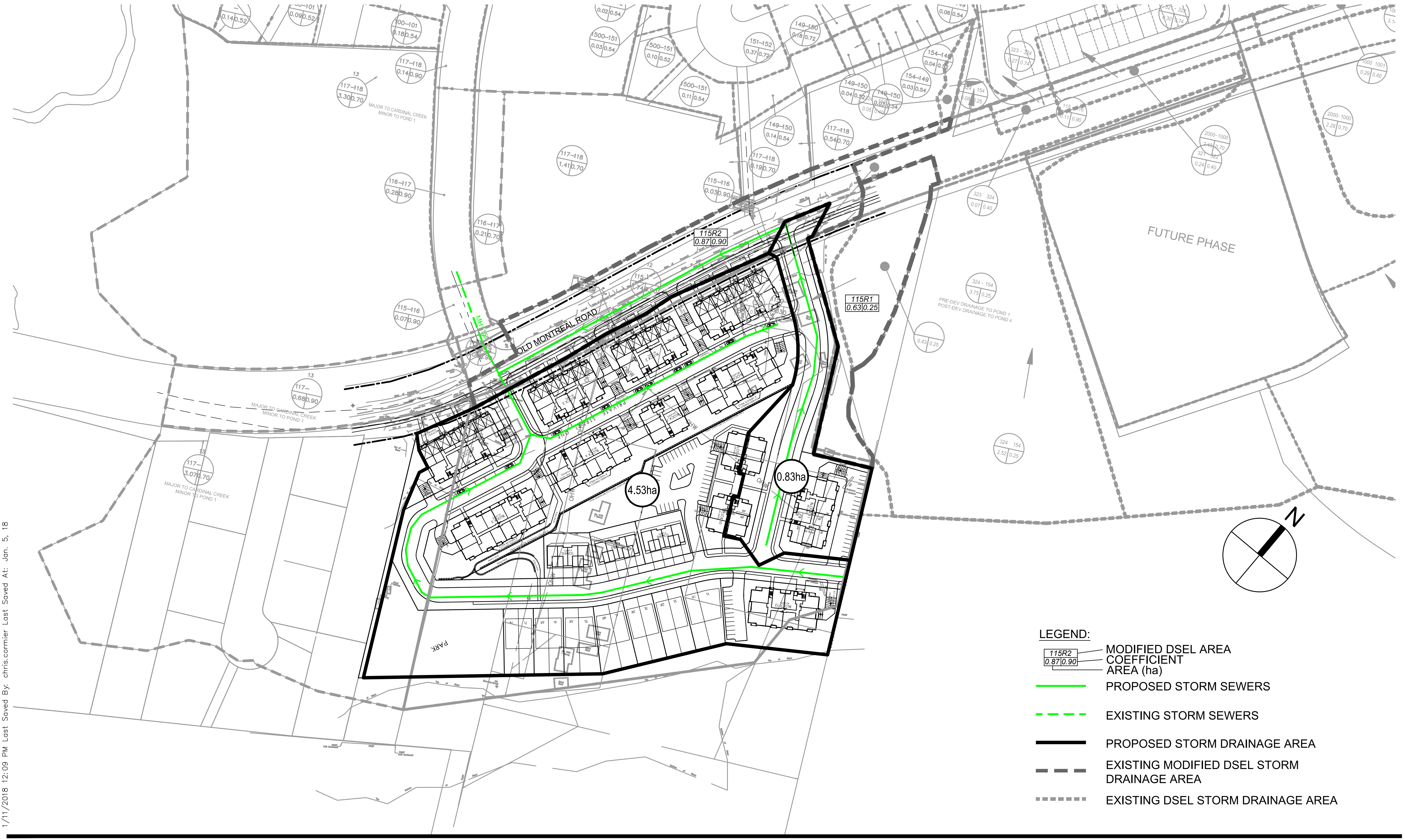
Scale
N.T.S.

Project Title
DCR / PHOENIX
1208 OLD MONTREAL ROAD

Drawing Title
CONCEPTUAL STORMWATER
DISPOSAL SYSTEM

Sheet No.
FIG.4.1

J:\109575_OldMontrealRd\5.9 Drawings\59civil\current\Serviceability\Layout\109575-FIG 4.2 - STORM DRAINAGE AREA.dwg Layout Name: 24x36 Plan Plot Style: ---- Plot Scale: 1:4.526 Plotted At: 1/11/2018 12:09 PM Last Saved By: chris.cormier Last Saved At: Jan. 5, 18



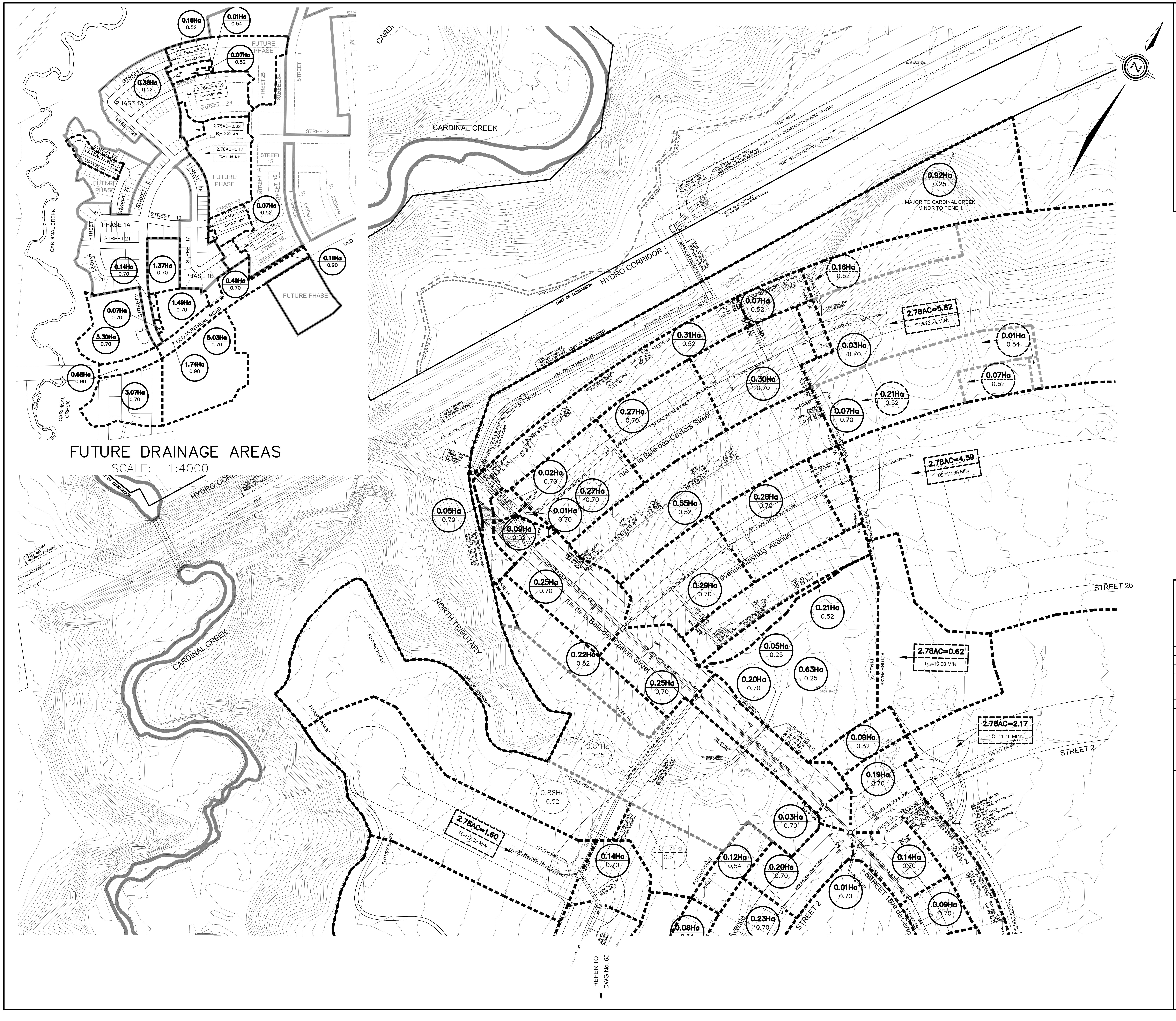
IBI

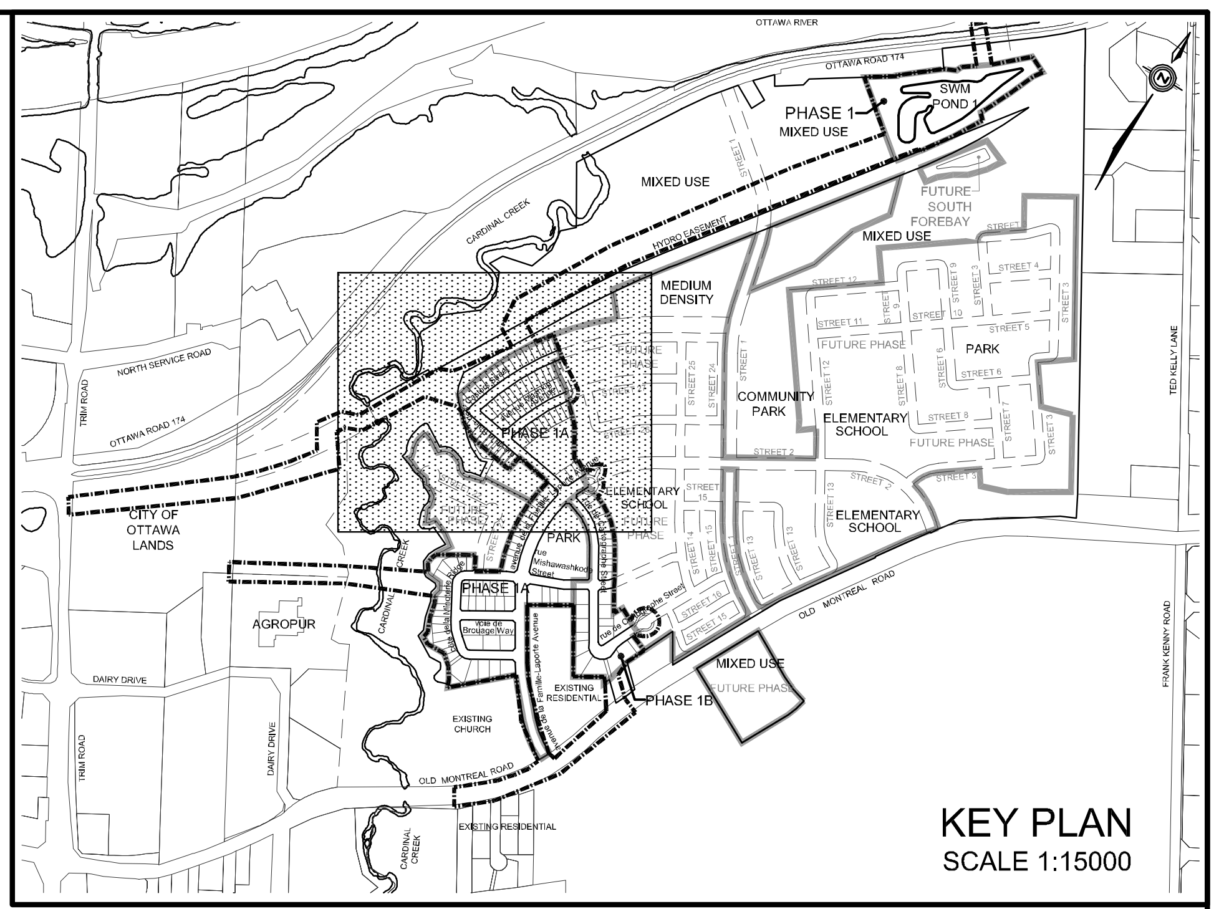
Scale
N.T.S.

Project Title
DCR / PHOENIX
1208 OLD MONTREAL ROAD

Drawing Title
CONCEPTUAL STORM DRAINAGE AREA

Sheet No.
FIG. 4.2





LEGEND

0.25Ha / 0.75 — DRAINAGE AREA IN HECTARES / RUN–OFF COEFFICIENT
0.29Ha / 0.65 — EXTERNAL DRAINAGE AREA IN HECTARES (BY OTHERS) / RUN–OFF COEFFICIENT
OVERLAND FLOW DIRECTION
EXTERNAL OVERLAND FLOW DIRECTION
STORM MANHOLE
STORM MANHOLE IN OTHER PHASES
CATCHBASIN MANHOLE
RLCBS – ELBOW SECTION (CITY STD. S31) / 'T' SECTION (CITY STD. S30), AS NOTED ON THE DRAWING
SINGLE/DOUBLE CATCHBASIN
CATCHBASINS WITH INLET CONTROL DEVICE IPEX TEMPEST A (Q max = 19.9 l/s)
CATCHBASINS WITH INLET CONTROL DEVICE IPEX TEMPEST B (Q max = 28.4 l/s)
CACHBASINS WITH INLET CONTROL DEVICE IPEX TEMPEST C (Q max = 35.5 l/s)
CATCHBASINS WITH INLET CONTROL DEVICE IPEX TEMPEST D (Q max = 50.1 l/s)
CATCHBASINS WITH INLET CONTROL DEVICE IPEX TEMPEST E (Q max = 69.1 l/s)
STORM SEWER TRIBUTARY BOUNDARY
STORM SEWER SUB TRIBUTARY BOUNDARY
EXTERNAL STORM SEWER TRIBUTARY BOUNDARY
PHASE LINE
SINGLE STORM HOUSE CONNECTION

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY STANTEC GEOMATICS LTD, PROJECT No. 161611900–111 RECEIVED ON JULY 6, 2012 AND PROJECT No. 16162924–111 RECEIVED ON OCTOBER 24, 2013 AND NOVEMBER 29, 2013

LEGAL INFORMATION

CALCULATED M–PLAN PROVIDED BY STANTEC GEOMATICS LTD, PROJECT No. 161613098–132 RECEIVED ON APRIL 23, 2014.

2nd SUBMISSION 14–05–01

NOT FOR CONSTRUCTION

ELEVATION NOTE

ELEVATIONS HEREON ARE GEODETIC AND ARE DERIVED FROM THE CAN–NET VRS NETWORK.

No.	DATE	BY	DESCRIPTION	BY
2.	14–05–01	Z.L.	2nd SUBMISSION	
1.	14–02–07	Z.L.	1st SUBMISSION	

CITY OF OTTAWA

PROJECT No. 11–513 B–1

Z. LI
14-05-01

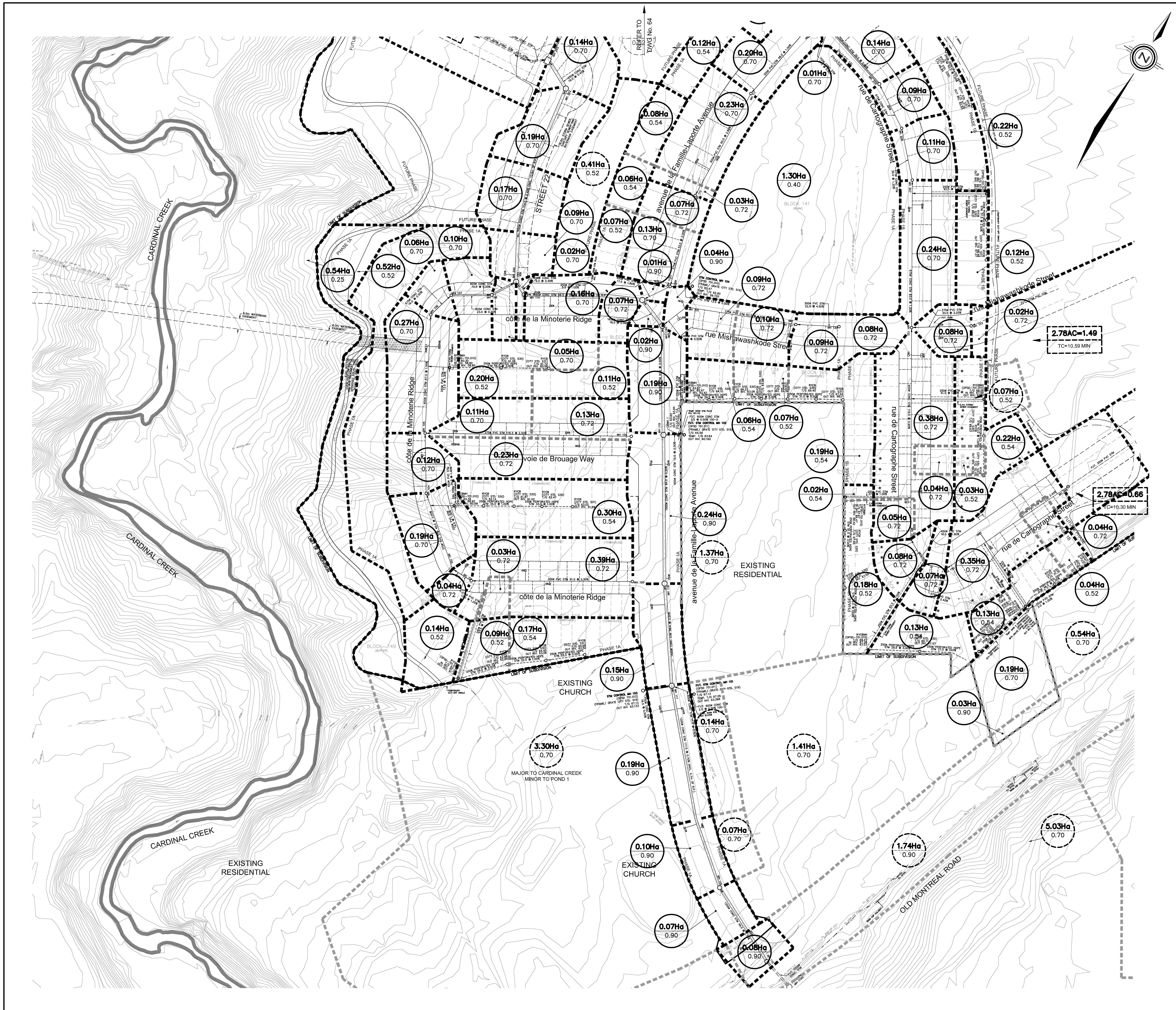
STORM DRAINAGE PLAN
© DSEL

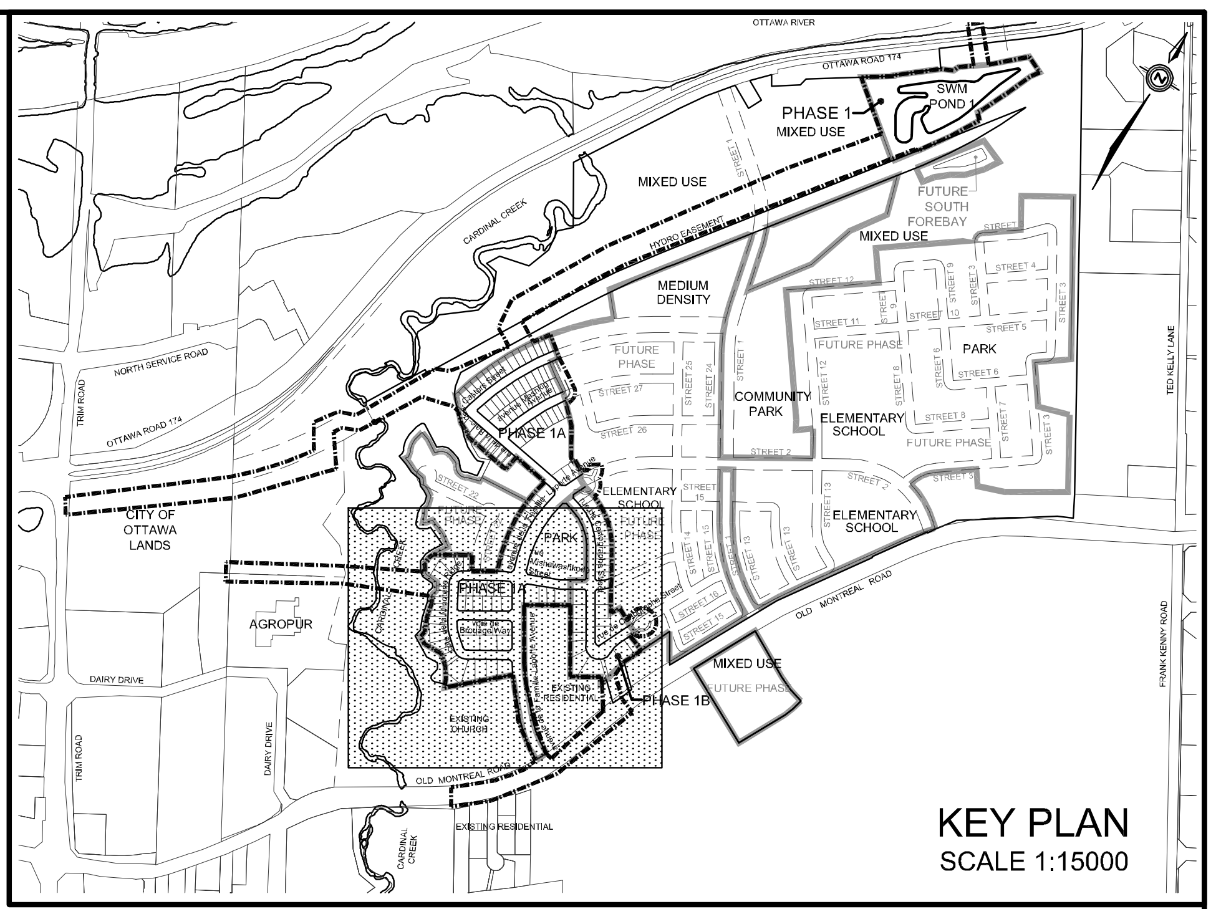
TAMARACK
(CARDINAL CREEK)
CORPORATION

CARDINAL CREEK
VILLAGE PHASE 1

david schaeffer engineering ltd
120 Iber Road, Unit 203
Stittsville, ON K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

DRAWN BY: W.L./H.P.	CHECKED BY: K.M.	DRAWING NO.	SHEET NO.
DESIGNED BY: K.M.	CHECKED BY: Z.L.		64
SCALE: 1:1000	DATE: FEBRUARY 2014		





KEY PLAN
SCALE 1:15000

LEGEND

0.25Ha 0.75	DRAINAGE AREA IN HECTARES RUN–OFF COEFFICIENT
0.29Ha 0.65	EXTERNAL DRAINAGE AREA IN HECTARES (BY OTHERS) RUN–OFF COEFFICIENT
⇨	OVERLAND FLOW DIRECTION
⇨	EXTERNAL OVERLAND FLOW DIRECTION
○	STORM MANHOLE
○	STORM MANHOLE IN OTHER PHASES
□	CATCHBASIN MANHOLE
●	RLCBS – ELBOW SECTION (CITY STD. S31) / 'T' SECTION (CITY STD. S30), AS NOTED ON THE DRAWING
□ □□	SINGLE/DOUBLE CATCHBASIN
▨ ▨▨	CATCHBASINS WITH INLET CONTROL DEVICE IPEX TEMPEST A (Q max = 19.9 l/s)
▨ ▨▨	CATCHBASINS WITH INLET CONTROL DEVICE IPEX TEMPEST B (Q max = 28.4 l/s)
▨ ▨▨	CACHBASINS WITH INLET CONTROL DEVICE IPEX TEMPEST C (Q max = 35.5 l/s)
▨ ▨▨	CATCHBASINS WITH INLET CONTROL DEVICE IPEX TEMPEST D (Q max = 50.1 l/s)
▨ ▨▨	CATCHBASINS WITH INLET CONTROL DEVICE IPEX TEMPEST E (Q max = 69.1 l/s)
▬ ▬ ▬	STORM SEWER TRIBUTARY BOUNDARY
▬ ▬ ▬	STORM SEWER SUB TRIBUTARY BOUNDARY
▬ ▬ ▬	EXTERNAL STORM SEWER TRIBUTARY BOUNDARY
▬▬▬	PHASE LINE
----	SINGLE STORM HOUSE CONNECTION

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY STANTEC GEOMATICS LTD, PROJECT No. 161611900–111 RECEIVED ON JULY 6, 2012 AND PROJECT No. 16162924–111 RECEIVED ON OCTOBER 24, 2013 AND NOVEMBER 29, 2013

LEGAL INFORMATION

CALCULATED M–PLAN PROVIDED BY STANTEC GEOMATICS LTD, PROJECT No. 161613098–132 RECEIVED ON APRIL 23, 2014.

2nd SUBMISSION 14–05–01

NOT FOR CONSTRUCTION

ELEVATION NOTE

ELEVATIONS HEREON ARE GEODETIC AND ARE DERIVED FROM THE CAN–NET VRS NETWORK.

No.	DATE	BY	DESCRIPTION	BY
2.	14–05–01	Z.L.	2nd SUBMISSION	
1.	14–02–07	Z.L.	1st SUBMISSION	

CITY OF OTTAWA

PROJECT No. 11–513 B–1

LICENSED PROFESSIONAL ENGINEER
Z. LI
14-05-01
PROVINCE OF ONTARIO

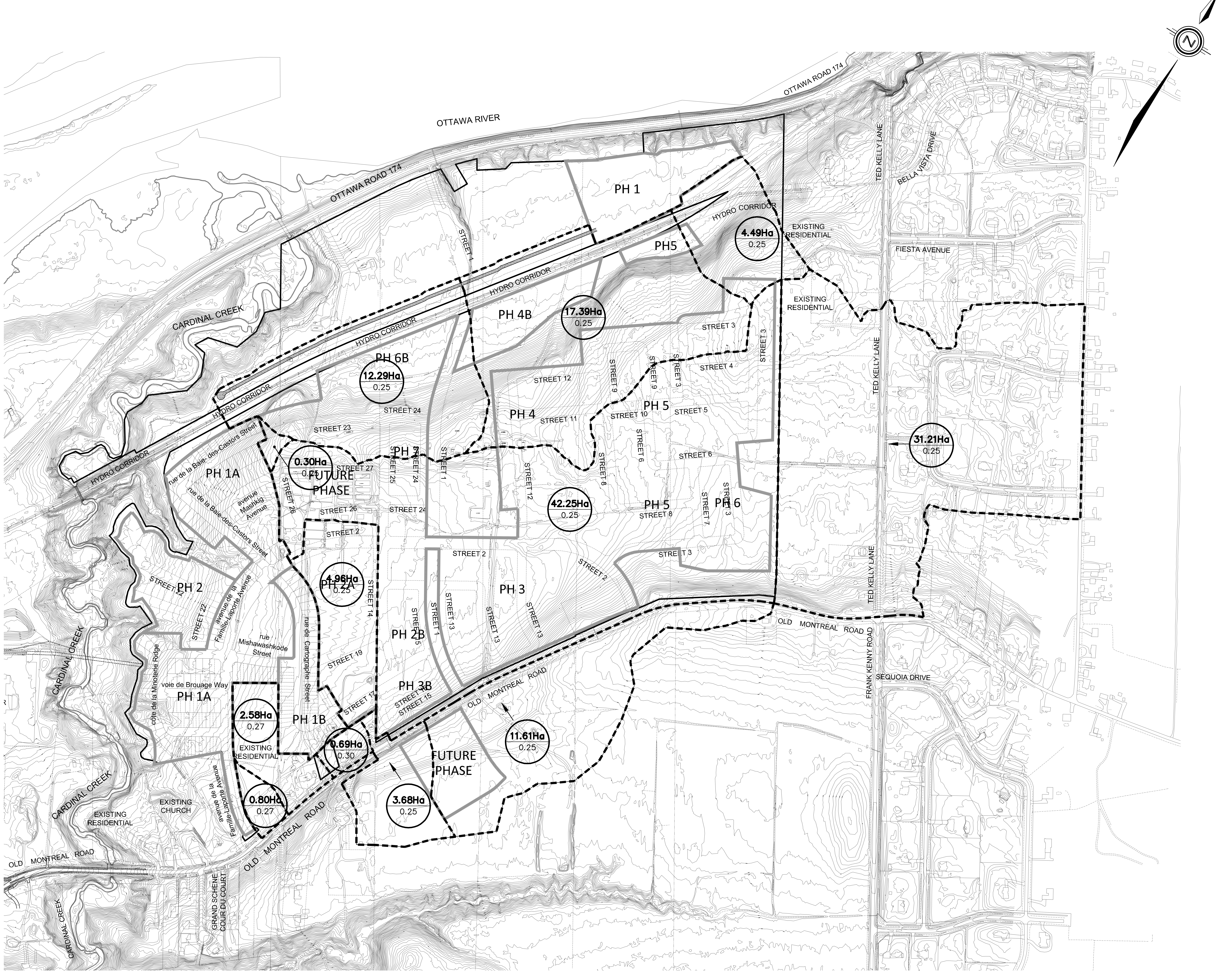
STORM DRAINAGE PLAN

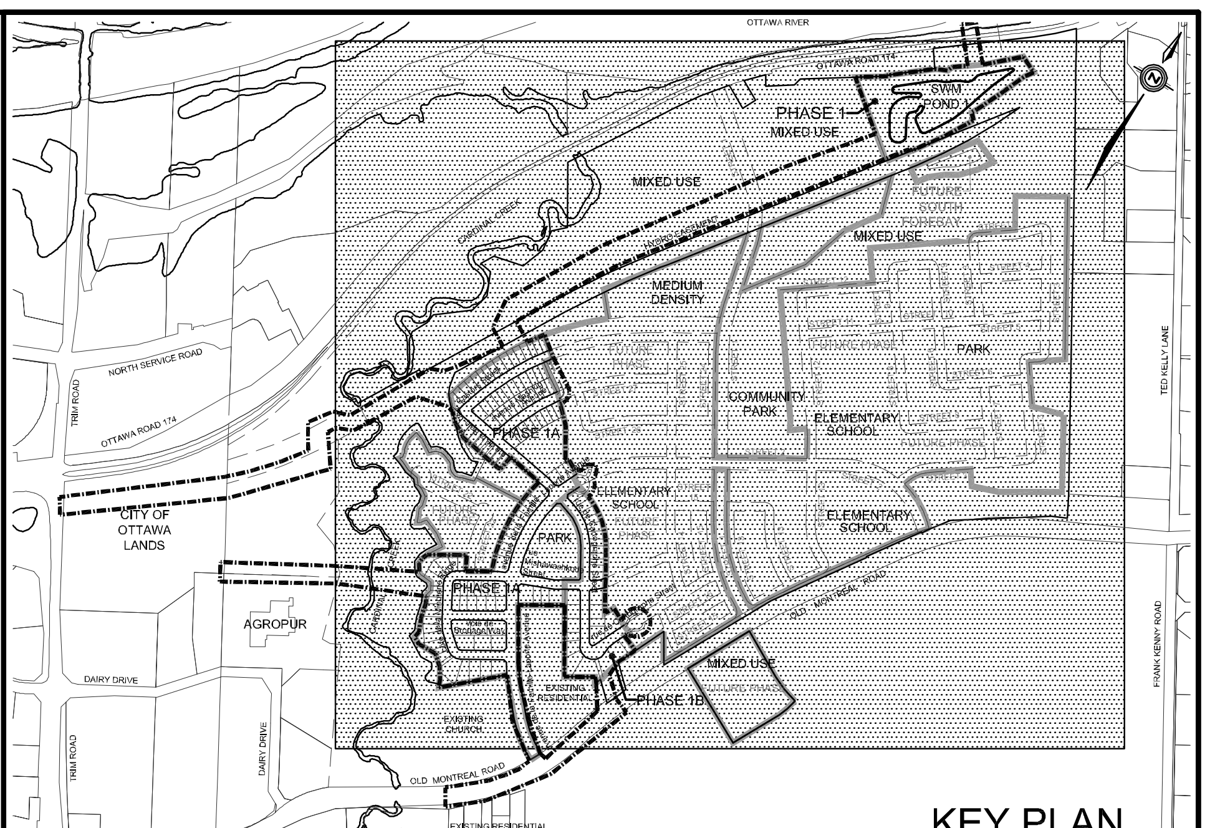
TAMARACK
(CARDINAL CREEK)
CORPORATION

CARDINAL CREEK VILLAGE PHASE 1

david schaeffer engineering ltd
120 Iber Road, Unit 203
Stittsville, ON K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

DRAWN BY: W.L./H.P.	CHECKED BY: K.M.	DRAWING NO.	SHEET NO.
DESIGNED BY: K.M.	CHECKED BY: Z.L.		65
SCALE: 1:1000	DATE: FEBRUARY 2014		





KEY PLAN
SCALE 1:15000

2.64Ha
0.25
DRAINAGE AREA IN HECTARES
RUN-OFF COEFFICIENT

▪▪▪▪▪▪▪ EXTERNAL STORM TRIBUTARY BOUNDARY

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY STANTEC GEOMATICS LTD, PROJECT No. 161611900–111 RECEIVED ON JULY 6, 2012 AND PROJECT No. 16162924–111 RECEIVED ON OCTOBER 24, 2013 AND NOVEMBER 29, 2013

LEGAL INFORMATION

CALCULATED M–PLAN PROVIDED BY STANTEC GEOMATICS LTD, PROJECT No. 161613098–132 RECEIVED ON APRIL 23, 2014.

2nd SUBMISSION 14–05–01

NOT FOR CONSTRUCTION

ELEVATION NOTE

ELEVATIONS HEREON ARE GEODETIC AND ARE DERIVED FROM THE CAN–NET VRS NETWORK.

2.	14–05–01	Z.L.	2nd SUBMISSION	
1.	14–02–07	Z.L.	1st SUBMISSION	
No.	DATE	BY	DESCRIPTION	BY

Ottawa CITY OF OTTAWA

PROJECT No. 11–513 B–1

LICENSED PROFESSIONAL ENGINEER
Z. LI
14-05-01
PROVINCE OF ONTARIO

EXTERNAL PRE-DEVELOPMENT STORM DRAINAGE PLAN

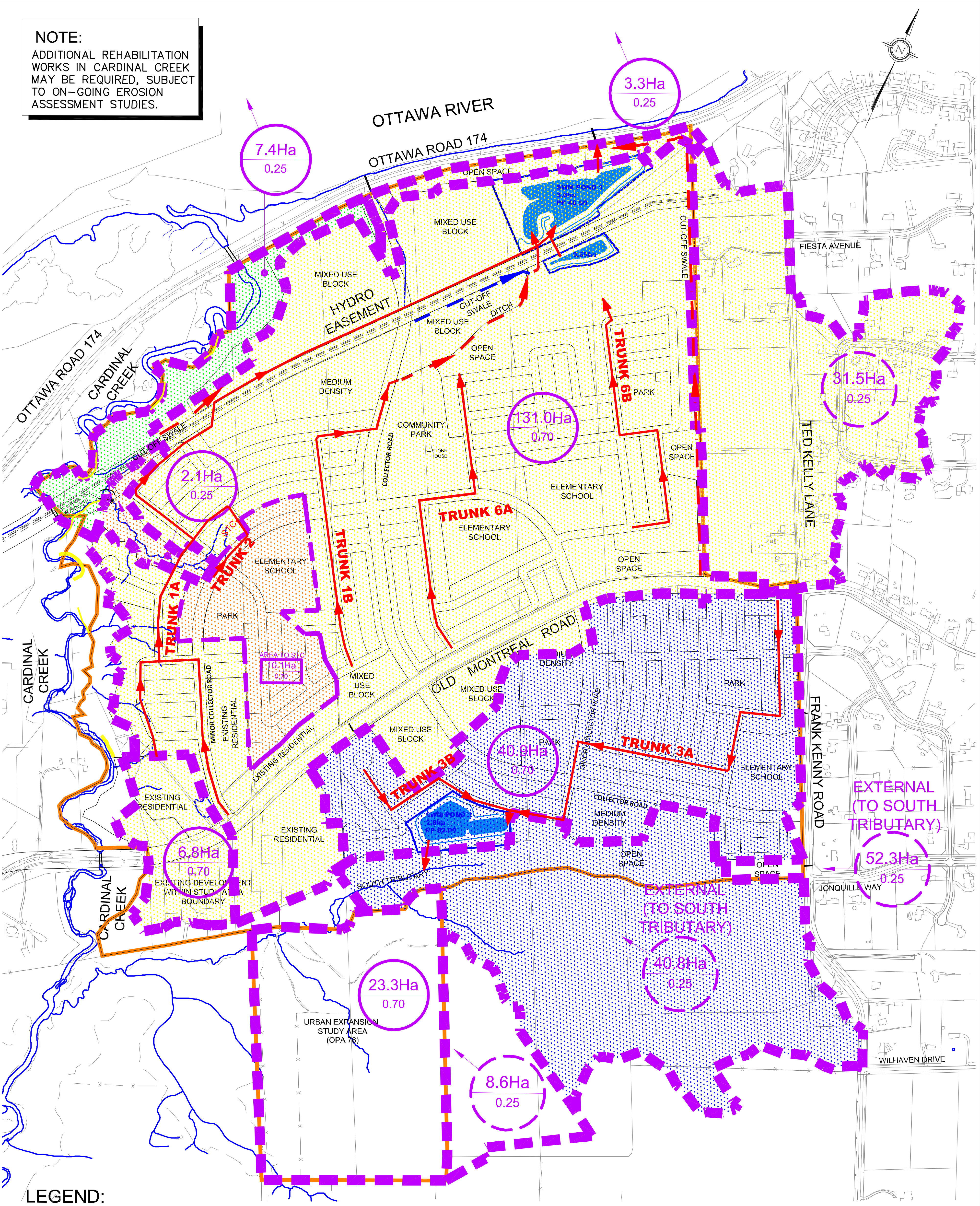
TAMARACK
(CARDINAL CREEK)
CORPORATION

CARDINAL CREEK VILLAGE PHASE 1

DSEL
david schaeffer engineering ltd
120 Iber Road, Unit 203
Stittsville, ON K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

DRAWN BY: W.L./H.P.	CHECKED BY: K.M.	DRAWING NO.	SHEET NO.
DESIGNED BY: K.M.	CHECKED BY: Z.L.		70A
SCALE: 1:4000	DATE: FEBRUARY 2014		

NOTE:
ADDITIONAL REHABILITATION WORKS IN CARDINAL CREEK MAY BE REQUIRED, SUBJECT TO ON-GOING EROSION ASSESSMENT STUDIES.



LEGEND:

▬	SUBJECT LANDS
→	STORM SEWER TRUNK
▬ ▬ ▬	DRAINAGE AREA BOUNDARY
39.9Ha 0.70	DRAINAGE AREA RUN-OFF COEFFICENT
23.2Ha 0.70	EXTERNAL DRAINAGE AREA RUN-OFF COEFFICENT
AREA TO STC 10.1Ha 0.70	SPECIFIED DRAINAGE AREA RUN-OFF COEFFICENT
▬	EROSION MITIGATION MEASURES
∘ STC	OIL & GRIT SEPERATOR UNIT
▨	OTTAWA RIVER
▨	CARDINAL CREEK
▨	NORTH TRIBUTARY OF CARDINAL CREEK
▨	SOUTH TRIBUTARY OF CARDINAL CREEK

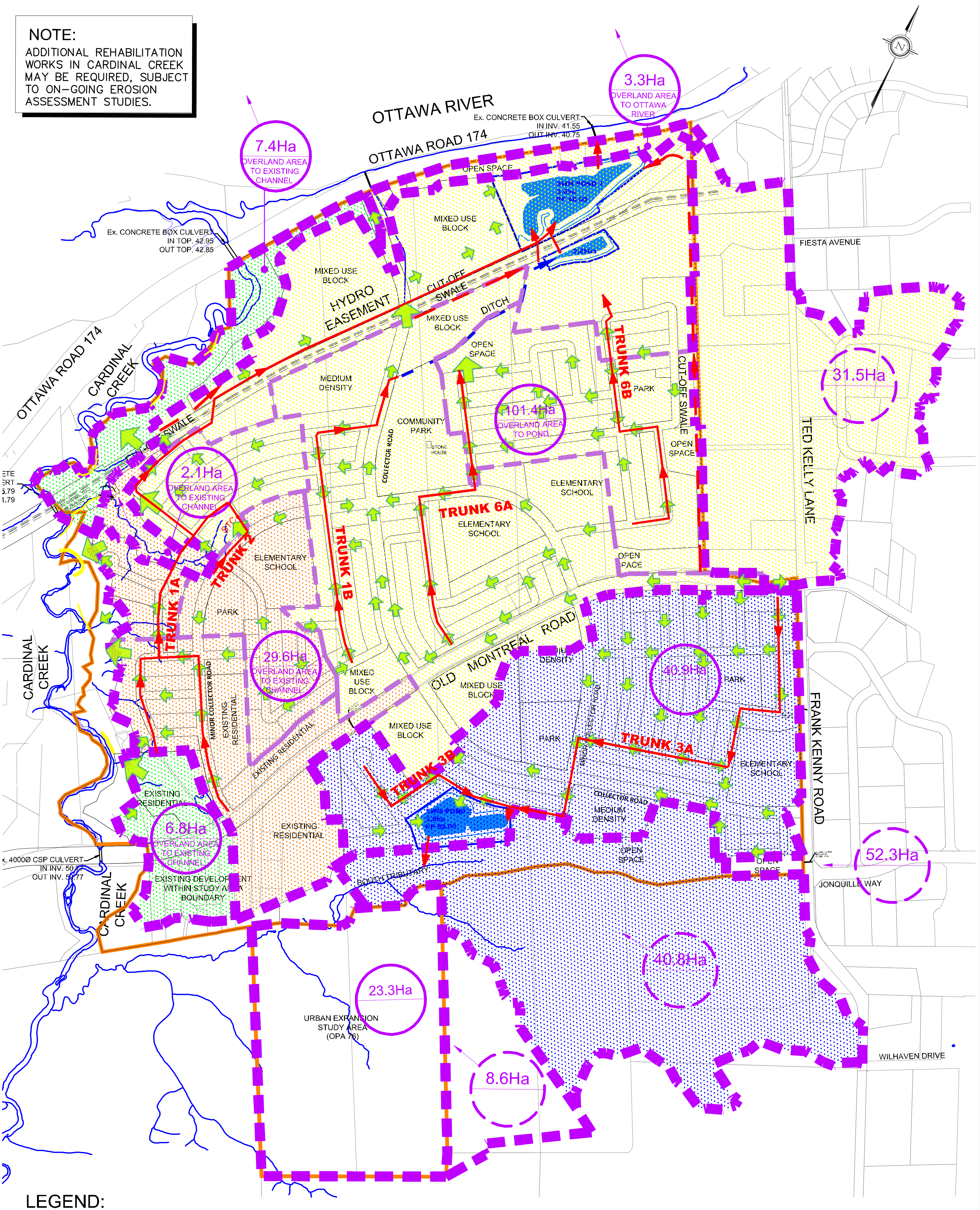
DSEL
david schaeffer engineering ltd

120 Iber Road, Unit 203
Stittsville, ON K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

CARDINAL VILLAGE
CONCEPTUAL STORM DRAINAGE
(MINOR SYSTEM)
CITY OF OTTAWA

DATE: JUNE 2013
SCALE: 1:8000
PROJECT No.: 11-513
FIGURE: 17

NOTE:
ADDITIONAL REHABILITATION WORKS IN CARDINAL CREEK MAY BE REQUIRED, SUBJECT TO ON-GOING EROSION ASSESSMENT STUDIES.



LEGEND:

━	SUBJECT LANDS
▬ ▬ ▬	DRAINAGE AREA BOUNDARY
39.9Ha	DRAINAGE AREA
➜	OVERLAND FLOW ROUTE
23.2Ha	EXTERNAL DRAINAGE AREA RUN-OFF COEFFICENT
━	EROSION MITIGATION MEASURES
▨	SOUTH TRIBUTARY OF CARDINAL CREEK
▨	OTTAWA RIVER
▨	CARDINAL CREEK
▨	NORTH TRIBUTARY OF CARDINAL CREEK
○ STC	OIL & GRIT SEPERATOR UNIT

DSEL
david schaeffer engineering ltd

120 Iber Road, Unit 203
Stittsville, ON K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

CARDINAL VILLAGE
CONCEPTUAL STORM DRAINAGE (MAJOR SYSTEM)
CITY OF OTTAWA

DATE: JUNE 2013
SCALE: 1:8000
PROJECT No.: 11-513
FIGURE: 18

APPENDIX D

J:\109575_OldMontrealRd\5.9 Drawings\59civil\current\Serviceability\Layout\109575-FIG 5.1 – MACRO GRADING OPTION 1.dwg Layout Name: 24x36 Plan Plot Style: ---- Plot Scale: 1:4.526 Plotted At:
1/11/2018 12:09 PM Last Saved By: chris.cormier Last Saved At: Jan. 11, 18

LEGEND:

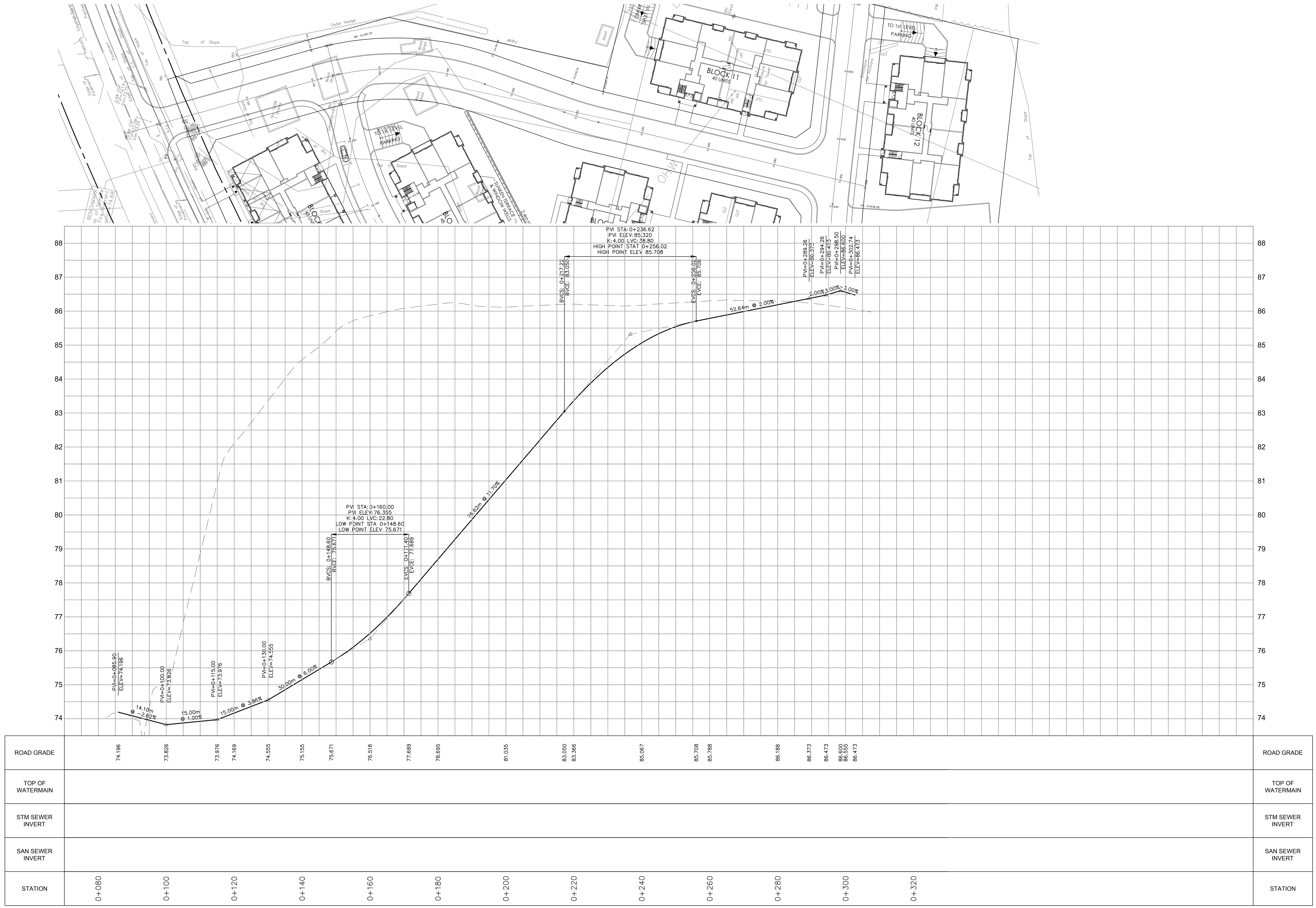
81.89 83.30	PROPOSED ELEVATION EXISTING ELEVATION
⇦	MAJOR OVERLAND FLOW ROUTE

IBI

Scale	Project Title	Drawing Title	Sheet No.
N.T.S.	DCR / PHOENIX 1208 OLD MONTREAL ROAD	CONCEPTUAL MACRO GRADING PLAN INTERIM DRAFT PLAN #1	FIG 5.1

J:\109575_OldMontrealRd\5.9 Drawings\59civil\current\Serviceability\Layout\109575-FIG 5.2 - MACRO GRADING OPTION 2.dwg Layout Name: 24x36 Plan Plot Style: ---- Plot Scale: 1:4.526 Plotted At: 1/11/2018 12:09 PM Last Saved By: chris.cormier Last Saved At: Jan. 11, 18

Scale	Project Title	Drawing Title	Sheet No.
N.T.S.	DCR / PHOENIX 1208 OLD MONTREAL ROAD	CONCEPTUAL MACRO GRADING PLAN ULTIMATE DRAFT PLAN #2	FIG 5.2



J:\109575_OldMontrealRd\5.9 Drawings\59civil\current\Serviceability\Layout\109575-FIG 5.3 - ROAD PROFILE 1.dwg Layout Name: 24x36 P-P Plot Style: ---- Plot Scale: 1:2.5849 Plotted At: 1/11/2018 12:10 PM Last Saved By: chris.cormier
Last Saved At: Jan. 11, 18

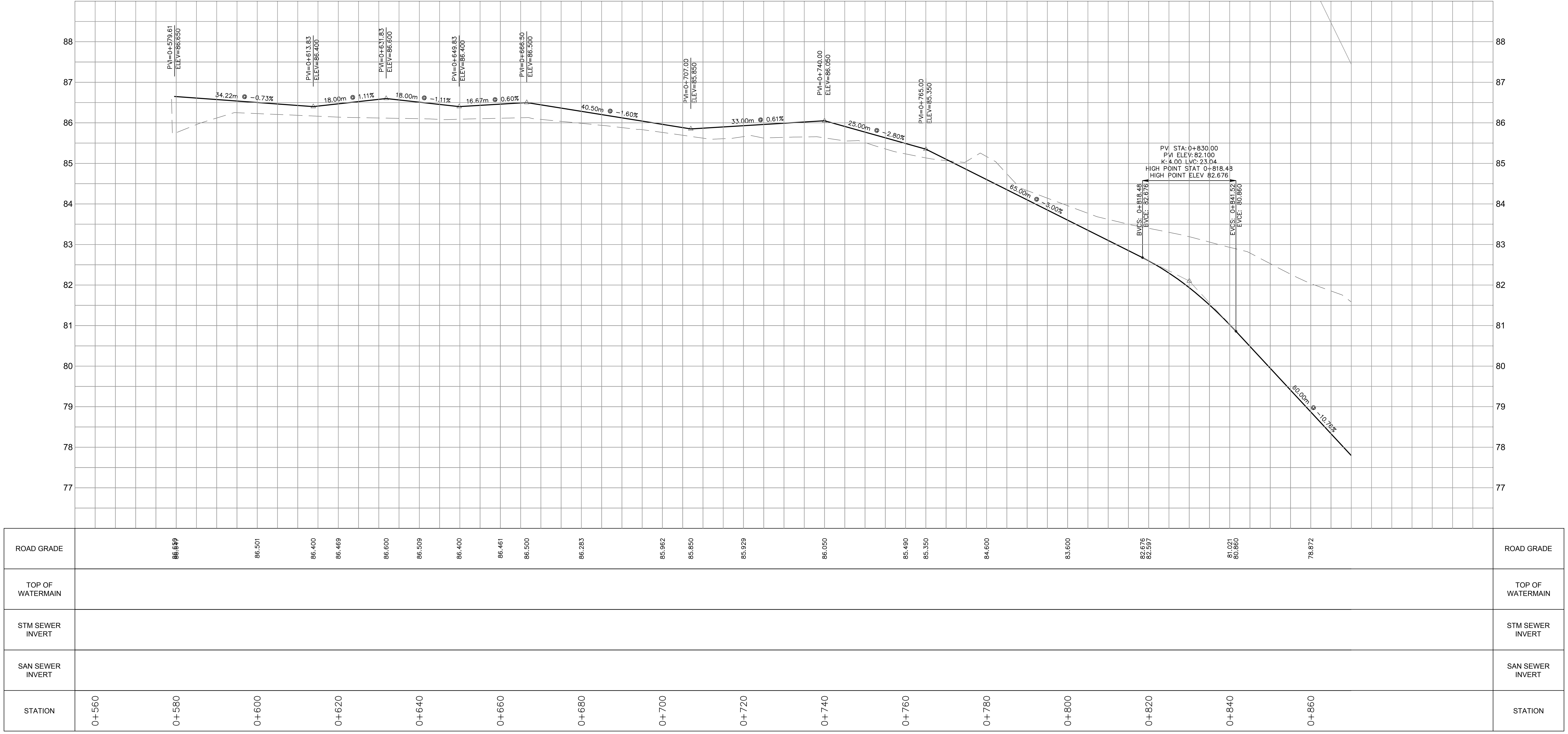
IBI

Scale
1 : 500

Project Title
DCR / PHOENIX
1208 OLD MONTREAL ROAD

Drawing Title
ROAD PROFILE 1

Sheet No.
FIG 5.3



J:\109575_OldMontrealRd\5.9 Drawings\59civil\current\Serviceability\Layout\109575-FIG 5.4 – ROAD PROFILE 2.dwg Layout Name: 24x36 P-P Plot Style: ---- Plot Scale: 1:2.5849 Plotted At: 1/11/2018 12:10 PM Last Saved By: chris.cormier
Last Saved At: Jan. 11, 18

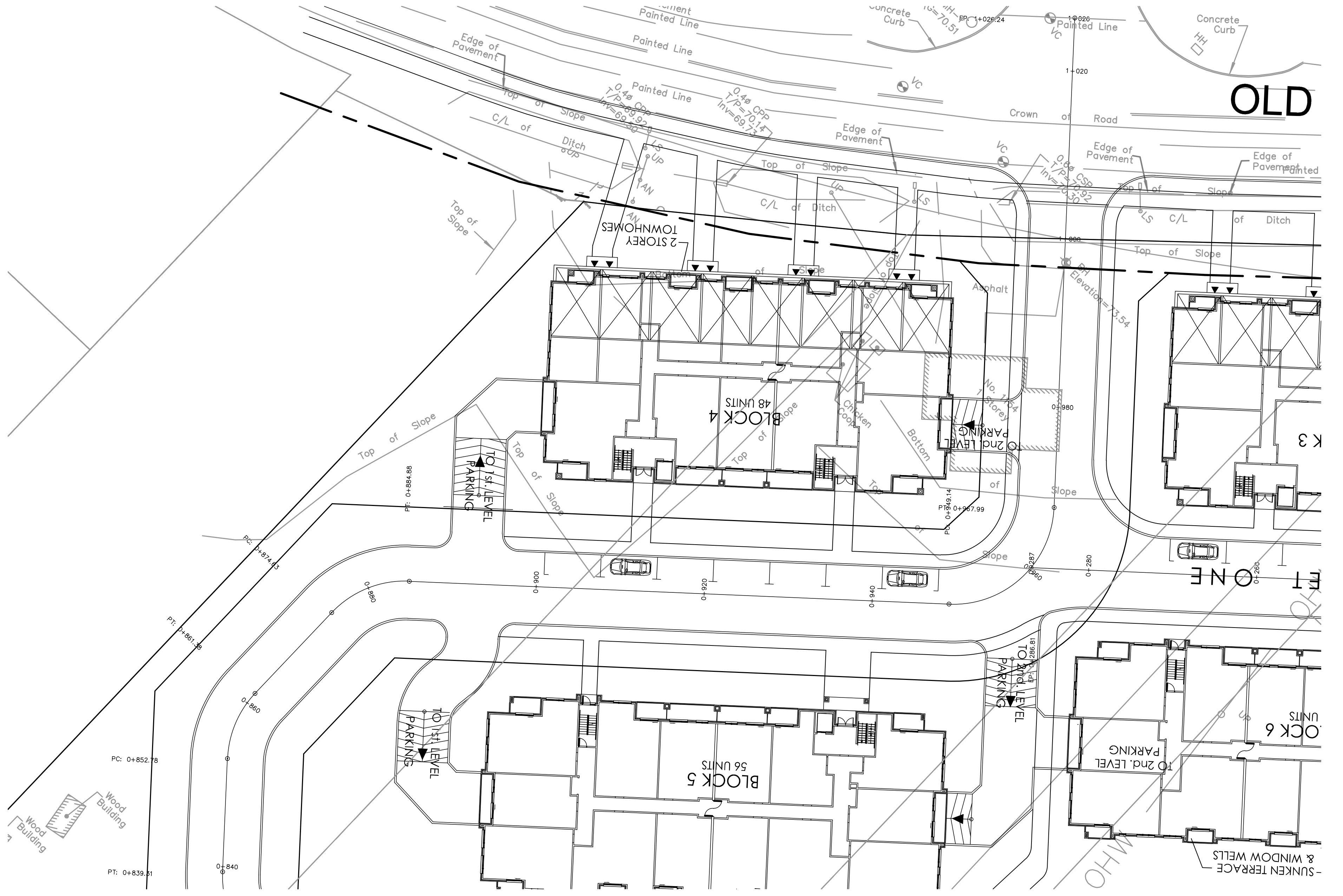
IBI

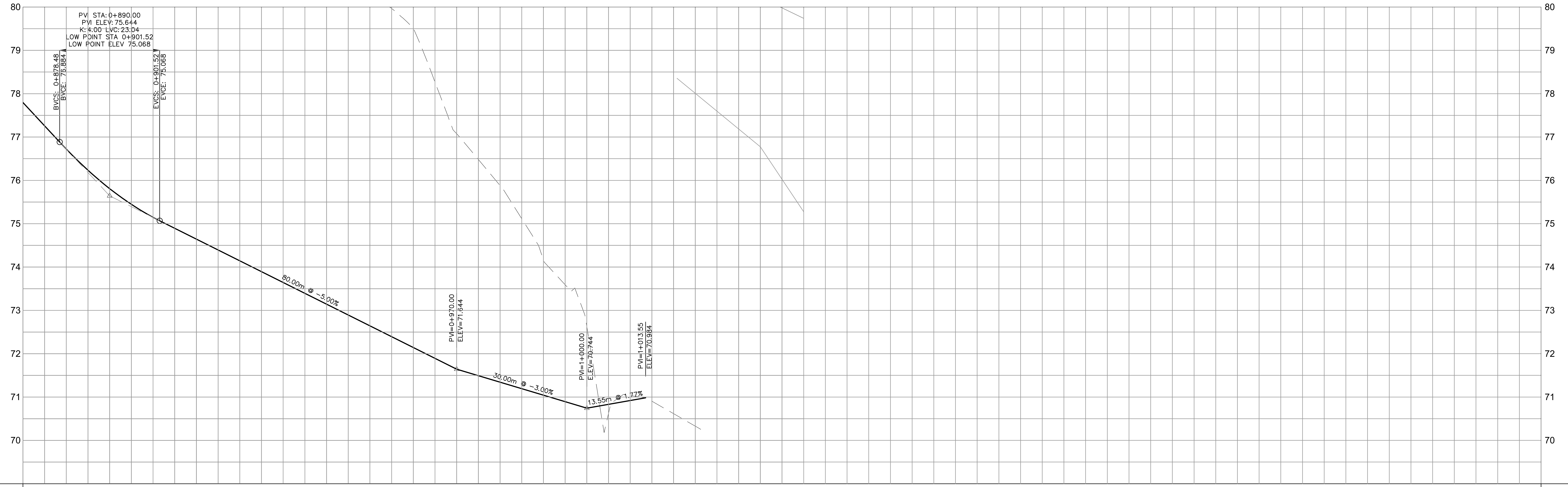
Scale
1 : 500

Project Title
DCR / PHOENIX
1208 OLD MONTREAL ROAD

Drawing Title
ROAD PROFILE 2

Sheet No.
FIG. 5.4





ROAD GRADE	76.884 76.723	75.147 75.068	74.144	73.144	72.144	71.644	71.344	70.744	70.984			ROAD GRADE
TOP OF WATERMAIN												TOP OF WATERMAIN
STM SEWER INVERT												STM SEWER INVERT
SAN SEWER INVERT												SAN SEWER INVERT
STATION	0+880	0+900	0+920	0+940	0+960		0+980	1+000		1+020	1+040	STATION

J:\109575_OldMontrealRd\5.9 Drawings\59civil\current\Serviceability\Layout\109575-FIG 5.5 - ROAD PROFILE 3.dwg Layout Name: 24x36 P-P Plot Style: ---- Plot Scale: 1:2.5849 Plotted At: 1/11/2018 12:10 PM Last Saved By: chris.cormier
Last Saved At: Jan. 11, 18

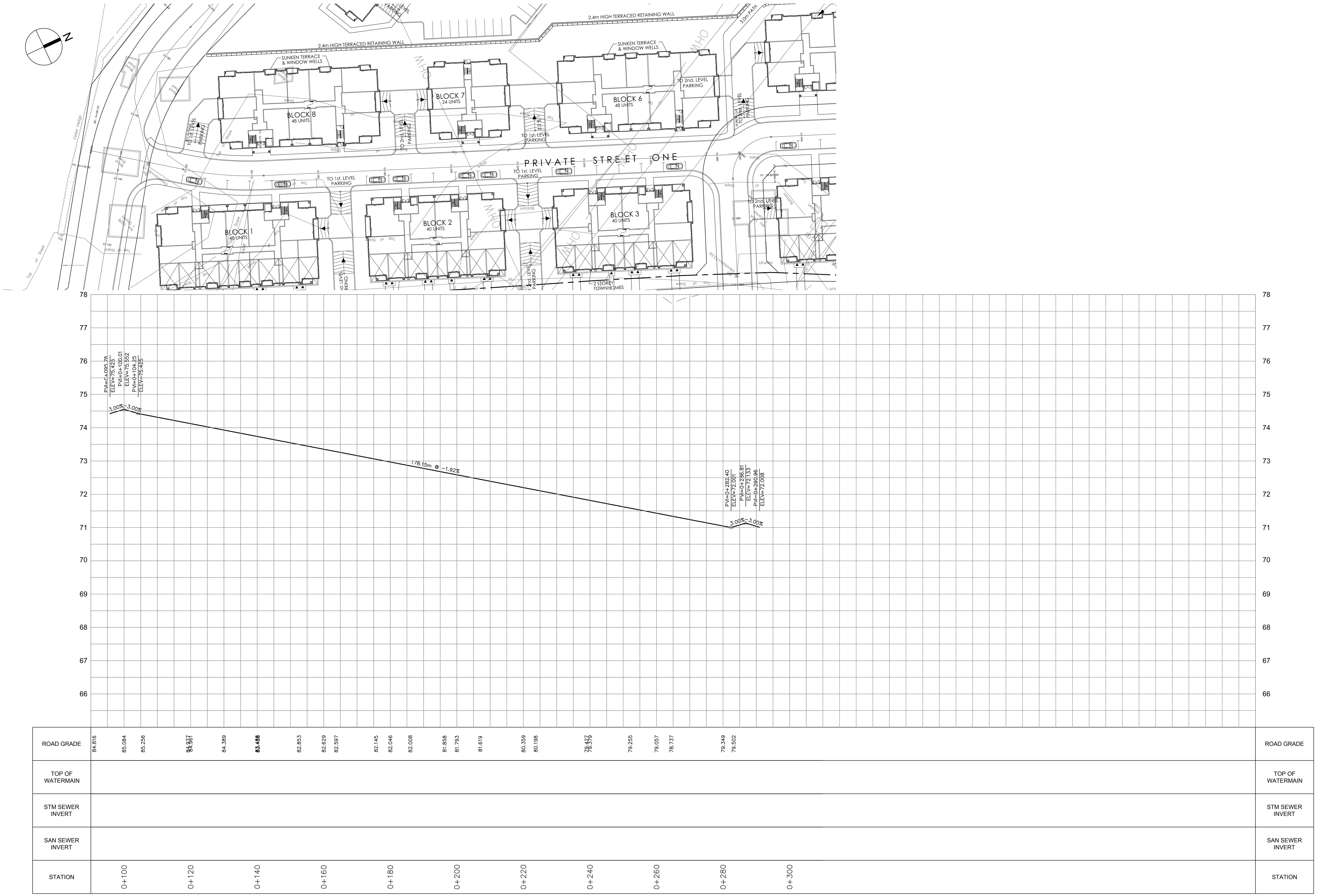
IBI

Scale
1 : 500

Project Title
DCR / PHOENIX
1208 OLD MONTREAL ROAD

Drawing Title
ROAD PROFILE 3

Sheet No.
FIG. 5.5



IBI

Scale
1 : 500

Project Title
DCR / PHOENIX
1208 OLD MONTREAL ROAD

Drawing Title
ROAD PROFILE 4

Sheet No.
FIG. 5.6

DCR Phoenix Group of Companies

Preliminary Geotechnical Investigation

Type of Document
Final

Project Name
Proposed Residential Subdivision
1154-1208 Old Montreal Road
Ottawa (Formerly Township of Cumberland), Ontario

Project Number
OTT-00234493-A0

Prepared By: Surinder K. Aggarwal, M.Sc., P.Eng.

Reviewed By: Ismail Taki, M.Eng., P.Eng.

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON   K2B 8H6
Canada

Date Submitted
November 7, 2016

DCR Phoenix Group of Companies
18 Bentley Avenue, Ottawa, Ontario

Attention: Mike Boucher, Manager of Planning

Preliminary Geotechnical Investigation

Type of Document:
Final

Project Name:
Proposed Subdivision
1154-1208 Old Montreal Road
Ottawa (Formerly Township of Cumberland), Ontario

Project Number:
OTT-00234493-A0

Prepared By:
exp
100-2650 Queensview Drive
Ottawa, ON K2B 8H6
Canada
T: 613 688-1899
F: 613 225-7337
www.exp.com

LICENSED PROFESSIONAL ENGINEER
Nov 7/16
S. K. AGGARWAL
PROVINCE OF ONTARIO

Surinder K. Aggarwal, M.Sc., P.Eng.
Senior Project Manager, Geotechnical Services
Earth and Environmental

Ismail Taki, M.Eng., P.Eng.
Manager, Geotechnical Services
Earth and Environmental

Date Submitted:
November 7, 2016

Legal Notification

This report was prepared by **exp** Services Inc. for the account of **DCR Phoenix Group of Companies**.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. **Exp** Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project

Executive Summary

A preliminary geotechnical investigation was undertaken at the site of the proposed residential subdivision to be located on the south side of Old Montreal Road at the civic address of 1154-1208, in the City of Ottawa, Ontario. This work was authorized by Phoenix Homes Ltd. A Phase I and II Environmental Site Assessments were also completed by **exp** on this property and reported under separate covers.

The proposed subdivision will comprise of one to two-storey single-family residences with basements. Associated roadways and underground services are also to be constructed as part of the subdivision.

The fieldwork for the geotechnical investigation comprised the drilling of seven boreholes (Borehole Nos. 1 to 7) to depths ranging between 7.2 and 23.3 m. The boreholes revealed that beneath 25 mm to 200 mm of topsoil, silty sand or fill extends to 0.7 m to 2.3 m depth. The silty sand/fill are underlain by clay, which extends to the entire depth investigated of 7.3 m to 8.6 m in Borehole Nos. 2, 4, 5, 6 and 7 and to a depth of 18.9 m and 20.9 m in Borehole Nos. 1 and 3 respectively. The clay is stiff to hard and is over-consolidated by 78.0 kPa to 520 kPa based on the results of consolidation tests undertaken on select undisturbed clay samples. The clay in Borehole Nos. 1 and 3 is underlain by gravelly sand till which extends to the maximum depth investigated of 20.4 in Borehole No. 1 and to refusal to auger depth of 23.3 m in Borehole No. 13.

Water level observations made in the boreholes indicate that the groundwater table is at 1.3 m to 1.5 m depth. However, this is considered to be a perched water table. The groundwater table is expected to be at a depth of 3 m to 4 m based on the natural moisture content of the soil samples.

Based on the results of the investigation and consolidation tests undertaken on the clay sample, a maximum grade raise of 2.5 m is permitted at the site.

The investigation has revealed that the geotechnical conditions at the site are suitable for construction of the 1 to 2 storey residential dwellings on spread and strip footing foundations. It is recommended that the footings should be founded above the groundwater table and designed for Serviceability Limit State (SLS) bearing pressure of 100 kPa and factored geotechnical resistance at Ultimate Limit State (ULS) of 150 kPa.

The lowest level floor slabs of the structures may be constructed as slabs-on-grade. Perimeter as well as underfloor drains should be provided for the structures with basements.

Excavations at the site will be undertaken to a maximum depth of 3 m below the existing ground surface and will be above the groundwater table. The excavations may be undertaken as open cut provided they are cut back at 45 degrees. Seepage of surface and subsurface water into the excavations should be anticipated. However, it should be possible to collect this water in perimeter ditches and remove by pumping from sumps. The backfill against the subsurface walls should be free draining granular materials conforming to OPSS 1090 for Granular B, Type II. It should be compacted to 95 percent of standard Proctor Maximum Dry Density (SPMDD).

The pavement structures of the access roads and driveways are given on Table IV. General Use (GU) Portland cement may be used in the subsurface structures at the site.

The site has been classified as Class D for seismic site response. In addition, the on-site soils are not considered to be liquefiable during a seismic event.

Trees should not be planted in close proximity of the structures to prevent settlements due to shrinkage of the clay as a result of water extraction by tree roots.

A slope stability analysis of the slope to a ravine located along the south boundary of the site was undertaken. It revealed that the slope is stable and that a geotechnical setback is not required. The exception to this is Section A-A where the factor of safety was less than 1.5. A reiterative analysis of this section was undertaken and gave a geotechnical setback of 24 m for factor of safety of 1.5. A slope is also located along the north property boundary to Old Montreal Road. This slope is at an incline of 4.2H:1V or flatter. Based on the results of the stability analysis of the south slope, the north slope is also considered to be stable and its stability was not analysed. Therefore, the limit of hazardous land was computed as 11 m (5 m toe erosion allowance and 6 m access allowance) from the crest of the south slope except in the vicinity of Section A-A where it is 35 m from the crest of the south slope. This setback was determined as 6 m from the crest of the north slope. No development should be undertaken beyond the limit of hazardous land shown on Figure 2.

The above and related considerations are discussed in greater detail in the report.

Table of Contents

List of Tables

List of Figures

Appendix

1 Introduction

A preliminary geotechnical investigation was undertaken at the site of the proposed residential subdivision to be located at 1154-1208 Old Montreal Road in the City of Ottawa, Ontario. The site location is shown on Figure 1. This work was authorized by Mike Boucher of Phoenix Homes Group of Companies.

The proposed development would consist of a residential subdivision with associated roadways and utilities

The investigation was undertaken to:

a) Establish geotechnical and groundwater profile at the site at the locations of the boreholes;

b) Establish the maximum grade raise permissible at the site;

c) Make recommendations regarding the most suitable type of foundations, founding depth and Serviceability Limit State (SLS) and Ultimate Limit State bearing capacities of the founding soil;

d) Determine anticipated settlements;

e) Classify the site for seismic site response in accordance with the requirements of National Building Code (NBC), 2012.

f) Comment on excavation conditions and effect of groundwater on the excavations;

g) Discuss backfilling requirements and suitability of on-site soils for backfilling purposes;

h) Recommend pavement structure thickness for access roads and parking areas;

i) Comment on subsurface concrete requirements; and

j) Assess the stability of the slopes of the valley located on the south side of the site and establish the limit of hazardous lands for the proposed subdivision;

The comments and recommendations given in this report are preliminary in nature and based on the assumption that the above-described design concept will proceed into construction. If changes are made either in the design phase or during construction, this office must be retained to review these modifications. The result of this review may be a modification of our recommendations or it may require additional field or laboratory work to check whether the changes are acceptable from a geotechnical viewpoint.

2 Procedure

The fieldwork for the preliminary geotechnical investigation was undertaken between August 15 and 18, 2016 and comprised the drilling of seven boreholes (Borehole Nos. 1 to 7) to depths ranging between 7.2 m and 23.3 m. A dynamic cone penetration test was performed in Borehole No. 5 below 8.5. m depth to refusal at 20.9 m depth. The locations of the boreholes are shown on Site Plan, Figure 2.

The fieldwork was undertaken with a track-mounted drill rig equipped with continuous flight hollow stem augers and was supervised on a full-time basis by a representative of **exp**.

Standard penetration tests were performed in all the boreholes at 0.75 m to 1.5 m depth intervals and soil samples retrieved by split barrel sampler. Relatively undisturbed thin wall tube samples of the silty clay were obtained from Borehole Nos. 2 and 3. The undrained shear strength of the clay was established by in-situ field-vane shear tests.

Water levels were measured in the open boreholes on completion of drilling. In addition, long-term groundwater monitoring installations consisting of 19 mm diameter PVC (polyvinyl chloride) pipes were placed in Borehole Nos. 1, 3 and 7. The installation configuration is documented on the respective borehole logs. All the boreholes were backfilled upon completion of the fieldwork. The initial locations of the boreholes were established by a representative of **exp** using GPS technology. The final elevations and locations of the boreholes were determined by a survey crew from **exp**.

All the soil samples were visually examined in the field for textural classification, logged, preserved in plastic bags and identified. The thin wall tube samples were also visually examined, logged, the thin wall tubes capped, taped and identified. On completion of the fieldwork, all the soil samples were transported to the **exp** laboratory in the City of Ottawa, Ontario.

All the soil samples were visually examined in the laboratory by a geotechnical engineer and borehole logs prepared. The engineer also assigned the laboratory testing which consisted of performing natural moisture content, unit weight, grain-size analysis, one dimensional oedometer, Atterberg Limit, pH and sulphate content tests on selected soil samples.

3 Site Description

The subject site is located on the south side of Old Montreal Road, at 1154, 1172, 1176, 1180, and 1208 Old Montreal Road, as shown on Figure 1. At the time of the investigation, the site was used for residential and agricultural purposes. The surrounding properties are mostly residential and agricultural. The site is rectangular and covers a total area of 14.6 hectares (36 acres).

The topography of the site consists of a topographic high at the house and barn locations of the site, with a steep slope downwards to the north to Old Montreal Road. The local groundwater flow direction is anticipated to be north towards the Ottawa River, at a distance of 1.2 km slope is located on the southeast side of the site to a deep ravine.

A slope is located on the southeast side of a site to a deep ravine. The crest of the slope is at an Elevation 82.0 m to Elevation 85.0 m whereas the toe of the slope is at Elevation 61.25 m to Elevation 72.25 m, resulting in a 20.75 m to 12.25 m high slope. The slope inclination varies from 2.63H:1V to 3.37H:1V. The slope is covered with vegetation.

Another slope is located along the northwest part of the site which extends to Old Montreal Road. The crest of this slope is at Elevation 85.0 m whereas its toe is at Elevation 70.0 m to 71.0 m, resulting in a 14.0 m to 15.0 m high slope. The inclination of this slope varies from 7.8H:1V to 1.9H:1V. This slope is also covered with vegetation.

The elevation of the relatively level part of the site varies from Elevation 82 m approximately to Elevation 86.4 m approximately in the east west direction, resulting in a relief of 4.4 m approximately in the westerly direction. The ground surface at the site varies in the north south direction from Elevation 82 m to Elevation 85 m in the south to Elevation 82.1 to Elevation 84.7 m in the north, indicating that it is relatively flat lying in the north-south direction. The site is currently occupied by a number of residences, which will be demolished for the proposed development.

4 Soil Description

A detailed description of the subsurface soil and groundwater conditions determined from the boreholes are given on the attached borehole logs, Figure Nos. 3 to 9. The borehole logs and related information depict subsurface conditions only at the specific locations and times indicated. Subsurface conditions and water levels at other locations may differ from conditions at the locations where sampling was conducted. The passage of time also may result in changes in the conditions interpreted to exist at the locations where sampling was conducted. Boreholes were drilled to provide representation of subsurface conditions as part of a geotechnical exploration program. Environmental assessment of the on-site soils and groundwater was completed as part of **exp**'s terms of reference and the results were reported under a separate cover.

It should be noted that the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The "Notes on Sample Descriptions" preceding the borehole logs form an integral part of this report and should be read in conjunction with this report.

A review of the borehole logs indicates the following soil stratigraphy in descending order. The soil properties have been summarized on Table I.

4.1 Topsoil

A 25 mm to 200 thick topsoil layer was contacted at the location of all the boreholes except Borehole No. 7.

4.2 Sand Fill

The surficial soil in the vicinity of Borehole No. 7 is sand fill which also underlies the topsoil in Borehole Nos. 3 and 6. It extends to 0.6 m to 2.3 m depth (Elev. 82.0 to 84.2 m). The natural moisture content of the fil varies from 21 percent to 30 percent.

4.3 Silty Clay Crust

The topsoil in Borehole No. 5, the fill in Borehole Nos. 3, 6 and 7, and the silty sand in Borehole Nos. 1, 2 and 4 are underlain by desiccated silty clay crust, which extends to 3 m to 5 m depth (Elev. 77.5 m to 83.6 m). The natural moisture content and unit weight of the crust vary from 30 to 48 percent and 17.8 to 19.1 kN/m^3 respectively.

The crust is very stiff to hard as indicated by its undrained shear strength, which varies from 180 kPa to greater than 250 kPa.

A grain size analysis performed on a sample of the crust yielded a composition of 72 percent clay, 26 percent silt and 2 percent sand (Figure 10).

The liquid and plastic limits of the clay were established as 64.5 percent and 26.1 percent respectively, indicating that the crust is inorganic clay of high plasticity.

4.4 Grey Silty Clay

The silty clay crust is underlain by grey silty clay which extends to the entire depth investigated in Borehole Nos. 2 and 4 to 7, i.e. 7.2 m to 8.5 m depth (Elevation 72.4 to 78.1 m) and to a depth of 18.9 m and 20.9 m in Borehole Nos. 1 and 3 respectively (Elevation 66.9 m and 63.4 m).

The natural moisture content and unit weight of the silty clay varies from 54 to 74 percent and 15.5 to 17.3 kN/m^3 respectively. The silty clay is stiff to hard as indicated by its undrained shear strength, which varies from 50 kPa to 220 kPa.

Two grain size analyses performed on the silty clay yielded a soil composition of 61 to 69 percent clay, 30 to 37 percent silt and 1 to 2 percent sand (Figure Nos. 11 and 12). The liquid and plastic limits of the silty clay vary from 52.7 to 62.7 percent and 24.6 to 28.3 percent respectively. On the basis of these test results, the grey silty clay may be described as highly plastic inorganic clay.

Results of two consolidation tests performed on the silty clay are shown on Figure Nos. 14 and 15 and have been summarized as Table I. A review of Figure 14 indicates that the desiccated silty clay crust is over-consolidated by 519.6 kPa approximately. Its recompression (c_{cr}) and compression index (c_c) are 0.153 and 1.07 respectively. The grey silty clay is over-consolidated by 78 kPa approximately. Its recompression and compression index are 0.11 and 1.36 respectively (Figure 14).

Table I: Results of Consolidation Tests

Borehole No.	Sample Depth	Effective Overburden Pressure p_o' (kPa)	Effective Consolidation Pressure p_c'(kPa)	Compression Index (C_c)	Re-Compression Index (C_r)	Over-consolidation Pressure (kPa)
2	4.0-4.6	75.4	595.0	1.07	0.153	519.6
3	7.6-8.2	114.0	192.0	1.36	0.110	78.0

4.5 Silty Sand Till

The grey silty clay in Borehole Nos. 1 and 3 is underlain by silty sand till which extends to the termination depth of 20.4 m (Elevation 65.4 m) in Borehole No. 1 and to the maximum auger depth of 23.3 m (Elevation 61.0 m) in Borehole No. 3. A dynamic cone penetration test performed in Borehole No. 5 below 8.5 m depth met refusal at 20.9 m depth (Elevation 60.1 m). The refusal in Borehole Nos. 3 and 5 were likely met on bedrock but not confirmed by core drilling techniques. The silty sand till is compact as indicated by its standard penetration resistance values (N values) which vary from 11 to 20. The natural moisture content of the till is 8 to 10 percent. A grain size analysis performed on a sample of the till from Borehole 1 yielded a soil composition of 3 percent clay, 12 percent silt, 46 percent sand and 39 percent gravel (Figure 13).

4.6 Bedrock

As indicated above, refusal to dynamic cone penetration test or to augering was met in two of the boreholes at a depth of 20.9 m and 23.3 m. This refusal is likely to have met on bedrock. Available information indicates that the bedrock in the area is likely to be shale of the Rockcliffe Formation.

4.7 Groundwater

Water level observations were made in open boreholes during drilling in the stand pipes installed in Boreholes 1, 3 and 7 subsequent to completion of the drilling. The observations made have been tabulated on Table II.

Table II: Groundwater Observations in Boreholes

Borehole No.	Date Drilled	Observation Date	Groundwater Depth (m)	Elevation to Groundwater Table (m)
1	August 15, 2016	September 10, 2016	1.5	84.3
3	August 17, 2016	September 10, 2016	2.5	81.8
7	August 16, 2016	September 10, 2016	1.3	83.8

A review of Table II indicates that the perched water table in Boreholes 1, 3 and 7 is at a depth of 1.3 m to 2.5 m below the existing ground surface, i.e. Elev. 84.3 m to 81.8 m. The natural groundwater table had not stabilized during the time interval near which observations were made. Based on a review of the natural moisture content of the soil samples, the groundwater table is estimated to be at a depth of 3 m to 4 m below the existing ground surface, i.e. Elev. 83.6 m to 77.5 m.

Water levels were determined in the boreholes at the times and under the conditions stated in the scope of services. Note that fluctuations in the level of groundwater may occur due to a seasonal variation such as precipitation, snowmelt, rainfall activities, and other factors not evident at the time of measurement and therefore may be at a higher level during wet weather periods.

A summary of the subsurface conditions established is presented in Table III:

Table III: Summary of Subsurface Conditions

Soil Type	MC (%)	γ (kN/m^3)	SPT N Values	Cu (kPa)	Atterberg Limit Test Results			Hydrometer Test Results (%)			
					MC (%)	PL (%)	LL (%)	Clay	Silt	Sand	Gravel.
Fill	21-30		5 - 14	-	-	-	-	-	-	-	-
Silty Sand	21		6 - 7	-	21-30	-	-	-	-	-	-
Clay Crust	30-48	17.8 - 19.1	5 - 23	180 - >250	38	26.1	64.5	72	26	2	-
Clay	54-74	15.5 - 17.3	HW - 4	50 - 220	54-70	24.6-28.3	52.7-62.7	61-69	30-37	1-2	-
Silty Sand Till	8-10	-	11 - 20	-	-	-	-	3	12	46	39

Mc = Natural Moisture Content, Cu= Undrained Shear Strength, HW = Hammer Weight, PL= Plastic Limit, LL= Liquid Limit

5 Site Re-grading

The investigation has reveled the site to be underlain by a deep deposit of clay (in the order of 19 m to 21 m). This clay deposit is prone to consolidation settlements if fill is placed on the site beyond the permissible amount which will result in settlements and cracking of any structures founded in the clay due to overstressing of the clay.

In order to evaluate if the grade at the site can be raised or the maximum allowable grade raise, two one-dimensional odometer tests were undertaken on the clay samples from Borehole Nos. 2 and 3 and the results summarized in Table I. A review of this table indicates that the clay is over-consolidated by 78 kPa to 520 kPa. It is therefore considered that the additional load that can be applied on the clay underlying the desiccated clay crust is 62 kPa below Elev. 76.4 m for the settlements to be within normally tolerated limits of 25 mm total and 19 mm differential (assumed 80 percent of over-consolidation pressure).

The groundwater table at the site is located 3 m to 4 m below the existing ground surface. As such, lowering of the groundwater table at the site will not result due to proposed development. Therefore, an allowance for groundwater lowering is not required. Allowing for the Serviceability Limit State (SLS) bearing pressure recommended in Section 6, it is considered that the grades at the site may be raised by up to 2.5 m.

The site-grading plan must be reviewed by this office when available to ensure that these requirements have been complied with.

6 Foundation Considerations

The investigation has revealed that the geotechnical conditions at the site are suitable for construction of the proposed one to two-storey structures with one level of basement on spread and strip footing foundations. As required by the City of Ottawa, it is recommended that the footings of the proposed structures should be set above the groundwater table, i.e. at a maximum depth of 2.5 m below the existing ground surface. Footings founded on the clay below any fill or silty sand at a maximum depth of 2.5 m below the existing ground surface may be designed for Serviceability Limit State (SLS) bearing pressure of 100 kPa and factored geotechnical resistance at Ultimate Limit State (ULS) of 150 kPa.

The recommended bearing capacities have been calculated by **exp** from the borehole information for the preliminary design stage only. The investigation and comments are necessarily on-going as new information of underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes, when foundation construction is underway. The interpretation between boreholes, and the recommendations of this report must therefore be checked through field monitoring provided by an experienced geotechnical engineer to validate the information for use during the construction stage.

A minimum of 1.5 m of earth cover should be provided to all the exterior footings of heated structures to protect them from damage due to frost penetration. Where earth cover is less than 1.5 m, an equivalent combination of earth fill and rigid polystyrene insulation (i.e. Styrofoam HI-40) should be provided. Footings of unheated structure should be provided with a cover of 2.1 m if snow would not be cleared from their vicinity. If the snow would be cleared from the vicinity of the footings, they should be provided with 2.4 m of earth cover.

All the footing beds should be examined by a geotechnical engineer/geotechnician to ensure that the founding soil is capable of supporting the design bearing pressure and that the footings beds have been prepared satisfactorily.

Settlements of the residences founded on strip and spread footings design according to the above recommendations and properly constructed are expected to be within the normally tolerated limits of 25 mm total and 19 mm differential movements.

7 Floor Slab and Drainage Requirements

The lowest level floors of the proposed structures may be constructed as slabs-on-grade provided they are set on beds of well-compacted 19 mm clear stone at least 200 mm thick placed on the natural soil or on well-compacted fill. The clear stone would prevent the capillary rise of moisture from the sub-soil to the floor slab. Adequate saw cuts should be provided in the floor slabs to control cracking. Any underfloor fill required should conform to OPSS 1010 for Granular B, Type II and should be placed in 300 mm lift thickness and each lift compacted to at least 98 percent of the standard Proctor maximum dry density (SPMDD).

Perimeter as well as underfloor drains should be provided for structures with basements (Figure 16). The drainage system should be outletted to roadside ditches. All subsurface walls should be properly damp-proofed. The exterior grade should be sloped away from the structures at an inclination of 1 to 2 percent to prevent the ingress of surface runoff.

8 Lateral Earth Pressure Against Subsurface Walls

The subsurface walls should be backfilled with free draining material, such as OPSS 1010 for Granular B, Type II and equipped with a perimeter drainage system to prevent the buildup of hydrostatic pressure behind the walls. The walls will be subjected to lateral static and dynamic (seismic) earth forces.

For design purposes, the lateral static earth thrust against the subsurface walls may be computed from the following equation:

$$P = K_0 H (q + ½ \gamma H)$$

where P = lateral earth thrust acting on the subsurface wall; kN/m

K_0 = lateral earth pressure coefficient for 'at rest' condition for Granular B Type II backfill material = 0.5

γ = unit weight of free draining granular backfill; Granular B = 22 kN/m^3

H = Height of backfill adjacent to foundation wall, m

q = surcharge load, kPa

The lateral seismic thrust may be computed from the equation given below:

$$\Delta P_E = 0.32 \gamma H^2$$

where ΔP_E = resultant thrust due to seismic activity; kN/m

γ = unit weight of free draining granular backfill; Granular B Type II = 22 kN/m^3

H = height of backfill behind wall, (m)

The ΔPE value does not take into account the surcharge load. The resultant load should be assumed to act at 0.6 H from the bottom of the wall.

9 Excavations

Excavations for construction of spread and strip footings are expected to extend to a maximum depth of 2.5 m below the existing grades. These excavations are expected to terminate in the clay. They are expected to be above the groundwater table.

Excavations above the groundwater table in the silty clay are expected to be stable when cut back at 45 degrees. Excavations in the clay below the groundwater table would not experience a ‘base-heave’ type of failure of the excavation and to slough and eventually stabilize at a slope of 2H:1V to 3H: 1V.

Seepage of surface and subsurface water into the excavations is anticipated. However, it should be possible to collect any water entering the excavations in perimeter ditches and to remove it by pumping from sumps. Although this investigation has estimated the groundwater levels at the time of the field work, and commented on dewatering and general construction problems, conditions may be present which are difficult to establish from standard boring techniques and which may affect the type and nature of dewatering procedures used by the contractor in practice. These conditions include local and seasonal fluctuations in the groundwater table, erratic changes in the soil profile, thin layers of soil with large or small permeabilities compared with the soil mass, etc. Only carefully controlled tests using pumped wells and observation wells will yield the quantitative data on groundwater volumes and pressures that are necessary to engineer construction dewatering systems adequately.

Many geologic materials deteriorate rapidly upon exposure to meteorological elements. Unless otherwise specifically indicated in this report, walls and floors of excavations must be protected from moisture, desiccation, and frost action throughout the course of construction.

The clay at the site is susceptible to disturbance due to the movement of construction equipment, and personnel on its surface. It is therefore recommended that the excavation at the site should be undertaken by equipment, which does not travel on the excavated surface e.g. a gradall, or mechanical shovel. It is anticipated that temporary granular roads may be required to gain access to the site.

Whether a Permit to Take Water will be required or not be will depend on the depth of the excavation. This office should be contacted once the site grades and invert of the underground services are known so comments can be provided regarding whether a Permit to take Water will be required for this site.

10 Backfilling Requirements and Suitability of On-Site Soils for Backfilling Purposes

The backfill in footing and service trenches inside the buildings and against subsurface walls should consist of free draining material preferably conforming to OPSS 1010 for Granular B, Type II. It should be compacted to 95 percent of the SPMDD.

The backfill in service trenches outside of the building areas should be compactible i.e. free of organics and debris and with natural moisture content, which is within 2 percent of the optimum moisture content. It should also be compacted to 95 percent of the SPMDD.

The material to be excavated during construction of the footings and installation of services is fill, silty sand and silty clay. The upper desiccated silty clay is expected to be compactible and may be used to backfill service trenches outside of the buildings and for regrading of driveways, etc. The silty sand and existing on-site fill may be used for general site grading. Any fill that has to be imported to backfill footing trenches, service trenches, and against subsurface walls should conform to OPSS 1010 for Granular B, Type II. It should be placed in 300 mm lift thickness and compacted to 95 percent of the SPMDD.

11 Access Roads

The subgrade at the site will be silty clay. Pavement structure thicknesses required for the access roads and parking areas set on sandy lean clay subgrade were computed and are shown on Table IV. The thicknesses are based upon an estimate of the subgrade soil properties determined from visual examination, textural classification of the soil samples and functional design life of 18 to 20 years. The proposed functional design life represents the number of years to the first rehabilitation, assuming regular maintenance is carried out.

Table IV: Recommended Pavement Structure Thicknesses

Pavement Layer	**Compaction Requirements**	**Driveways**	**Access Roads**	
			Sand Subgrade	**Clay Subgrade**
Asphaltic Concrete (PG 58-34)	92 to 97 % MRD	65 mm HL3	40 mm – SP12.5 50 mm – SP19	40 mm – SP12.5 50 mm – SP19
Granular A Base (crushed limestone)	100% SPMDD*	150 mm	150 mm	150 mm
Granular B Sub-base, Type II	100% SPMDD*	300 mm	450 mm	600 mm

SPMDD* Standard Proctor Maximum Dry Density, ASTM-D698
MRD denotes Maximum Relative Density, ASTM D2041
Asphaltic Concrete in accordance with OPSS 1150 and 1151

The foregoing design assumes that construction is carried out during dry periods and that the subgrade is stable under the load of construction equipment. If construction is carried out during wet weather, and heaving or rolling of the subgrade is experienced, additional thickness of granular material and/or geotextile may be required.

Additional comments on the construction of parking area are as follows:

1. As part of the subgrade preparation for the areas to be paved, the subdivision roadways should be stripped of topsoil and other obviously unsuitable material. Fill required to raise the grades to design elevations should conform to OPSS 1010 Select Subgrade Material (SSM) and should be placed in 300 mm lifts and each lift compacted to 95 percent of the SPMDD. The subgrade should be properly shaped, crowned, then proofrolled with a heavy vibratory roller in the full-time presence of a representative of this office. Any soft or spongy subgrade areas detected should be sub excavated and properly replaced with suitable OPSS 1010 Granular B Type II compacted to 95% SPMDD (ASTM D698) as indicated previously and in order to prevent overstressing the clay subgrade.

2. The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure that uniform subgrade moisture and density conditions are achieved. The need for adequate drainage

cannot be over-emphasized. Subdrains should be installed on both sides of the access road(s). Subdrains must be installed in the proposed parking area at low points and should be continuous between catchbasins to intercept excess surface and subsurface moisture and to prevent subgrade softening. This will ensure no water collects in the granular course, which could result in pavement failure during the spring thaw. The location and extent of subdrainage required within the paved areas should be reviewed by this office in conjunction with the proposed site grading.

3. To minimize the problems of differential movement between the pavement and catchbasins/manhole due to frost action, the backfill around the structures should consist of free-draining granular preferably conforming to OPSS Granular B, Type II material. Weep holes should be provided in the catchbasins/manholes to facilitate drainage of any water that may accumulate in the granular fill.

4. The most severe loading conditions on light-duty pavement areas and the subgrade may occur during construction. Consequently, special provisions such as restricted lanes, half-loads during paving, temporary construction roadways, etc., may be required, especially if construction is carried out during unfavorable weather.

5. The finished pavement surface should be free of depressions and should be sloped (preferably at a minimum cross fall of 2 percent) to provide effective surface drainage towards catchbasins. Surface water should not be allowed to pond adjacent to the outside edges of paved areas.

6. Relatively weaker subgrade may develop over service trenches at subgrade level. These areas may require the use of thicker/coarser sub-base material and the use of a geotextile at the subgrade level. if this is the case, it is recommended that additional 150 mm of granular sub-base Granular B should be provided in these areas in addition to the use of a geotextile at the subgrade level. On-site excavated wet soils should not be used as backfill of the service trenches.

7. The granular materials used for pavement construction should conform to OPSS 1010 for Granular A and Granular B, Type II and should be compacted to 100 percent of the SPMDD (ASTM D698). The asphaltic concrete used and its placement should meet OPSS 1151 and 310/313 requirements. It should be compacted to 92 to 97 percent of the maximum relative density in accordance with ASTM D2041.

It is recommended that **exp** be retained to review the final pavement structure design and drainage plans prior to construction to ensure that they are consistent with the recommendations of this report.

12 Subsurface Concrete Requirements

Subsurface concrete will be used to construct basements of the residences. Chemical tests limited to pH and sulphate tests were performed on three selected soil samples. The results are given on Table V.

Table V: Chemical Test Results

Borehole No.	Depth	PH	Sulphate (%)
2	1.5 – 2.1	6.83	0.003
4	1.4 – 1.6	6.40	0.0009
7	3.0 – 3.6	6.81	0.0005

The test results indicate the clay contains a sulphate content of less than 0.1 percent. This concentration of sulphates in the soil would have a negligible potential of sulphate attack on subsurface concrete. It is therefore considered that General Use Portland cement may be used in the basement walls of the residences. The concrete for the site should be designed in accordance with the requirements of CSA A23.1-14.

13 Seismic Site Classification and Liquefaction Potential of On-Site Soils

The subsoil and groundwater information at the site has been examined in relation to Section 4.1.8.4 of the Ontario Building Code (OBC) 2012. The subsoils at the site comprise of stiff to hard silty clay deposit, to 18.9 m to 20.9 m depth overlying compact gravelly sand till to 20.4 m to 23.3 m and limestone bedrock. The undrained shear strength of the silty clay varies between 50 kPa and greater than 250 kPa.

The average shear-wave velocity value of the overburden and bedrock to 30 m at the site was estimated. For this purpose, the shear-wave velocity value of bedrock was assumed as 760 m/s. The shear-wave velocity (Vs) values of the silty clay deposit layer are correlated to the undrained shear strength (S_u) values using Dickenson (1994) formula:

$$Vs(m/s) = 23.Su^{0.475}$$

The shear-wave velocity (V_s) of the compact gravelly sand till can be correlated to the standard penetration values (SPT) using Imai & Tonouchi[1] (1982) formula:

$$Vs(m/s) = 91.7\,N^{0.26}$$

An average shear-wave velocity value to 30 m depth was estimated as 213 m/s. On this basis, the site has been classified as Class D for seismic site response in accordance with Table 4.1.8.4A of the Ontario Building Code, 2012.

The liquefaction potential of the clay on the site was assessed by plotting the results of Atterberg Limit Tests on Bray et al plot. A review of this figure (Figure 17) indicates that the clay is not susceptible to liquefaction during a seismic event.

---

[1] Imai, T, and K Tonouchi (1982). Correlation of N value with S-wave velocity and shear modulus, Proc., 2nd European Symp. on Penetration Testing, Amsterdam, pp. 67–72.

14 Tree Planting

The clay in the Ottawa area is prone to shrinkage on drying. This process is largely not reversible. Therefore, settlement and cracking of the structures can result if trees are planted too close to the residences. During dry seasons, the tree roots draw moisture from the clay thereby resulting in the clay drying and shrinking.

City of Ottawa guidelines indicate that fast-growing, high-water demand trees must not be planted closer to a building than a distance equal to their height at maturity. Only one of the small-sized trees listed below can be placed a minimum distance of 7.5 m away from any buildings, including when planting along road allowances (see Table VI). In addition, newly planted trees must be a minimum of 2.5 m from the curb and have a small-sized canopy at maturity to allow sufficient space for snow and ice control.

Table VI: List of Trees Suitable for Planting On Site (City of Ottawa Guidelines)

Species	**Water Demand**
Amur Maple (Acer ginnala)	Moderate
Serviceberry (Amelanchier canadensis)	Low
Crabapple (Malus spp.)	Moderate
Japanese Lilac (Syringa reticulate)	Moderate
Green Colorado Spruce or any conifer species (Picea pungens)	Low

For further information, an arborist should be consulted.

15 Slope Stability

15.1 Slope Stability Analysis

The stability of the existing slopes was analyzed by using Morgenstern-Price Method, GeoStudio /Geo-slope office, Version 8.13 computerized system. The purpose of the analysis was to assess the stability of the existing slopes and to determine the required set back of the proposed structures from the crest of the slopes. A total of four cross-sections were analyzed. These cross-sections have been shown as Sections A-A, B-B, C-C and D-D on Figure 2.

These cross-sections were obtained from the 2015 Lidar Survey available for the site.

The natural slope inclinations at the cross-sections analyzed were determined, and the results have been presented on Table VII.

Table VII: Natural Slope Inclination of Cross-sections Analyzed

Section	Crest of Slope (m)	Toe of Slope (m)	Height of Slope (m)	Overall Slope Inclination
A-A	81.75	62.0	19.75	3.83H:1V
B-B	84.0	68.0	16.0	3.12H:1V
C-C	85.0	72.25	12.75	3.69H:1V

The slopes were analyzed for the following conditions:

1.) Effective stress analysis.
2.) Total stress analysis; and
3.) Total stress analysis with seismic loading;

The following assumptions were made:

1.) The crest of the existing slopes varies from Elevation 82.0 m to 85.0 m whereas the toe of the slopes is at Elevation 62.0 m to 72.25 m (Table VII).
2.) The soil stratigraphy for the various cross-sections is shown on Figure Nos. 18 to 26 inclusive. The soil stratigraphy was established from the boreholes drilled at the site.
3.) The unit weight of the various soils was established from laboratory tests. The undrained strength of the clay was established by performing in-situ field vane tests. The effective shear strength parameters were selected based on literature search. Previous work undertaken by various

researchers was reviewed. The review indicated that the effective cohesion (c’) and effective angle of internal friction (φ’) values for the silty clay crust and grey silty clay are as follows:

Weathered Silty Clay Crust	Effective cohesion = 0 – 12 kPa Effective angle of internal friction = 25° – 38°
Grey Silty Clay	Effective cohesion = 0 – 12 kPa Effective angle of internal friction = 25° – 38°

Based on the review of the literature and site conditions, and using somewhat conservative approach an effective cohesion of 9.8 kPa and effective angle of internal friction of 36 degrees was used in the analysis for the desiccated crust and the underlying grey clay.

The undrained shear strength used in the analysis was computed from the field-vane test results. Undrained shear strength of 100 kPa and 60 kPa respectively for the desiccated crust and grey clay was used in the analysis.

4.) The slopes were assumed to be fully submerged i.e. the groundwater table in the slope coincides with the existing ground surface.

5.) Building loads were not taken into consideration in the analyses since the structures would be located away from the slopes.

The results of the analyses are given on Figures 18 to 26 inclusive and have also been tabulated on Table VIII.

Table VIII: Results of Slope Stability Analysis

Section	Condition Analysed	Factor of Safety	Required Geotechnical Set Back	Figure No.
A-A	Effective stress analysis and set back determination	1.50	24 m	18
	Total stress analysis	1.94	-	19
	Total stress analysis with seismic loading	1.20	-	20
B-B	Effective stress analysis and set back determination	1.75	0	21
	Total stress analysis	2.55	-	22
	Total stress analysis with seismic loading	1.63	-	23
C-C	Effective stress analysis and set back determination	1.59	0	24
	Total stress analysis	2.21	-	25
	Total stress analysis with seismic loading	1.49	-	26

Current practice of the City of Ottawa requires a minimum acceptable factor of safety of 1.5 for static loading conditions. The minimum acceptable factor of safety for seismic loading conditions is 1.1 (Mitchell 1983). The computed factors of safety of all the cross-sections analyzed for effective stress analysis were 1.5 or greater except for Section A-A. A reiterative slope stability analysis was undertaken for this section to determine the set back required for a factor of safety of 1.5 m. A geotechnical set back of 24 m was computed for this section.

It is noted that a slope is also located along the north property boundary. The inclination of this slope to Montreal Road was determined to range between 4.2H:1V and 6.2H:1V. Based on the results of the slope stability analysis undertaken for the south slope (which indicates that a 3.1H:1V slope has a factor of safety of 1.5), it is considered that the north slope is stable. Therefore, this slope was not analyzed.

The slopes located at the north and south property boundaries are covered with vegetation and trees. The vegetation and trees provide stability to the slopes and should not be disturbed in anyway.

During construction, the following precautions should be taken so that the stability of the slopes is not adversely affected:

1.) Care should be exercised during construction to ensure that the existing slopes are not steepened by placement of fill close to the crest of the slope since this would reduce the stability of the slope.
2.) Excavations should not be undertaken at the toe of the slopes since this would adversely affect the stability of the slopes.
3.) Natural drainage paths should not be blocked by placement of fill on the slope. If fill must be placed on the slope, adequate drainage should be provided to prevent buildup of pore pressures in the soil.
4.) Vegetation should not be removed from the faces of the slopes to prevent erosion. Additional vegetation should be planted on the slopes wherever necessary.

15.2 Behaviour of Slopes During Earthquakes

Lafebvre, G. (1981)[2] has stated that if the clay is not liquefiable, liquefaction during dynamic loading of earthquake will not be a concern. It has been previously demonstrated that the clay at the site is not susceptible to liquefaction. Therefore, it is concluded that the stability of the slopes at the site will not be adversely affected during a seismic event.

15.3 Flow Slides

Mitchell and Markall (1974)[3] have developed a method based on undrained shear strength to estimate the likelihood of flow slides. They measured the undrained shear strength of the clay using field shear vane.

---

[2] Lefebvre, G. (1981), "*Fourth Canadian Geotechnical Colloquium: Strength and Slope Stability in Canadian Soft Clay Deposits"*, Can. Geot. J., Vol 18, pgs. 8420-422.6

[3] Mitchell, R..J. and Markell, A.R. 1974, *"Flow Slides in Sensitive Soils", Can Geot. J11, pgs. 423-454.*

Based on analyzing of the data for more than 40 sites, they established that flow slides will only occur in soils with total overburden pressure more than six times the undrained shear strength of the soil, i.e.:

$$\frac{\gamma H}{Su} > 6$$

Where ɣ is the bulk density of soil,

H is the height of the slope, and

Su is the undrained shear strength of the soil.

The maximum ratio of total overburden pressure to undrained shear strength of the on-site clay was computed as 3.6. Therefore, it is concluded that the clay at the site is not prone to flow slides.

16 Limit of Hazardous Lands

It is noted that to establish the limit of hazardous lands, in addition to the geotechnical set back, two other factors have to be taken into consideration. These are toe erosion allowance and erosion access allowance. The magnitude of the toe erosion allowance depends on the soil types, the state of erosion along the creek/river bank and upon the width of the channel. The Ministry of Natural Resources procedures permit either the installation of erosion protection or alternatively to consider a toe erosion allowance.

The north slopes of the creek located south of the site were examined by geotechnical engineers from **exp** to determine if creek banks are eroding. The examination of the slopes revealed that the slopes were heavily vegetated. The field observations also indicated that the ravine carries very little water except possibly during spring run-off. The locations along the creek where the photographs were taken have been plotted on Figure 2. However, localized minor erosion was observed at some locations as shown on photographs in Appendix A. Boreholes drilled at the site have indicated that the natural soil in the vicinity of the creek bottom is stiff clay. Based on this information, it is considered that a toe erosion allowance of 5 m should be provided. In addition to the toe erosion allowance, an erosion access allowance of 6 m is normally required. Therefore, the required setback for the south slopes (i.e. limit of hazardous lands) is 11 m from the crest of the slope except in the vicinity of Section A-A where it is 35 m.

The required limit of hazardous lands for the slope located on the south side of the site has been tabulated on Table IX at cross-section locations and has been plotted on Site Plan, Figure 2. The crest of the slope was assumed at the location where the ground surface flattens to inclination of 10H:1V. The limit of hazardous lands should be staked out in the field by a registered Ontario Land Surveyor as shown in Figure 2. No development should take place within the hazardous lands limits.

Table IX: Limit of Hazardous Lands at Cross-Section Locations

Section	Geotechnical Setback from the Toe (m)	Erosion Set Back (m)	Available Erosion Allowance in Valley Floor (m)	Erosion Access Allowance (m)	Total Setback from creek or toe of the slope (Limit of Hazardous Lands) (m)
A-A	24	5	0	6	35
B-B	0	5	0	6	11
C-C	0	5	0	6	11

A ravine or creek is not located along the north slope. Therefore, an erosion allowance is not required for the slope. The required setback along the north side of the site is 6 m (erosion access allowance) from the crest of the slope.

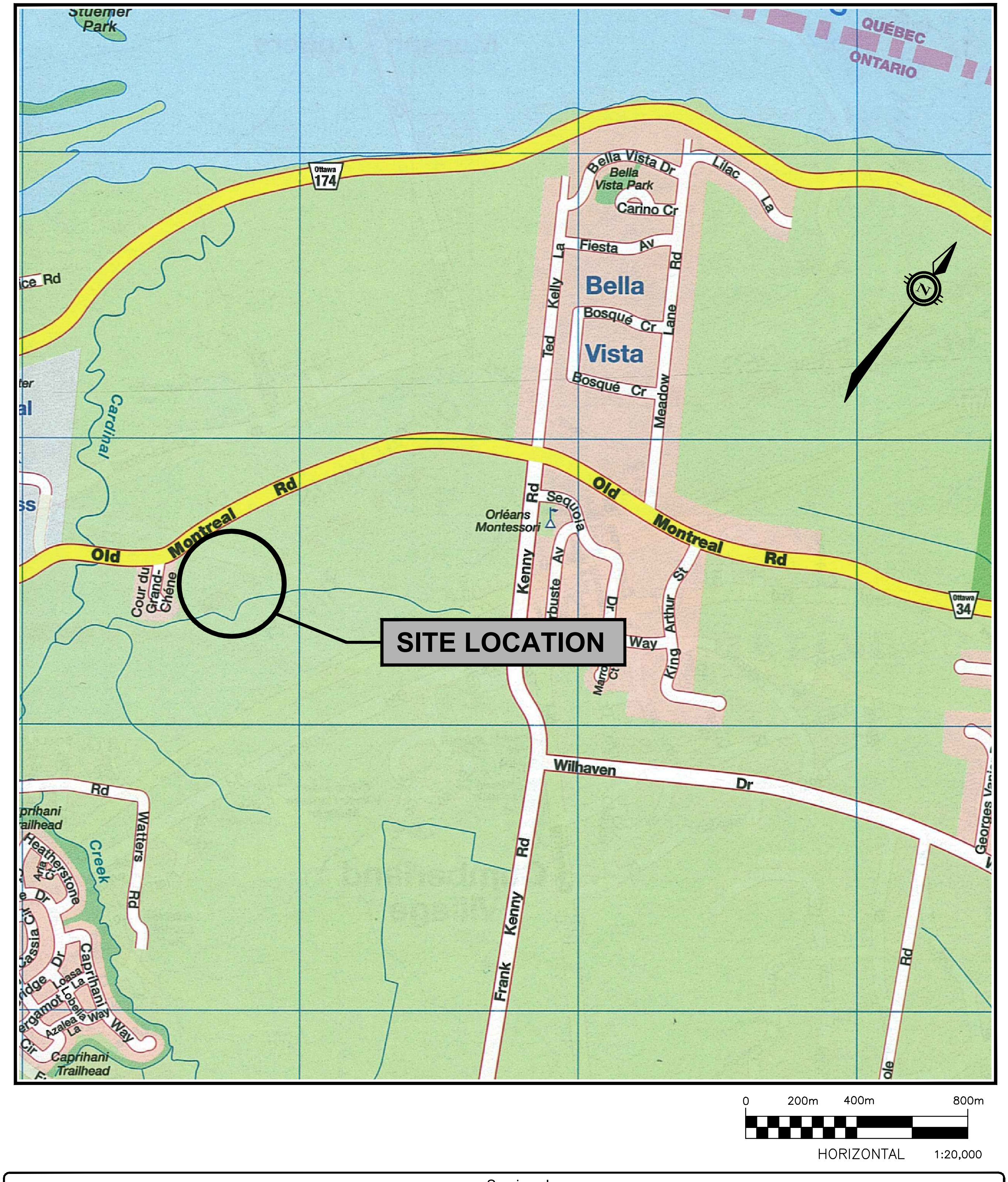
17 General Comments

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for the design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

The information contained in this report is not intended to reflect on environmental aspects of the soils. Should specific information be required, including for example, the presence of pollutants, contaminants or other hazards in the soil, additional testing may be required.

We trust that the information contained in this report will be satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

Figures



exp Services Inc.

t: +1.613.688.1899 | f: +1.613.225.7337
2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6
Canada

www.exp.com

• BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

scale 1:20,000	CLIENT: DCR/PHOENIX GROUP OF COMPANIES		project no. OTT-00234493-A0
date NOV. 2, 2016	TITLE: SITE LOCATION PLAN 1154 - 1208 OLD MONTREAL ROAD, OTTAWA, ON		FIG 1
drawn by M.N.			

Filename: r:\230000\234000\234493 - 1154-1208 old montreal road\drawings\1154-1208 old montreal.dwg
Last Saved: 11/2/2016 11:38:48 AM
Last Plotted: 11/2/2016 11:41:18 AM Plotted by: nugentm Pen Table:: exp-64.ctb

NOTES

THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

NOTES :

1. THE BOUNDARIES AND SOIL TYPES HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. SOIL SAMPLES AND ROCK WILL BE RETAINED IN STORAGE FOR THREE MONTHS AND THEN DESTROYED UNLESS THE CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. TOPSOIL QUANTITIES SHOULD NOT BE ESTABLISHED FROM THE INFORMATION PROVIDED AT THE BOREHOLE LOCATIONS.
4. BOREHOLE ELEVATIONS SHOULD NOT BE USED TO DESIGN BUILDING(S) OR FLOOR SLABS OR PARKING LOT(S) GRADES.
5. THIS DRAWING FORMS PART OF THE REPORT PROJECT NUMBER AS REFERENCED AND SHOULD BE USED ONLY IN CONJUNCTION WITH THIS REPORT.
6. BASE PLAN OBTAINED FROM CITY OF OTTAWA

NO.	REVISION DESCRIPTION	DATE	BY	APPD
1		DD/MM/YY		

SCALE

HORZ 1:1000

0 10m 20m 40m
HORIZONTAL 1:1000

LEGEND

BH1 ELEVATION= 85.82	BOREHOLE NUMBER, LOCATION AND ELEVATION
①	PHOTO NUMBER, LOCATION AND DIRECTION

CLIENT
DCR/PHOENIX GROUP OF COMPANIES
18 BENTLEY AVENUE,
OTTAWA, ON

exp.
exp Services Inc.
t: +1.613.688.1899 | f: +1.613.225.7337
2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6
Canada
www.exp.com
• BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

BASEPLAN
DESIGN: S. AGGARWAL
CHECKED: S. AGGARWAL
CAD: J.R./ M.N.
PROJ. MAN: I. TAKI
APPROVED: I. TAKI

PROJECT
PROPOSED RESIDENTIAL DEVELOPMENT
1154 - 1208 OLD MONTREAL ROAD
OTTAWA, ONTARIO

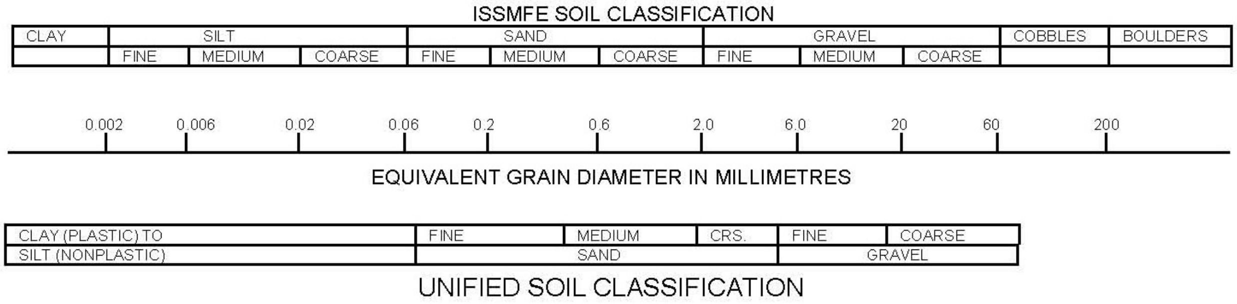
TITLE
BOREHOLE LOCATION
& LIMIT OF HAZARDOUS LANDS

PROJ NO. OTT-00234493-A0
SURVEY
DATE NOV. 2, 2016
DRAWING NO. FIG 2

Filename: r:\230000\234000\234493 - 1154-1208 old montreal road\drawings\1154-1208 old montreal road.dwg
Last Saved: 11/2/2016 11:56:19 AM
Last Plotted: 11/2/2016 11:57:57 AM Plotted by: nugentm
Pen Table:: omm pen setting july 20.ctb
References: 385039A.DWG; 385039B.DWG; 385040D.DWG

Notes On Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Societv for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by **exp** Services Inc. also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.



2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Log of Borehole BH-1

Project No: OTT-00234493-A0

Project: Preliminary Geotechnical Investigation. Proposed Residential Subdivision

Location: 1154, 1172, 1176, 1180, and 1208 Old Montreal Road, Ottawa, ON

Figure No. 3

Page. 1 of 2

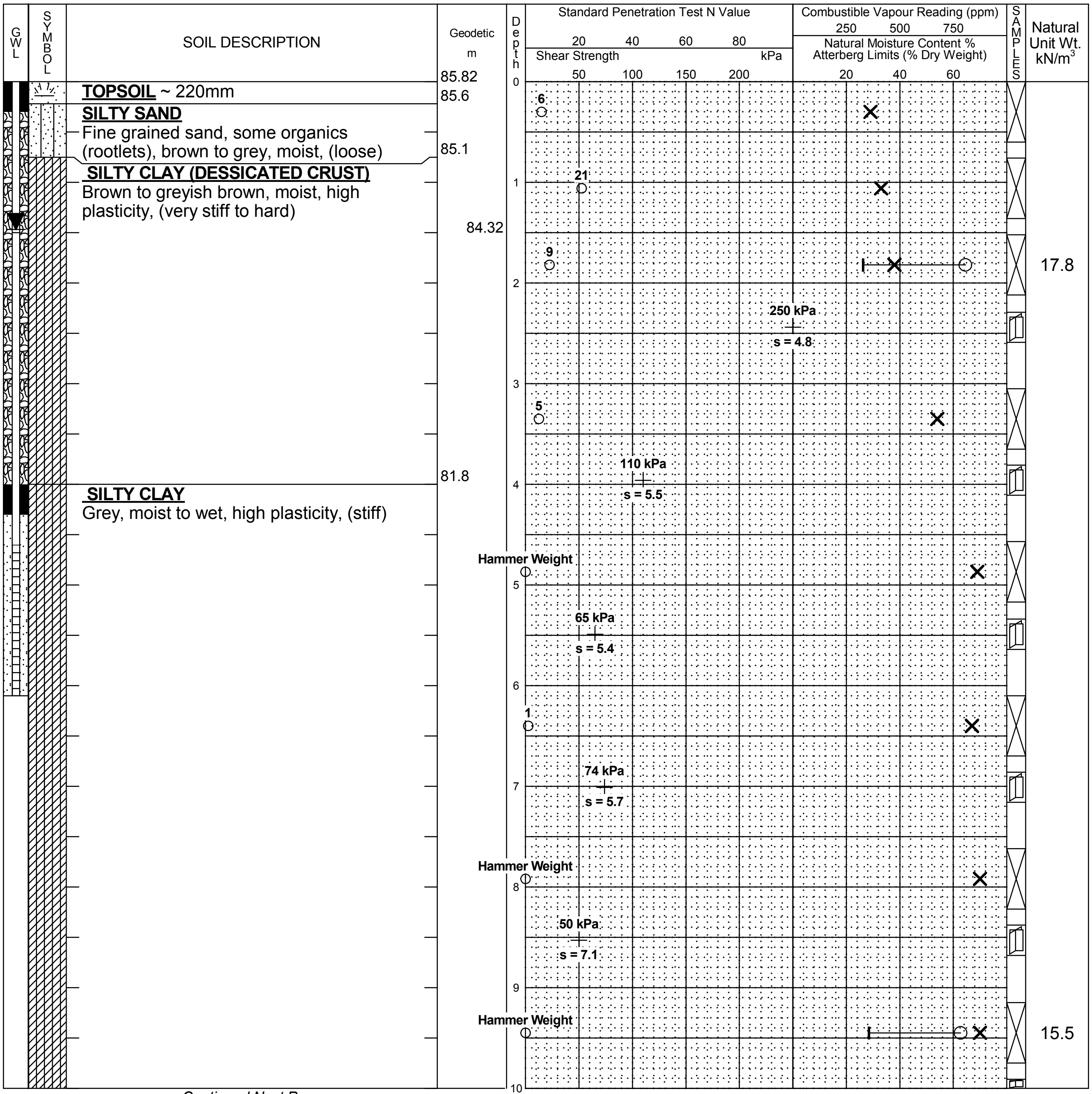
Date Drilled: 'August 15, 2016

Drill Type: 'Trackmount CME 55

Datum: Geodetic

Logged by: ________ Checked by:________

Split Spoon Sample	☒	Combustible Vapour Reading	☐
Auger Sample	◨	Natural Moisture Content	✕
SPT (N) Value	○	Atterberg Limits	├──○
Dynamic Cone Test	──	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■	Shear Strength by Penetrometer Test	▲
Shear Strength by Vane Test	+ S		



Geodetic m	Soil Description
85.82 85.6	**TOPSOIL** ~ 220mm
85.1	**SILTY SAND** Fine grained sand, some organics (rootlets), brown to grey, moist, (loose)
84.32	**SILTY CLAY (DESSICATED CRUST)** Brown to greyish brown, moist, high plasticity, (very stiff to hard)
81.8	**SILTY CLAY** Grey, moist to wet, high plasticity, (stiff)

Continued Next Page

Continued Next Page

NOTES:

1. Borehole data requires interpretation by exp. before use by others
2. A 19 mm diameter piezometer was installed upon completion
3. Field work supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00234493-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
'Sept 10, 2016	1.5	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH-1

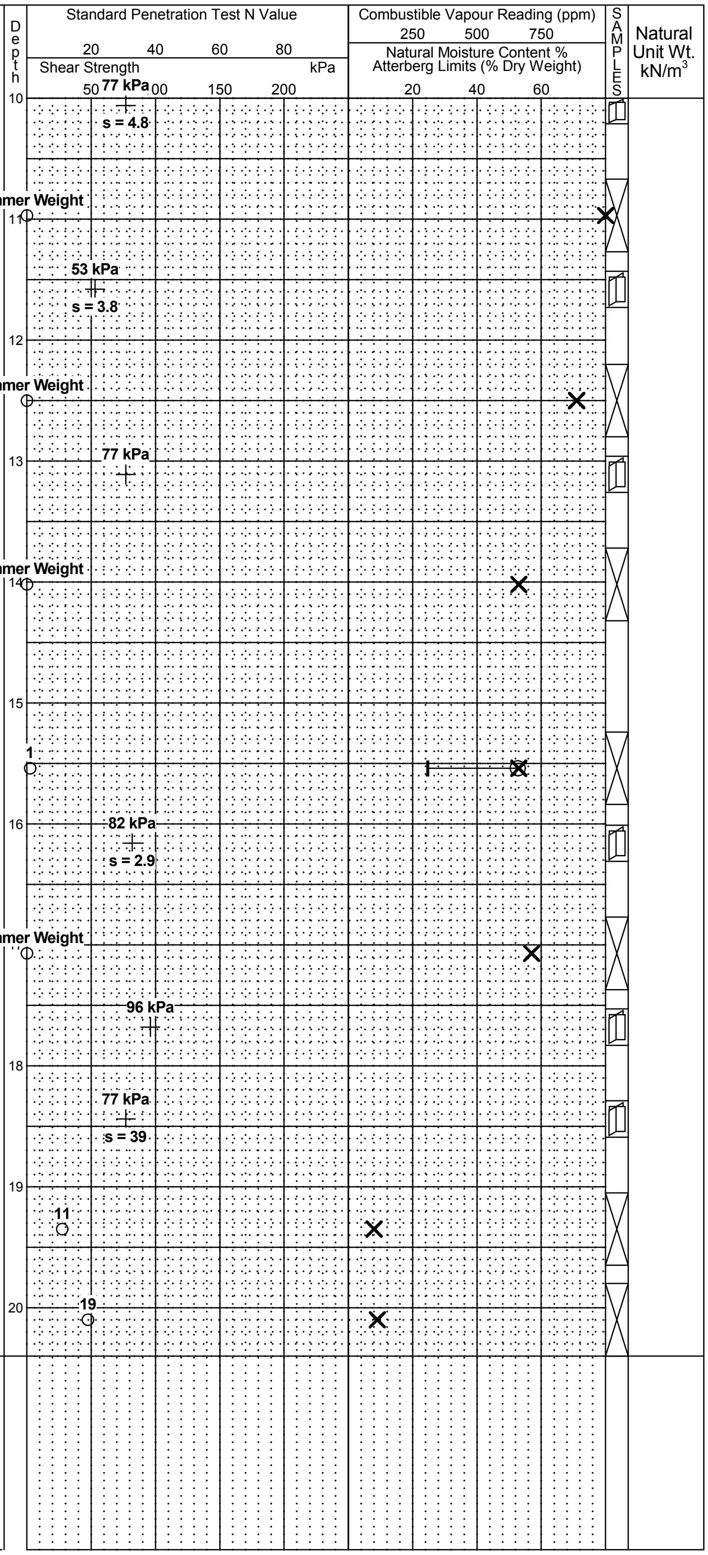
Project No: OTT-00234493-A0

Figure No. 3

Page. 2 of 2

Project: Preliminary Geotechnical Investigation. Proposed Residential Subdivision

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m
			75.82
		SILTY CLAY Grey, moist to wet, high plasticity, (stiff) *(continued)*	
		GRAVELLY SAND TILL Some silt, trace clay, grey, wet, (compact)	66.9
			65.4
		Borehole Terminated at 20.4 m Depth	



NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 19 mm diameter piezometer was installed upon completion
3. Field work supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00234493-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
'Sept 10, 2016	1.5	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH-2

Project No: OTT-00234493-A0

Project: Preliminary Geotechnical Investigation. Proposed Residential Subdivision

Location: 1154, 1172, 1176, 1180, and 1208 Old Montreal Road, Ottawa, ON

Figure No. 4

Page. 1 of 1

Date Drilled: 'August 16, 2016

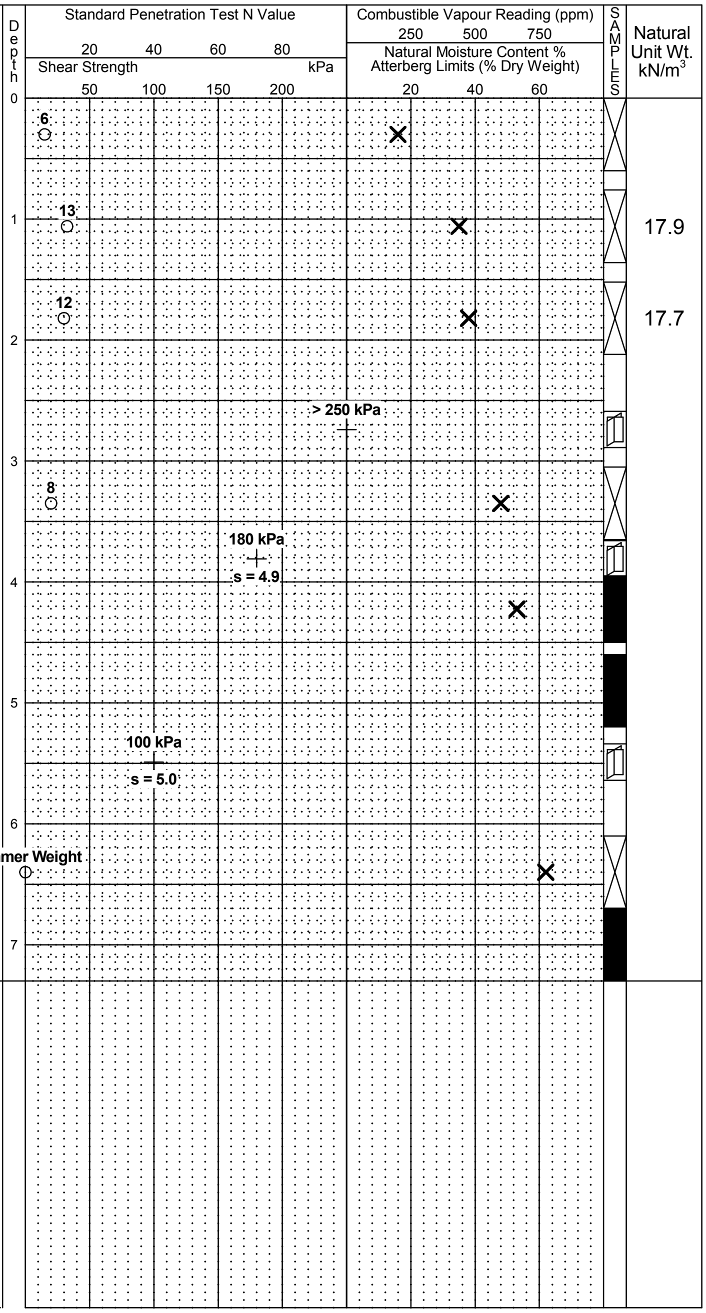
Drill Type: 'Trackmount CME 55

Datum: Geodetic

Logged by: _________ Checked by: _________

Split Spoon Sample	☒	Combustible Vapour Reading	☐
Auger Sample	◨	Natural Moisture Content	×
SPT (N) Value	○	Atterberg Limits	⊢○
Dynamic Cone Test	—	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■		
Shear Strength by Vane Test	+ S	Shear Strength by Penetrometer Test	▲

SOIL DESCRIPTION	Geodetic m
	85.4
TOPSOIL ~ 200mm	85.2
GRAVELLY SAND Some silt, trace clay, brown, grey, moist, (loose)	84.7
SILTY CLAY (DESSICATED CRUST) Brown to greyish brown, moist, high plasticity, (very stiff to hard)	81.4
SILTY CLAY Grey, moist to wet, high plasticity, (stiff)	78.1
Borehole Terminated at 7.3 m Depth	



NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Borehole Backfilled With Cuttings Upon Completion
3. Field work supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00234493-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH-3

Project No: OTT-00234493-A0

Project: Preliminary Geotechnical Investigation. Proposed Residential Subdivision

Location: 1154, 1172, 1176, 1180, and 1208 Old Montreal Road, Ottawa, ON

Figure No. 5

Page. 1 of 3

Date Drilled: 'August 17, 2016

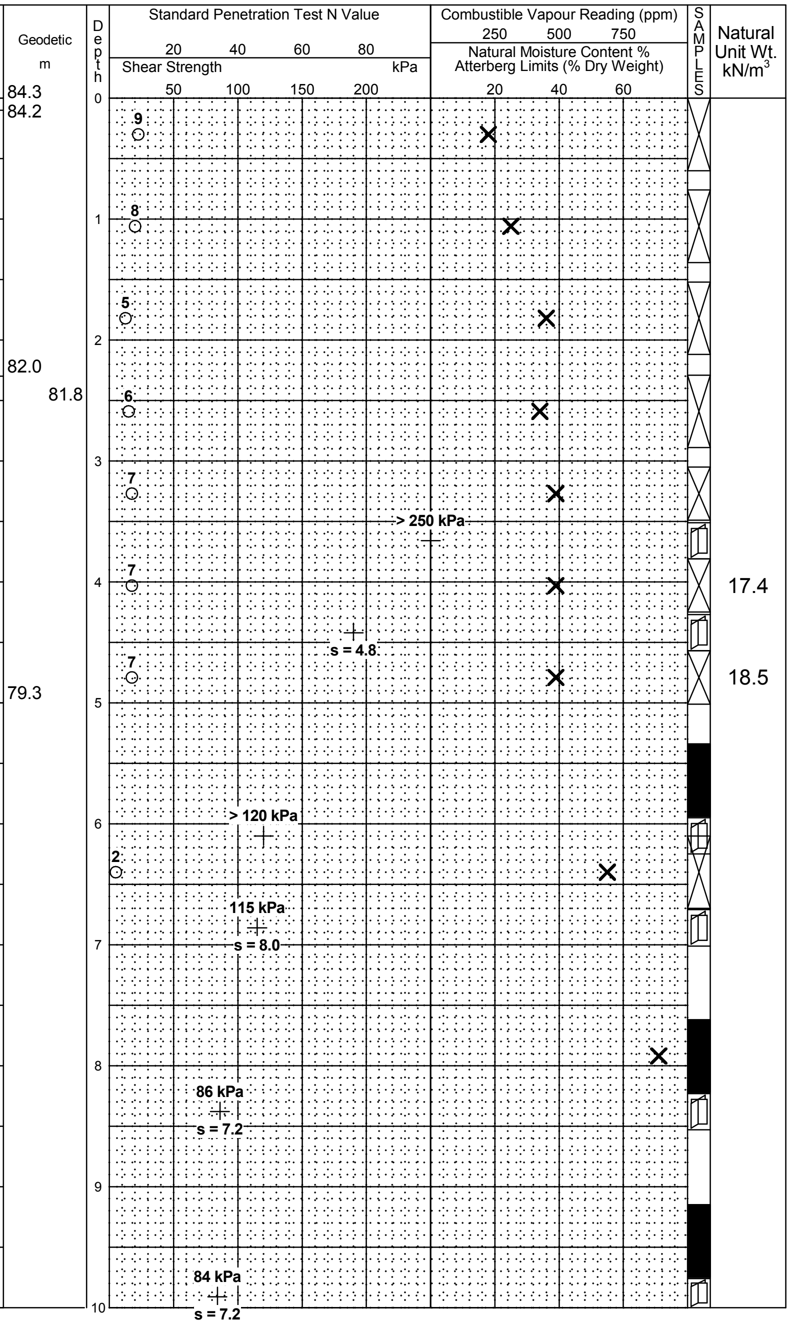
Drill Type: 'Trackmount CME 55

Datum: Geodetic

Logged by: ________ Checked by: ________

Split Spoon Sample	☒	Combustible Vapour Reading	☐
Auger Sample	◫	Natural Moisture Content	×
SPT (N) Value	○	Atterberg Limits	├─○
Dynamic Cone Test	───	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■	Shear Strength by Penetrometer Test	▲
Shear Strength by Vane Test	+ S		

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m
			84.3
		TOPSOIL ~ 100mm	84.2
		FILL Sand and gravel to silty clay with gravel, some organics, dark brown to grey, moist (loose)	
			82.0
▼		**SILTY CLAY (DESSICATED CRUST)** Brown to greyish brown, moist, high plasticity, (hard to very stiff)	81.8
			79.3
		SILTY CLAY Grey, moist to wet, high plasticity, (very stiff to stiff)	



Continued Next Page

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 19 mm diameter piezometer was installed upon completion
3. Field work supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00234493-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
'Sept 10, 2016	2.5	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH-3

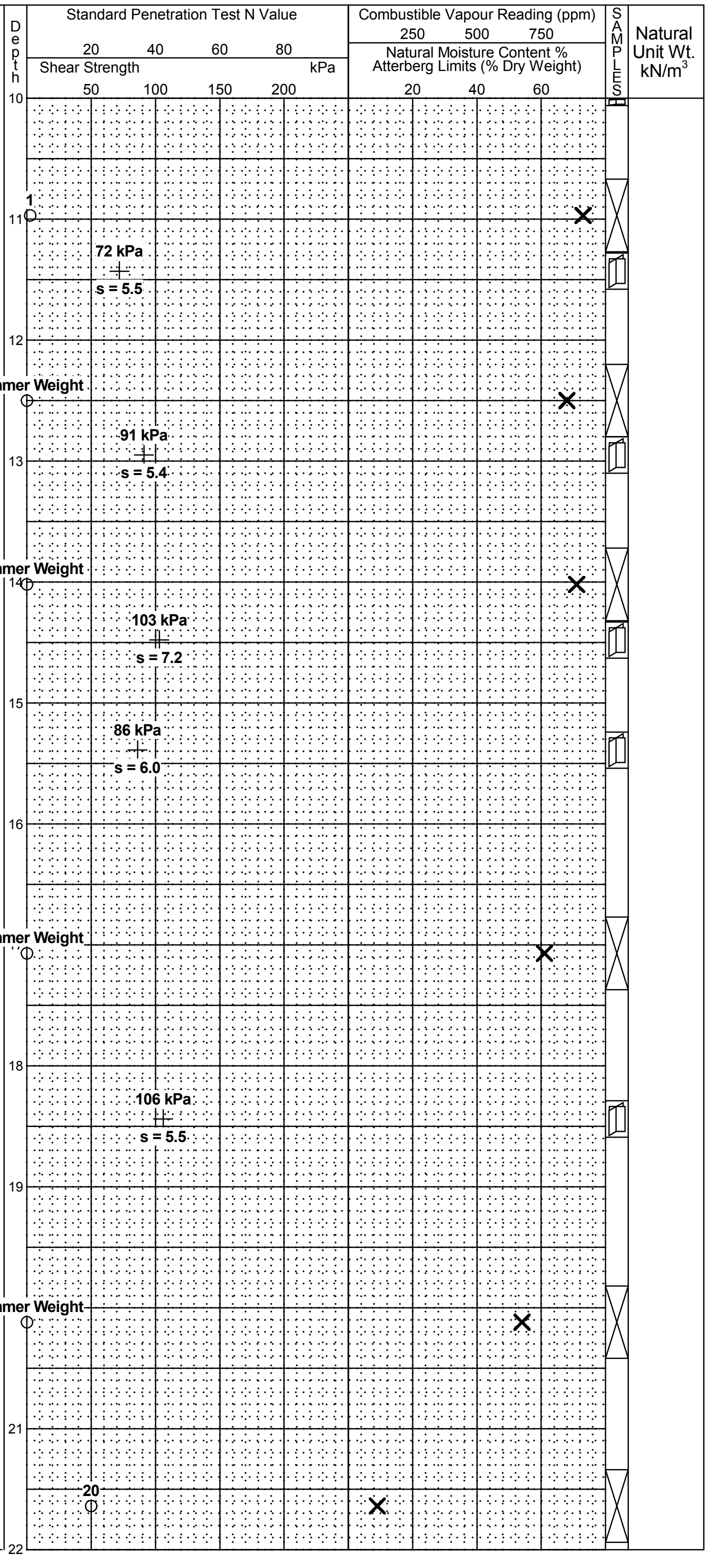
Project No: OTT-00234493-A0

Project: Preliminary Geotechnical Investigation. Proposed Residential Subdivision

Figure No. 5

Page. 2 of 3

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m
		SILTY CLAY Grey, moist to wet, high plasticity, (very stiff to stiff) *(continued)*	74.3
		GRAVELLY SAND TILL Some silt, trace clay, grey, wet, (compact)	63.4



Continued Next Page

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 19 mm diameter piezometer was installed upon completion
3. Field work supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00234493-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
'Sept 10, 2016	2.5	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole **BH-3**

Project No: OTT-00234493-A0

Figure No. 5

Project: Preliminary Geotechnical Investigation. Proposed Residential Subdivision

Page. 3 of 3

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth	Standard Penetration Test N Value (20, 40, 60, 80) Shear Strength kPa (50, 100, 150, 200)	Combustible Vapour Reading (ppm) (250, 500, 750) Natural Moisture Content % Atterberg Limits (% Dry Weight) (20, 40, 60)	SAMPLES	Natural Unit Wt. kN/m^3
		GRAVELLY SAND TILL Some silt, trace clay, grey, wet, (compact) *(continued)*	62.3	22				
				23				
			61.0					
		Borehole Terminated at 23.3 m Depth **Upon Auger Refusal**						

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 19 mm diameter piezometer was installed upon completion
3. Field work supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00234493-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
'Sept 10, 2016	2.5	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH-4

Project No: OTT-00234493-A0

Project: Preliminary Geotechnical Investigation. Proposed Residential Subdivision

Location: 1154, 1172, 1176, 1180, and 1208 Old Montreal Road, Ottawa, ON

Figure No. 6

Page. 1 of 1

Date Drilled: 'August 18, 2016

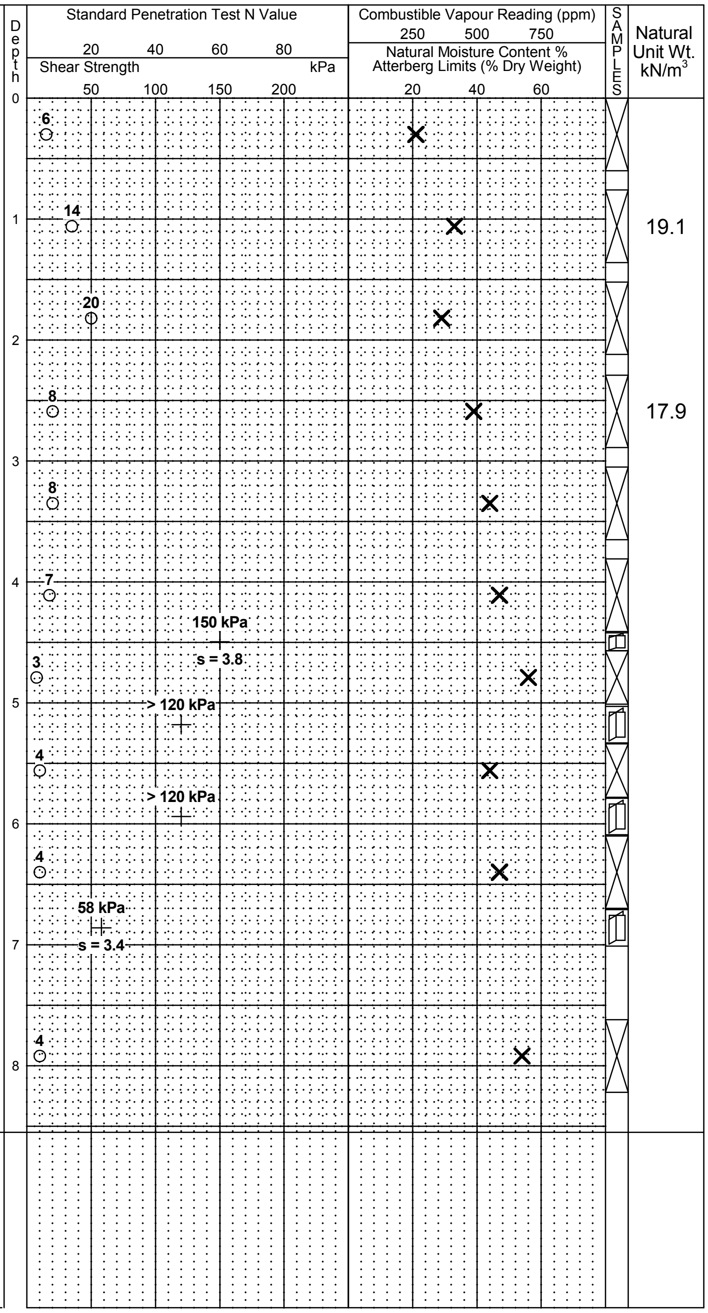
Drill Type: 'Trackmount CME 55

Datum: Geodetic

Logged by: ________ Checked by:________

Split Spoon Sample	☒	Combustible Vapour Reading	☐
Auger Sample	◧	Natural Moisture Content	×
SPT (N) Value	○	Atterberg Limits	├─○
Dynamic Cone Test	—	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■		
Shear Strength by Vane Test	+ S	Shear Strength by Penetrometer Test	▲

GWL	SOIL DESCRIPTION	Geodetic m
		83
	TOPSOIL ~ 150mm	82.9
	SILTY SAND Fine grained sand, some organics (rootlets), brown to grey, moist, (loose)	82.3
	SILTY CLAY (DESSICATED CRUST) Brown to greyish brown, moist, high plasticity (very stiff)	79.0
	SILTY CLAY Grey, moist to wet, high plasticity, (very stiff to stiff)	74.4
	Borehole Terminated at 8.60 m Depth	



NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Borehole Backfilled With Cuttings Upon Completion
3. Field work supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00234493-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH-5

Project No: OTT-00234493-A0

Project: Preliminary Geotechnical Investigation. Proposed Residential Subdivision

Location: 1154, 1172, 1176, 1180, and 1208 Old Montreal Road, Ottawa, ON

Figure No. 7

Page. 1 of 2

Date Drilled: 'August 18, 2016

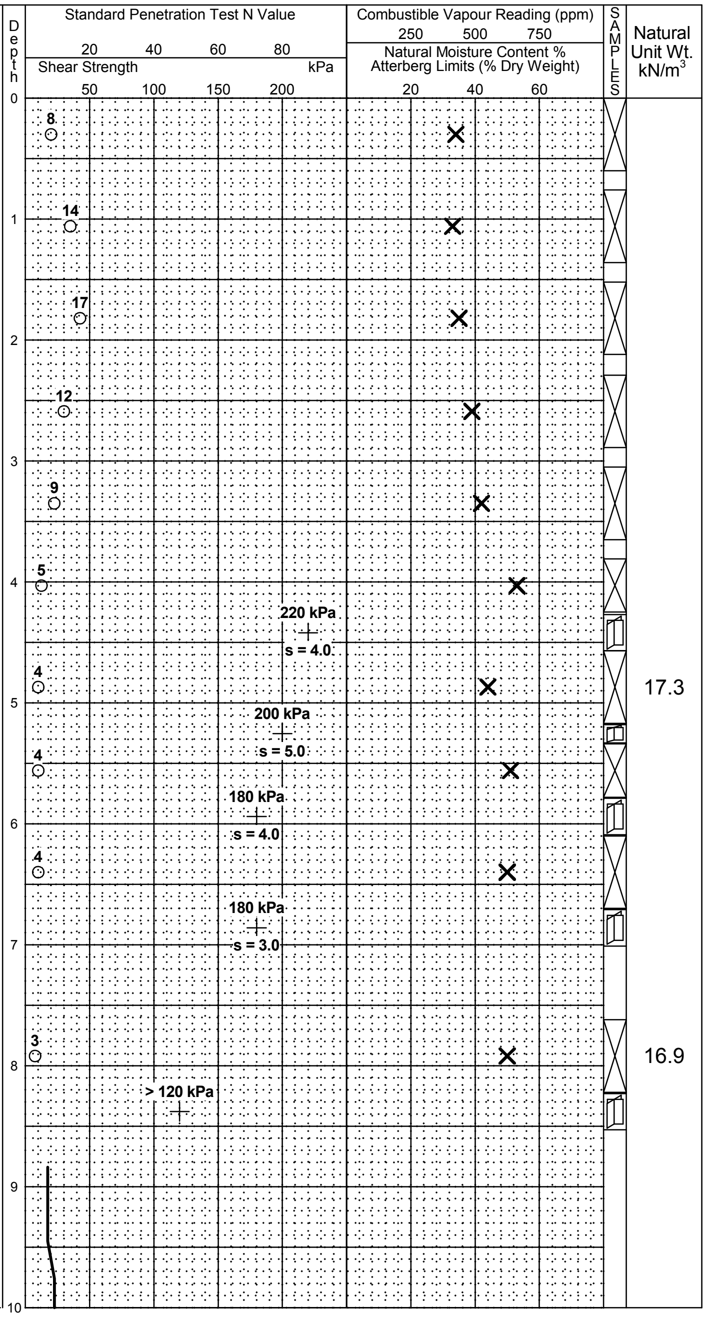
Drill Type: 'Trackmount CME 55

Datum: Geodetic

Logged by: _________ Checked by:_________

Split Spoon Sample	☒	Combustible Vapour Reading	☐
Auger Sample	◫	Natural Moisture Content	✕
SPT (N) Value	○	Atterberg Limits	├─○
Dynamic Cone Test	───	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■	Shear Strength by Penetrometer Test	▲
Shear Strength by Vane Test	+ S		

SOIL DESCRIPTION	Geodetic m
	81
TOPSOIL ~ 50mm	80.9
SILTY CLAY (DESSICATED CRUST) Brown to greyish brown, moist, high plasticity (hard)	
SILTY CLAY Grey, moist to wet, high plasticity, (hard to very stiff)	77.5
	72.4
Borehole Terminated at 8.60 m Depth	72.3
INFERRED OVERBURDEN Cone advanced from 8.6 m to to refusal at 20.9 m depth	



Continued Next Page

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Borehole Backfilled With Cuttings Upon Completion
3. Field work supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00234493-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH-5

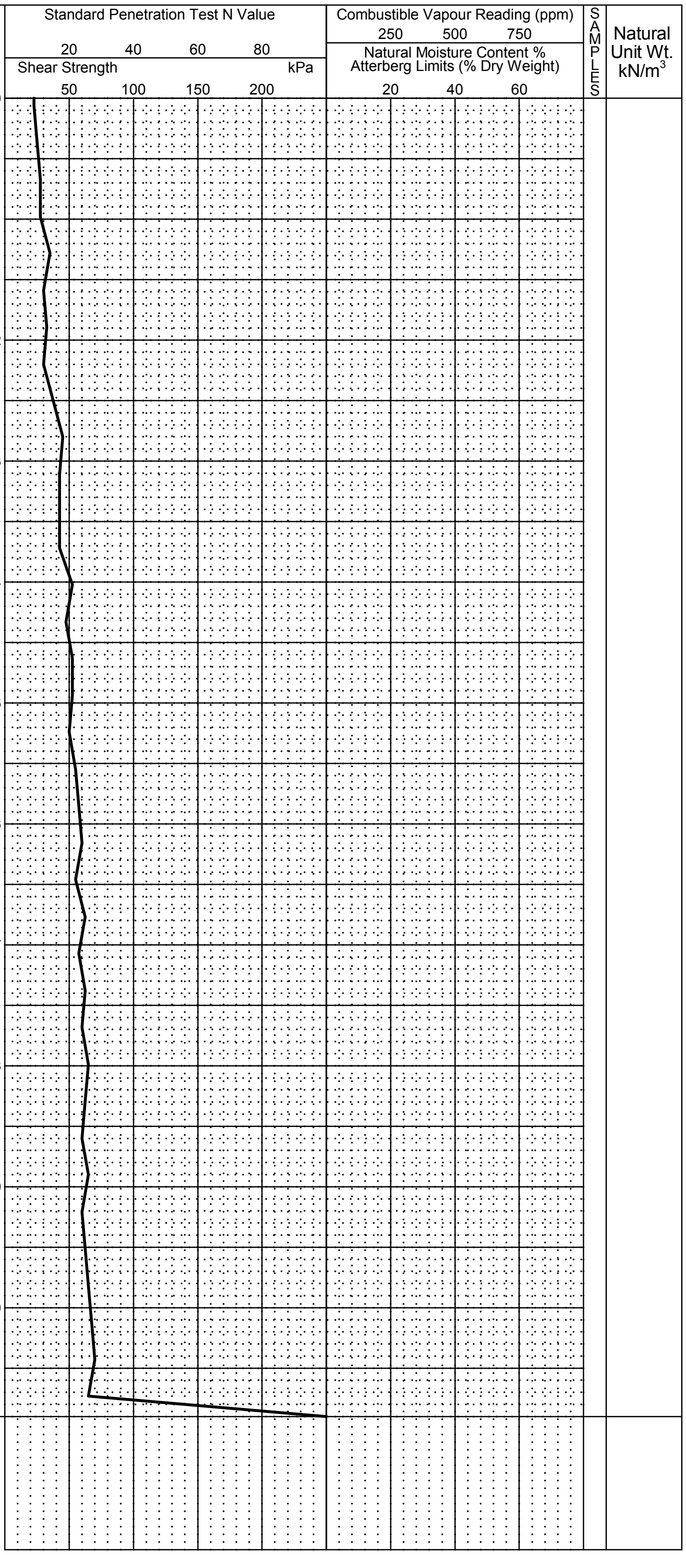
Project No: OTT-00234493-A0

Project: Preliminary Geotechnical Investigation. Proposed Residential Subdivision

Figure No. 7

Page. 2 of 2

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic m	Depth
		INFERRED OVERBURDEN Cone advanced from 8.6 m to to refusal at 20.9 m depth *(continued)*	71 60.1	10 – 20
		Refusal to Cone Penetration at 20.9 m Depth		



NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Borehole Backfilled With Cuttings Upon Completion
3. Field work supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00234493-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH-6

Project No: OTT-00234493-A0

Figure No. 8

Page. 1 of 1

Project: Preliminary Geotechnical Investigation. Proposed Residential Subdivision

Location: 1154, 1172, 1176, 1180, and 1208 Old Montreal Road, Ottawa, ON

Date Drilled: 'August 16, 2016

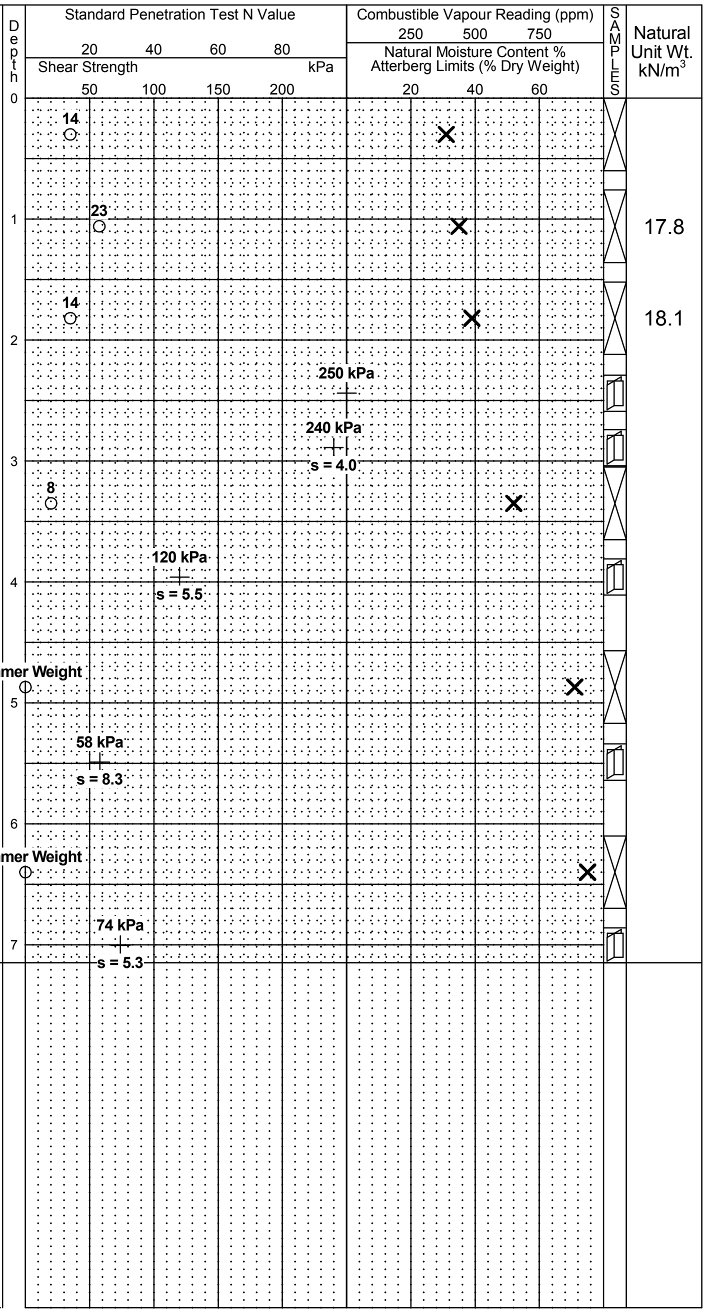
Drill Type: 'Trackmount CME 55

Datum: Geodetic

Logged by: ________ Checked by:________

Split Spoon Sample	☒	Combustible Vapour Reading	☐
Auger Sample	◨	Natural Moisture Content	✕
SPT (N) Value	○	Atterberg Limits	├──○
Dynamic Cone Test	──	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■		
Shear Strength by Vane Test	+ S	Shear Strength by Penetrometer Test	▲

SOIL DESCRIPTION	Geodetic m
	86.6
TOPSOIL ~ 50mm	86.5
FILL Sand and gravel mixed with silty sand, brown, moist, (compact)	85.9
SILTY CLAY (DESSICATED CRUST) Brown to greyish brown, moist, high plasticity (hard)	83.6
SILTY CLAY Grey, moist to wet, high plasticity, (very stiff to stiff)	79.5
Borehole Terminated at 7.2 m Depth	



NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. Borehole Backfilled With Cuttings Upon Completion
3. Field work supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00234493-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH-7

Project No: OTT-00234493-A0

Project: Preliminary Geotechnical Investigation. Proposed Residential Subdivision

Location: 1154, 1172, 1176, 1180, and 1208 Old Montreal Road, Ottawa, ON

Figure No. 9

Page. 1 of 1

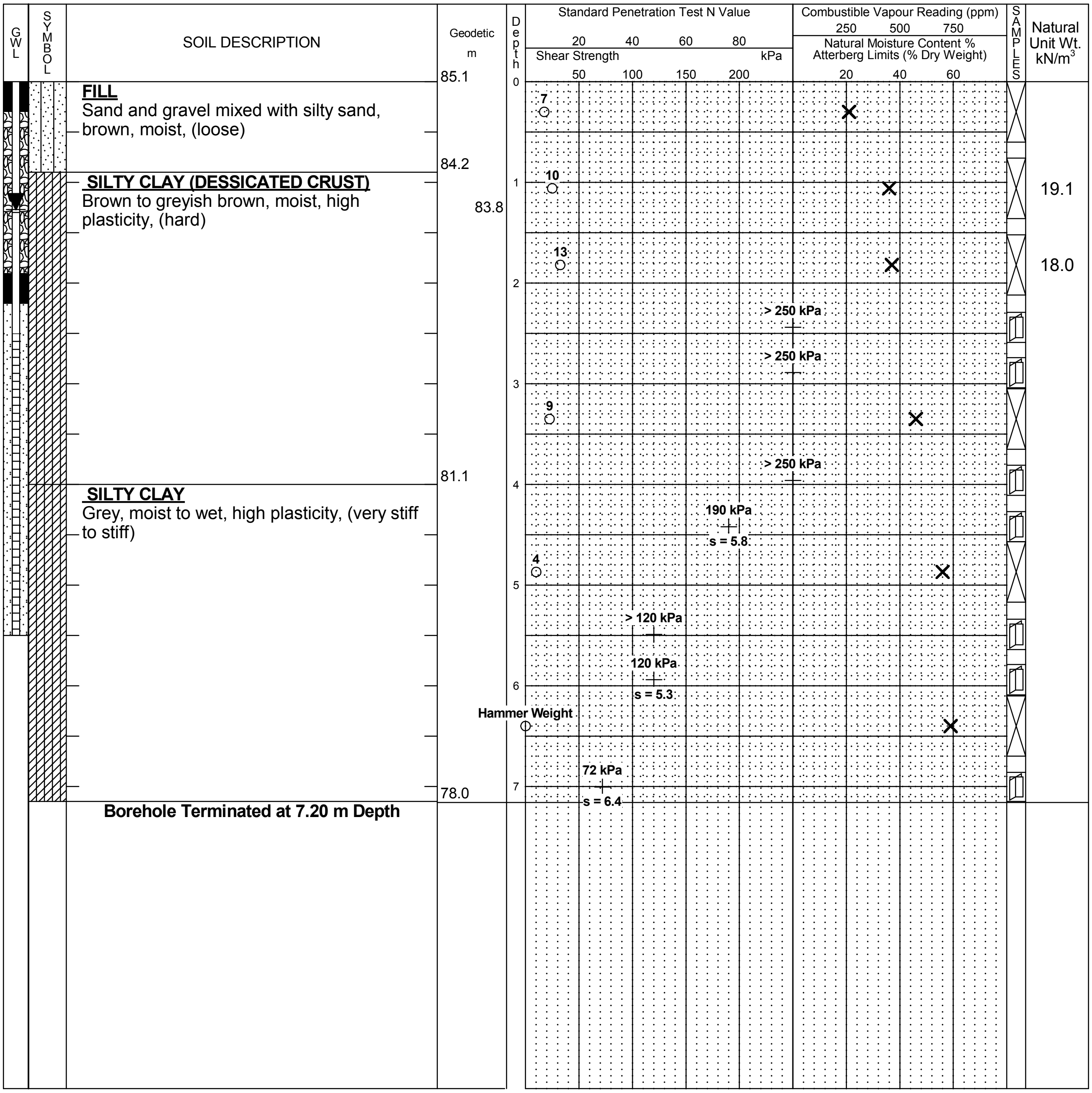
Date Drilled: 'August 16, 2016

Drill Type: 'Trackmount CME 55

Datum: Geodetic

Logged by: ______ Checked by: ______

Split Spoon Sample	☒	Combustible Vapour Reading	☐
Auger Sample	◧	Natural Moisture Content	×
SPT (N) Value	○	Atterberg Limits	⊢○
Dynamic Cone Test	—	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■	Shear Strength by Penetrometer Test	▲
Shear Strength by Vane Test	+ S		



Geodetic m	SOIL DESCRIPTION
85.1	**FILL** Sand and gravel mixed with silty sand, brown, moist, (loose)
84.2	**SILTY CLAY (DESSICATED CRUST)** Brown to greyish brown, moist, high plasticity, (hard)
81.1	**SILTY CLAY** Grey, moist to wet, high plasticity, (very stiff to stiff)
78.0	**Borehole Terminated at 7.20 m Depth**

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A 19 mm diameter piezometer was installed upon completion
3. Field work supervised by an exp representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00234493-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
'Sept 10, 2016	1.3	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON   K2B 8H6

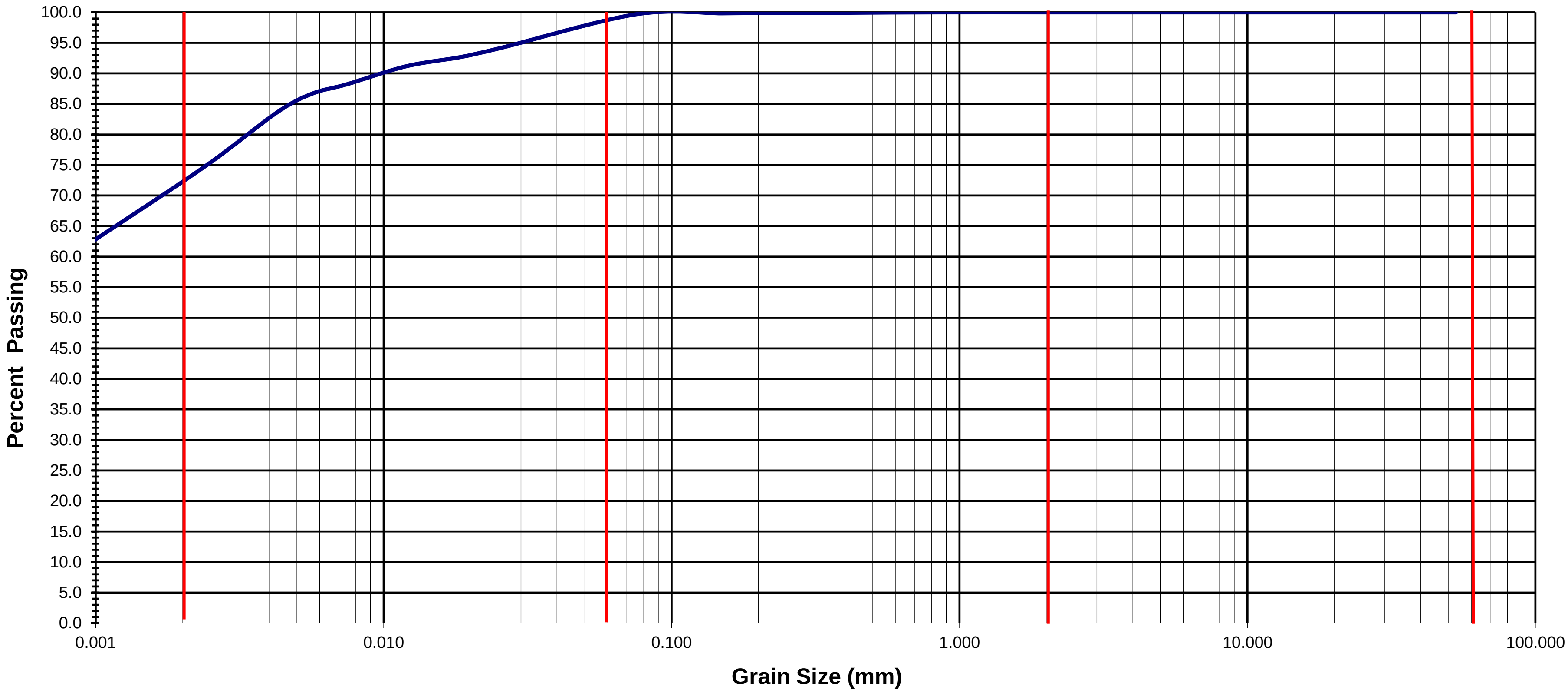
Grain-Size Distribution Curve

Method of Test for Particle Size Analysis of Soil

Test Method ASTM D-422

Modified M.I.T. Classification

CLAY	SILT			SAND			GRAVEL			
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	



Exp Project No.:	**OTT-00234493-A0**	**Project Name :**	**Preliminary Geotechnical Invsetigation. Proposed Residential Subdvision**				
Client :	**DCR/Phoenix Group of Companies**	**Project Location :**	**1154 - 1208 Old Montreal Road, City of Ottawa, Ontario**				
Date Sampled :	**August 15, 2016**	**Borehole.:**	**1**	**Sample No.:**	**SS3**	**Depth (m) :**	**1.5-2.1**
Sample Description :	**Silty Clay. Trace Sand**					**Figure :**	**10**

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

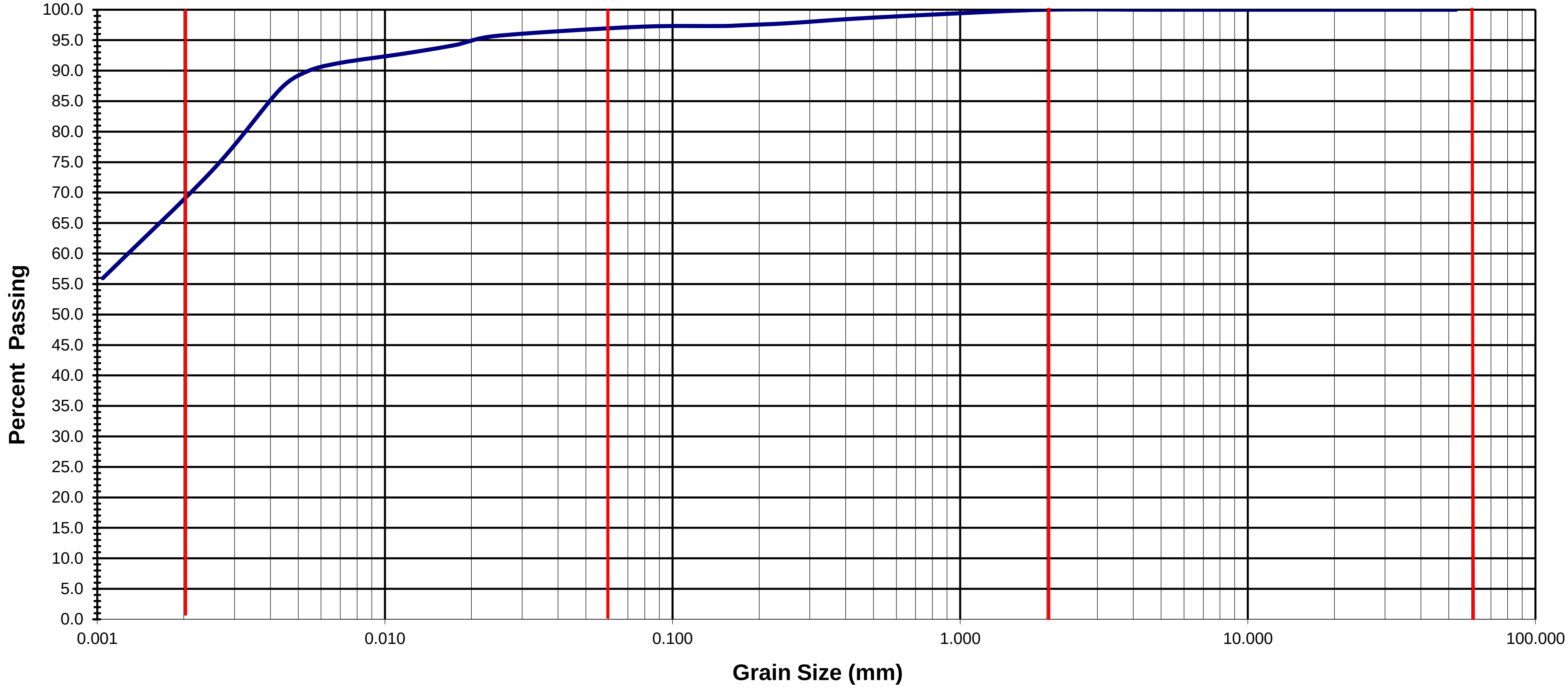
Grain-Size Distribution Curve

Method of Test for Particle Size Analysis of Soil

Test Method ASTM D-422

Modified M.I.T. Classification

CLAY	SILT			SAND			GRAVEL			
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	



Exp Project No.:	**OTT-00234493-A0**	**Project Name :**	**Preliminary Geotechnical Invsetigation. Proposed Residential Subdvision**		
Client :	**DCR/Phoenix Group of Companies**	**Project Location :**	**1154 - 1208 Old Montreal Road, City of Ottawa, Ontario**		
Date Sampled :	**August 15, 2016**	**Borehole.:** **1**	**Sample No.:** **SS8**	**Depth (m) :**	**9.1-9.8**
Sample Description :	**Silty Clay. Trace Sand**			**Figure :**	**11**

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

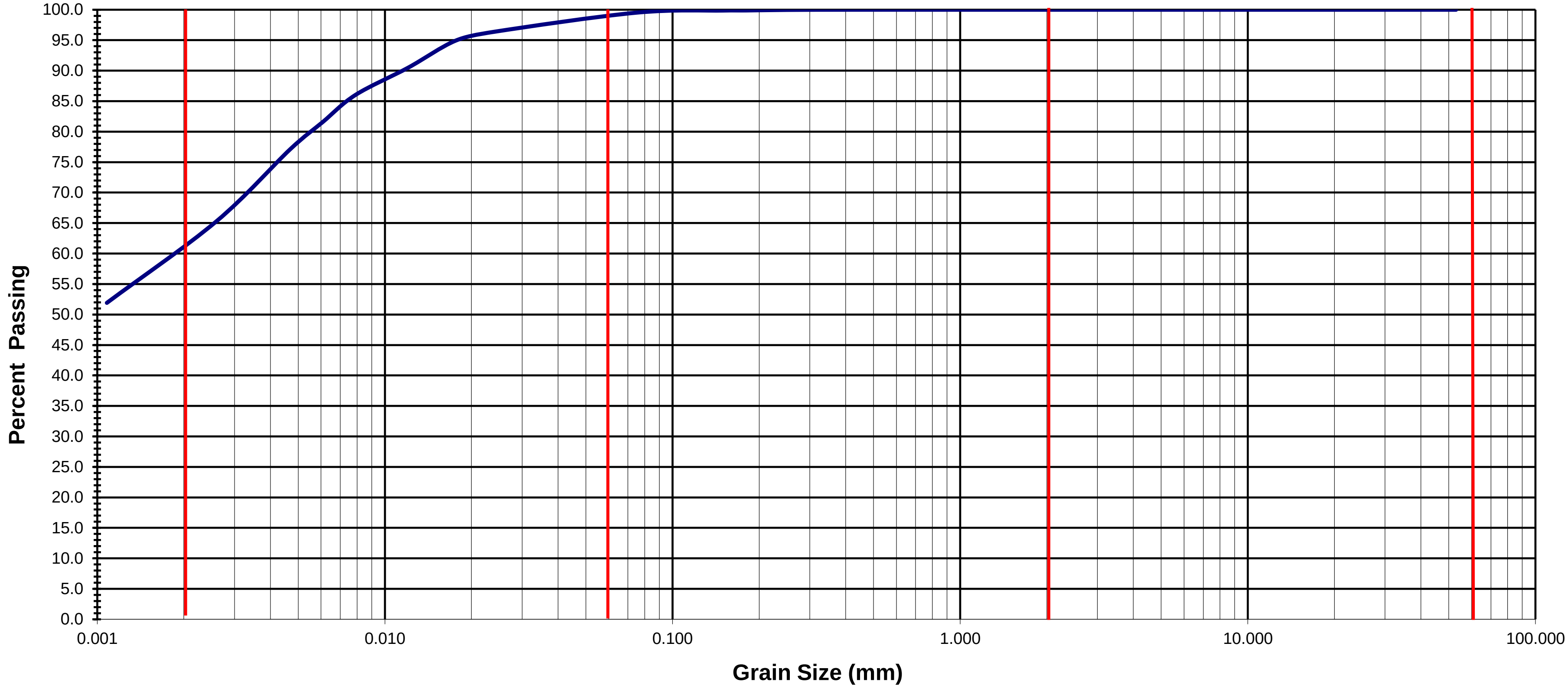
Grain-Size Distribution Curve

Method of Test for Particle Size Analysis of Soil

Test Method ASTM D-422

Modified M.I.T. Classification

CLAY	SILT			SAND			GRAVEL			
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	



Exp Project No.: OTT-00234493-A0	Project Name : Preliminary Geotechnical Invsetigation. Proposed Residential Subdvision				
Client : DCR/Phoenix Group of Companies	Project Location : 1154 - 1208 Old Montreal Road, City of Ottawa, Ontario				
Date Sampled : August 15, 2016	Borehole.: 1	Sample No.: SS12	Depth (m) : 15.2-15.8		
Sample Description : Silt - Clay			Figure : 12		

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON   K2B 8H6

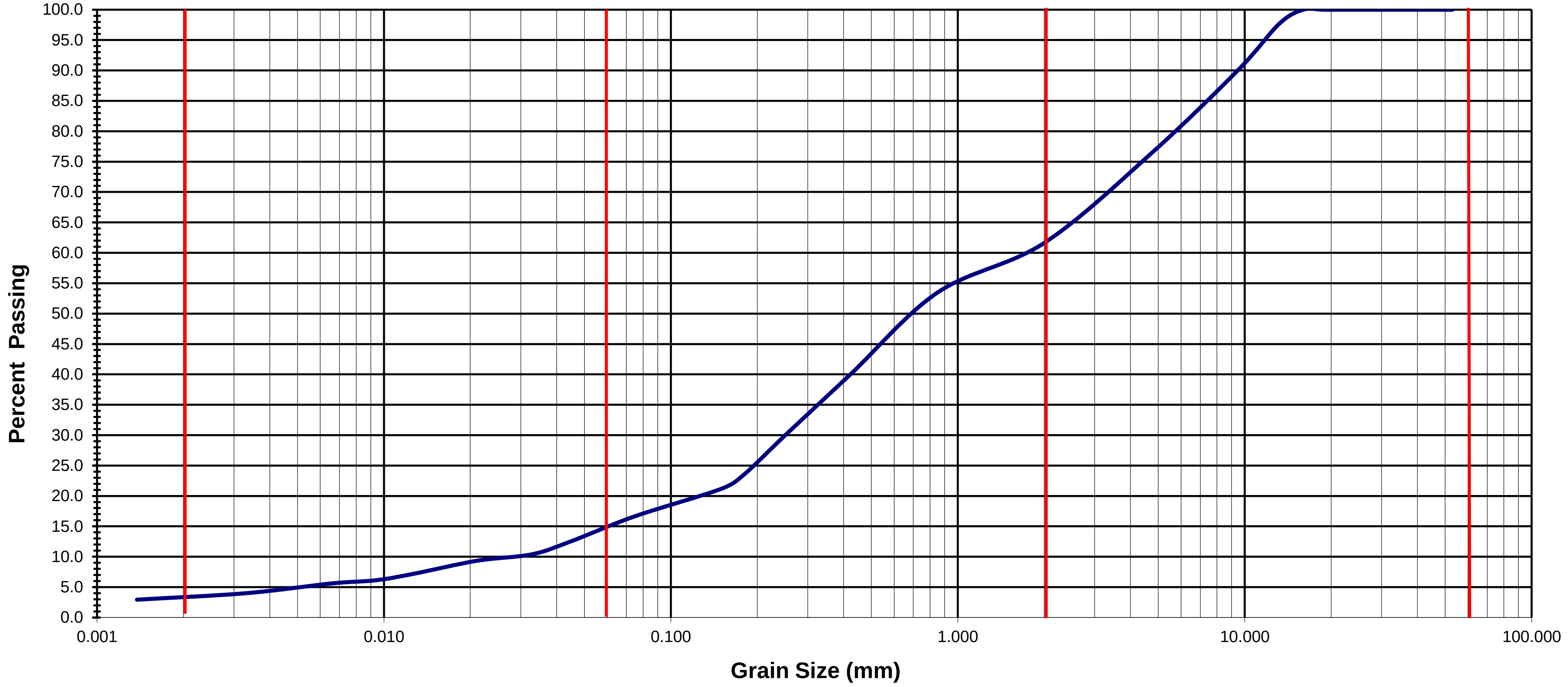
Grain-Size Distribution Curve

Method of Test for Particle Size Analysis of Soil

Test Method ASTM D-422

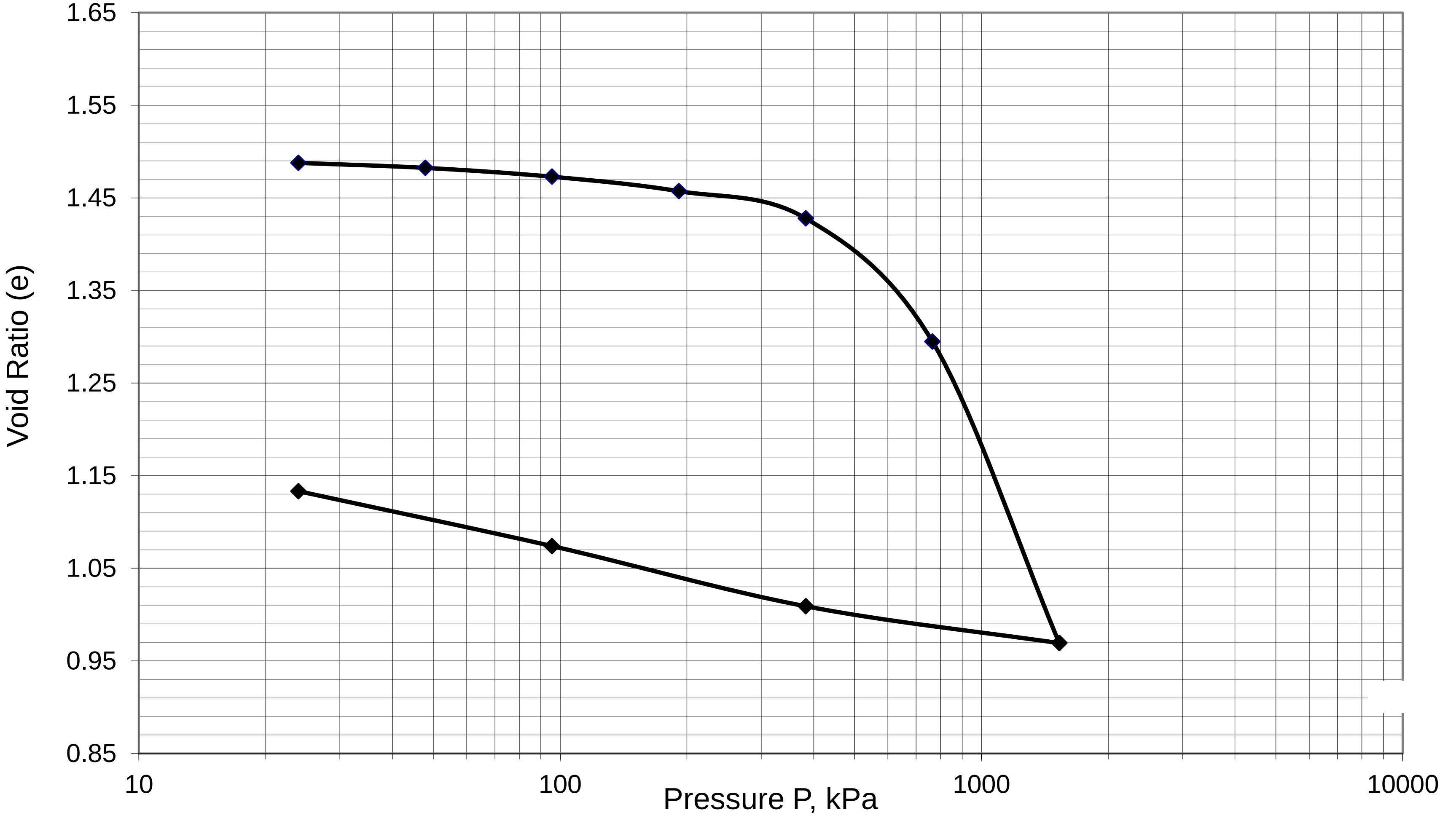
Modified M.I.T. Classification

CLAY	SILT			SAND			GRAVEL			
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	



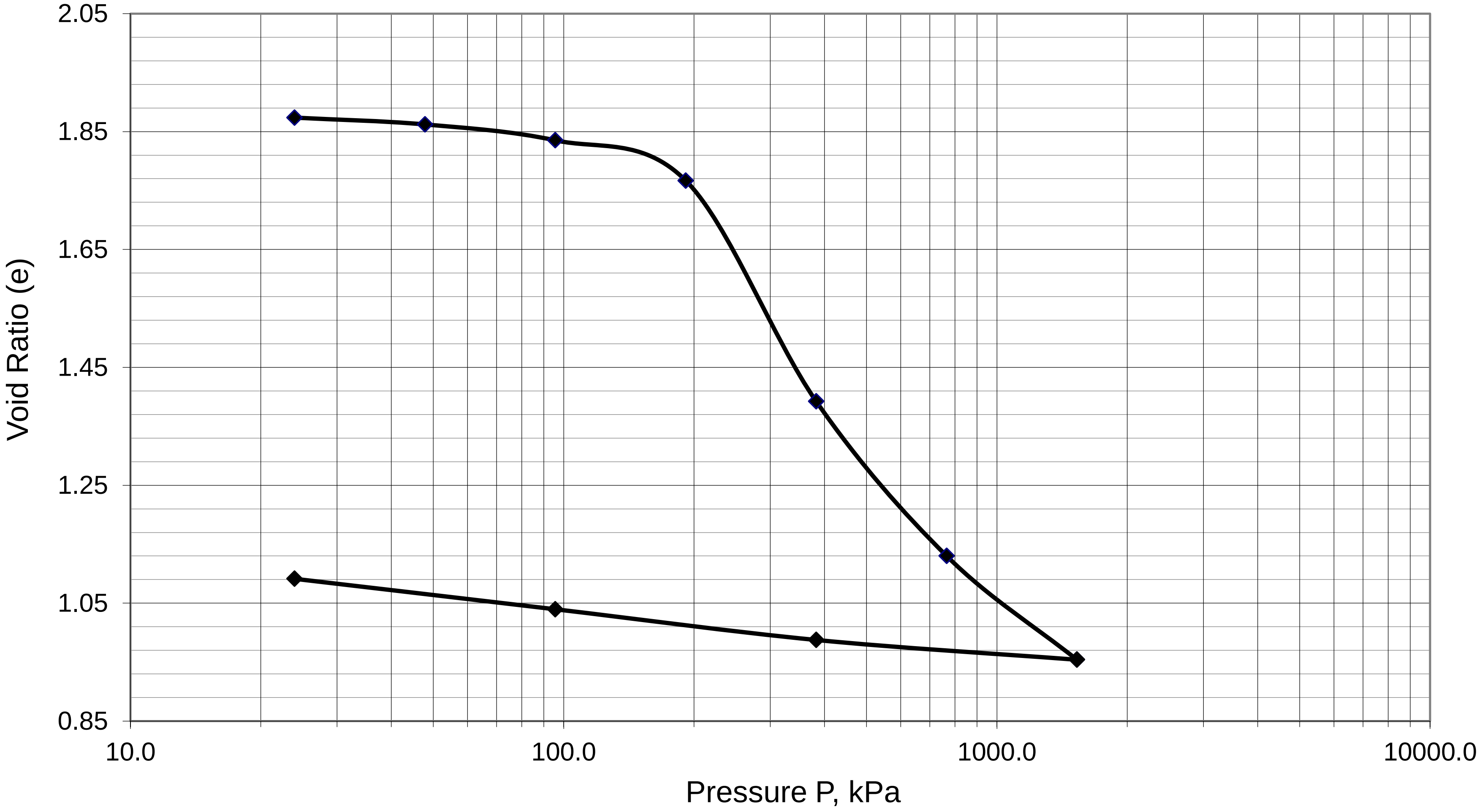
Exp Project No.:	**OTT-00234493-A0**	**Project Name :**	**Preliminary Geotechnical Invsetigation. Proposed Residential Subdvision**		
Client :	**DCR/Phoenix Group of Companies**	**Project Location :**	**1154 - 1208 Old Montreal Road, City of Ottawa, Ontario**		
Date Sampled :	**August 15, 2016**	**Borehole.:**	**1**	**Sample No.:** **SS15**	**Depth (m) :** **19.8-20.4**
Sample Description :	**Sand and Gravel, Some Silt, Trace Clay**				**Figure :** **13**

Consolidation Test Results - BH 2 -TW5



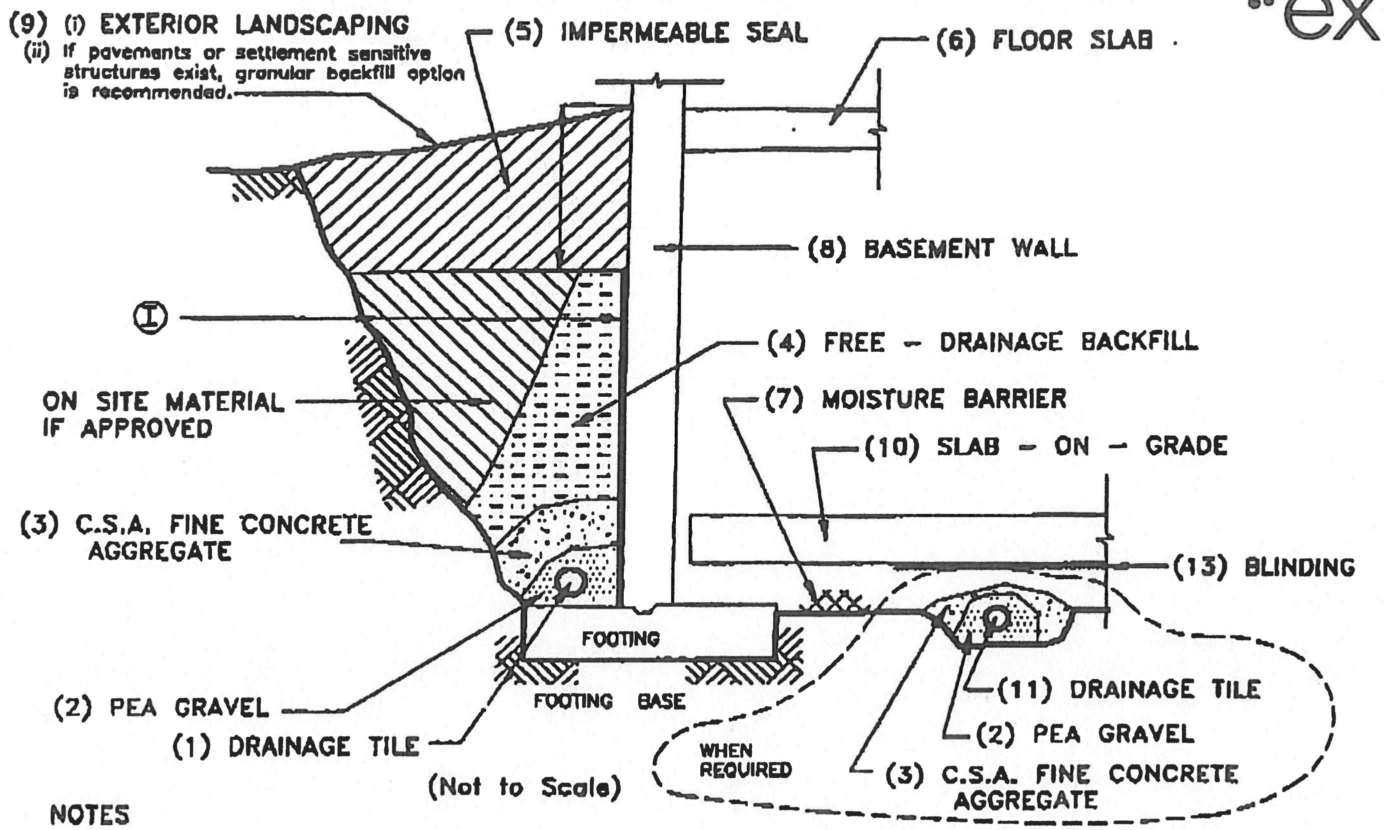
Borehole	**BH-2**	P'o	**75.4**	Ccr	**0.153**
Sample No.	**TW5**	P'c	**595.0**	Cc	**1.070**
Sample Depth (m)	**4.3**	OC Ratio	**7.9**	Wo (%)	**53**
Sample Elev. (m)	**81.1**	Initial Void Ratio	**1.497**	Unit Wt.(KN/m3)	**Crust 18, Grey Clay 16.5**
Project Number	**OTT-00234493-A0**	**Sample Description**	**Silty Clay**	**Figure Number**	14

Consolidation Test Results - BH3 - TW10



Borehole	**BH-3**	P'o	**114.0**	Ccr	**0.110**
Sample No.	**TW-10**	P'c	**192.0**	Cc	**1.360**
Sample Depth (m)	**7.9**	OC Ratio	**1.7**	Wo (%)	**71.0**
Sample Elev. (m)	**76.4**	Initial Void Ratio	**1.892**	Unit Wt.(KN/m3)	**Crust 18, Grey Clay 16.5**
Project Number	**OTT-00234493-A0**	**Sample Description**	**Clay - Grey**	**Figure Number**	**15**

BASEMENT DRAINAGE DRAWING



NOTES

OPTION A – GRANULAR BACKFILL

1. Drainage tile to consist of 100mm (4 in.) diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet. Invert to be minimum of 150mm (6 in.) below underside of floor slab.
2. Pea gravel 150mm (6 in.) top and sides of drain. If drain is not on footing, place 100mm (4 in.) of pea gravel below drain. 20mm (3/4 in.) clear stone may be used provided it is covered by an approved porous geotextile membrane (Terrafix 270R or equivalent).
3. C.S.A. fine concrete aggregate to act as filter material. Miniumum 300mm (12 in.) top and sides of drain. This may be replaced by an approved porous geotextile membrane (Terrafix 270R or equivalent).
4. Free–draining backfill – OPSS Granular B or equivalent compacted to 93 to 95 (maximum) percent Standard Proctor density. Do not compact closer than 1.8m (6 ft.) from wall with heavy equipment. Use hand controlled light compaction equipment within 1.8m (6 ft.) of wall.
5. Impermeable backfill seal of compacted clay, clayey silt or equivalent. If original soil is free–draining seal may be omitted.
6. Do not backfill until wall is supported by basement and floor slabs or adequate bracing.
7. Moisture barrier to consist of compacted 20mm (3/4 in.) clear stone or equivalent free–draining material. Layer to be 200mm (8 in.) minimum thickness.
8. Basement walls to be damp–proofed.
9. Exterior grade to slope away from wall.
10. Slab–on–grade should not be structurally connected to wall or footing.
11. Underfloor drain invert to be a least 300mm (12 in.) below underside of floor slab. Drainage tile placed in parallel rows 6 to 8m (20 to 25ft.) centres one way. Place drain on 100mm (4 in.) of pea gravel with 150mm (6 in.) of pea gravel top and sides. CSA fine concrete aggregate to be provided as filter material or an approved geotextile membrane (as in 2 above) may be used.
12. Do not connect the underfloor drains to perimeter drains.
13. If the 20mm (3/4 in.) clear stone requires surface blinding, use 6mm (1/4 in.) clear stone chips.

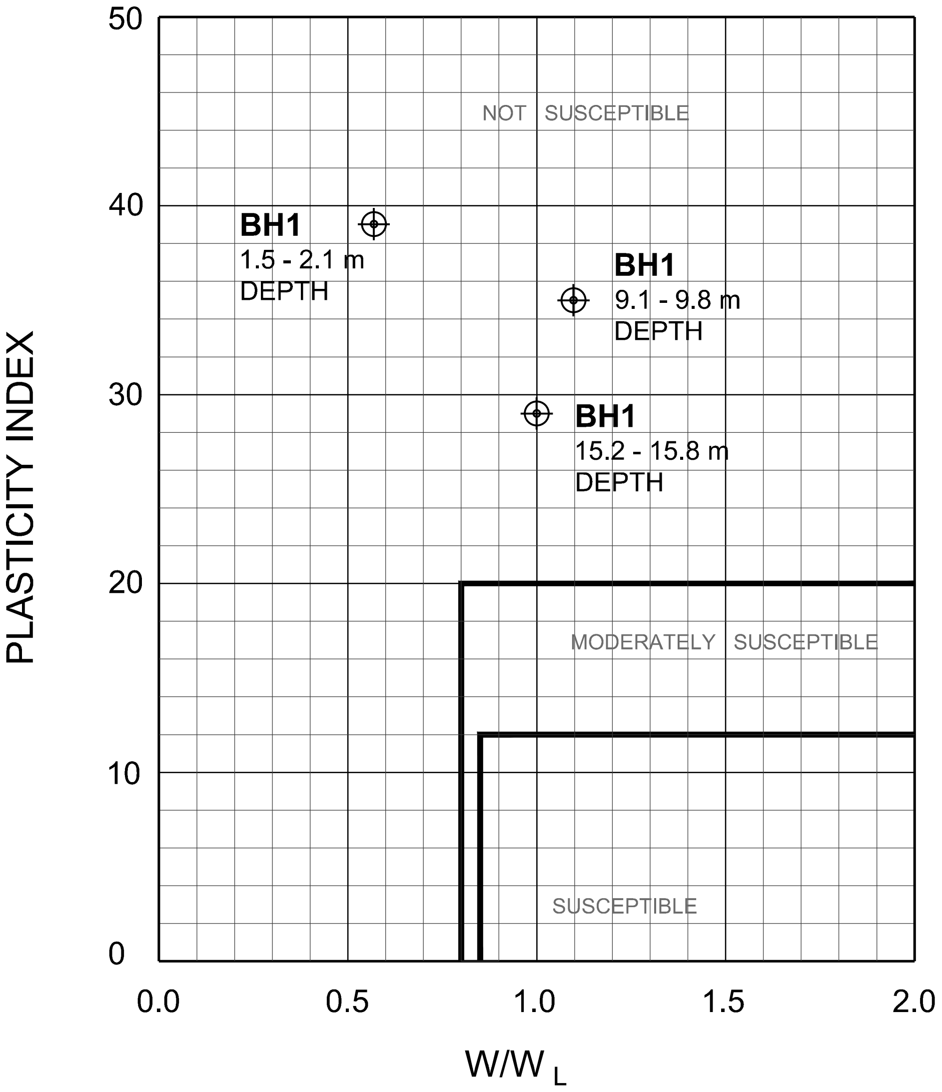
NOTE: A) Underfloor drainage can be deleted where not required (see report).

OPTION B – CORE DRAIN

Prefabricated continuous wall drains Ⓘ may be installed and Zone 4 backfilled with on site material compacted to 93 – 95% proctor. Further cost savings may result by placing the wall drains at equal distance strips no greater then 2.5m spacing but the risks of water leakage must by assessed and then assumed by the client.

1. Wall drain option Ⓘ may increase the lateral pressures above those of the conventional detail.
2. The use of waterproofing details at construction and expansion joints may also be required.
3. For Block walls or unreinforced cast in place concrete, the granular backfill option is recommended

Note: If water table exists above the floor slab, then options of granular in combinations with the wall drain should be reviewed



BRAY ET AL. (2004) CRITERIA FOR LIQUEFACTION ASSESSMENT OF FINE-GRAINED SOILS

exp Services Inc.
t: +1.613.688.1899 | f: +1.613.225.7337
2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6
Canada
www.exp.com

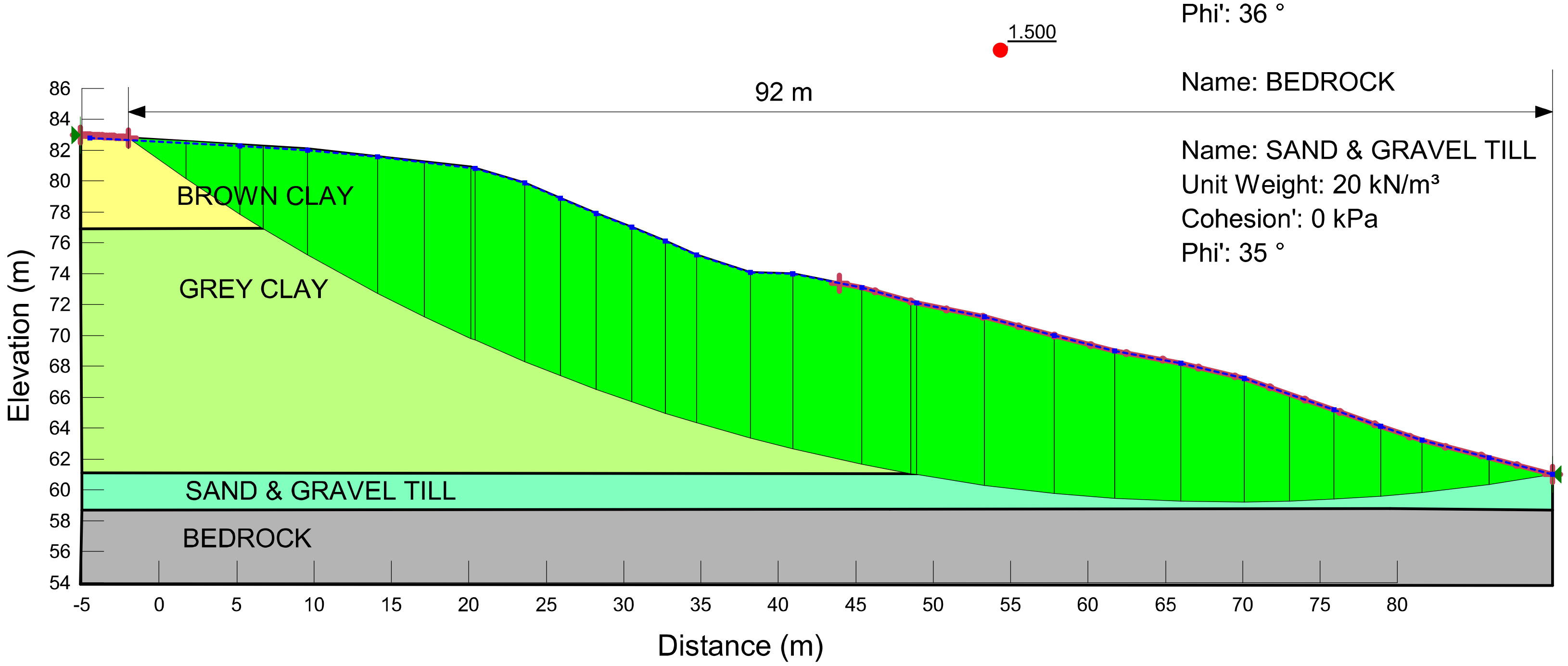
• BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

scale N.T.S.	CLIENT: DCR PHOENIX GROUP OF COMPANIES		project no. OTT-00234493-A0
date OCT. 31, 2016	TITLE: PRELIMINARY GEOTECHNICAL INVESTIGATION 1154 - 1208 OLD MONTREAL ROAD, OTTAWA, ON		FIG 17
drawn by M.N.			

Filename: r:\230000\234000\234493 - 1154-1208 old montreal road\fig 17 liquefaction assessment.dwg
Last Saved: 10/31/2016 11:28:17 AM
Last Plotted:10/31/2016 11:29:44 AMPlotted by: nugentm Pen Table:: trow standard, july 01, 2004.ctb

PROJECT No.: OTT-00234493-A0
1154-1208 Old Montreal, Ottawa, Ontario
Section A-A
Effective Stress Analysis

Figure No. 18



Name: BROWN CLAY
Unit Weight: 18 kN/m³
Cohesion': 9.8 kPa
Phi': 36 °

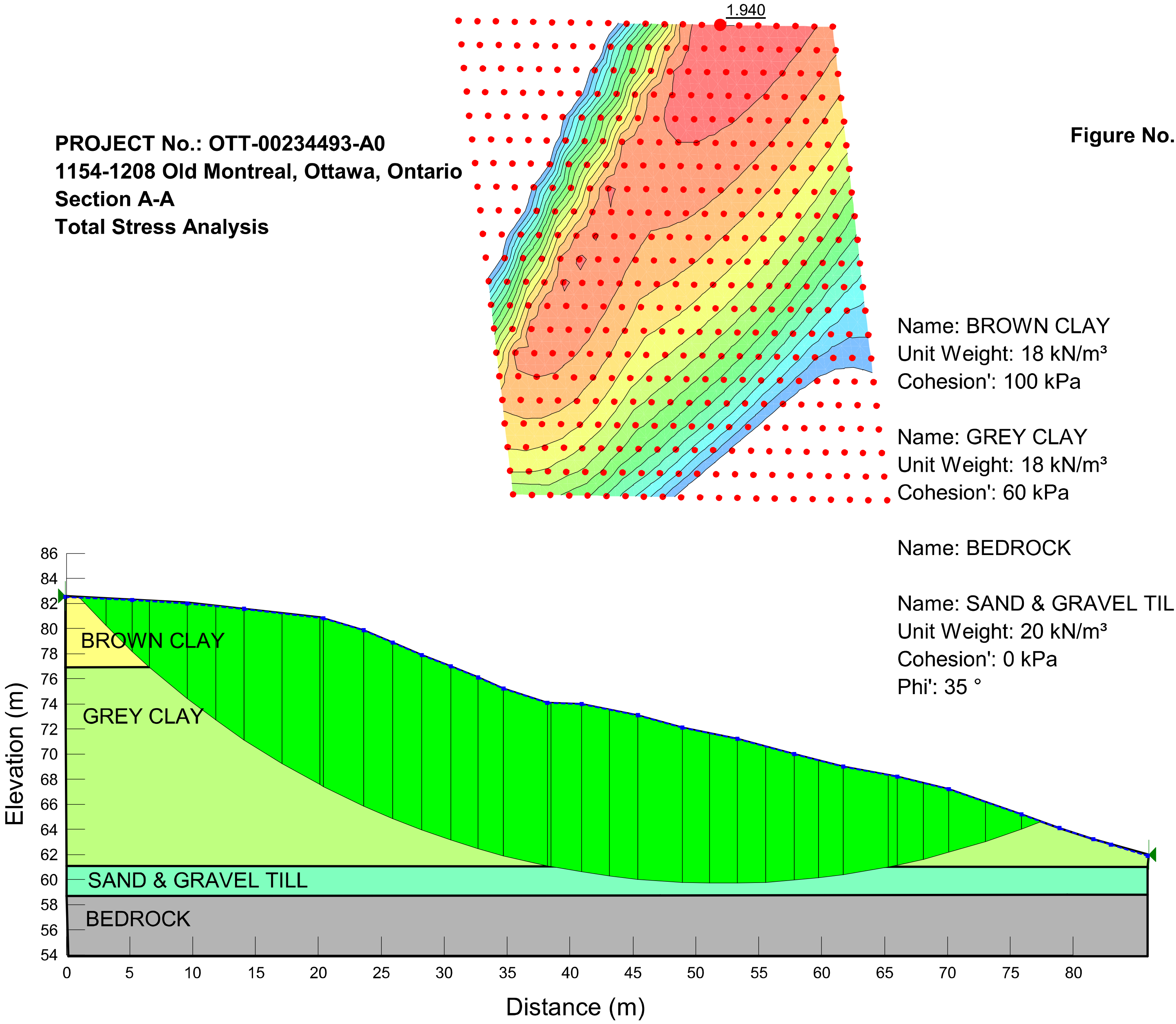
Name: GREY CLAY
Unit Weight: 18 kN/m³
Cohesion': 9.8 kPa
Phi': 36 °

Name: BEDROCK

Name: SAND & GRAVEL TILL
Unit Weight: 20 kN/m³
Cohesion': 0 kPa
Phi': 35 °

PROJECT No.: OTT-00234493-A0
1154-1208 Old Montreal, Ottawa, Ontario
Section A-A
Total Stress Analysis

Figure No. 19



Name: BROWN CLAY
Unit Weight: 18 kN/m³
Cohesion': 100 kPa

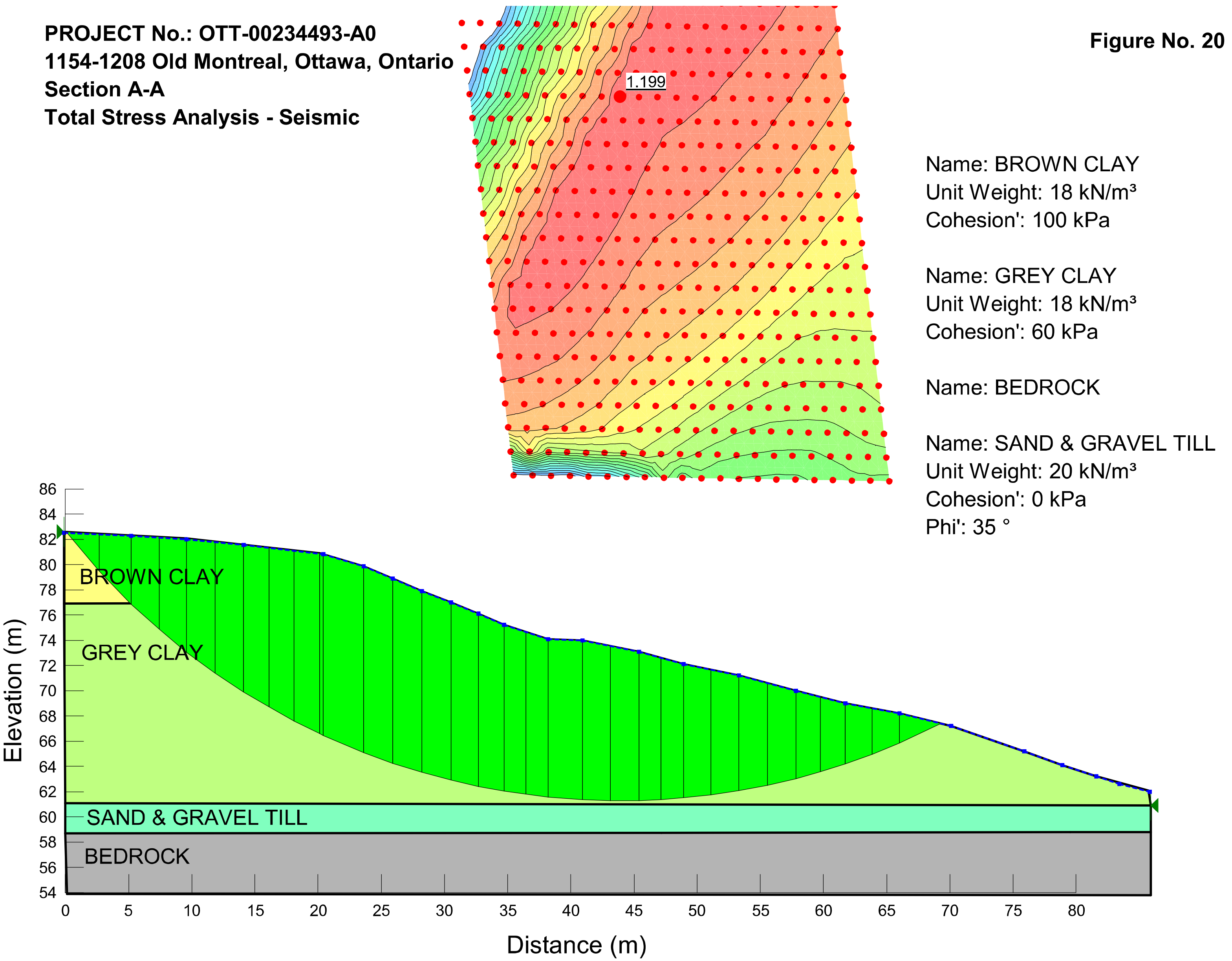
Name: GREY CLAY
Unit Weight: 18 kN/m³
Cohesion': 60 kPa

Name: BEDROCK

Name: SAND & GRAVEL TILL
Unit Weight: 20 kN/m³
Cohesion': 0 kPa
Phi': 35 °

PROJECT No.: OTT-00234493-A0
1154-1208 Old Montreal, Ottawa, Ontario
Section A-A
Total Stress Analysis - Seismic

Figure No. 20



Name: BROWN CLAY
Unit Weight: 18 kN/m³
Cohesion': 100 kPa

Name: GREY CLAY
Unit Weight: 18 kN/m³
Cohesion': 60 kPa

Name: BEDROCK

Name: SAND & GRAVEL TILL
Unit Weight: 20 kN/m³
Cohesion': 0 kPa
Phi': 35 °

Project No.: OTT-00234493-A0
1154-1208 Old Montreal, Ottawa, Ontario
Section B-B
Effective Stress Analysis

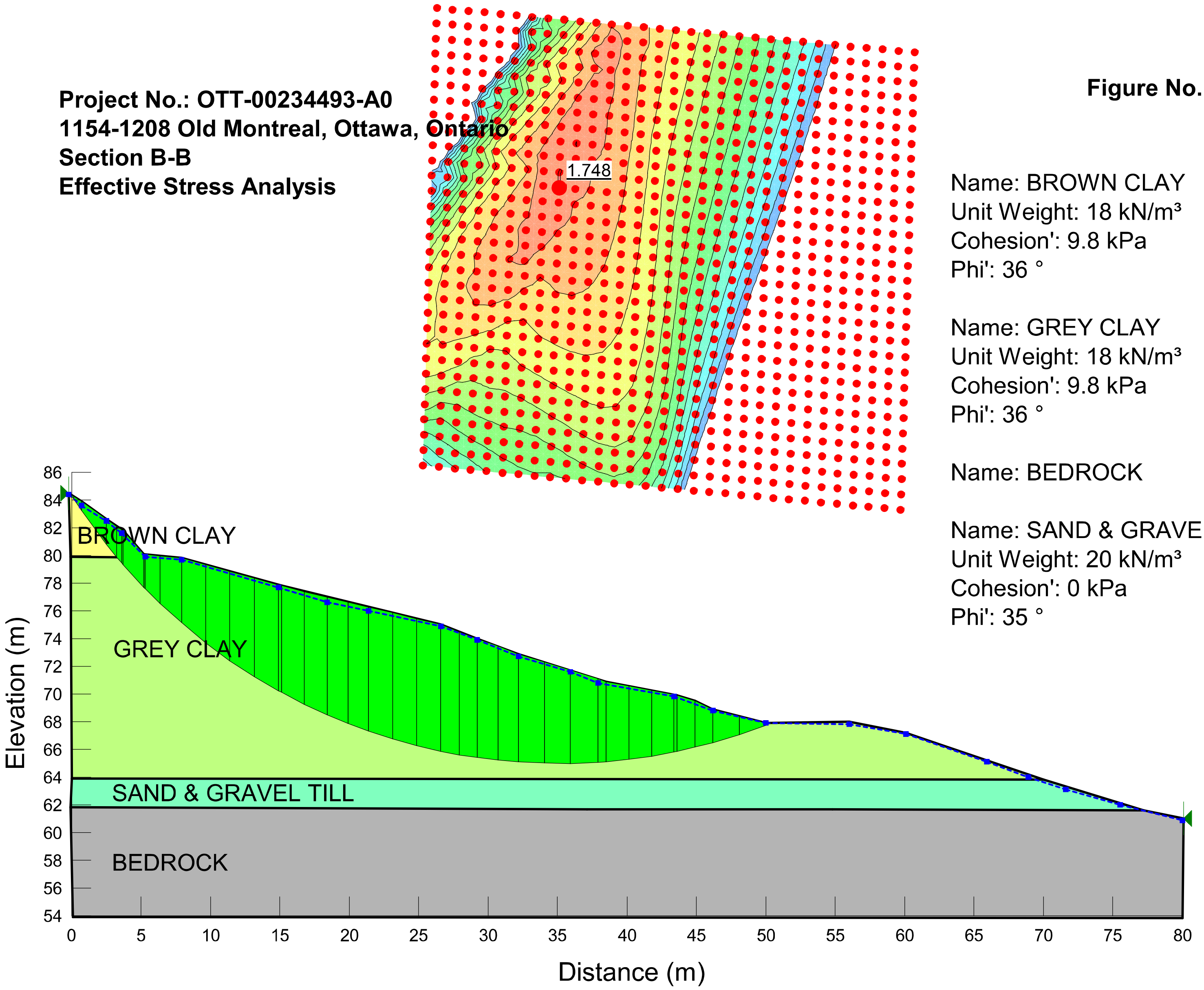
Figure No. 21

Name: BROWN CLAY
Unit Weight: 18 kN/m³
Cohesion': 9.8 kPa
Phi': 36 °

Name: GREY CLAY
Unit Weight: 18 kN/m³
Cohesion': 9.8 kPa
Phi': 36 °

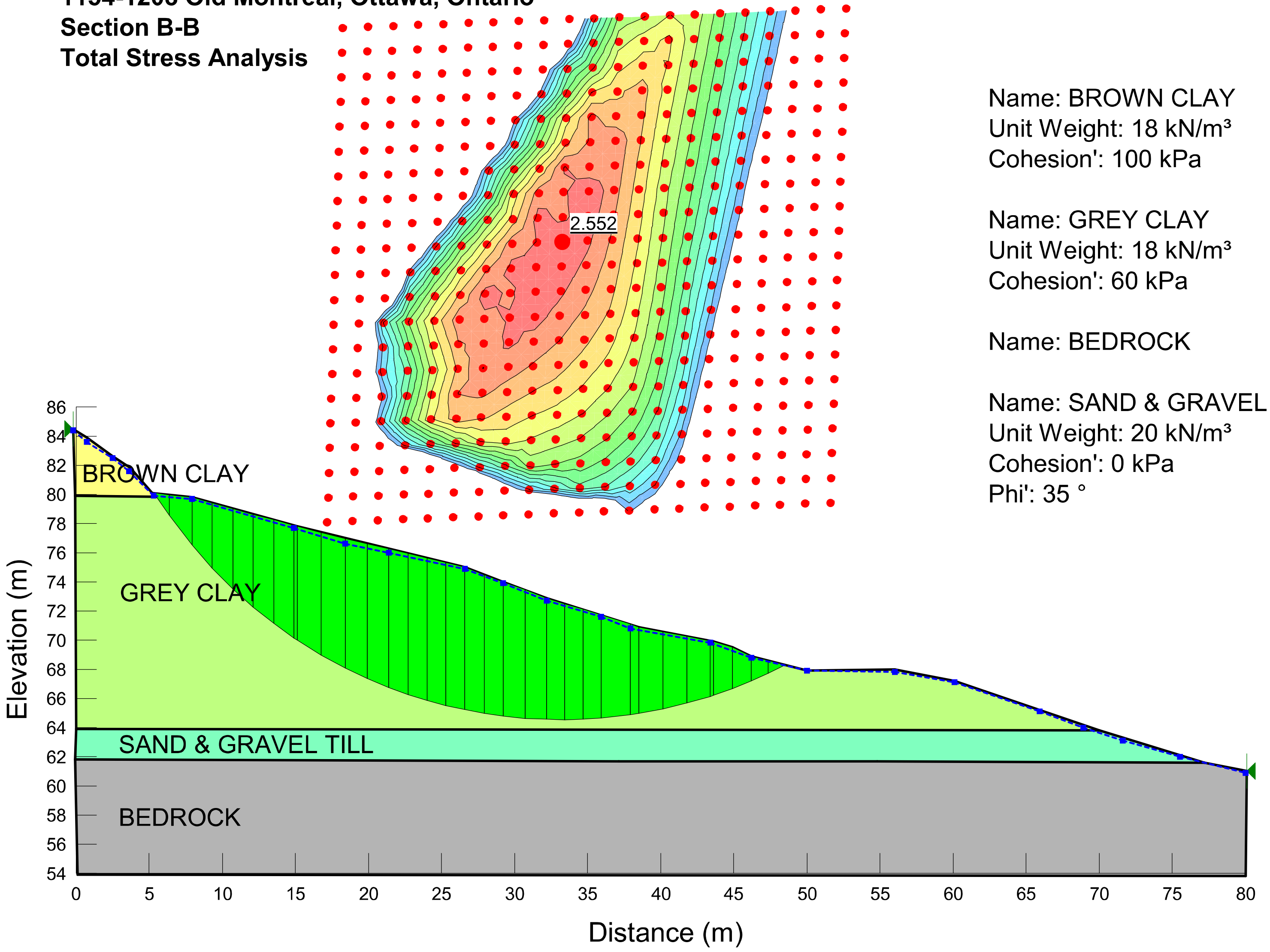
Name: BEDROCK

Name: SAND & GRAVEL TILL
Unit Weight: 20 kN/m³
Cohesion': 0 kPa
Phi': 35 °



Project No.: OTT-00234493-A0
1154-1208 Old Montreal, Ottawa, Ontario
Section B-B
Total Stress Analysis

Figure No. 22



Name: BROWN CLAY
Unit Weight: 18 kN/m³
Cohesion': 100 kPa

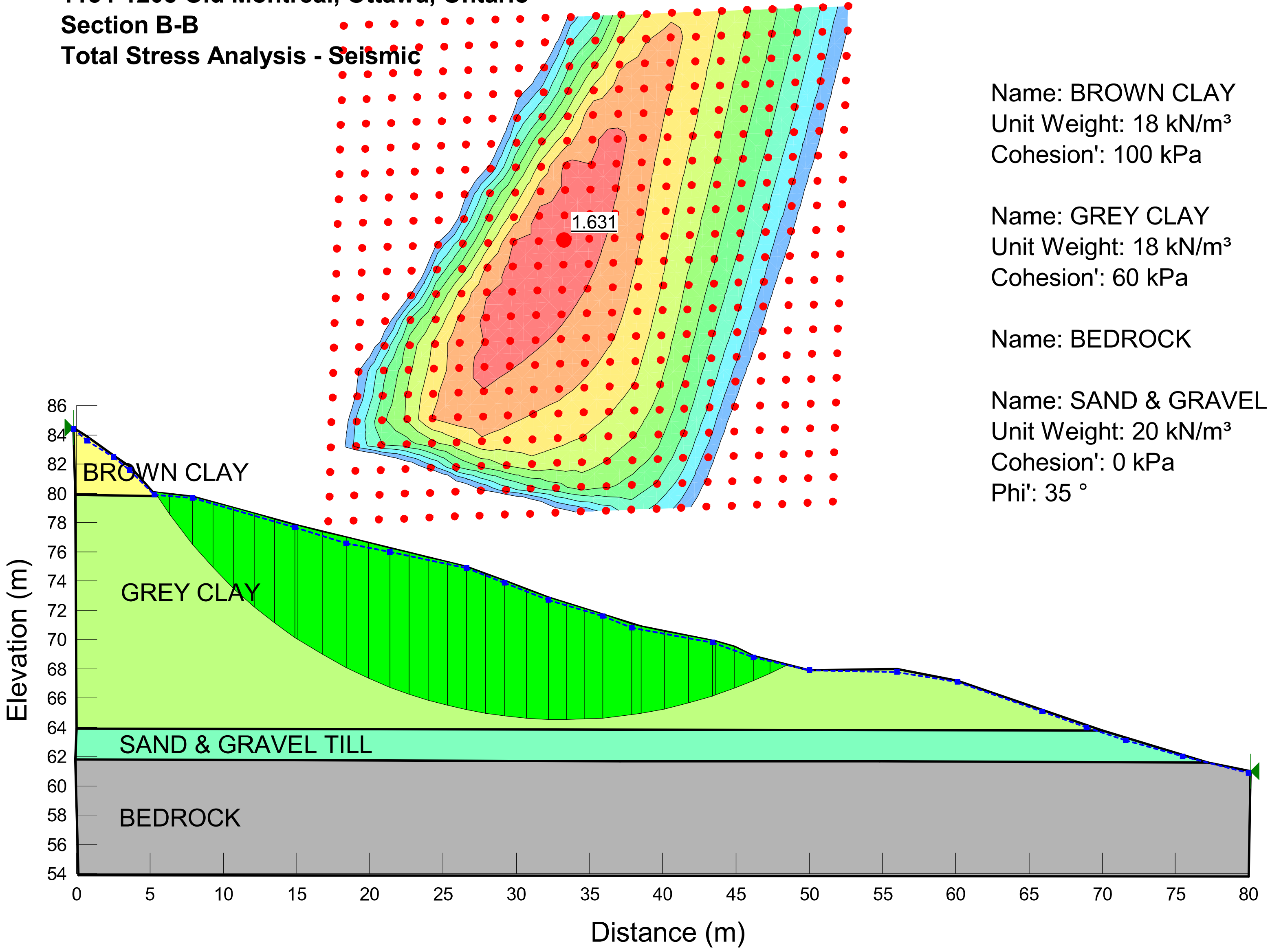
Name: GREY CLAY
Unit Weight: 18 kN/m³
Cohesion': 60 kPa

Name: BEDROCK

Name: SAND & GRAVEL TILL
Unit Weight: 20 kN/m³
Cohesion': 0 kPa
Phi': 35 °

Project No.: OTT-00234493-A0
1154-1208 Old Montreal, Ottawa, Ontario
Section B-B
Total Stress Analysis - Seismic

Figure No. 23



Name: BROWN CLAY
Unit Weight: 18 kN/m³
Cohesion': 100 kPa

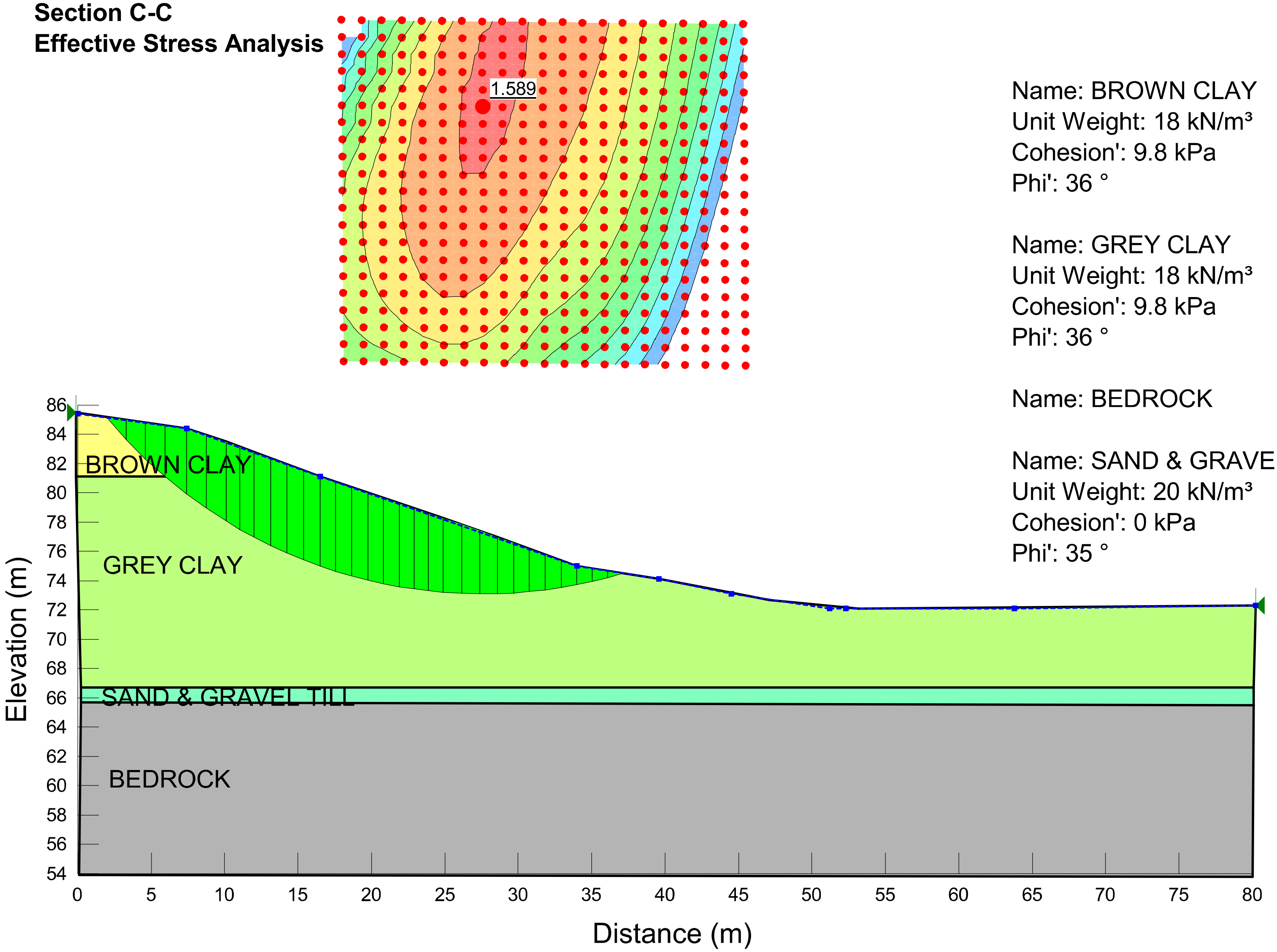
Name: GREY CLAY
Unit Weight: 18 kN/m³
Cohesion': 60 kPa

Name: BEDROCK

Name: SAND & GRAVEL TILL
Unit Weight: 20 kN/m³
Cohesion': 0 kPa
Phi': 35 °

Project No.: OTT-00234493-A0
1154-1208 Old Montreal, Ottawa, Ontario
Section C-C
Effective Stress Analysis

Figure No. 24



Name: BROWN CLAY
Unit Weight: 18 kN/m³
Cohesion': 9.8 kPa
Phi': 36 °

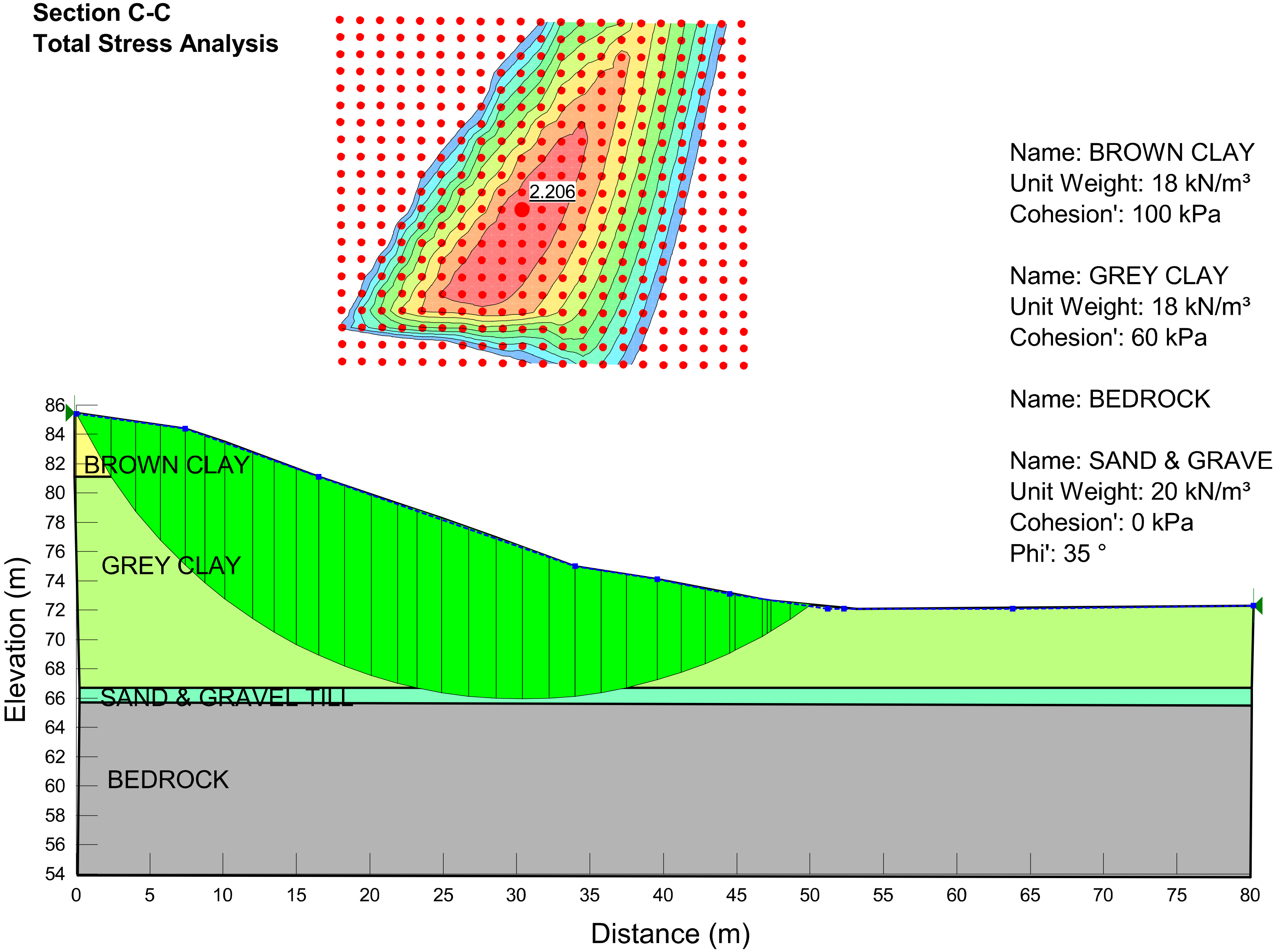
Name: GREY CLAY
Unit Weight: 18 kN/m³
Cohesion': 9.8 kPa
Phi': 36 °

Name: BEDROCK

Name: SAND & GRAVEL TILL
Unit Weight: 20 kN/m³
Cohesion': 0 kPa
Phi': 35 °

Project No.: OTT-00234493-A0
1154-1208 Old Montreal, Ottawa, Ontario
Section C-C
Total Stress Analysis

Figure No. 25



Name: BROWN CLAY
Unit Weight: 18 kN/m³
Cohesion': 100 kPa

Name: GREY CLAY
Unit Weight: 18 kN/m³
Cohesion': 60 kPa

Name: BEDROCK

Name: SAND & GRAVEL TILL
Unit Weight: 20 kN/m³
Cohesion': 0 kPa
Phi': 35 °

Project No.: OTT-00234493-A0
1154-1208 Old Montreal, Ottawa, Ontario
Section C-C
Total Stress Analysis - Seismic

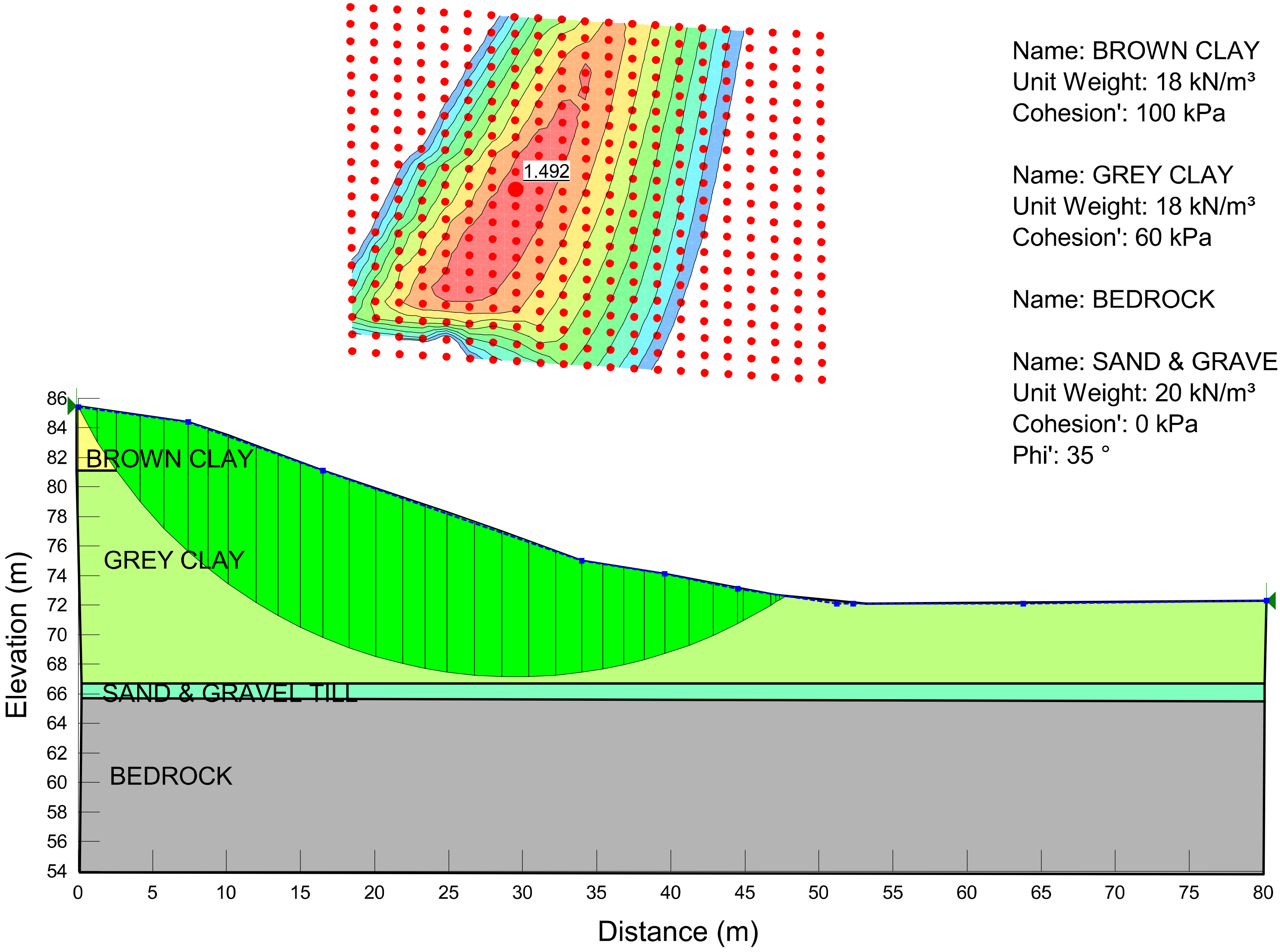
Figure No. 26

Name: BROWN CLAY
Unit Weight: 18 kN/m³
Cohesion': 100 kPa

Name: GREY CLAY
Unit Weight: 18 kN/m³
Cohesion': 60 kPa

Name: BEDROCK

Name: SAND & GRAVEL TILL
Unit Weight: 20 kN/m³
Cohesion': 0 kPa
Phi': 35 °



Appendix A: Photos of Erosion Along Creek Bank

Photograph No. 1
View of creek west of Pedestrian Bridge (Location 1 on Figure 2)

Photograph No. 2:
View of west end of culvert under the roadway (Location 2 on Figure 2)

Photograph No. 3
View of creek looking west from pathway (Location 3 on Figure 2)

Photograph No. 4
View looking west from east side of pathway near creek (Location 4 on Figure 2)

Photograph No. 5
View of creek looking east from Location 5 on Figure 2

Photograph No. 6:
View along creek bank looking west from north bank at Location 6 on Figure 2

Photograph No. 7
View of creek looking north from south bank of creek at Location 7 on Figure 2

Photograph No. 8
View of toe of slope looking west from Location 8 on Figure 2

Photograph No. 9
View of creek looking south from Location 9 on Figure 2

List of Distribution

Report Distributed To:

Mike Boucher, DCR Phoenix Group of Companies: mboucher@phoenixhomes.ca