- **Mr. Steve Smith**

Preliminary Geotechnical Investigation Report

Type of Document
Final

Project Name:
Proposed Residential Subdivision
Part of Lot 20, Concession 4
Township of Beckwith, Ontario

Project Number
OTT-00236288-A0

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Date Submitted
July 21, 2017

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Attention: Mr. Steve Smith

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Legal Notification

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Executive Summary

Exp Services Inc. (**exp**) was retained by Mr. Steve Smith to conduct a geotechnical investigation for a proposed residential subdivision to be located in the southwest corner of the Derry Side Road and Ferguson Road intersection in the Township of Beckwith. The site is legally described as part of Lot 20, Concession 4, Township of Beckwith in the County of Lanark (Figure 1).

It is proposed that the property, covering an area of approximately 16 hectares, be subdivided into 24 residential lots with average lot sizes of the order of 0.6 hectare (1.4 acre). The development will be comprised of single-family dwellings, which may or may not have basements. Each lot will be serviced by private wells and a septic system. The subdivision will have paved roadways. Design details of the subdivision were not available at the time of this geotechnical investigation. Therefore, the comments and recommendations provided in this report should be considered preliminary in nature.

The investigation consisted of drilling three (3) boreholes at the site to 2.1 m to 5.1 m depths and six (6) Test Pits to 1.0 m to 3.4 m depths. It revealed that 75 mm to 300 mm of topsoil in Borehole Nos. 1 to 3 and Test Pit No. 3 is underlain by a layer of silty sand with trace to some gravel, which extends to depths of 0.3 m to 0.8 m. The topsoil and silty sand are underlain by compact to very dense till, which extends to a 1.0 m depth in Borehole No. 3. In Borehole No. 3, the bedrock was cored from depth of 1 to 2.6 m. The bedrock consists of grey dolostone with fine shale layers of Oxford formation. The dolostone was weathered, fractured and oxidized with frequent sandy silt seams up to 1.9 m depth. The bedrock quality is poor.

The groundwater table at the site was established at 0.2 m to 1.9 m depths below the ground surface.

The investigation has revealed that the site is underlain by compact to very dense till and bedrock. Therefore, there are no grade raise restrictions at the site.

The proposed structures may be founded on conventional spread and strip footing foundations set on the till, engineered fill or on the bedrock. The Serviceability Limit State (SLS) bearing pressure of the till and engineered fill is 150 kPa and the factored geotechnical resistance at Ultimate Limit State (ULS) is 225 kPa. The factored ULS resistance of the bedrock may be taken as 480 kPa. Settlements of footings founded on the till or engineered fill are expected to be within the normally tolerated limits of 25 mm total and 19 mm differential movements. Settlements of footings founded on bedrock are expected to be virtually negligible.

For heated structures, a minimum of 1.2 m of earth cover should be provided to footings set on the bedrock and a 1.5 m earth cover is required for footings set on the till or the engineered fill.

All the footing beds should be examined by geotechnical personnel to ensure that the founding stratum is capable of supporting the design bearing pressure and that the footing beds have been prepared adequately.

The lowest level floors of the residences may be constructed as slabs-on-grade. Perimeter and underfloor drainage systems for each building will likely be required.

The excavations at the site may be undertaken as open-cut provided they meet the requirements of the Ontario Occupational Health and Safety Act. The soils are classified as Type 3 and must be cut back at

1H:1V from the bottom of the excavation. For excavations below the groundwater level, the side slopes should be cut back at 2 to 3H:1V from the bottom of the excavation. The bedrock may be excavated with rear vertical sides, subject to examination by a geotechnical engineer. Some scaling back of the bedrock face may be required in areas of weathered bedrock.

Seepage of the 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.

It is anticipated that the majority of the material required for backfilling purposes or as subgrade fill for the project would have to be imported and should preferably conform to the following specification:

- Engineered fill under slabs-on-grade, foundation walls and against basement walls - OPSS 1010 Granular B Type II placed in 300 mm thick lifts and each lift compacted to 98 percent of the SPMDD.
- Backfill in services trenches inside buildings – OPSS 1010 Granular B Type II placed in 300 mm thick lifts and each lift compacted to 95 percent of the SPMDD.
- Trench backfill and subgrade fill in roadways – OPSS 1010 Select Subgrade Material (SSM) placed in 300 mm thick lifts and each lift compacted to 95 percent of the SPMDD.

Pavement structure thickness of the subdivision roads constructed on a glacial till and/or SSM subgrade may consist of 90 mm of asphaltic concrete underlain by 150 mm of Granular A base and 450 mm of Granular B sub-base. The granular sub-base thickness may be decreased to 300 mm of Granular B Type II sub-base on rock subgrade. Transition zone treatment in accordance with OPSD-205.030 should be provided where the subgrade changes from till to bedrock and vice versa. Drainage of the subgrade may be achieved by providing roadside ditches. The ditches should extend at least 300 mm below the subgrade level.

Normal Portland cement may be used in the subsurface concrete at the site.

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

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1 Introduction

Exp Services Inc. (**exp**) was retained by Mr. Steve Smith to conduct a geotechnical investigation for a proposed residential subdivision to be located in the southwest corner of the Derry Side Road and Ferguson Road intersection in the Township of Beckwith. The site is legally described as part of Lot 20, Concession 4, Township of Beckwith in the County of Lanark (Figure 1).

It is proposed that the property, covering an area of approximately 16 hectares, be subdivided into 24 residential lots with average lot sizes of 0.6 hectare (1.4 acres). The development will be comprised of single-family dwellings, which may or may not have basements. Each lot will be serviced by private wells and a septic system. The subdivision will have paved roadways. Details regarding final site grades were not provided at the time of this geotechnical investigation.

The investigation was undertaken to:

a) Establish geotechnical and groundwater conditions at the borehole and test pit locations;

b) Comment on site grade restrictions;

c) Classify the site for seismic site response in accordance with the requirements of the 2012 Ontario Building Code (OBC) and assess the potential for liquefaction of the subsurface soil/rock during a seismic event;

d) Make recommendations regarding the most suitable type of foundations, founding depth, serviceability limit state (SLS) bearing pressure and factored geotechnical resistance at ultimate limit state (ULS) of the founding soil/engineered fill/rock;

e) Estimate anticipated total and differential settlements;

f) Discuss slab-on-grade construction and permanent drainage requirements;

g) Comment on the lateral earth pressure (static and seismic conditions) against subsurface walls;

h) Comment on excavation conditions and de-watering requirements during construction;

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

j) Recommend pavement structure thickness for the subdivision roadways; and

k) Comment on the corrosion potential of the subsurface soil to buried concrete and metal structures/members.

The comments and recommendations given in this report are 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.

A hydrogeological investigation, terrain analysis and impact assessment was undertaken by **exp** in conjunction with this geotechnical investigation and the results are reported under separate report.

2 Site Description

The site consists of approximately 16 hectares of land located approximately 14.7 km west of the Town of Carleton Place and 19.2 km southeast of the Village of Richmond. The site is accessed via Derry Side Road and located to the southwest of the intersection between Derry Side Road and Ferguson Road; approximately 1 km north of Richmond Road, (Figures 1 & 2). The site is bounded to the northwest by Ferguson Road, to the northeast by Derry Side Road, to the east by a stable and to the south by forested land.

The subject site is mostly wooded and relatively flat with some site influences associated with the municipal drain that traverses the centre of the property and borders the northwest. The site was deemed poorly draining based on evident water on the site during the spring drilling. No visible bedrock outcrops and/or significant grade changes were noted on site.

3 Procedure

The fieldwork for this investigation was undertaken between April 3 and 18, 2017 and comprised the excavation of six (6) test pits (Test Pit Nos. 1 and 6) to 1.0 to 3.4 m depth and the drilling of three (3) boreholes (Borehole Nos. 1 to 3) to auger/casing refusal depths ranging between 1 m and 5.1 m. Borehole No. 3 was cased and the bedrock was core drilled from 1 m depth to termination depth of 2.6 m.

Prior to commencement of the fieldwork, the locations of the testholes (boreholes and test pits) were established on site by **exp**. Testholes could not be located in the northwest portion of the site, since this area was inaccessible to the drillrig and excavator. It is recommended that once access is made available to this area of the site, additional boreholes and test pits be conducted to establish the subsurface conditions in the northwest portion of the site. The borehole and test pit locations were cleared of private and public underground services by USL-1 Cable Locators. The approximate locations of the test pits and boreholes are presented in Figure 2.

Borehole No. 1 was undertaken with a CME 750 truck-mounted drill rig and Borehole Nos. 2 and 3 were undertaken by a CME 850 truck-mounted drill rig. Standard penetration tests were performed in all the boreholes at 0.6 m and 0.75 m depth intervals, with soil samples retrieved by the split-barrel sampler in accordance with ASTM 1586. The boreholes were advanced with hollow-stem auger and casing to refusal at 1 m to 5.1 m depths. Borehole No. 3 was then cased and the bedrock was core drilled using NQ-size core barrel. During bedrock coring, a careful record of any sudden drops of the drill rods, colour of wash water and wash water return was kept.

The test pits were excavated using a rubber-tired excavator. Grab samples were collected from selected depths in the test pits. Upon completion of the excavation, 52 mm diameter monitoring wells were installed in Test Pit Nos. 1 to 3 to monitor the groundwater level over time. The installation configuration is documented on the respective test pit logs.

The remaining testholes were backfilled on completion of the fieldwork and the backfill of the test pits was nominally packed in place with the excavator bucket.

All the soil samples were visually examined in the field for textural classification, logged, preserved in plastic bags and identified. Similarly, all the rock cores were placed in core boxes, identified, visually examined and logged. On completion of the fieldwork, all the soil samples and rock cores were transported to the **exp** laboratory in the City of Ottawa, Ontario.

All the soil samples were visually examined and the rock cores were logged in the laboratory by geotechnical engineer. The engineer also assigned the laboratory testing which consisted of performing natural moisture content and unit weight determination, grain-size analysis and corrosion analyses (pH, chloride, sulphate content and electrical resistivity determinations) on selected soil samples.

4 Soil Description

Detailed descriptions of the geotechnical conditions encountered in the boreholes and test pits are given on borehole/test pit logs, Figures 3 to 11 inclusive. The borehole/test pit 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. Test pits were excavated and boreholes were drilled/cored to provide representation of subsurface conditions as part of a geotechnical exploration program and are not intended to provide evidence of potential environmental conditions.

It should be noted that the soil boundaries indicated on the testhole 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/test pit logs forms an integral part of this report and should be read in conjunction with this report.

A review of the borehole and test pit logs indicates the following subsurface soil, bedrock and groundwater conditions with depth.

4.1 Topsoil

The site is covered by 75 mm to 300 mm thick topsoil layer.

4.2 Silty Sand

The topsoil in Borehole Nos. 1 to 3 and Test Pit No. 3 is underlain by a layer of silty sand with trace to some gravel, which extends to depths of 0.3 m to 0.8 m. The silty sand is brown to dark brown roots/rootlets. This stratum is very loose to loose as indicated by ‘N’ values of 1 to 6. Its moisture content varies from 9 to 25 percent.

4.3 Till

The topsoil and silty sand are underlain by glacial till to 1 m to 5.1 m depth. The till consists of different proportions of silt, sand and gravel with trace to some clay. This stratum is compact to very dense as indicated by ‘N’ values of 17 to 128. Its moisture content varies from 8 to 20 percent. The unit weight of the till ranges between 19 and 21.4 kN/m^3.

Five grain-size analyses performed on samples of the till stratum are given on Figures 12 to 16 inclusive. A review of these figures indicates that this stratum is comprised of 5 to 13 percent silt and clay, 18 to 49 percent sand and 18 to 74 percent gravel.

4.4 Bedrock/Inferred Bedrock

Refusal to augering/casing was met in all the boreholes at 1.0 m to 5.1 m depths on inferred bedrock, cobbles and/or boulders. In Borehole No. 3, the bedrock was cored from 1 m depth to termination depth of 2.6 m. Test Pit Nos. 2 to 6 terminated on the bedrock surface at depths ranging from 1.0 to 2.5 m.

The bedrock consists of grey dolostone with fine shale layers of the Oxford Formation. The dolostone is weathered, fractured and oxidized with frequent sandy silt seams in the upper level up to 1.9 m depth. Below 1.9 m depth, the bedrock has occasional vertical calcite veins and sandy silt seams.

A Total Corey Recovery (TCR) and Rock Quality Designation (RQD) of 100 percent and 44 percent respectively was obtained when core drilling the bedrock. On this basis, the bedrock quality within these depths can be described as poor.

4.5 Groundwater Table

Water level observations were made in the monitoring wells installed in Test Pit Nos. 1 to 3 and the observations are summarized in Table No. I. Groundwater levels were recorded at depths ranging from 0.2 m to 1.9 m below the existing ground surface. It is subject to seasonal fluctuations and may be at a higher depth during wet weather periods.

Table No. I: Summary of Groundwater Levels

Test Pit No.	Elapsed Days	Depth (1) to Water Level (m)	Elapsed Days	Depth (1) to Water Level (m)
TP1	1 day	2.7	24 days	1.9
TP2	3 days	At Ground Surface	24 days	0.4
TP3	2 days	0.09	24 days	0.2
Note: (1) : Depth is below existing ground surface.				

Water levels were made in the exploratory test pits at the times and under the conditions stated in the scope of services. These data were reviewed and **exp**'s interpretation of them discussed in the text of the report. Note that fluctuations in the level of the groundwater may occur due to 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.

5 Grade Raise Restriction

The site is underlain by glacial till and bedrock. Clayey soils were not encountered at the site. Therefore, there are no grade raise restrictions at the site.

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

The geotechnical investigation has revealed that the proposed development is underlain by compact to very dense till, which extends to a depth of 1 m to 5.1 m below the existing ground surface. The overburden is underlain by bedrock. The site has therefore been classified as Class C for seismic site response in accordance with Table 4.1.8.4.A of the 2012 Ontario Building Code. A higher site class can be likely obtained if shear wave velocity measurement is completed at the site.

Geotechnical investigation has indicated that the till is not susceptible to liquefaction during a seismic event.

7 Site Grading

Details regarding the final site grades were not provided at the time of this investigation. Based on a review of the subsurface conditions, it is considered feasible to support the building foundations on the native glacial till, bedrock or on engineered fill pad as discussed in Section 8 of this report. The procedure for the construction of the engineered fill is discussed below.

As part of the site preparation, the site grading within the footprint of the proposed buildings and paved areas should consist of the excavation and removal of all topsoil, any fill and any organic stained soils from the site. Any soft/loose areas identified in the interior of the buildings footprint should be excavated and replaced with Ontario Provincial Standard Specification (OPSS 1010 as amended by SSP110S13) Granular B Type II compacted to 98 percent standard Proctor maximum dry density (SPMDD).

Following approval of the exposed subgrade, the grades may be raised to the underside of the floor slab by the placement of engineered fill consisting of OPSS 1010 Granular B Type II placed in 300 mm thick lifts and each lift compacted to 98 percent of the SPMDD.

If the footings for the residences will be founded on an engineered fill pad, the excavation for the removal of unsuitable material should be as noted above and should extend a sufficient distance beyond the limits of the proposed structure to accommodate a 1.0 m wide bench of engineered fill around the perimeter of the structure, which is thereafter sloped at an inclination of 1H:1V. The exposed subgrade should be evaluated by a geotechnical engineer prior to placement of engineered fill.

For the proposed parking areas and roadways, the site grades may be raised to the design subgrade level by the placement of OPSS 1010 select site material (SSM) compacted to 95 percent of the SPMDD.

In-place density tests should be performed on each lift of placed material to ensure that it has been compacted to the project specifications.

8 Foundation Considerations

The investigation has revealed that the site is underlain by silty sand layer and glacial till which extends to bedrock surface encountered at depths ranging between 1 m and 2.5 m. The proposed residential buildings can be supported on spread and strip footings set on native undisturbed till, bedrock or on engineered fill constructed on the native undisturbed glacial till. Final design details for the proposed subdivision were not available at the time of this report. Therefore, the geotechnical comments and recommendations provided in the following sections of this report are preliminary in nature. Once final design details of the subdivision are available, a detailed geotechnical investigation consisting of additional boreholes and/or test pits should be conducted at each lot for the purpose of assessing the lot specific subsurface conditions and providing detailed geotechnical comments and recommendations for the design and construction of each individual residential building.

The geotechnical conditions at the site vary from a surficial till deposit to bedrock at shallow depth over the majority of the site. Footings of the proposed residences may be founded on the bedrock below any weathered fractured zones and designed for factored geotechnical resistance at Ultimate Limit State (ULS) of 480 kPa. Footings founded on the till or on an engineered fill pad constructed as per Section 7 of this report, may be designed for serviceability limit state (SLS) bearing pressure of 150 kPa and factored geotechnical resistance at ultimate limit state (ULS) of 225 kPa. In the case where some footings will be founded on engineered fill/glacial till and bedrock, **exp** should be contacted to provide transition zone detail for foundations.

Settlement of the footings set on the native glacial till or engineered fill pad and designed for the SLS value recommend above and properly constructed are expected to be within the normally tolerated limits of 25 mm total and 19 mm differential. Settlements of footings set on the bedrock are expected to be virtually negligible.

A minimum of 1.5 m of earth cover should be provided to all the exterior footings of heated structures founded on the till or engineered fill 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.

A minimum of 1.2 m of earth cover should be provided to all the exterior footings of heated structures founded on bedrock. Footings of unheated structure founded on bedrock should be provided with a cover of 1.8 m if snow would not be cleared from their vicinity. If snow would be cleared from their vicinity, they should be provided with 2.1 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.

8.1 General Comment

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.

9 Floor Slab and Drainage Requirements

The lowest level floors of the proposed buildings may be constructed as slabs-on-grade provided they are set on beds of well compacted 19 mm clear stone at least 300 mm thick placed on the natural soil or on well compacted fill as discussed in Section 7. The clear stone would prevent the capillary rise of moisture from the sub-soil to the floor slab.

Final design grades and building floor slab elevations for the proposed subdivision were not available at the time of this report. However, because of the high level of the ground water level, it is likely that perimeter as well as underfloor drains will be required for the proposed buildings. The need for the perimeter and underfloor drains can be confirmed during the detailed geotechnical investigation for each lot. The exterior grade should be sloped away from the structures at an inclination of 1 to 2 percent to prevent surface ponding close to the exterior walls.

10 Lateral Earth Pressure against Subsurface Walls

The subsurface walls should be backfilled with free draining material, such as OPSS Granular B Type II and provided with a permanent drainage system to prevent the build-up of hydrostatic pressure behind the walls. The walls will be subjected to lateral static and dynamic (seismic) earth pressures.

The lateral static earth pressure against the subsurface wall may be computed from the following equation:

$$P = K_0 (\gamma h + q)$$

where P = lateral earth pressure acting on the subsurface wall; kPa

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 Type II = 22 kN/m^3

h = depth of interest below final grade behind wall, m

q = surcharge load, kPa

The lateral force due to seismic loading may be computed from the equation given below:

$$\Delta P_E = (a_h/g).\ Fp.\gamma.H^2 = 0.32\ \gamma\ H^2$$

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

a_h = pseudo static horizontal acceleration, a_h=0.32 g (Ottawa).

F_p = dimensionless dynamic thrust factor, (Wood, 1973).

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 and it should be assumed to act at about 0.6 H from the bottom of the wall.

11 Excavations and De-Watering Requirements

Excavations for the construction of spread and strip footings and installation of any underground services at the site are expected to extend to a maximum depth of 2 to 3 m below the existing ground surface. The excavations will be undertaken predominantly in the glacial till and bedrock. These excavations are expected to be below groundwater table.

The till at the site may be excavated with conventional mechanical equipment capable of removing cobbles and boulders within the till. Excavation of the bedrock would require the use of drilling and blasting techniques. The blasting should be carried out by an experienced contractor under the supervision of a blasting specialist to ensure that integrity of any existing structures and underground services is not adversely affected. A condition survey of the existing structures, groundwater wells and services in the vicinity of the work area should be undertaken prior to commencement of construction. Vibrations generated by blasting operations should be monitored and should not exceed 50 mm per second at the property boundaries. Alternatively, the bedrock may be excavated with a hoe ram. However, the progress is anticipated to be slow.

The excavations at the site may be undertaken as open-cut provided they meet the requirements of the Ontario Occupational Health and Safety Act. The soils are classified as Type 3 and must be cut back at 1H:1V from the bottom of the excavation. For excavations below the groundwater level, the side slopes should be cut back at 2 to 3H:1V from the bottom of the excavation. The bedrock may be excavated with rear vertical sides, subject to examination by a geotechnical engineer. Some scaling back of the bedrock face may be required in areas of weathered bedrock.

Seepage of the 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.

It has been assumed that the maximum excavation depth at the site will be approximately 2 to 3 m and would necessitate groundwater removal from the site. It is noteworthy to mention that new legislation came into force in Ontario on March 29, 2016 to regulate groundwater takings for construction dewatering purposes. Prior to March 29, 2016, a Category 2 Permit to Take Water (PTTW) was required from the Ontario Ministry of the Environment and Climate Change (MOECC) for groundwater takings related to construction dewatering, where taking volumes in excess of 50 m^3/day, but less than 400 m^3/day, and the taking duration was no more than 30 consecutive days. The new legislation replaces the Category 2 PTTW for construction dewatering with a new process under the Environmental Activity and Sector Registry (EASR). The EASR is an on-line registry, which allows persons engaged in prescribed activities, such as water takings, to register with the MOECC instead of applying for a PTTW.

To be eligible for the new EASR process, the construction dewatering taking must be less than 400 m^3/day under normal conditions. The water taking can be groundwater, storm water, or a combination of both. It should be noted that the 30-consecutive day limit on the water taking under the old Category 2 PTTW process has been removed in the new EASR process. Also, it should be noted that the EASR process requires two technical studies be prepared by a Qualified Person, prior to any water taking. These studies include a Water Taking Report, which provides assurance that the taking will not cause any unacceptable impacts, and a Discharge Plan, which provides assurance that the discharge will not result in any adverse impacts to the environment. A significant advantage of the new EASR

process over the former Category 2 PTTW process, is that the groundwater taking may begin immediately after completing the on-line registration of the taking and paying the applicable fee, assuming the accompanying technical studies have been completed. The former PTTW process typically took more than 90 days, which had the potential to impact construction schedules. Exp can provide assistance during the EASR/PTTW process, if required.

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 adequately engineer construction dewatering systems.

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.

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

The on-site soils to be excavated are anticipated to consist of silty sand, glacial till and bedrock. Select portions of the silty sand and glacial till (no cobbles and boulders) from above the groundwater level may be used in service trenches outside the building area, subject to further examination and testing during the early stages of construction. These soils are moisture sensitive and should be protected from the effects of weather if stockpiled on site. The glacial till below the groundwater level are considered too wet to achieve the required degree of compaction. Therefore, the glacial till may be used for general grading purposes in landscaped areas, provided the moisture content of these soils is lowered by air-drying in the sun and the till does not include cobbles and boulders. The blast shattered rock will not be suitable for backfilling against subsurface walls or in footing and service trenches. The exception to this would be if the blast shattered rock is crushed to meet the physical properties and gradation requirements of OPSS Granular B Type II. Shale layers should be removed from the rock designated for crushing.

It is anticipated that the majority of the material required for backfilling purposes or as subgrade fill for the project would have to be imported and should preferably conform to the following specification:

- Engineered fill under slabs-on-grade, foundation walls (no basement) and against basement walls - OPSS 1010 Granular B Type II placed in 300 mm thick lifts and each lift compacted to 98 percent of the SPMDD.
- Backfill in services trenches inside buildings – OPSS 1010 Granular B Type II placed in 300 mm thick lifts and each lift compacted to 95 percent of the SPMDD.
- Trench backfill and subgrade fill in roadways – OPSS 1010 Select Subgrade Material (SSM) placed in 300 mm thick lifts and each lift compacted to 95 percent of the SPMDD.

13 Subsurface Concrete Requirements

Chemical tests limited to pH, chloride, sulphate and electrical resistivity tests were performed on two (2) selected soil samples. The results presented in Table No. II.

Table No. II: Results of pH, Chloride, Sulphate and Electrical Resistivity Tests on Soil Samples

Test Pit No.	Soil	Depth (m)	pH	Sulphate (%)	Chloride (%)	Electrical Resistivity Ohm.cm
Threshold Values			**<5**	**>0.1**	**>0.04**	**<1500 ohm.cm High corrosion potential**
TP-5	Till:Sand and Gravel	0.3-0.9	7.5	<0.0002	0.0012	8330
TP-6	Till:Sand and Gravel	0.3-1.4	7.6	<0.0002	<0.0002	12200

The results indicate a soil with a sulphate content of less than 0.1 percent. These concentrations of sulphate in the soil would have a negligible potential of sulphate attack on subsurface concrete. The chloride content is less than the threshold value of 0.04 percent. The concrete should be designed in accordance with Table Nos. 3 and 6 of CSA A.23.1-14. However, the concrete should be dense, well compacted and cured. Certificate of the laboratory test results is attached in Appendix A.

The results of the electrical resistivity tests indicate that the soil corrosivity is weakly to moderately aggressive to buried steel. A corrosion expert should be contacted to provide recommendations.

14 Pavement Structure for Subdivision Roads

Pavement structure thicknesses required for the subdivision roadways were computed. The road subgrade is expected to be till and/or SSM. It is possible that bedrock will be encountered at shallow depths and form portions of the road subgrade. The pavement structures are shown on Table No. III. The thicknesses are based upon an estimate of the subgrade soil properties determined from visual examination and textural classification of the soil samples and pavement functional design life of eight to ten years. The proposed functional design life represents the number of years to the first rehabilitation, assuming regular maintenance is carried out.

Table No. III: Recommended Pavement Structure Thicknesses

Pavement Layer	Compaction Requirements	Pavement Structure Thickness	
		Bedrock Subgrade	SSM/Till Subgrade
Asphaltic Concrete (PG 58-34)	92-97% Maximum Relative Density	40 mm SP12.5-Cat C 50 mm SP19 Cat C	40 mm SP12.5-Cat C 50 mm SP19 Cat C
OPSS Granular "A" Base (crushed limestone)	100% SPMDD*	150 mm	150 mm
OPSS Granular "B" Sub-Base, Type II	100% SPMDD*	300 mm	450 mm

* *Denotes standard Proctor maximum dry density, ASTM-D698.*
Any subgrade fill must be compacted to 98% SPMDD for at least the upper 300 mm.

Transition zone treatment should be provided where the road subgrade changes from till/engineered fill to bedrock and vice versa. The transition zone treatment should be provided in accordance with OPSD-205.030. The transition treatment depth 't' should be assumed as 1340 mm.

Additional comments on the construction of the subdivision roads are as follows:

1. As part of the subgrade preparation, the proposed roadway areas should be stripped of topsoil and other obviously unsuitable material. Fill required to raise the grades to design elevations should conform to requirement as per Section 7 and should be placed and 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 approved backfill compacted to 95% SPMDD (ASTM D698-12e2).

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 drainage cannot be over-emphasized. In view of the measured high groundwater levels, drainage ditches should be installed on both sides of the roadway(s) and suitably outletted. Further, the invert depth of the ditches should be 300 mm below the subgrade level. Once the grading plan for the

subdivision is available, **exp** can provide additional details regarding the drainage ditches along the roads.

3. The most severe loading conditions on pavement areas and the subgrade may occur during construction. Consequently, special restrictions such as restricted lanes and half-loads during paving may be required, particularly if construction is carried out during unfavorable weather.

4. 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 the ditches. Surface water should not be allowed to pond adjacent to the outside edges of paved areas.

5. The granular materials used for pavement construction should conform to Ontario Provincial Standard Specifications (OPSS 1010) for Granular A and Granular B Type II and should be compacted to 100 percent of the SPMDD.

6. It should be noted that due to the variable nature of the subgrade soils, some cracking of the asphalt may occur as a result of long term settlements. In this regard, it is recommended the surface course of asphalt should be delayed for about a year after the binder course is put down, where practical.

The asphaltic concrete used and its placement should meet OPSS 1150 or 1151 requirements. It should be compacted to between 92 and 97 percent of the Maximum Relative Density (ASTM D2041). Asphalt placement should be in accordance with OPSS 310 and OPSS 313. It is recommended that **exp** be retained to review the final pavement structure design and drainage plans prior to construction to ensure they are consistent with the recommendations of this report.

15 Additional Geotechnical Investigation

Once design details are available, it is recommended that a geotechnical investigation be undertaken for each lot and in the currently inaccessible northwest portion of the site.

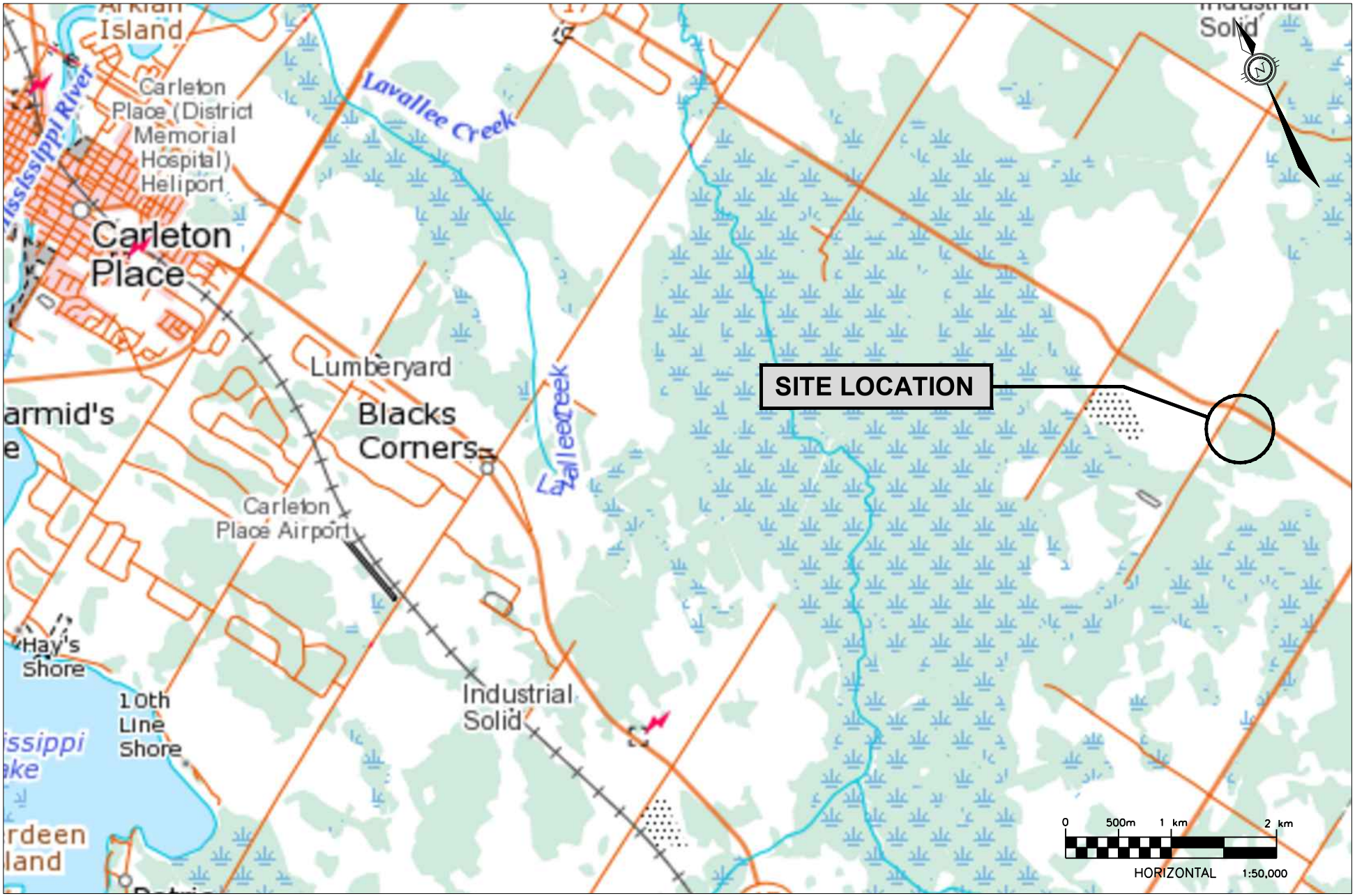
16 General Comments

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes and test pits required to determine the localized underground conditions between boreholes and test pits 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



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• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

scale	1:50,000
date	JUNE 2017
drawn by	J.R.
CLIENT:	MR. STEVE SMITH
project no.	OTT-00236288-A0
TITLE:	SITE LOCATION PLAN DERRY SIDE ROAD, TOWNSHIP OF BECKWITH, ON PROPOSED RESIDENTIAL SUBDIVISION
	FIG 1

Filename: r:\23000\236000\236288-a0 derry side road, lanark\geotechnical\236288-geo.1.dwg
Last Saved: 6/26/2017 3:33:57 PM Plotted by: RevellJ Pen Table:: trow standard, july 01, 2004.ctb
Last Plotted: 6/26/2017 3:34:27 PM

NOTES :

1. THE BOUNDARIES AND SOIL TYPES HAVE BEEN ESTABLISHED ONLY AT BOREHOLE AND TEST PIT 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. THIS DRAWING FORMS PART OF THE REPORT PROJECT NUMBER AS REFERENCED AND SHOULD BE USED ONLY IN CONJUNCTION WITH THIS REPORT.
5. BASE PLAN OBTAINED FROM Stantec Geomatics Ltd.,

LEGEND

TP5 TESTHOLE LOCATION & NUMBER

BH3 BOREHOLE LOCATION & NUMBER

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scale 1:2500	CLIENT: MR. STEVE SMITH	project no. OTT-00236288-A0
date JUNE 2017	TITLE: SITE LOCATION PLAN DERRY SIDE ROAD, TOWNSHIP OF BECKWITH, ON PROPOSED RESIDENTIAL SUBDIVISION	FIG 2
drawn by J.R.		

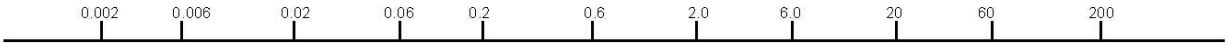
Filename: r:\23000\00236000\236288-a0 derry side road, lanark\geotechnical\236288-geo.1.dwg
Last Saved: 6/26/2017 3:41:12 PM Plotted by: ReveilJ Pen Table:: trow standard, july 01, 2004.ctb
Last Plotted:6/26/2017 3:47:15 PM

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.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

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 BH1

Project No: OTT-00236288-A0

Project: Geotechnical Investigation, Proposed Residential Subdivision

Location: Derry Side Road, Beckwith Township, ON

Figure No. 3

Page. 1 of 1

Date Drilled: April 11th, 2017

Drill Type: CME 750

Datum: Below Grade

Logged by: MAD Checked by: RA/ZG

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Below Grade m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~ 75 mm	0	0	6			
		SILTY SAND Some gravel, presence of roots, brown, moist to wet, (loose).	-0.1					
		TILL Sandy gravel to gravel with some sand, trace to some silt, cobbles and boulders, brown to grey, moist to wet, (very dense).	-0.8	1	61			
				2	115			
				2	128			
				3	76			
				4	88			
				4	50/75mm			19.0
			-5.1	5				
		Casing Refusal at 5.1 m Depth						

LOG OF BOREHOLE LOGS OF BOREHOLES AND TESTPITS - APRIL 2017.GPJ TROW OTTAWA.GDT 6/26/17

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. The borehole was backfilled 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-00236288-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 BH2

Project No: OTT-00236288-A0

Project: Geotechnical Investigation, Proposed Residential Subdivision

Location: Derry Side Road, Beckwith Township, ON

Figure No. 4

Page. 1 of 1

Date Drilled: April 18th, 2017

Drill Type: CME 850 trackmount

Datum: Below Grade

Logged by: MAD Checked by: RA/ZG

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Below Grade m	Depth
		TOPSOIL ~ 300 mm	0	0
		SILTY SAND	-0.1	
		Some gravel, presence of roots, brown to dark brown, moist to wet, (very loose).	-0.6	
		TILL Silt and sand with some gravel and clay to sand and gravel, some silt and trace clay, cobbles and boulders, brown to grey, moist to wet (compact to vey dense).		1
				2
			-2.1	
		Auger Refusal at 2.1 m Depth, Borehole Terminated		

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/m³

1 ○
17 ○
61 ○
× ×
× ×

LOG OF BOREHOLE LOGS OF BOREHOLES AND TESTPITS - APRIL 2017.GPJ TROW OTTAWA.GDT 6/26/17

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. The borehole was backfilled 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-00236288-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 BH3

Project No: OTT-00236288-A0

Project: Geotechnical Investigation, Proposed Residential Subdivision

Location: Derry Side Road, Beckwith Township, ON

Figure No. 5

Page. 1 of 1

Date Drilled: April 18th, 2017

Drill Type: CME 850 trackmount

Datum: Below Grade

Logged by: MAD Checked by: RA/ZG

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Below Grade 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/m³
		TOPSOIL ~ 130 mm	0	0				
		SILTY SAND	-0.1					
		Some gravel, presence of roots, brown to dark brown, moist to wet, (very loose).	-0.3		2			
		TILL			50/75 mm			21.4
		Sand and gravel, some silt, cobbles and boulders, brown to grey, moist to wet (very dense).	-1.0	1				
		WEATHERED & FRACTURED DOLOSTONE BEDROCK	-1.9					RUN1
		Oxidized, frequent sandy silt seams.		2				
		DOLOSTONE BEDROCK						
		Grey, fine shale layers, occasional vertical calcite veins, occasional sandy silt seams, (poor quality)	-2.6					
		Borehole Terminated at 2.6 m Depth						

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. The borehole was backfilled 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-00236288-A0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	0.99 - 2.64	93	44

LOG OF BOREHOLE LOGS OF BOREHOLES AND TESTPITS - APRIL 2017.GPJ TROW OTTAWA.GDT 6/26/17

Log of Test Pit TP1

Project No: OTT-00236288-A0

Project: Geotechnical Investigation, Proposed Residential Subdivision

Location: Derry Side Road, Beckwith Township, ON

Figure No. 6

Page. 1 of 1

Date Drilled: April 3rd, 2017

Drill Type: Takeuchi TB175 Excavator

Datum: Below Grade

Logged by: MAD Checked by: RA/ZG

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test —
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—⊖
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Below Grade m	Depth
		TOPSOIL ~ 180 mm	0	0
		-0.2		
		TILL		
		Sand and gravel, trace to some silt, cobbles and boulders, brown to grey, moist to wet.		1
				2
				3
			-3.4	
		Testpit Terminated at 3.4 m Depth		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60
SAMPLE: 129
Natural Unit Wt. kN/m³

LOG OF BOREHOLE LOGS OF BOREHOLES AND TESTPITS - APRIL 2017.GPJ TROW OTTAWA.GDT 6/26/17

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A Piezometer with a 52 mm slotted standpipe was installed in the testpit 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-00236288-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
completion	1.5	2.1
1 day	2.7	-
24 days	1.9	

CORE DRILLING RECORD

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

Log of Test Pit TP2

Project No: OTT-00236288-A0

Project: Geotechnical Investigation, Proposed Residential Subdivision

Location: Derry Side Road, Beckwith Township, ON

Figure No. 7

Page. 1 of 1

Date Drilled: April 3rd, 2017

Drill Type: Takeuchi TB175 Excavator

Datum: Below Grade

Logged by: MAD Checked by: RA/ZG

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits |—⊖
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Below Grade m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~ 130 mm	0	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
		TILL	-0.1					
		Sand and gravel, cobbles and boulders, brown to grey, moist to wet.						
			-1.0	1				
		Testpit Terminated at 1.0 m Depth on Bedrock						

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A Piezometer with a 52 mm slotted standpipe was installed in the testpit 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-00236288-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
completion	1.0	
2 days	0.0	-
3 days	0.0	-
24 days	0.4	

CORE DRILLING RECORD

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

LOG OF BOREHOLE LOGS OF BOREHOLES AND TESTPITS - APRIL 2017.GPJ TROW OTTAWA.GDT 6/26/17

Log of Test Pit TP3

Project No: OTT-00236288-A0

Project: Geotechnical Investigation, Proposed Residential Subdivision

Location: Derry Side Road, Beckwith Township, ON

Figure No. 8

Page. 1 of 1

Date Drilled: April 3rd, 2017

Drill Type: Takeuchi TB175 Excavator

Datum: Below Grade

Logged by: MAD Checked by: RA/ZG

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Below Grade m	Depth
		TOPSOIL ~ 200 mm	0	0
		SILTY SAND	-0.2	
		Trace gravel, presence of organic matter, roots, brown, very loose, moist to wet.	-0.8	1
		TILL Sand and gravel, cobbles and boulders, brown to grey, moist to wet.		2
		Testpit Terminated at 2.4 m Depth on Bedrock	-2.4	

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60
SAMPLE: 92
Natural Unit Wt. kN/m³

LOG OF BOREHOLE LOGS OF BOREHOLES AND TESTPITS - APRIL 2017.GPJ TROW OTTAWA.GDT 6/26/17

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. A Piezometer with a 52 mm slotted standpipe was installed in the testpit 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-00236288-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
completion	0.9	
1 day	0.1	-
2 days	0.1	-
24 days	0.2	

CORE DRILLING RECORD

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

Log of Test Pit TP4

Project No: OTT-00236288-A0

Project: Geotechnical Investigation, Proposed Residential Subdivision

Location: Derry Side Road, Beckwith Township, ON

Figure No. 9

Page. 1 of 1

Date Drilled: April 10th, 2017

Drill Type: Takeuchi TB175 Excavator

Datum: Below Grade

Logged by: MAD Checked by: RA/ZG

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test (S)

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Below Grade m	Depth
		TOPSOIL ~ 175 mm	0	0
		Sand with organics and silt and some gravel, dark brown, humic, moist.	-0.2	
		TILL		
		Sand and gravel, cobbles and boulders, brown to grey, moist to wet.		1
				2
			-2.4	
		Testpit Terminated at 2.4 m Depth on Bedrock		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m^3

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. The testpit was backfilled 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-00236288-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
completion	1.5	1.5

CORE DRILLING RECORD

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

LOG OF BOREHOLE LOGS OF BOREHOLES AND TESTPITS - APRIL 2017.GPJ TROW OTTAWA.GDT 6/26/17

Log of Test Pit TP5

Project No: OTT-00236288-A0

Project: Geotechnical Investigation, Proposed Residential Subdivision

Location: Derry Side Road, Beckwith Township, ON

Figure No. 10

Page. 1 of 1

Date Drilled: April 10th, 2017

Drill Type: Takeuchi TB175 Excavator

Datum: Below Grade

Logged by: MAD Checked by: RA/ZG

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Below Grade m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~ 300 mm	0	0	20 40 60 80 / 50 100 150 200 kPa	250 500 750 / 20 40 60	153	
			-0.3					
		TILL Sand and gravel, cobbles and boulders, brown to grey, moist to wet.		1				21.2
				2				
			-2.5					
		Testpit Terminated at 2.5 m Depth on Bedrock						

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. The testpit was backfilled 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-00236288-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
completion	0.0	1.0

CORE DRILLING RECORD

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

LOG OF BOREHOLE LOGS OF BOREHOLES AND TESTPITS - APRIL 2017.GPJ TROW OTTAWA.GDT 6/26/17

Log of Test Pit TP6

Project No: OTT-00236288-A0

Project: Geotechnical Investigation, Proposed Residential Subdivision

Location: Derry Side Road, Beckwith Township, ON

Figure No. 11

Page. 1 of 1

Date Drilled: April 10th, 2017

Drill Type: Takeuchi TB175 Excavator

Datum: Below Grade

Logged by: MAD Checked by: RA/ZG

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Below Grade m	Depth
		TOPSOIL ~ 300 mm	0	0
		TILL Sand and gravel, cobbles and boulders, brown to grey, moist to wet.	-0.3	1
		Testpit Terminated at 1.4 m Depth on Bedrock	-1.4	

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by exp. before use by others
2. The testpit was backfilled 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-00236288-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
completion	1.0	

CORE DRILLING RECORD

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

LOG OF BOREHOLE LOGS OF BOREHOLES AND TESTPITS - APRIL 2017.GPJ TROW OTTAWA.GDT 6/26/17

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

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136 (LS-602)

Modified M.I.T. Classification

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

Exp Project No.:	**OTT-00236288-A0**	**Project Name :**	**Geotechnical Investigation, Proposed Residential Subdivision**				
Client :	**Mr Steve Smith**	**Project Location :**	**Derry Side Road, Beckwith, ON**				
Date Sampled :	**April 11, 2017**	**Borehole:**	**BH-1**	**Sample:**	**SS3**	**Depth (m) :**	**1.5-2.1**
Sample Description :		**Sandy Gravel, Some Silt**				**Figure :**	**12**

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

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136 (LS-602)

Modified M.I.T. Classification

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

Exp Project No.:	OTT-00236288-A0	Project Name :	Geotechnical Investigation, Proposed Residential Subdivision				
Client :	Mr Steve Smith	Project Location :	Derry Side Road, Beckwith, ON				
Date Sampled :	April 11, 2017	Borehole:	1	Sample:	SS4	Depth (m) :	2.3-2.9
Sample Description :	Gravel, Some Sand, Trace Silt					Figure :	13

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

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136 (LS-602)

Modified M.I.T. Classification

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

Exp Project No.:	**OTT-00236288-A0**	**Project Name :**	**Geotechnical Investigation, Proposed Residential Subdivision**				
Client :	**Mr Steve Smith**	**Project Location :**	**Derry Side Road, Beckwith, ON**				
Date Sampled :	**April 18, 2017**	**Borehole:**	**BH-2**	**Sample:**	**SS2**	**Depth (m) :**	**0.8-1.4**
Sample Description :		**Sand & Gravel, Some Silt**				**Figure :**	**14**

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

Grain-Size Distribution Curve

Method of Test for Particle Size Analysis of Soil

MTO Test Method LS - 702, Rev. No. 19

Modified M.I.T. Classification

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

Exp Project No.:	**OTT-00236288-A0**	**Project Name :**	**Geotechnical Investigation, Proposed Residential Subdivision**		
Client :	**Mr Steve Smith**	**Project Location :**	**1009 Derry Road, Beckwith, On**		
Date Sampled :	**April 18, 2017**	**Bore Hole/Test Pit No.:**	**BH-2**	**Sample No.: SS3**	**Depth (m) : 1.5-2.3**
Sample Description :		**Silt and Sand, Some Gravel and Clay**			**Figure : 15**

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

Grain-Size Distribution Curve

Method of Test for Sieve Analysis of Aggregate

ASTM C-136 (LS-602)

Modified M.I.T. Classification

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

Exp Project No.:	**OTT-00236288-A0**	**Project Name :**	**Geotechnical Investigation, Proposed Residential Subdivision**				
Client :	**Mr Steve Smith**	**Project Location :**	**Derry Side Road, Beckwith, ON**				
Date Sampled :	**April 10, 2017**	**Test Pit:**	**TP4**	**Sample:**	**S2**	**Depth (m) :**	**0.2-0.9**
Sample Description :		**Sand & Gravel, Trace Silt**				**Figure :**	**16**

Appendix A:

AGAT Laboratories Certificate of Analysis

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: EXP SERVICES INC
2650 QUEENSVIEW DRIVE, UNIT 100
OTTAWA, ON K2B8H6
(613) 688-1899

ATTENTION TO: Ismail M. Taki

PROJECT: OTT-236288

AGAT WORK ORDER: 17Z214242

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

DATE REPORTED: May 17, 2017

PAGES (INCLUDING COVER): 5

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 17Z214242

PROJECT: OTT-236288

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Ismail M. Taki

SAMPLING SITE:1009 Derry

SAMPLED BY:EXP

Inorganic Chemistry (Soil)

DATE RECEIVED: 2017-05-11

DATE REPORTED: 2017-05-17

				SAMPLE DESCRIPTION:	TP5 S2 0.3-0.9m	TP6 S2 0.3-1.4m
				SAMPLE TYPE:	Soil	Soil
				DATE SAMPLED:	2017-04-10	2017-04-10
Parameter	Unit	G / S	RDL		8378707	8378709
Chloride (2:1)	µg/g		2		<2	<2
Sulphate (2:1)	µg/g		2		12	<2
pH, 2:1 CaCl2 Extraction	pH Units		NA		7.52	7.57
Resistivity (2:1)	ohm.cm		1		8330	12200

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

8378707-8378709 EC/Resistivity, Chloride and Sulphate were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.

Please note that samples were received and analyzed past hold time.

Certified By: Amanjot Bhela

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 17Z214242

PROJECT: OTT-236288

ATTENTION TO: Ismail M. Taki

SAMPLING SITE:1009 Derry

SAMPLED BY:EXP

Soil Analysis

RPT Date: May 17, 2017			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Inorganic Chemistry (Soil)															
Chloride (2:1)	8388149		94	94	0.0%	< 2	93%	70%	130%	101%	70%	130%	101%	70%	130%
Sulphate (2:1)	8388149		16	15	6.5%	< 2	95%	70%	130%	103%	70%	130%	102%	70%	130%
pH, 2:1 CaCl2 Extraction	8381164		7.39	7.45	0.8%	NA	101%	90%	110%	NA			NA		

Comments: NA signifies Not Applicable.

Certified By: Amanjot Bhela

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 17Z214242

PROJECT: OTT-236288

ATTENTION TO: Ismail M. Taki

SAMPLING SITE:1009 Derry

SAMPLED BY:EXP

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	pH METER
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	EC METER

AGAT Laboratories

SRB

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Laboratory Use Only

Work Order #: 17Z214242

Cooler Quantity: one - non ice.

Arrival Temperatures: 15.2 | 15.1 | 15.0
6°C | 6°C | 6°C

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes:

Report Information:

Company: Exp Services Inc
Contact: Raad Akrawi
Address: 100-2650 Queensview dr
Ottawa Ont K2B 8H6
Phone: 613-688-1899 Fax:
Reports to be sent to:
1. Email: Raad.Akrawi@exp.com
2. Email: Ismail.Taki@exp.com

Regulatory Requirements:

☐ No Regulatory Requirement

(Please check all applicable boxes)

☐ Regulation 153/04
Table (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (Check One) ☐ Coarse ☐ Fine

☐ Sewer Use
☐ Sanitary ☐ Storm
Region (Indicate One)

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
(Indicate One)

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

*Please provide prior notification for **rush TAT***
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: OTT-236288
Site Location: 1009 Derry
Sampled By: Exp
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions
TP5 S2 0.3-0.9m	Apr 10				
TP6 S2 0.3-1.4m	Apr 10				

Field Filtered - Metals, Hg, CrVI (Y/N)	O. Reg 153: Metals and Inorganics	All Metals ☐ 153 Metals (excl. Hydrides)	Hydride Metals	ORPs: ☐ B-HWS ☐ Cl⁻ ☐ CN⁻ ☐ Cr^{6+} ☐ EC ☐ FOC ☐ Hg ☐ pH ☐ SAR	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3+NO_2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	CCME Fractions 1 to 4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use				
																pH	Sulphates	Chlorides	Elec. Resistivity
	✓															✓	✓	✓	✓
	✓															✓	✓	✓	✓

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
Ryan DiGiuseppe	May 10/17	4:30pm		10 May 17	16h50
UPS to FedEx	11 May-17	16h00		17/5/12	9:30

Page 1 of 1

N°: T 041763

List of Distribution

Report Distributed To:

Mr. Steve Smith……. ottawaguy5661@gmail.com