Geotechnical Investigation
Proposed Storage Buildings D, E, I, and J
3169 Hawthorne Road and Vacant Land
City of Ottawa, Ontario

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1. Introduction

A geotechnical investigation was undertaken for the proposed storage buildings to be located at 3169 Hawthorne Road and on a vacant parcel of land located west of the 3169 Hawthorne Road, Ottawa, Ontario (Figure 1). The terms and conditions of this assignment were outlined in EXP Services Inc. (EXP) proposal number: P89856GM-R dated September 28, 2020. Authorization to proceed with this work was provided by Access Property Development via purchase order number: 2653 dated October 30, 2020.

The proposed development will comprise of eight (8) slab on grade (no basement) storage buildings. Each proposed building will measure approximately 9 m by 47 m. Four (4) of the proposed buildings will be constructed at the location of the existing storage buildings D, E, I, and J, with the remaining four (4) buildings located in the vacant parcel land west of the existing storage buildings (Figure 2). It is our understanding that the existing storage buildings will be demolished as part of the proposed development. Final site grades and design floor slab elevations were not available at the time of this geotechnical investigation.

This geotechnical investigation was undertaken to:

a) Establish the subsurface soil, bedrock and groundwater conditions at the six (6) borehole locations on the site;

b) Provide classification of the site for seismic design in accordance with requirements of the 2012 Ontario Building Code (OBC) as amended May 2, 2019 and assess the liquefication potential of the subsurface soils in a seismic event;

c) Comment on grade-raise restrictions for the site;

d) Provide recommendations on the most suitable type of foundations, founding depth and Serviceability Limit State (SLS) bearing pressures and Ultimate Limit State (ULS) factored geotechnical resistances for the proposed buildings as well as anticipated total and differential settlements;

e) Discuss slab-on-grade construction;

f) Discuss excavation conditions and dewatering requirements during construction;

g) Provide pipe bedding requirements;

h) Comment on backfilling requirements and suitability of the on-site soils for backfilling purposes;

i) Discuss subsurface concrete and steel requirements; and

j) Recommend pavement structure thicknesses for the reinstatement of paved areas and for new parking lot and access road areas.

The comments and recommendations given in this report assume 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. Site Description

The subject site is bounded by Hawthorne Road on the west side and industrial developments on the remaining sides and is occupied by eleven (11) existing storage buildings including storage buildings D, E, I, and J. A parking lot exists on the east side of the site with vacant land and an access road from Hawthorne Road located on the west and south sides of the site. The site is generally flat with elevations ranging between Elevation 72.5 m and Elevation 74.2 m at the borehole locations.

3. Procedure

The fieldwork for the geotechnical investigation was completed on October 23 and 26, 2020 and consists of six (6) boreholes (Borehole Nos. BH-1 to BH-6) advanced to depths ranging between 6.4 m and 8.2 m below the existing ground surface (Elevation 67.8 m to Elevation 65.5 m). The boreholes were drilled using a CME-75 track-mounted drill rig operated by a drilling specialist subcontracted to EXP Services Inc. (EXP). The fieldwork was supervised on a full-time basis by a representative of EXP.

The borehole locations and geodetic elevations were established in the field by EXP and are shown on Figure 2.

Prior to the fieldwork, the locations of the boreholes were cleared of any public and private underground services. Standard penetration tests (SPT) were performed in all boreholes at selected depth intervals and soil samples retrieved by split-barrel sampler. Field vane and penetrometer tests were carried out in the cohesive soil to measure the undrained shear strength.

A 19 mm diameter standpipe with slotted section was installed in Borehole Nos. 2, 5, and 6 for long-term monitoring of the groundwater levels. The standpipes were installed in accordance with EXP standard practice and the installation configuration is documented on the respective borehole log. The boreholes were backfilled upon completion of drilling and the installation of the standpipes.

All soil samples were visually examined in the field for textural classification, logged, preserved in plastic bags and identified. On completion of the fieldwork, all the soil samples were transported to the EXP laboratory in Ottawa, Ontario, where they were visually examined by a geotechnical engineer, and borehole logs were prepared. The engineer also assigned the laboratory testing which consisted of performing the following tests on the soil samples:

Natural Moisture Content.....49 Tests
Grain Size Analysis.....2 Tests
Atterberg Limits.....2 Tests
Chemical Analysis (pH, sulphate, chloride and resistivity).....1 Test

4. Subsurface Soil and Groundwater Conditions

A detailed description of the geotechnical conditions encountered in the boreholes is given on the borehole logs, Figures 3 to 8 inclusive. 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 may also 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 and are not intended to provide evidence of environmental conditions.

It should be noted that the soil and rock boundaries indicated on the borehole logs 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 subsurface soil conditions with depth and groundwater level measurements.

4.1 Pavement Structure

The pavement structure in Borehole Nos. 1 to 3 comprises of a 55 mm to 75 mm thick asphaltic concrete layer underlain by 150 mm to 625 mm of granular fill. The granular fill has a natural moisture content of 14 percent.

4.2 Topsoil

A 50 mm and 75 mm thick topsoil layer was contacted at ground surface in Borehole Nos. 4 to 6.

4.3 Fill

The pavement structure and topsoil are underlain by fill consisting of sand with gravel to silty sand or silty clay with some sand. The fill contains organic inclusions in Borehole Nos. 4 to 6 . The fill extends to depths of 0.9 m to 1.7 m (Elevation 73.0 m to 71.0 m). The fill material is loose to compact as indicated by the SPT N-values which range from 6 to 26. The fill has a natural moisture content ranging from 6 percent to 25 percent.

4.4 Silty Sand (Possible Fill)

A silty sand was contacted beneath the fill in Borehole No. 6 and extends to a 2.3 m depth (Elevation 70.2 m). The silty sand is identified as a possible fill due to its slight reworked appearance. Based on the SPT N-value of 8, the silty sand is in a loose state. The natural moisture content of the silty sand is 18 percent.

4.5 Clay

The fill and silty sand (possible fill) in all boreholes is underlain by clay that extends to depths of 4.6 m to 6.6 m (Elevation 67.9 m to Elevation 66.9 m) in Borehole Nos.4 to 6. Borehole Nos. 1 to 3 terminated within the clay at 6.4

m and 8.2 m depths (Elevation 67.8 m to Elevation 65.6 m). The consistency of the clay is firm to hard, as indicated by undrained shear strength measurements from field vane and penetrometer tests, ranging between 43 kPa to greater than 250 kPa. The clay has a natural moisture content ranging from 23 percent to 70 percent.

Grain size analysis and Atterberg Limits were conducted on two (2) samples of the clay and the grain size distribution curves are shown in Figure Nos. 9 and 10 and summarized in Tables I and II below.

Table I: Summary of Grain-size Analysis Results – Clay Samples

Borehole No. – Sample No.	Depth (m)	Grain-size Analysis (%)				Soil Classification (USCS)
		Gravel	Sand	Silt	Clay	
BH-2 – SS3	1.5 – 2.1	0	22	40	38	CLAY with Sand (CL)
BH-3 – SS9	7.6 – 8.2	0	2	43	55	CLAY (CL)

Table II: Summary of Atterberg Limits Results – Clay Samples

Borehole No. – Sample No.	Depth (m)	Atterberg Limits Results					Soil Classification (USCS)
		w_c (%)	LL (%)	PL (%)	PI (%)	LI	
BH-2 – SS3	1.5 – 2.1	27	34	18	16	0.6	CL – Clay of low plasticity
BH-3 – SS9	7.6 – 8.2	46	39	19	20	1.4	CL – Clay of low plasticity

w_c: Moisture Content, **LL**: Limit Liquid; **PL:** Plastic Limit; **PI**: Plasticity Index; **LI**: Liquidity Index; [(1)]: Refer to Casagrande Plasticity Chart (1932)

Based on the results of the grain size analysis and Atterberg limits, the clay may be classified as clay with sand to clay (CL) of low plasticity in accordance with the Unified Soil Classification System (USCS).

4.6 Glacial Till

The clay in Borehole Nos. 4 to 6 is underlain by glacial till which extends to a 7.0 m depth (Elevation 66.6 m and Elevation 66.1 m) in Borehole Nos. 4 and 5. Borehole No. 6 terminated within the glacial till at 6.4 m depth (Elevation 66.1 m). The glacial till consists of silty clay with some sand and gravel. The consistency of the glacial till is very stiff as indicated by undrained shear strength measurements from field vane tests of 100 kPa and 110 kPa. The natural moisture content of the glacial till is 12 percent and 65 percent.

4.7 Possible Weathered Shale Bedrock

Possible weathered shale bedrock was encountered beneath the glacial till in Borehole Nos. 4 and 5 at a 7.0 m depth (Elevation 66.6 m and Elevation 66.1m). It was possible to auger 600 mm and 700 mm into the possible weathered shale bedrock. The natural moisture content of the possible weathered shale bedrock is 15 percent.

4.8 Groundwater Level

Groundwater level measurements taken in standpipes installed in Borehole Nos. 2, 5, and 6 indicate the groundwater level ranges from 1.1 m to 2.7 m depths below the ground surface (Elevation 72.7 m to Elevation 70.4 m).

Groundwater 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.

5. Seismic Site Classification and Liquefaction Potential of Soils

5.1 Site Classification for Seismic Site Response

Based on the borehole information, the shear wave velocity was calculated to be 618 m/s. The 2012 Ontario Building Code (as amended May 2, 2019) indicates in Table 4.1.8.4.A that for a site with a shear wave velocity of 618 m/s, the site classification for seismic site response is **Class C.**

5.2 Liquefaction Potential of Soils

The subsurface soils are not susceptible to liquefaction during a seismic event.

6. Grade Raise

The site is underlain by a clay deposit that is prone to consolidation settlement if overstressed by loads imposed on it by site grade raise, foundations, and by groundwater level lowering following construction. Overstressing of the clay may result in its consolidation and subsequent settlement of foundations, which may exceed the tolerable limits of the structure resulting in cracking of the structure.

Based on a review of the engineering properties of the clay in conjunction with the recommended bearing pressure at serviceability limit state (SLS) for foundations in Section 7 of this report it is recommended that the grades at the site may be raised by 0.5 m. An allowance for permanent groundwater lowering was not required as part of the review, since the foundations will be at or above the groundwater level and measures will be employed in new service trenches to minimize the permanent lowering of the groundwater level at the site (use of clay seals), as recommended in Section 10 of this report.

If the grade raise will differ from the recommended 0.5 m, EXP should be contacted to review the acceptability of the revised grade raise and update the SLS value and factored geotechnical resistance at ultimate limit state (ULS) for the foundations of the proposed buildings.

7. Foundation Considerations

Based on a review of the borehole information, it is considered feasible to support the proposed buildings on strip and spread footings founded on the native clay. The proposed buildings may also be supported by a thickened reinforced concrete mat foundation set at 0.6 m below finished grade founded on an engineered fill pad constructed on the native clay and silty sand. The two (2) foundation alternatives are discussed in the following sections of this report.

7.1 Footings

The proposed buildings may be supported by strip and spread footings founded on the native clay contacted at 0.9 m to 2.3 m depths below existing grade (Elevation 73.0 m to Elevation 70.2 m). Strip footings founded to a maximum depth of 0.5 m below the clay surface and having a maximum width of 1.5 m may be designed for a bearing pressure at serviceability limit state (SLS) of 120 kPa and factored geotechnical resistance at ultimate limit state (ULS) of 180 kPa. Square pad footings founded to a maximum depth of 0.5 m depth below the clay surface and having a maximum width of 3.0 m and length of 3.0 m may be designed for a bearing pressure at SLS of 150 kPa and factored geotechnical resistance at ULS of 225 kPa. The factored geotechnical resistance at ULS includes a resistance factor of 0.5. The SLS and factored ULS values are based on a 0.5 m grade raise.

The settlement of footings designed for the above SLS bearing pressures are expected to be within the tolerable limits of 25 mm total and 19 mm differential.

All footing beds should be examined by a geotechnical engineer to ensure that the founding surfaces are capable of supporting the design bearing pressure at SLS and that the footing beds have been properly prepared.

It should be noted that the exposed surface of the clay is susceptible to disturbance due to movement of workers and construction equipment. It is therefore recommended that the approved subgrade in the footing beds must be covered with a 50 mm thick concrete mud slab to prevent disturbance to the clay subgrade.

A minimum of 1.5 m of earth cover should be provided to the exterior foundations of heated structures to protect them from damage due to frost penetration. The frost cover should be increased to 2.1 m for unheated structures if snow will not be removed from their vicinity and to 2.4 m if snow will be removed from the vicinity of the structure. When earth cover is less than the required cover, an equivalent thermal combination of earth cover and rigid insulation or rigid insulation alone should be provided. EXP can provide additional comments in this regard, if required.

7.2 Mat Foundation

It is our understanding that the mat foundation will be 9 m by 47 m in size. The proposed buildings may be supported by a reinforced concrete mat foundation. The existing fill is not considered suitable to support the mat foundation. Therefore, it is recommended that the mat foundation be founded on an engineered fill pad constructed on top of the native clay and silty sand.

Preparation of the engineered fill pad should consist of the excavation and removal of all topsoil and existing fill down to the top of the native clay and silty sand. The excavation should extend a sufficient distance beyond the perimeter of the mat foundation to accommodate a 1.0 m wide bench of engineered fill, which is thereafter sloped at an inclination of 1H:1V down to the native clay and silty sand.

During construction, the silty sand should be evaluated to confirm that it is native soil. If it is determined that the silty sand is fill, it may require partial or complete excavation and removal down to the native clay.

As part of the construction of the engineered fill pad, the surface of the exposed native clay and silty sand subgrade should be reviewed by a geotechnician. The native silty sand may need to be compacted. Following approval of the subgrade surface, the engineered fill should be placed in 300 mm thick lifts and each lift compacted to 100 percent standard Proctor maximum dry density (SPMDD). The engineered fill may consist of OPSS Granular B Type II. The engineered fill should be placed under the full-time supervision of a geotechnician working under the direction of a geotechnical engineer. In-place density tests should be undertaken on each lift of the engineered fill to ensure that it is properly compacted prior to placement of the subsequent lift.

The mat foundation designed to bear on the engineered fill pad with the base of the mat set 0.6 m below the final grade and the engineered fill pad constructed as noted above may be designed for a bearing pressure at Serviceability Limit State (SLS) of 150 kPa and factored geotechnical resistance at Ultimate Limit State (ULS) of 225 kPa. The factored geotechnical resistance at ULS includes a geotechnical resistance factor of 0.5. The SLS and factored ULS values are based on a 0.5 m site grade raise.

Settlements of the mat foundation designed for the SLS bearing pressure recommended above and properly constructed are expected to be within the normally tolerated limits of 25 mm total and 19 mm differential movements.

The mat foundation may be designed for a modulus of subgrade reaction of 4000 kN/m^3. The modulus of subgrade reaction calculation is based on the modulus of subgrade reaction of the engineered fill constructed as indicated in this report, the underlying clay and taking into consideration the size of the mat foundation.

The surface of the engineered fill pad that the mat will be set upon should be examined by a geotechnical engineer prior to concrete placement to ensure the engineered fill founding surface is capable of supporting the design bearing pressure at SLS and that the engineered fill pad has been properly prepared.

Frost protection for the mat foundation assuming the proposed buildings are unheated may be provided by rigid insulation in the form of extruded polystyrene rigid insulation board (Dow Chemical Canada Inc. Styrofoam Brand HI-60 or equivalent). For the bottom of the mat foundation set at 600 mm below final grade, the rigid insulation board should be 75 mm thick, placed directly on top of the surface of the approved engineered fill pad beneath the mat foundation and extend 1.8 m horizontally beyond the outer edge of the mat on all sides. If the proposed buildings will be heated, the same insulation type as noted above may be used and should be 50 mm thick, placed

directly on top of the surface of the approved engineered fill pad beneath the mat foundation and extend 900 mm horizontally beyond the outer edge of the mat on all sides.

7.3 Additional Comment

The recommended bearing pressure at SLS and factored geotechnical resistances at ULS have been calculated by EXP from the borehole information for the 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.

8. Floor Slab and Drainage Requirements

8.1 Slab-on-Grade

If the proposed buildings will be supported by strip and spread footings, the floor slab may be designed as a slab-on-grade. The existing fill is not considered suitable to support the slab-on-grade and therefore, should be excavated and removed down to the surface of the native clay and silty sand. The area beneath the slab-on-grade should be backfilled with engineered fill consisting of OPSS Granular B Type II to the underside of the clear stone layer and each lift compacted to 98 percent SPMDD. The floor slab should be set on a bed of well-packed 19 mm clear stone at least 300 mm thick placed on the engineered 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.

8.2 Permanent Drainage Systems – Slab-on-Grade and Mat Foundation

It is recommended that perimeter drains should be provided for slab-on-grade design with footing foundations. The need for permanent drains beneath the slab-on-grade and the mat foundation should be assessed by EXP, once the final design elevation of the floor slab and mat foundation are known.

The surface of the slab-on-grade and mat foundation should be at least 150 mm above the finished exterior grade. The finished exterior grade should be sloped away from the proposed buildings to prevent ponding of surface water close to the exterior walls of the proposed buildings.

9. Excavation and De-Watering Requirements

9.1 Excess Soil Management

Ontario Regulation 406/19 made under the Environmental Protection Act (November 28, 2019) is scheduled to be implemented on January 1, 2021. The new regulation will dictate the testing protocol that will be required for the management and disposal of excess soils. As set forth in the regulation, specific analytical testing protocols will need to be implemented and followed based on the volume of soil to be managed. The testing protocols are specific as to whether the soils are stockpiled or *in situ*. In either scenario, the testing protocols are far more onerous than have been historically carried out as part of standard industry practices. These decisions should be factored in and accounted for prior to the initiation of the project-defined scope of work. EXP would be pleased to assist with the implementation of a soil management and testing program that would satisfy the requirements of Ontario Regulation 406/19.

9.2 Excavations

Excavations for the foundations of the proposed structures and installation of underground services are expected to extend to an approximate depth of 3.0 m below the existing ground surface. These excavations will extend through the topsoil, pavement structure, fill, silty sand and into the clay. The excavations are anticipated to be approximately 2.0 m below the groundwater level.

It is anticipated that excavations may be undertaken using conventional equipment. All excavation work should be completed in accordance with the Occupational Health and Safety Act (OHSA), Ontario, Reg. 213/91. Based on the definitions provided in OHSA, the subsurface soils at the site are considered to be Type 3 soil. Excavations may be undertaken as open cut in Type 3 soil, provided the excavation walls are sloped back at 1H:1V from the bottom of the excavation as per OHSA. For excavations that extend below the groundwater level, the side slopes are expected to slough and eventually stabilize at 2H:1V to 3H:1V from the bottom of the excavation.

Base heave type failure is not anticipated in excavations that extend to a 3.0 m depth below existing grade.

The clay stratum 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 that does not travel on the excavated surface, such as a gradually or mechanical shovel. It is anticipated that temporary granular roads may be required to gain access to the site by construction equipment.

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.

9.3 De-Watering Requirements

Seepage of the surface and subsurface water into these excavations is anticipated. However, it should be possible to collect water entering the excavations at low points and to remove it by conventional pumping techniques. In areas of high infiltration or in areas where more permeable soil layers may exist, a higher seepage rate should be anticipated. Therefore, the need of high capacity pumps to keep the excavation dry should not be ignored.

It has been assumed that the maximum excavation depth at the site will be approximately 3.0 m and may require 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. EXP has qualified persons who can prepare these types of reports, if required. 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.

Although this investigation has estimated the groundwater levels at the time of the fieldwork, and commented on dewatering and general construction problems, conditions may be present which are difficult to establish from standard boring and excavating 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.

10. Pipe Bedding Requirements

It is recommended that the bedding for the underground services including material specifications, thickness of cover material and compaction requirements conform to City of Ottawa requirements and/or Ontario Provincial Standard Specification and Drawings (OPSS and OPSD).

The pipe subgrade material is anticipated to be clay. In this case, it is recommended the pipe bedding consist of 300 mm thick OPSS 1010 Granular B Type II sub-bedding material overlain by 150 mm thick OPSS 1010 Granular A bedding material. The bedding materials should be compacted to at least 98 percent SPMDD.

The bedding thickness may be further increased in areas where the clay subgrade becomes disturbed. Trench base stabilization techniques, such as removal of loose/soft material, placement of crushed stone sub-bedding (Granular B Type II), completely wrapped in a non-woven geotextile, may also be used if trench base disturbance becomes a problem in wet or soft areas.

If the backfill for the service trenches will consist of granular fill, clay seals should be installed in the service trenches at select intervals as per City of Ottawa Drawing No. S8. The seals should be 1 m wide, extend over the entire trench width and from the bottom of the trench to the underside of the pavement structure. The clay should be compacted to 95 percent SPMDD. The purpose of the clay seals is to prevent the permanent lowering of the groundwater level.

The underground services should be installed in short open trench sections that are excavated and backfilled the same day.

11. Backfilling Requirements and Suitability of On-Site Soils for Backfilling Purposes

The material to be excavated from the site will mainly comprise of topsoil, fill, clay and silty sand (possible fill). These soils are not considered suitable for use under structural elements and for backfilling purposes. However, they may be used for general grading purposes in landscaped areas.

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

- Engineered fill for the mat foundation and under slab-on-grade - OPSS 1010 Granular B Type II placed in 300 mm thick lifts and each lift compacted to 100 and 98 percent SPMDD under the mat foundation and slab on grade respectively.

- Backfill in services trenches inside building – OPSS 1010 Granular B Type II placed in 300 mm thick lifts and each lift compacted to 98 percent of the SPMDD.

- Backfill in exterior services trenches – OPSS 1010 Select Subgrade Material (SSM) placed in 300 mm thick lifts and each lift compacted to 95 percent of the SPMDD.

12. Subsurface Concrete and Steel Requirements

Chemical tests limited to pH, chloride, sulphate and resistivity were performed on two (2) selected soil samples. The certificate of the laboratory test results is attached in Appendix A and the results are summarized in Table III below.

Table III: Results of pH, Chloride, Sulphate and Resistivity Tests on Soil Samples

Borehole No. (Sample No.)	Soil Type	Depth (m)	pH	Sulphate (%)	Chloride (%)	Resistivity ohm.cm
BH-1 (SS3)	Clay	1.5 – 2.1	7.73	0.0164	0.0118	2350
BH-6 (SS4)	Clay	2.3 – 2.9	8.13	0.0128	0.0039	3030

The results indicate the clay has a sulphate content and chloride content of less than 0.1 percent and 0.04 percent respectively. These concentrations of sulphate and chloride in the clay would have a negligible potential of sulphate and chloride attack on subsurface concrete. 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.

Based on a review of the resistivity test results, the clay samples are considered mildly corrosive to bare steel as per the National Association of Corrosion Engineers (NACE). Appropriate measures should be undertaken to protect buried steel elements from corrosion.

13. Pavement Reinstatement and New Construction

Pavement structure thicknesses required to reinstate the areas affected by the proposed storage building construction and for any new pavement areas were computed and are shown on Table IV. 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 ten (10) to fifteen (15) years. The proposed functional design life represents the number of years to the first rehabilitation, assuming regular maintenance is carried out. The subgrade is anticipated to consist of fill, silty sand, clay, OPSS Granular B Type II material and select subgrade material (SSM).

Table IV: Recommended Pavement Structure Thicknesses			
Pavement Layer	**Compaction Requirements**	**Pavement Design to be used by Light Duty Vehicles**	**Heavy Duty Vehicles**
Asphaltic Concrete (PG 58-34)	92-97 % MRD*	65 mm HL/SP12.5 Cat B3	40 mm HL3/SP12.5 Cat B 50 mm HL8 SP19.0 Cat B
OPSS 1010 Granular A Base	100% SPMDD**	150 mm	150 mm
OPSS 1010 Granular B Sub-Base Type II	100% SPMDD**	450 mm	600 mm
Denotes maximum relative density.* * Denotes standard Proctor maximum dry density, ASTM-D698-12e2.*			

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 the parking areas and access roads are as follows:

1. As part of the subgrade preparation for the areas to be paved, the proposed parking and access roadway should be stripped of topsoil, organic stained soil and other obviously unsuitable material. 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 percent SPMDD (ASTM D698). To prevent overstressing the clay subgrade, coarser material may be required in the lower 300 mm of the subgrade fill such as OPSS 1010 Granular B Type II or well graded blast-shattered bedrock.

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 sub drainage 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 1010 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 Type II should be provided in these areas in addition to the use of a geotextile at the subgrade level. On-site excavated 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 and its placement should meet OPSS 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.

14. 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 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 and groundwater. Should specific information be required, including for example the presence of pollutants, contaminants or other hazards in the soil, additional testing may be required.

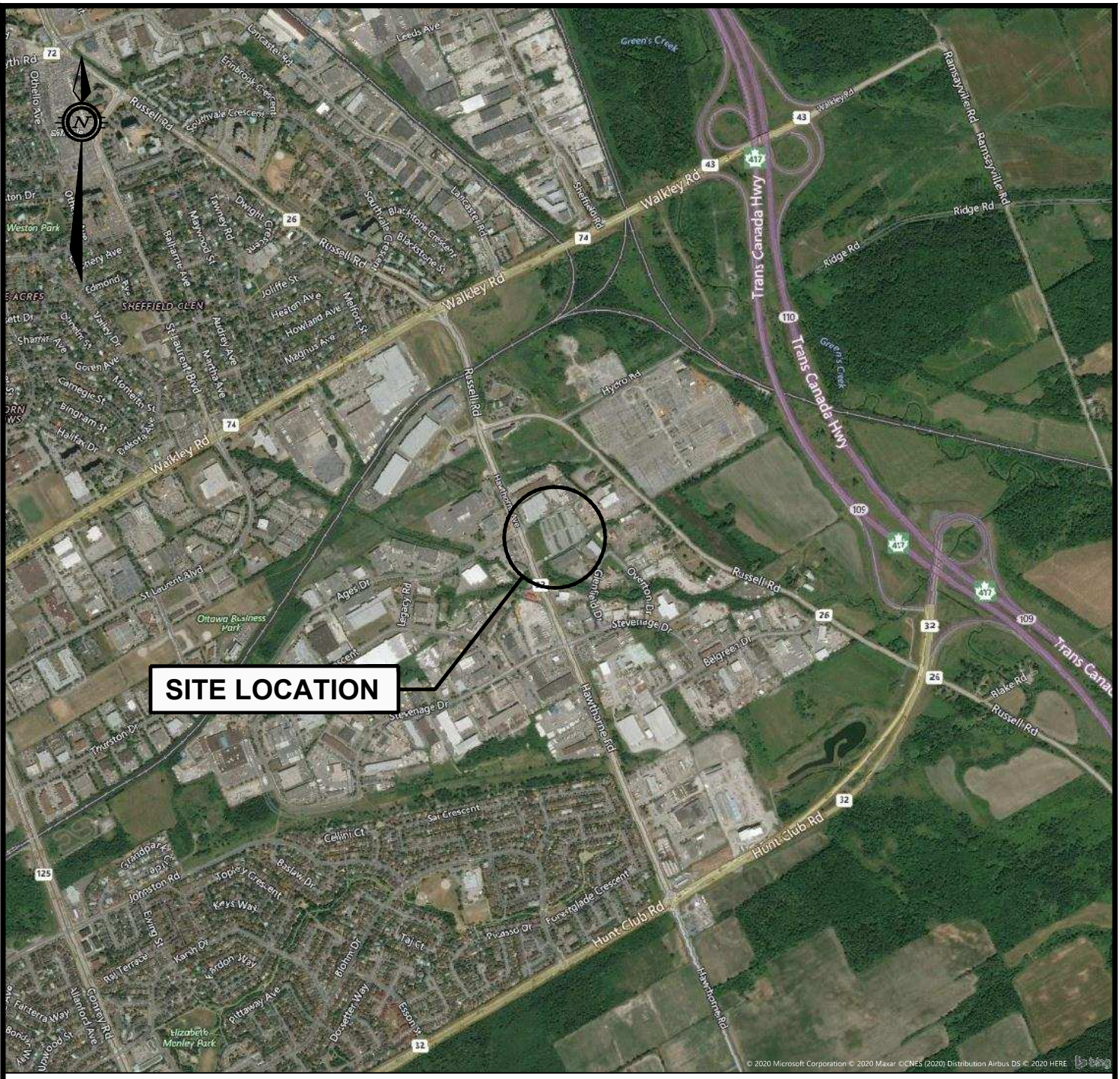
We trust that this information is satisfactory for your purposes. Should you have any questions, please contact this office.

Sincerely,

Athir Nader, M.A.Sc., P.Eng.
Senior Project Manager and Geotechnical Engineer,
Geotechnical Services
Earth and Environment

Susan M. Potyondy, P.Eng.
Senior Project Manager, Geotechnical Services
Earth and Environment

Figures



0 200m 400m 800m

HORIZONTAL 1:20,000

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

DATE: NOV. 2020	CLIENT:	ACCESS PROPERTY DEVELOPMENT	project no.: OTT-00262560-A0
DESIGN: A.N. / CHECKED: I.T.	TITLE:	PROPOSED STORAGE BUILDINGS D, E, I, & J AND VACANT LAND - SITE LOCATION PLAN 3169 HAWTHORNE ROAD, OTTAWA, ON	scale: 1:20,000
DRAWN BY: M.P.			FIG 1

Filename: E:\OTT\OTT-00262560-A0\60 Execution\65 Drawings\3169 Hawthorne – Fig 1–2.dwg
Last Saved: Nov 10, 2020 7:35 AM Last Plotted: Nov 10, 2020 1:06 PM Plotted by: ParkerM

LEGEND

BH-5 (73.1) — BOREHOLE LOCATION & NUMBER (GROUND ELEVATION)

0 15m 30m 60m

HORIZONTAL 1:1500

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2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6, Canada

DATE: NOV. 2020	CLIENT:	ACCESS PROPERTY DEVELOPMENT	project no.: OTT-00262560-A0
DESIGN: A.N. / CHECKED: I.T.	TITLE:	PROPOSED STORAGE BUILDINGS D, E, I, & J AND VACANT LAND - BOREHOLE LOCATION PLAN 3169 HAWTHORNE ROAD, OTTAWA, ON	scale: 1:1,500
DRAWN BY: M.P.			FIG 2

Filename: E:\OTT\OTT-00262560-A0\60 Execution\65 Drawings\3169 Hawthorne – Fig 1-2.dwg
Last Saved: Nov 10, 2020 1:45 PM Last Plotted: Nov 10, 2020 1:46 PM Plotted by: ParkerM

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		

0.002 0.006 0.02 0.06 0.2 0.6 2.0 6.0 20 60 200

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 BH-1

Project No: OTT-00262560-A0

Project: Proposed Storage Buildings D, E, I, and J

Location: 3169 Hawthorne Road and Vacant Land, Ottawa, Ontario

Figure No. 3

Page. 1 of 1

Date Drilled: 'October 23, 2020

Drill Type: Track-Mounted Drill-Rig

Datum: Geodetic Elevation

Logged by: M. Leroux Checked by: A. Nader

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	Depth 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
		PAVEMENT STRUCTURE 55 mm asphaltic concrete over 150 mm granular fill	74.2 / 74.0	0	10		SS1	
		FILL Sand with gravel to silty sand, grey to brown, moist, (loose to compact)	73.0	1	7		SS2	
		CLAY WITH SAND TO CLAY (CL) Grey, moist to wet, (stiff to very stiff)		2	4; 140 s=10		SS3	
				3	3; 120 s=8		SS4	
				4	2; 86 s=6		SS5	
				5	2; 101 s=5		SS6	
				6	Hammer Weight; 67 s=8		SS7	
					Hammer Weight; 53 s=4		SS8	
		Borehole Terminated at 6.4 m Depth	67.8					

NOTES:
1. Borehole data requires Interpretation by exp. before use by others.
2. Borehole backfilled upon completion of the drilling.
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-00262560-A0.

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	4.6	6.1

CORE DRILLING RECORD

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

LOG OF BOREHOLE BH LOGS - 262560.GPJ TROW OTTAWA.GDT 11/13/20

Log of Borehole BH-2

Project No: OTT-00262560-A0

Project: Proposed Storage Buildings D, E, I, and J

Location: 3169 Hawthorne Road and Vacant Land, Ottawa, Ontario

Figure No. 4

Page. 1 of 1

Date Drilled: 'October 23, 2020

Drill Type: Track-Mounted Drill-Rig

Datum: Geodetic Elevation

Logged by: M. Leroux Checked by: A. Nader

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	Depth 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
		PAVEMENT STRUCTURE 75 mm asphaltic concrete over 625 mm granular fill	73.8	0	14		SS1	
		FILL Silty clay, some sand and gravel, grey to brown, moist, (very stiff)	73.1	1	15		SS2	
		CLAY WITH SAND TO CLAY (CL) Grey, moist to wet, (firm to very stiff)	72.7	2	11; 180		SS3	
			72.3	3	6; 115 s=7		SS4	
				4	3; 86 s=6		SS5	
				5	2; 53 s=5		SS6	
				6	Hammer Weight; 58 s=6		SS7	
					Hammer Weight; 48 s=7		SS8	
		Borehole Terminated at 6.4 m Depth	67.4					

NOTES:
1. Borehole data requires Interpretation by exp. before use by others.
2. 19 mm standpipe was installed upon the completion of the drilling as noted above.
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-00262560-A0.

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	4.9	6.1
18 Days	1.1	N/A

CORE DRILLING RECORD

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

LOG OF BOREHOLE BH LOGS - 262560.GPJ TROW OTTAWA.GDT 11/13/20

Log of Borehole BH-3

Project No: OTT-00262560-A0

Project: Proposed Storage Buildings D, E, I, and J

Location: 3169 Hawthorne Road and Vacant Land, Ottawa, Ontario

Figure No. 5

Page. 1 of 1

Date Drilled: 'October 23, 2020

Drill Type: Track-Mounted Drill-Rig

Datum: Geodetic Elevation

Logged by: M. Leroux Checked by: A. Nader

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	Depth 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
		PAVEMENT STRUCTURE 60 mm asphaltic concrete over 200 mm granular fill	73.8	0	26		SS1	
		FILL Silty sand, grey to brown, moist to wet, (compact)	73.5	1	13		SS2	
		CLAY WITH SAND TO CLAY (CL) Grey, moist to wet, (stiff to very stiff)	72.6	2	7; 156; 190 +S s=6		SS3	
				3	3; 160 +S s=7		SS4	
				4	3; 101 +S s=6		SS5	
				5	1; 86 +S s=7		SS6	
				6	Hammer Weight; 58 +S s=8		SS7	
				7	Hammer Weight; 53 +S s=7		SS8	
				8	Hammer Weight		SS9	
		Borehole Terminated at 8.2 m Depth	65.6					

NOTES:
1. Borehole data requires Interpretation by exp. before use by others.
2. Borehole backfilled upon completion of the drilling.
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-00262560-A0.

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	4.9	7.6

CORE DRILLING RECORD

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

LOG OF BOREHOLE BH LOGS - 262560.GPJ TROW OTTAWA.GDT 11/13/20

Log of Borehole BH-4

Project No: OTT-00262560-A0

Project: Proposed Storage Buildings D, E, I, and J

Location: 3169 Hawthorne Road and Vacant Land, Ottawa, Ontario

Figure No. 8

Page. 1 of 1

Date Drilled: 'October 26, 2020

Drill Type: Track-Mounted Drill-Rig

Datum: Geodetic Elevation

Logged by: A. Neguss Checked by: A. Nader

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	Depth 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 ~50 mm thick	73.6	0	6		SS1	
		FILL Silty clay, some sand and gravel, some organics, brown, moist, (loose)		1	8		SS2	
			71.9		5		SS3	
		CLAY WITH SAND TO CLAY (CL) Brown to grey, moist to wet, (firm to hard)		2	10	168	SS4	
				3	4	>250	SS5	
				4	53 s=7		SS6	
					2			
				5	43 Hammer Weight		SS7	
					62 s=9			
				6	3		SS8	
		GLACIAL TILL Silty clay, some sand and gravel, grey, wet	67.0					
			66.6	7	50 for 75 mm		SS9	
		POSSIBLE WEATHERED BEDROCK Shale pieces	65.9					
		Auger Refusal 7.7 m Depth						

LOG OF BOREHOLE BH LOGS - 262560.GPJ TROW OTTAWA.GDT 11/13/20

NOTES:
1. Borehole data requires Interpretation by exp. before use by others.
2. Borehole backfilled upon completion of the drilling.
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-00262560-A0.

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	4.6	7.6

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

Log of Borehole BH-5

Project No: OTT-00262560-A0

Project: Proposed Storage Buildings D, E, I, and J

Location: 3169 Hawthorne Road and Vacant Land, Ottawa, Ontario

Figure No. 7

Page. 1 of 1

Date Drilled: 'October 26, 2020

Drill Type: Track-Mounted Drill-Rig

Datum: Geodetic Elevation

Logged by: A. Neguss Checked by: A. Nader

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	Depth 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 ~50 mm thick	73.1	0				
		FILL Sand with gravel, brown, moist, (compact)	73.1		12		SS1	
				1	11		SS2	
		CLAY WITH SAND TO CLAY (CL) Brown to grey, moist to wet, (stiff to very stiff)	72.2		8, 144		SS3	
▽				2	2, 96		SS4	
			70.4	3	2		SS5	
					58, s=8			
					Hammer Weight		SS6	
					53, s=7			
					Hammer Weight		SS7	
				5	58, s=23			
		GLACIAL TILL Silty clay, some sand and gravel, grey, wet, (firm)	66.9	6	7		SS8	
		POSSIBLE WEATHERED BEDROCK Shale pieces	66.1	7	50 for 50 mm		SS9	
		Auger Refusal AT 7.6 m Depth	65.5					

LOG OF BOREHOLE BH LOGS - 262560.GPJ TROW OTTAWA.GDT 11/13/20

NOTES:
1. Borehole data requires Interpretation by exp. before use by others.
2. 19 mm standpipe was installed upon the completion of the drilling as noted above.
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-00262560-A0.

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	4.6	7.6
18 Days	2.7	N/A

CORE DRILLING RECORD

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

Log of Borehole BH-6

Project No: OTT-00262560-A0

Project: Proposed Storage Buildings D, E, I, and J

Location: 3169 Hawthorne Road and Vacant Land, Ottawa, Ontario

Figure No. 6

Page. 1 of 1

Date Drilled: 'October 23, 2020

Drill Type: Track-Mounted Drill-Rig

Datum: Geodetic Elevation

Logged by: M. Leroux Checked by: A. Nader

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	Depth 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 thick	72.5	0				
		FILL Silty clay, some gravel, some organics, dark brown, moist, (loose)	72.4		6		SS1	
				1	7		SS2	
		SILTY SAND (POSSIBLE FILL) With clay, grey, wet, (loose)	71.0 / 70.9		8		SS3	
		CLAY WITH SAND TO CLAY (CL) Grey, moist to wet, (stiff to very stiff)	70.2	2	3		SS4	
				3	101 s=6		SS5	
				4	2 / 86 s=6		SS6	
		GLACIAL TILL Silty clay, some sand and gravel, grey, wet, (very stiff)	67.9		2 / 86 s=6		SS7	
				5	110 s=5		SS8	
				6	4 / 100 s=8			
		Borehole Terminated at 6.4 m Depth	66.1					

LOG OF BOREHOLE BH LOGS - 262560.GPJ TROW OTTAWA.GDT 11/13/20

NOTES:
1. Borehole data requires Interpretation by exp. before use by others.
2. 19 mm standpipe was installed upon the completion of the drilling as noted above.
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-00262560-A0.

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	4.3	6.1
18 Days	1.6	N/A

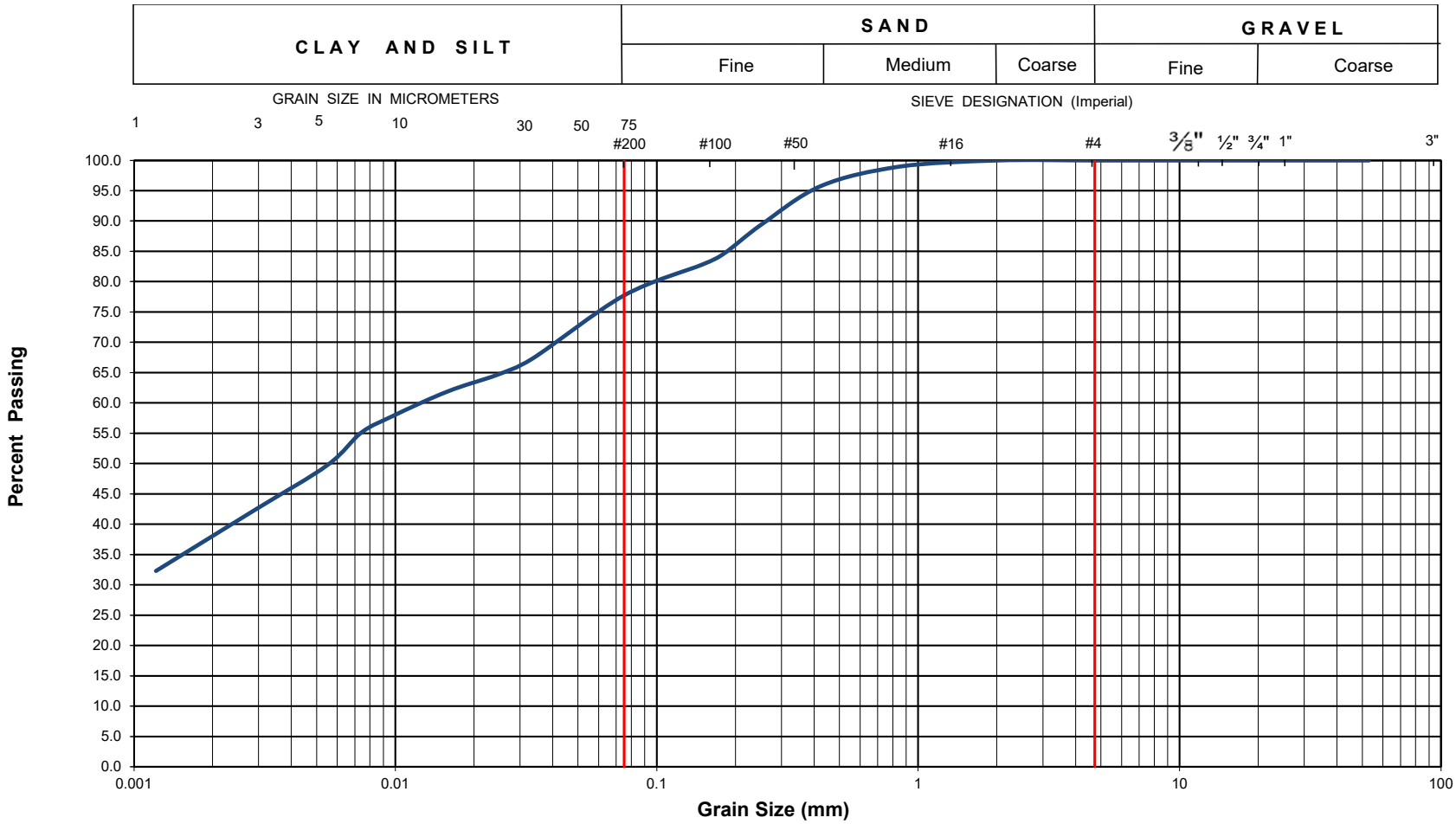
CORE DRILLING RECORD

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
ASTM C-136/ASTM D422

Unified Soil Classification System

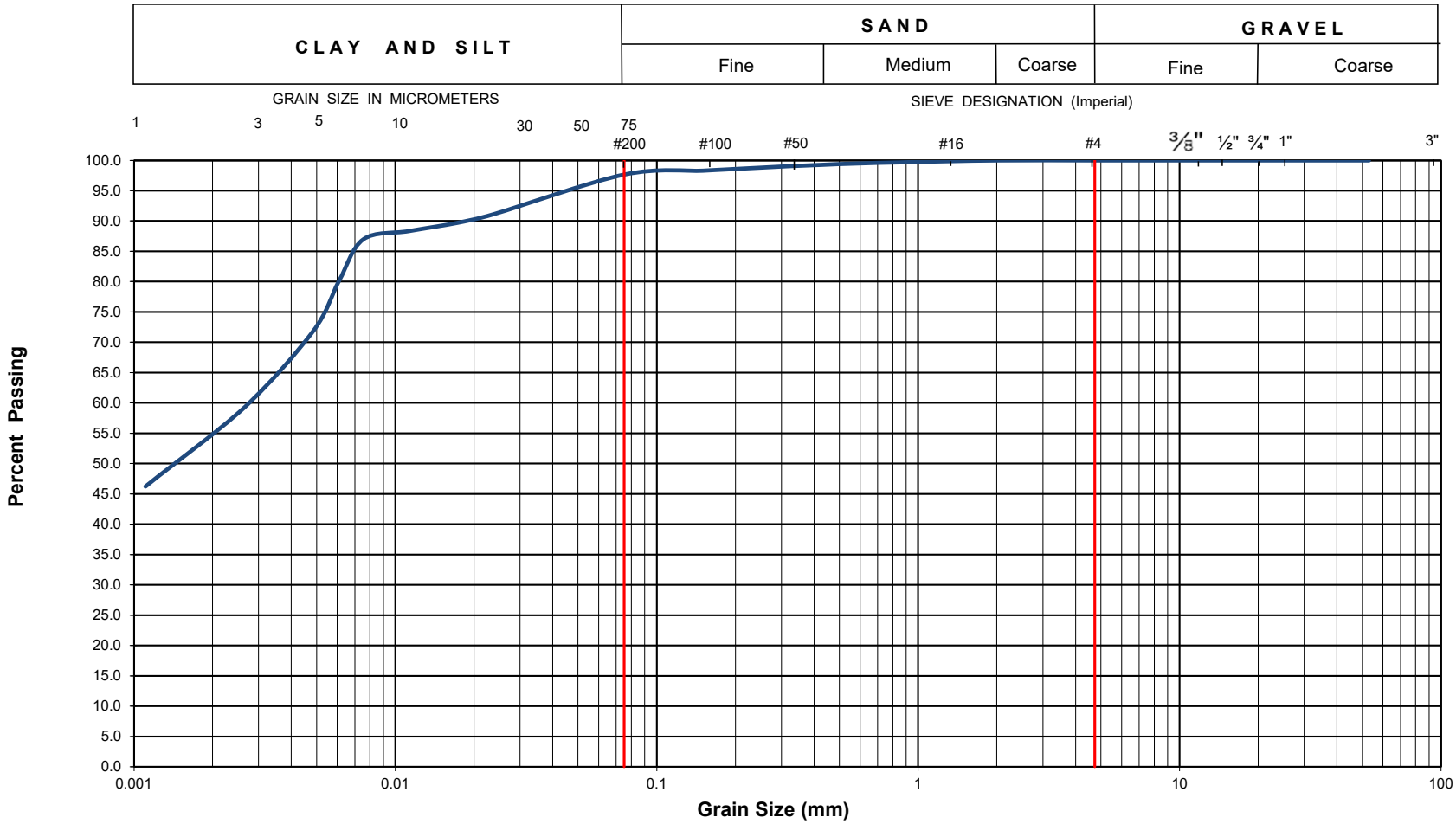


EXP Project No.:	**OTT-00262560-A0**	**Project Name :**	**Proposed Storage Buildings D, E, I, and J**						
Client :	**Access Property Development**	**Project Location :**	**3169 Hawthorne Road, Ottawa, ON**						
Date Sampled :	**October 23, 2020**	**Borehole No:**	**BH-2**		**Sample No.:**	**SS3**		**Depth (m) :**	**1.5-2.1**
Sample Description :		**% Silt and Clay**	**78**	**% Sand**	**22**	**% Gravel**	**0**	**Figure :**	**9**
Sample Description :		**CLAY with Sand (CL)**							

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

Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422

Unified Soil Classification System



EXP Project No.:	**OTT-00262560-A0**	**Project Name :**	**Proposed Storage Buildings D, E, I, and J**						
Client :	**Access Property Development**	**Project Location :**	**3169 Hawthorne Road, Ottawa**						
Date Sampled :	**October 23, 2020**	**Borehole No:**	**BH-3**		**Sample No.:**	**SS9**		**Depth (m) :**	**7.6-8.2**
Sample Description :		**% Silt and Clay**	**98**	**% Sand**	**2**	**% Gravel**	**0**	**Figure :**	**10**
Sample Description :	**CLAY (CL)**								

Appendix A:
Laboratory Certificates 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-262560**
AGAT WORK ORDER: **20Z671399**
SOIL ANALYSIS REVIEWED BY: **Nivine Basily, Inorganics Report Writer**
DATE REPORTED: **Nov 06, 2020**
PAGES (INCLUDING COVER): **6**
VERSION*: **1**

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

Notes

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: 20Z671399

PROJECT: OTT-262560

CLIENT NAME: EXP SERVICES INC

SAMPLING SITE:3169 Hawthorne Rd

ATTENTION TO: Ismail M. Taki

SAMPLED BY:EXP

Inorganic Chemistry (Soil)

DATE RECEIVED: 2020-10-30 **DATE REPORTED: 2020-11-06**

Parameter	Unit	G / S	RDL	SAMPLE DESCRIPTION: BH1 SS3 5'-7'	BH6 SS4 7. 5'-9.5'
			SAMPLE TYPE:	Soil	Soil
			DATE SAMPLED:	2020-10-23	2020-10-23
				1624127	1624129
Chloride (2:1)	µg/g		2	118	39
Sulphate (2:1)	µg/g		2	164	128
pH (2:1)	pH Units		NA	7.73	8.13
Resistivity (2:1) (Calculated)	ohm.cm		1	2350	3030

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

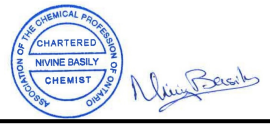
1624127-1624129 Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

pH was determined on the 0.01M CaCl2 extract obtained from 2:1 leaching procedure (2 parts extraction fluid:1 part wet soil).

Resistivity is a calculated parameter.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



AGAT Laboratories

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MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
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Certificate of Analysis

AGAT WORK ORDER: 20Z671399

PROJECT: OTT-262560

CLIENT NAME: EXP SERVICES INC

SAMPLING SITE:3169 Hawthorne Rd

ATTENTION TO: Ismail M. Taki

SAMPLED BY:EXP

Inorganic Chemistry (Soil) %

DATE RECEIVED: 2020-10-30 **DATE REPORTED: 2020-11-06**

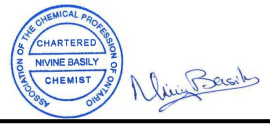
		SAMPLE DESCRIPTION:		BH1 SS3 5'-7'	BH6 SS4 7. 5'-9.5'
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		2020-10-23	2020-10-23
Parameter	Unit	G / S	RDL	1624127	1624129
Chloride (2:1)	%		0.0002	0.0118	0.0039
Sulfate (2:1)	%		0.0002	0.0164	0.0128

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

1624127-1624129 Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



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Quality Assurance

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 20Z671399

PROJECT: OTT-262560

ATTENTION TO: Ismail M. Taki

SAMPLING SITE:3169 Hawthorne Rd

SAMPLED BY:EXP

Soil Analysis

RPT Date: Nov 06, 2020			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)	1636288		22	22	0.0%	< 2	100%	70%	130%	103%	80%	120%	105%	70%	130%
Sulphate (2:1)	1636288		38	39	2.6%	< 2	106%	70%	130%	104%	80%	120%	108%	70%	130%
pH (2:1)	1624127	1624127	7.73	7.77	0.5%	NA	100%	90%	110%						

Comments: NA signifies Not Applicable.
Duplicate NA: results are under 5X the RDL and will not be calculated.

Inorganic Chemistry (Soil) %															
Chloride (2:1)	1636288		0.0022	0.0022	0.0%	< 0.0002	100%	70%	130%	103%	70%	130%	105%	70%	130%
Sulfate (2:1)	1636288		0.0038	0.0039	2.6%	< 0.0002	106%	70%	130%	104%	70%	130%	108%	70%	130%

Comments: NA signifies Not Applicable.

Certified By:

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Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 20Z671399

PROJECT: OTT-262560

ATTENTION TO: Ismail M. Taki

SAMPLING SITE:3169 Hawthorne Rd

SAMPLED BY:EXP

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

1g BTK LT(ice) -5.8|6.7|6.9

AGAT Laboratories
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 consumed by humans)

Laboratory Use Only

Work Order #: 2076713 99

Cooler Quantity: 9no - no ice

Arrival Temperatures: 16.2 | 16.3 | 16.1

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

Report Information:

Company: EXP Services

Contact: Ismail Tak

Address: 2650 Queensview Drive Suite 100
Ottawa ON K2B 8H6

Phone: 613-688-1899 Fax:

Reports to be sent to:

1. Email: Ismail.Tak@exp.com

2. Email:

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) ☐ MISA

☐ 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-262560

Site Location: 3169 Hawthorne Rd

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	Field Filtered - Metals, Hg, CrVI (Y/N)	O. Reg 153: Metals and Inorganics	All Metals ☐ 153 Metals (excl. Hydrides)	Hydride Metals ☐ 153 Metals (incl. Hydrides)	ORPs: ☐ B-HWS ☐ Cl ☐ CN	☐ Cr⁶⁺ ☐ EC ☐ FOC ☐ Hg	☐ pH ☐ SAR	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH_3 ☐ TKN	☐ NO_3 ☐ NO_2 ☐ NO_2+NO_3	Volatiles: ☐ VOC ☐ BTEX ☐ THM	PHCs F1 - F4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use	pH	Sulphide	Electro Conductivity			Potentially Hazardous or High Concentration (Y/N)
BH1 SS3 5'-7'	Oct 23/20																								✓	✓	✓			
BH4 SS4 7.5'-9.5'	Oct 26/20																								✓	✓	✓			

Samples Relinquished By (Print Name and Sign): Ryan DiGiuseppe	Date: Oct 29/20	Time: 6:30p.m	Samples Received By (Print Name and Sign):	Date: 2020.10.30	Time: 9hrs		
Samples Relinquished By (Print Name and Sign):	Date: 2020/10/30	Time: 15hrs	Samples Received By (Print Name and Sign): SIMRAN	Date: Oct 31/20	Time: 8:50am	Page ____ of ____	
Samples Relinquished By (Print Name and Sign):	Date:	Time:	Samples Received By (Print Name and Sign):	Date:	Time:	Nº: T 101293	

Appendix B:
Legal Notification

Legal Notification

This report was prepared by EXP Services Inc. (EXP) for the account of Mr. Jonathan el Rosario, Access Property Development.

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 accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.

Report Distribution

Mr. Jonathan el Rosario, invoices@accesspd.ca, Access Property Development