Geotechnical Investigation

Proposed Residential Site Re-Development
400 Coventry Road
Ottawa, Ontario
Revision 1

Prepared for:

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LRL File No.: 220200.03

June 2023; *Revised May 2025*

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1 INTRODUCTION

LRL Associates Ltd. (LRL) was retained by Groupe Oradev Inc. to perform a geotechnical investigation for a proposed residential site redevelopment, to be located at 400 Coventry Road, Ottawa, Ontario.

The purpose of the investigation was to identify the subsurface conditions across the site by the completion of a limited borehole drilling program. Based on the visual and factual information obtained, this report will provide preliminary guidelines on the geotechnical engineering aspects of the design of the project, including construction considerations.

This report has been prepared in consideration of the terms and conditions noted above. Should there be any changes in the design features, which may relate to the geotechnical recommendations provided in the report, LRL should be advised in order to review the report recommendations.

2 SITE AND PROJECT DESCRIPTION

The site under investigation is currently the Enbridge Gas Distribution Inc. Corporate Building. The site is rectangular in shape, having about 111 m of frontage along Coventry Road, and an approximate surface area of about 20,000 m^2. The general topography of the site is considered to be relatively flat. The site is bound by 380 Coventry Road to the west, Coventry Road to the north, Belfast Road to the east, and Highway 417 to the south. The location is presented in Figure 1 included in **Appendix A**, and is civically located at 400 Coventry Road, Ottawa ON.

At the time generating this report, it is understood that development on this site will consist of construction of five (5) apartment complexes, ranging in height from six (6) to thirty (30) storey. The development will also have a designated park land, as well as below grade parking.

3 PROCEDURE

Concurrently with the Phase II Environmental Site Assessment (ESA) study, the initial fieldwork for this investigation was carried out on May 4 and 5, 2022. Subsequent field work was carried out and additional boreholes were drilled December 12, 2022 through January 17, 2023. Prior to the fieldwork, the site was cleared for the presence of any underground services and utilities. A total of thirteen (13) boreholes, labelled BH1 through BH13, were drilled across the site to get a general representation of the site's soil conditions. The approximate locations of the boreholes are shown in Figure 2 included in **Appendix A**.

The boreholes were advanced using a truck mount CME 55 drill rig equipped with 200 mm diameter continuous flight hollow stem auger supplied and operated by CCC Geotechnical and Environmental Drilling Ltd. A "two man" crew experienced with geotechnical drilling operated the drill rig and equipment.

Sampling of the overburden materials encountered in the boreholes was carried out at regular depth intervals using a 50.8 mm diameter drive open conventional spoon sampler in conjunction with standard penetration testing (SPT) "N" values. The SPT were conducted following the method **ASTM D1586** and the results of SPT, in terms of the

number of blows per 0.3 m of split-spoon sampler penetration after first 0.15 m designated as “N” value.

All boreholes were advanced until practical auger refusal over inferred bedrock at depths ranging between 2.90 and 8.23 m below ground surface (bgs). Upon completion, the boreholes were backfilled using the overburden cuttings and topped with asphalt cold patch.

The fieldwork was supervised throughout by a member of our engineering staff who oversaw the drilling activities, cared for the samples obtained and logged the subsurface conditions encountered within each of the boreholes. All soil samples collected from the boreholes were placed and sealed in plastic bags to prevent moisture loss. The recovered soil samples collected from the boreholes were classified based on visual examination of the materials recovered and the results of the in-situ testing.

Furthermore, all boreholes were located using a Garmin Etrex Legend GPS (Global Positioning System) receiver using NAD 83 datum (North American Datum). LRL’s field personnel determined the existing grade elevations at the borehole locations through a topographic survey carried out using a temporary site bench mark (top of concrete pad at the south-west corner of the existing building), and given an elevation of 100.00 m. Ground surface elevations of the boring locations are shown on their respective borehole logs.

4 SUBSURFACE SOIL AND GROUNDWATER CONDITIONS

4.1 General

A review of local surficial geology maps provided by the Department of Energy, Mines and Resources Canada suggest that the surficial geology for this area consists of till; having a heterogeneous mixture of material ranging from clay to large boulders, generally sandy, grading downwards into unmodified till.

The subsurface conditions encountered in the boreholes were classified based on visual and tactile examination of the materials recovered from the boreholes and the results of in-situ laboratory testing. The soil descriptions presented in this report are based on commonly accepted methods of classification and identification employed in geotechnical practice. Classification and identification of soil were conducted according to the procedure **ASTM D2487** and judgement, and LRL does not guarantee descriptions as exact, but infers accuracy to the extent that is common in current geotechnical practice.

The subsurface soil conditions encountered at the boreholes are given in their respective logs presented in **Appendix B**. A greater explanation of the information presented in the borehole logs can be found in **Appendix C** of this report. These logs indicate the subsurface conditions encountered at a specific test location only. Boundaries between zones on the logs are often not distinct, but are rather transitional and have been interpreted as such.

4.2 Pavement Structure

At the surface of all boring locations, with the exception of BH13, a pavement structure was encountered. This consisted of asphalt overlying granular material (crushed stone).

4.3 Topsoil

At the surface of BH13, a 300 mm thick layer of topsoil was encountered.

This material was classified as topsoil based on colour and the presence of organic material and is intended as identification for geotechnical purposes only. It does not constitute a statement as to the suitability of this layer for cultivation and sustaining plant growth.

4.4 Fill

Underlying the pavement structure in BH2 and BH5, a layer of fill was encountered and extended to depths of 1.37 and 1.20 m bgs respectively. This can generally be described as ranging from a sandy clay to a mixture of silt-sand-clay with some gravel sized stone. The recorded SPT "N" values of this deposit varied from 6 to 25, indicating the deposit is loose to compact. The natural moisture contents were found ranging between 7 and 25%.

4.5 Sand

Underlying the pavement structure in BH1, BH3 and BH4, a layer of sand was encountered and extended to depths of 1.88 and 1.98 m bgs. This can generally be described as brown to greyish brown, and moist. The recorded SPT "N" values of this deposit varied from 7 to 21, indicating the deposit is loose to compact. The natural moisture contents were found ranging between 7 and 21%.

4.6 Clay

Underlying the sand in BH3, a layer of clay was encountered and extended to a depth of 2.43 m bgs. This can be described as grey and wet. The recorded SPT "N" values of this deposit was 6, indicating the deposit is firm.

4.7 Silty Sand

Underlying the pavement structure in BH6, BH7, BH8, and BH13, a layer of silty sand was encountered and extended to depths of 1.50 and 1.80 m bgs. This can generally be described as brown, and moist. The recorded SPT "N" values of this deposit varied from 6 to 11, indicating the deposit is loose to compact. The natural moisture contents were found ranging between 14 and 24%.

4.8 Sandy Clay

Underlying the pavement structure in BH10 and BH11, a layer of sandy clay was encountered and extended to depths of 1.37 and 1.50 m bgs. This can generally be described as greyish brown, and dry. The recorded SPT "N" values of this deposit was 9 and 11, indicating the deposit is stiff. The natural moisture contents were found to be 22 and 32%.

4.9 Glacial Till

Underlying the fill in BH2 and BH5, the sand in BH1, and BH4, the clay in BH3, the pavement structure in BH9 and BH12, the sandy clay in BH10 and BH11, and the silty sand in BH6, BH7, BH8, and BH13 a layer of glacial till was encountered and extended until the end of exploration, at depths between 2.90 and 8.23 m bgs. This material can generally be described as a mixture of silt-sand-gravel sized stone, trace clay, brown to dark grey, and moist. The SPT "N" values were found to range between 10 and 50+, indicating the material is compact to very dense. The natural moisture contents were determined to range between 5 and 18%.

4.10 Refusal

Practical auger refusal over inferred bedrock was encountered in all boreholes. This was encountered at depths ranging between 2.90 and 8.23 m bgs.

4.11 Laboratory Analysis

Eight (8) soil samples were collected for laboratory gradation analyses. The gradation analyses comprised of sieve and hydrometer were conducted following the procedure **ASTM D422.** Details of laboratory analyses are reflected in **Table 1**.

Table 1: Gradation Analysis Summary

Sample Location	Depth (m)	Percent for Each Soil Gradation							Estimated Hydraulic Conductivity K (m/s)
		Gravel		Sand			Silt (%)	Clay (%)	
		Coarse (%)	Fine (%)	Coarse (%)	Medium (%)	Fine (%)			
BH2	2.1-2.7	4.5	21.4	7.9	11.1	16.3	32.4	6.4	5×10^{-6}
BH3	2.4-3.0	0.0	8.7	8.1	8.6	29.8	39.1	5.7	5×10^{-6}
BH5	0.9-1.5	0.0	10.2	7.0	14.0	27.1	35.1	6.6	5×10^{-6}
BH6	1.5-2.1	1.9	12.9	7.1	12.1	17.2	39.3	9.5	5×10^{-6}
BH7	4.6-5.1	0.0	18.5	7.8	12.7	21.7	30.5	8.8	5×10^{-6}
BH8	3.1-3.7	5.9	20.1	6.6	10.2	21.5	29.4	6.3	5×10^{-6}
BH10	5.3-5.9	0.0	19.5	9.9	13.8	23.3	27.9	5.6	5×10^{-6}
BH12	2.3-2.9	0.0	15.0	8.0	12.7	25.3	32.4	6.6	5×10^{-6}

The laboratory reports can be found in **Appendix D** of this report.

4.12 Groundwater Conditions

Groundwater was carefully monitored during this field investigation. Water was not encountered during the drilling operation.

Long term groundwater levels were monitored as part of the Phase II ESA. The water levels were found ranging between about 0.8 and 1.8 m bgs.

It should be noted that groundwater levels could fluctuate with seasonal weather conditions, (i.e.: rainfall, droughts, spring thawing) and due to construction activities at or in the vicinity of the site.

5 GEOTECHNICAL CONSIDERATIONS

This section of the report provides general geotechnical recommendations for the design aspect of the project based on our interpretation of the information gathered from the boreholes performed at this site and from the project requirements.

This section will detail the specific requirements and limitations with regard to allowable foundation bearing pressure and depth, grade raise and size of the footings.

5.1 Foundations

Depending on each respective building's Underside of Footing (USF) elevation, the buildings will either be founded on glacial till, or bedrock underlying the glacial till. Therefore, all overburden material shall he removed from each building footprint down to the required USF elevation.

5.2 Shallow Foundation

For buildings founded on the undisturbed native glacial till, conventional strip and column footings may be designed using a maximum allowable bearing pressure of **150 kPa** for serviceability limit state **(SLS)** and **225 kPa** for ultimate limit state **(ULS)** factored bearing resistance. The factored ULS value includes the geotechnical resistance factor of 0.5.

Alternatively, Conventional strip and column footings set over sound bedrock may be designed using a maximum allowable bearing pressure of **1,000 kPa** for Ultimate Limit State **(ULS)** factored bearing resistance. Serviceability Limit State **(SLS)** does not apply for footings founded on bedrock since failure of the concrete would occur before unacceptable settlement of the foundation.

Prior to pouring the footings, the bedrock and or glacial till should be inspected and approved by a geotechnical engineer. Any incompetent subgrade areas within the glacial till as identified from in-situ testing must be sub-excavated and backfilled with approved structural fill. Similarly, any soft or wet areas should also be sub-excavated and backfilled with approved structural fill only.

Where any sub-excavation is required within the bedrock, a lean concrete mix (minimum 10 MPa) shall be poured up to the USF elevation.

There are no maximum footing widths nor grade raise restrictions for this site.

5.3 Structural Fill

For foundations set over undisturbed native soil and where excavation below the underside of the footings is performed in order to reach a suitable founding stratum, consideration should also be given to support the footings on structural fill. The structural fill should be placed over undisturbed native soils in layers not exceeding 300 mm and compacted to 98% of its Standard Proctor Maximum Dry Density (SPMDD) within ±2% of its optimum moisture content. In order to allow the spread of load beneath the footings and to prevent undermining during construction, the structural fill should extend minimum 1.0 m beyond the outside edges of the footings and then outward and downward at 1 horizontal to 1 vertical profile (or flatter) over a distance equal to the depth of the structural fill below the footing. Furthermore, the structural fill must be tested to ensure that the specified compaction level is achieved.

5.4 Bedrock Excavation

Where bedrock excavation is required (if any), it is anticipated that bedrock removal will be possible with the use of heavy excavation equipment, but that removal of most of the bedrock could be facilitated by means of a hoe ramming operation. Both horizontal and vertical overbreak of the bedrock excavation face/bottom can be expected due to the hoe ramming operation. If control of potential bedrock overbreak is required, line drilling at the

proposed excavation face is recommended. The smaller the distance between the drill holes, the fewer overbreaks is expected. It is generally considered that the drilling at 150 mm horizontal spacing to the full depth of the excavation should control overbreak to an acceptable level. Considering the proximity of the existing structures adjacent to the site and the potential for vibration during excavating and removal of the bedrock, monitoring of the hoe ramming shall be carried out throughout the operation on nearby buildings to ensure that the vibration limit is not exceeded. As outlined in **OPSS 120, Table 2** below summarizes the following vibration limits for the nearest existing structures.

In addition, a pre and post construction excavation condition survey of nearby structures is recommended to be carried out.

Table 2: Vibration Frequency and Limit

Frequency of Vibration (HZ)	Vibration Limit, PPV (Peak Particle Velocity) mm/sec
≤ 40	20
> 40	50

5.5 Lateral Earth Pressure

The following equation should be used to estimate the intensity of the lateral earth pressure against any earth retaining structure/foundation walls.

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

Where;

P = Earth pressure at depth h;

K = Appropriate coefficient of earth pressure;

γ = Unit weight of compacted backfill, adjacent to the wall;

h = Depth (below adjacent to the highest grade) at which P is calculated;

q = Intensity of any surcharge distributed uniformly over the backfill surface (usually surcharge from traffic, equipment or soil stockpiled and typically considered 10 kPa).

The coefficient of earth pressure at rest (K_0) should be used in the calculation of the earth pressure on the storm water manhole/basement walls, which are expected to be rather rigid and not to deflect.

The above expression assumes that perimeter drainage system prevents the build-up of any hydrostatic pressure behind the foundation wall.

Table 3 below provides various material types and their respective earth pressure properties.

Table 3: Material and Earth Pressure Properties

Type of Material	Bulk Density (kN/m^3)	Friction Angle (Φ)	Pressure Coefficient		
			At Rest (K_0)	Active (K_A)	Passive (K_P)
Granular A	23.0	34	0.44	0.28	3.53
Granular B Type I	20.0	31	0.49	0.32	3.12
Granular B Type II	23.0	32	0.47	0.31	3.25
Glacial Till	21.5	32	0.47	0.31	3.25

5.6 Settlement

The estimated total settlement of the shallow foundations, designed using the recommended serviceability limit state capacity value, as well as other recommendations given above, will be less than 25 mm. The differential settlement between adjacent column footings is anticipated to be 15 mm or less.

5.7 Seismic

Based on the information of this geotechnical investigation and in accordance with the Ontario Building Code 2015 (Table 4.1.8.4.A.) and Canadian Foundation Engineering Manual (4^{th} edition), the site can be classified for Seismic Site Response Site Class C.

The above classifications were recommended based on conventional method exercised for Site Classification for Seismic Site Response and in accordance with the generally accepted geotechnical engineering practice. It should be noted that a greater Seismic Site Class might be possible to achieve by carrying out a site-specific Multichannel Analysis of Surface Waves (MASW) survey, and is recommended to be carried out for the final geotechnical report.

5.8 Liquefaction Potential

The potential for liquefaction is not a concern for this site.

5.9 Frost Protection

All exterior footings for any heated structure exposed to frost conditions should have a minimum of 1.5 m of earth cover. Footings for any unheated structures, signage or lighting, and where snow will be cleared, 1.8 m of earth cover is required. Alternatively, the required frost protection could be provided using a combination of earth cover and extruded polystyrene insulation. Detailed guidelines for footing insulation frost protection can be provided upon request.

In the event that foundations are to be constructed during winter months, the foundation soils are required to be protected from freezing temperatures using suitable construction techniques. The base of all excavations should be insulated from freezing temperatures immediately upon exposure, until heat can be supplied to the building interior and the footings have sufficient soil cover to prevent freezing of the subgrade soils.

5.10 Foundation Walls Backfill (Shallow Foundations)

To prevent possible foundation frost jacking and lateral loading, the backfill material against any foundation walls, grade beams, isolated walls, or piers should consist of free

draining, non-frost susceptible material such as sand or sand and gravel meeting OPSS Granular B Type II or I, or a Select Subgrade Material (SSM).

The foundation wall backfill should be compacted to minimum 95% of its SPMDD using light compaction equipment, where no loads will be set over top. The compaction shall be increased to 98% of its SPMDD under walkways, slabs or paved areas close to the foundation or retaining walls. Backfilling against foundation walls should be carried out on both sides of the wall at the same time where applicable.

5.11 Corrosion Potential and Cement Type

A soil sample was submitted to Paracel Laboratories Ltd. for chemical testing. The following **Table 4** below summarizes the results.

Table 4: Results of Chemical Analysis

Sample Location	Depth (m)	pH	Sulphate (µg/g)	Chloride (µg/g)	Resistivity (Ohm.cm)
BH2	2.1 – 2.7	7.72	90	<397	1,170

The above results revealed a measured sulphate concentration of 90 µg/g in the sample. Based on the CAN/CSA-A23.1 standards (Concrete Materials and Methods of Concrete Construction), a sulphate concentration of less than 1000 µg/g falls within the negligible category for sulphate attack on buried concrete. The test results from soil samples were below the noted threshold. As such, buried concrete for footings and foundations walls will not require any special additive to resist sulphate attack and the use of normal Portland cement is acceptable.

The pH, resistivity and chloride concentration provide an indication of the degree of corrosiveness of the sub-surface environment. The soil resistivity was measured to be 1,170 ohm.cm, which falls between the “highly corrosive” range for soil resistivity.

5.12 Slab-on-grade Construction

Concrete slab-on-grade should rest over compacted, free draining and well graded structural fill only. Therefore, all fill including organic or otherwise deleterious material shall be removed from the proposed buildings’ footprint. The exposed undisturbed native subgrade should then be inspected and approved by a qualified geotechnical personnel.

Any underfloor fill needed to raise the general floor grade shall consist of OPSS Granular B Type II material or an approved equivalent, compacted to 95% of its SPMDD. The final lift shall be compacted to 98% of its SPMDD. A 200 mm Granular A meeting the **OPSS 1010** shall be placed underneath the slab and compacted to 100% of its SPMDD. Alternatively, if wet condition persists, 200 mm thickness of 19 mm clear stone meeting the **OPSS 1004** requirements shall be used instead of Granular A.

It is also recommended that the area of extensive exterior slab-on-grade (sidewalks, ramp etc.) shall be constructed using Granular B subbase of thickness 150 mm and Granular A base of thickness 150 mm with incorporating subdrain facilities. The modulus of subgrade reaction (ks) for the design of the slabs set over competent native soil/structural fill is **24 MPa/m.**

In order to further minimize and control cracking, the floor slab shall be provided with wire or fibre mesh reinforcement and construction or control joints. The construction or control

joints should be spaced equal distance in both directions and should not exceed 4.5 m. The wire or fibre mesh reinforcement shall be carried out through the joints.

6 EXCAVATION AND BACKFILLING REQUIREMENTS

6.1 Excavation

Most of the excavation being carried out on this site will be through glacial till material. Excavation must be carried out in accordance with Occupational Health and Safety Act and Regulations for construction Projects.

According to the Ontario's Occupational Health and Safety Act (OHSA), O. Reg. 213/91 and its amendments, the surficial overburden expected to be excavated into at this site can be classified as Type 3. Therefore, shallow temporary excavations can be cut at 1 horizontal to 1 vertical (1H: 1V) for a fully drained excavation starting at the base of the excavation and as per requirements of the OHSA regulations.

If excavating into bedrock, the side of the bedrock excavation does not need to be sloped, and can be cut vertically from the base of excavation. It is recommended to install a protective meshing over the side walls of the bedrock to ensure loose rock debris will not fall into excavation.

Any excavated material stockpiled near an excavation or trench should be stored at a distance equal to or greater than the depth of the excavation/trench and construction equipment, traffic should be limited near open excavation.

6.2 Ground Water Control

Based on the subsurface conditions encountered at this site, groundwater seepage or infiltration into the temporary excavations during construction is expected. This will be able to be controlled by pumping with sump pumps. Surface water runoff into the excavation should be minimized and diverted away from the excavation.

Any water discharged from site shall be done in accordance with the "Remedial Action Plan", generated by LRL, dated May 16, 2025.

A permit to take water (PTTW) is required from Ministry of Environment and Climate Change (MOECC), Ontario Reg. 387/04, if more than 400,000 litres per day of groundwater will be pumped during a construction period less than 30 days. Registration in the Environmental Activity and Sector Registry (EASR) is required when water takings range between 50,000 and 400,000 litres per day.

The actual amount of groundwater inflow into open excavations will depend on several factors such as the contractor's schedule, rate of excavation, the size of excavation, depth below the groundwater level, and at the time of year which the excavation is executed. It is expected that pumping rates will be less than 50,000 litres per day. As such, EASR registration is not required for the construction at this site. However, a hydrological study may be carried out to better determine the amount of water to be pumped

6.3 Pipe Bedding Requirements

It is anticipated that any underground services required as part of this project will be founded over till material. Alternately, underground services may be founded over properly prepared and approved structural fill, where excavation below the invert is required. Consequently all organic material should be removed down to a suitable bearing layer. Any sub-excavation of disturbed soil should be removed and replaced with a

Granular B Type II or I or approved equivalent, laid in loose lifts of thickness not exceeding 300 mm and compacted to 95% of its SPMDD. Bedding, thickness of cover material and compaction requirements for any pipes should conform to the manufacturers design requirements and to the detailed installations outlined in the Ontario Provincial Standard Specifications (OPSS) and any applicable standards or requirements.

If services are required to be founded below the groundwater table the native materials may be sensitive to disturbances and may also be susceptible to piping and scouring from water pressure at the base of the excavation. Therefore, special precautions should be taken in these areas to stabilize and confine the base of the excavation such as using recompression (thicker bedding) and/or dewatering methods (pre-pumping). In order to properly compact the bedding, the water table should be kept at least 300 mm below the base of the excavation at all time during the installation of any sewers and structures.

As an alternative to Granular A bedding and only where wet conditions are encountered, the use of “clear stone” bedding, such as 19 mm clear stone, **OPSS 1004**, may be considered only in conjunction with a suitable geotextile filter (such as terrafix 270R or approved equivalent). Without proper filtering, there may be entry of fines from native soils and trench backfill into the bedding, which could result in loss of support to the pipes and possible surface settlements. The sub-bedding, bedding and cover materials should be compacted in maximum 200 mm thick lifts to at least 95% of its SPMDD within ±2% of its optimum moisture content using suitable vibratory compaction equipment.

6.4 Trench Backfill

All service trenches should be backfilled using compactable material, free of organics, debris and large cobbles or boulders. Acceptable native materials (if encountered and where possible) should be used as backfill between the roadway subgrade level and the depth of seasonal frost penetrations (i.e. 1.8 m below finished grade) in order to reduce the potential for differential frost heaving between the new excavated trench and the adjacent section of roadway. Where native backfill is used, it should match the native materials exposed on the trench walls. Backfill below the zone of seasonal frost penetration could consist of either acceptable native material or imported granular material conforming to OPSS Granular B Type II or I. Any boulders larger than 150 mm in size should not be used as trench backfill.

To minimize future settlement of the backfill and achieve an acceptable subgrade for the roadway, the trench should be compacted in maximum 300 mm thick lifts to at least 95% of its SPMDD. The specified density may be reduced where the trench backfill is not located within or in close proximity to existing roadways or any other structures.

For trenches carried out in existing paved areas, transitions should be constructed to ensure that proper compaction is achieved between any new pavement structure and the existing pavement structure to minimize potential future differential settlement between the existing and new pavement structure. The transition should start at the subgrade level and extend to the underside of the asphaltic concrete level (if any) at a 1 horizontal to 1 vertical slope. This is especially important where trench boxes are used and where no side slopes are provided to the excavation. Where asphaltic concrete is present, it should be cut back to a minimum of 150 mm from the edge of the excavation to allow for proper compaction between the new and existing pavement structures.

7 REUSE OF ON-SITE SOILS

The existing surficial overburden soils consist mostly of glacial till material. This material is considered to be frost susceptible and should not be used as backfill material directly against foundation walls or underneath unheated concrete slabs. However, these could be reused as general backfill material (service trenches, general landscaping/backfilling) if it can be compacted according to the specifications outlined herein at the time of construction and found free from any waste, organics and debris. Any imported material shall conform to OPSS Granular B – Type II or I, SSM or approved equivalent.

It should be noted that the adequacy of any material for reuse as backfill will depend on its water content at the time of its use and on the weather conditions prevailing prior to and during that time. Therefore, all excavated materials to be reused shall be stockpiled in a manner that will prevent any significant changes in their moisture content, especially during wet conditions. Any excavated materials proposed for reuse should be stockpiled in a manner to promote drying and should be inspected and approved for reuse by a geotechnical engineer.

8 RECOMMENDED PAVEMENT STRUCTURE

It is anticipated that the subgrade soils for the new parking areas will consist mostly of silty sand and/or sand material. The construction of the parking areas will be acceptable over this material after it is properly compacted and approved by a geotechnical engineer or their representative.

The following **Table 5** presents the recommended pavement structures to be constructed over a stable subgrade along the proposed parking areas and access lanes as part of this project.

Table 5: Recommended Pavement Structure

Course	Material	Thickness (mm)	
		Light Duty Parking Area (mm)	Heavy Duty Parking Area (Access Roads, Fire Routes and Trucks) (mm)
Surface	HL3/SP12.5 A/C	50	40
Binder	HL8/SP19.0 A/C	-	50
Base course	Granular A	150	150
Sub base	Granular B Type II	350	450
Total:		500	690

Performance Graded Asphaltic Cement (PGAC) **58-34** is recommended for this project.

The base and subbase granular materials shall conform to **OPSS 1010** material specifications. Any proposed materials shall be tested and approved by a geotechnical engineer prior to delivery to the site and shall be compacted to 98% of its SPMDD. Asphaltic concrete shall conform to **OPSS 1150** and be placed and compacted to at least 93% of the Marshall Density. The mix and its constituents shall be reviewed, tested and approved by a geotechnical engineer prior to delivery to the site.

8.1 Paved Areas & Subgrade Preparation

The access lanes and parking areas shall be stripped of vegetation, debris and other obvious objectionable material. Following the backfilling and satisfactory compaction of any underground service trenches up to the subgrade level, the subgrade shall be shaped, crowned and proof-rolled. A loaded Tandem axle, dual wheel dump truck or approved equivalent heavy duty smooth drum roller shall be used for proof-rolling. Any resulting loose/soft areas should be sub-excavated down to an adequate bearing layer and replaced with approved backfill.

The preparation of subgrade shall be scheduled and carried out in manner so that a protective cover of overlying granular material (if required) is placed as quickly as possible in order to avoid unnecessary circulation by heavy equipment, except on unexcavated or protected surfaces. Frost protection of the surface shall be implemented if works are carried out during the winter season.

The performance of the pavement structure is highly dependent on the subsurface groundwater conditions and maintaining the subgrade and pavement structure in a dry condition. The surface of the pavement should be properly graded to direct runoff water towards suitable drainage features. It is recommended that the lateral extent of the subbase and base layers not be terminated vertically immediately behind the curb/edge of pavement line but be extended beyond the curb.

9 INSPECTION SERVICES

The engagement of the services of the geotechnical consultant during construction is recommended to confirm that the subsurface conditions throughout the proposed site do not materially differ from those given in the report and that the construction activities do not adversely affect the intent of the design.

All footing areas and any structural fill areas for the proposed structures should be inspected by LRL to ensure that a suitable subgrade has been reached and properly prepared. The placing and compaction of any granular materials beneath the foundations and slab-on-grade should be inspected to ensure that the materials used conform to the grading and compaction specifications.

The subgrade for the pavement areas and underground services should be inspected and approved by geotechnical personnel. In-situ density testing should be carried out on the pavement granular materials, pipe bedding and backfill to ensure the materials meet the specifications for required compaction.

If footings are to be constructed during winter season, the footing subgrade should be protected from freezing temperatures using suitable construction techniques.

10 REPORT CONDITIONS AND LIMITATIONS

It is stressed that the information presented in this report is provided for the guidance of the designers and is intended for this project only. The use of this report as a construction document or its use by a third party beyond the client specifically listed in the report is neither intended nor authorized by LRL Associates Ltd. Contractors bidding on or undertaking the works should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction, and make their own interpretation of the factual data as it affects their construction techniques, schedule, safety and equipment capabilities.

The professional services for this project include only the geotechnical aspects of the subsurface conditions at this site. The presence or implications of possible contamination resulting from previous uses or activities at this site or adjacent properties, and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this report.

The recommendations provided in this report are based on subsurface data obtained at the specific boring locations only. Boundaries between zones presented on the borehole are often not distinct but transitional and were interpreted. Experience indicates that the subsurface soil and groundwater conditions can vary significantly between and beyond the test locations. For this reason, the recommendations given in this report are subject to a field verification of the subsurface soil conditions at the time of construction.

The recommendations are applicable only to the project described in this report. Any changes to the project will require a review by LRL Associates Ltd., to ensure compatibility with the recommendations contained in this project.

We trust this report provides sufficient information for your present purposes. If you have any questions concerning this report or if we may be of further services to you, please do not hesitate to contact the undersigned.

Yours truly,
LRL Associates Ltd.

Brad Johnson, P.Eng.
Geotechnical Engineer

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APPENDIX A

Site and Borehole Location Plan

LRL
ENGINEERING | INGÉNIERIE
5430 Canotek Road | Ottawa, ON, K1J 9G2
www.lrl.ca | (613) 842-3434

PROJECT

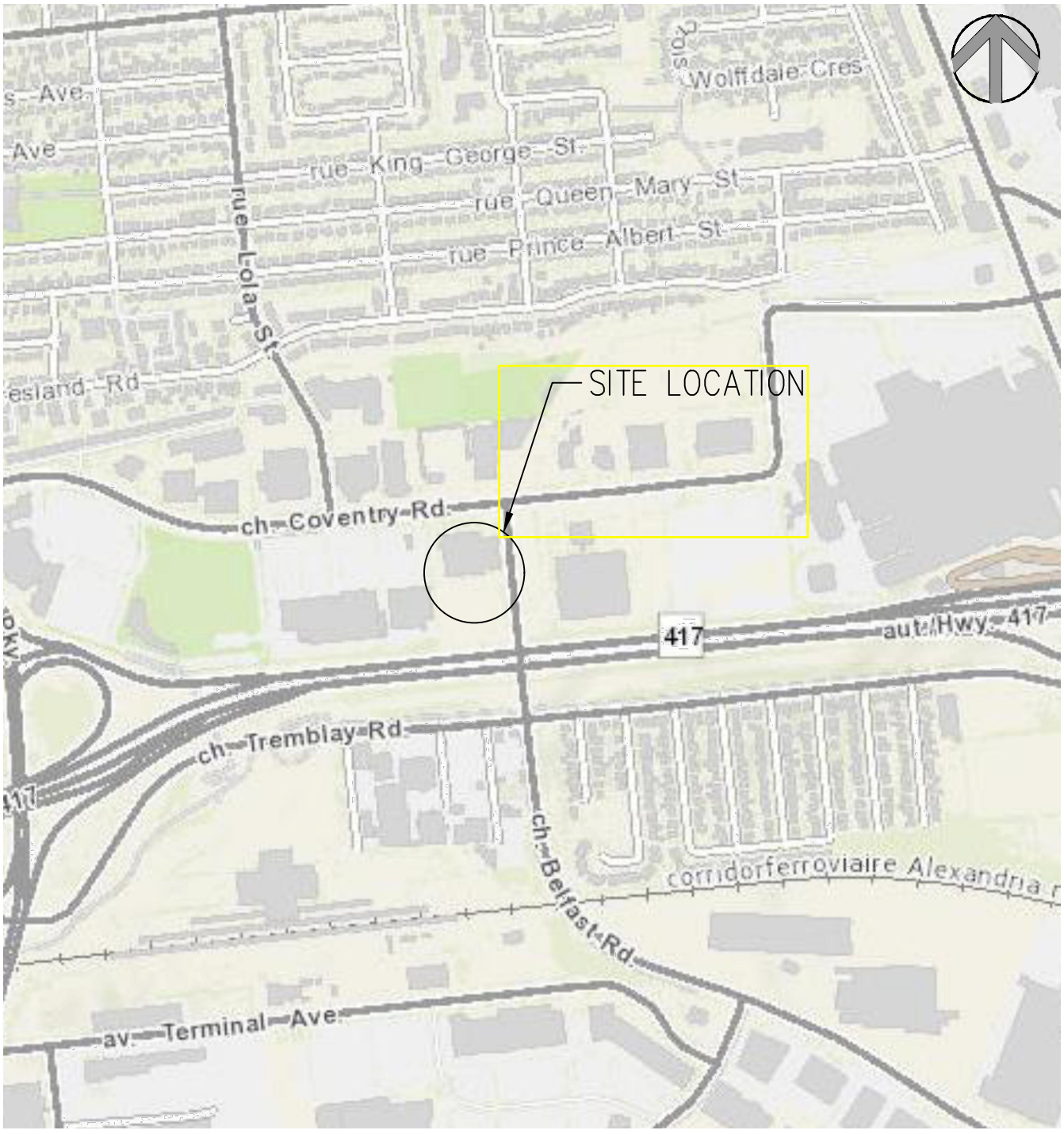
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL SITE REDEVELOPMENT
400 COVENTRY ROAD
OTTAWA, ONTARIO

DRAWING TITLE

SITE LOCATION
SOURCE: GEOOTTAWA

CLIENT	DATE	PROJECT
GROUPE ORADEV INC.	JUNE 2023	220200

FIGURE 1



LRJ
ENGINEERING | INGÉNIERIE
5430 Canotek Road | Ottawa, ON, K1J 9G2
www.lrl.ca | (613) 842-3434

PROJECT

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL SITE REDEVELOPMENT
400 COVENTRY ROAD
OTTAWA, ONTARIO

DRAWING TITLE

BOREHOLE LOCATION
SOURCE: GOOGLE IMAGE

CLIENT	DATE	PROJECT	
GROUPE ORADEV INC.	JUNE 2023	220200	FIGURE 2

APPENDIX B
Borehole Logs

Borehole Log: BH1

Project No.: 220200 **Project:** Proposed Residential Site Redevelopment

Client: Groupe Oradev Inc. **Location:** 400 Coventry Road, Ottawa

Date: May 4, 2022 **Field Personnel:** DC

Driller: CCC Geotech and Enviro Drilling **Drilling Equipment:** Truck Mount CME 850 **Drilling Method:** Hollow Stem Auger

Depth (ft / m)	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)	Shear Strength (kPa) / SPT N Value (Blows/0.3 m)	Water Content (%) / Liquid Limit (%)	Monitoring Well Details
0 ft / 0 m	Ground Surface	99.16							
0 – 1 ft / 0 m	**PAVEMENT STRUCTURE** Asphalt overlying granular material.	0.00		SS1	6	75	6	24	
		98.39							
3 – 4 ft / 1 m	**SAND** greyish brown, moist, loose.	0.77		SS2	7	54	7	9	
5 – 6 ft / 2 m				SS3	21	71	21	10	
		97.18							
7 – 8 ft / 2 m	**GLACIAL TILL** silt-sand-gravel sized stone, trace clay, brown, becoming dark grey with increased depth, compact.	1.98		SS4	29	71	29	6	
10 – 11 ft / 3 m				SS5	18	54	18	8	
12 ft / 4 m				SS6	50+		50+		
		94.59							
15 – 16 ft / 5 m	End of Borehole Borehole terminated after practical auger refusal over inferred bedrock.	4.57							

Easting: 440321 m **Northing:** 5029810 m

Site Datum: Temporary Site BM

Groundsurface Elevation: 99.163 m **Top of Riser Elev.:** NA

Hole Diameter: 200 mm **Monitoring Well Diameter:** N/A

NOTES:

No water encountered while drilling.

Borehole Log: BH2

Project No.: 220200 **Project:** Proposed Residential Site Redevelopment

Client: Groupe Oradev Inc. **Location:** 400 Coventry Road, Ottawa

Date: May 4, 2022 **Field Personnel:** DC

Driller: CCC Geotech and Enviro Drilling **Drilling Equipment:** Truck Mount CME 850 **Drilling Method:** Hollow Stem Auger

Depth (ft / m)	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)
0 / 0	Ground Surface	99.27				
	PAVEMENT STRUCTURE Asphalt overlying granular material.	0.00				
1	**FILL** sandy clay, some gravel, grey, dry, firm.	98.91 / 0.36		SS1	6	75
2 / 1				SS2	10	54
4		97.90 / 1.37				
5	**GLACIAL TILL** silt-sand-gravel sized stone, trace clay, brown, becoming dark grey with increased depth, compact.			SS3	43	71
6 / 2						
7				SS4	14	71
8						
9 / 3						
10				SS5	10	54
11						
12		95.69 / 3.58				
13 / 4	End of Borehole Borehole terminated after practical auger refusal over inferred bedrock.					
14						
15 / 5						
16						
17						
18						
19						

Shear Strength (kPa) 50 150

SPT N Value (Blows/0.3 m) 20 40 60 80

SS1: 6 — SS2: 10 — SS3: 43 — SS4: 14 — SS5: 10

Water Content (%) 25 50 75

Liquid Limit (%) 25 50 75

SS1: 23 — SS2: 15 — SS3: 7 — SS4: 8 — SS5: 5

Monitoring Well Details

Easting: 449315 m **Northing:** 5029867 m

Site Datum: Temporary Site BM

Groundsurface Elevation: 99.268 m **Top of Riser Elev.:** NA

Hole Diameter: 200 mm **Monitoring Well Diameter:** N/A

NOTES:

No water encountered while drilling.

Borehole Log: BH3

Project No.: 220200 **Project:** Proposed Residential Site Redevelopment

Client: Groupe Oradev Inc. **Location:** 400 Coventry Road, Ottawa

Date: May 4, 2022 **Field Personnel:** DC

Driller: CCC Geotech and Enviro Drilling **Drilling Equipment:** Truck Mount CME 850 **Drilling Method:** Hollow Stem Auger

Depth (ft / m)	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)	Shear Strength (kPa) / SPT N Value (Blows/0.3 m)	Water Content (%) / Liquid Limit (%)	Monitoring Well Details
0 / 0	Ground Surface	98.08							
0 – 1 / 0	**PAVEMENT STRUCTURE** Asphalt overlying granular material.	0.00							
		97.48		SS1	24	71	24	10	
2 – 3 / 1	**SAND** greyish brown, moist, compact.	0.60		SS2	13	67	13		
4 – 5				SS3	8	63	8	13	
6 / 2		96.20							
	CLAY grey, wet, firm	1.88		SS4	6	54	6		
		95.65							
8 – 10 / 3	**GLACIAL TILL** silt-sand, some gravel sized stone, trace clay, brown, becoming dark grey with increased depth, compact.	2.43		SS5	46	63	46	13	
				SS6	36	63	36	8	
12 – 13 / 4				SS7	34	50	34	8	
15 / 5		93.51							
	End of Borehole Borehole terminated after practical auger refusal over inferred bedrock.	4.57							
16 – 19 / 5									

Easting: 449257 m **Northing:** 5029885 m

Site Datum: Temporary Site BM

Groundsurface Elevation: 98.082 m **Top of Riser Elev.:** NA

Hole Diameter: 200 mm **Monitoring Well Diameter:** N/A

NOTES:

No water encountered while drilling.

Borehole Log: BH4

Project No.: 220200 **Project:** Proposed Residential Site Redevelopment

Client: Groupe Oradev Inc. **Location:** 400 Coventry Road, Ottawa

Date: May 4, 2022 **Field Personnel:** DC

Driller: CCC Geotech and Enviro Drilling **Drilling Equipment:** Truck Mount CME 850 **Drilling Method:** Hollow Stem Auger

Depth (ft / m)	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)	Shear Strength (kPa) / SPT N Value (Blows/0.3 m)	Water Content (%) / Liquid Limit (%)	Monitoring Well Details
0 / 0	Ground Surface	98.10							
0 / 0	**PAVEMENT STRUCTURE** Asphalt overlying granular material.	0.00							
1 /				SS1	20	12	20		
2 /		97.50							
2 /	**SAND** brown, moist, compact.	0.60							
3 / 1				SS2	12	0	12		
4 /				SS3	13	100	13	21	
5 /									
6 /		96.12							
7 / 2	**GLACIAL TILL** silt-sand, some gravel sized stone, trace clay, brown, becoming dark grey with increased depth, compact.	1.98		SS4	26	100	26	8	
8 /									
9 /				SS5	25	75	25	7	
10 / 3									
11 /				SS6	32	96	32	6	
12 /		94.44							
13 / 4	End of Borehole Borehole terminated after practical auger refusal over inferred bedrock.	3.66							
15 /									
16 / 5									
17 /									
18 /									
19 /									

Easting: 449256 m **Northing:** 5029847 m

Site Datum: Temporary Site BM

Groundsurface Elevation: 98.10 m **Top of Riser Elev.:** NA

Hole Diameter: 200 mm **Monitoring Well Diameter:** N/A

NOTES:

No water encountered while drilling.

Borehole Log: BH5

Project No.: 220200 **Project:** Proposed Residential Site Redevelopment

Client: Groupe Oradev Inc. **Location:** 400 Coventry Road, Ottawa

Date: May 4, 2022 **Field Personnel:** DC

Driller: CCC Geotech and Enviro Drilling **Drilling Equipment:** Truck Mount CME 850 **Drilling Method:** Hollow Stem Auger

Depth (ft / m)	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)	Shear Strength (kPa) / SPT N Value (Blows/0.3 m)	Water Content (%) / Liquid Limit (%)	Monitoring Well Details
0 / 0	Ground Surface	97.84							
	PAVEMENT STRUCTURE Asphalt overlying granular material.	0.00							
1		97.38							
2	**FILL** silt-sand-clay, some gravel sized stone, dark brown, moist, compact.	0.46		SS1	25	71	25	7	
3 / 1									
4		96.64		SS2	23	46	23	10	
	GLACIAL TILL silt-sand, some gravel sized stone, trace clay, brown, becoming dark grey with increased depth, compact.	1.20							
5									
6				SS3	30	71	30	7	
7 / 2									
8									
9				SS4	28	63	28	7	
		94.94							
10 / 3	End of Borehole	2.90							
11	Borehole terminated after practical auger refusal over inferred bedrock.								
12									
13 / 4									
14									
15									
16									
17 / 5									
18									
19									

Easting: 449247 m **Northing:** 5029909 m

Site Datum: Temporary Site BM

Groundsurface Elevation: 97.84 m **Top of Riser Elev.:** NA

Hole Diameter: 200 mm **Monitoring Well Diameter:** N/A

NOTES:

No water encountered while drilling.

Borehole Log: BH6

Project No.: 220200 **Project:** Proposed Residential Site Redevelopment

Client: Groupe Oradev Inc. **Location:** 400 Coventry Road, Ottawa

Date: December 12, 2022 **Field Personnel:** DC

Driller: CCC Geotech and Enviro Drilling **Drilling Equipment:** Truck Mount CME 850 **Drilling Method:** Hollow Stem Auger

Depth (ft)	Depth (m)	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)
0	0	Ground Surface	98.32				
0	0	**PAVEMENT STRUCTURE** Asphalt overlying granular material.	0.00				
			97.72		SS1	18	33
2		**SILTY SAND** brown, dry, loose to compact.	0.60				
3	1				SS2	9	71
5			96.82				
5		**GLACIAL TILL** silt-sand, some gravel sized stone, trace clay, brown, becoming dark grey with increased depth, compact to very dense.	1.50		SS3	11	79
8	2				SS4	21	92
10	3				SS5	50+	100
13	4				SS6	50+	88
15					SS7	28	67
18	5				SS8	50+	70
19			92.48				
20	6	End of Borehole Borehole terminated after practical auger refusal over inferred bedrock.	5.84				
21							

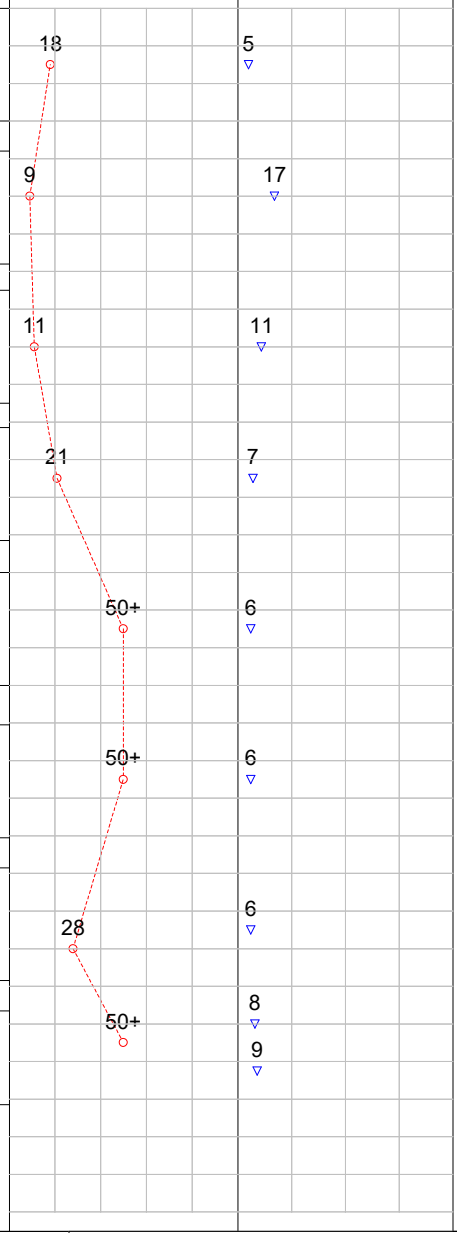
Shear Strength (kPa) 50 150

SPT N Value (Blows/0.3 m) 20 40 60 80

Water Content (%) 25 50 75

Liquid Limit (%) 25 50 75

Monitoring Well Details



Easting: 449336 m **Northing:** 5029808 m

Site Datum: Temporary Site BM

Groundsurface Elevation: 98.32 m **Top of Riser Elev.:** NA

Hole Diameter: 200 mm **Monitoring Well Diameter:** N/A

NOTES:

No water encountered while drilling.

Borehole Log: BH7

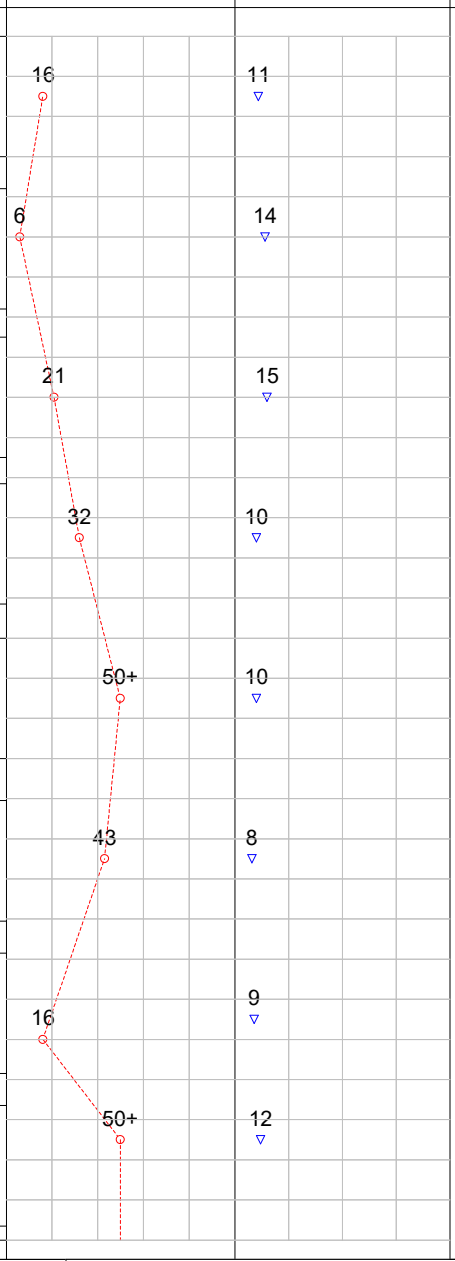
Project No.: 220200 | **Project:** Proposed Residential Site Redevelopment

Client: Groupe Oradev Inc. | **Location:** 400 Coventry Road, Ottawa

Date: January 03, 2023 | **Field Personnel:** DC

Driller: CCC Geotech and Enviro Drilling | **Drilling Equipment:** Truck Mount CME 850 | **Drilling Method:** Hollow Stem Auger

Depth (ft / m)	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)
0 / 0	Ground Surface	98.42				
0 / 0	**PAVEMENT STRUCTURE** Asphalt overlying granular material.	0.00		SS1	16	29
		97.82				
2 /	**SILTY SAND** brown, dry, loose to compact.	0.60		SS2	6	25
5 / 1		96.92				
	GLACIAL TILL silt-sand, some gravel sized stone, trace clay, brown, becoming dark grey with increased depth, compact to very dense.	1.50		SS3	21	42
7 /				SS4	32	58
10 / 3				SS5	50+	63
13 / 4				SS6	43	75
15 /				SS7	16	33
18 / 5				SS8	50+	58
19 /						



Monitoring Well Details

Easting: 449326 m | **Northing:** 5029810 m

Site Datum: Temporary Site BM

Groundsurface Elevation: 98.42 m | **Top of Riser Elev.:** NA

Hole Diameter: 200 mm | **Monitoring Well Diameter:** N/A

NOTES:

No water encountered while drilling.

Borehole Log (continued): BH7

Project No.: 220200
Project: Proposed Residential Site Redevelopment
Client: Groupe Oradev Inc.
Location: 400 Coventry Road, Ottawa
Date: January 03, 2023
Field Personnel: DC

Driller: CCC Geotech and Enviro Drilling
Drilling Equipment: Truck Mount CME 850
Drilling Method: Hollow Stem Auger

SUBSURFACE PROFILE		SAMPLE DATA					Shear Strength (kPa) 50 150 / SPT N Value (Blows/0.3 m) 20 40 60 80	Water Content (%) 25 50 75 / Liquid Limit (%) 25 50 75	Monitoring Well Details
Depth	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)			
20									
21				SS9	50+	75	50+	9	
22									
23		91.26							
24	End of Borehole Borehole terminated after practical auger refusal over inferred bedrock.	7.16							
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
37									
38									
39									

8
9
10
11

NOTES

Borehole Log: BH8

Project No.: 220200
Project: Proposed Residential Site Redevelopment
Client: Groupe Oradev Inc.
Location: 400 Coventry Road, Ottawa
Date: December 12, 2023
Field Personnel: DC

Driller: CCC Geotech and Enviro Drilling
Drilling Equipment: Truck Mount CME 850
Drilling Method: Hollow Stem Auger

Depth (ft / m)	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)	Shear Strength (kPa) / SPT N Value (Blows/0.3 m)	Water Content (%) / Liquid Limit (%)	Monitoring Well Details
0 ft / 0 m	Ground Surface	98.80							
0 – 1 ft	**PAVEMENT STRUCTURE** Asphalt overlying granular material.	0.00 – 98.20		SS1	12	42	12	4	
2 – 3 ft / 1 m	**SILTY SAND** brown, dry, loose to compact.	0.60 – 97.30		SS2	7	67	7	24	
5 – 7 ft / 2 m	**GLACIAL TILL** silt-sand, some gravel sized stone, trace clay, brown, becoming dark grey with increased depth, compact to very dense.	1.50		SS3	25	92	25	9	
8 ft				SS4	31	67	31	6	
10 – 11 ft / 3 m				SS5	34	67	34	6	
13 – 14 ft / 4 m				SS6	18	63	18	9	
15 – 16 ft / 5 m				SS7	15	67	15	9	
18 ft				SS8	50+	71	50+	9	
19 ft				SS9	50+				

Easting: 449328 m
Northing: 5029849 m
Site Datum: Temporary Site BM
Groundsurface Elevation: 98.80 m
Top of Riser Elev.: NA
Hole Diameter: 200 mm
Monitoring Well Diameter: N/A

NOTES:
No water encountered while drilling.

Borehole Log (continued): BH8

Project No.: 220200
Project: Proposed Residential Site Redevelopment
Client: Groupe Oradev Inc.
Location: 400 Coventry Road, Ottawa
Date: December 12, 2023
Field Personnel: DC

Driller: CCC Geotech and Enviro Drilling
Drilling Equipment: Truck Mount CME 850
Drilling Method: Hollow Stem Auger

SUBSURFACE PROFILE		SAMPLE DATA					Shear Strength (kPa) 50 150 / SPT N Value (Blows/0.3 m) 20 40 60 80	Water Content (%) 25 50 75 / Liquid Limit (%) 25 50 75	Monitoring Well Details
Depth	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)			
20		92.55		SS9	50+	100	50+	6	
		6.25							
21	End of Borehole								
22	Borehole terminated after practical auger refusal over inferred bedrock.								
23 — 7									
24									
25									
26 — 8									
27									
28									
29									
30 — 9									
31									
32									
33 — 10									
34									
35									
36 — 11									
37									
38									
39									

NOTES

Borehole Log: BH9

Project No.: 220200 | **Project:** Proposed Residential Site Redevelopment

Client: Groupe Oradev Inc. | **Location:** 400 Coventry Road, Ottawa

Date: December 21, 2022 | **Field Personnel:** DC

Driller: CCC Geotech and Enviro Drilling | **Drilling Equipment:** Truck Mount CME 850 | **Drilling Method:** Hollow Stem Auger

Depth (ft / m)	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)	Shear Strength (kPa) / SPT N Value (Blows/0.3 m)	Water Content (%) / Liquid Limit (%)	Monitoring Well Details
0 ft / 0 m	Ground Surface	98.63							
0 – 1	**PAVEMENT STRUCTURE** Asphalt overlying granular material.	0.00		SS1	26	50	26	16	
1 – 2		98.03							
2 – 3	**GLACIAL TILL** silt-sand, some gravel sized stone, trace clay, brown, becoming dark grey with increased depth, compact to very dense.	0.60		SS2	11	54	11	18	
5 – 6				SS3	22	75	22	11	
7 – 8				SS4	47	100	47	8	
9 – 10				SS5	24	42	24	7	
12 – 13				SS6	22	21	22	7	
14 – 16				SS7	34	83	34	7	
17 – 18				SS8	50+	50	50+	12	
19									

Easting: 449303 m | **Northing:** 5029846 m

Site Datum: Temporary Site BM

Groundsurface Elevation: 98.63 m | **Top of Riser Elev.:** NA

Hole Diameter: 200 mm | **Monitoring Well Diameter:** N/A

NOTES:

No water encountered while drilling.

Borehole Log (continued): BH9

Project No.: 220200
Project: Proposed Residential Site Redevelopment
Client: Groupe Oradev Inc.
Location: 400 Coventry Road, Ottawa
Date: December 21, 2022
Field Personnel: DC

Driller: CCC Geotech and Enviro Drilling
Drilling Equipment: Truck Mount CME 850
Drilling Method: Hollow Stem Auger

SUBSURFACE PROFILE		SAMPLE DATA					Shear Strength (kPa) 50 150 / SPT N Value (Blows/0.3 m) 20 40 60 80	Water Content (%) 25 50 75 / Liquid Limit (%) 25 50 75	Monitoring Well Details
Depth	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)			
20				SS9	50+	75	50+	16	
21									
22									
23 — 7									
24									
25		91.11							
	End of Borehole	7.52							
26 — 8	Borehole terminated after practical auger refusal over inferred bedrock.								
27									
28									
29									
30 — 9									
31									
32									
33 — 10									
34									
35									
36 — 11									
37									
38									
39									

NOTES

Borehole Log: BH10

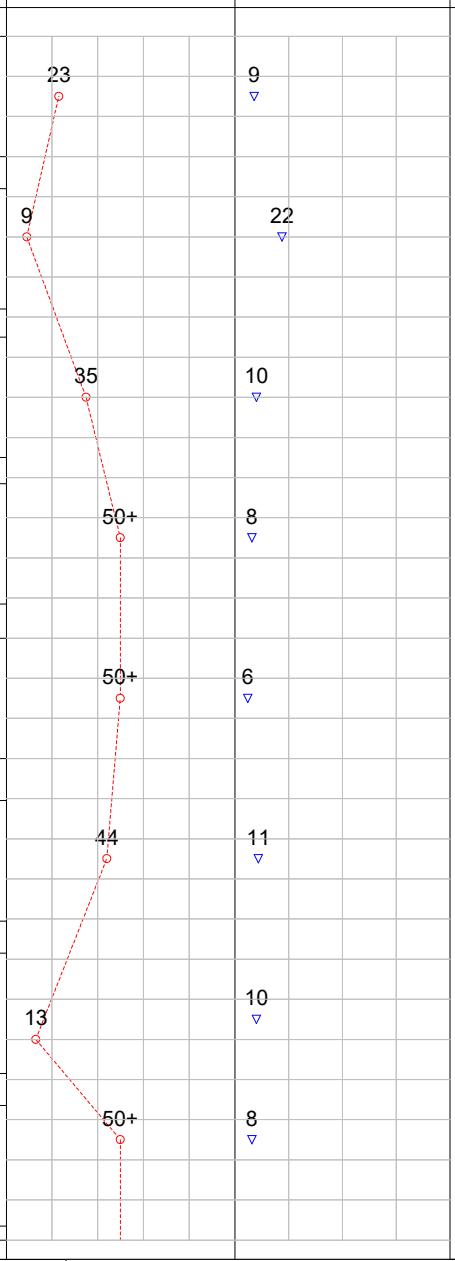
Project No.: 220200 | **Project:** Proposed Residential Site Redevelopment

Client: Groupe Oradev Inc. | **Location:** 400 Coventry Road, Ottawa

Date: December 14, 2022 | **Field Personnel:** DC

Driller: CCC Geotech and Enviro Drilling | **Drilling Equipment:** Truck Mount CME 850 | **Drilling Method:** Hollow Stem Auger

Depth (ft / m)	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)
0 / 0	Ground Surface	98.93				
0 / 0	**PAVEMENT STRUCTURE** Asphalt overlying granular material.	0.00		SS1	23	67
2 / 1	**SANDY CLAY** greyish brown, dry, stiff.	98.33 0.60		SS2	9	75
4 / 1	**GLACIAL TILL** silt-sand, some gravel sized stone, trace clay, brown, becoming dark grey with increased depth, compact to very dense.	97.56 1.37		SS3	35	67
7 / 2				SS4	50+	25
10 / 3				SS5	50+	50
13 / 4				SS6	44	88
15 / 5				SS7	13	100
18 / 5				SS8	50+	50



Monitoring Well Details

Easting: 449318 m | **Northing:** 5029862 m

Site Datum: Temporary Site BM

Groundsurface Elevation: 98.93 m | **Top of Riser Elev.:** NA

Hole Diameter: 200 mm | **Monitoring Well Diameter:** N/A

NOTES:

No water encountered while drilling.

Borehole Log (continued): BH10

Project No.: 220200
Project: Proposed Residential Site Redevelopment
Client: Groupe Oradev Inc.
Location: 400 Coventry Road, Ottawa
Date: December 14, 2022
Field Personnel: DC

Driller: CCC Geotech and Enviro Drilling
Drilling Equipment: Truck Mount CME 850
Drilling Method: Hollow Stem Auger

SUBSURFACE PROFILE		SAMPLE DATA					Shear Strength (kPa) 50 150 / SPT N Value (Blows/0.3 m) 20 40 60 80	Water Content (%) 25 50 75 / Liquid Limit (%) 25 50 75	Monitoring Well Details
Depth	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)			
20				SS9	50+	38	50+	15	
21									
22		92.22							
	End of Borehole	6.71							
23 7	Borehole terminated after practical auger refusal over inferred bedrock.								
24									
25									
26 8									
27									
28									
29									
30 9									
31									
32									
33 10									
34									
35									
36 11									
37									
38									
39									

NOTES

Borehole Log: BH11

Project No.: 220200 | **Project:** Proposed Residential Site Redevelopment

Client: Groupe Oradev Inc. | **Location:** 400 Coventry Road, Ottawa

Date: December 13, 2022 | **Field Personnel:** DC

Driller: CCC Geotech and Enviro Drilling | **Drilling Equipment:** Truck Mount CME 850 | **Drilling Method:** Hollow Stem Auger

Depth (ft / m)	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)	Shear Strength (kPa) / SPT N Value (Blows/0.3 m)	Water Content (%) / Liquid Limit (%)	Monitoring Well Details
0 / 0	Ground Surface	99.11							
0 – 1 / 0	**PAVEMENT STRUCTURE** Asphalt overlying granular material.	0.00		SS1	14	46	14	8	
2 – 3 / 1	**SANDY CLAY** greyish brown, dry, stiff.	98.25 0.86		SS2	11	58	11	32	
4 – 5 / 1	**GLACIAL TILL** silt-sand, some gravel sized stone, trace clay, brown, becoming dark grey with increased depth, compact to very dense.	97.61 1.50		SS3	22	75	22	10	
6 – 7 / 2				SS4	33	50	33	6	
8 – 9 / 2				SS5	50+	0	50+		
10 – 11 / 3				SS6	33	67	33	6	
12 – 13 / 4				SS7	50+	100	50+	6	
14 – 15 / 4				SS8	50+	58	50+	5	
16 – 17 / 5									
18 – 19 / 5									

Easting: 449349 m | **Northing:** 5029829 m

Site Datum: Temporary Site BM

Groundsurface Elevation: 99.11 m | **Top of Riser Elev.:** NA

Hole Diameter: 200 mm | **Monitoring Well Diameter:** N/A

NOTES:

No water encountered while drilling.

Borehole Log (continued): BH11

Project No.: 220200
Project: Proposed Residential Site Redevelopment
Client: Groupe Oradev Inc.
Location: 400 Coventry Road, Ottawa
Date: December 13, 2022
Field Personnel: DC

Driller: CCC Geotech and Enviro Drilling
Drilling Equipment: Truck Mount CME 850
Drilling Method: Hollow Stem Auger

SUBSURFACE PROFILE		SAMPLE DATA							
Depth	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)	Shear Strength (kPa) 50 150 / SPT N Value (Blows/0.3 m) 20 40 60 80	Water Content (%) 25 50 75 / Liquid Limit (%) 25 50 75	Monitoring Well Details
20									
21				SS9	50+	50	50+	5	
22									
23	7								
24									
25									
26	8			SS10	44	38	44	13	
27		90.88							
	End of Borehole Borehole terminated after practical auger refusal over inferred bedrock.	8.23							
28									
29									
30	9								
31									
32									
33	10								
34									
35									
36	11								
37									
38									
39									

NOTES

Borehole Log: BH12

Project No.: 220200 **Project:** Proposed Residential Site Redevelopment

Client: Groupe Oradev Inc. **Location:** 400 Coventry Road, Ottawa

Date: December 21, 2022 **Field Personnel:** DC

Driller: CCC Geotech and Enviro Drilling **Drilling Equipment:** Truck Mount CME 850 **Drilling Method:** Hollow Stem Auger

Depth (ft)	Depth (m)	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)	Shear Strength (kPa) / SPT N Value (Blows/0.3 m)	Water Content (%) / Liquid Limit (%)	Monitoring Well Details
0	0	Ground Surface	99.33							
		PAVEMENT STRUCTURE Asphalt overlying granular material.	0.00							
1			98.73		SS1	33	38	33	9	
2		**GLACIAL TILL** silt-sand, some gravel sized stone, trace clay, brown, becoming dark grey with increased depth, compact to very dense.	0.60							
3	1				SS2	17	42	17	8	
4										
5					SS3	50+	75	50+	7	
6	2									
7					SS4	25	58	25	7	
8										
9	3				SS5	50+	33	50+	7	
10										
11					SS6	50+	67	50+	8	
12	4									
13					SS7	50+	100	50+	8	
14										
15	5				SS8	50+	60	50+	4	
16										
17										
18										
19										

Easting: 449290 m **Northing:** 5029801 m

Site Datum: Temporary Site BM

Groundsurface Elevation: 99.33 m **Top of Riser Elev.:** NA

Hole Diameter: 200 mm **Monitoring Well Diameter:** N/A

NOTES:

No water encountered while drilling.

Borehole Log (continued): BH12

Project No.: 220200
Project: Proposed Residential Site Redevelopment
Client: Groupe Oradev Inc.
Location: 400 Coventry Road, Ottawa
Date: December 21, 2022
Field Personnel: DC

Driller: CCC Geotech and Enviro Drilling
Drilling Equipment: Truck Mount CME 850
Drilling Method: Hollow Stem Auger

SUBSURFACE PROFILE		SAMPLE DATA					Shear Strength (kPa) 50 150 / SPT N Value (Blows/0.3 m) 20 40 60 80	Water Content (%) 25 50 75 / Liquid Limit (%) 25 50 75	Monitoring Well Details
Depth	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)			
20				SS9	37	75	37	15	
21									
22									
23 – 7									
24									
25	End of Borehole Borehole terminated after practical auger refusal over inferred bedrock.	91.81 7.52							
26 – 8									
27									
28									
29									
30 – 9									
31									
32									
33 – 10									
34									
35									
36 – 11									
37									
38									
39									

NOTES

Borehole Log: BH13

Project No.: 220200 | **Project:** Proposed Residential Site Redevelopment

Client: Groupe Oradev Inc. | **Location:** 400 Coventry Road, Ottawa

Date: January 17, 2023 | **Field Personnel:** DC

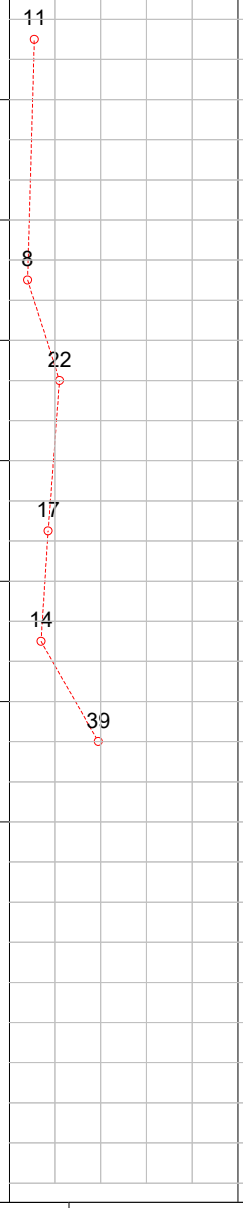
Driller: CCC Geotech and Enviro Drilling | **Drilling Equipment:** Truck Mount CME 850 | **Drilling Method:** Hollow Stem Auger

Depth (ft / m)	Soil Description	Elev./Depth (m)	Type	Sample Number	N or RQD	Recovery (%)
0 / 0	Ground Surface	99.23				
0 / 0	**TOPSOIL** approximately 300 mm thick, dark brown.	0.00				
1	**SILTY SAND** dry, brown, loose to compact.	98.93 / 0.30		SS1	11	79
2						
3 / 1						
4				SS2	8	79
5		97.43				
6	**GLACIAL TILL** silt-sand, some gravel sized stone, trace clay, brown, becoming dark grey with increased depth, compact to dense.	1.80		SS3	22	75
7 / 2						
8				SS4	17	75
9						
10 / 3				SS5	14	83
11						
12				SS6	39	58
13 / 4						
14		94.93				
14	End of Borehole	4.30				
15	Borehole terminated after practical auger refusal over inferred bedrock.					
16 / 5						
17						
18						
19						

Shear Strength (kPa) 50 150 | **SPT N Value** (Blows/0.3 m) 20 40 60 80

Water Content (%) 25 50 75 | **Liquid Limit** (%) 25 50 75

Monitoring Well Details



Easting: 449224 m | **Northing:** 5029439 m

Site Datum: Temporary Site BM

Groundsurface Elevation: 99.23 m | **Top of Riser Elev.:** NA

Hole Diameter: 200 mm | **Monitoring Well Diameter:** N/A

NOTES:

No water encountered while drilling.

APPENDIX C

Symbols and Terms used in Borehole Logs

Symbols and Terms Used on Borehole and Test Pit Logs

1. Soil Description

The soil descriptions presented in this report are based on commonly accepted methods of classification and identification employed in geotechnical practice. Classification and identification of soil involves some judgement and LRL Associates Ltd. does not guarantee descriptions as exact, but infers accuracy to the extent that is common in current geotechnical practice. Boundaries between zones on the logs are often not distinct but transitional and were interpreted.

a. Proportion

The proportion of each constituent part, as defined by the grain size distribution, is denoted by the following terms:

Term	Proportions
"trace"	1% to 10%
"some"	10% to 20%
prefix (i.e. "sandy" silt)	20% to 35%
"and" (i.e. sand "and" gravel)	35% to 50%

b. Compactness and Consistency

The state of compactness of granular soils is defined on the basis of the Standard Penetration Number (N) as per ASTM D-1586. It corresponds to the number of blows required to drive 300 mm of the split spoon sampler using a metal drop hammer that has a weight of 62.5 kg and free fall distance of 760 mm. For a 600 mm long split spoon, the blow counts are recorded for every 150 mm. The "N" value is obtained by adding the number of blows from the 2nd and 3rd count. Technical refusal indicates a number of blows greater than 50.

The consistency of clayey or cohesive soils is based on the shear strength of the soil, as determined by field vane tests and by a visual and tactile assessment of the soil strength.

The state of compactness of granular soils is defined by the following terms:

State of Compactness Granular Soils	Standard Penetration Number "N"	Relative Density (%)
Very loose	0 – 4	<15
Loose	4 – 10	15 – 35
Compact	10 - 30	35 – 65
Dense	30 - 50	65 - 85
Very dense	> 50	> 85

The consistency of cohesive soils is defined by the following terms:

Consistency Cohesive Soils	Undrained Shear Strength (C_u) (kPa)	Standard Penetration Number "N"
Very soft	<12.5	<2
Soft	12.5 - 25	2 - 4
Firm	25 - 50	4 - 8
Stiff	50 - 100	8 - 15
Very stiff	100 - 200	15 - 30
Hard	>200	>30

c. Field Moisture Condition

Description (ASTM D2488)	Criteria
Dry	Absence of moisture, dusty, dry to touch.
Moist	Dump, but not visible water.
Wet	Visible, free water, usually soil is below water table.

2. Sample Data

a. Elevation depth

This is a reference to the geodesic elevation of the soil or to a benchmark of an arbitrary elevation at the location of the borehole or test pit. The depth of geological boundaries is measured from ground surface.

b. Type

Symbol	Type	Letter Code
	Auger	AU
	Split Spoon	SS
	Shelby Tube	ST
	Rock Core	RC

c. Sample Number

Each sample taken from the borehole is numbered in the field as shown in this column.

LETTER CODE (as above) – Sample Number.

d. Recovery (%)

For soil samples this is the percentage of the recovered sample obtained versus the length sampled. In the case of rock, the percentage is the length of rock core recovered compared to the length of the drill run.

3. Rock Description

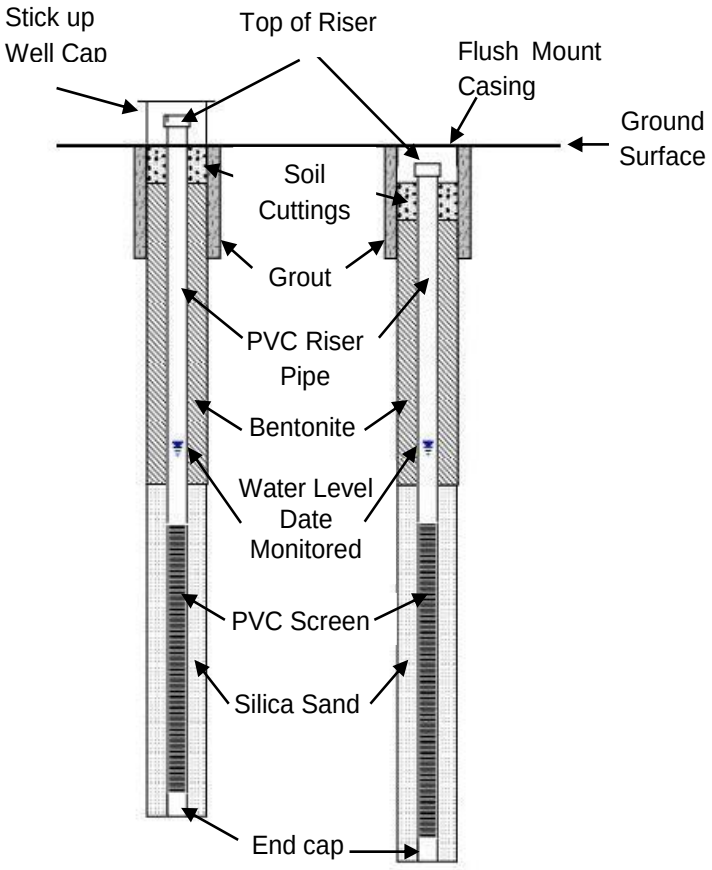
Rock Quality Designation (RQD) is a rough measure of the degree of jointing or fracture in a rock mas. The RQD is calculated as the cumulative length of rock pieces recovered having lengths of 100 mm or more divided by the length of coring. The qualitative description of the bedrock based on RQD is given below.

Rock Quality Designation (RQD) (%)	Description of Rock Quality
0 –25	Very poor
25 – 50	Poor
50 – 75	Fair
75 – 90	Good
90 – 100	Excellent

Strength classification of rock is presented below.

Strength Classification	Range of Unconfined Compressive Strength (MPa)
Extremely weak	< 1
Very weak	1 – 5
Weak	5 – 25
Medium strong	25 – 50
Strong	50 – 100
Very strong	100 – 250
Extremely strong	> 250

4. General Monitoring Well Data



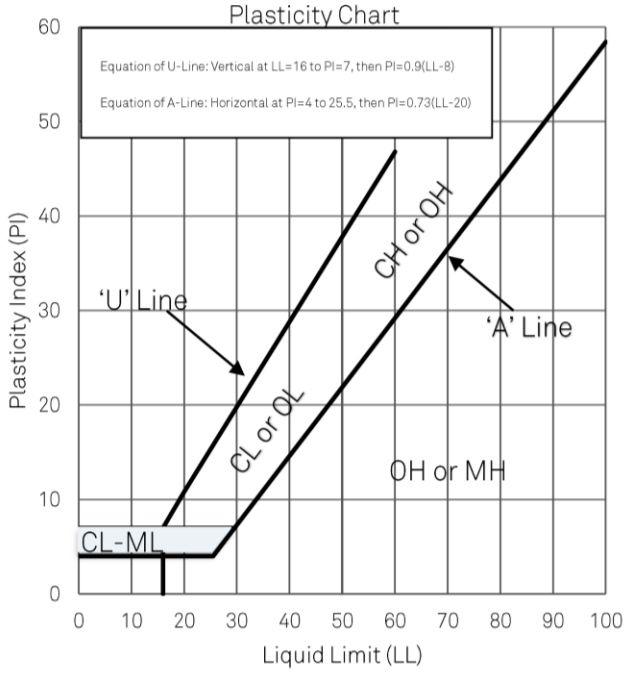
5. Classification of Soils for Engineering Purposes (ASTM D2487)

(United Soil Classification System)

Major divisions			Group Symbol	Typical Names	Classification Criteria
Coarse-grained soils More than 50% retained on No. 200 sieve* (>0.075 mm)	Gravels More than 50% of coarse fraction retained on No. 4 sieve(4.75 mm)	Clean gravels <5% fines	GW	Well-graded gravel	If 15% sand add "with sand" to group name.
			GP	Poorly graded gravel	
		Gravels with >12% fines	GM	Silty gravel	
			GC	Clayey gravel	
	Sands 50% or more of coarse fraction passes No. 4 sieve(<4.75 mm)	Clean sands <5% fines	SW	Well-graded sand	If 15% gravel add "with gravel to group name
			SP	Poorly graded sand	
		Sands with >12% fines	SM	Silty sand	
			SC	Clayey sand	
Fine-grained soils50% or more passes No. 200 sieve* (<0.075 mm)	Silts and Clays Liquid Limit <50%	Inorganic	ML	Silt	If 15 to 29% coarse-grained, add "with sand" or "with gravel" as appropriate. If > 30% coarse-grained, add "sandy" or "gravelly" as appropriate. Class as organic when oven dried liquid limit is < 75% of undried liquid limit.
			CL	Lean Clay -low plasticity	
		Organic	OL	Organic clay or silt (Clay plots above 'A' Line)	
	Silts and Clays Liquid Limit >50%	Inorganic	MH	Elastic silt	
			CH	Fat Clay -high plasticity	
		Organic	OH	Organic clay or silt (Clay plots above 'A' Line)	
	Highly Organic Soils		PT	Peat, muck and other highly organic soils	

Classification on basis of percentage of fines:
Less than 5% pass No. 200 sieve - GW, GP, SW, SP
More than 12% pass No. 200 sieve - GM, GC, SM, SC
5 to 12% pass No. 200 sieve - Borderline classifications, use of dual symbols

$C_u = \frac{D_{60}}{D_{10}} \geq 4$; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3		
Not meeting either Cu or Cc criteria for GW		
Atterberg limits below "A" line or PI less than 4		Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
Atterberg limits on or above "A" line and PI > 7		If fines are organic add "with orgnic fines" to group name
$C_u = \frac{D_{60}}{D_{10}} \geq 6$; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3		
Not meeting either Cu or C ccriteria for SW		
Atterberg limits below "A" line or PI less than 4		Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
Atterberg limits on or above "A" line and PI > 7		If fines are organic add "with orgnic fines" to group name



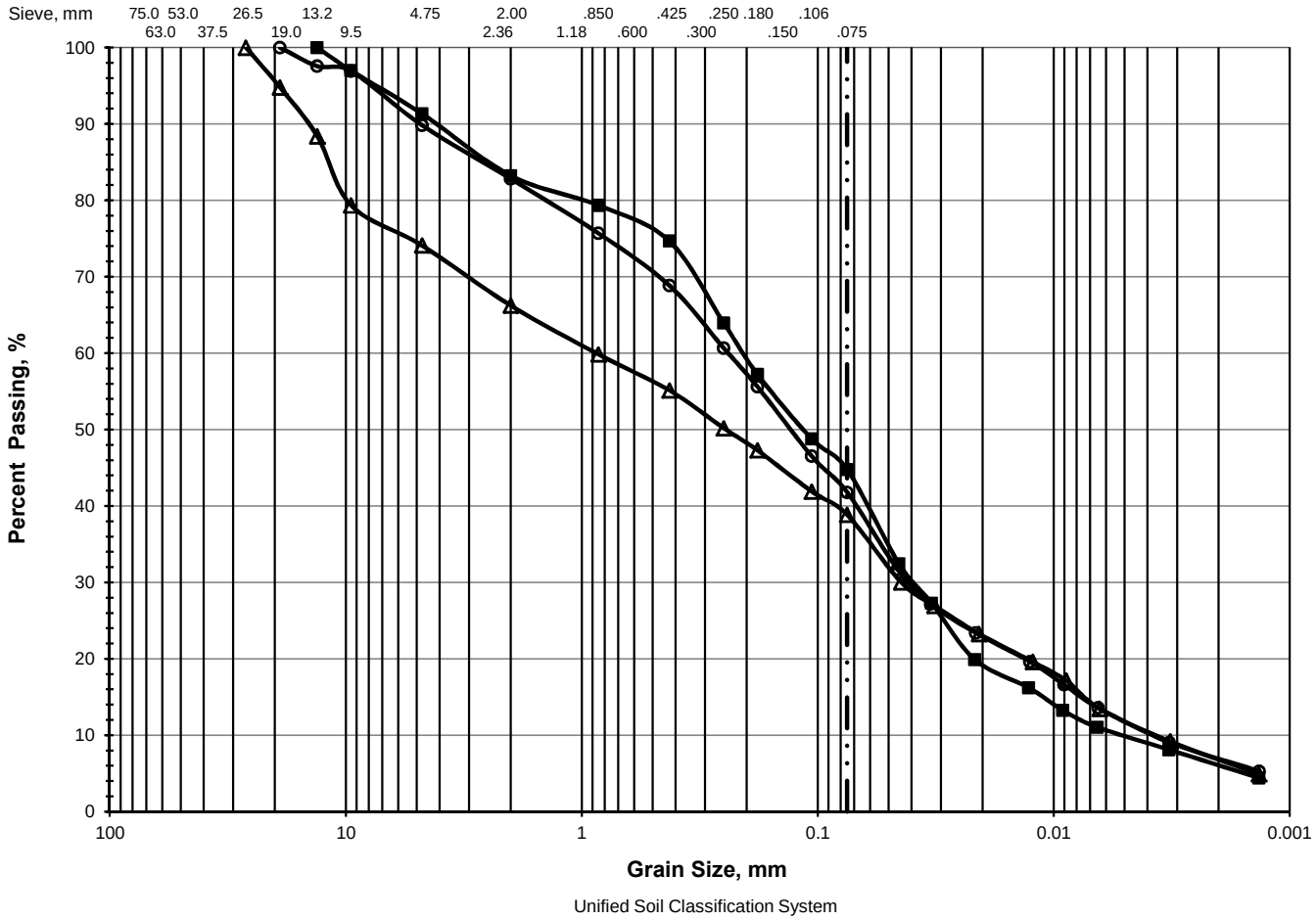
APPENDIX D
Laboratory Results

LRL Associates Ltd.

PARTICLE SIZE ANALYSIS

ASTM D 422 / LS-702

Client:	Groupe Oradev Inc.	**File No.:**	220200
Project:	Geotechnical Investigation	**Report No.:**	1
Location:	400 Coventry Road, Ottawa, ON.	**Date:**	May 5, 2022



Unified Soil Classification System

	> 75 mm	% GRAVEL		% SAND			% FINES	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
△	0.0	4.5	21.4	7.9	11.1	16.3	32.4	6.4
■	0.0	0.0	8.7	8.1	8.6	29.8	39.1	5.7
○	0.0	0.0	10.2	7.0	14.0	27.1	35.1	6.6

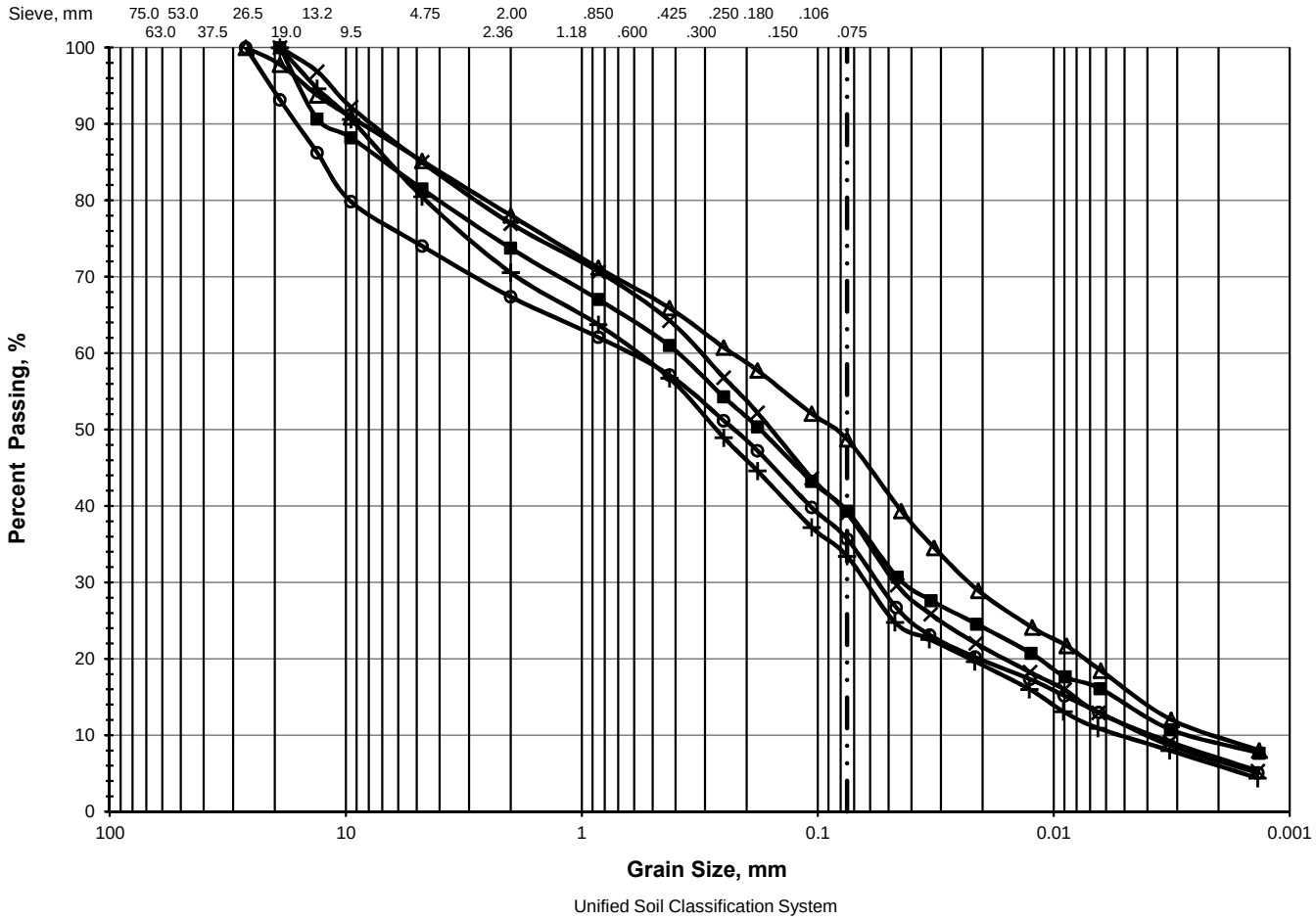
	Location	Sample	Depth, m	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
△	BH 2	SS-4	2.13 - 2.74	0.8770	0.2455	0.0442	0.0074	0.0038	0.6	230.8
■	BH 3	SS-5	2.44 - 3.05	0.2089	0.1168	0.0394	0.0113	0.0054	1.4	38.7
○	BH 5	SS-2	0.91 - 1.52	0.2410	0.1343	0.0411	0.0077	0.0039	1.8	61.8

LRL Associates Ltd.

PARTICLE SIZE ANALYSIS

ASTM D 422 / LS-702

Client:	400 Coventry Investments Inc.	**File No.:**	220200
Project:	Geotechnical Investigation	**Report No.:**	1
Location:	400 Coventry Road, Ottawa, ON.	**Date:**	December 12, 2022



Unified Soil Classification System

	> 75 mm	% GRAVEL		% SAND			% FINES	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
△	0.0	1.9	12.9	7.1	12.1	17.2	39.3	9.5
■	0.0	0.0	18.5	7.8	12.7	21.7	30.5	8.8
○	0.0	5.9	20.1	6.6	10.2	21.5	29.4	6.3
+	0.0	0.0	19.5	9.9	13.8	23.3	27.9	5.6
X	0.0	0.0	15.0	8.0	12.7	25.3	32.4	6.6

	Location	Sample	Depth, m	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
△	BH6	SS-3	1.52 - 2.13	0.2327	0.0868	0.0230	0.0046	0.0022	1.0	105.8
■	BH7	SS-7	4.57 - 5.18	0.3994	0.1764	0.0430	0.0057	0.0027	1.7	147.9
○	BH8	SS-5	3.05 - 3.66	0.6716	0.2292	0.0569	0.0088	0.0042	1.1	159.9
+	BH10	SS-8	5.33 - 5.94	0.6239	0.2739	0.0639	0.0114	0.0055	1.2	113.4
X	BH12	SS-4	2.29 - 2.90	0.3249	0.1609	0.0472	0.0082	0.0040	1.7	81.2

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Certificate of Analysis

LRL Associates Ltd.

5430 Canotek Road
Ottawa, ON K1J 9G2
Attn: Brad Johnson

Client PO:
Project: 220200
Custody: 66387

Report Date: 13-May-2022
Order Date: 9-May-2022

Order #: 2220045

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
2220045-01	BH2 SS4 7-9'

Approved By:

Dale Robertson, BSc
Laboratory Director

Certificate of Analysis

Client: LRL Associates Ltd.

Client PO:

Report Date: 13-May-2022

Order Date: 9-May-2022

Project Description: 220200

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC, water extraction	10-May-22	10-May-22
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	9-May-22	10-May-22
Resistivity	EPA 120.1 - probe, water extraction	13-May-22	13-May-22
Solids, %	Gravimetric, calculation	9-May-22	10-May-22

Certificate of Analysis

Client: LRL Associates Ltd.

Client PO:

Report Date: 13-May-2022

Order Date: 9-May-2022

Project Description: 220200

	Client ID:	BH2 SS4 7-9'	-	-	-
	Sample Date:	05-May-22 09:00	-	-	-
	Sample ID:	2220045-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	91.9	-	-	-
General Inorganics					
pH	0.05 pH Units	7.72	-	-	-
Resistivity	0.10 Ohm.m	11.7	-	-	-
Anions					
Chloride	5 ug/g dry	397	-	-	-
Sulphate	5 ug/g dry	90	-	-	-

Certificate of Analysis

Client: LRL Associates Ltd.

Client PO:

Report Date: 13-May-2022

Order Date: 9-May-2022

Project Description: 220200

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	5	ug/g						
Sulphate	ND	5	ug/g						
General Inorganics									
Resistivity	ND	0.10	Ohm.m						

Certificate of Analysis

Client: LRL Associates Ltd.

Client PO:

Report Date: 13-May-2022

Order Date: 9-May-2022

Project Description: 220200

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	5.5	5	ug/g	5.8			5.4	20	
Sulphate	112	5	ug/g	105			6.3	20	
General Inorganics									
pH	7.39	0.05	pH Units	7.45			0.8	2.3	
Resistivity	28.8	0.10	Ohm.m	28.6			0.4	20	
Physical Characteristics									
% Solids	85.1	0.1	% by Wt.	91.7			7.4	25	

Certificate of Analysis

Client: LRL Associates Ltd.

Client PO:

Report Date: 13-May-2022

Order Date: 9-May-2022

Project Description: 220200

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	106	5	ug/g	5.8	101	82-118			
Sulphate	212	5	ug/g	105	107	80-120			

Qualifier Notes:

None

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable
ND: Not Detected
MDL: Method Detection Limit
Source Result: Data used as source for matrix and duplicate samples
%REC: Percent recovery.
RPD: Relative percent difference.
NC: Not Calculated

Soil results are reported on a dry weight basis when the units are denoted with 'dry'.
Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.