Subsurface Investigation Report

917 Merivale Rd., Ottawa, ON, K1Z 6A4

Abstract

This report presents the findings of a Subsurface Investigation completed at the 917 Merivale Rd. parcel, in the City of Ottawa, ON, K1Z 6A4, and issue recommendations for a proposed 6 storey residential building development. It provides geotechnical information about the subsurface conditions at 3 borehole locations compiled from field sampling and testing. The borehole locations are shown in figure 1 in page 7. The information reviewed also includes readily available geologic information from the Geological Survey of Canada (GSC) and local climate data from Environment Canada.

Yuri Mendez M. Eng., P. Eng.

Report number: 63-SPD-R0[1]
September 27, 2023

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[1]For the account of Sheppard Property Development (SPD) as per proposal in email dated August 22, 2023..

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Contents

1 Introduction

This document reports the findings of a subsurface investigation completed at 917 Merivale Rd., in the City of Ottawa, ON, K1Z 6A4, having extents and geometry shown in figure 1 in page 7.

The investigation was carried out by advancing 3 boreholes through overburden soils using available exploration techniques for engineering purposes. The information compiled from the exploration and sampling and testing completed in the boreholes is to assist in the design and construction of a proposed 6 storey residential building development. The information reviewed also includes readily available geologic information from the Geological Survey of Canada (GSC), and local climate data from Environment Canada.

2 Report Organization

The body of this report and its appendices constitute the entire report. The discussion presented under sections in the body may refer to further information and/or background and/or details in the appendices. The reader is responsible of reviewing the information in the appendices. Other references may be presented as footnotes.

Future revisions to this report will be referred to as "63-SPD-R#", where # is the consecutive number of the revision. Additions and/or alterations and/or inclusions to the information provided in this report at the request of any institution and/or body with authority to request the additions and/or alterations and/or inclusion will be provided in a separate "Response to " (RT) section at the end of the report, before the appendices. The RT section shall state the section that is added and/or altered, the name of the person making the request and the reason. The section altered and or portions added will be provided in full as a subsection of the RT section. Any subsection added under the RT section will be considered a replacement to the original section.

Part I
Investigation

3 Sampling and Testing

The field and laboratory program set out in our proposal is guided by the following standards:

- ASTM D 420-98 Standard Guide to Site Characterization for Engineering Design and Construction Purposes,
- ASTM D5434 - 12 Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock,

- ASTM D1586 - 11 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils,
- ASTM D1586 - 11 based Dynamic Cone Penetration Test (DCPT),
- ASTM D2573 - 08 Standard Test Method for Field Vane Shear Test in Cohesive Soil.

The ASTM D1586 tests were completed using an "auto safety" hammer rated at 60% energy.

The field program consisted in sampling the subsurface profile using boreholes located as shown in fig. 1 in page 7 along with field review, assessments and classification of samples.

The program also included an elevation survey referenced to the door sill at the rear door of the existing house shown in the Test Hole Locations Plan in fig. 1 in page 7 which is understood to have a 78.92 m geodetic elevation. The program included in addition a laboratory review of samples recovered from the field and one sample submitted to a local laboratory to investigate soluble ions concentration, PH and resistivity.

The soil sampling and field testing at each location are shown in the soil profile testing and sampling logs (BH) in the appendices.

Part II
Findings

4 Physical Settings, Strata and Topography

The site consist on the nearly flat 917 Merivale Rd. residential parcel within a city block in the City of Ottawa, ON. Figure 1 in page 7 shows a plan view of the site displaying the approximate borehole locations and depth.

The geology data base by Belanger J. R. 1998 suggests 10 to 15 m of overburden soils underlain by interbedded limesone and dolomite bedrock at this site.

5 Surface and Subsurface Materials

The site surface is in majority lawn covered with an asphalt access lane and the 917 Merivale Rd residential building. The arrangement of strata found in our investigation is shown in the borehole logs in appendix A.

The near surface materials are clay filll and fine sand fill extending to a 1.7 to 2 m depth. Generally, the materials beneath the near surface fill is a very stiff brown silty clay crust extending to a depth of approximately 4.2 m which in turn is underlain by firm to stiff silty clay having shear strength between 34 and 89 kPa. The mechanical properties to the 12.95 m depth of the DCPT test

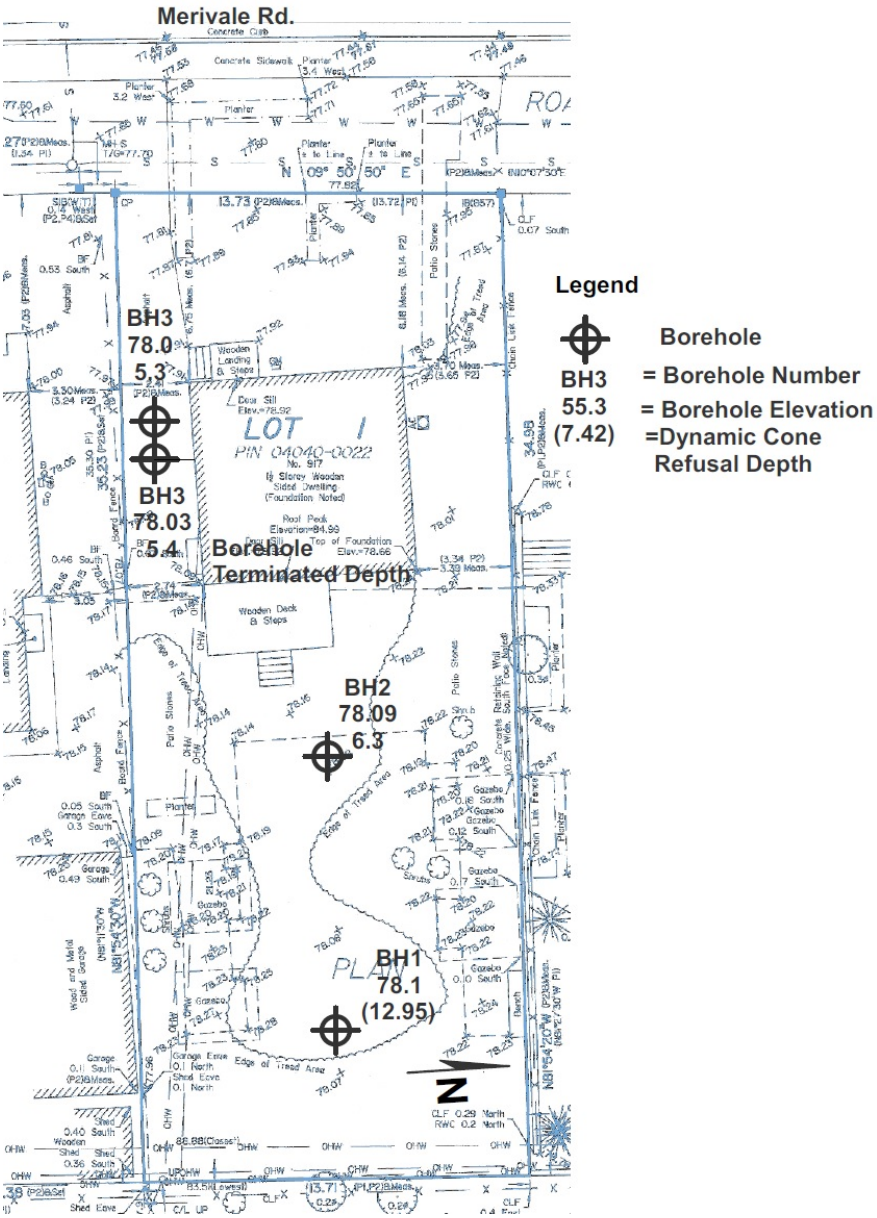

Figure 1: Test hole Locations Plan

completed in BHs 1 can be estimated based on its results shown in the borehole logs in appendix A which have been used in combination with other field tests to determined the site class assigned in this report.

Refer to the borehole logs in appendix A for specific details at each location.

5.1 Groundwater and Moisture

Generally, the groundwater table is estimated based on the observed soil strata and measurements. The permanent water table, where a stiff brown crust of weathered clay is found is typically evidenced by coloration and stiffness change which typically occurs below the brown stiff crust. The water level was measured at a 4.25 m depth on October 06, 2023, in a stand pipe installed in BH 1.

The crust thickness and water level measurements completed on October 06, 2023 in a standpipe installed during this investigation have been assessed to define the approximate depth of water table. The groundwater table is estimated at a 4.2 m depth. Moisture contents vary above the ground water table.

5.2 Freezing Index, Frost Depth and Frost Susceptibility

It is generally assumed that the frost depth for the 1,000 degree Celsius-days freezing index applicable to Ottawa will reach no deeper than 1.8 m on bare ground (snow free) or pavement. It is also assumed that frost depth will reach no deeper than 1.5 m on snow covered ground.

The soil materials encountered at this site are frost susceptible and thus will heave upon exposure to freezing temperatures. Heaving destroys the mechanical properties of soils so that any soil which has been frozen is considered disturbed.

Part III
Recommendations

The following set of the recommendations result from sampling and testing outlined in section 3 and from geotechnical engineering evaluation and assessments.

It is understood that the proposed development will consist of a 6 storey residential building.

6 Foundations General

Generally speaking, code compliant Part 9 and Part 4 buildings can be founded on shallow foundations using the bearing capacities for spread footings provided below.

Where building loads cannot be accommodated using the spread footings bearing capacity below the following can be considered:

- a raft foundation can be considered *if* the entire perimeter of the building has a basement (bearing capacity for a raft foundation is not provided in this report). If a portion of the building perimeter does not have a basement, this consideration does not apply. This option requires a review of a proposal (made by other designers) by the geotechnical engineer.
- deep foundation alternatives such as piles driven to refusal.

6.1 Load and Resistance Factors

Where soft to stiff clays are present the bearing capacity is defined at its service limit based on the estimated consolidation. Under the consideration of consolidation the following is to be noted with respect to the factors that are applied for the estimation:

- A resistance factor of approximately 0.5 is applied to the computed or estimated (nominal) bearing resistance from field or lab tests to obtain the service limit (SLS). This factor keeps the clay at load below the estimated consolidation.
- An average load factor of 1.5 is applied to the SLS limit to define the ultimate limit (ULS) for factored loads.

6.2 Bearing Capacity of Strip and/or Pad Footings

Based on the findings of this investigation and geotechnical assessments, the following bearing capacity can be used *for strip footings up to 1 m wide and pad footings up to 2.5 m wide placed on undisturbed native very stiff brown silty clay soils or engineered fill placed on native soils encountered in the testholes.*:

- 100 kPa at service limit (SLS).
- 150 kPa for factored loads (ULS).

The above bearing capacity can be used for strip and/or spread footings at a maximum depth of 2.2 m.

6.3 Settlements

For the footing loads provided in section 6.2 building settlements for foundations on undisturbed very stiff silty clay are not to exceed service limit values (SLS) of 25 mm and 20 mm total and differential settlements respectively at this site.

6.4 Deep Foundation Alternatives

Where building loads can not be accommodated with the bearing capacity described in section 6.2 deep foundations, such as driven or bored piles need to be considered.

Piles are generally driven to refusal and/or drilled to bedrock and proof tested.

Where the friction angle of the bedrock is required for design 30 degrees can be used.

Specific geotechnical resistance for specific pile systems will be provided if requested as part of this report.

6.5 Frost Protection for Foundations

Shallow foundations on frost susceptible soils which may be required on the perimeter of the building for canopies or other structures are considered to be frost protected when placed at sufficient depth to prevent supporting soils from freezing. Foundations in the perimeter of heated buildings where snow is not cleared are considered frost protected at 1.5 m depth (as having a soil cover of 1.5 m). Foundations away from heated buildings or in areas where snow is cleared, need to be at about 1.8 m depth to be frost protected. On the alternative frost protection can be provided by using foundation insulation for shallower foundations.

6.6 Foundation Insulation

To meet the required frost protection in section 6.5 for foundations for canopies or other structures in the perimeter of the building and in unheated areas in otherwise heated buildings 50 mm of extruded polystyrene insulation (XPS) type V, VI or VII meet foundation insulation requirements for the freezing index in the Ottawa area.

6.7 Foundation Wall Damproofing and Drainage

Appendix C.1 presents page 2 of NRC Construction Evaluation Reports CCMC 12658-R showing damproofing and foundation wall drainage system details satisfying the provisions under OBC 2012 and suitable for the conditions found at this site. Other available similar systems having the components shown in CCMC 12658-R may be used. Foundation drainage must be provided to daylight or a positive outlet, or sump.

7 Site Class for Seismic Design

At this site, the geotechnical testing completed along with the estimated soil properties via Dynamic Cone Penetration (DCPT) conducted in BH1 are indicative of a Vs(30) exceeding 180 m/s. As such, site class D is assigned under the provisions in section 4.1.8.4 of the Ontario Building Code 2012 (OBC 2012) for seismic design.

8 Roadbed Soils and Pavement Structure

Generally, for low volume roads, the pavement structure to be placed on native soils or engineered roadbed at this site may consist of 400 mm of OPSS granular B, 150 mm of OPSS Granular A and up to 75 mm of asphalt.

For parking lots, pavement structure to be placed on native soils or engineered roadbed at this site may consist of 300 mm of OPSS granular B, 150 mm of OPSS Granular A and 50 mm of asphalt. This thicknesses will vary depending on expected traffic at different locations.

9 Excavations, Open Cuts, Trenches and Safety

Typically, the main concern when excavating soils or rock is the stability of the sides of excavations. The stability of the sides is achieved by either cutting the sides to safe slopes or by providing shoring. It is also an issue of safety because of imminent hazards to the safety of workers and to property. As such, excavations are governed by the provisions in the Occupational Health and Safety Act of Ontario (O. Reg. 213/91). The application of O. Reg. 213/91 requires a classification of soils in one or several of four types (type I to type IV).

At this site for soils can be considered type II under O. Reg. 213/91. As such, the following key aspects of O. Reg. 213/91 are applicable to excavations:

- Safe open cut is 1 vertical to 1 horizontal.
- Within 1.2 m of the bottom of open cut areas or trenches, the soil can be cut vertical.

Where the safe open cut is not provided, either the shoring systems described in O. Reg. 213/91 or engineered shoring systems need be used. Information regarding physical and mechanical properties of subsurface materials which will be required for shoring design are provided in this report.

9.1 Conditions Requiring Engineered Shoring

O. Reg. 213/91 describe the conditions in which engineered shoring systems are required. Some key aspects of O.Reg. 213/91 regarding the conditions in which an engineered shoring system is required are:

- Where soils are type I to III and the prescribed safe open cuts are not provided and
  - The excavation is not a trench or
  - The excavation is a trench either deeper than 6 m or wider than 3.6 m or both
- For trench excavations or open cut, where soils are type IV and the safe open cuts are not provided.

Note that along with the descriptions in O. Reg. 213/91 for soils type IV, any difficult soil having significant seepage and/or strength loss upon excavation such as caving soils can be rendered as type IV.

Note also that since excavation and safety are usually in control of the contractor, *shoring design and construction is done by the contractor.*

9.2 Construction and Excavation Along Adjacent Structures and Property Boundaries

Significant concerns regarding safety and property damage result from excavations along adjacent structures. O. Reg. 213/91 under "*Protection of Adjacent Structures*" establishes the following for excavations near adjacent structures:

- 229. (1) If an excavation may affect the stability of an adjacent building or structure, the constructor shall take precautions to prevent damage to the adjacent building or structure. O. Reg. 213/91, s. 229 (1).
- 229. (2) A professional engineer shall specify in writing the precautions required under subsection (1). O. Reg. 213/91, s. 229 (2).
- 229 (3) Such precautions as the professional engineer specifies shall be taken. O. Reg. 213/91, s. 229 (3).
- any comment and/or precaution and/o recommendation in this report is followed.

This section establishes the precautions required under O. Reg. 213/91 section 229 (2) above.

Excavation depths below the founding depth of adjacent structures will not take place, unless:

- Lateral support is provided to soils by cutting the slope to 1 horizontal to 1 vertical or
- lateral support is provided by shoring.
- any comment and/or precaution and/o recommendation in this report is followed.

It is also recommended that the edge of the 1 horizontal to 1 vertical slope providing lateral support be offset 0.3 m away from the edge of the foundation.

10 Water Inflow Within Excavations and Water Takings

Water inflow within excavations in soils is influenced by the depth of excavations relative to the water table and flow behavior of water in soils as controlled by the permeability of soils. In view of the assessments under section 5.1 and information seen in the borehole logs, water inflow is expected to be low and controllable by pumping from open sumps.

11 Underground Corrosion

For the resistivity, PH and soluble ions concentrations found at this site and shown in the Paracel Laboratories certificate of analysis in appendix B.1, the soils are mildly corrosive. Resistivity, PH and soluble ions testing was completed in a representative sample at 3.35 m depth in BH1. After Romanoff (1957)[2], the following corrosion rates can be used:

1. For carbon steel:
    - 16 μm/year for the first 2 years,
    - 12 μm/year, thereafter.
2. For galvanized metal:
    - 4.6 μm/year for the first 2 years,
    - 3.2 μm/year until depletion of zinc,
    - 12 μm/year for carbon steel.

12 Potential of Sulphate Attack to Concrete

For the sulphate content less than 0.1% in soil encountered at this site, there are no restrictions to the cement type which can be used for underground structures. This refers to restrictions associated with sulphate attack only.

13 Stripping, Excavation to Undisturbed Soils and rock, Earth and Rock Fill Placement. Asphalt Placement and Compaction

Appendix D presents recommended geotechnical specifications and guidelines for stripping, earth and rock excavation to undisturbed surfaces, earth and rock fill placement, asphalt placement, compacted lifts thicknesses for equipment type and compaction for different placements.

13.1 Winter Construction

Winter construction is not recommended. Many construction practices are inadequate to provide protection for all the details and geometries which could allow exposure of frost susceptible soils to freezing temperatures rendering them disturbed.

In situations where YME is required for guidance and inspections during winter, YME will provide its best approach with the resources available for protections during construction in real time and its expected that the contractors

[2]Romanoff's work for the U. S. National Bureau of Standards is authoritative in underground corrosion

will act in real time to provide the protections. YME has insufficient control of the contractor operations and and/or the construction tasks and/or the method of protection to provide any warranties in those situations. Irresponsive contractors add great potential to induce damage.

Disclaimer

Sheppard Property Development SPD and other professionals understand that soils and groundwater information in this report has been collected in boreholes guided by standards and practice guidelines generally accepted for engineering characterization of ground conditions in Ontario and in no case borehole data and their interpretation warrant understanding of conditions away from the borehole locations. SPD accepts that as development will have spread away from the boreholes other designers will need the best opinion from the geotechnical consultant based on the findings of the investigation so that any statements which could be implicitly or explicitly depart from the conditions at borehole may be given to fulfill this need in good faith as best available opinion with the information available at the time without any warranties.

User Agreement

Acknowledgment of Duties

In this 63-SPD-R0 report, Yuri Mendez Engineering (YME) has pursued to fulfill every aspect of the obligations of professional engineers. As a part of those duties, from field work, operations, testing, analyses, application of knowledge and report, YME has ensured that it meats a high standard of Geotechnical engineering practice and care in the province of Ontario. Obligations under R.R.O. 1990, Reg. 941: Professional Engineers Act, R.S.O. 1990, c. P.28, further referred to as Reg. 941 which are of immediate interest to this service are:

"77. 7. A practitioner shall,

i. act towards other practitioners with courtesy and good faith,

ii. not accept an engagement to review the work of another practitioner for the same employer except with the knowledge of the other practitioner or except where the connection of the other practitioner with the work has been terminated,

iii. not maliciously injure the reputation or business of another practitioner,

8. A practitioner shall maintain the honour and integrity of the practitioner's profession and without fear or favour expose before the proper tribunals unprofessional, dishonest or unethical conduct by any other practitioner."

Communications

63-SPD-R0 is to be used solely in connection with the 6 storey residential building by Sheppard Property Development (SPD) and thus subject of communications amongst other professionals (OP), government bodies and authorities, and SPD for that purpose. YME demands great care in precluding damage to the integrity of this professional work which may arise from careless communications from engineers of Canada. OP and SPD acknowledge understanding that where any such communication occur in connection with this report, they are bound by this agreement as an extension to the standard of care embodied in R.R.O. 1990, Reg. 941 and thus accept that any correspondence from OP or the public seen to add any bad connotations to the breadth, depth, typesetting, typography, formal semantics and scope of this report or otherwise diminish the breadth of services and knowledge delivered in this report which

in any way raise concerns or insecurities to the qualities and/or the *reasonable completeness* delivered to SPD in this report will be forwarded to YME.

Reasonable Completeness

OP and Sheppard Property Development acknowledge understanding that said care and said standard has been applied equality to the reasonable completeness of this report relative to the information available from the field program and acknowledge understanding that is neither feasible nor possible to convey geotechnical information in this report that would cover for every possible consideration by OP and/or SPD and that upon issuance it will be subject to reviews which may trigger the need to add information which at the discretion of YME will be added when considered within the practice obligations under Reg. 941. The geotechnical information here provided is thus envisioned as to cover for the scope and breadth of design figures and assessments generally foreseeable as needed by other designers at the time of issuance and which could be amended as needed within the context of services provided by other designers. YME agrees to issue revised versions of this 63-SPD-R0 report by adding R# to each revision where # is the number of the revision. OP covenant to conduct all communications in connection with these reviews following great care to preclude the suggestion of a breach to the reasonable completeness acknowledged herein. Written communications which may trigger reviews under this agreement will be acknowledged as requests for "review under the 63-SPD-R0 report user agreement". This reasonable completeness is also relative to the scope of services generally accepted in geotechnical engineering work in Ontario

Errors

Where errors are found during reviews under the 63-SPD-R0 report user agreement, OP covenant great care in communications to preclude the suggestion of a breach to the duties acknowledge herein which could induce damages to YME. Communications triggered by errors or any such communication which would render the person doing the request in a position of technical authority above the author implies an unauthorized review and constitute a serious breach of the code of ethics under Reg. 941 and damages to YME and so subject to disciplinary measures and/or liability for damages to YME. SPD is thus acquainted that correction of errors will be made and acknowledged by YME as they may arise in any professional work but in no way OP will purport or render such corrections as omissions departing away from the correction of errors set forth in this agreement. Where communications in connection with the correction of errors process set forth in this agreement raise concerns or insecurities to the qualities and/or the reasonable completeness delivered to SPD in this report occur, SPD covenants to inform YME. SPD is acquainted that such corrections are part of the natural processes associated with the applied sciences nature of this report and so typified explicitly in this agreement to protect YME from inappropriate manipulation of those processes by OP and others.

Disclaimer

SPD and OP understand that soils and groundwater information in this report has been collected in boreholes guided by standards and practice guidelines generally accepted for engineering characterization of ground conditions in Ontario and in no case borehole data and their interpretation warrant understanding of conditions away from the borehole locations. SPD accepts that as development will have spread away from the boreholes other designers will need the best opinion from the geotechnical consultant based on the findings of the investigation so that any statements which could be implicitly or explicitly depart from the conditions at borehole may be given to fulfill this need in good faith as best available opinion with the information available at the time without any warranties.

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Part IV
Appendices

A Borehole Logs

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Project:	**Proposed Six Storey Residential Building**	YME Yuri Mendez Engineering.
Location: **917 Merivale Rd.**	Client: **Sheppard Developments**	**Test Hole No.: BH1 of 3**
Job No.: **63-SPD**	Test Hole Type: **7" OD Auger.**	Date: **September 20, 2023**
"7" OD Auger."	SPT Hammer Type: **Safety auto hammer**	Logged By: **Yuri Mendez**

Depth (m)	Elevation (m) 78.1	Lithology and color	Material Description	Samples or Blows/Ft	Water	Elevation (m) 78.1	Depth (m)	Shear Strength (kPa)	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Rock Quality RQD %	Laboratory Tests: Other Lab Tests
0	78		Topsoil			78	0				
0.25			Fill: clay				0.25				
0.5	77.5					77.5	0.5				
0.75							0.75				
1	77		Fill: Brown clean fine sand	5		77	1				
1.25							1.25				
1.5	76.5					76.5	1.5				
1.75				9			1.75				
2	76		Brown very stiff silty clay			76	2				
2.25							2.25				
2.5	75.5			2		75.5	2.5				
2.75							2.75				
3	75					75	3				
3.25				6			3.25				
3.5	74.5					74.5	3.5				
3.75							3.75				
4	74		Firm to stiff silty clay	2	▼	74	4				
4.25							4.25				
4.5	73.5					73.5	4.5				
4.75							4.75	63.4			
5	73					73	5	80.3			
5.25							5.25				
5.5	72.5					72.5	5.5				
5.75							5.75	42.3			
6	72					72	6	48.6			
6.25			Strata tested using Dynamic Cone Penetration Test (DCPT)	5			6.25				
6.5	71.5			7		71.5	6.5				
6.75							6.75				
7	71			9		71	7				

S = Sample for lab review and moisture content

▼ Interpreted water level

Project:	**Proposed Six Storey Residential Building**	YME Yuri Mendez Engineering.
Location: **917 Merivale Rd.**	Client: **Sheppard Developments**	**Test Hole No.: BH1 of 3**
Job No.: **63-SPD**	Test Hole Type: **7" OD Auger.**	Date: **September 20, 2023**
"7" OD Auger."	SPT Hammer Type: **Safety auto hammer**	Logged By: **Yuri Mendez**

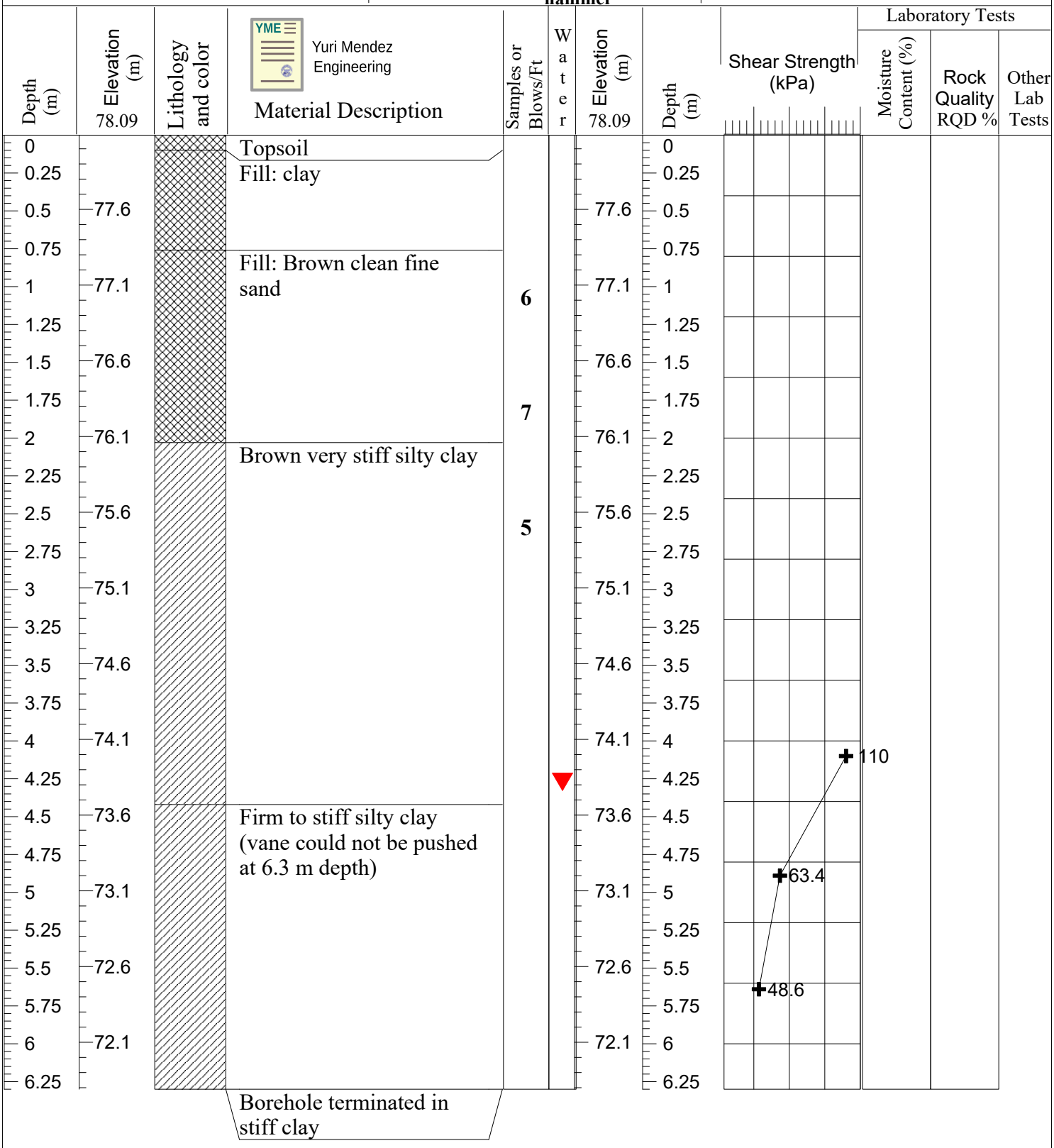
Depth (m)	Elevation (m) 78.1	Lithology and color	Material Description	Samples or Blows/Ft	Water	Elevation (m) 78.1	Depth (m)	Shear Strength (kPa)	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Rock Quality RQD %	Laboratory Tests: Other Lab Tests
7.25	70.5			19		70.5	7.25				
7.5				15			7.5				
7.75				13			7.75				
8	70			16		70	8				
8.25				15			8.25				
8.5	69.5			15		69.5	8.5				
8.75				14			8.75				
9	69			13		69	9				
9.25				15			9.25				
9.5	68.5			18		68.5	9.5				
9.75				18			9.75				
10	68			19		68	10				
10.25				24			10.25				
10.5	67.5			28		67.5	10.5				
10.75				29			10.75				
11	67			48		67	11				
11.25				35			11.25				
11.5	66.5			36		66.5	11.5				
11.75				31			11.75				
12	66					66	12				
12.25							12.25				
12.5	65.5					65.5	12.5				
12.75							12.75				

Cone Penetration Refusal at 12.95 m depth.

S = Sample for lab review and moisture content

▼ Interpreted water level

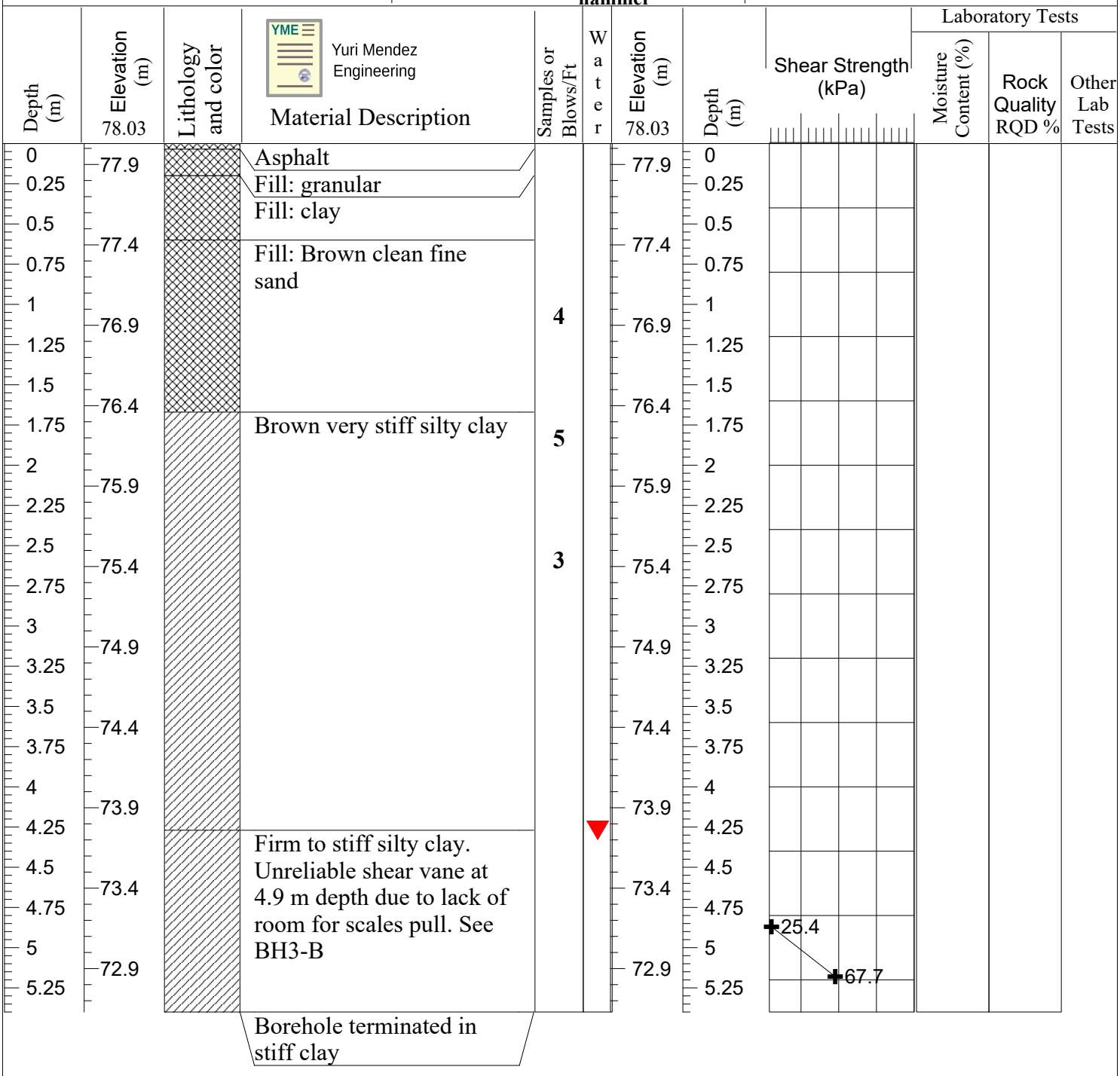
Project: **Proposed Six Storey Residential Building**		YME Yuri Mendez Engineering.
Location: **917 Merivale Rd.**	Client: **Sheppard Developments**	**Test Hole No.: BH2 of 3**
Job No.: **63-SPD**	Test Hole Type: **7" OD Auger.**	Date: **September 20, 2023**
"7" OD Auger."	SPT Hammer Type: **Safety auto hammer**	Logged By: **Yuri Mendez**



S = Sample for lab review and moisture content

▼ Interpreted water level

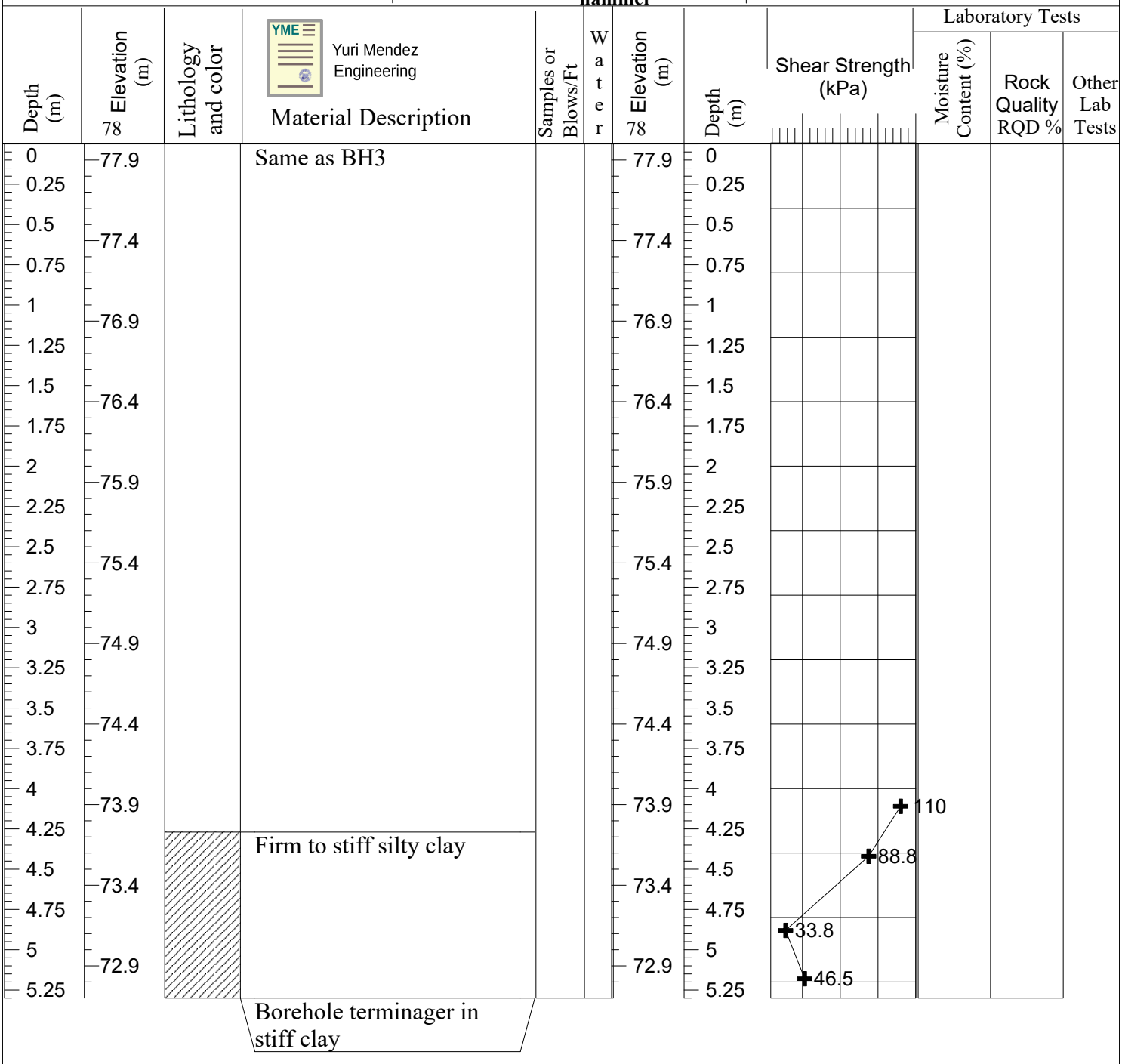
Project:	**Proposed Six Storey Residential Building**	YME Yuri Mendez Engineering.
Location: **917 Merivale Rd.**	Client: **Sheppard Developments**	**Test Hole No.: BH3 of 3**
Job No.: **63-SPD**	Test Hole Type: **7" OD Auger.**	Date: **September 20, 2023**
"7" OD Auger."	SPT Hammer Type: **Safety auto hammer**	Logged By: **Yuri Mendez**



S = Sample for lab review and moisture content

▼ Interpreted water level

Project:	**Proposed Six Storey Residential Building**	YME Yuri Mendez Engineering.
Location: **917 Merivale Rd.**	Client: **Sheppard Developments**	**Test Hole No.: BH3-B of 3**
Job No.: **63-SPD**	Test Hole Type: **7" OD Auger.**	Date: **September 20, 2023**
"7" OD Auger."	SPT Hammer Type: **Safety auto hammer**	Logged By: **Yuri Mendez**



S = Sample for lab review and moisture content

▼ Interpreted water level

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Appendix

B Resistivity, PH and Soluble Salts Test

PARACEL LABORATORIES LTD.

Order #: 2339520

Certificate of Analysis

Report Date: 05-Oct-2023

Client: Geoseismic

Order Date: 29-Sep-2023

Client PO:

Project Description: 917 Merivale Rd.

	Client ID:	BH1 SS4	-	-	-		
	Sample Date:	20-Sep-23 09:00	-	-	-	-	-
	Sample ID:	2339520-01	-	-	-		
	Matrix:	Soil	-	-	-		
	MDL/Units						
Physical Characteristics							
% Solids	0.1 % by Wt.	70.0	-	-	-	-	-
General Inorganics							
pH	0.05 pH Units	6.80	-	-	-	-	-
Resistivity	0.1 Ohm.m	83.4	-	-	-	-	-
Anions							
Chloride	10 ug/g	<10	-	-	-	-	-
Sulphate	10 ug/g	28	-	-	-	-	-

Appendix

C Foundation Drainage

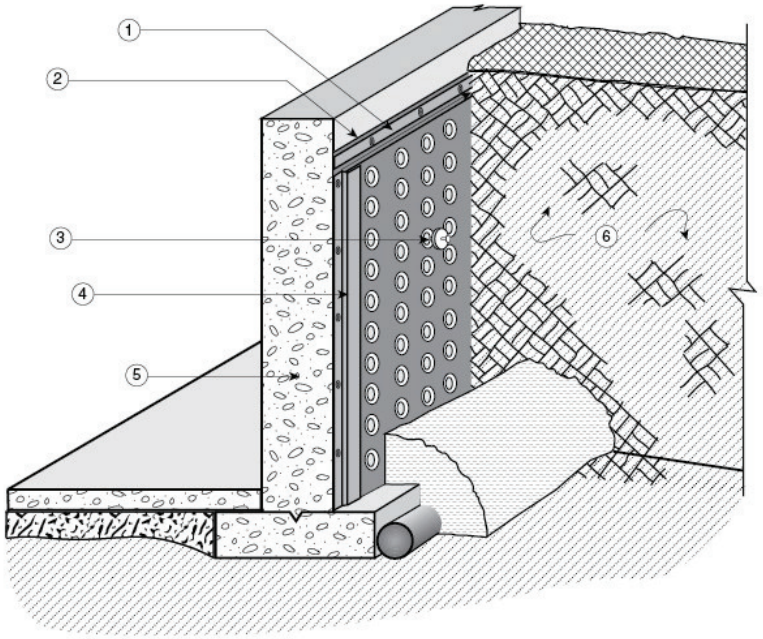

Figure 1. "Cosella-Dörken DELTA®-MS and DELTA®-MS CLEAR Dampproofing Membranes" – face in contact with the soil

1. **termination bar**
2. **caulking (behind membrane)**
3. **fastener**
4. **mould strip**
5. **concrete foundation**
6. **backfill**

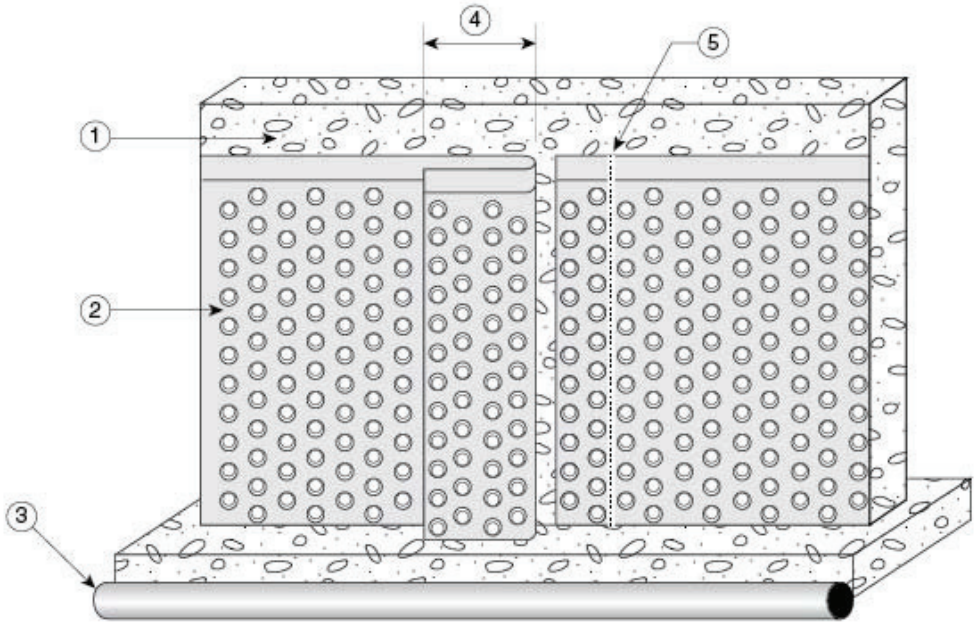

Figure 2. "Cosella-Dörken DELTA®-MS and DELTA®-MS CLEAR Dampproofing Membranes" – face in contact with the wall

1. **concrete foundation**
2. **membrane**
3. **drainage tile**
4. **minimum 6" overlap**
5. **caulking**

Appendix

D Construction Recommendations for Stripping, Earth and Rock Excavation to Undisturbed Soils, Earth and Rock Fill Placement, Asphalt Placement and Compaction

In the event that any of the following recommendations conflict with municipal and or provincial specifications, the most restrictive applies. For the case when products involving ground conditions are used, the manufacturer's specifications take precedence.

The contractor shall be prepared to proceed as directed by the geotechnical consultant within the framework of these recommendations. Construction methods will abide to these recommendations and/or be discussed and agreed upon with the consultant on site in real time or as expressed in writing.

D.1 Removal of Water

Removal and diversion of surface water and ground water will be planed prior to all earthwork within the scope of these recommendations. All surfaces in which to commence construction will be maintained dry and free of muddy conditions.

D.2 Earth Excavation

Earth excavations are subject to the provisions in O. Reg. 213/91: Construction Projects under Occupational Health and Safety Act. Refer to section 9 for key aspect of O. Reg. 213/91 applicable to the findings in testholes at this site.

For the purpose of these recommendations earth materials will be refer to as one or more of the general material classes: topsoil and organic soils, non engineered fill, granular fill, native soils and rock. Topsoil and organic soils and non engineered fill are the subject of striping in subsection D.2.2.

D.2.1 Suitability of Earth Materials

The suitability of material for specific purposes is determined by the geotechnical engineer. To the extent they are needed, suitable material from the excavations can be used in the construction of required permanent earthfill or rockfill.

D.2.2 Striping

Topsoil and/or organic soils and/or existing fill must be removed from the perimeter of all proposed structures, including retaining wall, buildings, pavement, parking areas and earth or fill banks for grading.

D.2.3 Excavation to Undisturbed Soil Surface

All soil surfaces in which to commence construction for all structures are to be preserved in undisturbed condition (Undisturbed Soil Surface (USS)). Native soil surfaces exposed to the weather for a period exceeding 72 hours are considered disturbed. Where rainy weather and/or equipment operation and/or labor make impractical or difficult the preservation of USS a working-leveling granular pad may be used. Use the compaction requirements and materials in Table 1.

Except as otherwise indicated for select earthfill materials at this site, reinstatement of excavated soil is not allowed. When excavation exceeds the depth of the proposed USS, a granular pad using the compaction requirements and materials in Table 1.

It can be assumed that it is impractical to conduct excavations to an even USS. In such case a granular pad not less than 150mm thick must be used to remedy for irregularities caused by the operation of equipment.

D.3 Foundations Placement

Native soil surfaces exposed to the weather for a period exceeding 72 hours are considered disturbed. Place foundations on a OPSS.MUNI 1010 granular B type 2 granular pad that is at least 150 mm thick placed on undisturbed soils.

D.4 Retaining Wall Foundations

Retaining wall foundations are to be placed on a OPSS.MUNI 1010 granular B type 2 granular pad that is at least 150 mm thick.

D.5 Imported Materials

Materials to be imported are subject to prior approval by the geotechnical engineer. The exceptions are granular materials having 12 % or less fines including clean sands. Fines are materials passing the # 200 sieve (70 μm).

D.5.1 Granular Earthfill Placement

D.5.1.1 Moisture for Granular Earthfill

For granular earthfill it is to be assumed that moisture will be added for placement. Compaction in wet of optimum condition is preferred for granulars.

D.5.1.2 Compacted Lifts Thicknesses Equipment and Passes for Granular Eathfill

Compacted lifts will not exceed 250 mm. Subject to test trials a maximum compacted lift of 300 mm may be accepted provided vibratory compaction equipment rated at 60,000 lb-f (27,300 kg-f) of dynamic force is used.

For road construction passes are to overlap by 300 mm for full coverage.

Where non vibratory pneumatic compactors with ballast an tire pressure of 100 psi (7 kg/cm2) are used (9 or 13 ply) the compacted lift thicknesses will not exceed 150 mm for granular.

For services and culvert trenches, when using rammers and light vibratory plates weighing less than 115 kg (250 lbs) the compacted lift thicknesses will not exceed 100 and 125 mm respectively. For heavier trench equipment the compacted lifts will not exceed 250 mm.

No heavy equipment will be operated above the crown of pipes or culverts unless 1.2 m of fill has been placed or the subgrade elevation has been reached.

For all trenches below the water table, trench foundation not less than 200 mm will be provided as per materials and specification in Table 1 in page 32.

Materials lift placement beneath foundations, slabs or any placement not specified above must abide to the above specifications as they relate to the equipment being used.

D.5.2 Compaction Guide for Passes and Level of Compaction

The contents of this section are provided as guidelines for construction. The resulting compaction densities and compacted lift thicknesses can only be verified by actual testing and field trials respectively.

For equipment passes the contractor may consider not less than 4, 5 or 6 passes for 95, 98 or 100 % Proctor Standard compaction.

For granular materials loose lifts may be approximately 150, 175 and 235 mm for compacted lift thicknesses 125, 150 and 200 mm respectively.

For select earthfill materials loose lifts may be approximately 125 and 190 mm for compacted lift thicknesses 100 and 150 mm respectively.

D.6 Compaction General

It is to be assumed that water will be added for compaction and that the required maximum grain size shall be 3/4 of the compacted lift thickness.

Obtain the approximate loose lift thickness by dividing the compacted lift by 0.88. Compacted lifts are approximately 12% less than the loose lift thickness.

Each lift shall be compacted by the specified number of passes of the approved type and weight of roller or other equipment.

Table 1 in page 32 presents Proctor Standard (PS) compaction requirements for specified placement and materials.

D.7 Compaction Specific

D.7.1 Compaction Along Basement Walls, Retaining Walls and Structures

No heavy compaction equipment is to be operated within 0.9 m of any structure. The consolidation zone is defined as the zone within 0.9 m of the exterior edge of basements or the interior edge of retaining walls or any structure. Only light

Material Placement	Material Description	% PS
Base	OPSS.MUNI 1010 Granular A	100
Subbase	OPSS.MUNI 1010 Granular B Type II	100
Subgrade	Granular earthfill (with 12 % or less fines) and 100% passing 106 mm sieve	95
	Select earthfill	95
Backfill for trenches under pavement	Granular earthfill (with 12 % or less fines) and 100% passing 106 mm sieve.	95
	Select earthfill	95
Under sidewalks top 200 mm	Any OPSS.MUNI 1010 Granular specification for which 100% passes the 26.5 mm sieve	95
Under foundations	OPSS.MUNI 1010 Granular B type 2 with 12% or less fines and for which 100% passes the 106 mm sieve	98
Backfill under slabs on grade	Cohesionless (with 12 % or less fines) and 100% passing 106 mm sieve.	100
	Select earthfill	100
Top 100 mm under slabs	Crushed stone 9.5 to 19 mm (use one or several sizes).	90
Pipe bedding and cover (150 mm for bedding to 150 mm above the crown)	Any OPSS.MUNI 1010 Granular specification for which 100% passes the 26.5 mm sieve	95
Trench foundation (stabilization minimum 200 mm)	Any OPSS 1010.MUNI Granular specification for which 100% passes the 106 mm sieve except Granular B Type I	95
Backfill for non building, non traffic and/or non parking areas	Granular (with 12 % or less fines) and 100% passing 106 mm sieve	90
	Select earthfill	90
Placement not specified above	Granular (with 12% or less fines) and 100% passing 106 mm sieve	95
	Select earthfill	95

Table 1: Proctor Standard (PS) compaction requirements for specified placement and materials.

to very light compaction is to be applied along the consolidation zone with no more than 2 passes of light vibratory equipment.

D.7.2 Self Compacting Materials

There are no self compacting materials. Total fill thickness of 200 mm of granular materials consisting of more than 90% of one nominal size referred to as crushed stone are acceptable without compaction under concrete slabs.

D.7.3 Settlement Allowance and Overfill

The settlement (consolidation) of lightly compacted earthfill can be excessive. Overfill to compensate for settlement allowance will be discussed with the geotechnical engineer.

D.7.4 Compaction Quality Control

Provide moisture density relationships for Standard Proctor compaction for the proposed materials and source. Conduct one in situ test at randomly selected locations per 60 m3 of fill. This is approximately one test, each 300 m2 of lift in place. Nuclear or non-nuclear density probes testing can be used. Density probes will only measure the density within 0.12 m depth at the point of the measurement.

D.8 Asphalt Pavement

Place asphalt mix only when base course, or previous course is dry and air temperature is 7 degrees C and increasing.

Asphalt pavement mix temperatures at the time of placement will be within the range of 120 to 160 degrees C.

Do not place asphalt on a surface which is wet or covered by snow or ice or if the ground is frozen.

D.8.1 Surface Preparation for Asphalt Pavement

It is to be assumed that rough grading and fine grading shall take place before asphalt placement. Rough grading will be completed to within $\pm$ 25 mm of the underside of asphalt and tested to meet the specified density. Fine grading and rolling will completed by the paving contractor. The granular material for fine grading will meet OPSS.MUNI 1010 Granular M.

D.8.2 Proof Rolling Prior to Asphalt Pavement

Conduct proof rolling using a single pass of a tandem-axle dump truck or a tri-axle dump truck with the third axle raised loaded to a minimum gross vehicle weight of 26 metric tons at walking speed. Rutting in excess of 25 mm is considered failure. Where proof rolling reveals areas of defective subgrade,

Remove base, Sub-base and subgrade material to depth and extent and width that will allow reconstruction using the available equipment or as directed by the Consultant.

D.8.3 Asphalt compaction

The compacted lifts are accepted to be 80% of the loose lift thickness (the loose lift reduces thickness by 20% when compacted). Divide the compacted lift thickness by 0.8 to obtain the thickness of the loose lift.

Compaction will consist on at least three passes at approximately walking speed (5.4 km/hr) as follows: *break down rolling* using a vibratory steel drum roller, *intermediate rolling* with a static (non-vibrating) roller or a pneumatic roller and *finish rolling* with a smooth static roller.