Subsurface Investigation Report

3075 Palladium Dr., Ottawa, ON, K2S 1B9

Abstract

This report presents the findings of a Subsurface Investigation completed at a portion of the 3075 Palladium Dr. parcel, in the City of Ottawa, ON, K2S 1B9, shown in figure 1 in page 9 and issue recommendations for a proposed Four 1 Storey Commercial Buildings development. It provides geotechnical information about the subsurface conditions at 4 borehole locations compiled from field sampling and testing. The borehole locations are shown in figure 1 in page 9. It was found that 7 m of overburden soils are underlain by bedrock and that dense sandy silt lays beneath 0.15 m of surface organic topsoil. 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: 69-608OI-V2-R2[1]
November 11, 2024

Yuri Mendez
Engineering

Compaction Tests, Geotec.
Engineering, Inspection
Ottawa, On.

PO Box 74087
RPO Beechwood
Ottawa, ON, K1M 2H9

Phone: 613-899-0834
e-mail: yuri@ymendez.ca

[1]For the account of 1000514608 Ontario Inc. (608OI) as per proposal in email dated January 22, 2024..

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1 Introduction

This document reports the findings of a subsurface investigation completed at a portion of the 3075 Palladium Dr. parcel, in the City of Ottawa, ON, K2S 1B9, having extents and geometry shown in figure 1 in page 9.

The investigation was carried out by advancing 4 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 Four 1 Storey Commercial Buildings development. The information reviewed also includes boreholes by others supplied by 1000514608 Ontario Inc. for inclusion in this report, 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 "69-608OI-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),
- AASHTO T 11 Materials Finer Than No. 200 (75um) Sieve in Minneral Aggregates by Washing,
- ASTM C-136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

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 9 along with field review, assessments and classification of samples.

The elevation of the boreholes were estimated based on their location within available survey plans showing elevations and are shown in the Test Hole Locations Plan in fig. 1 in page 9. 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, grass-covered 3075 Palladium Dr. parcel within a block surrounded by streets in the City of Ottawa, ON. Figure 1 in page 9 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 m of overburden soils underlain by interbedded limestone and shale bedrock at this site.

5 Surface and Subsurface Materials

The site surface is grass covered. The arrangement of strata found in our investigation is shown in the borehole logs in appendix B.

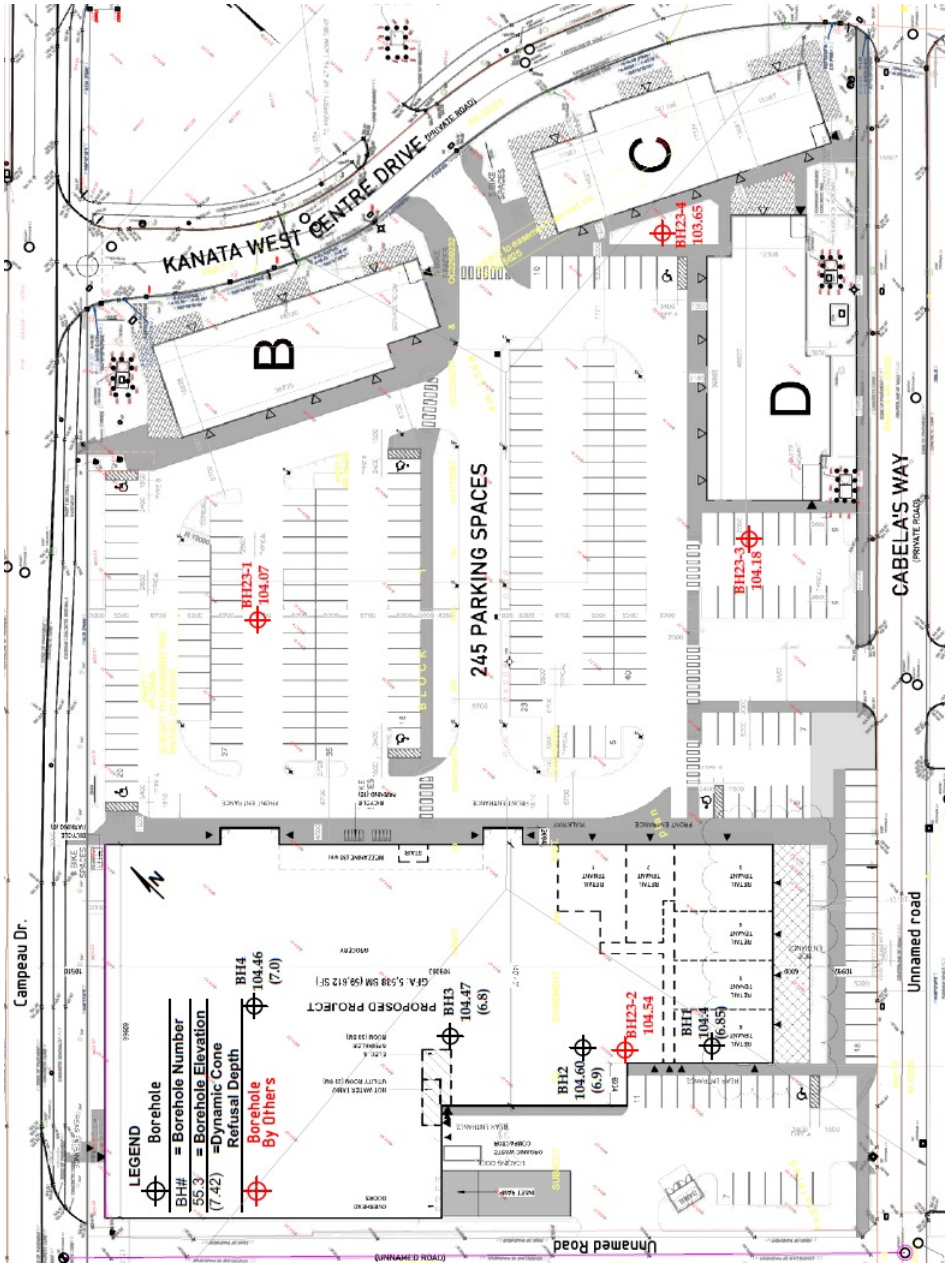

Figure 1: Test hole Locations Plan

It can be seen in the borehole logs that at all borehole locations bedrock is inferred from DCPT testing at 6.8 to 7 m depth. Throughout the depth profile at all borehole locations dense sandy silt was found in all 4 boreholes. The site is covered with roughly 0.15 m of topsoil.

Gradation testing indicates that the silt encountered has 20.7% content of very fine sand finer than 0.18 mm.

Sandy silt is very susceptible to caving onto excavations exceeding the high water table encountered at this site. Refer to the excavation/open-cut section for guidance.

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

5.1 Groundwater and Moisture

The water level was measured at BH1 on March 2024 at 0.9 m depth (103.5 m elevation), on July 4 2024 at a 1.55 m depth (102.85 m elevation), and on September 19 at 2.16 m depth (102.24 m elevation). At BH23-2 by others, the water level was measured at 1.9 (102.64 m elevation), 2.3 (102.24 m elevation), 1.45 m depth (103.09 m elevation), and 2.3 m depth (102.24) on May 26 and June 2, 2023, on July 04, 2024 and September 19, 2024 respectively. This information is summarized below.

Hole	Date	Depth	Elevation
BH1	March, 2024	0.9	103.5
BH1	July 4, 2024	1.55	102.85
BH1	September 19, 2024	2.16	102.24
BH23-2	May 26, 2023	1.9	102.64
BH23-2	June 02, 2023	2.3	102.24
BH23-2	July 04, 2024	1.45	103.09
BH23-2	September 19, 2024	2.3	102.24

Table 1: Ground Water Level measurements

It is of note that the shallowest water level measurement at 0.9 m depth deviates substantially from all other measurements completed at this site and could be rendered as an outlier in the data set and could be treated as such.

The investigation findings confirm shallow water conditions. 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 Four 1 Storey Commercial Buildings and that consideration is being given to the preservation of the foundation walls of the existing building.

6 Foundations General

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

6.1 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 m wide placed on undisturbed dense sandy silt soils and/or engineered fill placed on undisturbed dense fine sand soils encountered in the testholes.*:

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

6.2 Retaining Walls

The following can be considered for the design of retaining walls:

- Generally in Ottawa, a horizontal PGA of 0.2 is used for seismic design of free-standing retaining walls;
- generally the at-rest factor of 0.5 is used for nonyielding walls such as basements;
- the Mononobe Okabe method is often used for seismic design;
- YME recommends that foundations for retaining walls be placed on a 15 cm compacted granular B-type 2 or similar crushed granular fill placed at

USF on undisturbed soils. This is due to low friction for footings placed directly on native soils;

- Where the above recommendation is applied, 0.55 friction δ can be used at this site. Otherwise, use $\delta = 0.35$
- use $\delta = 0.4$ for granular fill on formed concrete;
- if the angle of native soils cut behind a retaining wall slopes at 45 degrees or more use $\phi = 30$. If it is less than 45 use $\phi = 38$ for clean granular fill.
- use 20 kN/m^3 unit weight for soils and 22 kN/m^3 for granular fill.
- ensure proper foundation drainage via available means such as crushed stone, drainage pipes, weep holes, etc.
- compaction within 0.9 m of a retaining wall is very light with light equipment;
- additional recommendations in section 16 are applicable.

6.3 Settlements

For the footing loads provided in section 6.1 building settlements for foundations on undisturbed sandy silt are not to exceed service limit values (SLS) of 25 mm and 20 mm total and differential settlements respectively at this site.

6.4 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.

6.5 Foundation Insulation

To meet the required frost protection in section 6.4 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.

6.5.1 Creep Deformation of Insulation

Service loads on foundation insulation must be kept at no more than 1/3 of its rated capacity. Creep deformations occur on insulation at loads exceeding 1/3 of its rated capacity. The rated capacity is at 10 % strains.

6.6 Foundation Wall Damproofing and Drainage

Foundation walls damproofing and foundation drainage are not required for foundations serving buildings of slab-on-grade construction not having floor levels lower than the finished grade on the perimeter for the conditions encountered at this site.

Elevator pits deeper than the exterior grade of buildings do require foundation drainage.

Appendix E.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 Rates of Infiltration, Percolation and Permeability

Values of permeability, infiltration and percolation which could be associated[2] to the sandy silt encountered at this site are the following:

- Permeability of 5×10^{-5} cms/sec
- Percolation of 15 min/cm
- Infiltration of 5 cm/hr

7.1 Infiltration Gallery Comments

Infiltration galleries (IG) are being proposed at this site to meet low-impact development goals. Because buildings of slab-on-grade construction are not required to have foundation drainage at this site the requirement of depth based on the risk of water backing into a drainage system is reduced. Infiltration galleries are designed to improve recharge of the water table on site, however, their design often accepts that the system may fill and include means to discharge into the storm sewer upon filling.

In view of the high ground water table at this site, it is reasonably acceptable to reduce the 1m distance requirement between the gallery and the estimated

[2]MMAH Supplementary Standard SB-6 and approximate relationship between the permeability and infiltration rate

water table and preserve its functional goals through the high water season, albeit with the possibility of filling. Because the discharge would only occur at an elevation defined as the maximum elevation (as if it is full) which is yet higher than the underside of the gallery, there shouldn't be a negative impact in a worst-case condition. In addition to fulfilling the functional goals noted above, post-development groundwater levels are generally lower adding to the confidence that galleries at the elevations proposed at this site clear sufficient elevation difference from the water table for acceptable performance.

8 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 all boreholes are indicative of a Vs(30) exceeding 360 m/s. As such, site class C is assigned under the provisions in section 4.1.8.4 of the Ontario Building Code 2012 (OBC 2012) for seismic design.

9 Roadbed Soils and Pavement Structure

The flexible pavement structures supplied in this report follow the guidelines set out in AASHTO 1993 Guide for Design of Pavement Structures (AASHTO) for climatic Region III. Under AASHTO pavements are designed to withstand 20 year accumulated design Equivalent Single Axle 80 kN (18,000 pounds) load applications (ESALs). ESALs are a measure of mix traffic loads including vehicle loads and truck loads. The number of ESALs applications depend on traffic class and use.

Roadbed denotes the materials beneath pavement structures. The term pavement is used to denote the layered structure that forms a road carriageway or vehicle parking. *The general quality of the near surface undisturbed soil to serve as foundation for pavement structure (Roadbed soil) at this site are assumed to be very poor* as defined in the AASHTO guide. It is hence recommended to refer to the following information in appendix D:

- *Yuri Mendez Engineering's pavement catalog in appendix D.1 to select pavement structures* for traffic classes on the very poor roadbed soils encountered at this site.
- Appendix D.2 for guidelines regarding frost heave.
- Appendix D.3 for frost protection recommendations for manholes and catch basin construction.

10 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, due to the presence of caving sandy silt and the high water table, soil type IV applies unless the water table is lowered via well points along the perimeter of excavations. Soil type 2 is applicable where an adequate de-watering strategy is implemented. Pumping from open sumps does not remedy the caving of soils. The following thus stems from this limitation:

At this site for all excavations to a 1.2 m depth and for all excavations for which the water table has been lowered to an elevation lower than the bottom of the excavation via well points, soils can be considered type II under O. Reg. 213/91 and type IV for excavations deeper than 1.2 m depth *and* for which well points de-watering has not been implemented. As such, the following key aspects of O. Reg. 213/91 are applicable to this site:

1. For excavations in soil type II:
    - 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.
2. For excavations in soil type IV:
    - implement well points de-watering along the perimeter of excavations to apply the provisions for soil type II.
3. Where the safe open cut in item 1 and/or 2 are 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.

10.1 Conditions Requiring Engineered Shoring

It is to be understood that at this site, if shoring is used for deep excavations, it is to be used in conjunction with proper de-watering as described in the previous section.

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.*

11 Reinstatement of Excavated Soils

As stated in appendix F 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.

Excavated sandy silt soils may be used to build up the subgrade under parking and pavement *only if* closely supervised by a geotechnical engineer. Otherwise soils must be hauled out or could *only be used for landscaping areas where no structures or pavement will be built.*

12 Water Inflow Within Excavations and Service Trenches 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. Section 7 provides estimated values of permeability, infiltration, and percolation which can be used for calculations in connection with water behavior at this site.

In view of the assessments under section 5.1 and information seen in the borehole logs, water inflow in excavations is expected to be significant. In addition, sandy silt encountered at this site is susceptible to caving.

Refer to the excavations/open-cut section 10 for guidance for excavation on difficult soils. Pumping from open sumps does not prevent the caving of soils into excavations. In general, section 10 recommends to use well points dewatering and apply the provisions for type 2 soils.

12.1 Use of Clay Seals in Service Trenches

In order to prevent long term de-watering through service trenches, clay seals are recommended. The City of Ottawa detail “Clay seal for Pipe Trenches” S8 can be used at each 100 m intervall within service trenches. The moisure content for compaction of clay is generally less than 22%. Clay placement can be with

several passes of jumping jack type equipment or sheep-foot rollers. Proctor dry density percent can be approximately 95% of its Proctor Standard Density.

12.2 Water Takings and Permits

Water takings from the environment, including groundwater in excavations, are regulated under Ontario Water Resources Act, R.S.O. 1990, c. O.40. (OWRA). The OWRA is enforced by the Ministry of Environment (MOE). Under the OWRA. a Permit to Take Water (PTTW) is required for pumping from excavations exceeding 400 cubic meters per day. Along with the consideration of ground water from excavations, PTTW applications require in addition the consideration of precipitation.

Where construction phase ground and surface water is estimated to be between 50,000 to 400,000 L/day, it is a requirement to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16.

If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

Section 7 provides estimates of infiltration, permeability, and percolation rates which could be used in the context of the EASR registry and/or the PTTW.

Based on estimates a registration under the EASR for volumes between 50,000 to 400,000 L/day will be required. In addtion, it is recommended to reduce groundwater takings by phasing construction in sections.

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

12.3 Impacts to Adjacent Buildings and Infrastructure from Water Takings

Water takings induce water table draw-down.

Water table draw-down can impact neighboring buidlings and infrastructure in particularly sensitive soil conditions. Soil conditions that can be considered sensitive are ligthly overconsolidated clays and very loose soils. The soils encountered at this site are not considered sensitive.

Development induce short term draw-down during construction and long term via service trenches and foundation drainage.

Because the soil conditions at this site are not considered sensitive, short term negative impacts for neighboring buildings are not foreseeable at this time, however, to reduce long-term water table draw-down which may affect the area on a larger scale, are expected to be minimal because the water table will not be drawn down by foundation drainage and because service trenches are to have

clay seals to reduce ground water lowering. Long term impacts in the greater scale are also reduced via the implementation of an infiltration gallery.

13 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 C.1, the soils are moderately corrosive. Resistivity, PH and soluble ions testing was completed in a representative sample at 1.8 m depth in BH1. After Romanoff (1957)[3], the following corrosion rates can be used:

1. For carbon steel:
    - 25 μm/year for the first 2 years,
    - 18 μm/year, thereafter.
2. For galvanized metal:
    - 6 μm/year for the first 2 years,
    - 4.25 μm/year until depletion of zinc,
    - 18 μm/year for carbon steel.

14 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.

15 Special Issues or Concerns

This investigation revealed excavation challenges due to the caving susceptibility of the sandy silt materials encountered at this site.

Excavation challenges are largely reduced at this site via an adequate dewatering strategy including well points for water drawdown prior to any excavation exceeding the water table.

The excavation/open-cut section 10 should be closely examined by the developer and contractors.

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

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

Appendix F 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.

16.1 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 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

1000514608 Ontario Inc. 608OI 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. 608OI 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 69-608OI-V2-R2 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

69-608OI-V2-R2 is to be used solely in connection with the Four 1 Storey Commercial Buildings by 1000514608 Ontario Inc. (608OI) and thus subject of communications amongst other professionals (OP), government bodies and authorities, and 608OI 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 608OI 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 608OI in this report will be forwarded to YME.

Reasonable Completeness

OP and 1000514608 Ontario Inc. 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 608OI 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 69-608OI-V2-R2 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 69-608OI-V2-R2 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 69-608OI-V2-R2 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. 608OI 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 608OI in this report occur, 608OI covenants to inform YME. 608OI 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

608OI 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. 608OI 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 2 Storey Commercial Building**	YME Yuri Mendez Engineering.
Location: **3075 Palladium Dr.**	Client: **1000514608 Ontario Inc.**	**Test Hole No.: BH1 of 4**
Job No.: **69-OI608**	Test Hole Type: **7" OD Auger.**	Date: **February 21, 2024**
"7" OD Auger."	SPT Hammer Type: **Safety auto hammer**	Logged By: **Yuri Mendez**

Yuri Mendez Engineering

Material Description

Depth (m)	Elevation (m) 104.4	Lithology and color	Material Description	Samples or Blows/Ft	Water	Elevation (m) 104.4	Depth (m)	Shear Strength (kPa)	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Rock Quality RQD %	Laboratory Tests: Other Lab Tests
0	104.2		Topsoil			104.2	0				
0.25			Brown Dense Sandy Silt: Turning gray at 1.2 m				0.25				
0.5							0.5				
0.75	103.7					103.7	0.75				
1				28	▼		1				
1.25	103.2					103.2	1.25				
1.5							1.5				
1.75	102.7			15		102.7	1.75				
2							2				
2.25	102.2					102.2	2.25				
2.5				13			2.5				
2.75	101.7					101.7	2.75				
3							3				
3.25	101.2			18		101.2	3.25				
3.5							3.5				
3.75	100.7					100.7	3.75				
4				10			4				
4.25	100.2					100.2	4.25				
4.5							4.5				
4.75	99.7					99.7	4.75				
5							5				
5.25	99.2					99.2	5.25				
5.5							5.5				
5.75	98.7			6		98.7	5.75				
6			Strata tested using Dynamic Cone Penetration Test (DCPT)				6				
6.25	98.2					98.2	6.25				
6.5				40			6.5				
6.75	97.7			>>100		97.7	6.75				
			Cone Penetration Refusal at 6.85 m depth.								

S = Sample for lab review and moisture content

▼ Interpreted water level

Project:	**Proposed 2 Storey Commercial Building**	YME Yuri Mendez Engineering.
Location: **3075 Palladium Dr.**	Client: **1000514608 Ontario Inc.**	**Test Hole No.: BH2 of 4**
Job No.: **69-OI608**	Test Hole Type: **7" OD Auger.**	Date: **February 21, 2024**
"7" OD Auger."	SPT Hammer Type: **Safety auto hammer**	Logged By: **Yuri Mendez**

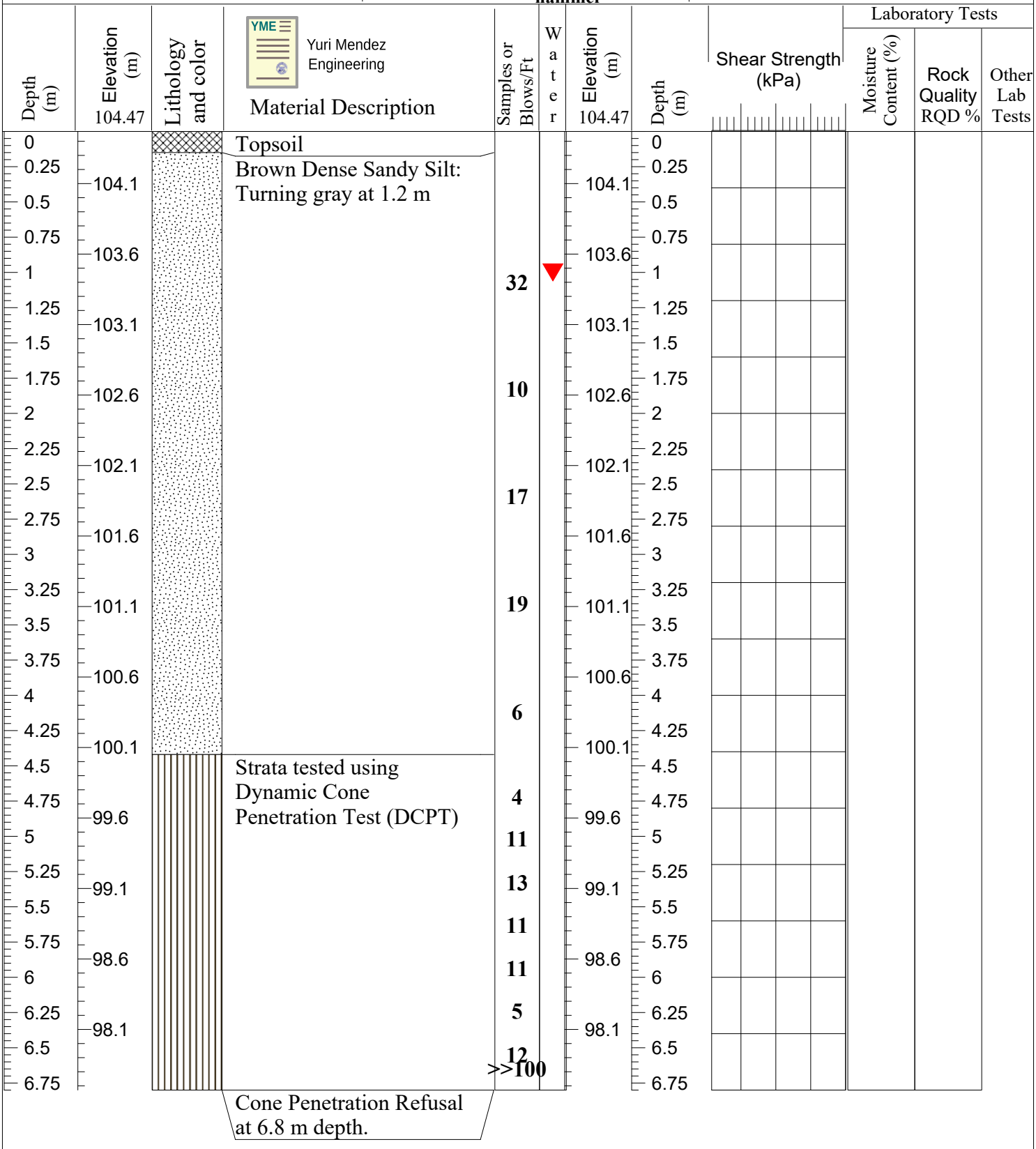
Yuri Mendez Engineering

Depth (m)	Elevation (m) 104.6	Lithology and color	Material Description	Samples or Blows/Ft	Water	Elevation (m) 104.6	Depth (m)	Shear Strength (kPa)	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Rock Quality RQD %	Laboratory Tests: Other Lab Tests
0	104.6		Topsoil			104.6	0				
0.25			Brown Dense Sandy Silt:				0.25				
0.5	104.1		Turning gray at 1.2 m			104.1	0.5				
0.75							0.75				
1	103.6			12	▼	103.6	1				
1.25							1.25				
1.5	103.1					103.1	1.5				
1.75				13			1.75				
2	102.6					102.6	2				
2.25							2.25				
2.5	102.1			8		102.1	2.5				
2.75							2.75				
3	101.6					101.6	3				
3.25				9			3.25				
3.5	101.1					101.1	3.5				
3.75							3.75				
4	100.6			17		100.6	4				
4.25							4.25				
4.5	100.1					100.1	4.5				
4.75							4.75				
5	99.6			28		99.6	5				
5.25			Strata tested using	19			5.25				
5.5	99.1		Dynamic Cone			99.1	5.5				
5.75			Penetration Test (DCPT)	34			5.75				
6	98.6			25		98.6	6				
6.25				7			6.25				
6.5	98.1			3		98.1	6.5				
6.75				>>100			6.75				
			Cone Penetration Refusal at 6.9 m depth.								

S = Sample for lab review and moisture content

▼ Interpreted water level

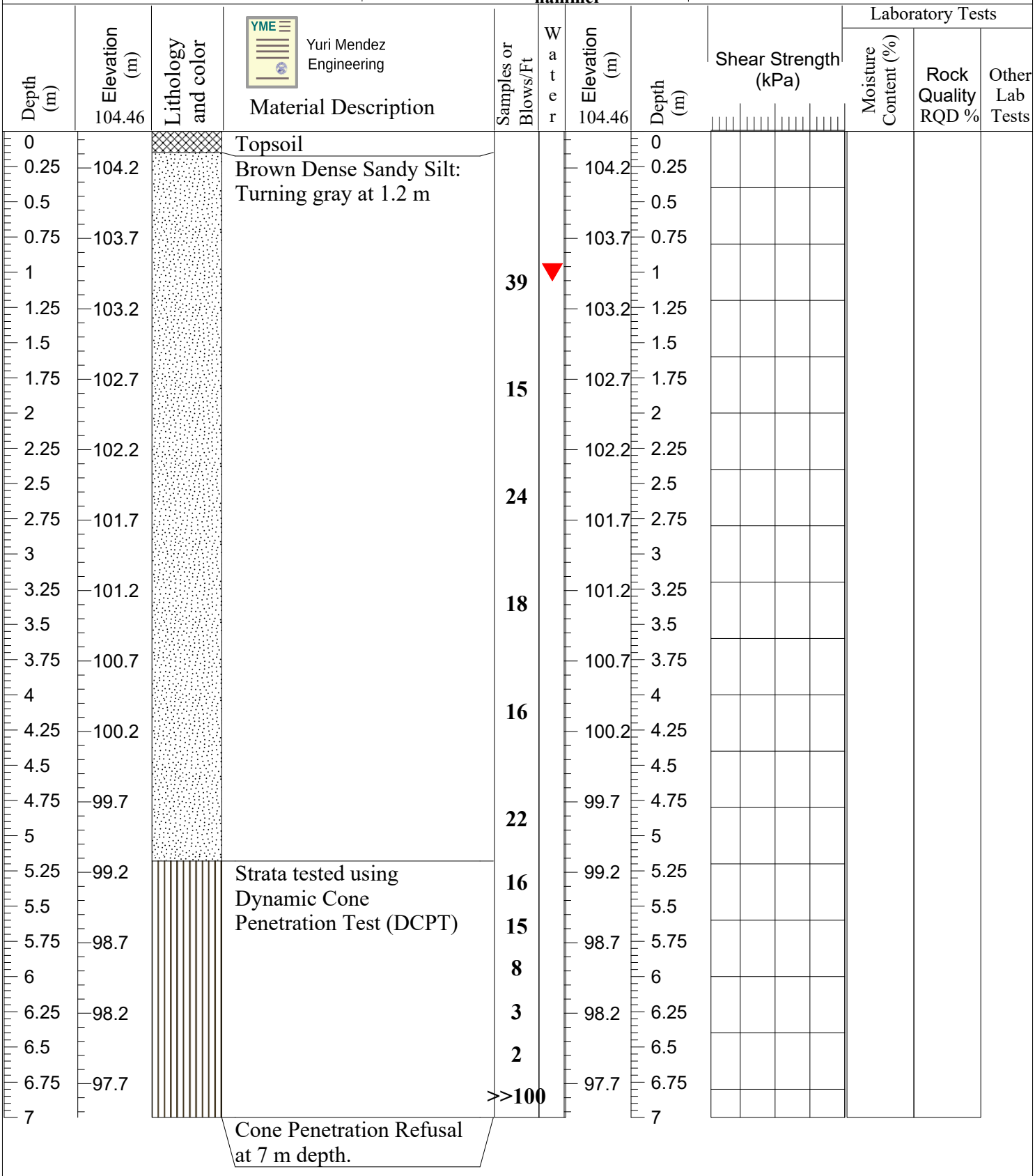
Project:	**Proposed 2 Storey Commercial Building**	YME Yuri Mendez Engineering.
Location: **3075 Palladium Dr.**	Client: **1000514608 Ontario Inc.**	**Test Hole No.: BH3 of 4**
Job No.: **69-OI608**	Test Hole Type: **7" OD Auger.**	Date: **February 21, 2024**
"7" OD Auger."	SPT Hammer Type: **Safety auto hammer**	Logged By: **Yuri Mendez**



S = Sample for lab review and moisture content

▼ Interpreted water level

Project:	**Proposed 2 Storey Commercial Building**	YME Yuri Mendez Engineering.
Location: **3075 Palladium Dr.**	Client: **1000514608 Ontario Inc.**	**Test Hole No.: BH4 of 4**
Job No.: **69-OI608**	Test Hole Type: **7" OD Auger.**	Date: **February 21, 2024**
"7" OD Auger."	SPT Hammer Type: **Safety auto hammer**	Logged By: **Yuri Mendez**



S = Sample for lab review and moisture content

▼ Interpreted water level

B Borehole Logs By Others

Report 69-608OI-V2-R2
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RECORD OF BOREHOLE 23-01

CLIENT: 3075 Palladium GP Inc.
PROJECT: 3075 Palladium Drive, Ottawa, ON
JOB#: 102670.001
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: May 25 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger / Hollow Stem Auger (210mm OD)	Ground Surface		104.07						Above ground protector
		Brown silty sand, trace gravel, with cobbles, with organic material (TOPSOIL)		103.84 / 0.23	1	SS	610	7		Bentonite chips 9.5 mm
		Compact, brown to grey brown SILT, some sand, trace clay to SANDY SILT, trace clay								
1					2	SS	508	24	MH	Auger cuttings
					3	SS	406	13		
2										Bentonite chips 9.5 mm
				101.61 / 2.46	4	SS	432	9	MH	
		Loose, grey SANDY SILT, trace clay to SAND and SILT, trace clay.								
3					5	SS	381	7		
4					6	SS	356	4		Filter sand #2
					7	SS	610	5		3.05 m length, 51 mm diameter SCH 40 slotted PVC well screen
5				98.68						
		Loose, grey silty sand/sandy silt, some gravel, some clay (GLACIAL TILL)		5.39	8	SS	559	4		
6				97.97						
		Practical auger refusal End of borehole		6.10						
7										
8										
9										
10										

SAMPLES

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: NATURAL, REMOULDED
WATER CONTENT, %: W_P, W, W_L
10 20 30 40 50 60 70 80 90

GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
23/05/26	1.6 ▽	102.5

GEMTEC
Consulting Engineers and Scientists

LOGGED: A.N.
CHECKED: M.R.

GEO - BOREHOLE LOG 102670.001_BH LOGS_2023-06-13.GPJ GEMTEC 2018.GDT 6/13/23

RECORD OF BOREHOLE 23-02

CLIENT: 3075 Palladium GP Inc.
PROJECT: 3075 Palladium Drive, Ottawa, ON
JOB#: 102670.001
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: May 24 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0	Power Auger Hollow Stem Auger (210mm OD)	Ground Surface		104.54						Above ground protector
		Brown silty sand with organic material (TOPSOIL)		104.13	1	SS	508	9		Bentonite chips 9.5 mm
		Compact, light brown to brown to grey brown SILT, some sand, trace clay to SANDY SILT, trace clay		0.41						Auger cuttings
1					2	SS	432	16		
										Bentonite chips 9.5 mm
2					3	SS	457	11		
				102.05						
		Loose to compact, grey SANDY SILT, trace clay to SAND and SILT, trace clay. (possible silty clay seams)		2.49	4	SS	406	9		
3					5	SS	508	11	MH	
										Filter sand #2
4					6	SS	432	9		
					7	SS	610	20		3.05 m length, 51 mm diameter SCH 40 slotted PVC well screen
5										
					8	SS	610	18		
6										Slough
		End of borehole		98.44 6.10						
7										
8										
9										
10										

SOIL PROFILE / SAMPLES

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: NATURAL, REMOULDED
WATER CONTENT, %: W_P, W, W_L
10 20 30 40 50 60 70 80 90

GROUNDWATER OBSERVATIONS

DATE	DEPTH (m)	ELEV. (m)
23/05/26	1.9 ▽	102.6

GEMTEC
Consulting Engineers and Scientists

LOGGED: A.N.
CHECKED: M.R.

GEO - BOREHOLE LOG 102670.001_BH LOGS_2023-06-13.GPJ GEMTEC 2018.GDT 6/13/23

RECORD OF BOREHOLE 23-03

CLIENT: 3075 Palladium GP Inc.
PROJECT: 3075 Palladium Drive, Ottawa, ON
JOB#: 102670.001
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: May 24 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
		Ground Surface		104.18				
0	Power Auger Hollow Stem Auger (210mm OD)	Brown silty sand, trace gravel, with organic material (TOPSOIL)		103.98				
		Very stiff to stiff, grey brown SILTY CLAY, trace sand (WEATHERED CRUST)		0.20 103.47	1	SS	356	4
1		Compact to dense, brown to grey brown SILT, some sand, trace clay to SANDY SILT, trace clay		0.71	2	SS	483	28
2					3	SS	610	41
		Compact, grey SANDY SILT, trace clay to SAND and SILT, trace clay.		101.79 2.39	4	SS	508	11
3					5	SS	508	22
		Loose, grey silty sand/sandy silt, some gravel, some clay (GLACIAL TILL)		100.60 3.58	6	SS	610	7
4								
5					7	SS	508	7
		Practical auger refusal End of borehole		98.92 5.26				
6								
7								
8								
9								
10								

SAMPLES

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: NATURAL, REMOULDED
WATER CONTENT, %: W_P, W, W_L
10 20 30 40 50 60 70 80 90

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Borehole backfilled with auger cuttings

GEMTEC
Consulting Engineers and Scientists

LOGGED: A.N.
CHECKED: M.R.

GEO - BOREHOLE LOG 102670.001_BH LOGS_2023-06-13.GPJ GEMTEC 2018.GDT 6/13/23

RECORD OF BOREHOLE 23-04

CLIENT: 3075 Palladium GP Inc.
PROJECT: 3075 Palladium Drive, Ottawa, ON
JOB#: 102670.001
LOCATION: See Borehole Location Plan, Figure 1

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: May 24 2023

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m
0	Power Auger / Hollow Stem Auger (210mm OD)	Ground Surface		103.65				
		Dark brown silty clay, with organics (TOPSOIL)		103.50 / 0.15	1	SS	508	5
		Very stiff to stiff, grey brown SILTY CLAY, trace sand, with occasional silty sand seams (WEATHERED CRUST)			2	SS	610	9
1				102.00				
		Grey brown SILT, some sand, trace clay to SANDY SILT, trace clay		1.65 / 101.67	3	SS	483	24
2		Compact, grey SANDY SILT, trace clay to SAND and SILT, trace clay.		1.98	4	SS	457	15
3				100.14	5	SS	533	14
		Compact, grey silty sand/sandy silt, some gravel, some clay (GLACIAL TILL)		3.51	6	SS	457	14
4				99.33				
		Practical auger refusal End of borehole		4.32				
5								
6								
7								
8								
9								
10								

SAMPLES

PENETRATION RESISTANCE (N), BLOWS/0.3m
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m
SHEAR STRENGTH (Cu), kPA: + NATURAL ⊕ REMOULDED
WATER CONTENT, % — W_P W W_L
10 20 30 40 50 60 70 80 90

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Borehole backfilled with auger cuttings

GEMTEC
Consulting Engineers and Scientists

LOGGED: A.N.
CHECKED: M.R.

GEO - BOREHOLE LOG 102670.001_BH LOGS_2023-06-13.GPJ GEMTEC 2018.GDT 6/13/23

Appendix

C Resistivity, PH and Soluble Salts Test

PARACEL LABORATORIES LTD.

Order #: 2410064

Certificate of Analysis

Report Date: 08-Mar-2024

Client: Geoseismic

Order Date: 4-Mar-2024

Client PO:

Project Description: 3075 Palladium Dr

	Client ID:	BH1 SS3	-	-	-		
	Sample Date:	21-Feb-24 09:00	-	-	-	-	-
	Sample ID:	2410064-01	-	-	-		
	Matrix:	Soil	-	-	-		
	MDL/Units						
Physical Characteristics							
% Solids	0.1 % by Wt.	82.4	-	-	-	-	-
General Inorganics							
pH	0.05 pH Units	7.36	-	-	-	-	-
Resistivity	0.1 Ohm.m	47.4	-	-	-	-	-
Anions							
Chloride	10 ug/g	32	-	-	-	-	-
Sulphate	10 ug/g	34	-	-	-	-	-

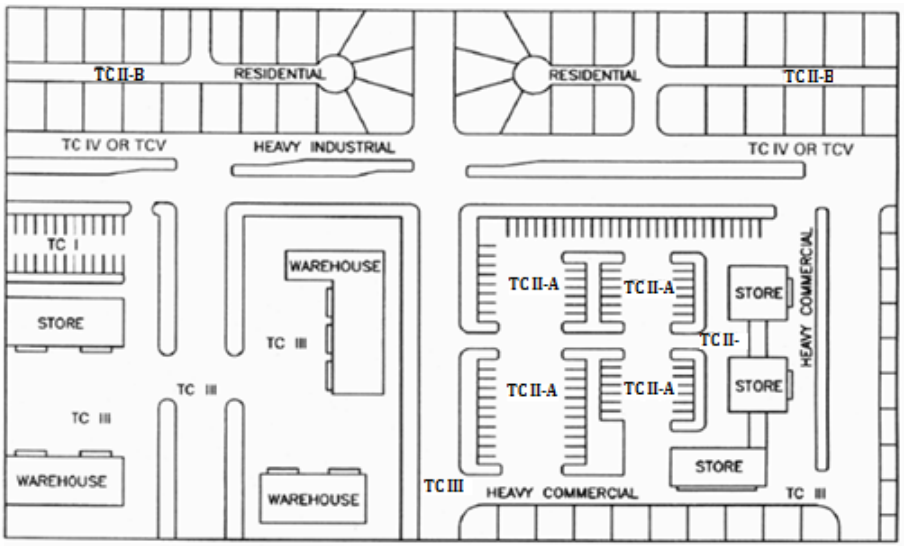

Figure 2: Traffic Classes

Appendix

D Pavement

D.1 Traffic Classes and Pavement Catalog

Figure 2 in page 37 presents a schematic site plan differentiating example uses for five traffic classes developed by the Wisconsin Asphalt Pavement Association and presented in their Design Guide May, 2001.

1. Refer to figure 2 in page 37 to differentiate pavement classes for the proposed Four 1 Storey Commercial Buildings.
2. Refer to table 2 in page 38 for additional information and design ESALs.
3. Refer to Tables 3, 4 and 5 in page 38 to select pavement structures for each traffic class on very poor soils encountered at this site.

Consult Yuri Mendez Engineering for pavement structures on roadbed consisting of newly placed engineered fill, underground parking or as required, where the roadbed is not the near surface very poor soil encountered at this site.

D.2 Frost Heave in Pavements

Frost heave of founding materials for pavement induces reduction (serviceability losses) of the performance period (along with traffic ESALs) for which the

Ontario Category	Classes	ESALs	Uses
A	I	50,000	Residential dead end and parking lots 50 stalls or less.
A	II-A	100,000	Parking lots 51 to 500 stalls.
A	II-B	200,000	Residential streets, parking lots more than 500 stalls.
B	III	600,000	Minor colectors, local streets and light industrial lots.
B	IV	900,000	Collector Streets and heavy industrial parking lots.
B	V	2,200,000	Minor Arterial.

Table 2: Design ESALs (20 years) and uses for traffic classes

Material	Specification	Thicknesses			
		Class I		Class II-A	
Class		mm	in	mm	in
Surface course	OPSS 1151 Superpave 9.5	50.8	2	50.8	2
Surface course	OPSS 1151 Superpave 12.5				
Binder course	OPSS 1151 Superpave 19.0				
Base	OPSS 1010 Granular A	152.4	6	152.4	6
Subbase	OPSS 1010 Granular B Type II	228.6	9	279.4	11
Subgrade	Undisturbed In situ Soil				

Table 3: Flexible Pavement Structure Classes I and II-A

Material	Specification	Thicknesses			
		Class II-B		Class III	
Class		mm	in	mm	in
Surface course	OPSS 1151 Superpave 9.5				
Surface course	OPSS 1151 Superpave 12.5	63.5	2.5	76.2	3
Binder course	OPSS 1151 Superpave 19.0				
Base	OPSS 1010 Granular A	152.4	6	152.4	6
Subbase	OPSS 1010 Granular B Type II	330.2	13	406.4	16
Subgrade	Undisturbed In situ Soil				

Table 4: Flexible Pavement Structure Classes II-B and III

Material	Specification	Thicknesses			
		Class IV		Class V	
Class		mm	in	mm	in
Surface course	OPSS 1151 Superpave 9.5	31.8	1.25		
Surface course	OPSS 1151 Superpave 12.5				
Binder course	OPSS 1151 Superpave 19.0	57.2	2.25		
Base	OPSS 1010 Granular A	152.4	6		
Subbase	OPSS 1010 Granular B Type II	457.2	18		
Subgrade	Undisturbed In situ Soil				

Table 5: Flexible Pavement Structure Classes IV and V

structure was designed. Generally speaking, AASHTO 1993 does not provide for an increase in thicknesses (structural number) for reduction of losses, as such increase has very small influence in the detrimental effects of frost heave. Frost heave affects pavements by roughness induced by differential frost heave, i.e., if the longitudinal vertical alignment is all equally frost susceptible, there is negligible detrimental effect. This is difficult to achieve in urban developments in which services trenches are backfilled with non frost susceptible materials. For long lasting pavements on frost susceptible soils, the general guideline is, where possible; ensure that all soils serving as pavement foundation are equally frost susceptible. This could be achieved by providing frost susceptible backfill within 1.4 m of the pavement foundation in service trenches. Where measures to mitigate the effect of frost heave are not undertaken, decrease of the performance period is accepted to occur.

D.3 Frost Protection for Manholes, Catch Basins and Others

Manholes and catch basin type structures provide a cold bridge to a deeper portion of the soil profile and create localized areas prompt to pavement failure by excessive frost heave roughness in frost susceptible soils. This can be prevented by providing insulation extending downward around the structure and horizontally outward to create a transition from the varying pavement elevation to the more stable catch basin elevation. On the alternative, non frost susceptible backfill can be provided tapered outward from the structure to the surrounding pavement.

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Appendix

E Foundation Drainage

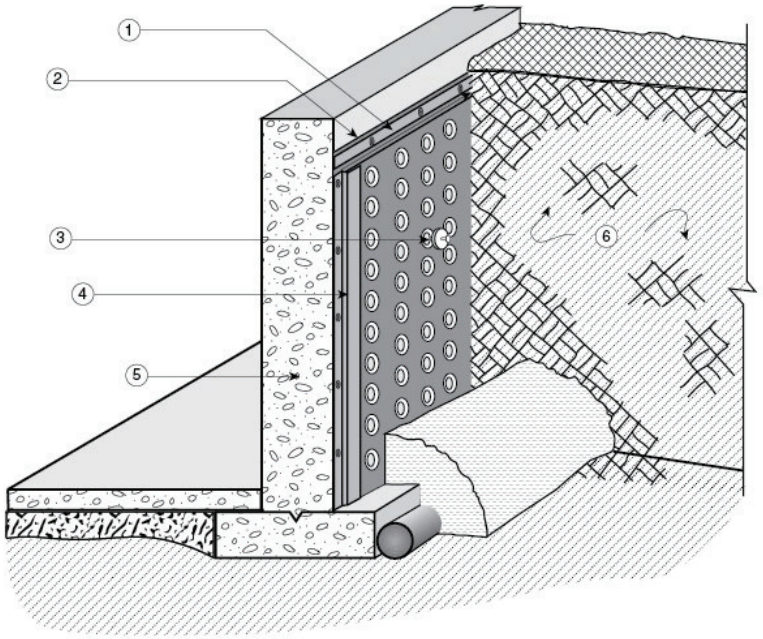

Figure 1. "Cosella-Dörken DELTA®-MS and DELTA®-MS CLEAR Dampproofing Membranes" – face in contact with the soil

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

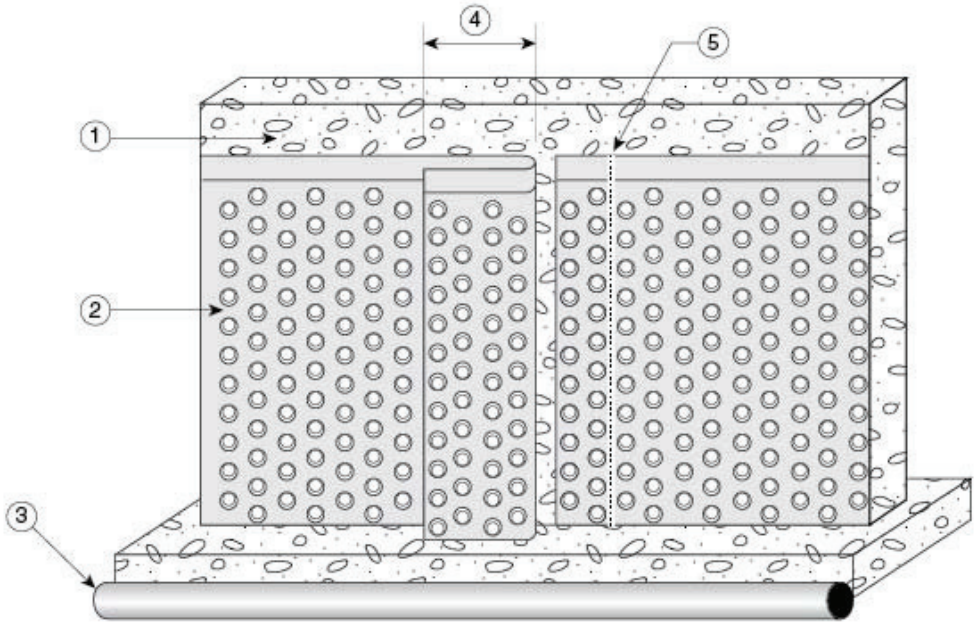

Figure 2. "Cosella-Dörken DELTA®-MS and DELTA®-MS CLEAR Dampproofing Membranes" – face in contact with the wall

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

Appendix

F 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.

F.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.

F.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 10 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 F.2.2.

F.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.

F.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.

F.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 6.

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 6.

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.

F.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.

F.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.

F.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).

F.5.1 Granular Earthfill Placement

F.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.

F.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 6 in page 46.

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.

F.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.

F.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 6 in page 46 presents Proctor Standard (PS) compaction requirements for specified placement and materials.

F.7 Compaction Specific

F.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 6: 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.

F.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.

F.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.

F.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.

F.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.

F.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 ± 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.

F.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.

F.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.