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# GEOTECHNICAL INVESTIGATION




## 2093, 2097, 2101 OLD LAKESHORE ROAD & 2096, 2100 LAKESHORE ROAD, BURLINGTON, ONTARIO

Prepared for:

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# TABLE OF CONTENTS

**1. INTRODUCTION ..... 1**

**2. SITE AND PROJECT DESCRIPTIONS ..... 1**

**4. FIELD AND LABORATORY WORK ..... 3**

**5. SUBSOIL AND BEDROCK CONDITIONS ..... 5**

**6. GROUNDWATER LEVELS ..... 8**

**7. FOUNDATION CONSIDERATIONS ..... 10**

7.1 SPREAD/ STRIP FOOTING FOUNDED ON NATIVE SOILS/BEDROCK ..... 10

7.2 GENERAL COMMENTS ABOUT FOOTING CONSTRUCTION ..... 11

**8. SEISMIC DESIGN CONSIDERATIONS ..... 11**

**9. GROUNDWATER CONSIDERATIONS ..... 12**

**10. EXCAVATION AND BACKFILL CONSIDERATIONS ..... 13**

10.1 STABILITY OF EXCAVATION ..... 14

10.2 IMPACT ON CONSTRUCTION AND DURABILITY OF SHALE ..... 14

**11. SHORING ..... 15**

**12. SLAB ON GRADE AND PERMANENT DRAINAGE ..... 16**

**13. UNDERGROUND UTILITIES ..... 16**

**14. PAVEMENT ..... 17**

**15. LIMITATIONS ..... 18**

**APPENDIX A – SITE AND LOCATION PLANS ..... A**

**APPENDIX B – LOG OF BOREHOLES ..... B**

**APPENDIX C – GRAIN SIZE AND HYDROMETER ANALYSES ..... C**

**APPENDIX D - CHEMICAL ANALYSES - SOIL ..... D**

**APPENDIX E - CHEMICAL ANALYSES - WATER ..... E**

**APPENDIX F – ROCK CORE COMPRESSIVE STRENGTH TESTS AND PHOTOS ..... F**

**APPENDIX G – DRAINAGE AND BACKFILL RECOMMENDATION ..... G**

# 1. INTRODUCTION

Fisher Environmental Limited (Fisher) was commissioned by Core FSC Lakeshore Limited & Core FSC Lakeshore GP Inc. to conduct a Geotechnical Investigation for the proposed redevelopment of the property located at 2093, 2097 & 2101 Old Lakeshore Road and 2096 & 2100 Lakeshore Road, Burlington, ON hereinafter referred to as the 'Site'.

The purpose of this investigation was to assess the subsurface soil and groundwater conditions at the Site, and to outline geotechnical parameters and make recommendations for the design of the proposed redevelopment.

Discussion of the findings and results of the geotechnical investigation is in accordance with the general terms of reference. This report was prepared specifically and solely for the purpose of assessing geotechnical conditions as they relate to the development of the site with respect to the proposed structures as detailed to Fisher at the time of the investigation.

# 2. SITE AND PROJECT DESCRIPTIONS

## Site Settings

The Site is located on the north side of Old Lakeshore Road and on the south side of Lakeshore Road, approximately 50m north of Lake Ontario, in downtown Burlington, Ontario. The Site is in a mixed commercial and residential area and is bounded by parking lots to the east and west and roadways to the north and south. The total Site area is approximately 0.3357 hectares.

At the time of the investigation, a 1-storey residential building with basement was located at 2096 Lakeshore Road. The remaining portions of the lot were mainly covered with asphalt pavement and utilized for parking. The previous building at 2100 Lakeshore Road was demolished and the unpaved area is now used for parking. A 2-storey residential building, with basement, and a 2-storey commercial building were located at 2093 & 2097 Old Lakeshore Road, respectively. The Carriage House restaurant occupied a 2-storey building located at 2101 Old Lakeshore Road. The northern portion of the land was paved and used for parking while the southern portion was landscaped grass at the time. Site and Location Plans are presented in Appendix A.

### Topography

The site, which is mostly flat, is graded towards Old Lakeshore Road and Lakeshore Road for drainage purposes and generally slopes gently from north to south, with elevation changes from approximately 82.2m in the northwest to 81.29m asl at the southeast corner of the Site. An average grade of 81.5m asl is used on the drawing elevations provided by Studio JCI dated August 22, 2019.

### Proposed Development

It was understood that the existing buildings will be demolished to permit the construction of a new residential building comprising a 27-storey mixed use residential and commercial building that will have a shared podium linked to 4 levels of underground parking.

Site plans by Studio JCI, dated August 22, 2019, show the underside of the proposed lowest slab level at 14.35m below grade which is assumed at an average of 81.5m asl. It should be noted that the borehole locations for the investigation were restricted by the existing buildings. Therefore, further test pit investigations should be carried out prior to construction.

## 3. OTHER INVESTIGATIONS

### Previous Geotechnical and Hydrogeological Investigations

Fisher Environmental Ltd conducted preliminary geotechnical and hydrogeological investigations for the subject properties and submitted reports dated November 1, 2017 under FE-P 17-8409 and FE-P 17-8522, respectively. During those investigations, which were conducted concurrent to a Phase Two ESA, six (6) boreholes were advanced from approximate depths of 3.5m to 12m below existing surface grade. The geotechnical and hydrogeological reports were revised to account for the increase in the number of underground levels to four and reports submitted under FP 19-9255 Geo and 19-9256 Hydro respectively dated February 15, 2019. Two new boreholes (BH205 and BH206) were drilled, during the investigation, over the period January 25 to February 5, 2019 to approximate depths of 15m (50') bgs.

The investigations showed that the subsurface soils consist mainly of a layer of sand and silt fill extending generally to depths of 0.61 to 1.37m bgs with corresponding elevations between 80.29m and 81.57m asl. The fill was underlain by very stiff to hard silt and clay which extended to depths of generally less than 2.3m. The silt and clay layers were underlain by clay and

weathered shale, with shale of the Queenston Formation at depths generally from approximately 3.5m bgs (elevation of 78.5m asl).

**Current Investigations**

Concurrent to this geotechnical investigation, Fisher Environmental conducted a revised Hydrogeological Investigation. The findings and recommendations of the revised Hydrogeological Investigation are presented under Fisher Project No. 19-9571 dated August 14, 2019. The same boreholes were used for the revised Hydrogeological and Geotechnical Investigations.

## 4. FIELD AND LABORATORY WORK

Public utilities clearances were carried out by Ontario One-Call while private utilities clearances were done by All Clear Locates on behalf of Fisher.

**Subsurface Investigation**

Field exploration for the initial geotechnical investigation was carried out concurrent with drilling for a Phase Two ESA over the period October 2 to 6 and November 20, 2017 and consisted of the advancement of six (6) boreholes (BH1 to BH6). Boreholes BH1 to BH3 and BH5 were drilled to approximate depths of 12.0m (40') while BH4 was drilled in the overburden soil to auger refusal at 3.5m below existing grade. Two boreholes, BH(MW)205 and BH(MW)206, were drilled over the period January 25 to February 5, 2019 to approximate depths of 15m (50') bgs. One borehole, BH(MW)301 was drilled on July 9, 2019 and extended to approximate depth of 19.38m bgs (62.67m asl). The boreholes were drilled at approximate locations as detailed in the Site Plan at Appendix A.

A CME-55 Truck mounted drill rig equipped with hollow stems from Terra Firma Services was used for all drilling work. Soil samples in the overburden soils were taken at regular intervals using a split–spoon sampler advanced by means of the Standard Penetration Test (SPT) which was conducted in general accordance with ASTM Specification D1586. Rock core samples were collected in boreholes BH1 to BH3, BH5, BH206, BH210 and BH301. Water was used as the flushing fluid for rock coring. Upon completion of drilling, the boreholes were backfilled with Bentonite as shown on the Log of Boreholes in Appendix B. All recovered soil and rock samples were placed in clear, sealable plastic bags in the field and were transported back to Fisher Environmental laboratory for further examination, characterization and laboratory analyses.

Additionally, all boreholes were instrumented as monitoring wells with 50mm diameter pipes and 10 feet (3.05m) slotted screens except MW2, MW4 and MW6 in which 20 feet, 5 feet and 25 feet long screens respectively (1.52m, 6.10m and 7.62m) were installed.

A description of the subsurface conditions encountered at each borehole location is presented in Appendix B - Log of Boreholes.

**Laboratory Analyses**

Three (3) representative soil samples from boreholes BH3, BH4 and BH5 were selected and submitted to ALS Environmental laboratory for grain size distribution and hydrometer analyses. The laboratory results, which are presented in Appendix C, confirm the field descriptions for subsurface soils discussed in Section 5.0.

Three (3) soil and four (4) water samples were selected from BH1, BH3, BH4 and BH205 and submitted to Fisher Laboratories for chloride, sulphate and pH analyses during the investigations. The results from the chloride and sulphate tests show that the subsurface strata generally have a mild sulphate environment and are not aggressive to concrete. Water-cement ratio in concrete should not exceed 0.5. Additionally, subsurface concrete for footings and exterior walls should have minimum 28-day and 56-day compressive strengths of 25 and 30 MPa respectively. The pH analyses show that the pH levels are within acceptable range for groundwater in soils. The laboratory results are included in Appendix D and Appendix E for soil and groundwater samples respectively.

**Rock core testing**

Nine (9) rock core samples were selected from boreholes BH1, BH2, BH4, BH205, BH206 and BH301 and submitted to AGS Associates Inc (now DS Consultants) for compressive strength tests. Details of the rock samples are given in Table 1. Rock core test results along with relevant photographic details are given in Appendix F.

The soil and rock samples recovered during the current investigation will be stored in the Fisher Environmental laboratory for a period of 30 days after submitting this report and will be discarded thereafter unless otherwise instructed by the client.

**Site Survey**

Fisher personnel surveyed the ground surface elevations of the boreholes using the sanitary manhole cover (MH) located south of 2097 Old Lakeshore Road as a temporary benchmark (TBM). The TBM has an elevation of 81.38m above sea level as per site survey provided by ASKAN PILLER CORPORATION LTD dated October 4, 2017.

**Table 1: Details of rock samples**

| Borehole | Rock Sample No. | Sample Depth (m) | Length of sample (mm) | Sample Elevation (m asl) |
|---|---|---|---|---|
| **BH1** | RS1 | 8.5 | 320 | 73.16 |
| **BH3** | RS2 | 8.5 | 380 | 73.68 |
| **BH4** | RS3 | 10.2 | 400 | 71.47 |
| **BH205** | RS4 | 12.70 | 510 | 69.30 |
| | RS5 | 14.95 | 340 | 67.06 |
| **BH206** | RS6 | 12.42 | 280 | 69.83 |
| | RS7 | 15.16 | 430 | 66.81 |
| **BH301** | RS12 | 14.79 | 320 | 67.26 |
| | RS13 | 15.24 | 350 | 66.81 |

## 5. SUBSOIL AND BEDROCK CONDITIONS

Details of subsoil conditions encountered at borehole locations are shown in Appendix B – Log of Boreholes and are summarized as follows:

- **PAVEMENT** – An asphalt pavement layer, 50 to 150mm in thickness, was encountered at the surface of all boreholes except BH3 where coarse gravel was encountered to a depth of approximately 150mm.
- **FILL (Sand and Silt)** – A layer of fill was detected below the asphalt paving in boreholes BH1, BH2, BH4 to BH6, BH205, BH206 and BH301 and below the layer of gravel in BH3. The fill generally comprised sand and silt, trace gravel with rootlets and extended in depth from 0.6m in BH2 to 1.37m in BH1. The sand and silt were loose to compact, brown to dark brown (mostly black in BH2) with black spots observed in BH3 and in a moist to dry state. A slight odour was detected in BH2 and BH5.

  It should be noted that the thickness and the condition of the sand and silt fill could vary significantly between and beyond the borehole locations. Therefore, further test pit investigations should be carried out during construction. The thicknesses of the fill layers encountered are summarized in Table 2.

**Table 2: Summary of Depths and Elevations of Fill**

| Borehole No. | BH1 | BH2 | BH3 | BH4 | BH5 | BH6 | BH205 | BH206 | BH301 |
|---|---|---|---|---|---|---|---|---|---|
| Borehole Ground Elevation (m asl) | 81.66 | 82.18 | 81.64 | 81.91 | 81.67 | 82.15 | 82.01 | 81.97 | 82.05 |
| Depth of Borehole (m) | 12.20 | 12.25 | 12.30 | 3.51 | 12.22 | 6.10 | 15.55 | 15.62 | 19.38 |
| Elev. at Bottom of BH (m asl) | 69.46 | 69.93 | 69.34 | 78.40 | 69.45 | 76.05 | 66.46 | 66.35 | 62.67 |
| Depth of Fill (m) | 1.37 | 0.61 | 0.76 | 0.91 | 1.37 | 1.20 | 0.76 | 0.76 | 1.22 |
| Elev. at Bottom of Fill (m asl) | 80.29 | 81.57 | 80.88 | 81.00 | 80.30 | 80.95 | 81.25 | 81.21 | 80.83 |

- **SILT and CLAY –** Silt and clay with trace gravel and trace sand were encountered in BH1 to BH6, BH205, BH206 and BH301 below the layer of fill. The predominantly brown to dark brown silt and clay were dry to moist and of a very stiff to hard consistency with SPT 'N' values varying from 15 to 40 blows per 0.3m depth. Orange coloured spots were observed in BH3. The silt and clay in BH4 were mostly grey with dark spots and mostly red in BH5 to a depth of approximately 2.3m. Grey sand seams were also encountered in this layer.
- **CLAY and WEATHERED SHALE** – A moist to dry, red brown to brown clay with trace gravel was encountered in boreholes BH1 to BH3, BH5, BH205, BH206 and BH301 at depths generally below approximately 2.3m bgs. The clay layer was of a hard consistency with SPT 'N' values starting at 37 and increasing to over 100 at greater depths. Red brown clay with trace gravel and sand pockets was observed in BH4 from a depth of about 1.5m. The clay also contained fractured rock pieces and was of a hard consistency.

  Weathered shale was encountered at the end of drilling in the overburden soil in all boreholes. The red shale contained fractured pieces of grey siltstone. Drilling in the overburden soils terminated in weathered shale at auger refusal in all boreholes at depths varying from 3.1m to 3.96m.
- **SHALE (Queenston Formation)** – Rock coring into the predominantly red shale was carried out to approximate depths as follows:
  - 12m bgs in BH1 to BH3 and BH5,
  - 15m bgs in BH205 and BH206 and
  - 19.38m bgs in BH301.

The weathered, very fine grained, red, relatively weak to medium strong, SHALE, thinly to medium bedded with slightly weathered to fresh, light grey, weak to medium strong SILTSTONE was encountered below the soil overburden in boreholes BH1 to BH3, BH5 and in BH205, BH206 and BH301. The thickness of the siltstone layers was generally between 20 and 150mm with no defined frequency. The shale is weathered just below the overburden soil and becomes less weathered with depth. A band of weathered shale was generally observed between approximately 5.5m and 6.0m below existing grade in boreholes BH1, BH2 and BH3 and between 5.5 and 6.5m below existing grade in BH5. Weathered shale seams were generally encountered in the boreholes between approximately 11 and 12m below existing grade. Occasional water bearing weathered seams were observed at depths between 15 and 19m bgs in BH301.

- **Rock Quality**

  Rock Quality Designation (RQD) values calculated for boreholes BH1 to BH3, BH5, BH205, BH206 and BH301 are generally in the range 50 to 90 indicating Fair to Good rock quality. It should be noted however that RQD for RC13, from BH301, at approximate depth of 15 to 16.5m bgs (elevation of 67.05 to 65.55m asl) was 40% indicating Poor quality rock at that depth. This is also reflected in the laboratory tests in which lower than average compressive strengths were obtained. The Canadian Foundation Engineering Manual classification rating criteria by Rock Quality Designation (RQD) covers Poor (RQD = 25 - 50), Fair (RQD = 50 - 75), Good (RQD = 75 - 90) and Excellent (RQD = 90 - 100). Observed RQD values generally increased with depth.

  The results of the unconfined uniaxial compressive strengths for the shale cores, at stated elevations, are presented in Appendix F. It should be noted, that bands/seams of weathered shale and areas of micro defects were observed during rock coring. Therefore, based on inspection of the rock cores and results from the compressive strength tests, the shale is classified as a **Grade R2 to R3** rock which is a relatively weak to medium strong rock. Table 3 summarizes the depths at which bedrock was encountered along with laboratory compressive strength tests results.

**Table 3: Summary of rock contact depths, elevation and compressive strength tests**

| Borehole No. | Ground Surface Elevation (m asl) | Hammer Refusal in Overburden Soils/weathered shale, m bgs (m asl) | Bedrock Contact Depth (Elevation), m (m asl) | Unconfined Uniaxial Compressive Strengths, MPa | Elevation of sample, m asl |
|---|---|---|---|---|---|
| BH1 | 81.66 | 3.20 (78.46) | 3.86 (77.80) | 47.1 | 73.16 |
| BH2 | 82.18 | 3.10 (79.08) | 3.35 (78.83) | 47.5 | - |
| BH3 | 81.64 | 3.51 (78.13) | 3.51 (78.13) | - | 73.68 |
| BH4 | 81.91 | 3.51 (78.40) | - | - | 71.47 |
| BH5 | 81.67 | 3.20 (78.47) | 3.2 (78.47) | 54.5 | - |
| BH6 | 82.15 | 3.60 (78.55) | 4.5 (77.65) | - | - |
| BH205 | 82.01 | 3.20 (78.81) | 3.4 (78.61) | 75.0 | 69.30 |
| | | | | 54.8 | 67.06 |
| BH206 | 81.97 | 3.05 (78.92) | 3.35 (78.62) | 58.6 | 69.83 |
| | | | | 49.8 | 66.81 |
| BH301 | 82.05 | 3.20 (78.85) | 3.96 (78.09) | 25.3 | 67.72 |
| | | | | 20.7 | 66.81 |

## 6. GROUNDWATER LEVELS

All boreholes, down to the bottom of the overburden soil, were observed to be dry on completion of drilling. Water was used as flushing fluid for coring into the shale in BH1 to BH3, BH5, BH205, BH206 and BH301; hence the degree of dryness/wetness on completion of drilling was not determined in these boreholes.

Groundwater levels were measured in the monitoring wells installed for the geotechnical and hydrogeological investigations, along with MW106 and MW109 installed as part of the Phase II ESA. The locations of the monitoring wells are presented in the Site Plan at Appendix A. Measured groundwater depths and elevations are summarized in Table 4.

The measured groundwater levels in MW1, MW3, MW6 and MW205 broadly correspond to the water table in the bedrock at depths of generally 5 to 7m below ground level. This is typical of the ground water level in the shale bedrock in the area. The water levels in MW4, MW106 and MW109 are measured solely in the overburden. The groundwater levels observed in MW2 and MW5 may be indicative of localized perched water pockets in the weathered shale. Similarly, the different elevations at which the screens are placed in the wells and the observed water levels in the shale indicate water bearing weathered seams at different elevations as evident in the rock core. It should also be noted that the groundwater levels at the Site are subject to seasonal fluctuations and to major weather events.

## Table 4: Groundwater Levels and Elevations

| Monitoring Well ID | Elev. at Ground (m) | Screen Length (m) | Depth of Well (m) | Groundwater Depth (m bgs) | | | | | Groundwater Elevation (m asl) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 16-Oct-18 | 20-Nov-17 | 01-Dec-17 | 08-Feb-19 | 09-Aug-19 | 16-Oct-17 | 20-Nov-17 | 01-Dec-17 | 08-Feb-19 | 09-Aug-19 |
| **MW1** | 81.66 | 3.05 | 12.19 | 5.10 | 4.40 | 4.75 | 4.38 | 4.33 | 76.56 | 77.26 | 76.91 | 77.28 | 77.33 |
| **MW2** | 82.18 | 6.10 | 12.25 | 2.16 | 1.88 | 2.06 | 1.96 | 1.82 | 80.02 | 80.30 | 80.12 | 80.22 | 80.36 |
| **MW3** | 81.64 | 3.05 | 12.30 | 6.10 | 5.95 | 6.12 | 3.14 | 3.20 | 75.54 | 75.69 | 75.52 | 78.50 | 78.44 |
| **MW5** | 81.67 | 3.05 | 12.22 | 2.70 | 2.62 | 2.72 | 1.80 | 2.71 | 78.97 | 79.05 | 78.95 | 79.87 | 78.96 |
| **MW6** | 82.15 | 3.05 | 12.40 | - | - | 4.73 | 3.75 | 3.45 | - | - | 77.42 | 78.40 | 78.70 |
| **MW4** | 81.91 | 1.52 | 3.51 | 2.10 | 1.52 | 1.85 | 2.00 | 2.11 | 79.81 | 80.39 | 80.06 | 79.91 | 79.80 |
| **MW106** | 81.30 | 3.05 | 4.59 | - | - | - | 2.33 | 1.72 | - | - | - | 78.97 | 79.59 |
| **MW109** | 81.70 | 3.05 | 3.63 | - | - | - | 2.67 | 2.75 | - | - | - | 79.03 | 78.95 |
| **MW205** | 82.01 | 3.05 | 15.55 | - | - | - | 6.35 | 6.20 | - | - | - | 75.66 | 75.81 |
| **MW206** | 81.97 | 3.05 | 15.62 | - | - | - | 3.15 | 3.45 | - | - | - | 78.82 | 78.52 |
| **MW301** | 82.05 | 3.05 | 19.38 | - | - | - | - | 5.60 | - | - | - | - | 76.45 |

## 7. FOUNDATION CONSIDERATIONS

It is understood that the proposed development will comprise mainly of a new 27-storey mixed use residential building, including a podium, linked to 4 levels of underground parking.

The overburden soils below the fill, at approximate depths varying from 0.6 to 1.4m, are stiff to hard silt & clay / clay. Geotechnical resistances of **250 kPa** (SLS) and **350kPa** (ULS) may be used for footings placed, in the overburden soil, at or below an approximate depth of 1.8m (elevations of 79.84 to 80.38m asl). The investigation showed that the predominant native stratum, below the overburden soil, is shale bedrock which provides favourable bearing conditions to support buildings on concrete footings. For buildings founded at or lower than 15m below existing grade, for five underground levels, excavation will be in the shale bedrock.

### 7.1 Spread/ Strip Footing Founded on Native Soils/bedrock

For the proposed residential building, with five underground levels, the structure may be supported on conventional spread/strip footings founded on the native undisturbed shale bedrock at approximately 15m below existing grade. Inspection of the rock base after excavation is required to confirm the rock quality.

Recommended approximate founding depths / elevations and corresponding bearing resistance for limit states (SLS and ULS) are presented in Table 5.

**Table 5: Foundation Design for Conventional Footings**

| Building/Borehole | | | Elev. of B.H. Ground (m asl) | Approx. Depth of Footings at or below (m) | Approx. Elevation of Footings at or below (m asl) | Bearing Resistance at SLS (KPa) | Bearing Resistance at ULS (KPa) |
|---|---|---|---|---|---|---|---|
| Proposed 26-storey Building | BH205 | With Five Underground Levels | 82.01 | 15.0 | 67.01 | 2600 | 3000 |
| | BH206 | | 81.97 | 15.0 | 66.97 | 2600 | 3000 |
| | BH301 | | 82.05 | 15.0 | 67.05 | 2600 | 3000 |

Note:

Foundation excavations should be subject to inspection by a representative of Fisher Environmental to confirm the foundation soil condition / rock quality at the time of construction.

### 7.2 General Comments about Footing Construction

- Adjacent footings founded at different elevations should be stepped at 10 horizontals to 7 verticals.
- For frost protection, all exterior footings and footings in unheated basement must have a minimum soil cover of 1.5m.
- Footings designed to the above specified bearing pressure values are expected to settle less than 25mm total and 19mm differential.
- The recommended bearing resistance and foundation elevations have been calculated from limited borehole information and are intended for design purposes only.
- More specific information with respect to soil conditions between and beyond the boreholes will be available when the proposed construction is underway. Therefore, the encountered soil/foundation conditions must be verified in the field, and all footings must be inspected and approved by engineering personnel from our office prior to placement of concrete.
- During construction, should areas of less competent soil be encountered at the design grade, over-excavations may be advanced until suitable soil conditions are achieved. The resulting over-excavation may be returned to the proposed design grade through the placement of a low strength concrete (~ 5 MPa). This should be conducted under the direct supervision of geotechnical personnel from Fisher.

## 8. SEISMIC DESIGN CONSIDERATIONS

The building must be designed to resist a minimum earthquake force. The Ontario Building Code (2016) specifies that the building be designed to withstand a minimum lateral seismic force ***V***, which is assumed to act non-currently in any direction on the building as per the following expression:

$$V = S(T_a)M_v I_E W/(R_d R_o)$$

Where $S(T_a)$ should be calculated by $S_a(T_a)F_a$ or $S_a(T_a)F_v$, depending on the fundamental lateral period $T_a$. The term, which is relevant to the geotechnical conditions at the Site, are acceleration-based Site coefficient $F_a$ and velocity–based Site coefficient $F_v$.

In accordance with **Table 4.1.8.4.A**. of the current Ontario Building Code, the Site may be classified as Site Class B (rock) for Seismic Site Response. This classification may be revised if supported by the results of onsite shear wave velocity tests. Acceleration and velocity based

site coefficients, $F_a$ and $F_v$, should be determined from **Tables 4.1.8.4.B**. and **4.1.8.4.C**. respectively of the OBC, using linear interpolation for intermediate values of $S_a(0.2)$ and $S_a(1.0)$.

The seismic design data given in Table 1.2 of the Supplementary Standard SB-1 in Volume 2 of the Ontario Building Code, for selected Municipal locations, should be used to complete the seismic analysis.

## 9. GROUNDWATER CONSIDERATIONS

Static groundwater measurements in the eight (8) monitoring wells installed in the bedrock, MW1 to MW3, MW5, MW6, MW205, MW206 and MW301 vary between 1.80m and 6.35m bgs with corresponding elevation of 75.52m to 78.82m asl. Groundwater levels in the overburden soils vary between 1.52m and 2.75m bgs (elevation of 78.95 and 80.39m asl). The high groundwater levels measured in MW2 and MW5 represent perched pockets of water in the shale and are not representative of the general groundwater levels in the shale bedrock. The groundwater levels in the shale in the area, based on experience on other projects, are generally between 5m and 7m below ground level (74m to 78m asl), which broadly corresponds to the observed groundwater levels in MW1 and MW3.

It should be noted however, that the local aquifer comprises weathered and fractured shale seams. Consequently, varying quantities of groundwater are expected to be encountered within the estimated excavation depths due to the occurrence of localized perched water table and seepage through the fractured/weathered shale seams.

In order to protect the bottom and sides of the excavation from been disturbed by excess groundwater pressures, and to ensure a ‘dry’ work area, the water table should be lowered to below the bottom of the footing excavation. Groundwater may be pumped out using conventional sump pits.

Further details of the hydrogeological conditions at the site are covered in the Hydrogeological Investigation conducted by Fisher Environmental and submitted under project number FE19-9571 dated August 14, 2019.

## 10. EXCAVATION AND BACKFILL CONSIDERATIONS

Excavation on the Site is expected to encounter a sand and silt fill generally to depths of about 1.5m. The fill may be classified as a Type 3 soil while the silt and clay, below the fill, can be classified as Type 2 soils. The red shale is part of a sedimentary formation where the moist to dry, hard shale has moisture content and strength properties of a Type 1 soil as set out in the Occupational Health and Safety Act Classification Part III.

For the proposed construction it should be possible to excavate the weathered shale and most of the hard shale with either a backhoe equipped with a rock bucket for service trenches, or a dozer mounted with rock rippers for large excavation areas. The excavations for footings or underground services must be carried out in accordance with the latest edition of the Occupational Health and Safety Act (OHSA).

Slopes in the sand and silt may be constructed at a gradient of 1m horizontal to 1m vertical. For trenches or excavation into the silt & clay and clay layers, a vertical face can be supported up to 1.2m. If the excavation is deeper than 1.2m, the excavation sides must be sloped at a gradient of 1:1 in accordance with requirements of the OHSA. If this condition cannot be met, a temporary shoring system should be introduced.

Excavation into the solid shale should be stable at near vertical side slopes during the construction period provided adequate measures are taken to ensure the face of the rock remains in good condition. In order to prevent loose material spilling into the excavated areas, grouting of fractures may be required to stabilize the face of the excavation.

The groundwater level in the excavation area is expected to vary depending on the time of year, and the amount of precipitation during the period of construction. Vertical seepage through the shale should be negligible however horizontal seepage may be significant where fissures, fractures and local weathering of the rock layers exist. Water in the excavation, due to seepage from the more permeable seams/lenses or surface run-off, can be controlled by pumping from sumps at the base of the excavation.

It is anticipated that the main excavated material on the site will be red shale. The weathered shale will appear to be, and closely resemble, very stiff to hard clayey soil. The more solid shale will be in the form of large slabs. The excavated shale may be reused as backfilled material after inspection and approval by a geotechnical engineer. Prior to reuse as backfill, the shale material will need to be conditioned as engineering fill by breaking down the material into less than 150mm sizes and moisture conditioning the dry shale with water and approved by staff

from Fisher. Compaction should then be carried out using heavy steel vibratory type sheep's foot rollers (at least 10 ton) in controlled lift thicknesses of no more than 200mm.

The material to be used for backfill in service trenches should be suitable for compaction, i.e. free of organics and with moisture content within 2 percent of the optimum moisture value. The backfill material in service trenches should be compacted, in lifts of no more than 200mm in thickness, to at least 98 percent of Standard Proctor Maximum Dry Density (SPMDD) in the upper 1.0m from road subgrade or in settlement sensitive areas. Beyond these zones, a 95 % SPMDD compaction criterion is considered acceptable.

For backfill against the subsurface walls and footings it is recommended that backfill materials consist of Granular Class 'B' aggregates.

### 10.1 Stability of Excavation

It is expected that the excavation walls into the red shale will be stable at near vertical slopes during the construction period. The sand and silt are expected to be stable at 1V:1H in the absence of seepage. Loose rock pieces should be removed, and the rock face of the excavation cut back to approximately 10V:1H. Onsite inspection by qualified geotechnical engineer will determine if the slope needs to be flatter, particularly where weathered shale is encountered. A geogrid may be required to cover the full face of the exposed shale to minimize rock fall.

Other factors which could adversely impact the stability of the excavated rock face is the installation of utilities. The need for shoring should be evaluated and anticipated where excavation for utilities is in close proximity to the building excavation.

### 10.2 Impact on Construction and Durability of Shale

Shale comprise over-consolidated clay and silt or in some instances mudstone. Shale is usually susceptible to slaking which can be defined as the disintegration of the clay material when exposed to water and or wetting/drying and freezing/thawing cycles. Consequently, the following measures are recommended to minimize degradation of the shale during construction:

- Minimize the amount of time that the excavated shale is exposed to the elements to a maximum of 7 days,
- Protect exposed shale base by placing ±75mm of 15MPa concrete to form a working surface; Alternatively, a ±250mm thick layer of free draining granular material (OPSS 1004 19mm Type 2 clear stone) could be applied.

## 11. SHORING

In the event that a shoring system, in the overburden soil, is required to protect adjacent structures and to facilitate the excavation for utilities etc. in the proposed development, the system should be designed in accordance with the requirements set out in the Canadian Foundation Engineering Manual.

The geotechnical parameters, which are considered applicable for the design, are as follows:

In the overburden soils

- Active earth pressure coefficient Ka = 0.45 for the walls in areas where structures or sensitive services are being supported.
- Active earth pressure coefficient Ka = 0.28 for remaining areas.
- Natural unit weight of soil = 21.0 KN/$m^3$
- Any surcharge loads must be included in the lateral earth pressure calculations.
- Lateral movement for the shoring wall, designed using Ka = 0.28, are expected to be in order of 15mm and are expected to be less if Ka value of 0.45 is used.
- Anchors should be designed for 35KPa.

In the shale bedrock

- Ka = 0.2,
- Kp = 5.0
- Natural unit weight of soil = 25.0 KN/$m^3$
- Anchors should be designed for 200KPa.

The design values must be confirmed by at least two load tests, carried out to 2× the design loads.

The shoring system and surrounding structures should be monitored for horizontal and vertical movement, prior to shoring / or dewatering and during the excavation to ensure satisfactory performance of the shoring system.

A pre-construction inspection of the surrounding structures and roads is recommended prior to commencement of shoring construction and /or dewatering.

## 12. SLAB ON GRADE AND PERMANENT DRAINAGE

For the subject Site, the floor slab should rest on a compacted bed of size 19mm clear stone at least 200mm thick which will act as a vapour barrier. The vapour barrier stones should meet the requirements of OPSS 1004 for 19mm Type II clear stone.

A permanent perimeter and sub-floor drainage system for shoring system/foundation walls must be provided as shown in Appendix G.

Perimeter drainage pipes, with a positive gravity outlet, should be solid PVC with a minimum of 0.5% slope with silt traps provided at convenient/accessible locations. To further minimize siltation, all drainage pipe connections should be solid PVC elbows and T's. No "butt" end should be permitted. The perforated pipes should slope to a sump at a minimum 1% slope.

## 13. UNDERGROUND UTILITIES

Pipe bedding and backfill materials specifications and compaction criteria for water and sewer services should be in accordance with the pipe designer's recommendations and/or local municipal requirements.

If the excavation is deeper than 1.2m, the excavation sides should be sloped in accordance with requirements of OHSA. If this condition cannot be met, a temporary shoring system or trench box should be introduced.

Trench backfill should be uniformly compacted to a density that minimizes the risk of long-term settlement. Selected on-site excavated native soils may be suitable for re-use in trench backfilling, provided that organics / construction debris are sorted out and materials are not allowed to be wet. Moisture content should be within 2% of the optimum moisture content.

In normal sewer construction practice, the problem of road settlement largely occurs adjacent to manholes, catch basins and service crossings. In these areas, granular materials are generally required for backfill and compaction.

The backfill in the upper 1.0m from road subgrade or in settlement sensitive areas should be placed in maximum 200mm thick lifts and compacted to 98% SPMDD. Beyond these zones, a 95% SPMDD compaction criterion is considered acceptable.

Water lines installed outside of heated areas should be provided with a minimum of 1.8m soil cover or equivalent for frost protection.

## 14. PAVEMENT

It is expected that associated pavement of driveways and parking areas would be developed on the site. Pavement structures can be constructed on the native soils, engineering fill, or possibly fill materials from the subject Site, subject to design grade and further onsite inspection.

Prior to asphalt pavement construction, topsoil/organic soil/ construction debris must be removed. The exposed base should be proof-rolled and supervised / approved by geotechnical personnel from Fisher. Any soft spongy spots detected during proof-rolling should be sub-excavated and replaced with suitable materials and compacted to 98% of SPMDD. Engineering fill placement, if any, should be supervised and inspected by engineering staff from Fisher.

The finished subgrade must be contoured / graded and finally proof-rolled and approved before placing the upper granular materials.

Granular materials will be used in construction of asphalt pavement base. Compaction for granular bases should reach 100% of Standard Proctor Maximum Dry Density,

Perforated drains connected to sewer MHs/ CBs should be provided under the entire length of curb and constructed in accordance with required local regulations.

Typical flexible pavement designs are presented in Table 6.

**Table 6: Typical flexible pavement design**

| Layer | Heavy Duty | Medium Duty | Light Duty |
|---|---|---|---|
| **Asphaltic Concrete** | 40mm HL3 | 40mm HL3 | 50mm HL3 |
| | 65mm HL8 | 50mm HL8 | |
| **19 mm Crushed Limestone** | 150mm | 150mm | 200mm |
| **Granular B Sub-base** | 300mm | 200mm | |

The pavement thickness should also meet the minimum local region Pavement Design Standards.

The asphalt material should meet the OPSS requirements for specified grade and be compacted to at least 97% of their Marshall Density.

## 15. LIMITATIONS

This report is limited in scope to those items specifically referenced in the text. The discussions and recommendations presented in this report are intended only as guidance for the client named, their design engineers and those directly involved in the implementation and control of the project.

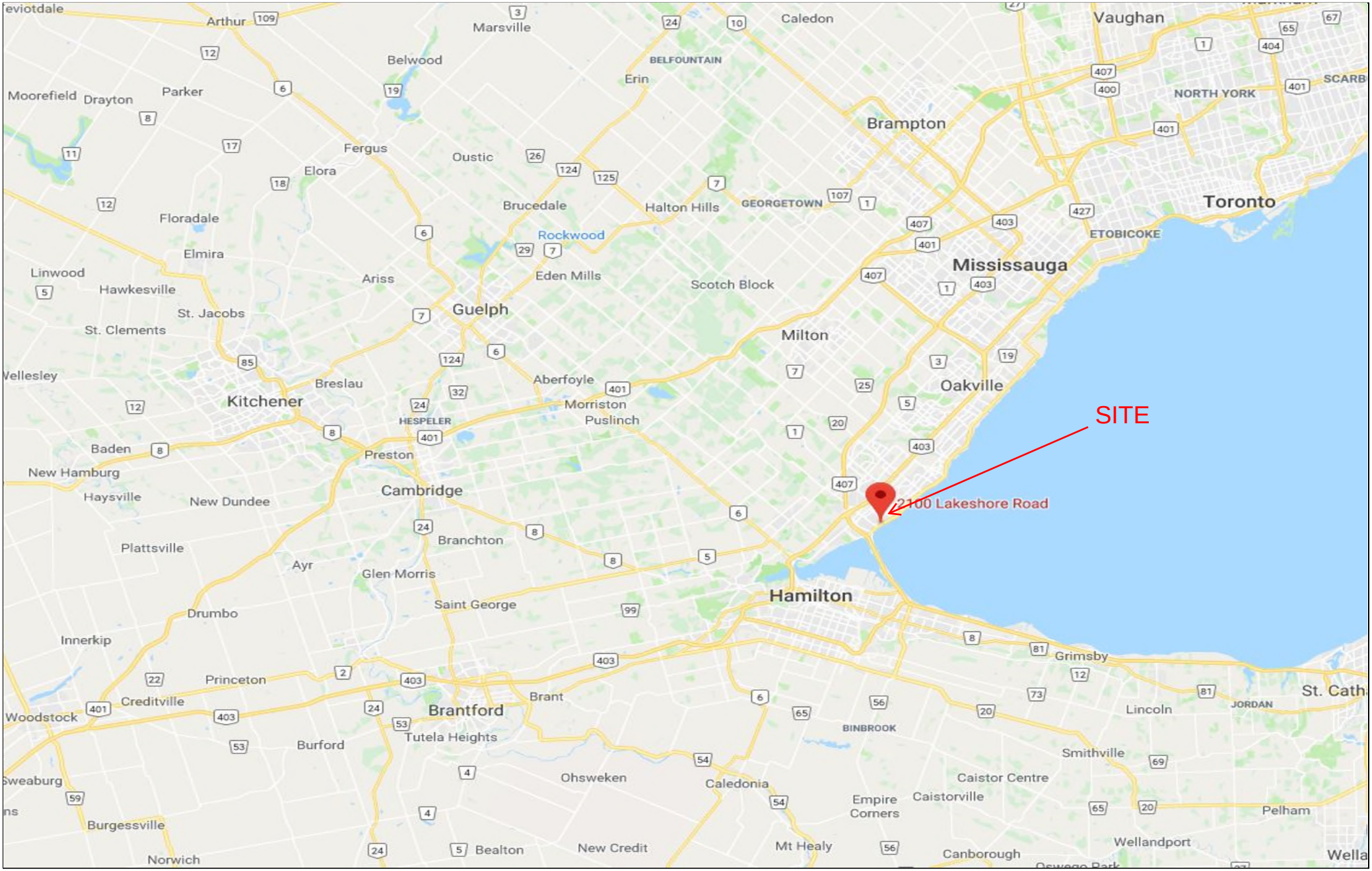
The information on which these recommendations are based is subject to confirmation by engineering personnel at the time of construction.

Localized variations in subsoil conditions may be present between and beyond the boreholes on which the recommendations are made and will have to be verified during construction. As more specific subsurface information becomes available during excavations on the subject Site, this report should be updated.

Contractors bidding on or undertaking the work should decide on their own investigations, as well as their own interpretations of the factual borehole results. This concern specifically applies to the classification of the subsurface soils and the potential reuse of these soils on/off site.

The contractors must draw their own conclusions as to how the near surface and subsurface conditions may affect them.

# APPENDIX A – SITE AND LOCATION PLANS




**Fisher Environmental Ltd.**

400 Esna Park Dr., #15
Markham, Ontario
L3R 3K2

Tel: 905 475-7755
Fax: 905 475-7718

KEY PLAN

N

LEGEND

PROJECT NAME AND ADDRESS

Geotechnical Investigation

2093-2101 Old Lakeshore &
2096-2100 Lakehore RD,
BURLINGTON, ON

PROJECT NO.
FE-P 19-9255

DATE
February 13, 2019

SCALE
AS SHOWN

FIGURE A
SITE LOCATION MAP.



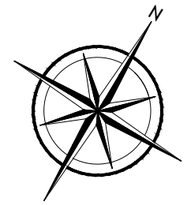


**Fisher Environmental Ltd.**

400 Esna Park Dr., #15
Markham, Ontario
L3R 3K2

Tel: 905 475-7755
Fax: 905 475-7718


KEY PLAN




LEGEND

- EXISTING GEOTECHNICAL MONITORING WELL LOCATIONS
- GEOTECHNICAL MONITORING WELL LOCATIONS FEB 2019
- EXISTING PHASE II ESA WELL LOCATIONS
- GEOTECHNICAL MONITORING WELL JULY 2019

PROJECT NAME AND ADDRESS

# GEOTECHNICAL INVESTIGATION

2093, 2097, 2101 Old Lakeshore Rd
& 2096, 2100 Lakeshore Rd,
Burlington, Ontario

FIGURE 1:

SITE PLAN WITH MONITORING WELLS

| PROJECT NO. | SHEET NO. |
|---|---|
| FE-P 19-9570 | 1 |
| DATE: AUGUST 2019 | |
| SCALE: AS SHOWN | |




Revisions:

| | |
|---|---|
| Issued for OPA / ZBA | August 22, 2019 |
| DESCRIPTION: | DATE: |

General Notes:

1. These Contract Documents are the property of the Architect. The Architect bears no responsibility for the interpretations of these documents by the Contractor. Upon written application the Architect will provide written/graphic clarification or supplementary information regarding the intent of the Contract Documents. The Architect will review Shop Drawings submitted by the Contractor for design conformance only.

2. Drawings are not to be scaled for construction. Contractor to verify all existing conditions and dimensions required to perform the Work and report any discrepancies with the Contract Documents to the Architect before commencing work.

3. Positions of exposed or finished mechanical or electrical devices, fittings, and fixtures are indicated on the Architectural drawings. The locations shown on the Architectural drawings govern over the Mechanical and Electrical drawings. Those items not clearly located will be located as directed by the Architect.


ARCHITECT:

STUDIO JCI

20 De Boers Drive suite 525
Toronto ON M3H 0H1
t. 416.901.6528 f. 416.901.8962
www.studiojci.com

STRUCTURAL:

READ JONES CHRISTOFFERSEN LTD.

100 University Ave, North Tower, Suite 400
Toronto ON M5J 1V6
t. 416.977.5335

MECHANICAL:

THE MITCHELL PARTNERSHIP INC.

285 Yorkland Blvd,
North York, ON M2J 1S5
t. 416.499.8000

ELECTRICAL:

MULVEY & BANANI INTERNATIONAL INC.

44 Mobile Drive, Toronto, Ontario
M4A 1P2
t. 416.751.2520

LANDSCAPE:

STUDIO TLA

20 Champlain Blvd,
North York, ON M3H 2Z1
t. 416.638.4911

CIVIL:

LITHOS GROUP INC.

150 Bermondsey Rd, Unit #200
North York, Ontario M4A 1Y1
t. 416.750.7769


BURLINGTON MIXED-USE BUILDING

ADDRESS:
2096 - 2100 Lakeshore Rd, Burlington

## SECTION A

| | |
|---|---|
| PROJECT NO.: | 1816 |
| SCALE: | 1:200 |
| DATE: | AUGUST 22, 2019 |
| DRAWN BY: | |

DRAWING NO.:

A6.00

# APPENDIX B – LOG OF BOREHOLES

FISHER ENVIRONMENTAL LTD.

# LOG OF BOREHOLE NO. BH1 SHEET. 1 of 6

PROJECT NO.: FE-P 17-8409 /19-9255

PROJECT NAME: Updated Geotechnical Investigation

LOCATION: 2093 Old Lakeshore Rd

DRILLING METHOD: Hollow Stem

DRILLING DATE: 05 October 2017

| DEPTH (feet) | DEPTH (metres) | DESCRIPTION | STRATA PLOT | ELEV. DEPTH (m) | SAMPLES NUMBER | SAMPLES Type | SAMPLES "N" VALUE |
|---|---|---|---|---|---|---|---|
| | | GROUND SURFACE (m asl) | | 81.66 | | | |
| 0 | 0 | FILL (50 mm Asphalt) | | | | | |
| 2 | | SAND & SILT trace GRAVEL, dark brown, dry, loose to compact | | | 1 | SS | 7 |
| 4 | 1 | Slightly moist at 1.2m | | | 2 | SS | 17 |
| | | | | 80.29 | | | |
| 6 | 2 | SILT & CLAY: Trace GRAVEL, trace SAND, brown, moist, hard | | | 3 | SS | 34 |
| | | | | 79.56 | | | |
| 8 | | CLAY: Light brown, moist, hard | | | 4 | SS | 37 |
| 10 | 3 | | | | | | |
| | | Weathered SHALE, Red with grey seams, dry hard | | 78.46 | 5 | SS | 100+ |
| 12 | | | | 77.80 | | | |
| | 4 | SHALE (Queenston formation), layered sedimentary deposit, grey Siltstone layers, red, moist to dry, hard | | | | | |
| 16 | | | | | | | |
| | 5 | Weathered seam at 5.5 to 6m | | | | | |
| 20 | | | | | | | |
| | 6 | | | | | | |
| 22 | | Solid core sticks (lengths > 200mm) | | | | | |
| 24 | 7 | | | | | | |
| 26 | | | | | | | |
| | 8 | 320mm long lab sample taken at 8.5m | | | 1 | RS | |
| 28 | | | | | | | |
| 30 | 9 | | | | | | |
| 32 | | | | | | | |
| | 10 | | | | | | |
| 34 | | | | | | | |
| 36 | 11 | | | | | | |
| 38 | | | | | | | |
| | 12 | | | | | | |
| 40 | | End of Borehole at 12.19m | | 69.47 | | | |
| 42 | 13 | | | | | | |
| 44 | | | | | | | |
| 46 | 14 | | | | | | |
| 48 | | | | | | | |
| 50 | 15 | | | | | | |

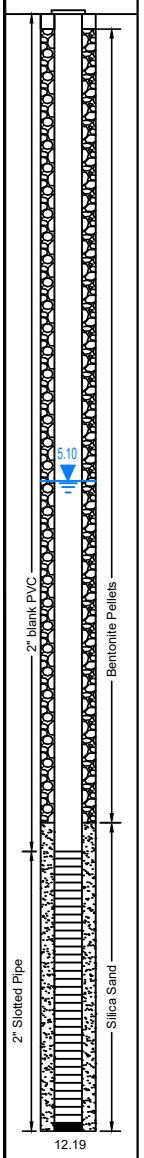
PENETRATION TESTING (SPT) ▲ 20 40 60 80

SHEAR STRENGTH (Kpa) ✚ 40 80 120 160

VAPOUR READING (ppm) □ 20 40 60 80

MOISTURE CONTENT (%) ○ 10 20 30 40

PIEZOMETER OR WELL CONSTRUCTION




Groundwater Depth (m): 76.56m asl on Oct 15, 2017

LOGGED: ZV

CHECKED: CW

FISHER ENVIRONMENTAL LTD.

# LOG OF BOREHOLE NO. BH2 SHEET. 2 of

PROJECT NO.: FF-P 17-8409 /19-9255

PROJECT NAME: Updated Geotechnical Investigation

LOCATION: 2096 Lakeshore Rd, Burlington

DRILLING METHOD: Hollow Stem

DRILLING DATE: 04 October 2017

| DEPTH (feet) | DEPTH (metres) | DESCRIPTION | STRATA PLOT | ELEV. DEPTH (m) | SAMPLES NUMBER | SAMPLES Type | SAMPLES "N" VALUE |
|---|---|---|---|---|---|---|---|
| 0 | 0 | GROUND SURFACE (m asl) | | 82.18 | | | |
| 0 | 0 | FILL (75mm of asphalt) SAND & SILT, trace gravel, black, moist, odour, loose | | 81.57 | 1 | SS | 6 |
| 4 | 1 | SILT & CLAY: Trace GRAVEL, trace SAND, brown to dark brown, , moist, very stiff to hard | | | 2 | SS | 16 |
| 6 | 2 | | | | 3 | SS | 40 |
| 8 | 2 | CLAY: Trace GRAVEL, brown, dry, hard | | 79.88 | 4 | SS | 48 |
| 10 | 3 | Weathered SHALE: Red with grey pieces, dry, hard | | 78.13 | 5 | SS | 100+ |
| 12 | 4 | SHALE: (Queenston formation) layered sedimentary deposit, grey siltstone layers, red, moist to dry, hard | | 78.83 | | | |
| 18 | 5 | Weathered layer at 5.5 to 6m | | | | | |
| 20 | 6 | | | | | | |
| 22 | 7 | Mostly solid core sticks recovered lengths > 200mm | | | | | |
| 24 | 7 | | | | | | |
| 26 | 8 | | | | | | |
| 28 | 9 | 380mm long lab sample taken at 8.5m | | | 2 | RS | |
| 30 | 9 | | | | | | |
| 32 | 10 | | | | | | |
| 34 | 10 | Fractured at 10.3m - some micro defects observed | | | | | |
| 36 | 11 | | | | | | |
| 38 | 12 | 100mm Weathered seam at 12m | | | | | |
| 40 | 12 | | | 69.93 | | | |
| 42 | 13 | End of Borehole at 12.25 m | | | | | |
| 44 | 13 | | | | | | |
| 46 | 14 | | | | | | |
| 48 | 15 | | | | | | |
| 50 | | | | | | | |

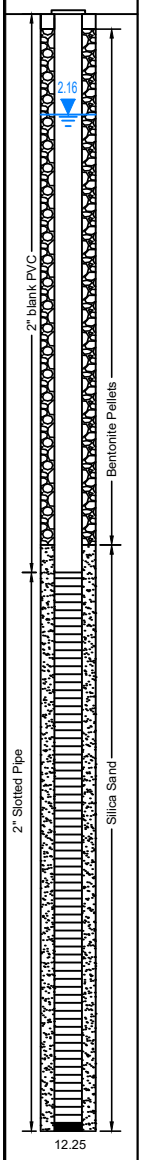
PENETRATION TESTING (SPT) ▲ 20 40 60 80

SHEAR STRENGTH (Kpa) ✚ 40 80 120 160

VAPOUR READING (ppm) □ 20 40 60 80

MOISTURE CONTENT (%) ○ 10 20 30 40

PIEZOMETER OR WELL CONSTRUCTION




Groundwater Depth (m): 80.02m asl on Oct 16, 2017

LOGGED: ZV

CHECKED: CW

FISHER ENVIRONMENTAL LTD.

# LOG OF BOREHOLE NO. BH3 SHEET. 3 of

PROJECT NO.: FF-P 17-8409 /19-9255

PROJECT NAME: Updated Geotechnical Investigation

LOCATION: 2100 Lakeshore Rd

DRILLING METHOD: Hollow Stem

DRILLING DATE: 03 October 2017

| DEPTH (feet) | DEPTH (metres) | DESCRIPTION | STRATA PLOT | ELEV. DEPTH (m) | SAMPLES NUMBER | SAMPLES Type | SAMPLES "N" VALUE |
|---|---|---|---|---|---|---|---|
| 0 | 0 | GROUND SURFACE (m asl) | | 81.64 | | | |
| | | FILL (150mm of Gravel), SAND & SILT, trace gravel, brown, black spots, dry, loose | | 80.88 | 1 | SS | 4 |
| 4 | 1 | SILT & CLAY: Trace Gravel, trace SAND, brown with orange spots, dry, very stiff to hard | | | 2 | SS | 15 |
| 6 | 2 | | | | 3 | SS | 100+ |
| | | | | 79.34 | | | |
| 8 | | CLAY: Trace gravel, red brown, dry, grey pieces, hard | | | 4 | SS | 59 |
| 10 | 3 | Weathered SHALE @ 3.5m | | 78.13 | 5 | SS | 100+ |
| 12 | 4 | SHALE: Queenston formation, layered sedimentary rock with grey Siltstone layers, red, moist to dry, hard | | | | | |
| 18 | | Weathered layer 5.5 - 6m | | | | | |
| 20 | 6 | | | | | | |
| 22 | 7 | | | | | | |
| 24 | | | | | | | |
| 26 | 8 | | | | | | |
| 28 | | | | | | | |
| 30 | 9 | | | | | | |
| 32 | | | | | | | |
| 34 | 10 | | | | | | |
| 36 | 11 | Weathered between 11 and 12m | | | | | |
| 38 | | | | | | | |
| 40 | 12 | | | 69.34 | | | |
| | | End of Borehole at 12.30m | | | | | |
| 42 | 13 | | | | | | |
| 44 | | | | | | | |
| 46 | 14 | | | | | | |
| 48 | | | | | | | |
| 50 | 15 | | | | | | |

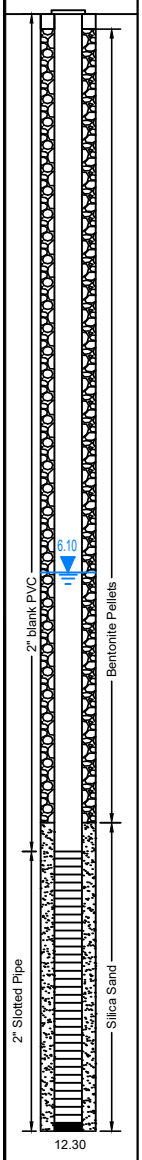
PENETRATION TESTING (SPT) ▲ 20 40 60 80

SHEAR STRENGTH (Kpa) ✚ 40 80 120 160

VAPOUR READING (ppm) □ 20 40 60 80

MOISTURE CONTENT (%) ○ 10 20 30 40

PIEZOMETER OR WELL CONSTRUCTION




Groundwater Depth (m): 75.54m asl on Oct 16, 2017

LOGGED: ZV

CHECKED: CW

FISHER ENVIRONMENTAL LTD.

# LOG OF BOREHOLE NO. BH4 SHEET. 4 of

PROJECT NO.: FF-P 17-8409 /19-9255

PROJECT NAME: Updated Geotechnical Investigation

LOCATION: 2097 Old Lakeshore Rd

DRILLING METHOD: Hollow Stem

DRILLING DATE: 02 October 2017

| DEPTH (feet) | DEPTH (metres) | DESCRIPTION | STRATA PLOT | ELEV. DEPTH (m) | SAMPLES NUMBER | SAMPLES Type | SAMPLES "N" VALUE |
|---|---|---|---|---|---|---|---|
| 0 | 0 | GROUND SURFACE (m asl) | | 81.91 | | | |
| | | FILL (100mm asphalt) SAND & SILT, trace gravel, brown,dry, loose | | | 1 | SS | 10 |
| 4 | 1 | SILT & CLAY: trace gravel spots, grey, dry, very stiff | | 81.00 | 2 | SS | 27 |
| | | | | 80.41 | | | |
| 6 | 2 | CLAY: Trace gravel, sand seams, red brown, dry, hard | | | 3 | SS | 32 |
| 8 | | | | | 4 | SS | 60 |
| 10 | 3 | Auger refusal at 3.51m in fractured SHALE | | 78.40 | 5 | SS | 100+ |
| | | End of Borehole at 3.51m | | | | | |

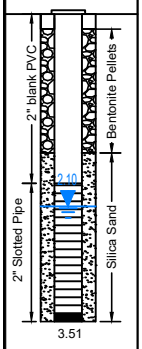
PENETRATION TESTING (SPT) ▲ 20 40 60 80

SHEAR STRENGTH (Kpa) ✚ 40 80 120 160

VAPOUR READING (ppm) □ 20 40 60 80

MOISTURE CONTENT (%) ○ 10 20 30 40

PIEZOMETER OR WELL CONSTRUCTION




Groundwater Depth (m): 79.81m asl on Oct 16, 2017

LOGGED: ZV

CHECKED: CW

FISHER ENVIRONMENTAL LTD.

# LOG OF BOREHOLE NO. BH5 SHEET. 5 of 6

PROJECT NO.: FF-P 17-8409 /19-9255

PROJECT NAME: Updated Geotechnical Investigation

LOCATION: 2101 Old Lakeshore Rd

DRILLING METHOD: Hollow Stem

DRILLING DATE: 02 October 2017

| DEPTH (feet) | DEPTH (metres) | DESCRIPTION | STRATA PLOT | ELEV. DEPTH (m) | SAMPLES NUMBER | SAMPLES Type | SAMPLES "N" VALUE |
|---|---|---|---|---|---|---|---|
| | | GROUND SURFACE (m asl) | | 81.67 | | | |
| 0 | 0 | FILL (150mm asphalt) SAND & SILT, trace gravel, roots, slight odour, brown, dry, compact | | | 1 | SS | 13 |
| 2 | 1 | | | | 2 | SS | 18 |
| 4 | 1 | | | 80.30 | | | |
| 6 | 2 | SILT & CLAY: With sand seams, red, dry, hard | | | 3 | SS | 39 |
| 8 | 2 | | | 79.37 | | | |
| 8 | 2 | CLAY: Trace gravel, sand seams, red, dry, hard | | | 4 | SS | 100+ |
| 10 | 3 | | | 78.47 | 5 | SS | 100+ |
| 12 | 4 | Weathered SHALE @ 3.2m | | | | | |
| 14 | 4 | SHALE: Queenston formation, layered sedimentary deposit, grey siltstone layers, red, moist to dry, hard | | | | | |
| 16 | 5 | | | | | | |
| 18 | 5 | | | | | | |
| 20 | 6 | Weathered 5.5 to 6.5m | | | | | |
| 22 | 7 | Soild core sticks i.e., recovered lengths > 200mm | | | | | |
| 24 | 7 | | | | | | |
| 26 | 8 | | | | | | |
| 28 | 9 | | | | | | |
| 30 | 9 | Weathered 9.0 to 9.5m | | | | | |
| 32 | 10 | | | | | | |
| 34 | 10 | 400mm long lab sample taken at 10.2m | | | 1 | RS | |
| 36 | 11 | | | | | | |
| 38 | 12 | Weathered 11.5 to 12m | | | | | |
| 40 | 12 | | | 69.45 | | | |
| 42 | 13 | End of Borehole at 12.22m | | | | | |
| 44 | 13 | | | | | | |
| 46 | 14 | | | | | | |
| 48 | 14 | | | | | | |
| 50 | 15 | | | | | | |

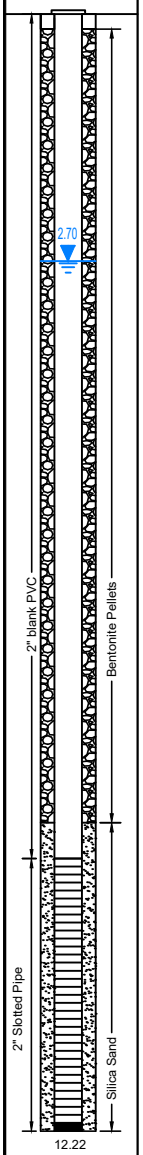
PENETRATION TESTING (SPT) ▲ 20 40 60 80

SHEAR STRENGTH (Kpa) ✚ 40 80 120 160

VAPOUR READING (ppm) □ 20 40 60 80

MOISTURE CONTENT (%) ○ 10 20 30 40

PIEZOMETER OR WELL CONSTRUCTION




Groundwater Depth (m): 78.97m asl on Oct 16, 2017

LOGGED: ZV

CHECKED: CW

FISHER ENVIRONMENTAL LTD.

# LOG OF BOREHOLE NO. BH6(MW) SHEET. 6 of 6

PROJECT NO.: FE-P FF-P 17-8409 /19-9255

PROJECT NAME: Updated Geotechnical Investigation

LOCATION: 2097 Old Lakeshore Road

DRILLING METHOD: Hollow Stem

DRILLING DATE: 20 November 2017

| DEPTH (feet) | DEPTH (metres) | DESCRIPTION | STRATA PLOT | ELEV. DEPTH (m) | SAMPLES NUMBER | SAMPLES Type | SAMPLES "N" VALUE |
|---|---|---|---|---|---|---|---|
| | | GROUND SURFACE (m asl) | | 82.15 | | | |
| 0 | 0 | FILL(asphalt 75mm): Sand and silt, trace gravel, dark brown, dry. | | | | | |
| 4 | 1 | | | 80.95/ 1.20 | | | |
| 6 | 2 | SILT and CLAY: Trace gravel, trace sand, brown, moist. | | 80.15/ 2.00 | | | |
| 8 | 3 | CLAY: Brown, moist. | | | | | |
| 12 | 4 | | | 78.15/ 4.00 | | | |
| 14 | | WEATHERED SHALE: Red with grey pieces, wet (hollow stem drilling 0-4.5m). | | 77.65/ 4.50 | | | |
| 16 | 5 | SHALE: Layered sedimentary deposit with grey siltstone layers. (air rotary auger drilling from 4.5-12.4m). | | | | | |
| 20 | 6 | | | | | | |
| 22 | 7 | | | | | | |
| 24 | | | | | | | |
| 26 | 8 | | | | | | |
| 28 | | | | | | | |
| 30 | 9 | | | | | | |
| 32 | 10 | | | | | | |
| 34 | | | | | | | |
| 36 | 11 | | | | | | |
| 38 | | | | | | | |
| 40 | 12 | | | 69.75/ 12.40 | | | |
| | | End of Borehole at 12.40m | | | | | |
| 42 | 13 | | | | | | |
| 44 | | | | | | | |
| 46 | 14 | | | | | | |
| 48 | | | | | | | |
| 50 | 15 | | | | | | |

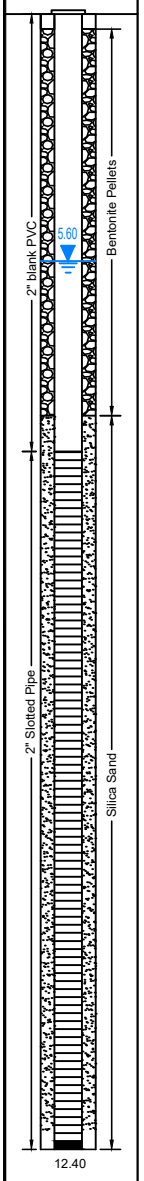
PENETRATION TESTING (SPT) ▲ 20 40 60 80

SHEAR STRENGTH (Kpa) ✚ 40 80 120 160

VAPOUR READING (ppm) □ 20 40 60 80

MOISTURE CONTENT (%) ○ 10 20 30 40

PIEZOMETER OR WELL CONSTRUCTION




Groundwater Depth (m): 5.60m on completion.

LOGGED: AH

CHECKED: CW

FISHER ENVIRONMENTAL LTD.

# LOG OF BOREHOLE NO. BH205 SHEET. 1 of 1

PROJECT NO.: FE-P 19-9255

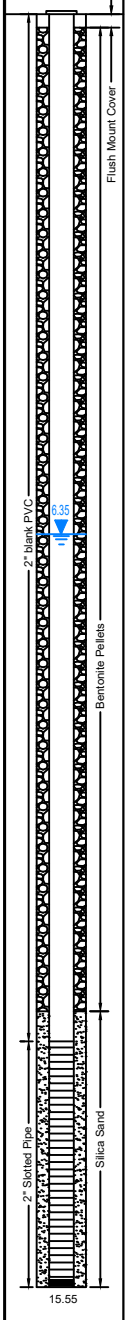
PROJECT NAME: GEOTECHNICAL/HYDRO

LOCATION: 2097 Old Lakeshore Rd., Burlington, ON

DRILLING METHOD: Diedrich D-120

DRILLING DATE: 8 FEB, 2019

| DEPTH (feet) | DEPTH (metres) | DESCRIPTION | STRATA PLOT | ELEV. DEPTH (m) | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUE | PENETRATION TESTING (SPT) ▲ 20 40 60 80 / SHEAR STRENGTH (Kpa) ✙ 40 80 120 160 | VAPOUR READING (ppm) □ 20 40 60 80 / MOISTURE CONTENT (%) ○ 10 20 30 40 | PIEZOMETER OR WELL CONSTRUCTION |
|---|---|---|---|---|---|---|---|---|---|---|
| | | GROUND SURFACE (m asl) | | 81.01 | | | | | | |
| 0 | 0 | Asphalt ~75mm<br>FILL:<br>Sand and silt, trace gravel, dark brown, moist | | 81.25 | | | | | | |
| 2 | 1 | SILT CLAY:<br>Trace gravel, trace sand, brown to dark brown, moist | | 79.72 | | | | | | |
| 8 | 2 | CLAY:<br>Trace gravel, brown, slightly moist to dry | | 78.81 | | | | | | |
| 10 | 3 | Weathered SHALE, red with grey pieces, dry | | | | | | | | |
| 12 | 4 | SHALE:<br>(Queenston formation)<br>layered sedimentary deposit, grey siltstone bands, red, moist to dry. | | | 1 | RC | | RUN=1.55m<br>REC=1.52m,98%<br>RQD=81% | | |
| 16 | 5 | | | 77.08 | 2 | RC | | RUN=0.82m<br>REC=0.82m,100%<br>RQD=73% | | |
| 18 | | | | 76.24 | 3 | | | RUN=0.71m<br>REC=0.71m,100%<br>RQD=37% | | |
| 20 | 6 | | | 75.53 | 4 | RC | | RUN=1.5m<br>REC=1.5m,100%<br>RQD=76% | | |
| 26 | 8 | | | 74.03 | 5 | RC | | RUN=1.57m<br>REC=1.57m,100%<br>RQD=90% | | |
| 32 | 10 | | | 72.46 | 6 | RC | | RUN=1.58m<br>REC=1.58m,100%<br>RQD=86% | | |
| 36 | 11 | | | 70.88 | 7 | RC | | RUN=1.64m<br>REC=1.64m,100%<br>RQD=59% | | |
| 40 | 12 | Lab sample at 12.70m BGS (Elevation at 69.3m ASL) | | 69.31 | 8 | RC | | RUN=1.55m<br>REC=1.53m,99%<br>RQD=93% | | |
| 46 | 14 | Rock core lab sample recovered from 14.95m to 15.29m BGS (Elevation of 67.06m to 66.72m ASL) | | 67.80 | 9 | RC | | RUN=1.50m<br>REC=1.50m,100%<br>RQD=71% | | |
| 50 | 15 | | | 66.46 | | | | | | |
| 52 | 16 | End of BH at 15.53m (66.46m ASL) | | | | | | | | |
| 58 | 17 | | | | | | | | | |




Groundwater Depth (m): 6.35m

LOGGED: NL

CHECKED: CW

FISHER ENVIRONMENTAL LTD.

# LOG OF BOREHOLE NO. BH206 SHEET. 1 of 1

PROJECT NO.: FE-P 19-9255

PROJECT NAME: GEOTECHNICAL/HYDRO

LOCATION: 2097 Old Lakeshore Rd., Burlington, ON

DRILLING METHOD: Diedrich D-120

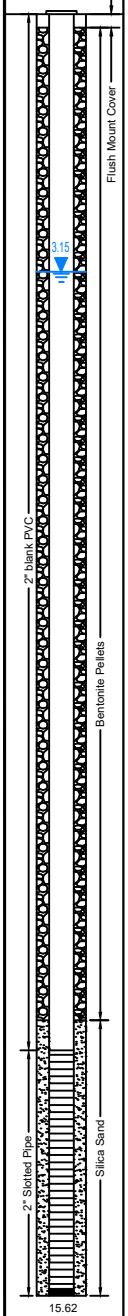
DRILLING DATE: 4 FEB, 2019

| DEPTH (feet) | DEPTH (metres) | DESCRIPTION | STRATA PLOT | ELEV. DEPTH (m) | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES "N" VALUE | PENETRATION TESTING (SPT) ▲ 20 40 60 80 / SHEAR STRENGTH (Kpa) ✙ 40 80 120 160 | VAPOUR READING (ppm) □ 20 40 60 80 / MOISTURE CONTENT (%) ○ 10 20 30 40 | PIEZOMETER OR WELL CONSTRUCTION |
|---|---|---|---|---|---|---|---|---|---|---|
| | | GROUND SURFACE (m asl) | | 81.01 | | | | | | |
| 0 | 0 | Asphalt ~60mm | | | | | | | | |
| 2 | 1 | FILL: Sandy silt, trace gravel, dark brown, dry | | 81.21 | | | | | | |
| 4 | | SILTY CLAY: Trace gravel, brown to dark brown, moist | | | | | | | | |
| 6 | 2 | | | 79.86 | | | | | | |
| 8 | | CLAY: Trace gravel, reddish brown, dry | | | | | | | | |
| 10 | 3 | | | 78.92 | | | | | | |
| | | CLAY and weathered SHALE, red brown with grey bits, dry | | 78.62 | | | | | | |
| 12 | 4 | SHALE: (Queenston formation), layered sedimentary deposit, grey siltstone layers, red, moist to dry, very hard | | | 1 | RC | RUN=1.63m REC=1.36m,83% RQD=60% | | | |
| | | | | 76.99 | 2 | RC | RUN=1.45m REC=1.45m,100% RQD=97% | | | |
| 20 | 6 | | | 75.54 | 3 | RC | RUN=1.55m REC=1.53m,99% RQD=85% | | | |
| 24 | 7 | | | | | | | | | |
| 26 | 8 | | | 73.99 | 4 | RC | RUN=1.52m REC=1.52m,100% RQD=100% | | | |
| 30 | 9 | | | | | | | | | |
| 32 | 10 | | | 72.47 | 5 | RC | RUN=1.55m REC=1.55m,100% RQD=95% | | | |
| 34 | | | | | | | | | | |
| 36 | 11 | | | 70.92 | 6 | RC | RUN=1.54m REC=1.54m,100% RQD=82% | | | |
| 38 | 12 | | | | | | | | | |
| 40 | | | | 69.37 | 7 | RC | RUN=1.55m REC=1.53m,99% RQD=93% | | | |
| 42 | 13 | | | | | | | | | |
| 44 | | | | | | | | | | |
| 46 | 14 | | | 67.82 | 8 | RC | RUN=1.48m REC=1.48m,100% RQD=78% | | | |
| 48 | 15 | | | | | | | | | |
| 50 | | Lab sample at 66.81m-66.38m (66.38m ASL) | | | | | | | | |
| 52 | 16 | | | 66.35 | | | | | | |
| | | End of BH at 15.62m BGS (66.35m ASL) | | | | | | | | |
| 54 | | | | | | | | | | |
| 56 | 17 | | | | | | | | | |
| 58 | | | | | | | | | | |

Groundwater Depth (m): 3.15m on 5 Feb, 2019

LOGGED: NL

CHECKED: CW



FISHER ENVIRONMENTAL LTD.

# LOG OF BOREHOLE NO. BH301(MW) SHEET. 1 of 2

PROJECT NO.: FE-P 19-9570Geo & 19-9571Hydro

PROJECT NAME: Geotechnical & Hydrogeological Investigation

LOCATION: 2097 Old Lakeshore Road, Burlington, ON

DRILLING METHOD: Mud Rotary

DRILLING DATE: 9 July, 2019

| DEPTH (feet) | DEPTH (metres) | DESCRIPTION | STRATA PLOT | ELEV. DEPTH (m) | SAMPLES Type | NO. | "N" VALUE | PENETRATION TESTING (SPT) ▲ / SHEAR STRENGTH (Kpa) ✤ | VAPOUR READING (ppm) □ / MOISTURE CONTENT (%) ○ | PIEZOMETER OR WELL CONSTRUCTION |
|---|---|---|---|---|---|---|---|---|---|---|
| | | GROUND SURFACE (m asl) | | 82.05 | | | | | | |
| 0 | 0 | 150mm Asphalt | | | | | | | | |
| 2 | | FILL: sand & silt, trace gravel, some roots, brown, slightly moist to dry. | | | SS | 1 | 14 | | | |
| 4 | 1 | 1.22m | | 80.83 | SS | 2 | 17 | | | |
| 6 | | SILT & CLAY: trace gravel, trace sand, brown, slightly moist. | | | SS | 3 | 38 | | | |
| | 2 | 2.13m | | 79.92 | | | | | | |
| 8 | | CLAY: trace gravel, and sand seams, red, dry, hard. | | | SS | 4 | 75 | | | |
| 10 | 3 | | | | SS | 5 | 100+ | | | |
| 12 | | Weathered shale starts at 3.96m. | | | | | | | | |
| | 4 | 4.11m | | 77.94 | | | | | | |
| 14 | | SHALE: Queenston formation, layered sedimentary deposit, grey siltstone layers, red, moist to dry, hard. | | | RC | 6 | Run=1.75m Rec=1.305m,75% RQD=70% | | | |
| 16 | 5 | | | | | | | | | |
| 18 | | | | | | | | | | |
| 20 | 6 | | | | RC | 7 | Run=1.95m Rec=1.350m,69% RQD=46% | | | |
| 22 | | | | | | | | | | |
| 24 | 7 | | | | | | | | | |
| 26 | | | | | RC | 8 | Run=1.58m Rec=1.529m,97% RQD=96% | | | |
| 28 | 8 | | | | | | | | | |
| 30 | | | | | RC | 9 | Run=1.55m Rec=1.485m,96% RQD=93% | | | |
| 32 | 9 | | | | | | | | | |
| 34 | | | | | | | | | | |
| 36 | 10 | | | | RC | 10 | Run=1.50m Rec=1.423m,95% RQD=80% | | | |
| 38 | | | | | | | | | | |
| 40 | 11 | | | | RC | 11 | Run=1.60m Rec=1.159m,72% RQD=60% | | | |
| 42 | | | | | | | | | | |
| 44 | 12 | | | | RC | 12 | Run=1.448m Rec=1.23m,93% RQD=85% | | | |
| 46 | | | | | | | | | | |
| 48 | 13 | | | | | | | | | |
| 50 | 14 | | | | | | | | | |
| | 15 | Continued | | | | | | | | |

Concrete

5.60

2" blank PVC

Bentonite Pellets

Groundwater Depth (m): On 9 August, 2019: 5.60m.

LOGGED: BL

CHECKED: CW

FISHER ENVIRONMENTAL LTD.

# LOG OF BOREHOLE NO. BH301(MW) SHEET. 2 of 2

PROJECT NO.: FE-P 19-9570Geo & 19-9571Hydro

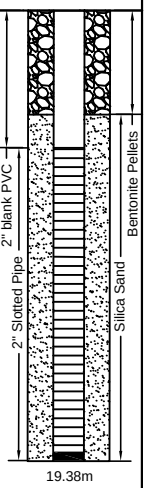
PROJECT NAME: Geotechnical & Hydrogeological Investigation

LOCATION: 2097 Old Lakeshore Road, Burlington, ON

DRILLING METHOD: Mud Rotary

DRILLING DATE: 9 July, 2019

| SOIL PROFILE | | | SAMPLES | | | PENETRATION TESTING (SPT) ▲ 20 40 60 80 / SHEAR STRENGTH (Kpa) ✤ 40 80 120 160 | VAPOUR READING (ppm) □ 20 40 60 80 / MOISTURE CONTENT (%) ○ 10 20 30 40 | PIEZOMETER OR WELL CONSTRUCTION |
|---|---|---|---|---|---|---|---|---|
| DEPTH (feet) / (metres) | DESCRIPTION | STRATA PLOT / ELEV. DEPTH (m) | TYPE | Number | "N" VALUE | | | |
| 50 / 16 | | | RC | 13 | Run=1.60m Rec=1.075m,67% RQD=40% | | | |
| 54 / 17 | | | RC | 14 | Run=1.45m Rec=1.30m,90% RQD=62% | | | |
| 58 / 18 | | | RC | 15 | Run=1.60m Rec=1.365m,85% RQD=79% | | | |
| 62 / 19 | 19.38m | 62.67 | | | | | | |
| 64 / 20 | End of Borehole at 19.38 bgs<br>MW installed at 19.38m. | | | | | | | |
| 66 / 68 / 70 / 72 / 74 / 76 / 78 / 80 / 82 / 84 / 86 / 88 / 90 / 92 / 94 / 96 / 98 / 100 | | | | | | | | |




Groundwater Depth (m): On 9 August, 2019: 5.60m.

LOGGED: BL

CHECKED: CW

# APPENDIX C – GRAIN SIZE AND HYDROMETER ANALYSES

FISHER ENVIRONMENTAL
ATTN: MARIUS VOINEA
15-400 ESNA PARK DRIVE
MARKHAM ON --

Date Received: 12-OCT-17
Report Date: 27-OCT-17 07:02 (MT)
Version: FINAL

Client Phone: 905-475-7755

# Certificate of Analysis

## Lab Work Order #: L2006307

Project P.O. #: NOT SUBMITTED
Job Reference: 17-8409
C of C Numbers: 15-611631
Legal Site Desc:

Mathy Mahadeva
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

GRAIN SIZE DETERMINATIONS

| | | | |
|---|---|---|---|
| **Client:** | FISHER ENVIRONMENTAL | Sample Location: | |
| Project Number: | 23379 | Sample ID: | BH3-SS2 (2.5' - 4,5') |
| Sampler: | | Sample Depth: | |
| Technician: | CB6 | Date Sampled: | 06-10-17 |
| **Lab ID Number:** | L2006307-1 | Date Submitted: | 12-10-17 |
| | | Date Completed: | 26-10-17 |

| | | | | | |
|---|---|---|---|---|---|
| Total Sample Weight | 174 | grams | Specific Gravity: | 2.650 | |
| Hydro. Sample Weight | 50.000 | grams | Liquid Specific Gravity: | 1.000 | |
| % Past #10 | 0.948 | * 100 | Grav Factor: | 1.606 | |
| Sub Factor | 3.300 | | | | |

| Sieve Size | Weight Retained (grams) | Percent Retained | Diameter (mm) | Cum. % Retained | Cum. % Passing |
|---|---|---|---|---|---|
| 38.1 mm. DIA.: | 0.000 | 0.000 | 38.100 | 0.000 | 100.000 |
| 25.4 mm. DIA.: | 0.000 | 0.000 | 25.400 | 0.000 | 100.000 |
| 19.0 mm. DIA.: | 0.000 | 0.000 | 19.000 | 0.000 | 100.000 |
| 9.5 mm. DIA.: | 6.000 | 3.448 | 9.500 | 3.448 | 96.552 |
| NO. 4 SIEVE : | 0.000 | 0.000 | 4.500 | 3.448 | 96.552 |
| NO. 10 SIEVE : | 3.000 | 1.724 | 2.000 | 5.172 | 94.828 |
| NO. 20 SIEVE : | 2.000 | 3.793 | 0.850 | 8.966 | 91.034 |
| NO. 40 SIEVE : | 1.000 | 1.897 | 0.425 | 10.862 | 89.138 |
| NO. 60 SIEVE : | 1.000 | 1.897 | 0.250 | 12.759 | 87.241 |
| NO. 100 SIEVE: | 1.000 | 1.897 | 0.150 | 14.655 | 85.345 |
| NO. 200 SIEVE: | 2.000 | 3.793 | 0.075 | 18.448 | 81.552 |

| Time (min) | Hydrometer Reading | Temperature (C) | Diameter (mm) | % Suspended (Subsample) | % Suspended (Total Sample) |
|---|---|---|---|---|---|
| 1.00 | 24.0 | 19.8 | 0.043 | 67.650 | 64.151 |
| 2.00 | 23.0 | 19.8 | 0.031 | 64.438 | 61.105 |
| 4.00 | 23.0 | 19.8 | 0.022 | 64.438 | 61.105 |
| 8.00 | 22.0 | 19.8 | 0.016 | 61.226 | 58.059 |
| 15.00 | 21.0 | 19.9 | 0.012 | 58.077 | 55.073 |
| 30.00 | 20.0 | 19.9 | 0.008 | 54.865 | 52.027 |
| 60.00 | 19.0 | 19.5 | 0.006 | 51.402 | 48.743 |
| 120.00 | 16.0 | 20.3 | 0.004 | 42.267 | 40.080 |
| 240.00 | 15.0 | 20.0 | 0.003 | 38.867 | 36.856 |
| 480.00 | 15.0 | 20.0 | 0.002 | 38.867 | 36.856 |
| 1440.00 | 13.0 | 20.0 | 0.001 | 32.442 | 30.764 |

| GRAIN SIZE | % BY WT. | DIA. RANGE (mm) |
|---|---|---|
| % GRAVEL : | 3.45 | > 4.5 |
| % COARSE SAND : | 1.72 | 2.0 - 4.5 |
| % MEDIUM SAND : | 5.69 | 0.425 - 2.0 |
| % FINE SAND : | 7.59 | 0.075 - 0.425 |
| % SILT : | 45.75 | 0.075 - 0.002 |
| % CLAY : | 35.80 | < 0.002 |
| % CLAY : | 44.01 | < 0.005 |

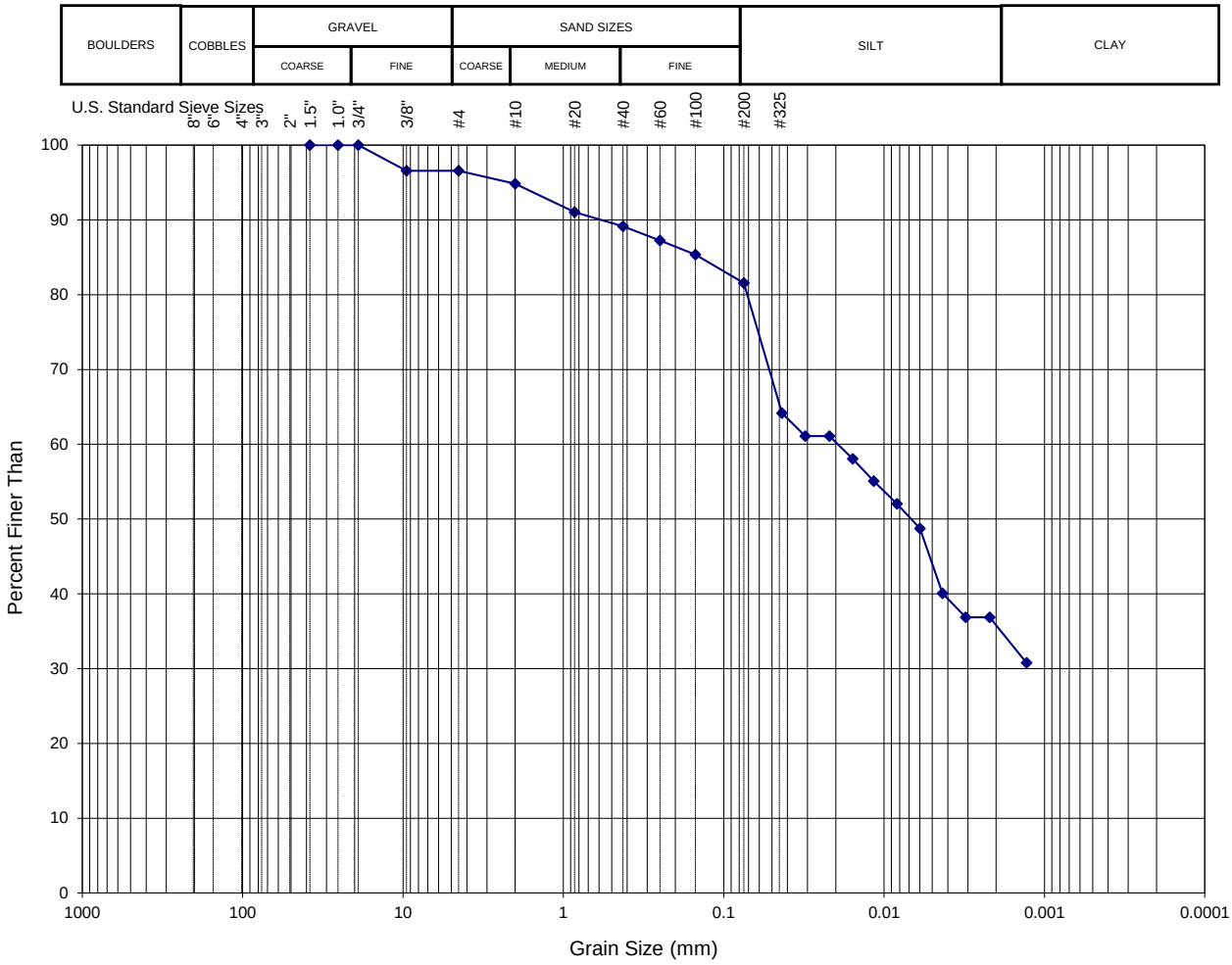
# ALS Environmental

**WATERLOO**

## PARTICLE SIZE DISTRIBUTION CURVE

ASTM METHOD D422-63

| | |
|---|---|
| **Project Name:** | FISHER ENVIRONMENTAL |
| **Project Number:** | 23379 |
| **Sample Location:** | |
| **Sample Number:** | BH3-SS2 (2.5' - 4,5') |
| **Sample Depth:** | |
| **Lab ID Number:** | L2006307-1 |
| **Technician:** | CB6 |
| **Sampler:** | |
| **Dates:** | |
| Collected On: | 06-10-17 |
| Analyzed: | 26-10-17 |




| DESCRIPTION | SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS | | SUMMARY | | |
|---|---|---|---|---|---|
| **SILT AND CLAY WITH SAND, TRACE GRAVEL** | AND | 36 - 50 % | GRAVEL | 3 | % |
| FINE GRAINED | ADJECTIVE (e.g. sandy) | 21 - 35 % | SAND | 15 | % |
| ESTIMATED HAZEN NUMBER: 4.56E-08 cm/s | WITH | 11 - 20 % | SILT + CLAY | 82 | % |
| **NOTE:** UNIFIED SOIL CLASSIFICATION SYSTEM | TRACE | 1 - 10 % | | | |

GRAIN SIZE DETERMINATIONS

| | | | |
|---|---|---|---|
| **Client:** | FISHER ENVIRONMENTAL | Sample Location: | |
| Project Number: | 23379 | Sample ID: | BH4-SS3 (5' - 7') |
| Sampler: | | Sample Depth: | |
| Technician: | CB6 | Date Sampled: | 06-10-17 |
| **Lab ID Number:** | L2006307-2 | Date Submitted: | 12-10-17 |
| | | Date Completed: | 26-10-17 |

| | | | | | |
|---|---|---|---|---|---|
| Total Sample Weight | 226 | grams | Specific Gravity: | 2.650 | |
| Hydro. Sample Weight | 50.000 | grams | Liquid Specific Gravity: | 1.000 | |
| % Past #10 | 0.951 | * 100 | Grav Factor: | 1.606 | |
| Sub Factor | 4.300 | | | | |

| Sieve Size | Weight Retained (grams) | Percent Retained | Diameter (mm) | Cum. % Retained | Cum. % Passing |
|---|---|---|---|---|---|
| 38.1 mm. DIA.: | 0.000 | 0.000 | 38.100 | 0.000 | 100.000 |
| 25.4 mm. DIA.: | 0.000 | 0.000 | 25.400 | 0.000 | 100.000 |
| 19.0 mm. DIA.: | 0.000 | 0.000 | 19.000 | 0.000 | 100.000 |
| 9.5 mm. DIA.: | 6.000 | 2.655 | 9.500 | 2.655 | 97.345 |
| NO. 4 SIEVE : | 1.000 | 0.442 | 4.500 | 3.097 | 96.903 |
| NO. 10 SIEVE : | 4.000 | 1.770 | 2.000 | 4.867 | 95.133 |
| NO. 20 SIEVE : | 0.000 | 0.000 | 0.850 | 4.867 | 95.133 |
| NO. 40 SIEVE : | 1.000 | 1.903 | 0.425 | 6.770 | 93.230 |
| NO. 60 SIEVE : | 0.000 | 0.000 | 0.250 | 6.770 | 93.230 |
| NO. 100 SIEVE: | 1.000 | 1.903 | 0.150 | 8.673 | 91.327 |
| NO. 200 SIEVE: | 2.000 | 3.805 | 0.075 | 12.478 | 87.522 |

| Time (min) | Hydrometer Reading | Temperature (C) | Diameter (mm) | % Suspended (Subsample) | % Suspended (Total Sample) |
|---|---|---|---|---|---|
| 1.00 | 30.0 | 19.8 | 0.040 | 86.923 | 82.692 |
| 2.00 | 28.0 | 19.8 | 0.029 | 80.499 | 76.581 |
| 4.00 | 27.0 | 19.8 | 0.021 | 77.287 | 73.525 |
| 8.00 | 26.0 | 19.8 | 0.015 | 74.075 | 70.469 |
| 15.00 | 24.0 | 19.9 | 0.011 | 67.713 | 64.417 |
| 30.00 | 22.0 | 19.9 | 0.008 | 61.289 | 58.306 |
| 60.00 | 21.0 | 19.5 | 0.006 | 57.826 | 55.012 |
| 120.00 | 18.0 | 20.3 | 0.004 | 48.691 | 46.321 |
| 240.00 | 16.0 | 20.0 | 0.003 | 42.079 | 40.031 |
| 480.00 | 16.0 | 20.0 | 0.002 | 42.079 | 40.031 |
| 1440.00 | 15.0 | 20.0 | 0.001 | 38.867 | 36.975 |

| GRAIN SIZE | % BY WT. | DIA. RANGE (mm) |
|---|---|---|
| % GRAVEL : | 3.10 | > 4.5 |
| % COARSE SAND : | 1.77 | 2.0 - 4.5 |
| % MEDIUM SAND : | 1.90 | 0.425 - 2.0 |
| % FINE SAND : | 5.71 | 0.075 - 0.425 |
| % SILT : | 47.95 | 0.075 - 0.002 |
| % CLAY : | 39.57 | < 0.002 |
| % CLAY : | 50.89 | < 0.005 |

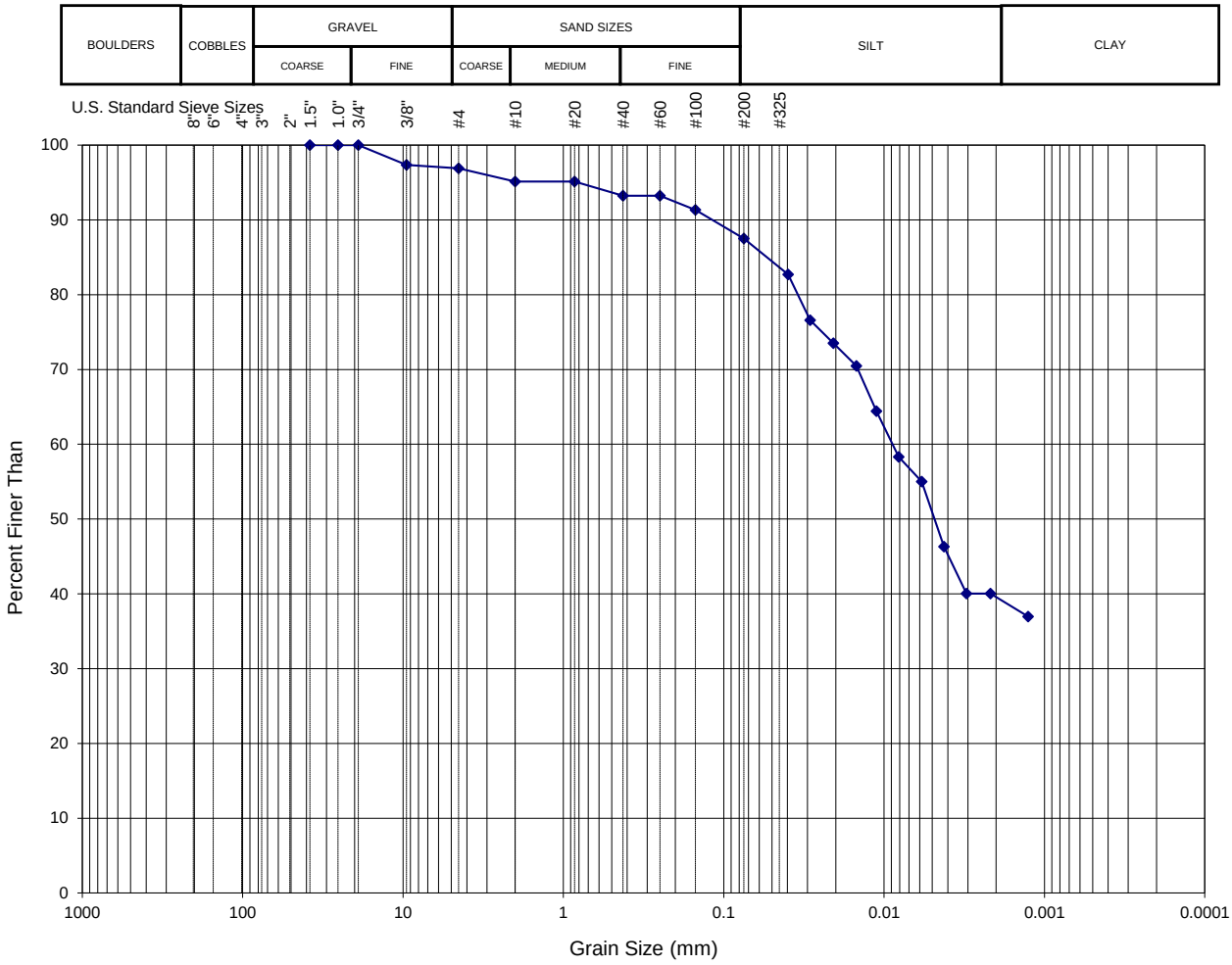
# ALS Environmental

**WATERLOO**

## PARTICLE SIZE DISTRIBUTION CURVE

ASTM METHOD D422-63

| | |
|---|---|
| **Project Name:** | FISHER ENVIRONMENTAL |
| **Project Number:** | 23379 |
| **Sample Location:** | |
| **Sample Number:** | BH4-SS3 (5' - 7') |
| **Sample Depth:** | |
| **Lab ID Number:** | L2006307-2 |
| **Technician:** | CB6 |
| **Sampler:** | |
| **Dates:** | |
| Collected On: | 06-10-17 |
| Analyzed: | 26-10-17 |




| DESCRIPTION | SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS | | SUMMARY | | |
|---|---|---|---|---|---|
| **SILT AND CLAY TRACE SAND, TRACE GRAVEL** | AND | 36 - 50 % | GRAVEL | 3 | % |
| FINE GRAINED | ADJECTIVE (e.g. sandy) | 21 - 35 % | SAND | 9 | % |
| ESTIMATED HAZEN NUMBER: 1.19E-10 cm/s | WITH | 11 - 20 % | SILT + CLAY | 88 | % |
| **NOTE:** UNIFIED SOIL CLASSIFICATION SYSTEM | TRACE | 1 - 10 % | | | |

GRAIN SIZE DETERMINATIONS

| | | | |
|---|---|---|---|
| **Client:** | FISHER ENVIRONMENTAL | Sample Location: | |
| Project Number: | 23379 | Sample ID: | BH5-SS2 (2.5' - 4,5') |
| Sampler: | | Sample Depth: | |
| Technician: | CB6 | Date Sampled: | 06-10-17 |
| **Lab ID Number:** | L2006307-3 | Date Submitted: | 12-10-17 |
| | | Date Completed: | 26-10-17 |

| | | | | | |
|---|---|---|---|---|---|
| Total Sample Weight | 183 | grams | Specific Gravity: | 2.650 | |
| Hydro. Sample Weight | 50.000 | grams | Liquid Specific Gravity: | 1.000 | |
| % Past #10 | 1.000 | * 100 | Grav Factor: | 1.606 | |
| Sub Factor | 3.660 | | | | |

| Sieve Size | Weight Retained (grams) | Percent Retained | Diameter (mm) | Cum. % Retained | Cum. % Passing |
|---|---|---|---|---|---|
| 38.1 mm. DIA.: | 0.000 | 0.000 | 38.100 | 0.000 | 100.000 |
| 25.4 mm. DIA.: | 0.000 | 0.000 | 25.400 | 0.000 | 100.000 |
| 19.0 mm. DIA.: | 0.000 | 0.000 | 19.000 | 0.000 | 100.000 |
| 9.5 mm. DIA.: | 0.000 | 0.000 | 9.500 | 0.000 | 100.000 |
| NO. 4 SIEVE : | 0.000 | 0.000 | 4.500 | 0.000 | 100.000 |
| NO. 10 SIEVE : | 0.000 | 0.000 | 2.000 | 0.000 | 100.000 |
| NO. 20 SIEVE : | 1.000 | 2.000 | 0.850 | 2.000 | 98.000 |
| NO. 40 SIEVE : | 1.000 | 2.000 | 0.425 | 4.000 | 96.000 |
| NO. 60 SIEVE : | 1.000 | 2.000 | 0.250 | 6.000 | 94.000 |
| NO. 100 SIEVE: | 1.000 | 2.000 | 0.150 | 8.000 | 92.000 |
| NO. 200 SIEVE: | 4.000 | 8.000 | 0.075 | 16.000 | 84.000 |

| Time (min) | Hydrometer Reading | Temperature (C) | Diameter (mm) | % Suspended (Subsample) | % Suspended (Total Sample) |
|---|---|---|---|---|---|
| 1.00 | 26.0 | 19.8 | 0.042 | 74.075 | 74.075 |
| 2.00 | 25.0 | 19.8 | 0.030 | 70.863 | 70.863 |
| 4.00 | 24.0 | 19.8 | 0.022 | 67.650 | 67.650 |
| 8.00 | 24.0 | 19.8 | 0.015 | 67.650 | 67.650 |
| 15.00 | 23.0 | 19.9 | 0.011 | 64.501 | 64.501 |
| 30.00 | 22.0 | 19.9 | 0.008 | 61.289 | 61.289 |
| 60.00 | 20.0 | 19.5 | 0.006 | 54.614 | 54.614 |
| 120.00 | 18.0 | 20.3 | 0.004 | 48.691 | 48.691 |
| 240.00 | 16.0 | 20.0 | 0.003 | 42.079 | 42.079 |
| 480.00 | 16.0 | 20.0 | 0.002 | 42.079 | 42.079 |
| 1440.00 | 15.0 | 20.0 | 0.001 | 38.867 | 38.867 |

| GRAIN SIZE | % BY WT. | DIA. RANGE (mm) |
|---|---|---|
| % GRAVEL : | 0.00 | > 4.5 |
| % COARSE SAND : | 0.00 | 2.0 - 4.5 |
| % MEDIUM SAND : | 4.00 | 0.425 - 2.0 |
| % FINE SAND : | 12.00 | 0.075 - 0.425 |
| % SILT : | 42.40 | 0.075 - 0.002 |
| % CLAY : | 41.60 | < 0.002 |
| % CLAY : | 51.69 | < 0.005 |

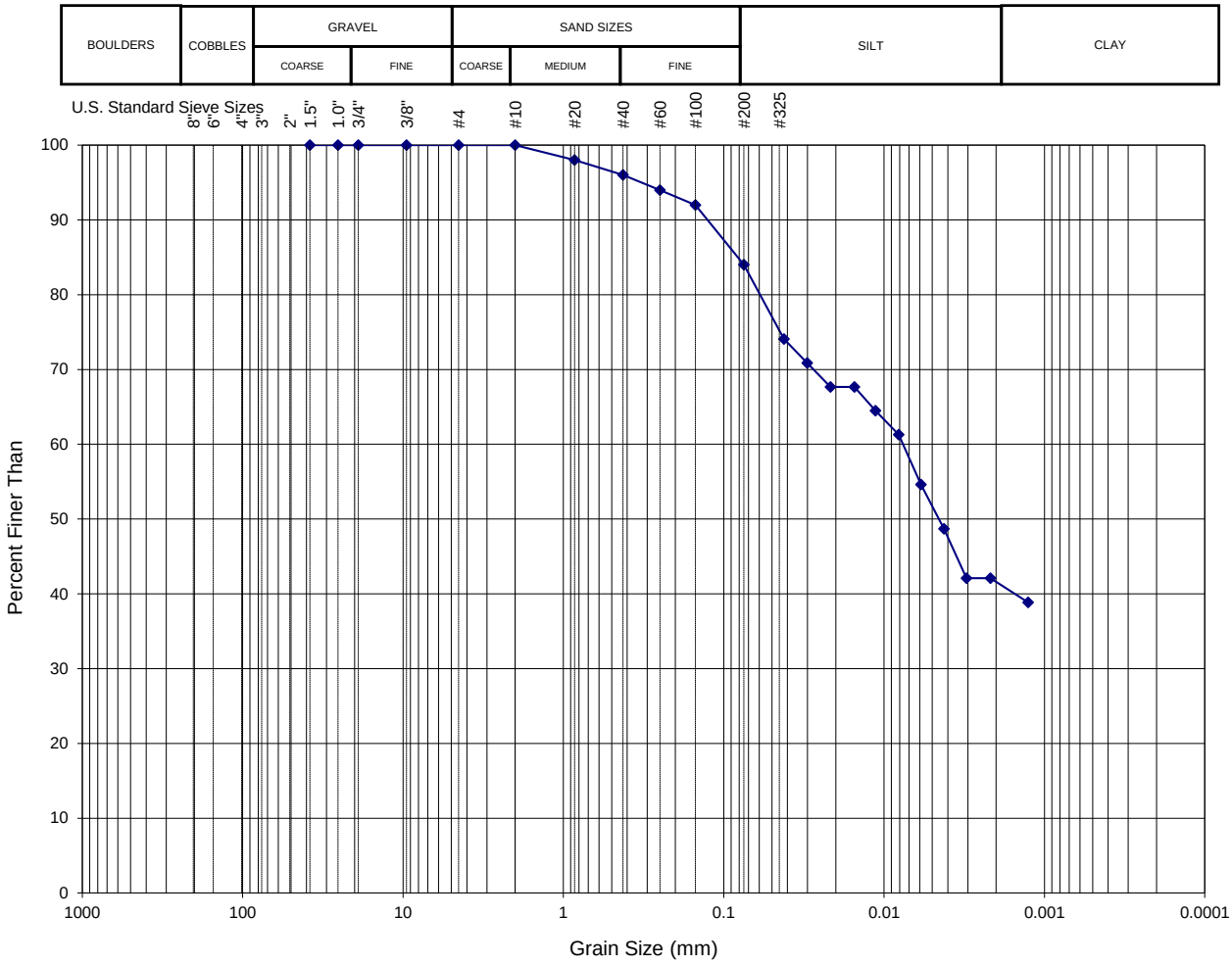
# ALS Environmental

**WATERLOO**

## PARTICLE SIZE DISTRIBUTION CURVE

ASTM METHOD D422-63

| | |
|---|---|
| **Project Name:** | FISHER ENVIRONMENTAL |
| **Project Number:** | 23379 |
| **Sample Location:** | |
| **Sample Number:** | BH5-SS2 (2.5' - 4,5') |
| **Sample Depth:** | |
| **Lab ID Number:** | L2006307-3 |
| **Technician:** | CB6 |
| **Sampler:** | |
| **Dates:** | |
| Collected On: | 06-10-17 |
| Analyzed: | 26-10-17 |




| DESCRIPTION | SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS | | SUMMARY | | |
|---|---|---|---|---|---|
| **SILT AND CLAY WITH SAND** | AND | 36 - 50 % | GRAVEL | 0 | % |
| FINE GRAINED | ADJECTIVE (e.g. sandy) | 21 - 35 % | SAND | 16 | % |
| ESTIMATED HAZEN NUMBER: 1.00E-10 cm/s | WITH | 11 - 20 % | SILT + CLAY | 84 | % |
| **NOTE:** UNIFIED SOIL CLASSIFICATION SYSTEM | TRACE | 1 - 10 % | | | |

ALS Environmental
www.alsglobal.com

# Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2006307-COFC

COC Number: 15 - 611631

Page 1 of 1

| Report To | Contact and company name below will appear on the final report | Report Format / Distribution | Select Service Level below - Please confirm all E&P TATs with your AM - surcharges will apply |
|---|---|---|---|
| Company: | FISHER ENVIRONMENTAL LTD. | Select Report Format: ☒ PDF ☐ EXCEL ☐ EDD (DIGITAL) | Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply |
| Contact: | MARIUS VOINEA | Quality Control (QC) Report with Report ☒ YES ☐ NO | PRIORITY (Business Days): 4 day [P4] ☐ / 3 day [P3] ☐ / 2 day [P2] ☐ — EMERGENCY: 1 Business day [E1] ☐ / Same Day, Weekend or Statutory holiday [E0] ☐ |
| Phone: | (905) 475-7755 | ☐ Compare Results to Criteria on Report - provide details below if box checked | |
| | Company address below will appear on the final report | Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX | |
| Street: | 400 ESNA PARK DR, #15 | Email 1 or Fax | Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm |
| City/Province: | MARKHAM, ON | Email 2 marius@fisherenvironmental.com | For tests that can not be performed according to the service level selected, you will be contacted. |
| Postal Code: | L3R 3K2 | Email 3 | |
| Invoice To | Same as Report To ☒ YES ☐ NO | Invoice Distribution | Analysis Request |
| | Copy of Invoice with Report ☐ YES ☐ NO | Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX | Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below |
| Company: | | Email 1 or Fax | |
| Contact: | | Email 2 | |

| Project Information | | Oil and Gas Required Fields (client use) | |
|---|---|---|---|
| ALS Account # / Quote #: | | AFE/Cost Center: | PO# |
| Job #: | 17-8409 | Major/Minor Code: | Routing Code: |
| PO / AFE: | | Requisitioner: | |
| LSD: | | Location: | |
| ALS Lab Work Order # (lab use only) | L2006307 | ALS Contact: M | Sampler: |

| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | GRAIN SIZE + HYDROMETER | Number of Containers |
|---|---|---|---|---|---|---|
| 1 | BH3-SS2 (2.5'-4.5') | 6/10/17 | | SOIL | X | 1 |
| 2 | BH4-SS3 (5'-7') | " | | SOIL | X | 1 |
| 3 | BH5-SS2 (2.5'-4.5') | " | | SOIL | X | 1 |

| Drinking Water (DW) Samples' (client use) | Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only) |
|---|---|
| Are samples taken from a Regulated DW System? ☐ YES ☒ NO | |
| Are samples for human drinking water use? ☐ YES ☐ NO | |

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

| INITIAL COOLER TEMPERATURES °C | | | FINAL COOLER TEMPERATURES °C | | |
|---|---|---|---|---|---|
| 21.3 | | | 18.1 | | |

| SHIPMENT RELEASE (client use) | | | INITIAL SHIPMENT RECEPTION (lab use only) | | | FINAL SHIPMENT RECEPTION (lab use only) | | |
|---|---|---|---|---|---|---|---|---|
| Released by: MARIUS VOINEA | Date: Oct. 12/2017 | Time: 2:10 | Received by: CB | Date: Oct/12/17 | Time: 14:10 | Received by: RW | Date: 04-12-2017 | Time: 16:00 |

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

# APPENDIX D - CHEMICAL ANALYSES - SOIL

# FISHER ENVIRONMENTAL LABORATORIES

FULL RANGE ANALYTICAL SERVICES • SOIL/WATER/AIR TESTING • ENVIRONMENTAL COMPLIANCE PACKAGES • 24 HOUR EMERGENCY RESPONSE • CALA ACCREDITED

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www.fisherenvironmental.com


***Client:*** Core Development Group
***Address:*** 287 MacPherson Ave, #101
Toronto, ON
M3V 1A4
***Tel.:*** (416) 966-2673
***Email:*** bryan@coredevelopment.ca
***Attn.:*** Bryan Nykoliation

***F.E. Job #:*** 17-7311
***Project Name:*** Geotechnical Investigation
***Project #:*** FE-P-17-8421
***Date Sampled:*** 6-Oct-17
***Date Received:*** 11-Oct-17
***Date Reported:*** 18-Oct-17
***Location:*** Old Lakeshore & Lakeshore Rd
Burlington, ON

# Certificate of Analysis

| Analyses | Matrix | Quantity | Date Extracted | Date Analyzed | Lab SOP | Method Reference |
|---|---|---|---|---|---|---|
| Chloride | Soil | 3 | 17-Oct-17 | 17-Oct-17 | Chloride F-20 | SM 4500-Cl-E |
| Sulphate | Soil | 3 | 17-Oct-17 | 17-Oct-17 | Sulphate F-21 | SM 4500-$SO_4$ |
| pH | Soil | 3 | 11-Oct-17 | 11-Oct-17 | pH-EC-SAR F-16 | SW-846, 9045D |

Fisher Environmental Laboratories is accredited by CALA (the Canadian Association for Laboratory Accreditation Inc.) for specific parameters as required by Ontario Regulation 153/04. All analytical testing has been performed in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act published by Ontario Ministry of the Environment.

***Authorized by:***




*Roger Lin, Ph. D., C. Chem.*
*Laboratory Manager*



*Results relate only to the items tested*

# Certificate of Analysis

| | |
|---|---|
| ***Analysis Requested:*** | Chloride, Sulphate, pH |
| ***Sample Description:*** | 3 Soil Samples |

| **Parameter** | ***17-7311-1*** BH1 3.00-3.60m | ***17-7311-2*** BH3 0.00-0.60m | ***17-7311-3*** BH4 3.00-3.60m | | | |
|---|---|---|---|---|---|---|
| ***Chloride*** *(mg/kg)* | 103 | 101 | 69 | | | |

# QA/QC Report

| **Parameter** | **Blank** | **RL** | **MS (%)** | **AR** | **Duplicate** | **AR** |
|---|---|---|---|---|---|---|
| | **(mg/kg)** | | **Recovery (%)** | | **RPD (%)** | |
| ***Chloride*** | <5 | 5 | 120 | 70-130 | 3 | 0-30 |

***LEGEND:***

RL - Reporting Limit
MS - Matrix Spike
AR - Acceptable Range
RPD - Relative Percent Difference



*Results relate only to the items tested*

# Certificate of Analysis

| | |
|---|---|
| ***Analysis Requested:*** | Chloride, Sulphate, pH |
| ***Sample Description:*** | 3 Soil Samples |

| **Parameter** | ***17-7311-1*** BH1 3.00-3.60m | ***17-7311-2*** BH3 0.00-0.60m | ***17-7311-3*** BH4 3.00-3.60m | | | |
|---|---|---|---|---|---|---|
| ***Sulphate*** *(mg/kg)* | 35 | 233 | 131 | | | |

# QA/QC Report

| **Parameter** | **Blank** | **RL** | **LCS/Spike** | **AR** | **Duplicate** | **AR** |
|---|---|---|---|---|---|---|
| | **(mg/kg)** | | **Recovery (%)** | | **RPD (%)** | |
| ***Sulphate*** | <0.1 | 0.1 | 95 | 70-130 | 15 | 0-30 |

***LEGEND:***
RL - Reporting Limit
LCS - Laboratory Control Sample
AR - Acceptable Range
RPD - Relative Percent Difference



*Results relate only to the items tested*

# Certificate of Analysis

| | |
|---|---|
| ***Analysis Requested:*** | Chloride, Sulphate, pH |
| ***Sample Description:*** | 3 Soil Samples |

| **Parameter** | ***17-7311-1*** BH1 3.00-3.60m | ***17-7311-2*** BH3 0.00-0.60m | ***17-7311-3*** BH4 3.00-3.60m | | | |
|---|---|---|---|---|---|---|
| ***pH*** *(pH unit)* | 8.15 | 7.45 | 8.17 | | | |

# QA/QC Report

| **Parameter** | **LCS** | **AR** | **Duplicate** | **AR** | | |
|---|---|---|---|---|---|---|
| | | | **Absolute Difference** *(pH Unit)* | | | |
| ***pH*** *(pH unit)* | 7.38 | 7.00-7.40 | 0.03 | <0.3 | | |

***LEGEND:***
LCS - Laboratory Control Sample
AR - Acceptable Range



*Results relate only to the items tested*

# APPENDIX E - CHEMICAL ANALYSES - WATER

# FISHER ENVIRONMENTAL LABORATORIES

FULL RANGE ANALYTICAL SERVICES • SOIL/WATER/AIR TESTING • ENVIRONMENTAL COMPLIANCE PACKAGES • 24 HOUR EMERGENCY RESPONSE • CALA ACCREDITED

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***Client:*** Core Development Group
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Toronto, ON
M3V 1A4
***Tel.:*** (416) 966-2673
***Email:*** bryan@coredevelopment.ca
***Attn.:*** Bryan Nykoliation

***F.E. Job #:*** 17-7343
***Project Name:*** Geotechnical Investigation
***Project #:*** FE-P-17-8421
***Date Sampled:*** 16-Oct-17
***Date Received:*** 16-Oct-17
***Date Reported:*** 23-Oct-17
***Location:*** Old Lakeshore & Lakeshore Rd
Burlington, ON

# Certificate of Analysis

| Analyses | Matrix | Quantity | Date Extracted | Date Analyzed | Lab SOP | Method Reference |
|---|---|---|---|---|---|---|
| Chloride | Water | 3 | N/A | 17-Oct-17 | Chloride F-20 | SM 4500-Cl-E |
| Sulphate | Water | 3 | N/A | 17-Oct-17 | Sulphate F-21 | SM 4500-$SO_4$ |
| pH | Water | 3 | N/A | 16-Oct-17 | pH-EC-SAR F-16 | SW-846, 9045D |

Fisher Environmental Laboratories is accredited by CALA (the Canadian Association for Laboratory Accreditation Inc.) for specific parameters as required by Ontario Regulation 153/04. All analytical testing has been performed in accordance with ISO 17025 and the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act published by Ontario Ministry of the Environment.

***Authorized by:***

*Roger Lin, Ph. D., C. Chem.*
*Laboratory Manager*

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
Ronggen (Roger) Lin
CHEMIST



*Results relate only to the items tested*

# Certificate of Analysis

| | |
|---|---|
| ***Analysis Requested:*** | Chloride, Sulphate, pH |
| ***Sample Description:*** | 3 Water Samples |

| **Parameter** | ***17-7343-1*** BH1 | ***17-7343-2*** BH3 | ***17-7343-3*** BH4 | | | |
|---|---|---|---|---|---|---|
| ***Chloride*** *(mg/L)* | 185 | 336 | 519 | | | |

# QA/QC Report

| **Parameter** | **Blank** | **RL** | **MS (%)** | **AR** | **Duplicate** | **AR** |
|---|---|---|---|---|---|---|
| | **(mg/L)** | | **Recovery (%)** | | **RPD (%)** | |
| ***Chloride*** | <5 | 5 | 120 | 70-130 | 3 | 0-30 |

***LEGEND:***

RL - Reporting Limit
MS - Matrix Spike
AR - Acceptable Range
RPD - Relative Percent Difference



*Results relate only to the items tested*

# Certificate of Analysis

| | |
|---|---|
| ***Analysis Requested:*** | Chloride, Sulphate, pH |
| ***Sample Description:*** | 3 Water Samples |

| **Parameter** | ***17-7343-1*** BH1 | ***17-7343-2*** BH3 | ***17-7343-3*** BH4 | | | |
|---|---|---|---|---|---|---|
| ***Sulphate*** *(mg/L)* | 113 | 71 | 203 | | | |

# QA/QC Report

| **Parameter** | **Blank** | **RL** | **LCS/Spike** | **AR** | **Duplicate** | **AR** |
|---|---|---|---|---|---|---|
| | **(mg/L)** | | **Recovery (%)** | | **RPD (%)** | |
| ***Sulphate*** | <0.1 | 0.1 | 95 | 70-130 | 15 | 0-30 |

***LEGEND:***

RL - Reporting Limit
LCS - Laboratory Control Sample
AR - Acceptable Range
RPD - Relative Percent Difference



*Results relate only to the items tested*

# Certificate of Analysis

| | |
|---|---|
| ***Analysis Requested:*** | Chloride, Sulphate, pH |
| ***Sample Description:*** | 3 Water Samples |

| **Parameter** | ***17-7343-1*** BH1 | ***17-7343-2*** BH3 | ***17-7343-3*** BH4 | | | |
|---|---|---|---|---|---|---|
| ***pH*** *(pH unit)* | 7.40 | 7.10 | 6.96 | | | |

# QA/QC Report

| **Parameter** | **LCS** | **AR** | **Duplicate** | **AR** | | |
|---|---|---|---|---|---|---|
| | | | **Absolute Difference** *(pH Unit)* | | | |
| ***pH*** *(pH unit)* | 7.38 | 7.00-7.40 | 0.03 | <0.3 | | |

***LEGEND:***
LCS - Laboratory Control Sample
AR - Acceptable Range



*Results relate only to the items tested*

# FISHER ENVIRONMENTAL LABORATORIES

FULL RANGE ANALYTICAL SERVICES • SOIL/WATER/AIR TESTING • ENVIRONMENTAL COMPLIANCE PACKAGES • 24 HOUR EMERGENCY RESPONSE • CALA ACCREDITED

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***Client:*** Core Development Group Ltd.
***Address:*** 287 MacPherson Ave, Suite202
Toronto, ON
M4V 1A4
***Tel:*** (416) 966-2673
***Email:*** bryan@coredevelopment.ca
***Attn.:*** Bryan Nykoliation

***F.E. Job #:*** 19-1924
***Project Name:*** Hydrogeological Investigation
***Project ID:*** FE-P-19-9256
***Date Sampled:*** 11-Feb-19
***Date Received:*** 12-Feb-19
***Date Reported:*** 14-Feb-19
***Location:*** 2100 Lakeshore Rd
Burlington, ON

# Certificate of Analysis

| Analyses | Matrix | Quantity | Date Extracted | Date Analyzed | Lab SOP | Method Reference |
|---|---|---|---|---|---|---|
| Chloride | Water | 1 | N/A | 14-Feb-19 | Chloride F-20 | SM 4500-Cl-E |
| Sulphate | Water | 1 | N/A | 14-Feb-19 | Sulphate F-21 | SM 4500-$SO_4$ |
| pH | Water | 1 | N/A | 14-Feb-19 | pH-EC-SAR F-16 | SW-846, 9045D |

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***Authorized by:***

*Roger Lin, Ph. D., C. Chem.*
*Laboratory Manager*

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
Ronggen (Roger) Lin
CHEMIST



*Results related only to the items tested*

# Certificate of Analysis

| | |
|---|---|
| ***Analysis Requested:*** | Chloride, Sulphate, pH |
| ***Sample Description:*** | 1 Water Sample |

| **Parameter** | ***19-1924-1*** MW205 | | | | | **Ground Water Standards [1]** |
|---|---|---|---|---|---|---|
| ***Chloride*** *(ug/L)* | 196,000 | | | | | 2,300,000 |

< result obtained was below RL (Reporting Limit).
**Bold**: Result exceeds limit noted in Ground Water Standards.
[1] MOE - Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, April 15, 2011.
**Table 3**: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition.
All Types of Property Use.

# QA/QC Report

| **Parameter** | **Blank** | **RL** | **LCS** | **AR** | **MS** | **AR** |
|---|---|---|---|---|---|---|
| | **(ug/L)** | | **Recovery (%)** | | **Recovery (%)** | |
| ***Chloride*** | <1000 | 1000 | 93 | 70-130 | 120 | 70-130 |

| **Parameter** | **Duplicate** | **AR** | | | | |
|---|---|---|---|---|---|---|
| | **RPD (%)** | | | | | |
| ***Chloride*** | 2.5 | 0-20 | | | | |

***LEGEND:***
RL - Reporting Limit
MS - Matrix Spike
AR - Acceptable Range
RPD - Relative Percent Difference



*Results related only to the items tested*

# Certificate of Analysis

| | |
|---|---|
| ***Analysis Requested:*** | Chloride, Sulphate, pH |
| ***Sample Description:*** | 1 Water Sample |

| **Parameter** | ***19-1924-1*** MW205 | | | | | **Ground Water Standards [1]** |
|---|---|---|---|---|---|---|
| ***Sulphate*** *(ug/L)* | 109000 | | | | | N/A |

N/A : Not Available.
< result obtained was below RL (Reporting Limit).
[1] MOE - Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, April 15, 2011.
**Table 3**: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition.
All Types of Property Use; ( ) Standard value in brackets applies to medium and fine textured soils.

# QA/QC Report

| **Parameter** | **Blank** | **RL** | **LCS** | **AR** | **MS** | **AR** |
|---|---|---|---|---|---|---|
| | **(ug/L)** | | **Recovery (%)** | | **Recovery (%)** | |
| ***Sulphate*** | <100 | 100 | 98 | 70-130 | 128 | 70-130 |

| **Parameter** | **Duplicate** | **AR** | | | | |
|---|---|---|---|---|---|---|
| | **RPD (%)** | | | | | |
| ***Sulphate*** | 1.0 | 0-20 | | | | |

***LEGEND:***
RL - Reporting Limit
LCS - Laboratory Control Sample
AR - Acceptable Range
RPD - Relative Percent Difference



*Results related only to the items tested*

# Certificate of Analysis

| | |
|---|---|
| ***Analysis Requested:*** | Chloride, Sulphate, pH |
| ***Sample Description:*** | 1 Water Sample |

| **Parameter** | ***19-1924-1*** MW205 | | | | | **Ground Water Standards** [1] |
|---|---|---|---|---|---|---|
| ***pH*** *(pH unit)* | 8.41 | | | | | N/A |

N/A : Not Available.

[1] MOE - Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, April 15, 2011.

**Table 3**: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition.

All Types of Property Use; ( ) Standard value in brackets applies to medium and fine textured soils.

# QA/QC Report

| **Parameter** | **LCS** | **AR** | **Duplicate** | **AR** | | |
|---|---|---|---|---|---|---|
| | | | **Absolute Difference** *(pH Unit)* | | | |
| ***pH*** *(pH unit)* | 7.01 | 6.90-7.10 | 0.03 | <0.3 | | |

***LEGEND:***

LCS - Laboratory Control Sample

AR - Acceptable Range



*Results related only to the items tested*

# APPENDIX F – ROCK CORE COMPRESSIVE STRENGTH TESTS AND PHOTOS

AGS ASSOCIATES INC.
Geotechnical, Materials,
Building Science & Environmental
Testing and Inspection

# COMPRESSIVE STRENGTH OF DRILLED CORES

**CLIENT:** **FISHER ENVIRONMENTAL LTD.**
400 Esna Park Drive, Unit # 15
Markham, ON
L3R 3K2

**Attention:** Mr. Sean Fisher, P. Eng.

**AGS File No.:** **809 - 17**
**Date Reported :** October 17, 2017
**Date Cored :** October 5 & 6, 2017
**Date Received :** October 11, 2017
**PROJECT No.:** 17 - 8409
Specified 28 Day Strength: N / A Mpa

| Core No. | AGS Lab No. | Test Date | Location on Structure / Core Descriptions | Mass of test portion of Core (Kg) | Length of test portion of Core (mm) | Ave. Dia of Core (mm) | Max. Applied Load KN | Compressive Strength (Corrected) Mpa | Type of Fracture |
|---|---|---|---|---|---|---|---|---|---|
| BH. # 1 | 1501 | Oct. 16, 2017 | 2093 Old Lakeshore Rd. | 0.399 | 83.0 | 50.0 | 95.36 | 47.1 | MTO Type 2 |
| | | | | | | | | | |
| BH. # 2 | 1502 | Oct. 16, 2017 | 2096 Old Lakeshore Rd. | 0.389 | 87.0 | 50.0 | 96.16 | 47.5 | MTO Type 2 |
| | | | | | | | | | |
| BH. # 5 | 1503 | Oct. 16, 2017 | 2101 Old Lakeshore Rd. | 0.415 | 89.0 | 50.0 | 110.3 | 54.5 | MTO Type 2 |
| | | | Burlington | | | | | | |
| | | | | | | | | | |

**Remarks:**

- Three core samples were brought to our laboratory on October 11, 2017.
- The cores were visually examined , saw cut & tested for compression Test.
- As received Core Length
  B.H. # 1 = 317 mm
  B.H. # 2 = 390 mm
  B.H. # 5 = 399 mm

A. Chohan, B.Sc., C.E.T.

DS Consultants Ltd.
Geotechnical, Materials,
Building Science & Environmental
Testing and Inspection

# COMPRESSIVE STRENGTH OF DRILLED CORES

**Client :** **FISHER ENVIRONMENTAL LTD.**
**Client File # :** **19-9255**

**Address :** 400 Esna Park Drive, Unit # 15
Markham, ON
L3R 3K2

**DS Project No.:** **18 -590-200**
**DS File #:** **809-18**

**Date Reported :** 14-Feb-18
**Date Sampled :** 1 & 5 Feb 2019
**Date Received :** 8-Feb-19

**Attention:** Mr. Sean Fisher, P. Eng.

**Specified 28 Day Strength (MPa):** N/A

| Core No. | DS Lab No. | Test Date | Location on Structure / Core Descriptions | Mass of Test portion of Core (Kg) | Length of test portion of Core (mm) | Ave. Dia of Core (mm) | Max. Applied Load KN | Compressive Strength (Corrected) MPa | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| BH. #205 (RS-1) | 120 | 14-Feb-19 | B.H. 205 @ 40' - 0" 2100 Lakeshore, Burlington | 0.70 | 125 | 62.0 | 226.4 | 75.0 | See attachment |
| BH. #205 (RS-2) | 121 | 14-Feb-19 | B.H. 205 @ 50' - 0" 2100 Lakeshore, Burlington | 0.75 | 126 | 62.0 | 165.5 | 54.8 | See attachment |
| BH. #206 (RS-1) | 122 | 14-Feb-19 | 2100 Lakeshore, Burlington | 0.65 | 120.0 | 62.0 | 177.0 | 58.6 | See attachment |
| BH. #206 (RS-2) | 123 | 14-Feb-19 | 2100 Lakeshore, Burlington | 0.70 | 125.0 | 62.0 | 150.3 | 49.8 | See attachment |
| | | | | | | | | | |

**Remarks:**

- Four core samples were brought to our laboratory on February 08, 2019.
- The cores were saw cut and tested.
- Visual observations are attached herewith
- As received Core Length and Mass
  B.H. # 205 (RS-1) = 497 mm, 4.13 Kg
  B.H. # 205 (RS-2) = 324 mm, 2.68 Kg
  B.H. # 206 (Rs-1) = 268 mm, 2.23 Kg
  B.H. # 206 (Rs-2) = 416 mm, 3.43 Kg

Amer Taslim, P. Eng.
Supervisor Quality Control - Concrete Department

# DS Consultants Ltd.

6201 Highway 7, Unit 4
Vaughan, ON L4H 0K7
Tel: 905 264 9393


## CONCRETE LABORATORY

### Rock CORE STRENGTH TEST REPORT

(CSA - A 23.2 - 14C)

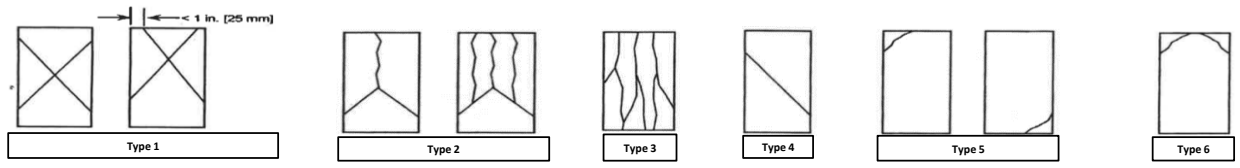
**Project Name: 2093 Old Lakeshore Road, Burlington**
**Project No.:** 19-9570
**Lab No.: V**C-0270 & VC-0271

**DS Project NO. 18-590-200**

**Date Cast:**
**Date Received:**
**Tested By:** K.Meet
**Reporting By:** S.Kirupa

| Core Sample Information | | | | |
|---|---|---|---|---|
| **Core No.** | **A** | **B** | | |
| Location in structure | Rock Core at 50 ' | Rock Core at 47' - 48.5' | | |
| Lab No. | VC-0270 | VC-0271 | | |
| Date Tested | 02-Aug-19 | 02-Aug-19 | | |
| Specified Strength (Mpa) | | | | |
| **Age (days)** | | | | |
| Average Diameter (mm) | 63.0 | 64.0 | | |
| Length after grinding (mm) | 121.0 | 124.0 | | |
| Weight (kg) | 1.00 | 1.00 | | |
| Load (N) | 64500 | 81400 | | |
| Density (kg/m³) | 2651 | 2507 | | |
| **Compressive Strength (Mpa)** | **20.7** | **25.3** | | |
| Type of Failure * | T2 | T2 | | |
| Moisture Condition at the time of test | Moist | Moist | | |
| **Remarks** | | | | |

* Type of Failure :




Issued by: _____

**S.Kirupaharan**
Laboratory Supervisor

# Cores Before Testing

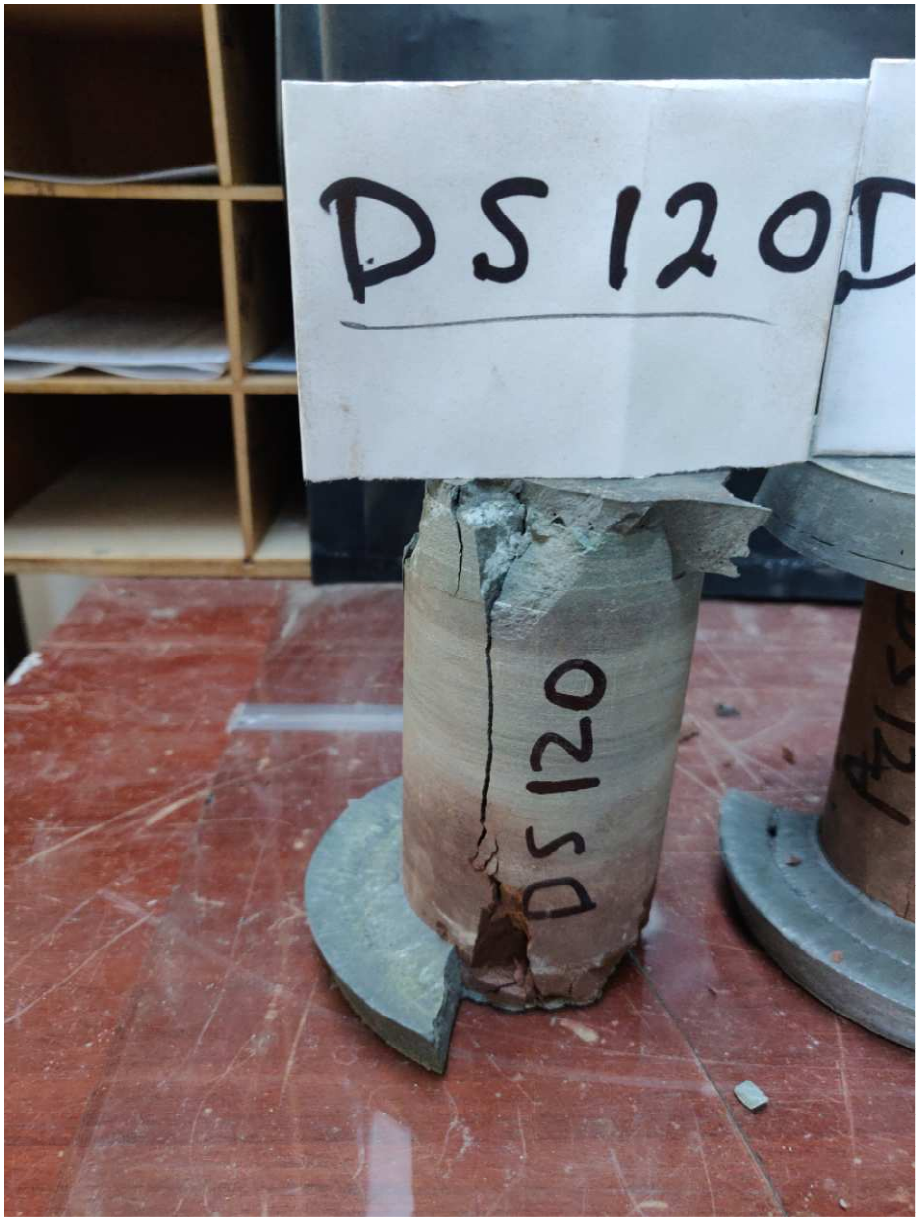




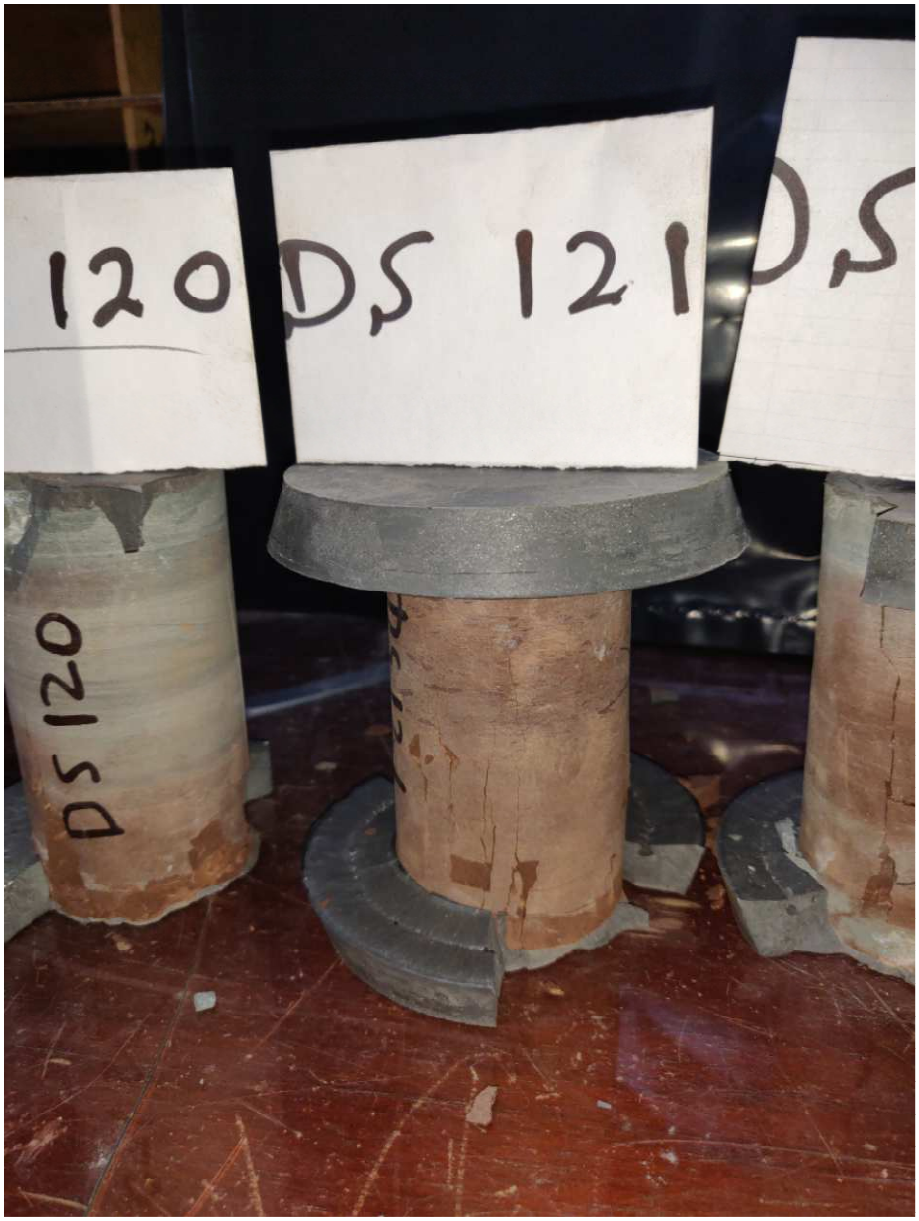

**Cores Before Testing**

# Cores After Testing

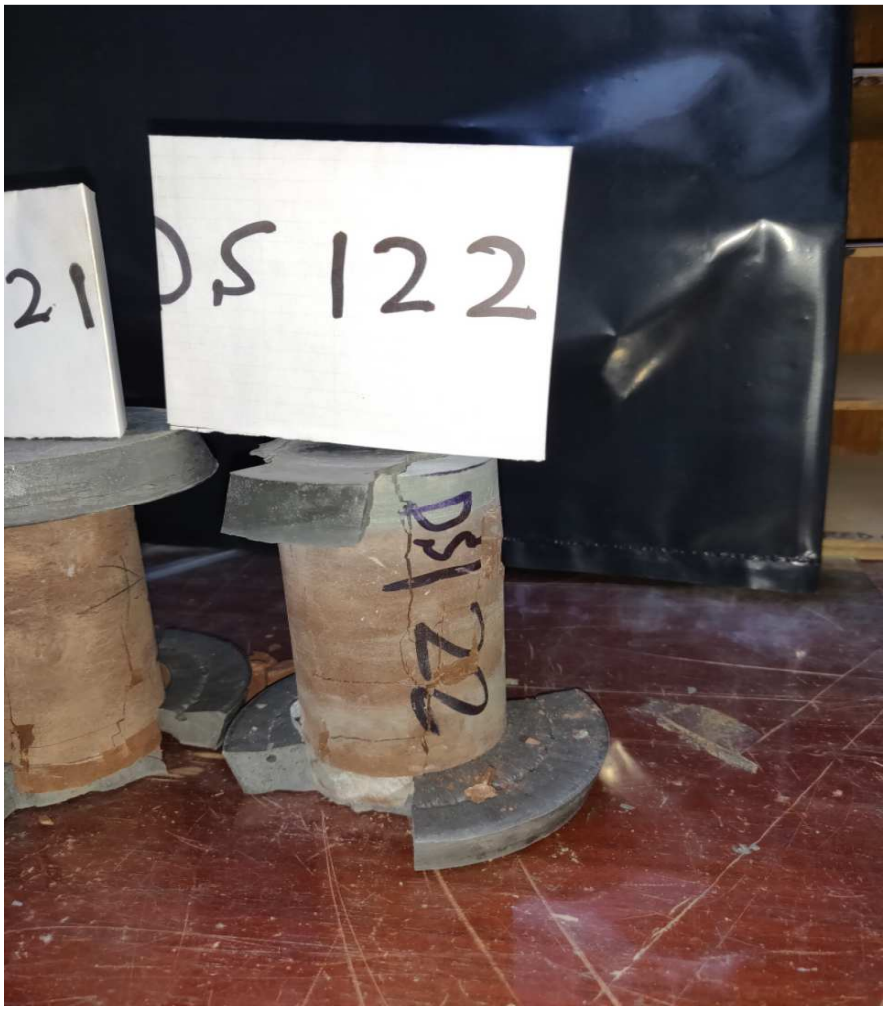




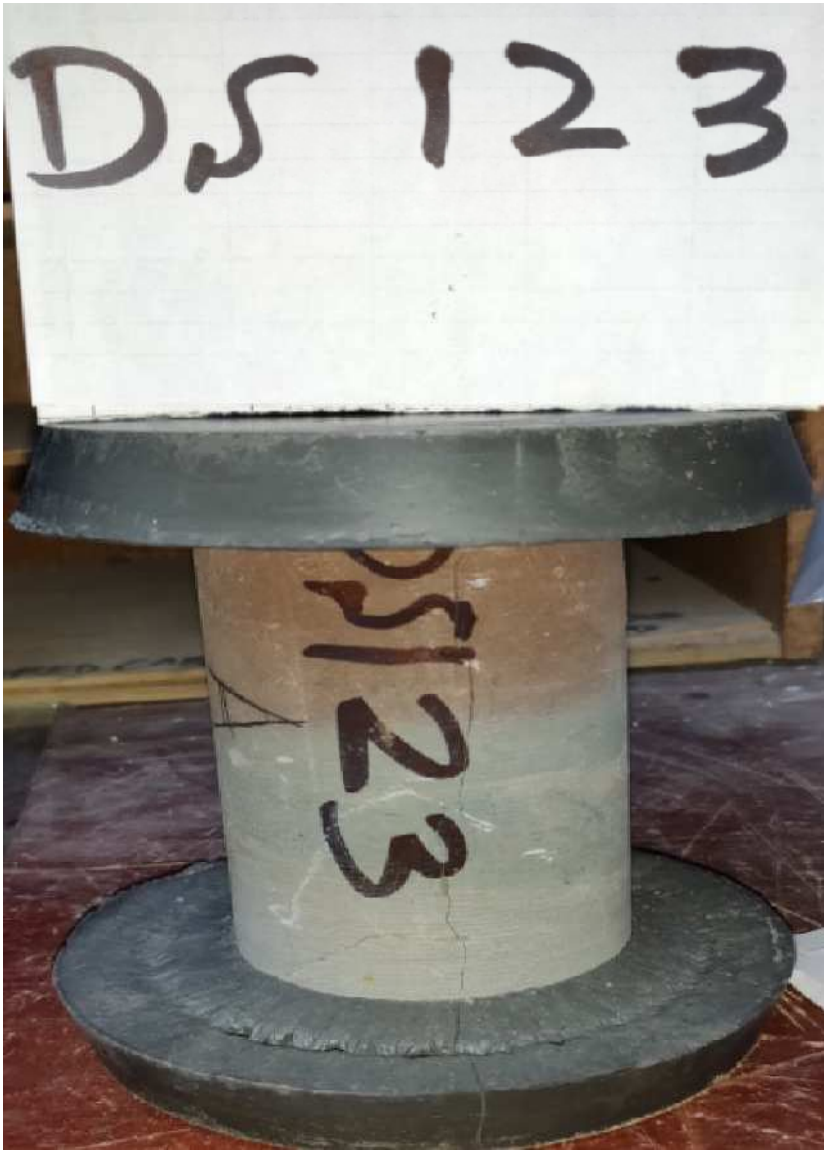

**Cores After Testing**




**Cores After Testing**




**Cores After Testing**




**Cores After Testing**

# Cores Before Testing

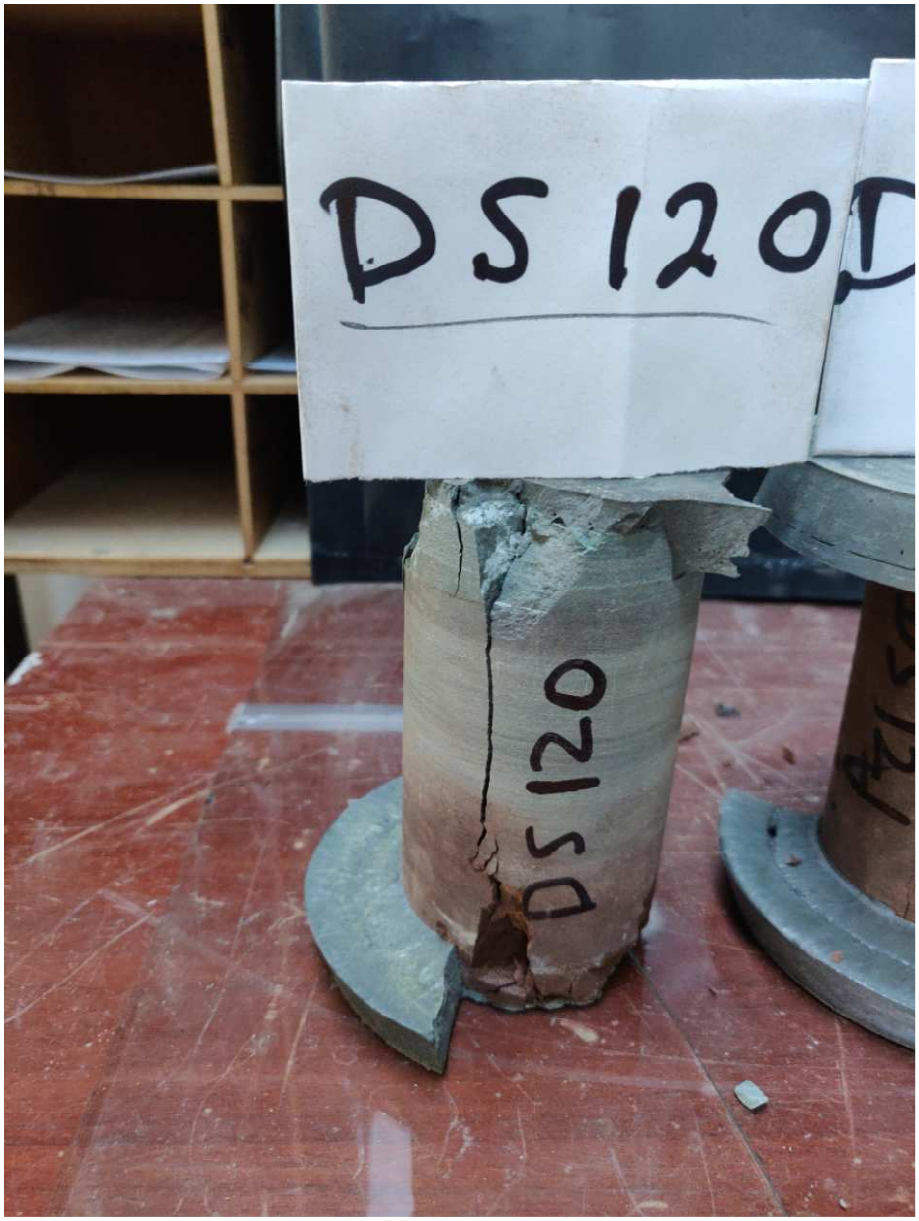




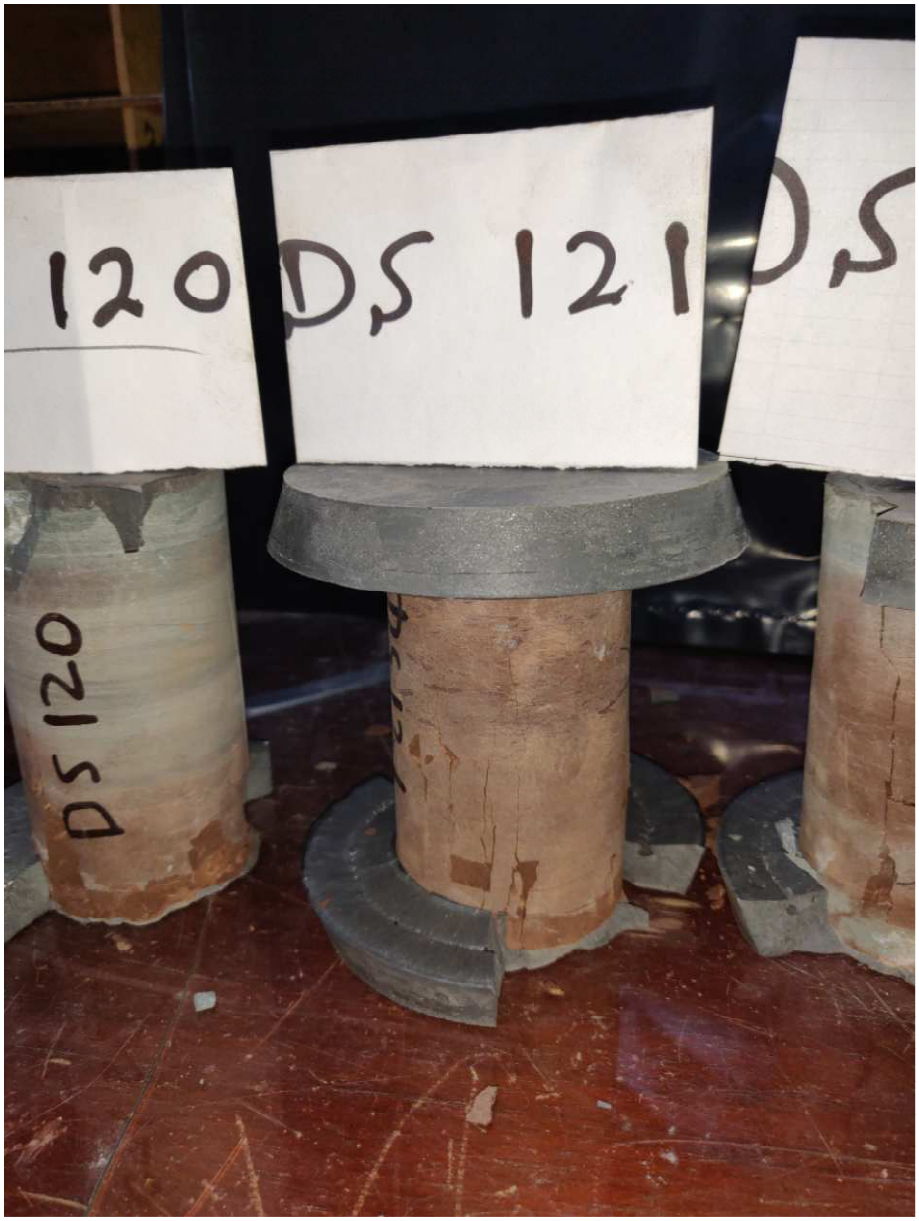

**Cores Before Testing**

# Cores After Testing

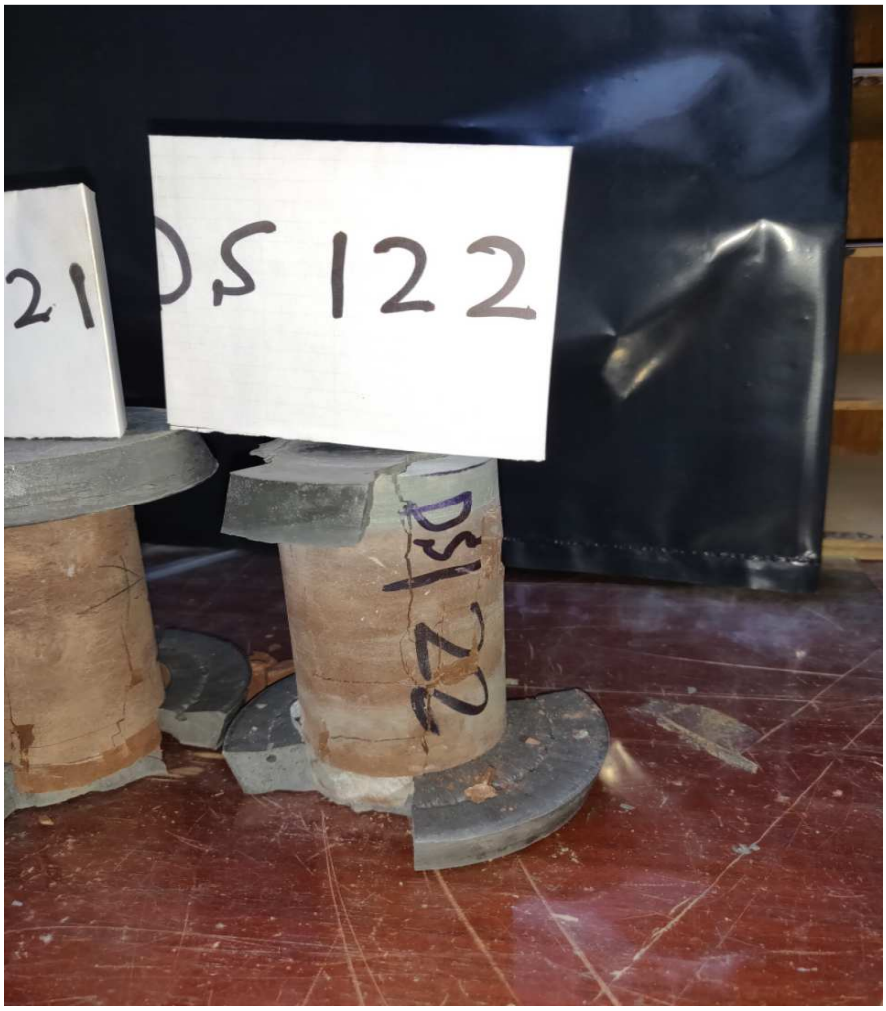




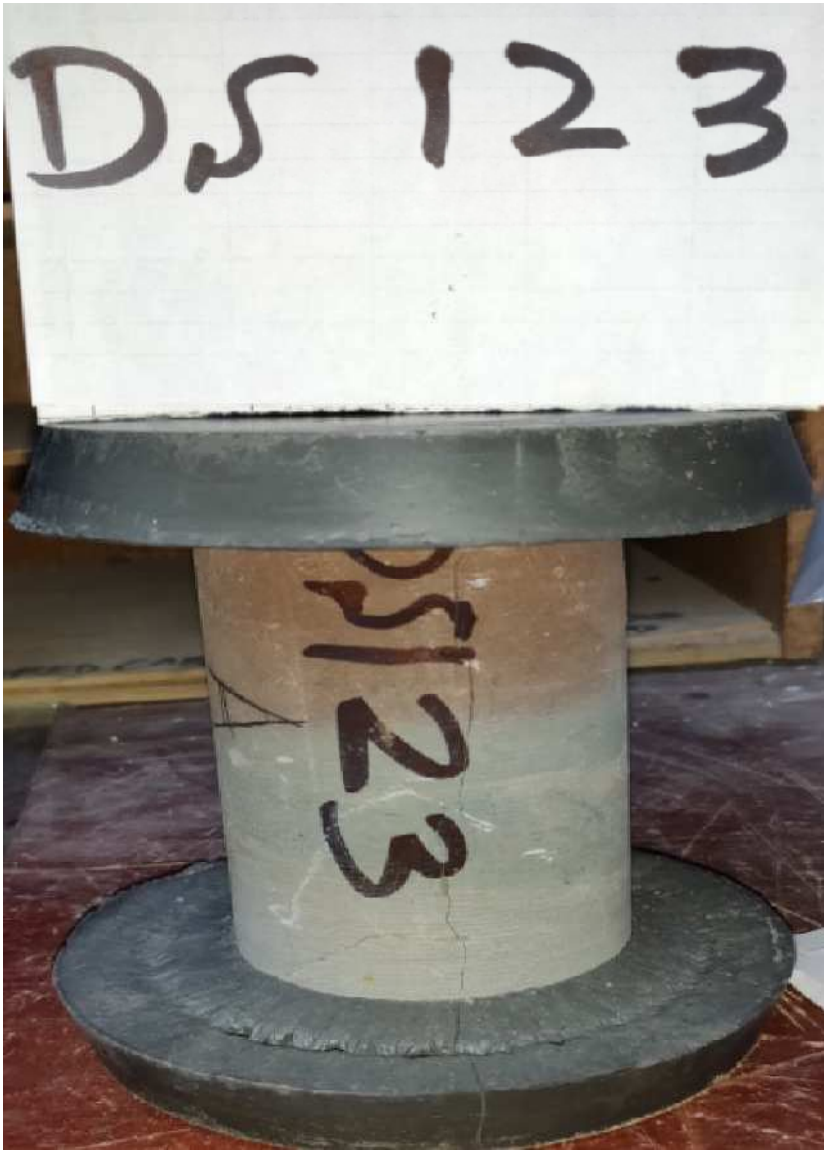

**Cores After Testing**




**Cores After Testing**




**Cores After Testing**




**Cores After Testing**

# Rock Coring Pictures for BH205 – February 2019




**Borehole BH205:** Depth of 3.40m – 6.48m bgs; Elevation of 78.81m to 75.53m asl




**Borehole BH205:** Depth of 6.48m – 9.55m; Elevation of 75.53m to 72.46m asl




**Borehole BH205:** Depth of 9.55m – 12.70m; Elevation of 72.46m to 69.31m asl

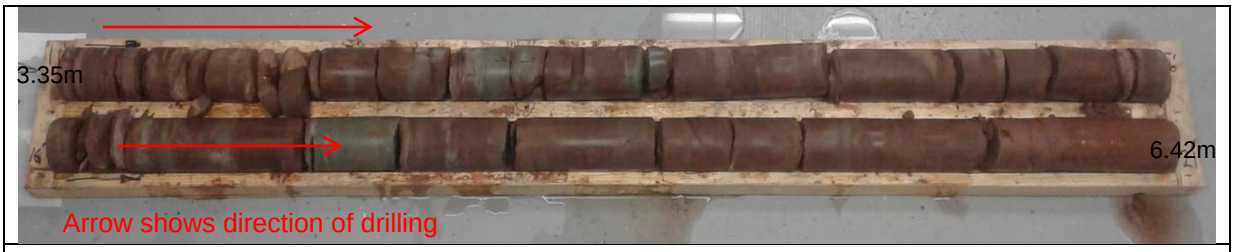



**Borehole BH205:** Depth of 12.70m – 14.25m; Elevation of 69.31m to 67.76m asl




**Borehole BH205:** Depth of 14.25m – 15.55m; Elevation of 67.76m to 66.46m asl

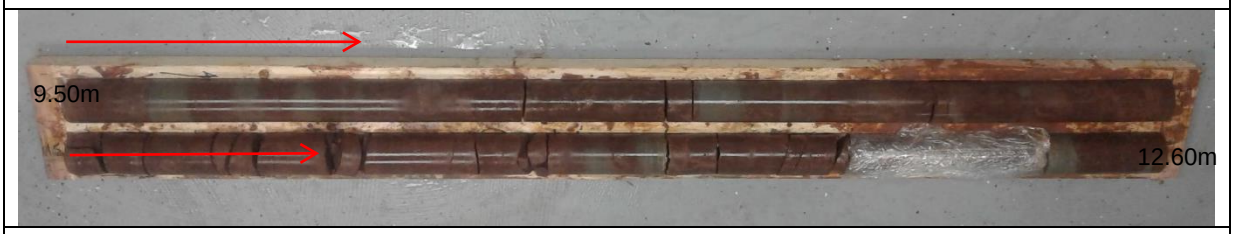
# Rock Coring Pictures for BH206 – February 2019



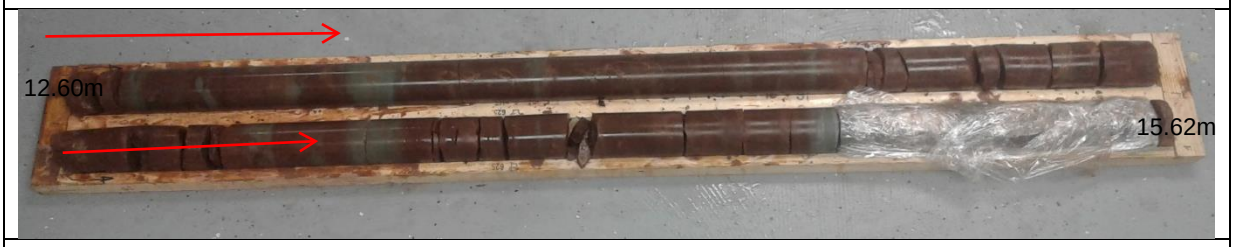

**Borehole BH206:** Depth of 3.35m – 6.42m bgs; Elevation of 78.62m to 75.54m asl




**Borehole BH206:** Depth of 6.42m – 9.50m; Elevation of 75.54m to 72.47m asl




**Borehole BH206:** Depth of 9.50m – 12.60m; Elevation of 72.47m to 69.37m asl




**Borehole BH206:** Depth of 12.60m – 15.62m; Elevation of 69.37m to 66.35m asl

# Rock Coring in BH301 July 2019

77.94M ASL

Direction of curing

68.79M ASL

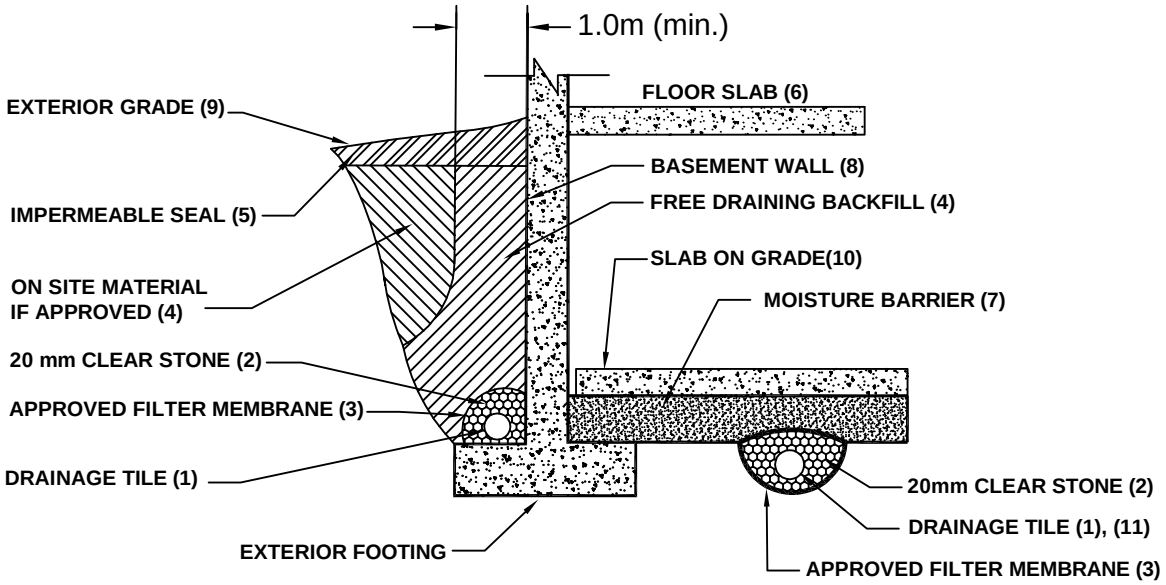
LAB SAMPLE

LAB SAMPLE

62.67M ASL

# APPENDIX G – DRAINAGE AND BACKFILL RECOMMENDATION

FISHER ENVIRONMENTAL LTD.




NOTES:

(1) DRAINAGE TILE TO CONSIST OF 100mm (4") DIAMETER WEEPING TILE OR EQUIVALENT PERFORATED PIPE LEADING TO A POSITIVE SUMP OR OUTLET.

(2) 20mm (3/4") CLEAR STONE - 150mm (6") TOP AND SIDE OF DRAIN. IF DRAIN IS NOT ON FOOTING, PLACE 100mm (4") OF STONE BELOW DRAIN.

(3) WRAP THE CLEAR STONE WITH AN APPROVED FILTER MEMBRANE (TERRAFIX 279R OR EQUIVALENT).

(4) FREE DRAINING BACKFILL - OPSS GRANULAR B OR EQUIVALENT COMPACTED TO THE SPECIFIED DENSITY. DO NOT USE HEAVY COMPACTION EQUIPMENT WITHIN 1.8m (6') OF WALL.

(5) IMPERMEABLE BACKFILL SEAL - COMPACTED CLAY, CLAYEY SILT OR EQUIVALENT. IF ORIGINAL SOIL IS FREE-DRAINING, SEAL MAY BE OMITTED. MAXIMUM THICKNESS OF SEAL TO BE 0.5m.

(6) DO NOT BACKFILL UNTIL WALL IS SUPPORTED BY BASEMENT AND FLOOR SLABS OR ADEQUATE BRACING.

(7) MOISTURE BARRIER TO BE AT LEAST 200mm (8") OF COMPACTED CLEAR 20mm (3/4") STONE OR EQUIVALENT FREE DRAINING MATERIAL. A VAPOUR BARRIER MAY BE REQUIRED FOR SPECIALTY FLOORS.

(8) BASEMENT WALL TO BE DAMP PROOFED.

(9) EXTERIOR GRADE TO SLOPE AWAY FROM BUILDING.

(10) SLAB ON GRADE SHOULD NOT BE STRUCTURALLY CONNECTED TO THE WALL OR FOOTING

(11) UNDERFLOOR DRAIN INVERT TO BE AT LEAST 300mm (12") BELOW UNDERSIDE OF FLOOR SLAB. DRAINAGE TILE PLACED IN PARALLEL ROWS 6 TO 8m (20-25') CENTERS ONE WAY. PLACE DRAIN ON 100mm (4") CLEAR STONE WITH 150mm (6") OF CLEAR STONE ON TOP AND SIDES. ENCLOSE STONE WITH FILTER FABRIC AS NOTED IN (3)

(12) THE ENTIRE SUBGRADE TO BE SEALED WITH APPROVED FILER FABRIC (TERRAFIX 270R OR EQUIVALENT) IF NON-COHESIVE(SANDY) SOILS BELOW GROUND WATER TABLE ENCOUNTERED.

(13) DO NOT CONNECT THE UNDERFLOOR DRAINS TO PERIMETER DRAINS.

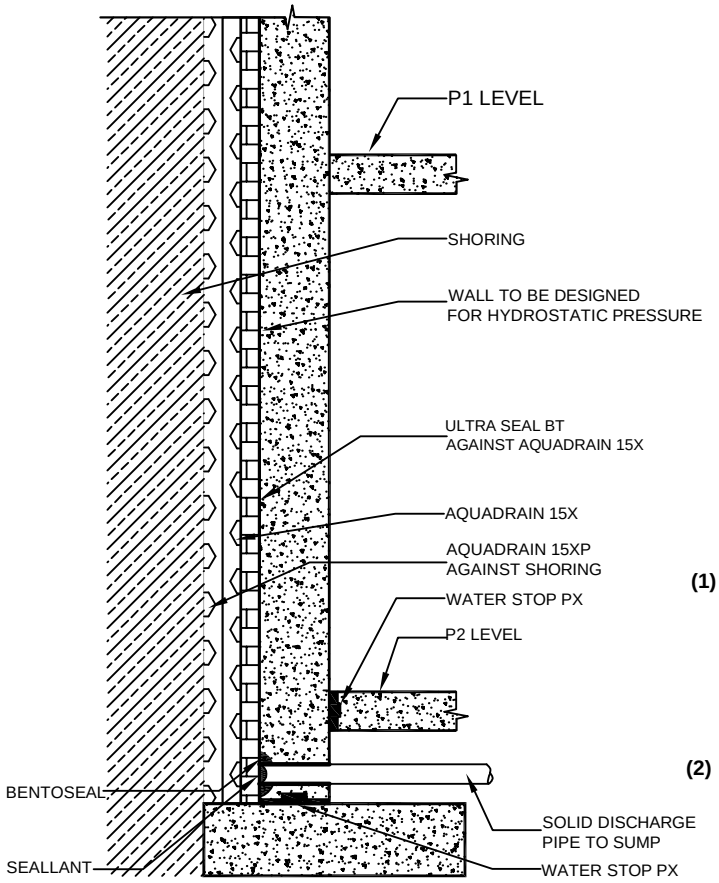
(14) REVIEW THE GEOTECHNICAL REPORT FOR SPECIFIC DETAILS.

## DRAINAGE AND BACKFILL RECOMMENDATIONS

BASEMENT WITH UNDERFLOOR DRAINAGE

(NOT TO SCALE)

FISHER ENVIRONMENTAL LTD.



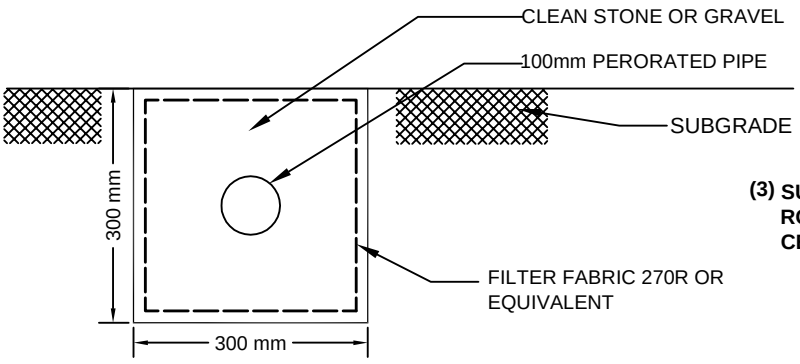

**NOTES:**

**(1) ALL PERMANENT DRAINAGE PIPES MUST HAVE GEOTEXTILE FILTER SLEEVE TO PREVENT LONG TERM SILTING. TO FURTHER MINIMIZE SILTATION OF THE DRAINAGE SYSTEM, ALL DRAINAGE PIPE CONNECTION MUST BE SOLID PVC ELBOWS AND Ts. NO "BUTT" END CONNECTIONS SHOULD BE PERMITTED.**

**(2) PERIMETER COLLECTION PIPE TO BE SOLID PIPE,**

## SUGGESTED EXTERIOR DRAINAGE AGAINST SHORING

**(NOT TO SCALE)**




**(3) SUBGRADE DRAIN TO BE PLACED IN PARALLEL ROWS 6-8 m (20'-25'), FROM CENTERLINE TO CENTERLINE.**

## DETAIL OF SUBGRADE DRAIN

**(NOT TO SCALE)**