January 2018

GEOTECHNICAL EXPLORATION

Proposed Development
187 Byron Avenue
Dorchester, Ontario

Submitted to:
Mr. Mark Sinden, Project Manager, Development
Sifton Properties Limited
1295 Riverbend Road, Suite 300
London, Ontario
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REPORT

Report Number: 1788468-1000-R01

Distribution:

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Golder Associates

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1.0 INTRODUCTION

This report presents the results of the geotechnical exploration and testing carried out for the design of the proposed development to be located at 187 Byron Avenue in Dorchester, Municipality of Thames Centre, Ontario. The location of the site is shown on the Key Plan, Figure 1. The purpose of the work was to explore the subsurface soil and groundwater conditions at the site and provide geotechnical engineering recommendations for the design of the development. Authorization to proceed with the exploration and testing program was provided by Mr. Mark Sinden of Sifton Properties Limited in accordance with our proposal letter P1788468, dated October 5, 2017.

Based on the information provided to Golder Associates Ltd. (Golder), the approximately 21-hectare, irregularly shaped parcel of land is to be developed for residential, commercial, and parkland uses. It is understood that stormwater is to be directed to the Mill Pond west of Dorchester Road.

This report should be read in conjunction with the attached document “Important Information and Limitations of This Report”, which comprises an integral component hereof. The reader’s attention is specifically drawn to this material, as it is essential for proper use and interpretation of the information presented and discussed herein.

2.0 BACKGROUND

Golder previously carried out a groundwater modelling study for the Dorchester Well Field using the subsurface data from monitoring wells completed in the area of the site by Lotowater Technical Services Inc. (Lotowater) in 2006. The results of the groundwater study were provided in Lotowater Report No. 297-003 titled “Source Water Protection, Dorchester, Part 1. Aquifer Test”, prepared for the Municipality of Thames Centre, dated May 2, 2007. Several monitoring wells were completed within the vicinity of the site, as shown on the Location Plan, Figure 1. Monitoring Well Drilling and Completion Logs are provided in Appendix A.

3.0 SITE DESCRIPTION AND PHYSIOGRAPHY

The site is currently agricultural farm land located to the south of Byron Avenue in Dorchester, Ontario. The property is bound to the north by Byron Avenue, to the west by Dorchester Road, to the east by Oakwood Drive, and to the south by Dorchester Creek. The site is located within the Dorchester Wellfield and the south portion of the site is protected by the Upper Thames River Conservation Authority (UTRCA). The property slopes gently to the south from about elevation 258 metres at the north end of the site to about elevation 255.5 metres at the south end of the site.

The site is located in the physiographic region of southwestern Ontario known as the Mount Elgin Ridges.[1] Geotechnical and geological information indicates that the predominant soil type in the area is a pale brown calcareous clay or silty clay within the moraines with alluvium deposits of gravel, sand or silt in the vales. Based on the Ontario Division of Mines Preliminary Map P.606 titled “Pleistocene Geology of the St. Thomas Area (East Half), Southern Ontario”, the soils in the immediate area of the site are valley train deposits consisting of gravel and gravelly sands.

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[1] The Physiography of Southern Ontario; Ontario Geological Survey, Special Volume 2. By Chapman and Putnam, 1984.

4.0 FIELD PROCEDURES

The field work for the exploration was carried out on October 23, 2017 during which time six boreholes, labelled BH-101 to BH-106, were drilled at the approximate locations shown on the Location Plan, Figure 1. Members of our engineering staff designated the borehole locations in the field, obtained underground utility clearances, monitored the drilling, logged the boreholes, and cared for the samples obtained. The ground surface elevations at the borehole locations are referenced to the top of casing in MW6 from a previous investigation conducted by others. The top of casing elevation is reportedly 256.89 metres and is assumed to be geodetic datum.

The boreholes were drilled using a track-mounted drill rig supplied and operated by a specialist drilling contractor under the direction of a member of our engineering staff. The subsurface conditions encountered in the boreholes are shown in detail on the attached Record of Borehole sheets.

Standard penetration testing and sampling was carried out in the boreholes at suitable intervals of depth using 35 millimetre inside diameter split spoon sampling equipment, in accordance with ASTM D1586 “Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils”. All of the samples obtained during the exploration were transported to our laboratory for further examination and testing. The soil stratigraphy encountered in the boreholes and the results of the field and laboratory testing are shown on the Record of Borehole sheets and Figures 2 and 3.

Groundwater levels were observed in the boreholes during drilling. Temporary piezometers were installed in BH-102 and BH-105 and an observation well was installed in BH-103. Upon completion of drilling, sampling and installations, the boreholes were backfilled in accordance with Ontario Regulation (O.Reg.) 903, as amended. Monitoring well drilling and completion logs prepared by others for previously-installed observation wells on, and around, the site are provided in Appendix A for reference.

In addition, two soil samples collected from the boreholes were submitted to a specialist analytical laboratory for analyses of Ministry of the Environment and Climate Change (MOECC) Table 1 metals and inorganics. These samples represent typical soils in the upper 0.8 to 1.2 metres below the existing ground surface in the explored locations. The results of the analyses are provided in Appendix B and summarized in Table II.

4.1 Environmental Soil Sampling

Soil samples recovered from the boreholes were examined in the field for indications of chemical impacts (i.e., odour or staining). The samples were subsequently placed in sealable plastic jars for headspace vapour testing. Combustible gas concentrations in the headspace of soil samples were analyzed using an RKI Eagle combustible vapour detector. The RKI Eagle was calibrated prior to use to a known hexane standard.

The soil conditions encountered in the boreholes were described in terms of soil materials, texture and the presence of staining, odour and debris, if any. Field observations made during drilling and sampling, and headspace vapour readings are summarized on the Record of Borehole sheets, attached. The headspace vapour readings indicated non-detection for all soil samples tested. Accordingly, no additional testing for organic chemical constituents is considered warranted at this time.

5.0 SUBSURFACE CONDITIONS

The subsurface conditions encountered in the boreholes drilled at the site are shown in detail on the attached Record of Borehole sheets. The following discussion has been simplified in terms of major soil strata for the purposes of geotechnical design. The soil boundaries indicated are inferred from non-continuous samples and observations of drilling resistance and typically represent transitions from one soil type to another rather than exact planes of geological change. Further, subsurface conditions may vary significantly between and beyond the borehole locations.

The subsurface conditions encountered in the boreholes generally consisted of the existing surficial topsoil overlying granular deposits and glacial sandy silt till.

5.1 Summary Soil and Groundwater Conditions

Topsoil was encountered at the ground surface in all boreholes. The topsoil ranged in thickness from about 220 to 430 millimetres with an average thickness of about 295 millimetres. Materials designated as topsoil in this report were classified based solely on visual and textural evidence. Testing of organic or nutrient content was not carried out. Accordingly, materials classified as topsoil herein cannot necessarily be relied upon for support and growth of landscaping vegetation without supplemental soil nutrient analyses.

Granular deposits, consisting of sand and gravelly sand, were encountered beneath the surficial topsoil in all boreholes. All boreholes, except BH-104, were terminated in the granular deposits after exploring the layers for about 4.6 to 4.8 metres. The granular layer in BH-104 was 2.9 metres thick and was underlain by sandy silt till. The sand deposit had N[2] values of 3 to 33 blows per 0.3 metres and water contents of about 3 to 14 per cent above the groundwater level and about 12 to 25 per cent below the groundwater level. Grain size distribution curves for samples of the gravelly sand and sand are provided on Figures 2 and 3, respectively.

BH-104 was terminated in glacial clayey sandy silt till after exploring the layer for about 1.8 metres. The glacial till had N values ranging from 17 blows per 0.3 metres to 50 blows per 0.1 metres with water contents of about 9 to 11 per cent.

Groundwater levels were observed in the boreholes during drilling and measured in the observation well and piezometers following their completion. The encountered and measured groundwater levels are shown on the Record of Borehole sheets and Table I. Groundwater seepage was encountered in all boreholes at depths of 2.1 to 3.6 metres below ground surface, or at about elevations of 253.3 to 254.1 metres.

Groundwater was encountered in the boreholes on October 23, 2017 at depths between 2.1 to 3.6 metres below existing ground surface, or about elevation 254.1 to 253.3 metres. The groundwater levels measured in the piezometers and observation wells installed in BH-102, BH-103 and BH-105 between October 31, 2017 and January 25, 2018 ranged from depths of 1.8 to 2.7 metres below existing ground surface or about elevation 254.3 to 253.6 metres. Perched groundwater may be present periodically in the upper sand layers following significant

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[2] The SPT N value is defined as the number of blows required by a 63.5 kilogram hammer dropped from a height of 760 millimetres to drive a split spoon sampler a distance of 300 millimetres into the soil after having first penetrated 150 millimetres.

precipitation events. Groundwater levels at the site should be expected to fluctuate seasonally and in response to significant precipitation events.

The subsurface conditions encountered in the previous monitoring wells completed by Lotowater are consistent with the current boreholes completed for this project.

5.2 Results of Analytical Laboratory Testing

Two samples of the soil encountered in the boreholes were submitted to a specialist analytical laboratory for analyses of MOECC Table 1 metals and inorganics. The results of the analyses are summarized in Table II. The Table 1 and Table 2 Standards of Part XV.1 of the Environmental Protection Act.as tabulated in the MOECC (2011) document: “Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act” (the Standards) are included in the table for comparison purposes. The test results indicated that the constituent concentrations and parameter values for the submitted soil samples were all below the Table 1 Standards. A copy of the analytical report is provided in Appendix B.

6.0 DISCUSSION

This section of the report provides our recommendations related to the geotechnical aspects of design of the proposed development. It should be noted that the interpretation and recommendations provided are intended for use only by the design engineer. Where comments are made on construction, they are provided only to highlight those aspects which could affect the design of the project. Those requiring information on construction should make their own interpretation of the factual information provided as it may affect equipment selection, proposed construction means and methods, scheduling, and the like.

Based on the information provided to Golder, the approximately 21-hectare, irregularly shaped parcel of land is to be developed for residential, commercial, and parkland uses. It is understood that stormwater is to be directed to the Mill Pond west of Dorchester Road. The property is bound to the north by Byron Avenue, to the west by Dorchester Road, to the east by Oakwood Drive, and to the south by Dorchester Creek. The site is located within the Dorchester Wellfield and the south portion of the site is protected by the Upper Thames River Conservation Authority (UTRCA). Only limited design information was available at the time of preparation of this report; however, it is understood that typical new service inverts will be about 3.5 to 4.0 metres below existing ground surface. This report should be revisited and revised, if necessary, upon receipt of a more detailed design package.

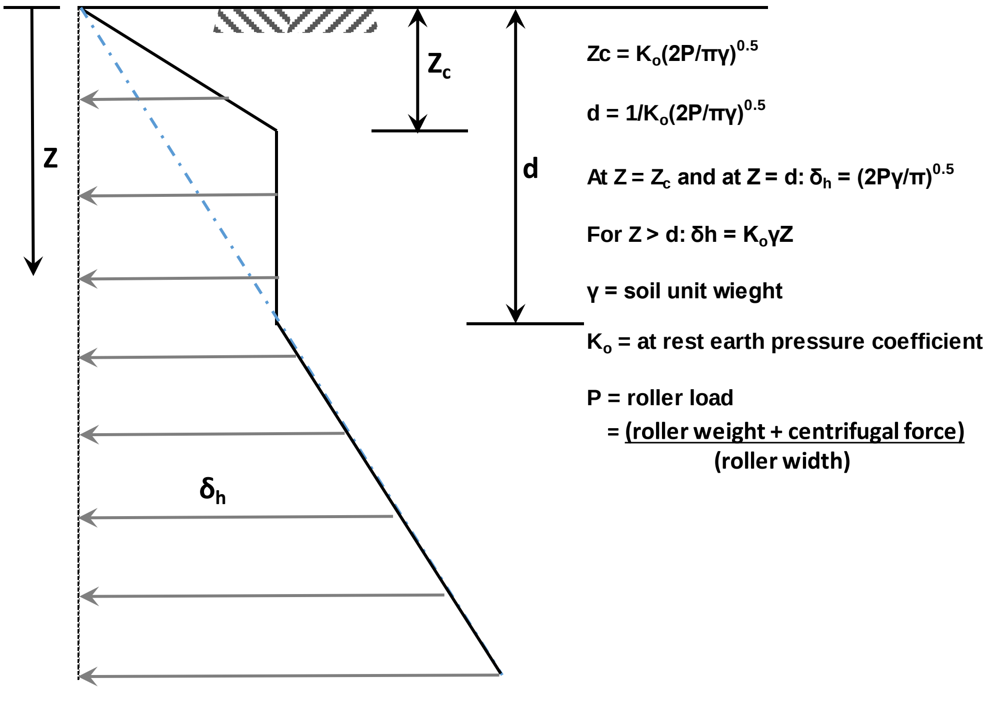
6.1 Foundations

Based on the conditions encountered in the boreholes, the proposed buildings may be founded on conventional spread and/or strip footings bearing on the undisturbed native granular soils above the groundwater level at a minimum depth of 1.2 metres below grade. The footings should fully penetrate any topsoil or fill materials to bear on undisturbed native materials. For design purposes, a factored geotechnical resistance at Ultimate Limit States (ULS) of 150 kilopascals (kPa) and a geotechnical reaction at Serviceability Limit States (SLS) of 100 kPa may be used based on a minimum footing width of 600 millimetres at a depth of 1.2 metres below the ground surface. The foundation excavations should be inspected by the geotechnical engineer prior to placing concrete. Depending on foundation depths, proofrolling of the native very loose to loose upper sands may be required in some areas. Upon final design of the development and known basement elevations, these values should be revised and/or revisited. The underside of footing elevations should extend above the groundwater elevations by a minimum distance equal to the width of the footing.

6.2 Lateral Earth Pressures

Backfill adjacent to the foundation walls should consist of free draining Granular A or Granular B material meeting Ontario Provincial Standards Specifications (OPSS) and Municipality Standards. For design purposes, a coefficient of lateral earth pressure at rest of 0.5 and a total unit weight of 2.1 megagrams per cubic metre (or 21 kilonewtons (kN) per cubic metre) may be used for analysis. The Granular A or Granular B backfill should be placed in loose lift thicknesses not exceeding 200 millimetres and be uniformly compacted to at least 98 per cent of standard Proctor maximum dry density (SPMDD).

To account for lateral pressures inducted by compactive effort adjacent to foundation walls, the design lateral earth pressure distribution should consist of a combined trapezoidal/triangular distribution as depicted below. Typical roller loads are provided for reference.



$Zc = K_o(2P/\pi\gamma)^{0.5}$

$d = 1/K_o(2P/\pi\gamma)^{0.5}$

At $Z = Z_c$ and at $Z = d$: $\delta_h = (2P\gamma/\pi)^{0.5}$

For $Z > d$: $\delta h = K_o\gamma Z$

γ = soil unit wieght

K_o = at rest earth pressure coefficient

P = roller load

$= \frac{\text{(roller weight + centrifugal force)}}{\text{(roller width)}}$

Typical Roller Loads

Roller Type	Weight (kN)	Cent. Force (kN)	Width (mm)	P (kN/m)
1-drum walk-behind	2.3	8.3	560	18.9
2-drum walk-behind	1.6	10.1	560	20.9
2-drum walk-behind	12.1	8.8	760	27.5
2-drum walk-behind	9.2	19.8	750	38.7

6.3 Seismic Site Classification and Hazard Values

Based on the results of the exploration and our experience in the area of the site, a Site Class D designation is appropriate for design in accordance with Section 4 of the National Building Code of Canada (NBCC).

Mean seismic hazard values were determined for a 2 per cent in 50-year (0.000404 per annum) probability of exceedance for the standard base condition assuming "firm ground" (NBCC 2015 Soil Class C, average Vs30 shear wave velocity 450 m/s). The 5 per cent damped spectral acceleration (S_a) values for the location of the site (as multiples of gravitational acceleration, or 9.81 m/s^2) are: $S_a(0.2) = 0.11$; $S_a(0.5) = 0.07$; $S_a(1.0) = 0.04$; and $S_a(2) = 0.02$. The peak ground acceleration (PGA) value for the site is 0.66 m/s^2, with a peak ground velocity (PGV) of 0.06 m/s. Acceleration-based (F_a) and velocity-based (F_v) site coefficients of 1.3 and 1.4, respectively, should be applied to account for the Site Class D designation.

6.4 Excavations

Based on the results of the exploration, the excavations will encounter the existing surficial topsoil, granular deposits of sand and gravelly sand and glacial sandy silt till. The excavations for the proposed sewers based on inverts of 3.5 to 4.0 metres below the ground surface will require proactive dewatering in the form of vacuum well points. The granular soils below the groundwater level would be classified as Type 3 soils and the sandy silt till and granular soils above the groundwater level would be classified as Type 2 soils based on the current Occupational Health and Safety Act (OHSA) criteria. Groundwater flow rates into open excavations below elevation 254.0 metres will be high and a Permit to Take Water (PTTW) will be required. The groundwater levels should be lowered to a minimum of 0.6 metres below the base of the trench. Further, information on the groundwater conditions and associated permitting and dewatering requirements are discussed in our Hydrogeological Assessment under separate cover.

For OHSA compliance, unsupported excavations in Type 3 soils should be constructed with sidewall slopes inclined no steeper than a gradient of 1 horizontal to 1 vertical extending upward and outward from the base of the excavation, and excavation sidewalls in Type 2 soils should be sloped to within a maximum of 1.2 metres above the base, with sidewall slopes inclined no steeper than a gradient of 1 horizontal to 1 vertical. Care will be required to provide support to all utilities and completed works located within the zone of influence of the excavation, as defined by a line drawn from the base of the trench upwards and outwards at an inclination of 1 horizontal to 1 vertical. Surface water should be directed away from open excavations.

6.5 Slab-on-Grade

Following removal of any fill materials and any excessively soft or deleterious materials, the area beneath slab-on-grade floors should be proofrolled and raised to meet the design subgrade level, as required, using OPSS Granular B fill. All foundation excavations beneath floor areas should also be backfilled with compacted Granular B fill. The Granular B should be placed in maximum 300 millimetre thick lifts and uniformly compacted to at least 98 per cent of the SPMDD to within 150 millimetres of the underside of the floor slab. Final construction should consist of 150 millimetres of OPSS Granular A compacted to 100 per cent of SPMDD.

Unless uncontrolled migration of water vapour through the slab is acceptable, a robust polyethylene vapour barrier should be provided between the concrete slab and the Granular A. The floor slab should be kept structurally separate from the foundation walls and columns and saw cut control joints provided at regular intervals to limit uncontrolled cracking during and after curing.

6.6 Engineered Fill

It is recommended that any engineered fill to be used for the proposed development consist of native dry granular soils or OPSS 1010 Granular B Type III. Following removal of all organic and fill materials and any loose, softened or excessively wet materials, the exposed subgrade should be inspected under the direction of the geotechnical engineer. The engineered fill should be placed in horizontal loose lifts a maximum of 300 millimetres thick and uniformly compacted to at least 98 per cent of SPMDD. Where engineered fill is used to fully support foundations, the limits of the engineered fill should extend beyond the building foundations a minimum of one metre plus the thickness of the fill and should be properly benched into the existing soils. Full-time geotechnical inspection and testing will be required during construction of any engineered fill to ensure that the subgrade is properly prepared, that suitable fill materials are utilized, and that an adequate degree of compaction is consistently achieved.

6.7 Bedding

Bedding for sewers and other buried services should consist of granular material consistent with the type, size and class of pipe and Municipality specifications. All bedding should be placed in maximum 300-millimetre-thick loose lifts and uniformly compacted to at least 95 per cent of SPMDD. Should a trench liner box be used, care will be required to ensure that the compacted bedding is not disturbed when the liner box is moved.

Should groundwater seepage be such that the bedding material cannot be adequately compacted, it may be necessary to use 19 millimetre crushed stone with a non-woven geotextile surround. A complete non-woven geotextile surround is considered critical with the crushed stone bedding to prevent migration of fines into the bedding which could subsequently result in loss of ground and loss of support of the pipe. The crushed stone bedding would also facilitate pumping from sumps as a groundwater control measure.

6.8 Trench Backfill

Based on the results of this exploration, the excavated materials will consist of the existing surficial topsoil, granular deposits and sandy silt till. Provided that all deleterious materials such as the existing topsoil and any excessively wet materials are removed, the remaining drier portions of the excavated materials are considered suitable for use as trench backfill. Native granular materials excavated below the water table may be stockpiled and allowed to drain and/or air dry to achieve a moisture content suitable for compaction. Any shortfall in trench backfill should be addressed with imported Granular B material.

Care will be required to ensure that sufficient effort is consistently put into placement and compaction of the trench backfill in order to control settlements, especially if a trench liner box is used. The general trench backfill should be placed in maximum 300 millimetre thick lifts and uniformly compacted to at least 95 per cent of SPMDD. Where the backfill forms the subgrade for access roads or parking areas, the upper 1 metre should be placed in maximum 200 millimetre thick lifts and uniformly compacted to at least 98 per cent of SPMDD.

6.9 Pavements

Following excavation to subgrade level and the removal of any topsoil or other deleterious materials, the subgrade should be proofrolled under the direction of the geotechnical engineer. Any poorly performing areas should be subexcavated and reinstated with compacted approved native granulars or imported Granular B. The pavement structure should consist of the following components placed on a competent, properly shaped (to drain the granular base) and prepared granular subgrade:

Component	**Thickness (mm)**	
	Residential Roadway	**Primary Collector Route**
HL 3 Surface Asphalt	40	50
HL 8 Binder Asphalt	50	60
Granular A Base	150	150
Granular B Subbase	300	400

The Granular A base and Granular B subbase should be uniformly compacted to 100 per cent of SPMDD. The asphalt should be produced, placed and compacted in accordance with the current OPSS for medium duty pavements. Milled notches 40 millimetres deep by 500 millimetres wide should be provided where new construction abuts existing pavements and care should be taken to properly tack coat all milled surfaces and butt joints.

Construction activities should be coordinated to minimize the amount of construction traffic over the exposed subgrade soils.

7.0 GEOTECHNICAL INSPECTIONS AND TESTING

A regular program of geotechnical inspections and materials testing should be carried out during construction to confirm that the conditions encountered are consistent with the results of the boreholes, to determine that the intent of the design recommendations provided is being met and that the various project and material specifications are consistently achieved.

The factual data, interpretation and recommendations in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, or if the project is not initiated within twelve months of the date of the report, Golder Associates Ltd. should be given an opportunity to confirm that the recommendations are still valid.

We trust that this report provides sufficient information for your present requirements. Should any point require clarification, please contact this office.

GOLDER ASSOCIATES LTD.

LICENSED PROFESSIONAL ENGINEER
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IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client’s expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder’s report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder’s report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder’s report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder’s report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder’s responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

TABLE I

SUMMARY OF GROUNDWATER LEVELS

Geotechnical Exploration
Proposed Development
187 Byron Avenue
Dorchester, Ontario

GOLDER REPORT	BOREHOLE	GROUND SURFACE ELEVATION (m)	DRILLING DATE	Installation	GROUNDWATER LEVEL (m)					
					Encountered		Oct. 31, 2017	Nov. 14, 2017	Dec. 21, 2017	Jan. 25, 2018
1788468-1000	BH-101	257.62	Oct. 23, 2017	-	254.0	-	-	-	-	-
(Current)	BH-102	255.92	Oct. 23, 2017	Piezometer	253.8	-	253.97	254.09	254.19	254.28
	BH-103	255.84	Oct. 23, 2017	Observation Well	253.4	-	253.56	253.65	253.63	253.94
	BH-104	255.44	Oct. 23, 2017	-	253.3	-	-	-	-	-
	BH-105	256.55	Oct. 23, 2017	Piezometer	253.6	-	253.79	253.86	253.93	254.06
	BH-106	257.14	Oct. 23, 2017	-	254.1	-	-	-	-	-
						Nov. 23, 2006				
Lotowater Report	MW6	255.90	Aug 9, 2006	Observation Well	-	252.33	251.96	252.01	252.05	252.30
	MW8 (deep)	256.26	Aug 9, 2006	Observation Well	-	252.26	251.90	251.96	252.10	252.36
	MW8 (shallow)	256.26	Aug 9, 2006	Observation Well	-	252.27	251.89	251.95	252.10	252.36

NOTES:

1. For installation details, see Record of Borehole sheets and Appendix A.
2. For borehole locations, see Location Plan, Figure 1.
3. Table to be read in conjunction with accompanying report.

Prepared By: BT
Checked By: DB

TABLE II

ANALYTICAL RESULTS FOR METALS AND INORGANICS IN SOIL

Geotechnical Exploration
Proposed Development
187 Byron Avenue
Dorchester, Ontario

				2011	2011
	Sample ID:	BH-102-1	BH-104-1	MOECC TABLE 1	MOECC TABLE 2
	Date:	23-Oct-2017	23-Oct-2017	STANDARDS(1)	STANDARDS(2)
PARAMETER	UNITS				
Metals					
Antimony	µg/g	<0.20	<0.20	1.3	40
Arsenic	µg/g	3.7	1.6	18	18
Barium	µg/g	15	5	220	670
Beryllium	µg/g	0.20	<0.20	2.5	8
Boron (Total)	µg/g	7.3	<5.0	36	120
Boron (Hot Water Soluble)	µg/g	0.057	<0.050	-	2
Cadmium	µg/g	<0.10	<0.10	1.2	1.9
Chromium (Total)	µg/g	11	4.6	70	160
Chromium (VI)	µg/g	<0.2	<0.2	0.66	8
Cobalt	µg/g	3.8	1.6	21	80
Copper	µg/g	20	7.4	92	230
Lead	µg/g	7.3	4.4	120	120
Mercury	µg/g	<0.050	<0.050	0.27	3.9
Molybdenum	µg/g	<0.50	<0.50	2	40
Nickel	µg/g	9.4	3.4	82	270
Selenium	µg/g	<0.50	<0.50	1.5	5.5
Silver	µg/g	<0.20	<0.20	0.5	40
Thallium	µg/g	0.09	<0.050	1	3.3
Uranium	µg/g	0.6	0.23	2.5	33
Vanadium	µg/g	0.089	<0.050	86	86
Zinc	µg/g	16	12	290	340
Inorganics					
Conductivity	mS/cm	0.12	0.11	0.57	1.4
Cyanide	µg/g	<0.01	<0.01	0.051	0.051
pH	pH	7.82	7.65	--	--
Sodium Adsorption Ratio	N/A	0.31	0.31	2.4	12

NOTES:

1. MOECC 'Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the *Environmental* Protection Act' (April 2011). Table 1 Standard is full depth background site condition standards for residential/parkland/institutional/industrial/commercial/community property use and coarse textured soil.
2. MOECC 'Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the *Environmental* Protection Act' (April 2011). Table 2 Standard is full depth site condition standards in a potable groundwater condition for industrial/commercial/community property use and coarse textured soil.
3. "µg/g" Micrograms per gram.
4. "mS/cm" milliSiemens per centimetre.
5. "<" Below reportable detection limit.
6. "--" No applicable standard, or not analysed.
7. Values in **bold** indicate exceedance of applicable 2011 MOECC Table 1 Standard. Values underlined indicate exceedance of applicable 2011 MOECC Table 2 Standard.
8. Table to be read in conjunction with accompanying report.

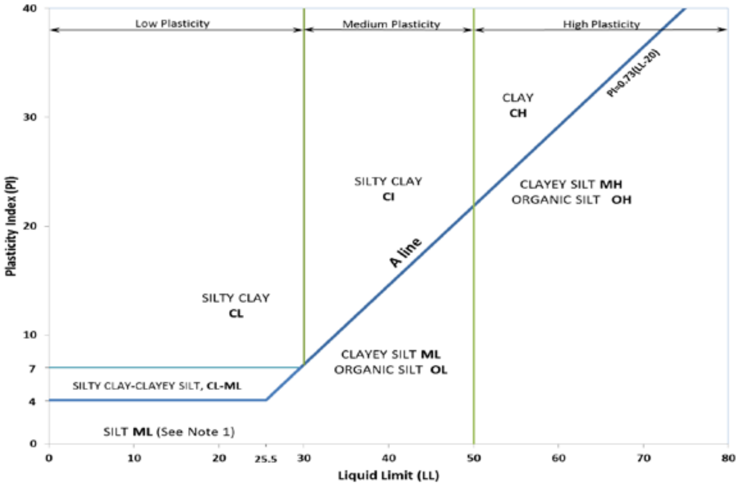
Prepared By: BT
Checked By: DB

METHOD OF SOIL CLASSIFICATION

The Golder Associates Ltd. Soil Classification System is based on the Unified Soil Classification System (USCS)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10} x D_{60}}$	Organic Content	USCS Group Symbol	Group Name
INORGANIC (Organic Content ≤30% by mass)	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Gravels with ≤12% fines (by mass)	Poorly Graded	<4	≤1 or ≥3	≤30%	GP	GRAVEL
				Well Graded	≥4	1 to 3		GW	GRAVEL
			Gravels with >12% fines (by mass)	Below A Line	n/a			GM	SILTY GRAVEL
				Above A Line	n/a			GC	CLAYEY GRAVEL
		SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Sands with ≤12% fines (by mass)	Poorly Graded	<6	≤1 or ≥3		SP	SAND
				Well Graded	≥6	1 to 3		SW	SAND
			Sands with >12% fines (by mass)	Below A Line	n/a			SM	SILTY SAND
				Above A Line	n/a			SC	CLAYEY SAND

Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators					Organic Content	USCS Group Symbol	Primary Name
				Dilatancy	Dry Strength	Shine Test	Thread Diameter	Toughness (of 3 mm thread)			
INORGANIC (Organic Content ≤30% by mass)	FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm)	SILTS (Non-Plastic or PI and LL plot below A-Line on Plasticity Chart below)	Liquid Limit <50	Rapid	None	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT
				Slow	None to Low	Dull	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT
				Slow to very slow	Low to medium	Dull to slight	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
			Liquid Limit ≥50	Slow to very slow	Low to medium	Slight	3mm to 6 mm	Low to medium	<5%	MH	CLAYEY SILT
				None	Medium to high	Dull to slight	1 mm to 3 mm	Medium to high	5% to 30%	OH	ORGANIC SILT
		CLAYS (PI and LL plot above A-Line on Plasticity Chart below)	Liquid Limit <30	None	Low to medium	Slight to shiny	~ 3 mm	Low to medium	0% to 30% **(see Note 2)**	CL	SILTY CLAY
			Liquid Limit 30 to 50	None	Medium to high	Slight to shiny	1 mm to 3 mm	Medium		CI	SILTY CLAY
			Liquid Limit ≥50	None	High	Shiny	<1 mm	High		CH	CLAY
HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures							30% to 75%	PT	SILTY PEAT, SANDY PEAT
		Predominantly peat, may contain some mineral soil, fibrous or amorphous peat							75% to 100%		PEAT



Note 1 – Fine grained materials with PI and LL that plot in this area are named (ML) SILT with slight plasticity. Fine-grained materials which are non-plastic (i.e. a PL cannot be measured) are named SILT.

Note 2 – For soils with <5% organic content, include the descriptor "trace organics" for soils with between 5% and 30% organic content include the prefix "organic" before the Primary name.

Dual Symbol — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC and CL-ML.

For non-cohesive soils, the dual symbols must be used when the soil has between 5% and 12% fines (i.e. to identify transitional material between "clean" and "dirty" sand or gravel.

For cohesive soils, the dual symbol must be used when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart (see Plasticity Chart at left).

Borderline Symbol — A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.

A borderline symbol should be used to indicate that the soil has been identified as having properties that are on the transition between similar materials. In addition, a borderline symbol may be used to indicate a range of similar soil types within a stratum.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BORHEOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
>35	Use 'and' to combine major constituents (*i.e.,* SAND and GRAVEL)
> 12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
> 5 to 12	some
≤ 5	trace

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.).

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DD	Diamond Drilling
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
FS	Foil sample
GS	Grab Sample
RC	Rock core
SC	Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size
TP	Thin-walled, piston – note size
WS	Wash sample

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness[2]

Term	SPT 'N' (blows/0.3m)[1]
Very Loose	0 - 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects.
2. Definition of compactness terms are based on SPT-'N' ranges as provided in Terzaghi, Peck and Mesri (1996) and correspond to typical average N_{60} values. Many factors affect the recorded SPT-'N' value, including hammer efficiency (which may be greater than 60% in automatic trip hammers), groundwater conditions, and grainsize. As such, the recorded SPT-'N' value(s) should be considered only an approximate guide to the compactness term. These factors need to be considered when evaluating the results, and the stated compactness terms should not be relied upon for design or construction.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\ \sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
σ_1, σ_2, σ_3	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = ($w_l - w_p$)
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c′	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes:
1 $\tau = c' + \sigma' \tan \phi'$
2 shear strength = (compressive strength)/2

PROJECT: 1788468

RECORD OF BOREHOLE BH-101

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 23, 2017
DRILLING CONTRACTOR: London Soil Test Ltd.

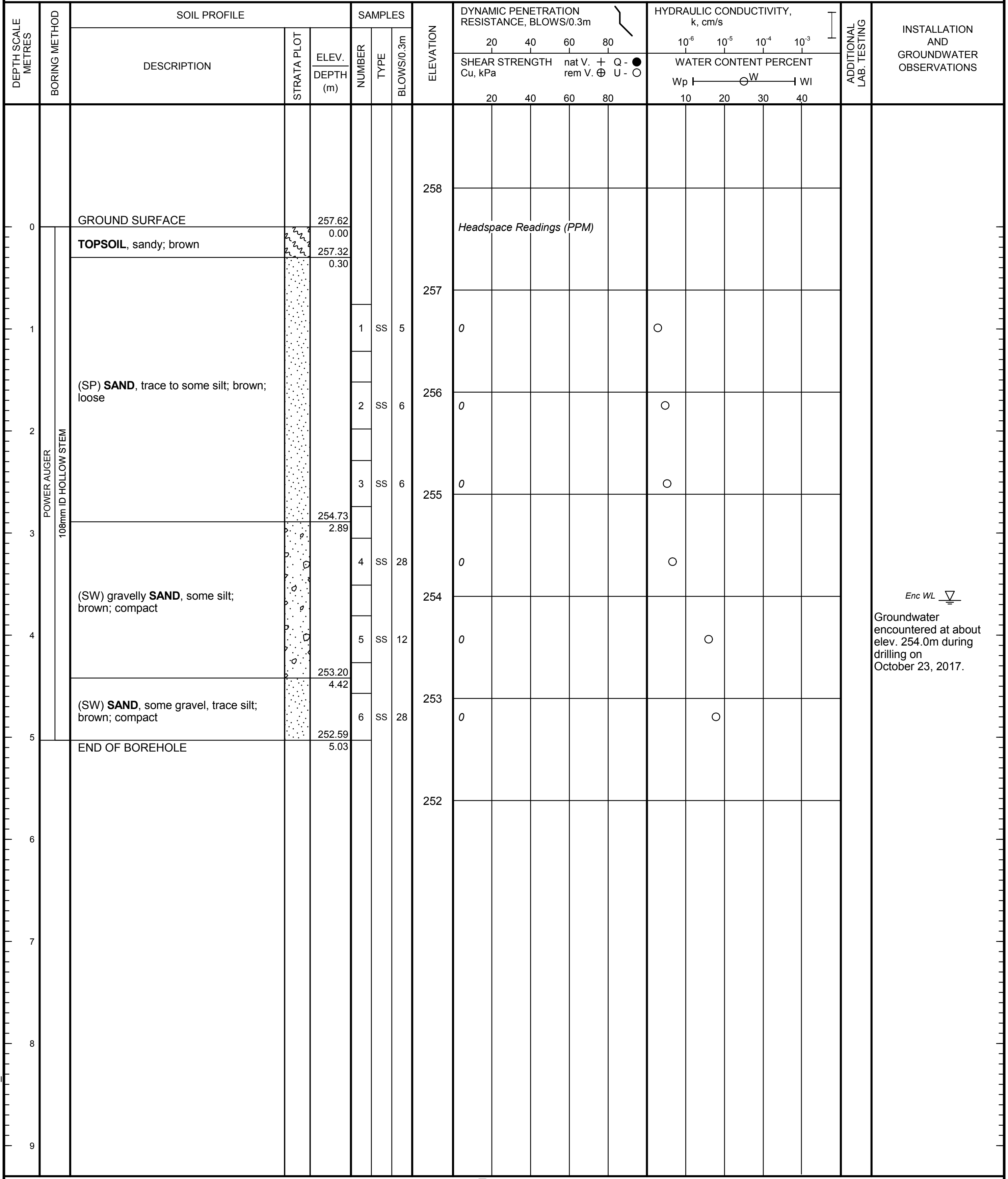
DATUM: GEODETIC

HAMMER TYPE: Auto Hammer

BORING METHOD: POWER AUGER 108mm ID HOLLOW STEM

DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	257.62 0.00
TOPSOIL, sandy; brown	257.32 0.30
(SP) **SAND**, trace to some silt; brown; loose	254.73 2.89
(SW) gravelly **SAND**, some silt; brown; compact	253.20 4.42
(SW) **SAND**, some gravel, trace silt; brown; compact	252.59 5.03
END OF BOREHOLE	

NUMBER	TYPE	BLOWS/0.3m	Headspace Readings (PPM)
1	SS	5	0
2	SS	6	0
3	SS	6	0
4	SS	28	0
5	SS	12	0
6	SS	28	0



Groundwater encountered at about elev. 254.0m during drilling on October 23, 2017.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: BT
CHECKED: DB

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PROJECT: 1788468

RECORD OF BOREHOLE BH-102

SHEET 1 OF 1

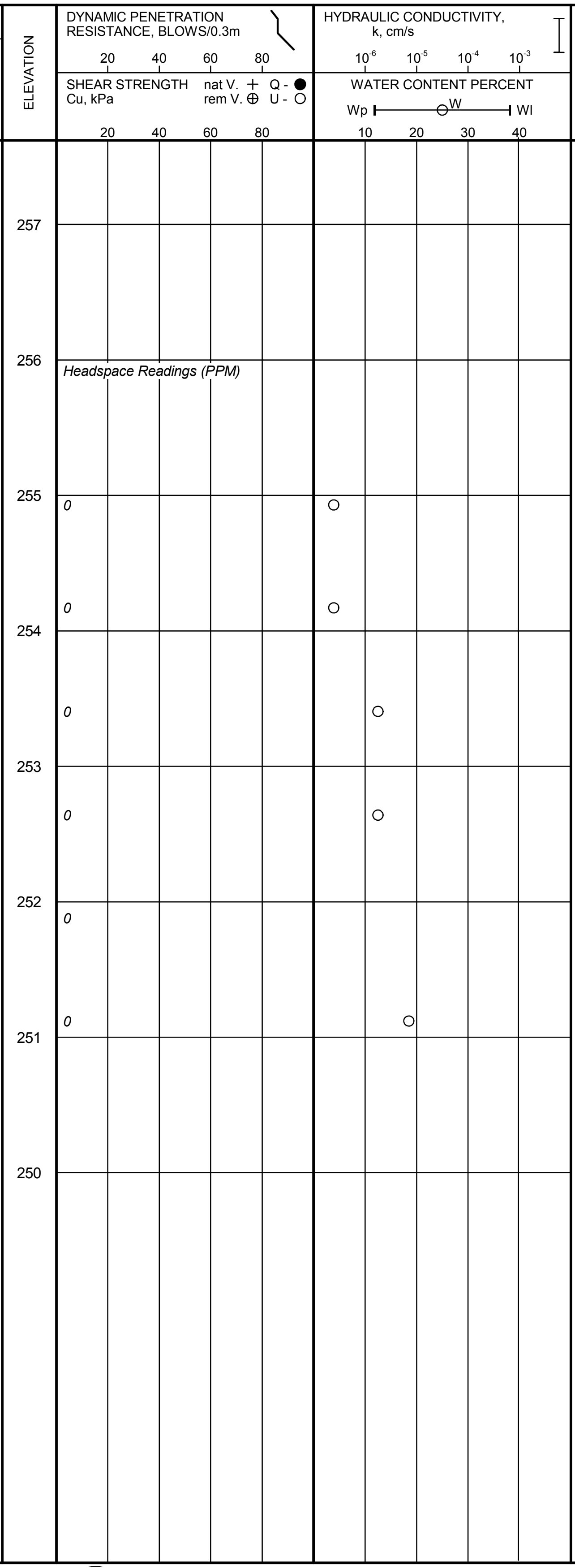
LOCATION: REFER TO LOCATION PLAN

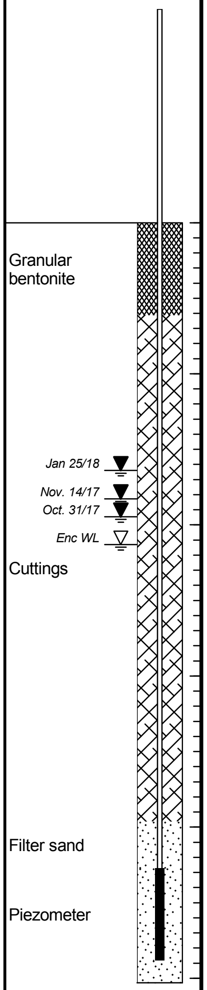
BORING DATE: October 23, 2017
DRILLING CONTRACTOR: London Soil Test Ltd.

DATUM: GEODETIC

HAMMER TYPE: Auto Hammer

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	Headspace Readings (PPM)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	POWER AUGER 108mm ID HOLLOW STEM	GROUND SURFACE	255.92 0.00						Granular bentonite
		TOPSOIL, sandy; brown	255.49 0.43						
1		(SW) gravelly **SAND**, trace silt; brown; compact to dense		1	SS	33	0		
				2	SS	24	0		Cuttings
				3	SS	16	0		
				4	SS	19	0	MH	
				5	SS	19	0		Filter sand
			250.89 5.03	6	SS	31	0		Piezometer
5		END OF BOREHOLE							





Groundwater encountered at about elev. 253.8m during drilling on October 23, 2017.

Water level measured in piezometer at elev. 253.97m on October 31, 2017.

Water level measured in piezometer at elev. 254.09m on November 14, 2017.

Water level measured in piezometer at elev. 254.28m on January 25, 2018.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: BT
CHECKED: DB

PROJECT: 1788468

RECORD OF BOREHOLE BH-103

SHEET 1 OF 1

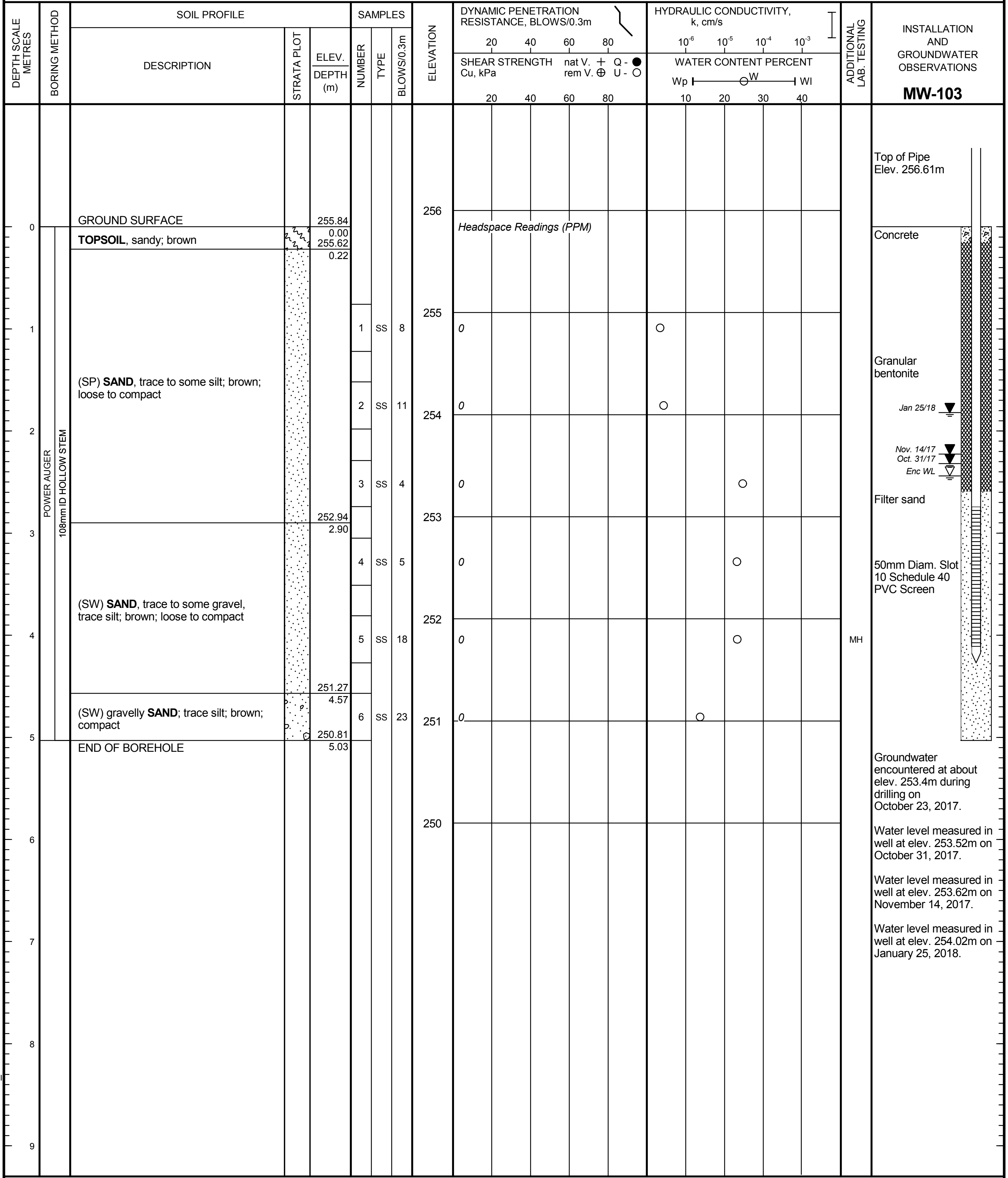
LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 23, 2017

DRILLING CONTRACTOR: London Soil Test Ltd.

DATUM: GEODETIC

HAMMER TYPE: Auto Hammer



DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	255.84
TOPSOIL, sandy; brown	0.00
(SP) **SAND**, trace to some silt; brown; loose to compact	255.62 0.22
(SW) **SAND**, trace to some gravel, trace silt; brown; loose to compact	252.94 2.90
(SW) gravelly **SAND**; trace silt; brown; compact	251.27 4.57
END OF BOREHOLE	250.81 5.03

NUMBER	TYPE	BLOWS/0.3m	Headspace Readings (PPM)	ADDITIONAL LAB. TESTING
1	SS	8	0	
2	SS	11	0	
3	SS	4	0	
4	SS	5	0	
5	SS	18	0	MH
6	SS	23	0	

Top of Pipe Elev. 256.61m

Concrete

Granular bentonite

Filter sand

50mm Diam. Slot 10 Schedule 40 PVC Screen

Groundwater encountered at about elev. 253.4m during drilling on October 23, 2017.

Water level measured in well at elev. 253.52m on October 31, 2017.

Water level measured in well at elev. 253.62m on November 14, 2017.

Water level measured in well at elev. 254.02m on January 25, 2018.

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DEPTH SCALE

1 : 50

Golder Associates

LOGGED: BT

CHECKED: DB

PROJECT: 1788468

RECORD OF BOREHOLE BH-104

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 23, 2017
DRILLING CONTRACTOR: London Soil Test Ltd.

DATUM: GEODETIC

HAMMER TYPE: Auto Hammer

BORING METHOD: POWER AUGER 108mm ID HOLLOW STEM

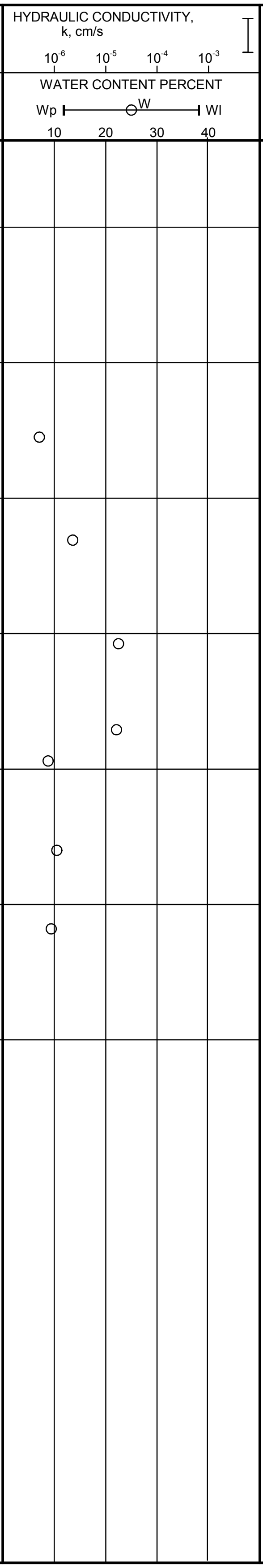
SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	255.44 0.00
TOPSOIL, sandy; brown	255.09 0.35
(SP) **SAND**, trace to some silt; brown; loose	254.07 1.37
(SW) **SAND**, trace gravel, trace silt; brown; compact	252.18 3.26
(ML) **CLAYEY SANDY SILT**, trace gravel, with cobbles; brown turning grey at about elev. 251.8m, **TILL**; compact to very dense	250.77 4.67
END OF BOREHOLE	

NUMBER	TYPE	BLOWS/0.3m	Headspace Readings (PPM)
1	SS	6	0
2	SS	10	0
3	SS	12	0
4	SS	17	0
5	SS	20	0
6	SS	50/100mm	0

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

ELEVATION: 256 255 254 253 252 251 250



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

Enc WL ▽

Groundwater encountered at about elev. 253.3m during drilling on October 23, 2017.

DEPTH SCALE
1 : 50

LOGGED: BT
CHECKED: DB

PROJECT: 1788468

RECORD OF BOREHOLE BH-105

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 23, 2017
DRILLING CONTRACTOR: London Soil Test Ltd.

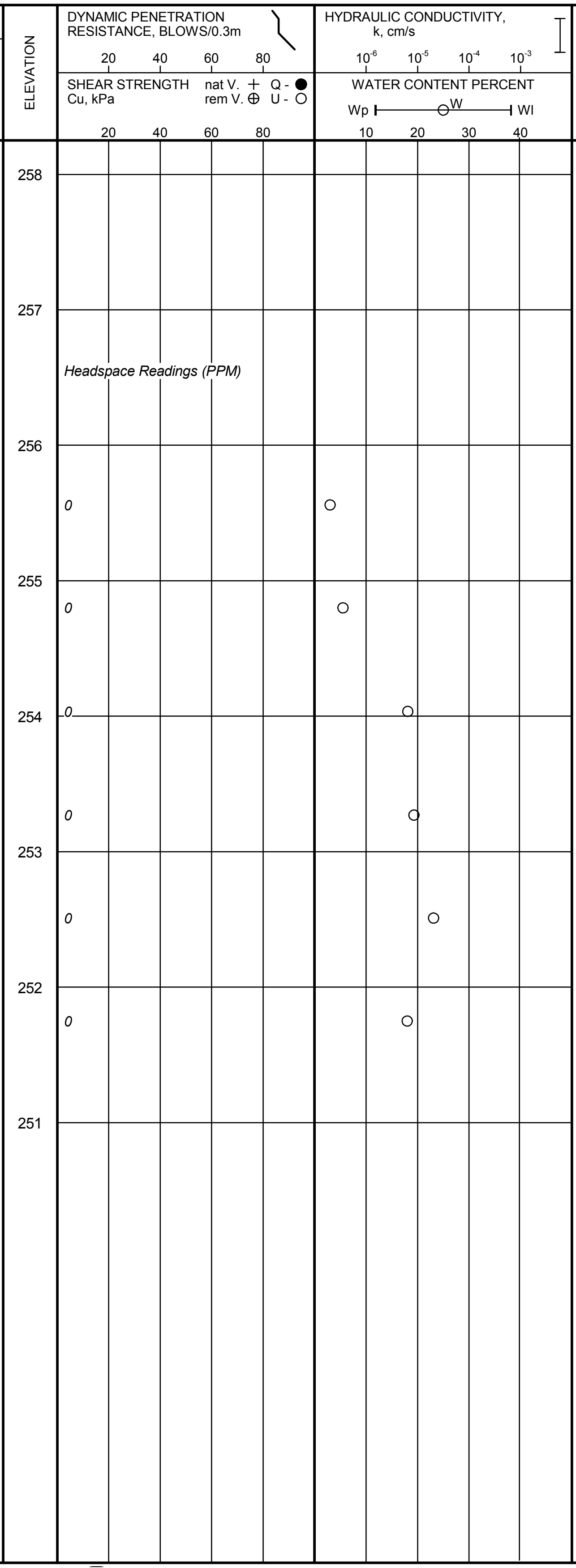
DATUM: GEODETIC

HAMMER TYPE: Auto Hammer

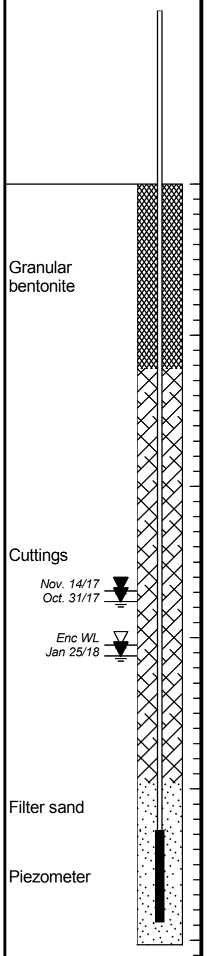
BORING METHOD: POWER AUGER 108mm ID HOLLOW STEM

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
0	GROUND SURFACE	256.55
	TOPSOIL, sandy; brown	0.00
	(SP) **SAND**, trace gravel, trace silt; brown; loose	256.30 0.25
	(SW) **SAND**, trace to some gravel, trace silt; brown; loose to compact	254.42 2.13
5	END OF BOREHOLE	251.52 5.03

SAMPLES NUMBER	TYPE	BLOWS/0.3m	Headspace Readings (PPM)	ADDITIONAL LAB. TESTING
1	SS	6	0	
2	SS	7	0	
3	SS	7	0	
4	SS	13	0	
5	SS	15	0	MH
6	SS	24	0	



INSTALLATION AND GROUNDWATER OBSERVATIONS



Groundwater encountered at about elev. 253.6m during drilling on October 23, 2017.

Water level measured in piezometer at elev. 253.79m on October 31, 2017.

Water level measured in piezometer at elev. 253.86m on November 14, 2017.

Water level measured in piezometer at elev. 253.43m on January 25, 2018.

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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: BT
CHECKED: DB

PROJECT: 1788468

RECORD OF BOREHOLE BH-106

SHEET 1 OF 1

LOCATION: REFER TO LOCATION PLAN

BORING DATE: October 23, 2017
DRILLING CONTRACTOR: London Soil Test Ltd.

DATUM: GEODETIC

HAMMER TYPE: Auto Hammer

BORING METHOD: POWER AUGER, 108mm ID HOLLOW STEM

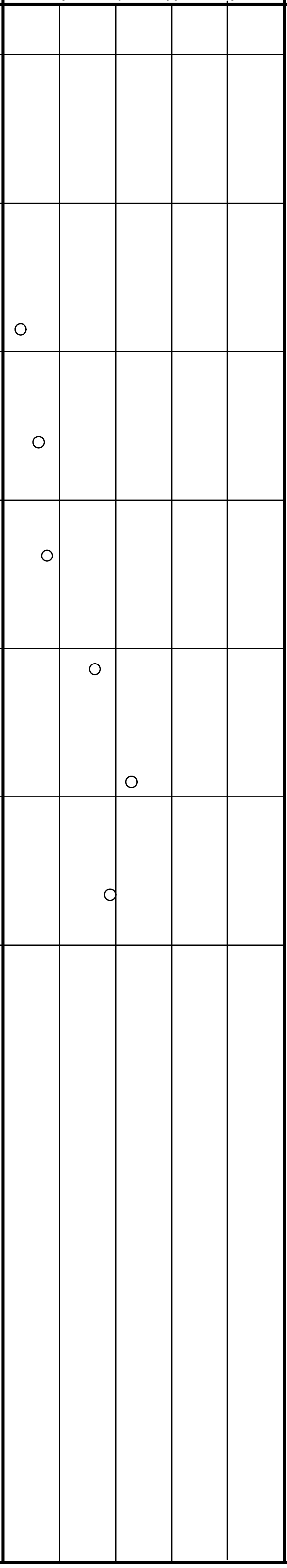
SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	257.14
TOPSOIL, sandy; brown	0.00 256.91 0.23
(SP) **SAND**, trace to some silt; brown; very loose to loose	255.01 2.13
(SW) gravelly **SAND**, trace silt; brown; compact	253.48 3.66
(SW) **SAND**, some gravel, trace silt; brown; compact	252.11 5.03
END OF BOREHOLE	

SAMPLES NUMBER	TYPE	BLOWS/0.3m	Headspace Readings (PPM)
1	SS	4	0
2	SS	3	0
3	SS	17	0
4	SS	12	0
5	SS	16	0
6	SS	14	0

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa — nat V. + Q - ● rem V. ⊕ U - ○: 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}



ADDITIONAL LAB. TESTING

INSTALLATION AND GROUNDWATER OBSERVATIONS

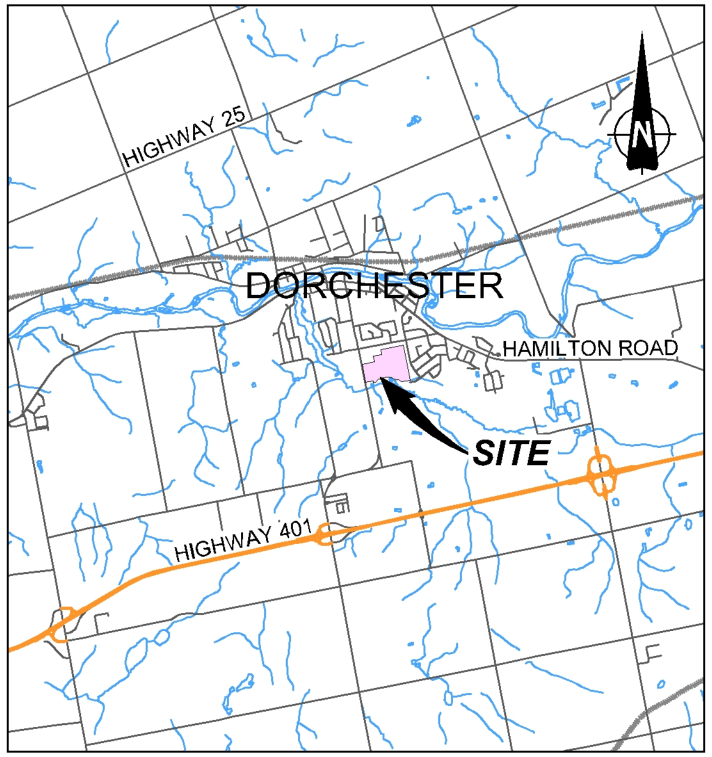
Enc WL ∇

Groundwater encountered at about elev. 254.1m during drilling on October 23, 2017.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: BT
CHECKED: DB



KEY PLAN

LEGEND

● BOREHOLE

⊕ BOREHOLE / MONITORING WELL

◒ BOREHOLE/MONITORING WELL
(LOTOWATER TECHNICAL SERVICES INC. 2006)

REFERENCE

DRAWING BASED ON BING IMAGERY AS OF NOVEMBER 7, 2017 (IMAGE DATE UNKNOWN); "CONCEPTUAL LAYOUT D" PROVIDED BY SIFTON, AUTOCAD FILE "18-827 CONCEPT D JAN 17, 2018".DWG"; LOTOWATER TECHNICAL SERVICES INC, FIGURE 2, DORCHESTER PART 1 AQUIFER TEST FINAL, MAY 2007; AND CANMAP STREETFILES V2008.4.

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

BING IMAGERY USED FOR ILLUSTRATION PURPOSES ONLY AND NOT TO BE USED FOR MEASUREMENTS.

ALL LOCATIONS ARE APPROXIMATE.

PROJECT

PROPOSED DEVELOPMENT
187 BYRON AVENUE
DORCHESTER, ONTARIO

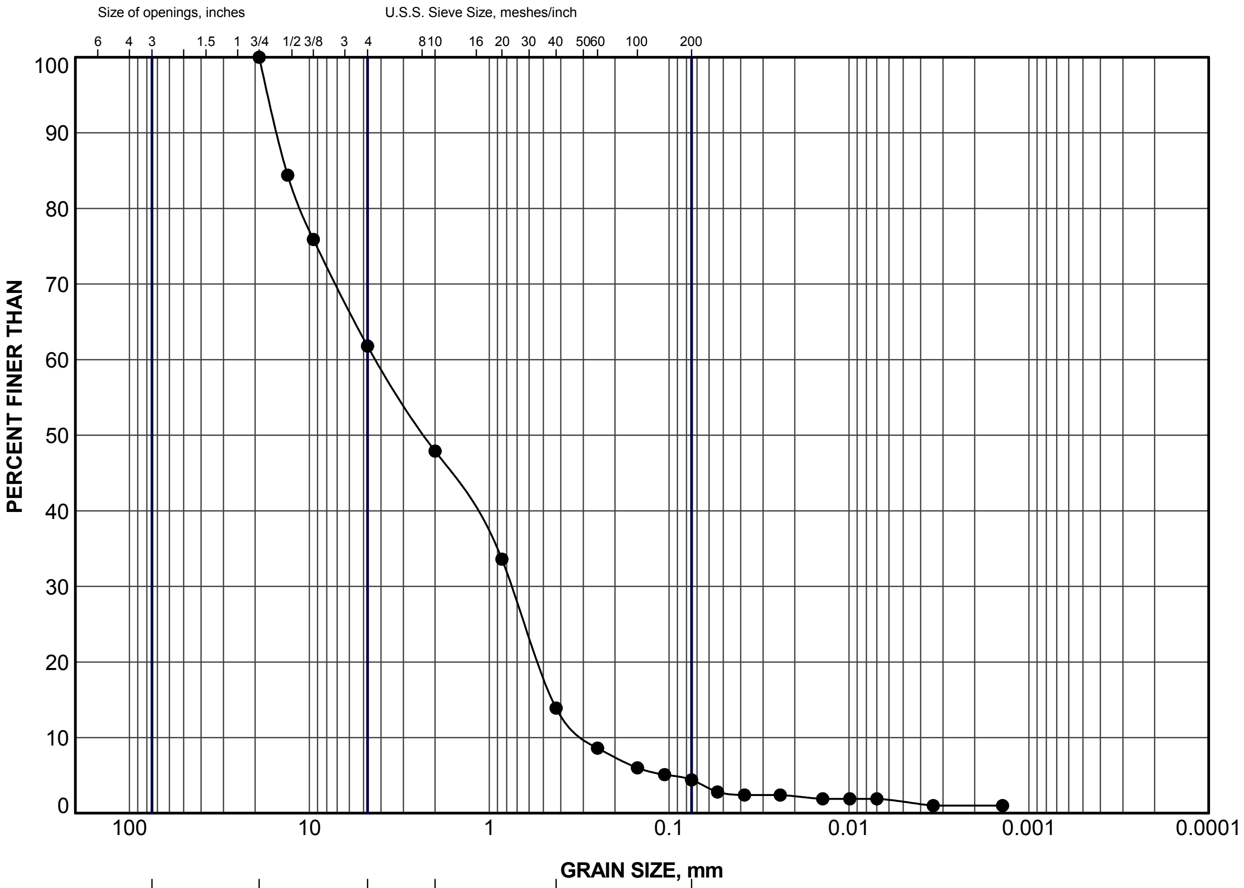
TITLE

LOCATION PLAN

Golder Associates

PROJECT No.		1788468	FILE No.	1788468-R01001
			SCALE AS SHOWN	REV.
CADD	ZB/LK/DH	Jan 25/18	FIGURE 1	
CHECK	DB			

Drawing file: 1788468-R01001.dwg Jan 25, 2018 - 11:16am



Cobble Size	coarse	fine	coarse	medium	fine	SILT AND CLAY
	GRAVEL SIZE		SAND SIZE			

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	BH-102	4	252.6

PROJECT

PROPOSED DEVELOPMENT
187 BYRON AVENUE
DORCHESTER, ONTARIO

TITLE

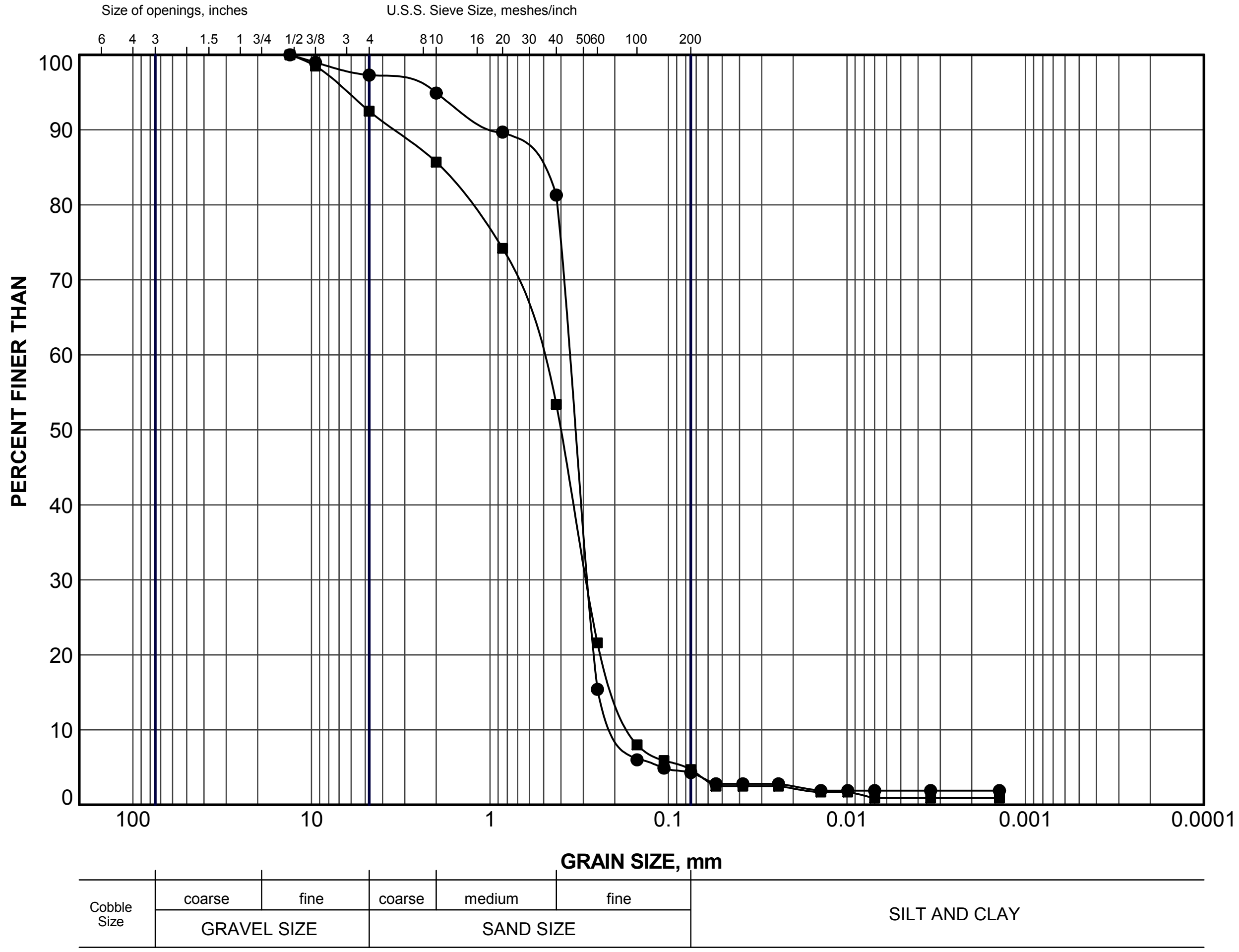
GRAIN SIZE DISTRIBUTION

gravelly SAND

Golder Associates

PROJECT No.		1788468	FILE No.	1788468-R01002
			SCALE N/A	REV.
DRAWN	LMK	Nov 09/17	**FIGURE 2**	
CHECK	DB			

LDN_GSD GLDR_LDN.GDT 09/11/17 09:29



LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	BH-103	5	251.8
■	BH-105	5	252.5

PROJECT

PROPOSED DEVELOPMENT
187 BYRON AVENUE
DORCHESTER, ONTARIO

TITLE

GRAIN SIZE DISTRIBUTION

SAND

Golder Associates

PROJECT No.		1788468	FILE No. 1788468-R01003
			SCALE N/A REV.
DRAWN	LMK	Nov 09/17	
CHECK	DB		**FIGURE 3**

LDN_GSD GLDR_LDN.GDT 09/11/17 13:27

APPENDIX A

Records of Previous Monitoring Wells (By Others)

MONITORING WELL DRILLING & COMPLETION LOG

MW3

CLIENT: Municipality of Thames Centre

LOCATION: Dorchester Water Supply
Dorchester, Ontario

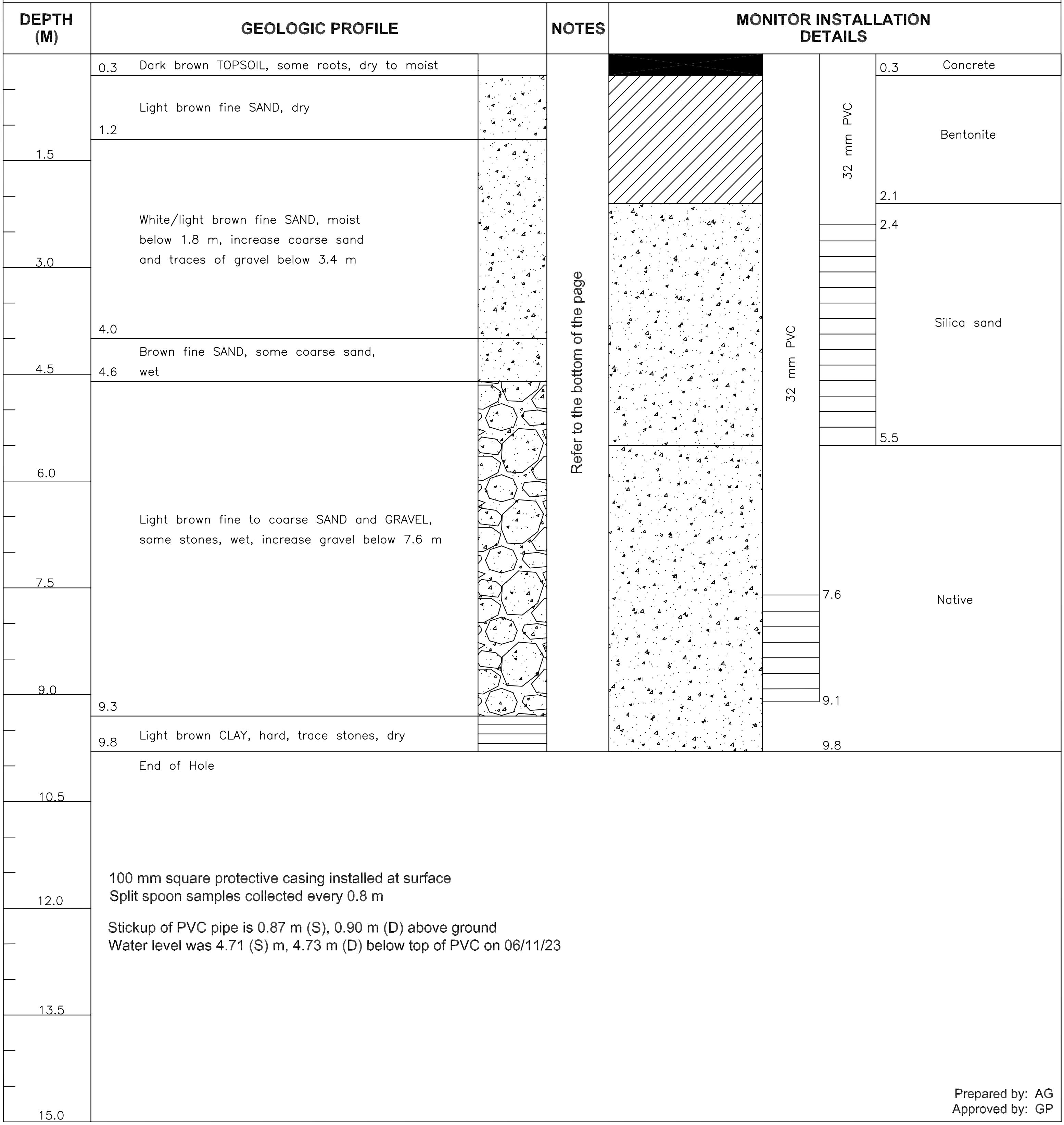
DRILLING METHOD: Hollow Stem Auger

COMPLETION DATE: August 3, 2006

TOTAL DEPTH OF HOLE: 9.8 m B.G.L.

GRADE ELEVATION: 255.92 m ASL

CASING ELEVATION: 256.79(S) m ASL
256.82(D) m ASL



0.3	Dark brown TOPSOIL, some roots, dry to moist
1.2	Light brown fine SAND, dry
4.0	White/light brown fine SAND, moist below 1.8 m, increase coarse sand and traces of gravel below 3.4 m
4.6	Brown fine SAND, some coarse sand, wet
9.3	Light brown fine to coarse SAND and GRAVEL, some stones, wet, increase gravel below 7.6 m
9.8	Light brown CLAY, hard, trace stones, dry
	End of Hole

0.3	Concrete
2.1	Bentonite
2.4	
5.5	Silica sand
7.6	
9.1	
9.8	Native

100 mm square protective casing installed at surface
Split spoon samples collected every 0.8 m

Stickup of PVC pipe is 0.87 m (S), 0.90 m (D) above ground
Water level was 4.71 (S) m, 4.73 m (D) below top of PVC on 06/11/23

Prepared by: AG
Approved by: GP

Reference: 297-003

MONITORING WELL DRILLING & COMPLETION LOG

MW5

CLIENT: Municipality of Thames Centre

LOCATION: Dorchester Water Supply
Dorchester, Ontario

DRILLING METHOD: Hollow Stem Auger

COMPLETION DATE: August 8, 2006

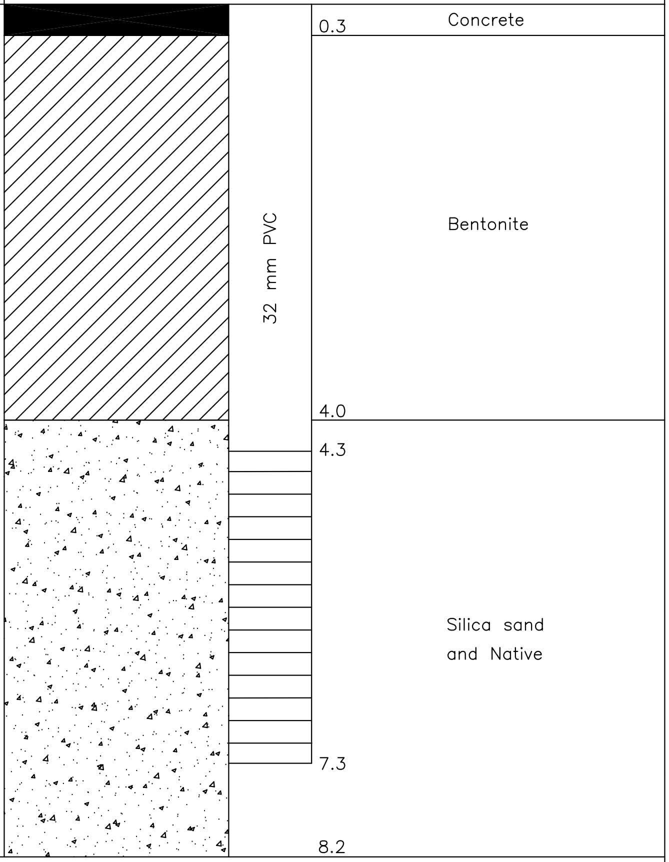
TOTAL DEPTH OF HOLE: 8.2 m B.G.L.

GRADE ELEVATION: 259.11 m ASL

CASING ELEVATION: 259.96 m ASL

DEPTH (M)		GEOLOGIC PROFILE	NOTES
	0.3	Dark brown TOPSOIL, dry	Refer to the bottom of the page
1.5	2.4	Light brown fine SAND, dry	
3.0 4.5	5.0	White/light brown fine to coarse SAND, moist below 3.0 m	
6.0	6.1	Brown fine to coarse SAND, some gravel, wet	
	7.3	Brown fine to coarse SAND and GRAVEL, some stones, wet	
7.5	7.5	Light brown GRAVEL, trace sand with stones	
	8.2	Light brown/grey CLAY, hard, some stones, dry	
9.0 10.5 12.0 13.5 15.0		End of Hole	

MONITOR INSTALLATION DETAILS



100 mm square protective casing installed at surface
Split spoon samples collected every 0.8 m

Stickup of PVC pipe is 0.85 m above ground
Water level was 6.13 m below top of PVC on 06/11/23

Prepared by: AG
Approved by: GP

Reference: 297-003

MONITORING WELL DRILLING & COMPLETION LOG

MW6

CLIENT: Municipality of Thames Centre

LOCATION: Dorchester Water Supply
Dorchester, Ontario

DRILLING METHOD: Hollow Stem Auger

COMPLETION DATE: August 9, 2006

TOTAL DEPTH OF HOLE: 7.5 m B.G.L.

GRADE ELEVATION: 255.90 m ASL

CASING ELEVATION: 256.89 m ASL

DEPTH (M): 1.5, 3.0, 4.5, 6.0, 7.5, 9.0, 10.5, 12.0, 13.5, 15.0

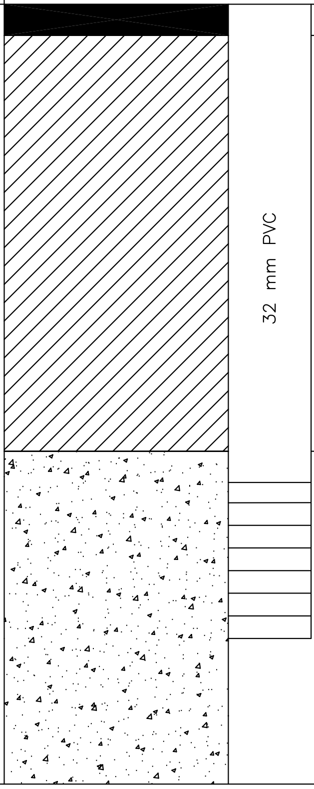
GEOLOGIC PROFILE

0.2	Dark brown TOPSOIL, some roots, dry
1.8	Light brown/orange fine SAND, dry
3.5	White/light brown fine to coarse SAND, some gravel, dry
4.6	Brown fine to coarse SAND, moist/wet
6.4	Light brown fine to coarse SAND and GRAVEL, some stones, wet
7.5	Grey CLAY, hard, some stones, dry
	End of Hole

NOTES

Refer to the bottom of the page

MONITOR INSTALLATION DETAILS



0.3	Concrete
4.3	Bentonite
4.6	
6.1	
7.5	Silica sand

100 mm square protective casing installed at surface
Split spoon samples collected every 1.5 m

Stickup of PVC pipe is 0.99 m above ground
Water level was 4.56 m below top of PVC on 06/11/23

Prepared by: AG
Approved by: GP

Reference: 297-003

MONITORING WELL DRILLING & COMPLETION LOG

MW8

CLIENT: Municipality of Thames Centre

LOCATION: Dorchester Water Supply
Dorchester, Ontario

DRILLING METHOD: Hollow Stem Auger

COMPLETION DATE: August 9, 2006

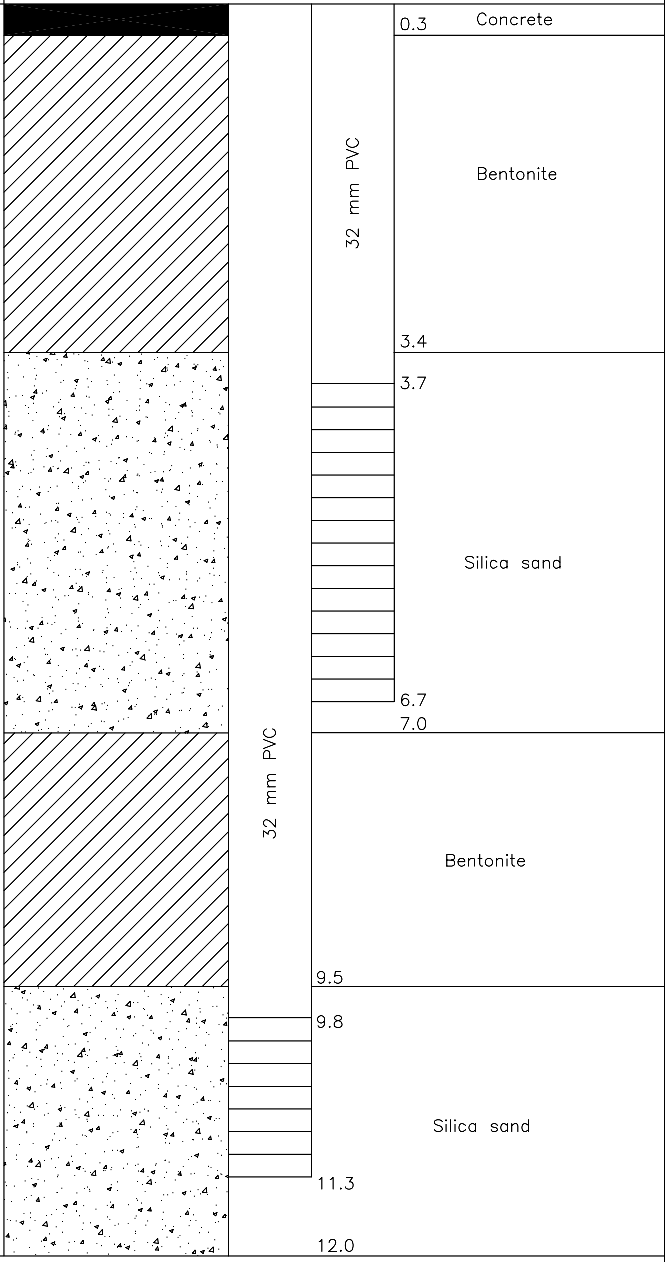
TOTAL DEPTH OF HOLE: 12.0 m B.G.L.

GRADE ELEVATION: 256.26 m ASL

CASING ELEVATION: 257.16(S) m ASL
257.12(D) m ASL

DEPTH (M)	GEOLOGIC PROFILE		NOTES
	0.3	Dark brown TOPSOIL, some roots, dry	Refer to the bottom of the page
1.5 3.0 4.5	4.6	Light brown fine to coarse SAND, some stones, moist below 2.0 m	
6.0 7.5 9.0 10.5	11.6	Light brown fine to coarse SAND AND GRAVEL, some stones, wet, increase gravel below 9.5 m	
12.0	12.0	Grey CLAY, hard, some stones, dry	
13.5 15.0		End of Hole	

MONITOR INSTALLATION DETAILS



100 mm square protective casing installed at surface
Split spoon samples collected every 1.5 m

Stickup of PVC pipe is 0.90 m (S), 0.87 m (D) above ground
Water level was 4.89 m (S), 4.87 m (D) below top of PVC on 06/11/23

Prepared by: AG
Approved by: GP

Reference: 297-003

MONITORING WELL DRILLING & COMPLETION LOG

MW10

CLIENT: Municipality of Thames Centre

LOCATION: Dorchester Water Supply
Dorchester, Ontario

DRILLING METHOD: Hollow Stem Auger

COMPLETION DATE: August 8, 2006

TOTAL DEPTH OF HOLE: 10.5 m B.G.L.

GRADE ELEVATION: 259.60 m ASL

CASING ELEVATION: 260.67(S) m ASL
260.56(D) m ASL

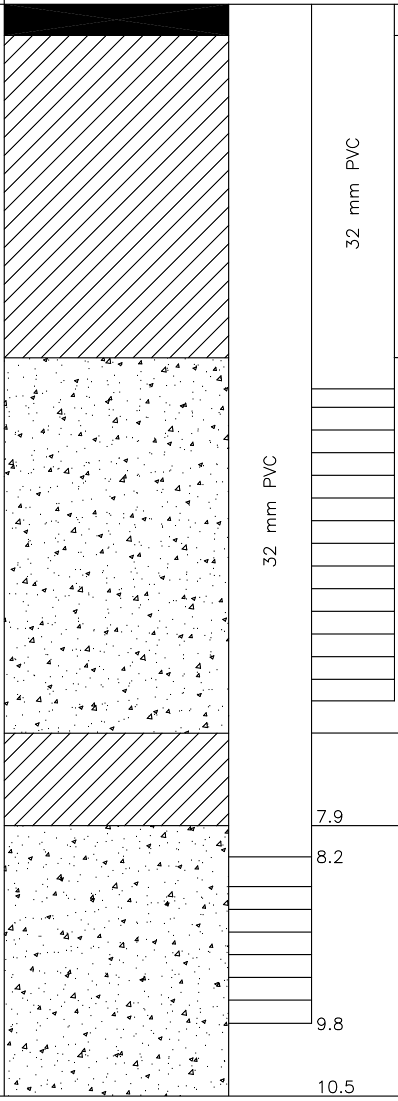
GEOLOGIC PROFILE

Depth (M)	Description
0.3	Dark brown TOPSOIL, some roots, dry
1.1	Light brown/orange fine SAND, trace gravel, dry
4.3	White/light brown fine SAND, moist below 2.4 m
5.2	GRAVEL, some stones and coarse sand, moist
10.1	Light brown coarse SAND and GRAVEL, some stones, wet, increase fine to medium sand below 6.4 m
10.5	Grey CLAY, hard, trace stones, dry
	End of Hole

NOTES

Refer to the bottom of the page

MONITOR INSTALLATION DETAILS



Depth (M)	Material
0.3	Concrete
3.4	Bentonite
3.7 – 6.7	
7.0	Silica sand and Native
7.9	Bentonite
8.2 – 9.8	
10.5	Silica sand and Native

100 mm square protective casing installed at surface
Split spoon samples collected every 0.8 m

Stickup of PVC pipe is 1.07 m (S), 0.97 m (D) above ground
Water level was 6.14 m (S), 6.03 m (D) below top of PVC on 06/11/23

Prepared by: AG
Approved by: GP

Reference: 297-003

MONITORING WELL DRILLING & COMPLETION LOG

MW13

CLIENT: Municipality of Thames Centre

LOCATION: Dorchester Water Supply
Dorchester, Ontario

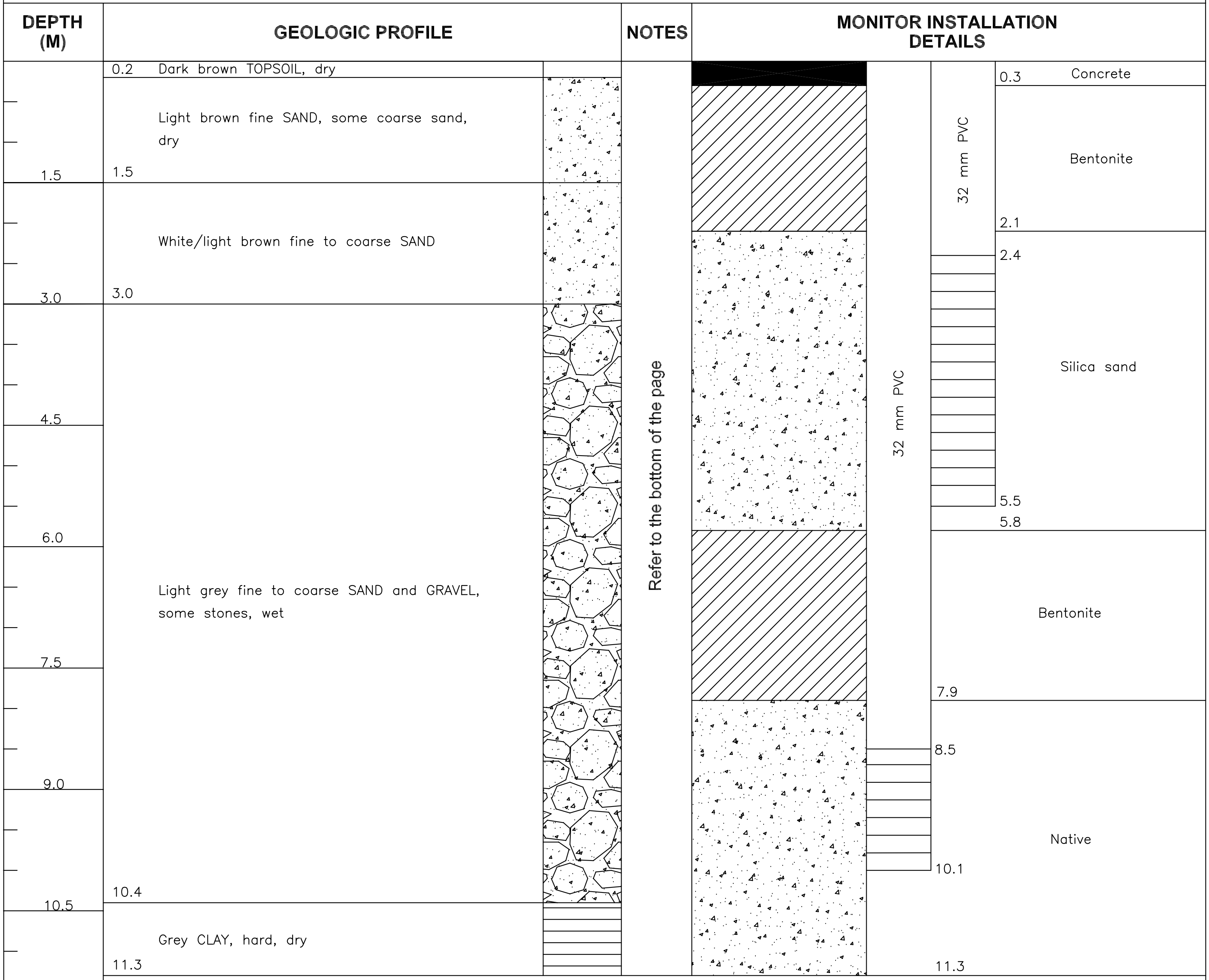
DRILLING METHOD: Hollow Stem Auger

COMPLETION DATE: August 2, 2006

TOTAL DEPTH OF HOLE: 11.3 m B.G.L.

GRADE ELEVATION: 255.38 m ASL

CASING ELEVATION: 256.31 m ASL (S & D)



Depth	Geologic profile
0.2	Dark brown TOPSOIL, dry
1.5	Light brown fine SAND, some coarse sand, dry
3.0	White/light brown fine to coarse SAND
10.4	Light grey fine to coarse SAND and GRAVEL, some stones, wet
11.3	Grey CLAY, hard, dry
	End of Hole

Depth	Monitor installation details
0.3	Concrete
2.1	Bentonite
2.4 – 5.5	
5.8	Silica sand
7.9	Bentonite
8.5 – 10.1	
11.3	Native

100 mm square protective casing installed at surface
Split spoon samples collected every 1.5 m

Stickup of PVC pipe is 0.93 m (S & D) above ground
Water level was 3.13 m (S), 3.14 m (D) below top of PVC on 06/11/23

Prepared by: AG
Approved by: GP

Reference: 297-003

APPENDIX B

Certificates of Analysis

Your Project #: 1788468
Site#: BYRON AVE.
Site Location: DORCHESTER
Your C.O.C. #: 58389

Attention:Brett Thorner
Golder Associates Ltd
309 Exeter Rd
Unit 1
London, ON
N6L 1C1

Report Date: 2017/11/10
Report #: R4843263
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7O7491
Received: 2017/11/03, 12:25

Sample Matrix: Soil
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Hot Water Extractable Boron	2	2017/11/08	2017/11/08	CAM SOP-00408	R153 Ana. Prot. 2011
Free (WAD) Cyanide	2	2017/11/07	2017/11/08	CAM SOP-00457	OMOE E3015 m
Conductivity	2	2017/11/08	2017/11/08	CAM SOP-00414	OMOE E3530 v1 m
Hexavalent Chromium in Soil by IC (1)	2	2017/11/07	2017/11/09	CAM SOP-00436	EPA 3060/7199 m
Strong Acid Leachable Metals by ICPMS	2	2017/11/07	2017/11/07	CAM SOP-00447	EPA 6020B m
Moisture	2	N/A	2017/11/07	CAM SOP-00445	Carter 2nd ed 51.2 m
pH CaCl2 EXTRACT	2	2017/11/08	2017/11/08	CAM SOP-00413	EPA 9045 D m
Sodium Adsorption Ratio (SAR)	2	N/A	2017/11/09	CAM SOP-00102	EPA 6010C

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Soils are reported on a dry weight basis unless otherwise specified.

Your Project #: 1788468
Site#: BYRON AVE.
Site Location: DORCHESTER
Your C.O.C. #: 58389

Attention:Brett Thorner

Golder Associates Ltd
309 Exeter Rd
Unit 1
London, ON
N6L 1C1

Report Date: 2017/11/10
Report #: R4843263
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B7O7491
Received: 2017/11/03, 12:25

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Christine Gripton, Senior Project Manager
Email: CGripton@maxxam.ca
Phone# (800)268-7396 Ext:250
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B7O7491
Report Date: 2017/11/10

Golder Associates Ltd
Client Project #: 1788468
Site Location: DORCHESTER
Sampler Initials: BT

O.REG 153 METALS & INORGANICS PKG (SOIL)

Maxxam ID			FMF357	FMF358		
Sampling Date			2017/10/23 10:40	2017/10/23 10:40		
COC Number			58389	58389		
	UNITS	**Criteria**	**BH-102-1**	**BH-104-1**	**RDL**	**QC Batch**
Calculated Parameters						
Sodium Adsorption Ratio	N/A	**2.4**	0.31	0.31		5248112
Inorganics						
Conductivity	mS/cm	**0.57**	0.12	0.11	0.002	5254135
Moisture	%	-	4.4	6.2	1.0	5252334
Available (CaCl2) pH	pH	-	7.82	7.65		5252301
WAD Cyanide (Free)	ug/g	**0.051**	<0.01	<0.01	0.01	5252213
Chromium (VI)	ug/g	**0.66**	<0.2	<0.2	0.2	5252298
Metals						
Hot Water Ext. Boron (B)	ug/g	-	0.057	<0.050	0.050	5254599
Acid Extractable Antimony (Sb)	ug/g	**1.3**	<0.20	<0.20	0.20	5252932
Acid Extractable Arsenic (As)	ug/g	**18**	3.7	1.6	1.0	5252932
Acid Extractable Barium (Ba)	ug/g	**220**	15	5.0	0.50	5252932
Acid Extractable Beryllium (Be)	ug/g	**2.5**	0.20	<0.20	0.20	5252932
Acid Extractable Boron (B)	ug/g	**36**	7.3	<5.0	5.0	5252932
Acid Extractable Cadmium (Cd)	ug/g	**1.2**	<0.10	<0.10	0.10	5252932
Acid Extractable Chromium (Cr)	ug/g	**70**	11	4.6	1.0	5252932
Acid Extractable Cobalt (Co)	ug/g	**21**	3.8	1.6	0.10	5252932
Acid Extractable Copper (Cu)	ug/g	**92**	20	7.4	0.50	5252932
Acid Extractable Lead (Pb)	ug/g	**120**	7.3	4.4	1.0	5252932
Acid Extractable Molybdenum (Mo)	ug/g	**2**	<0.50	<0.50	0.50	5252932
Acid Extractable Nickel (Ni)	ug/g	**82**	9.4	3.4	0.50	5252932
Acid Extractable Selenium (Se)	ug/g	**1.5**	<0.50	<0.50	0.50	5252932
Acid Extractable Silver (Ag)	ug/g	**0.5**	<0.20	<0.20	0.20	5252932
Acid Extractable Thallium (Tl)	ug/g	**1**	0.089	<0.050	0.050	5252932
Acid Extractable Uranium (U)	ug/g	**2.5**	0.60	0.23	0.050	5252932
Acid Extractable Vanadium (V)	ug/g	**86**	16	12	5.0	5252932
Acid Extractable Zinc (Zn)	ug/g	**290**	72	22	5.0	5252932
Acid Extractable Mercury (Hg)	ug/g	**0.27**	<0.050	<0.050	0.050	5252932

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Criteria: Ontario Reg. 153/04 (Amended April 15, 2011)
Table 1: Full Depth Background Site Condition Standards
Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use

TEST SUMMARY

Maxxam ID: FMF357
Sample ID: BH-102-1
Matrix: Soil

Collected: 2017/10/23
Shipped:
Received: 2017/11/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	5254599	2017/11/08	2017/11/08	Suban Kanapathippllai
Free (WAD) Cyanide	TECH	5252213	2017/11/07	2017/11/08	Louise Harding
Conductivity	AT	5254135	2017/11/08	2017/11/08	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5252298	2017/11/07	2017/11/09	Manoj Kumar Gera
Strong Acid Leachable Metals by ICPMS	ICP/MS	5252932	2017/11/07	2017/11/07	Daniel Teclu
Moisture	BAL	5252334	N/A	2017/11/07	Min Yang
pH CaCl2 EXTRACT	AT	5252301	2017/11/08	2017/11/08	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5248112	N/A	2017/11/09	Automated Statchk

Maxxam ID: FMF358
Sample ID: BH-104-1
Matrix: Soil

Collected: 2017/10/23
Shipped:
Received: 2017/11/03

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Hot Water Extractable Boron	ICP	5254599	2017/11/08	2017/11/08	Suban Kanapathippllai
Free (WAD) Cyanide	TECH	5252213	2017/11/07	2017/11/08	Louise Harding
Conductivity	AT	5254135	2017/11/08	2017/11/08	Neil Dassanayake
Hexavalent Chromium in Soil by IC	IC/SPEC	5252298	2017/11/07	2017/11/09	Manoj Kumar Gera
Strong Acid Leachable Metals by ICPMS	ICP/MS	5252932	2017/11/07	2017/11/07	Daniel Teclu
Moisture	BAL	5252334	N/A	2017/11/07	Min Yang
pH CaCl2 EXTRACT	AT	5252301	2017/11/08	2017/11/08	Tahir Anwar
Sodium Adsorption Ratio (SAR)	CALC/MET	5248112	N/A	2017/11/09	Automated Statchk

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	19.0°C

Sample FMF357 [BH-102-1] : SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Sample FMF358 [BH-104-1] : SAR Analysis: Sodium was not detected. To report SAR the sodium detection limit was used in the calculation. This value represents a maximum ratio.

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5252213	WAD Cyanide (Free)	2017/11/08	101	75 - 125	102	80 - 120	<0.01	ug/g	NC	35
5252298	Chromium (VI)	2017/11/09	83	75 - 125	88	80 - 120	<0.2	ug/g	NC	35
5252301	Available (CaCl2) pH	2017/11/08			100	97 - 103			0.19	N/A
5252334	Moisture	2017/11/07							3.1	20
5252932	Acid Extractable Antimony (Sb)	2017/11/07	99	75 - 125	96	80 - 120	<0.20	ug/g		
5252932	Acid Extractable Arsenic (As)	2017/11/07	101	75 - 125	97	80 - 120	<1.0	ug/g		
5252932	Acid Extractable Barium (Ba)	2017/11/07	103	75 - 125	94	80 - 120	<0.50	ug/g		
5252932	Acid Extractable Beryllium (Be)	2017/11/07	101	75 - 125	96	80 - 120	<0.20	ug/g		
5252932	Acid Extractable Boron (B)	2017/11/07	95	75 - 125	95	80 - 120	<5.0	ug/g		
5252932	Acid Extractable Cadmium (Cd)	2017/11/07	102	75 - 125	97	80 - 120	<0.10	ug/g		
5252932	Acid Extractable Chromium (Cr)	2017/11/07	101	75 - 125	98	80 - 120	<1.0	ug/g		
5252932	Acid Extractable Cobalt (Co)	2017/11/07	100	75 - 125	99	80 - 120	<0.10	ug/g		
5252932	Acid Extractable Copper (Cu)	2017/11/07	98	75 - 125	98	80 - 120	<0.50	ug/g		
5252932	Acid Extractable Lead (Pb)	2017/11/07	98	75 - 125	98	80 - 120	<1.0	ug/g	5.3	30
5252932	Acid Extractable Mercury (Hg)	2017/11/07	94	75 - 125	98	80 - 120	<0.050	ug/g		
5252932	Acid Extractable Molybdenum (Mo)	2017/11/07	101	75 - 125	98	80 - 120	<0.50	ug/g		
5252932	Acid Extractable Nickel (Ni)	2017/11/07	98	75 - 125	99	80 - 120	<0.50	ug/g		
5252932	Acid Extractable Selenium (Se)	2017/11/07	101	75 - 125	99	80 - 120	<0.50	ug/g		
5252932	Acid Extractable Silver (Ag)	2017/11/07	99	75 - 125	97	80 - 120	<0.20	ug/g		
5252932	Acid Extractable Thallium (Tl)	2017/11/07	100	75 - 125	98	80 - 120	<0.050	ug/g		
5252932	Acid Extractable Uranium (U)	2017/11/07	97	75 - 125	97	80 - 120	<0.050	ug/g		
5252932	Acid Extractable Vanadium (V)	2017/11/07	104	75 - 125	95	80 - 120	<5.0	ug/g		
5252932	Acid Extractable Zinc (Zn)	2017/11/07	NC	75 - 125	101	80 - 120	<5.0	ug/g		
5254135	Conductivity	2017/11/08			100	90 - 110	<0.002	mS/cm	0.25	10

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**UNITS**	**Value (%)**	**QC Limits**
5254599	Hot Water Ext. Boron (B)	2017/11/08	96	75 - 125	93	75 - 125	<0.050	ug/g	NC	40

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Eva

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
Eva Pranjic
CHEMIST

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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