



Regional Municipality of York

**Geotechnical Investigation
Proposed Paramedic Response Station
2960 Teston Road
Vaughan, Ontario**

Project Number
GOR-00247181-A0

Prepared By:

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Date Submitted
August 3, 2018

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1. Introduction

This report presents the findings of a geotechnical investigation conducted for the proposed paramedic response station located at 2960 Teston Road in Vaughan, Ontario. The work was authorized by The Regional Municipality of York.

It is understood the proposed paramedic response station will be a single storey basementless structure with two (2) vehicle bays. The development will also include paved parking areas and driveways.

The purpose of this investigation was to determine the subsurface soil and groundwater conditions at the site by putting down sampled boreholes and, based on an assessment of the factual borehole data, to provide geotechnical engineering guidelines for the design and construction of the proposed development. More specifically, recommendations and/or comments regarding site grading, foundation type, geotechnical resistance, excavation and groundwater control, backfill considerations, slab-on-grade construction, permanent drainage requirements, earthquake considerations, installation of underground services and pavement structures were to be provided.

The comments and recommendations given in this report are based on the assumption the above-described design concept will proceed into construction. If changes are made either in the design phase or during construction, this office must be retained to review these modifications. The result of this review may be a modification of our recommendations or the requirement of additional field or laboratory work to check whether the changes are acceptable from a geotechnical viewpoint.

2. Site Description

The site is located at the northeast corner of Teston Road and Jane Street in Vaughan, Ontario. The site is irregular in shape, covers an area of approximately 0.64 acres and slopes towards the east and west from the centre portion of the site.

The site consists of two (2) properties. The east property (0.22 acres) is occupied by a residential and commercial property, including one residential building, one residential mobile home and parking areas rented to various businesses for commercial vehicle storage. The west property (0.42 acres) is a vacant lot covered with grass and some large trees. Surrounding land usage is agricultural and residential in nature.

3. Procedure

The fieldwork was carried out on June 12, 13 and 14, 2018. Prior to drilling, the borehole locations were cleared of underground services by Ontario One Call contractors and a private locator. Ten (10) sampled boreholes were drilled to depths of 4.25 to 8.25 m below existing grade at the approximate locations shown on the attached Borehole Location Plan (Drawing No. 1). Boreholes 2 to 7 were drilled within or near the proposed building area. Boreholes 1 and 8 to 10 were drilled in proposed pavement areas. The majority of the boreholes were relocated due to the presence of large trees.

The boreholes were advanced using continuous flight solid stem augering equipment owned and operated by a specialist drilling contractor. In each borehole, soil samples were recovered using conventional split spoon equipment and standard penetration test methods.

Water levels were observed in the open boreholes during the course of the fieldwork.

The fieldwork was supervised by a geotechnical engineer from EXP Services Inc. who monitored the drilling operations and logged the borings. All split spoon samples were transported to our laboratory for detailed examination and moisture content determination. One (1) soil sample was also analyzed for pH and sulphate content.

The location and ground surface elevation of the boreholes were established in the field by EXP Services Inc. The elevations were referenced to a temporary benchmark (TBM) described as follows:

TBM: Ministry of Natural Resources and Forestry Control Station #00819688062
(Concrete bridge carrying Teston Sideroad over Highway 400, 2.1 km north of Highway 400 and Major Mackenzie Drive Interchange and 2.1 km south of Kirby Sideroad. Tablet is set horizontally in west face of east concrete abutment, 5.03 m north of southwest corner, 61 cm above ground level and 14.3 m east of centre line of Highway 400)

Elevation: 239.226 m (geodetic)

4. Subsurface Conditions

4.1 Soil

The detailed soil profile encountered in each borehole and the results of laboratory moisture content determinations are indicated on the attached borehole logs (Drawing Nos. 2 to 11). It should be noted the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The "Notes on Sample Descriptions" preceding the borehole logs form an integral part of and should be read in conjunction with this report.

The stratigraphy of the site, as revealed in the boreholes, comprised fill overlying native deposits of upper sandy silt, silt till, lower sandy silt, sand and silty sand.

A brief description of the stratigraphy, in order of depth, follows.

Pavement Structure

Pavement structure, comprising 75 mm asphaltic concrete and 330 to 405 mm granular material, was encountered surficially in Boreholes 1 and 2.

Fill

Fill was encountered in all of the boreholes. Below the pavement structure in Boreholes 1 and 2 and a veneer of grass/topsoil in Boreholes 3 to 10, the fill varied from silty sand to clayey silt with some gravel and topsoil stains/inclusions. The compactness of the fill varied from very loose to compact but was typically loose. Moisture contents of the moist to wet fill ranged from 6 to 20%. The fill extended to depths of approximately 1.4 to 2.9 m below existing grade.

Sandy Silt (upper)

An upper sandy silt stratum was encountered below the fill in Boreholes 1 to 4, 6, 7 and 9. The sandy silt stratum was brown in colour and existed in a compact state of compactness. Moisture contents of this material ranged from 18 to 21%, indicating a saturated condition. The upper sandy silt stratum extended to depths of about 2.1 to 2.9 m below existing grade.

Silt Till

Silt till was encountered at depths ranging from about 2.1 to 2.9 m below existing grade in all of the boreholes. The silt till deposit was brown in colour and contained some sand and gravel. The compactness of the silt till varied from compact to very dense. Moisture contents of the silt till ranged from 10 to 13%, indicating a moist condition. The silt till deposit extended to depths of approximately 6.75 m or 7.0 m below existing grade in Boreholes 1 to 5 and 7 to 9. Boreholes 6 and 10 were terminated within the silt till deposit at depths of 8.10 m and 4.25 m below existing grade, respectively.

Sandy Silt (lower)

A lower sandy silt stratum was encountered below the silt till deposit in Boreholes 1, 2, 4, 5, 7 and 9. The sandy silt stratum was brown in colour and existed in a very dense state of compactness. Moisture contents of this material ranged from 12 to 18%, indicating a moist to saturated condition. The lower sandy silt deposit extended to a depth of about 7.75 m below existing grade in Boreholes 1 and 2. Boreholes 4, 5, 7 and 9 were terminated within the lower sandy silt stratum at a depth of 8.05 m or 8.10 m below existing grade.

Sand/Silty Sand

Deposits of sand or silty sand were encountered at depths of approximately 7.0 to 7.75 m below existing grade in Boreholes 1 to 3 and 8. The sand and silty sand deposits were brown in colour and existed in a dense to very dense state of compactness. Moisture contents of the sand and silty sand ranged from 4 to 9%, indicating a moist condition. Boreholes 1 to 3 and 8 were terminated within the sand and silty sand deposits at a depth of 8.10 or 8.25 m below existing grade.

4.2 Groundwater

Groundwater conditions were observed in the open boreholes during the course of the fieldwork. Groundwater measurements are included in the attached borehole logs.

All of the boreholes were dry on completion of drilling. However, minor groundwater seepage should be anticipated from perched water in the fill, the saturated upper sandy silt stratum and pervious seams in the silt till deposit. The stabilized groundwater table at the site is below 8 m depth.

5. Engineering Discussion and Recommendations

5.1 General

A geotechnical investigation has been conducted for the proposed paramedic response station located at 2960 Teston Road in Vaughan, Ontario. It is understood the proposed paramedic response station will be a single-storey basementless structure with two (2) vehicle bays. The development will also include paved parking areas and driveways.

The boreholes revealed typically loose fill extending to depths of about 1.4 to 2.9 m below existing grade overlying native deposits of saturated, compact upper sandy silt; moist, compact to very dense silt till; moist to saturated, very dense lower sandy silt; and moist, dense to very dense sand/silty sand. The stabilized groundwater table at the site is below 8 m depth.

The following subsections provide geotechnical engineering guidelines for the design and construction of the proposed development.

5.2 Site Grading

Substantial regrading (cut and fill operations) will be required based on the presence of loose fill within the proposed building and pavement areas. It is assumed the existing residential dwelling/foundations and large trees will be removed prior to site grading. The following procedures are recommended for the construction of structural fill for building and pavement areas at the site.

- All grass/topsoil, fill and any wet/loose native soils should be removed from the proposed building area. In proposed pavement areas, grass/topsoil, existing pavement structure and fill extending to 1 m below proposed top of subgrade level should be removed.
- The exposed subgrade surfaces should be proofrolled with a heavy roller (no vibration) and examined by a geotechnical engineer. Any soft areas detected during the proofrolling process should be further subexcavated.
- Low areas can then be brought up to final subgrade level with approved on-site and imported material placed in lifts not exceeding 300 mm and compacted to 100% SPMDD within the building area ("engineered fill") and to at least 98% SPMDD in proposed pavement areas. The moisture content of the fill to be placed should be at or near its optimum moisture content in order to assure the specified densities can be achieved with reasonable compactive effort. It should be noted that the fill contained topsoil stains and inclusions. As such, only portions of the existing fill which are free of topsoil and are not wet may be suitable for reuse as backfill. This should be reviewed during excavation to determine the suitability of the fill material.
- All imported borrow fill material from local sources should be free from organic material and foreign objects (i.e. trees, roots, debris, etc.) and should be tested geotechnically by EXP Services Inc. prior to transport to the site. In addition, the chemical quality of the borrow fill material should be assessed by

Exp Services Inc. in accordance with applicable soil criteria listed in the Ministry of the Environment standards (Ontario Regulation 153) dated April 15, 2011.

- All excavation, backfilling and compaction operations should be monitored on a full-time basis by geotechnical staff to approve materials and to ensure the specified degrees of compaction have been obtained.

5.3 Building Construction

5.3.1 Foundation

Based on the results of the investigation, the site is generally considered suitable for construction of the paramedic response station with two (2) vehicle bays and no basement. However, investigation has revealed loose fill extending to depths of about 1.4 to 2.3 m below existing grade within the proposed building area.

Based on the soil conditions, the most feasible foundation scheme to support the proposed building is footings on engineered fill. Other alternatives such as extended footings on native soil, short caissons and helical piles may also be considered. However, these alternatives do not address the loose fill within the building area which is not suitable for foundation and slab-on-grade support.

Footings founded on engineered fill developed over competent native soil may be designed for a geotechnical resistance of 150 kPa at S.L.S. (225 kPa at U.L.S.). It is recommended the engineered fill be constructed to design floor subgrade level prior to installation of footings. This will ensure the engineered fill placed will be suitable for foundation and slab-on-grade construction.

The engineered fill should be constructed by removing all grass/topsoil, fill and any wet/loose native sandy silt down to competent native subgrade. The engineered fill should extend at least 3 m beyond the outside edge of exterior footings. The required extent of engineered fill should be determined based on a known fixed location for the structure and adherence of the conditions outlined above. The boundaries of the engineered fill should be laid out by a surveyor in consultation with engineering staff from EXP Services Inc.

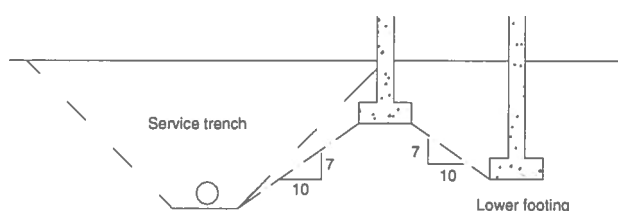
Prior to placement of engineered fill, the exposed native subgrade surface should be examined by geotechnical personnel. Any soft/wet sandy silt detected during proofrolling should be further removed and replaced with approved material compacted to 100% SPMDD. The area can then be brought up to design subgrade level with approved on-site and imported material placed in lifts not exceeding 300 mm and compacted to 100% SPMDD. Portions of the existing fill which are free of topsoil and are not wet may be suitable for reuse as backfill. This should be reviewed during excavation to determine the suitability of the fill material.

The engineered fill construction should be monitored on a full-time basis by geotechnical personnel from EXP Services Inc. to examine and approve backfill materials, to evaluate placement operations and to verify the specified degree of compaction is being achieved uniformly throughout the fill.

It is recommended nominal reinforcing steel be installed in the foundation walls to minimize cracking from differential settlement due to variable thickness of engineered fill. The reinforcing steel detail should be designed by a structural engineer.

5.3.1.1 Foundations General

Footings which are to be placed at different elevations should be located such that the higher footing is set below a line drawn up at 10 horizontal to 7 vertical from the near edge of the lower footing, as indicated on the following sketch:



FOOTINGS NEAR SERVICE TRENCHES OR AT DIFFERENT ELEVATIONS

All footings exposed to seasonal freezing conditions should be protected from frost action by at least 1.2 m of soil cover or equivalent insulation, depending on the final design requirements.

The total and differential settlements of well designed and constructed footings on engineered fill placed in accordance with the above recommendations are expected to be less than 25 mm and 20 mm, respectively.

It should be noted the recommended geotechnical resistance value has been calculated by EXP from the borehole information for the design stage only. The investigation and comments are necessarily ongoing as new information on underground conditions becomes available. For example, it should be appreciated modification to bearing levels may be required if unforeseen subsoil conditions are revealed after the excavation is exposed to full view or if final design decisions differ from those assumed in this report. For this reason this office should be retained to review final foundation drawings and to provide field inspections during the construction stage.

5.3.2 Excavation and Groundwater Control

Excavation must be carried out in accordance with the Occupational Health and Safety Act (OHSA) and local regulations. Within the meaning of OHSA, moist silt till is classified as Type 2 soil. Loose fill and saturated sandy silt are classified as Type 4 soils. For preliminary guidance, side slopes of 1 vertical to 1 horizontal may be used for the temporary excavations, subject to geotechnical inspection. Where loose soil is encountered, it may be necessary to locally flatten the side slopes.

Groundwater seepage into the excavations should be anticipated. It should be possible to control and remove seepage from perched water in the fill, the upper saturated sandy silt stratum and pervious seams in the silt

till deposit using conventional construction dewatering techniques, i.e. pumping from sumps in conjunction with perimeter drainage ditches.

5.3.3 Backfill Considerations

Backfill used to satisfy underfloor slab requirements, in footing and service trenches, etc., should be compactible fill, i.e. inorganic soil with its moisture content close to its optimum value determined in the standard Proctor maximum dry density test. Portions of the on-site fill which are free of topsoil and exist in a moist condition may be suitable for backfilling purposes. The native sandy silt is saturated and will require partial drying before it can be properly compacted. The native silt till is suitable for backfilling purposes.

Topsoil, fill containing topsoil inclusions and excessively wet or otherwise deleterious material should not be used for backfilling purposes. Any shortfall of suitable on-site excavated material can be made up with imported granular material, OPSS Granular 'B' or equivalent. The backfill should be placed in lifts not more than 300 mm thick in the loose state with each lift being compacted to 100% SPMDD before subsequent lifts are placed. Smaller lifts may be required depending on the size of compaction equipment used by the contractor and the moisture content of the fill at the time of compaction. Heavy compactors which generate large stresses should be kept a safe distance from walls to avoid structural damage. The degree of compaction achieved in the field should be checked by in-place density tests.

The on-site soils are not free-draining and therefore should not be used where this characteristic is required or in confined areas where smaller compaction equipment is required. Imported OPSS Granular 'B' would also be suitable for these purposes.

5.3.4 Floor Slab Construction and Permanent Drainage

The floor slab can be constructed as a slab-on-grade on the engineered fill subgrade.

Prior to slab-on-grade construction, all grass/topsoil, fill and any wet/loose native soils should be removed from the underfloor area. Following rough grading, the exposed subgrade surface should be proofrolled with a heavy roller (no vibration) under the supervision of EXP Services Inc. Any soft areas detected should be further subexcavated and brought up to design grade using compactible fill in the manner described in the "Site Grading" section of this report.

A 250 mm layer of 19 mm clear stone should be placed between the prepared subgrade and the floor slab to serve as a moisture barrier. Also, within any unheated areas, 50 mm of Styrofoam insulation should be provided below the floor slab to protect against frost heave. The granular material below the concrete sidewalks and patio should consist of 300 mm compacted 19 mm crusher-run limestone.

Around the perimeter of the building, the ground surface should be sloped on a positive grade away from the structure to promote surface water run-off and to reduce groundwater infiltration adjacent to the foundation.

5.3.5 Earthquake Considerations

The recommendations for the geotechnical aspects to determine the earthquake loading are presented below.

5.3.5.1 Subsoil Conditions

The subsoil information at this site has been examined in relation to Section 4.1.8.4 of OBC 2012. The subsoil consisted of fill overlying native deposits of upper sandy silt, silt till, lower sandy till, sand and silty sand. The shallow foundation will be founded on engineered fill developed over the compact native deposits.

There have been no shear wave velocity measurements carried out at this site and therefore, N-values will be used to determine the site classification.

5.3.5.2 Depth of Boreholes

Table 4.1.8.4.A Site Classification for Seismic Site Response in OBC 2012 indicated that to determine the site classification, the average properties in the top 30 m are to be used. The boreholes were drilled to depths of 4.25 to 8.25 m below existing grade. No bedrock was encountered within the investigated depths.

5.3.5.3 Site Classification

Based on the known subsurface conditions, the Site Class for this site is “D” as per Table 4.1.8.4.A, Site Classification for Seismic Site Response, OBC 2012.

5.3.6 Subsurface Concrete

One (1) soil sample from Borehole 4 was submitted for analysis of pH and sulphate content. The test results, included in Appendix A, indicated a pH value of 7.81 and a sulphate content of less than 20 ppm as SO₄, indicating a ‘negligible’ degree of sulphate attack on subsurface concrete structures. Therefore, Type 10 Portland Cement should be suitable for use in concrete at this site.

5.4 Installation of Underground Services

The sewer and watermain invert levels are expected to range from about 1.5 to 3.0 m below existing grade. All sewers and watermains should be protected from frost action by at least 1.2 m of soil cover.

Excavation in open cuts should be relatively straightforward using a hydraulic backhoe. Side slopes of temporary excavation must conform to the Occupational Health and Safety Act and local regulations. It should be possible to control groundwater seepage by conventional construction dewatering techniques, i.e. pumping from sumps.

No bearing capacity problems are anticipated for pipes founded in the native soils. Any loose fill encountered at the base of the trenches should be removed down to native soil and backfilled with granular material compacted to 100% SPMDD. For pipes founded in the saturated native soils, the pipe bedding should comprise 19 mm clear stone completely wrapped in geotextile filter fabric to prevent the migration of fines into the void spaces of the bedding material. Where the subgrade consists of moist native soil, a minimum 150 mm bedding thickness of OPSS Granular “A” crusher-run limestone is recommended under the pipes. The bedding material should be compacted to at least 98% SPMDD.

Granular material should be extended upward as trench backfill for at least 300 mm above the obvert of the pipe or as per local practice. The remaining trench to final subgrade level should be backfilled in 300 mm thick lifts with approved excavated material compacted to at least 98% SPMDD.

Frequent inspection by EXP Services Inc. geotechnical personnel should be carried out to examine and approve backfill materials, to carefully inspect placement and to verify the specified degrees of compaction have been obtained.

5.5 Parking Areas and Driveways

The pavement subgrade is expected to comprise compacted fill. The recommended pavement structures provided in Table 1 are based upon an estimate of the subgrade soil properties determined from visual examination and textural classification of the soil samples. A functional design life of eight to ten years has been used to establish the pavement recommendations. This represents the number of years to the first rehabilitation, assuming regular maintenance is carried out.

Table 1: Recommended Pavement Structure Thicknesses

Pavement Layer	Compaction Requirements	Light-Duty Asphalt (Car Parking)	Medium-Duty Asphalt (Driveways/Loading Areas)
Asphaltic Concrete (OPSS 310)	Minimum 92% MRD*	40 mm HL3 50 mm HL8	40 mm HL3 50 mm HL8
OPSS Granular A Base *** (OPSS 310)	100% SPMDD**	150 mm	150 mm
OPSS Granular B Subbase *** (OPSS 310)	100% SPMDD**	250 mm	450 mm

* Denotes maximum relative density, MTO LS-264

** Denotes standard Proctor maximum dry density, MTO LS-706

*** Crusher-run limestone or recycled concrete are recommended for fall and winter construction

The foregoing design assumes construction is carried out during dry periods and the subgrade is stable under the load of construction equipment. If construction is carried out during wet weather and heaving or rolling of the subgrade is experienced, additional thickness of subbase course material may be required.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure uniform subgrade moisture and density conditions are achieved. In addition, the need for adequate drainage cannot be over-emphasized. The finished pavement surface and underlying subgrade should be free of depressions and should be sloped to provide effective surface drainage toward catchbasins. Surface water should not be allowed to pond adjacent to the outside edges of pavement areas.

Additional comments on the construction of parking areas and driveways are as follows:

1. Proposed parking areas and driveways should be stripped of grass/topsoil, existing pavement structure and existing fill extending to 1 m below proposed top of subgrade level. The exposed fill subgrade should be proofrolled and compacted in the presence of a representative of this office. Soft or spongy subgrade areas should be further subexcavated and replaced with suitable approved backfill compacted to at least 98% SPMDD. Fill required to raise the grades to design elevations should be organic-free and at a moisture content which will permit compaction to at least 98% SPMDD. The final subgrade surface should be properly shaped and crowned.
2. Perimeter subdrains should be provided around parking areas and along driveways. Subdrains extending from and between catchbasins should also be installed.
3. To minimize problems of differential movement between the pavement and catchbasins/manholes due to frost action, backfill around these structures should consist of free-draining granular material. The granular material should be compacted to at least 98% SPMDD with a smaller tamper to avoid damaging the structures.
4. The most severe loading conditions on light-duty pavement areas and the subgrade may occur during construction. Consequently, special provisions such as half-loads during paving may be required, especially if construction is carried out during unfavorable weather.

6. General Comments

EXP Services Inc. should be retained for a general review of the final design and specifications to verify this report has been properly interpreted and implemented. If not accorded the privilege of making this review, EXP Services Inc. will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations as well as their own interpretations of the factual borehole results so that they may draw their own conclusions as to how the subsurface conditions may affect them.

More specific information with respect to the conditions between samples or the lateral and vertical extent of materials may become apparent during excavation operations. The interpretation of the borehole information must, therefore, be validated during excavation operations. Consequently, during the future development of the property, conditions not observed during this investigation may become apparent; should this occur, EXP Services Inc. should be contacted to assess the situation and additional testing and reporting may be required. EXP Services Inc. has qualified personnel to provide assistance in regard to future geotechnical issues related to this property.

We trust this report is satisfactory for your purposes. Should you have any questions or comments, please do not hesitate to contact this office.

Yours truly,

EXP Services Inc.

Clement Chow, P. Eng.
Project Engineer



Peter Chan, P.Eng.
Senior Manager, Geotechnical Division



Appendix A

pH and Sulphate Analysis

Attention: Clement Chow

exp Services Inc
Markham Branch
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CANADA L3T 0A8

Your P.O. #: MRK-GEO
Your Project #: GOR-00247181-A0 002
Site Location: 2960 TESTON ROAD
Your C.O.C. #: 668602-21-01

Report Date: 2018/07/09
Report #: R5286913
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B8G2805

Received: 2018/06/30, 14:53

Sample Matrix: Soil
Samples Received: 1

Analyses	Quantity Extracted	Date	Date Analyzed	Laboratory Method	Reference
pH CaCl2 EXTRACT	1	2018/07/06	2018/07/06	CAM SOP-00413	EPA 9045 D m
Sulphate (20:1 Extract)	1	N/A	2018/07/09	CAM SOP-00464	EPA 375.4 m

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.

Your P.O. #: MRK-GEO
Your Project #: GOR-00247181-A0 002
Site Location: 2960 TESTON ROAD
Your C.O.C. #: 668602-21-01

Attention: Clement Chow

exp Services Inc
Markham Branch
220 Commerce Valley Dr W
Suite 500
Markham, ON
CANADA L3T 0A8

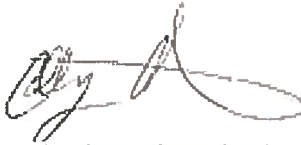
Report Date: 2018/07/09
Report #: R5286913
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B8G2805

Received: 2018/06/30, 14:53

Encryption Key



Colby Coutu
Project Manager Assistant
09 Jul 2018 16:15:12

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Tanya Fidlin, Project Manager

Email: tfidlin@maxxam.ca

Phone# (905)817-5700

=====

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 #: B8G2805
Report Date: 2018/07/09

exp Services Inc
Client Project #: GOR-00247181-A0 002
Site Location: 2960 TESTON ROAD
Your P.O. #: MRK-GEO
Sampler Initials: CC

RESULTS OF ANALYSES OF SOIL

Maxxam ID		HCL094		
Sampling Date		2018/06/13		
COC Number		668602-21-01		
	UNITS	BH4 1.7-2.0M	RDL	QC Batch
Inorganics				
Available (CaCl2) pH	pH	7.81		5615982
Soluble (20:1) Sulphate (SO4)	ug/g	<20	20	5616006
RDL = Reportable Detection Limit				
QC Batch = Quality Control Batch				

Maxxam Job #: B8G2805
Report Date: 2018/07/09

exp Services Inc
Client Project #: GOR-00247181-A0 002
Site Location: 2960 TESTON ROAD
Your P.O. #: MRK-GEO
Sampler Initials: CC

TEST SUMMARY

Maxxam ID: HCL094
Sample ID: BH4 1.7-2.0M
Matrix: Soil

Collected: 2018/06/13
Shipped:
Received: 2018/06/30

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
pH CaCl2 EXTRACT	AT	5615982	2018/07/06	2018/07/06	Gnana Thomas
Sulphate (20:1 Extract)	KONE/EC	5616006	N/A	2018/07/09	Deonarine Ramnarine

Maxxam Job #: B8G2805
Report Date: 2018/07/09

exp Services Inc
Client Project #: GOR-00247181-A0 002
Site Location: 2960 TESTON ROAD
Your P.O. #: MRK-GEO
Sampler Initials: CC

GENERAL COMMENTS

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

Package 1	10.7°C
-----------	--------

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

exp Services Inc
Client Project #: GOR-00247181-A0 002
Site Location: 2960 TESTON ROAD
Your P.O. #: MRK-GEO
Sampler Initials: CC

QC Batch	Parameter	Date	Matrix Spike		SPIKED BLANK		Method Blank		RPD	
			% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5615982	Available (CaCl ₂) pH	2018/07/06			99	97 - 103			0.58	N/A
5616006	Soluble (20:1) Sulphate (SO ₄)	2018/07/09	NC	70 - 130	104	70 - 130	<20	ug/g	13	35

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)



Maxxam Analytics International Corporation
1540 Lumberton Road, Massachusetts, United States
Tel: (508) 817-5000 Fax: (508) 817-3773 www.maxxam.ca

INVOICE TO:

Company Name: **EXP Energy Services Ltd.**
Attention: **Clement Chow**
Address: **220 Commerce Valley Dr W Suite 110**
Markham ON L3T 0A8
Tel: **(905) 695-3217** Fax: **(905) 695-3217**
Email: **clement.chow@exp.com**

REPORT TO:

Company Name: **EXP Energy Services Ltd.**
Attention: **Clement Chow**
Address: **220 Commerce Valley Dr W Suite 110**
Markham ON L3T 0A8
Tel: **(905) 695-3217** Fax: **(905) 695-3217**
Email: **clement.chow@exp.com**

CHAIN OF CUSTODY RECORD

Page 1 of 1

PROJECT INFORMATION:

Maxxam Job #: **118K-G50**
Bottle Order #: **099502**
COC #: **2960 Testa Road**
Project Manager: **Kyle Reinhardt**
Sampled By: **Clement Cam Simpson**

LABORATORY USE ONLY:

Turnaround Time (TAT) Required: ☒ **Regular (Standard) TAT:**
(We be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests
Please note: Standard TAT for certain tests such as BOD and Denitrification are > 5 days. Contact your Project Manager for details.
Job Specific Rush TAT (if applies to entire submission)
Date Required: _____ Time Required: _____
Rush Confirmation Number: _____
Comments: _____

ANALYSIS REQUESTED (PLEASE BE SPECIFIC):

Analysis	Request	Result	Comments
PH + Sulphate	✓		
Metals / Hg / Cr VI			
Field Filtered (please circle)			

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE MAXXAM DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)	Other Regulations	Sample Location Identification	Date Sampled	Time Sampled	Matrix
<input type="checkbox"/> Table 1 <input type="checkbox"/> Res/Plank <input type="checkbox"/> Medium/No <input type="checkbox"/> GCME <input type="checkbox"/> Sanitary Sewer Bylaw <input type="checkbox"/> Table 2 <input type="checkbox"/> Ind/Comm <input type="checkbox"/> Coarse <input type="checkbox"/> Reg 558 <input type="checkbox"/> Storm Sewer Bylaw <input type="checkbox"/> Table 3 <input type="checkbox"/> Agri/Other <input type="checkbox"/> For RSC <input type="checkbox"/> MCA <input type="checkbox"/> Municipality <input type="checkbox"/> Table 4 <input type="checkbox"/> PWOD <input type="checkbox"/> Other		BH 4 1.7-2.0m	2018/06/13	2:26 PM	soil

RELINQUISHED BY: (Signature/Print) C. Chow **Date: (YY/MM/DD)** 2018/06/13 **Time** 2:26 PM **RECEIVED BY: (Signature/Print)** Ant Laranson **Date: (YY/MM/DD)** 2018/06/13 **Time** 14:29

LABORATORY USE ONLY:

Time Sensitive	Temperature (°C) on Rece	Custody Seal Intact	Yrs	Rn
	11/10/11			

SAMPLES MUST BE KEPT COOL (4°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

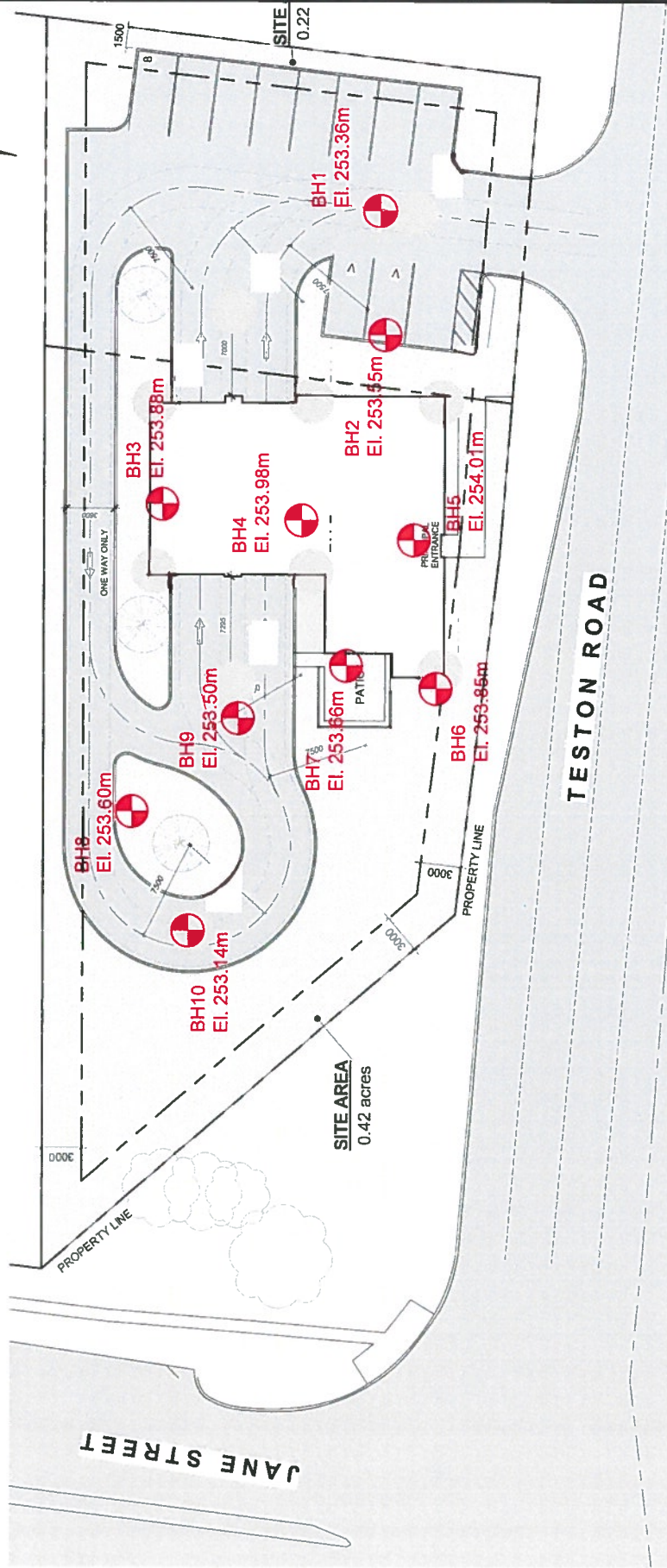
White: Maxxam Yellow: Client

on ice

Drawings

Borehole Location Plan

Borehole Logs



NOTES:

1. THE BOUNDARIES AND SOIL TYPES HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR
2. SOIL SAMPLES WILL BE RETAINED IN STORAGE FOR 3 MONTHS AND THEN DESTROYED UNLESS CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. THIS DRAWING WAS REPRODUCED FROM A BOREHOLE PLAN PROVIDED FROM THOMAS BROWN ARCHITECTS.

LEGEND:

● BOREHOLE LOCATION

exp.
Geotechnical Engineering & Construction
2960 TESTON ROAD
VAUGHAN, ONTARIO

exp Services Inc.
P.O. Box 895, 2217
MARKHAM, ON L3T 0A2
Canada
www.exp.com

PROJECT TITLE AND LOCATION:

GEOTECHNICAL INVESTIGATION
PROPOSED PARAMEDIC RESPONSE STATION
2960 TESTON ROAD
VAUGHAN, ONTARIO

DRAWING TITLE:

BOREHOLE LOCATION PLAN

PROJECT#:

GOR-00247181-AO

DWN.:

LC

SCALE:

1:450

CHKD.:

CC

DATE:

JULY 2018

DWG. No.:

1

Notes On Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by exp also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		
	0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	200

EQUIVALENT GRAIN DIAMETER IN MILLIMETERS

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS	FINE	COARS E
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.
3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Log of Borehole 1

Project No. GOR-00247181-AO

Drawing No. 2

Project: Geotechnical Investigation - Paramedic Response Station

Sheet No. 1 of 1

Location: 2960 Teston Road, Vaughan, Ontario

Date Drilled: June 12, 2018

Auger Sample

Combustible Vapour Reading

Drill Type: B45HD

SPT (N) Value

Natural Moisture

Datum: Geodetic

Dynamic Cone Test

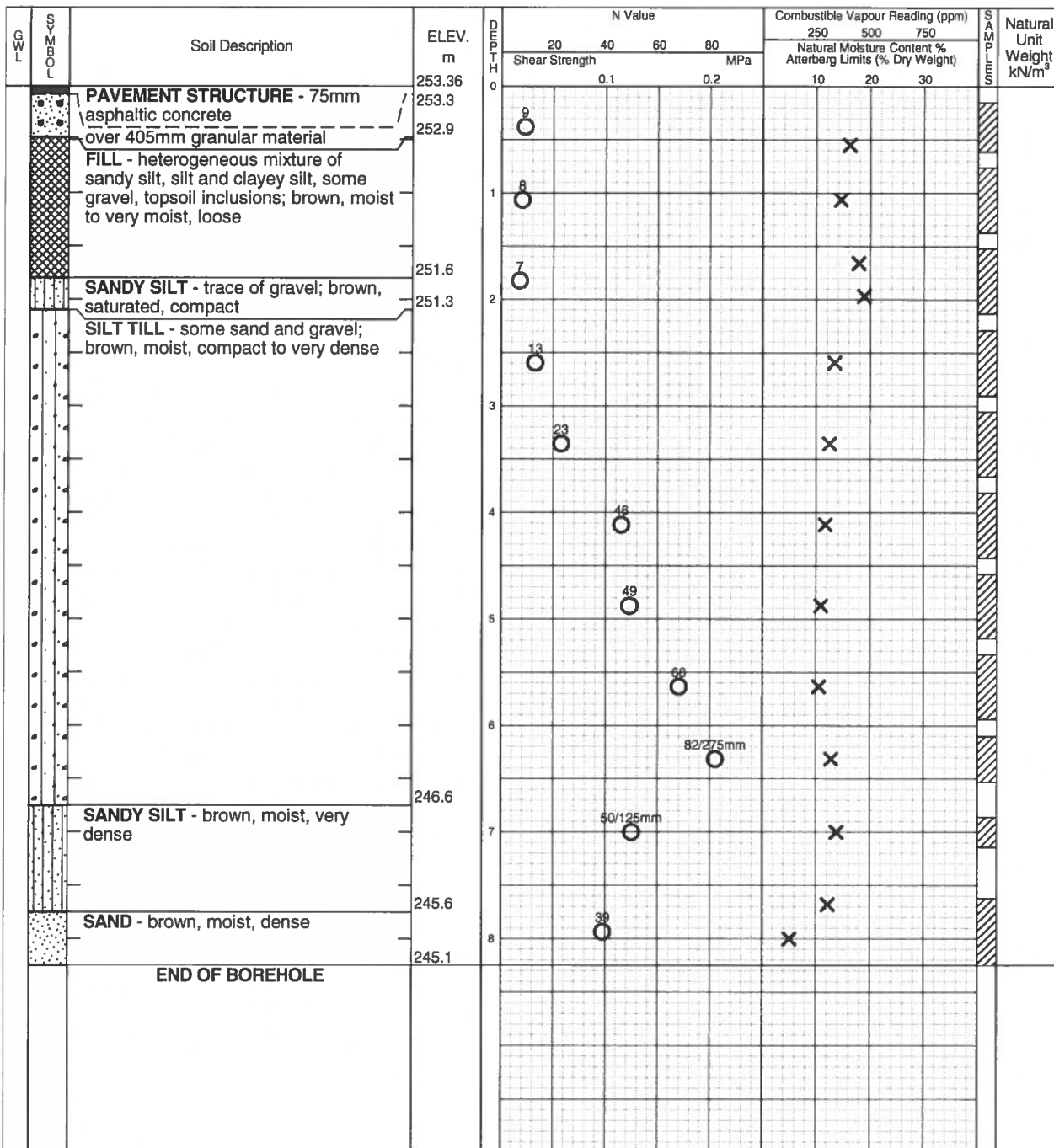
Plastic and Liquid Limit

Shelby Tube

Undrained Triaxial at % Strain at Failure

Field Vane Test

Penetrometer



LAGWGL02_GOR00247181-AO.GPJ NEW.GDT 7/12/18



Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	7.77

Log of Borehole 2

Project No. GOR-00247181-AO

Drawing No. 3

Project: Geotechnical Investigation - Paramedic Response Station

Sheet No. 1 of 1

Location: 2960 Teston Road, Vaughan, Ontario

Date Drilled: June 13, 2018

Auger Sample



Combustible Vapour Reading



Drill Type: B45HD

SPT (N) Value



Natural Moisture



Datum: Geodetic

Dynamic Cone Test



Plastic and Liquid Limit



Shelby Tube



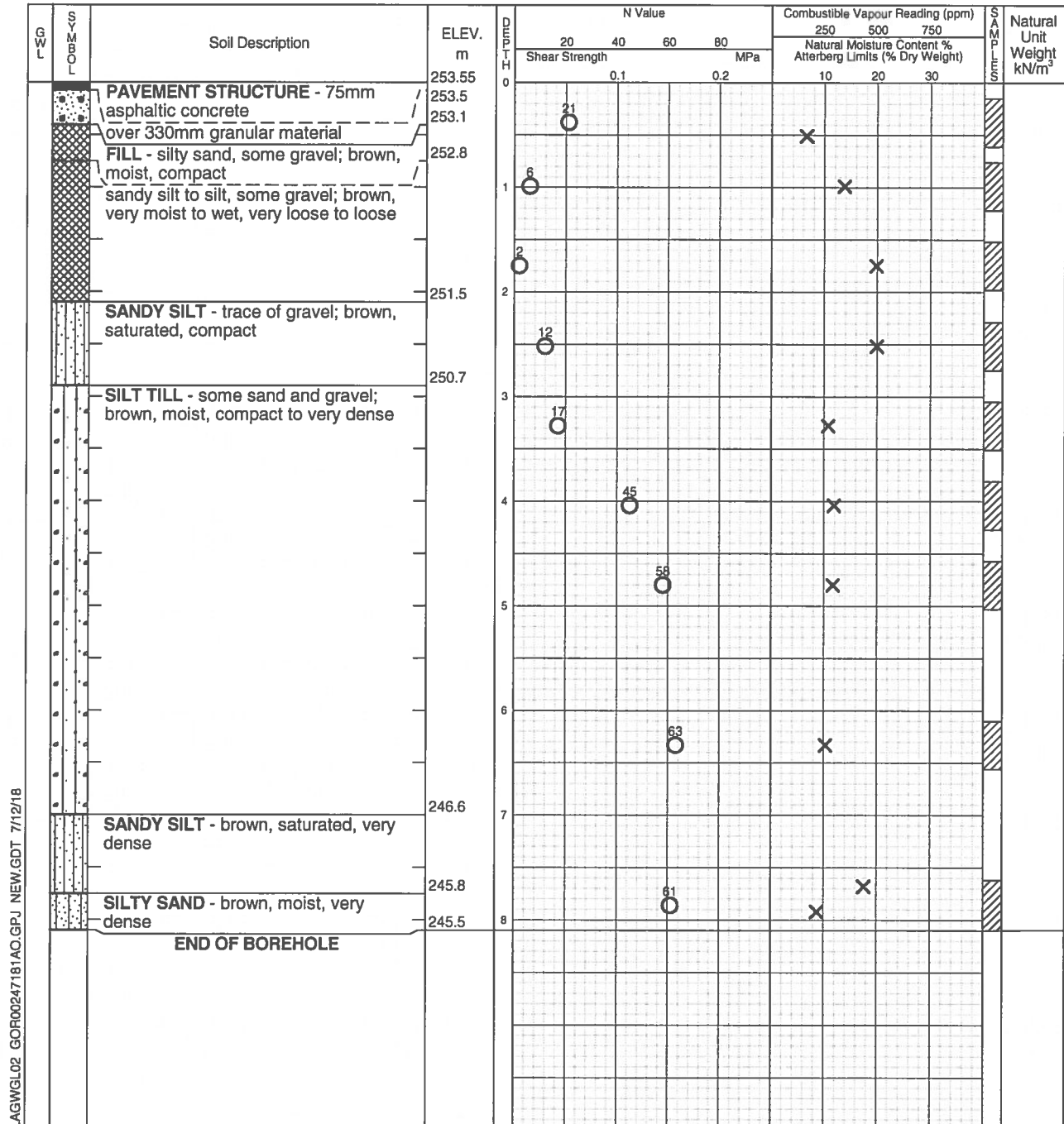
Undrained Triaxial at % Strain at Failure



Field Vane Test



Penetrometer



Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	7.62

Log of Borehole 3

Project No. GOR-00247181-AO

Drawing No. 4

Project: Geotechnical Investigation - Paramedic Response Station

Sheet No. 1 of 1

Location: 2960 Teston Road, Vaughan, Ontario

Date Drilled: June 13, 2018

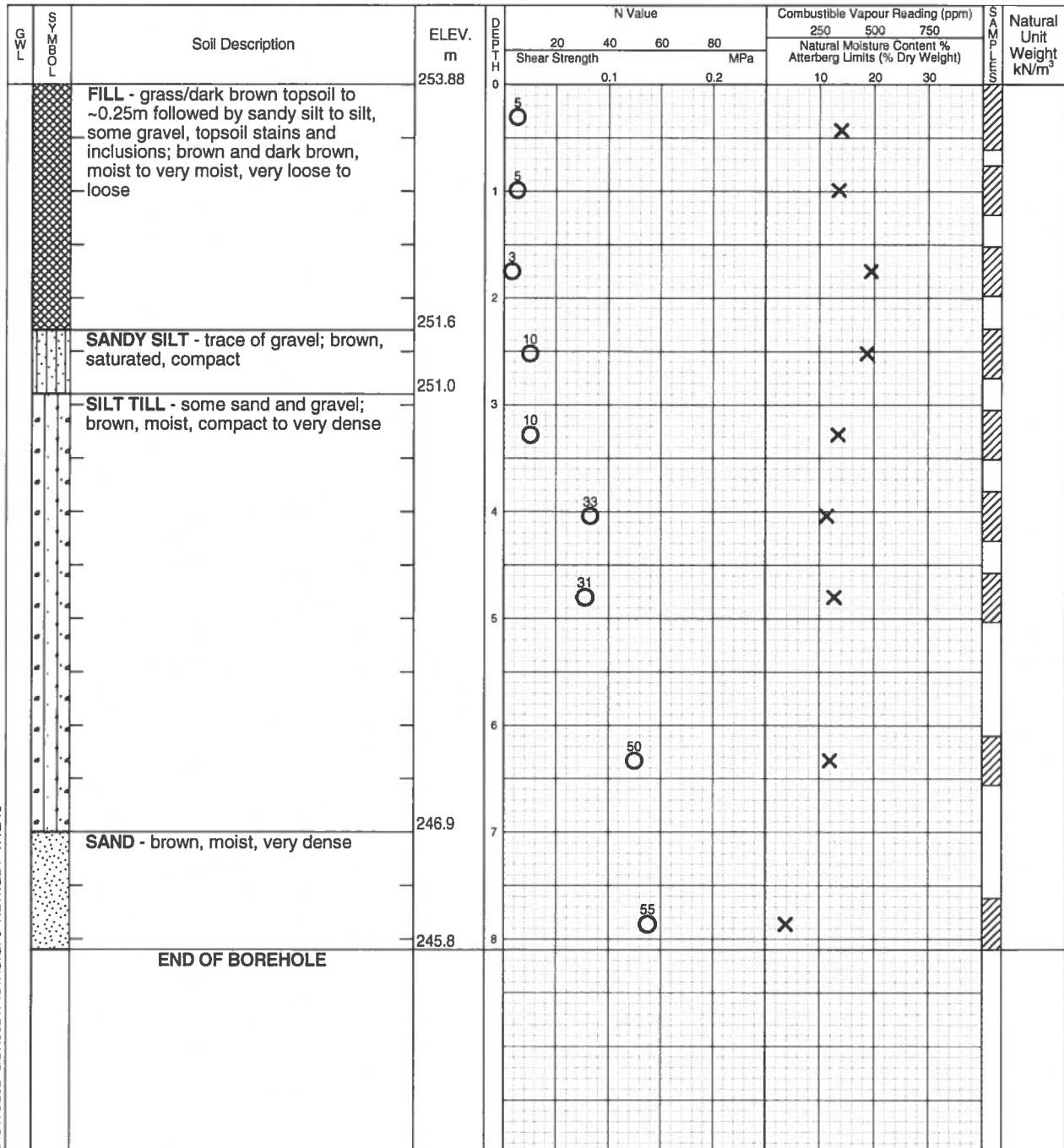
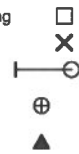
Drill Type: B45HD

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test



Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at
% Strain at Failure
Penetrometer



LAGWGL02 GOR00247181AO.GPJ NEW.GDT 7/12/18



Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	7.62

Log of Borehole 4

Project No. GOR-00247181-AO

Drawing No. 5

Project: Geotechnical Investigation - Paramedic Response Station

Sheet No. 1 of 1

Location: 2960 Teston Road, Vaughan, Ontario

Date Drilled: June 13, 2018

Auger Sample

Combustible Vapour Reading

Drill Type: B45HD

SPT (N) Value

Natural Moisture

Datum: Geodetic

Dynamic Cone Test

Plastic and Liquid Limit

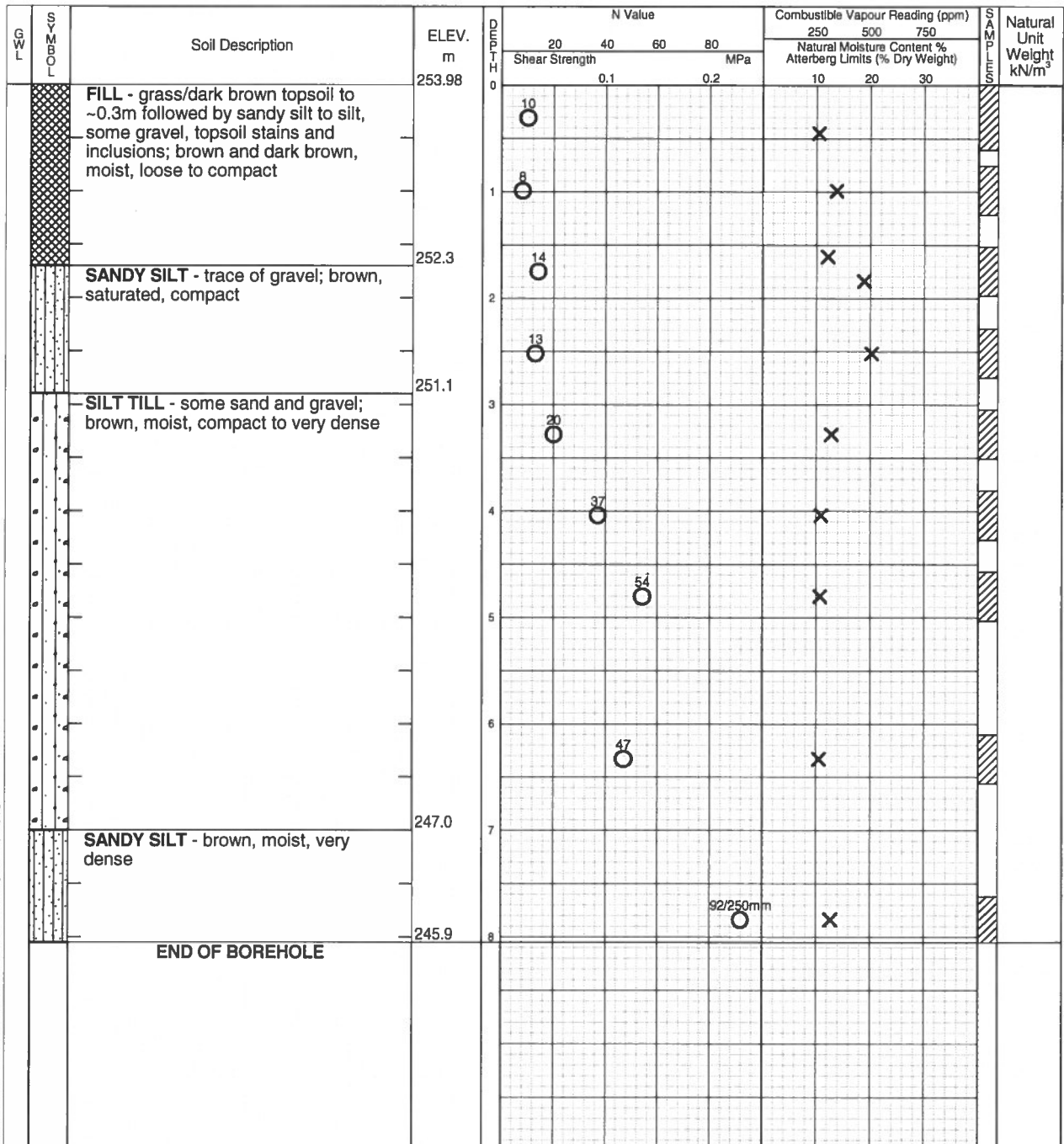
Shelby Tube

Undrained Triaxial at

Field Vane Test

% Strain at Failure

Penetrometer



LAGWGL02 GOR00247181AO.GPJ NEW.GDT 7/12/18



Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	7.31

Log of Borehole 5

Project No. GOR-00247181-AO

Drawing No. 6

Project: Geotechnical Investigation - Paramedic Response Station

Sheet No. 1 of 1

Location: 2960 Teston Road, Vaughan, Ontario

Date Drilled: June 13, 2018

Drill Type: B45HD

Datum: Geodetic

Auger Sample

SPT (N) Value

Dynamic Cone Test

Shelby Tube

Field Vane Test

Combustible Vapour Reading

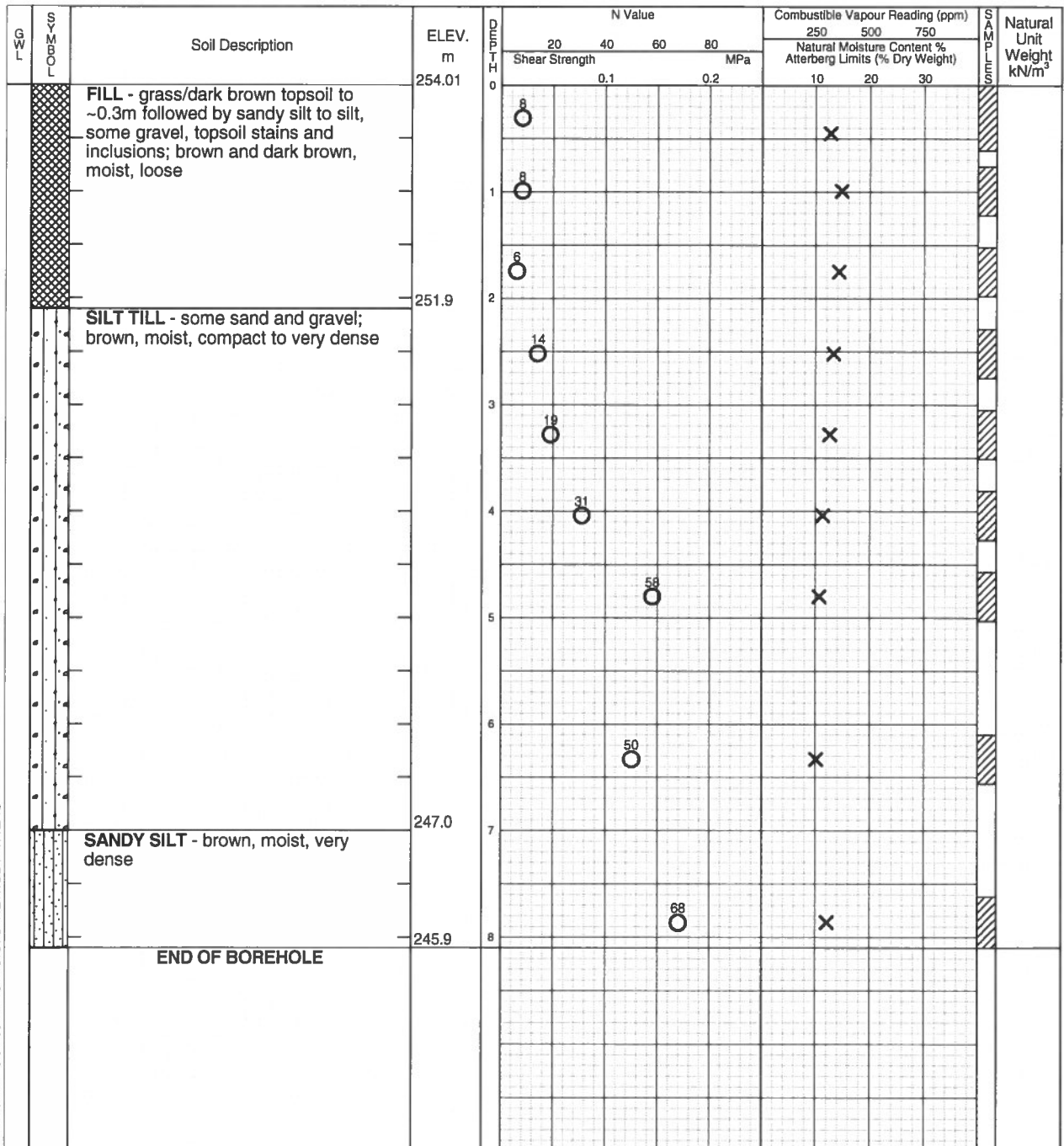
Natural Moisture

Plastic and Liquid Limit

Undrained Triaxial at

% Strain at Failure

Penetrometer



LAGWGL02 GOR00247181AO.GPJ NEW.GDT 7/12/18



Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	7.31

Log of Borehole 6

Project No. GOR-00247181-AO

Drawing No. 7

Project: Geotechnical Investigation - Paramedic Response Station

Sheet No. 1 of 1

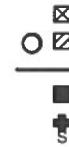
Location: 2960 Teston Road, Vaughan, Ontario

Date Drilled: June 14, 2018

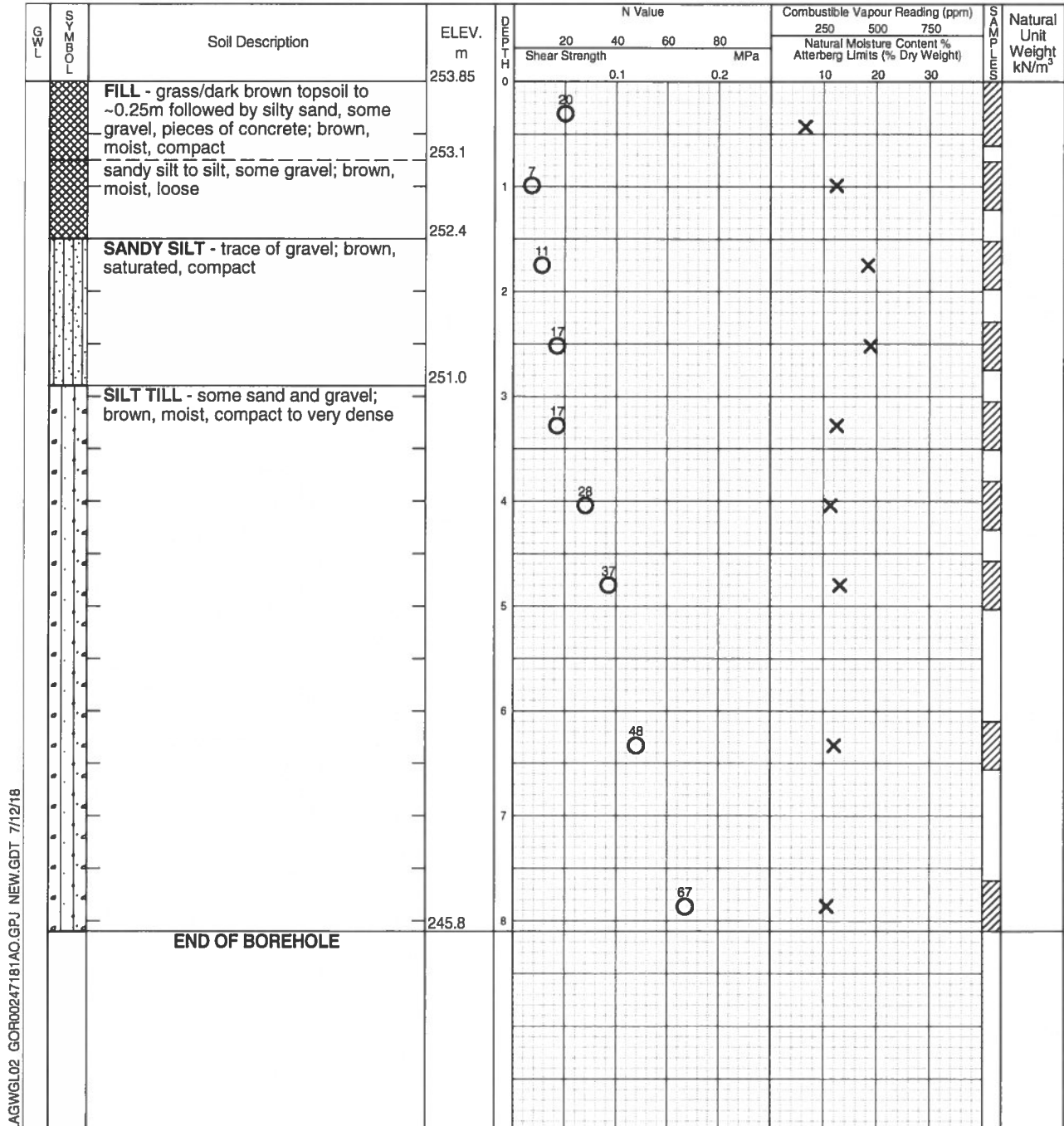
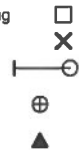
Drill Type: B45HD

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test



Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at % Strain at Failure
Penetrometer



Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	7.31

Log of Borehole 7

Project No. GOR-00247181-AO

Drawing No. 8

Project: Geotechnical Investigation - Paramedic Response Station

Sheet No. 1 of 1

Location: 2960 Teston Road, Vaughan, Ontario

Date Drilled: June 14, 2018

Auger Sample

Combustible Vapour Reading

Drill Type: B45HD

SPT (N) Value

Natural Moisture

Datum: Geodetic

Dynamic Cone Test

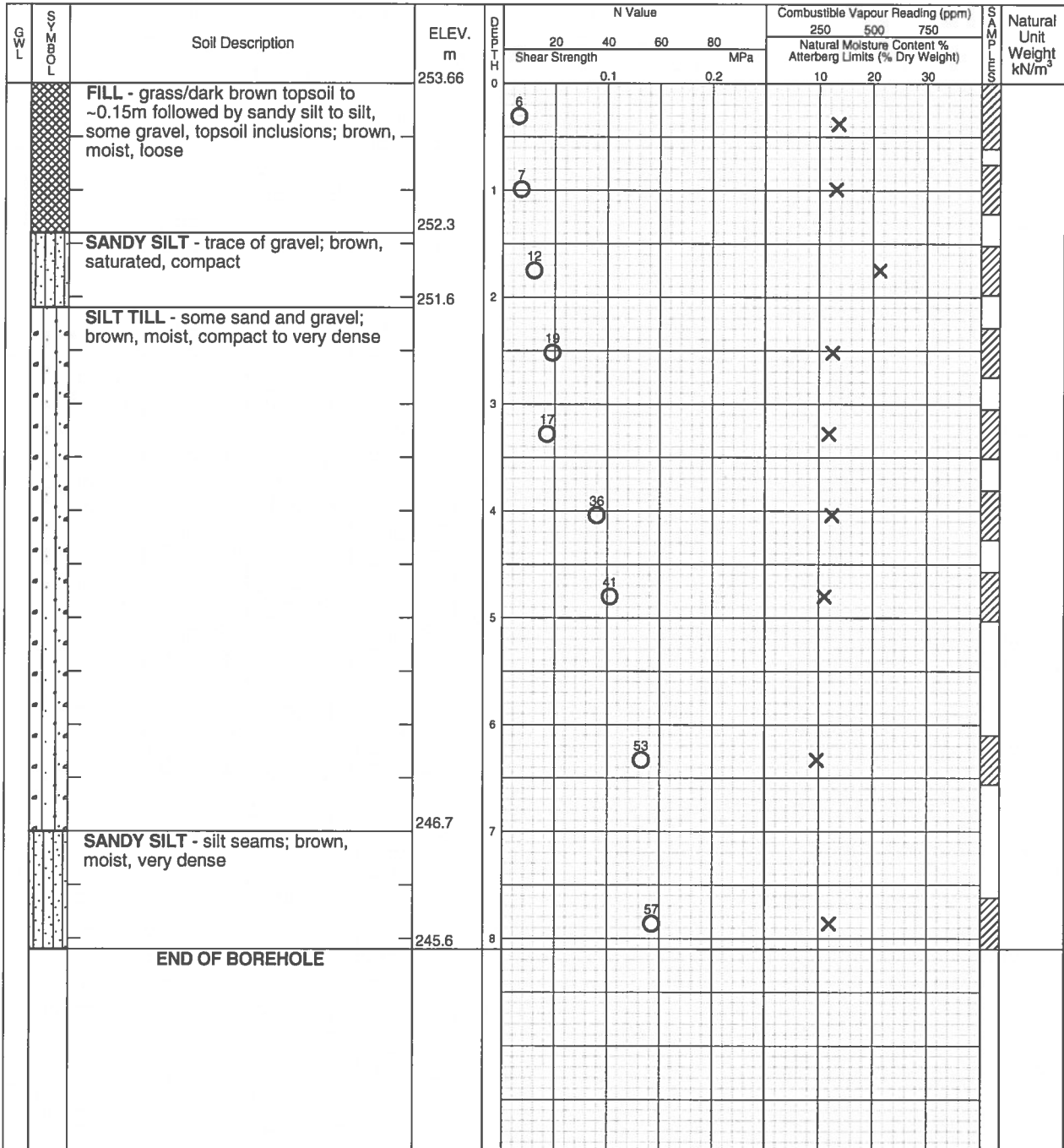
Plastic and Liquid Limit

Shelby Tube

Undrained Triaxial at % Strain at Failure

Field Vane Test

Penetrometer



LAGWGL02 GOR00247181AO.GPJ NEW.GDT 7/12/18



Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	7.47

Log of Borehole 8

Project No. GOR-00247181-AO

Drawing No. 9

Project: Geotechnical Investigation - Paramedic Response Station

Sheet No. 1 of 1

Location: 2960 Teston Road, Vaughan, Ontario

Date Drilled: June 14, 2018

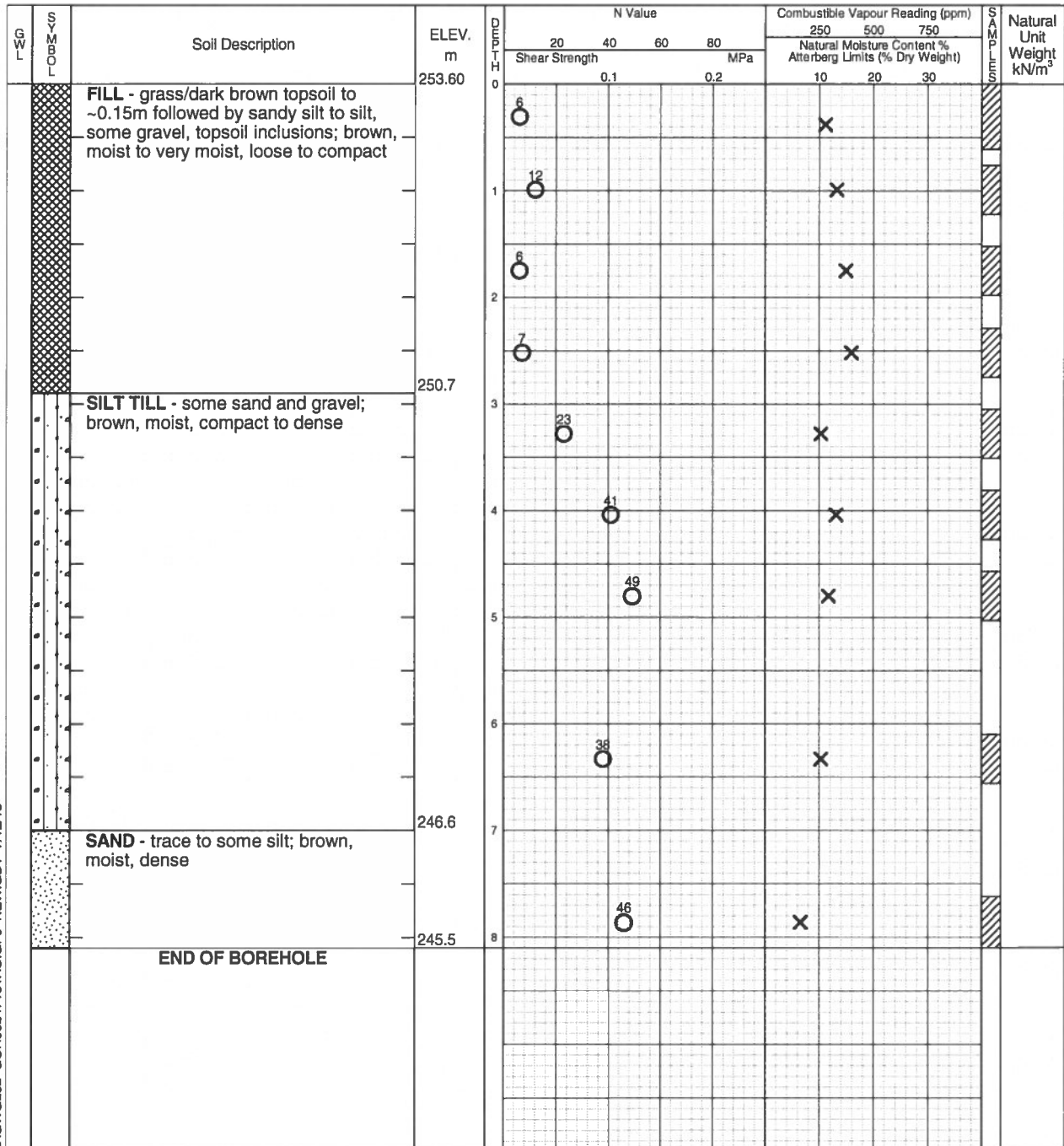
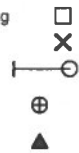
Drill Type: B45HD

Datum: Geodetic

Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Field Vane Test



Combustible Vapour Reading
Natural Moisture
Plastic and Liquid Limit
Undrained Triaxial at
% Strain at Failure
Penetrometer



LAGWGL02 GOR00247181AO.GPJ NEW.GDT 7/12/18



Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	7.31

Log of Borehole 9

Project No. GOR-00247181-AO

Drawing No. 10

Project: Geotechnical Investigation - Paramedic Response Station

Sheet No. 1 of 1

Location: 2960 Teston Road, Vaughan, Ontario

Date Drilled: June 14, 2018

Auger Sample

Combustible Vapour Reading

Drill Type: B45HD

SPT (N) Value

Natural Moisture

Datum: Geodetic

Dynamic Cone Test

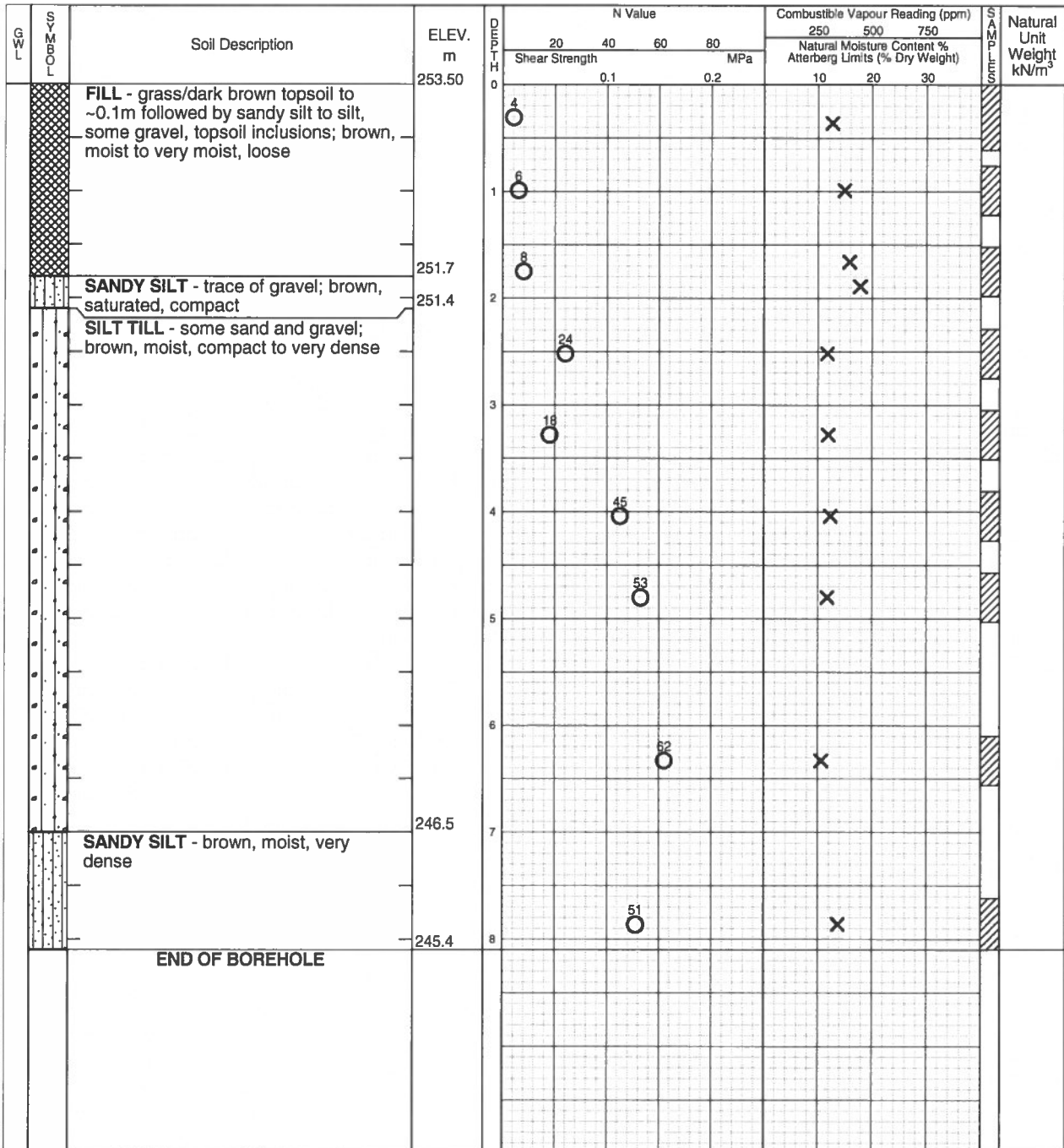
Plastic and Liquid Limit

Shelby Tube

Undrained Triaxial at % Strain at Failure

Field Vane Test

Penetrometer



LAGWGL02 GOR00247181AO.GPJ NEW.GDT 7/12/18



Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	7.31

Log of Borehole 10

Project No. GOR-00247181-AO

Drawing No. 11

Project: Geotechnical Investigation - Paramedic Response Station

Sheet No. 1 of 1

Location: 2960 Teston Road, Vaughan, Ontario

Date Drilled: June 14, 2018

Auger Sample

Combustible Vapour Reading ☐

Drill Type: B45HD

SPT (N) Value

Natural Moisture

Datum: Geodetic

Dynamic Cone Test

Plastic and Liquid Limit

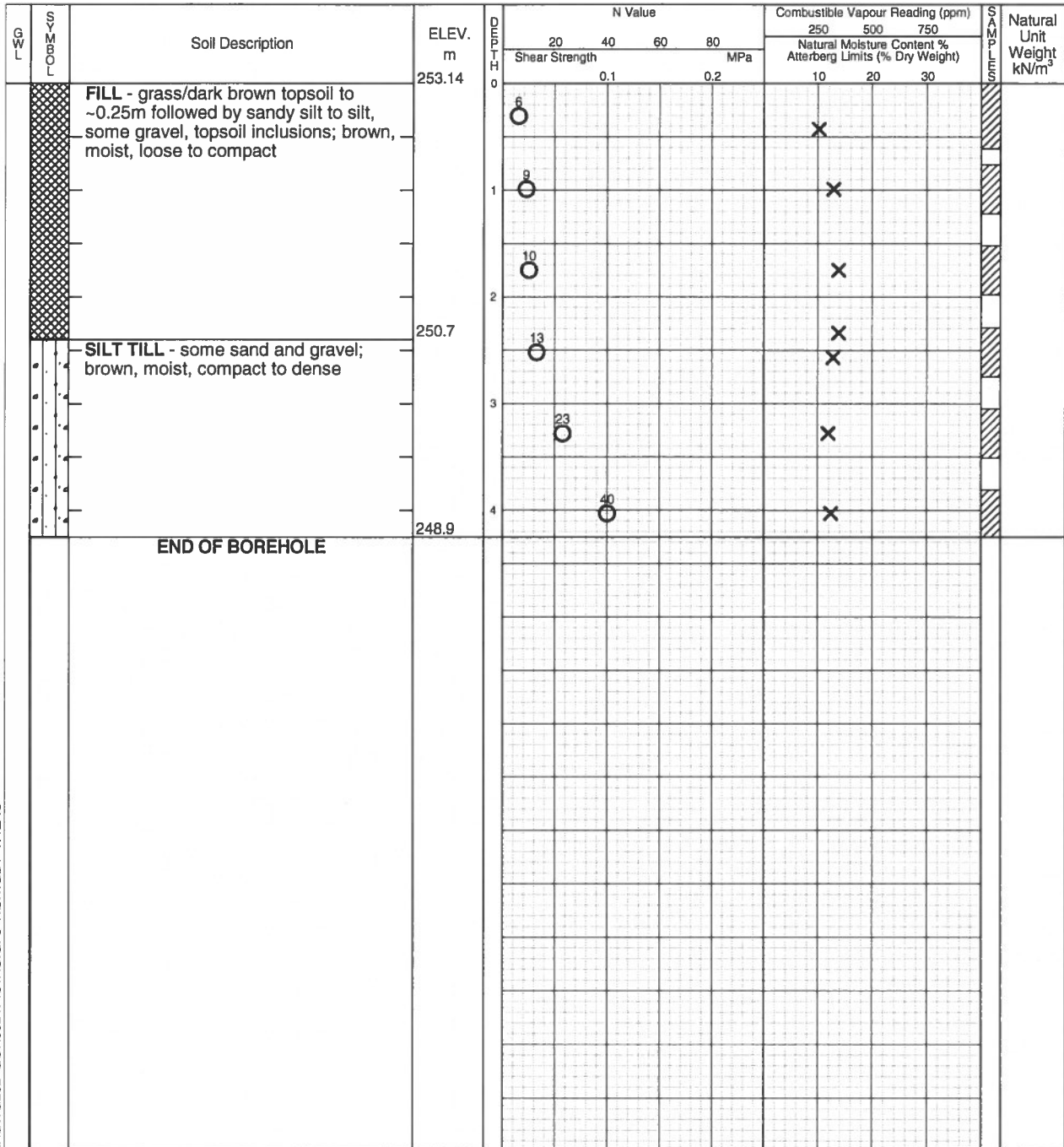
Shelby Tube

Undrained Triaxial at

Field Vane Test

% Strain at Failure

Penetrometer



LAGWGL02 GOR00247181AO.GPJ NEW/GDT 7/12/18



Time	Water Level (m)	Depth to Cave (m)
On completion	Dry	3.81