APPENDIX ‘A’

GEOTECHNICAL REPORT

THE
NATIONAL
TESTING
LABORATORIES
LIMITED
Established in 1923

GEOTECHNICAL INVESTIGATION
FOR
GUNN ROAD RECONSTRUCTION AND DAY STREET AND GUNN ROAD BOX CULVERT

Prepared for
STANTEC CONSULTING
905 WAVERLEY STREET
WINNIPEG, MANITOBA
R3T 5P4

Prepared by
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WINNIPEG, MANITOBA
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November 27, 2009

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1.0 SUMMARY

The National Testing Laboratories Limited was retained to undertake a geotechnical investigation to establish the soil conditions and provide recommendations for the proposed reconstruction of Gunn Road between Plessis Road and Redonda Road in Winnipeg, Manitoba. The total length of the reconstruction is 3.6 km. Gunn Road will be realigned at Day Street to a direct and true eastbound-westbound connection. The project includes the construction of a concrete box culvert at the intersection of Day Street and Gunn Road. Twenty-one testholes were drilled on the project site on August 19 and 20, 2009. The geotechnical investigation revealed a general soil profile of mixed clay and granular fill, or granular fill only at the surface. Clay fill was encountered below the mixed clay and granular fill material in some testholes. Silt layers were typically encountered at a depth of 1.0 to 1.5 m below existing grade. High plasticity clay overlying silt till was encountered in the testholes drilled to auger refusal. Based upon the soil and groundwater conditions encountered at the site, the box culvert may be supported on a raft slab. Alternatively, the proposed box culvert may be supported on driven precast concrete piles. Cast-in-place concrete friction piles are not recommended for this site due to the limited frictional support provided by the soft to firm clay encountered in the testholes.

2.0 TERMS OF REFERENCE

The National Testing Laboratories Limited was retained to undertake a geotechnical investigation to establish the soil conditions and provide recommendations for the proposed reconstruction of Gunn Road between Plessis Road and Redonda Road in Winnipeg, Manitoba. Authorization to proceed with the geotechnical investigation was provided by Wayne Byczek on July 16, 2009.

3.0 GEOTECHNICAL INVESTIGATION

3.1 Testhole Drilling and Soil Sampling

The subsurface drilling and sampling program was conducted on August 19 and 20, 2009 with drilling services provided by Paddock Drilling Ltd. under the supervision of our geotechnical field personnel. Nineteen testholes were drilled along Gunn Road between Plessis Road and Redonda Road to depths of 3 m. Two additional testholes were drilled to auger refusal near the proposed box culvert. The testholes were drilled using a track-mounted drill rig equipped with 125 mm diameter solid stem augers. The testhole locations are shown on the attached Testhole Location Plan.

Representative soil samples were obtained directly off the augers. Upon completion of drilling, the testholes were examined for evidence of sloughing and groundwater seepage. The testholes were backfilled with auger cuttings. The samples were visually classified in the field and returned to our soils laboratory for additional examination and testing.

3.2 Laboratory Testing

Laboratory testing included moisture content determinations, Atterberg limits, particle size analyses and unconfined compressive strength testing. The results of the Atterberg limits, particle size analysis, and unconfined compressive strength are summarized in the tables below.

Testhole No.	Depth (m)	Soil Type	Particle Size			Atterberg Limits		
			Sand (%)	Silt (%)	Clay (%)	Liquid Limit	Plastic Limit	Plasticity Index
TH5	0.9	Clay	0.7	7.6	91.7	80	23	57
TH8	0.9	Silt	0	63.5	36.5	31	17	14
TH15	1.8	Silt	1.1	62.7	36.2	33	16	17
TH17	1.5	Clay	0.7	5.5	93.8	96	29	67

Testhole No.	Depth (m)	Soil Type	Unconfined Compressive Strength (kPa)
TH20	3.1	Clay	64
TH20	6.1	Clay	52
TH21	4.6	Clay	54

4.0 SUBSURFACE CONDITIONS

4.1 Soil Profile

The general soil stratigraphy at the site, as interpreted from the testhole logs, typically consists of fill materials at the ground surface overlying clay and silt till. Silt layers were typically encountered at a depth of 1.0 to 1.5 m below existing grade. A hydrocarbon odour was detected in Testholes TH2, TH3, and TH4. The hydrocarbon odour was detected below a depth of 1.8 m in Testhole TH2 and below a depth of 0.9 m in Testholes TH3 and TH4. Additional information on the soils encountered in the testholes is provided below.

Mixed Clay/Granular Fill

Mixed clay and granular fill was encountered at the surface of Testholes TH1 to TH11, TH15, TH16, and TH20. The mixed clay and granular fill was composed of medium sand to coarse gravel with high plasticity clay. The mixed clay and granular fill extended to depths ranging from 0.2 to 0.3 m.

Granular Fill

Granular fill was encountered at the surface of Testholes TH12, TH13 TH14, TH17, TH18 and TH19. The granular fill consisted of medium to coarse sand with a trace of fine to coarse gravel and clay. The granular fill extended to depths ranging from 0.3 to 1.4 m. Water contents of the granular fill ranged from 4 to 16%.

Clay Fill

Clay fill was encountered beneath the mixed clay and granular fill or granular fill in all testholes with the exception of Testholes TH3, TH4, TH7, and TH12. In TH21, clay fill was encountered at the surface of the testhole. The clay fill was grey to black, stiff, moist, and of high plasticity. The clay fill extended to depths ranging from 0.3 to 0.9 m. Water contents of the clay fill ranged from 16 to 43%.

Clay

Clay was encountered in all testholes. The clay was brown to grey, soft to stiff, moist, and of high plasticity. The clay extended to a depth of 13.7 m in Testholes TH20 and TH21 and to the depths explored in the remaining testholes. Water contents of the clay ranged from 22 to 59%.

Silt

Silt was encountered in Testholes TH4, TH6, TH7, TH8, TH10, TH15, TH16, and TH17. Silt was encountered at depths between 0.8 and 2.1 m below grade. Thickness of the silt layer was typically in the range of 0.1 to 0.3 m. The silt was tan, soft, moist, and of low plasticity. Water contents of the silt ranged from 22 to 33%.

Silt Till

Silt till was encountered below the clay layer at a depth of 13.7 m in Testholes TH20 and TH21. The silt till was tan, dense, moist, and of low plasticity. Water contents of the silt till ranged from 9 to 16%.

4.2 Groundwater

Groundwater conditions were observed during and upon the completion of drilling the testholes. Moderate groundwater seepage was observed in Testholes TH13 and TH20, and minor groundwater seepage was observed in Testhole TH21. In Testhole TH13, groundwater seepage was observed from the granular fill at a depth of 1.2 m. In testholes TH20 and TH21, groundwater seepage from the silt till was observed. The groundwater level upon completion of drilling was 1.2 m in Testhole TH13, 10.4 m in Testhole TH20, and 12.2 m in Testhole TH21. No groundwater seepage was observed in the remaining testholes.

Soil sloughing was observed in Testholes TH20 and TH21 to depths of 12.8 and 12.2 m respectively. No soil sloughing was observed in the remaining testholes. It should be noted that only short-term seepage and sloughing conditions were observed and groundwater levels will normally fluctuate during the year and will be dependent upon precipitation and surface drainage.

5.0 DESIGN RECOMMENDATIONS AND COMMENTS

5.1 Subgrade Preparation

The pavement structure must be constructed on a stable subgrade. The fill materials and clay encountered at a shallow depth in the testholes should provide a suitable subgrade for the proposed road reconstruction. Proof rolling should be conducted to identify any unsuitable materials at the subgrade level. Where subcutting is required to remove unsuitable subgrade materials, the underlying material should be scarified and compacted to at least 95% Standard Proctor dry density. Sub-base materials, complying with the requirements of CW3110, should be used to backfill areas with unsuitable subgrade materials. Subcutting of unsuitable subgrade materials should typically not extend more than 1 m below the final elevation of the road surface. Preparation of the subgrade should comply with the City of Winnipeg Standard Construction Specification CW3110.

Where stable subgrade is exposed at the base of the pavement structure, a geotextile fabric should be placed between the stable subgrade and the sub-base material to provide separation. If an unstable subgrade is exposed beneath the proposed pavement structure, a geotextile fabric together with geogrid should be placed over the unstable subgrade. Supply and installation of geotextile fabric and geogrid should comply with the requirements of City of Winnipeg Standard Construction Specification CW3130.

Silt layers were encountered at a shallow depth in Testholes TH4, TH6, TH7, TH8, TH10, TH15, TH16 and TH17. The depth to silt ranged from 0.8 m in Testhole TH8 to 2.1 m in Testhole TH`7. The thickness of the silt layer was typically in the range of 0.1 to 0.3 m. Silt is considered to be a frost-susceptible soil. If silt is found within the annual depth of frost penetration, the service life of the pavement may be reduced due to frost heave and thaw weakening of the subgrade. The annual depth of frost penetration is dependent upon several factors but is typically in the order of 2 m in the Winnipeg area. To eliminate frost-related distress in the pavement would require removal of frost-susceptible soils within the depth of annual frost penetration. To minimize frost-related distress, it is recommended that silt, if encountered at the subgrade level, be subcut to a maximum depth of 1 m below the final elevation of the road surface. It is recommended that the final grades for the pavement be set as high as possible to avoid the potential requirement for subexcavation and reduce the risk of frost-related distress in the pavement.

5.2 Drainage

Drainage of water from the subgrade is an important consideration because excess water will lead to reduced subgrade strength and consequently, increase the potential for subgrade failure and frost heave. During construction, the surface of the subgrade should be graded to prevent water from ponding on the exposed subgrade. Where ditches are provided adjacent to the roadway, they should be deep enough to ensure that the surface of the free water will be maintained below the pavement structure. Where ditches are not provided, underdrains should be installed along the full length of the roadway to provide drainage of the sub-base and base course layers. Risers should be installed for the inspection and cleaning of the underdrains.

5.3 Box Culvert

It is our understanding that a box culvert will be constructed at the proposed realigned intersection of Gunn Road and Day Street. Based upon the soil and groundwater conditions encountered at the testhole locations, the box culvert may be supported on a raft slab. A raft slab bearing on stiff clay may be designed based upon an allowable bearing pressure of 100 kPa. The excavation sidewalls and base must be maintained in a frost-free condition for the duration of construction to prevent potential frost heave and thaw settlement of the structure. Measures should be taken to prevent moisture content changes in the high plasticity clay during construction. Protecting the bearing surface from wetting or drying during construction will minimize moisture changes in the clay subsoil. The bottom of the excavation must be kept free from excessive moisture and free-flowing water.

A 300 mm thick layer of free draining granular material should be provided beneath the raft slab. The granular material should be compacted to a minimum of 95% maximum standard proctor density. The free draining granular backfill should consist of hard crushed stone, free from organic material meeting the following gradation requirements:

Canadian Metric Sieve Size	Percent Passing
40,000	95 to 100
20,000	35 to 70
10,000	10 to 30
5,000	0 to 5

To prevent channel flow from seeping through the base course and prevent the potential for underslab piping, a concrete cutoff wall extending through the base course into the foundation clay should be installed along the upstream and downstream lip of the raft slab.

Backfill for the culvert should be unfrozen granular material that complies with the following gradation requirements:

Canadian Metric Sieve Size	**Percent Passing**
50,000	100
20,000	75 to 100
5,000	45 to 85
2,500	35 to 55
315	15 to 35
160	5 to 20
80	0 to 7

The granular backfill should be placed in layers not exceeding 150 mm in thickness and compacted to at least 95% maximum standard proctor density.

The culvert walls should be designed based on the following expression which assumes a triangular pressure distribution:

$$P_o = K_o (\gamma D + q)$$

where P_o = lateral earth pressure (at-rest condition) at depth D, kPa

K_o = at-rest coefficient of lateral earth pressure (0.5 for granular backfill)

γ = soil unit weight (21 kN/m^3 for granular backfill)

q = live load surcharge within distance D, kPa

Excavation for the culvert will occur in the fill materials and native clay soils. The stability of temporary excavations is a function of several factors, including the total time the excavation is exposed, soil moisture conditions, soil type and consistency, and the contractor's operations. It is the responsibility of the contractor to maintain safe and stable slopes or design and provide shoring during construction. As a guideline, temporary excavations may be sloped 1 horizontal to 1 vertical within the clay. If temporary shoring is used, it should be designed by a registered professional engineer who has experience with excavation shoring. The design of the shoring system should take into consideration lateral surcharge pressures from construction equipment close to the excavation. Groundwater seepage may occur and pumps should be available to remove water that collects in the excavation. Excavated materials must be stockpiled a safe distance from the edge of the excavation. All excavations must comply with Manitoba Workplace Safety and Health regulations.

5.4 Pile Foundation

An alternative foundation system suitable to support the box culvert structure is a system of driven, prestressed, precast concrete piles. These units, when driven to practical refusal with a hammer capable of delivering a minimum rated energy of 40 KJ per blow, may be assigned the following allowable loads.

Nominal Pile Size	Allowable Load	Refusal Criteria
300 mm	450 kN	5 blows/25 mm
350 mm	625 kN	8 blows/25 mm
400 mm	800 kN	12 blows/25 mm

Pile spacing should not be less than 2.5 pile diameters, measured center to center. Pile heave for piles within 5 pile diameters should be monitored and redriving done where pile heave is found to be significant. Pre-boring to at least 3 m should be considered for all driven piles to enhance pile alignment and minimize vibration levels in adjacent structures during installation. The prebored hole diameter should be slightly larger than the nominal pile diameter. All piles should be driven continuously to their required depth once driving is initiated. Precast concrete piles driven to practical refusal will develop the majority of their capacity from toe resistance, and therefore, no reduction in pile capacity is necessary for group action. The design capacity of a pile group is equal to the number of piles in the group times the allowable capacity per pile.

Auger refusal was encountered within the silt till at depths of 15.2 and 18.3 m in the deep testholes near the proposed location of the culvert. Driven piles are expected to reach refusal at similar depth ranges. Some variation in pile refusal depths should be anticipated on the site. Negligible settlement beyond the elastic compression of the pile can be expected with an end-bearing pile system. A minimum void space of 200 mm should be provided beneath all structural elements to accommodate potential heave of the high plasticity clay. To ensure that the piles achieve their design capacities, full time inspection by qualified geotechnical personnel is recommended during pile installation.

6.0 CLOSURE

Professional judgments and recommendations are presented in this report. They are based on an evaluation of the technical information gathered during our site investigation. We do not guarantee the performance of the project in any respect other than that our engineering work and judgment rendered meet the standards and care of our profession. It should be noted that the testholes may not represent potentially unfavourable subsurface conditions between testholes. If during construction soil conditions are encountered that vary from those

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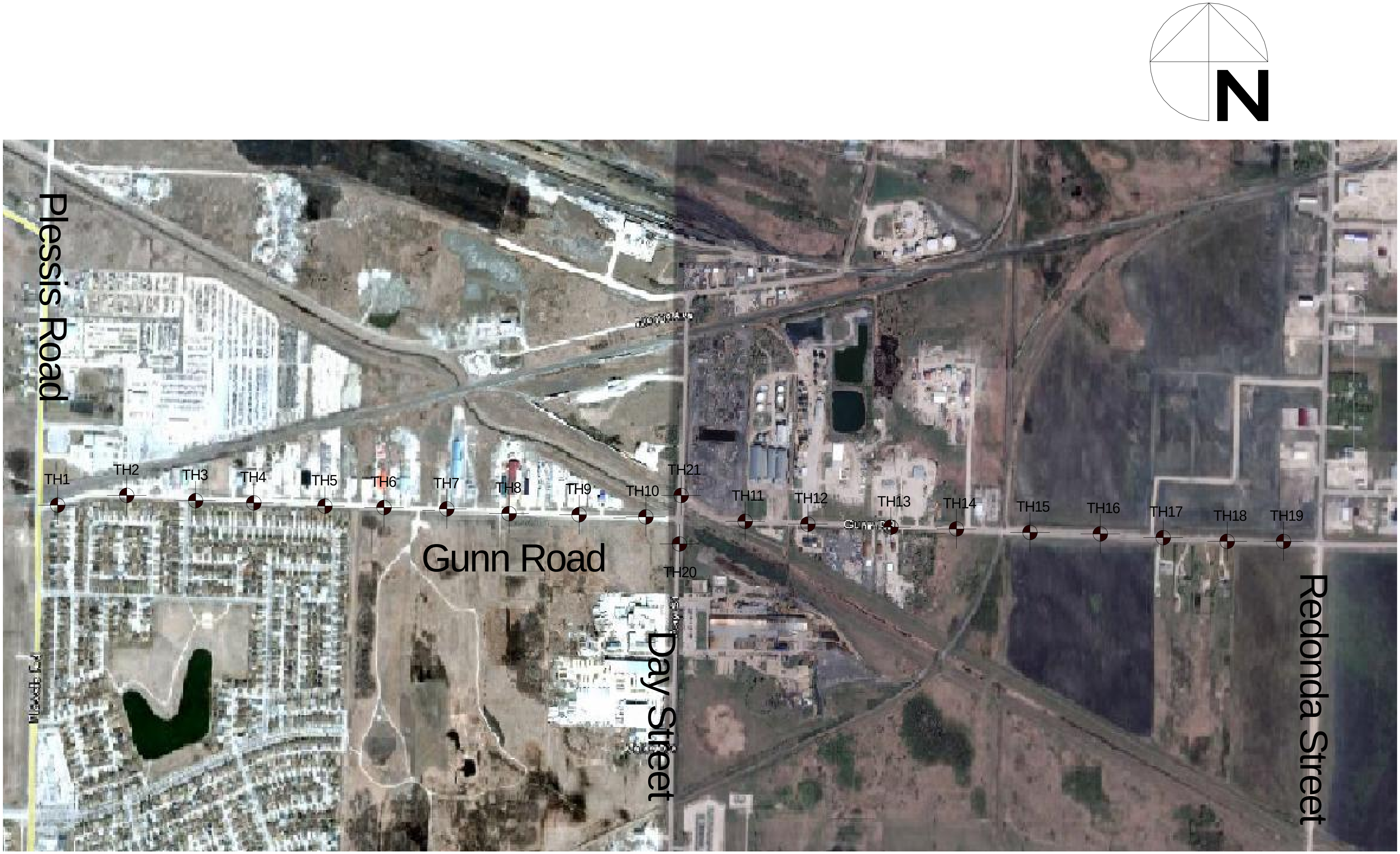
We appreciate the opportunity to assist you in this project. Please call me if you have any questions regarding this report.

Don Flatt

Don Flatt, M. Eng., P.Eng.
Senior Geotechnical Engineer

PROVINCE OF MANITOBA
D.G.
FLATT
Member
5062
REGISTERED PROFESSIONAL ENGINEER

APEGM
Certificate of Authorization
The National Testing Laboratories Limited
No. 690 Date: Nov 27/09



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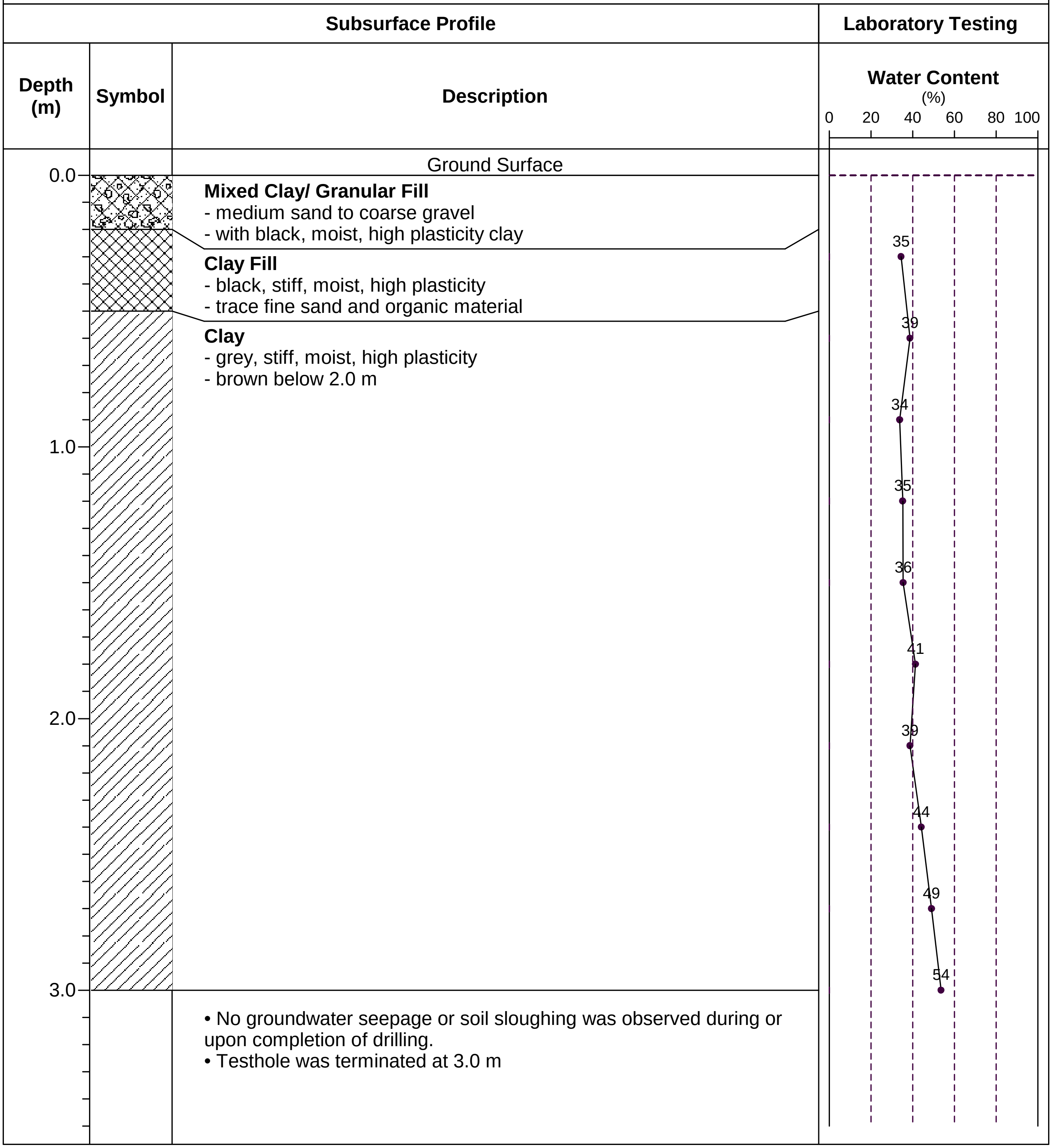
Established in 1923

Project No. STA-927	Drawn by: AP	Figure: 1	Testhole Location Plan Gunn Road Reconstruction Winnipeg, Manitoba
Date: Oct 1, 2009	Reviewed by: DF	Scale: NTS	

TESTHOLE TH1

Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 19, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt



Ground Surface

Mixed Clay/ Granular Fill
- medium sand to coarse gravel
- with black, moist, high plasticity clay

Clay Fill
- black, stiff, moist, high plasticity
- trace fine sand and organic material

Clay
- grey, stiff, moist, high plasticity
- brown below 2.0 m

- No groundwater seepage or soil sloughing was observed during or upon completion of drilling.
- Testhole was terminated at 3.0 m

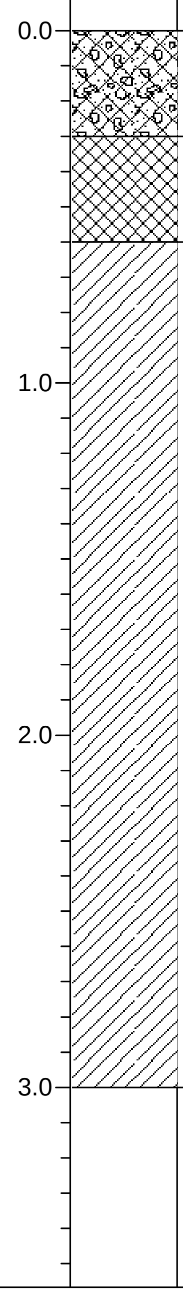
TESTHOLE TH2

Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 19, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt

Subsurface Profile | **Laboratory Testing**

Depth (m) | **Symbol** | **Description**



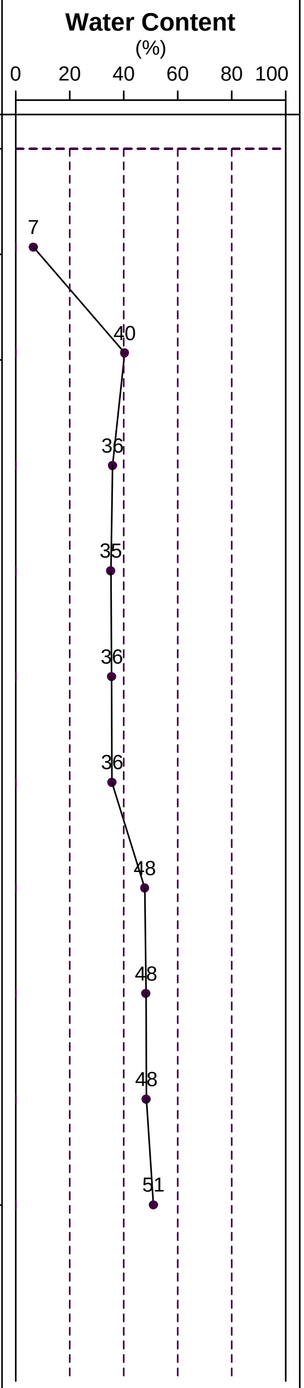
Ground Surface

Mixed Clay/ Granular Fill
- medium sand to coarse gravel
- with black, moist, high plasticity clay

Clay Fill
- grey, stiff, moist, high plasticity
- trace silt and fine sand

Clay
- grey to brown, stiff, moist, high plasticity
- brown, trace silt below 1.8 m

- No groundwater seepage or soil sloughing was observed during or upon completion of drilling.
- Testhole was terminated at 3.0 m
- Hydrocarbon odour below 1.8 m



TESTHOLE TH3

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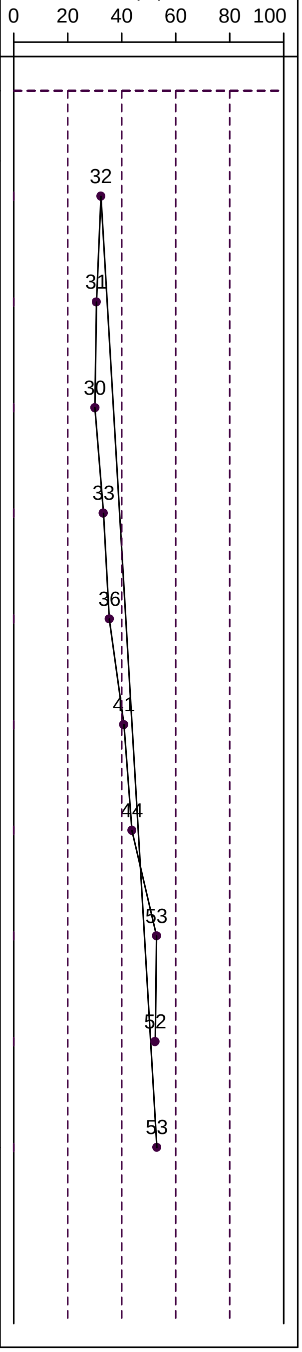
Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 19, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt

Subsurface Profile			**Laboratory Testing**
Depth (m)	**Symbol**	**Description**	**Water Content** (%)
		Ground Surface	
0.0	▨	**Mixed Clay/ Granular Fill** - medium sand to coarse gravel - with black, moist, high plasticity clay	
	▨	**Clay** - grey, stiff, moist, high plasticity - trace silt	
1.0			
2.0			
3.0			



- No groundwater seepage or soil sloughing was observed during or upon completion of drilling.
- Testhole was terminated at 3.0 m
- Hydrocarbon odour below 0.9 m

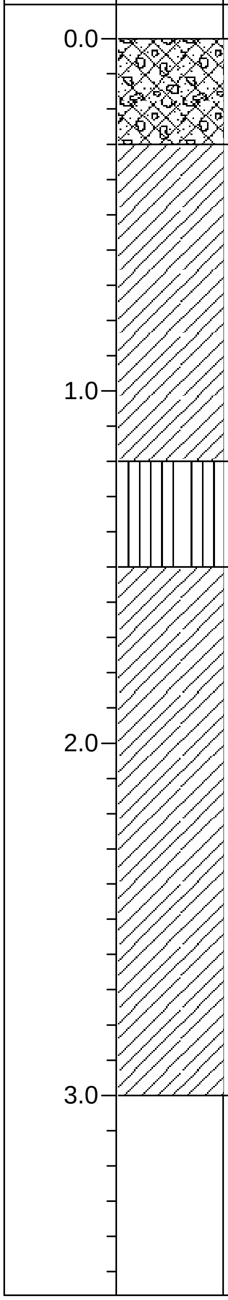
TESTHOLE TH4

Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 19, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt

Subsurface Profile

Depth (m) **Symbol** **Description**



Ground Surface

Mixed Clay/ Granular Fill
- medium sand to coarse gravel
- with black, moist, high plasticity clay

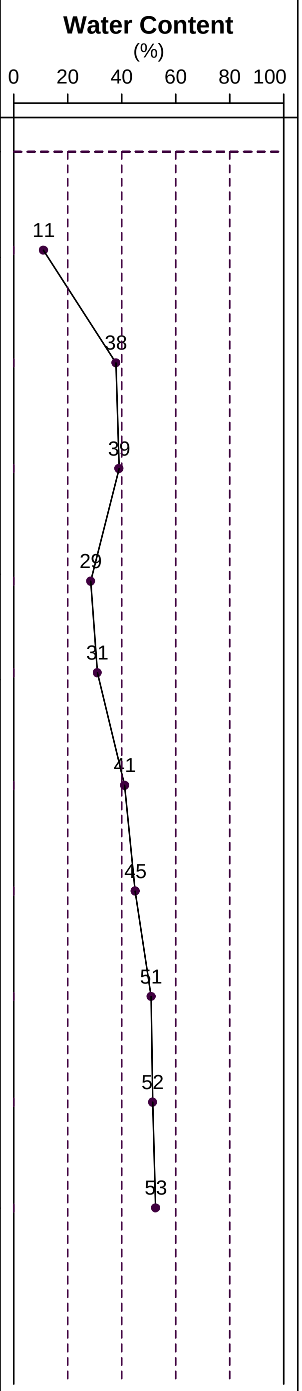
Clay
- grey to brown, stiff, moist, high plasticity

Silt
- brown, soft, moist, low plasiticity
- some sand and clay

Clay
- brown, stiff, moist, high plasticity

- No groundwater seepage or soil sloughing was observed during or upon completion of drilling.
- Testhole was terminated at 3.0 m
- Hydrocarbon odour below 0.9 m

Laboratory Testing



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Established in 1923

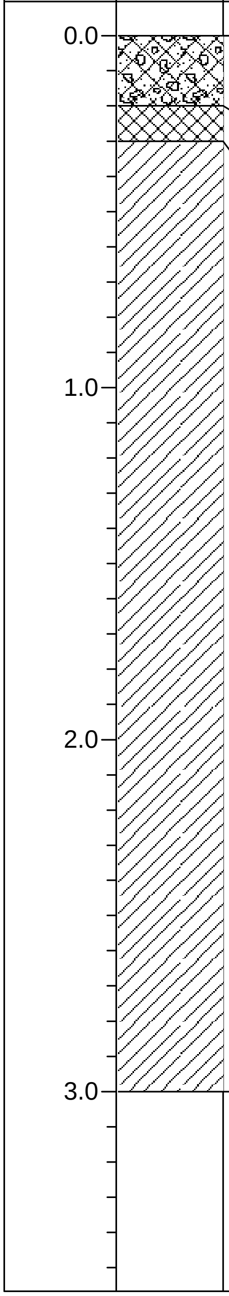
TESTHOLE TH5

Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 19, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt

Subsurface Profile

Depth (m)	Symbol	Description



Ground Surface

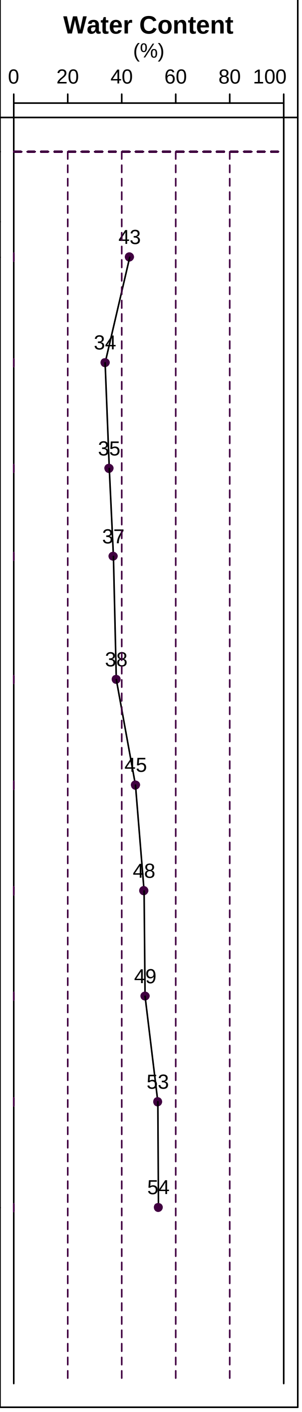
Mixed Clay/ Granular Fill
- medium sand to coarse gravel
- with black, moist, high plasticity clay

Clay Fill
- grey, stiff, moist, high plasticity

Clay
- grey to brown, stiff, moist, high plasticity
- tan, soft, medium plasticity, silty below 1.2 m
- brown, stiff, high plasticity below 1.7 m

- No groundwater seepage or soil sloughing was observed during or upon completion of drilling.
- Testhole was terminated at 3.0 m

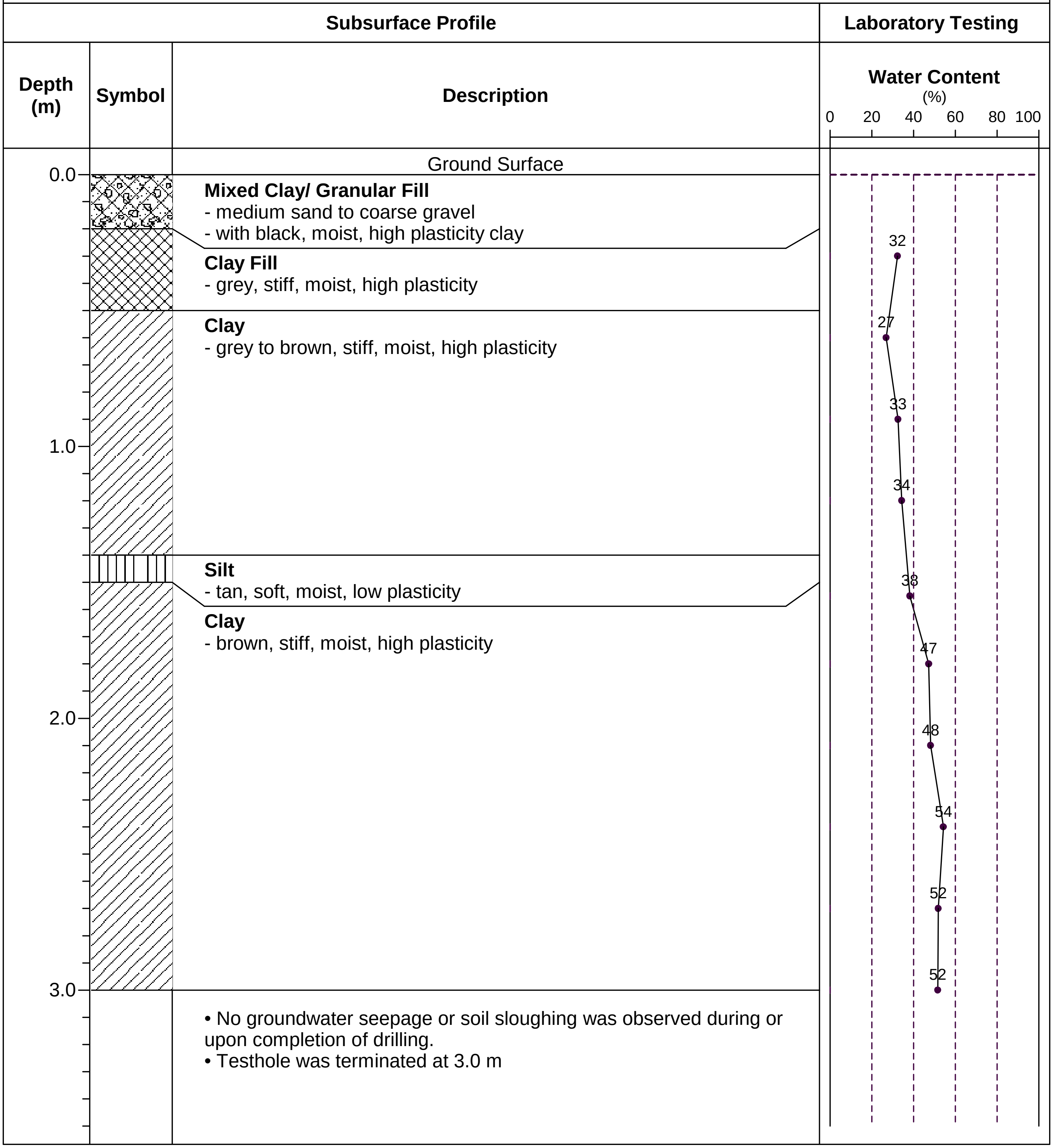
Laboratory Testing



TESTHOLE TH6

Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 19, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt



Ground Surface

Mixed Clay/ Granular Fill
- medium sand to coarse gravel
- with black, moist, high plasticity clay

Clay Fill
- grey, stiff, moist, high plasticity

Clay
- grey to brown, stiff, moist, high plasticity

Silt
- tan, soft, moist, low plasticity

Clay
- brown, stiff, moist, high plasticity

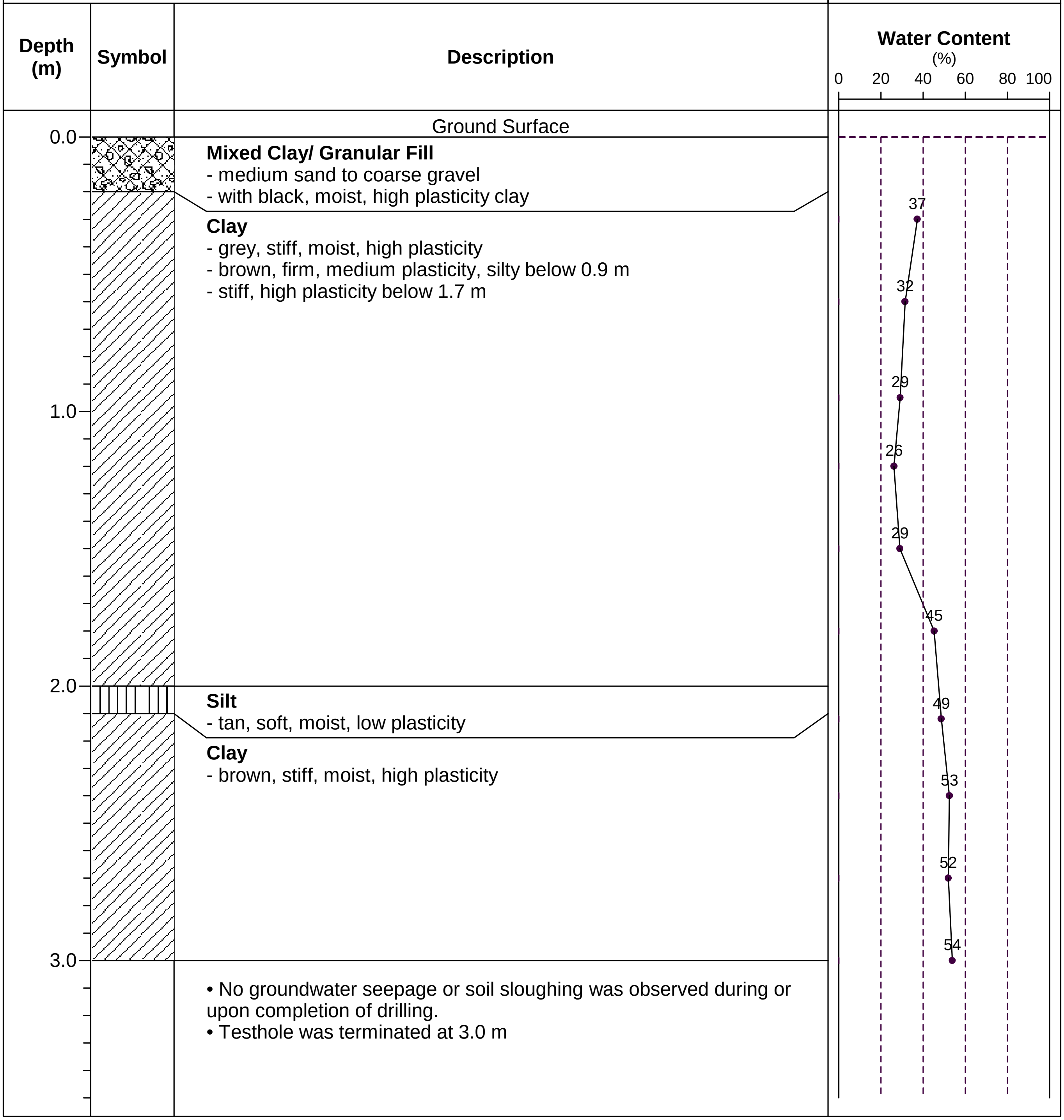
• No groundwater seepage or soil sloughing was observed during or upon completion of drilling.
• Testhole was terminated at 3.0 m

TESTHOLE TH7

Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 19, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt

Subsurface Profile | **Laboratory Testing**



Ground Surface

Mixed Clay/ Granular Fill
- medium sand to coarse gravel
- with black, moist, high plasticity clay

Clay
- grey, stiff, moist, high plasticity
- brown, firm, medium plasticity, silty below 0.9 m
- stiff, high plasticity below 1.7 m

Silt
- tan, soft, moist, low plasticity

Clay
- brown, stiff, moist, high plasticity

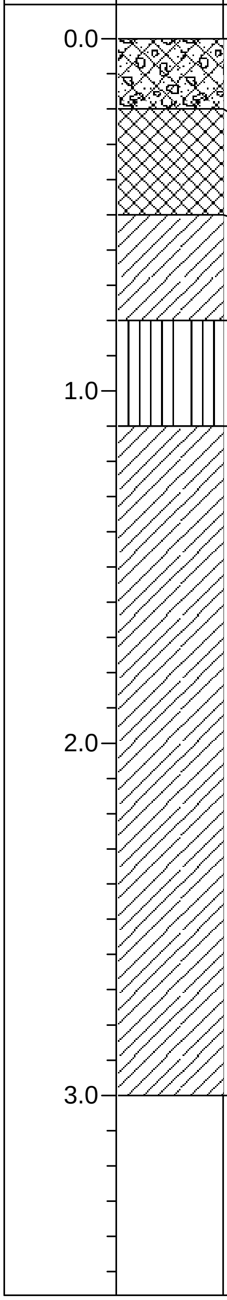
- No groundwater seepage or soil sloughing was observed during or upon completion of drilling.
- Testhole was terminated at 3.0 m

TESTHOLE TH8

Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 19, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt

Subsurface Profile



Description

Ground Surface

Mixed Clay/ Granular Fill
- medium sand to coarse gravel
- with black, moist, high plasticity clay

Clay Fill
- grey, stiff, moist, high plasticity
- trace organic material

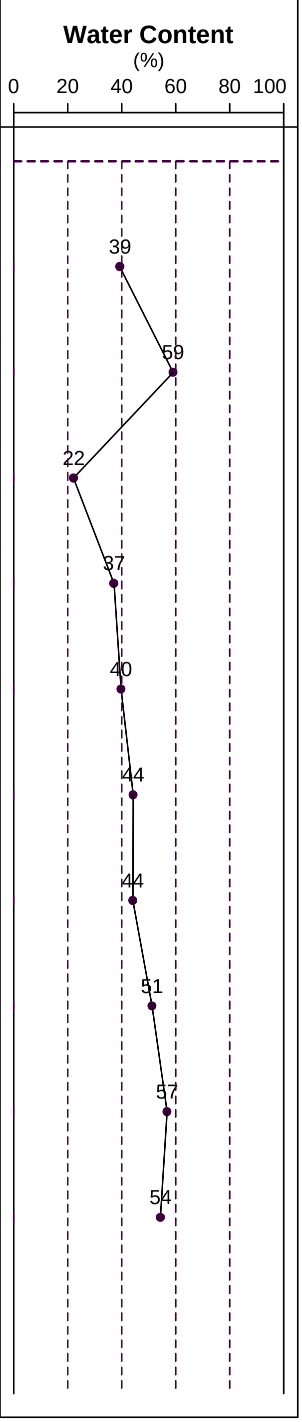
Clay
- grey to brown, stiff, moist, high plasticity

Silt
- tan, soft, moist, low plasticity, clayey

Clay
- brown, stiff, moist, high plasticity

- No groundwater seepage or soil sloughing was observed during or upon completion of drilling.
- Testhole was terminated at 3.0 m

Laboratory Testing



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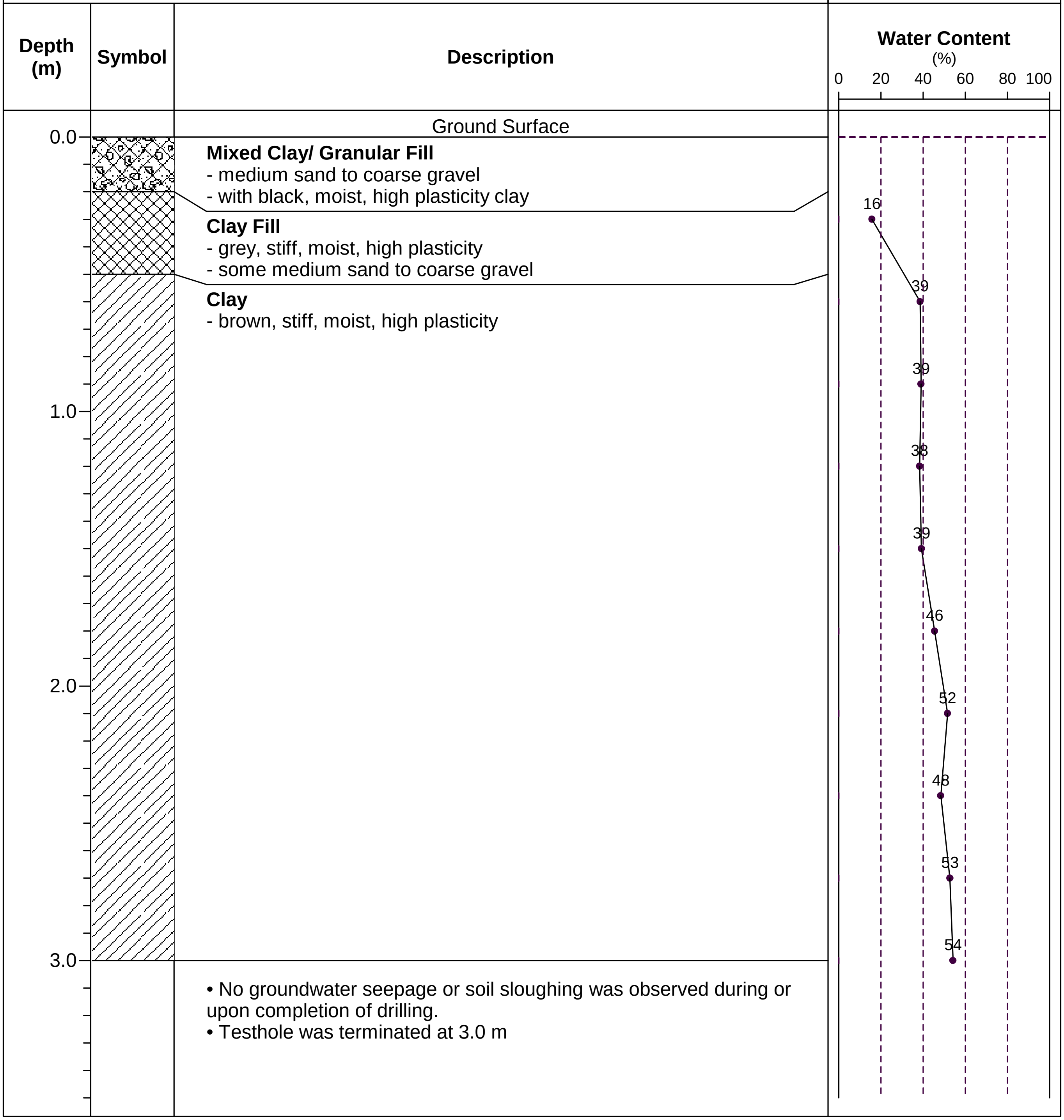
TESTHOLE TH9

Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 19, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt

Subsurface Profile | **Laboratory Testing**



Ground Surface

Mixed Clay/ Granular Fill
- medium sand to coarse gravel
- with black, moist, high plasticity clay

Clay Fill
- grey, stiff, moist, high plasticity
- some medium sand to coarse gravel

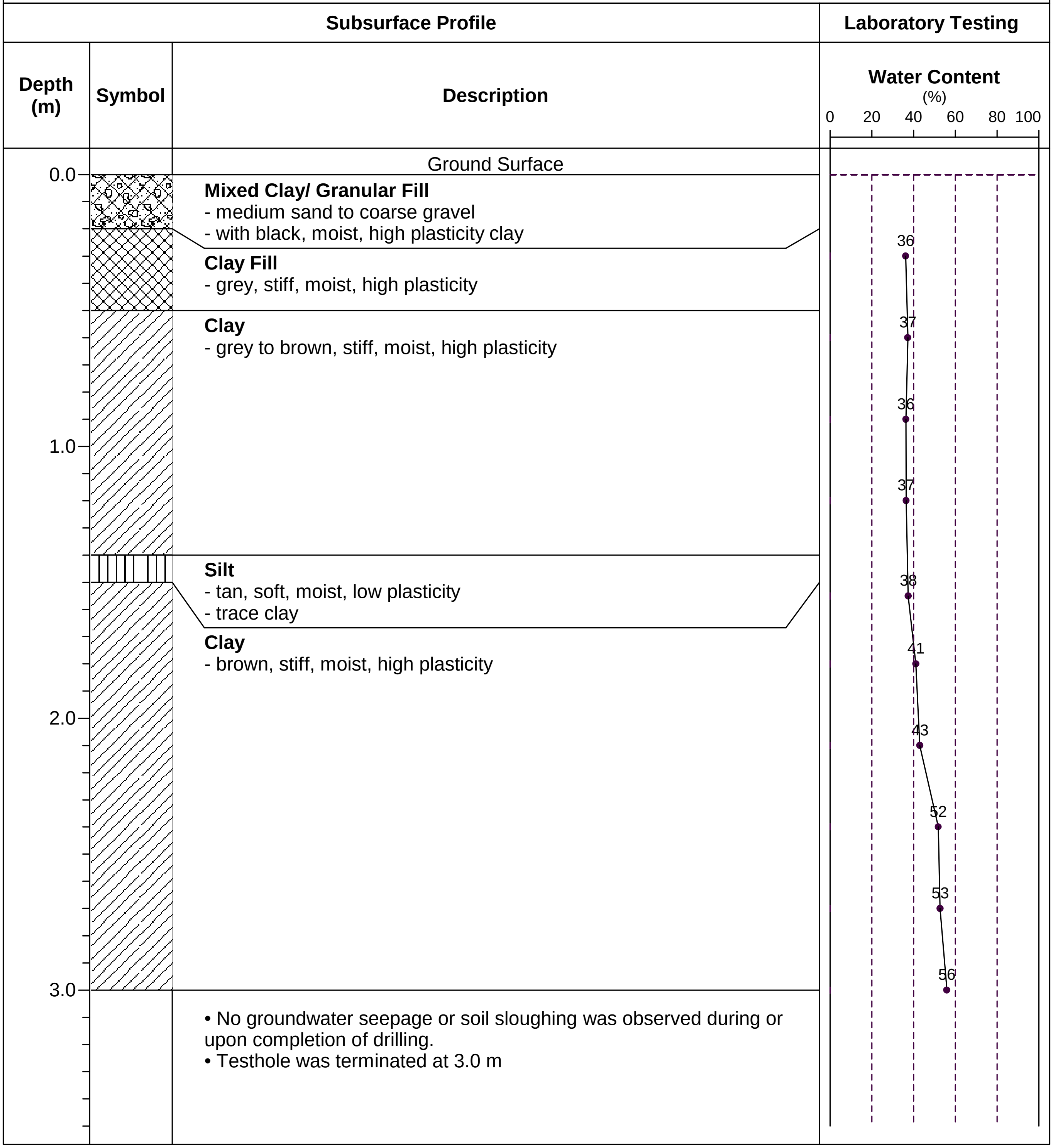
Clay
- brown, stiff, moist, high plasticity

- No groundwater seepage or soil sloughing was observed during or upon completion of drilling.
- Testhole was terminated at 3.0 m

TESTHOLE TH10

Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 19, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt



Ground Surface

Mixed Clay/ Granular Fill
- medium sand to coarse gravel
- with black, moist, high plasticity clay

Clay Fill
- grey, stiff, moist, high plasticity

Clay
- grey to brown, stiff, moist, high plasticity

Silt
- tan, soft, moist, low plasticity
- trace clay

Clay
- brown, stiff, moist, high plasticity

- No groundwater seepage or soil sloughing was observed during or upon completion of drilling.
- Testhole was terminated at 3.0 m

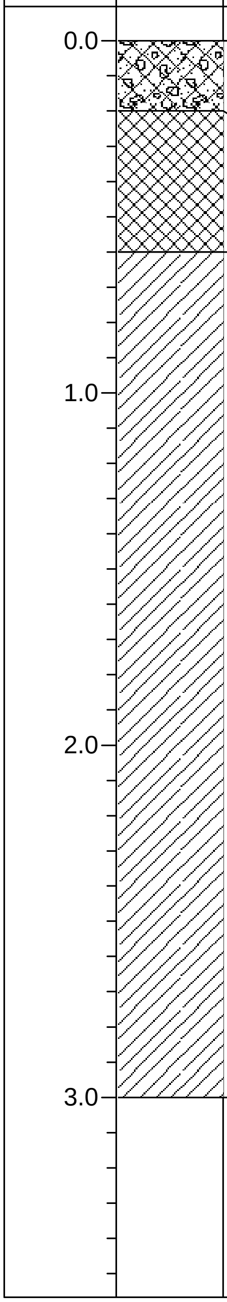
TESTHOLE TH11

Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 19, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt

Subsurface Profile

Depth (m) | **Symbol** | **Description**



Ground Surface

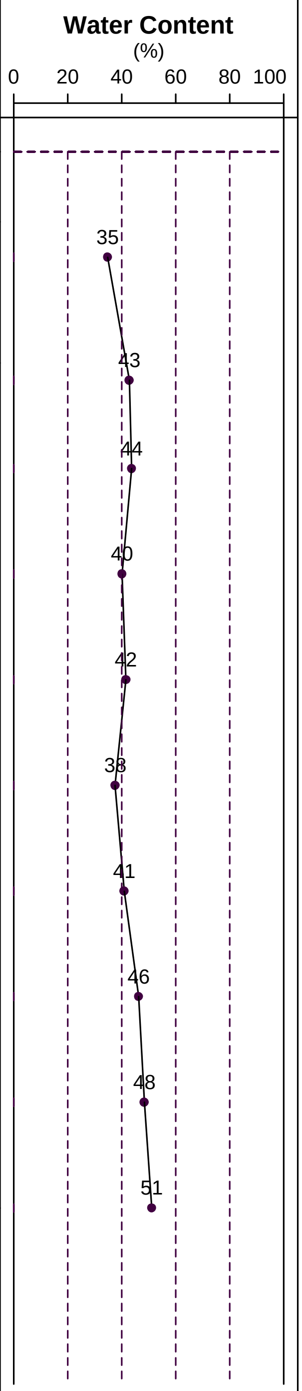
Mixed Clay/ Granular Fill
- medium sand to coarse gravel
- with black, moist, high plasticity clay

Clay Fill
- black, stiff, moist, high plasticity

Clay
- grey to brown, stiff, moist, high plasticity

- No groundwater seepage or soil sloughing was observed during or upon completion of drilling.
- Testhole was terminated at 3.0 m

Laboratory Testing



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TESTHOLE TH12

Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 19, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt

Subsurface Profile | **Laboratory Testing**

Depth (m) | **Symbol** | **Description**

Ground Surface

0.0

Granular Fill
- medium to coarse sand
- trace fine to coarse gravel and trace clay

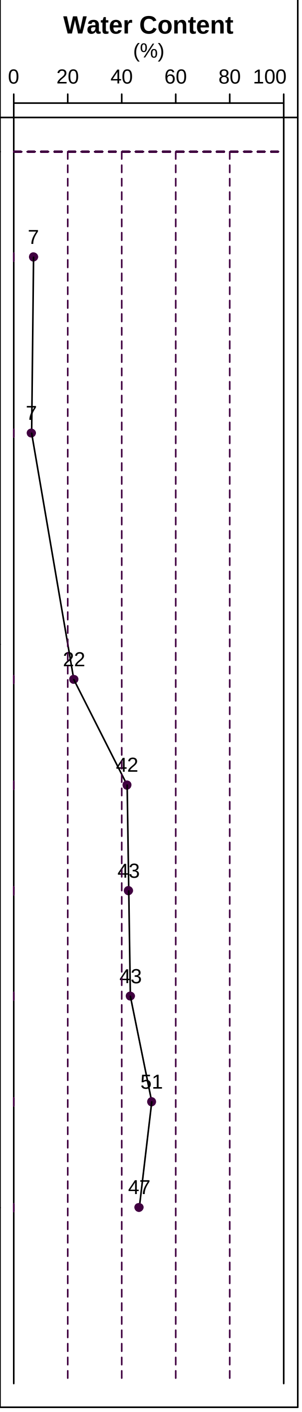
1.0

Clay
- brown, stiff, moist, high plasticity

2.0

3.0

• No groundwater seepage or soil sloughing was observed during or upon completion of drilling.
• Testhole was terminated at 3.0 m



TESTHOLE TH13

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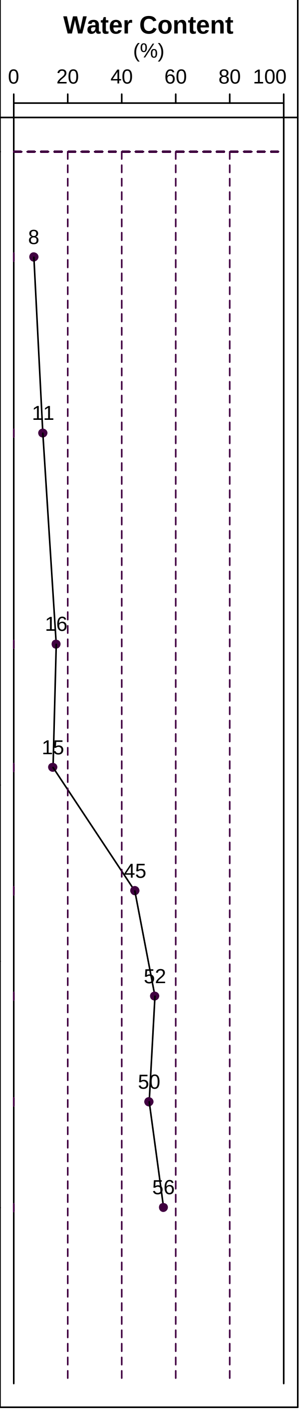
Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 19, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt

Depth (m)	Symbol	Description
		Ground Surface
0.0 1.0	▒	**Granular Fill** - medium to coarse sand - trace fine to coarse gravel and trace clay
2.0	▩	**Clay Fill** - grey, stiff, moist, high plasticity - some concrete debris observed at bottom of clay fill layer
	▨	**Clay** - brown, stiff, moist, high plasticity
3.0		• Moderate groundwater seepage was observed below a depth of 1.2 m from the granular fill. • Groundwater level at a depth of 1.2 m upon completion of drilling. • No soil sloughing was observed during or upon completion of drilling. • Testhole was terminated at 3.0 m.

Laboratory Testing



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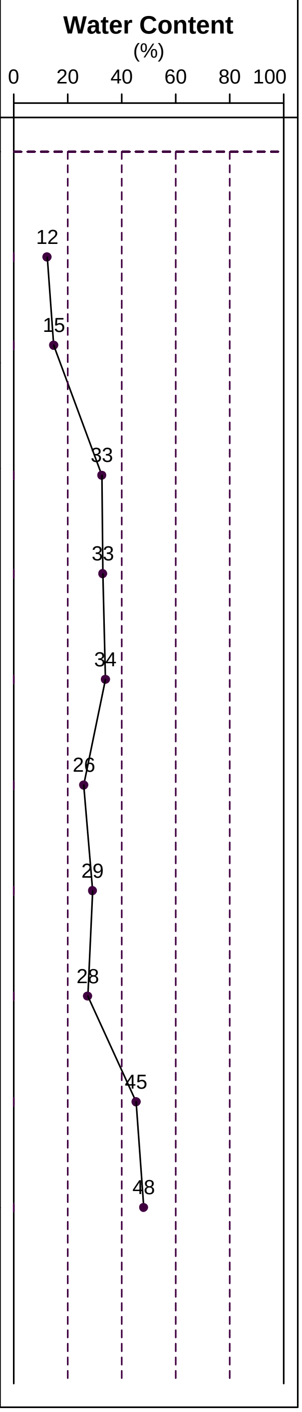
TESTHOLE TH14

Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 19, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt

Subsurface Profile | **Laboratory Testing**

Depth (m)	Symbol	Description
		Ground Surface
0.0		**Granular Fill** - medium to coarse sand - trace fine to coarse gravel and trace clay
		Clay Fill - black, stiff, moist, high plasticity
1.0 2.0		**Clay** - grey, stiff, moist, high plasticity - trace silt from 1.5 to 2.6 m
3.0		• No groundwater seepage or soil sloughing was observed during or upon completion of drilling. • Testhole was terminated at 3.0 m

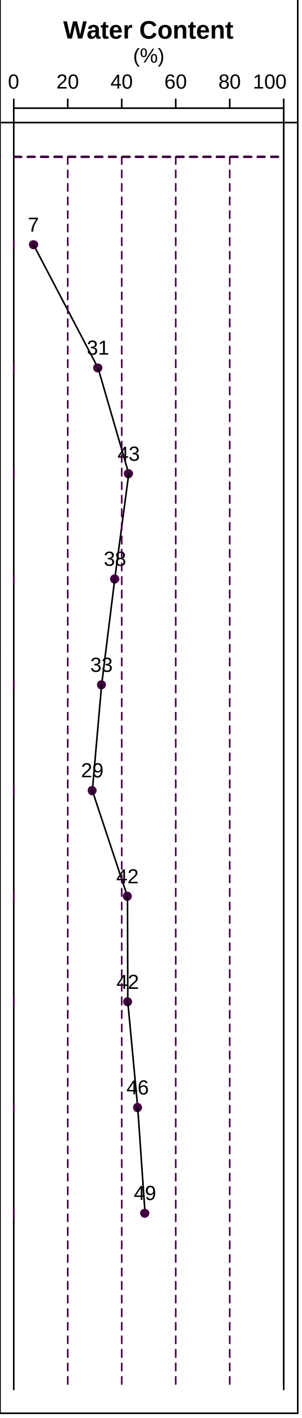


TESTHOLE TH15

Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 19, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt

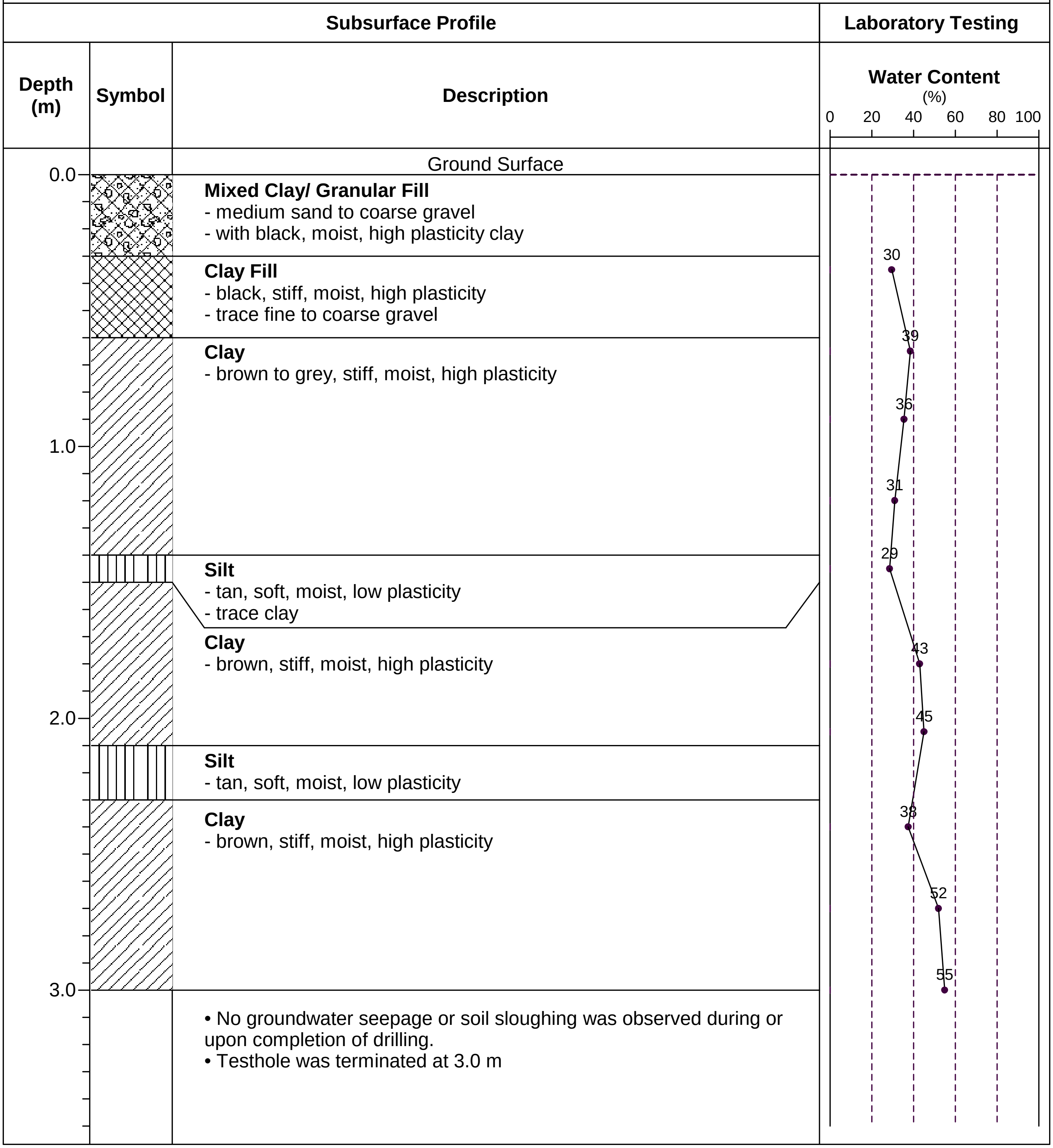
Subsurface Profile			Laboratory Testing
Depth (m)	**Symbol**	**Description**	**Water Content** (%)
		Ground Surface	
0.0	▨	**Mixed Clay/ Granular Fill** - medium sand to coarse gravel - with black, moist, high plasticity clay	
	▨	**Clay Fill** - black, stiff, moist, high plasticity	
1.0	▨	**Clay** - brown, stiff, moist, high plasticity	
	▥	**Silt** - tan, soft, moist, low plasticity, clayey	
2.0	▨	**Clay** - brown, stiff, moist, high plasticity	
3.0		• No groundwater seepage or soil sloughing was observed during or upon completion of drilling. • Testhole was terminated at 3.0 m	



TESTHOLE TH16

Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 20, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt



Ground Surface

Mixed Clay/ Granular Fill
- medium sand to coarse gravel
- with black, moist, high plasticity clay

Clay Fill
- black, stiff, moist, high plasticity
- trace fine to coarse gravel

Clay
- brown to grey, stiff, moist, high plasticity

Silt
- tan, soft, moist, low plasticity
- trace clay

Clay
- brown, stiff, moist, high plasticity

Silt
- tan, soft, moist, low plasticity

Clay
- brown, stiff, moist, high plasticity

• No groundwater seepage or soil sloughing was observed during or upon completion of drilling.
• Testhole was terminated at 3.0 m

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TESTHOLE TH17

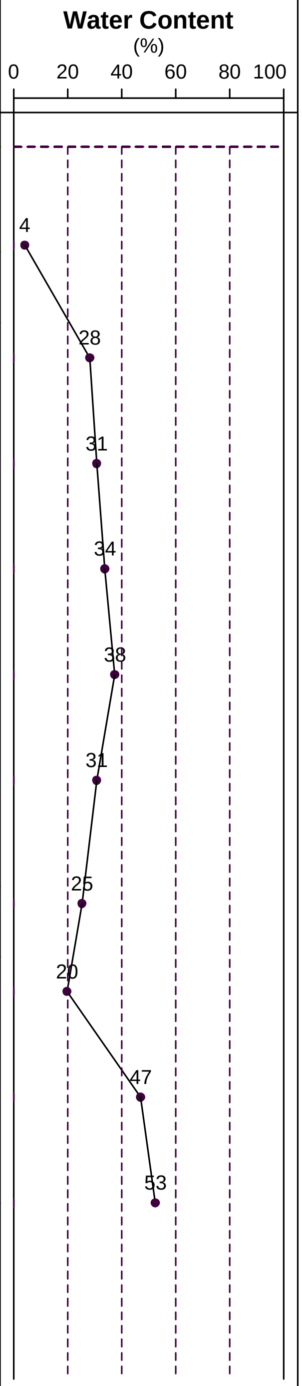
Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 20, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt

Subsurface Profile

Depth (m)	Symbol	Description
		Ground Surface
0.0		**Granular Fill** - medium to coarse sand - trace fine to coarse gravel and trace clay
		Clay Fill - grey, stiff, moist, high plasticity - trace fine to coarse gravel
		Clay - brown to grey, stiff, moist, high plasticity
1.0		
2.0		
		Silt - tan, soft, moist, low plasticity
		Clay - brown, stiff, moist, high plasticity - some fine to coarse gravel to 2.6 m
3.0		• No groundwater seepage or soil sloughing was observed during or upon completion of drilling. • Testhole was terminated at 3.0 m

Laboratory Testing

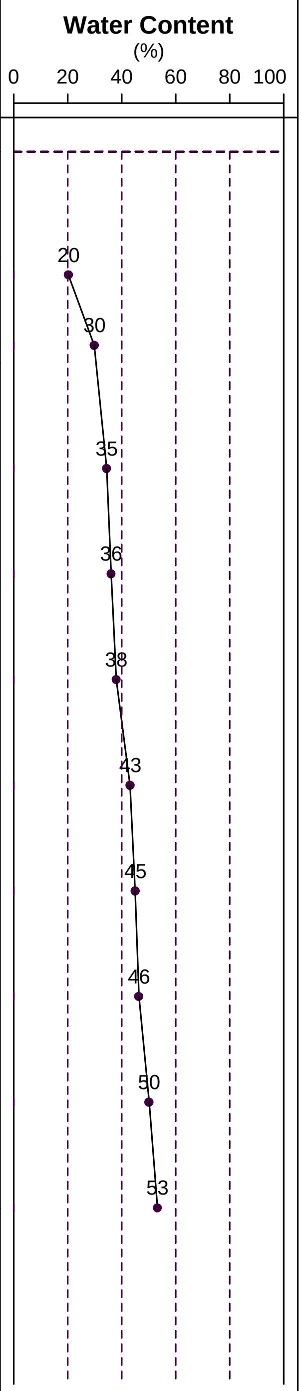


TESTHOLE TH18

Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 20, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt

Subsurface Profile			Laboratory Testing
Depth (m)	**Symbol**	**Description**	**Water Content** (%)
		Ground Surface	
0.0		**Granular Fill** - medium to coarse sand - trace fine to coarse gravel and trace clay	
		Clay Fill - black, stiff, moist, high plasticity - trace fine to coarse gravel	
1.0 2.0		**Clay** - grey to brown, stiff, moist, high plasticity - 0.2 m silt layer at 1.8 m	
3.0		• No groundwater seepage or soil sloughing was observed during or upon completion of drilling. • Testhole was terminated at 3.0 m	



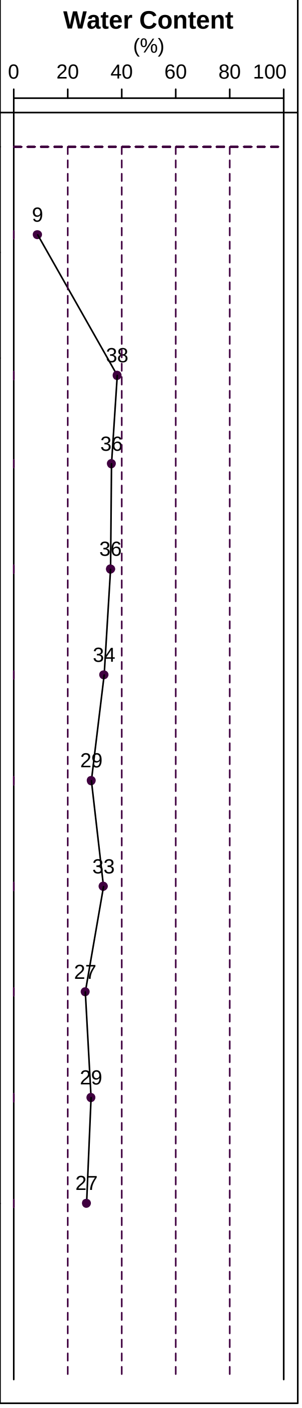
TESTHOLE TH19

Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 20, 2009
Depth of Testhole: 3.0 m
Logged by: Farouk Fourar
Reviewed by: Don Flatt

Depth (m)	Symbol	Description
		Ground Surface
0.0		**Granular Fill** - medium to coarse sand - trace fine to coarse gravel and trace clay
		Clay Fill - black, stiff, moist, high plasticity - trace fine to coarse gravel
		Clay - grey to brown, stiff, moist, high plasticity - silty below 2.9 m
1.0		
2.0		
3.0		• No groundwater seepage or soil sloughing was observed during or upon completion of drilling. • Testhole was terminated at 3.0 m

Laboratory Testing



TESTHOLE TH20

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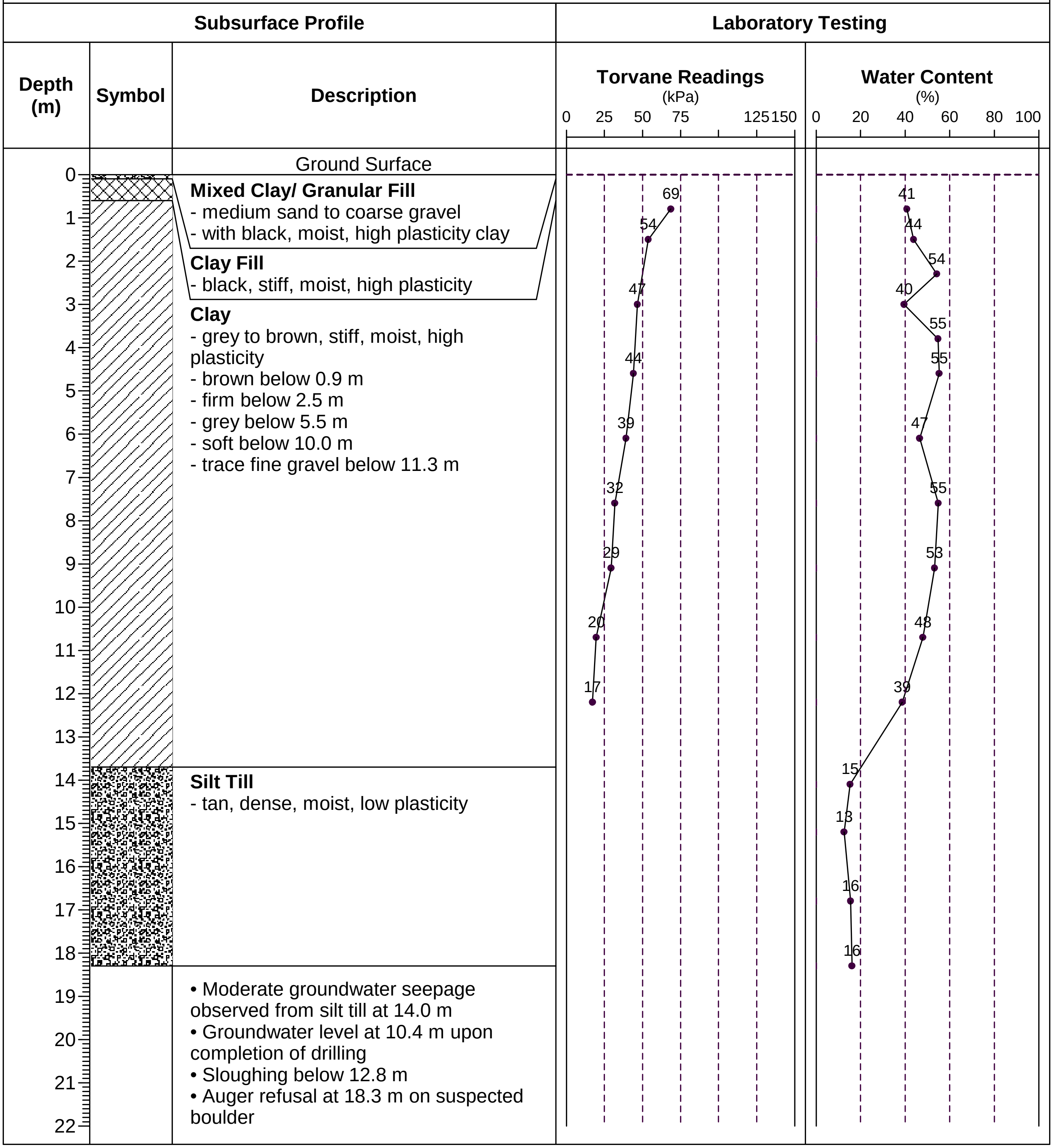
Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 20, 2009
Depth of Testhole: 18.3
Logged by: Farouk Fourar
Reviewed by: Don Flatt



Mixed Clay/ Granular Fill
- medium sand to coarse gravel
- with black, moist, high plasticity clay

Clay Fill
- black, stiff, moist, high plasticity

Clay
- grey to brown, stiff, moist, high plasticity
- brown below 0.9 m
- firm below 2.5 m
- grey below 5.5 m
- soft below 10.0 m
- trace fine gravel below 11.3 m

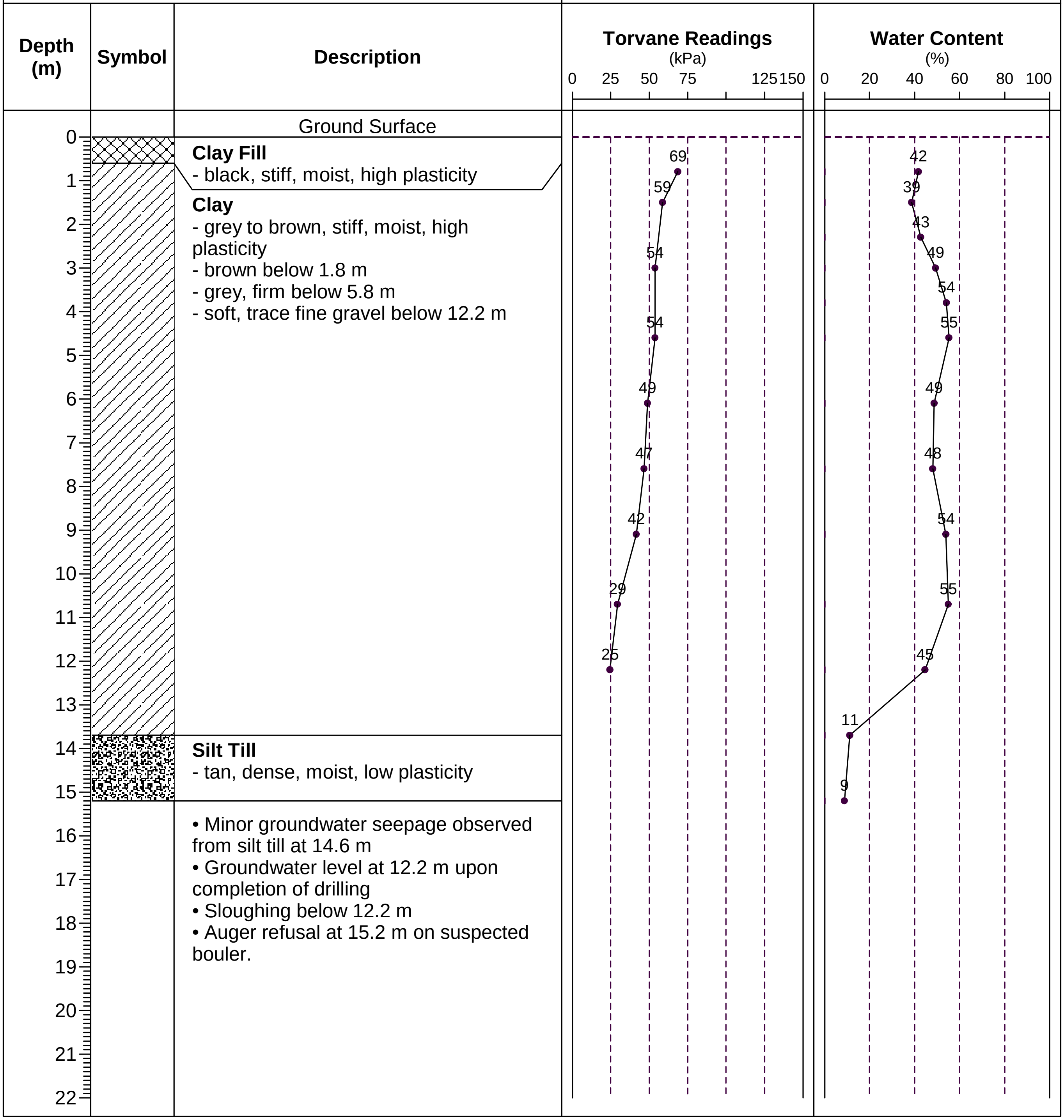
Silt Till
- tan, dense, moist, low plasticity

- Moderate groundwater seepage observed from silt till at 14.0 m
- Groundwater level at 10.4 m upon completion of drilling
- Sloughing below 12.8 m
- Auger refusal at 18.3 m on suspected boulder

TESTHOLE TH21

Project Name: Gunn Road Reconstruction
Client: Stantec Consulting Ltd.
Drilling Contractor: Paddock Drilling Ltd.
Drilling Method: 125 mm Auger

Date Drilled: August 20, 2009
Depth of Testhole: 18.3
Logged by: Farouk Fourar
Reviewed by: Don Flatt



Ground Surface

Clay Fill
- black, stiff, moist, high plasticity

Clay
- grey to brown, stiff, moist, high plasticity
- brown below 1.8 m
- grey, firm below 5.8 m
- soft, trace fine gravel below 12.2 m

Silt Till
- tan, dense, moist, low plasticity

- Minor groundwater seepage observed from silt till at 14.6 m
- Groundwater level at 12.2 m upon completion of drilling
- Sloughing below 12.2 m
- Auger refusal at 15.2 m on suspected bouler.