Stantec Consulting Ltd.
300W-675 Cochrane Drive
Markham ON L3R 0B8

January 10, 2025

Project/File: 122120514

Domenic Battistella
1398493 Ontario Inc.
5783 Bloomington Road, Whitchurch-Stouffville, Ontario

Dear Domenic Battistella,

Reference: Summary of Geotechnical Conditions and Fill Placement Recommendations, 5783 Bloomington Road, Town of Whitchurch-Stouffville, ON – Revision 1

1 INTRODUCTION

Stantec was retained by 1398493 Ontario Inc. (the Client) to provide environmental and geotechnical consulting services in support of a Site Alteration and Fill Permit application with the Town of Whitchurch-Stouffville for the property located at 5783 Bloomington Road (Site) in the Town of Whitchurch-Stouffville, Ontario.

It is understood that the Site has been previously used for aggregate extraction which has resulted in the formation of four (4) manmade ponds within the Site. It is also understood that it is intended to restore the property to historic grades for future agricultural use, which calls for a Site Alteration/Fill Permit from the Town. A hydrogeological assessment is required for the Site Alteration/Fill Permit.

Two (2) geotechnical investigations were conducted at the Site by Golder Associates (Golder) in 2011 and 2012 and the reports were provided to Stantec for the purpose of this study. This memorandum provides a summary of the subsurface conditions encountered during these investigations as well as the recommendations for fill placement as provided by Golder to be used in the Site Alteration/Fill Permit application.

Limitations associated with this memorandum and its contents are provided in the Statement of General Conditions, attached.

2 SITE DESCRIPTION

The Site is located at 5783 Bloomington Road East in the Town of Whitchurch-Stouffville, Ontario. The Site location is shown on the Key Plan from the Golder report (Figure 1 in Appendix B).

The west portion of the Site consists of active farm fields with associated structures and access roads as well as two (2) ponds. The east portion of the Site is dominated by two (2) large ponds which are remnants of previous aggregate extraction activities. The ground surface cover generally consists of grass and ploughed fields. There are scattered trees throughout the Site, specifically along the northern and southern property boundaries and at the center of the Site, in the area of the existing structures.

A topographic plan of the Site dated June 2012 was provided in the Golder report and is included in Appendix B. The plan indicates that within the west portion of the Site, the ground surface generally slopes down from approximately Elevation 333 m in the north to approximately Elevation 320 m in the south. The plan also indicates that within the east potion of the Site, the ground surface slopes down towards the two large ponds.

A site visit conducted by Stantec environmental team on July 17, 2024 indicated that there have been no significant changes to the site from the time of the investigations by Golder in 2012.

3 SUBSURFACE STRATIGRAPHY

3.1 Overview

Golder carried out two (2) geotechnical investigations within the Site in 2011 and 2012. A summary of subsurface conditions encountered during these investigations and provided in Golder reports is provided in the following sections of this memorandum.

3.2 Geotechnical Investigation (Golder, 2012)

Golder completed a geotechnical investigation in support of the Site Alteration/Fill Permit for the Site in 2012 and provided the results in the following report:

Geotechnical Investigation
South of Bloomington Road East
Between Highway 48 and Ninth Line
Whitchurch-Stouffville, Ontario

Submitted to
Camrock Development Corporation/ RCG Haulage (1757196 Ontario Inc.)
Dated June 15, 2012

The investigation consisted of a total of five (5) boreholes (MW201 to MW205), advanced to depths ranging from approximately 13.92 m to 21.95 m below grade, corresponding to approximately Elevations 308.93 m to 303.84 m. Standard penetration testing and sampling were completed at regular intervals in all boreholes. Groundwater conditions were observed in open boreholes during drilling and monitoring wells were installed in all boreholes. The locations of the boreholes are shown on the topographic plan included in Appendix B.

The subsurface stratigraphy encountered in the boreholes generally consisted of:

- Topsoil (150 mm to 300 mm thick); underlain by,
- Fill comprising very loose to compact sandy silt, sand and silt/firm to hard silty clay to depths ranging from approximately 1.1 m to 4.11 m below grade (corresponding to approximately elevation 328.37 m to 319.65 m); underlain by,
- Compact to very dense silty sand, sand, sand and gravel, sandy gravel and silt; underlain by/interbedded with,
- Stiff to hard clayey silt to silty clay till /very dense silty sand to sandy silt till.

The native cohesionless strata typically contained various but minor amounts of fines and cobbles/boulders. The cohesive till strata were low plasticity and, where tested, had natural moisture contents close to their Plastic Limits.

Groundwater level was observed at depths ranging from approximately 10 m to 18.3 m below grade in open boreholes. Groundwater level was measured at depths ranging from approximately 10 m to 17.7 m below grade, corresponding to elevations raging from approximately 313.1 m to 310 m.

The Borehole Records are included in Appendix C for reference.

3.3 Geotechnical Investigation and Baseline Groundwater Monitoring Program (Golder, 2011)

Golder completed a geotechnical investigation and groundwater monitoring program in support of a Site grading/alteration Permit for the northwest portion of the Site in 2011 and provided the results in the following report:

Geotechnical Investigation and Baseline Groundwater Monitoring Program
5783 Bloomington Road East ("Battistella: Lands, Part of Lot 10 , Concession 8)
Between Highway 48 and Ninth Line
Whitchurch-Stouffville, Ontario

Submitted to
Camrock Development Corporation
Dated February 24, 2011

The investigation consisted of a total of five (5) boreholes (BH1 and BH2, MW31 to MW5), advanced to depths ranging from approximately 7.9 m to 11.1 m below grade, corresponding to approximately Elevations 317.9 m to 309.7 m, as well as eight (8) shallow test pits. Standard penetration testing and sampling were completed at regular intervals in all boreholes. Groundwater conditions were observed in open boreholes during drilling and monitoring wells were installed in three (3) of the boreholes. The locations of the boreholes are shown on the plan included in Appendix B.

The subsurface stratigraphy encountered in the boreholes generally consisted of:

- Topsoil (130 mm to 350 mm thick); underlain by,
- Fill comprising very loose to compact sandy silt to silty sandy/firm to stiff clayey silt to depths ranging from approximately 1.9 m to 6.4 m below grade (corresponding to approximately elevation 321.1 m to 315.6 m); underlain by,
- Loose to very dense silty sand, sand and gravel, sandy silt and silt; underlain by/interbedded with,
- Dense sandy silt till/very stiff to hard clayey silt till.

Four (4) of the boreholes were dry upon completion of drilling. Groundwater level was observed at a depth of approximately 9.8 m below grade in open borehole in MW4. MW3 was dry and groundwater level was measured at depths of approximately 8.1 m and 4.8 m below grade, corresponding to approximately elevations 312.4 m to 320.2 m in MW4 and MW5, respectively.

The Borehole Records are included in Appendix C for reference.

3.4 Additional Groundwater Level measurements

Stantec environmental team measured the groundwater levels in the monitoring wells installed by Golder on July 17, 2024. A summary of the measurements and additional comments are provided in below table. The groundwater levels measured by Golder have also been included for reference.

Table 1 – Groundwater Levels in Monitoring Wells

	Stantec, July 2024			Golder, May 2012	
Monitoring Well ID	**Groundwater Depth (m below grade)**	**Groundwater Elevation (m)**	**Comments**	**Groundwater Depth (m below grade)**	**Groundwater Elevation (m)**
MW201	17.64	313.24	Well in good condition	17.74	313.14
MW202	N/A	N/A	Blockage at 0.96 m. Well pipe likely damaged	10.66	313.1
MW203	10.05	311.51	Well in good condition.	9.96	311.6
MW204	N/A	N/A	Well could not be located	10.40	310.55
MW205	15.47	310.16	Well in good condition	15.59	310.04

4 FILL PLACEMENT RECOMMENDATIONS

It is understood that fills up to 20 m will be required in some areas to bring the Site to near the elevations of the surrounding lands for future agricultural use. Based on the information received from the Client, it is understood that the fill placement will follow the “Layered-Cake” approach provided in document titled “Best Management Practices for Aggregate Pit and Quarry Rehabilitation in Ontario” prepared by Ontario Society of Professional Engineers and dated March 2021.

Based on the results of the geotechnical investigations, there are not anticipated to be any major constraints for placement of the proposed fill for agricultural use. However, it is noted that placement of the fill as described below will preclude any future development (residential, commercial, etc.) for the fill areas. Any limited development within the fill areas would require detailed subsurface investigations, geotechnical and hydrogeological assessment and likely ground improvement methods.

From a geotechnical perspective, the existing subsurface soils can support fill materials up to 20 meters thick for backfilling the existing ponds. Self-weight settlements and long-term settlements are expected, but these may not pose significant concerns for future agricultural use and can be mitigated by additional fill (overfilling) during the final grading stage. For agricultural use where settlement is not a concern, the approved fill can be placed in lifts and nominally compacted, which typically results in compaction to 90 - 92% of the material’s Standard Proctor Maximum Dry Density (SPMDD). Increasing the compaction to 95% of the material’s SPMDD can reduce the magnitude of settlement. The specifications and compaction level for the surficial soil used for agriculture are not addressed here.

Reference: Summary of Geotechnical Conditions and Fill Placement Recommendations, 5783 Bloomington Road, Town of Whitchurch-Stouffville, ON

Should imported fill materials be required for this purpose, it is recommended that materials with characteristics similar to the granular soils on site (silty sand and sandy silt as described in this report) be imported. Typically, where the fine content of a soil is in excess of 30%, the soil will tend to soften and become unsuitable and difficult to work with when it becomes wetter than its optimum moisture content and is disturbed. Any imported materials must be approved by qualified geotechnical personnel at the source(s), prior to hauling to the site.

If the water depth in the existing ponds is shallow (less than 0.5 m depth), consideration can be given to spreading a sufficient thickness of granular fill at the initial stage to provide a safe working platform for the construction equipment. Depending on the depth of water in the ponds, some water removal may be required to facilitate the fill placement. It is noted that under the current MECP regulations, a Permit to Take Water is required for dewatering applications that require removals exceeding 400,000 L/day.

All soil materials for use as fill must be approved by qualified geotechnical personnel prior to placement. Some drying may be required prior to placement during periods of wet weather. No frozen soil materials should be included as fill. The placement of fill should be monitored by qualified geotechnical personnel on a full-time basis.

All fill materials imported to the site must meet all applicable municipal, provincial, and federal guidelines and requirements associated with environmental characterization of the materials.

The program for grading and earthworks should be designed in advance, and carefully executed in consideration of the time of year, prevailing weather conditions, construction storm-water management control, and associated issues and concerns, and the intended end-use of the site as described herein.

Reference: **Summary of Geotechnical Conditions and Fill Placement Recommendations, 5783 Bloomington Road, Town of Whitchurch-Stouffville, ON**

5 CLOSURE

We trust that this memorandum is satisfactory for your present purposes. Should you have any questions, please do not hesitate to contact the undersigned.

Regards,

STANTEC CONSULTING LTD.

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Team Lead, Geotechnical Engineering
Mollie.bownessmiles@stantec.com

Attachment: Statement of General Conditions
Site Location
Topographic Plan and 2012 Golder Borehole Location Plan
2011 Golder Borehole Location Plan
2012 Golder Borehole Records
2011 Golder Borehole Records

STATEMENT OF GENERAL CONDITIONS

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Stantec Consulting Ltd. and the Client. Any use which a third party makes of this report is the responsibility of such third party.

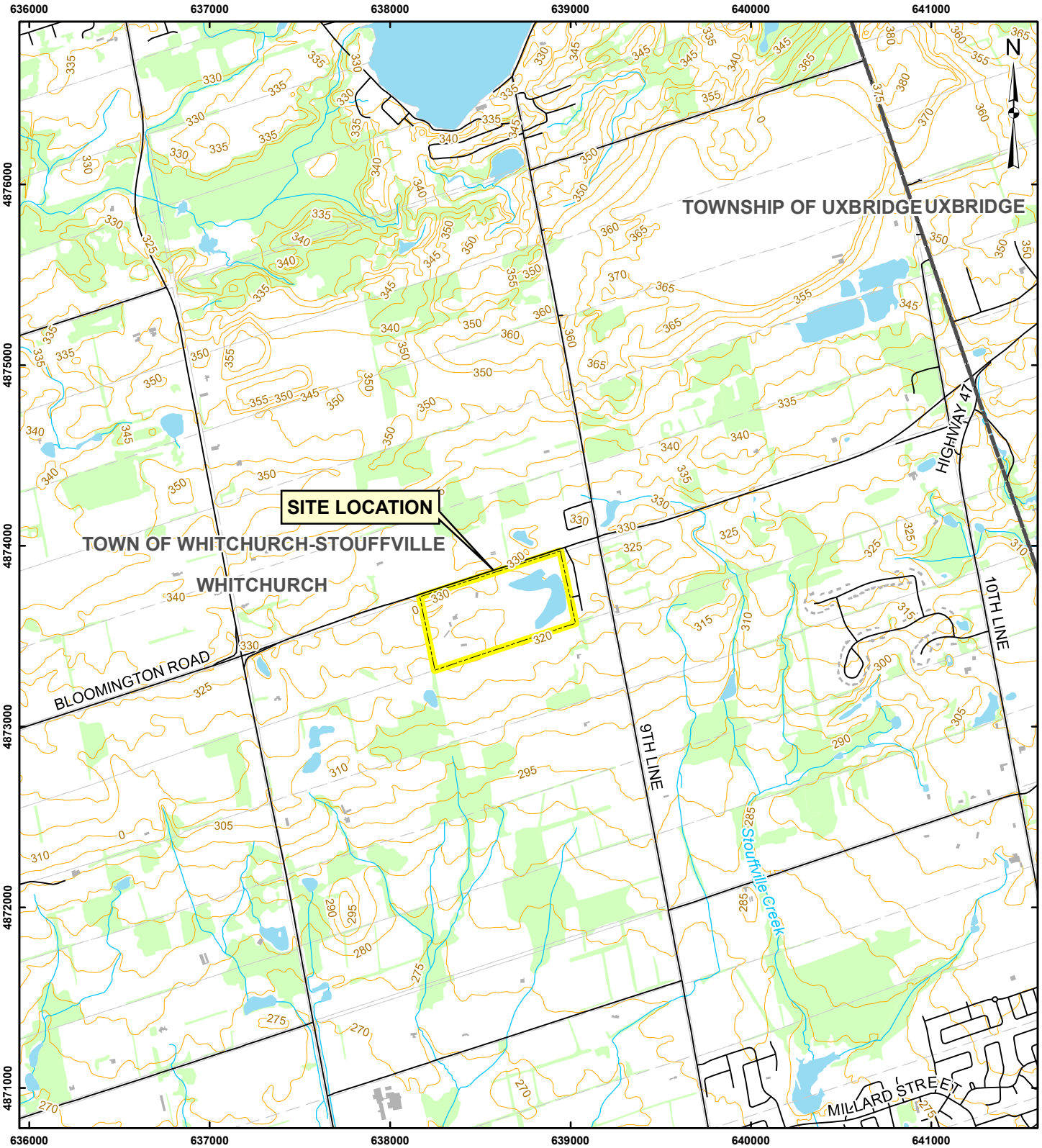
BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Stantec Consulting Ltd.'s present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Stantec Consulting Ltd. is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Stantec Consulting Ltd. at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec Consulting Ltd. must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Stantec Consulting Ltd. will not be responsible to any party for damages incurred as a result of failing to notify Stantec Consulting Ltd. that differing site or sub-surface conditions are present upon becoming aware of such conditions.

PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Stantec Consulting Ltd., sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Stantec Consulting Ltd. cannot be responsible for site work carried out without being present.



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SCALE 1:25,000 METRES

PROJECT
GEOTECHNICAL INVESTIGATION
SOUTH OF BLOOMINGTON ROAD EAST,
BETWEEN HIGHWAY 48 AND NINTH LINE
WHITCHURCH-STOUFFVILLE, ONTARIO

TITLE
KEY PLAN

REFERENCE

Base Data - MNR NRVIS, obtained 2004
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2008
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 17N

Golder Associates
Whitby, Ontario

PROJECT NO. 12-1111-0008		SCALE AS SHOWN	REV. 0.0
DESIGN			
GIS	JT	MAY 2012	FIGURE 1
CHECK	AM	June 2012	
REVIEW			

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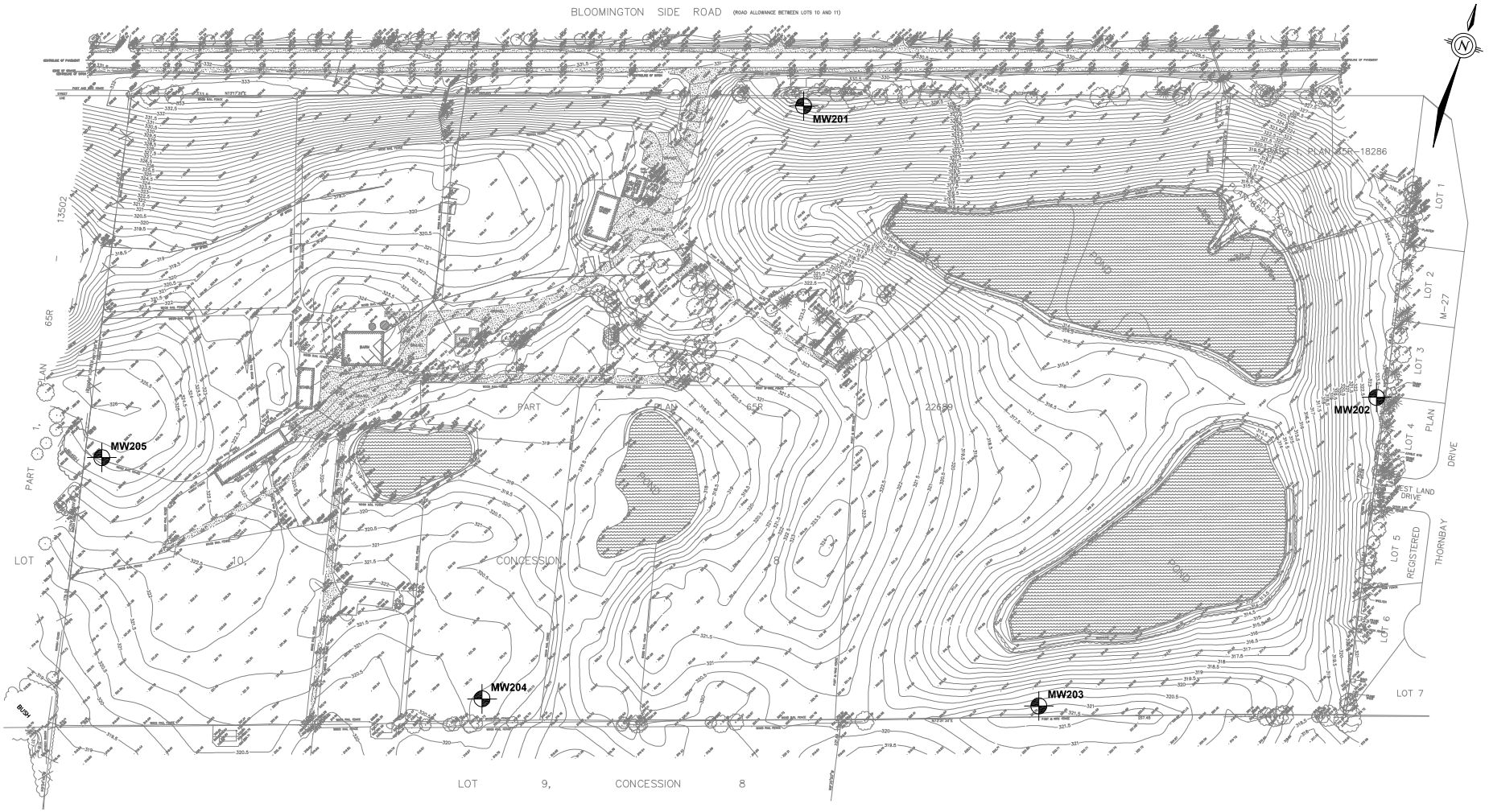


LEGEND

BOREHOLE LOCATION IN PLAN

REFERENCE

Base plan provided by Guido Papa Surveying Ltd., entitled "Part of Lots 9 and 10 Concession 8 Town of Whitchurch-Stouffville", Dated April 10, 2012.

PROJECT

GEOTECHNICAL INVESTIGATION
SOUTH OF BLOOMINGTON ROAD EAST,
BETWEEN HIGHWAY 48 AND NINTH LINE
WHITCHURCH-STOUFFVILLE, ONTARIO

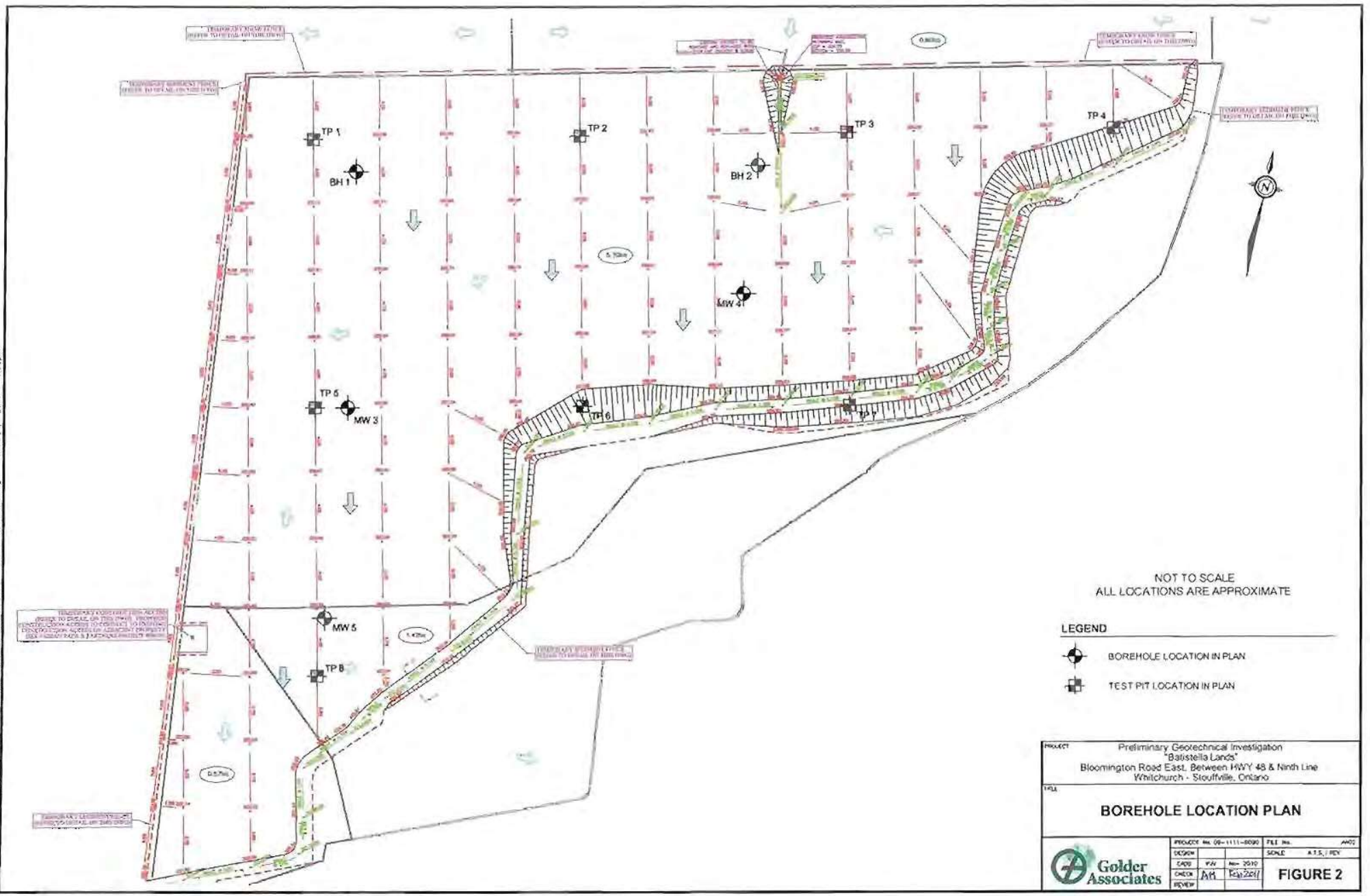
TITLE

BOREHOLE LOCATION PLAN

Golder Associates

PROJECT No. 12-1111-0008			FILE No. AA02
DESIGN			SCALE AS SHOWN REV. 0
CADD	MK	May 2012	FIGURE 2
CHECK	AM	June 2012	
REVIEW			

Drawing file: T:\Projects\2012\12-1111-0008\-AA-\12111100008AA02.dwg Jun 14, 2012 - 4:10pm



PROJECT: Preliminary Geotechnical Investigation
"Balistella Lands"
Bloomington Road East, Between HWY 48 & Ninth Line
Whitchurch - Stouffville, Ontario

TITLE: **BOREHOLE LOCATION PLAN**

Golder Associates

PROJECT No. 09-1111-6090 | FILE No. | AMO
DESIGN | SCALE: N.T.S. / REV
DRAFT: KW Nov 2010
CHECK: AM Feb 2011
REVIEW

FIGURE 2

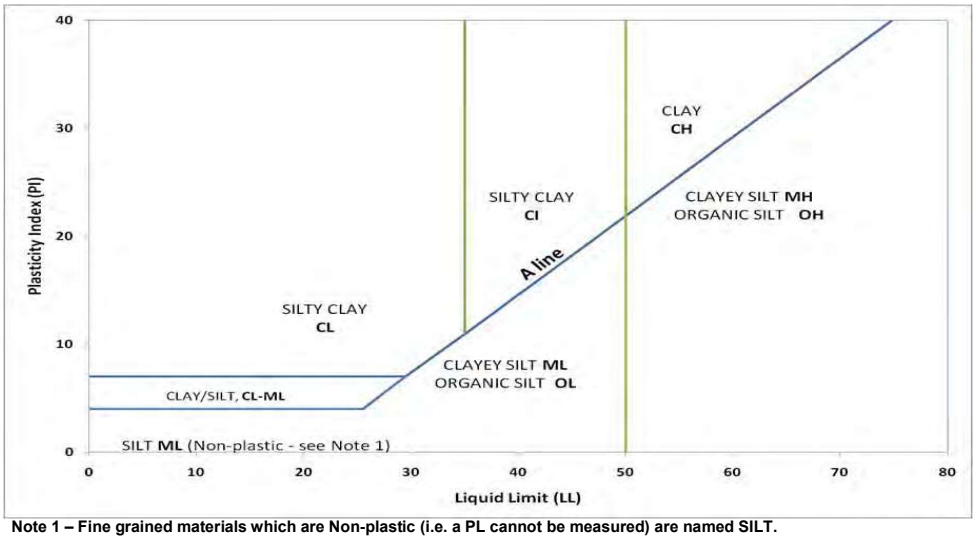
Drawing File: R:\CAD_PROJECTS\2009\09-1111-6090 (Balistella Lands)\~AM~\09111160904A02.dwg Feb 24, 2011 - 1:58pm

METHOD OF SOIL CLASSIFICATION

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 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 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	Group Name
				Dilatancy	Dry Strength	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 (PI and LL plot below A-Line on Plasticity Chart)	Liquid Limit <50	Rapid	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT
				Slow	None to Low	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT
				Slow to very slow	Low to medium	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
			Liquid Limit >50	Slow to very slow	Low to medium	3mm to 6 mm	Low to medium	<5%	MH	CLAYEY SILT
				None	Medium to High	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)	Liquid Limit <35	None	Low to medium	~ 3 mm	Low to medium	0% to 30%	CL	SILTY CLAY
			Liquid Limit 35 to 50	None	Medium to High	1 mm to 3 mm	Medium		CI	SILTY CLAY
			Liquid Limit >50	None	High	<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%		PEAT

PLASTICITY CHART



Note 1 – Fine grained materials which are Non-plastic (i.e. a PL cannot be measured) are named SILT.

Dual Symbol — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC, CL-ML used when the soil has between 5 and 12% fines (*i.e.* between "clean" sand and "dirty" sand) or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart.

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

SYMBOLS AND TERMS USED ON RECORDS OF BOREHOLES 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
≤ 5	trace
5 to 12	some
12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
>35	Use 'and' to combine major constituents (*i.e.,* SAND and GRAVEL, SAND and CLAY)

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.) drive open sampler for a distance of 300 mm (12 in.).

Piezo-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; 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
SS	Split-spoon
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

SOIL TESTS

w	water content
PL	plastic limit
LL	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

Note: [1] Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness

Term	SPT 'N' (blows/0.3m) *
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 D 1586, uncorrected for overburden pressure effects or energy transfer.
2. Definition of compactness descriptions based on SPT 'N' ranges from Terzaghi and Peck (1967) and correspond to typical average N_{60} values.

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' (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 D 1586, uncorrected for overburden pressure effects or energy transfer.

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.

PROJECT: 12-1111-0008

RECORD OF BOREHOLE: MW201

SHEET 1 OF 3

LOCATION: SEE FIGURE 2

BORING DATE: April 13, 2012

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	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}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		330.88							
0	TRACK-MOUNTED POWER AUGER 200 mm Diameter Hollow Stem Auger	TOPSOIL (FILL)		0.00							
		(ML) sandy SILT, trace gravel, trace roots; brown (FILL); moist, compact		0.15	1	50 DO	11				Concrete and Casing
1				329.81							
		(SM/ML) SAND and SILT, trace gravel; brown (PROBABLY FILL); moist, compact		1.07	2	50 DO	12				
2				328.37							
		(SM) SILTY SAND, trace gravel, zones of fine to medium sand; moist, dense		2.51	3	50 DO	40				
3											
4				326.08							
		(SW) SAND, fine to medium, trace gravel, trace to some fines; brown; moist, dense		4.80							Bentonite Seal
5					4	50 DO	44				
6											
7											
8											
9					5	50 DO	31				
10		*CONTINUED NEXT PAGE*									

GTA-BHS 001 1211110008.GPJ GAL-MIS.GDT 6/14/12

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AZ

CHECKED: AH

PROJECT: 12-1111-0008

RECORD OF BOREHOLE: MW201

SHEET 2 OF 3

LOCATION: SEE FIGURE 2

BORING DATE: April 13, 2012

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	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}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	TRACK-MOUNTED POWER AUGER 200 mm Diameter Hollow Stem Auger	(SW) SAND, fine to medium, trace gravel, trace to some fines; brown; moist, dense		319.91							
11		(SW/GW) SAND and GRAVEL, trace to some fines; brown, cobbles/ boulders; moist, very dense		10.97							
12					6	50 DO	53/ .15				
13											
14											Bentonite Seal
15					7	50 DO	50/ .1				
16											
17		(SW) SAND, medium to coarse, trace gravel, trace to some fines; brown; wet, very dense		314.12 16.76							
18											May 8, 2012
19					8	50 DO	76				Silica Sand Filter
20		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AZ

CHECKED: AH

GTA-BHS 001 1211110008.GPJ GAL-MIS.GDT 6/14/12

PROJECT: 12-1111-0008

RECORD OF BOREHOLE: MW201

SHEET 3 OF 3

LOCATION: SEE FIGURE 2

BORING DATE: April 13, 2012

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	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}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
20		*--- CONTINUED FROM PREVIOUS PAGE ---*									
20	TRACK-MOUNTED POWER AUGER 200 mm Diameter Hollow Stem Auger	(ML) SILT, trace fine sand; grey; wet, compact to dense		329.84 20.84							Silica Sand Filter
21											
					9	50 DO	30				
22				308.93							
		END OF BOREHOLE		21.95							Water encountered during drilling at a depth of 18.3 m below ground surface, Apr. 13/12 Water level in monitoring well at a depth of 17.74 m below ground surface, May 8/12
23											
24											
25											
26											
27											
28											
29											
30											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AZ

CHECKED: AH

GTA-BHS 001 1211110008.GPJ GAL-MIS.GDT 6/14/12

PROJECT: 12-1111-0008

RECORD OF BOREHOLE: MW202

SHEET 1 OF 2

LOCATION: SEE FIGURE 2

BORING DATE: April 13, 2012

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	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}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		323.76							
0	TRACK-MOUNTED POWER AUGER 200 mm Diameter Hollow Stem Auger	TOPSOIL (FILL)		0.00 / 323.58							
		(SM) SILTY SAND, trace gravel; dark brown to brown (FILL); moist, loose		0.18	1	50 DO	9				
1				322.69							
		(CL) SILTY CLAY, low plasticity, some sand, trace to some gravel; brown (PROBABLY FILL); Wn>PL, hard to firm		1.07							
2					2	50 DO	31				
3					3	50 DO	7				
4				319.65							Bentonite Seal
		(CL) SILTY CLAY, low plasticity, some sand, trace to some gravel; brown (TILL); Wn~PL to Wn<PL, very stiff to hard		4.11	4	50 DO	18				
5											
6		Stone obstruction at a depth of 6.22 m below ground surface			5	50 DO	50/ .13				
7											
8				315.63							
		(SW/GW) SAND and GRAVEL, trace to some fines; cobbles/ boulders; moist, very dense		8.13							
9					6	50 DO	50/ .13				Silica Sand Filter
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AM

CHECKED: AH

GTA-BHS 001 1211110008.GPJ GAL-MIS.GDT 6/14/12

PROJECT: 12-1111-0008

RECORD OF BOREHOLE: MW202

SHEET 2 OF 2

LOCATION: SEE FIGURE 2

BORING DATE: April 13, 2012

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	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}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10	TRACK-MOUNTED POWER AUGER 200 mm Diameter Hollow Stem Auger	*--- CONTINUED FROM PREVIOUS PAGE ---*									
		(SW/GW) SAND and GRAVEL, trace to some fines; cobbles/ boulders; moist, very dense		312.79							May 8, 2012
11		(ML) sandy SILT, some gravel; brown, cobbles/ boulders (TILL); moist		10.97							Silica Sand Filter
12					7	AS	-		○		
13											
											Cave
14		(SW/GW) SAND and GRAVEL, trace to some fines; brown, containing cobbles and boulders; wet, very dense		309.74 14.02							
15											
				308.47	8	50 DO	50/ .05		○		
		END OF BOREHOLE		15.29							
16											Water encountered during drilling at a depth of 13.7 m below ground surface, Apr. 13/12
17											Water level measured in open borehole at a depth of 10.7 m below ground surface upon completion of drilling, Apr. 13/12
18											Water level in monitoring well at a depth of 10.66 m below ground surface, May 8/12
19											
20											

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DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AM

CHECKED: AH

PROJECT: 12-1111-0008

RECORD OF BOREHOLE: MW203

SHEET 1 OF 2

LOCATION: SEE FIGURE 2

BORING DATE: April 13, 2012

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	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}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		321.56							
0	TRACK-MOUNTED POWER AUGER 200 mm Diameter Hollow Stem Auger	TOPSOIL (FILL)		0.00 / 321.26	1	50 DO	13				
		(ML) sandy SILT, trace to some gravel; dark brown to brown, organic inclusions (FILL); moist, compact		0.30 / 320.49							
1		(CL) SILTY CLAY, low plasticity, some sand, some gravel; brown (PROBABLY FILL); Wn~PL, stiff		1.07 / 318.97	2	50 DO	11				
2		(CL) SILTY CLAY, low plasticity, some sand, trace gravel; brown (TILL); Wn~PL, hard		2.59 / 317.45	3	50 DO	32				
3		(SM) SILTY SAND, some gravel, zones of sand and gravel; brown; moist, compact		4.11 / 315.16	4	50 DO	26				Bentonite Seal
4		(SW/GW) SAND and GRAVEL, trace to some fines; brown, cobbles/ boulders; moist, very dense		6.40 / 312.11	5	50 DO	50/ .1				
5		(GW) sandy GRAVEL, trace to some fines; brown, cobbles/ boulders; wet, very dense		9.45							Silica Sand Filter
6		*CONTINUED NEXT PAGE*									
7											
8											
9											
10											

DEPTH SCALE

1 : 50

LOGGED: AM

CHECKED: AH

Golder Associates

GTA-BHS 001 1211110008.GPJ GAL-MIS.GDT 6/14/12

PROJECT: 12-1111-0008

RECORD OF BOREHOLE: MW203

SHEET 2 OF 2

LOCATION: SEE FIGURE 2

BORING DATE: April 13, 2012

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	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}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10		*--- CONTINUED FROM PREVIOUS PAGE ---*									
10	TRACK-MOUNTED POWER AUGER 200 mm Diameter Hollow Stem Auger	(GW) sandy GRAVEL, trace to some fines; brown, cobbles/ boulders; wet, very dense									May 8, 2012
11					6	50 DO	50/ .13				Silica Sand Filter
12											
13											Cave
				307.64	7	50 DO	50/ .05				
14		END OF BOREHOLE		13.92							Water encountered during drilling at a depth of 10.4 m below ground surface, Apr. 13/13
15											Water level measured in open portion of the borehole at a depth of 10.1 m below ground surface upon completion of drilling, Apr. 13/13
16											Borehole caved at a depth of 12.5 m below ground surface upon completion of driling, Apr. 13/13
17											Water level in monitoring well at a depth of 9.96 m below ground surface, May 8/12
18											
19											
20											

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DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AM

CHECKED: AH

PROJECT: 12-1111-0008

RECORD OF BOREHOLE: MW204

SHEET 1 OF 2

LOCATION: SEE FIGURE 2

BORING DATE: April 13, 2012

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	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}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		320.95							
0	TRACK-MOUNTED POWER AUGER; 200 mm Diameter Hollow Stem Auger	TOPSOIL (FILL)		0.00 / 320.70							
		(ML) sandy SILT, trace gravel; dark brown to brown (FILL); moist, loose		0.25 / 319.88	1	50 DO	9				
1		(CL) SILTY CLAY, low plasticity, some sand, trace to some gravel, zones of silty sand; brown (TILL); moist, very stiff to hard		1.07	2	50 DO	19				
2											
3					3A	50 DO	33				
					3B						
4					4A						
5		(SM) SILTY SAND, some gravel; brown (TILL); moist, very dense		315.92 / 5.03	4B	50 DO	53				Bentonite Seal
6				314.55							
		(SW/GW) SAND and GRAVEL, trace to some fines; brown, cobbles and boulders; moist to wet, very dense		6.40							
7											
8					5	50 DO	50/.15				
9											
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AM

CHECKED: AH

GTA-BHS 001 1211110008.GPJ GAL-MIS.GDT 6/14/12

PROJECT: 12-1111-0008

RECORD OF BOREHOLE: MW204

SHEET 2 OF 2

LOCATION: SEE FIGURE 2

BORING DATE: April 13, 2012

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	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}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10		*--- CONTINUED FROM PREVIOUS PAGE ---*									
10	TRACK-MOUNTED POWER AUGER 200 mm Diameter Hollow Stem Auger	(SW/GW) SAND and GRAVEL, trace to some fines; brown, cobbles and boulders; moist to wet, very dense			6	50 DO	50/ .13				May 8, 2012 ▽
11											
12											Silica Sand Filter
13											
14				306.93	7	50 DO	50/ .13				
14		END OF BOREHOLE		14.02							Water encountered during drilling at a depth of 10.1 m below gorund surface, Apr. 13/12 Water level measured in open borehole at a depth of 10.7 m below ground surface upon completion of drilling, Apr. 13/12 Water level in monitoring well at a depth of 10.40 m below ground surface, May 8/12
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AM

CHECKED: AH

GTA-BHS 001 1211110008.GPJ GAL-MIS.GDT 6/14/12

PROJECT: 12-1111-0008

RECORD OF BOREHOLE: MW205

SHEET 1 OF 3

LOCATION: SEE FIGURE 2

BORING DATE: April 13, 2012

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	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}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		325.63							
0	TRACK-MOUNTED POWER AUGER 200 mm Diameter Hollow Stem Auger	TOPSOIL (FILL)		0.00							
		(ML) sandy SILT, trace gravel, trace roots, topsoil pockets; brown (FILL); moist, very loose to compact		0.15	1	50 DO	13				Concrete and Casing
1											
2					2	50 DO	4				
3					3	50 DO	12				
4				321.52							
		(ML) CLAYEY SILT, some sand, trace gravel; brown (TILL); cohesive, W~PL, stiff to very stiff		4.11	4	50 DO	15				Bentonite Seal
5											
6				319.23							
		(CL) SILTY CLAY, some sand, trace to some gravel; grey (TILL); cohesive, W>PL, stiff to very stiff		6.40							
7											
8					5	50 DO	15				
9											
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AZ

CHECKED: AH

GTA-BHS 001 1211110008.GPJ GAL-MIS.GDT 6/14/12

PROJECT: 12-1111-0008

RECORD OF BOREHOLE: MW205

SHEET 2 OF 3

LOCATION: SEE FIGURE 2

BORING DATE: April 13, 2012

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	TRACK-MOUNTED POWER AUGER 200 mm Diameter Hollow Stem Auger	(CL) SILTY CLAY, some sand, trace to some gravel; grey (TILL); cohesive, W>PL, stiff to very stiff									
11					6	50 DO	21				
12											
13				312.52							
		(SM) SILTY SAND, zones of silt; brown; wet, dense to very dense		13.11							Bentonite Seal
14					7	50 DO	44				
15											
16					8	50 DO	56				May 8, 2012
17				308.64							
		(SP) SAND, fine, trace to some fines; brown; wet, very dense to compact		16.99							
18											
					9	50 DO	66				
19											Silica Sand Filter
20		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

LOGGED: AZ

CHECKED: AH

Golder Associates

GTA-BHS 001 1211110008.GPJ GAL-MIS.GDT 6/14/12

PROJECT: 12-1111-0008

RECORD OF BOREHOLE: MW205

SHEET 3 OF 3

LOCATION: SEE FIGURE 2

BORING DATE: April 13, 2012

DATUM: Geodetic

HAMMER TYPE: AUTOMATIC

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	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}) / WATER CONTENT PERCENT (Wp W Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
20		*--- CONTINUED FROM PREVIOUS PAGE ---*									
	TRACK-MOUNTED POWER AUGER / 200 mm Diameter Hollow Stem Auger	(SP) SAND, fine, trace to some fines; brown; wet, very dense to compact		303.84	10	50 DO	26		W		Silica Sand Filter
21		END OF BORHOLE		21.79							Water level in monitoring well at a depth of 15.59 m below ground surface, May 8/12
22											
23											
24											
25											
26											
27											
28											
29											
30											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AZ

CHECKED: AH

GTA-BHS 001 1211110008.GPJ GAL-MIS.GDT 6/14/12

LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

II. 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.) drive open sampler for a distance of 300 mm (12 in.).

Dynamic Penetration Resistance; 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

Piezo-Cone Penetration Test (CPT):
An electronic cone penetrometer with a 60° conical tip and a projected 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 (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Cohesionless Soils

Density Index (Relative Density)	N Blows/300 mm or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

Consistency	c_u, s_u kPa	c_u, s_u psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

IV. SOIL TESTS

w	water content
w_p	plastic limit
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, G_S)
DS	direct shear test
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	field vane test (LV-laboratory vane test)
γ	unit weight

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

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
F factor of safety
V volume
W weight

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
ν Poisson's ratio
σ total stress
σ' effective stress ($\sigma' = \sigma - u$)
σ'_{vo} initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$ principal stresses (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 x acceleration due to gravity)

(a) Index Properties (con't.)

w water content
w_l liquid limit
w_p plastic limit
I_P 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)

(c) 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

(d) Consolidation (one-dimensional)

C_c compression index (normally consolidated range)
C_r recompression index (overconsolidated range)
C_S swelling index
C_α coefficient of secondary consolidation
m_v coefficient of volume change
c_v coefficient of consolidation
T_v time factor (vertical direction)
U degree of consolidation
σ'_p pre-consolidation pressure
OCR Overconsolidation ratio $= \sigma'_p / \sigma'_{vo}$

(e) 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: 09-1111-6090

RECORD OF BOREHOLE BH 1

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: November 29, 2010

DATUM:

SAMPLER HAMMER, 63.5kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. ⊕ - ⊕ rem V. ⊕ U - ⊖) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-4} 10^{-5} 10^{-6} 10^{-7})	WATER CONTENT PERCENT (Wp ⊢ ○ W ⊣ Wl) (10 20 30 40)	ADDITIONAL LAB TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		327.50										
		TOPSOIL		0.00	1A	50 DO	7					○		
		Loose to compact brown sandy silt to silty sand, trace to some clay, trace to some gravel, trace organics, trace wood pieces (FILL)		0.20	1B	50 DO		327				○		
1					2	50 DO	22					○		
								326						
					3	50 DO	15					○		
2														
					4	50 DO	19	325				○		
3														
					5	50 DO	12					○		
								324						
4														
								323						
5					6	50 DO	12					○		
								322						
6														
					7A	50 DO	19					○		
		Compact brown and grey mottled SANDY SILT, some clay, trace gravel (TILL)		321.10 6.40	7B			321						
7														
		Dense brown SILTY FINE SAND, trace gravel		320.34 7.16										
					8	50 DO	33	320				○		
8														
				318.81				319						
		Very dense brown SILT, trace fine sand, trace clay		8.69										
9					9	50 DO	50/ 13	318				○		
				317.90										
		END OF BOREHOLE		9.60										Borehole dry and open upon completion of drilling, Nov 29/10
10														

TRACK MOUNTED POWER AUGER
110 mm Diameter Solid Stem Auger

LDN_BHS 09-1111-6090.GPJ GLDR_LDN.GDT 24/2/11 DATA NPJT JT 12/20/10

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM

CHECKED: AM

PROJECT: 09-1111-6090

RECORD OF BOREHOLE BH 2

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: November 29, 2010

DATUM:

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (20 40 60 80); anl V. + Q - ⊗ rem V. ⊙ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	TRACK MOUNTED POWER AUGER 110 mm Diameter Solid Stem Auger	GROUND SURFACE		321.50								
		TOPSOIL		0.00	1A	SS	6			○		
				321.19								
		Compact to very loose brown to grey silty sand to sandy silt, trace to some clay, trace to some gravel (FILL)		0.31	1B	DO		321		○		
1					2	DO	14			○		
								320				
					3	DO	8			○		
2												
					4	DO	4	319				
				318.60								
3		Firm to stiff grey clayey silt, trace to some sand, trace to some gravel, trace wood pieces (FILL)		2.90	5	DO	5			○		
								318				
4												
								317				
					6	DO	9			⊖		
5												
				316.01				316				
		Compact brown SILTY FINE SAND, trace clay, trace gravel		5.49								
6												
					7	DO	17			○		
								315				
				314.50								
7		Very dense brown SAND and GRAVEL, trace silt		7.00								
								314				
					8	DO	52			○		
				313.58								
8		END OF BOREHOLE		7.92								Borehole dry and open upon completion of drilling, Nov. 29/10
9												
10												

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AM

CHECKED: AM

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PROJECT: 09-1111-6090

RECORD OF BOREHOLE MW 3

SHEET 1 OF 2

LOCATION: SEE FIGURE 2

BORING DATE: November 29, 2010

DATUM:

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m; SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕)	HYDRAULIC CONDUCTIVITY, k, cm/s; WATER CONTENT PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		321.30								
		TOPSOIL		0.00 / 321.07	1A	50 DO	9	321				
		Loose brown sandy silt, trace to some clay, trace to some gravel, topsoil inclusions (FILL)		0.23	1B							50 mm Diameter Monitoring Well
1					2	50 DO	6					
								320				
					3A	50 DO	7					
2				319.37	3B	50 DO						
		Loose to very dense brown SILTY FINE SAND to FINE SANDY SILT		1.93				319				
					4	50 DO	34					
3												Bentonite Seal
					5	50 DO	45	318				
4												
								317				
					6	50 DO	54					
5												
								316				
6												
					7	50 DO	50/ .13	315				
7				314.29								
		Very dense brown SILT, trace to some fine sand, trace clay, zones of fine sand		7.01				314				
					8	50 DO	50/ .13					Silica Sand Filter
8												
								313				
9												
					9	50 DO	61	312			MH	
10				311.30								
		--- CONTINUED NEXT PAGE ---										

TRACK MOUNTED POWER AUGER
110 mm Diameter Solid Stem Auger

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM

CHECKED: AM

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PROJECT: 09-1111-6090

RECORD OF BOREHOLE MW 3

SHEET 2 OF 2

LOCATION: SEE FIGURE 2

BORING DATE: November 29, 2010

DATUM:

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. ⊕ rem V. ⊖	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-4} 10^{-5} 10^{-6} 10^{-7}) / WATER CONTENT PERCENT Wp, W, Wl (10 20 30 40)	ADDITIONAL LAB TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---										
10		Very dense brown SILTY FINE SAND		10.00				311				
11				310.17	10	50 DO	63			O		
		END OF BOREHOLE		11.13								Borehole dry upon completion of drilling Borehole caved in to a depth of 9.5 m below ground surface upon completion of drilling, Nov. 29/10 Monitoring well was dry, Dec. 15/10
12												
13												
14												
15												
16												
17												
18												
19												
20												

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM
CHECKED: AM

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PROJECT: 09-1111-6090

RECORD OF BOREHOLE MW 4

SHEET 1 OF 2

LOCATION: SEE FIGURE 2

BORING DATE: November 29, 2010

DATUM:

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (20 40 60 80); nat V. + Q - ●; rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp, W, Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0		GROUND SURFACE		320.50								
		TOPSOIL		0.00	1A	50 DO	19					
				320.17				320				50 mm Diameter Monitoring Well
		Compact to very loose brown to grey silty sand to sandy silt, trace to some clay, trace gravel (FILL)		0.33	1B							
1					2	50 DO	15					
								319				
					3	50 DO	6					
2												
					4	50 DO	2	318				
3												
					5	50 DO	21					
								317				Bentonite Seal
4												
								316				
				315.62	6A	50 DO	17					
5	TRACK MOUNTED POWER AUGER 110 mm Diameter Solid Stem Auger	Compact brown FINE SANDY SILT, trace clay		4.88	6B							
				314.86				315				
		Very dense brown SAND and GRAVEL, trace silt		5.64								
6					7	50 DO	53					
								314				
				313.49								
7		Dense brown SILTY FINE SAND, trace gravel		7.01								
					8	50 DO	39	313			MH	
8												
								312				
				311.81								
		Very dense brown SILT, trace to some fine sand, trace clay		8.69								Silica Sand Filter
9					9	50 DO	50/ .13					
								311				
10		--- CONTINUED NEXT PAGE ---										

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM
CHECKED: AM

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PROJECT: 09-1111-6090

RECORD OF BOREHOLE MW 4

SHEET 2 OF 2

LOCATION: SEE FIGURE 2

BORING DATE: November 29, 2010

DATUM:

SAMPLER HAMMER 63.5kg, DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	ELEVATION	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}) / WATER CONTENT PERCENT Wp — W — Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
10		*--- CONTINUED FROM PREVIOUS PAGE ---*										
		Very dense brown SILT, trace to some fine sand, trace clay						310				Silica Sand Filter
				309.70	10	SS	50/ .13					
		END OF BOREHOLE		10.80								Water level in open borehole at a depth of 9.8 m below ground surface upon completion of drilling, Nov. 29/10 Water level measured at 8.08 m depth below ground surface, Dec. 15/10
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM

CHECKED: AM

LDN_BHS 09-1111-6090.GPJ GLDR_LDN.GDT 24/2/11 DATA INPUT: JT 12/2010

PROJECT: 09-1111-6090

RECORD OF BOREHOLE MW 5

SHEET 1 OF 2

LOCATION: SEE FIGURE 2

BORING DATE: November 29, 2010

DATUM

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg, DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	ELEVATION	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}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
0	TRACK MOUNTED POWER AUGER 110 mm Diameter Solid Stem Auger	GROUND SURFACE		325.00				325				
		TOPSOIL		0.00 / 324.75	1A							
		Loose to compact brown sandy silt, some clay, trace gravel, cobbles (FILL)		0.25	1B	SS DO	5					50 mm Diameter Monitoring Well
1					2	SS DO	6	324				
		Sampler encountered cobble			3	SS DO	50/ .15					
2								323				
					4	SS DO	21					
3								322				
					5	SS DO	13					
												Bentonite Seal
4				320.89				321				
		Compact brown SILT, trace to some clay, trace fine sand		4.11								
					6	SS DO	18					
5								320				
				319.50								
		Dense grey SANDY SILT, some clay, trace gravel (TILL)		5.50								
6								319				
					7	SS DO	39					
				318.00								
7		Very stiff to hard grey CLAYEY SILT, some sand, trace gravel (TILL)		7.00				318				
					8	SS DO	16					
8								317				
												Silica Sand Filter
9								316				
					9	SS DO	22				MH	
10		--- CONTINUED NEXT PAGE ---						315				

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM
CHECKED: AM

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PROJECT: 09-1111-6090

RECORD OF BOREHOLE MW 5

SHEET 2 OF 2

LOCATION: SEE FIGURE 2

BORING DATE: November 29, 2010

DATUM

SAMPLER HAMMER, 63.5kg; DROP, 760mm

PENETRATION TEST HAMMER, 63.5kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	ELEVATION	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. + Q - ⊗ rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp — W — Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	INSTALLATION AND GROUNDWATER OBSERVATIONS
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Very stiff to hard grey CLAYEY SILT, some sand, trace gravel (TILL)						315				Silica Sand Filter
11					10	SS DO	39	314		○		
		END OF BOREHOLE		313.87 11.13								Borehole dry and open upon completion of drilling, Nov. 29/10 Water level measured at 4.81 m below ground surface, Dec. 15/10
12												
13												
14												
15												
16												
17												
18												
19												
20												

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AM
CHECKED:

LDN_BHS 09-1111-6090.GPJ GLDR_LDN.GDT 24/2/11 DATA INPUT: JT 12/2010