

APPENDIX 'A'

GEOTECHNICAL REPORT

NORTH END SEWAGE TREATMENT PLANT UPGRADE

Sign-off Sheet


This document entitled NORTH END SEWAGE TREATMENT PLANT UPGRADE (a.k.a. NEWPCC, North End Water Pollution Control Centre Upgrade) Geotechnical Evaluation and Foundation Engineering Report was prepared by Stantec Consulting Ltd. ("Stantec") in association with AECOM Canada Ltd. (AECOM) for the City of Winnipeg. (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by 
(signature)

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Reviewed by 
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Independent Review by 
(signature)

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Senior Geotechnical Engineer



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2016/11/16 4:38 PM By: Bun_Sothea








ORIGINAL SHEET - ISO 8.5x11 H - v14.06

November, 2016
111216800



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Winnipeg MB Canada R3B 2B9
Tel. 204.489.5900 Fax. 204.453.9012
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Legend

-  TESTHOLE
-  TESTHOLE WITH CORING
-  TESTHOLE AND PUMP TEST
-  TESTHOLE WITH SLUG TEST
-  TESTHOLE WITH CORING AND MONITORING WELL

Notes

Client/Project

AECOM CANADA LTD.
NORTH END POLLUTION CONTROL CENTRE UPGRADE
WINNIPEG, MB

Figure No.

C1

Title

TESTHOLE LOCATION PLAN
PARCEL B

V:\1233\active\111216800\245\0300_drawing\drawings\16800_rhp_zone2.dwg 2
2016/11/10 5:20 PM By: Bun_Sothea







ORIGINAL SHEET - ISO 8.5x11 H - v14.06

November, 2016
111216800



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Legend

-  TESTHOLE
-  TESTHOLE WITH CORING
-  TESTHOLE WITH VW
PIEZOMETER
-  TESTHOLE WITH SLUG TEST

Notes

Client/Project

AECOM CANADA LTD.
NORTH END POLLUTION CONTROL CENTRE UPGRADE
WINNIPEG, MB

Figure No.

C2

Title

TESTHOLE LOCATION PLAN
PARCEL A WEST

SYMBOLS AND TERMS USED ON BOREHOLE AND TEST PIT RECORDS

SOIL DESCRIPTION

Terminology describing common soil genesis:

<i>Rootmat</i>	- vegetation, roots and moss with organic matter and topsoil typically forming a mattress at the ground surface
<i>Topsoil</i>	- mixture of soil and humus capable of supporting vegetative growth
<i>Peat</i>	- mixture of visible and invisible fragments of decayed organic matter
<i>Till</i>	- unstratified glacial deposit which may range from clay to boulders
<i>Fill</i>	- material below the surface identified as placed by humans (excluding buried services)

Terminology describing soil structure:

<i>Desiccated</i>	- having visible signs of weathering by oxidization of clay minerals, shrinkage cracks, etc.
<i>Fissured</i>	- having cracks, and hence a blocky structure
<i>Varved</i>	- composed of regular alternating layers of silt and clay
<i>Stratified</i>	- composed of alternating successions of different soil types, e.g. silt and sand
<i>Layer</i>	- > 75 mm in thickness
<i>Seam</i>	- 2 mm to 75 mm in thickness
<i>Parting</i>	- < 2 mm in thickness

Terminology describing soil types:

The classification of soil types are made on the basis of grain size and plasticity in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 or D 2488) which excludes particles larger than 75 mm. For particles larger than 75 mm, and for defining percent clay fraction in hydrometer results, definitions proposed by Canadian Foundation Engineering Manual, 4th Edition are used. The USCS provides a group symbol (e.g. SM) and group name (e.g. silty sand) for identification.

Terminology describing cobbles, boulders, and non-matrix materials (organic matter or debris):

Terminology describing materials outside the USCS, (e.g. particles larger than 75 mm, visible organic matter, and construction debris) is based upon the proportion of these materials present:

<i>Trace, or occasional</i>	Less than 10%
<i>Some</i>	10-20%
<i>Frequent</i>	> 20%

Terminology describing compactness of cohesionless soils:

The standard terminology to describe cohesionless soils includes compactness (formerly "relative density"), as determined by the Standard Penetration Test (SPT) N-Value - also known as N-Index. The SPT N-Value is described further on page 3. A relationship between compactness condition and N-Value is shown in the following table.

Compactness Condition	SPT N-Value
<i>Very Loose</i>	<4
<i>Loose</i>	4-10
<i>Compact</i>	10-30
<i>Dense</i>	30-50
<i>Very Dense</i>	>50

Terminology describing consistency of cohesive soils:

The standard terminology to describe cohesive soils includes the consistency, which is based on undrained shear strength as measured by *in situ* vane tests, penetrometer tests, or unconfined compression tests. Consistency may be crudely estimated from SPT N-Value based on the correlation shown in the following table (Terzaghi and Peck, 1967). The correlation to SPT N-Value is used with caution as it is only very approximate.

Consistency	Undrained Shear Strength		Approximate SPT N-Value
	kips/sq.ft.	kPa	
<i>Very Soft</i>	<0.25	<12.5	<2
<i>Soft</i>	0.25 - 0.5	12.5 - 25	2-4
<i>Firm</i>	0.5 - 1.0	25 - 50	4-8
<i>Stiff</i>	1.0 - 2.0	50 - 100	8-15
<i>Very Stiff</i>	2.0 - 4.0	100 - 200	15-30
<i>Hard</i>	>4.0	>200	>30

ROCK DESCRIPTION

Except where specified below, terminology for describing rock is as defined by the International Society for Rock Mechanics (ISRM) 2007 publication "The Complete ISRM Suggested Methods for Rock Characterization, Testing and Monitoring: 1974-2006"

Terminology describing rock quality:

RQD	Rock Mass Quality
0-25	Very Poor Quality
25-50	Poor Quality
50-75	Fair Quality
75-90	Good Quality
90-100	Excellent Quality

Alternate (Colloquial) Rock Mass Quality	
Very Severely Fractured	Crushed
Severely Fractured	Shattered or Very Blocky
Fractured	Blocky
Moderately Jointed	Sound
Intact	Very Sound

RQD (Rock Quality Designation) denotes the percentage of intact and sound rock retrieved from a borehole of any orientation. All pieces of intact and sound rock core equal to or greater than 100 mm (4 in.) long are summed and divided by the total length of the core run. RQD is determined in accordance with ASTM D6032.

SCR (Solid Core Recovery) denotes the percentage of solid core (cylindrical) retrieved from a borehole of any orientation. All pieces of solid (cylindrical) core are summed and divided by the total length of the core run (It excludes all portions of core pieces that are not fully cylindrical as well as crushed or rubble zones).

Fracture Index (FI) is defined as the number of naturally occurring fractures within a given length of core. The Fracture Index is reported as a simple count of natural occurring fractures.

Terminology describing rock with respect to discontinuity and bedding spacing:

Spacing (mm)	Discontinuities	Bedding
>6000	Extremely Wide	-
2000-6000	Very Wide	Very Thick
600-2000	Wide	Thick
200-600	Moderate	Medium
60-200	Close	Thin
20-60	Very Close	Very Thin
<20	Extremely Close	Laminated
<6	-	Thinly Laminated

Terminology describing rock strength:

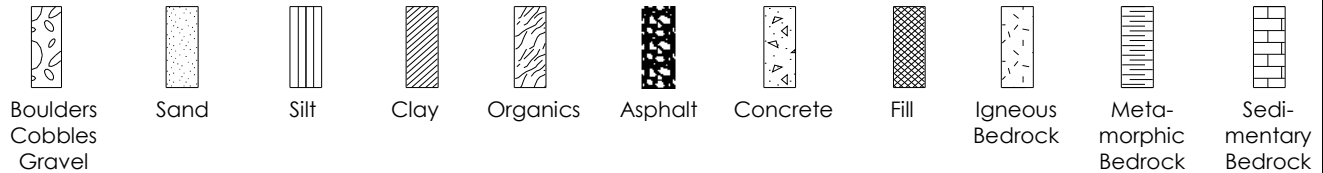
Strength Classification	Grade	Unconfined Compressive Strength (MPa)
Extremely Weak	R0	<1
Very Weak	R1	1 – 5
Weak	R2	5 – 25
Medium Strong	R3	25 – 50
Strong	R4	50 – 100
Very Strong	R5	100 – 250
Extremely Strong	R6	>250

Terminology describing rock weathering:

Term	Symbol	Description
Fresh	W1	No visible signs of rock weathering. Slight discoloration along major discontinuities
Slightly	W2	Discoloration indicates weathering of rock on discontinuity surfaces. All the rock material may be discolored.
Moderately	W3	Less than half the rock is decomposed and/or disintegrated into soil.
Highly	W4	More than half the rock is decomposed and/or disintegrated into soil.
Completely	W5	All the rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.
Residual Soil	W6	All the rock converted to soil. Structure and fabric destroyed.

STRATA PLOT

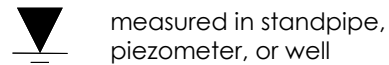
Strata plots symbolize the soil or bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



SAMPLE TYPE

SS	Split spoon sample (obtained by performing the Standard Penetration Test)
ST	Shelby tube or thin wall tube
DP	Direct-Push sample (small diameter tube sampler hydraulically advanced)
PS	Piston sample
BS	Bulk sample
HQ, NQ, BQ, etc.	Rock core samples obtained with the use of standard size diamond coring bits.

WATER LEVEL MEASUREMENT



measured in standpipe, piezometer, or well



inferred

RECOVERY

For soil samples, the recovery is recorded as the length of the soil sample recovered. For rock core, recovery is defined as the total cumulative length of all core recovered in the core barrel divided by the length drilled and is recorded as a percentage on a per run basis.

N-VALUE

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 140 pound (63.5 kg) hammer falling 30 inches (760 mm), required to drive a 2 inch (50.8 mm) O.D. split spoon sampler one foot (300 mm) into the soil. In accordance with ASTM D1586, the N-Value equals the sum of the number of blows (N) required to drive the sampler over the interval of 6 to 18 in. (150 to 450 mm). However, when a 24 in. (610 mm) sampler is used, the number of blows (N) required to drive the sampler over the interval of 12 to 24 in. (300 to 610 mm) may be reported if this value is lower. For split spoon samples where insufficient penetration was achieved and N-Values cannot be presented, the number of blows are reported over sampler penetration in millimetres (e.g. 50/75). Some design methods make use of N-values corrected for various factors such as overburden pressure, energy ratio, borehole diameter, etc. No corrections have been applied to the N-values presented on the log.

DYNAMIC CONE PENETRATION TEST (DCPT)

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to 'A' size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone one foot (300 mm) into the soil. The DCPT is used as a probe to assess soil variability.

OTHER TESTS

S	Sieve analysis
H	Hydrometer analysis
k	Laboratory permeability
γ	Unit weight
G_s	Specific gravity of soil particles
CD	Consolidated drained triaxial
CU	Consolidated undrained triaxial with pore pressure measurements
UU	Unconsolidated undrained triaxial
DS	Direct Shear
C	Consolidation
Q_u	Unconfined compression
I_p	Point Load Index (I_p on Borehole Record equals $I_p(50)$ in which the index is corrected to a reference diameter of 50 mm)

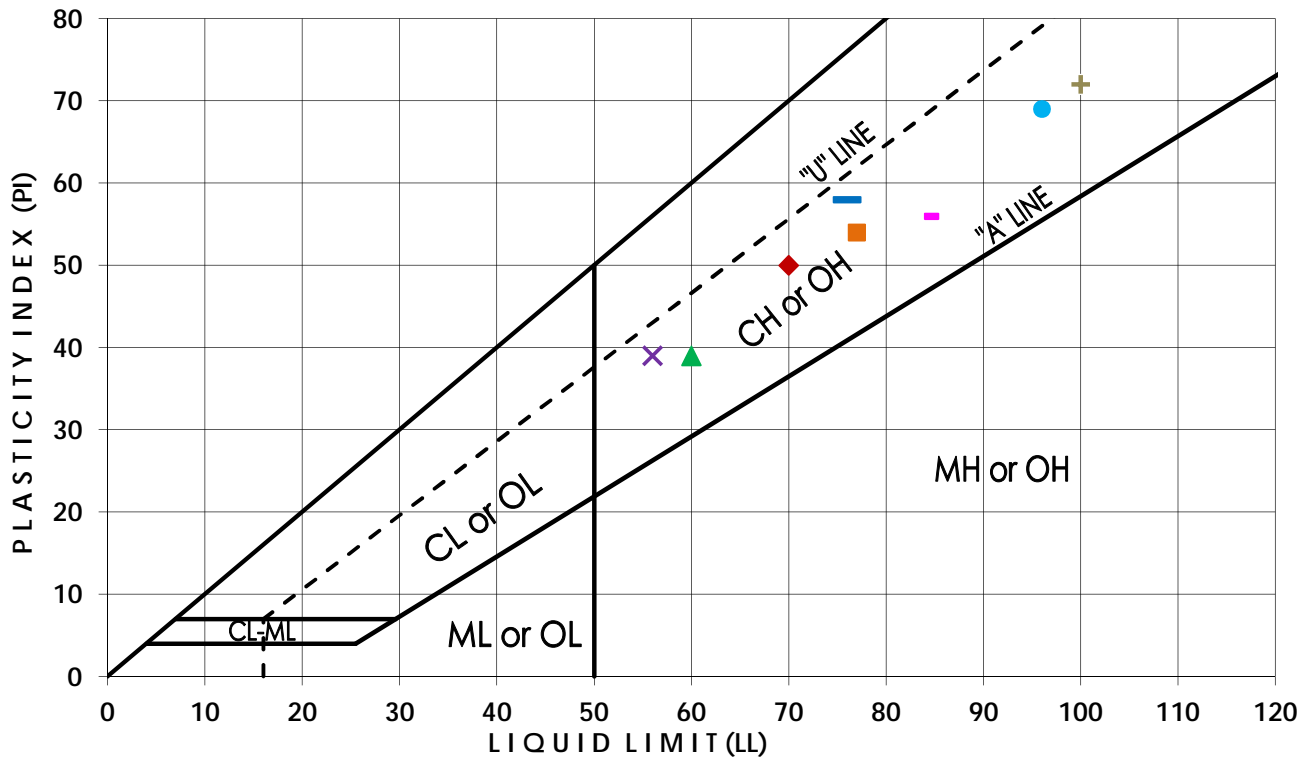
	Single packer permeability test; test interval from depth shown to bottom of borehole
	Double packer permeability test; test interval as indicated
	Falling head permeability test using casing
	Falling head permeability test using well point or piezometer

AECOM Canada Inc.
 99 Commerce Drive
 Winnipeg, MB
 R3B 2B9

 Project No.: 111216800.245
 Project Name: North End Water Pollution Control
 Centre Upgrade

 Date Samples Received: September 21, 2016
 Tested By: N. Abarca & C. Woods

Symbol	Testhole No.	Depth (m)	Liquid Limit	Plastic Limit	Plasticity Index	USCS
◆	TH06	1.8	70	20	50	CH
■	TH06	3.1	77	23	54	CH
●	TH09	4.9	96	27	69	CH
▲	TH09	7.9	60	21	39	CH
x	TH09	11.0	56	17	39	CH
—	TH13	3.4	76	18	58	CH
+	TH13	6.4	100	28	72	CH
-	TH14	1.8	84	28	56	CH

Plasticity Chart

 Reviewed By: Nathan Boenders, B.Sc., EIT
 Date Reviewed: November 10, 2016

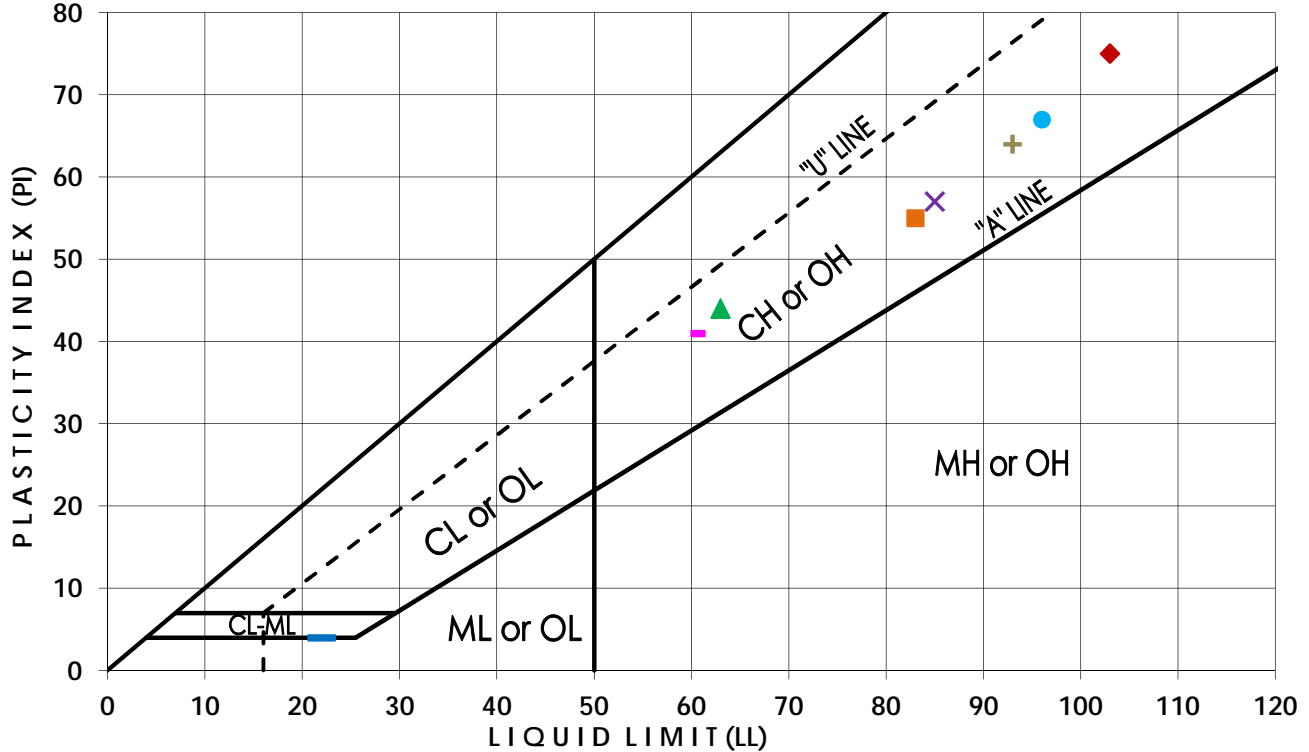
AECOM Canada Inc.
 99 Commerce Drive
 Winnipeg, MB
 R3B 2B9

Project No.: 111216800.245
 Project Name: North End Water Pollution Control
 Centre Upgrade

Date Samples Received: September 21, 2016
 Tested By: N. Abarca & C. Woods

Symbol	Testhole No.	Depth (m)	Liquid Limit	Plastic Limit	Plasticity Index	USCS
◆	TH14	4.9	103	28	75	CH
■	TH19	1.8	83	28	55	CH
●	TH19	4.9	96	29	67	CH
▲	TH19	11.0	63	19	44	CH
x	TH23	7.9	85	28	57	CH
—	TH25	3.4	22	18	4	CL-ML
+	TH25	7.9	93	29	64	CH
-	TH28	14.0	60	19	41	CH

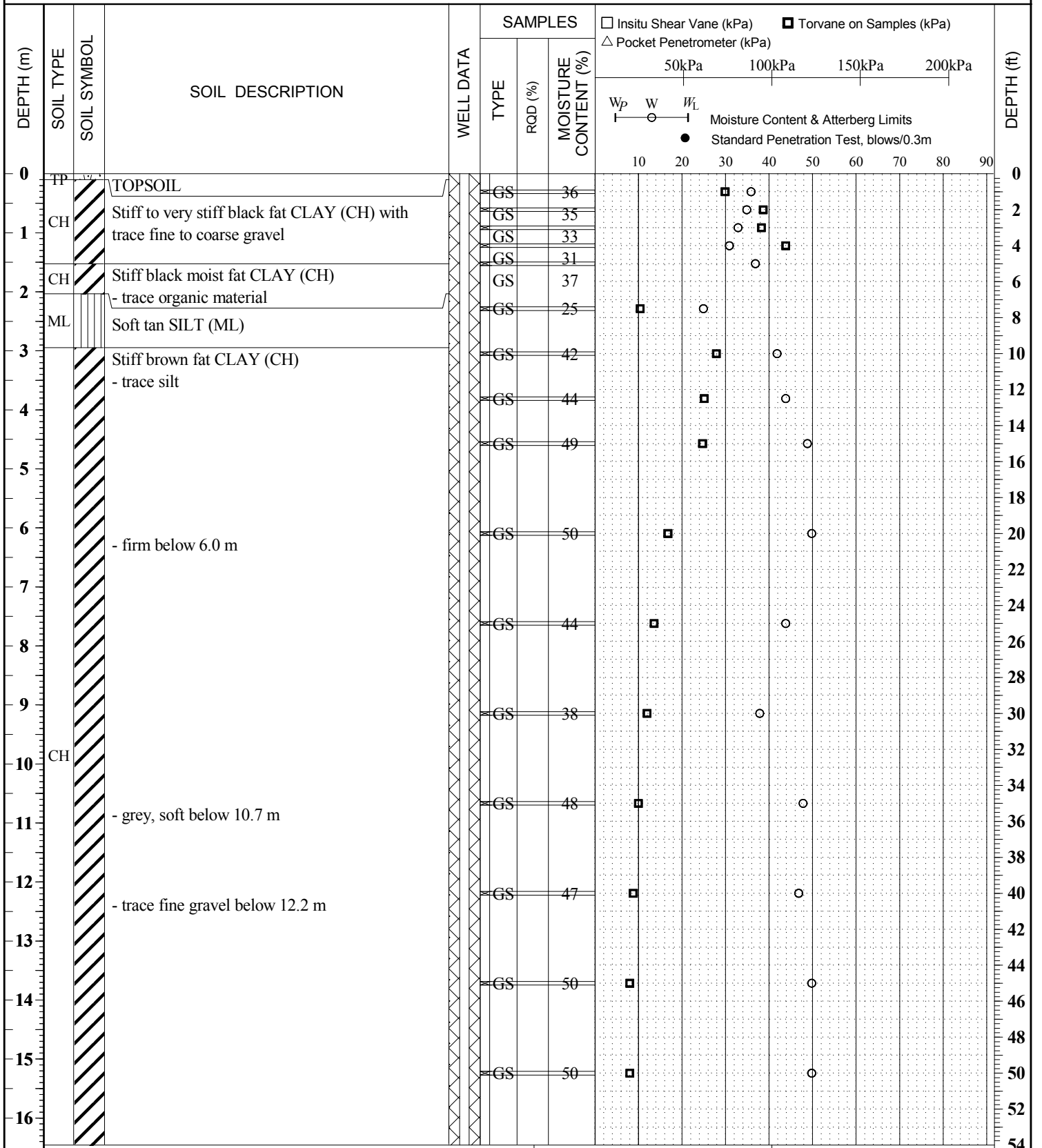
Plasticity Chart



Reviewed By: Nathan Boenders, B.Sc., EIT
 Date Reviewed: November 10, 2016

TH01 TESTHOLE RECORD

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535456
 LOCATION Winnipeg, Manitoba ELEVATION 230.43 m EASTING 634995
 DRILLING DATE October 13, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: Bentonite Drill Cuttings Sand Slough

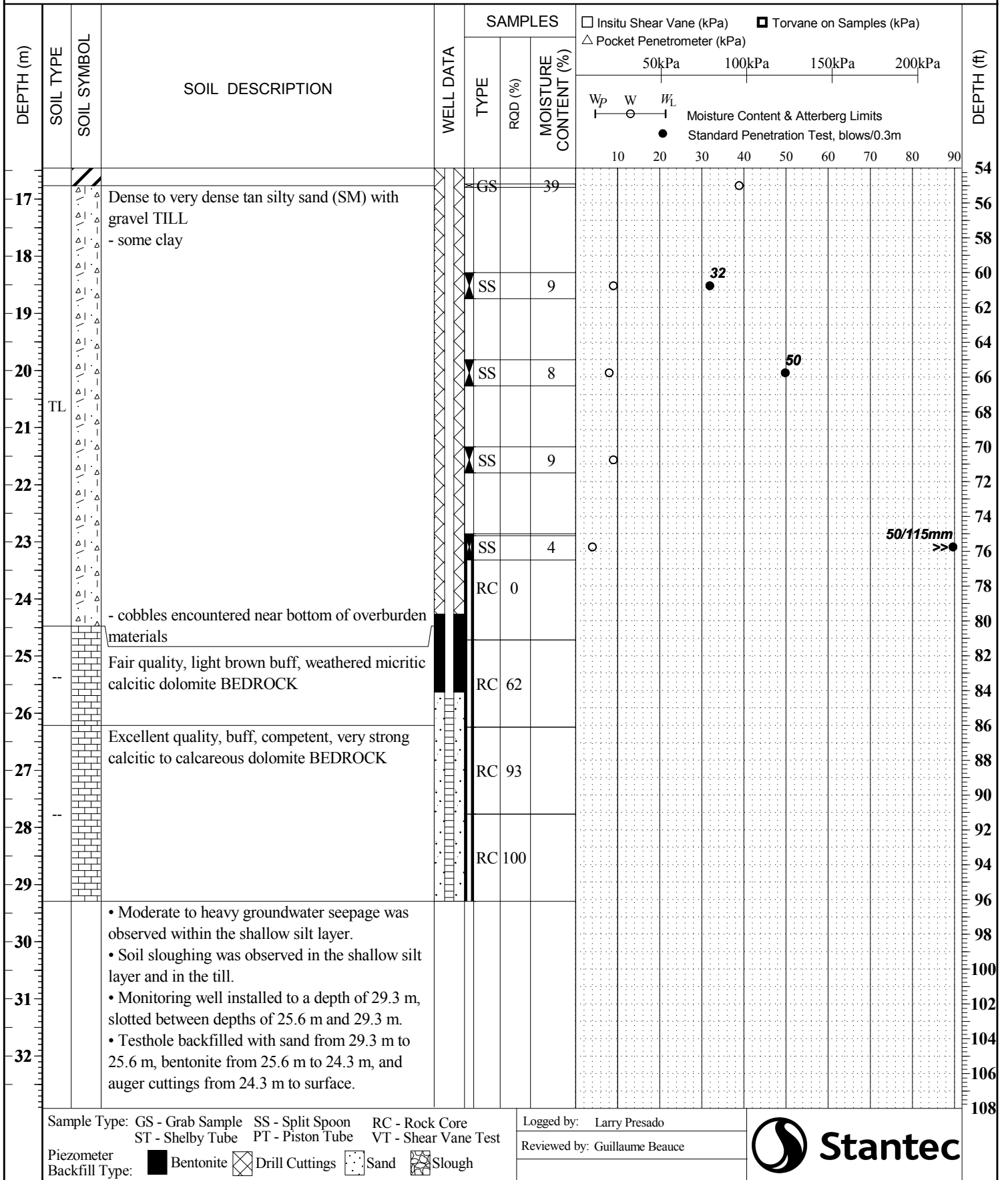
Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH01 TESTHOLE RECORD

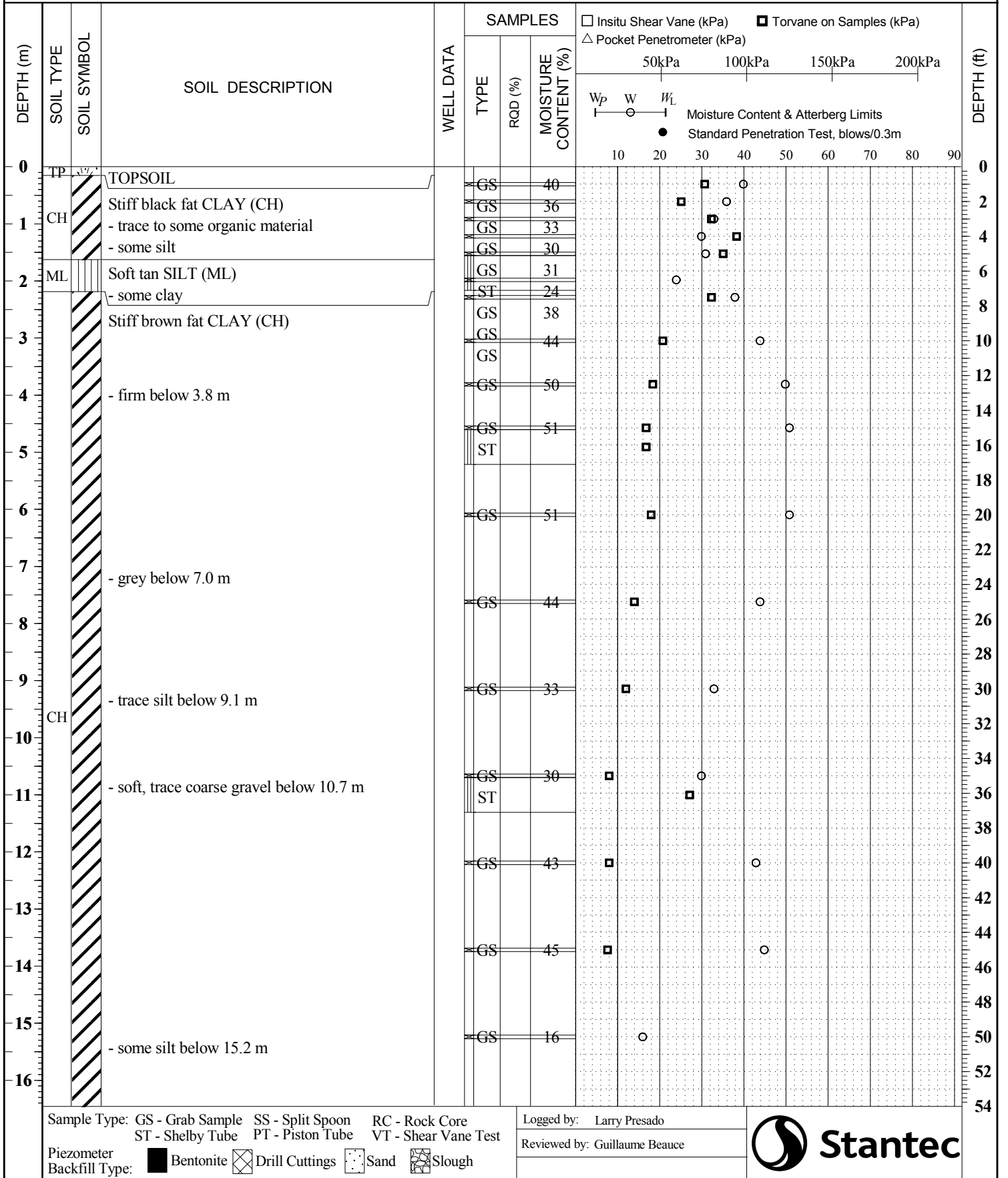
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CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535456
 LOCATION Winnipeg, Manitoba ELEVATION 230.43 m EASTING 634995
 DRILLING DATE October 13, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



TH02 TESTHOLE RECORD

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535418
 LOCATION Winnipeg, Manitoba ELEVATION 230.70 m EASTING 635076
 DRILLING DATE October 12, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: Bentonite Drill Cuttings Sand Slough

Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH02 TESTHOLE RECORD

cont'd

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535418
 LOCATION Winnipeg, Manitoba ELEVATION 230.70 m EASTING 635076
 DRILLING DATE October 12, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLES			TEST DATA				DEPTH (ft)	
				TYPE	RQD (%)	MOISTURE CONTENT (%)	Insitu Shear Vane (kPa)	Torvane on Samples (kPa)	Pocket Penetrometer (kPa)	Moisture Content & Atterberg Limits		
17	TL		Compact tan silty sand (SM) with gravel TILL • Moderate to heavy groundwater seepage was observed within the shallow silt layer. • Soil sloughing was observed in the shallow silt layer. • Auger refusal at a depth of 17.5 m on very dense till.	GS	18						54	
				GS	11							56
18				GS	10							58
				SS	9							58
18											58	
19											60	
20											62	
21											64	
22											66	
23											68	
24											70	
25											72	
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											102	
											104	
											106	
											108	

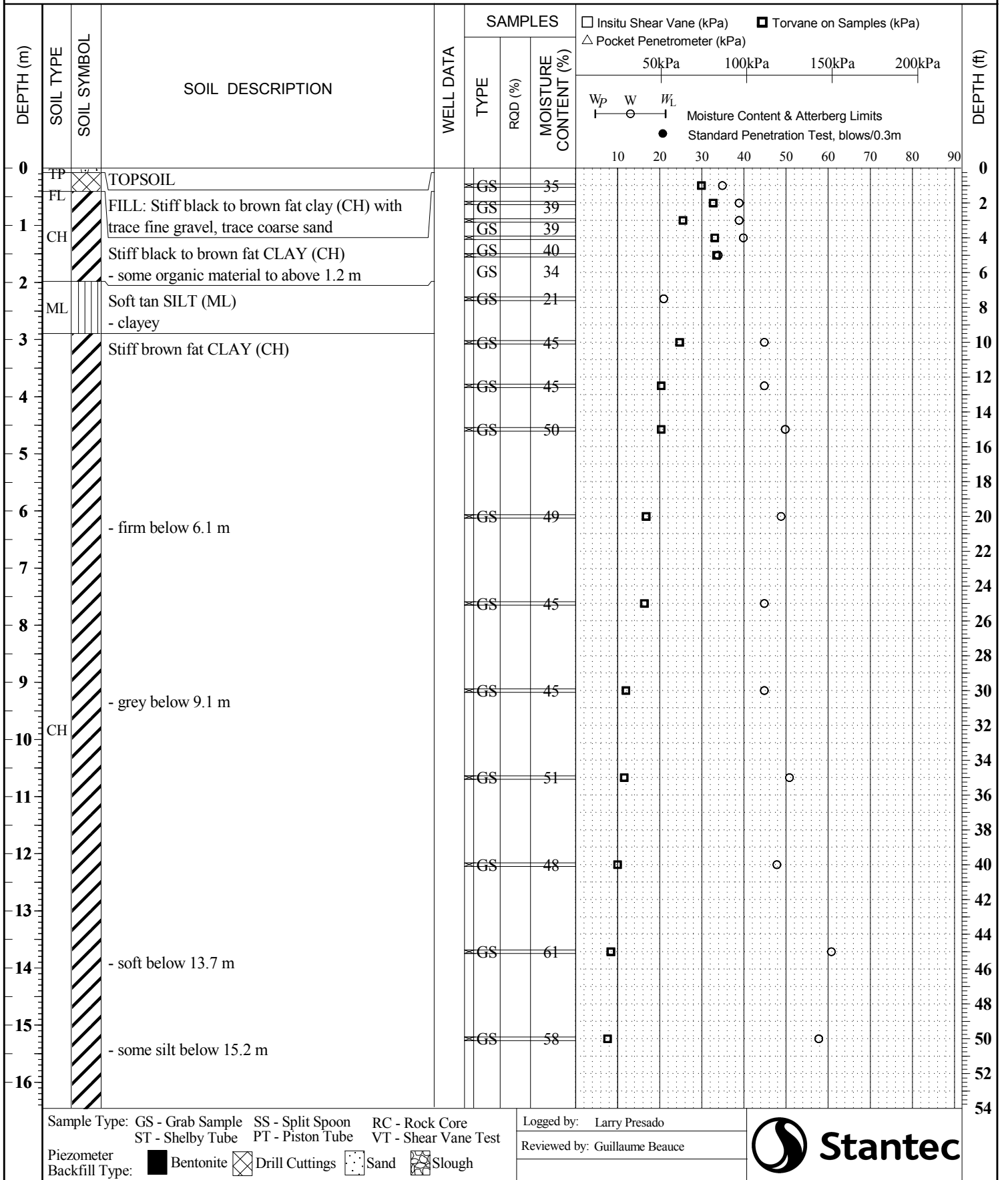
Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: Bentonite Drill Cuttings Sand Slough

Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH03 TESTHOLE RECORD

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535376
 LOCATION Winnipeg, Manitoba ELEVATION 231.01 m EASTING 635146
 DRILLING DATE October 12, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: ■ Bentonite ☒ Drill Cuttings ▨ Sand ▨ Slough

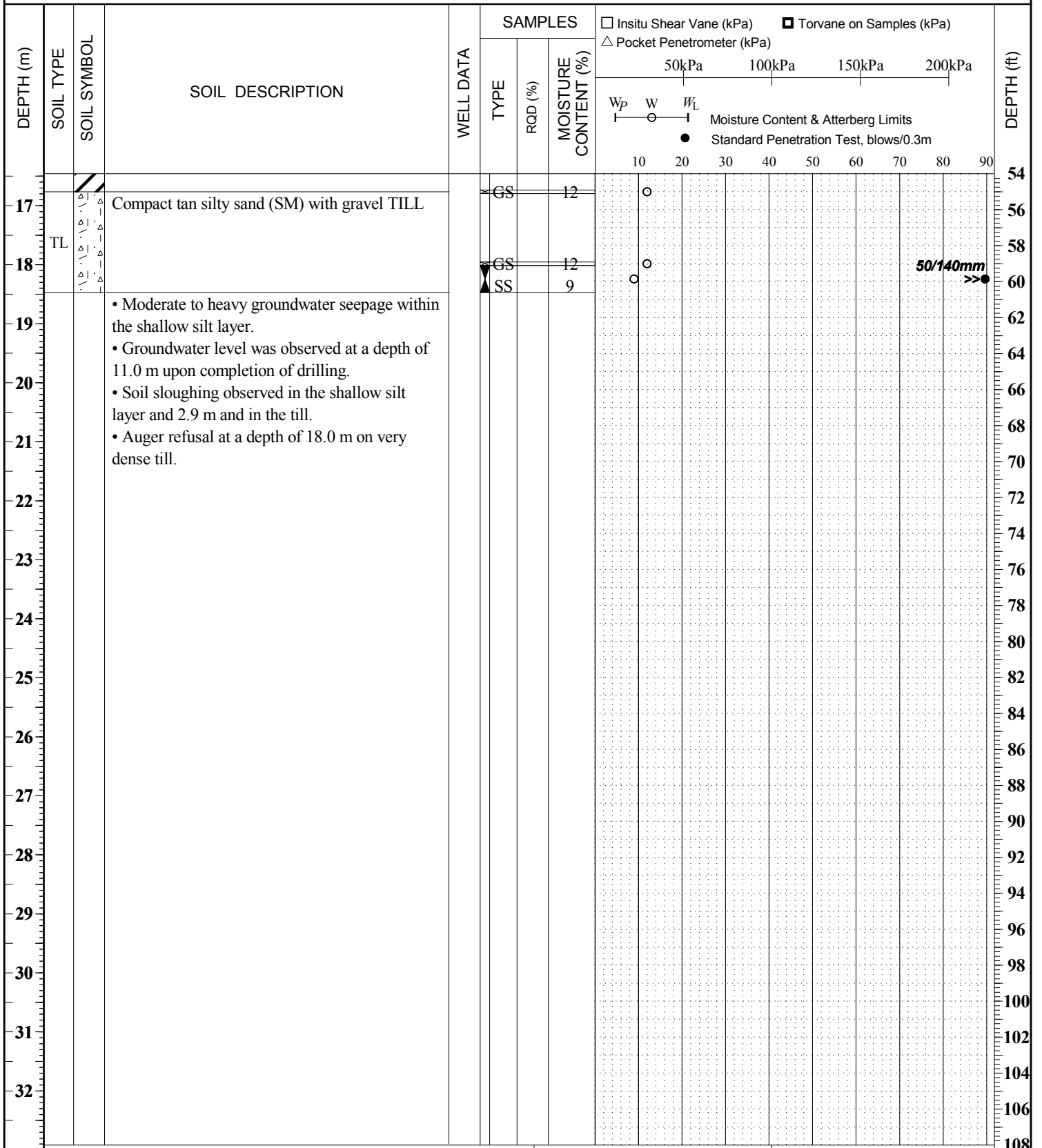
Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH03 TESTHOLE RECORD

cont'd

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 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535376
 LOCATION Winnipeg, Manitoba ELEVATION 231.01 m EASTING 635146
 DRILLING DATE October 12, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



50/140mm >>>

Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test

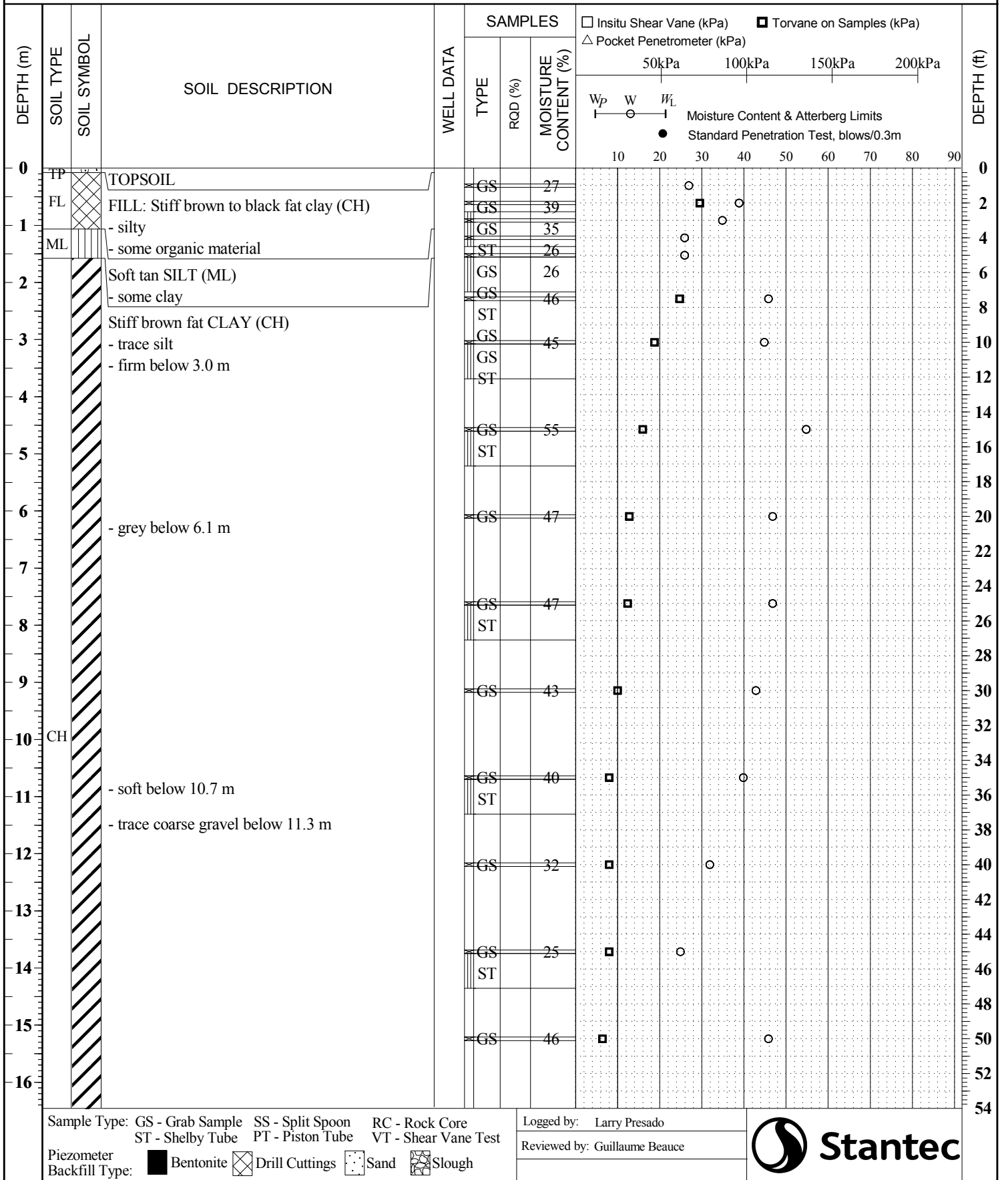
Piezometer Backfill Type: Bentonite Drill Cuttings Sand Slough

Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH04 TESTHOLE RECORD

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535345
 LOCATION Winnipeg, Manitoba ELEVATION 231.00 m EASTING 635210
 DRILLING DATE October 12, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: ■ Bentonite ⊠ Drill Cuttings □ Sand ⊞ Slough

Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH04 TESTHOLE RECORD

cont'd

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535345
 LOCATION Winnipeg, Manitoba ELEVATION 231.00 m EASTING 635210
 DRILLING DATE October 12, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA

DEPTH (m)	SOIL TYPE	SOIL SYMBOL	SOIL DESCRIPTION	WELL DATA		SAMPLES		<input type="checkbox"/> Insitu Shear Vane (kPa) <input checked="" type="checkbox"/> Torvane on Samples (kPa) <input type="checkbox"/> Pocket Penetrometer (kPa) 50kPa 100kPa 150kPa 200kPa W _p W W _L Moisture Content & Atterberg Limits ● Standard Penetration Test, blows/0.3m 10 20 30 40 50 60 70 80 90										DEPTH (ft)					
				TYPE	RQD (%)	MOISTURE CONTENT (%)																	
17		▨	- some silt below 17.7 m	GS	37			□		○													54
18		▨		GS	10			○															56
19	TL	△	Compact to dense tan silty sand (SM) with gravel TILL - some clay	GS	11			○															60
20		△		GS	12			○															62
21			<ul style="list-style-type: none"> • Moderate to heavy groundwater seepage was observed within the shallow silt layer. • Groundwater level was observed at a depth of 13.7 m upon completion of drilling. • Soil sloughing was observed in the shallow silt layer and in the till. • Auger refusal at a depth of 20.4 m on very dense till. 					○															64
22																							66
23																							68
24																							70
25																							72
26																							74
27																							76
28																							78
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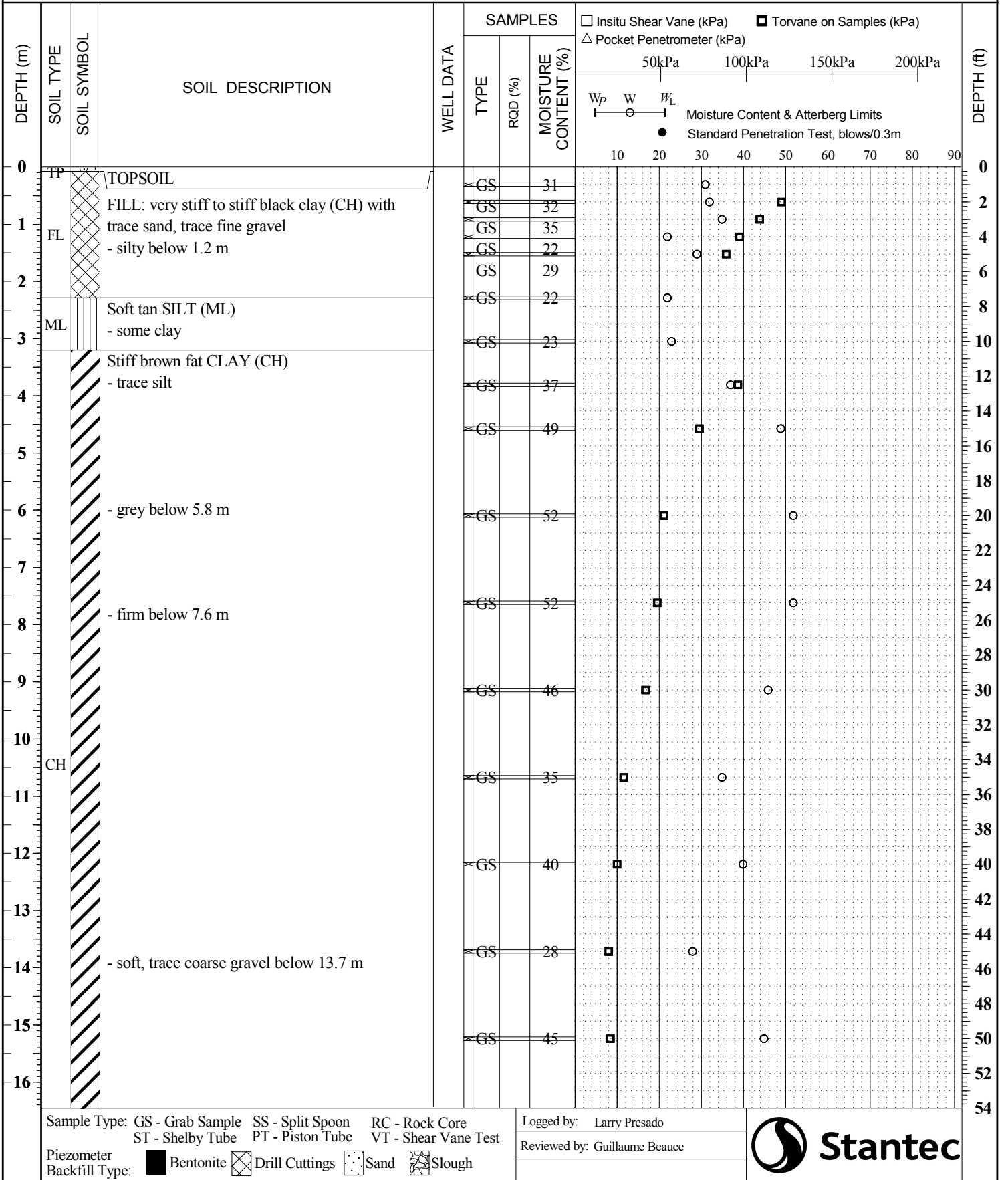
Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: Bentonite Drill Cuttings Sand Slough

Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH05 TESTHOLE RECORD

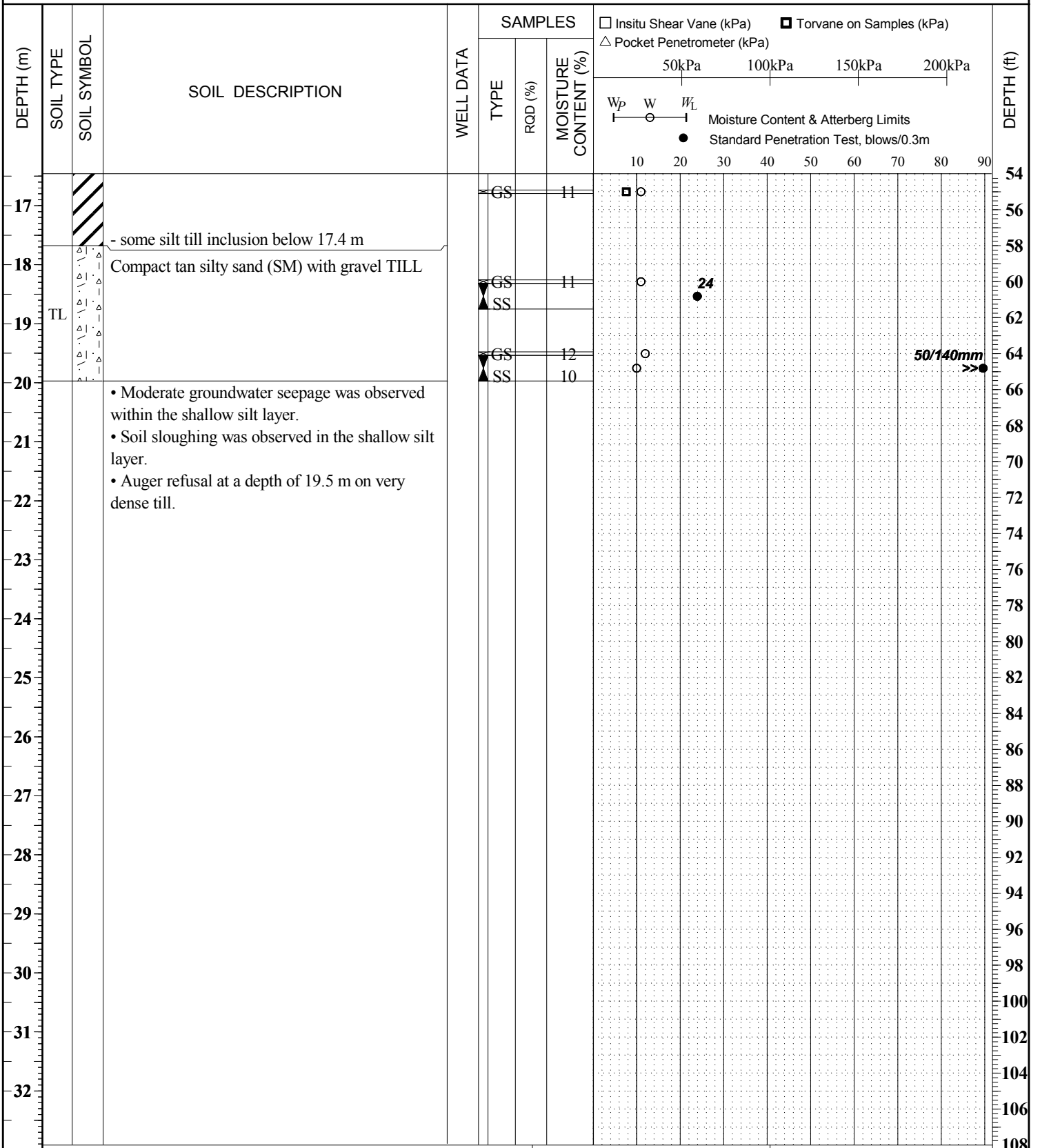
CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535384
 LOCATION Winnipeg, Manitoba ELEVATION 231.97 m EASTING 634960.2
 DRILLING DATE October 5, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



TH05 TESTHOLE RECORD

cont'd

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535384
 LOCATION Winnipeg, Manitoba ELEVATION 231.97 m EASTING 634960.2
 DRILLING DATE October 5, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



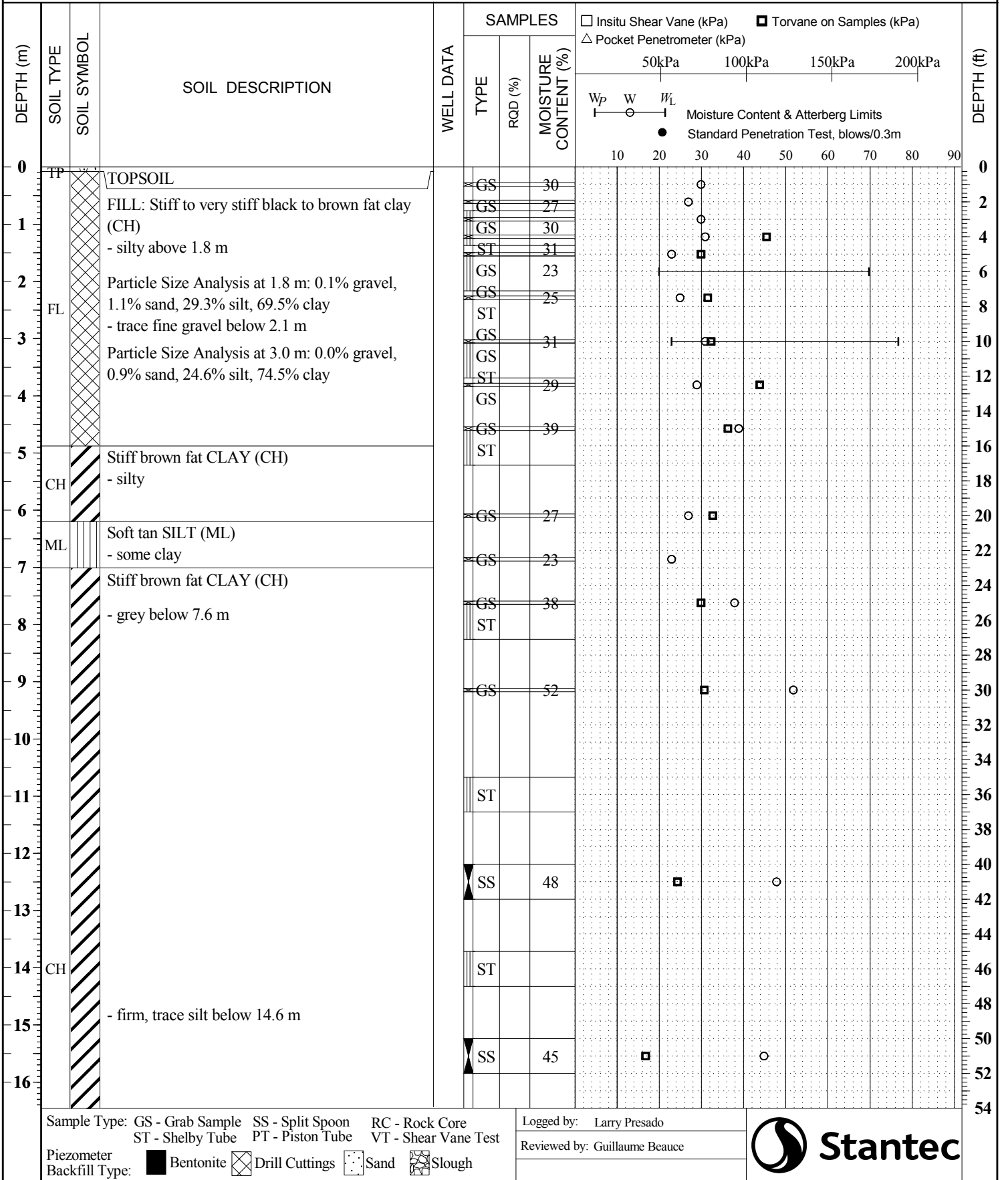
Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: ■ Bentonite ☒ Drill Cuttings ◻ Sand ☒ Slough

Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH06 TESTHOLE RECORD

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535348
 LOCATION Winnipeg, Manitoba ELEVATION 235.50 m EASTING 635032
 DRILLING DATE October 6, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test

Piezometer Backfill Type: ■ Bentonite ⊠ Drill Cuttings □ Sand ⊞ Slough

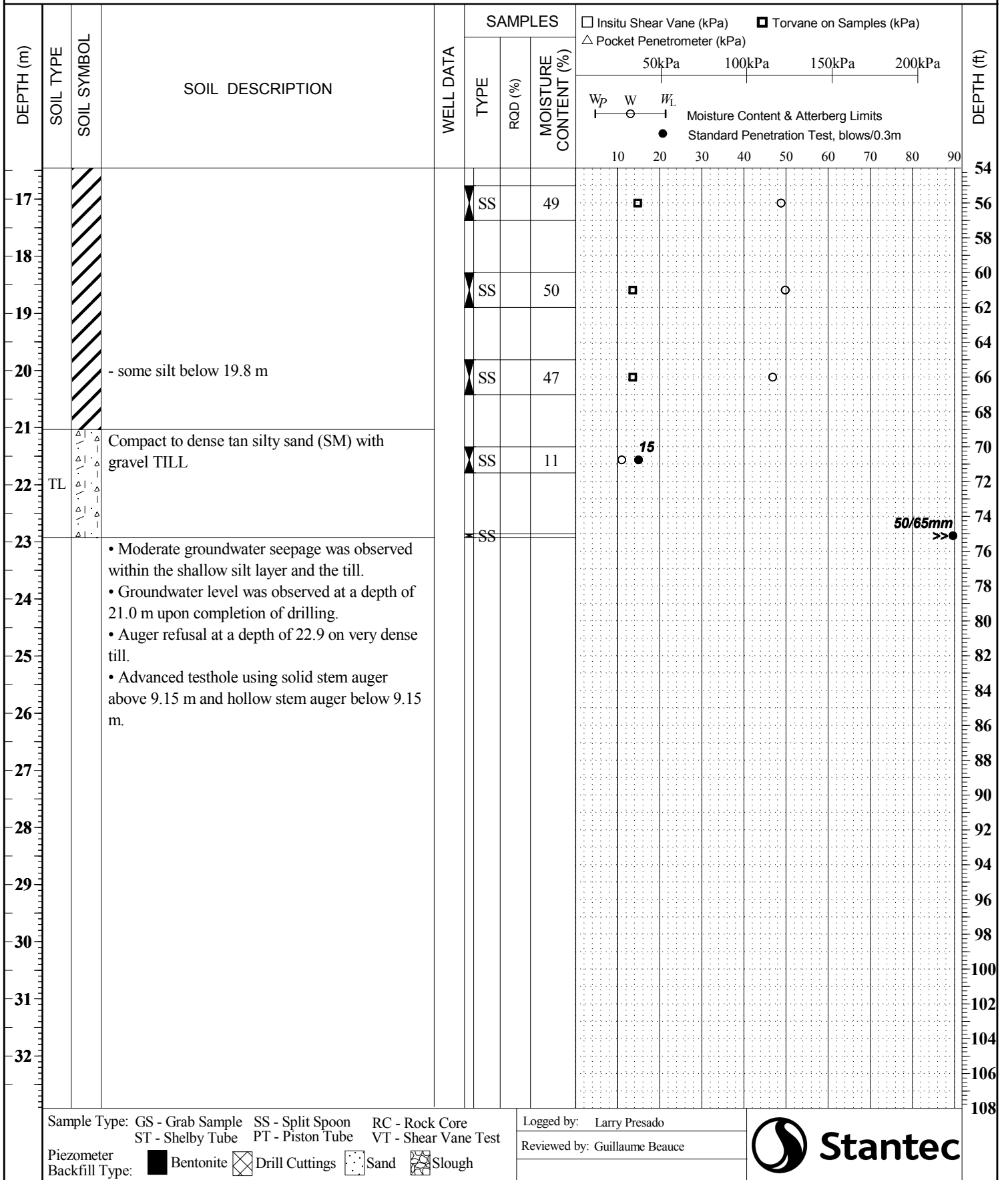
Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH06 TESTHOLE RECORD

cont'd

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535348
 LOCATION Winnipeg, Manitoba ELEVATION 235.50 m EASTING 635032
 DRILLING DATE October 6, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



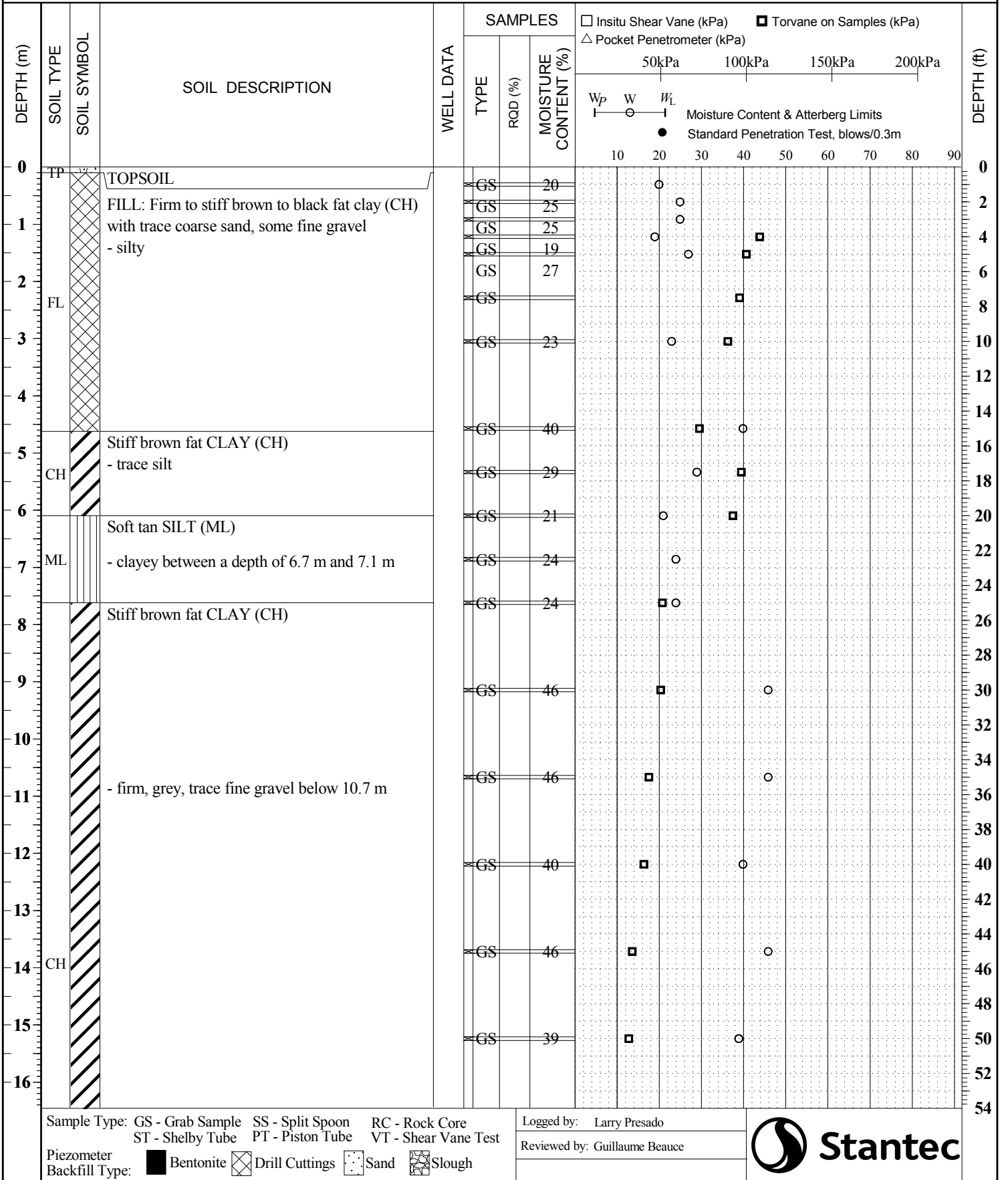
Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: Bentonite Drill Cuttings Sand Slough

Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH07 TESTHOLE RECORD

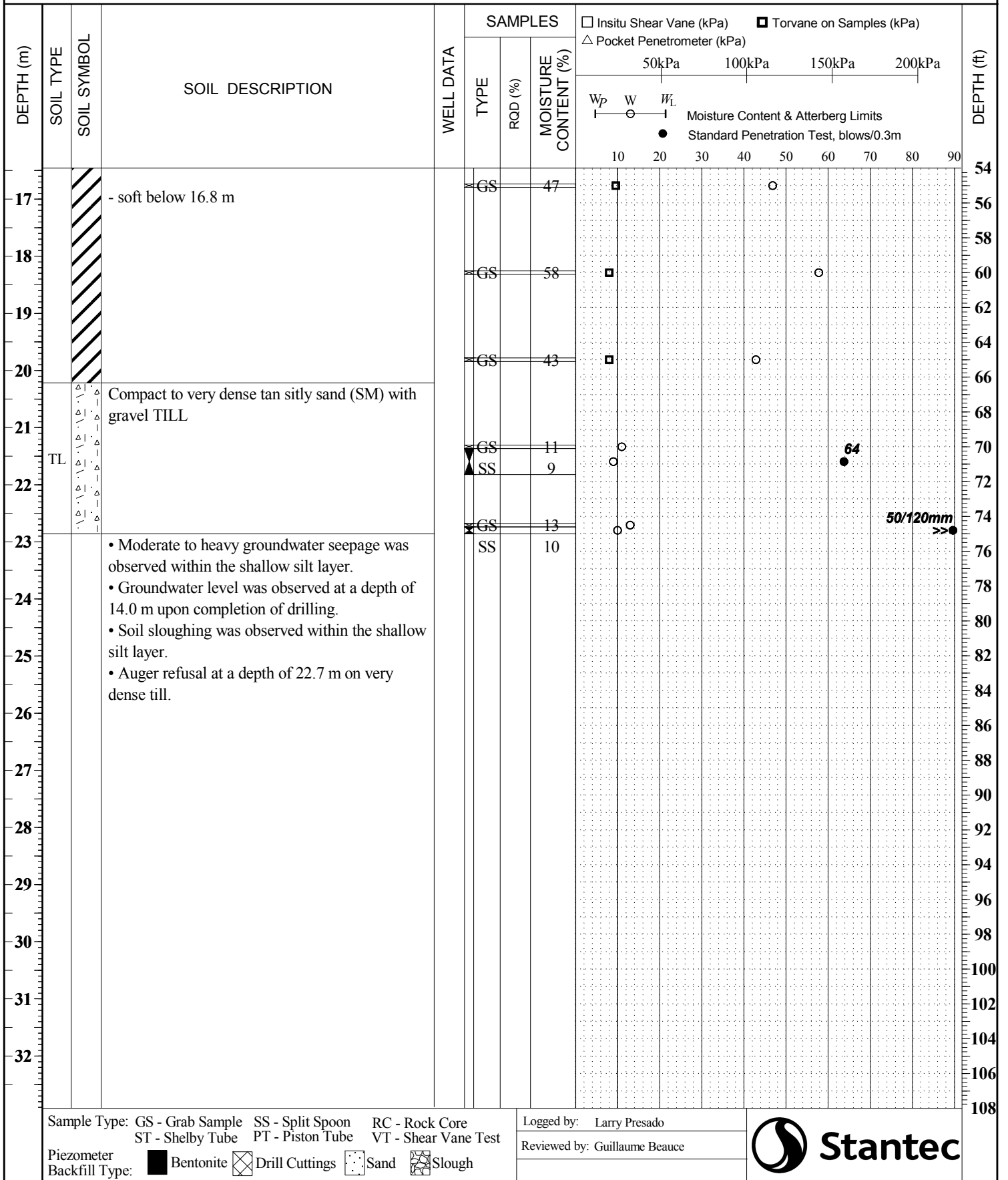
CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535314
 LOCATION Winnipeg, Manitoba ELEVATION 235.23 m EASTING 635103
 DRILLING DATE October 11, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



TH07 TESTHOLE RECORD

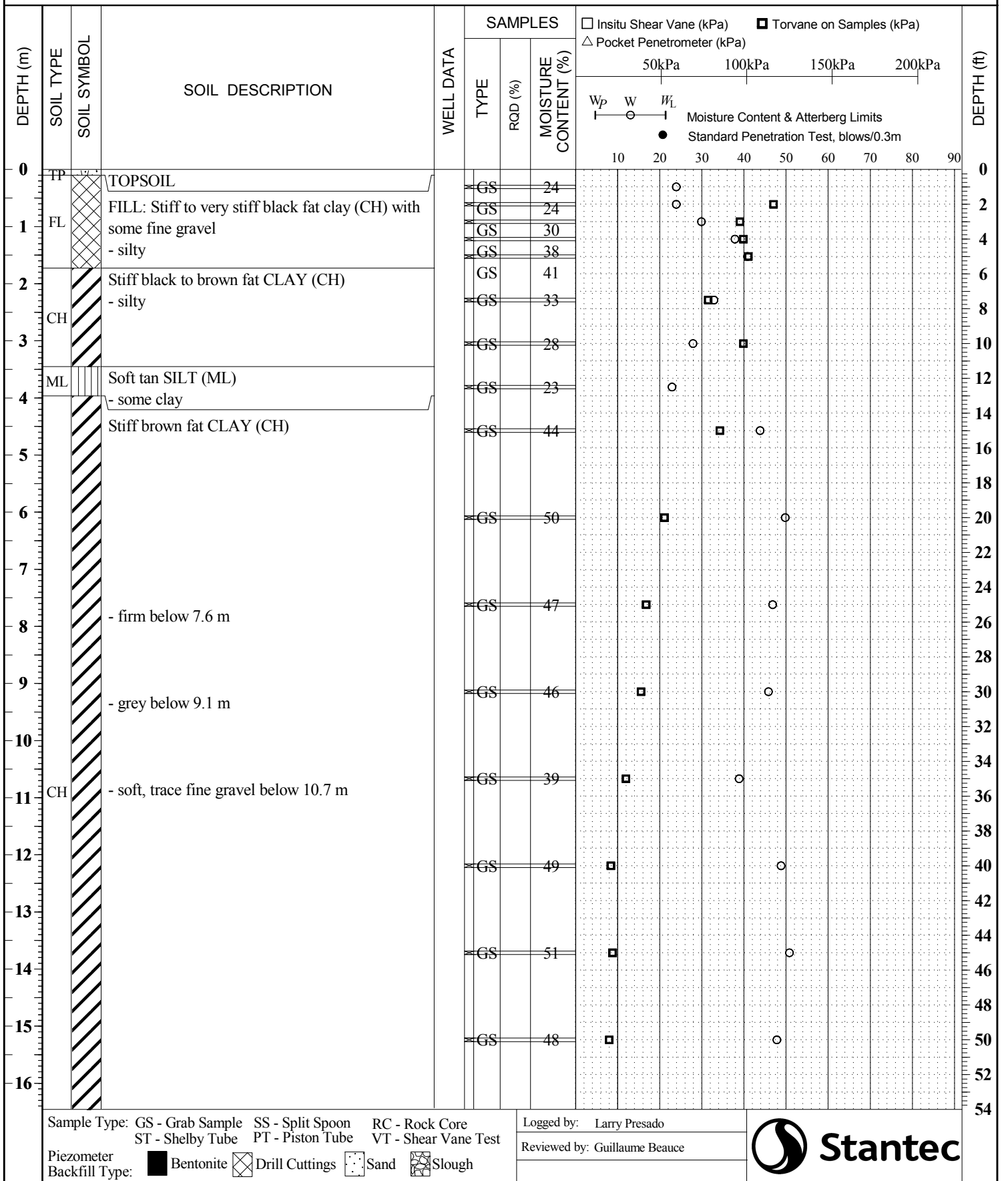
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CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535314
 LOCATION Winnipeg, Manitoba ELEVATION 235.23 m EASTING 635103
 DRILLING DATE October 11, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



TH08 TESTHOLE RECORD

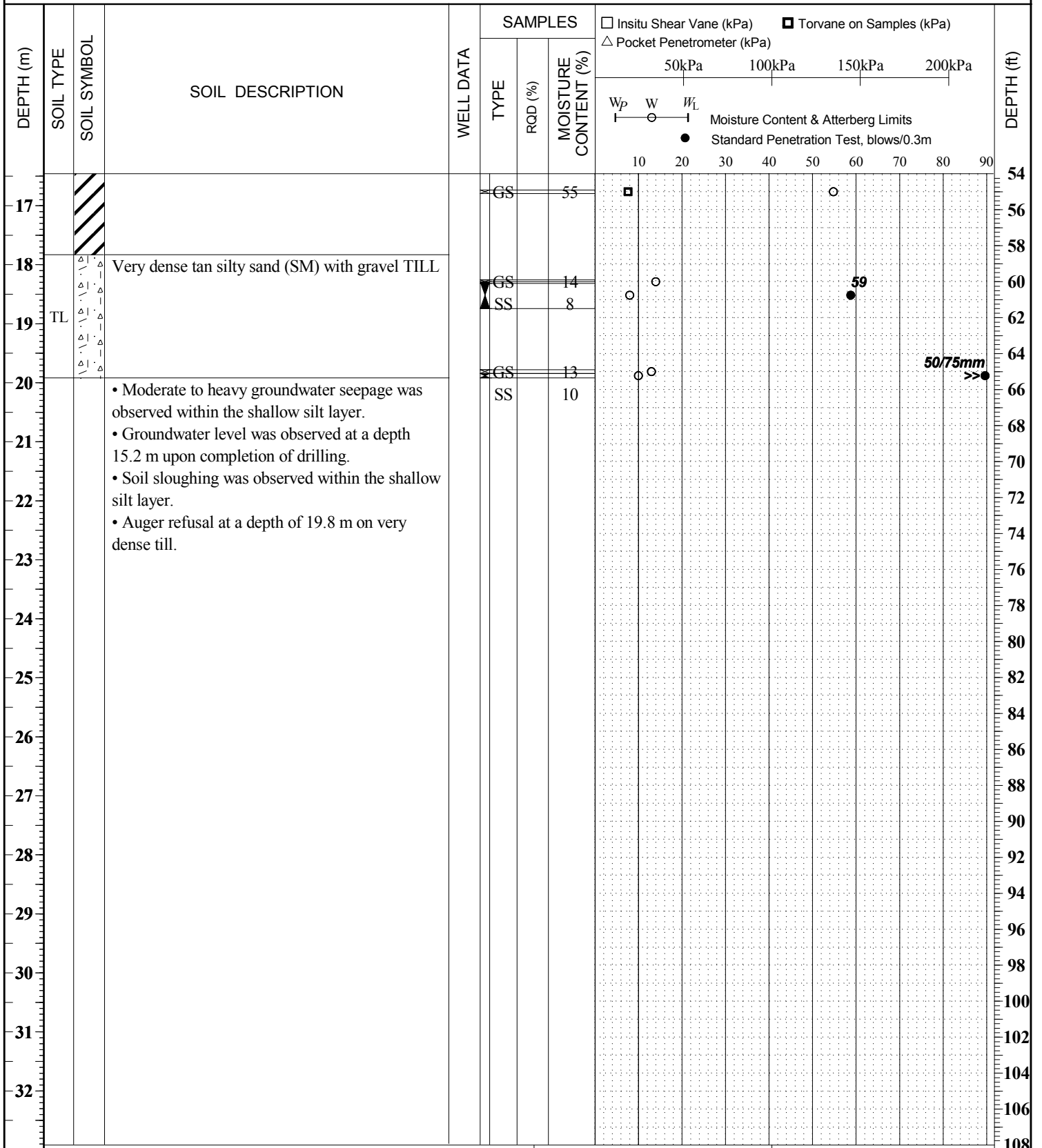
CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535273
 LOCATION Winnipeg, Manitoba ELEVATION 232.11 m EASTING 635164
 DRILLING DATE October 11, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



TH08 TESTHOLE RECORD

cont'd

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535273
 LOCATION Winnipeg, Manitoba ELEVATION 232.11 m EASTING 635164
 DRILLING DATE October 11, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



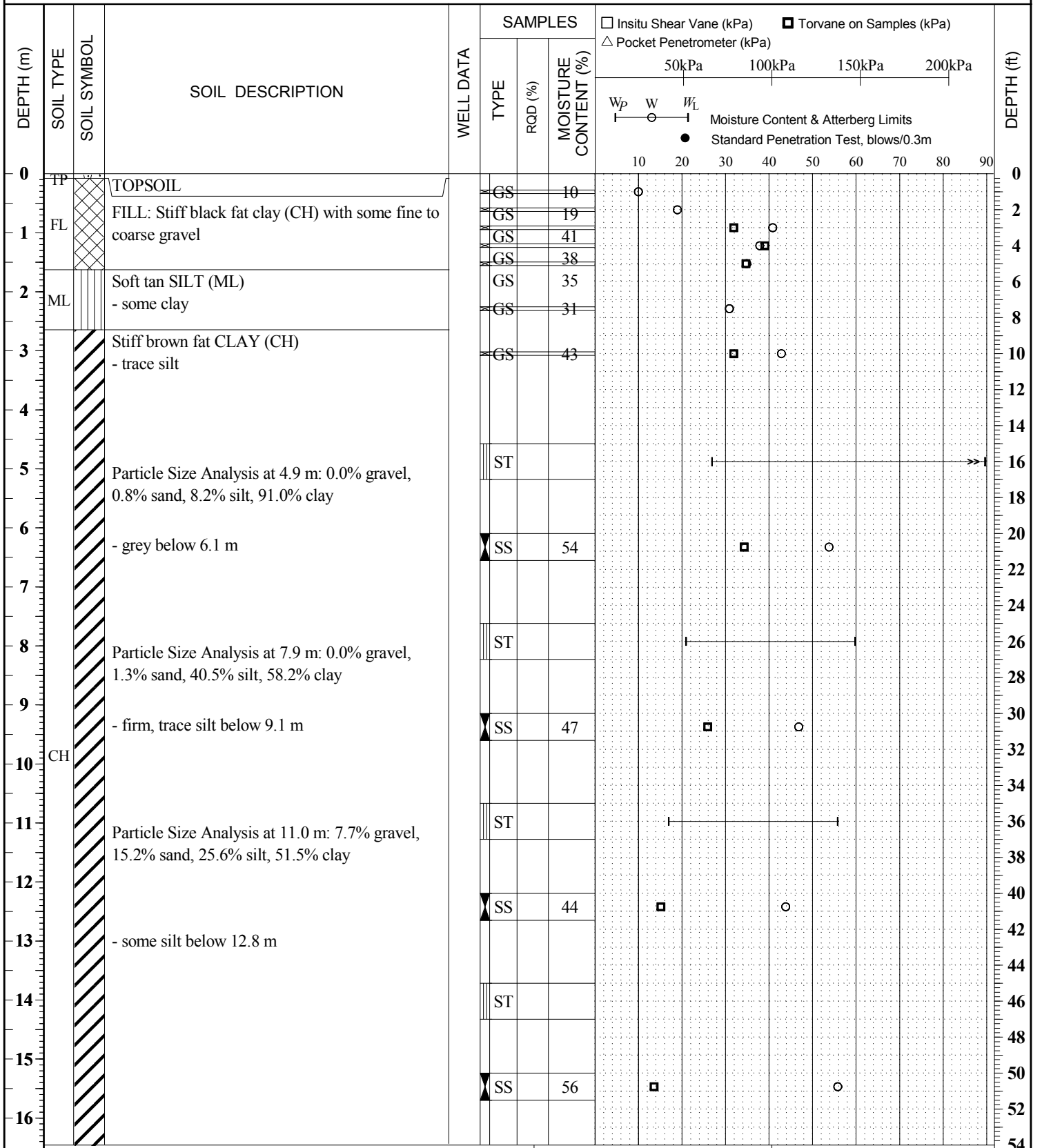
Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: Bentonite Drill Cuttings Sand Slough

Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH09 TESTHOLE RECORD

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535334.75
 LOCATION Winnipeg, Manitoba ELEVATION 231.27 m EASTING 634922.07
 DRILLING DATE October 5, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: Bentonite Drill Cuttings Sand Slough

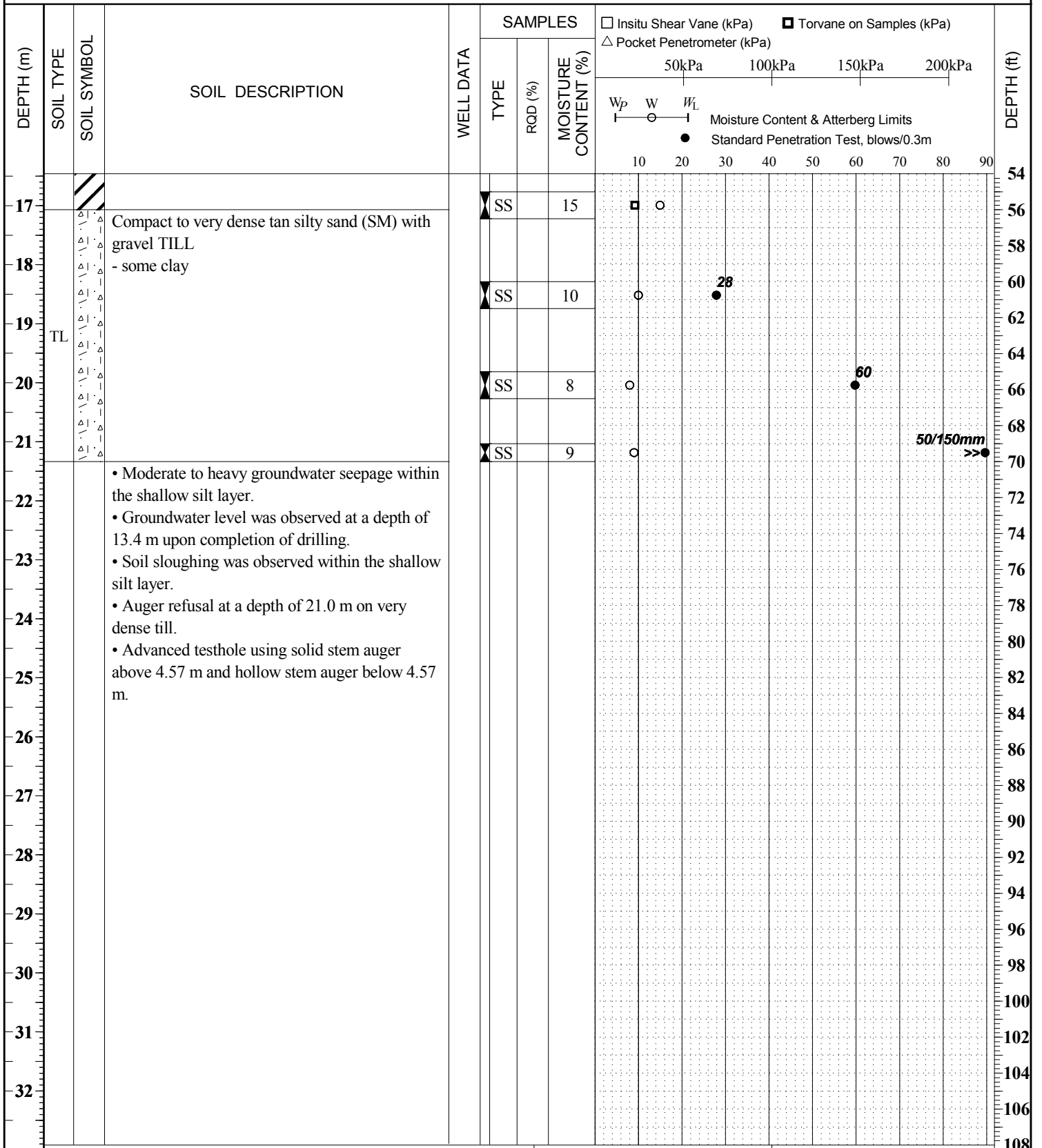
Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH09 TESTHOLE RECORD

cont'd

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535334.75
 LOCATION Winnipeg, Manitoba ELEVATION 231.27 m EASTING 634922.07
 DRILLING DATE October 5, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test

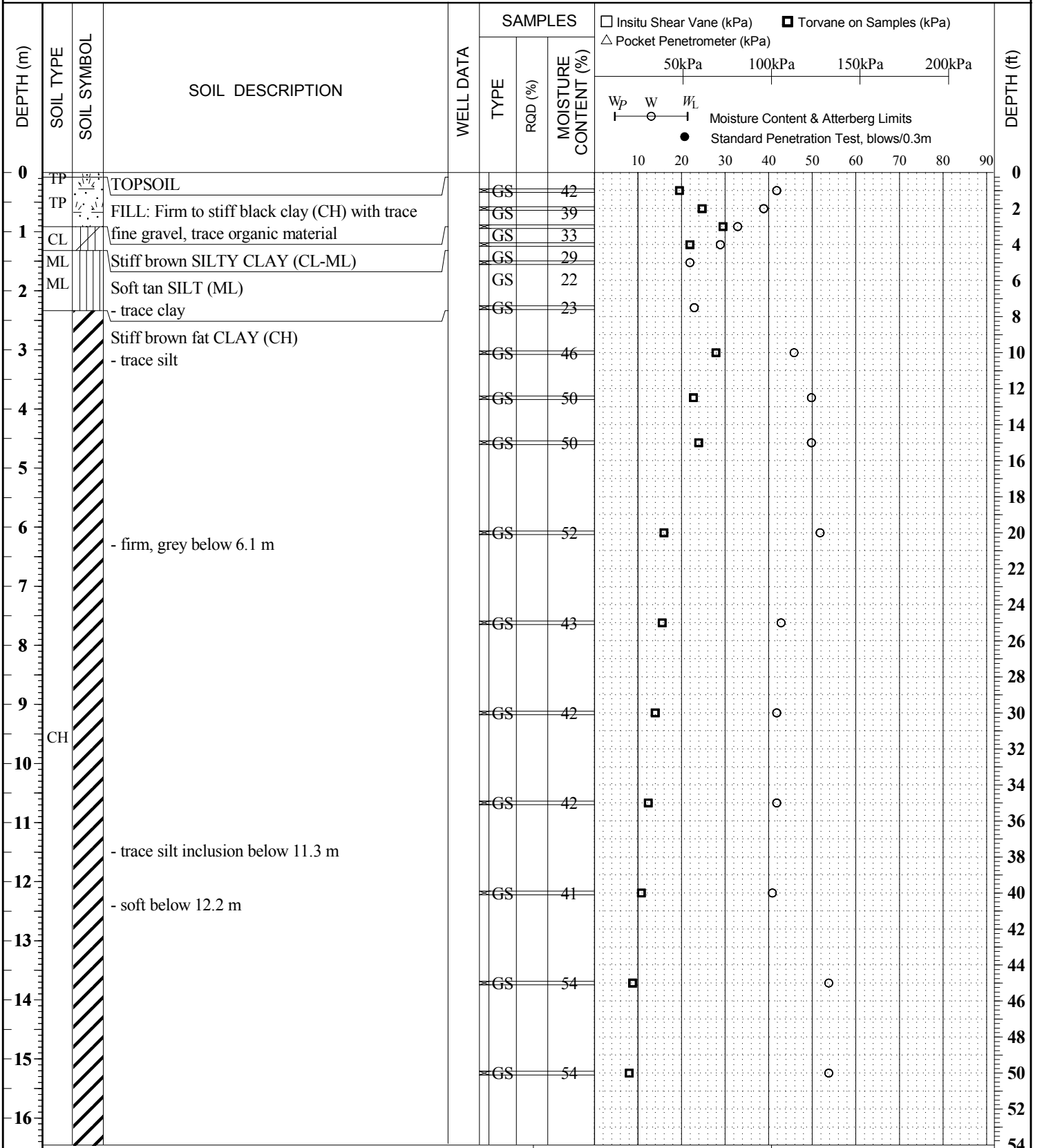
Piezometer Backfill Type: Bentonite Drill Cuttings Sand Slough

Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH10 TESTHOLE RECORD

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535307.26
 LOCATION Winnipeg, Manitoba ELEVATION 230.68 m EASTING 634993.01
 DRILLING DATE October 6, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: ■ Bentonite ⊠ Drill Cuttings □ Sand ⊞ Slough

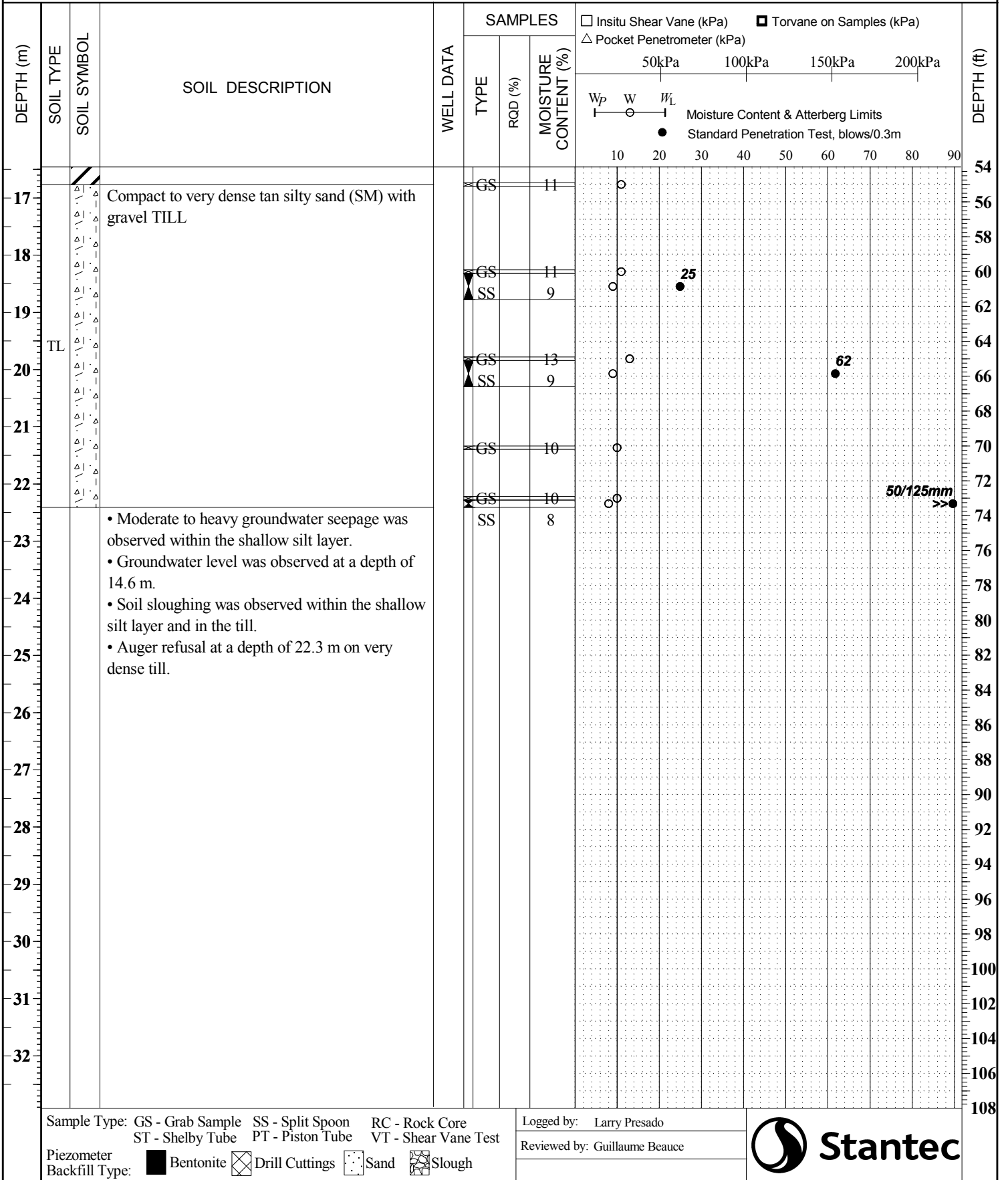
Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH10 TESTHOLE RECORD

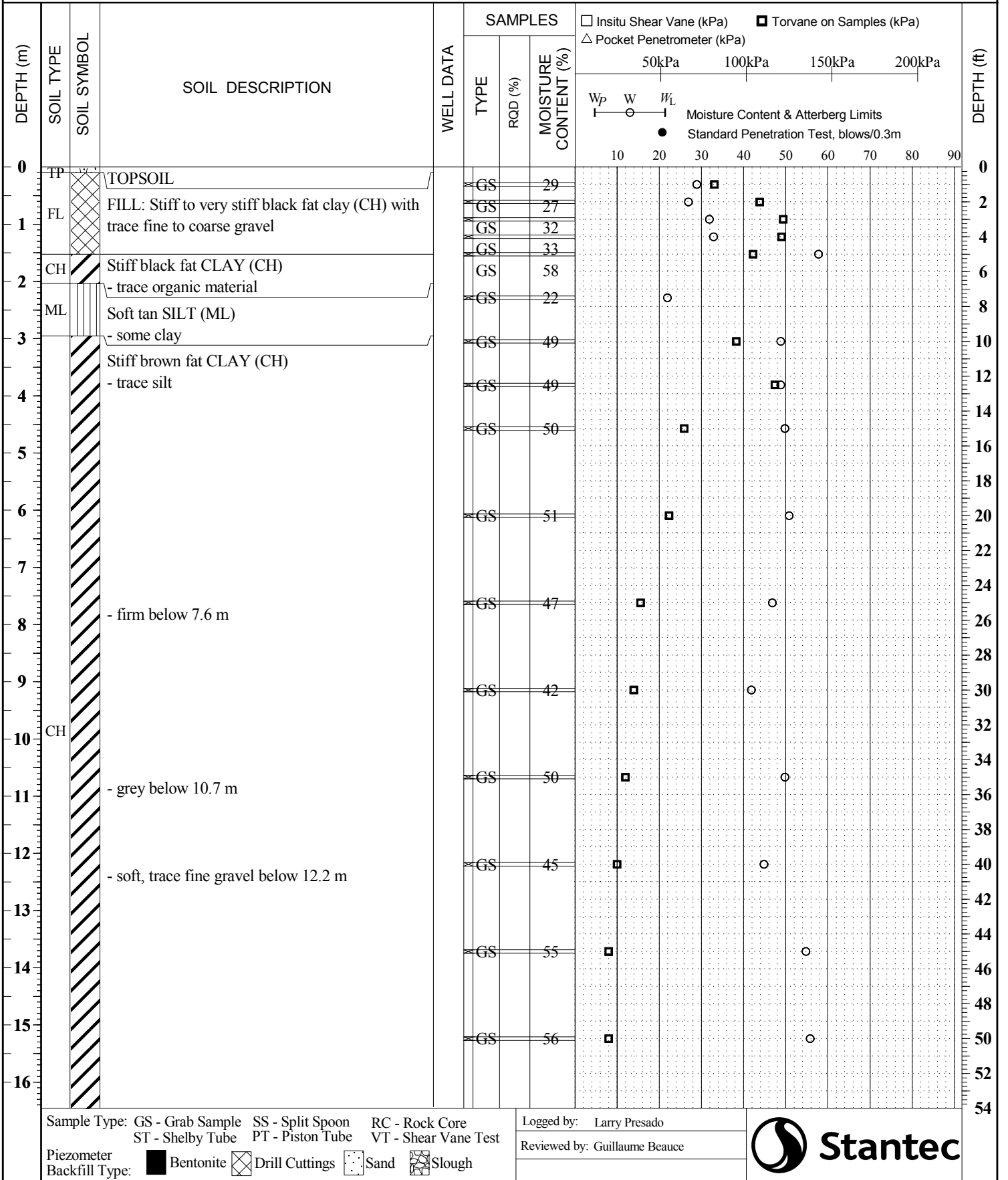
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CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535307.26
 LOCATION Winnipeg, Manitoba ELEVATION 230.68 m EASTING 634993.01
 DRILLING DATE October 6, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



TH11 TESTHOLE RECORD

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535288.04
 LOCATION Winnipeg, Manitoba ELEVATION 231.31 m EASTING 635051.97
 DRILLING DATE October 13, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: ■ Bentonite ⊠ Drill Cuttings □ Sand ⊞ Slough

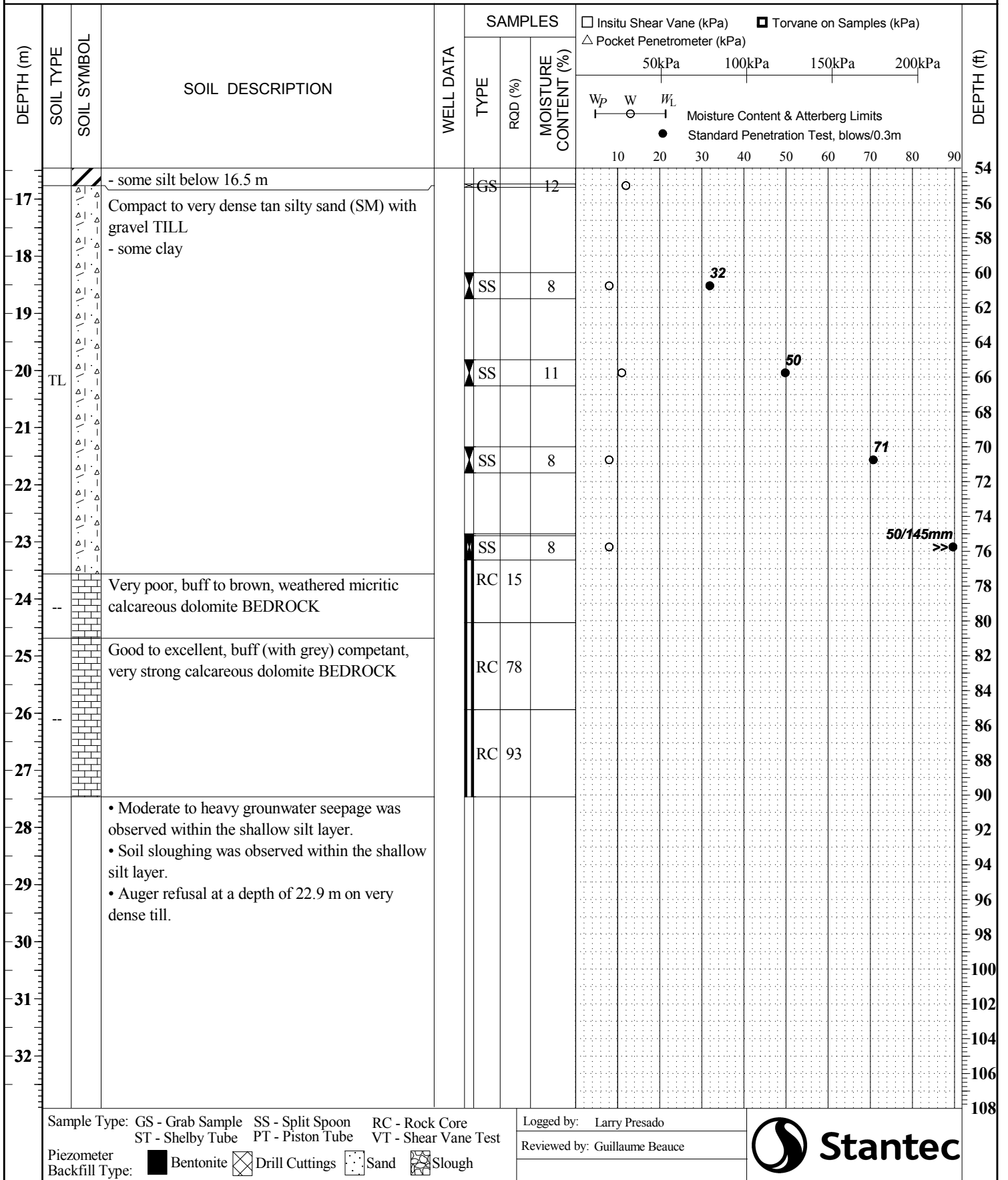
Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH11 TESTHOLE RECORD

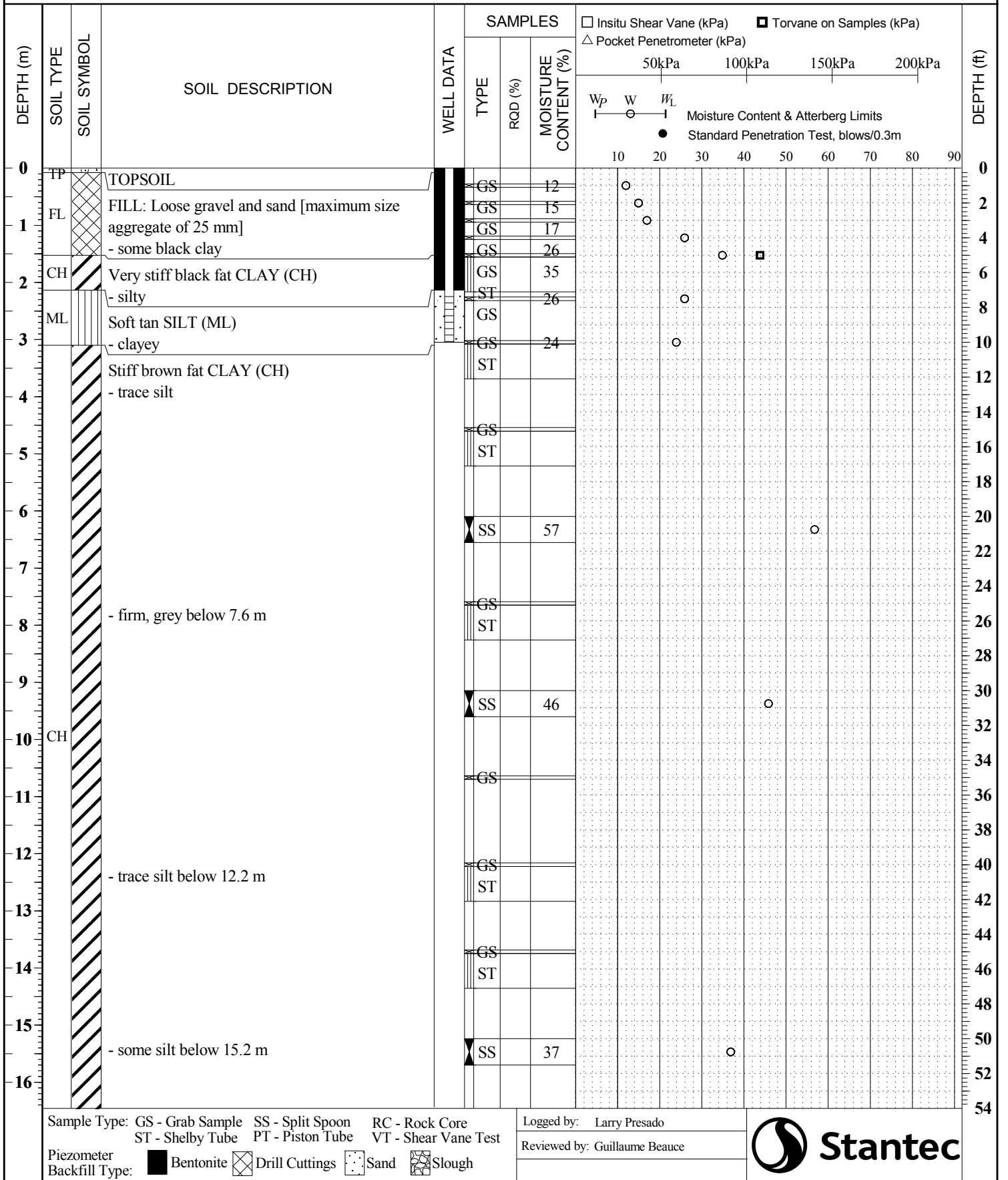
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CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535288.04
 LOCATION Winnipeg, Manitoba ELEVATION 231.31 m EASTING 635051.97
 DRILLING DATE October 13, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



TH12 TESTHOLE RECORD

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535245.59
 LOCATION Winnipeg, Manitoba ELEVATION 231.38 m EASTING 635123.03
 DRILLING DATE October 7, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: ■ Bentonite ⊠ Drill Cuttings □ Sand ⊡ Slough

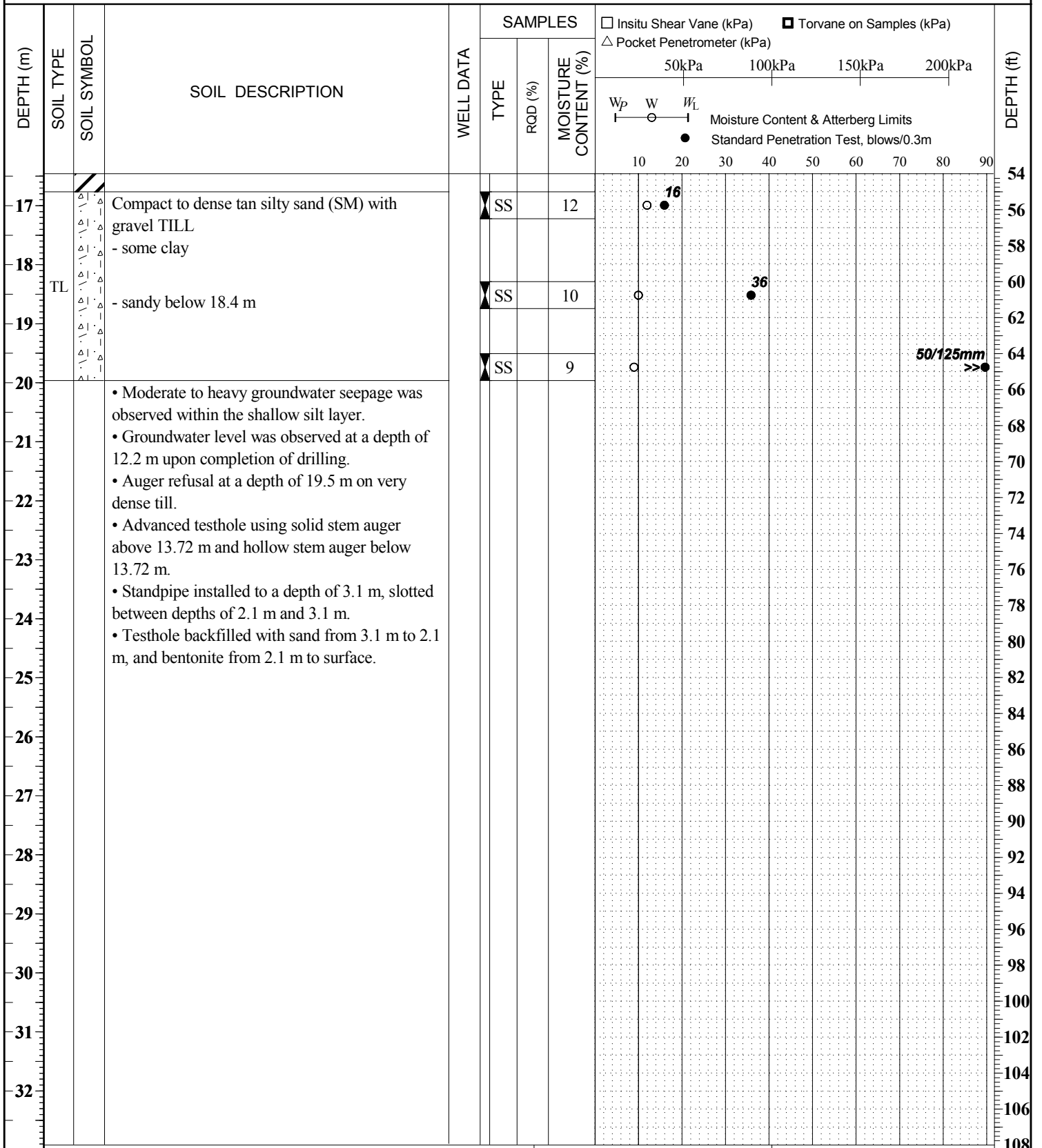
Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH12 TESTHOLE RECORD

cont'd

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535245.59
 LOCATION Winnipeg, Manitoba ELEVATION 231.38 m EASTING 635123.03
 DRILLING DATE October 7, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



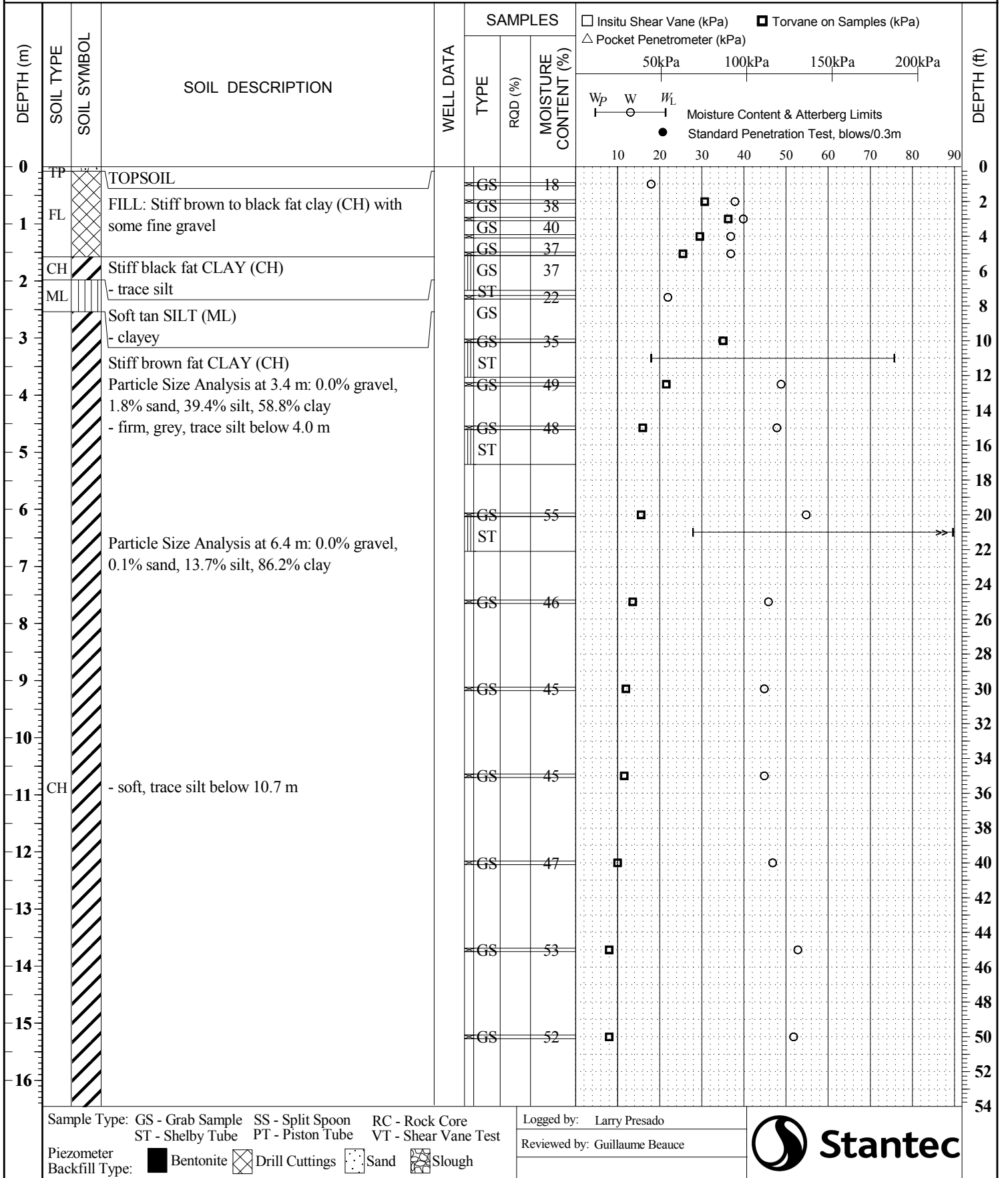
Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: Bentonite Drill Cuttings Sand Slough

Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH13 TESTHOLE RECORD

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535288
 LOCATION Winnipeg, Manitoba ELEVATION 231.32 m EASTING 635203
 DRILLING DATE October 11, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: ■ Bentonite [Cross-hatch] Drill Cuttings [Dotted] Sand [Diagonal lines] Slough [Cross-hatch]

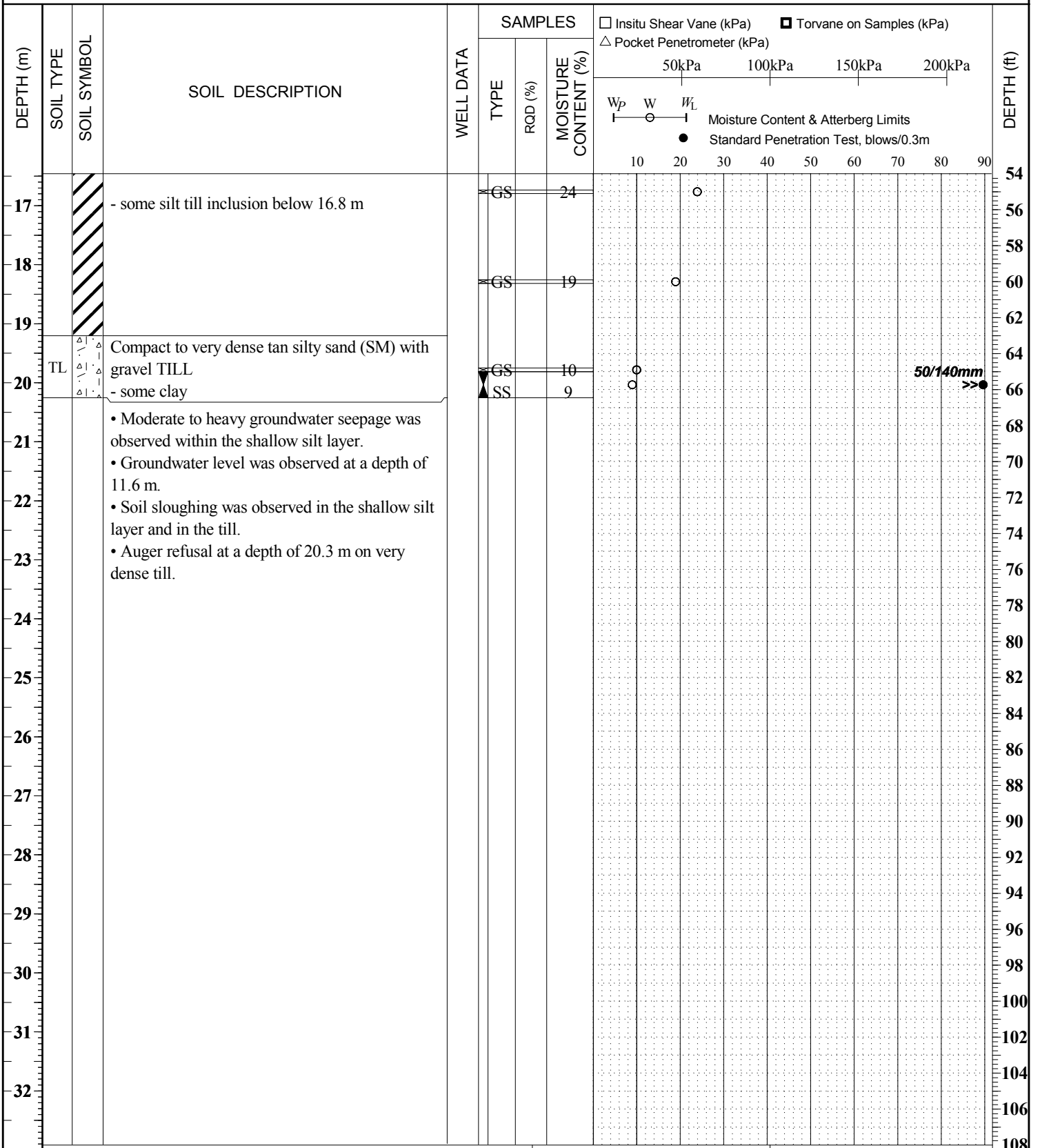
Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH13 TESTHOLE RECORD

cont'd

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535288
 LOCATION Winnipeg, Manitoba ELEVATION 231.32 m EASTING 635203
 DRILLING DATE October 11, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



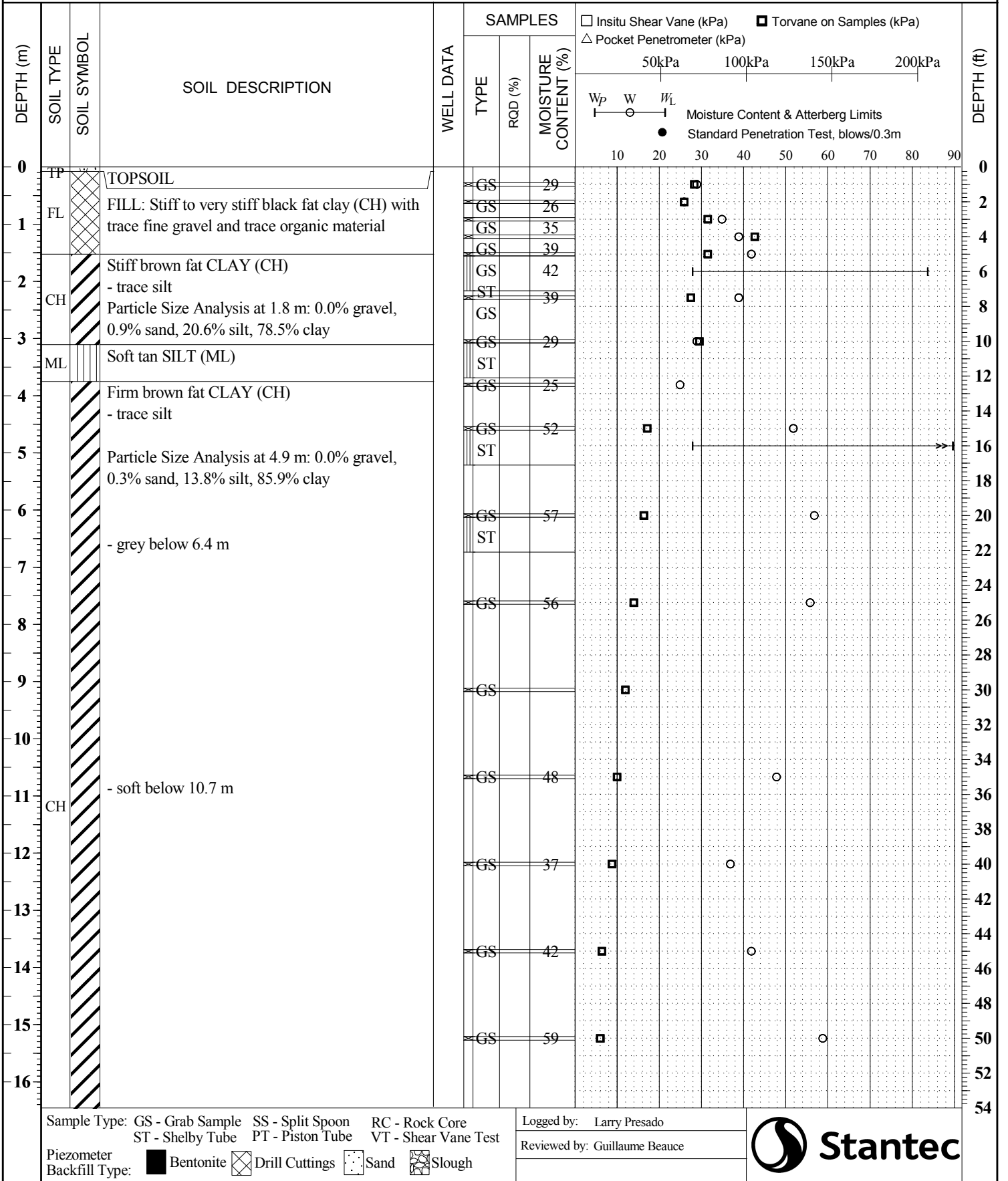
Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: Bentonite Drill Cuttings Sand Slough

Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH14 TESTHOLE RECORD

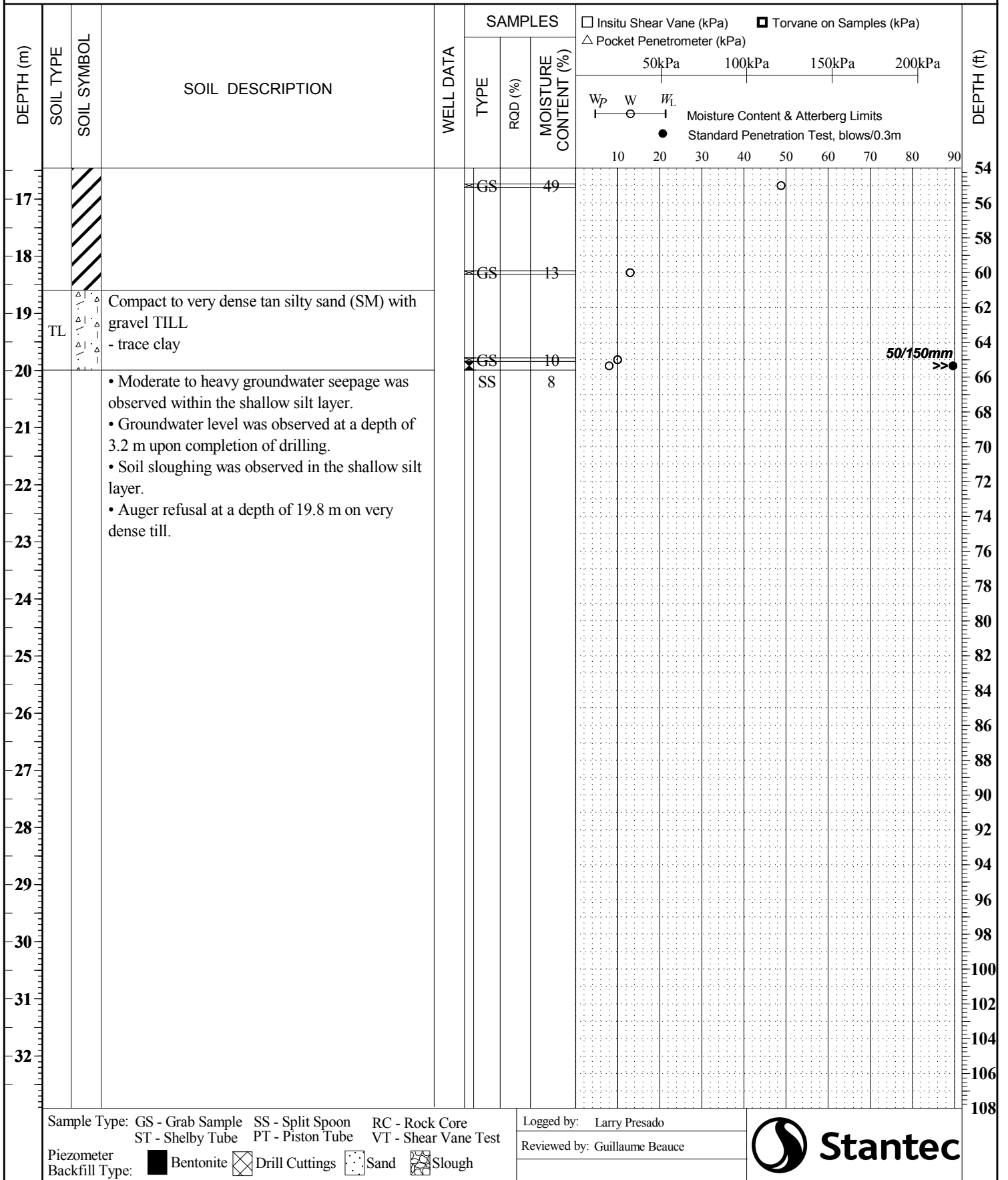
CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535209.871
 LOCATION Winnipeg, Manitoba ELEVATION 231.73 m EASTING 635202.526
 DRILLING DATE September 22, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



TH14 TESTHOLE RECORD

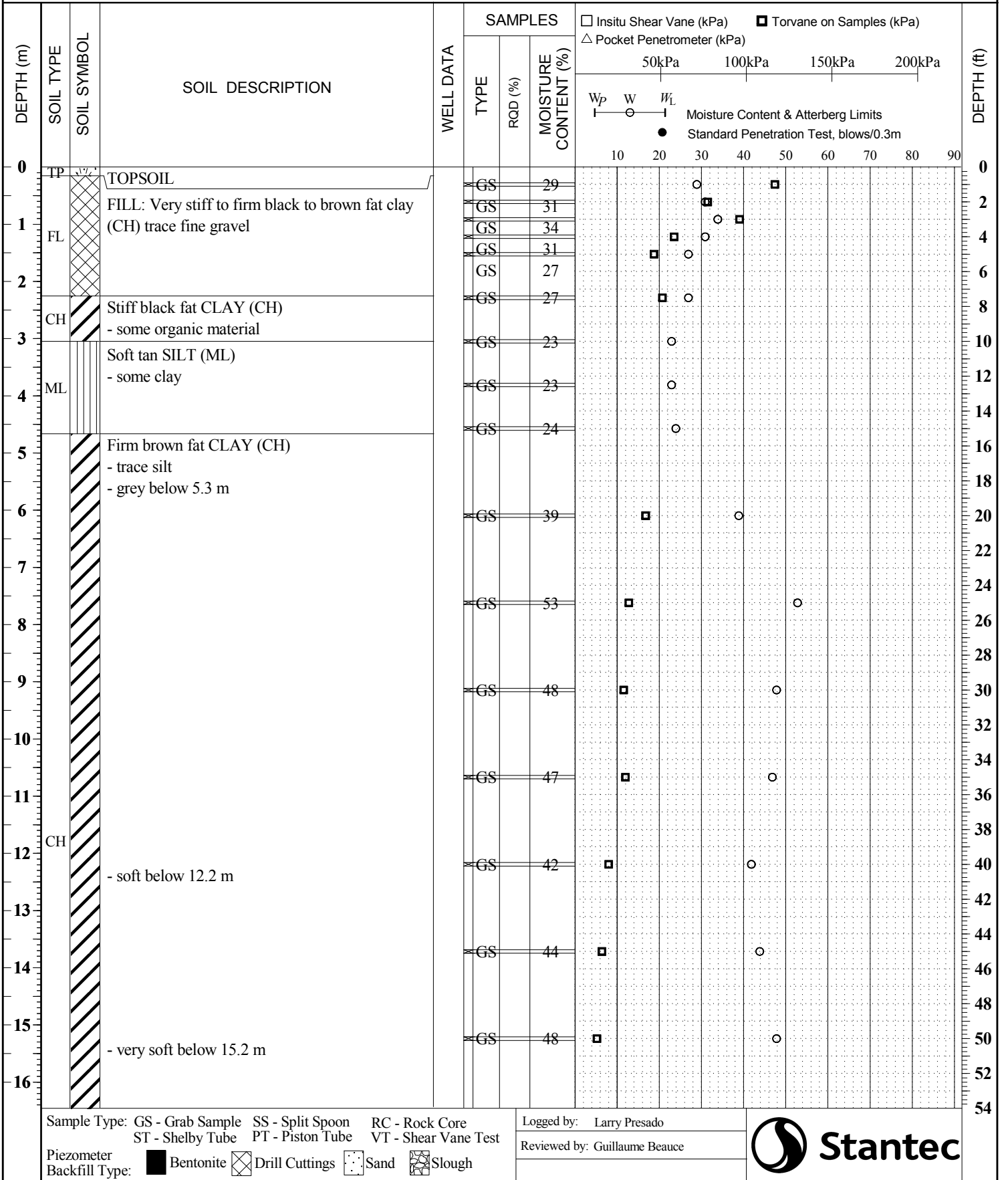
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CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535209.871
 LOCATION Winnipeg, Manitoba ELEVATION 231.73 m EASTING 635202.526
 DRILLING DATE September 22, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



TH15 TESTHOLE RECORD

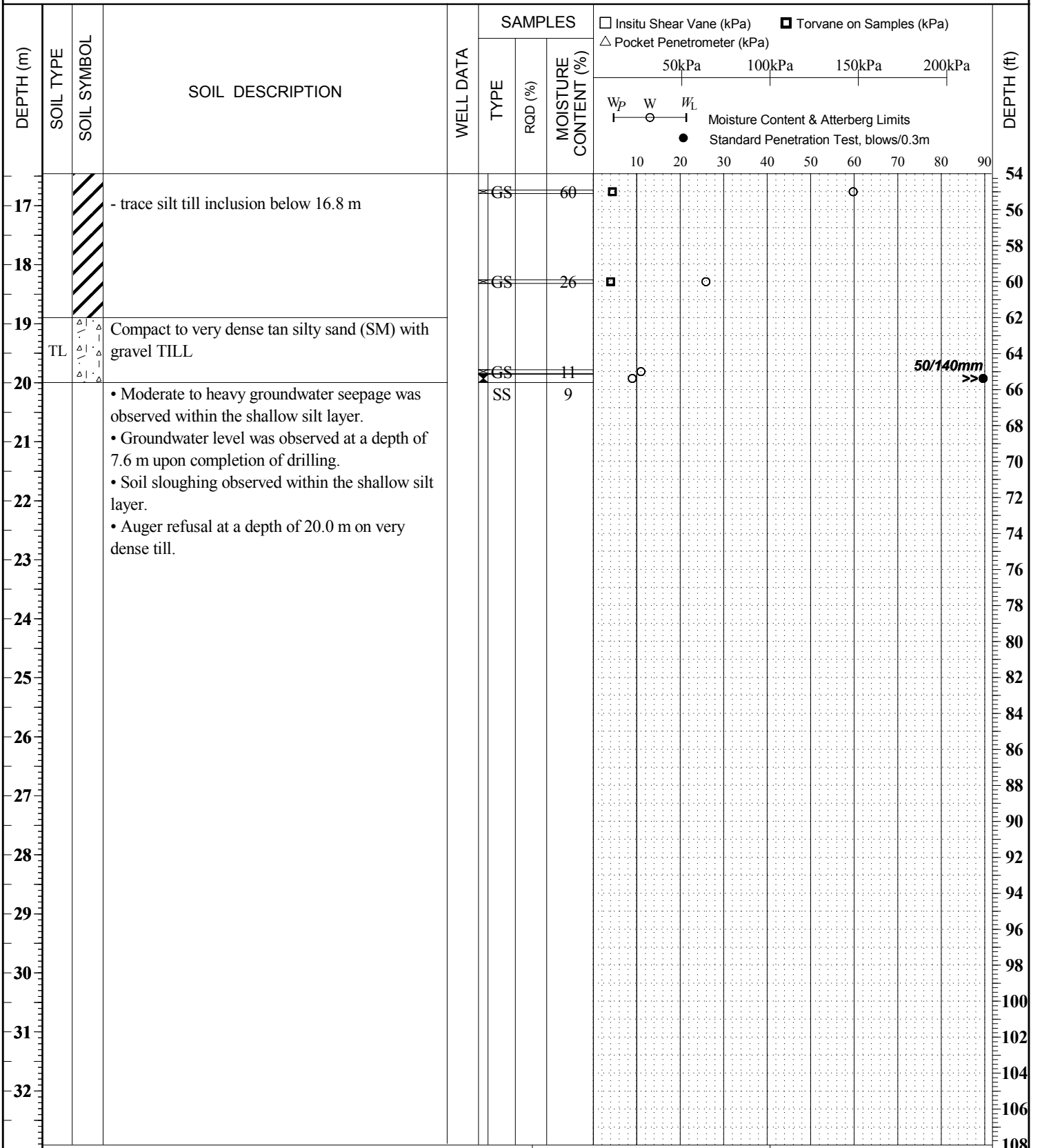
CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535294.543
 LOCATION Winnipeg, Manitoba ELEVATION 232.18 m EASTING 635340.298
 DRILLING DATE September 21, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



TH15 TESTHOLE RECORD

cont'd

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535294.543
 LOCATION Winnipeg, Manitoba ELEVATION 232.18 m EASTING 635340.298
 DRILLING DATE September 21, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



50/140mm >>>

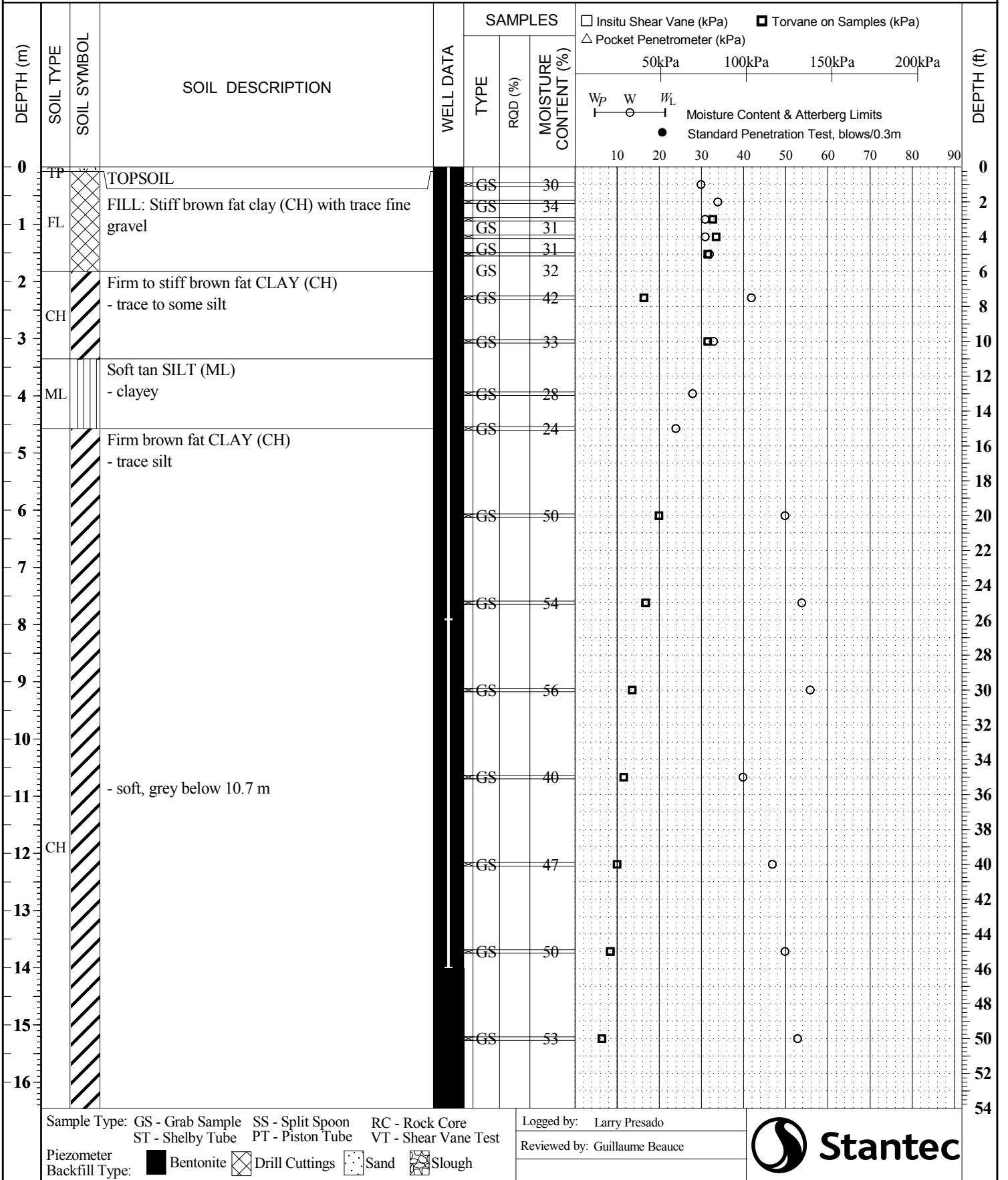
Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: ■ Bentonite ⊠ Drill Cuttings □ Sand ⊞ Slough

Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH16 TESTHOLE RECORD

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535205
 LOCATION Winnipeg, Manitoba ELEVATION 232.32 m EASTING 635252
 DRILLING DATE September 30, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: ■ Bentonite ⊠ Drill Cuttings □ Sand ⊞ Slough

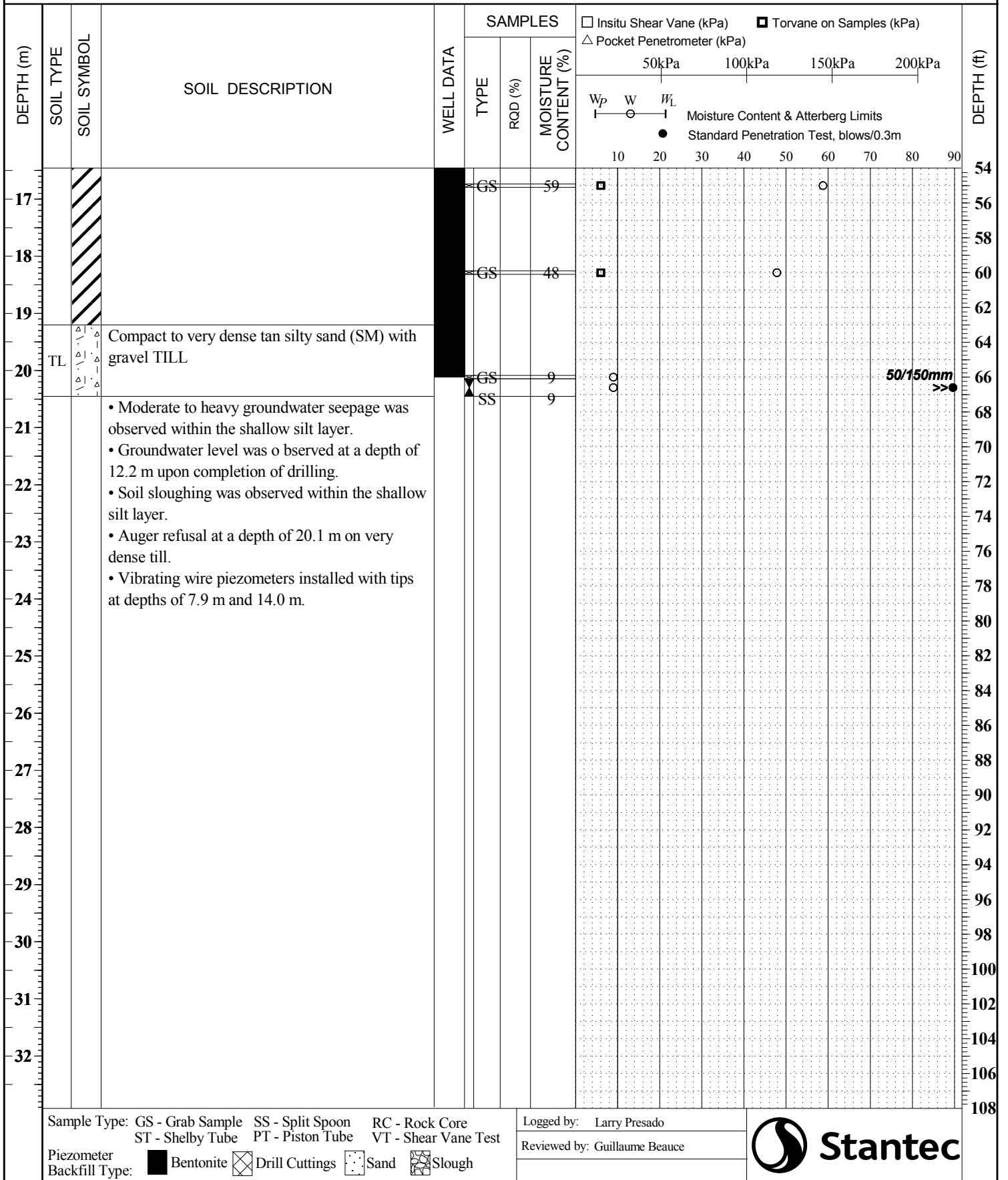
Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH16 TESTHOLE RECORD

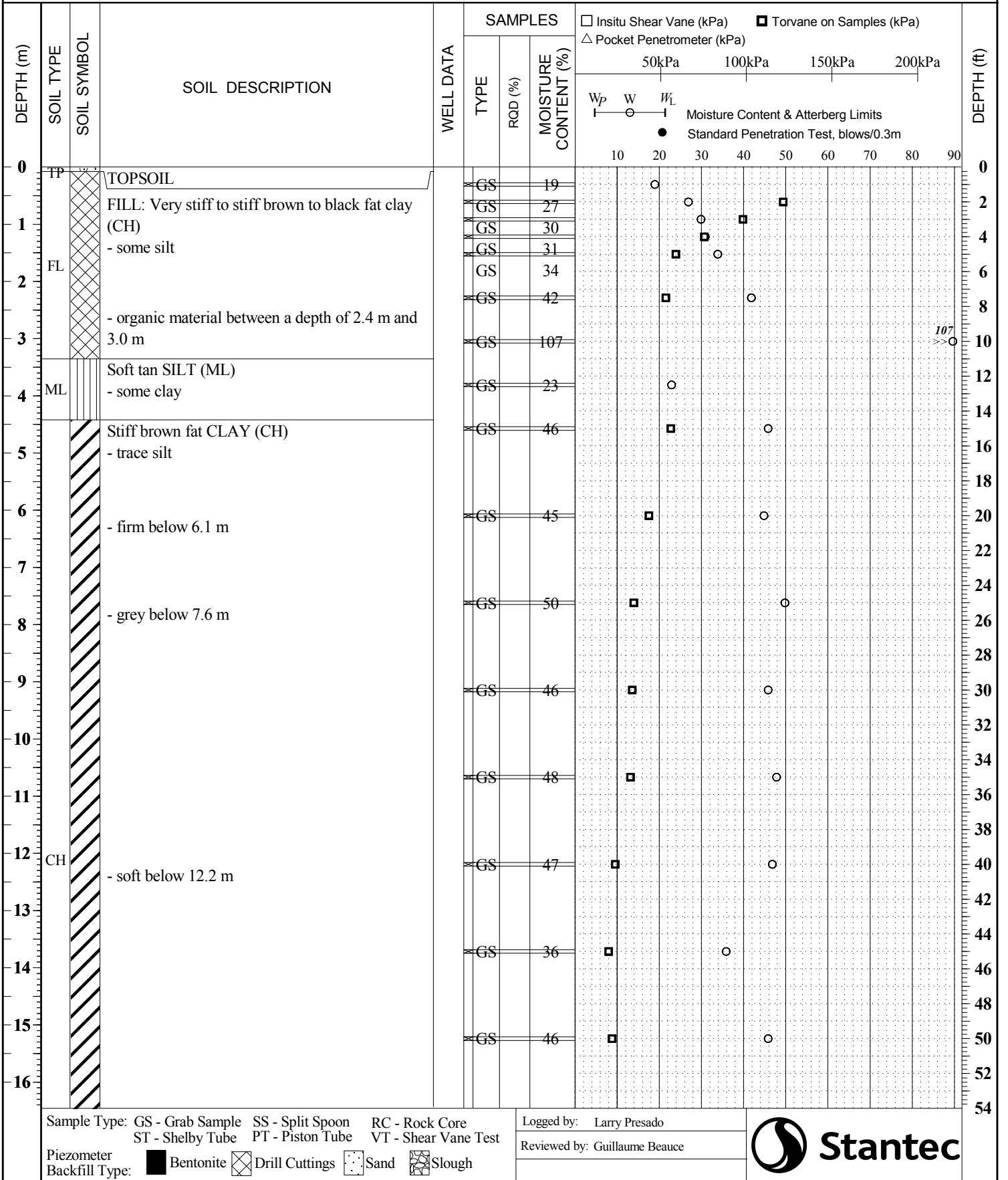
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CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535205
 LOCATION Winnipeg, Manitoba ELEVATION 232.32 m EASTING 635252
 DRILLING DATE September 30, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



TH17 TESTHOLE RECORD

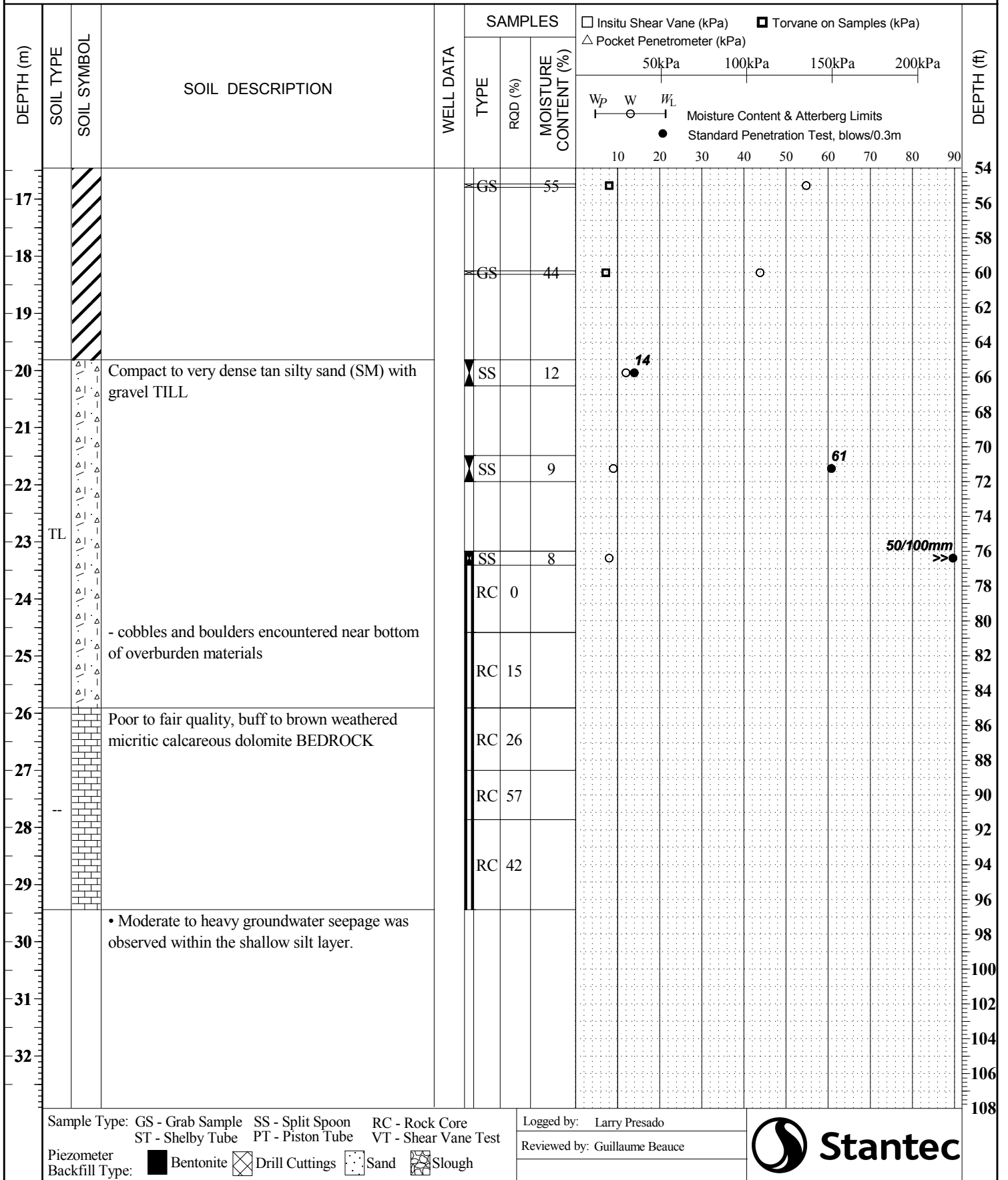
CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535182
 LOCATION Winnipeg, Manitoba ELEVATION 232.52 m EASTING 635292
 DRILLING DATE September 27, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



TH17 TESTHOLE RECORD

cont'd

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535182
 LOCATION Winnipeg, Manitoba ELEVATION 232.52 m EASTING 635292
 DRILLING DATE September 27, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



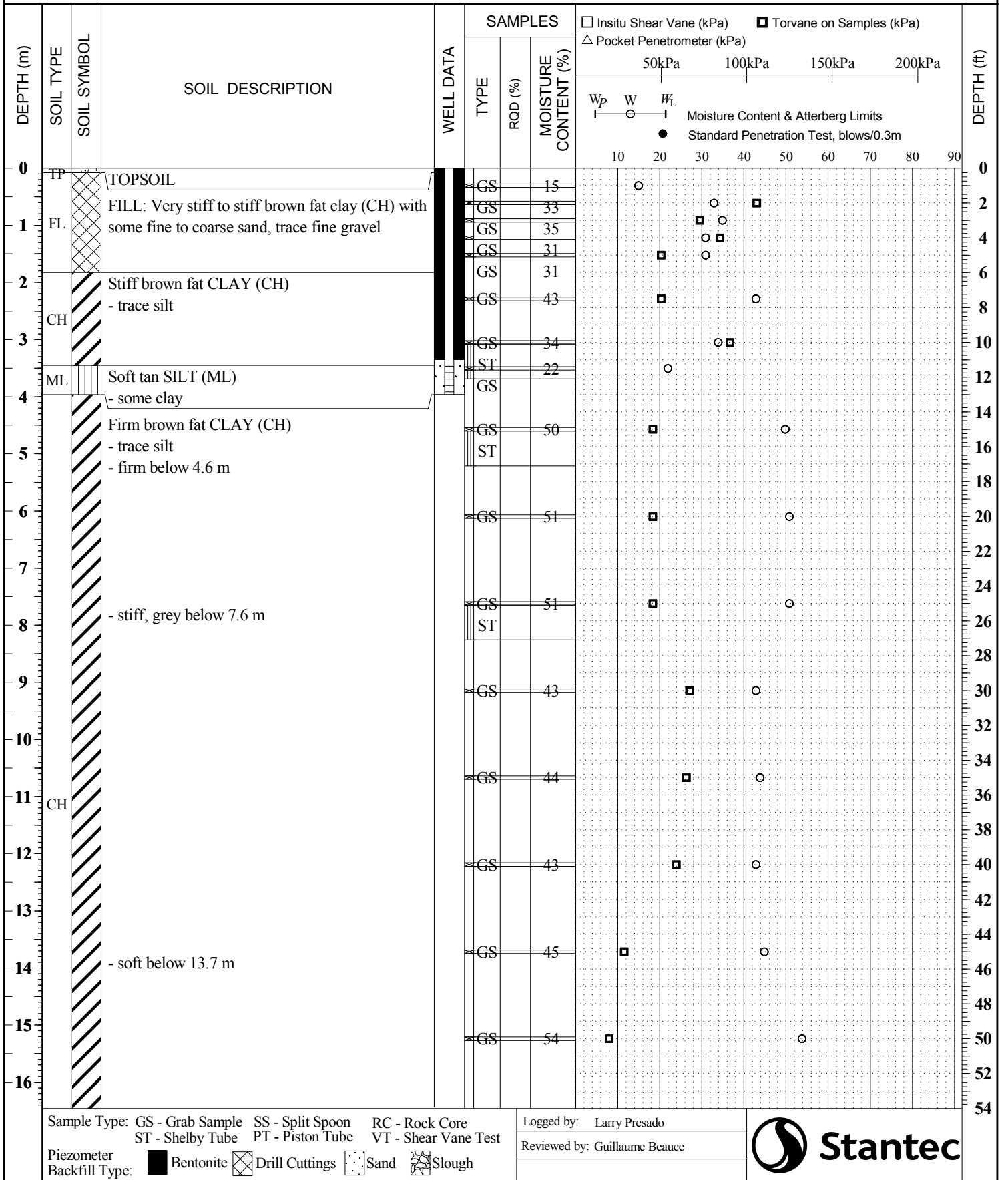
Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: ■ Bentonite ⊠ Drill Cuttings □ Sand ⊞ Slough

Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH18 TESTHOLE RECORD

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535160
 LOCATION Winnipeg, Manitoba ELEVATION 232.01 m EASTING 635334
 DRILLING DATE October 3, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: Bentonite
 Drill Cuttings
 Sand
 Slough

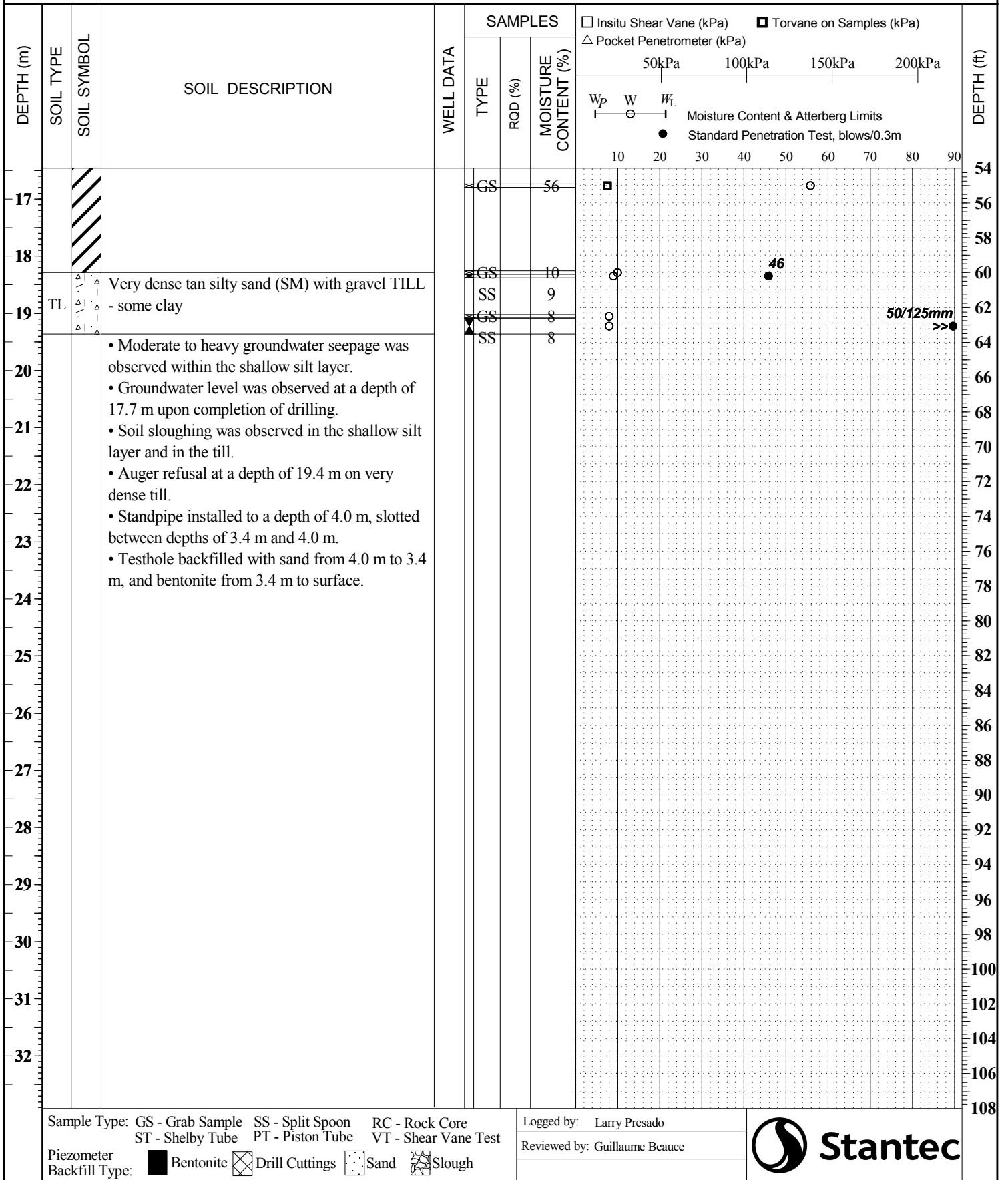
Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH18 TESTHOLE RECORD

cont'd

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535160
 LOCATION Winnipeg, Manitoba ELEVATION 232.01 m EASTING 635334
 DRILLING DATE October 3, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



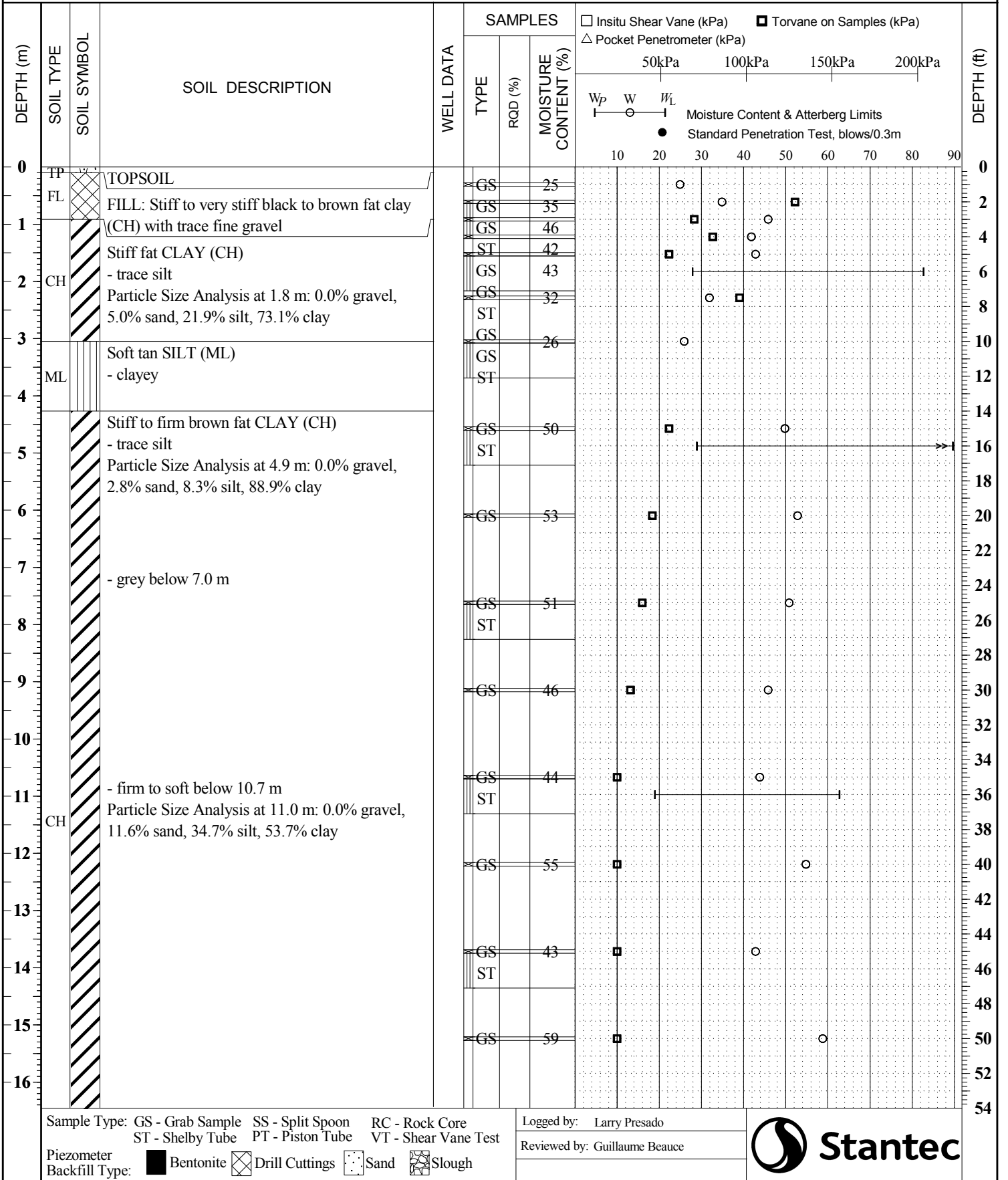
Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: ■ Bentonite ⊠ Drill Cuttings □ Sand ⊞ Slough

Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH19 TESTHOLE RECORD

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535147.021
 LOCATION Winnipeg, Manitoba ELEVATION 231.15 m EASTING 635377.014
 DRILLING DATE September 21, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: ■ Bentonite ⊠ Drill Cuttings □ Sand ⊞ Slough

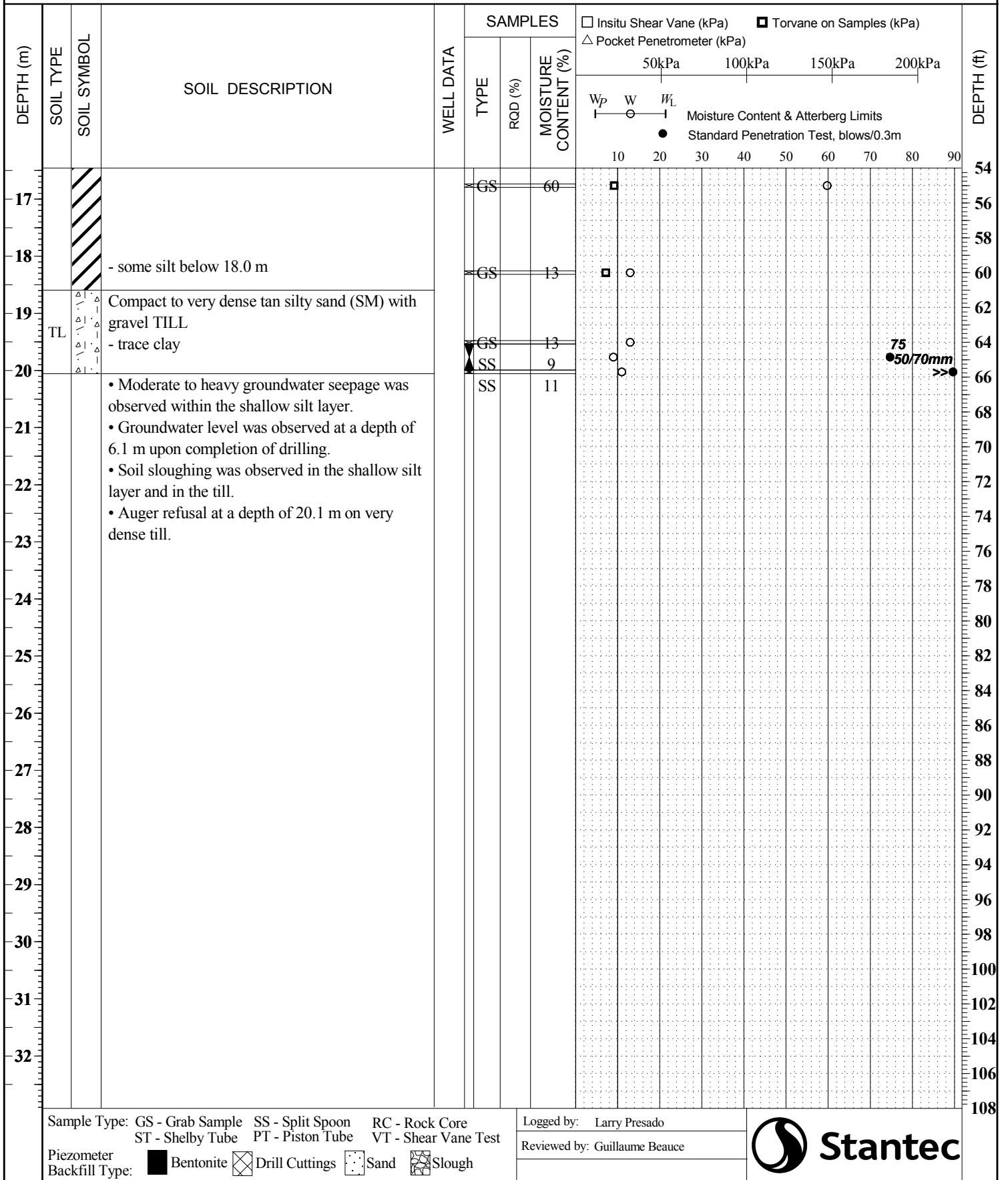
Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH19 TESTHOLE RECORD

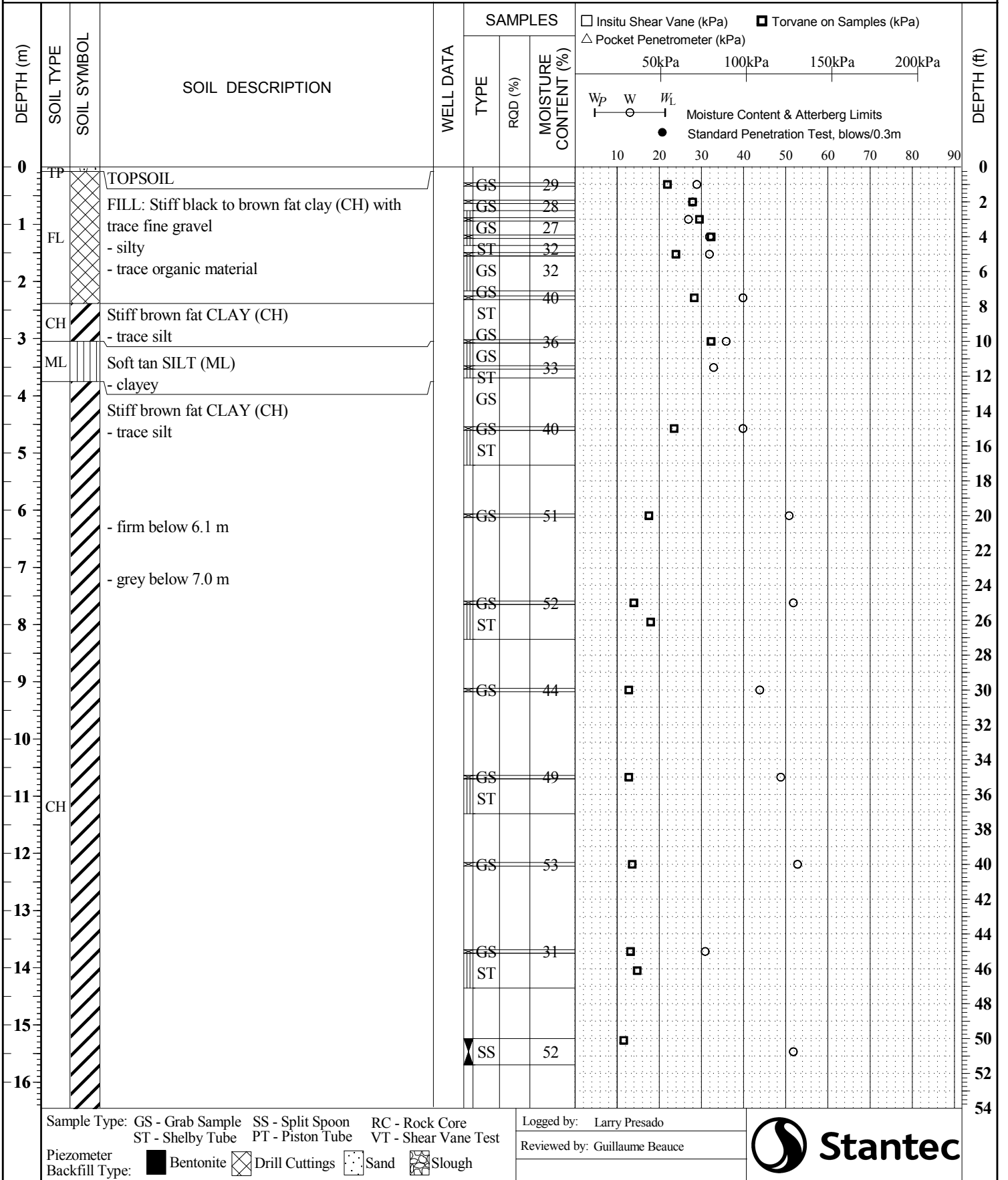
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CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535147.021
 LOCATION Winnipeg, Manitoba ELEVATION 231.15 m EASTING 635377.014
 DRILLING DATE September 21, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



TH20 TESTHOLE RECORD

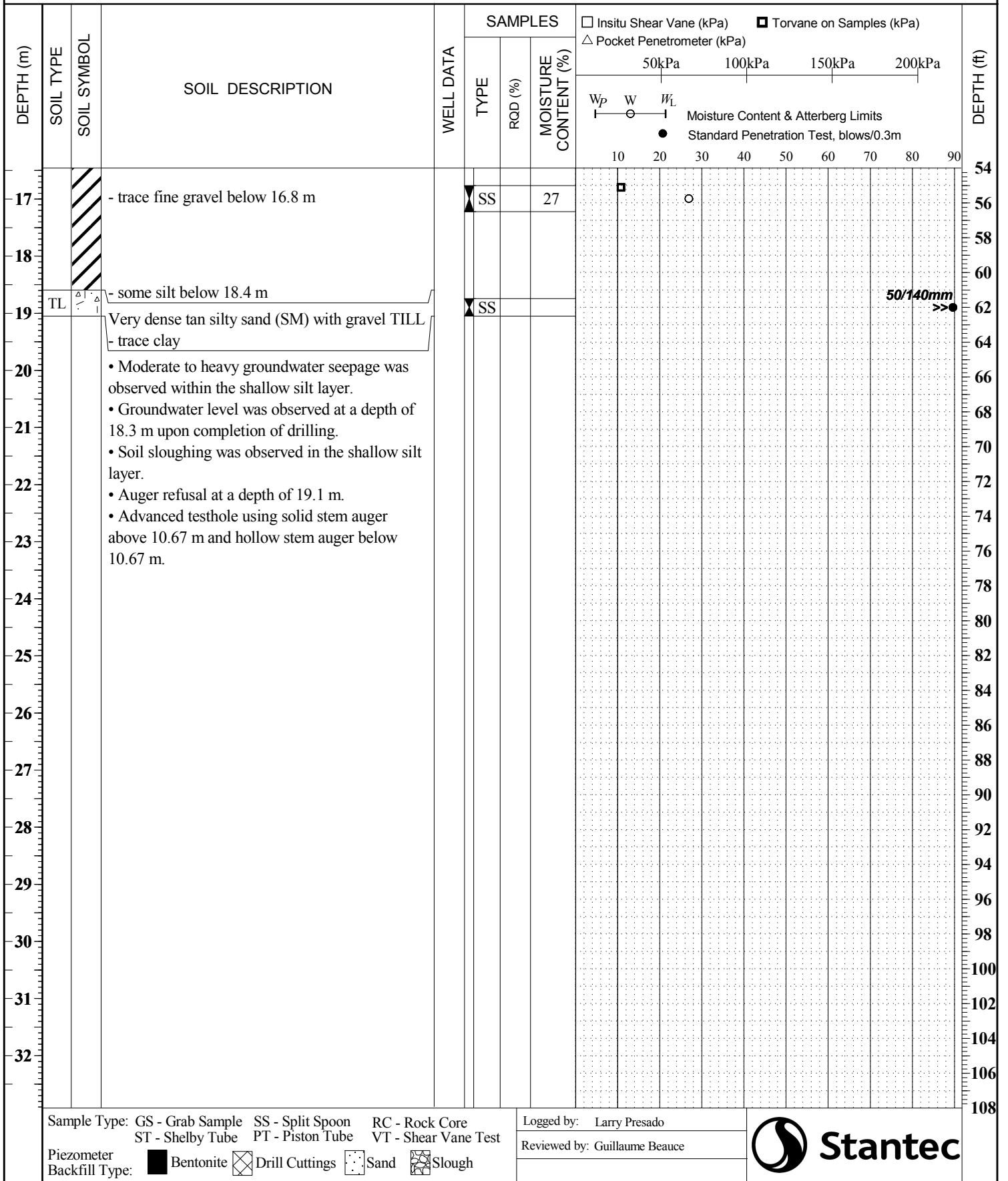
CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535147.011
 LOCATION Winnipeg, Manitoba ELEVATION 232.04 m EASTING 635221.993
 DRILLING DATE September 23, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA







TH20 TESTHOLE RECORD

cont'd

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535147.011
 LOCATION Winnipeg, Manitoba ELEVATION 232.04 m EASTING 635221.993
 DRILLING DATE September 23, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



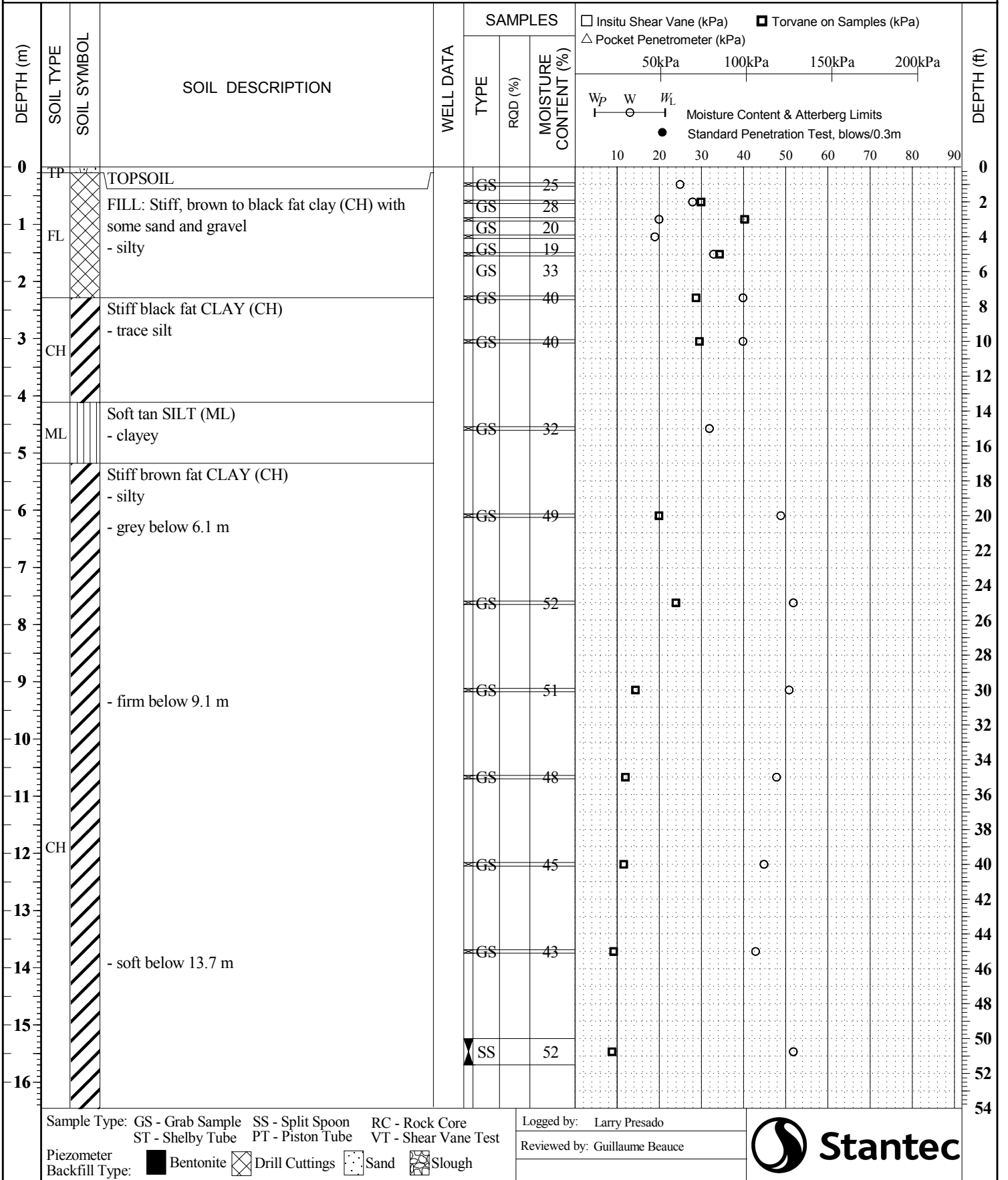
Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type:  Bentonite  Drill Cuttings  Sand  Slough

Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH21 TESTHOLE RECORD

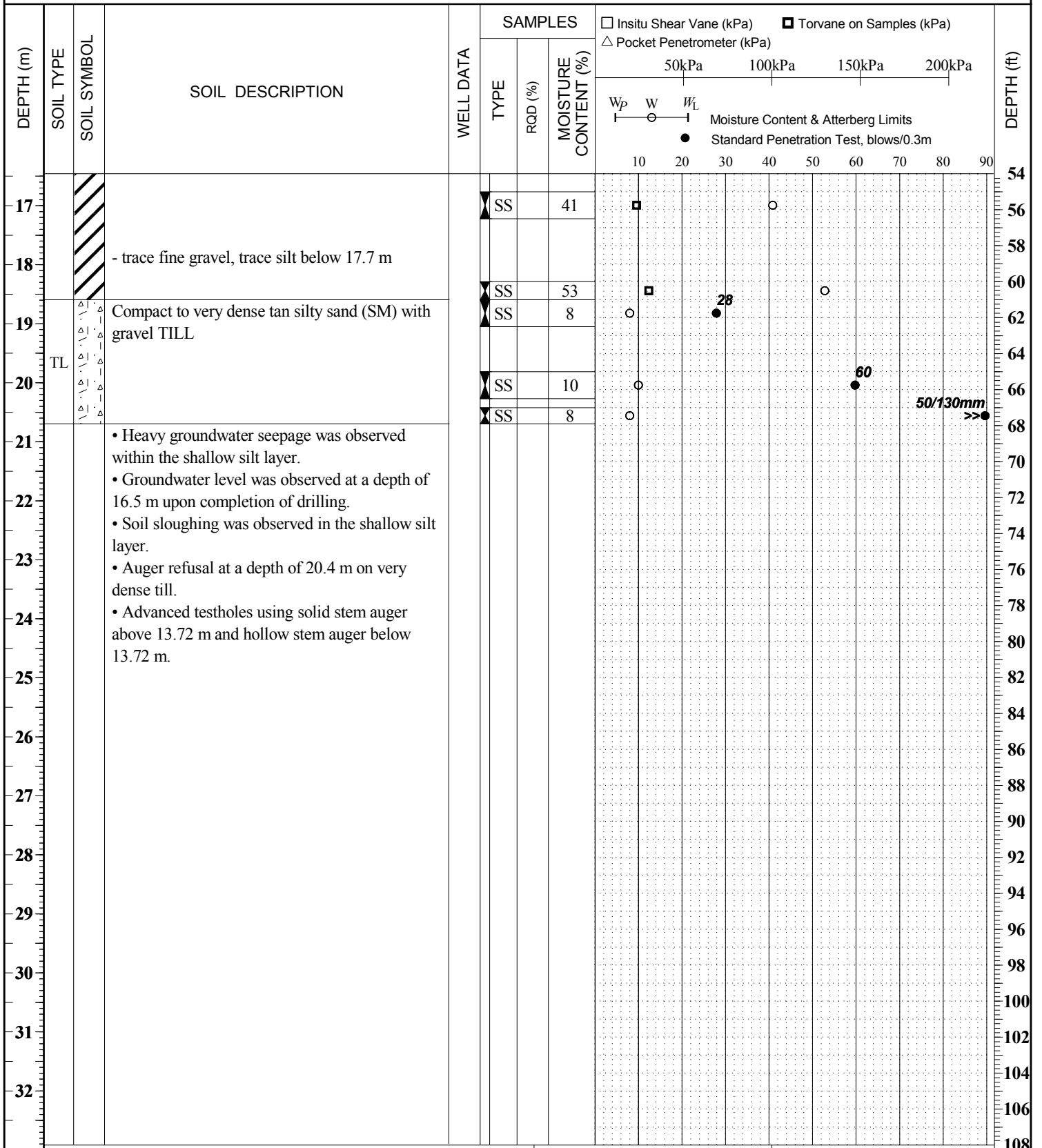
CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535117.956
 LOCATION Winnipeg, Manitoba ELEVATION 232.34 m EASTING 635258.987
 DRILLING DATE September 23, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



TH21 TESTHOLE RECORD

cont'd

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535117.956
 LOCATION Winnipeg, Manitoba ELEVATION 232.34 m EASTING 635258.987
 DRILLING DATE September 23, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test

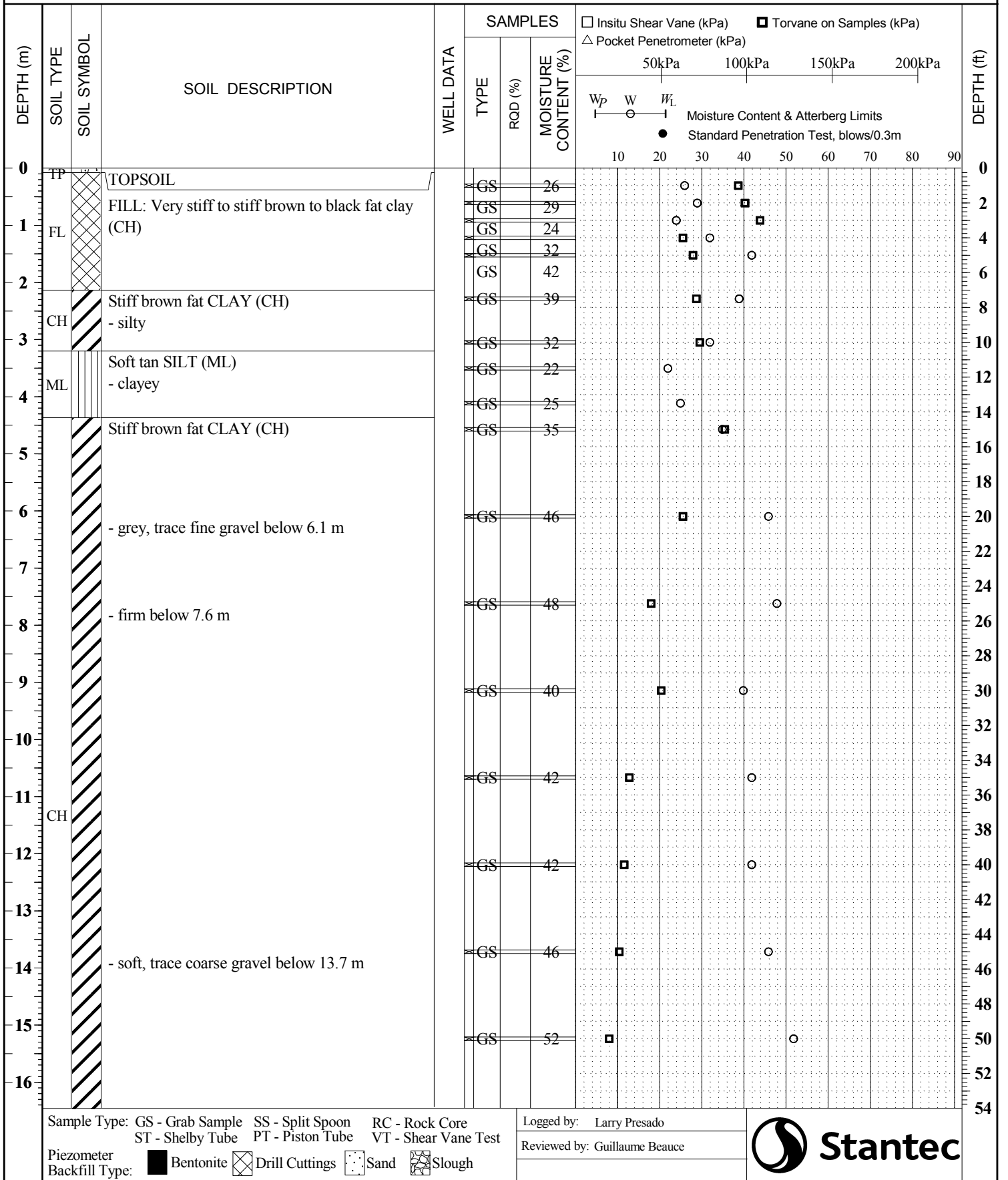
Piezometer Backfill Type: Bentonite Drill Cuttings Sand Slough

Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH22 TESTHOLE RECORD

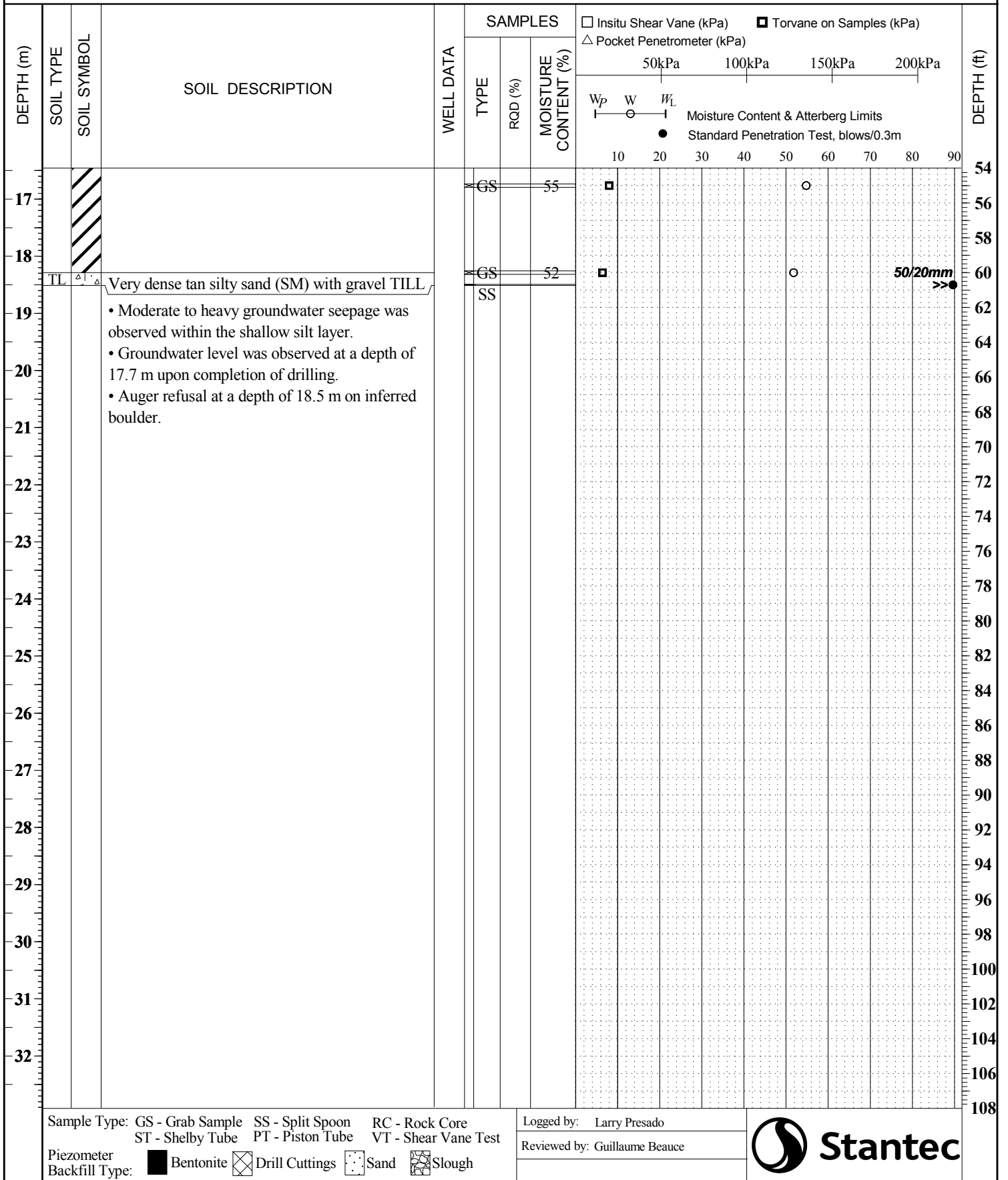
CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535092.945
 LOCATION Winnipeg, Manitoba ELEVATION 232.07 m EASTING 635300.956
 DRILLING DATE September 26, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



TH22 TESTHOLE RECORD

cont'd

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535092.945
 LOCATION Winnipeg, Manitoba ELEVATION 232.07 m EASTING 635300.956
 DRILLING DATE September 26, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



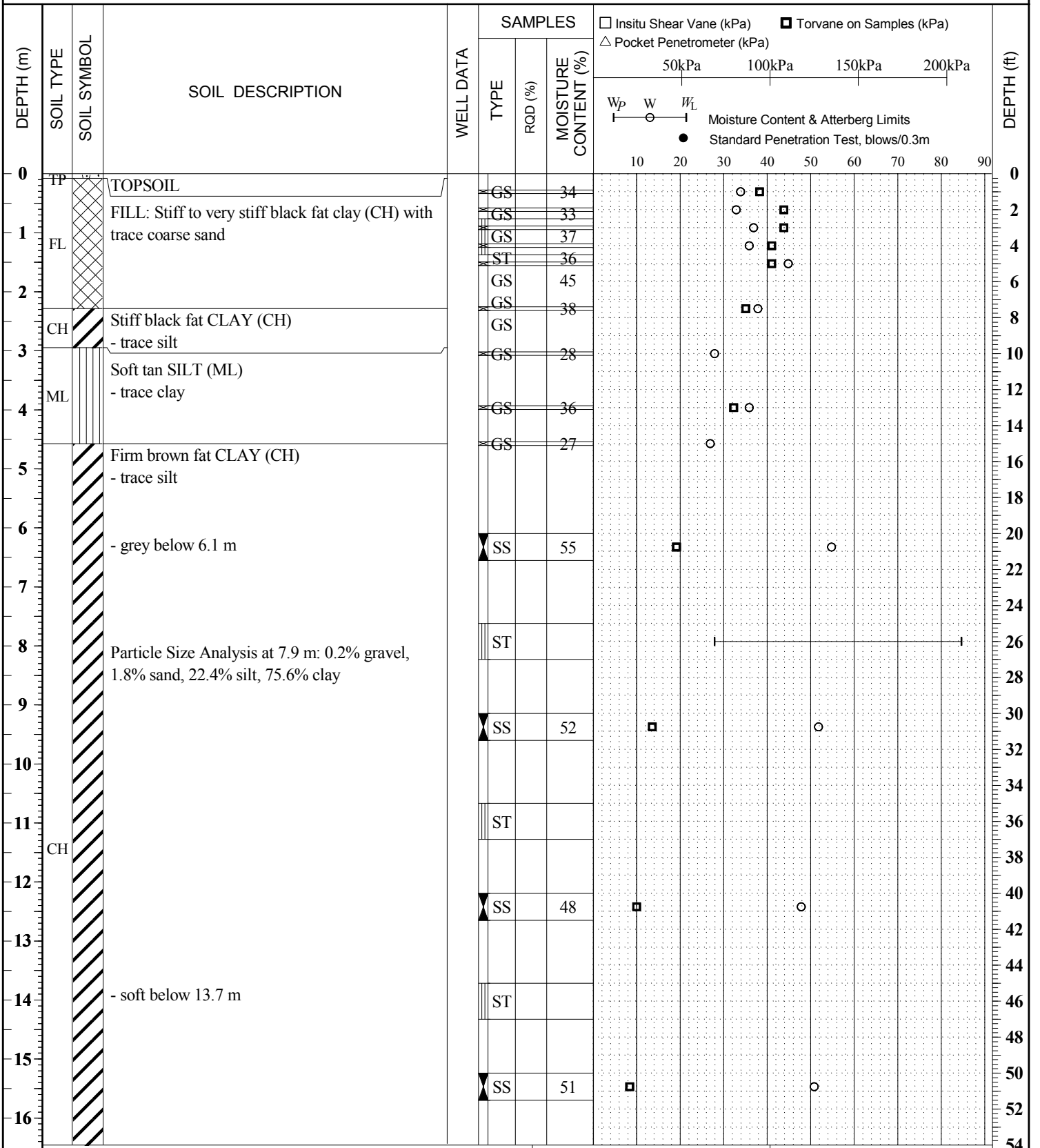
Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: ■ Bentonite ⊠ Drill Cuttings □ Sand ⊞ Slough

Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH23 TESTHOLE RECORD

CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535077.997
 LOCATION Winnipeg, Manitoba ELEVATION 231.95 m EASTING 635344.98
 DRILLING DATE September 26, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: ■ Bentonite ⊠ Drill Cuttings □ Sand ⊞ Slough

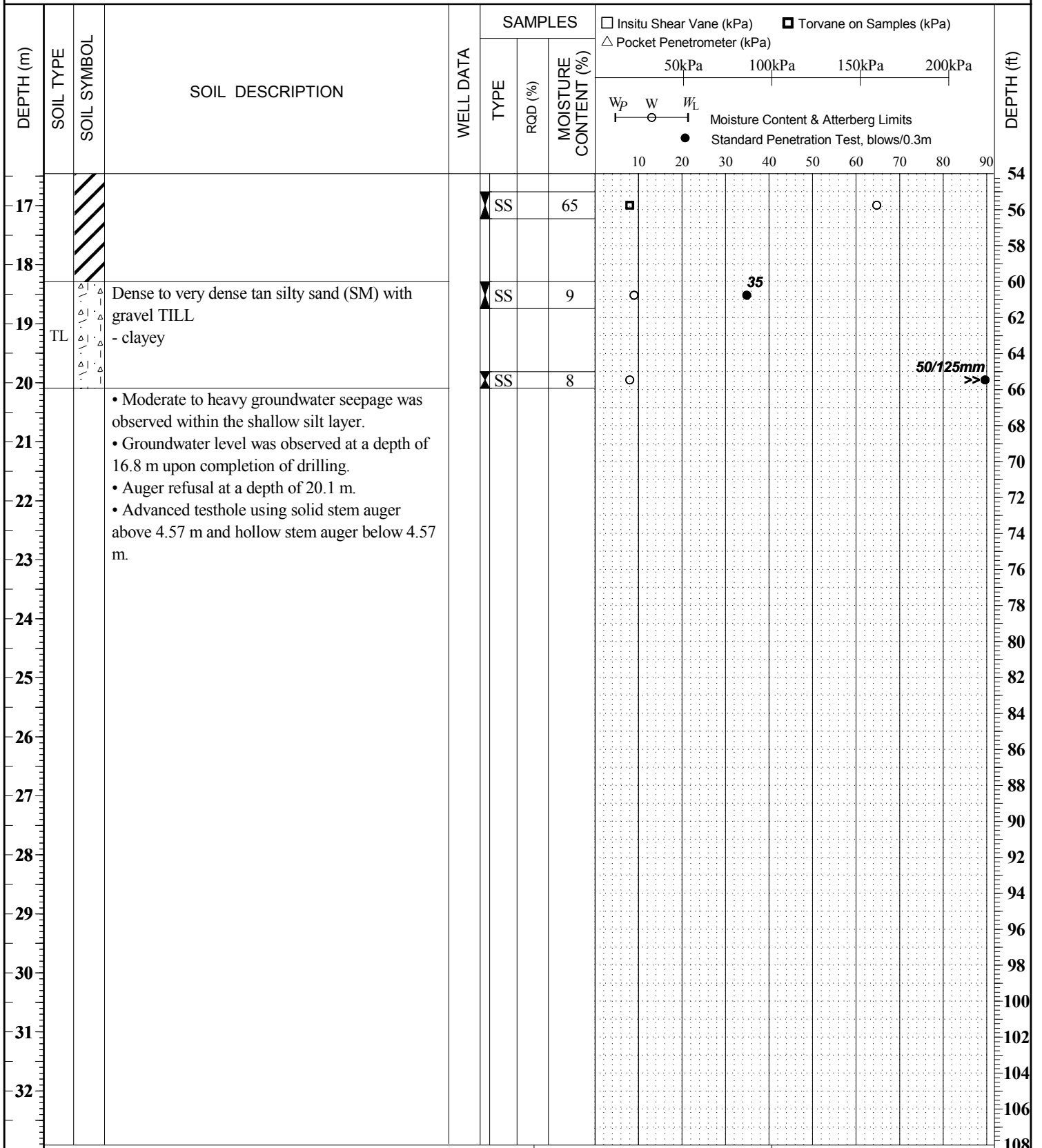
Logged by: Larry Presado
 Reviewed by: Guillaume Beauce



TH23 TESTHOLE RECORD

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CLIENT AECOM Canada Ltd. PROJECT No. 111216800
 PROJECT North End Water Pollution Control Centre Upgrade DATUM NAD83 NORTHING 5535077.997
 LOCATION Winnipeg, Manitoba ELEVATION 231.95 m EASTING 635344.98
 DRILLING DATE September 26, 2016 DRILLING CO. Paddock Drilling Ltd. DRILLING METHOD 125 mm SSA/95 mm HSA



Sample Type: GS - Grab Sample SS - Split Spoon RC - Rock Core
 ST - Shelby Tube PT - Piston Tube VT - Shear Vane Test
 Piezometer Backfill Type: Bentonite Drill Cuttings Sand Slough

Logged by: Larry Presado
 Reviewed by: Guillaume Beauce

