coffey geotechnics
SPECIALISTS MANAGING THE EARTH

FOUNDATION INVESTIGATION AND DESIGN REPORT, 975 MM STORM SEWER CROSSINGS OF HIGHWAY 7A, 1525 AND 1535 HIGHWAY7A, SCUGOG, ONTARIO

Smart Centres
700 Applewood Crescent, Vaughan, ON, L4K 5X3

GEOTMARK00209AA
November 1, 2010

WO 2010-11048

Coffey Geotechnics Inc.
351 Steelcase Road West, Unit 10, Markham, ON L3R 4H9 Canada

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

November 1, 2010

Smart Centres
700 Applewood Crescent, Vaughan, ON, L4K 5X3

Attention: Mr. Jeff Lumsden

RE: Foundation Investigation and Design Report (Final), 975 mm Storm Sewer Crossings of Highway 7A, 1525 and 1535 Highway7A, Scugog, Ontario

Please find enclosed four (4) hard copies and one (1) CD copy of the above mentioned report. We thank you for the opportunity to be of service to you on this project. Should you have any questions, please do not hesitate to contact our office.

For and on behalf of Coffey Geotechnics Inc.

Masoud Manzari, M.Sc.Eng., QP_{EV}, P.Eng.
Associate Geotechnical Engineer

Distribution: Original retained by Coffey Geotechnics Inc.
4 copies – Smart Centres
2 copies - Coffey Geotechnics Inc.

MM:dd

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CONTENTS

FOUNDATION INVESTIGATION REPORT
975 MM STORM SEWER CROSSING OF HIGHWAY 7A
1525 AND A535 HIGHWAY 7A, SCUGOG, ONTARIO

1.1 Introduction

Presented in this report are the results of a foundation investigation carried out by Coffey Geotechnics Inc. (Coffey) at the request of Smart Centres (the Client). The investigation was carried out in connection with the design of the proposed commercial development and Storm Water Management Pond (SWMP) to be located on the north and south sides of Highway 7A, respectively. Forming part of the proposed development is the trenchless crossing of Highway 7A with the storm sewer (975 mm O.D.).

This report addresses the trenchless section of the proposed storm sewer crossing Highway 7A. The proposed storm sewer crossing Highway 7A is located about 525 m west of the intersection of Highway 7A and Scugog Line 6. The general location of the proposed sewer is shown on the attached Drawing 1. To simplify the descriptions in this report, Highway 7A has been considered to run east-west.

1.2 Method of Investigation

The investigation in the field consisted of drilling three (3) exploratory boreholes at the locations shown on the attached Drawing 2.

The fieldwork for the drilling of the boreholes, designated as boreholes BH1 to BH3, was carried out on October 8 and 13, 2010, under the full-time monitoring of Coffey technical staff. Borehole locations and depths were selected by Coffey based on plan and profile drawings provided by the Client (Drawings No. "LOC" and "R-4", Project No. 10141, prepared by Sernas Associates). These drawings showed the location and length of the crossing, the proposed sewer invert levels and the approximate locations of the shafts. Prior to the subsurface investigation, public utility companies (e.g., hydro, gas, telephone, sewer, water and other local utilities) were contacted to locate and mark their buried services on site. Furthermore, a private utility locator was also retained.

The boreholes were advanced using solid-stem continuous-flight augers to depth of about 9 m each. Soil samples were taken at regular close intervals by the standard penetration test (SPT) method (ASTM D1586). Sampling started at ground surface, initially at 0.75 m intervals to a depth of 6 m, then increasing the sampling frequency to 1.5 m.

The groundwater level was measured in the uncased open-boreholes during and upon completion of drilling. A 19 mm and a 50 mm diameter standpipe type piezometer were installed in each of BH 1 and BH 3, respectively, to a depth of 6.1 m. The groundwater levels in the piezometers were measured on 13 October 2010. Groundwater observations are presented on the borehole logs and Drawings 3 and 4.

The ground surface elevations at the borehole locations were surveyed using the top of the existing catch basin to the northwest of BH 2 (Drawing 2), as a temporary benchmark with a geodetic elevation of 275.66 m. The geodetic elevation of the existing catch basin was obtained from the topographic plan provided by the Client.

The soil samples obtained from the boreholes were transported to Coffey's geotechnical laboratory in Markham, where they were re-examined by a senior engineer and samples were selected for laboratory testing. The laboratory testing consisted of the measurement of the natural moisture contents of all the soil samples, nine (9) grain size analyses and two (2) Atterberg limit tests. The results of these are shown on the individual borehole logs in Appendix A, and are also presented on Figures B1 to B4 in Appendix B.

1.3 Geology

The project site lies within the Drumlinized Uplands (Peterborough Drumlin Field) laid down as a ground moraine during the last ice age. The Dumlinized Uplands occurs both south and north of the Oakridges Moraines (ORM) in the subject region. The glacial deposits of the Drumlinized Uplands to the north of the ORM is predominantly Newmarket Till; while to the south of ORM, the glacial deposits are generally a thin layer of Halton Till underlain by Newmarket Till. The project site is about 5 km to the north of ORM.

The Newmarket Till can be traced across the GTA as distinct and consistent lithology. This widespread till sheet forms the main unit in the regional Drumlinized Uplands (Peterborough Drumlin Field). It is a dense silty sand to sandy silt deposit that occurs as 3 to 5 m thick beds, separated in places by sandy interbeds of 1 to 5 m thickness. The total thickness of the till is 5 to 50 m.

The overburden soil overlies the Ordovician Lindsay Formation limestone bedrock, the surface of which, however, is at relatively great depth and will have no significance for this project.

1.4 Subsurface Conditions

1.4.1 General Stratigraphy

The subsurface conditions encountered in the boreholes are consistent with the regional geology of the area. Broadly speaking, the subsurface profile consists of surficial fill overlying glacial till deposit which is interbeded with a layer of sand, separating the glacial deposit into upper and lower till. The glacial till extends to the full depth of the present investigation and is a well graded deposit with particle sizes ranging from gravel to clay. Silt is, however, the predominant component and, depending on the percentage of sand size particles present, the till exhibits "sand and silt" to "sandy silt" characteristics. The interbed sand layer is poorly graded deposit with particle sizes predominantly in the medium to fine sand range. The surface of the sand layer was encountered at about 3 m depth and its thickness at the borehole locations ranges from 0.8 to 1.7 m. The native till and sand layers are predominantly dense to very dense.

At the time of our investigation the groundwater table was recorded at about 3.3 to 4.1 m below ground surface at about Elevation 272 $\pm$ m but may fluctuate seasonally and in response to major weather events.

An Inferred Subsurface Profile is presented on Drawing 4 in Appendix A, and in the following paragraphs the relevant characteristics of the fill and the three main soil types making up the native deposits are described.

1.4.2 Topsoil, Fill

BH1 and BH3 encountered topsoil at the ground surface. The thickness of the topsoil was about 150 mm. In general, the topsoil consisted of soil mixed with trace to some organic matter with rootlets.

Fill soils were encountered on the ground surface in BH2 and underlying the topsoil in BH1 and BH3. At the borehole locations, the fill extended to depths of 0.8 m to 1.5 m. Fill composition ranged from sand (BH2) to silty clay/clayey silt (all the boreholes).

Based on N-values which ranged from 8 to 21 blows / 0.3 m, the silty clay/clayey silt fill was firm to very stiff and the sand fill (N=50 blows/0.3 m) was dense.

1.4.3 Upper Till

A layer of brown, sand and silt till (BH1) to sandy silt till (BH2 and BH3) was encountered underlying the fill soils in all of the boreholes (Drawing 4) and extended to depths of 2.9 to 3.0 m below ground surface (El 272.4 to 273.3 m).

The grain size distribution of three samples from the material is given in Figure B1 in Appendix B. The curves indicate the following grain size distribution:

Gravel: 0-16 %

Sand: 24-48 %

Silt: 35-59 %

Clay: 11-17%

From the grain size distribution, it can be seen that in addition to silt which is the predominant component, this till layer contains a significant amount of sand, ranging from sandy to equal proportion to the silt content. The till layer also contained trace to some gravel and clay size particles. In addition, due to their mode of deposition, the presence of cobbles and boulders can be expected in the deposit.

Based on the visual/tactile examination of the soil samples and the results of one Atterberg limit tests (BH 2 – SS3), the soil is non-plastic and non-cohesive. However, due to slight cementation, apparent cohesion was noted in some of the recovered samples.

Based on the above, the upper till is classified as SM to ML in the Unified Soil Classification System.

The measured natural moisture contents ranged from 4 to 13%.

Standard Penetration Test results, which range from 29 to more than 50 blows / 0.3 m, indicate compact to very dense compactness conditions. Based on the grain size distribution curves, the hydraulic conductivity of the upper till is estimated to be in the order of 10^{-5} to 10^{-6} cm /s.

1.4.4 Sand

A layer of brown sand was encountered underlying the upper till in all of the boreholes (Drawing 4) at a depth of 2.9 to 3.0 m and extended to the depths of 3.8 to 4.6 m below ground surface (El 270.9 to 272.2 m).

The grain size distribution of two samples from the sand is given in Figure B2 in Appendix B. The curves indicate the following grain size distribution:

Gravel: 0 -1 %

Sand: 87 - 88 %

Silt and clay: 11 - 13 %

From the grain size distribution, it can be seen that the sand contains negligible amount of gravel and traces of soil fines (silt and clay particle size). Based on the visual/tactile examination of the soil samples, the soil is non-plastic and non-cohesive.

Based on the above, the sand layer is classified as SP-SM in the Unified Soil Classification System.

The measured natural moisture contents ranged from 6 to 16%.

Standard Penetration Test results, which range from 30 to in excess of 50 blows / 0.3 m, indicate dense to very dense compactness conditions. Based on the grain size distribution curves, the hydraulic conductivity of the sand layer is estimated to be 10^{-2} to 10^{-3} cm /s.

1.4.5 Lower Till

A deposit of brown, sandy silt till to silt till was encountered underlying the sand layer at Elevations 272.2 m to 270.9 m in all of the boreholes (Drawing 4) and extended to the termination depth of the investigation (El 266.2 to 267.0 m).

The grain size distribution of three samples from the material is given in Figure B3 in Appendix B. The curves indicate the following grain size distribution:

Gravel: 0-5 %

Sand : 18-42 %

Silt ; 47-65 %

Clay: 11-14%

From the grain size distribution, it can be seen that in addition to silt which is the predominant component, this till contains a considerable amount of sand, trace gravel, and trace to some clay. In addition, due to their mode of deposition, the presence of cobbles and boulders can be expected. Furthermore, occasional silt seams were also encountered within the deposit.

Based on the visual/tactile examination of the soil samples and results of one Atterberg limit tests (BH 2 – SS7), the soil is non-plastic and non-cohesive. However, due to slight cementation, apparent cohesion was noted in some of the recovered samples.

Based on the above, the lower till is classified as ML in the Unified Soil Classification System.

The measured natural moisture contents ranged from 8 to 20%.

Standard Penetration Test results, which were consistently in excess of 50 blows / 0.3 m, indicate very dense compactness condition. Based on the grain size distribution curves, the hydraulic conductivity of the upper till is estimated to be 10^{-5} to 10^{-6} cm /s.

An about 450 mm thick sand pocket/lense was encountered within the deposit in BH 3, at depth of about 5.5 m. The grain size distribution of a sample of the sand pocket/lense is presented on Figure B4 (Appendix B) and the curve indicates 5% gravel, 73% sand, 15% silt, and 7% clay.

1.5 Groundwater Conditions

At the completion of the boreholes, before backfilling or installing the piezometers, the groundwater level in the open uncased boreholes was measured. Two standpipe piezometers were installed one in each of boreholes BH1 and BH3. Subsequent groundwater level readings were performed in the standpipes on 13 October 2010. The following table provides a summary of the groundwater reading as shown on the borehole logs and Drawing 4.

Borehole	Groundwater Depth (below the existing ground surface) / Elevation (m)	
	Upon completion	13 October 2010 (five days after completion)
BH 1	3.1 / 272.9	3.6 / 272.4
BH 2	4.1 / 272.1	--
BH 3	3.3 / 272.2	3.3 / 272.2

These indicate a small gradient from north to south, toward the ditch/creek located about 350 m south of Highway 7A. Based on the observations made, at the time of our investigation, the groundwater table at the site was at about Elevation 272 ± m. However, it should be pointed out that the water table at the site can be expected to be subject to seasonal variations and fluctuations in response to major weather events. As well, a perched water table may occur due to the accumulation of surface water in the fill soils overlying the native till deposits.

For and on behalf of Coffey Geotechnics Inc.

Masoud Manzari, P.Eng.
Associate Geotechnical Engineer

LICENCED PROFESSIONAL ENGINEER
M. MANZARI
100072203
1 Nov. 2010
PROVINCE OF ONTARIO

Ivan P. Lieszkowszky, P.Eng.
Senior Principal

Zuhtu Ozden, P.Eng.
Senior Principal, Designated MTO contact

REGISTERED PROFESSIONAL ENGINEER
Z. S. OZDEN
PROVINCE OF ONTARIO

Appendix A

Site Location Plan – Drawing 1
Borehole Location Plan – Drawing 2
Borehole Location Plan and Profile – Drawing 3
Inferred Subsurface Profile – Drawing 4
Borehole Logs – Enclosures 1 to 3

drawn	RH
approved	BL
date	OCTOBER 2019
scale	As Shown
original size	Tabloid

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

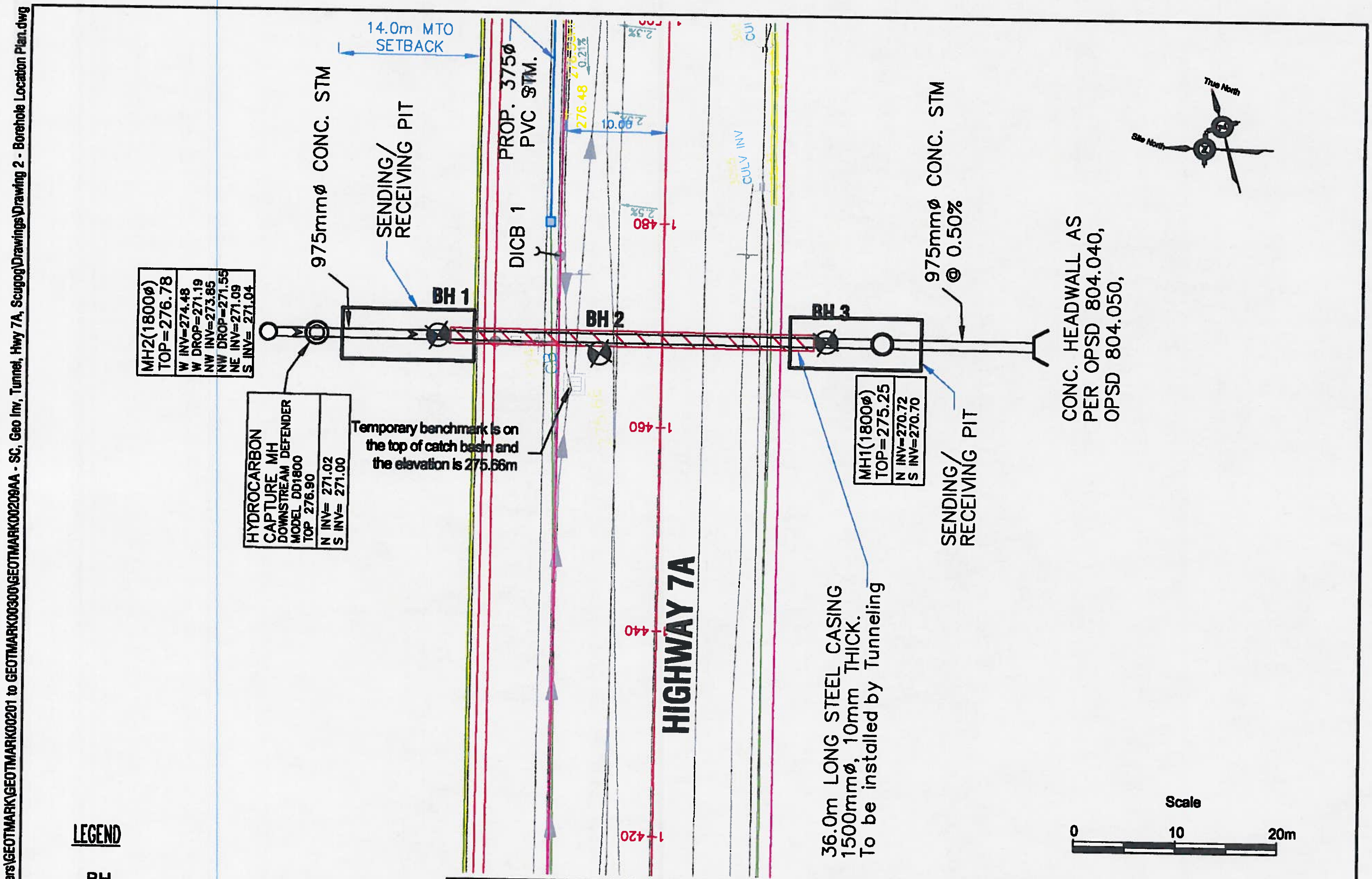
project no: GEOTMARK0020AA

client: SMART CENTRE

project: GEOTECHNICAL INVESTIGATION
975 mm SEWER CROSSING
1035 & 1036 HIGHWAY 7A
RICHMOND, ONTARIO

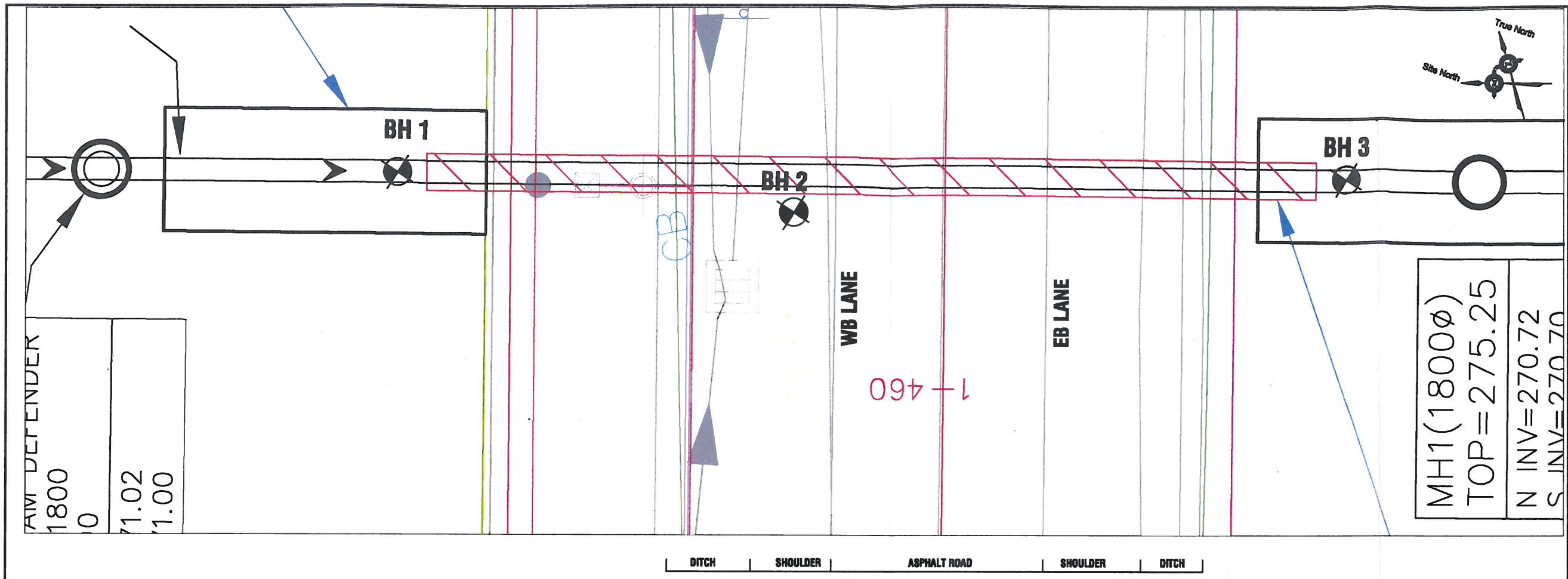
title: SITE LOCATION PLAN

Drawing No.: 1



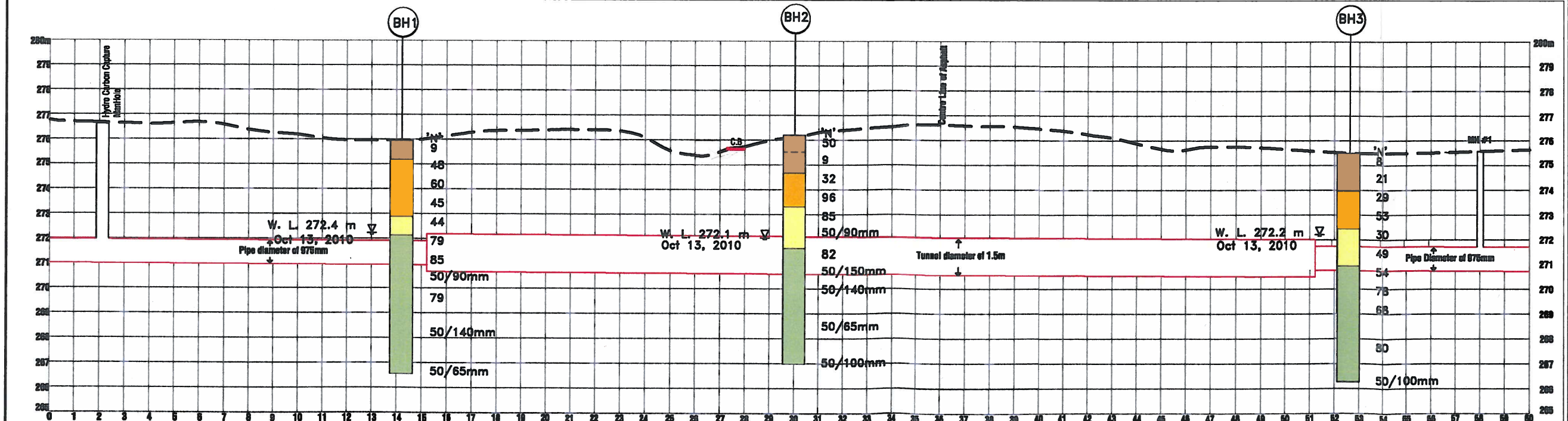
drawn	RN	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	SMART CENTRE
approved	BL		project:	GEOTECHNICAL INVESTIGATION 975 mm SEWER CROSSING 1525 & 1535 HIGHWAY 7A (SCUGOG, ONTARIO)
date	OCTOBER 2010		title:	BOREHOLE LOCATION PLAN
scale	AS SHOW		project no: GEOTMARK00209AA	drawing no: 2
original size	Letter			

F:\5_Geotechnical\Project folders\GEOTMARK\GEOTMARK00201 to GEOTMARK00300\GEOTMARK00209AA - SC, Geo Inv, Tunnel, Hwy 7A, Scugog\Drawings\Drawing 2 - Borehole Location Plan.dwg



LEGEND

- BH Coffey Borehole
- Water Level
- FILL
- SAND and SILT to SANDY SILT (TILL)
- SAND
- SANDY SILT to SILT, some Sand (TILL)



Scale

0m 2.5m 5m (Horizontal)

0m 2.5m 5m (Vertical)

drawn	RN
approved	BL
date	OCTOBER 2010
scale	As Shown
original size	Tabloid

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

project no: GEOTMARK00209AA

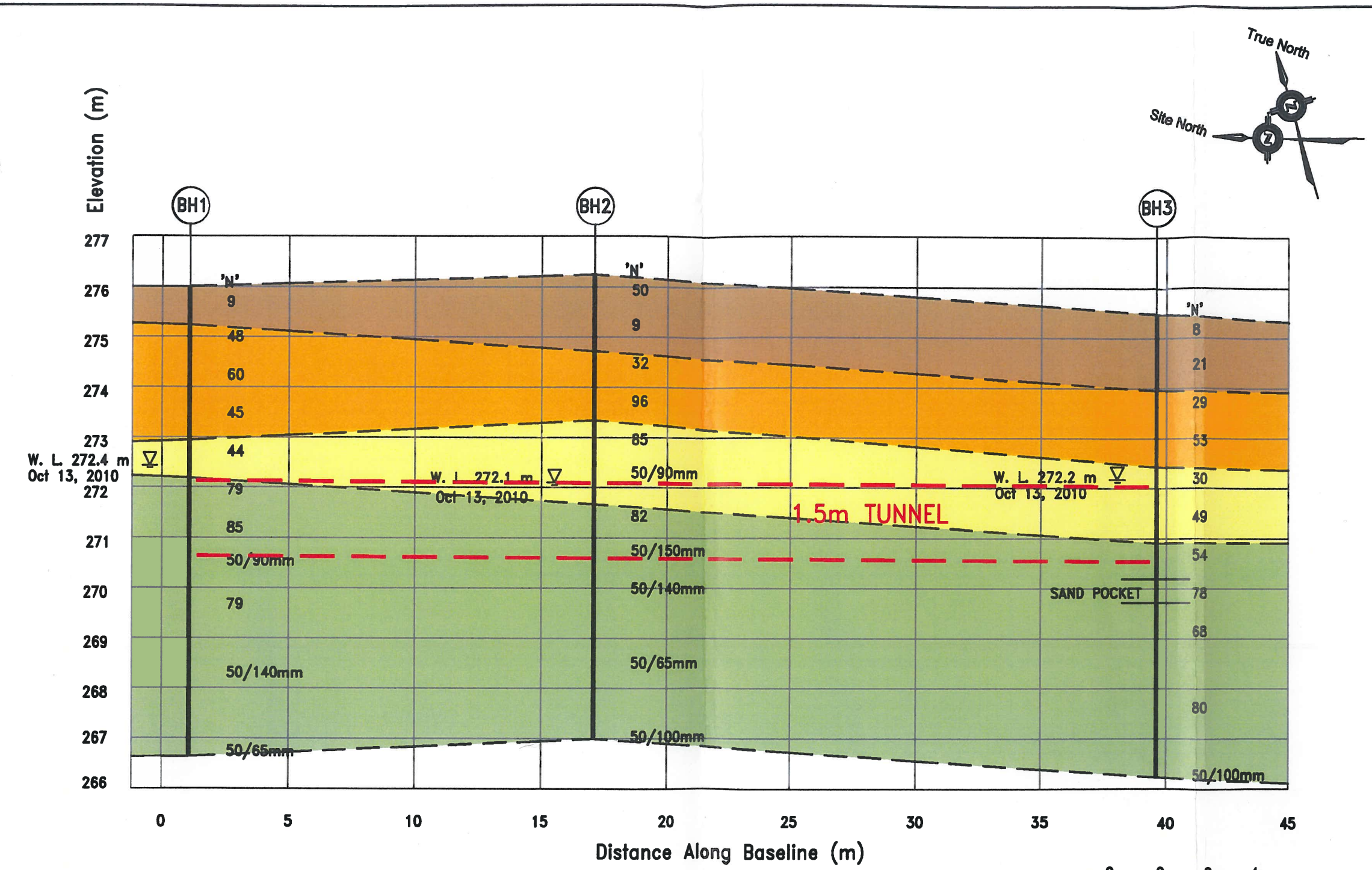
client: SMART CENTRE

project: GEOTECHNICAL INVESTIGATION
1525 & 1535 HIGHWAY 7A
(SCUGOG, ONTARIO)

title: BOREHOLE LOCATION PLAN & PROFILE

drawing no: 3

F:\5_Geotechnical\Project folders\GEOTMARK\GEOTMARK00201 to GEOTMARK00300\GEOTMARK00209AA - SC, Geo Inv, Tunnel, Hwy 7A, Scugog\Drawings\INFERRED SUBSURFACE PROFILE.dwg



LEGEND:

- Water Level
- FILL
- SAND and SILT to SANDY SILT (TILL)
- SAND
- SANDY SILT to SILT, some Sand (TILL)

SCALE: Horizontal 2 0 2 4m
Vertical 1 0 1 2m

drawn	JZ
approved	MM
date	October, 2010
scale	As Shown
original size	Letter

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client: SMART CENTRE

project: GEOTECHNICAL INVESTIGATION
975 mm SEWER CROSSING 1525 & 1535 HIGHWAY 7A
(SCUGOG, ONTARIO)

title: INFERRED SUBSURFACE PROFILE

project no: GEOTMARK00209AA

drawing no: 4

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EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg. FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS $\bar{N}$.

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 – 12	12 – 25	25 – 50	50 – 100	100 – 200	>200
	VERY SOFT	*SOFT*	*FIRM*	*STIFF*	*VERY STIFF*	*HARD*

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 – 5	5 – 10	10 – 30	30 – 50	>50
	VERY LOOSE	*LOOSE*	*COMPACT*	*DENSE*	*VERY DENSE*

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY IS:

RQD (%)	0 – 25	25 – 50	50 – 75	75 – 90	90 – 100
	VERY POOR	*POOR*	*FAIR*	*GOOD*	*EXCELLENT*

JOINTING AND BEDDING:

SPACING	50mm	50 – 300mm	0.3m – 1m	1m – 3m	>3m
JOINTING	*VERY CLOSE*	*CLOSE*	*MOD. CLOSE*	*WIDE*	*VERY WIDE*
BEDDING	*VERY THIN*	*THIN*	*MEDIUM*	*THICK*	*VERY THICK*

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

SS	SPLIT SPOON	TP	THINWALL PISTON
WS	WASH SAMPLE	OS	OSTERBERG SAMPLE
ST	SLOTTED TUBE SAMPLE	RC	ROCK CORE
BS	BLOCK SAMPLE	PH	TW ADVANCED HYDRAULICALLY
CS	CHUNK SAMPLE	PM	TW ADVANCED MANUALLY
TW	THINWALL OPEN	FS	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ε	%	LINEAR STRAIN
$\varepsilon_1, \varepsilon_2, \varepsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
C_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	- °	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	- °	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = c_u / τ_r

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES	e	1,%	VOID RATIO	e_{min}	1,%	VOID RATIO IN DENSEST STATE
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES	n	1,%	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m^3	DENSITY OF WATER						
γ_w	kN/m^3	UNIT WEIGHT OF WATER	w	1,%	WATER CONTENT	D	mm	GRAIN DIAMETER
ρ	kg/m^3	DENSITY OF SOIL	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
γ	kN/m^3	UNIT WEIGHT OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
ρ_d	kg/m^3	DENSITY OF DRY SOIL	w_P	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL	w_S	%	SHRINKAGE LIMIT	q	m^3/s	RATE OF DISCHARGE
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL	I_P	%	PLASTICITY INDEX = $(w_L - w_P)$	v	m/s	DISCHARGE VELOCITY
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $(w - w_P)/ I_P$	i	1	HYDRAULIC GRADIENT
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL	I_C	1	CONSISTENCY INDEX = $(w_L - w)/ I_P$	k	m/s	HYDRAULIC CONDUCTIVITY
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL	e_{max}	1,%	VOID RATIO IN LOOSEST STATE	j	kN/m^3	SEEPAGE FORCE

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LOG OF BOREHOLE 01

PROJECT: Geotechnical Investigation, Tunnelling for Sewer Crossing Hwy 7A
CLIENT: Smart Centres
PROJECT LOCATION: 1525 & 1535 Hwy 7A, Scugog, Ontario
DATUM ELEVATION: Geodetic
BOREHOLE LOCATION: North End of Tunnel

DRILLING DATA
Method: Solid Stem Augering
Diameter: 120mm
Date: October 8, 2010

REF. NO.: GEOTMARK00209AA
ENCL NO.: 1

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS 0.3 m	ELEVATION	PLASTIC LIMIT w_P	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w_L	UNIT WEIGHT γ (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
276.0	Ground Surface									
0.0	150mm **TOPSOIL**									
	FILL clayey silt, trace sand, trace gravel brown, stiff	1	SS	9						
275.2										
0.8	**SAND and SILT** (Glacial Till) trace to some gravel and clay non-plastic, brown, dense to very dense (SM/ML)	2	SS	48	275					16 33 38 13
		3	SS	60						
					274					
		4	SS	45						6 48 35 11
273.0					273					
3.0	**SAND** trace silt and clay non-plastic, brown, dense (SP-SM)	5	SS	44						0 87 8 5
272.2										
3.8	**SANDY SILT** (Glacial Till) trace gravel, trace to some clay non-plastic, occasional silt seams brown, very dense (ML)	6	SS	79	272					Spoon wet at 3.8m
		7	SS	85						5 34 47 14
					271					
		8	SS	50/ 90mm						
					270					
		9	SS	79						
					269					
		10	SS	50/ 40mm						
					268					
					267					
266.6		11	SS	50/ 65mm						
9.4	**END OF BOREHOLE** - Borehole caved in at depth of 5.5m upon completion. - 19 mm dia. piezometer was installed to a depth of 6.1m.									

Date / W.L. Depth (m)
upon completion 3.1
Oct. 13, 2010 3.6

W. L. 272.4 m
Oct 13, 2010

DYNAMIC CONE PENETRATION RESISTANCE PLOT
SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
WATER CONTENT (%)

GRAPH NOTES: $+^3$, $\times^3$ Numbers refer to Sensitivity; $\circ^{\varepsilon=3\%}$ Strain at Failure

COFFEY SOIL LOG BH LOG GM209.GPJ COFFEY TEMPLATE.GDT 10/25/10

coffey geotechnics

LOG OF BOREHOLE 02

PROJECT: Geotechnical Investigation, Tunnelling for Sewer Crossing Hwy 7A
CLIENT: Smart Centres
PROJECT LOCATION: 1525 & 1535 Hwy 7A, Scugog, Ontario
DATUM ELEVATION: Geodetic
BOREHOLE LOCATION: North Shoulder of Highway

DRILLING DATA
Method: Solid Stem Augering
Diameter: 120mm
Date: October 13, 2010

REF. NO.: GEOTMARK00209AA
ENCL NO.: 2

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) o UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
276.2	Ground Surface										
0.0	150mm sand and gravel **FILL**										
	FILL sand, trace silt and gravel brown, dense		1	SS	50		276				
275.6											
0.7	**FILL** silty clay, trace gravel, trace organics grey, stiff		2	SS	9						
274.7							275				
1.5	**SANDY SILT** (Glacial Till) occasional to trace gravel, trace clay non-plastic, brown, dense (ML)		3	SS	32						Atterberg Test Conducted: non-plastic
			4	SS	96		274				
273.3											
2.9	**SAND** trace silt, occasional gravel non-plastic, silt pockets, brown, very dense (SP-SM)		5	SS	85		273				
			6	SS	50/ 90mm	▽					
271.7						W. L. 272.1 m Oct 13, 2010					
4.6	**SANDY SILT** (Glacial Till) trace gravel, trace clay, non-plastic, occasional silt seam brown, very dense (ML)		7	SS	82						Spoon wet at 4.7m 0 42 47 11 Atterberg Test Conducted: non-plastic
			8	SS	50/ 150mm		271				
			9	SS	50/ 140mm		270				
							269				
			10	SS	50/ 65mm		268				
267.0			11	SS	50/ 100mm		267				
9.2	**END OF BOREHOLE** - Borehole caved in at depth of 7.3m upon completion. - Uncaved portion of the borehole was decommissioned by grout.										
	Date upon completion W.L. Depth (m) 4.1										

GRAPH NOTES: $+^3$, $\times^3$ Numbers refer to Sensitivity; ε=3% Strain at Failure

COFFEY SOIL LOG BH LOG GM209.GPJ COFFEY TEMPLATE.GDT 10/25/10

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LOG OF BOREHOLE 03

PROJECT: Geotechnical Investigation, Tunnelling for Sewer Crossing Hwy 7A
CLIENT: Smart Centres
PROJECT LOCATION: 1525 & 1535 Hwy 7A, Scugog, Ontario
DATUM ELEVATION: Geodetic
BOREHOLE LOCATION: South End of Tunnel

DRILLING DATA
Method: Solid Stem Augering
Diameter: 120mm
Date: October 8, 2010

REF. NO.: GEOTMARK00209AA
ENCL NO.: 3

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
275.5	Ground Surface										
0.0	150mm **TOPSOIL**										
	FILL clayey silt, trace sand, trace gravel and limestone fragments brown, firm to very stiff		1	SS	8		275		○		
			2	SS	21				○		
274.0							274				
1.5	**SANDY SILT** (Glacial Till) trace gravel, trace to some clay non-plastic, brown, compact to very dense (ML)		3	SS	29				○		0 24 59 17
			4	SS	53		273		○		
272.4											
3.0	**SAND** trace silt and clay non-plastic, brown, dense (SP-SM)		5	SS	30	▽	W. L. 272.2 m Oct 13, 2010		○		
			6	SS	49				○		1 88 (11) Spoon wet at 3.7m
270.9							271				
4.6	**SANDY SILT to SILT** some sand (Glacial Till) trace gravel, trace to some clay non-plastic, brown, very dense (ML)		7	SS	54				○		
	450 mm thick pocket of sand with silt		8	SS	78		270		○		5 73 15 7
			9	SS	68		269		○		3 18 65 14
			10	SS	80		268		○		
							267				
266.2			11	SS	50/ 100mm				○		
9.2	**END OF BOREHOLE** - Borehole caved in at depth of 3.6m upon completion. - Borehole redrill to depth of 6.1m. - 50 mm dia. monitoring well was installed to a depth of 6.1m.										

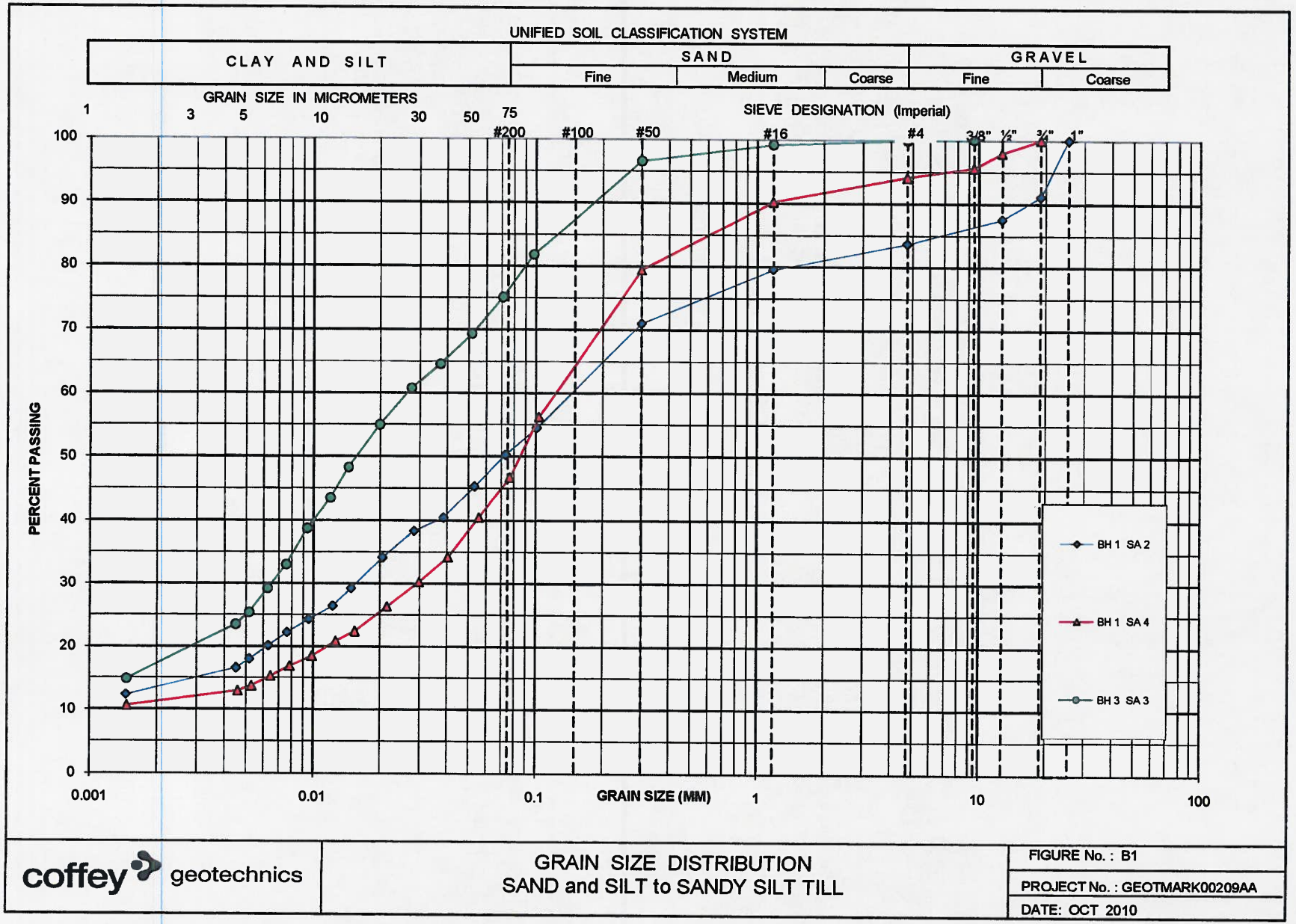
Date	W.L	Depth (m)
upon completion	3.3	
Oct. 13, 2010	3.3	

GRAPH NOTES: +³ ×³ Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

COFFEY SOIL LOG BH LOG GM209.GPJ COFFEY TEMPLATE.GDT 10/25/10

Appendix B

Laboratory Test Results - Figures B1 to B4



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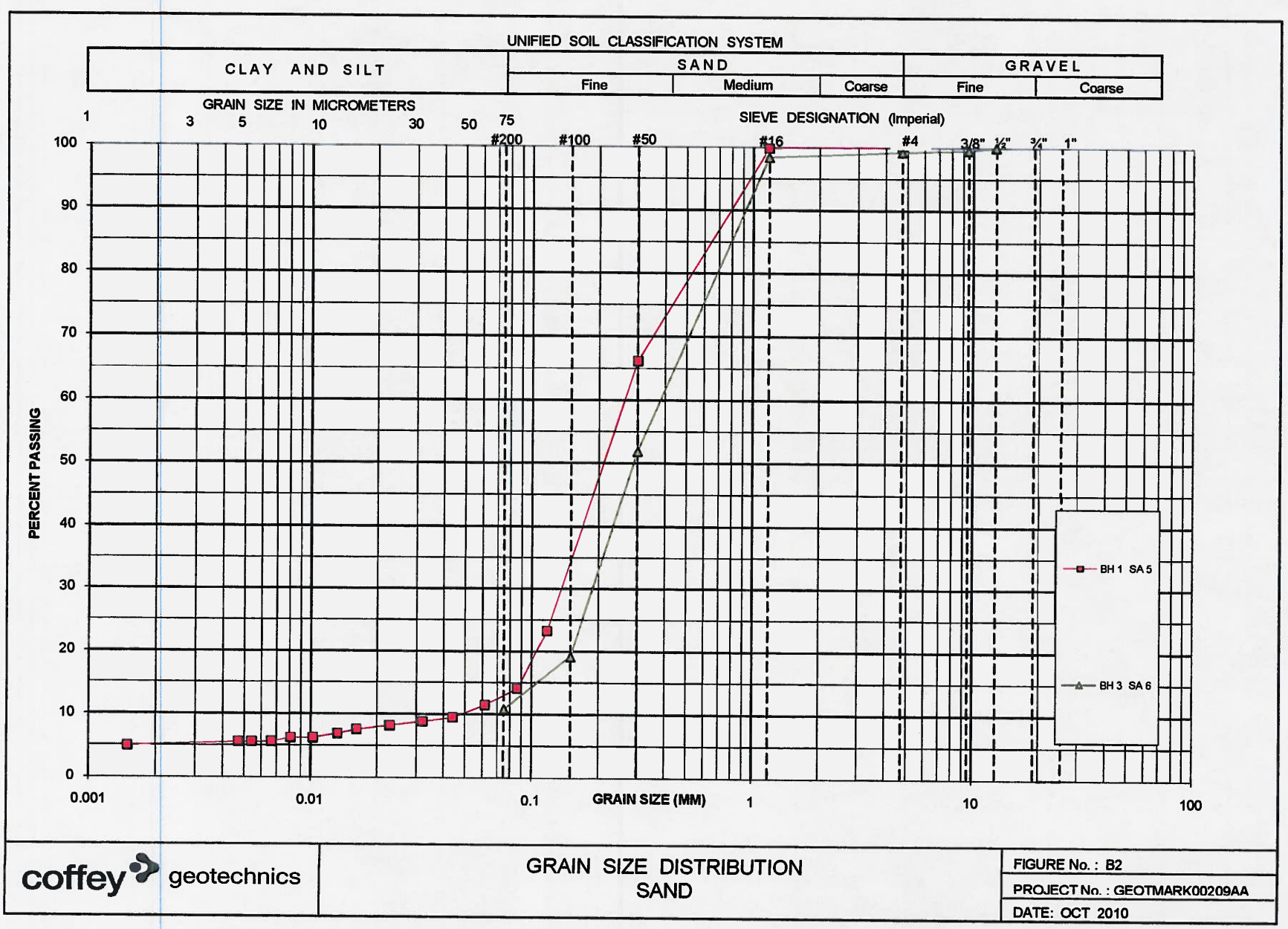
GRAIN SIZE DISTRIBUTION
SAND and SILT to SANDY SILT TILL

FIGURE No. : B1
PROJECT No. : GEOTMARK00209AA
DATE: OCT 2010

C:\Documents and Settings\masoud_manzari\Desktop\GEOTMARK00209AA - SC, Geo Inv, Tunnel, Hwy 7A, Scugog\Lab\Grainsize\BH 1,2,3



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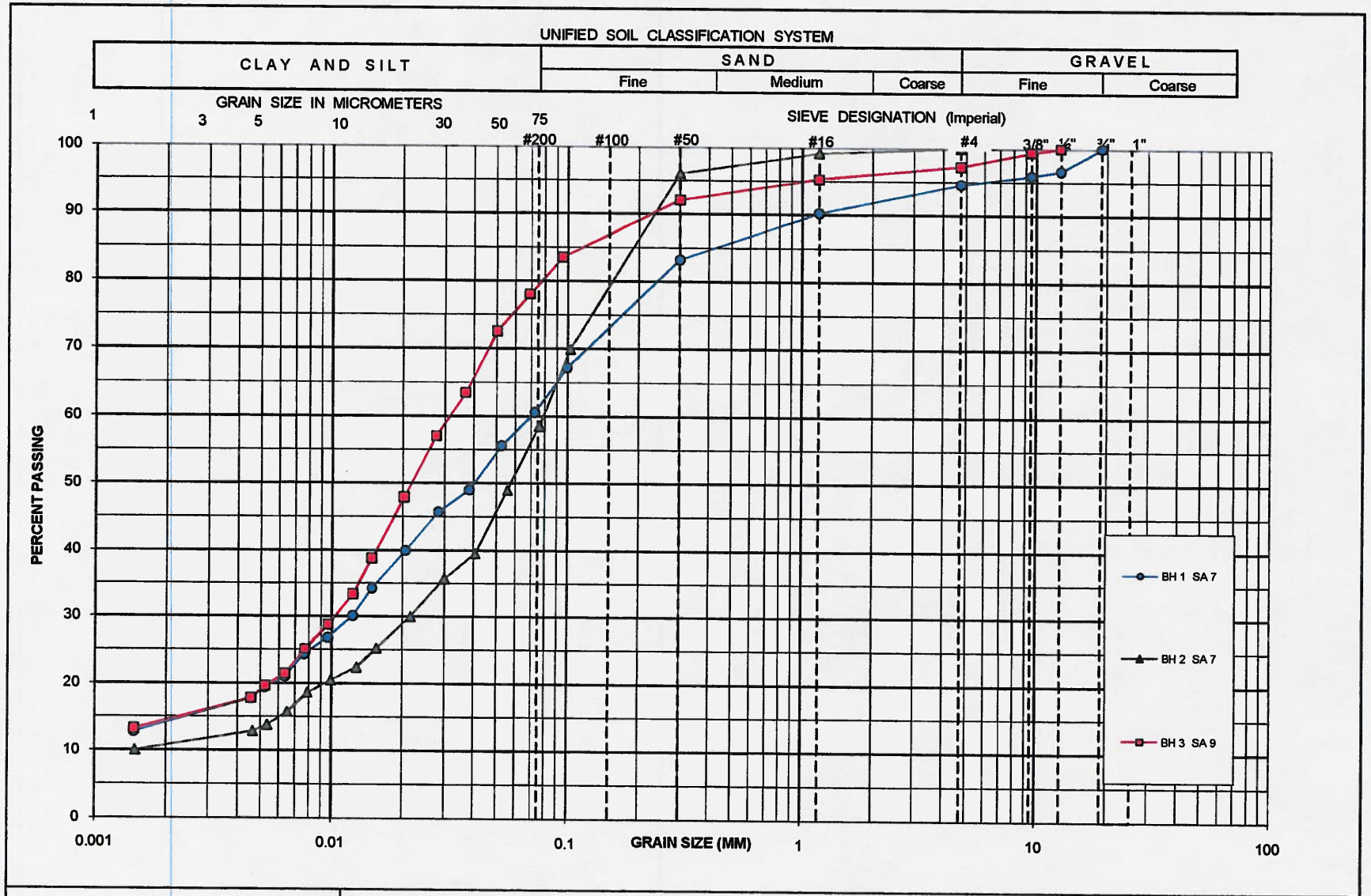
GRAIN SIZE DISTRIBUTION
SAND

FIGURE No. : B2
PROJECT No. : GEOTMARK00209AA
DATE: OCT 2010

C:\Documents and Settings\masoud_manzari\Desktop\GEOTMARK00209AA - SC, Geo Inv, Tunnel, Hwy 7A, Scugog\Report\BH 1,2,3-finalized for report



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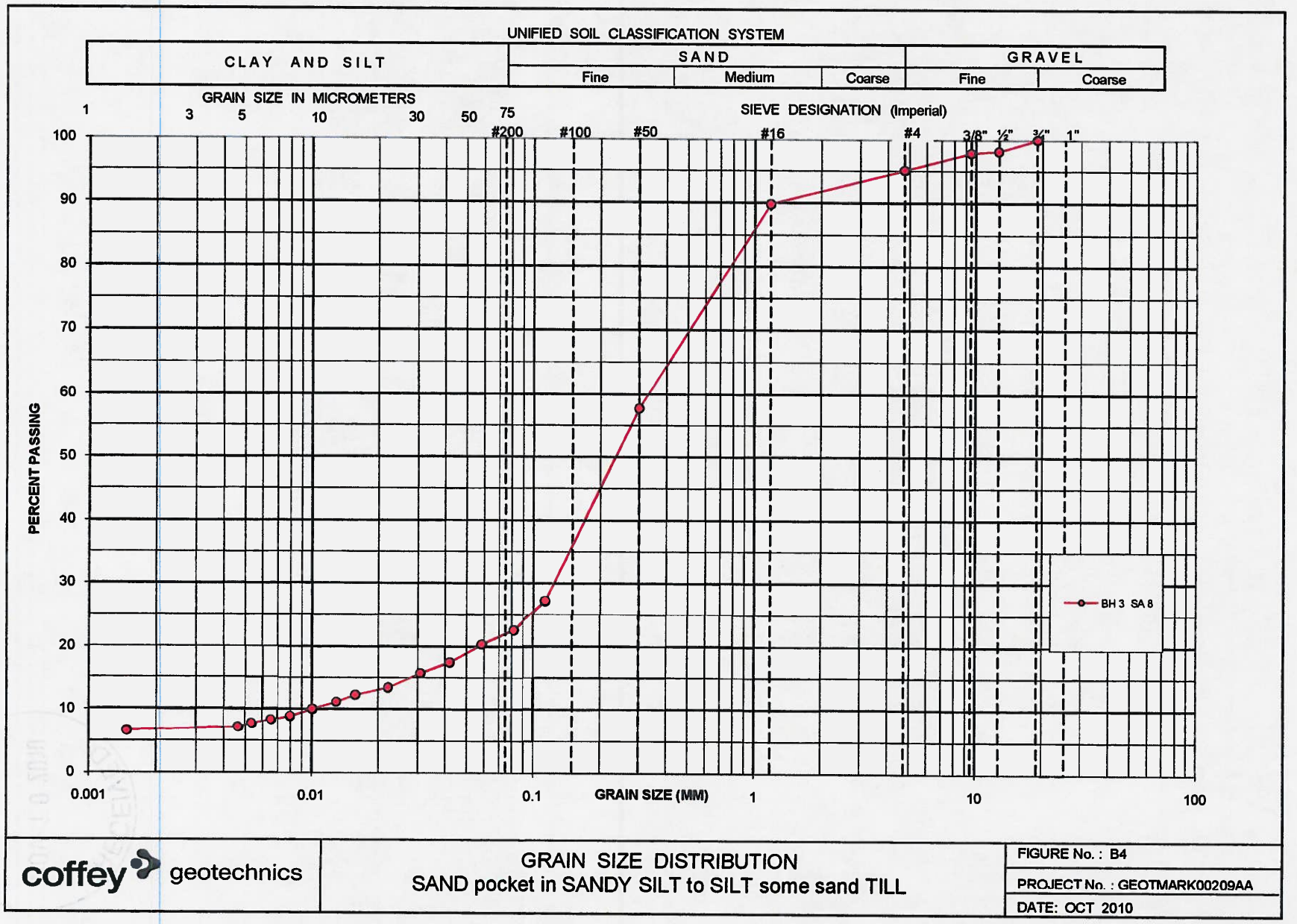
GRAIN SIZE DISTRIBUTION
SANDY SILT to SILT some sand TILL

FIGURE No. : B3
PROJECT No. : GEOTMARK00209AA
DATE: OCT 2010

C:\Documents and Settings\masoud_manzari\Desktop\GEOTMARK00209AA - SC, Geo Inv, Tunnel, Hwy 7A, Scugog\Report\BH 1,2,3-finalized for report



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GRAIN SIZE DISTRIBUTION
SAND pocket in SANDY SILT to SILT some sand TILL

FIGURE No. : B4
PROJECT No. : GEOTMARK00209AA
DATE: OCT 2010

C:\Documents and Settings\masoud_manzari\Desktop\GEOTMARK00209AA - SC, Geo Inv, Tunnel, Hwy 7A, Scugog\Report\BH 1,2,3-finalized for report