



**FOUNDATION INVESTIGATION REPORT  
HINKLER LAKE PATROL YARD  
TOWNSHIP OF MARTEL, ONTARIO**

**GEOCRES NO: 410-22  
LATITUDE 47.042436 LONGITUDE -83.144281**

Submitted to:

**Ministry of Transportation Ontario Northeast Region**  
74 McKeown Avenue  
North Bay, ON  
P1B 9S9

Submitted by:

**Amec Foster Wheeler**  
**Environment & Infrastructure**  
131 Fielding Road  
Lively, Ontario  
P3Y 1L7  
**(705) 682-2632**

February 16, 2017  
Amec Foster Wheeler Project No.: **TY163014**

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**PART A**

**FOUNDATION INVESTIGATION REPORT  
HINKLER LAKE PATROL YARD  
TOWNSHIP OF MARTEL, ONTARIO**

## **1.0 INTRODUCTION**

### **1.1 Background**

Amec Foster Wheeler Environment & Infrastructure (Amec Foster Wheeler) has been retained by The Ministry of Transportation Ontario, Northeast Region (MTO), for provision of foundation engineering services at six Patrol Yards as part of the Assignment No. 5015-E-0064.

This report addresses the results of the subsurface investigation carried out by Amec Foster Wheeler at the MTO Hinkler Lake Patrol Yard, located on Highway 129, approximately 82 km north of the MTO Axe Lake Patrol Yard in the Township of Martel, Ontario as shown on Drawing 1.

The terms of reference and scope of work for the foundation engineering services are outlined in MTO's Request for Quotation (RFQ), and associated Addendum and clarification responses for the Assignment.

Amec Foster Wheeler understands the MTO plans to construct a new sand/salt storage building structure at the Hinkler Lake Patrol Yard. The purpose of this investigation was to determine the subsurface conditions and relevant soil properties within the subject site in order to provide recommendations for the foundation design aspects of the proposed development at the yard. The proposed structure is to have an approximate area of 432 m<sup>2</sup> (18 m by 24 m), as shown on Drawing 1, and on the preliminary site plan provided to Amec Foster Wheeler by the MTO.

### **1.2 Site Description**

The patrol yard is located in the Township of Martel, District of Algoma. The entrance to the site is approximately 25.5 km north of the intersection of Highway 556 and Highway 129. The latitude and longitude coordinates for the site are Latitude 47.042436 and Longitude -83.144281.

At the time of the investigation, a salt/sand storage dome was located in the central portion of the Patrol Yard. An office building was located to the north of the salt/sand dome, adjacent to the site entrance. There was also a garage/fueling station to the east of the salt/sand dome. The remaining areas of the yard were generally vacant land, stockpile areas, and vehicle parking areas. Site photographs are included in Appendix A.

The proposed new structure will be located south of the existing sand/salt dome as shown on Drawing 1.

### **1.3 Site Geology**

The general surficial geology in the area of the site, can be characterized as Glaciofluvial outwash deposits which are comprised of gravel and sand, with some deltaic deposits, according to Ministry of Northern Development and Mines (MNDM) interactive "Quaternary Geology" map.

The bedrock in the area of the site can be described as Neo-to Mesoarchean massive to foliated grandiorite to granite. It is located in the Superior Province according to MNDM “Geology Survey August 2003, 1:250,000 Bedrock Geology of Ontario” map.

## 2.0 INVESTIGATION PROGRAM

### 2.1 Soil Drilling Investigation

The fieldwork at the site was carried out on October 12 and 13, 2016, when five boreholes (BH16-01 to BH16-05) were advanced within or near the proposed maintenance structure footprint all to a depth of 15.9 m below the existing ground surface. Borehole BH16-02 was offset from the proposed building footprint due to access limitations at the original borehole location.

The borehole locations (referenced to the MTM NAD83 Zone 13 northing and easting co-ordinate system), the ground surface elevations (referenced to Geodetic datum) and the drilled depths are summarized below and are shown on Drawing 1.

**Table 1: Hinkler Lake Borehole Summary**

Approximate Area	Borehole Designation	Location (MTM NAD83 Zone 13)		Ground Surface Elevation (m)	Borehole Termination Depth (m)
		Northing (m)	Easting (m)		
Southwest Corner	BH16-01	5,211,721	369,840	414.1	15.9
Northwest Corner	BH16-02	5,211,747	369,815	413.9	15.9
Northeast Corner	BH16-03	5,211,748	369,857	414.0	15.9
Southeast Corner	BH16-04	5,211,721	369,861	413.7	15.9
Centre	BH16-05	5,211,738	369,851	413.8	15.9

The ground surface elevation at the borehole locations were surveyed by Amec Foster Wheeler’s personnel. A local benchmark with a known elevation of 414.740 m was used as a reference. The borehole locations were geo-referenced to MTM co-ordinates using a hand-held Global Positioning System (GPS) unit. The ground surface elevations and GPS co-ordinates at the borehole locations are also presented on the Record of Borehole sheets, attached in Appendix B.

The boreholes were advanced using 108 mm inside diameter hollow stem augers and conventional soil sampling methods under the supervision of an Amec Foster Wheeler technician, providing soils information along with relative soil density under the direction of the Amec Foster Wheeler project manager. Soil samples were collected at predetermined depth intervals in accordance with Standard Penetration Testing (SPT) procedures (ASTM D-1586) utilizing a

mechanical hammer. Test results are recorded on the Record of Borehole sheets as 'N'-values. These values provide an indication of the various soil strata's condition with respect to compactness or consistency. The samples were placed in plastic bags and delivered to Amec Foster Wheeler's geotechnical laboratory in Sudbury for further examination and testing. One soil sample was submitted to AGAT Laboratories in Mississauga, Ontario, for analytical testing for pH, chlorides, sulphates and resistivity.

## 2.2 Laboratory Testing

In accordance with the TOR and Amec Foster Wheeler's proposal for this investigation, the following laboratory tests were conducted:

- Natural water content (63)
- Grain size distribution (15)
- Hydrometer (3)
- pH, chlorides, sulphates, resistivity (1)

The results of in-situ and laboratory tests are presented on the Record of Boreholes in Appendix B. The grain size distribution curves are shown in Appendix C, and the results of soil corrosivity tests are shown in Appendix D

## 3.0 SUBSURFACE CONDITIONS

In general, the subsurface condition encountered at the site consists of sand to sand and gravel fill underlain by native sand extending to the borehole termination depths. A summary of the subsurface conditions encountered in the boreholes is presented below and on the Record of Borehole sheets included in Appendix B.

### 3.1 Sand Fill/Gravelly Sand Fill/Sand and Gravel Fill

Non-cohesive fills were present at the ground surface in Boreholes BH16-01 to BH16-05. The thickness of the fill was between 0.7 m and 1.5 m. The fill layer consisted of brown gravelly sand or sand and gravel at Boreholes BH16-01, and BH16-03 to BH16-05, and sand with trace fines (silt and clay) at Borehole BH16-02. The measured SPT 'N' values within the fill ranged between 9 blows and 35 blows per 0.3 m of penetration, indicating a loose to dense, predominantly compact state of compactness.

The laboratory testing on selected fill samples resulted water contents ranging from 3% to 9% of the materials' dry weight.

Four grain size distribution tests were completed on selected samples of the fill layer, the results are as follows:

- Gravel (%): 21 to 39
- Sand (%): 57 to 68
- Silt & Clay Size (%): 4 to 13

The grain size distribution graphs are presented in Appendix C and the grain size distribution test results are shown on the Record of Borehole sheets.

### 3.2 Sand

A layer of sand was encountered below the fill in all boreholes. The sand extending to the borehole termination depth of 15.9 m at each borehole location. The sand consists of some to trace gravel, silt, and clay. A coarser gravelly sand layer was present interlayered within the sand deposit from approximately 3.0 m to 4.1 m below existing ground surface in Borehole BH16-04. A finer sand layer with no gravel and trace silt and clay was present near the bottom of Boreholes BH16-01, 03, and 05.

Measured SPT 'N' values within the sand ranged between 5 blows to 76 blows per 0.3 m of penetration indicating a loose to very dense state of compactness. The SPT Values also indicate that the sand layer is predominantly compact to dense with the exception of 1.5 m to 3.1 m thick layer of loose sand as encountered in all boreholes with the exception of Borehole BH16-02. The natural moisture content, as measured in selected samples from the boreholes ranged from 2% to 23%.

Fourteen grain size distributions were completed on selected split spoon samples of the sand layer, including the gravelly sand interlayer in Borehole BH16-04, the results summarized are as follows:

- Gravel (%): 0 to 29
- Sand (%): 67 to 94
- Silt & Clay Size (%) 1 to 13

The grain size distribution curves are presented in Appendix C and the grain size distribution test results are shown on the Record of Borehole sheets.

### 3.3 Groundwater Conditions

Upon the completion of drilling, groundwater was measured at depths ranging from 9.9 m to 10.9 m below ground surface, except for Borehole BH16-01 in which no groundwater measurement was conducted on completion. The groundwater measurements are shown on the Record of Borehole sheets and are summarized below.

The groundwater at the site is expected to fluctuate seasonally and can be expected to be somewhat higher during the spring months and in response to major weather events.



**Table 2: Hinkler Lake Groundwater Measurements**

Foundation Element <sub>1</sub>	Borehole Designation	Location (MTM NAD83 Zone 13)		Ground Surface Elevation (m)	Water Level Depth Below Ground Surface (m)
		Northing (m)	Easting (m)		
Southwest Corner	BH16-01	5,211,721	369,840	414.1	Not measured
Northwest Corner	BH16-02	5,211,747	369,815	413.9	10.1
Northeast Corner	BH16-03	5,211,748	369,857	414.0	10.9
Southeast Corner	BH16-04	5,211,721	369,861	413.7	10.1
Centre	BH16-05	5,211,738	369,851	413.8	9.9

### 3.4 Analytical Results

Split spoon sample number 4 from BH16-05 was sent to an independent laboratory for analytical testing comprising pH, sulphate, resistivity and chloride determination and the test results are presented in Appendix D.



## 4.0 CLOSURE

This Foundation Investigation Report was prepared by Nicholas Kicz, EIT, and reviewed by Mr. Mehdi Mostakhdemi, M.Sc., P.Eng. Mr. Ty Garde, M.Eng, P.Eng., a Designated MTO Foundations Contact for Amec Foster Wheeler, conducted an independent review of this report.

Respectfully submitted,

**Amec Foster Wheeler Environment & Infrastructure,  
a Division of Amec Foster Wheeler Americas Limited**

Prepared by:



Nicholas Kicz  
Geotechnical Engineer in Training



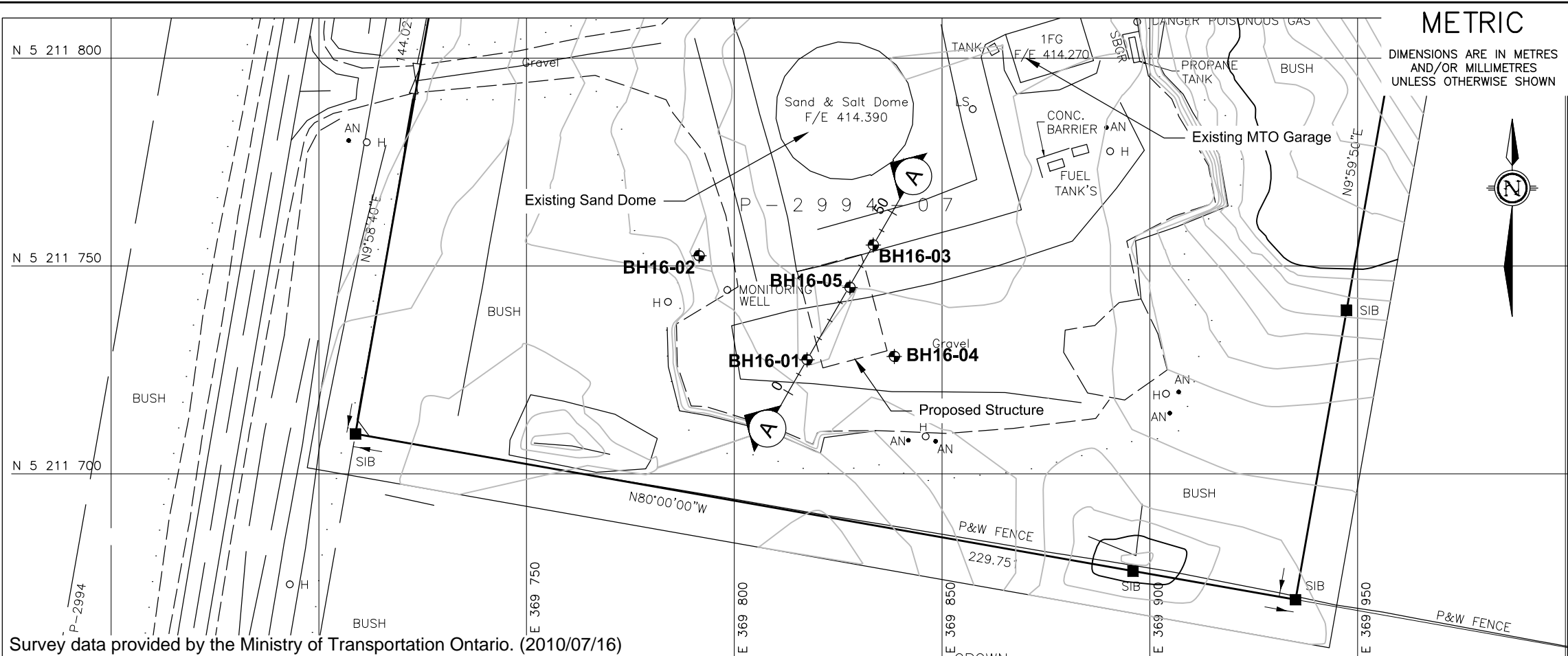
Mehdi Mostakhdemi, M.Sc., P. Eng.  
Geotechnical Engineer



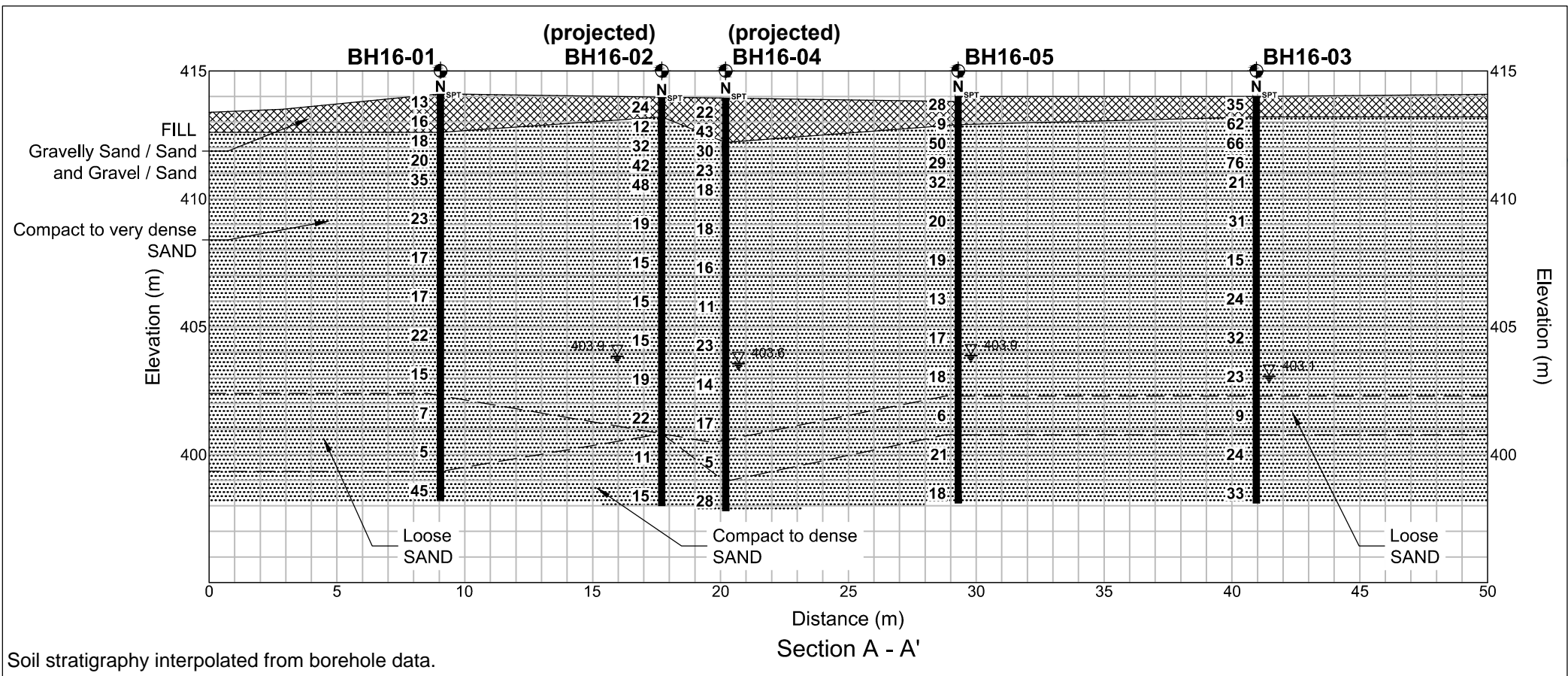
Ty Garde, M. Eng., M. Eng., P. Eng.,  
Designated MTO Foundations Contact



DATE PLOTTED: 2/21/2017 11:41:37 AM  
FILE LOCATION: P:\Projects\2016 Projects\Geotechnical\TY163014 MTO - Patrol Yards Eng. Drawings\TY163014 - Hinkler Lake.dwg



PLAN



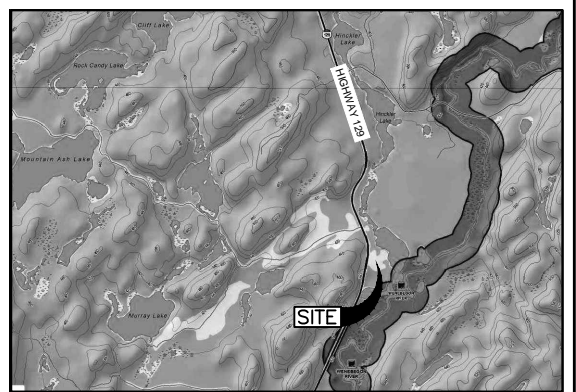
CENTERLINE PROFILE



Foundation Investigation  
and Design  
Assignment No. 5015-E-0064  
Hinkler Lake Patrol Yard  
Township of Martel, Ontario

PROPOSED STORAGE STRUCTURE  
BOREHOLE LOCATION PLAN AND  
SOIL STRATA SECTION

DRAWING  
1



KEY PLAN

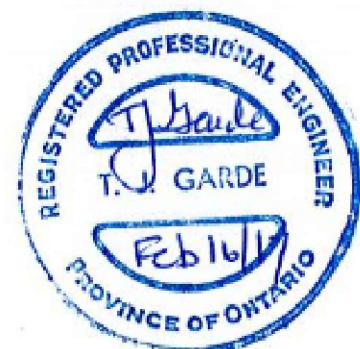
0 0.5 1.0 1.5 2.0 2.5  
Approximate Scale (km)

LEGEND

- BOREHOLE LOCATION - 2016 INVESTIGATION
- N<sub>SPT</sub> STANDARD PENETRATION TEST VALUE
- 10 BLOWS/0.3m UNLESS OTHERWISE STATED (STD. PEN. TEST, 475 J/BLOW)
- R REFUSAL
- WATER LEVEL UPON COMPLETION OF DRILLING
- EXISTING STRUCTURE
- PROPOSED STRUCTURE

NOTES

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING FOUNDATION DESIGN REPORT.
- THE INTERPRETED STRATIGRAPHY REPRESENTS SIMPLIFIED SUBSURFACE CONDITIONS. THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN DEFINED AT BOREHOLE LOCATIONS ONLY. CONDITIONS BETWEEN BOREHOLE LOCATIONS COULD DIFFER FROM ILLUSTRATED CONDITIONS.
- ELEVATIONS ARE REFERENCED TO GEODETIC DATUM.



NUMBER	ELEVATION (m)	CO--ORDINATES (MTM, NAD 83 ZONE 13)	
		NORTHING (m)	EASTING (m)
TESTHOLES BY OTHERS			
BH16--01	414.1	5211721	0369840
BH16--02	413.9	5211747	0369815
BH16--03	414.0	5211748	0369857
BH16--04	413.7	5211721	0369861
BH16--05	413.8	5211738	0369851
SITE LOCATION			
LATITUDE/LONGITUDE 47.042436, -83.144281			

0 20 40 60  
Scale (m)

REVISIONS				
	02/21/2017	1	NFK	REVISED PER MTO COMMENTS
	DATE	REV. BY	DESCRIPTION	
DESIGN	NFK	CHK	DMC	CODE
DRAWN	MAT	CHK	NFK	GEOCRES 410-22
				DATE 09-FEB-17

## **APPENDIX A**

### **SITE PHOTOGRAPHS**

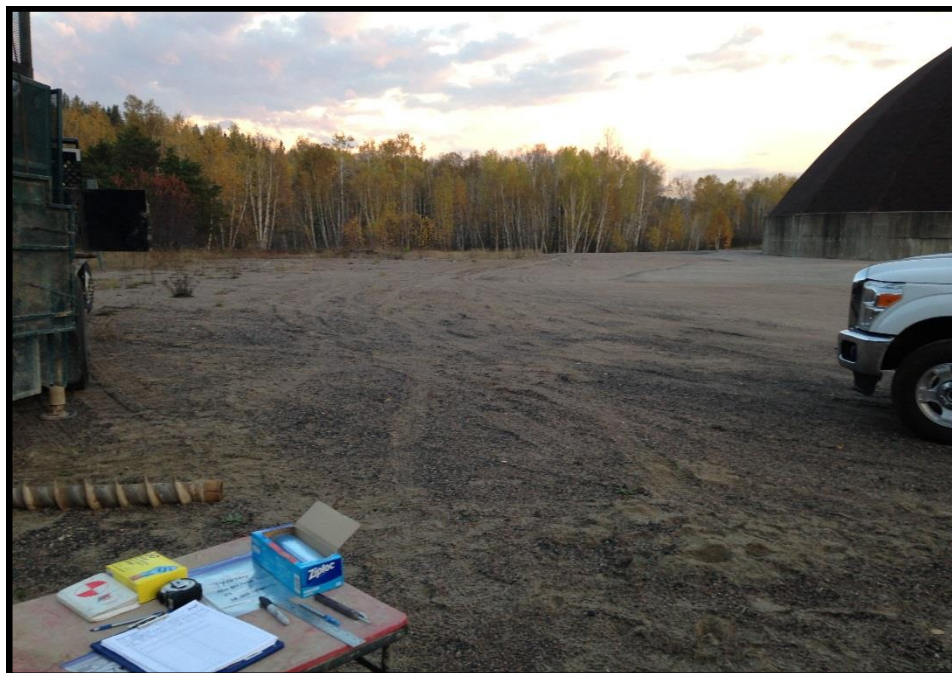




**Photo 1**

Drill rig auguring borehole with view of existing dome, photo taken facing northeast

**12 Oct 2016**



**Photo 2**

View of drill to the left and part of the dome on the right. View facing northwest of patrol yard landscape

**12 Oct 2016**



**Photo 3**

Drillers adjusting steel, with rig set up over borehole. View of flat area of site and west tree line

**13 Oct 2016**

## **APPENDIX B**

### **RECORD OF BOREHOLE NO. BH16-01 to BH 16-05**

## EXPLANATION OF BOREHOLE LOG

This form describes some of the information provided on the borehole logs, which is based primarily on examination of the recovered samples, and the results of the field and laboratory tests. Additional description of the soil/rock encountered is given in the accompanying geotechnical report.

### GENERAL INFORMATION

Project details, borehole number, location coordinates and type of drilling equipment used are given at the top of the borehole log.

### SOIL LITHOLOGY

#### ***Elevation and Depth***

This column gives the elevation and depth of inferred geologic layers. The elevation is referred to the datum shown in the Description column.

#### ***Lithology Plot***

This column presents a graphic depiction of the soil and rock stratigraphy encountered within the borehole.

#### ***Description***

This column gives a description of the soil strata, based on visual and tactile examination of the samples augmented with field and laboratory test results. Each stratum is described according to the *MTC Soil Classification Manual*.

The compactness condition of cohesionless soils (SPT) and the consistency of cohesive soils (undrained shear strength) are defined as follows (Ref. *MTC Soil Classification Manual*):

<b>Compactness of Cohesionless Soils</b>	<b>SPT N-Value*</b>
Very loose	0 to 5
Loose	5 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

<b>Consistency of Cohesive Soils</b>	<b>Undrained Shear Strength kPa</b>
Very soft	0 to 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	Over 200

\* For penetration of less than 0.3 m, N-values are indicated as the number of blows for the penetration achieved (e.g. 50/25: 50 blows for 25 centimeter penetration).

### Soil Sampling

Sample types are abbreviated as follows:

SS Split Spoon	TW Thin Wall Open (Pushed)	RC Rock Core	GS Grab Sample
AS Auger Sample	TP Thin Wall Piston (Pushed)	WS Washed Sample	AR Air Return Sample

Additional information provided in this section includes sample numbering, sample recovery and numerical testing results.

### Field and Laboratory Testing

Results of field testing (e.g., SPT, pocket penetrometer, and vane testing) and laboratory testing (e.g., natural moisture content, and limits) executed on the recovered samples are plotted in this section.

### Instrumentation Installation

Instrumentation installations (monitoring wells, piezometers, inclinometers, etc.) are plotted in this section. Water levels, if measured during fieldwork, are also plotted. These water levels may or may not be representative of the static groundwater level depending on the nature of soil stratum where the piezometer tips are located, the time elapsed from installation to reading and other applicable factors.

### Comments

This column is used to describe non-standard situations or notes of interest.



## BEDROCK DESCRIPTION

### STRENGTH CLASSIFICATION

Term (Grade)	Field Identification	Approximate Range of Uniaxial Compressive Strength (MPa)
Extremely Weak (R0)	Indented by thumbnail.	0.25 – 1.0
Very Weak (R1)	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife.	1.0 – 5.0
Weak (R2)	Can be peeled with a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer.	5.0 – 25
Medium Strong (R3)	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with a single firm blow of geological hammer.	25 – 50
Strong (R4)	Specimen requires more than one blow of geological hammer to fracture it.	50 – 100
Very Strong (R5)	Specimen requires many blows of geological hammer to fracture it.	100 – 250
Extremely Strong (R6)	Specimen can only be chipped with geological hammer.	>250

### JOINT SPACING CLASSIFICATION

Term	Average Joint Spacing (m)
Extremely close	< 0.02
Very close	0.02 – 0.06
Close	0.06 – 0.20
Moderately close	0.20 – 0.6
Wide	0.6 – 2.0
Very wide	2.0 – 6.0
Extremely wide	> 6.0

### ROCK QUALITY CLASSIFICATION

Rock Quality Designation, RQD (%)	Description of Rock Quality
0 – 25	Very Poor
25 – 50	Poor
50 – 75	Fair
75 – 90	Good
90 – 100	Excellent

Reference: Deere et al, 1967

### WEATHERING CLASSIFICATION

Term (Grade)	Description
Fresh (W1)	No visible sign of rock material weathering; perhaps slight discoloration on major discontinuity surfaces.
Slightly Weathered (W2)	Discoloration indicates weathering of rock material on discontinuity surfaces. Less than 5 % of rock mass altered.
Moderately Weathered (W3)	Less than half of the rock material is decomposed and/or disintegrated into a soil. Fresh or discoloured rock is present either as a continuous framework or as core stones.
Highly Weathered (W4)	More than half of the rock material is decomposed and/or disintegrated into a soil. Fresh or discoloured rock is present either as a discontinuous framework or as core stones.
Completely Weathered (W5)	All rock material is decomposed and/or disintegrated into soil. The original mass structure is still largely intact.
Residual Soil (W6)	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume but the soil has not been significantly transported.

Reference: Brown, 1981, "Suggested Methods for Rock Characterization Testing and Monitoring". International Society for Rock Mechanics.

### TERMINOLOGY

*Rock Quality Designation (RQD)* is defined as the percentage of intact core pieces longer than 100 mm (4 inches) to the total length of core. The core should be at least NW size (54.7 mm or 2.15 inches in diameter) and typically 5 ft (nominally 1.5 m) in length.

*Solid Core Recovery (SCR)* is defined as the percentage of intact cylindrical core pieces to the total length of core.

*Total Core Recovery (TCR)* is defined as the percentage of intact core pieces to the total length of core.

### GROUNDWATER

▽ Groundwater level at completion of drilling.

▼ Groundwater level several hours after completion of drilling.



MTC SOIL CLASSIFICATION  
Based on MTC Soil Classification Manual



MAJOR DIVISION					GROUP SYMBOL	TYPICAL DESCRIPTION	INFORMATION REQUIRED FOR DESCRIBING SOILS	LABORATORY CLASSIFICATION CRITERIA			
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75µm)	GRAVELS MORE THAN HALF THE COARSE FRACTION LARGER THAN 4.75mm	CLEAN GRAVELS (LITTLE OR NO FINES)	WIDE RANGE IN GRAIN SIZE & SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICAL SIZE		GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	GIVE TYPE, NAME, IF NECESSARY, INDICATE APPROX % OF SAND & GRAVEL ; MAX SIZE; ANGULARITY, SURFACE CONDITION, & HARDNESSOF THE COARSE GRAINS, LOCAL OR GEOLOGICAL NAME & OTHER PERTINENT DESCRIPTIVE INFORMATION, & SYMBOL IN PARENTHESIS.  FOR UNDISTURBED SOILS ADD INFORMATION ON STRATIFICATION, DEGREE OF COMPACTNESS, CEMENTATION, MOISTURE CONDITION & DRAINAGE CHARACTERISTICS	$C_u = \frac{D_{60}}{D_{10}}$ GREATER THAN 4;			
			PREDOMINANTLY ONE SIZE OF A RANGE OF SIZES WITH STONE INTERMEDIATE SIZES MISSING		GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES		$C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ BETWEEN 1 AND 3			
		GRAVEL WITH FINES (APPLICABLE AMOUNT OF FINES)	NON PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE ML BELOW)		GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND- SILT MIXTURES		NOT MEETING ALL GRADATION REQUIREMENTS FOR GW			
			PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW)		GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES					
	SANDS MORE THAN HALF THE COARSE FRACTION SMALLER THAN 4.75mm	CLEAN SANDS (LITTLE OR NO FINES)	WIDE RANGE IN GRAIN SIZE & SUBSTANTIAL AMOUNT OF ALL INTERMEDIATE PARTICLE SIZES		SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES		NOT MEETING ALL GRADATION REQUIREMENTS FOR GW			
			PREDOMINANTLY ONE SIZE OR A RANGE OF SIZES WITH SOME INTERMEDIATE SIZE MISSING		SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES					
		SANDS WITH FINES (APPLICABLE AMOUNT OF FINES)	NON PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE ML BELOW)		SM	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES		ATTERBERG LIMITS BELOW A-LINE OR Ip LESS THAN 4		ABOVE A-LINE WITH Ip BETWEEN 4 AND 7 ARE BORDERLINE CASES REQUIRING USE OF DUAL SYMBOLS	
			PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW)		SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE A- LINE WITH Ip GREATER THAN 7			
			IDENTIFICATION PROCEDURE ON FRACTION SMALLER THAN 425µm					ATTERBERG LIMITS ABOVE A- LINE WITH Ip GREATER THAN 7			
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75µm)	SILT AND CLAYS	LIQUID LIMIT LESS THAN 35	DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)		GIVE TYPE, NAME, IF NECESSARY, INDICATE DEGREE AND CHARACTER OF PLASTICITY, AMOUNT AND MAXIMUM SIZE OF COURSE GRAINS, COLOUR IN WET CONDITION, ODOUR, IF ANY, LOCAL OR GEOLOGIC NAME & OTHER PERTINENT DESCRIPTIVE INFORMATION & SYMBOL IN PARENTHESIS.  FOR UNDISTURBED SOILS AND INFORMATION ON STRUCTURE, STRATIFICATION, CONSISTANCY IN UNDISTURBED AND REMOLDED STATES, MOISTURE & DRAINAGE CONDITION.	LESS THAN 5% GW, GP, SW, SP MORE THAN 12% GM, GC, SM, SC 5% TO 12% <b>BORDER LINE</b> CASES REQUIRE USE OF DUAL SYMBOL.			
			NONE	QUICK	NONE	ML				INORGANIC SILTS & SANDY SILTS OR SLIGHTLY PLASTICITY, ROCK FLOUR	
			MEDIUM TO HIGH	NONE TO VERY SLOW	MEDIUM	CL				SILTY CLAYS (INORGANIC), GRAVELLY CLAYS, SANDY CLAYS, LEAN CLAYS	
			SLIGHT TO MEDIUM	SLOW	SLIGHT	OL				ORGANIC SILT OF LOW PLASTICITY, ORGANIC SANDY SILTS	
		LIQUID LIMIT BETWEEN 35 AND 50	NONE TO SLIGHT	SLOW TO QUICK	SLIGHT	MI				INORGANIC COMPRESSIBLE FINE SANDY SILT WITH CLAY OF MEDIUM PLASTICIT, CLAYEY SILTS	
			HIGH	NONE	MEDIUM TO HIGH	CI				SILTY CLAYS (INORGANIC) OF MEDIUM PLASTICITY	
			SLIGHT TO MEDIUM	VERY SLOW	SLIGHT	OI				ORGANIC SILTY CLAYS OF MEDIUM PLASTICITY	
		LIQUID LIMIT GREATER THAN 50	SLIGHT TO MEDIUM	SLOW TO NONE	MEDIUM	MH				INORGANIC SILTS, HIGHLY COMPRESSIBLE MICACEOUS OR DIATOMEACACOUS FINE SANDY SILTS, ELASTIC SILTS	
			HIGH TO VERY HIGH	NONE	HIGH	CH				CLAYS (INORGANIC) OF HIGH PLASTICITY, FAT CLAYS	
			MEDIUM TO HIGH	NONE TO VERY SLOW	SLIGHT TO MEDIUM	OH				ORGANIC CLAYS OF HIGH PLASTICITY	
	HIGH ORGANIC SOILS					PEAT AND OTHER HIGHLY ORGANIC SOILS					
	HIGH ORGANIC SOILS					PEAT AND OTHER HIGHLY ORGANIC SOILS					

# RECORD OF BOREHOLE No. BH16-01

1 OF 3

G.W.P. 5015-E-0064 LOCATION 0369840 E, 5211721 N ORIGINATED BY PW  
DIST HWY 129 BOREHOLE TYPE Hollow Stem Augers (108 mm I.D. - 210 mm O.D.) COMPILED BY PW  
DATUM MTM NAD 83 Zone 13 DATE 12 October 2016 CHECKED BY TJG  
PROJECT Foundation Investigation and Design Report - Hinkler Lake Patrol Yard, Township of Martel, Ontario JOB NO. TY163014

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa									WATER CONTENT (%)			GR	SA	SI	CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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## 2 OF 3

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# RECORD OF BOREHOLE No. BH16-01

3 OF 3

G.W.P. 5015-E-0064	LOCATION 0369840 E, 5211721 N	ORIGINATED BY PW
DIST HWY 129	BOREHOLE TYPE Hollow Stem Augers (108 mm I.D. - 210 mm O.D.)	COMPILED BY PW
DATUM MTM NAD 83 Zone 13	DATE 12 October 2016	CHECKED BY TJG
PROJECT Foundation Investigation and Design Report - Hinkler Lake Patrol Yard, Township of Martel, Ontario		JOB NO. TY163014

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			SOIL VAPOUR READING	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa					WATER CONTENT (%)				
									20 40 60 80 100					w <sub>p</sub> w w <sub>L</sub>				
									○ UNCONFINED + FIELD VANE									
									● QUICK TRIAXIAL × LAB VANE									
									20 40 60 80 100					20 40 60				
														20 40 60				

# RECORD OF BOREHOLE No. BH16-02

1 OF 3

G.W.P. 5015-E-0064 LOCATION 0369815 E, 5211747 N ORIGINATED BY PW  
DIST HWY 129 BOREHOLE TYPE Hollow Stem Augers (108 mm I.D. - 210 mm O.D.) COMPILED BY PW  
DATUM MTM NAD 83 Zone 13 DATE 12 October 2016 CHECKED BY TJG  
PROJECT Foundation Investigation and Design Report - Hinkler Lake Patrol Yard, Township of Martel, Ontario JOB NO. TY163014

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa									WATER CONTENT (%)			GR	SA	SI	CL
									20	40	60	80	100					20	40	60				
413.9	SW Corner of Proposed Building																							
0.0	SAND trace fines some gravel compact (FILL)		SS	1	24									6 <sub>O</sub>										
413.2																								
0.7	SAND trace to some fines trace to some gravel compact to dense		SS	2	12		1	413						8 <sub>O</sub>					1	87	(12)			
			SS	3	32		2	412						9 <sub>O</sub>										
			SS	4	42		3	411						9 <sub>O</sub>										
			SS	5	48									9 <sub>O</sub>										
							4	410																
			SS	6	19		5	409						9 <sub>O</sub>										
							6	408																
			SS	7	15									9 <sub>O</sub>					16	81	(3)			
								407																

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+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

## 2 OF 3

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+ 3, × 3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE



## RECORD OF BOREHOLE No. BH16-02

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3 OF 3

G.W.P. 5015-E-0064	LOCATION 0369815 E, 5211747 N	ORIGINATED BY PW
DIST _____ HWY 129	BOREHOLE TYPE Hollow Stem Augers (108 mm I.D. - 210 mm O.D.)	COMPILED BY PW
DATUM MTM NAD 83 Zone 13	DATE 12 October 2016	CHECKED BY TJG
PROJECT Foundation Investigation and Design Report - Hinkler Lake Patrol Yard, Township of Martel, Ontario		JOB NO. TY163014

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			SOIL VAPOUR READING	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa					WATER CONTENT (%)				COV/ TOV (ppm)	GR	SA	SI	CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

# RECORD OF BOREHOLE No. BH16-03

1 OF 3

G.W.P. 5015-E-0064 LOCATION 0369857 E, 5211748 N ORIGINATED BY PW  
DIST HWY 129 BOREHOLE TYPE Hollow Stem Augers (108 mm I.D. - 210 mm O.D.) COMPILED BY PW  
DATUM MTM NAD 83 Zone 13 DATE 12 October 2016 - 13 October 2016 CHECKED BY TJG  
PROJECT Foundation Investigation and Design Report - Hinkler Lake Patrol Yard, Township of Martel, Ontario JOB NO. TY163014

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa									
									20	40	60	80	100					
414.0	NW Corner of Proposed Building																	
0.0	GRAVELLY SAND some fines dense (FILL)		SS	1	35													21 66 (13)
413.3																		
0.7	SAND trace to some fines some gravel compact to very dense		SS	2	62		1	413										
			SS	3	66		2	412										
			SS	4	76													
							3	411										
			SS	5	21													
							4	410										
			SS	6	31		5	409										
							6	408										
			SS	7	15													

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+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

## 2 OF 3

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3 OF 3

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

# RECORD OF BOREHOLE No. BH16-04

1 OF 3

G.W.P. 5015-E-0064 LOCATION 0369861 E, 5211721 N ORIGINATED BY PW  
DIST HWY 129 BOREHOLE TYPE Hollow Stem Augers (108 mm I.D. - 210 mm O.D.) COMPILED BY PW  
DATUM MTM NAD 83 Zone 13 DATE 13 October 2016 CHECKED BY TJG  
PROJECT Foundation Investigation and Design Report - Hinkler Lake Patrol Yard, Township of Martel, Ontario JOB NO. TY163014

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa									WATER CONTENT (%)			GR	SA	SI	CL
									○ UNCONFINED	● QUICK TRIAXIAL	+ FIELD VANE	× LAB VANE	20					40	60	80				
413.7	NE Corner of Proposed Building																							
0.0	SAND & GRAVEL trace fines compact to dense (FILL)		SS	1	22																			
								413																
			SS	2	43		1											39	57 (4)					
412.3																								
1.5	SAND some gravel trace silt and clay compact to loose		SS	3	30			412																
							2																	
			SS	4	23			411																
410.7																								
3.0	GRAVELLY SAND		SS	5	18		3											29	67 (4)					
								410																
							4																	
409.6																								
4.1	SAND trace fines trace gravel compact		SS	6	18		5	409																
								408																
							6																	
			SS	7	16																			
								407																

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+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE



# RECORD OF BOREHOLE No. BH16-04

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2 OF 3

G.W.P. 5015-E-0064 LOCATION 0369861 E, 5211721 N 2 OF 3  
 DIST                      HWY 129 BOREHOLE TYPE Hollow Stem Augers (108 mm I.D. - 210 mm O.D.) ORIGINATED BY PW  
 DATUM MTM NAD 83 Zone 13 DATE 13 October 2016 COMPILED BY PW  
 PROJECT Foundation Investigation and Design Report - Hinkler Lake Patrol Yard, Township of Martel, Ontario CHECKED BY TJG  
 JOB NO. TY163014

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+ 3, × 3: Numbers refer to Sensitivity      ○ 3% STRAIN AT FAILURE

# RECORD OF BOREHOLE No. BH16-04

3 OF 3

G.W.P. 5015-E-0064 LOCATION 0369861 E, 5211721 N ORIGINATED BY PW  
DIST HWY 129 BOREHOLE TYPE Hollow Stem Augers (108 mm I.D. - 210 mm O.D.) COMPILED BY PW  
DATUM MTM NAD 83 Zone 13 DATE 13 October 2016 CHECKED BY TJG  
PROJECT Foundation Investigation and Design Report - Hinkler Lake Patrol Yard, Township of Martel, Ontario JOB NO. TY163014

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	SOIL VAPOUR READING COV/ TOV (ppm)	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
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# RECORD OF BOREHOLE No. BH16-05

1 OF 3

G.W.P. 5015-E-0064 LOCATION 0369851 E, 5211738 N ORIGINATED BY PW  
DIST HWY 129 BOREHOLE TYPE Hollow Stem Augers (108 mm I.D. - 210 mm O.D.) COMPILED BY PW  
DATUM MTM NAD 83 Zone 13 DATE 13 October 2016 CHECKED BY TJG  
PROJECT Foundation Investigation and Design Report - Hinkler Lake Patrol Yard, Township of Martel, Ontario JOB NO. TY163014

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH m	ELEVATION m	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			SOIL VAPOUR READING	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
ELEV DEPTH (m)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES				SHEAR STRENGTH kPa					WATER CONTENT (%)				COV/ TOV (ppm)	GR	SA	SI	CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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413.8	Center of Proposed Building																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													

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## 2 OF 3

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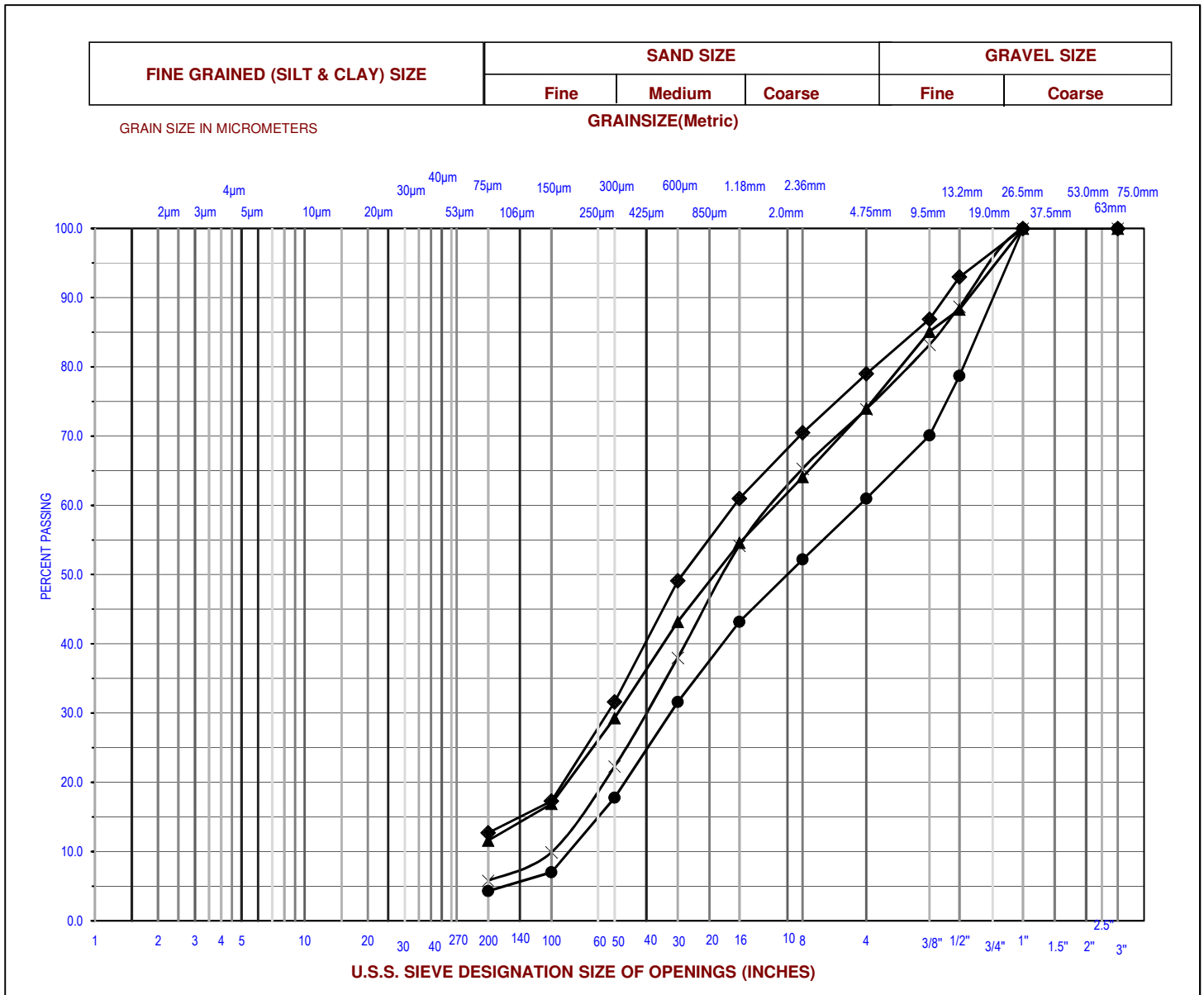
3 OF 3

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○<sup>3%</sup> STRAIN AT FAILURE

## **APPENDIX C**

### **LABORATORY TESTING RESULTS**

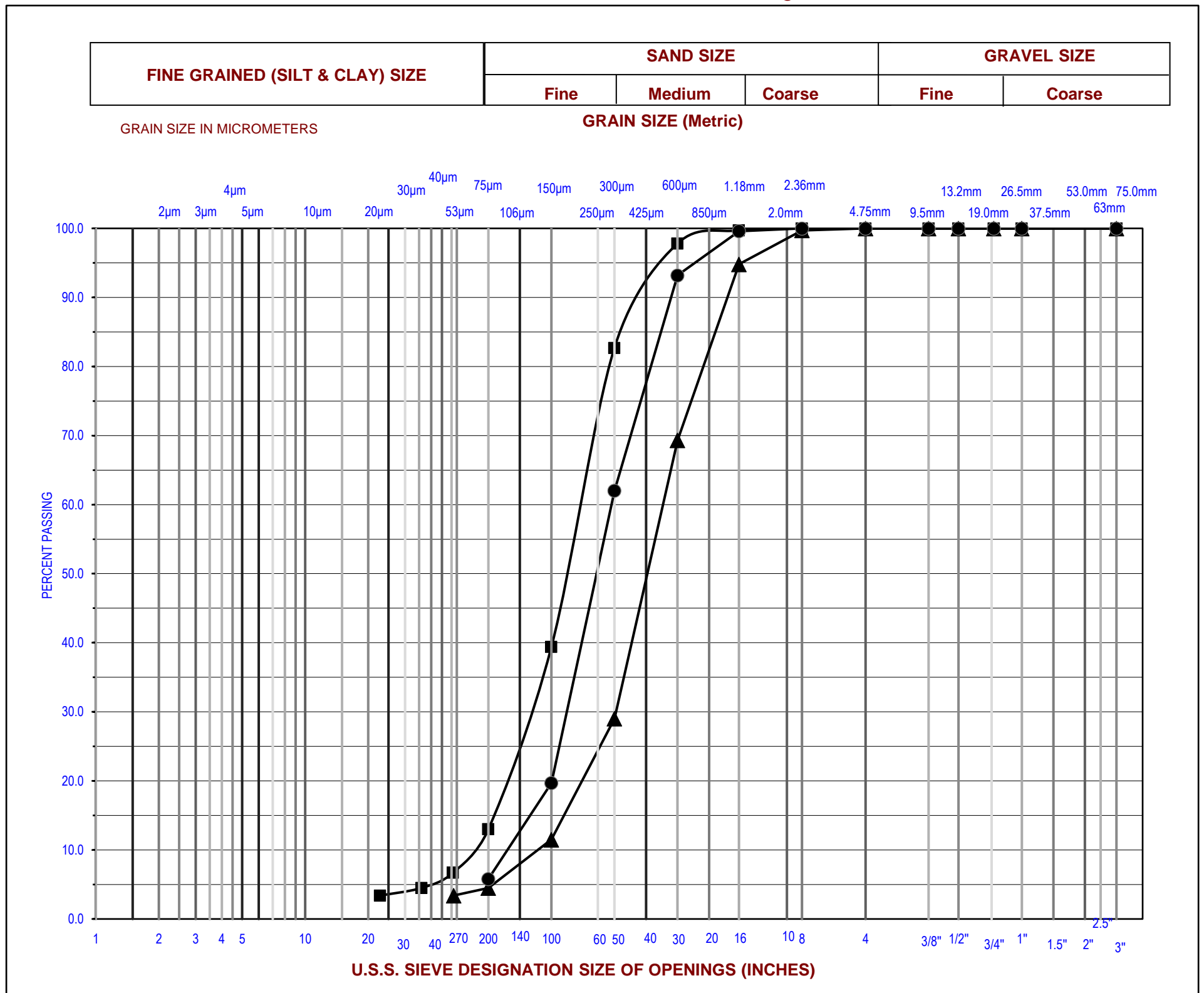
**FIGURE C1 - GRAIN SIZE DISTRIBUTION**  
**GRAVELLY SAND / SAND & GRAVEL (FILL)**



**LEGEND**

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)	GRAVEL(%)	SAND (%)	SILT & CLAY (%)
X	16-01	SS1	413.8	26	68	6
◆	16-03	SS1	413.7	21	66	13
●	16-04	SS2	412.6	39	57	4
▲	16-05	SS1	413.5	26	62	12

**FIGURE C2A - SIEVE AND HYDROMETER**  
SAND, trace to some silt, trace to some gravel

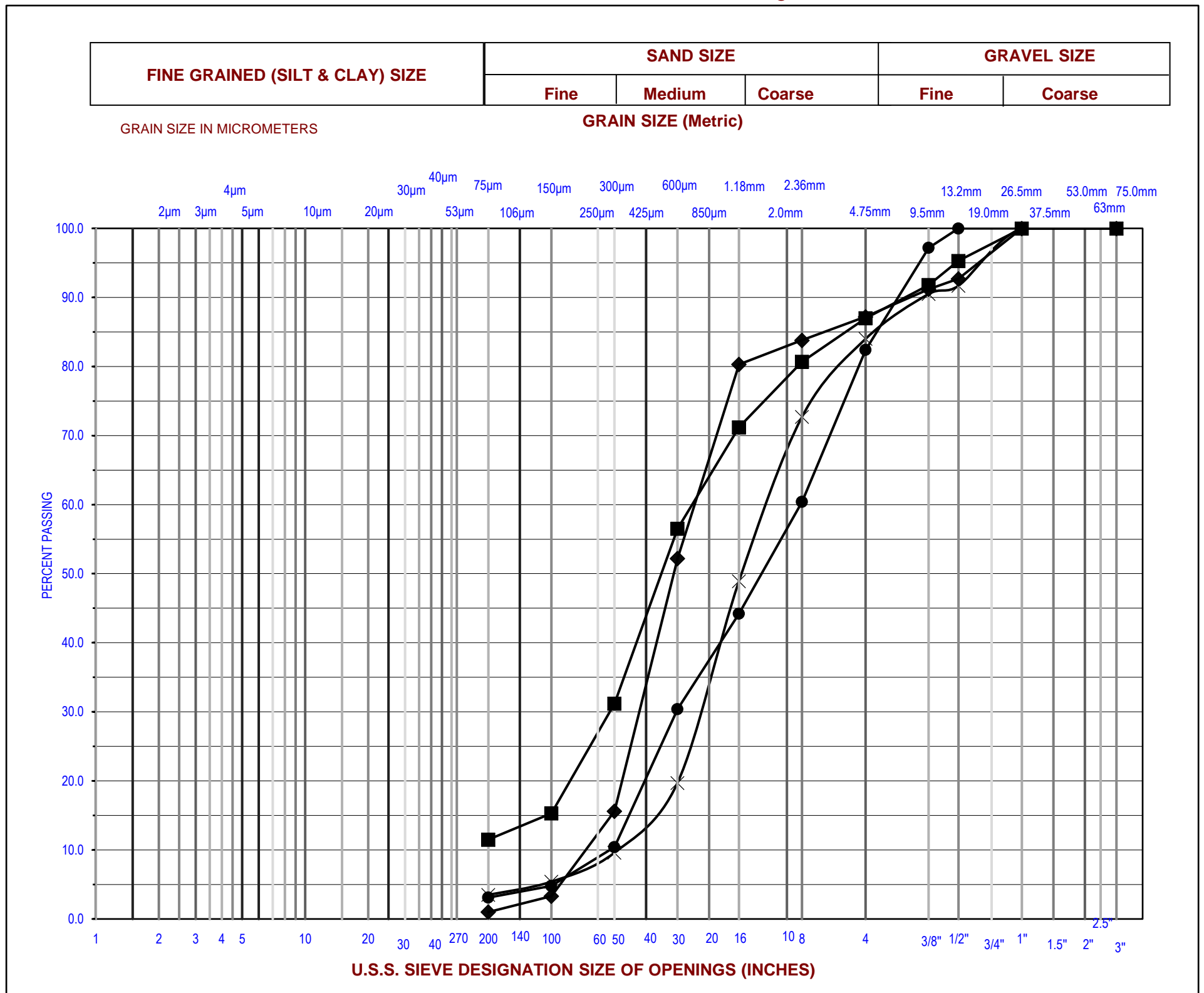


## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)	GRAVEL(%)	SAND (%)	SILT (%)	CLAY (%)
■	16-01	SS11	401.6	0	87	13	0
▲	16-01	SS12	400.2	0	88	12	0
●	16-01	SS13	398.6	0	94	6	0

### FIGURE C2B - GRAIN SIZE DISTRIBUTION

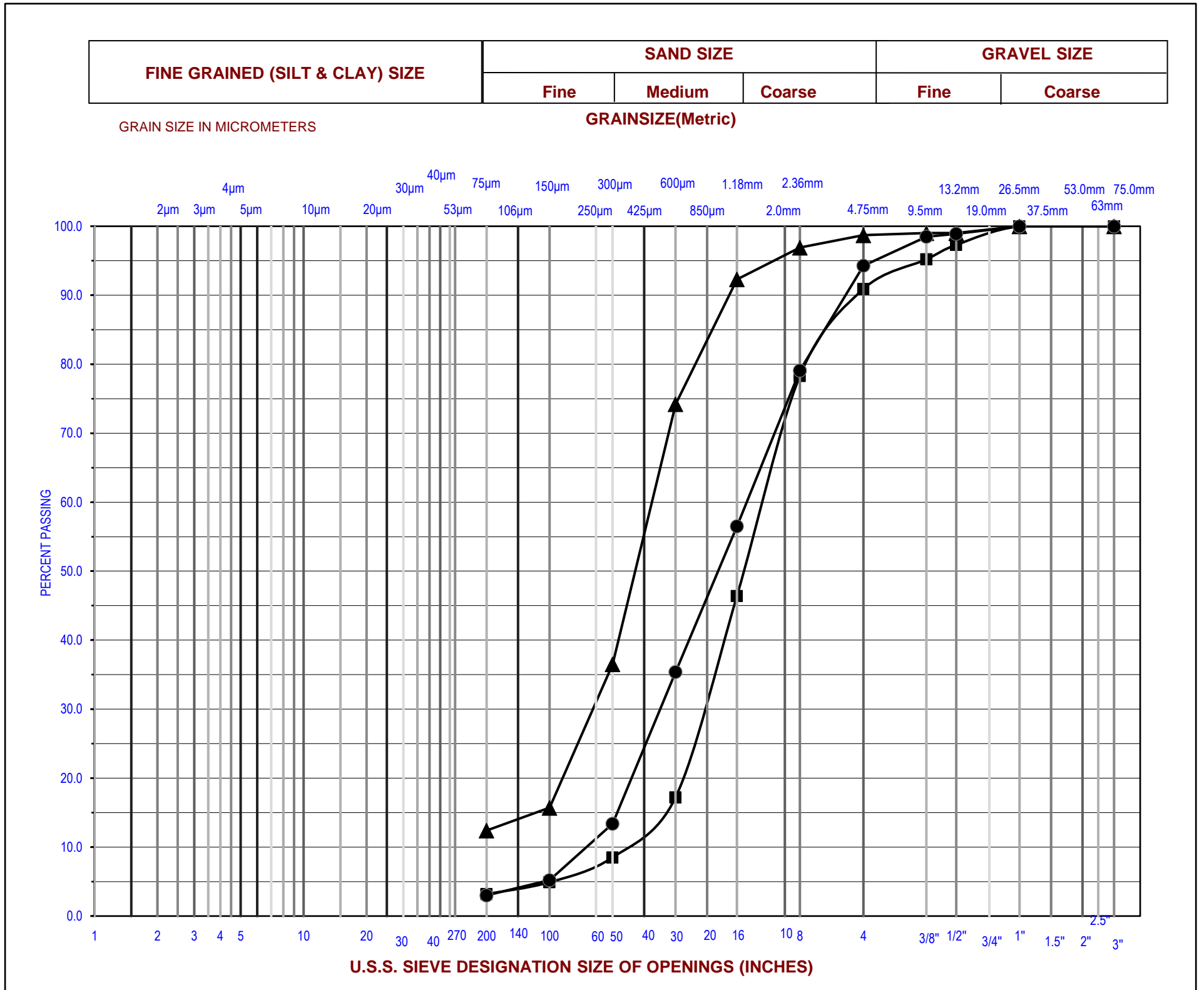
SAND, trace to some silt, trace to som gravel



## LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)	GRAVEL(%)	SAND (%)	SILT & CLAY (%)
X	16-02	SS7	407.5	16	80	4
o	16-02	SS11	401.4	13	86	1
●	16-03	SS9	404.6	18	79	3
■	16-05	SS2B	412.7	13	75	12

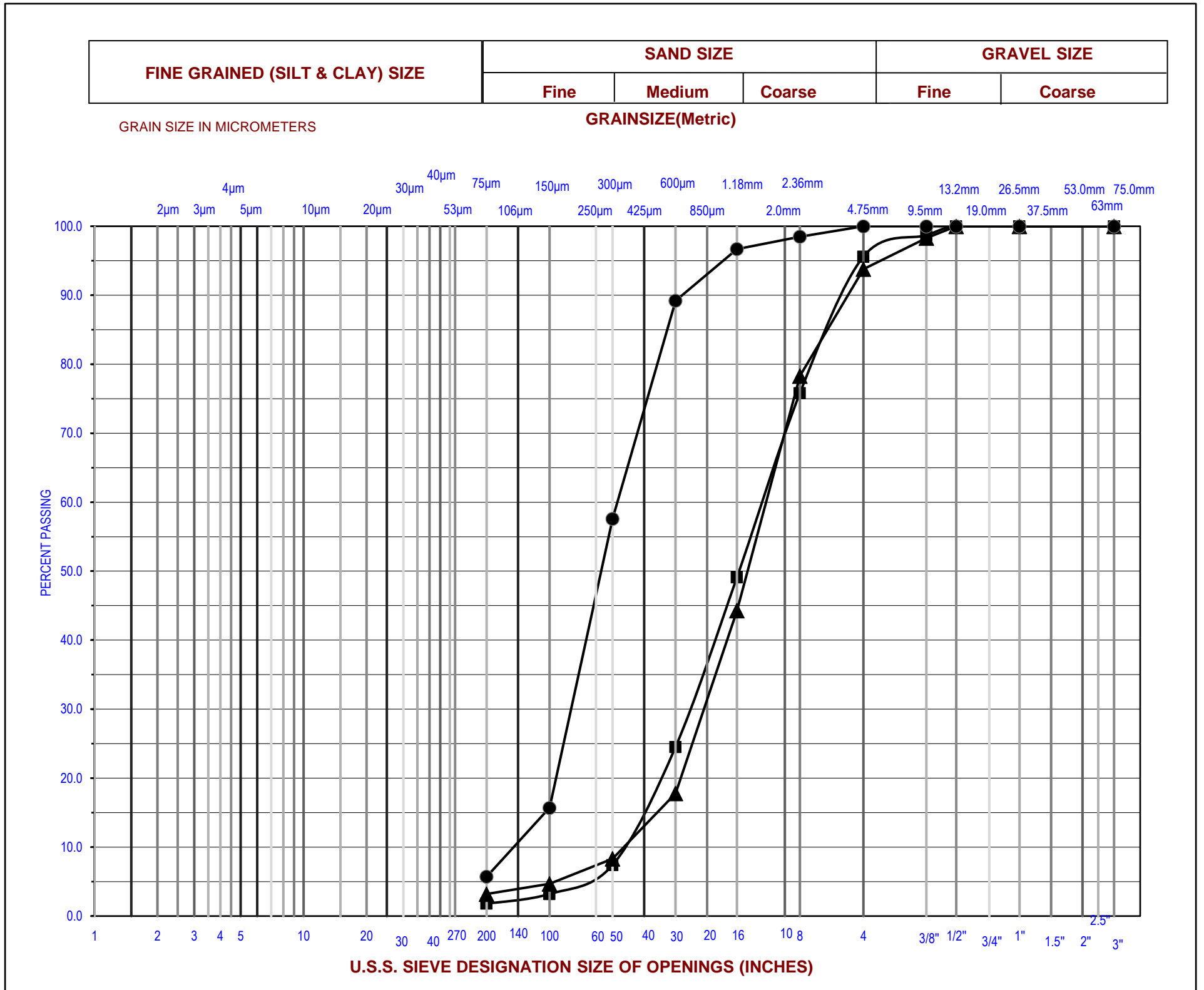
**FIGURE C2C- GRAIN SIZE DISTRIBUTION**  
SAND, trace to some silt, trace to some gravel





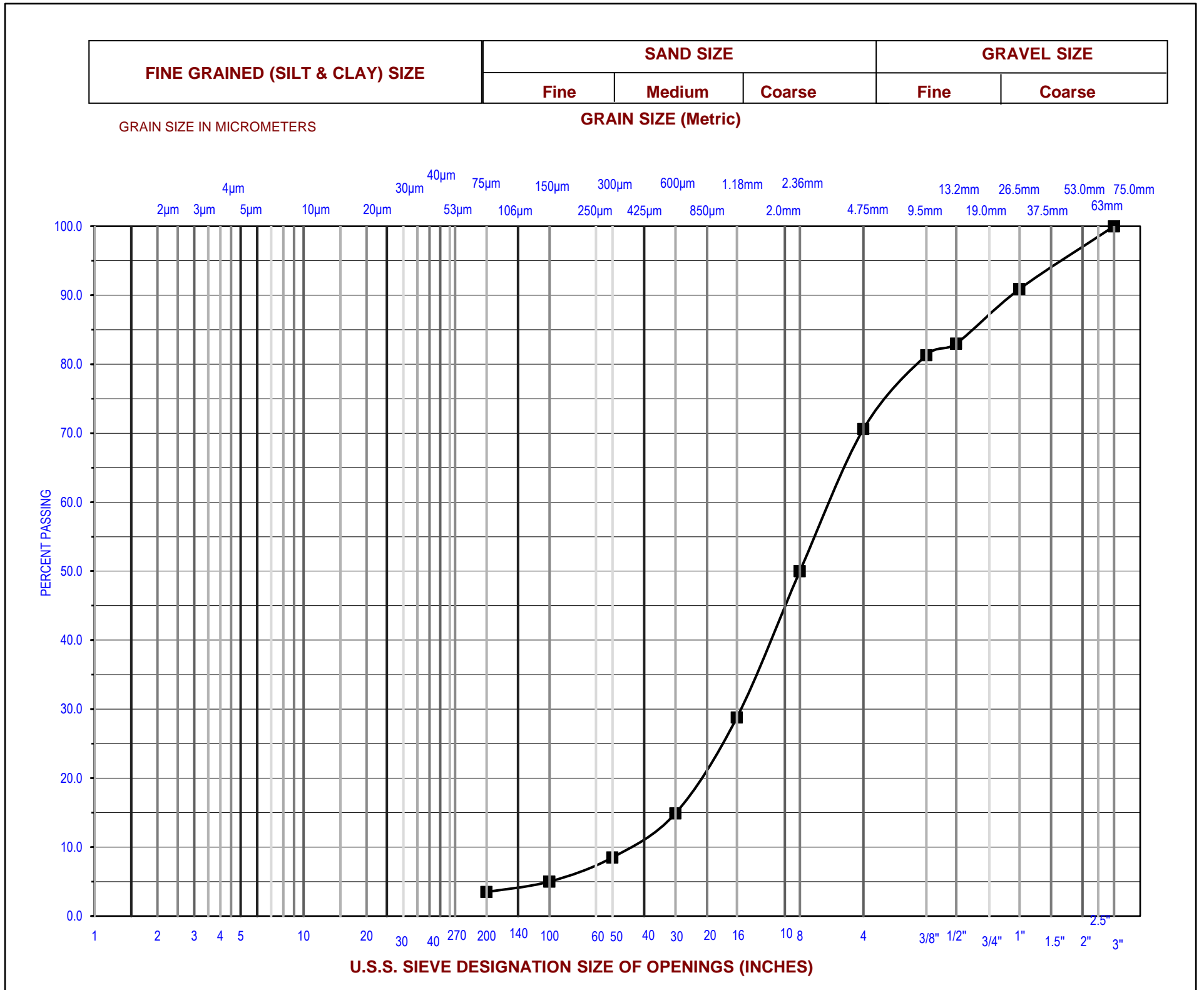
## FIGURE C2D - GRAIN SIZE DISTRIBUTION

SAND, trace to some silt, trace to some gravel



## FIGURE C3 - GRAIN SIZE DISTRIBUTION

GRAVELLY SAND, trace silt



### LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEVATION (m)	GRAVEL(%)	SAND (%)	SILT & CLAY (%)
■	16-04	SS5	410.4	29	67	4

Amec Foster Wheeler Environment & Infrastructure, a Division of Amec Foster Wheeler Americas Limited 131 Fielding Road, Lively, Ontario Canada, P3Y1L7 PH: (705) 682-2632, FX: (705) 682-2260 www.amecfw.com	<b>GRAIN SIZE DISTRIBUTION</b>	<b>Project No.:</b> TY163014	
		<b>Tested By:</b>	
		<b>MMD</b>	

## **APPENDIX D**

### **ANALYTICAL RESULTS**

**CLIENT NAME: AMEC FOSTER WHEELER ENVIRO&INFRASTR**  
**131 FIELDING ROAD**  
**LIVELY, ON P3Y1L7**  
**(705) 682-2632**

**ATTENTION TO: David Brown**

**PROJECT: TY163014**

**AGAT WORK ORDER: 16U160642**

**SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator**

**DATE REPORTED: Nov 22, 2016**

**PAGES (INCLUDING COVER): 5**

**VERSION\*: 1**

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

**\*NOTES**

**All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.**



**AGAT** Laboratories

## Certificate of Analysis

AGAT WORK ORDER: 16U160642

PROJECT: TY163014

5835 COOPERS AVENUE  
MISSISSAUGA, ONTARIO  
CANADA L4Z 1Y2  
TEL (905)712-5100  
FAX (905)712-5122  
<http://www.agatlabs.com>

CLIENT NAME: AMEC FOSTER WHEELER ENVIRO&INFRASTR

ATTENTION TO: David Brown

SAMPLING SITE:

SAMPLED BY:

### Inorganic Chemistry (Soil)

DATE RECEIVED: 2016-11-15

DATE REPORTED: 2016-11-22

		HIN BH16-05		
SAMPLE DESCRIPTION:		SS4		
SAMPLE TYPE:		Soil		
DATE SAMPLED:		2016-10-13		
Parameter	Unit	G / S	RDL	8017753
pH, 2:1 CaCl <sub>2</sub> Extraction	pH Units			6.70
Chloride (2:1)	µg/g	2		45
Sulphate (2:1)	µg/g	2		28
Electrical Conductivity (2:1)	mS/cm		0.005	0.152
Resistivity (2:1)	ohm.cm		1	6580

**Comments:** RDL - Reported Detection Limit; G / S - Guideline / Standard  
**8017753** EC/Resistivity, Chloride and Sulphate were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl<sub>2</sub> extract prepared at 2:1 ratio.

Please note that sample was received and analyzed past hold time.

**Certified By:**

*Amanjot Bhela*



## Quality Assurance

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### Soil Analysis

RPT Date: Nov 22, 2016			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE			MATRIX SPIKE			
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

#### Inorganic Chemistry (Soil)

pH, 2:1 CaCl <sub>2</sub> Extraction	8017932		7.23	7.18	0.7%	NA	101%	80%	120%	NA			NA		
Chloride (2:1)	8018372		42	43	2.4%	< 2	104%	80%	120%	102%	80%	120%	104%	70%	130%
Sulphate (2:1)	8018372		64	65	1.6%	< 2	94%	80%	120%	100%	80%	120%	102%	70%	130%
Electrical Conductivity (2:1)	8013796		4.59	4.59	0.0%	< 0.005	99%	90%	110%	NA			NA		

Comments: NA signifies Not Applicable.

**Certified By:**

*Amanjot Bhela*

## Method Summary

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PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
<b>Soil Analysis</b>			
pH, 2:1 CaCl <sub>2</sub> Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B, SSA #5 Part 3	CALCULATION

## **APPENDIX E**

### **LIMITATIONS OF REPORT**



## **AMEC FOSTER WHEELER ENVIRONMENT & INFRASTRUCTURE**

### **LIMITATIONS OF REPORT**

The conclusions and recommendations given in this report are based on information determined at the borehole locations. The information contained herein in no way reflects on the environmental aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the geotechnical engineer be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in test holes.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of boreholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices. No other warranty is expressed or implied.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Amec Foster Wheeler accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.