



THURBER ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT
BEAR BROOK BRIDGE REPLACEMENTS
HIGHWAY 417 FROM EIGHTH LINE TO OC 26
OTTAWA, ONTARIO
G.W.P. 455-98-00, SITES 3-266.1 & 3-266.2**

GEOCRES NO. 31G-248

Submitted

To

URS Canada Inc.

August 23, 2014

File: 19-4406-6

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PART 1 FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual data obtained from a foundation investigation carried out by Thurber Engineering Ltd. (Thurber) for the design of replacement structures for the existing Highway 417 bridges over Bear Brook just west of Piperville Road (Eighth Line Road), near Ottawa, Ontario. Thurber has been retained by URS Canada Inc. to carry out this investigation on behalf of the Ministry of Transportation Ontario (MTO) under Agreement 4012-E-0001, Part A.

The purpose of this investigation was to determine the subsurface conditions at the site and, based on this data, to provide records of boreholes, laboratory test results and a written description of the subsurface conditions.

2 SITE DESCRIPTION

The site is located within a physiographic region known as the Russell and Prescott Sand Plains which are characterized by a sand deposit ranging from 3 to 9 m thick underlain by deep marine clay deposits.

In the vicinity of Highway 417, Bear Brook meanders through the floor of a valley with flow generally from south to north. The floor of the valley is approximately 70 to 80 m wide and approximately 8 m below the surrounding grades (elevation 68 to 69 m). Bear Brook has been incised within the valley floor by erosion and has a depth of approximately 2 m below the valley floor and width of 10 to 12 m.

Highway 417 has a rural freeway configuration with two lanes in each direction, separated by a vegetated median which is approximately 130 to 140 m wide at the Bear Brook crossings. The existing bridges consist of a five span structure with a total length of 97 m in the eastbound lanes and a six span structure with a total length of approximately 120 m in the westbound lanes.

The existing bridge abutments are located within slopes leading down to the valley floor. The highway embankment slopes extend down at approximately 2H:1V and tie into the existing valley slopes. The roadway platform does not present evidence of settlement or stability concerns at the four approaches. The embankment slopes are vegetated with long grasses and occasional shrubs. No evidence of instability was noted, however, significant erosion was evident within the valley and particularly evident at the east approach to the west bound structure where stormwater is being directed down the slope.

3 INVESTIGATION PROCEDURES

3.1 Field Investigation

Historical data available from the MTO GEOCREST library was reviewed prior to mobilization of the field investigation crews. The available data included Foundation Investigation Reports, general arrangement drawings and limited pile driving records for the existing bridge structures. The field investigation plan was finalized after discussion with the MTO Foundations Section. Approximate locations of test holes are shown on the Borehole Location and Soil Strata drawing in Appendix A. The locations and depths of the test holes are tabulated below.

Location	Test Hole #	Test Holes
Eastbound Bridge		
East approach	13-13	1 Borehole to 10.1 m
East abutment	SCPT13-12	1 Static cone penetration test to 30 m
East pier	13-11	1 Borehole to 34.2 m
West pier	13-10	1 Borehole to 32.1 m
West abutment	13-9	1 Borehole to 41.6 m
West approach	13-8	1 Borehole to 10.1 m
Westbound Bridge		
East approach	13-7	1 Borehole to 10.4 m
East abutment	13-6	1 Borehole to 38.6 m
Existing Bridge East abutment	13-5	1 Borehole to 10.8 m
East pier	13-4	1 Borehole to 35.8 m
West pier	13-3	1 Borehole to 35.7 m
West abutment	SCPT13-02	1 Static cone penetration test to 29.8 m
West approach	13-1	1 Borehole to 11.1 m
TOTAL		11 Boreholes 2 Static cone penetration tests

The geotechnical field investigation was carried out between September 16 and October 16, 2013.

The static cone penetration testing (CPT) was carried out by ConeTec using a track mounted CPT rig. Testing included the standard measurement of tip resistance, sleeve friction and pore pressure as well as pore pressure dissipation tests at selected depths and measurement of shear wave velocities at regular depth intervals.

The borehole drilling was carried out using a combination of truck and track-mounted drill rigs supplied and operated by a specialist drilling contractor.

Soil drilling was carried out using a combination of hollow stem augers and casing. Soil samples were obtained using a 50 mm outside diameter split spoon sampler advanced in accordance with the Standard Penetration Test (SPT). In-situ shear vane testing was carried out using an MTO N-vane within soft to stiff cohesive deposits. Thin-walled tube samples were collected at selected depth intervals within the clay deposit. Coring was carried out using NQ-size diamond coring gear to penetrate through boulders and into the underlying bedrock. A combination of vibrating wire piezometers and standpipe piezometers were installed to allow for measurement of groundwater levels.

The field work was supervised on a full-time basis by a member of our field staff who located the boreholes in the field, cleared borehole locations of underground utilities, directed the drilling, sampling and in-situ testing operations, and logged the boreholes. The soil samples were identified in the field, placed in appropriately labelled containers and transported back to Thurber's laboratory for further examination and testing.

It is noted that the locations of the boreholes and ground surface elevations at the borehole locations were surveyed by others and provided to Thurber.

3.2 Laboratory Testing

Geotechnical laboratory testing was carried out in the Thurber laboratory in Oakville, Ontario, and consisted of natural moisture content determination and visual identification of all soil samples in accordance with the current MTO standards. Grain size distribution analysis, Atterberg limit testing, specific gravity and oedometer testing were also carried out to MTO and ASTM standards.

The laboratory test results are presented on the records of boreholes in Appendix B and the figures in Appendix C.

4 DESCRIPTION OF SUBSURFACE CONDITIONS

4.1 General

Reference is made to the Record of Borehole sheets in Appendix B. Details of the encountered soil stratigraphy are presented in that appendix and on the Borehole Location and Soil Strata Drawings in Appendix A. Relevant factual data obtained from previous

investigations are included in Appendix E. An overall description of the stratigraphy is given in the following paragraphs however the factual data presented in the borehole logs governs any interpretation of the site conditions.

In general terms, the site was found to be underlain by a thick deposit of clay which in turn is underlain by glacial till ranging from sandy clayey till to silty sand till, over interbedded shale and limestone bedrock. Bear Brook has eroded a valley into the clay layer. The clay is overlain by thin deposits of sand and/or fill at some locations.

More detailed descriptions of the individual strata are presented below.

4.2 Rootmat

A rootmat was encountered at the ground surface in Boreholes 13-8, 13-9, 13-10 and 13-13. The thickness ranged from 30 to 50 mm. Further variations in thickness may occur between or beyond the boreholes and in other areas of the site.

4.3 Fill Material

An asphalt layer 120 mm in thickness was observed at ground surface in Borehole 13-5.

Fill was encountered at the surface in Boreholes 13-4, 13-6 and 13-7, just under the asphalt in Borehole 13-5 and below the rootmat in Boreholes 13-8, 13-9 and 13-10. Where encountered, the thickness of the fill layer ranged from 0.9 to 3.1 m. The underside elevation of the fill ranged from 65.4 to 73.9 m.

This soil is classified as very loose to compact having SPT 'N' values of weight of hammer (WH) to 24 blows for 0.3 m of penetration.

The measured natural moisture content ranged between 2% and 52 %.

The grain size distributions of selected samples of this soil are plotted on the Record of Borehole sheets and shown in Figure C1 in Appendix C. The gradation test results are summarized below.

Soil Particles	(%)
Gravel	0 to 2
Sand	58 to 88
Silt	11 to 33
Clay	0 to 9

This composition of the fill ranged from sand and gravel, some silt to sandy clay. Wood fragments and woody organic material was identified within the fill at some locations. A thin layer of fibrous peat (100 mm thick) was encountered at the base of the fill in Borehole 13-10.

4.4 Silty Sand

A deposit of silty sand was encountered at the ground surface in Borehole 13-1, 13-11 and at depths of 1.5 m and 3.1 m in Boreholes 13-9 and 13-10, respectively. The thickness of this layer ranged from 0.7 to 1.6 m. The base of the silty sand deposit ranged from elevation 64.6 to 74.3 m.

This soil is classified as very loose to compact having SPT 'N' values of 1 to 12 blows for 0.3 m of penetration.

The measured natural moisture content ranged between 15% and 42 %.

The grain size distributions of selected samples of this soil are plotted on the Record of Borehole sheets and shown in Figure C2 in Appendix C. The gradation test results are summarized below.

Soil Particles	(%)
Gravel	0
Sand	74 to 76
Silt	18 to 19
Clay	7 to 8

4.5 Silty Clay

A deposit of silty clay, sandy was encountered at the ground surface in Borehole 13-3. The thickness of this layer was 2.3 m. The base of the silty clay, sandy was at elevation 66.4 m.

This soil is classified as firm. The SPT 'N' values ranged from 2 to 7 blows for 0.3 m of penetration.

The measured natural moisture content ranged between 20% and 23 %.

The grain size distribution of selected samples of this soil are plotted on the Record of Borehole sheets and shown in Figure C3 in Appendix C. The gradation test results are summarized below.

Soil Particles	(%)
Gravel	0
Sand	22 to 37
Silt	35
Clay	27 to 44

Atterberg Limit testing was carried out on one sample. The results are presented on the plasticity chart shown in Figure C10 (Appendix C) and summarized in the table below.

Liquid Limit	41
Plastic Limit	19
Plasticity Index	22

The results indicate that the material has intermediate plasticity and can be described as silty clay, sandy.

4.6 Clay

Underlying the above noted soils, a clay deposit was encountered in all boreholes. Where fully penetrated, the thickness of the clay layer ranged from 18.2 m to 29.6 m. The base of the clay layer ranges from Elevation 42.8 to 48.4 m.

The recorded SPT 'N' values in the clay layer ranged from 6 blows to less than 1 blow for 0.3 m of penetration. In many instances, the sampler sank into the clay under the self-weight of the hammer. In these instances the SPT 'N' has been recorded as WH for weight of hammer. Higher 'N' values were observed in the crust closer to the surface. The vane shear strengths measured in the deposit range from 15 to 90 kPa, indicating a soft to stiff consistency. Typically, the shear strength increased with depth. The sensitivity of the clay ranged from 3 to 34 but the deposit is typically of low to medium sensitivity.

The moisture content of the samples tested ranged from 20 to 86 %, typically between 45 and 80 %.

The grain size distribution of selected samples of this soil are provided on the Record of Borehole sheets and shown in Figures C4 to C8 in Appendix C. The gradation test results are summarized below.

Soil Particles	(%)
Gravel	0
Sand	0 to 8
Silt	17 to 76
Clay	24 to 83

Atterberg Limit testing was carried out on selected samples. The results are presented on the plasticity charts shown in Figures C11 through C15 (Appendix C) and summarized in

the table below. The results indicate that the material is typically high plasticity clay (CH) with zones of intermediate plasticity (CI).

Liquid Limit	37 to 71
Plastic Limit	19 to 34
Plasticity Index	21 to 42

The results of oedometer (one-dimensional consolidation) tests carried out on three undisturbed silty clay sample from different depths within Borehole 13-9 are provided in Appendix C. The sample locations and depths, and in-situ soil properties are summarized in the following table. The results of the tests indicate that the clay is slightly over-consolidated.

Borehole	13-9	13-9	13-9
Sample ID	TW-10	TW-15	TW-19
Depth/Elevation (m) (mid-sample)	7.9 / 67.0	15.5 / 59.4	23.2 / 51.7
Unit Weight (γ) kN/m³	18.5	15.7	17.0
Specific Gravity (G_s)	2.79	2.75	2.72
Initial Void Ratio (e_0)	1.052	2.008	1.396

4.7 Glacial Till

A glacial till (till) deposit was encountered below the clay in Boreholes 13-3, 13-4, 13-6, 13-9, 13-10 and 13-11. The composition of the till ranged from silty gravelly sand, some clay to silty sand, some clay, trace gravel. Cobbles and boulders are also present within the till deposit. Coring was required to get through the cobbles and boulders in some of the boreholes such as Borehole 13-9.

The thickness of this till layer varied from 3.9 to 11.1 m. The underside of the till ranges from elevation 37.3 to 40.0 m.

This soil is classified as compact to very dense having SPT 'N' values of 10 to 77 blows for 0.3 m of penetration.

The measured natural moisture ranged between 6 and 20 %.

The grain size distribution of selected samples of this soil are plotted on the Record of Borehole sheets and shown in Figure C9 in Appendix C. The gradation test results are summarized below.

Soil Particles	(%)
Gravel	0 to 21
Sand	26 to 55
Silt	16 to 31
Clay	7 to 54

4.8 Bedrock

Six of the boreholes fully penetrated the glacial till deposit and were advanced into the underlying bedrock. The depths and elevations at which bedrock was encountered are summarized in the following table:

Table of Bedrock Depths and Elevations (in metres)

Location	Borehole	Depth (m)	Elevation (m)
Westbound Pier #1	13-3	31.4	37.3
Westbound Pier #2	13-4	30.3	38.2
Westbound east abutment	13-6	34.9	40.0
Eastbound west abutment	13-9	39.0	35.9
Eastbound Pier #1	13-10	28.7	39.7
Eastbound Pier #2	13-11	30.9	37.3

The bedrock consisted of black shale. The following properties were measured from the rock cores recovered at the abutment and pier boreholes:

Total core recovery (TCR)	30 - 100%
Solid core recovery (SCR)	0 - 98%
Rock Quality Designation (RQD)	0 – 100%

The RQD values are indicative of poor to excellent quality rock.

4.9 Water Levels

Piezometric pressures were measured in the vibrating wire piezometers (VWP) that were installed within selected boreholes on November 7, 2013 and on April 28, 2014. The measured piezometric pressures and equivalent elevations are summarized in Table 1 in Appendix B. The water levels vary from 3.4 m below ground surface to as much as 3.8 m

above ground surface. It is noted that artesian pressures were observed during drilling in Boreholes 13-4, 13-10 and 13-11. These piezometers are in the valley and the piezometric head is up to 3.8 m above the ground surface. The artesian conditions appear to originate within the glacial till or in the lower part of the clay.

The values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level will be influenced by Bear Brook and may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

The bridge general arrangement drawings indicate a high water level in Bear Brook of 70.76 m and an observed water level of 66.30 m.

4.10 Cone Penetration Testing

Cone penetrometer testing was carried out in test holes SCPT13-2 and SCPT13-12. The testing was conducted by ConeTec utilizing an 18,000 kg, purpose built track-mounted CPT rigs. The CPT testing provides a near continuous depth profile of tip resistance, sleeve friction and pore pressure, which may identify the presence of thin layers (e.g. sand seams within clay) that may be missed with conventional drilling/sampling procedures and allows for in-situ measurement of shear wave velocity and pore pressure dissipation which can be used for seismic site characterization and assessment of consolidation characteristics, respectively.

The soil profile interpreted based on the CPT data indicates the presence of deep silt and clay deposits.

Shear wave velocities were measured at approximately 1 m intervals in piezocone soundings SCPT13-02 and SCPT13-12. The results indicate that the shear wave velocity within the upper 20 m is typically less than 150 m/s.

The CPT test results are provided in Appendix D.

5 MISCELLANEOUS

The borehole locations were marked in the field by Thurber. Borehole elevations and coordinates were surveyed by Callon Dietz. Thurber obtained utility clearances prior to drilling. Eastern Ontario Diamond Drilling Limited of Hawkesbury, Ontario supplied the drill rig and conducted the drilling, sampling and in-situ testing operations. CPT testing was conducted by ConeTec.

The drilling and sampling operations in the field were supervised on a full time basis by Ms. Gabrielle Marcotte, Ms. Katrina Young or Mr. Nick Weil of Thurber. Laboratory testing was carried out by Thurber in its MTO-approved Oakville laboratory. Mr. Shawn Lapain directed the field operations and Mr. Paul Carnaffan, P.Eng. prepared this report.

Alastair Gorman, P.Eng. and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations projects, reviewed the report.

THURBER ENGINEERING LTD.

Paul Carnaffan, P.Eng.
Associate, Senior Geotechnical Engineer



Alastair Gorman, P.Eng.
Associate, Senior Geotechnical Engineer

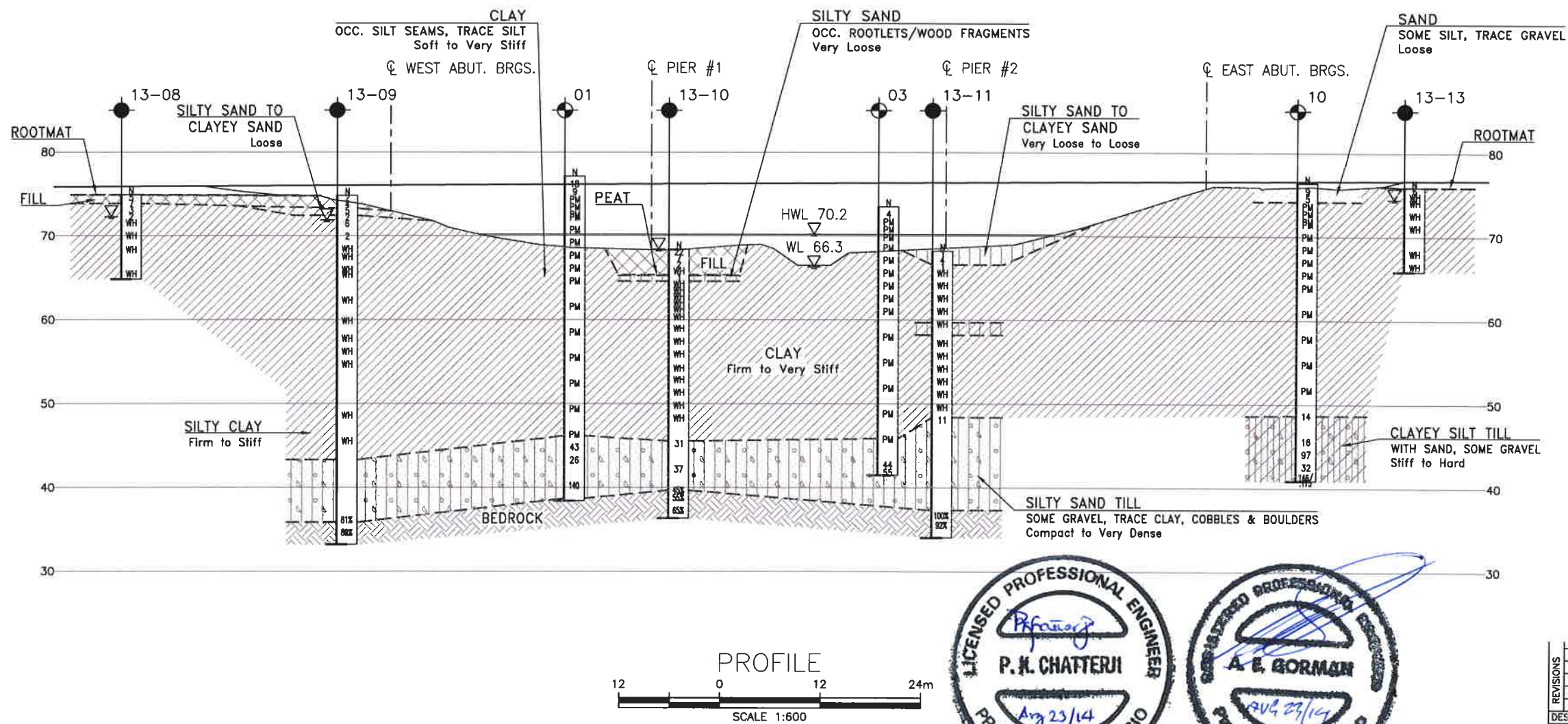
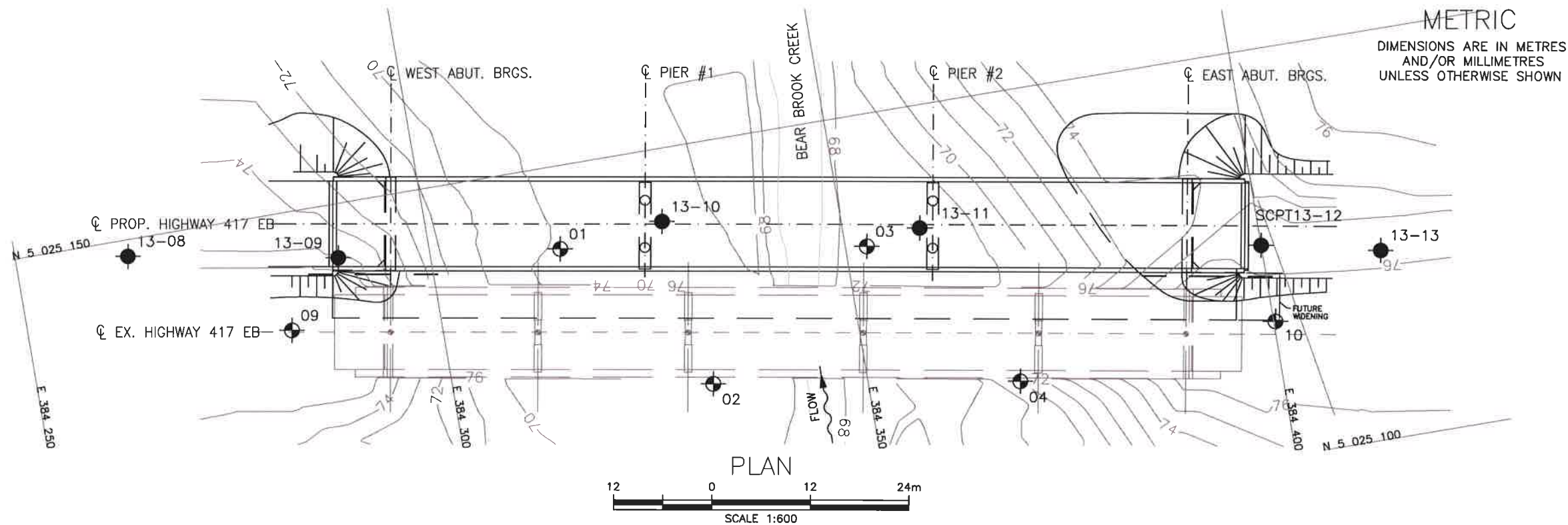


P.K. Chatterji, P.Eng.
Review Principal, Designated MTO Contact

Appendix A

Borehole Location Drawings & Soil Profiles

Bridge General Arrangement Drawings



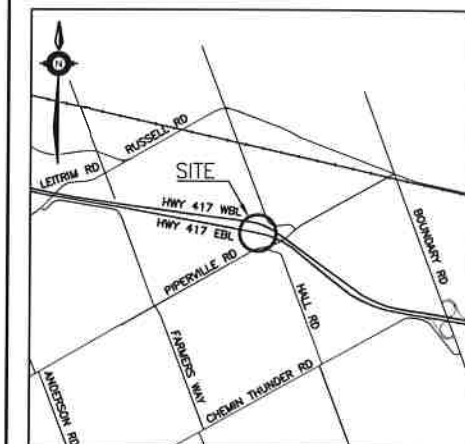
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GWP No 455-98-00

HIGHWAY 417
EASTBOUND LANES
BEAR BROOK BRIDGE
BOREHOLE LOCATIONS AND SOIL STRATA

URS

THURBER ENGINEERING LTD.

SHEET



LEGEND

◆	Borehole (Current Investigation by Thurber)
◊	Borehole (Previous Investigation by Others)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
W	Water Level
HA	Head Artesian Water
P	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
01	77.1	5 025 139.9	384 315.8
02	68.9	5 025 120.4	384 331.4
03	73.5	5 025 133.9	384 352.6
04	75.6	5 025 114.5	384 368.3
09	74.4	5 025 135.6	384 281.9
10	76.4	5 025 116.5	384 400.2
13-08	74.9	5 025 148.0	384 263.6
13-09	74.9	5 025 143.4	384 288.9
13-10	68.4	5 025 141.1	384 328.6
13-11	68.2	5 025 135.0	384 359.3
13-13	75.9	5 025 123.0	384 414.2

- NOTES-**
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
 - This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 31G-248

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	PC	CHK -	CODE
DRAWN	MFA	CHK PC	SITE 3-266.1
			STRUCT
			DWG 1
			DATE AUG 2014



METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
GWP No 455-98-00

HIGHWAY 417
WESTBOUND LANES
BEAR BROOK BRIDGE
BOREHOLE LOCATIONS AND SOIL STRATA



SHEET

URS



THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

●	Borehole (Current Investigation by Thurber)
◆	Borehole (Previous Investigation by Others)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
WH	Water Level
▽	Head Artesian Water
—	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

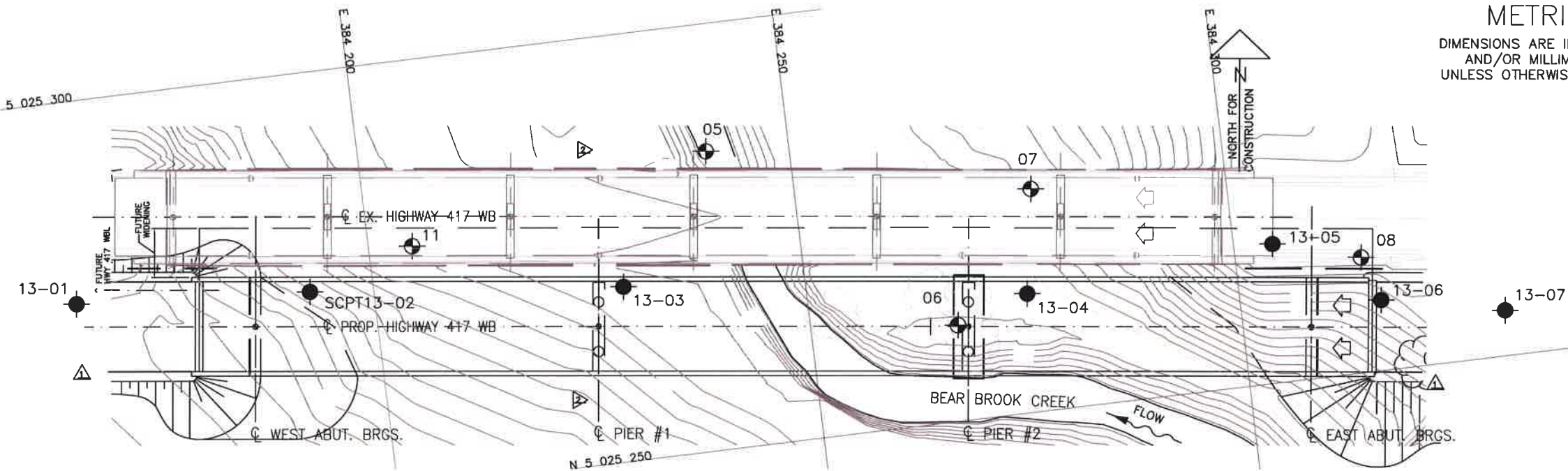
NO	ELEVATION	NORTHING	EASTING
05	66.2	5 025 285.0	384 240.3
06	67.9	5 025 261.2	384 267.0
07	68.5	5 025 276.0	384 277.3
08	76.4	5 025 263.4	384 314.6
11	69.3	5 025 278.1	384 205.0
13-01	75.9	5 025 276.2	384 165.4
13-03	68.7	5 025 270.4	384 228.9
13-04	68.5	5 025 263.9	384 275.4
13-05	76.1	5 025 266.2	384 304.5
13-06	75.0	5 025 258.2	384 316.3
13-07	75.2	5 025 255.2	384 330.5

-NOTES-

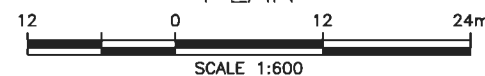
- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
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GEOCRES No. 31G-248

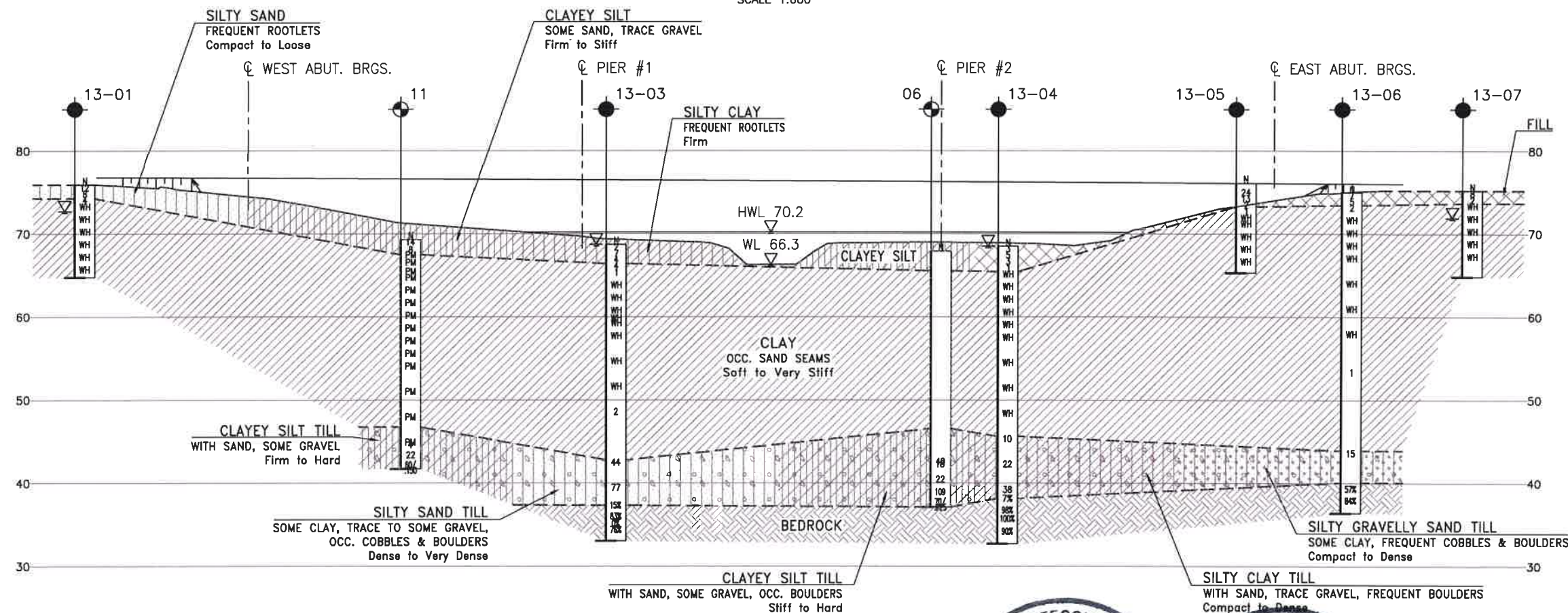
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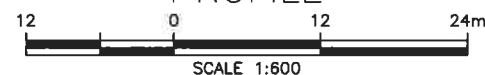
PLAN



SCALE 1:600



PROFILE



SCALE 1:600



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	PC	CHK -	CODE
DRAWN	MFA	CHK PC	SITE 3-266.2
			STRUCT
			DWG 1
			DATE AUG 2014

DATE: 11/07/2014
CADD FILE NAME : T:\Projects\2-33017245 - Hwy 417 OC 26 to Images\03 Structural\CADD\Bearing Brook Bridge\EBL\01_EBL_GA.dgn

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

HWY 417
CONT No
WP 455-98-00



HWY 417 TWINNING
BEAR BROOK BRIDGE EBL
GENERAL ARRANGEMENT

SHEET
S1

URS

GENERAL NOTES:

- CLASS OF CONCRETE.....30 MPa
UNLESS NOTED OTHERWISE
- CLEAR COVER TO REINFORCING STEEL:
FOOTINGS.....100±25
DECK - TOP.....70±20
DECK - BOTTOM.....40±10
REMAINDER.....70±20
UNLESS NOTED OTHERWISE.
- REINFORCING STEEL:
-REINFORCING STEEL SHALL BE GRADE 400W UNLESS OTHERWISE SPECIFIED.
-BAR MARKS WITH PREFIX 'S' DENOTE STAINLESS STEEL BARS..
-STAINLESS REINFORCING STEEL SHALL BE TYPE 316LN OR DUPLEX 2205 AND HAVE MINIMUM YIELD STRENGTH OF 500 MPa.
-BAR HOOKS SHALL HAVE STANDARD HOOK DIMENSIONS USING MINIMUM BEND DIAMETERS, WHILE STIRRUPS AND TIES SHALL HAVE MINIMUM HOOK DIMENSIONS, ALL HOOKS SHALL BE IN ACCORDANCE WITH THE STRUCTURAL STANDARD DRAWINGS SS12-1 UNLESS INDICATED OTHERWISE.
- UNLESS SHOWN OTHERWISE TENSION LAP SPLICES SHALL BE CLASS B.

CONSTRUCTION NOTES:

- THE CONTRACTOR SHALL ESTABLISH THE BEARING SEAT ELEVATIONS BY DEDUCTING THE ACTUAL BEARING THICKNESS FROM THE TOP OF BEARING ELEVATION, IF THE ACTUAL BEARING THICKNESSES ARE DIFFERENT FROM THOSE GIVEN IN THE BEARING DESIGN DATA, THE CONTRACTOR SHALL ADJUST THE REINFORCING STEEL TO SUIT.
- BACKFILL SHALL NOT BE PLACED BEHIND THE ABUTMENT DIAPHRAGMS UNTIL CONCRETE IN THE DECK SLAB HAS REACHED 25 MPa STRENGTH.
- PROTECTION SYSTEM SHALL MEET REQUIREMENTS FOR PERFORMANCE LEVEL 2. PROTECTION SYSTEM IS SHOWN SCHEMATICALLY ONLY. EXACT LIMITS SHALL BE DETERMINED BY THE CONTRACTOR.

LIST OF DRAWINGS

- GENERAL ARRANGEMENT
- BOREHOLE LOCATIONS AND SOIL STRATA
- FOUNDATION LAYOUT AND FOOTING REINFORCEMENT
- ABUTMENTS
- WINGWALLS
- PIERS
- BEARINGS
- STRUCTURAL STEEL I
- STRUCTURAL STEEL II
- DECK LAYOUT AND SCREED ELEVATIONS
- DECK REINFORCEMENT
- BARRIER WALL W/O RAILING - PL3
- 6000mm APPROACH SLAB
- TYPE 'C' STRIP SEAL EXPANSION JOINT AND SLEEPER SLAB
- STRIP SEAL EXPANSION JOINT - TYPE 'C' DETAILS
- PILE DRIVING CONTROL
- EXISTING BRIDGE REMOVAL, STANDARD DETAILS

APPLICABLE STANDARD DRAWINGS

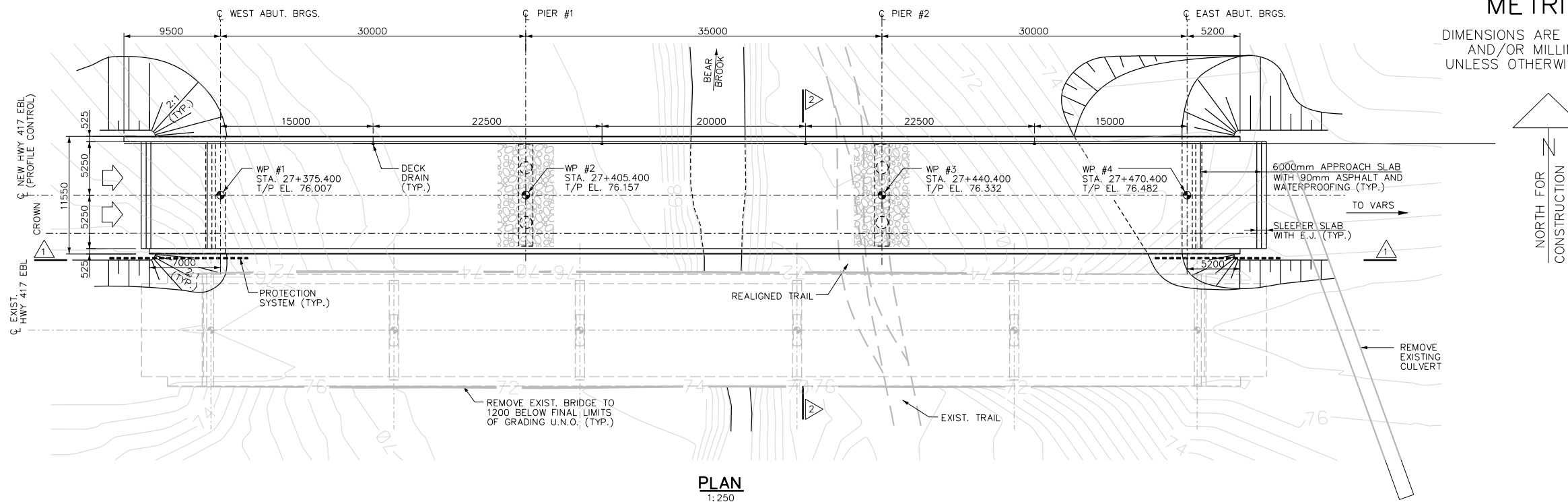
OPSD 3000.100	FOUNDATION, PILES, STEEL H-PILE DRIVING SHOE
OPSD 3000.150	FOUNDATION, PILES, STEEL H-PILE SPLICE
OPSD 3101.150	WALLS, ABUTMENT, BACKFILL, MINIMUM GRANULAR REQUIREMENT
OPSD 3370.100	DECK, WATERPROOFING HOT APPLIED ASPHALT MEMBRANE WITH PROTECTION BOARD
OPSD 3370.101	DECK, WATERPROOFING HOT APPLIED ASPHALT MEMBRANE AT ACTIVE CRACKS GREATER THAN 2mm WIDE AND CONSTRUCTION JOINTS
OPSD 3390.100	DECK DRIP CHANNEL
OPSD 3419.100	BARRIERS AND RAILINGS, STEEL BEAM, GUIDE RAIL AND CHANNEL ANCHORAGE
OPSD 3950.100	JOINTS, CONCRETE EXPANSION AND CONSTRUCTION ON STRUCTURE
OPSD 3941.200	FIGURES IN CONCRETE - SITE NUMBER AND DATE LAYOUT
OPSD 3340.150	DECK DRAINS WITH TRANSVERSE BAR OPENING

LIST OF ABBREVIATIONS

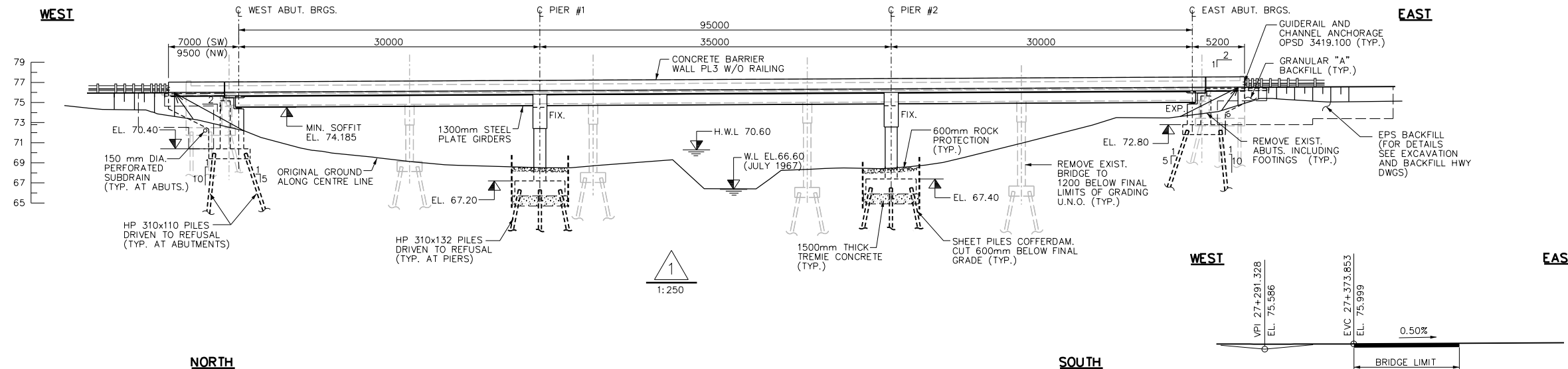
ABUT.	DENOTES ABUTMENT
BRGS.	DENOTES BEARING
DIA.	DENOTES DIAMETER
EBL	DENOTES EASTBOUND LANE
EL.	DENOTES ELEVATION
EXIST.	DENOTES EXISTING
E.J.	DENOTES EXPANSION JOINT
N.T.S.	DENOTES NOT TO SCALE
N.W.	DENOTES NORTHWEST
R.W.	DENOTES RETAINING WALL
SHLD.	DENOTES SHOULDER
STA.	DENOTES STATION
THK.	DENOTES THICKNESS
TYP.	DENOTES TYPICAL
U.N.O.	DENOTES UNLESS NOTED OTHERWISE
WP	DENOTES WORKING POINT
T/P	DENOTES TOP OF PAVEMENT

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

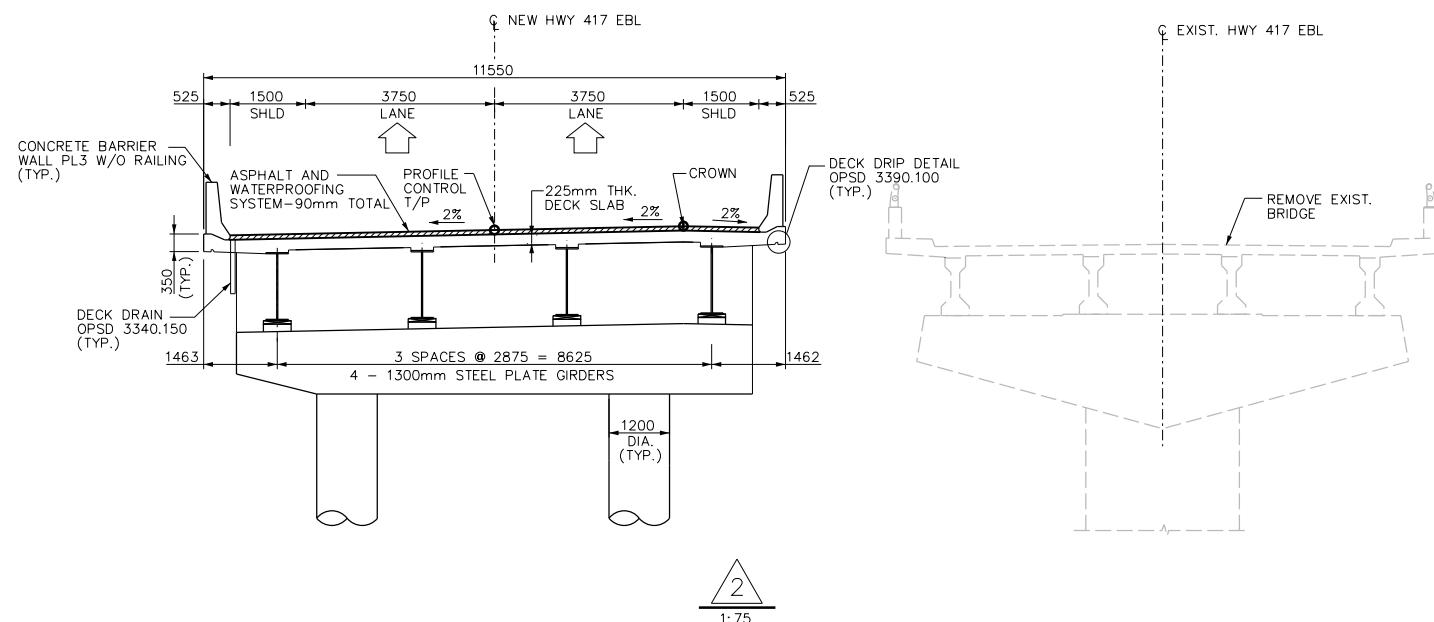
REVISIONS	DATE	BY	DESCRIPTION
DESIGN	L.X.	CHK	I.D.
DRAWN	F.P./V.A.	CHK	L.X.
CODE CAN/CSA 56-06	LOAD CL 625-ONT	DATE	JULY 2014
SITE	3-266.1	STRUCT	SCHEME
DWG	1		



PLAN
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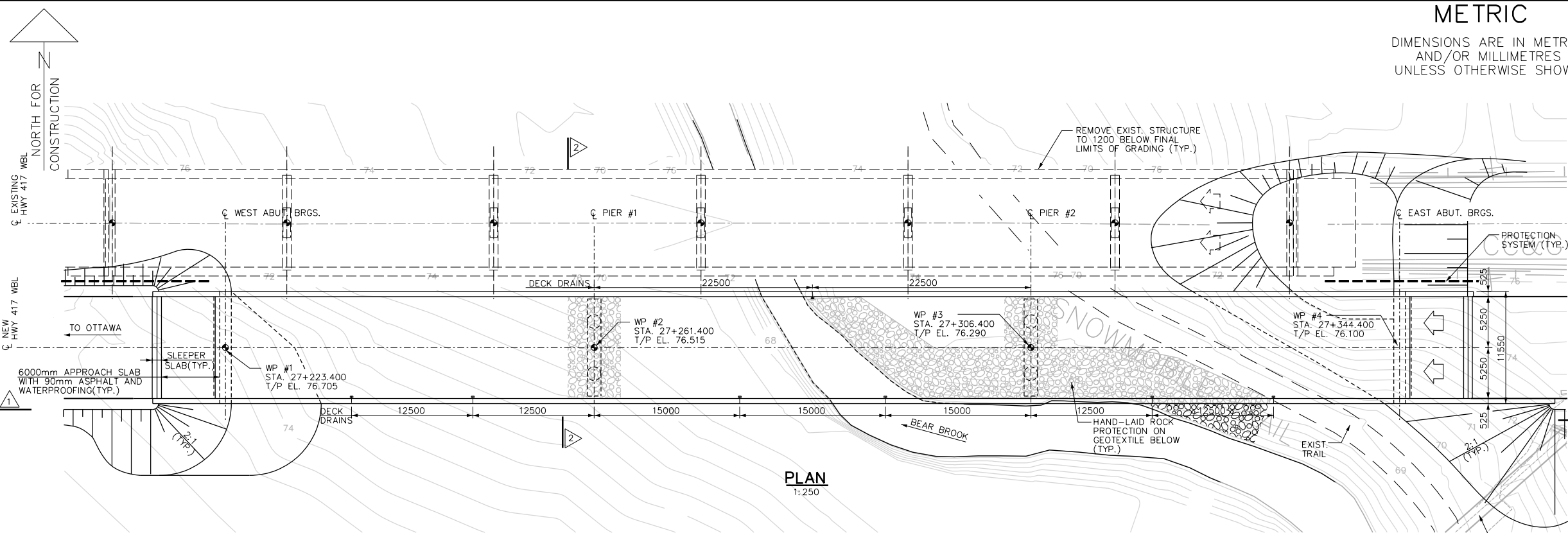


PROFILE OF HWY 417 EBL
N.T.S.

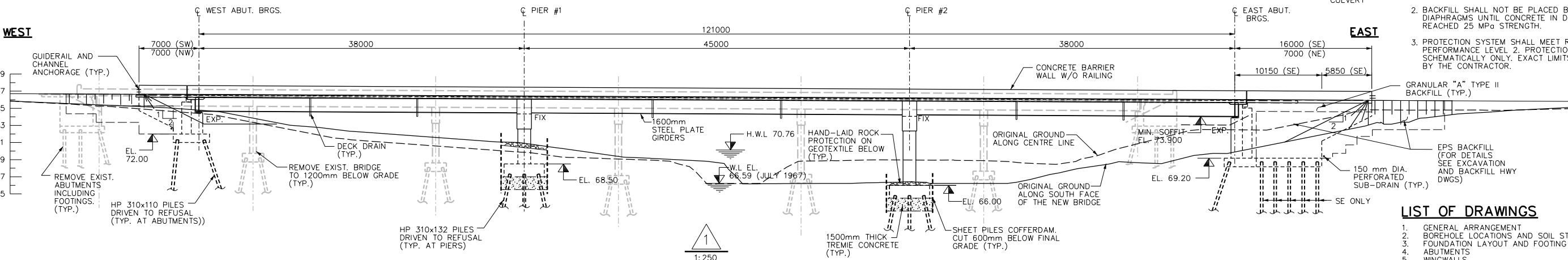


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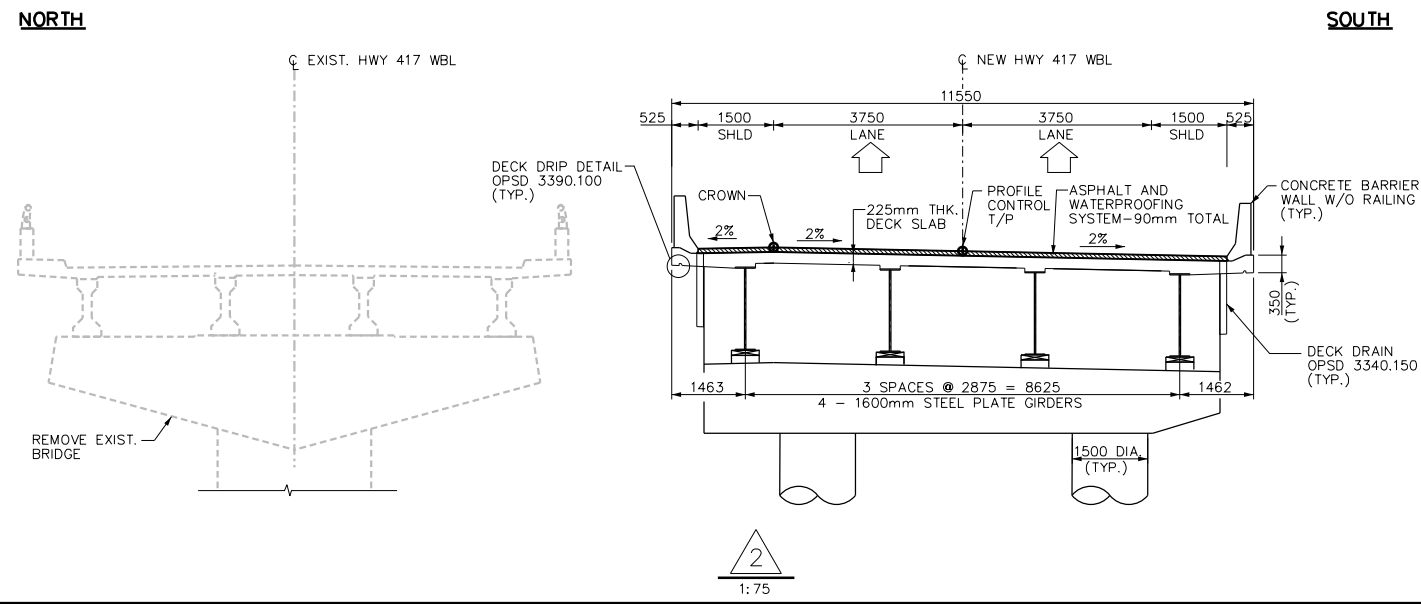
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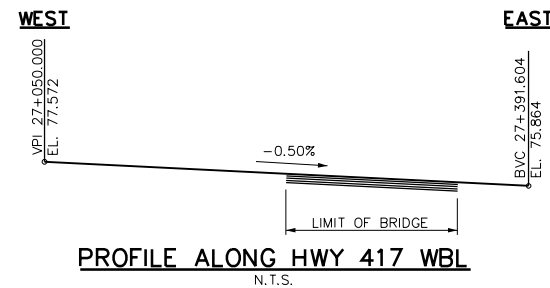
PLAN
1:250



1
1:250



2
1:75



PROFILE ALONG HWY 417 WBL
N.T.S.

LIST OF ABBREVIATIONS

ABUT.	DENOTES ABUTMENT
BRGS.	DENOTES BEARING
DIA.	DENOTES DIAMETER
EBL	DENOTES EASTBOUND LANE
EL.	DENOTES ELEVATION
EXIST.	DENOTES EXISTING
EXP.	DENOTES EXPANSION
N.T.S.	DENOTES NOT TO SCALE
N.W.	DENOTES NORTHWEST
R.W.	DENOTES RETAINING WALL
SHLD.	DENOTES SHOULDER
STA.	DENOTES STATION
THK.	DENOTES THICKNESS
TYP.	DENOTES TYPICAL
U.N.O.	DENOTES UNLESS NOTED OTHERWISE
WP.	DENOTES WORKING POINT

APPLICABLE STANDARD DRAWINGS

OPSD 3000.100	FOUNDATION, PILES, STEEL H-PILE DRIVING SHOE
OPSD 3000.150	FOUNDATION, PILES, STEEL H-PILE SPLICE
OPSD 3101.150	WALLS, ABUTMENT, BACKFILL, MINIMUM GRANULAR REQUIREMENT
OPSD 3370.100	DECK, WATERPROOFING HOT APPLIED ASPHALT MEMBRANE WITH PROTECTION BOARD
OPSD 3370.101	DECK, WATERPROOFING HOT APPLIED ASPHALT MEMBRANE AT ACTIVE CRACKS GREATER THAN 2mm WIDE AND CONSTRUCTION JOINTS
OPSD 3390.100	DECK DRIP CHANNEL
OPSD 3419.100	BARRIERS AND RAILINGS, STEEL BEAM, GUIDE RAIL AND CHANNEL ANCHORAGE
OPSD 3950.100	JOINTS, CONCRETE EXPANSION AND CONSTRUCTION ON STRUCTURE
OPSD 3340.150	DECK DRAINS WITH TRANSVERSE BAR OPENING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	A.P.	CHK J.J.	CODE CAN/CSA S6-06 LOAD CL 625-ONT
DRAWN	F.P.	CHK J.J.	SITE 3-266/2 STRUCT SCHEME DWG 1

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

Appendix B
Record of Boreholes
Summary of Groundwater Data

19-4406-6

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$



Water Level

C_{pen}






Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ($W_L < 30\%$).
		CI	Inorganic clays of medium plasticity, silty clays. ($30\% < W_L < 50\%$).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION		SYMBOLS	
Fresh (FR)	No visible signs of weathering.		
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

DISCONTINUITY SPACING		STRENGTH CLASSIFICATION			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.

TERMS					
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

RECORD OF BOREHOLE No 13-1

1 OF 2

METRIC

GWP# 455-98-00 LOCATION WB Structure - West Approach N 5 025 276.2 E 384 165.4 ORIGINATED BY GM
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY GM
 DATUM Geodetic DATE 16.10.13 - 16.10.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL	
								○ UNCONFINED + FIELD VANE					w _P w w _L								
								● QUICK TRIAXIAL × LAB VANE													
75.9							20	40	60	80	100										
0.0			1	SS	12								○								
			2	SS	8								○						0 76 18 7		
													○								
74.3																					
1.6			3	SS	4																
73.8																					
2.1																					
			4	SS	WH									┌───┐					0 0 44 56		
			5	SS	WH										○						

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+³, ×³: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13-1

2 OF 2

METRIC

GWP# 455-98-00 LOCATION WB Structure - West Approach N 5 025 276.2 E 384 165.4 ORIGINATED BY GM
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY GM
 DATUM Geodetic DATE 16.10.13 - 16.10.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
0.0	Clay Soft Grey Wet		9	SS	WH												
64.8							65	12.0 +									
11.1	End of Borehole Vibrating wire piezometer installed at 9.75 m Piezometric level on Nov. 7, 2013 = 72.7 m Elev.																

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RECORD OF BOREHOLE No 13-3

1 OF 4

METRIC

GWP# 455-98-00 LOCATION WB Structure - West Pier N 5 025 270.4 E 384 228.9 ORIGINATED BY GM
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY GM
 DATUM Geodetic DATE 10.9.13 - 10.10.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS ▽*	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT		NATURAL MOISTURE CONTENT		LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		w _p		w		w _L			GR SA SI CL				
								20 40 60 80 100	○ UNCONFINED + FIELD VANE		○		○								
68.7 0.0	Silty Clay (CI) , sandy, frequent rootlets near top Firm Brown Moist		1	SS	2		68										0 37 35 27				
			2	SS	7																
			3	SS	4														0 22 35 44		
66.4 2.3	Clay (CH) Very stiff to stiff Brown Moist		4	SS	4		66														
			5	SS	1																
64.9 3.8	Clay (CH) Firm Grey Wet						65														
			6	SS	WH																
			7	SS	WH																
			8	SS	WH																
	9	SS	WH																		
	10	SS	WH																		

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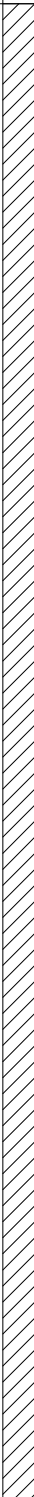
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RECORD OF BOREHOLE No 13-3

2 OF 4

METRIC

GWP# 455-98-00 LOCATION WB Structure - West Pier N 5 025 270.4 E 384 228.9 ORIGINATED BY GM
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY GM
 DATUM Geodetic DATE 10.9.13 - 10.10.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER • CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE							
								● QUICK TRIAXIAL × LAB VANE							
0.0	Clay (CH) Stiff Grey Wet														
			11	SS	WH										
			12	SS	WH										
			13	SS	WH										

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+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13-3

3 OF 4

METRIC

GWP# 455-98-00 LOCATION WB Structure - West Pier N 5 025 270.4 E 384 228.9 ORIGINATED BY GM
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY GM
 DATUM Geodetic DATE 10.9.13 - 10.10.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL
0.0	Clay (CH) Stiff Grey Wet <																			

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+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No 13-3

4 OF 4

METRIC

GWP# 455-98-00 LOCATION WB Structure - West Pier N 5 025 270.4 E 384 228.9 ORIGINATED BY GM
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY GM
 DATUM Geodetic DATE 10.9.13 - 10.10.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER • CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											WATER CONTENT (%)					
								○ UNCONFINED			+ FIELD VANE								○ UNCONFINED			+ FIELD VANE		
								● QUICK TRIAXIAL			× LAB VANE								● QUICK TRIAXIAL			× LAB VANE		
0.0	Silty Sand , some clay, trace to some gravel, occasional cobbles and boulders Dense to very dense Grey (TILL)																							
37.3																								
31.4	BEDROCK , shale Weathered to fresh Black		18	NQ												5	RUN #18 TCR=30% SCR=15% RQD=15%							
			19	NQ													5	RUN #19 TCR=90% SCR=90% RQD=83%						
			20	NQ														20	RUN #20 TCR=92% SCR=52% RQD=0%					
			21	NQ														10	RUN #21 TCR=100% SCR=87% RQD=76%					
33.0																								
35.7	End of Borehole Vibrating wire piezometer installed at 10.64 m Piezometric level on Nov. 7, 2013 = 68.7 m Elev.																							



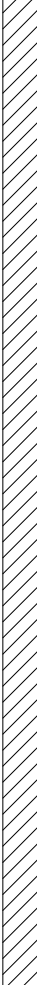
ONTMT4S 19-4406-6 BEARBROOK STRUCTURES.GPJ 2012TEMPLATE(MTO).GDT 6/6/14

RECORD OF BOREHOLE No 13-4

1 OF 4

METRIC

GWP# 455-98-00 LOCATION WB Structure - East Pier N 5 025 263.9 E 384 275.4 ORIGINATED BY GM/NW
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 30.9.13 - 30.9.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS ▽*	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL													
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																			
								20 40 60 80 100																			
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE																			
					WATER CONTENT (%)																						
					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT w _P w w _L																						
68.5 0.0	Silty sand , trace clay, frequent to occasional rootlets Very loose to loose Brown to grey Moist (FILL) - Frequent wood fragments		1	SS	3		68																				
			2	SS	5			67																			
			3	SS	3				66																		
	4	SS	1	65																							
65.5 3.1	Clay (CH) Firm to stiff Grey Wet		5		SS					WH	64																
			6		SS					WH		63															
			7		SS					WH			62														
			8		SS	WH	61																				
			9		SS	WH		60																			
					59																						

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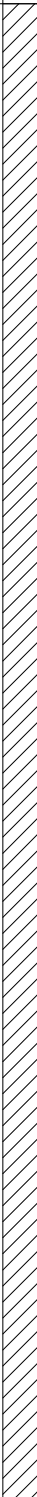
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RECORD OF BOREHOLE No 13-4

2 OF 4

METRIC

GWP# 455-98-00 LOCATION WB Structure - East Pier N 5 025 263.9 E 384 275.4 ORIGINATED BY GM/NW
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 30.9.13 - 30.9.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	W _P W W _L							
SHEAR STRENGTH kPa								20 40 60 80 100		WATER CONTENT (%)						
							○ UNCONFINED + FIELD VANE									
							● QUICK TRIAXIAL × LAB VANE									
0.0	Clay (CH) Stiff Grey Wet						58									
			10	SS	WH											
			11	SS	WH		54									

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+³, ×³: Numbers refer to
Sensitivity 20
15 10 5 0 (%) STRAIN AT FAILURE

METRIC

[illegible]

(%) STRAIN AT FAILURE

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RECORD OF BOREHOLE No 13-4

4 OF 4

METRIC

GWP# 455-98-00 LOCATION WB Structure - East Pier N 5 025 263.9 E 384 275.4 ORIGINATED BY GM/NW
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 30.9.13 - 30.9.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER • CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
								○ UNCONFINED + FIELD VANE										
								● QUICK TRIAXIAL × LAB VANE										
						20	40	60	80	100								
0.0																		
38.2																		
30.3	BEDROCK, shale Weathered to fresh Thinly laminated		17	RUN														
			18	RUN														
			19	RUN														
			20	RUN														
32.7																		
35.8	End of Borehole Vibrating wire piezometer installed at 25.3 m Piezometric level on Nov. 7, 2013 = 72.3 m Elev.																	

ONTMT4S 19-4406-6 BEARBROOK STRUCTURES.GPJ 2012TEMPLATE(MTO).GDT 6/6/14

RECORD OF BOREHOLE No 13-5

1 OF 2

METRIC

GWP# 455-98-00 LOCATION WB Structure - Existing East Abutment N 5 025 266.2 E 384 304.5 ORIGINATED BY NW
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY GM
 DATUM Geodetic DATE 16.10.13 - 16.10.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	W _P W W _L										
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE			WATER CONTENT (%) 20 40 60								
76.1																			
76.0	ASPHALT: 120 mm																		
0.1	Sand and Gravel, some silt Brown Dry (FILL)		1	GS															
75.3																			
0.8	Sand, some silt Compact to very loose Brown Moist (FILL)		1	SS	24														
			2	SS	13														
			3	SS	2														
73.2																			
2.8	Clay (CH) Stiff to firm Brownish red		4	SS	1														
			5	SS	WH														
71.5																			
4.6	Clay (CH) Soft to firm Grey Wet		6	SS	WH														
			7	SS	WH														
			8	SS	WH														
			9	SS	WH														

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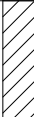
+³, ×³: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13-5

2 OF 2

METRIC

GWP# 455-98-00 LOCATION WB Structure - Existing East Abutment N 5 025 266.2 E 384 304.5 ORIGINATED BY NW
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY GM
 DATUM Geodetic DATE 16.10.13 - 16.10.13 CHECKED BY PC



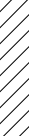
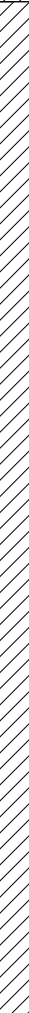
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					W _p W W _L 20 40 60					
0.0	Clay (CH) Soft to firm Grey Wet						66		7.0								
65.3									12.0								
10.8	End of Borehole																

RECORD OF BOREHOLE No 13-6

1 OF 4

METRIC

GWP# 455-98-00 LOCATION WB Structure - East Abutment N 5 025 258.2 E 384 316.3 ORIGINATED BY GM
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 10.7.13 - 10.7.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		<div><div>PLASTIC LIMIT</div><div>NATURAL MOISTURE CONTENT</div><div>LIQUID LIMIT</div></div> <div><div>W_P</div><div>W</div><div>W_L</div></div> <div>WATER CONTENT (%)</div>	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa												
75.0								20	40	60	80	100								
0.0	Silty sand , some gravel, frequent rootlets Loose Brown Dry (FILL)		1	SS	7															
74.2																				
0.8	Sandy Clay , occasional rootlets Firm Brownish grey (FILL)		2	SS	5		74													
73.4																				
1.5	Clay (CH) Stiff Brownish grey to grey Moist		3	SS	2															
72.5																				
2.4	Clay (CH) Firm Grey Wet																			
			4	SS	WH															
			5	SS	WH															
			6	SS	WH															
							</													

Continued Next Page



+³, ×³: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13-6

2 OF 4

METRIC

GWP# 455-98-00 LOCATION WB Structure - East Abutment N 5 025 258.2 E 384 316.3 ORIGINATED BY GM
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 10.7.13 - 10.7.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)			GR	SA	SI	CL	
								○ UNCONFINED + FIELD VANE												
								● QUICK TRIAXIAL × LAB VANE												
							20	40	60	80	100		W _p	W	W _L					
0.0	Clay (CH) Firm Grey Wet																			
			9	SS	WH		64													
							63													
							62													
							61													
			10	SS	WH															
60.0							60													
15.0	Clay (CH) Stiff Grey Wet																			
							59													
							58													
					11	SS	WH													
							57													
							56													
			12	TW																
							55													

Continued Next Page

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

METRIC

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+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 13-6

4 OF 4

METRIC

GWP# 455-98-00 LOCATION WB Structure - East Abutment N 5 025 258.2 E 384 316.3 ORIGINATED BY GM
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 10.7.13 - 10.7.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								20 40 60 80 100				W _p W W _L				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE								
0.0	Clay (CH) Stiff Grey Wet						44									
43.9																
31.1	Silty Gravelly Sand , some clay, frequent cobbles and boulders Compact to dense Grey (TILL)		15	SS	15		43								21 37 30 12	
			16	RUN			42									
							41									
			17	RUN												
40.0							40									
34.9	BEDROCK , shale with clay seams Weathered to fresh Black		18	RUN			39									
			19	RUN			38								RUN #19 TCR=100% SCR=46% RQD=57%	
	occasional calcite and fossil seams															
							37								RUN #20 TCR=103% SCR=84% RQD=84%	
36.4																
38.6	End of Borehole Vibrating wire piezometers installed at 8.5 m (VWP1) and 30.4 m (VWP2) Piezometric levels on Nov. 7, 2013: VWP1 = 71.7 m Elev. VWP2 = 73.3 m Elev.															

ONTMT4S 19-4406-6 BEARBROOK STRUCTURES.GPJ 2012TEMPLATE(MTO).GDT 6/6/14

METRIC

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+³, ×³: Numbers refer to Sensitivity

ONTMT4S 19-4406-6 BEARBROOK STRUCTURES.GPJ 2012TEMPLATE(MTO).GDT 6/6/14

RECORD OF BOREHOLE No 13-7

2 OF 2

METRIC

GWP# 455-98-00 LOCATION WB Structure - East Approach N 5 025 255.2 E 384 330.5 ORIGINATED BY GM
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 10.8.13 - 10.8.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)						
						20	40	60	80	100	20	40	60				
0.0	Clay (CH) Firm Grey Wet End of Borehole Vibrating wire piezometer installed at 9.6 m Piezometric level on Nov. 7, 2013 = 71.9 m Elev.																
64.8																	
10.4																	

ONTMT4S 19-4406-6 BEARBROOK STRUCTURES.GPJ 2012TEMPLATE(MTO).GDT 6/6/14

RECORD OF BOREHOLE No 13-8

1 OF 2

METRIC

GWP# 455-98-00 LOCATION EB Structure - West Approach N 5 025 148.0 E 384 263.6 ORIGINATED BY KMY
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 24.9.13 - 25.9.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)			
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					
74.9							20 40 60 80 100						
74.8	Rootmat: 50 mm												
0.1	Sand , occasional rootlets Loose Brown Moist to wet (FILL)		1	SS	5								
73.9			2	SS	7		74						0 0 34 66
1.0	Clay (CH) Stiff Grey and pink (Mottled) Moist												
			3	SS	3		73						
			4	SS	2		72						
			5	SS	WH								0 8 34 58
			6	AS			71	9.6					
70.3													
4.6	Clay (CH) Firm to stiff Grey Wet		7	SS	WH		70						
							69						
			8	SS	WH		68						
							67						
			9	TW			66	11.0					
			10	SS	WH								0 0 24 76
							65						

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+³, ×³: Numbers refer to
Sensitivity 20
15 10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13-8

2 OF 2

METRIC

GWP# 455-98-00 LOCATION EB Structure - West Approach N 5 025 148.0 E 384 263.6 ORIGINATED BY KMY
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 24.9.13 - 25.9.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
64.8 10.1	Clay (CH) Stiff Grey Wet End of Borehole Vibrating wire piezometer installed at 8.5 m Piezometric level on Nov. 7, 2013 = 72.3 m Elev.						20 40 60 80 100 9.6 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60 15 5 10						

METRIC

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+³, ×³: Numbers refer to Sensitivity

ONTMT4S 19-4406-6 BEARBROOK STRUCTURES.GPJ 2012TEMPLATE(MTO).GDT 6/6/14

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 13-9

3 OF 5

METRIC

GWP# 455-98-00 LOCATION EB Structure - West Abutment N 5 025 143.4 E 384 288.9 ORIGINATED BY KMY
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 19.9.13 - 24.9.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						WATER CONTENT (%)			GR	SA	SI	CL
								20	40	60	80	100		W _P	W	W _L				
								○ UNCONFINED	+ FIELD VANE											
								● QUICK TRIAXIAL	× LAB VANE											
								20	40	60	80	100	20	40	60					
0.0	Clay (CH) Stiff Grey Wet 																			

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+³, ×³: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

ONTMT4S 19-4406-6 BEARBROOK STRUCTURES.GPJ 2012TEMPLATE(MTO).GDT 6/6/14

RECORD OF BOREHOLE No 13-9

5 OF 5

METRIC

GWP# 455-98-00 LOCATION EB Structure - West Abutment N 5 025 143.4 E 384 288.9 ORIGINATED BY KMY
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 19.9.13 - 24.9.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
							20	40	60	80	100						
0.0	BEDROCK , shale Fresh Horizontally bedded Very thinly laminated Black		7	RUN		34											
33.2																	
41.6	End of Borehole Vibrating wire piezometer installed at 29.0 m Piezometric level on Nov. 7, 2013 = 72.0 m Elev.																

RECORD OF BOREHOLE No 13-10

1 OF 4

METRIC

GWP# 455-98-00 LOCATION EB Structure - West Pier N 5 025 141.1 E 384 328.6 ORIGINATED BY KMY
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 16.9.13 - 16.9.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS ▽*	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				w _p w w _L				
								20 40 60 80 100 20 40 60 80 100				20 40 60				
68.4																
68.0	Rootmat: 50 mm															
0.1	Clayey Silt		1	SS	22		68						○			
	Stiff															
67.7	Reddish brown															
	Dry (FILL)															
0.8																
	Sand, some silt, trace clay		2	SS	7								○			
	Very loose															
	Reddish brown to grey															
	Moist to wet (FILL)															
			3	SS	2								○		0 73 18 9	
			4	SS	WH		66						○			
65.4																
3.1	Peat, fibrous, soft, black, wet													490		
65.3	Silty Sand, occasional rootlets and wood fragments		5	SS	1		65						○		0 74 19 8	
3.1	Very loose															
64.6	Greyish brown															
3.8	Wet															
	Clay (CH)		6	SS	WH		64							○		
	Firm															
	Grey															
	Wet															
			7	SS	WH											
			8	SS	WH		63							○		
			9	SS	WH		62								0 0 21 79	
			10	SS	WH		61							○		
			11	SS	WH		60								80	

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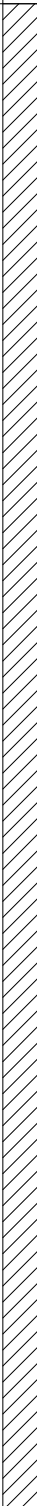
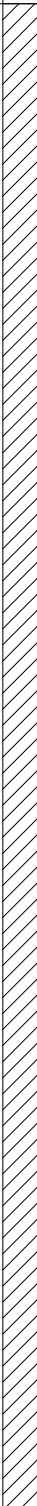
+³, ×³: Numbers refer to Sensitivity
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 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13-10

2 OF 4

METRIC

GWP# 455-98-00 LOCATION EB Structure - West Pier N 5 025 141.1 E 384 328.6 ORIGINATED BY KMY
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 16.9.13 - 16.9.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				GR	SA	SI	CL	
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE												
0.0	Clay (CH) Firm to stiff Grey Wet																				
			13	SS	WH																
			14	SS	WH																
			15	SS	WH																
			16	SS	WH																
			17	SS	WH																
	-Silty Clay (CI)																				
			18	SS	WH																

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+³, ×³: Numbers refer to
Sensitivity

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15
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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13-10

3 OF 4

METRIC

GWP# 455-98-00 LOCATION EB Structure - West Pier N 5 025 141.1 E 384 328.6 ORIGINATED BY KMY
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 16.9.13 - 16.9.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									WATER CONTENT (%)
0.0	Silty Clay (Cl) Firm to stiff Grey Wet		19	SS	WH		48										
45.6							47										
							46										
22.9	Silty Sand , some gravel, trace clay Dense Grey (TILL)		20	SS	31		45										
								44									
								43									
								42									
			21	SS	37												
							41										
							40										
39.7																	
28.7	BEDROCK shale Fine grained Thinly laminated Dark grey		22	RUN			39										

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

ONTMT4S 19-4406-6 BEARBROOK STRUCTURES.GPJ 2012TEMPLATE(MTO).GDT 6/6/14

RECORD OF BOREHOLE No 13-10

4 OF 4

METRIC

GWP# 455-98-00 LOCATION EB Structure - West Pier N 5 025 141.1 E 384 328.6 ORIGINATED BY KMY
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 16.9.13 - 16.9.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)						
						20	40	60	80	100	20	40	60				
0.0	BEDROCK shale Fine grained Thinly laminated Dark grey		23	RUN		38										>10	RUN #23 TCR=100% SCR=27% RQD=55%
			24	RUN		37											>10
36.4	End of Borehole Vibrating wire piezometer installed at 21.5 m Piezometric level on Nov. 7, 2013 = 71.8 m Elev.																
32.1																	

RECORD OF BOREHOLE No 13-11

1 OF 4

METRIC

GWP# 455-98-00 LOCATION EB Structure - East Pier N 5 025 135.0 E 384 359.3 ORIGINATED BY KMY
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 26.9.13 - 26.9.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _P	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)
68.2 0.0	Silty Sand to Clayey Sand Very loose to loose Brown Dry		1	SS	1												
			2	SS	4												
66.6																	
1.6	Clay (CH) Firm Grey Clay (CH)		3	SS	1												
			4	SS	WH												
			5	SS	WH												
			6	SS	WH												
			7	SS	WH												
59.7																	
8.5	Silty Clay (CH) Stiff Grey Wet		8	SS	WH												

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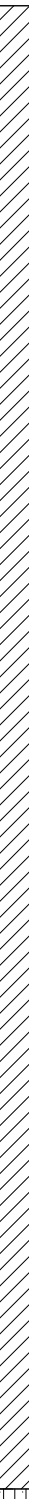

+³, ×³: Numbers refer to Sensitivity
 20
 15
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 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13-11

2 OF 4

METRIC

GWP# 455-98-00 LOCATION EB Structure - East Pier N 5 025 135.0 E 384 359.3 ORIGINATED BY KMY
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 26.9.13 - 26.9.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT		NATURAL MOISTURE CONTENT		LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W P		W		W L				
								○ UNCONFINED	+ FIELD VANE									
								● QUICK TRIAXIAL	× LAB VANE									
0.0	Clay (CH) Stiff Grey Wet																	
			9	SS	WH													
			10	SS	WH													
			11	SS	WH													
			12	SS	WH													
			13	SS	WH													
			14	SS	WH													
48.4																		
19.8																		

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+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 13-11

4 OF 4

METRIC

GWP# 455-98-00 LOCATION EB Structure - East Pier N 5 025 135.0 E 384 359.3 ORIGINATED BY KMY
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 26.9.13 - 26.9.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT						UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20 40 60 80 100									
								20 40 60 80 100									
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W P W W L WATER CONTENT (%)					
0.0	Silty Sand , some gravel, trace clay, frequent cobbles and boulders Compact to very dense Grey (TILL)		19	RUN			38										
37.3																	
30.9			BEDROCK shale Weathered to fresh Black		20	RUN			37								
					21	RUN			36								
34.0			22	RUN			35										
34.2	End of Borehole Standpipe installed																

ONTMT4S 19-4406-6 BEARBROOK STRUCTURES.GPJ 2012TEMPLATE(MTO).GDT 6/6/14

RECORD OF BOREHOLE No 13-13

1 OF 2

METRIC

GWP# 455-98-00 LOCATION EB Structure - East Approach N 5 025 123.0 E 384 414.2 ORIGINATED BY KMY
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 25.9.13 - 26.9.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	W P	W	W L			
75.9 76.8 0.0	Rootmat: 30 mm Clay (CH) Stiff to firm Brown Moist		1	SS	6									
75.0 0.9	Clay (CH) Soft Grey Wet		2	SS	WH									0 0 33 67
			3	SS	WH									
			4	SS	WH									
			5	SS	WH									
			6	TW										
			7	SS	WH									0 0 23 77
			8	SS	WH									
	- becomes firm													

Continued Next Page

+³, ×³: Numbers refer to Sensitivity
 20
 15
 10
 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 13-13

2 OF 2

METRIC

GWP# 455-98-00 LOCATION EB Structure - East Approach N 5 025 123.0 E 384 414.2 ORIGINATED BY KMY
 HWY 417 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SML
 DATUM Geodetic DATE 25.9.13 - 26.9.13 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
65.8 10.1	Clay (CH) Firm Grey Wet End of Borehole Vibrating wire piezometer installed at 7.0 m Piezometric level on Nov. 7, 2013 = 74.4 m Elev.	///												

Table 1 – Piezometric Pressures and Elevations

Borehole	Ground Surface Elev. (m)	VWP Tip Location			Nov 7, 2013 data			April 28, 2014 data		
		Depth (m)	Pressure (kPa)	Pressure (kPa)	Pressure (kPa)	Equivalent Water Depth / Elev. (m)		Pressure (kPa)	Equivalent Water Depth / Elev. (m)	
						Depth*	Elev.		Depth*	Elev.
13-1	75.9	9.8	64.3	64.3	64.3	3.2	72.7	69.1	2.6	73.3
13-3	68.7	10.6	103.9	103.9	103.9	0.0	68.7	108.2	-0.4 (artesian)	69.1
13-4	68.5	25.3	285.3	285.3	285.3	- 3.8 (artesian)	72.3	277.6	-3.0 (artesian)	71.5
13-6 shallow	75.0	8.5	50.6	50.6	50.6	3.3	71.7	54.5	3.0	72.0
13-6 deep	75.0	30.4	281.1	281.1	281.1	1.7	73.3	266.4	3.3	71.7
13-7	75.2	9.6	61.8	61.8	61.8	3.3	71.9	60.5	3.4	71.8
13-8	74.9	8.5	57.8	57.8	57.8	2.6	72.3	62.2	2.1	72.8
13-9	74.9	29.0	255.7	255.7	255.7	2.9	72.0	253.8	3.2	71.7
13-10	68.4	21.5	244.4	244.4	244.4	-3.4 (artesian)	71.8	231.8	-2.2 (artesian)	70.6
13-13	75.9	7.0	54.1	54.1	54.1	1.5	74.4	55.8	1.3	74.6

* Depth is relative to existing ground surface at the borehole location.

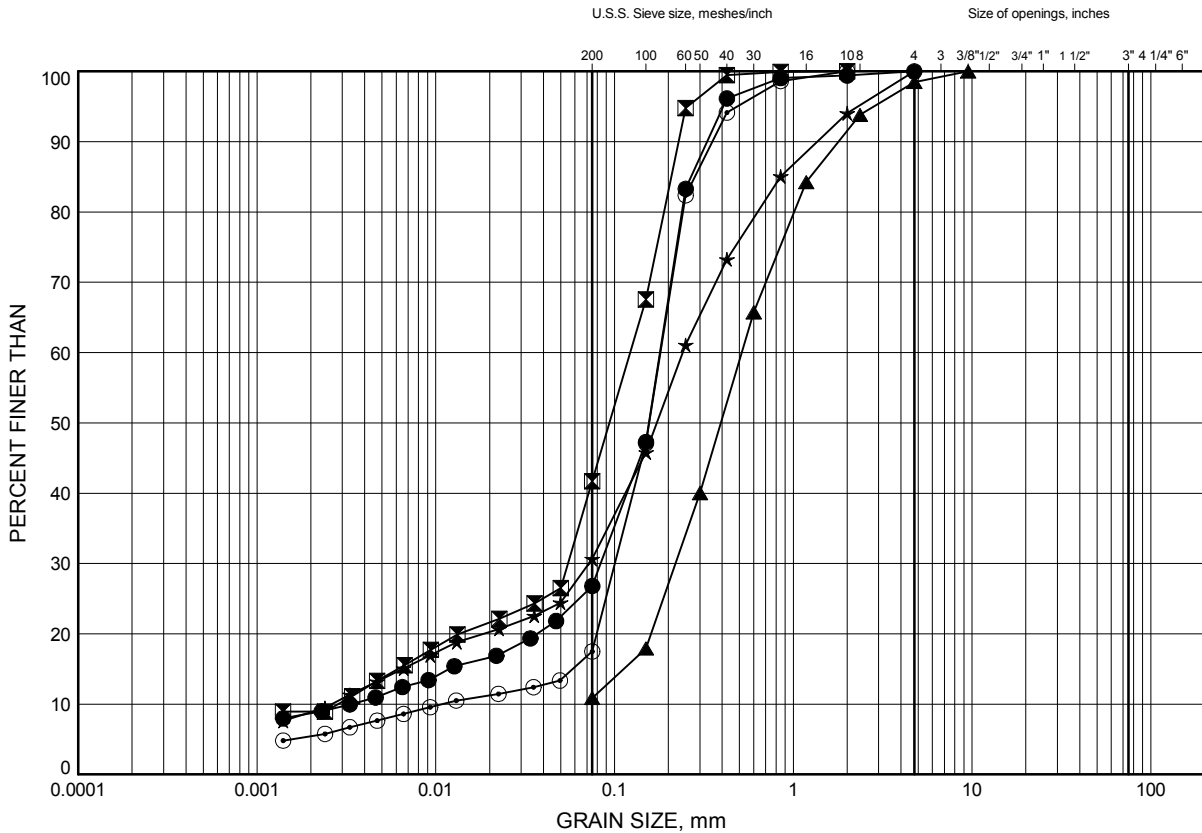
Appendix C
Geotechnical Laboratory Test Results

19-4406-6

Part A: Bear Brook Structures Realignment
GRAIN SIZE DISTRIBUTION

FIGURE C1

Fill Material



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-10	1.83	66.57
⊠	13-4	1.83	66.67
▲	13-5	1.83	74.27
★	13-7	0.30	74.90
⊙	13-9	1.07	73.83

Date June 2014
 GWP# 455-98-00

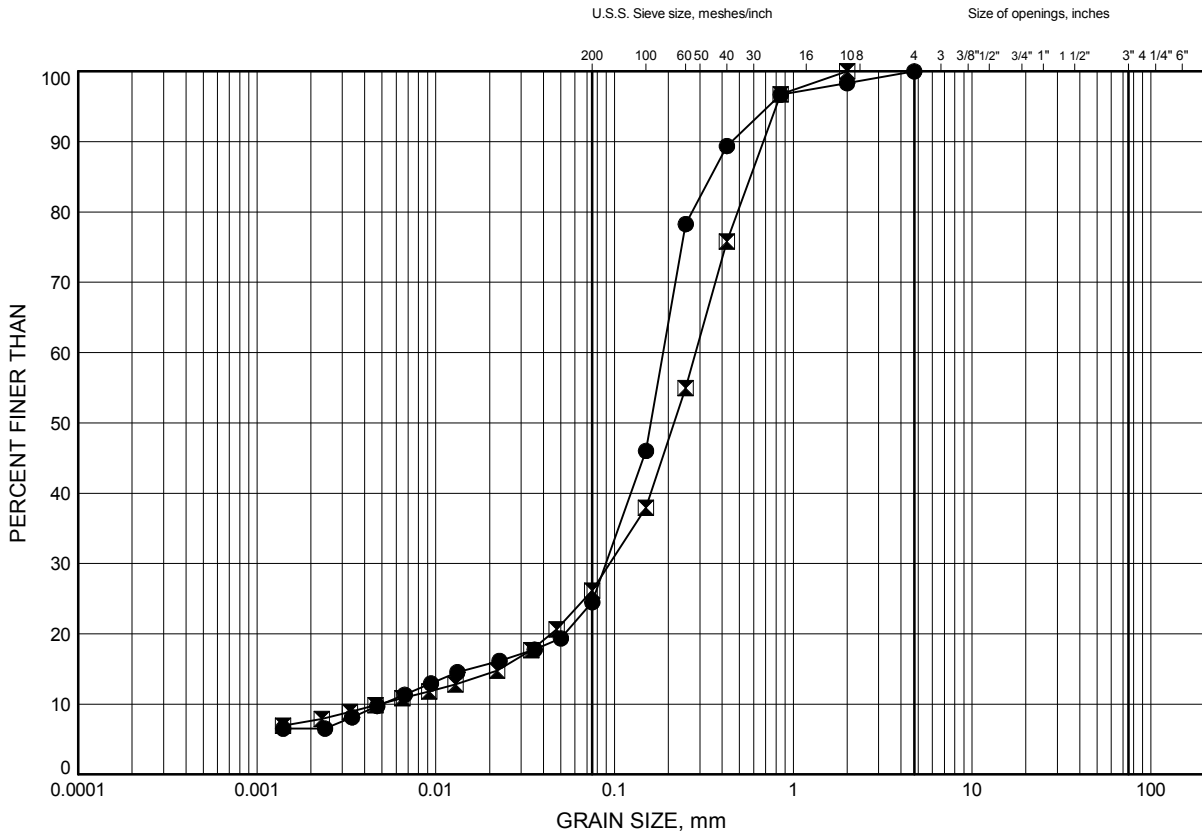


Prep'd CM
 Chkd. PC

Part A: Bear Brook Structures Realignment
GRAIN SIZE DISTRIBUTION

FIGURE C2

Silty Sand



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-1	1.07	74.83
⊠	13-10	3.37	65.03

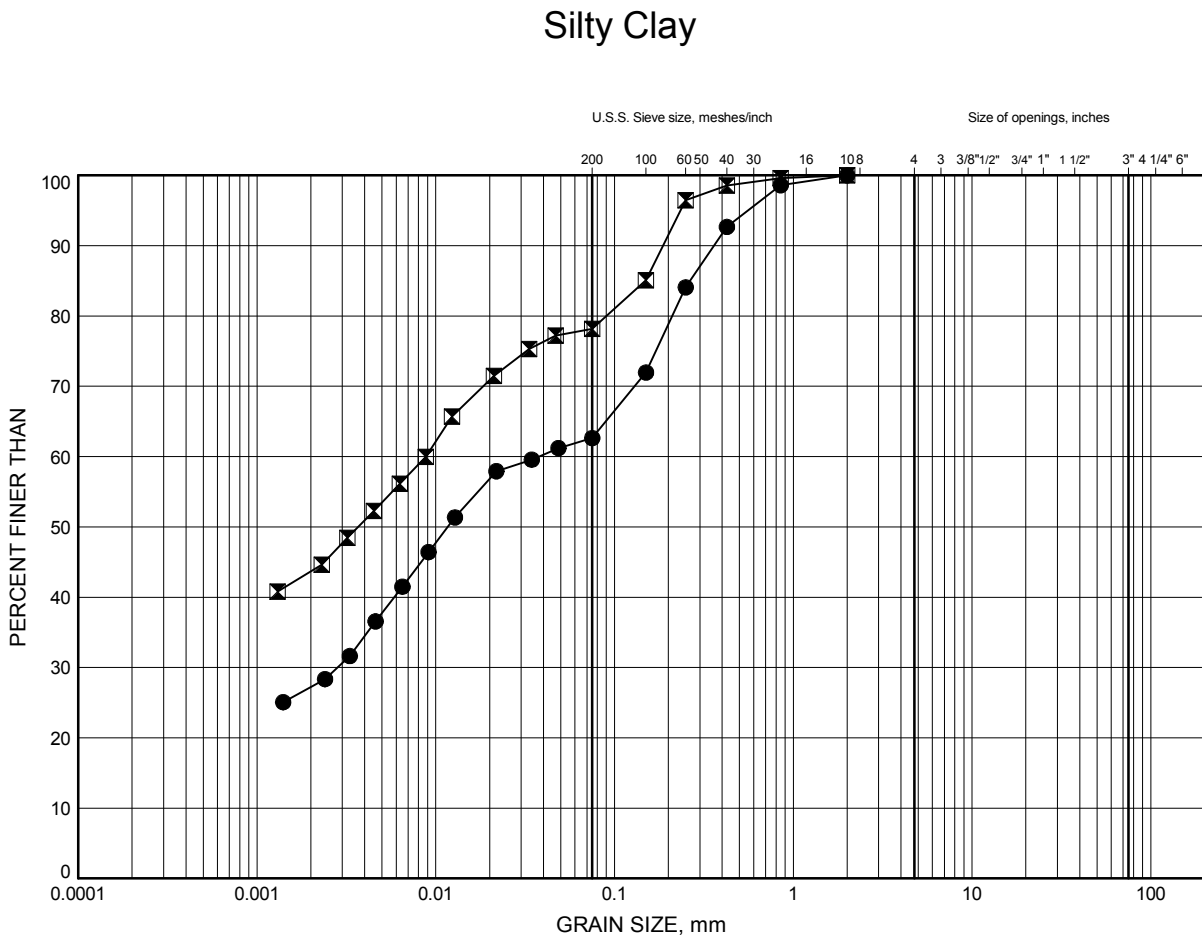
Date June 2014
GWP# 455-98-00



Prep'd CM
Chkd. PC

Part A: Bear Brook Structures Realignment
GRAIN SIZE DISTRIBUTION

FIGURE C3



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-3	0.30	68.40
⊠	13-3	1.83	66.87

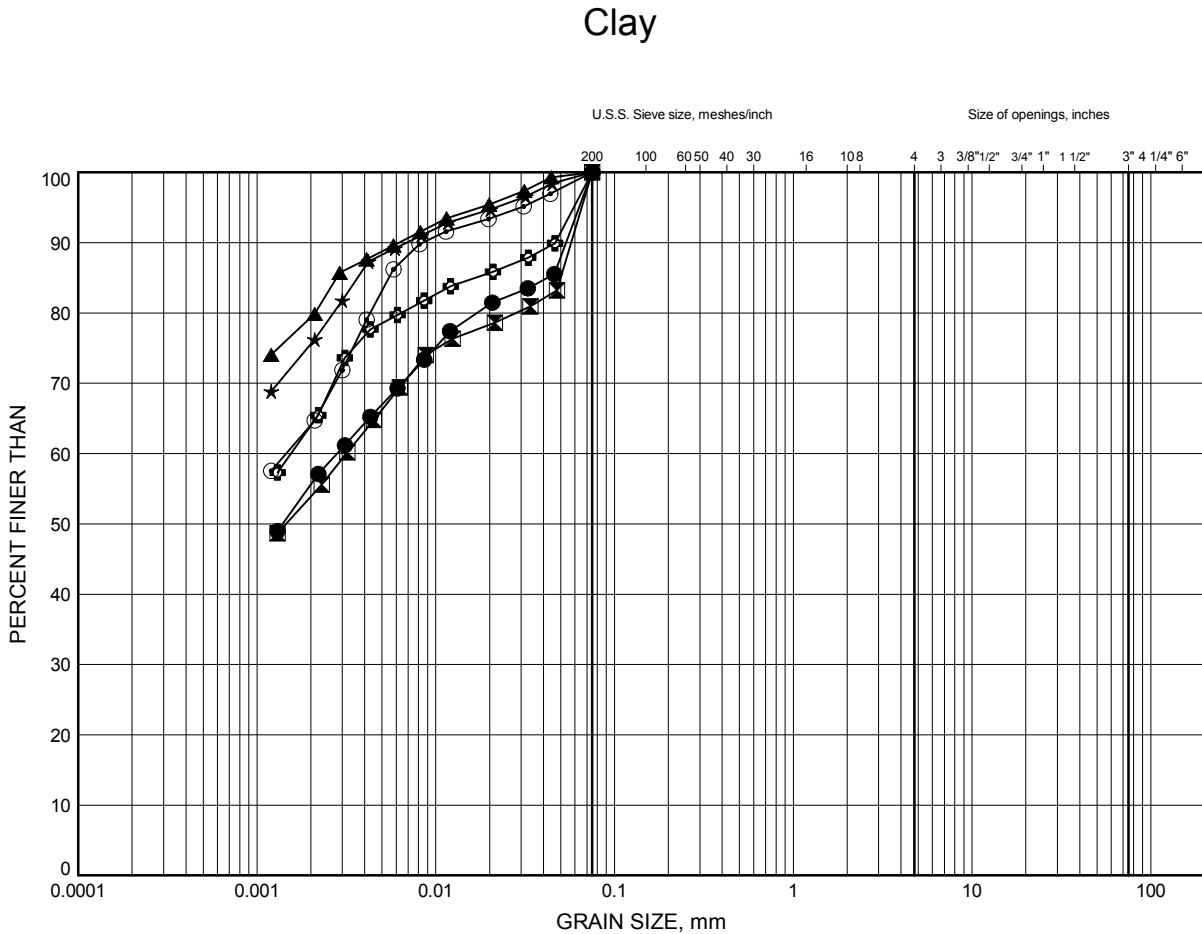
Date July 2014
 GWP# 455-98-00



Prep'd GM
 Chkd. PC

Part A: Bear Brook Structures Realignment
GRAIN SIZE DISTRIBUTION

FIGURE C4



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-1	2.59	73.31
⊠	13-1	8.69	67.21
▲	13-10	6.40	62.00
★	13-10	9.45	58.95
⊙	13-10	15.54	52.86
⊕	13-11	2.59	65.61

Date June 2014

GWP# 455-98-00

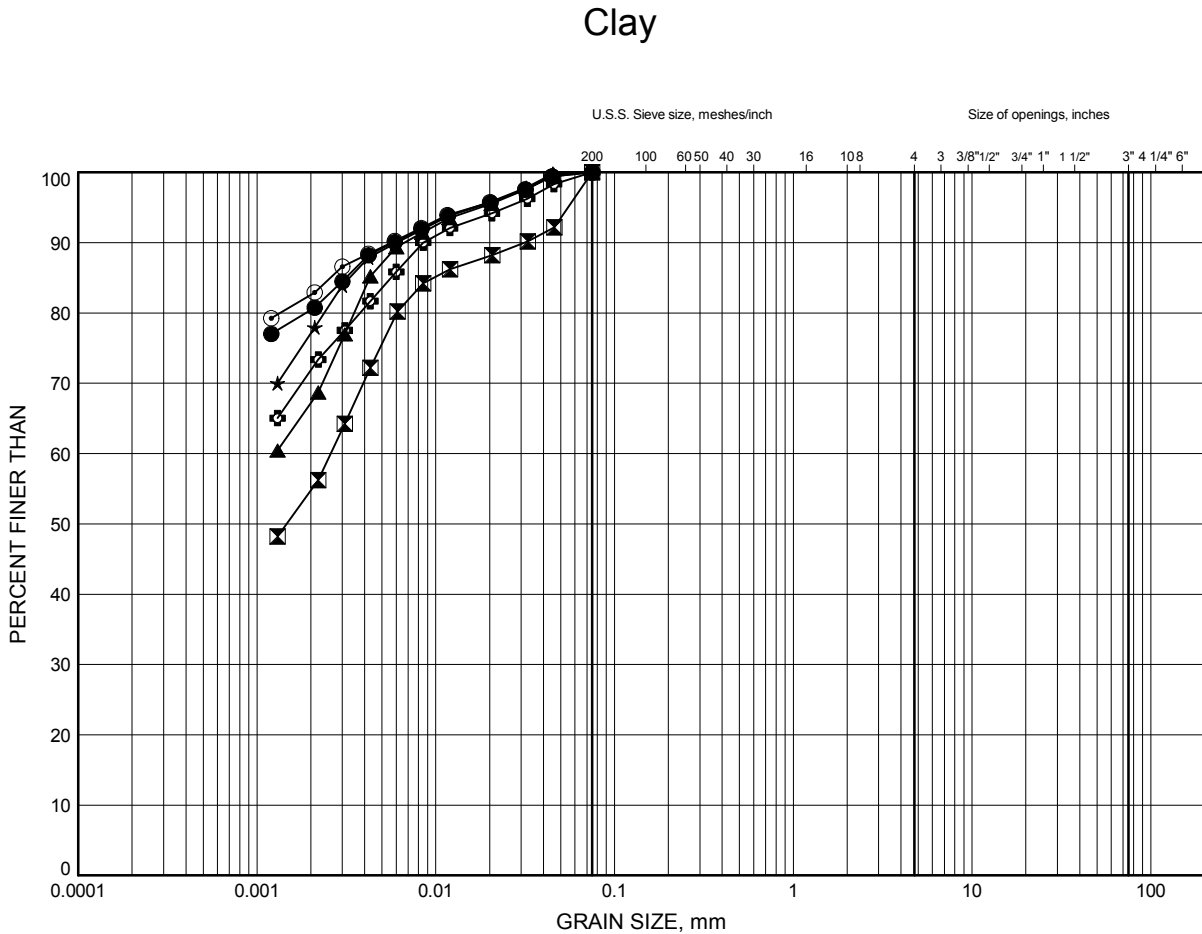


Prep'd CM

Chkd. PC

Part A: Bear Brook Structures Realignment
GRAIN SIZE DISTRIBUTION

FIGURE C5



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-11	8.69	59.51
⊠	13-11	15.54	52.66
▲	13-13	1.07	74.83
★	13-13	7.92	67.98
⊙	13-4	4.88	63.62
⊕	13-5	4.11	71.99

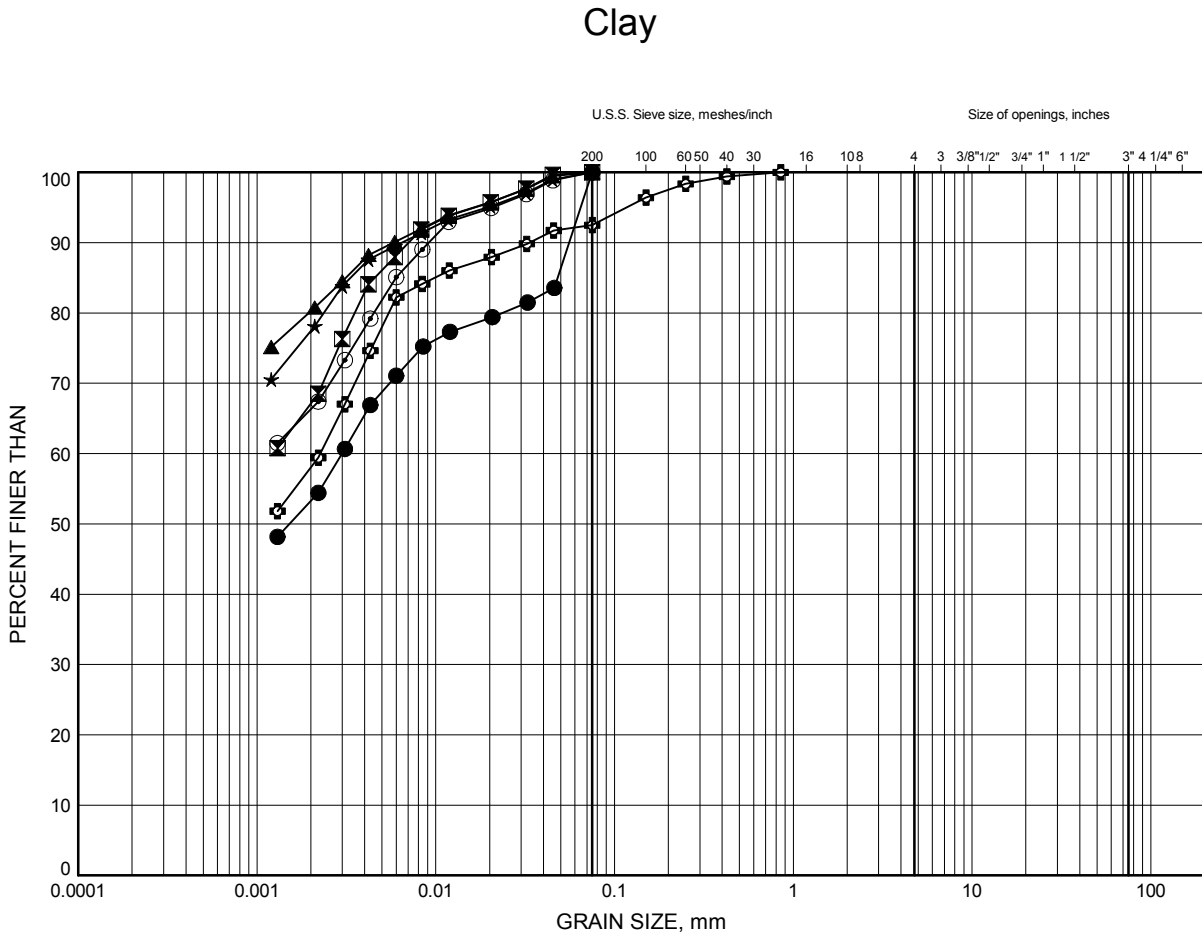
Date June 2014
GWP# 455-98-00



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Part A: Bear Brook Structures Realignment
GRAIN SIZE DISTRIBUTION

FIGURE C6



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-5	7.92	68.18
⊠	13-6	1.83	73.17
▲	13-6	14.02	60.98
★	13-7	7.92	67.28
⊙	13-8	1.08	73.82
⊕	13-8	3.35	71.55

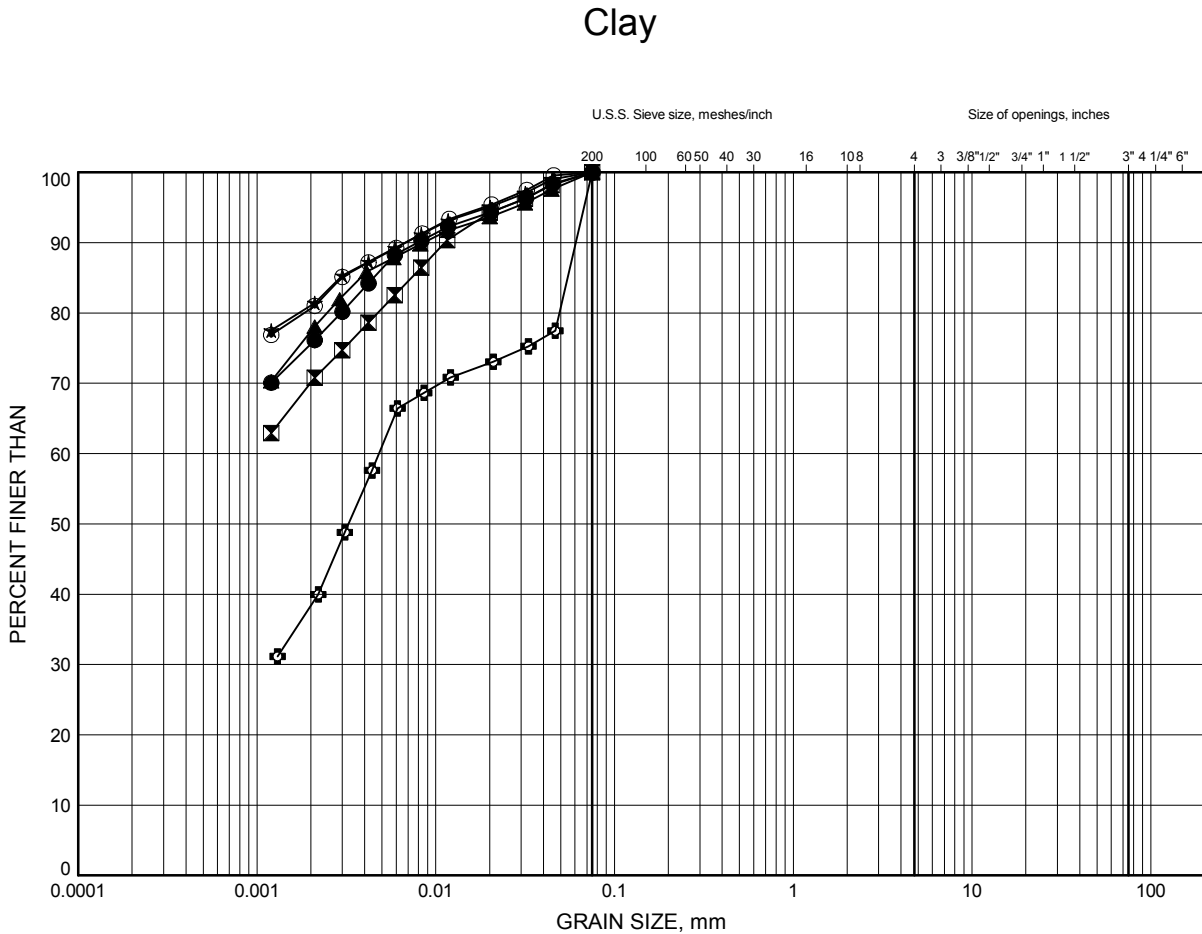
Date June 2014
GWP# 455-98-00



Prep'd CM
Chkd. PC

Part A: Bear Brook Structures Realignment
GRAIN SIZE DISTRIBUTION

FIGURE C7



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-8	9.45	65.45
⊠	13-9	3.35	71.55
▲	13-9	7.32	67.58
★	13-9	7.92	66.98
⊙	13-9	12.50	62.40
⊕	13-9	15.54	59.36

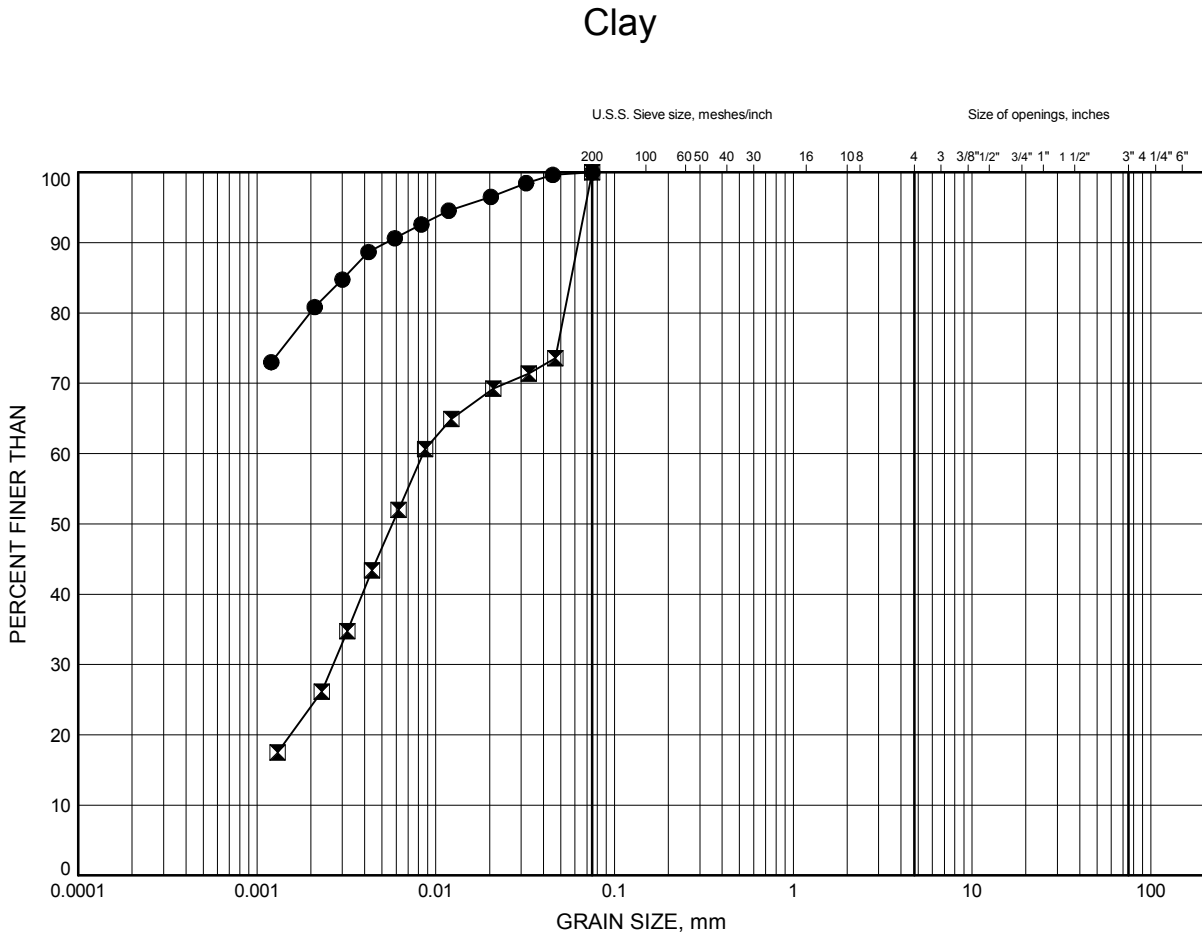
Date June 2014
 GWP# 455-98-00



Prep'd CM
 Chkd. PC

Part A: Bear Brook Structures Realignment
GRAIN SIZE DISTRIBUTION

FIGURE C8



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-9	20.12	54.78
⊠	13-9	23.16	51.74

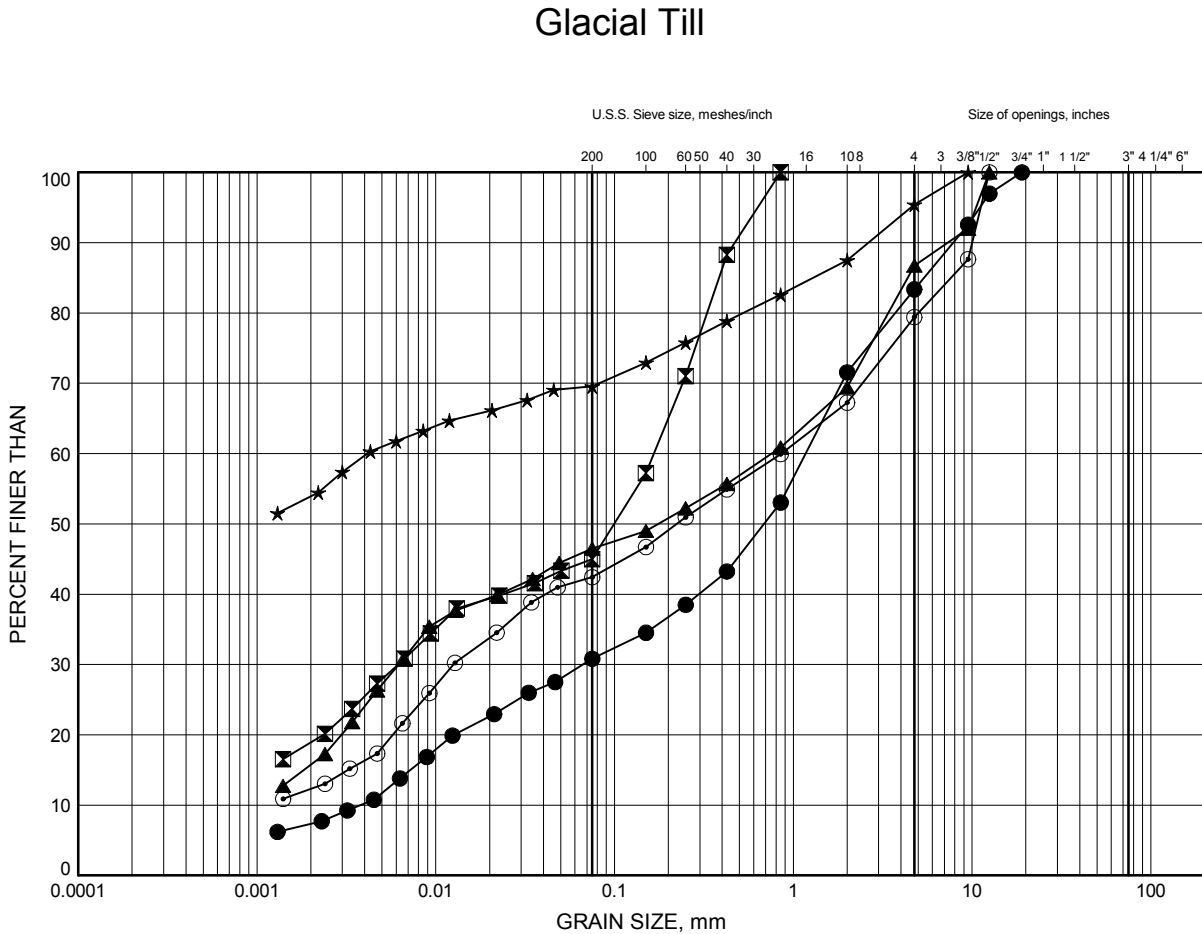
Date June 2014
 GWP# 455-98-00



Prep'd CM
 Chkd. PC

Part A: Bear Brook Structures Realignment
GRAIN SIZE DISTRIBUTION

FIGURE C9



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-10	26.21	42.19
⊠	13-3	26.21	42.49
▲	13-3	29.26	39.44
★	13-4	26.21	42.29
⊙	13-6	31.28	43.72

Date June 2014
 GWP# 455-98-00



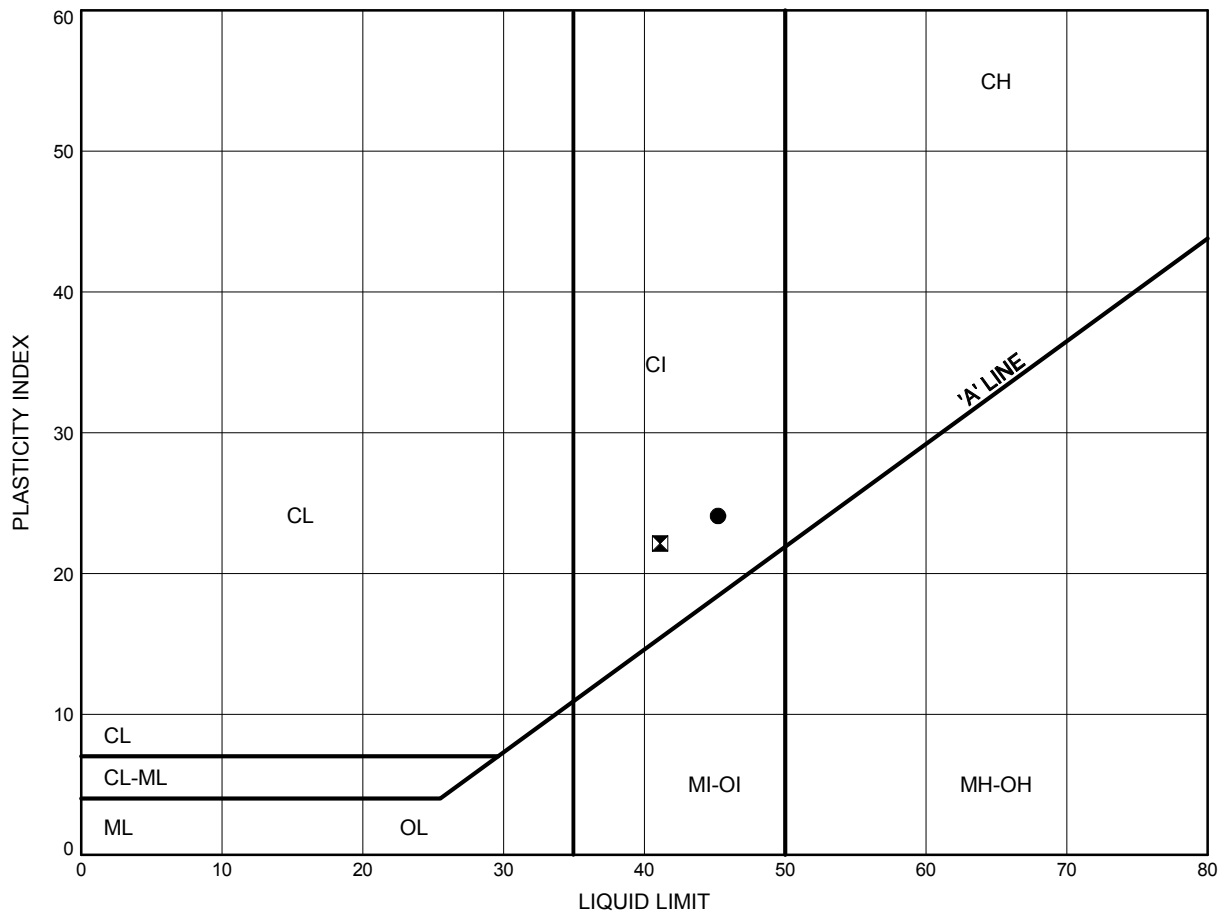
Prep'd CM
 Chkd. PC

Part A: Bear Brook Structures Realignment

ATTERBERG LIMITS TEST RESULTS

FIGURE C10

Sandy Silty Clay



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-10	15.54	52.86
⊠	13-3	1.83	66.87

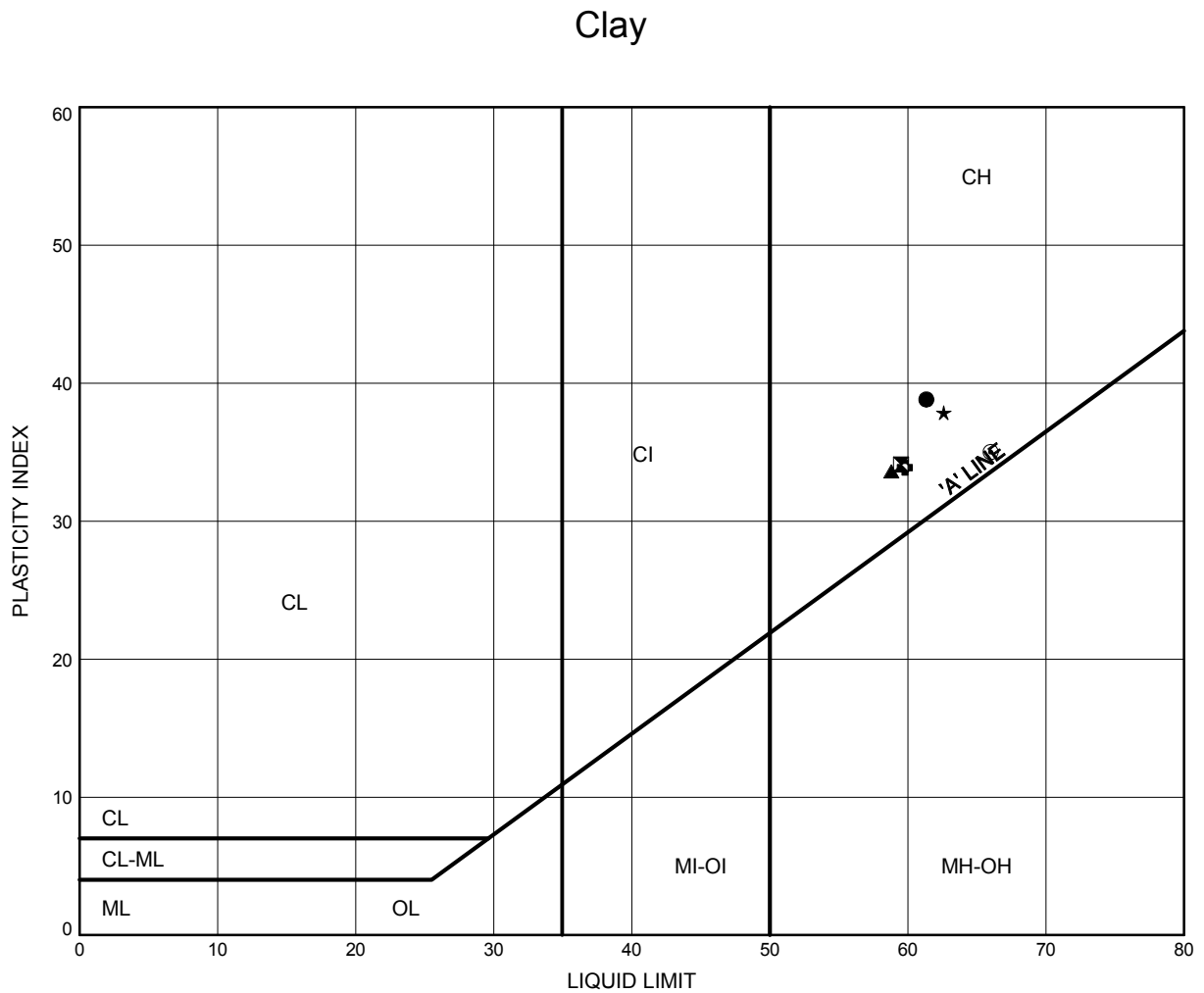
Date July 2014
GWP# 455-98-00



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Part A: Bear Brook Structures Realignment
ATTERBERG LIMITS TEST RESULTS

FIGURE C11



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-1	8.69	67.21
⊠	13-10	6.40	62.00
▲	13-10	9.45	58.95
★	13-11	2.59	65.61
⊙	13-11	8.69	59.51
⊕	13-3	3.35	65.35

Date July 2014
 GWP# 455-98-00

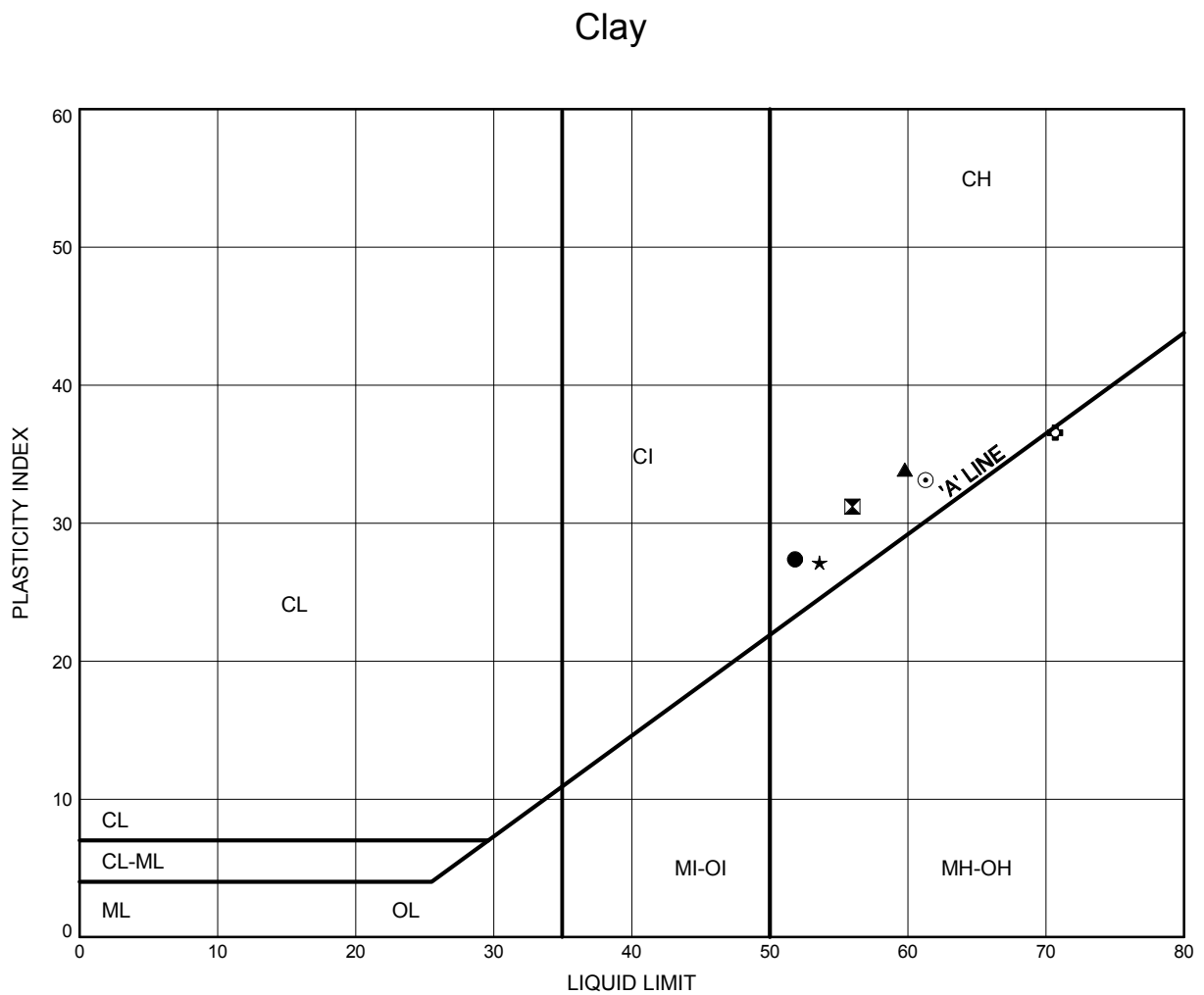


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 Chkd. PC

Part A: Bear Brook Structures Realignment

ATTERBERG LIMITS TEST RESULTS

FIGURE C12



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-11	15.54	52.66
⊠	13-13	7.92	67.98
▲	13-3	3.35	65.35
★	13-3	9.45	59.25
⊙	13-4	4.88	63.62
⊕	13-4	14.02	54.48

Date June 2014
GWP# 455-98-00

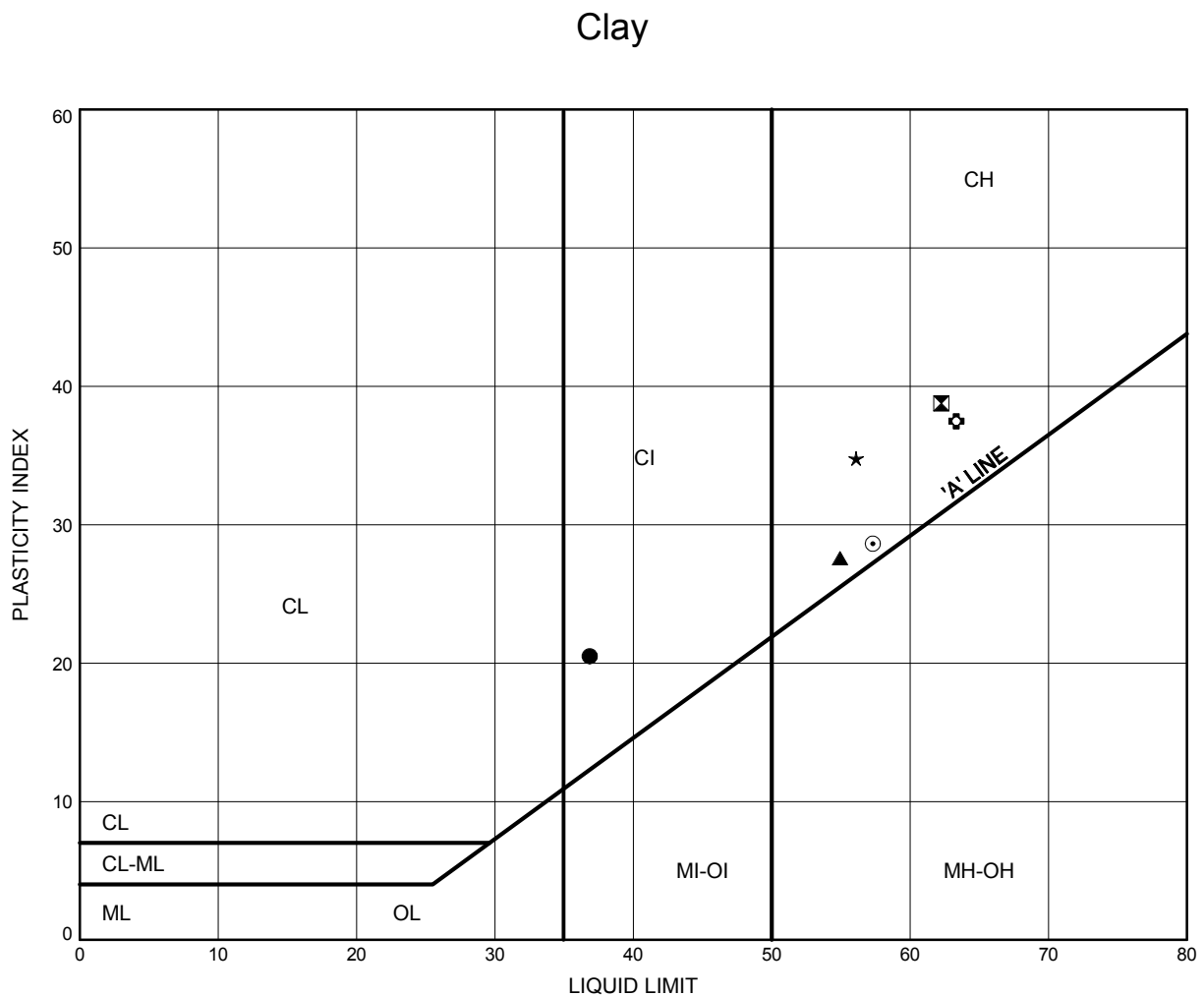


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Chkd. PC

Part A: Bear Brook Structures Realignment

ATTERBERG LIMITS TEST RESULTS

FIGURE C13



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-4	26.21	42.29
⊠	13-5	4.11	71.99
▲	13-5	7.92	68.18
★	13-6	1.83	73.17
⊙	13-6	6.40	68.60
⊕	13-6	21.64	53.36

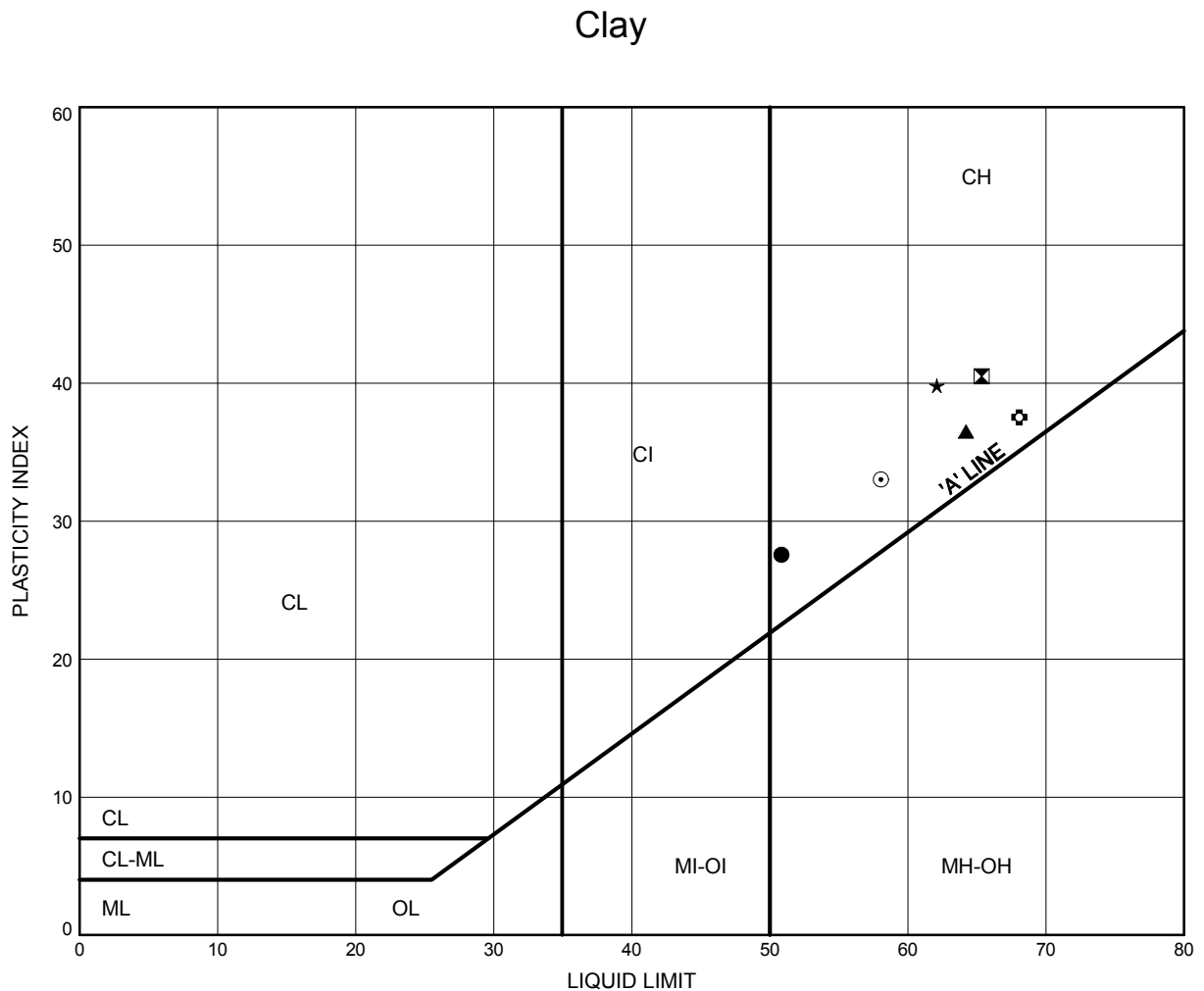
Date June 2014
GWP# 455-98-00



Prep'd CM
Chkd. PC

Part A: Bear Brook Structures Realignment
ATTERBERG LIMITS TEST RESULTS

FIGURE C14



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-7	3.35	71.85
⊠	13-8	3.35	71.55
▲	13-8	9.45	65.45
★	13-9	3.35	71.55
⊙	13-9	7.32	67.58
⊕	13-9	7.92	66.98

Date June 2014
 GWP# 455-98-00

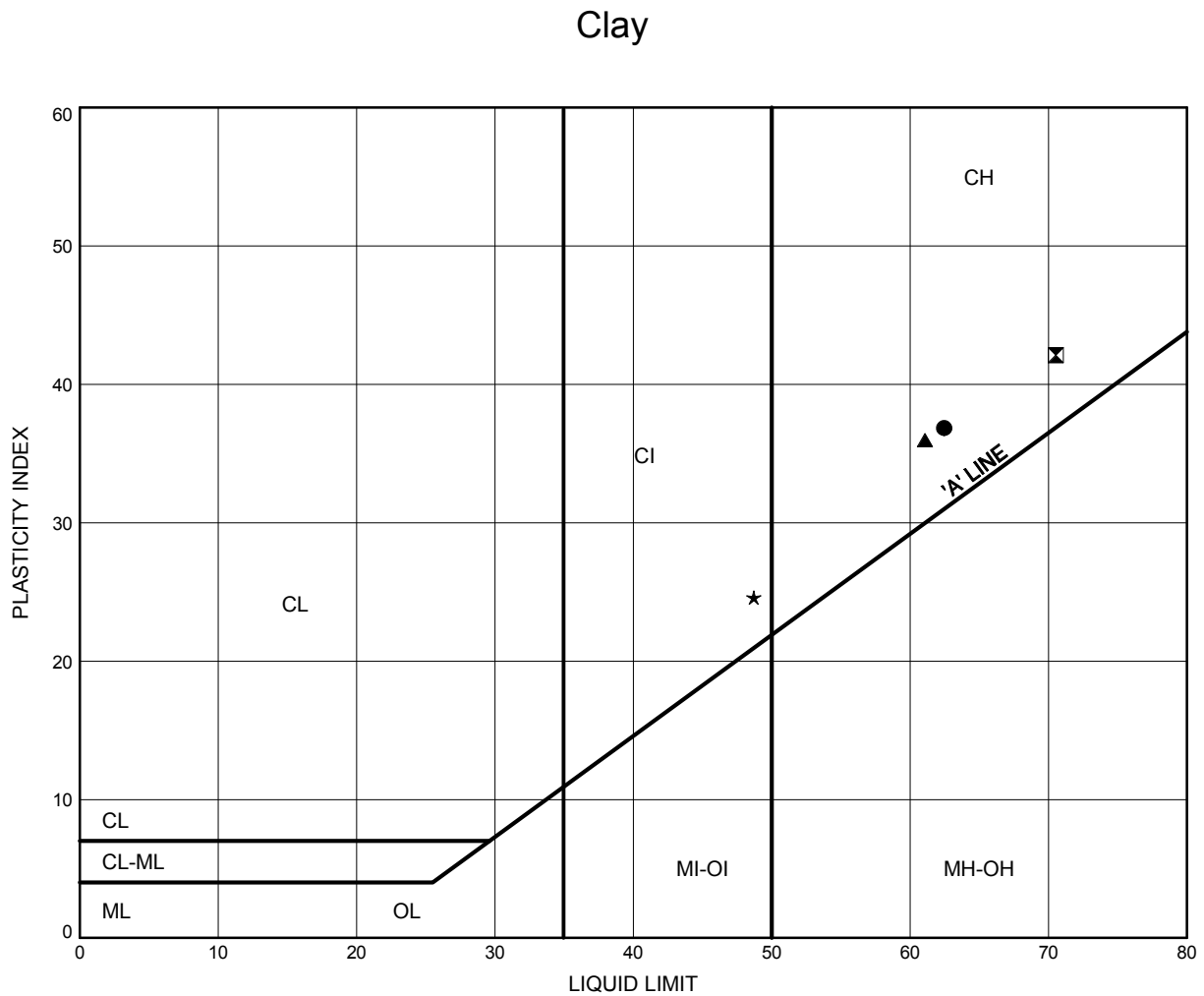


Prep'd CM
 Chkd. PC

Part A: Bear Brook Structures Realignment

ATTERBERG LIMITS TEST RESULTS

FIGURE C15



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-9	12.50	62.40
☒	13-9	15.54	59.36
▲	13-9	20.12	54.78
★	13-9	23.16	51.74

Date June 2014
GWP# 455-98-00



Prep'd CM
Chkd. PC

Consolidation Test Report

CLIENT: **URS Canada**

FILE NUMBER: **19-4406-6**

PROJECT: **HWY 417 Bearbrook**

REPORT DATE: **20-Nov-13**

TEST DATES: **October 21, 2013 - November 01, 2013**

SAMPLE: **BH13-9-TW10 (25' - 27')**
Silty Clay, contains 19% Silt and 81% Clay, LL=68%, PL=31%

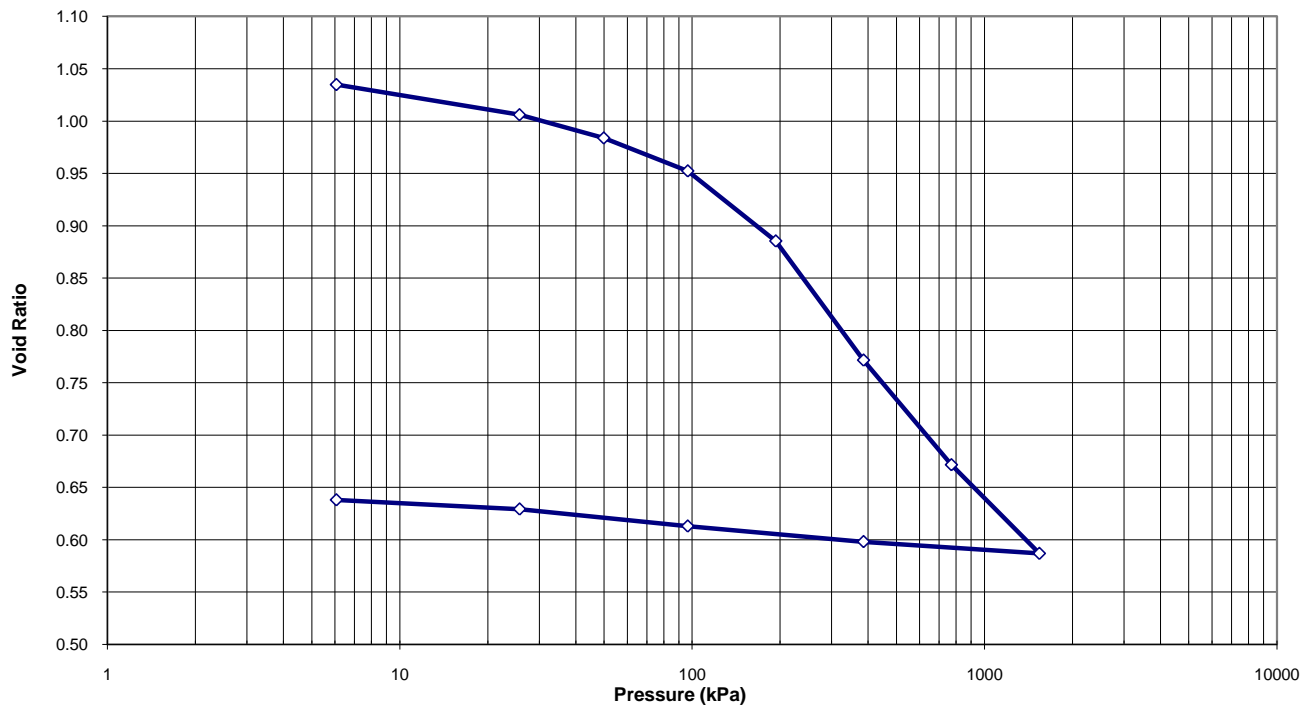
PROCEDURE: Test carried out in accordance with Standard Test Method for One-Dimensional Consolidation Properties of Soils, ASTM D 2435-04, method B

	<u>Start of Test</u>	<u>End of Test</u>
Wet Dens. (kg/m ³)	1888.5	2113.2
Dry Dens. (kg/m ³)	1357.3	1700.3
Moisture Cont. (%)	39.1	24.3
Void Ratio	1.052	0.638

Note: A Specific Gravity of 2.79 was measured for the void ratio and saturation calculations.

Project #: 19-4406-6
 Client: URS Canada
 Project Name: HWY 417 Bearbrook
 Sample: BH13-9-TW10 (25' - 27')

Void Ratio vs. Pressure





Consolidation Test Report

HWY 417 Bearbrook
19-4406-6

BH13-9-TW10 (25' - 27')

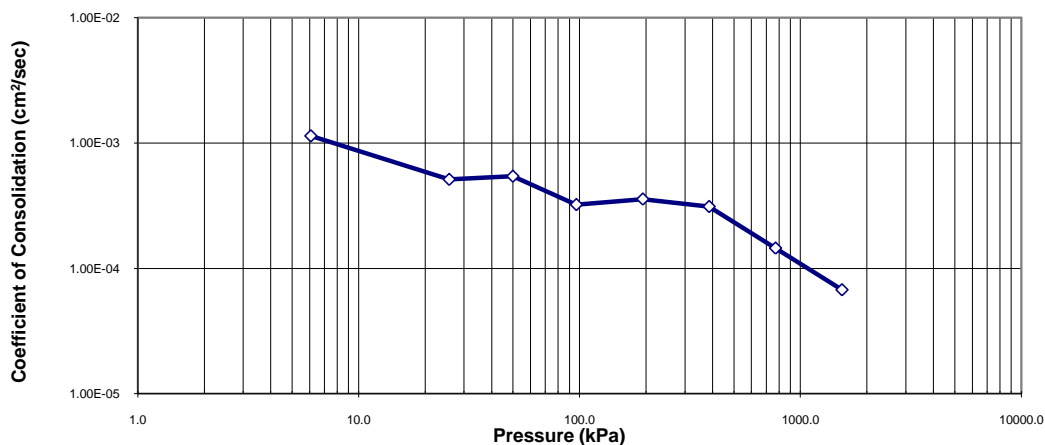
TRIMMING: The Specimen was manually trimmed to the size of consolidation ring, then mounted in a fixed ring consolidometer.

LOADING: A seating load of 6.1 kPa was applied and the consolidometer was flooded with distilled water. Sample was monitored to ensure no swelling effect occurred before the start of the test. Subsequent loads were applied after 100% primary consolidation was reached.

CALCULATIONS: Coefficients of Consolidation were calculated by the square root time method.

Pressure (kPa)	Corr. H. (mm)	Avg. H. (mm)	d_{90} (mm)	t_{90} (min)	c_v (cm ² /s)	Void Ratio	m_v (m ² /kN)	k (cm/s)
0.0	25.500					1.052		
6.1	25.324	25.412	-0.150	3.19	7.16E-03	1.038	1.14E-03	7.99E-07
25.7	25.070	25.197	-0.246	2.89	7.76E-03	1.017	5.12E-04	3.90E-07
49.9	24.741	24.906	-0.142	2.86	7.67E-03	0.991	5.43E-04	4.08E-07
96.6	24.368	24.555	-0.178	2.56	8.32E-03	0.961	3.22E-04	2.63E-07
193.2	23.529	23.949	-0.307	3.01	6.73E-03	0.893	3.56E-04	2.35E-07
385.7	22.121	22.825	-0.690	5.22	3.53E-03	0.780	3.11E-04	1.07E-07
770.7	20.887	21.504	-0.682	3.34	4.89E-03	0.681	1.45E-04	6.95E-08
1540.7	19.803	20.345	-0.594	2.25	6.50E-03	0.594	6.74E-05	4.30E-08
385.7	19.814	19.809				0.594		
96.6	19.998	19.906				0.609		
25.7	20.169	20.084				0.623		
6.1	20.257	20.213				0.630		

Coefficient of Consolidation vs. Pressure



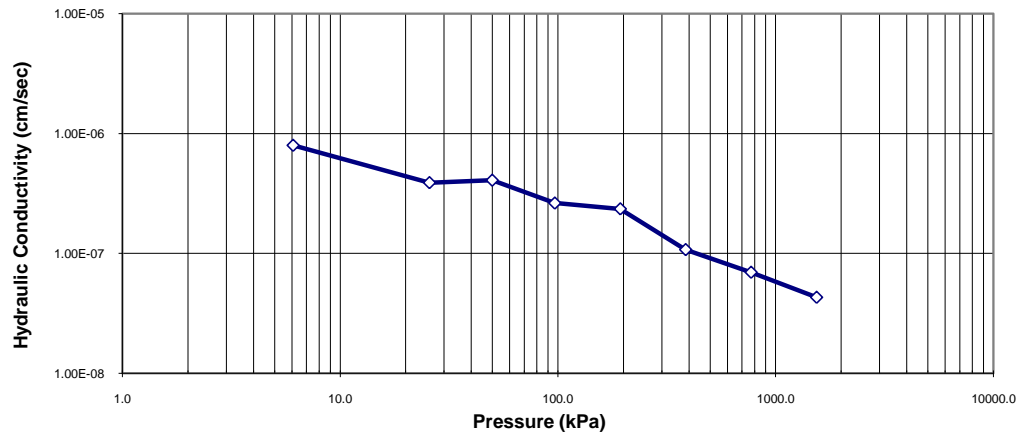
Notes: c_v and k calculated using t_{90} values

Consolidation Test Report

BH13-9-TW10 (25' - 27')

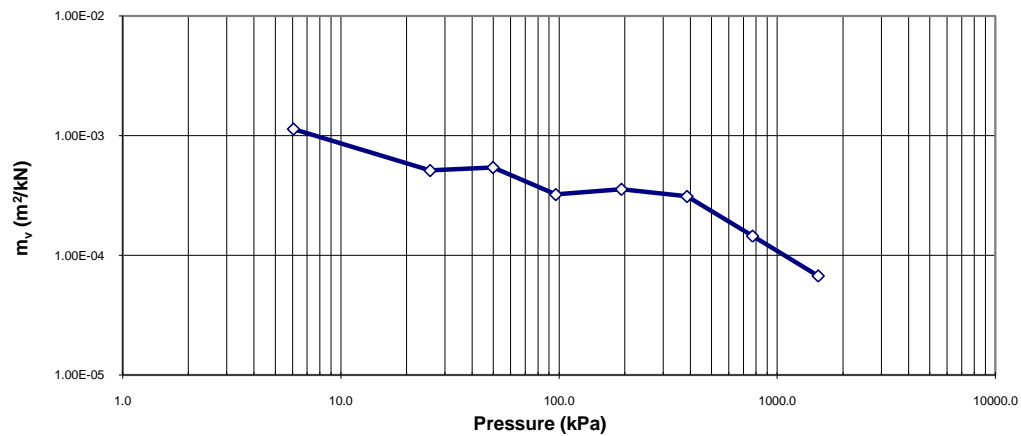
Project #: 19-4406-6
Client: URS Canada
Project Name: HWY 417 Bearbrook
Sample: BH13-9-TW10 (25' - 27')

Hydraulic Conductivity vs. Pressure



m_v vs. Pressure

Project #: 19-4406-6
Client: URS Canada
Project Name: HWY 417 Bearbrook
Sample: BH13-9-TW10 (25' - 27')



Consolidation Test Report

CLIENT: **URS Canada**

FILE NUMBER: **19-4406-6**

PROJECT: **HWY 17 Bearbrook**

REPORT DATE: **20-Nov-13**

TEST DATES: **November 04, 2013 - November 15, 2013**

SAMPLE: **BH13-9-TW15 (50' - 52')**
Silty Clay, Grey, 62% Silt and 38% Clay, LL=70%, PL=29%

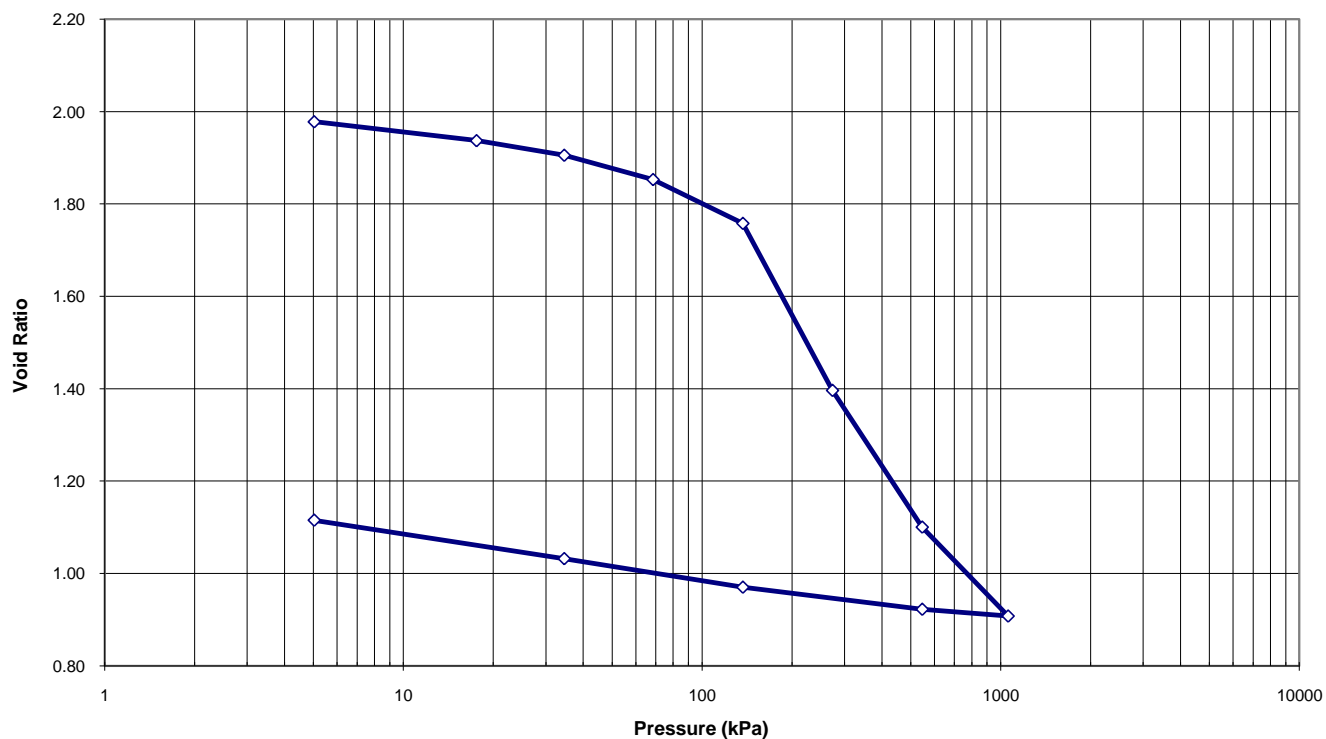
PROCEDURE: Test carried out in accordance with Standard Test Method for One-Dimensional Consolidation Properties of Soils, ASTM D 2435-04, method A (constant load duration of 24 hrs)

	<u>Start of Test</u>	<u>End of Test</u>
Wet Dens. (kg/m ³)	1599.0	1911.3
Dry Dens. (kg/m ³)	915.2	1301.5
Moisture Cont. (%)	74.7	46.9
Void Ratio	2.008	1.115

Note: A Specific Gravity of 2.75 was measured for the void ratio and saturation calculations.

Void Ratio vs. Pressure

Project #: 19-4406-6
 Client: URS Canada
 Project Name: HWY 17 Bearbrook
 Sample: BH13-9-TW15 (50' - 52')



Consolidation Test Report

HWY 17 Bearbrook
19-4406-6

BH13-9-TW15 (50' - 52')

TRIMMING: The Specimen was manually trimmed to the size of consolidation ring, then mounted in a fixed ring consolidometer.

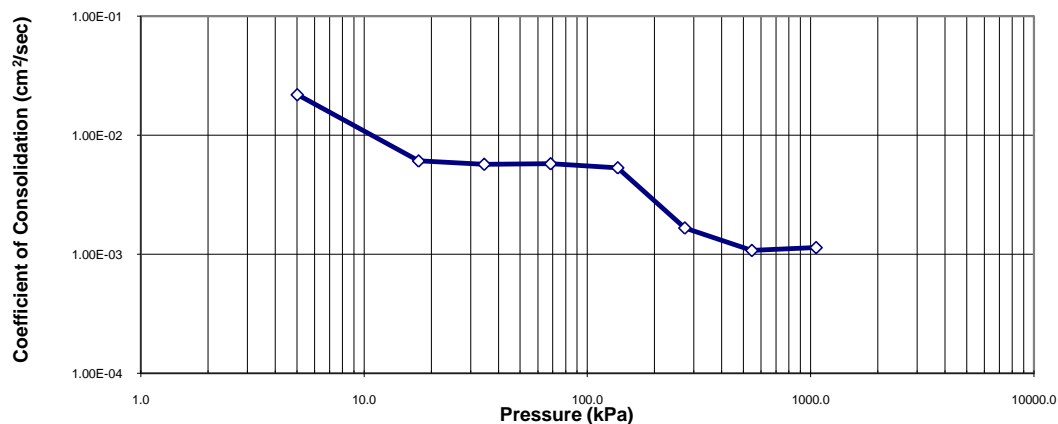
LOADING: A seating load of 5 kPa was applied and the consolidometer was flooded with distilled water. Sample was monitored to ensure no swelling effect occurred before the start of the test. Subsequent loads were applied after 100% primary consolidation was reached.

CALCULATIONS: Coefficients of Consolidation were calculated by the square root time method.

Pressure (kPa)	Corr. H. (mm)	Avg. H. (mm)	d_{90} (mm)	t_{90} (min)	C_v (cm ² /s)	Void Ratio	m_v (m ² /kN)	k (cm/s)
0.0	20.000					2.008		
5.0	19.801	19.901	-0.116	0.640	2.19E-02	1.978	1.98E-03	4.25E-06
17.6	19.529	19.665	-0.197	2.250	6.07E-03	1.937	1.10E-03	6.53E-07
34.5	19.319	19.424	-0.104	2.341	5.69E-03	1.906	6.34E-04	3.54E-07
68.5	18.969	19.144	-0.173	2.250	5.76E-03	1.853	5.34E-04	3.01E-07
136.9	18.338	18.654	-0.278	2.310	5.32E-03	1.758	4.87E-04	2.54E-07
273.2	15.933	17.136	-0.840	6.250	1.66E-03	1.396	9.62E-04	1.57E-07
545.5	13.964	14.949	-1.210	7.344	1.08E-03	1.100	4.54E-04	4.79E-08
1057.7	12.683	13.324	-0.785	5.523	1.14E-03	0.908	1.79E-04	1.99E-08
545.5	12.781	12.732				0.922		
136.9	13.099	12.940				0.970		
34.5	13.510	13.305				1.032		
5.0	14.064	13.787				1.115		

Coefficient of Consolidation vs. Pressure

Project #: 19-4406-6
Client: URS Canada
Project Name: HWY 17 Bearbrook
Sample: BH13-9-TW15 (50' - 52')



Notes: C_v and k calculated using t_{90} values

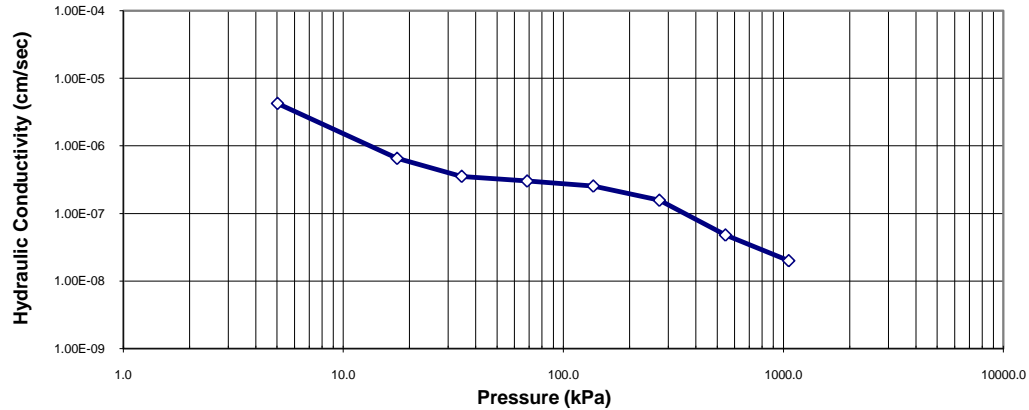
Consolidation Test Report

HWY 17 Bearbrook
19-4406-6

BH13-9-TW15 (50' - 52')

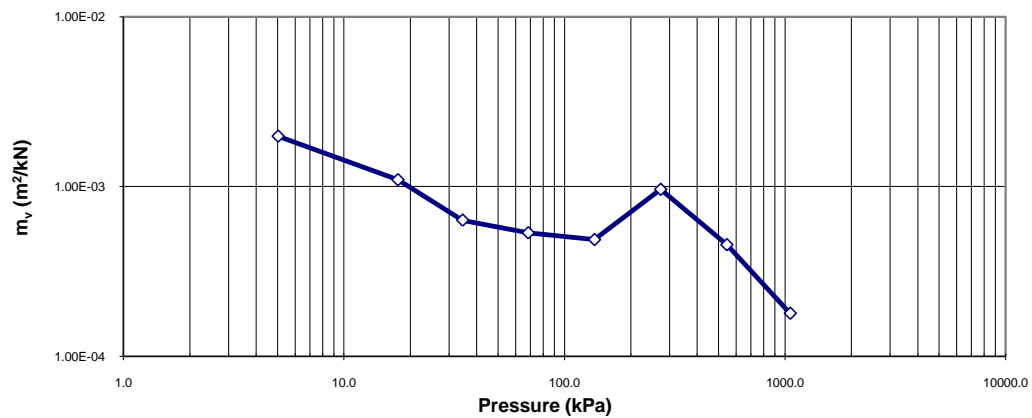
Hydraulic Conductivity vs. Pressure

Project #: 19-4406-6
Client: URS Canada
Project Name: HWY 17 Bearbrook
Sample: BH13-9-TW15 (50' - 52')



m_v vs. Pressure

Project #: 19-4406-6
Client: URS Canada
Project Name: HWY 17 Bearbrook
Sample: BH13-9-TW15 (50' - 52')



Consolidation Test Report

CLIENT: **URS Canada**

FILE NUMBER: **19-4406-6**

PROJECT: **HWY 417 Bearbrook**

REPORT DATE: **20-Nov-13**

TEST DATES: **November 04, 2013 - November 15, 2013**

SAMPLE: **BH13-9-TW19 (75' - 77')**
Silty Clay, contains 76% Silt and 24% Clay, LL=49%, PL=24%

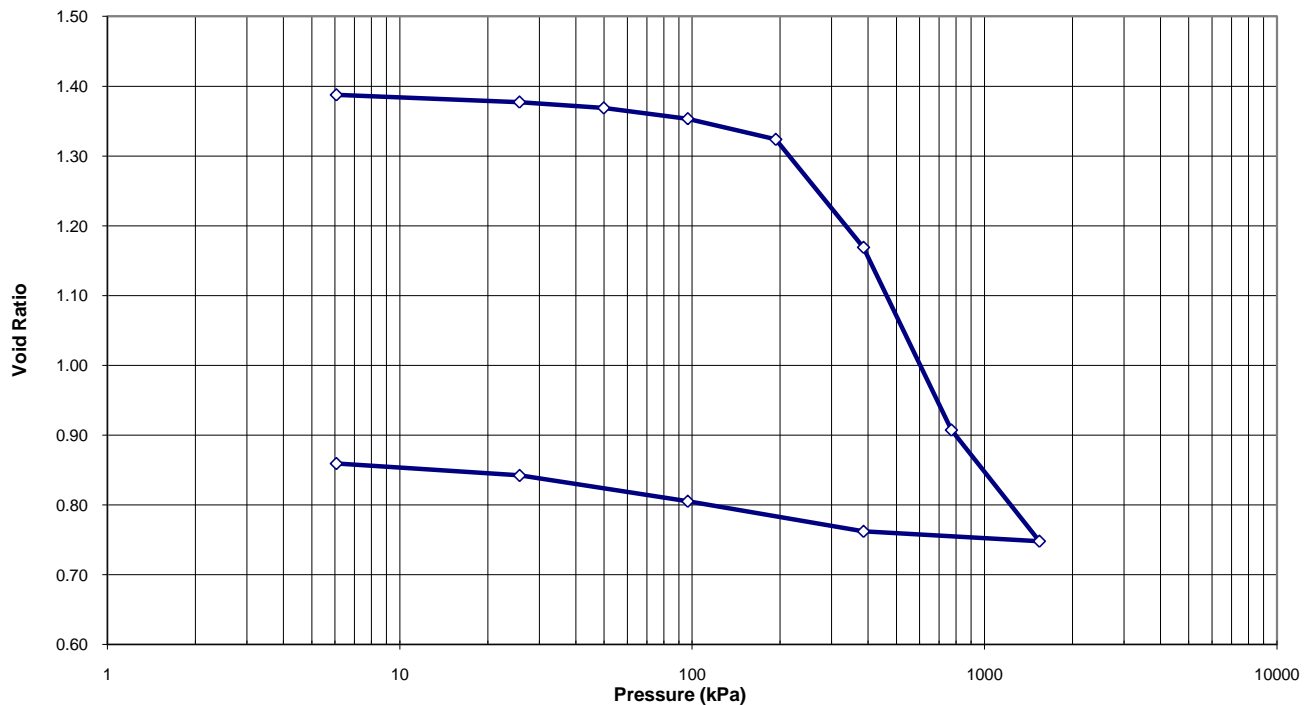
PROCEDURE: Test carried out in accordance with Standard Test Method for One-Dimensional Consolidation Properties of Soils, ASTM D 2435-04, method B

	<u>Start of Test</u>	<u>End of Test</u>
Wet Dens. (kg/m ³)	1741.4	1987.0
Dry Dens. (kg/m ³)	1136.1	1464.1
Moisture Cont. (%)	53.3	35.7
Void Ratio	1.396	0.859

Note: A Specific Gravity of 2.72 was measured for the void ratio and saturation calculations.

Project #: 19-4406-6
 Client: URS Canada
 Project Name: HWY 417 Bearbrook
 Sample: BH13-9-TW19 (75' - 77')

Void Ratio vs. Pressure





Consolidation Test Report

HWY 417 Bearbrook
19-4406-6

BH13-9-TW19 (75' - 77')

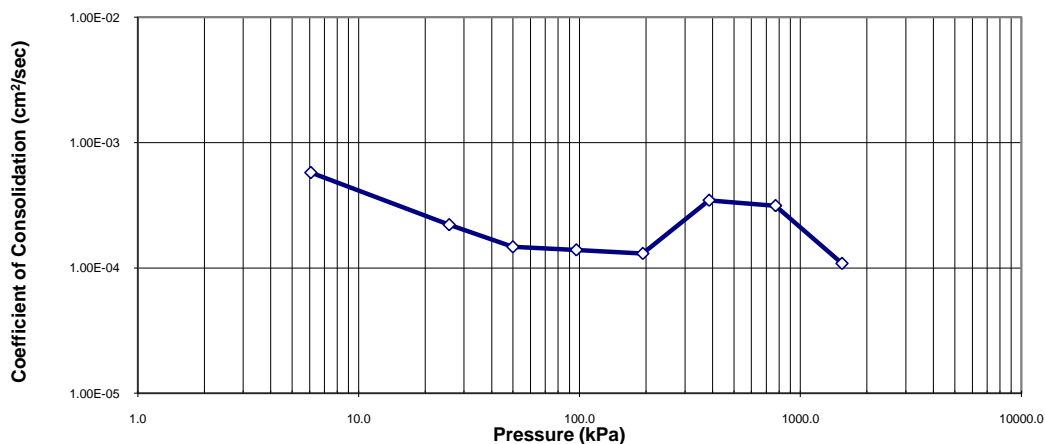
TRIMMING: The Specimen was manually trimmed to the size of consolidation ring, then mounted in a fixed ring consolidometer.

LOADING: A seating load of 6.1 kPa was applied and the consolidometer was flooded with distilled water. Sample was monitored to ensure no swelling effect occurred before the start of the test. Subsequent loads were applied after 100% primary consolidation was reached.

CALCULATIONS: Coefficients of Consolidation were calculated by the square root time method.

Pressure (kPa)	Corr. H. (mm)	Avg. H. (mm)	d_{90} (mm)	t_{90} (min)	c_v (cm ² /s)	Void Ratio	m_v (m ² /kN)	k (cm/s)
0	25.500					1.396		
6.1	25.411	25.456	-0.038	0.416	5.50E-02	1.388	5.75E-04	3.10E-06
25.7	25.301	25.356	-0.087	1.563	1.45E-02	1.377	2.21E-04	3.15E-07
49.9	25.211	25.256	-0.052	1.664	1.35E-02	1.369	1.47E-04	1.95E-07
96.6	25.047	25.129	-0.092	1.716	1.30E-02	1.353	1.39E-04	1.77E-07
193.2	24.732	24.890	-0.164	1.742	1.26E-02	1.324	1.30E-04	1.60E-07
385.7	23.085	23.909	-0.440	3.331	6.06E-03	1.169	3.46E-04	2.06E-07
770.7	20.299	21.692	-1.716	12.250	1.36E-03	0.907	3.14E-04	4.17E-08
1540.7	18.604	19.452	-0.980	6.003	2.23E-03	0.748	1.08E-04	2.37E-08
385.7	18.754	18.679				0.762		
96.6	19.213	18.984				0.805		
25.7	19.606	19.410				0.842		
6.1	19.788	19.697				0.859		

Coefficient of Consolidation vs. Pressure



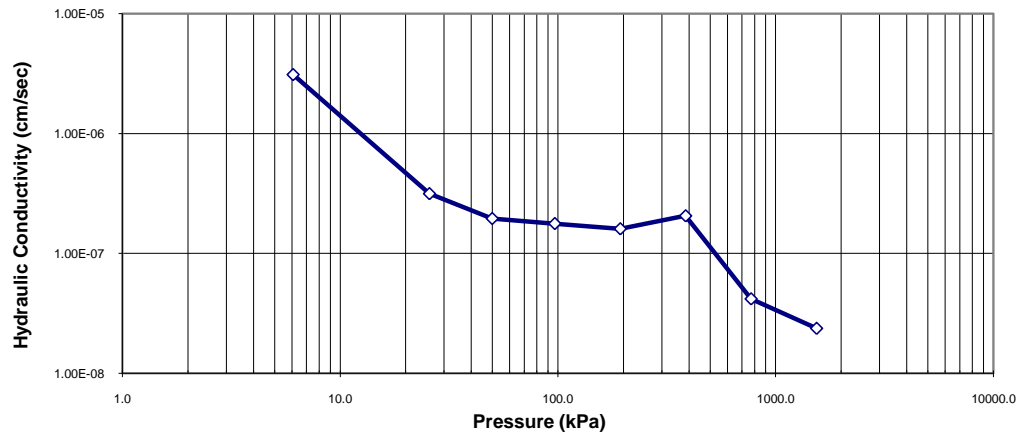
Notes: C_v and k calculated using t_{90} values



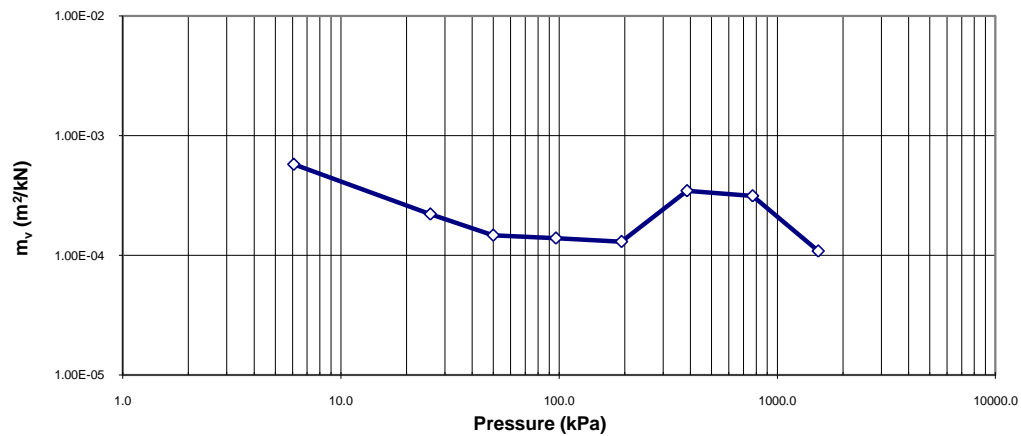
Consolidation Test Report

BH13-9-TW19 (75' - 77')

Hydraulic Conductivity vs. Pressure



m_v vs. Pressure



Appendix D
SCPTu Data

19-4406-6



Thurber Engineering

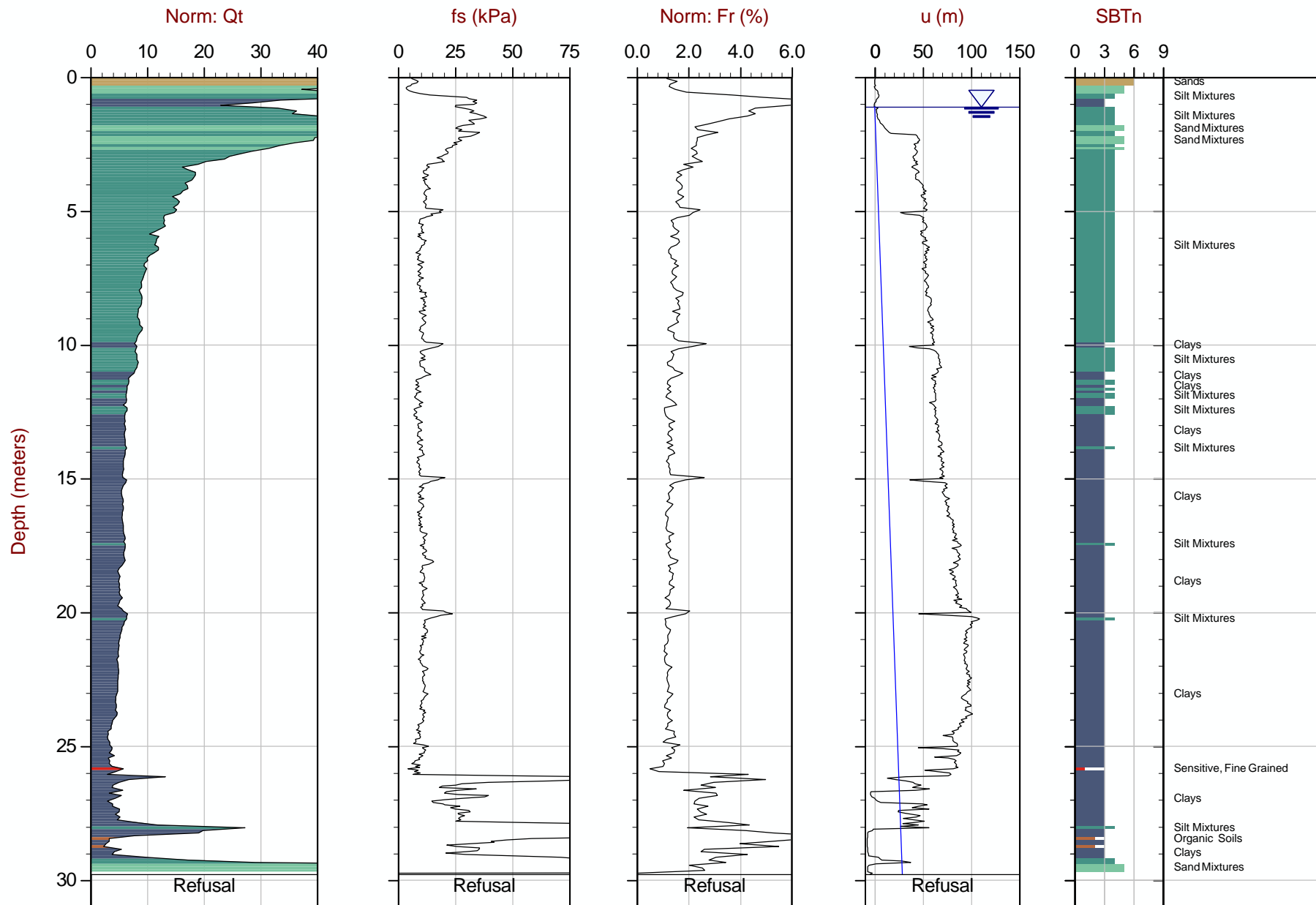
Job No: 13-05020

Date: 10:03:13 12:52

Site: HWY 417 Bear Brook Bridge, Ottawa, ON

Sounding: SCPT13-02

Cone: 374:T1500F15U500



Max Depth: 29.800 m / 97.77 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 13-05020_SP13-02.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 18 N: 5023375 E: 461897
Page No: 1 of 1



Thurber Engineering

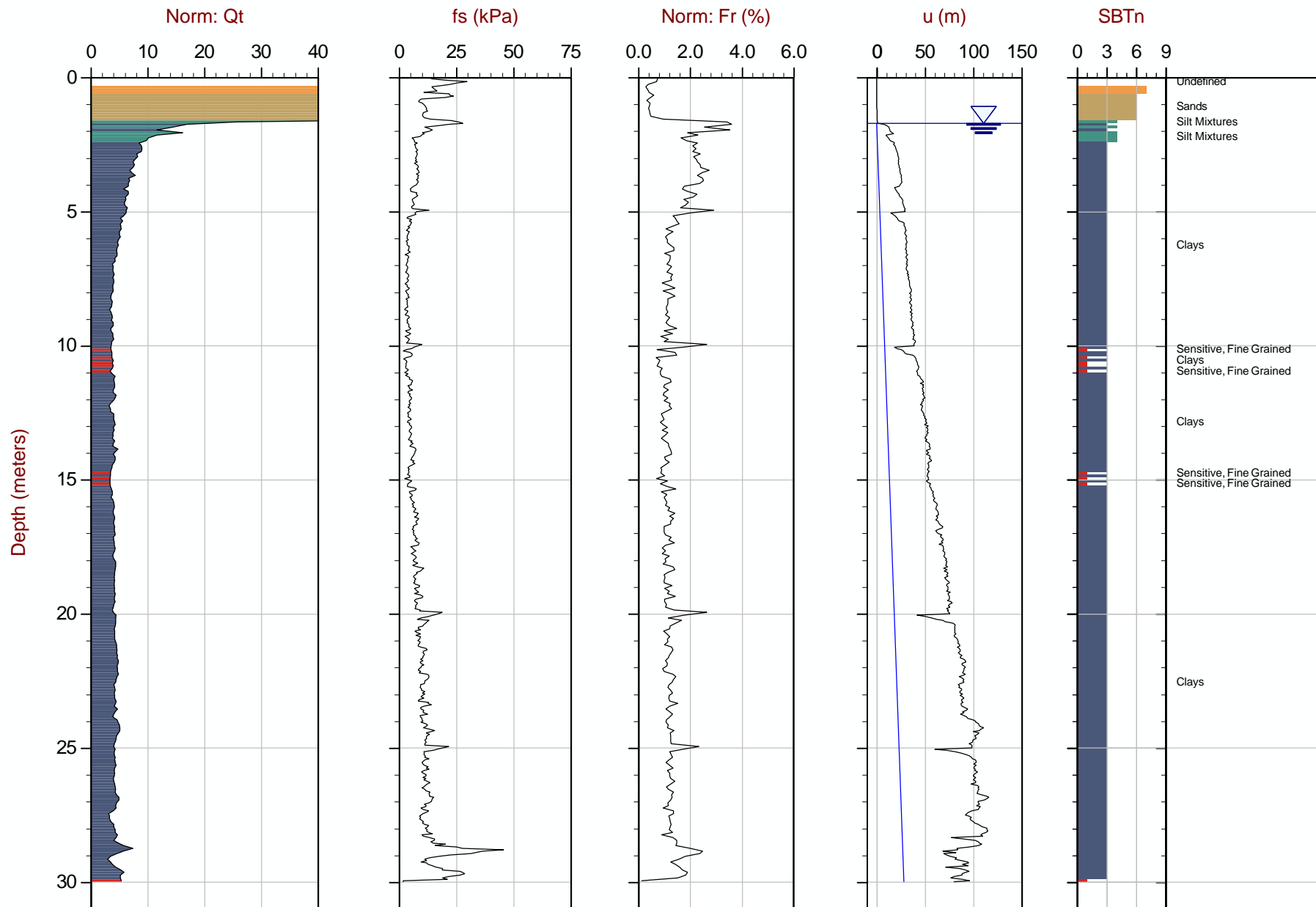
Job No: 13-05020

Date: 10:03:13 07:44

Site: HWY 417 Bear Brook Bridge, Ottawa, ON

Sounding: SCPT13-12

Cone: 374:T1500F15U500



Max Depth: 30.000 m / 98.42 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 13-05020_SP13-12.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 18 N: 5023232 E: 462101
Page No: 1 of 1



Client: Thurber Engineering
Project: Hwy. 417 Bear Brook Bridge, Ottawa, ON
Sounding: SCPT13-02
Date: October 3, 2013

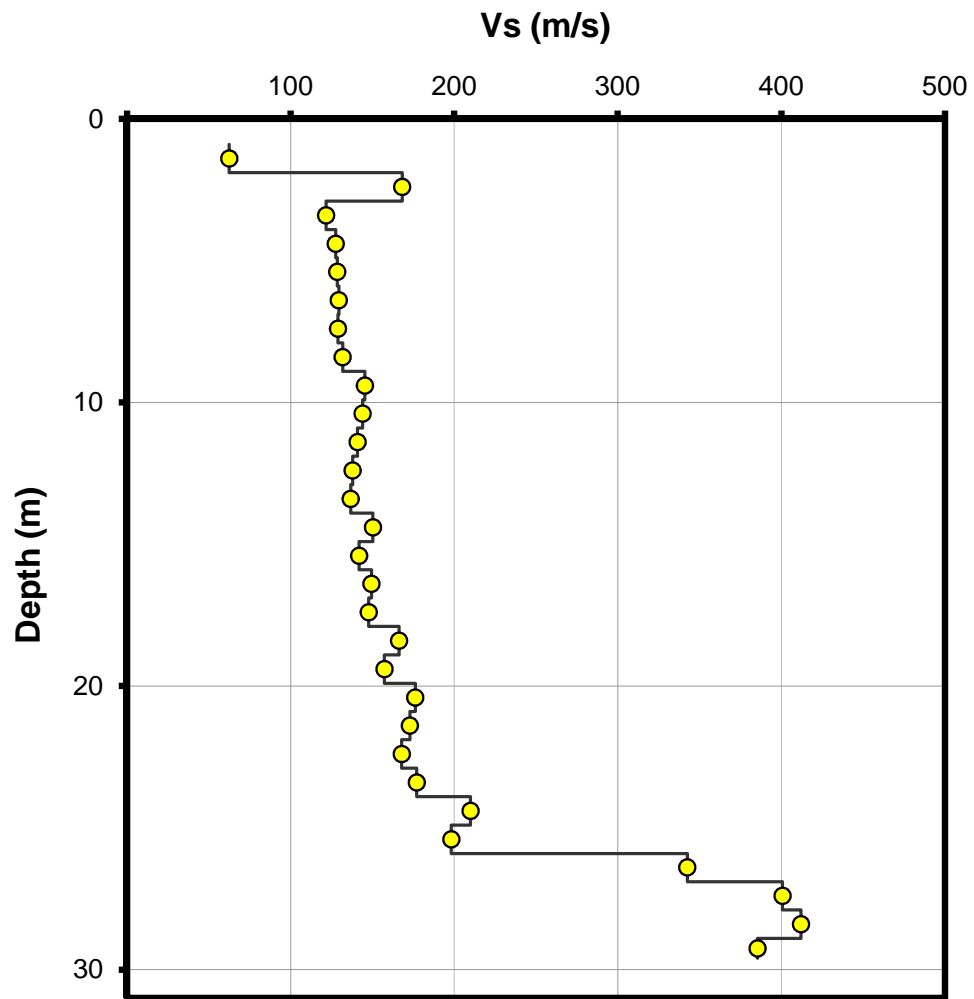
Seismic Source: Beam
Source Offset: 1.90 (m)
Source Depth: 0.00 (m)
Geophone Offset: 0.20 (m)

SEISMIC - Vs

Tip Depth (m)	Geophone Depth (m)	Ray Path (m)	Depth Interval (m)	Time Interval (ms)	Mid-layer Depth (m)	Vs Interval Velocity (m/s)
1.10	0.90	2.10				
2.10	1.90	2.69	0.58	9.37	1.40	62
3.10	2.90	3.47	0.78	4.64	2.40	168
4.10	3.90	4.34	0.87	7.16	3.40	122
5.10	4.90	5.26	0.92	7.19	4.40	128
6.10	5.90	6.20	0.94	7.34	5.40	128
7.10	6.90	7.16	0.96	7.40	6.40	129
8.10	7.90	8.13	0.97	7.51	7.40	129
9.10	8.90	9.10	0.98	7.40	8.40	132
10.10	9.90	10.08	0.98	6.74	9.40	145
11.10	10.90	11.06	0.98	6.84	10.40	144
12.10	11.90	12.05	0.99	7.00	11.40	141
13.10	12.90	13.04	0.99	7.17	12.40	138
14.10	13.90	14.03	0.99	7.25	13.40	137
15.10	14.90	15.02	0.99	6.59	14.40	150
16.10	15.90	16.01	0.99	7.00	15.40	142
17.10	16.90	17.01	0.99	6.64	16.40	149
18.10	17.90	18.00	0.99	6.73	17.40	148
19.10	18.90	19.00	0.99	5.98	18.40	166
20.10	19.90	19.99	1.00	6.32	19.40	158
21.10	20.90	20.99	1.00	5.65	20.40	176
22.10	21.90	21.98	1.00	5.76	21.40	173
23.10	22.90	22.98	1.00	5.93	22.40	168
24.10	23.90	23.98	1.00	5.63	23.40	177
25.10	24.90	24.97	1.00	4.75	24.40	210
26.10	25.90	25.97	1.00	5.03	25.40	198
27.10	26.90	26.97	1.00	2.91	26.40	342
28.10	27.90	27.96	1.00	2.49	27.40	401
29.10	28.90	28.96	1.00	2.42	28.40	412
29.80	29.60	29.66	0.70	1.81	29.25	385



Client: Thurber Engineering
Location: Hwy. 417 Bear Brook Bridge, Ottawa, ON
CPT Sounding: SCPT13-02
Date: October 3, 2013





Client: Thurber Engineering
Project: Hwy. 417 Bear Brook Bridge, Ottawa, ON
Sounding: SCPT13-12
Date: October 3, 2013

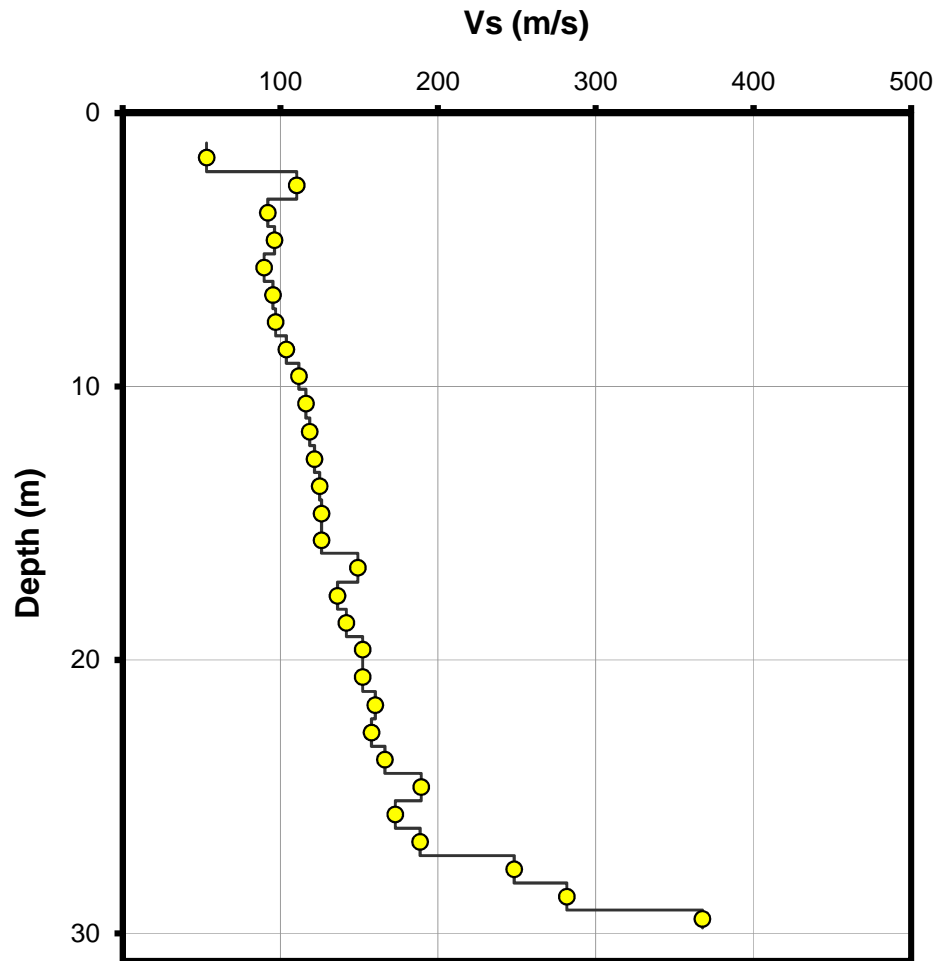
Seismic Source: Beam
Source Offset: 1.80 (m)
Source Depth: 0.00 (m)
Geophone Offset: 0.20 (m)

SEISMIC - Vs

Tip Depth (m)	Geophone Depth (m)	Ray Path (m)	Depth Interval (m)	Time Interval (ms)	Mid-layer Depth (m)	Vs Interval Velocity (m/s)
1.30	1.10	2.11				
2.35	2.15	2.80	0.69	13.05	1.62	53
3.35	3.15	3.63	0.82	7.46	2.65	110
4.35	4.15	4.52	0.90	9.73	3.65	92
5.35	5.15	5.46	0.93	9.68	4.65	96
6.35	6.15	6.41	0.95	10.62	5.65	90
7.35	7.15	7.37	0.97	10.13	6.65	95
8.35	8.15	8.35	0.97	10.04	7.65	97
9.35	9.15	9.33	0.98	9.43	8.65	104
10.30	10.10	10.26	0.93	8.35	9.63	112
11.35	11.15	11.29	1.04	8.91	10.63	116
12.35	12.15	12.28	0.99	8.33	11.65	119
13.35	13.15	13.27	0.99	8.13	12.65	122
14.35	14.15	14.26	0.99	7.93	13.65	125
15.35	15.15	15.26	0.99	7.87	14.65	126
16.30	16.10	16.20	0.94	7.49	15.63	126
17.35	17.15	17.24	1.04	6.99	16.63	149
18.35	18.15	18.24	0.99	7.30	17.65	136
19.35	19.15	19.23	1.00	7.02	18.65	142
20.30	20.10	20.18	0.95	6.22	19.63	152
21.35	21.15	21.23	1.05	6.87	20.63	152
22.35	22.15	22.22	1.00	6.22	21.65	160
23.35	23.15	23.22	1.00	6.31	22.65	158
24.35	24.15	24.22	1.00	5.99	23.65	166
25.35	25.15	25.21	1.00	5.27	24.65	189
26.35	26.15	26.21	1.00	5.77	25.65	173
27.35	27.15	27.21	1.00	5.29	26.65	189
28.35	28.15	28.21	1.00	4.02	27.65	248
29.35	29.15	29.21	1.00	3.54	28.65	282
30.00	29.80	29.85	0.65	1.76	29.48	368



Client: Thurber Engineering
Location: Hwy. 417 Bear Brook Bridge, Ottawa, ON
CPT Sounding: SCPT13-12
Date: October 3, 2013





Thurber Engineering

Job No: 13-05020

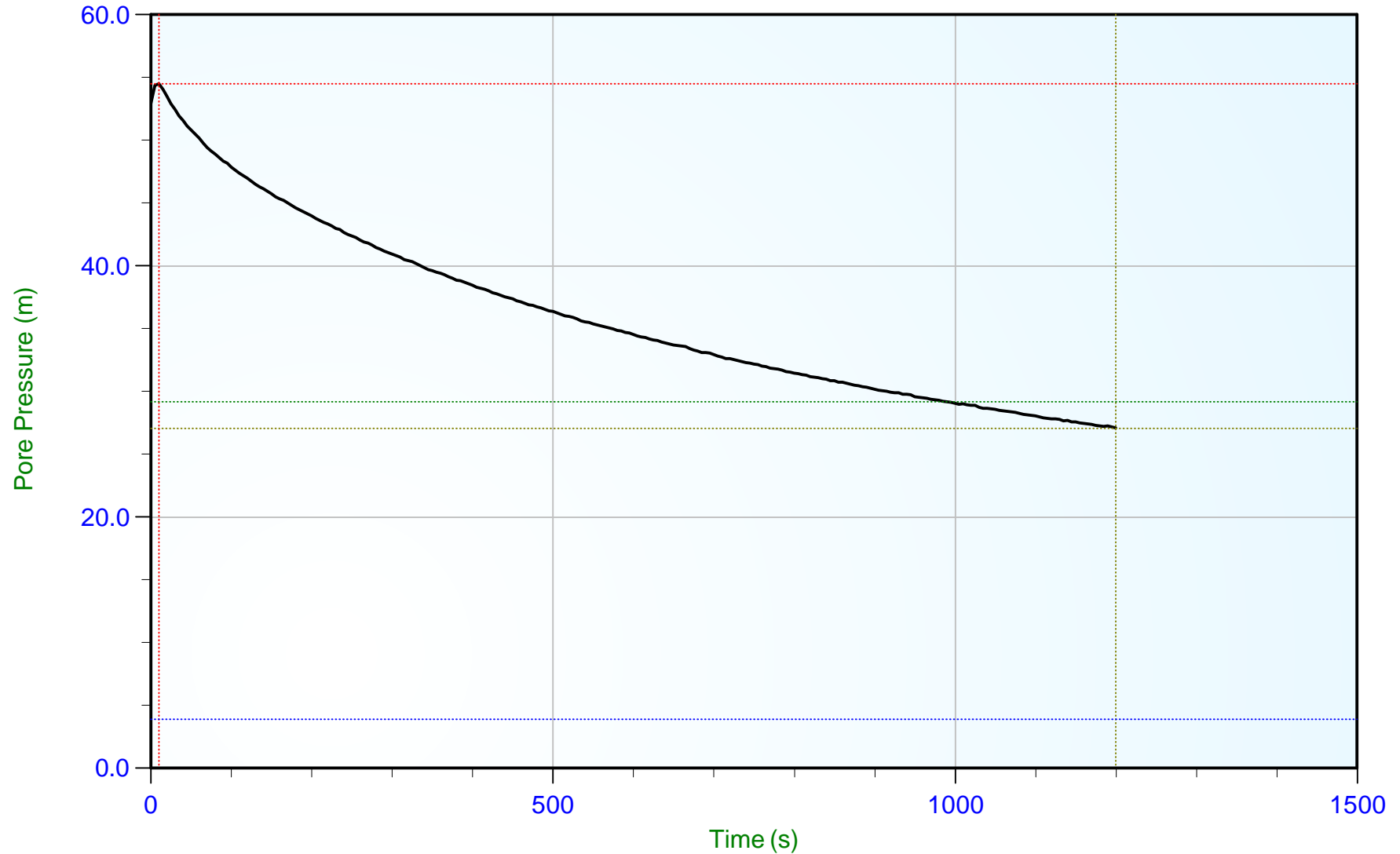
Date: 03-Oct-2013 12:52:58

Site: HWY 417 BEAR BROOK BRIDGE, OTTAWA, ON

Sounding: SCPT13-02

Cone: AD374

Area: 15 sq cm



Trace Summary:

Filename: 13-05020_SP13-02.PPT
Depth: 5.000 m / 16.404 ft
Duration: 1200.0 s
PDM Min: 27.1 m
U Max: 54.5 m

WT: 1.100 m / 3.609 ft
Ueq: 3.9 m
U(50): 29.21 m

T(50): 976.9 s
Ir: 100
Ch: 0.7 sq cm/min



Thurber Engineering

Job No: 13-05020

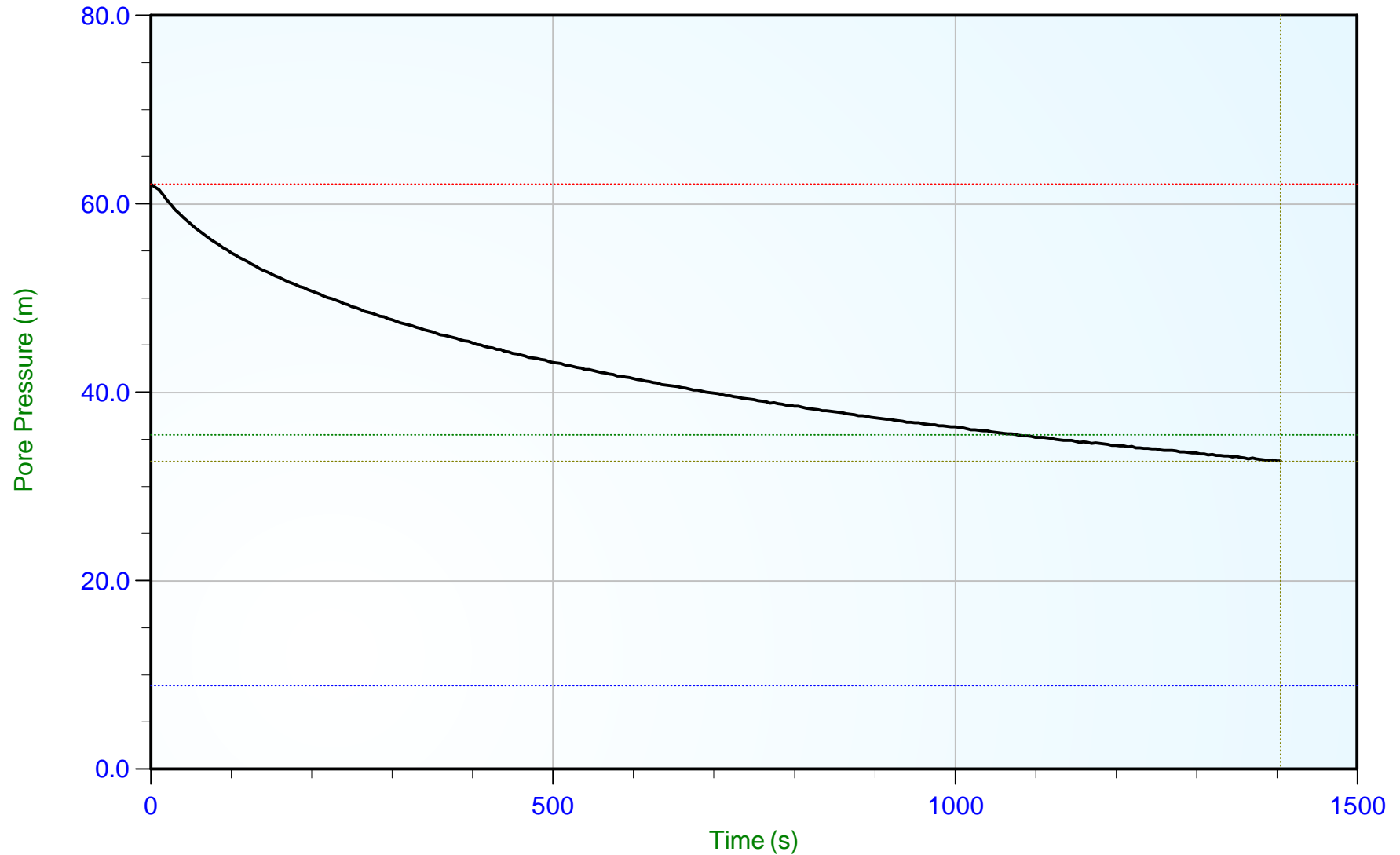
Date: 03-Oct-2013 12:52:58

Site: HWY 417 BEAR BROOK BRIDGE, OTTAWA, ON

Sounding: SCPT13-02

Cone: AD374

Area: 15 sq cm



Trace Summary:

Filename: 13-05020_SP13-02.PRD
Depth: 10.000 m / 32.808 ft
Duration: 1405.0 s
U Min: 32.7 m
U Max: 62.1 m

WT: 1.100 m / 3.609 ft
Ueq: 8.9 m
U(50): 35.51 m

T(50): 1077.3 s
Ir: 100
Ch: 0.7 sq cm/min



Thurber Engineering

Job No: 13-05020

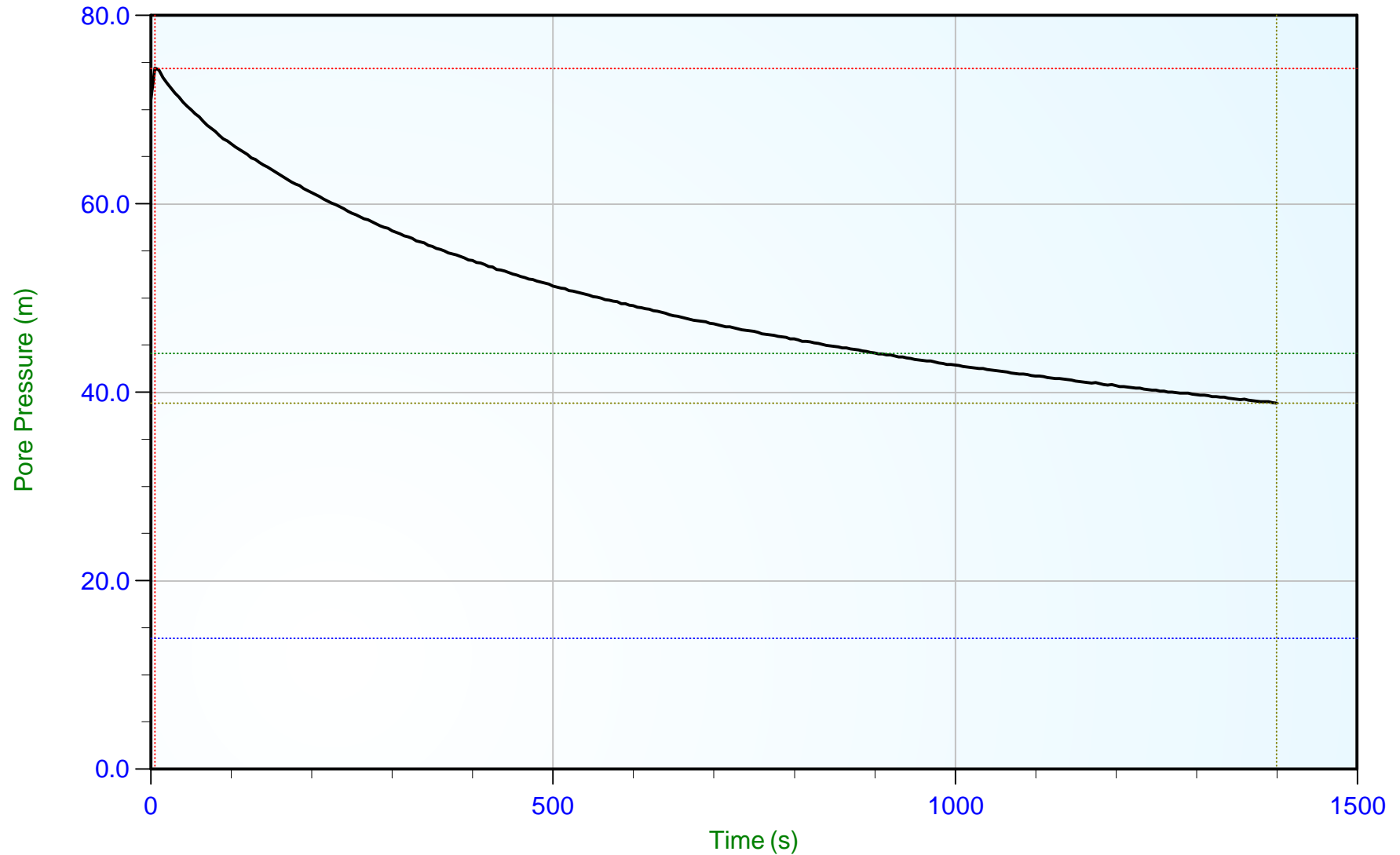
Date: 03-Oct-2013 12:52:58

Site: HWY 417 BEAR BROOK BRIDGE, OTTAWA, ON

Sounding: SCPT13-02

Cone: AD374

Area: 15 sq cm



Trace Summary:

Filename: 13-05020_SP13-02.PRD
Depth: 15.000 m / 49.212 ft
Duration: 1400.0 s
PDMin: 38.9 m
U Max: 74.4 m

WT: 1.100 m / 3.609 ft
Ueq: 13.9 m
U(50): 44.16 m

T(50): 895.9 s
Ir: 100
Ch: 0.8 sq cm/min



Thurber Engineering

Job No: 13-05020

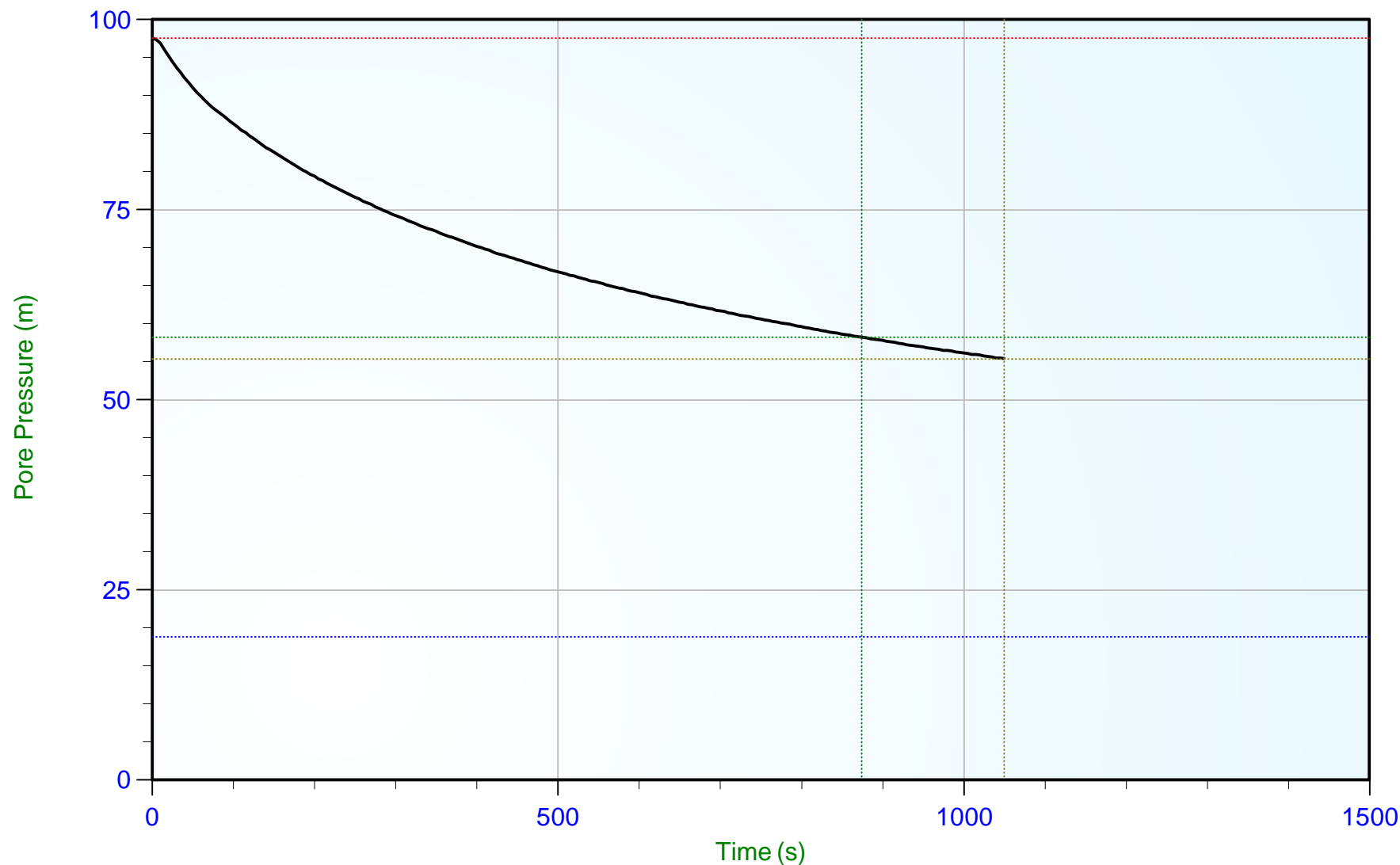
Date: 03-Oct-2013 12:52:58

Site: HWY 417 BEAR BROOK BRIDGE, OTTAWA, ON

Sounding: SCPT13-02

Cone: AD374

Area: 15 sq cm



Trace Summary:

Filename: 13-05020_SP13-02.PPT

Depth: 20.000 m / 65.616 ft

Duration: 1050.0 s

U Max: 97.6 m

WT: 1.100 m / 3.609 ft

Ueq: 18.9 m

U(50): 58.24 m

T(50): 874.4 s

Ir: 100

Ch: 0.8 sq cm/min



Thurber Engineering

Job No: 13-05020

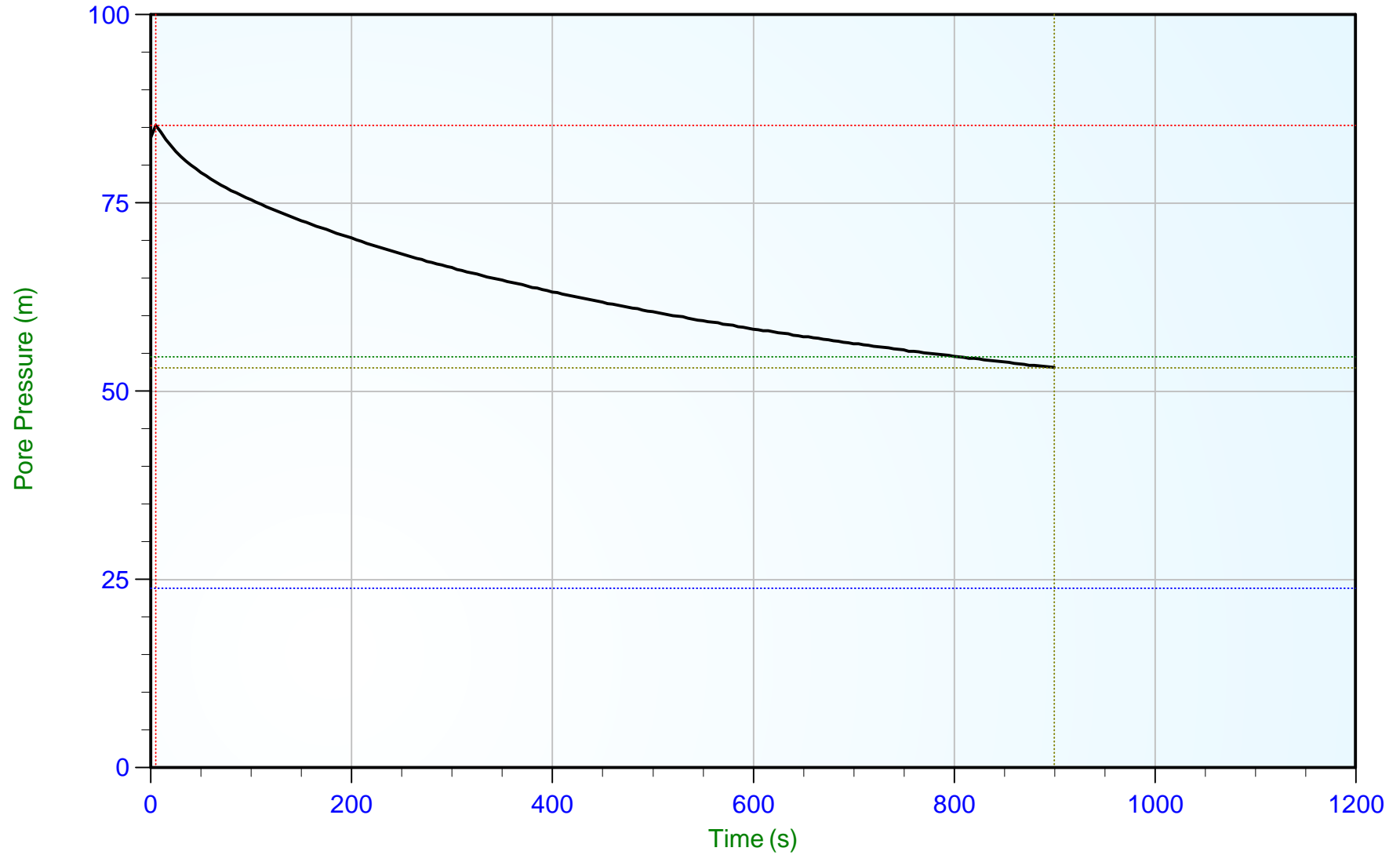
Date: 03-Oct-2013 12:52:58

Site: HWY 417 BEAR BROOK BRIDGE, OTTAWA, ON

Sounding: SCPT13-02

Cone: AD374

Area: 15 sq cm



Trace Summary: Filename: 13-05020_SP13-02.PPTD Min: 53.1 m WT: 1.100 m / 3.609 ft T(50): 797.8 s
Depth: 25.000 m / 82.020 ft U Max: 85.3 m Ueq: 23.9 m Ir: 100
Duration: 900.0 s U(50): 54.61 m Ch: 0.9 sq cm/min



Thurber Engineering

Job No: 13-05020

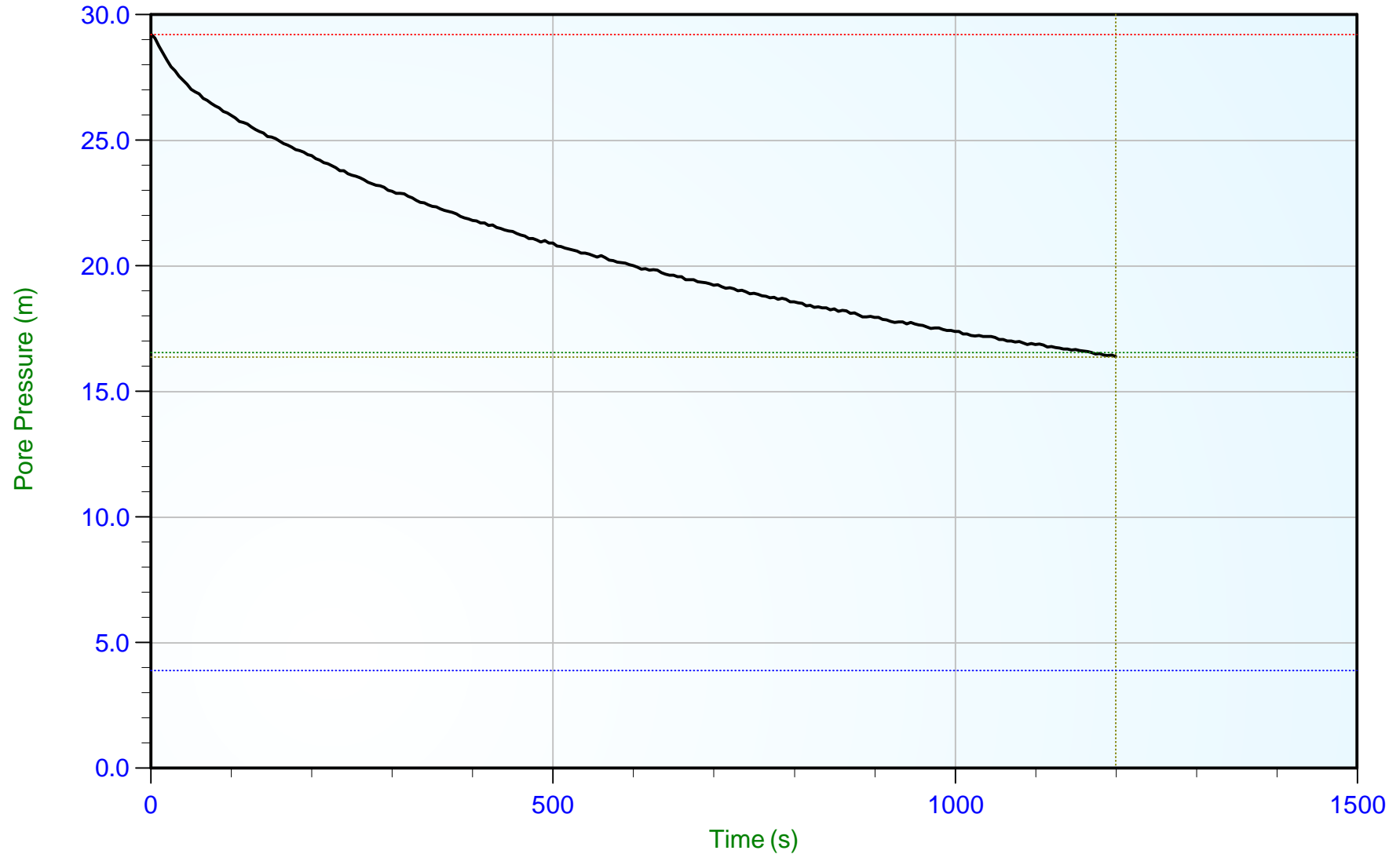
Date: 03-Oct-2013 07:44:50

Site: HWY 417 BEAR BROOK BRIDGE, OTTAWA, ON

Sounding: SCPT13-12

Cone: AD374

Area: 15 sq cm



Trace Summary: Filename: 13-05020_SP13-12.PRD Min: 16.4 m WT: 1.100 m / 3.609 ft T(50): 1169.0 s
Depth: 5.000 m / 16.404 ft U Max: 29.2 m Ueq: 3.9 m Ir: 100
Duration: 1200.0 s U(50): 16.56 m Ch: 0.6 sq cm/min



Thurber Engineering

Job No: 13-05020

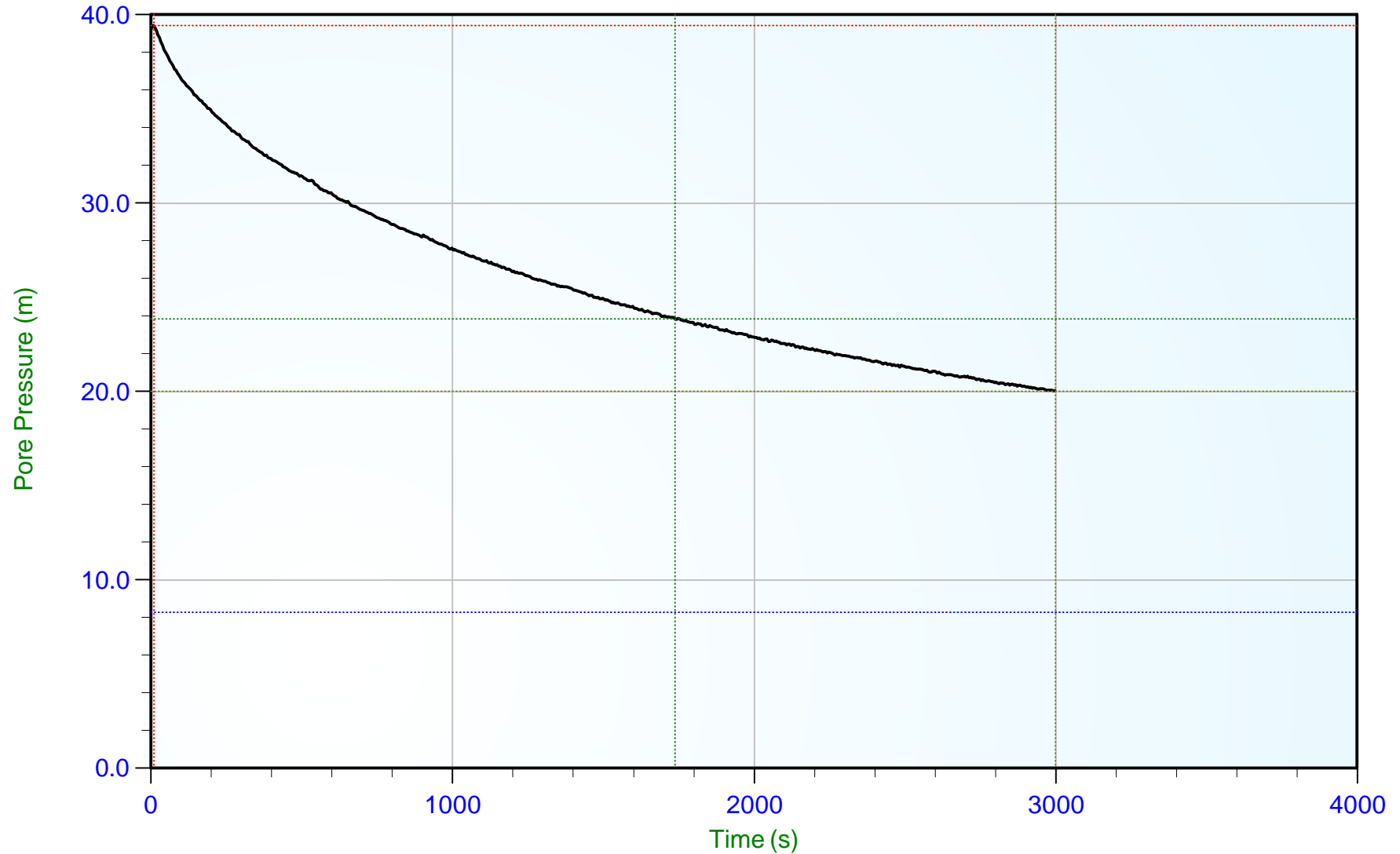
Date: 03-Oct-2013 07:44:50

Site: HWY 417 BEAR BROOK BRIDGE, OTTAWA, ON

Sounding: SCPT13-12

Cone: AD374

Area: 15 sq cm



Trace Summary: Filename: 13-05020_SP13-12.PPTD Min: 20.0 m WT: 1.700 m / 5.577 ft T(50): 1728.8 s
Depth: 10.000 m / 32.808 ft U Max: 39.4 m Ueq: 8.3 m Ir: 100
Duration: 3000.0 s U(50): 23.87 m Ch: 0.4 sq cm/min



Thurber Engineering

Job No: 13-05020

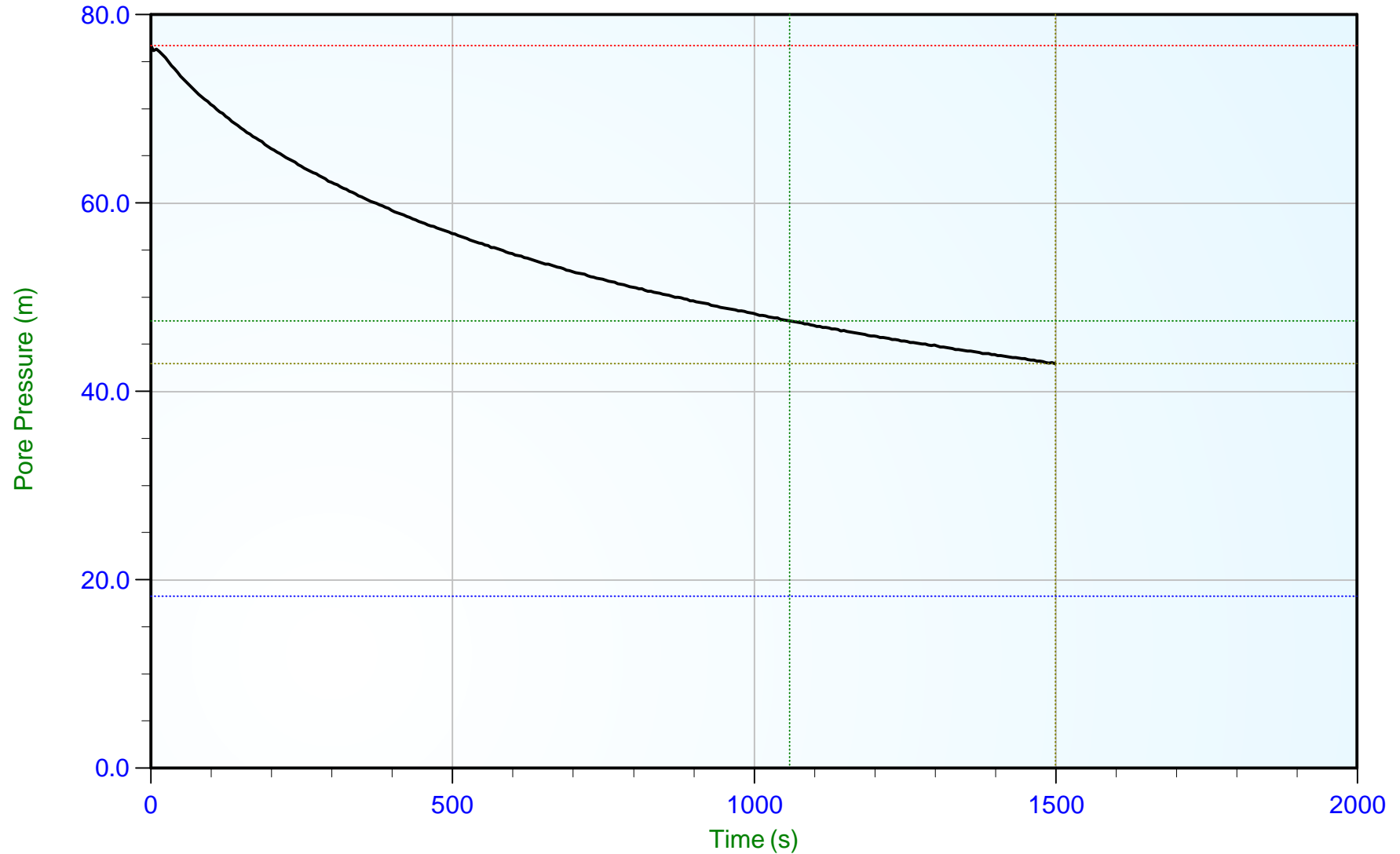
Date: 03-Oct-2013 07:44:50

Site: HWY 417 BEAR BROOK BRIDGE, OTTAWA, ON

Sounding: SCPT13-12

Cone: AD374

Area: 15 sq cm



Trace Summary: Filename: 13-05020_SP13-12.PPTD Min: 43.0 m WT: 1.700 m / 5.577 ft T(50): 1058.8 s
Depth: 20.000 m / 65.616 ft U Max: 76.7 m Ueq: 18.3 m Ir: 100
Duration: 1500.0 s U(50): 47.52 m Ch: 0.7 sq cm/min



Thurber Engineering

Job No: 13-05020

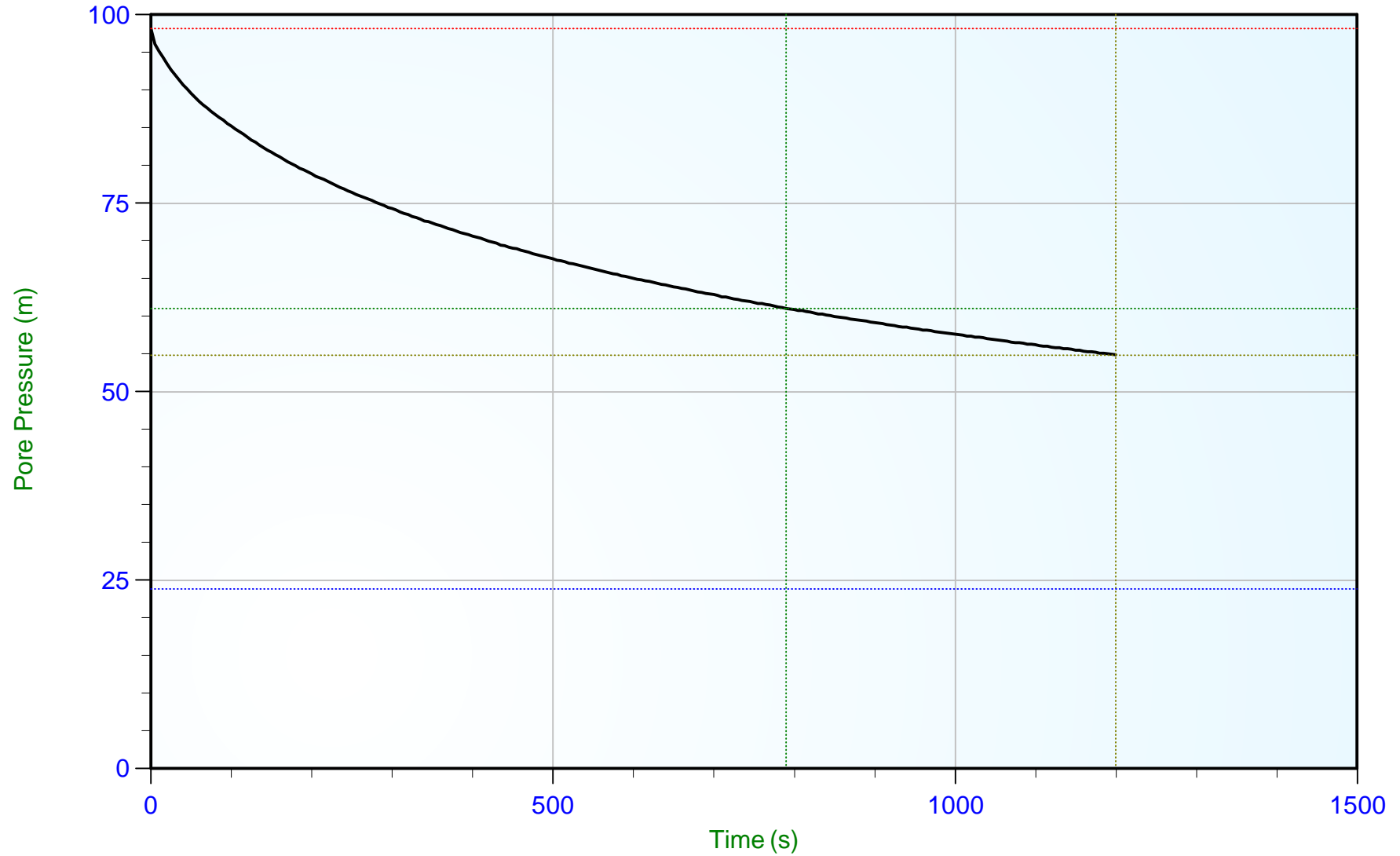
Date: 03-Oct-2013 07:44:50

Site: HWY 417 BEAR BROOK BRIDGE, OTTAWA, ON

Sounding: SCPT13-12

Cone: AD374

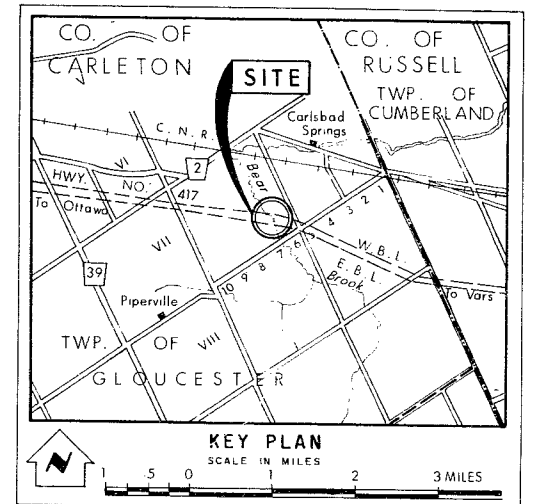
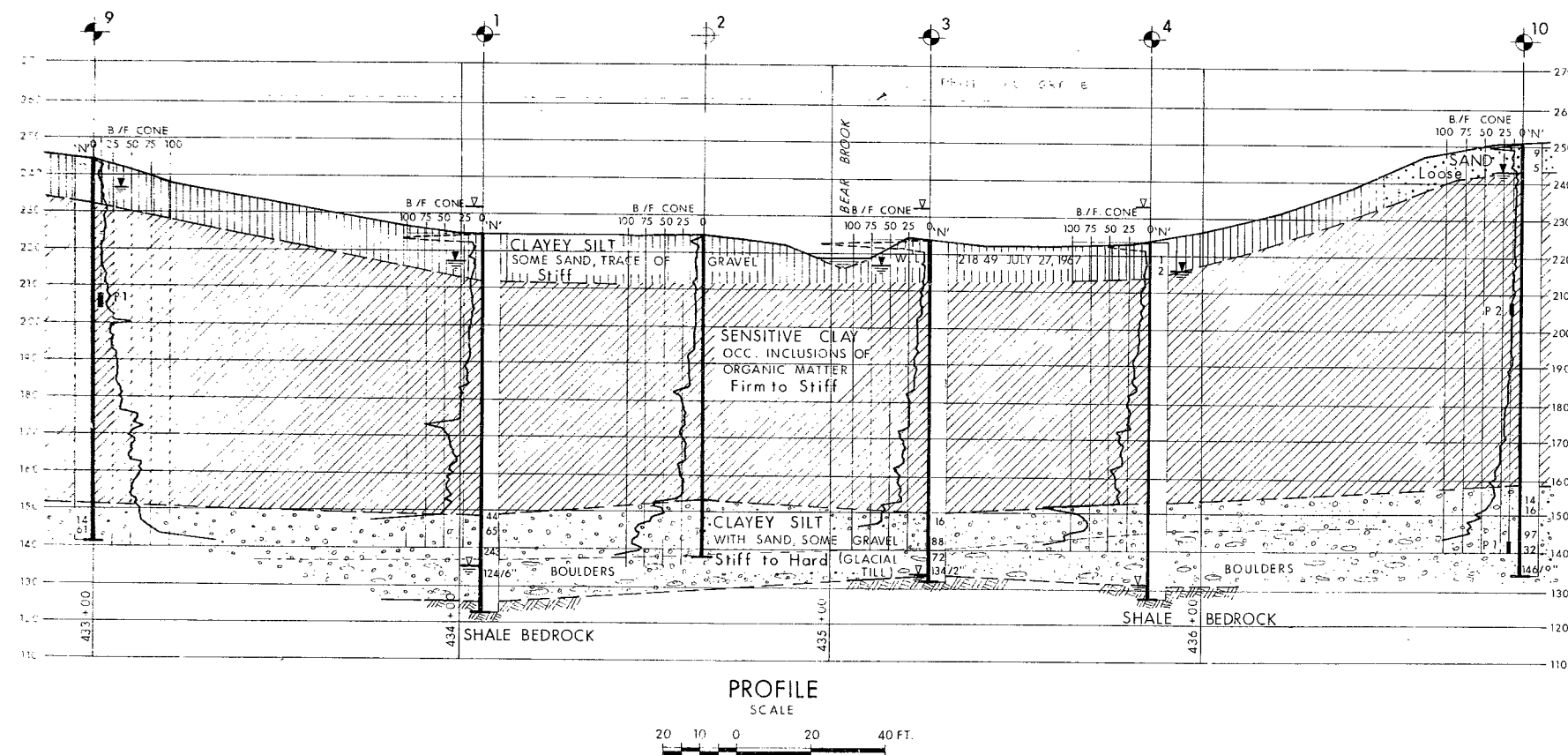
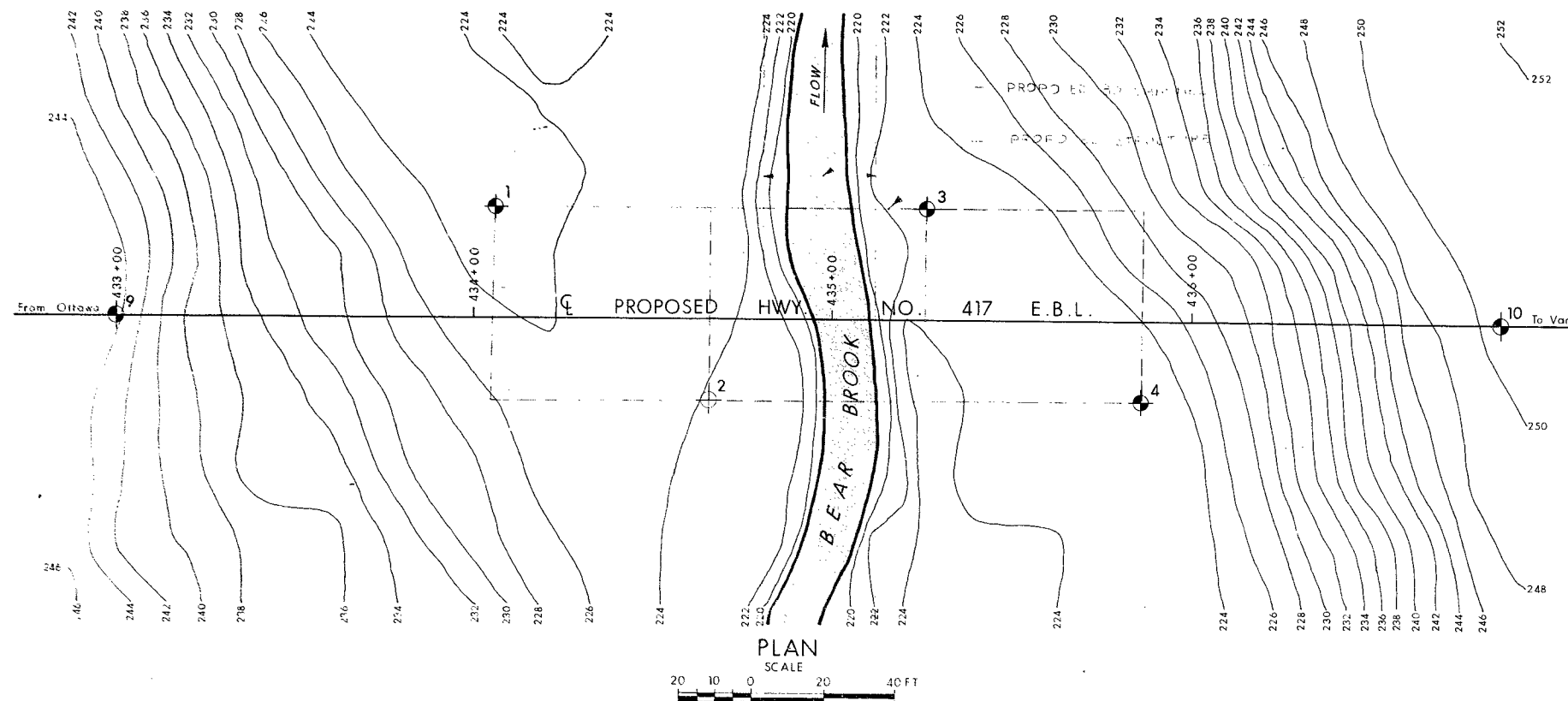
Area: 15 sq cm



Trace Summary: Filename: 13-05020_SP13-12.PRD Min: 54.9 m WT: 1.100 m / 3.609 ft T(50): 790.1 s
Depth: 25.000 m / 82.020 ft U Max: 98.2 m Ueq: 23.9 m Ir: 100
Duration: 1200.0 s U(50): 61.05 m Ch: 0.9 sq cm/min

Appendix E
Historical Geotechnical Data

19-4406-6



LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation		
	Piezometer		Head
			Arterial Water
			Encountered
NO.	ELEVATION	STATION	OFFSET
1	223.5	434+06	31' LT
2	223.1	434+66	23' RT
3	223.9	435+26	31' LT
4	223.1	435+86	23' RT
9	244.0	433+00	CL
10	250.5	436+80	CL

NOTE
The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION - FOUNDATION SECTION

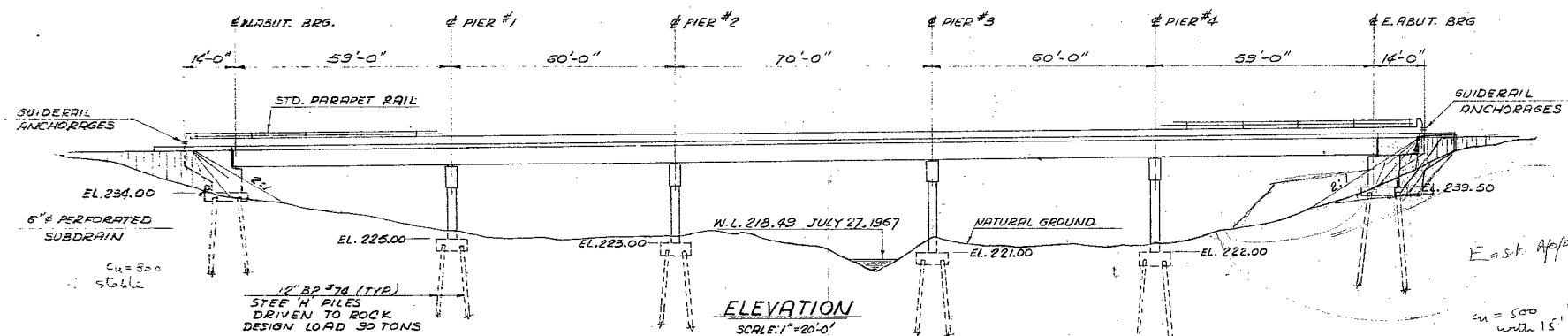
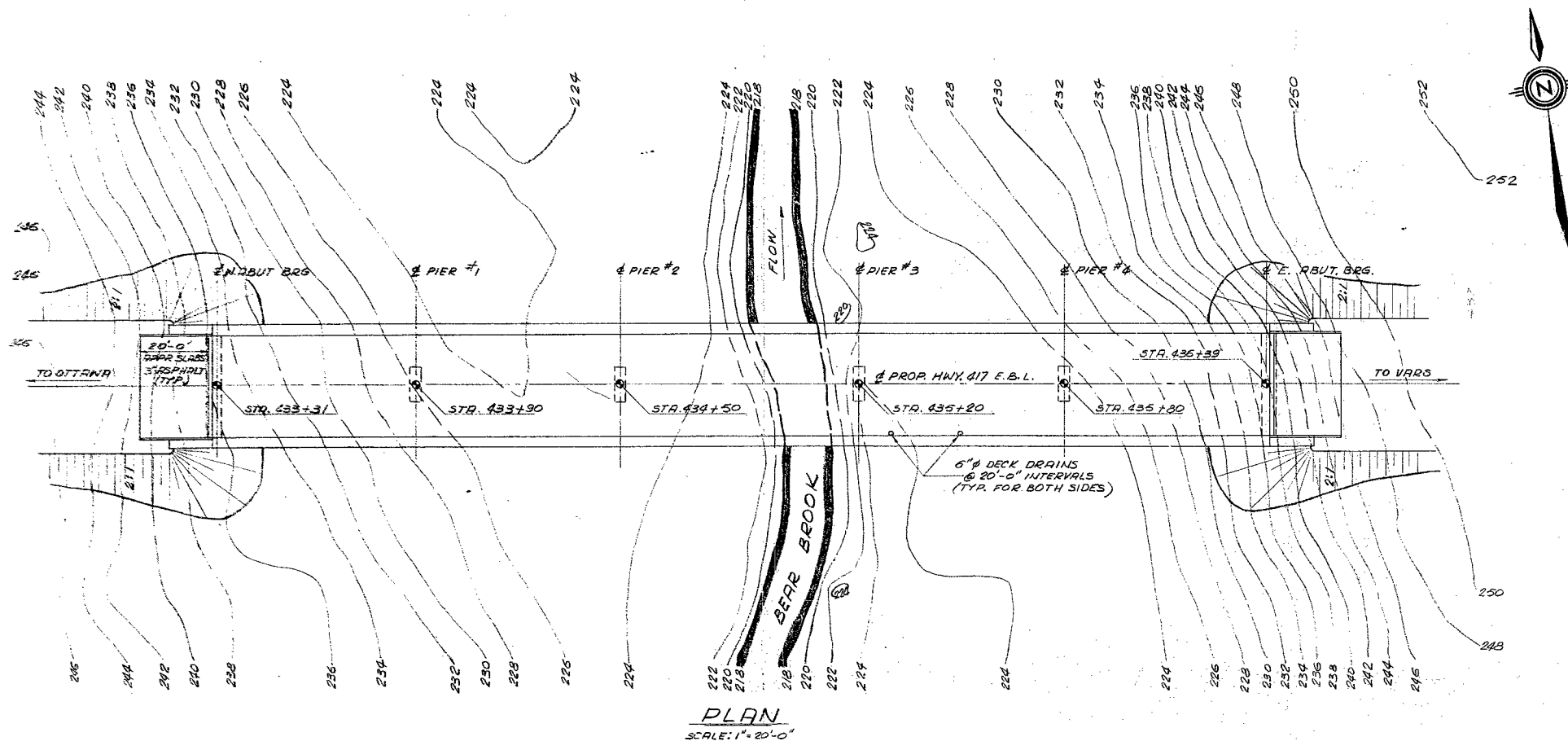
BEAR BROOK

KING'S HIGHWAY NO. 417 E.B.L. DIST. NO. 9
CO. CARLETON
TWP. GLOUCESTER LOT 6 CON. VII

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D B.D. CHECKED <i>[initials]</i>	W.P. NO. 34 - 66-05	W.B.T. DRAWING NO.
DRAWN G.P. CHECKED <i>[initials]</i>	JOB NO. 67 - F-111	67-F-111A
DATE FEB. 19 1968	SITE NO.	BRIDGE DRAWING NO.
APPROVED <i>[signature]</i>	CONT NO.	

REF. NO. E-4642-1

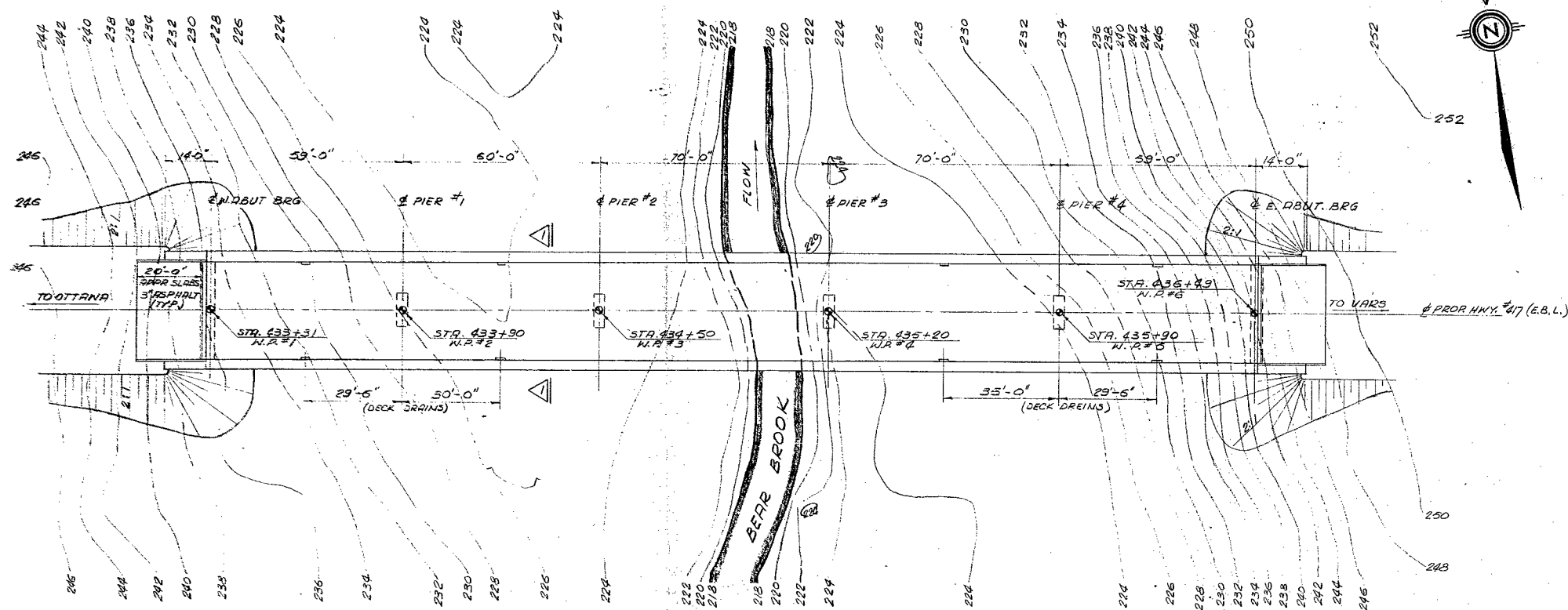


East App.
cu = 500 unstable, even
with 15' berm.
Suggest moving abutment
to east by 10'.
this has been
done as
per survey D-6467-P1 Nov 1968
see 11/68

INT RECORD
FOR DATE

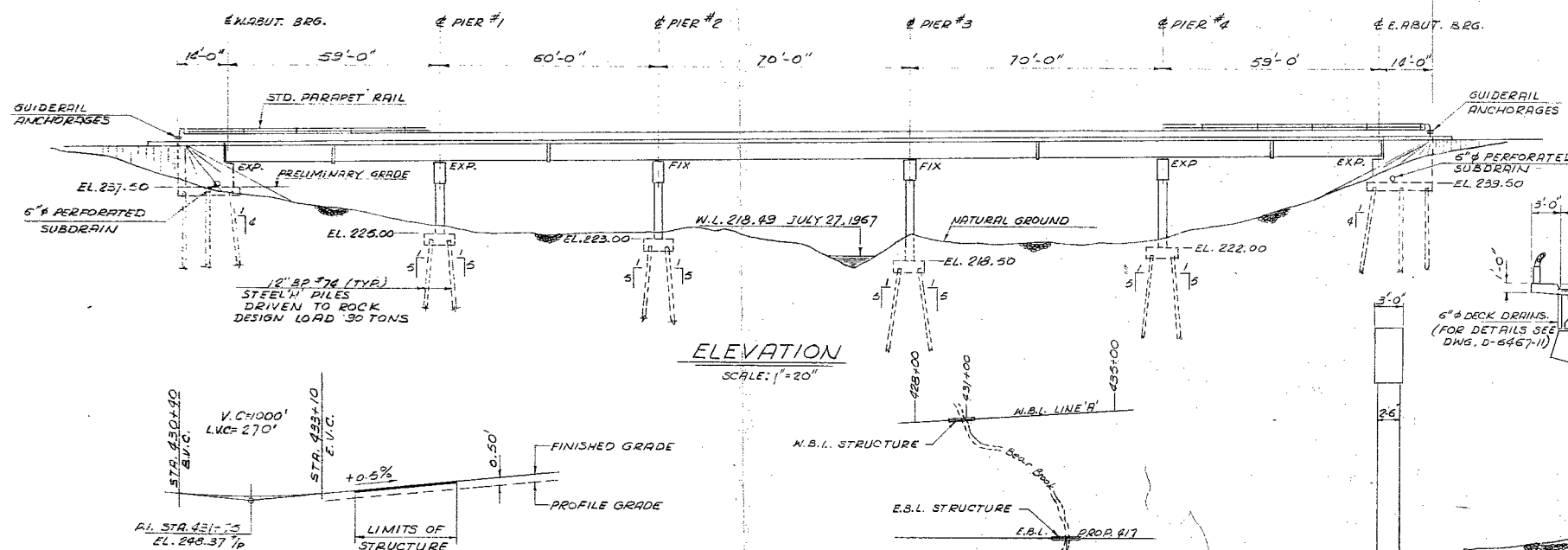
REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO BRIDGE DIVISION			
67-F-111			
BEAR BROOK BRIDGE (E.B.L. STRUCTURE)			
KING'S HIGHWAY No. 417		DIST. No. 9	
CO. CARLETON		TWP. GLOUCESTER	
LOT 5		CON. VII	
PRELIMINARY			
APPROVED		SITE No. 3-266	
BRIDGE ENGINEER		W.P. No. 34-66-05	
DESIGN	CHECK	CONTRACT	No.
DRAWING	CHECK	DRAWING	No.
DATE	LOADING	DATE	LOADING
OCT. 1968	AS 20-44	OCT. 1968	AS 20-44
D-6467-EPI		D-6467-EPI	

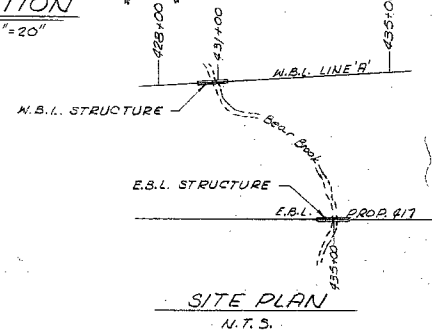


PLAN
SCALE: 1"=20'-0"

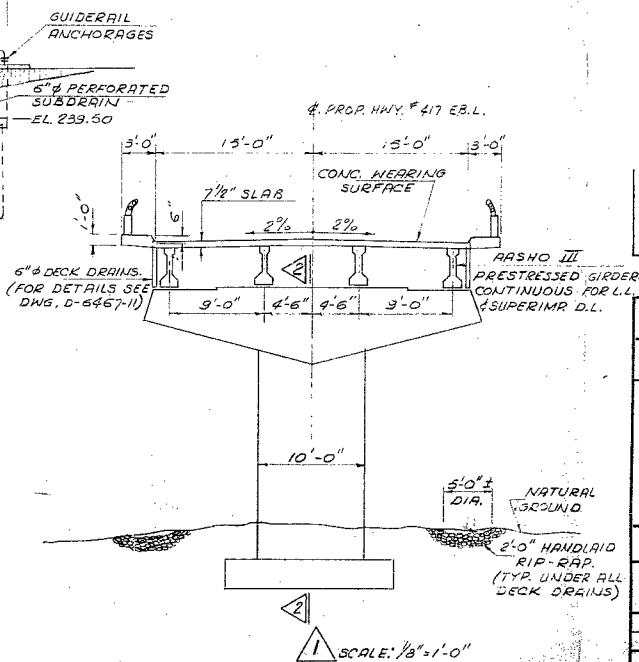
B.M. 245.34
GEOLOGIC DATUM
N. 44° E. IN W. ROOT OF 1' ELM
114' RT. OF 433+24 (E.B.L.)



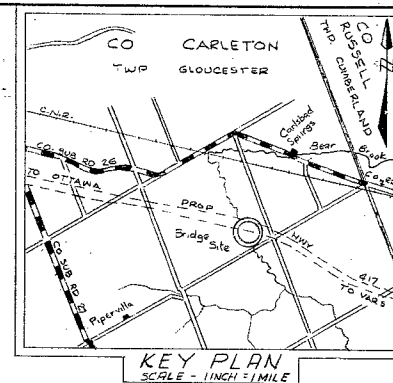
ELEVATION
SCALE: 1"=20'-0"



SITE PLAN
N.T.S.



SCALE: 1/8"=1'-0"



NOTES:

1. CLASS OF CONCRETE:

PRECAST MEMBERS - 5000 P.S.I.
DECK, CURBS & PARAPET WALLS - 4000 P.S.I.
REMAINDER - 3000 P.S.I.

2. CLEAR COVER ON REINFOR. STEEL:

FTS. ABUTTS & PIERS	CURBS	PARAPET WALLS	DECK
3"	2"	1 1/2"	TOP - 1 1/2" BOT. - 1"

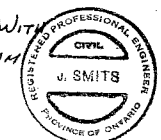
3. CONSTRUCTION NOTES:

THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF $\pm 1/8"$.
NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED.

LIST OF DRAWINGS

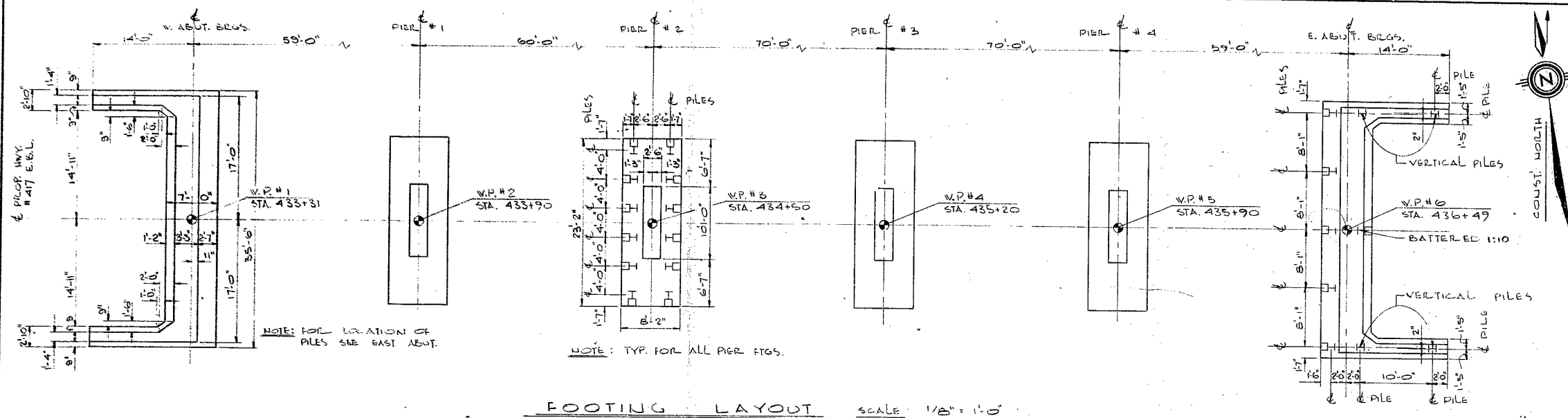
1. GENERAL PLAN
2. BOREHOLE LOCATIONS & SOIL STRATA
3. FOOTING LAYOUT & REINFORCEMENT
4. ABUTMENTS & WINGWALLS
5. PIERS
6. PRESTRESSED GIRDERS & BEARINGS
7. DECK DETAILS & ELEVATIONS
8. PARAPET WALL DETAILS
9. STD. STEEL PARAPET RAIL
10. APPROACH SLABS
11. STANDARD DETAILS

PROTECT PILE CAP PIER 3 WITH
RIP RAP COVER ON STREAM
BANK



REVISIONS	DATE	BY	DESCRIPTION

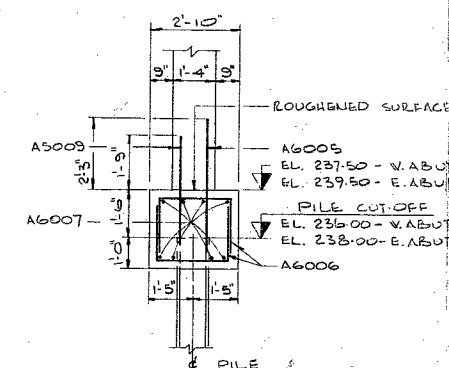
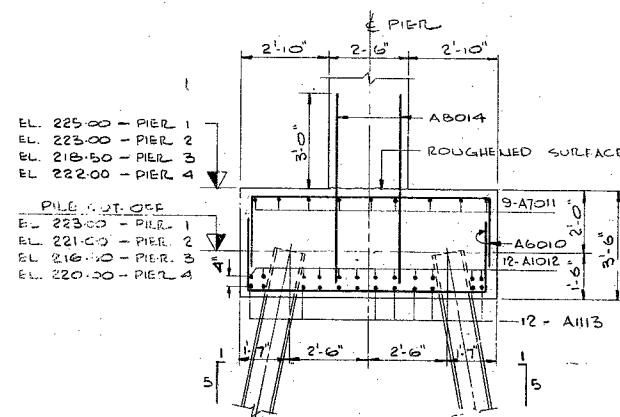
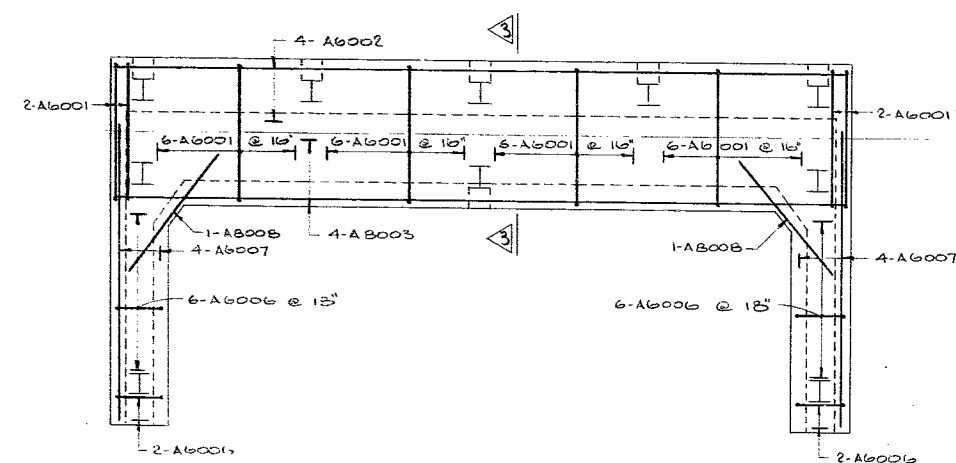
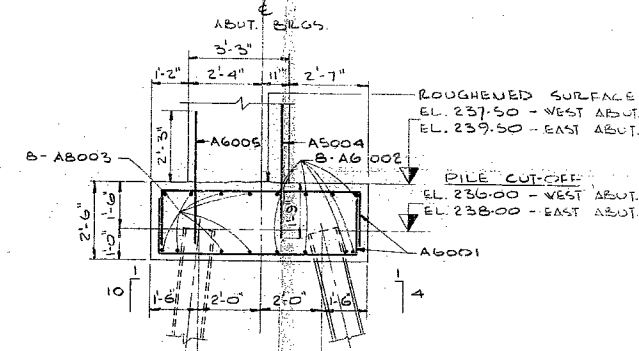
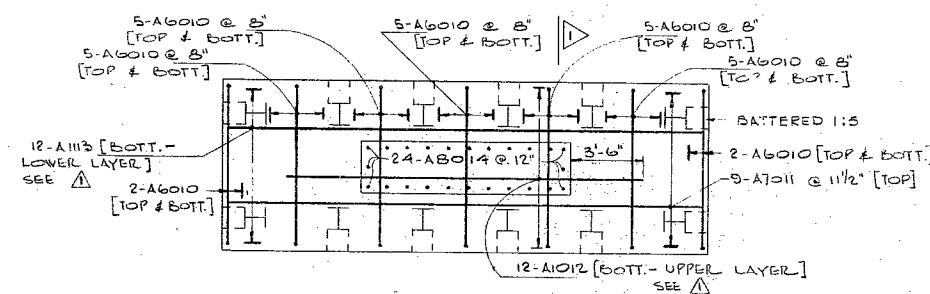
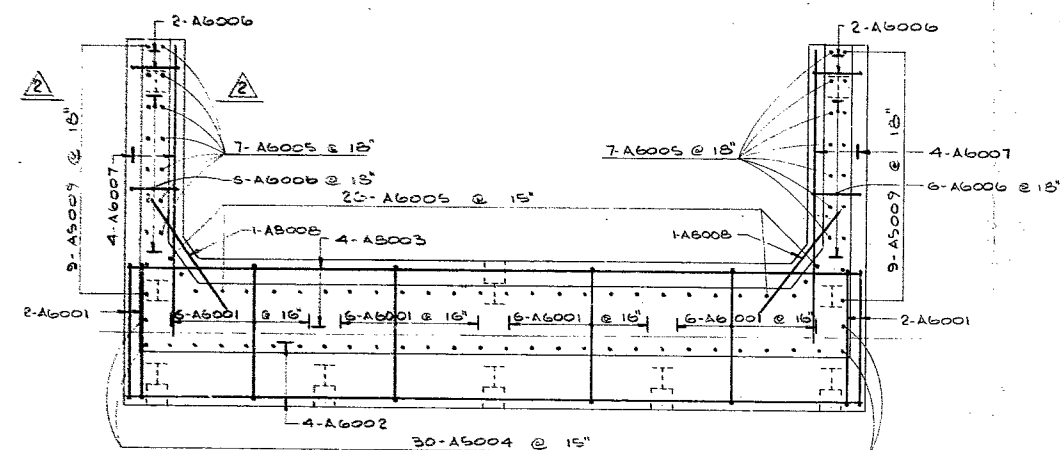
DEPARTMENT OF HIGHWAYS ONTARIO BRIDGE DIVISION			
67-F-111			
BEAR BROOK BRIDGE (E.B.L. STRUCTURE)			
KING'S HIGHWAY No. 417 (E.B.L.)		DIST. No. 9	
CO. CARLETON		LOT 5 CON. VII	
TWP. GLOUCESTER			
GENERAL PLAN			
APPROVED		SITE No. 3-255 W.P. No. 33-66-05	
DESIGN J.S.	CHECK S.B.D.	CONTRACT No.	
DRAWING B.S.	CHECK S.B.D.	DRAWING No.	D-6467-1
DATE NOV. 1968	LOADING 1520-44		



STEEL H-PILE DATA		
LOCATION	NO.	LENGTH
WEST ABUT.	10	114'-0"
PIER 1	12	100'-0"
PIER 2	12	97'-0"
PIER 3	12	88'-0"
PIER 4	12	92'-0"
EAST ABUT.	10	111'-0"

DESIGN LOAD - 90 TONS PER PILE

NOTE:
ALL PILES TO BE DRIVEN TO
PRACTICAL REFUSAL.

[illegible]DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

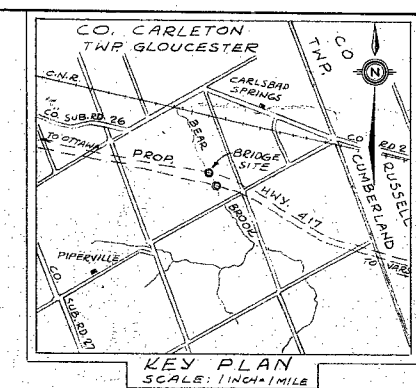
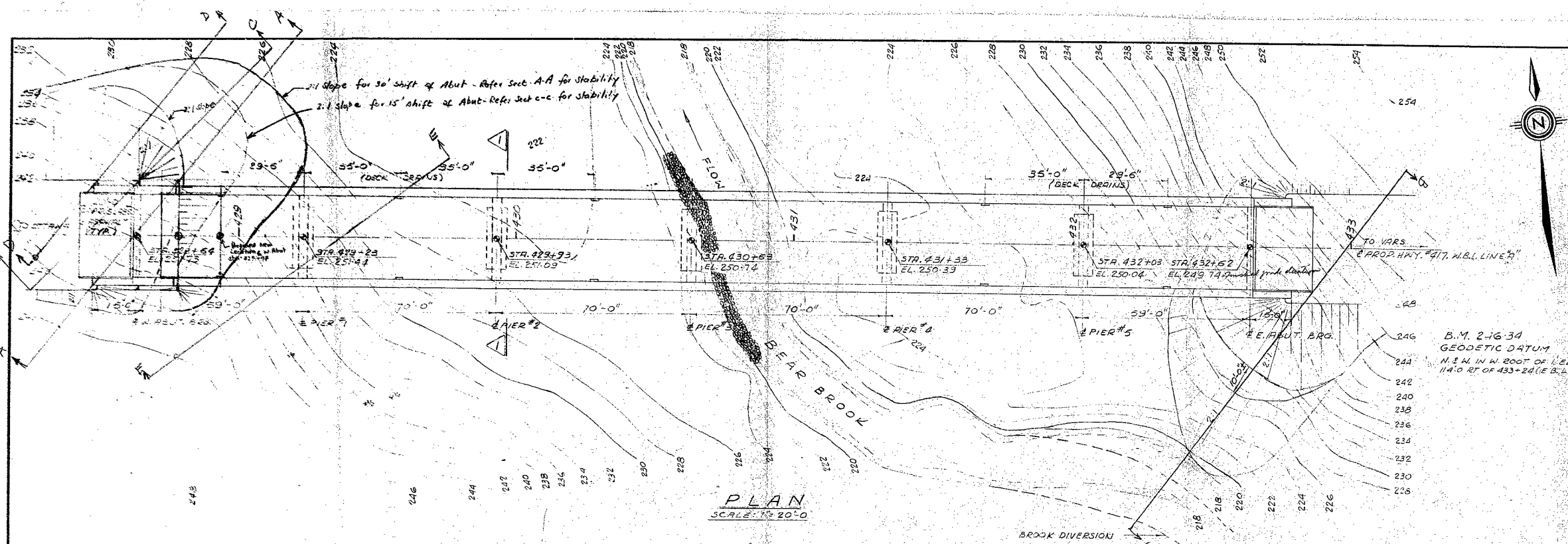
BEAR BLOOD BRIDGE

E.B.L. STRUCTURE

KING'S HIGHWAY No. 417 E.B.L. DIST. No. 9
CO. CARLETON
TWP. COLOUCESTER LOT 6 CON. VII

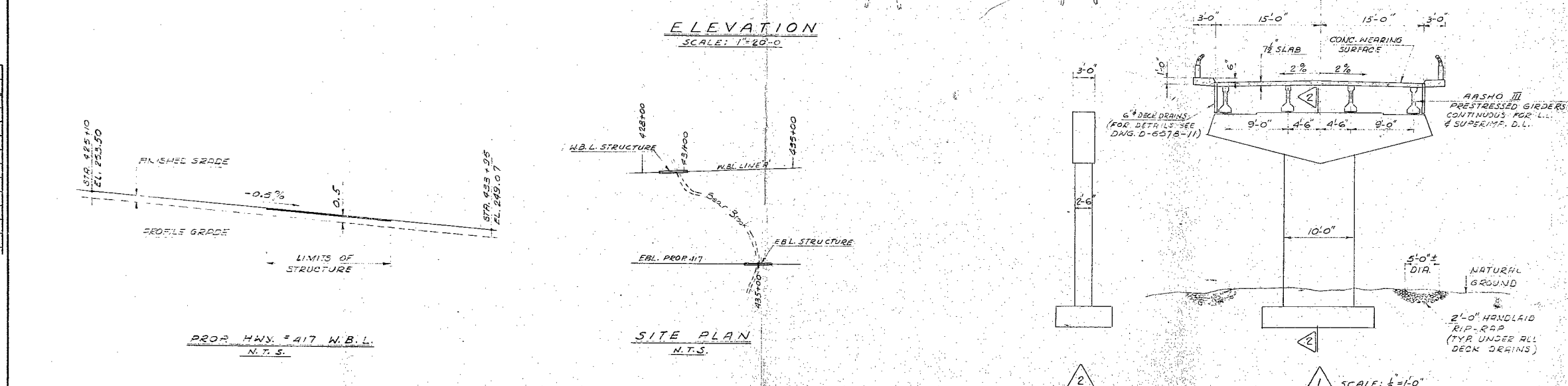
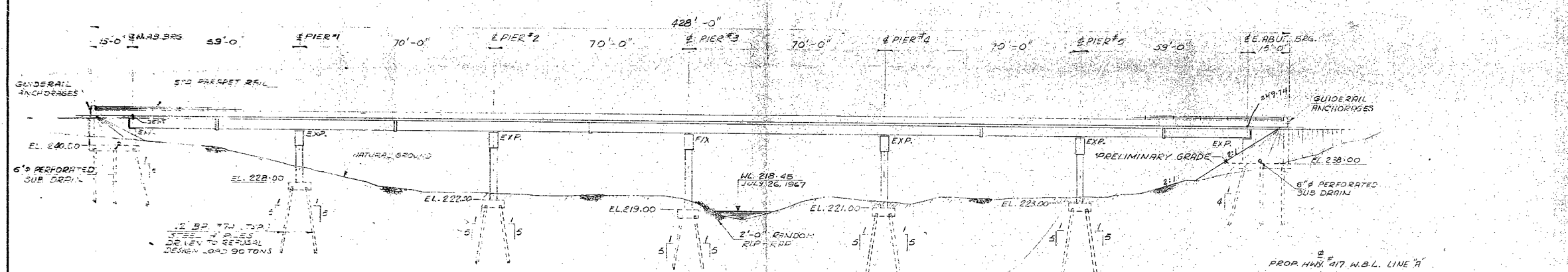
FOOTING LAYOUT & REINFORCEMENT

APPROVED _____ BRIDGE ENGINEER				SITE No. 3-266		W.P. No. 34-66-0	
				CONTRACT No.			
DESIGN	J. S.	CHECK	S. B. D.				
DRAWING	D	CHECK	S. B. O.				
DATE	NOV. 15, 68	LOADING	4520-44	DRAWING No.	D-6467-3		

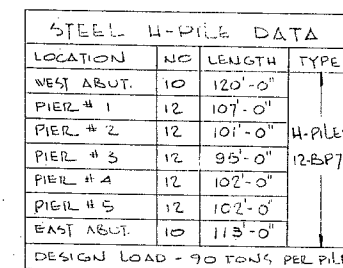


- NOTES:**
- CLASS OF CONCRETE:**
 PRECAST MEMBERS - 5000 P.S.I.
 DECK, CURBS & PARAPET WALLS - 4000 P.S.I.
 REMAINDER - 5000 P.S.I.
 - CLEAR COVER ON REINFOR. STEEL:**
 FIGS. ABUTS. CURBS PARAPET WALLS DECK & PIERS
 5" 2" 1 1/2" TOP 1 1/2" BOT. 1"
 - CONSTRUCTION NOTES:**
 THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF $\pm 1/8"$. NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED.

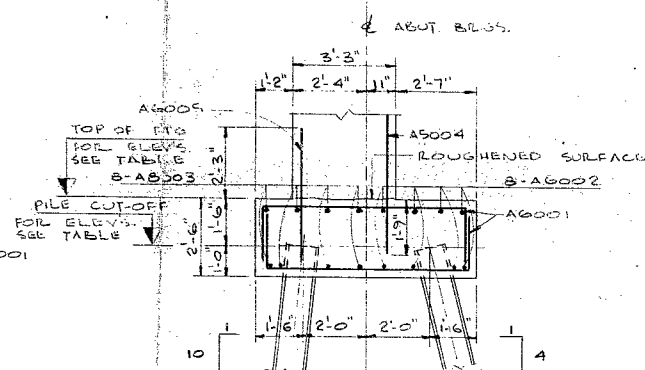
- LIST OF DRAWINGS**
1. GENERAL PLAN
 2. BORING LOCATIONS & SOIL STRATA
 3. FOOTING LAYOUT & REINFORCEMENT
 4. ABUTMENTS & WINGWALLS
 5. PIERS
 6. PRESTRESSED GIRDERS & BEARINGS
 7. DECK DETAILS & ELEVATIONS
 8. PARAPET WALL DETAILS
 9. STD. STEEL PARAPET RAIL
 10. APPROACH SLABS
 11. STANDARD DETAILS




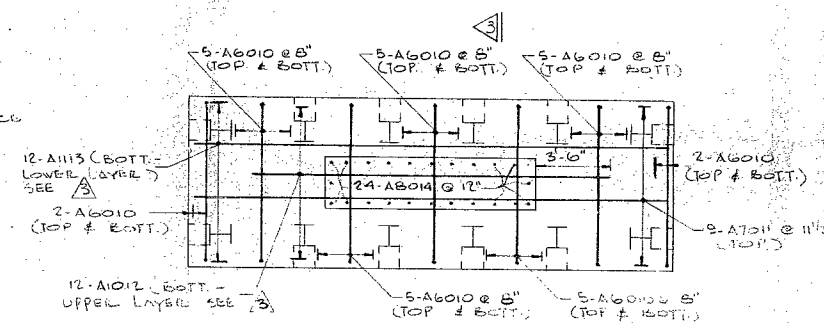
REVISIONS		DATE		BY		DESCRIPTION	
DEPARTMENT OF HIGHWAYS ONTARIO BRIDGE DIVISION 67-F-111 BEAR BROOK BRIDGE N.B.L. STRUCTURE 1 MILE SOUTH OF CARLETON SPRINGS KING'S HIGHWAY No. 417 DIST. No. 9 CO. CARLETON TWP. GLOUCESTER LOT 6 CON. VII							
GENERAL PLAN				SITE No. 3-266 W.P. No. 34-66-14			
APPROVED		BRIDGE ENGINEER		CONTRACT		No.	
DESIGN	J.S.	CHECK	S.D.D.	CONTRACT			
DRAWING	S.A./B.S.	CHECK	S.D.D.	DRAWING			
DATE	DEC. 68	LOADING	4520-44	DRAWING	No.	D-6578-1	



NOTE:
ALL FILES TO BE OILWENT TO
PRACTICAL REFUSAL.



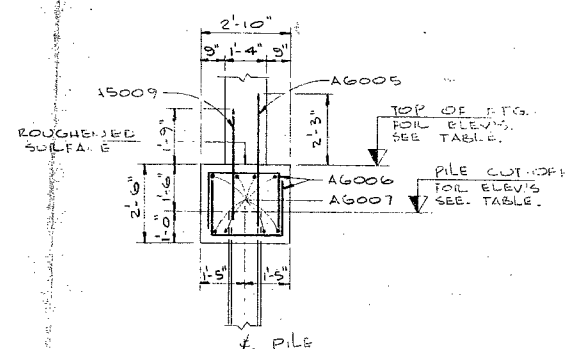
 SCALE: $3/8" = 1'-0"$



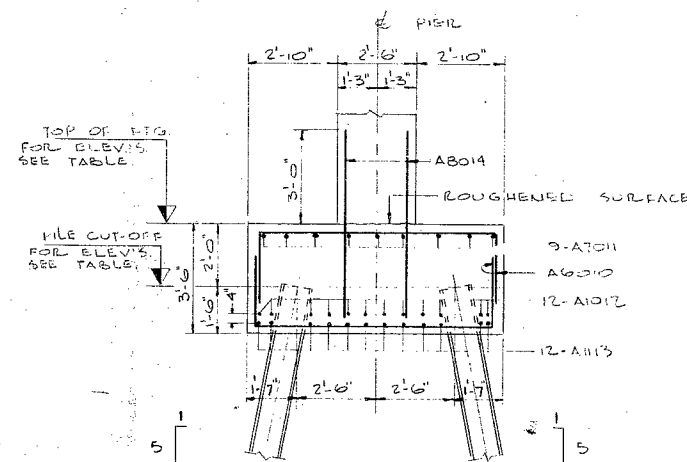
PLAN OF PIER FOOTINGS SCALE: $1/4" = 1'-0"$

FOOTING ELEVATIONS		
LOCATION	TOP OF FTG. ELEVATIONS	PILE CUT-OFF ELEVATION
WEST ABUT.	240.00	235.00
PIER #1	228.00	235.00
PIER #2	222.00	235.00
PIER #3	215.50	213.50
PIER #4	221.00	219.00
PIER #5	223.00	221.00
EAST ABUT.	238.50	236.50

cler. does not agree
with that shown
on orig. D-6578-1



2 scale: 3/8" = 1'-0"



3 SCALE: 3/8" = 1'-0"

[illegible]

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

67-F-111

BEAR BROOK BRIDGE

DEAR DEEPA DILIP
W.B.L. STRUCTURE

1 MILE SOUTH OF CARLSBAD SPRINGS

KING'S HIGHWAY No. 417 W.B.L. DIST No. 9

KING'S HIGHWAY No. 417 W.B.C. DIST. No. 5
CO. CARLTON

TWP. 6 S. R. 10 E. S. 17

11/10/68
 101
 CON. 41

FOOTING LAYOUT & REINFORCEMENT

SITE No.		W.P. No.
----------	--	----------

APPROVED _____	3-266	34-66-14
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DESIGN				I. S.				CHECK				S. A. D.				CONTRACT				
														Nos.						

DESIGN	J.S.	CHECK	S.B.D.	Nos.			
DRAWING	R	CHECK	S.B.D.	DRAWING			

DRAWING	F	CHECK	S.B.D.	DRAWING	D-6578-3
DATE	DEC. 1965	LOADING	4520-44	No.	

FOUNDATION SECTION

ORIGINATED BY CM

COMPILED BY _____ WH

CHECKED BY

SUPER IMPOSED DOCUMENT MAY
APPEAR AS MULTIFRAME ON FILM.

FOUNDATION SECTION

ORIGINATED BY CM

COMPILED BY _____ CM

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 67-F-111 LOCATION Sta. 435 + 26 @ Hwy. 417 EBL o/s 31' Lt. ORIGINATED BY CM
W.P. 34-66-05 BORING DATE Jan. 18 - 22, 1968 COMPILED BY WH
DATUM Geodetic BOREHOLE TYPE Diamond Drill NX BX CHECKED BY HL

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	20 40 60 80 100	WATER CONTENT %			
223.9	Ground Level							400 800 1200 1600 2000			▽ 232. Artes. Head
0.0	Probably clayey silt.										
214.											▽ 217.
	Probably Clay										
149.9											
74.0	Clayey silt with sand & some gravel. (Glacial Till) (occ. shale fragments below elev. 140) Stiff to hard. (gray)		1	SS	16						
			2	SS	88						
			3	SS	72						
133.6			4	SS	134 2"						
131.9	Shale Bedrock		5	MT RC	90%						▽ 133.9 90 Artesian water pressure encountered
92.0	End of Borehole										

FOUNDATION SECTION

ORIGINATED BY CM

COMPILED BY _____ WH

CHECKED BY

SUPER IMPOSED DOCUMENT MAY
APPEAR AS MULTI-FEED ON FILM.

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO.5

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 67-F-111 LOCATION Sta. 430 + 75 @ Hwy. 417 W.B.L. o/s 38' Lt. ORIGINATED BY CM
W.P. 34-66-05 BORING DATE Jan. 4 - 17, 1968 COMPILED BY WH
DATUM Geodetic BOREHOLE TYPE Diamond Drill NX BX CHECKED BY WH

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT	20	40	60	80	100	20	40	60		
217.2	Water Level					SHEAR STRENGTH P.S.F. ○ Unconfined + Field Vane ● Undrained Triaxial Lab Vane					WATER CONTENT %				Artes. Head
215.5	Water					400	800	1200	1600	2000	20	40	60		Gr. Sa. Si. Cl.
1.7	Clayey silt or silty clay with some sand & a trace of gravel - trace of organic matter. Firm.		1	TW	PM			+ S=15							0 19 28 5
208.2			2	TW	PM			+ S=6							0 38 38 24
9.0	Sensitive clay, with occasional inclusions of organic matter (seams of sandy silt up to 1/2" thick below elev. 168)		3	TW	PM			+ S=12							
			4	TW	PM			○ x + S=15						95	
			5	TW	PM			x + S=11						95	0 2 28 70
								+ S=9							
			6	TW	PM				+ S=8						
			7	TW	PM				+ S=5						
								+ S=6							
			8	TW	PM			○ x + S=9						96	
								+ S=9							
			9	TW	PM			+ S=10							
								+ S=8							
			10	TW	PM				+ S=10						
								+ S=9							
			11	TW	PM				+ S=9					94	
								+ S=7							
			12	TW	PM				+ S=8						
								+ S=8							
			13	TW	PM				+ S=8						
								+ S=7							
156.7			14	TW	PM				+ S=8					114	
60.5	Clayey silt with sand and some gravel (glacial till) (occasional seams & layers of sandy silt up to 6" thick throughout. Boulders up to 4" in size below elev. 130)							+ S=5							
			15	TW	PM										
			16	SS	30										12 43 35 10
			17	SS	34										
			18	SS	20										
	Stiff to hard.														17 1 73 9
															Elev. 132.
	Grey														Artesian Water
			19	AXT	40%										Encountered
			20	RC	0%										
			21	AXT	0%										
122.4															
94.8	Shale Bedrock		22	AXT	35%										
116.9	Grey			RC											
100.3	End of Borehole														

15.05 % Strain
10COPY WHEN DOCUMENTARY
WORK IS COMPLETED ON FILE

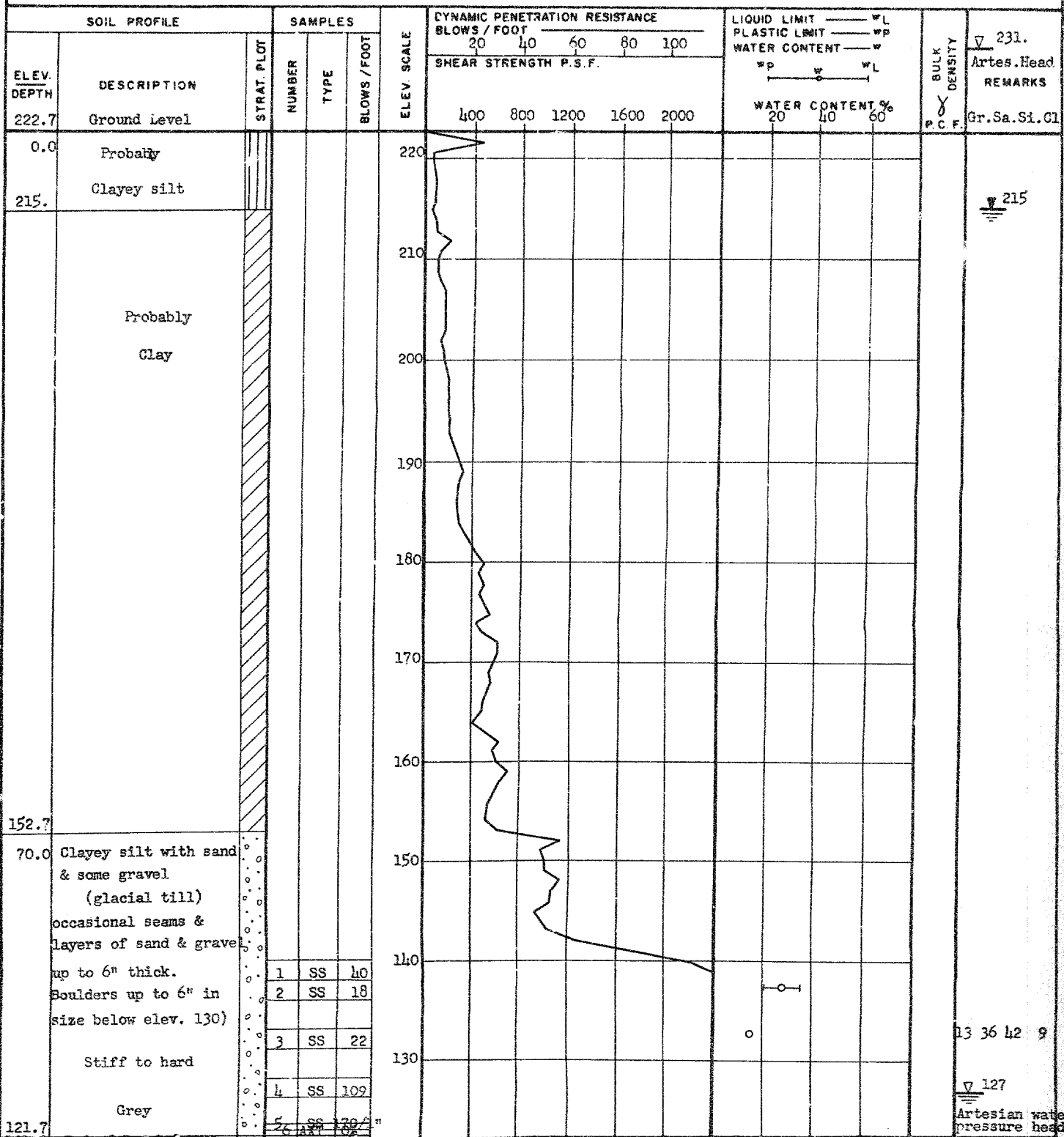
DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 67-F-111 LOCATION Sta. 431 + 75 @ Hwy. 417 WBL o/B 31' Rt. ORIGINATED BY CM
W.P. 34-66-05 BORING DATE Jan. 18 - 24, 1968 COMPILED BY WH
DATUM Geodetic BOREHOLE TYPE Diamond Drill NX BX Casing CHECKED BY [Signature]



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

JOB 67-F-111

LOCATION Sta. 432 + 02 @ Hwy. 417 WBL o/s 23' Lt.

ORIGINATED BY CM

W.P. 34-66-05

BORING DATE Jan. 18, 1968

COMPILED BY WH

DATUM Geodetic

BOREHOLE TYPE Diamond Drill

CHECKED BY *JK*

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — W _L		BULY DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT	BLOWS / FOOT	BLOWS / FOOT	BLOWS / FOOT	BLOWS / FOOT		
224.9	Ground Level										
0.0	Probably										
217.	Clayey silt										
	Probably										
	Clay										
150.4	Probably										
74.5	Glacial Till										
144.6											
80.3	End of Cone Test										

DEPARTMENT OF HIGHWAYS - ONTARIO				RECORD OF BOREHOLE NO. 8				FOUNDATION SECTION				
MATERIALS & TESTING DIVISION												
JOB 67-P-111				LOCATION Sta. 433 + 32 @ Hwy. 417 W. 9/s 3' Rt.				ORIGINATED BY CM				
W.P. 34-66-05				BORING DATE Jan. 3 - 4, 1968				COMPILED BY WH				
DATUM Geodetic				BOREHOLE TYPE Diamond Drill HX - BX casing - AXT Core				CHECKED BY <i>LL</i>				
SOIL PROFILE		SAMPLES		DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT — W _L		BULK DENSITY		REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	BLOWS / FOOT	WATER CONTENT — W _P	WATER CONTENT %	ρ _c F		
250.5	Ground Level											
0.0	Clayey silt with some sand & a trace of gra. occ. seams of silt. Brown to grey. Firm		1	SS	9							0 34 54 12
242.5			2	SS	6							242.9
8.0	Layered clay (alternate brown & red-brown layers up to 5" thick.		3	2"TW	PM							
236.5			4	2"TW	PM							0 0 30 70
14.0	Sensitive clay, occasional inclusions of organic matter.		5	2"TW	PM							
			6	2"TW	PM							
			7	2"TW	PM							0 1 35 64
	Firm to stiff		8	2"TW	PM							Plan #1 R Tip at Elev. 217.2
			9	2"TW	PM							
	Grey		10	2"TW	PM							
			11	2"TW	PM							
			12	2"TW	PM							
			13	2"TW	PM							
			14	2"TW	PM							
			15	2"TW	PM							
			16	2"TW	PM							
			17	2"TW	PM							
			18	2"TW	PM							
			19	2"TW	PM							
155.0			20	2"TW	PM							
95.5	Clayey silt with sand and some gravel (glacial till) (occasional seams of sandy silt up to 4" thick. Boulders up to 5" in size below elev. 144)		21	SS	48							6 43 40 11
	Stiff to hard.		22	SS	169/2"							
134.0	Grey		23	AXT	0%							
116.5	Shale Bedrock		24	AXT	85%							
128.5	Sound below elev. 130			RC	Rec.							
122.0	End of Borehole											

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 10

FOUNDATION SECTION

JOB 67-P-111

LOCATION Sta. 436 + 86 @ Hwy. 417 EBL

ORIGINATED BY CM

W.P. 34-66-05

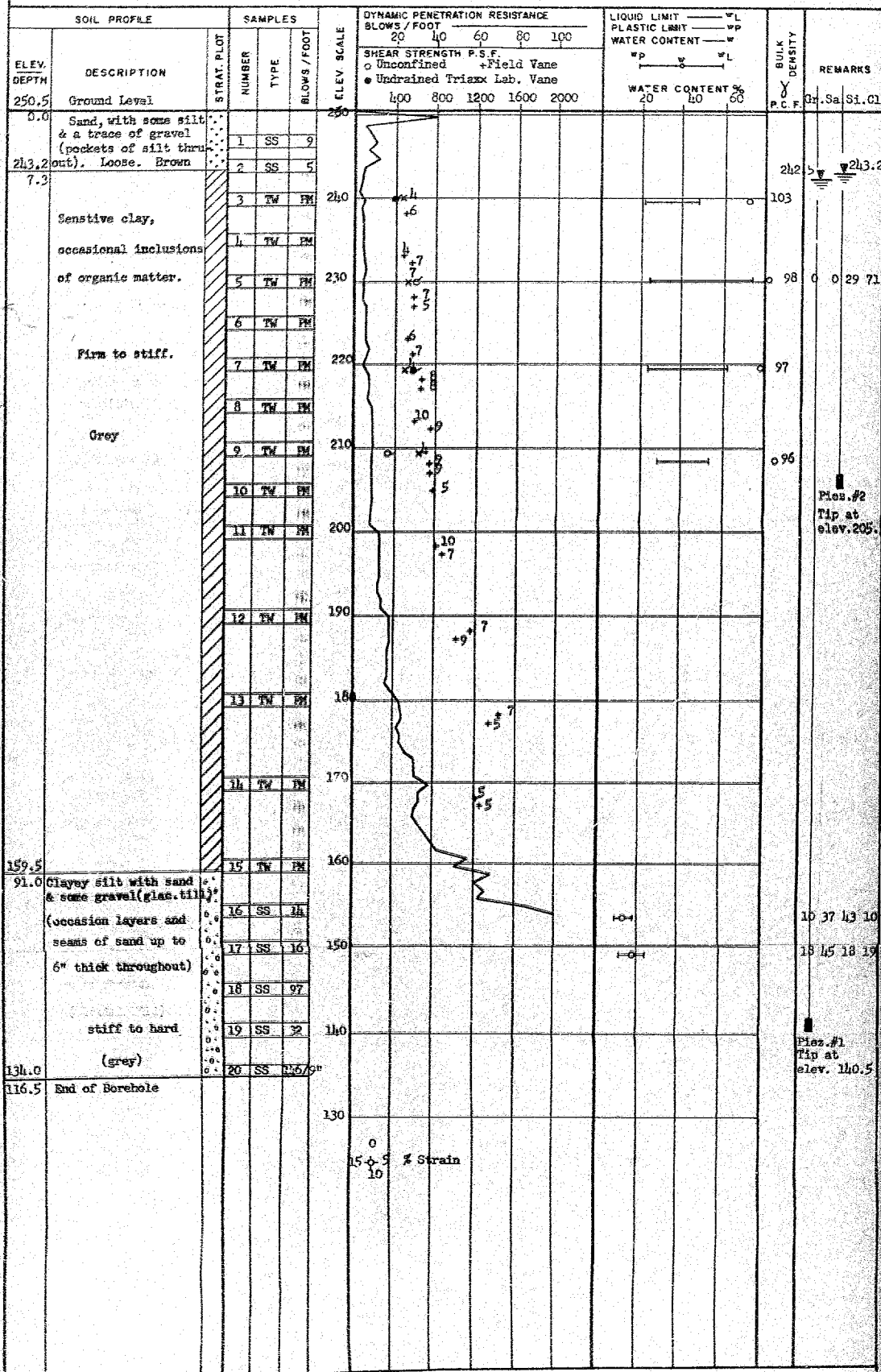
BORING DATE Jan. 23, 1968

COMPILED BY CM

DATUM Geodetic

BOREHOLE TYPE Diamond Drill

CHECKED BY



DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 11

FOUNDATION SECTION

JOB 67-F-111

LOCATION Sta. 429 + 60 @ Hwy. 417 WBL

ORIGINATED BY GEH

W.P. 34-66-05

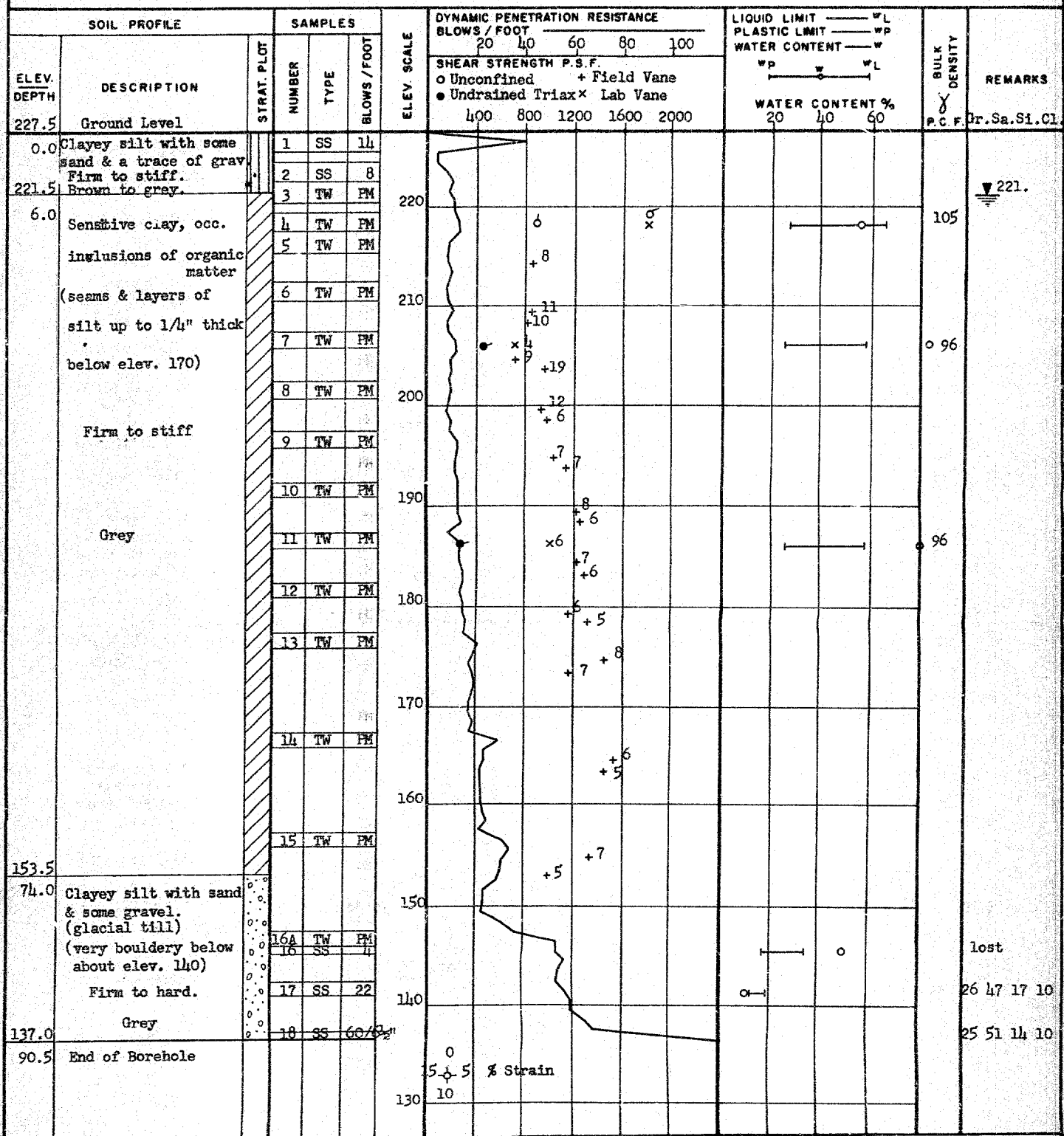
BORING DATE Jan. 25 - 29, 1968

COMPILED BY CM

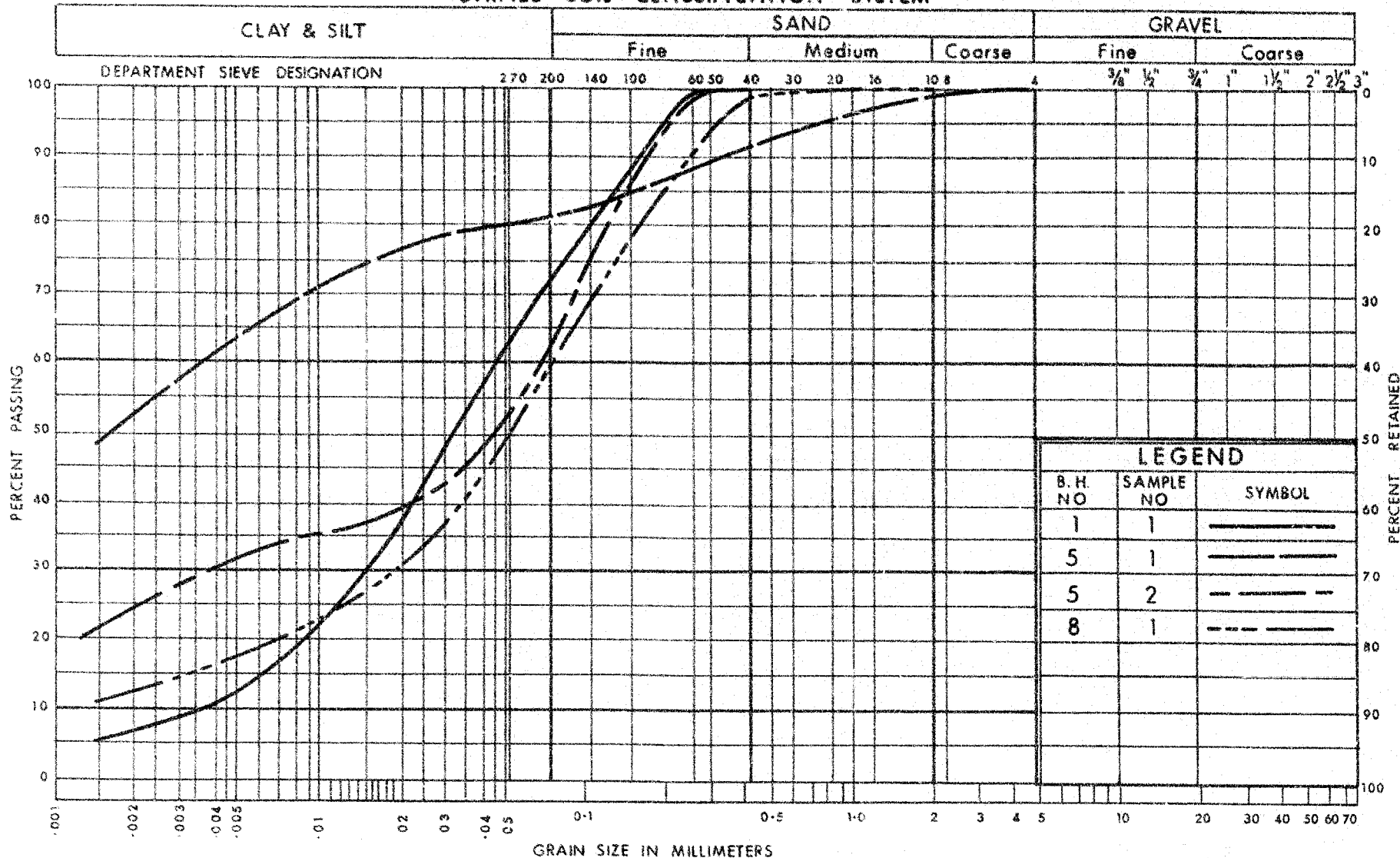
DATUM Geodetic

BOREHOLE TYPE Diamond Drill NX BX

CHECKED BY



UNIFIED SOIL CLASSIFICATION SYSTEM

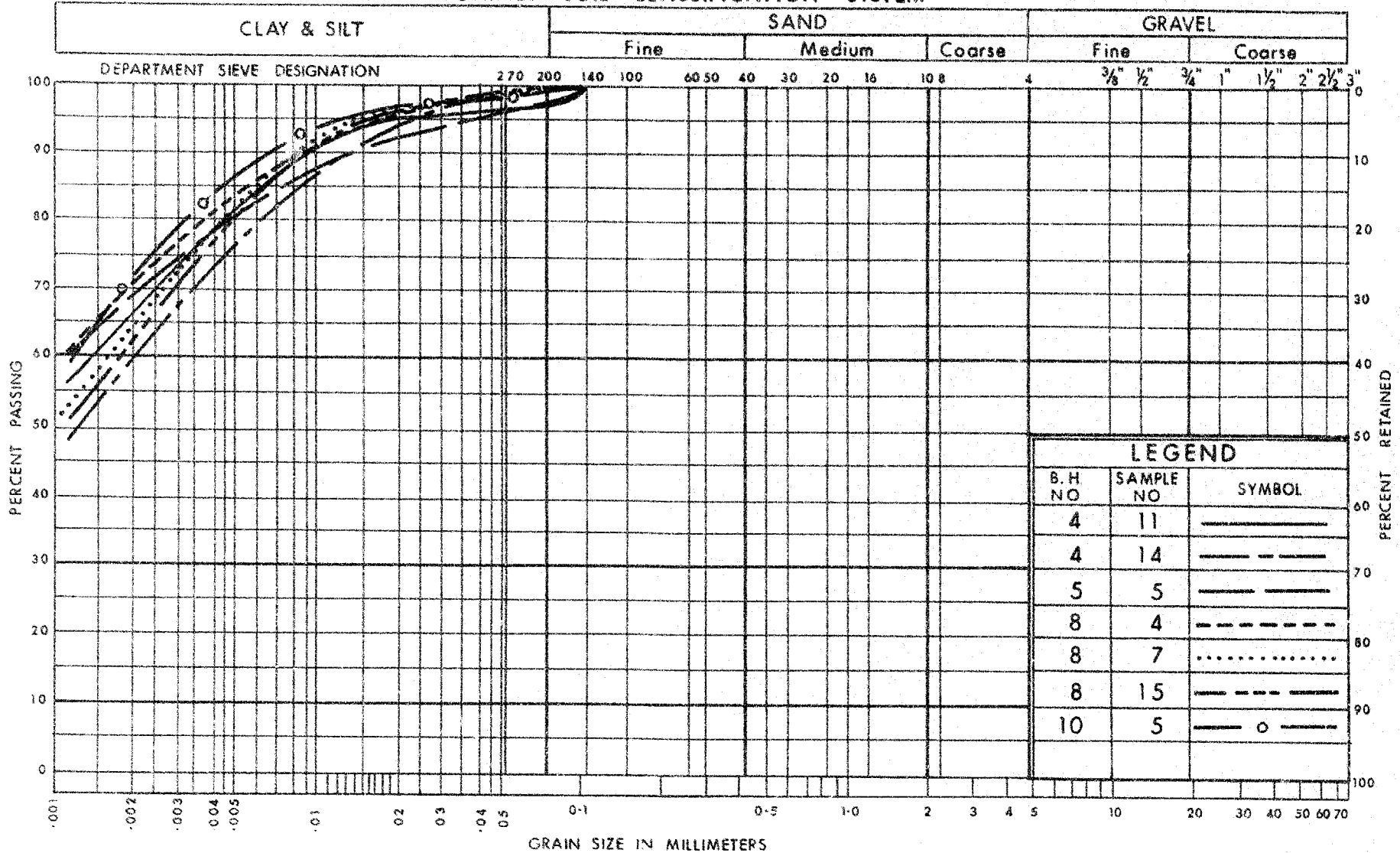


DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION CLAYEY SILT WITH SAND

W.P. No. 34 - 66 - 05
JOB No. 67 - F - 111
FIGURE NO. 6

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

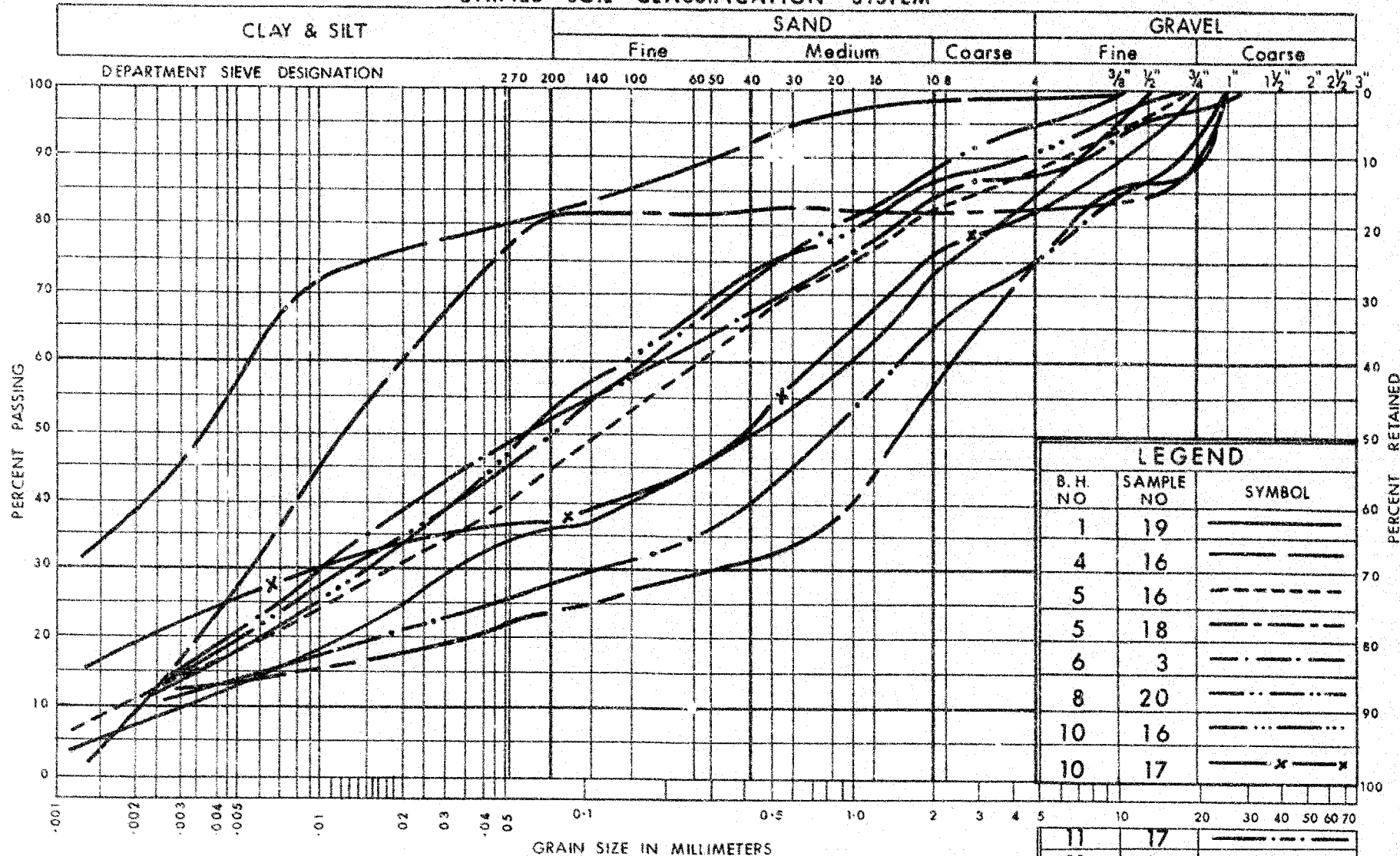
GRAIN SIZE DISTRIBUTION SENSITIVE CLAY

W.P. No. 34 - 66 - 05

JOB No. 67 - F - 111

FIGURE NO. 7

UNIFIED SOIL CLASSIFICATION SYSTEM



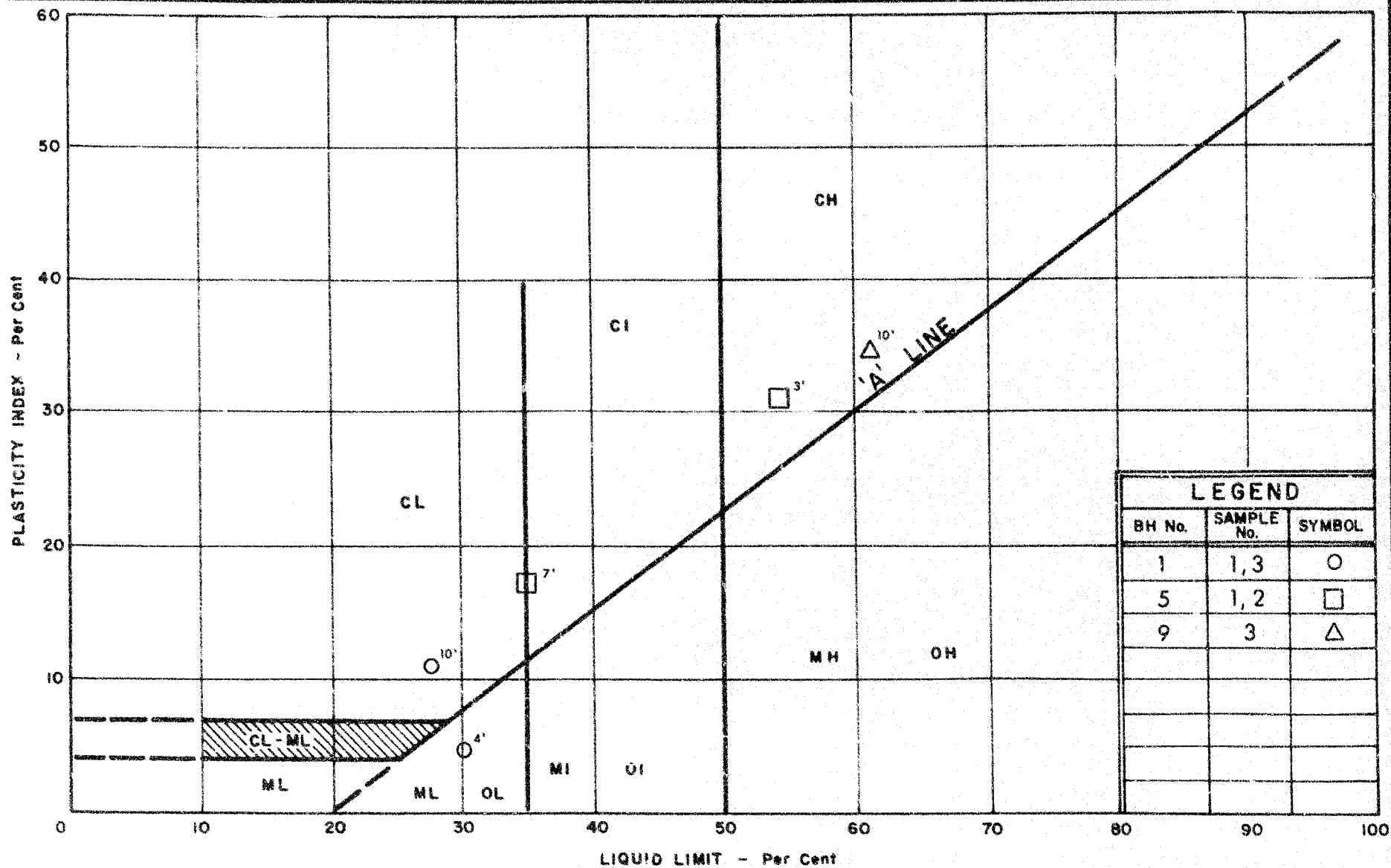
DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION
CLAYEY SILT WITH SAND & SOME GRAVEL
(GLACIAL TILL)

W.P. No. 34-66-05

JOB No. 67-F-111

FIGURE NO. 8



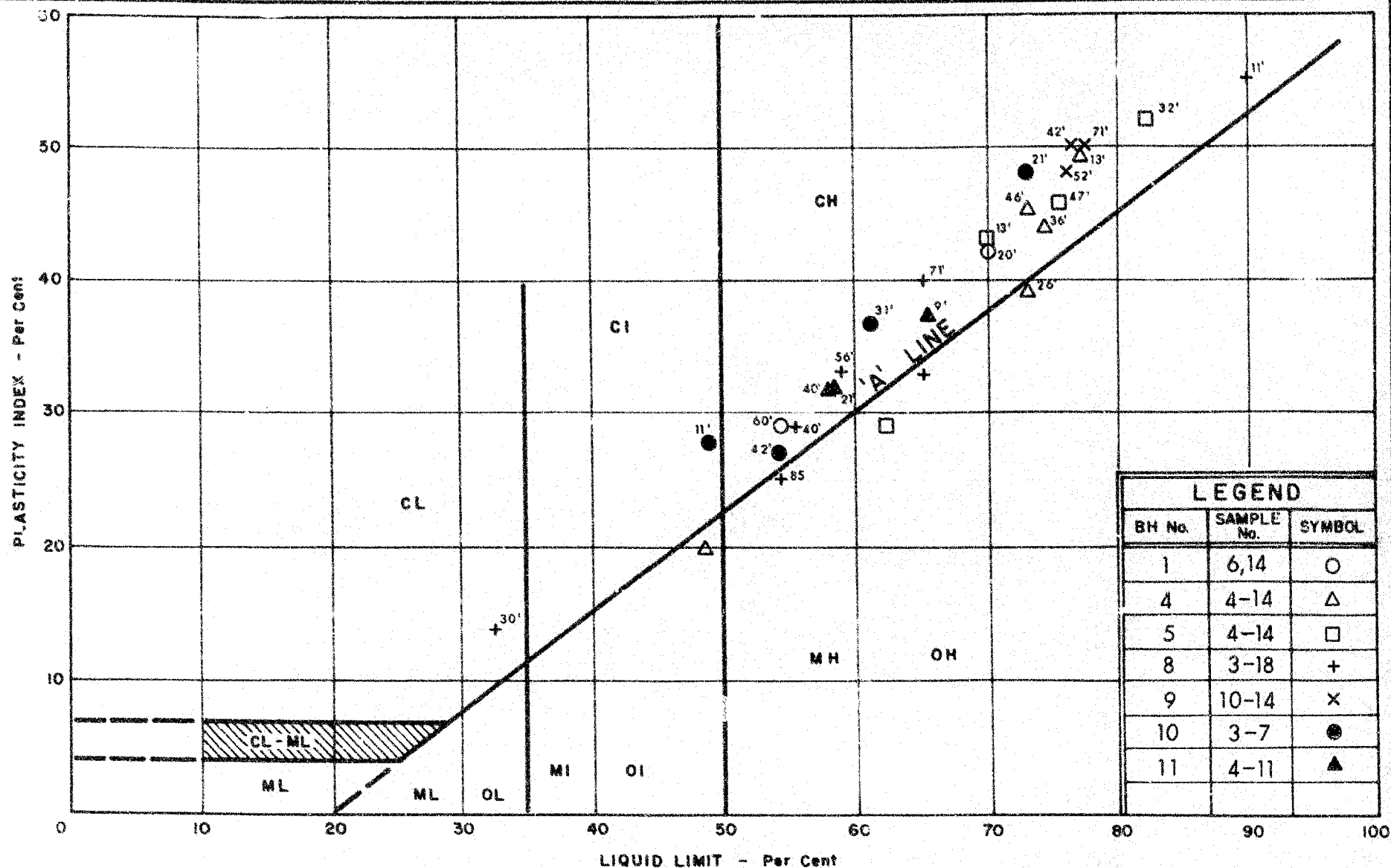
DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART CLAYEY SILT WITH SAND

WP. No. 34-66-05

JOB No. 67-F-111

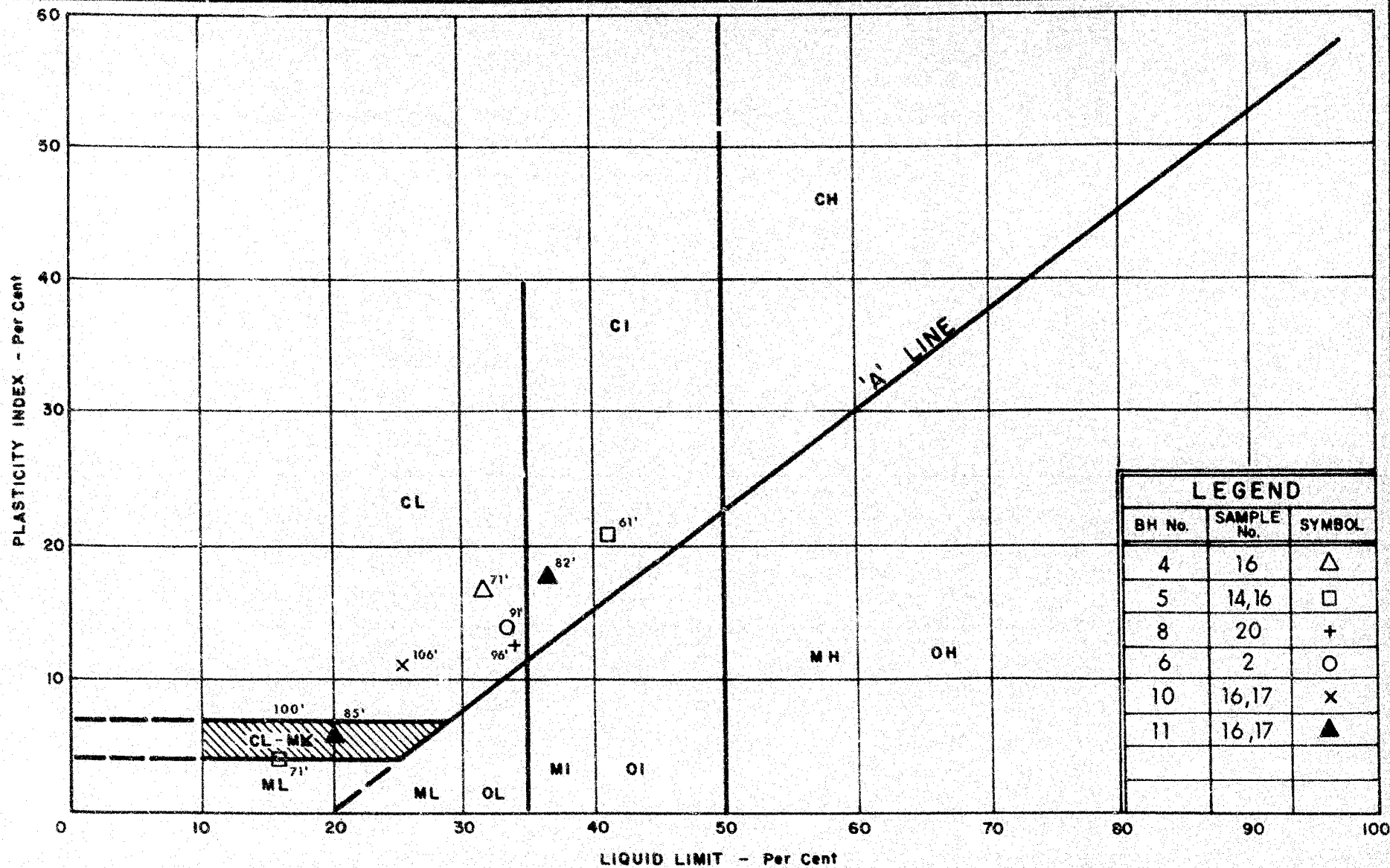
FIGURE NO. 9



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART GREY SENSITIVE CLAY

WP No. 34-66-05
JOB No. 67-F-111
FIGURE NO. 10



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART CLAYEY SILT WITH SAND & SOME GRAVEL (GLACIAL TILL)

W.P. No. 34 - 66 - 05
JOB No. 67 - F - 111
FIGURE NO. 11

VOID RATIO vs PRESSURE

$W_L = 72.7$
 $W_p = 27.6$
 $W = 71.3\%$
 $C_c = 2.16$

BORE HOLE 4
 SAMPLE 11
 DEPTH 46'2"
 ELEV. 117.4

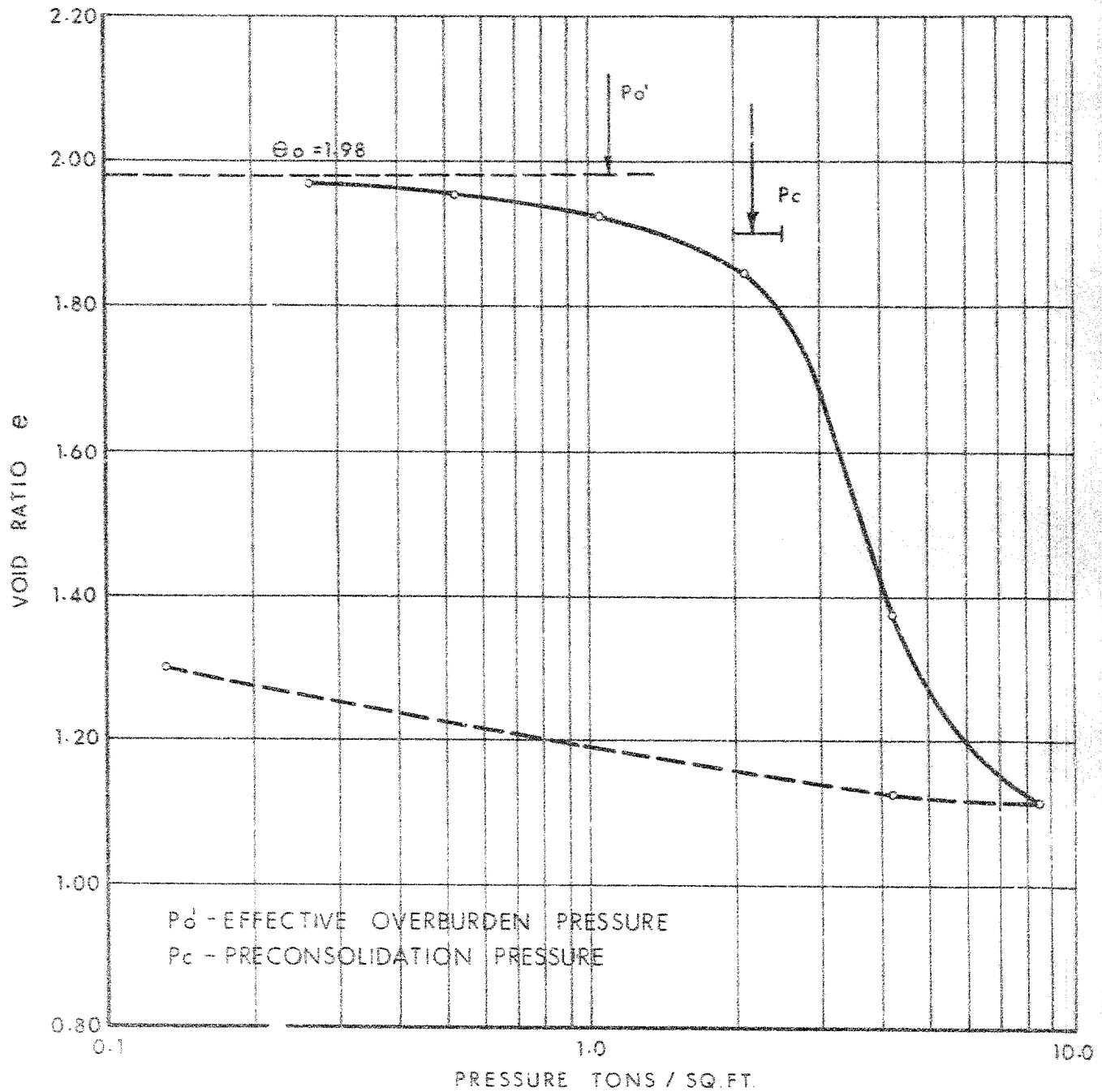


FIG. 12

VOID RATIO vs PRESSURE

$W_L = 48.3$
 $W_p = 19.6$
 $W = 61.4\%$
 $C_c = 0.93$

BORE HOLE 4
 SAMPLE 14
 DEPTH 61'3"
 ELEV. 161.8

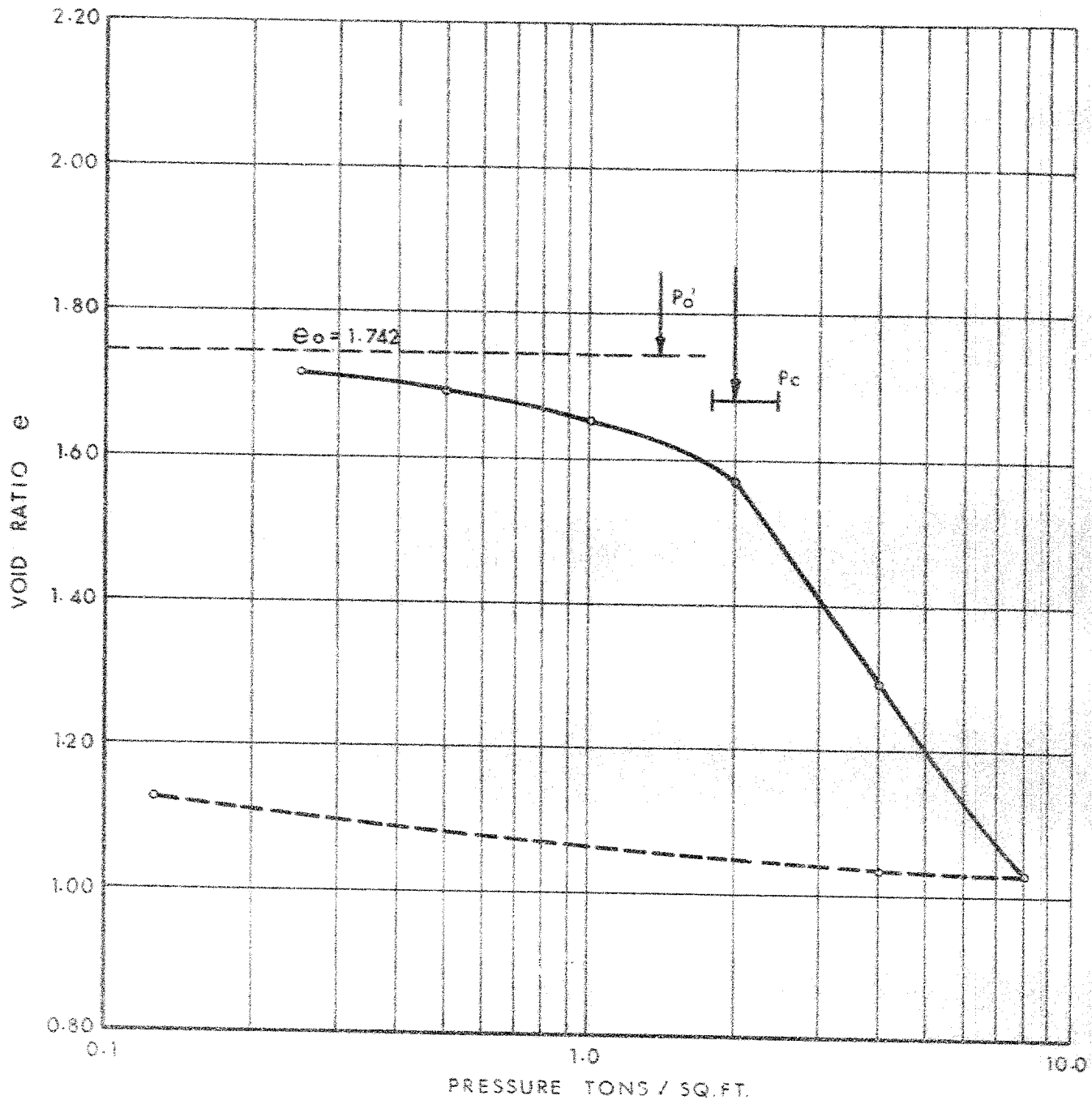


FIG. 13

VOID RATIO vs PRESSURE

$W_L = 62.6$

$W_p = 33.3$

$W = 80.8\%$

$C_c = 1.95$

BORE HOLE 5

SAMPLE 5

DEPTH 16 2"

ELEV. 201.1

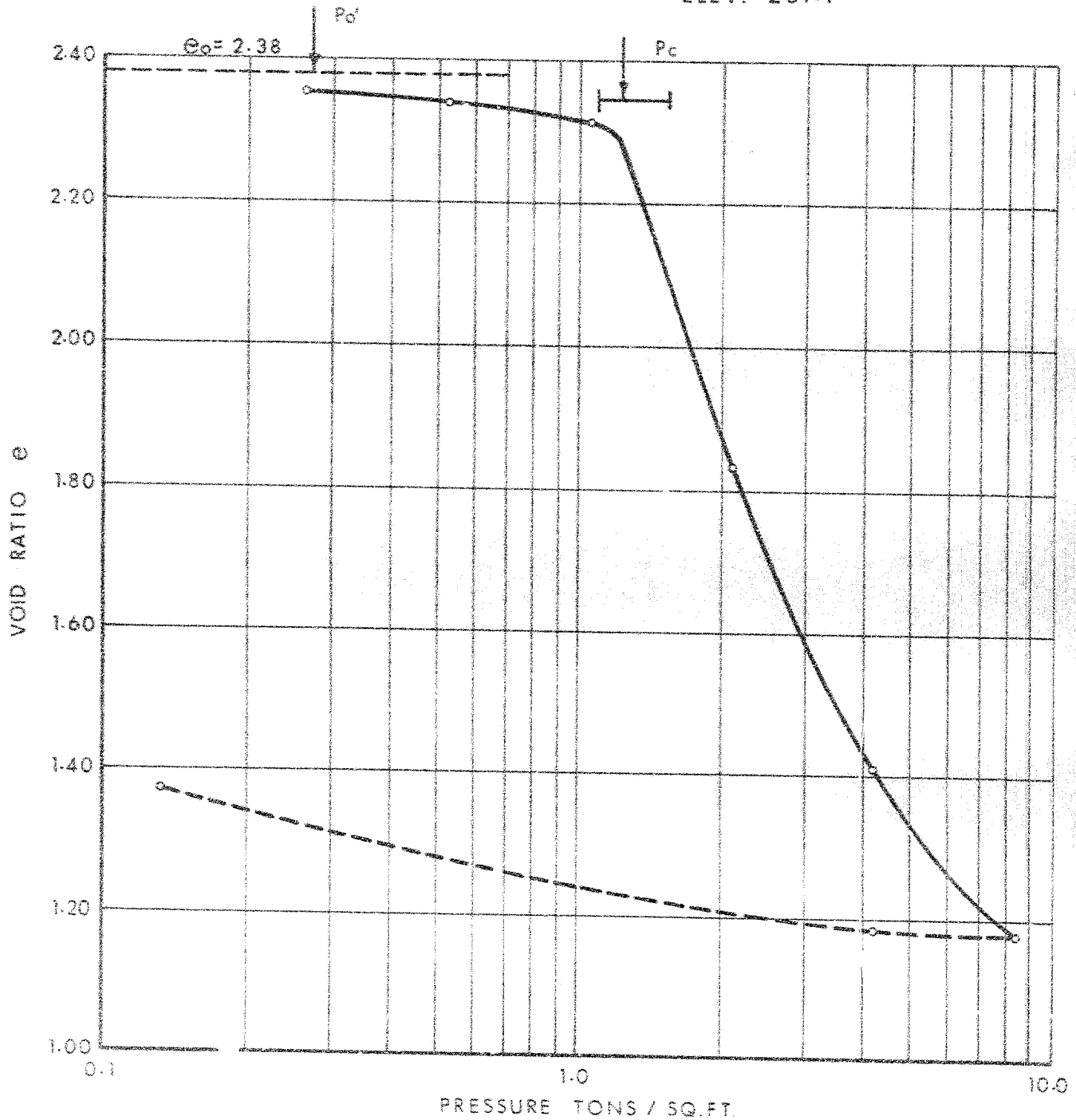


FIG. 14

VOID RATIO vs PRESSURE

$W_L = 65.0$

$W_p = 32.3$

$W = 84.6\%$

$C_c = 2.32$

BORE HOLE 8

SAMPLE 4

DEPTH 16' 0"

ELEV. 234.5

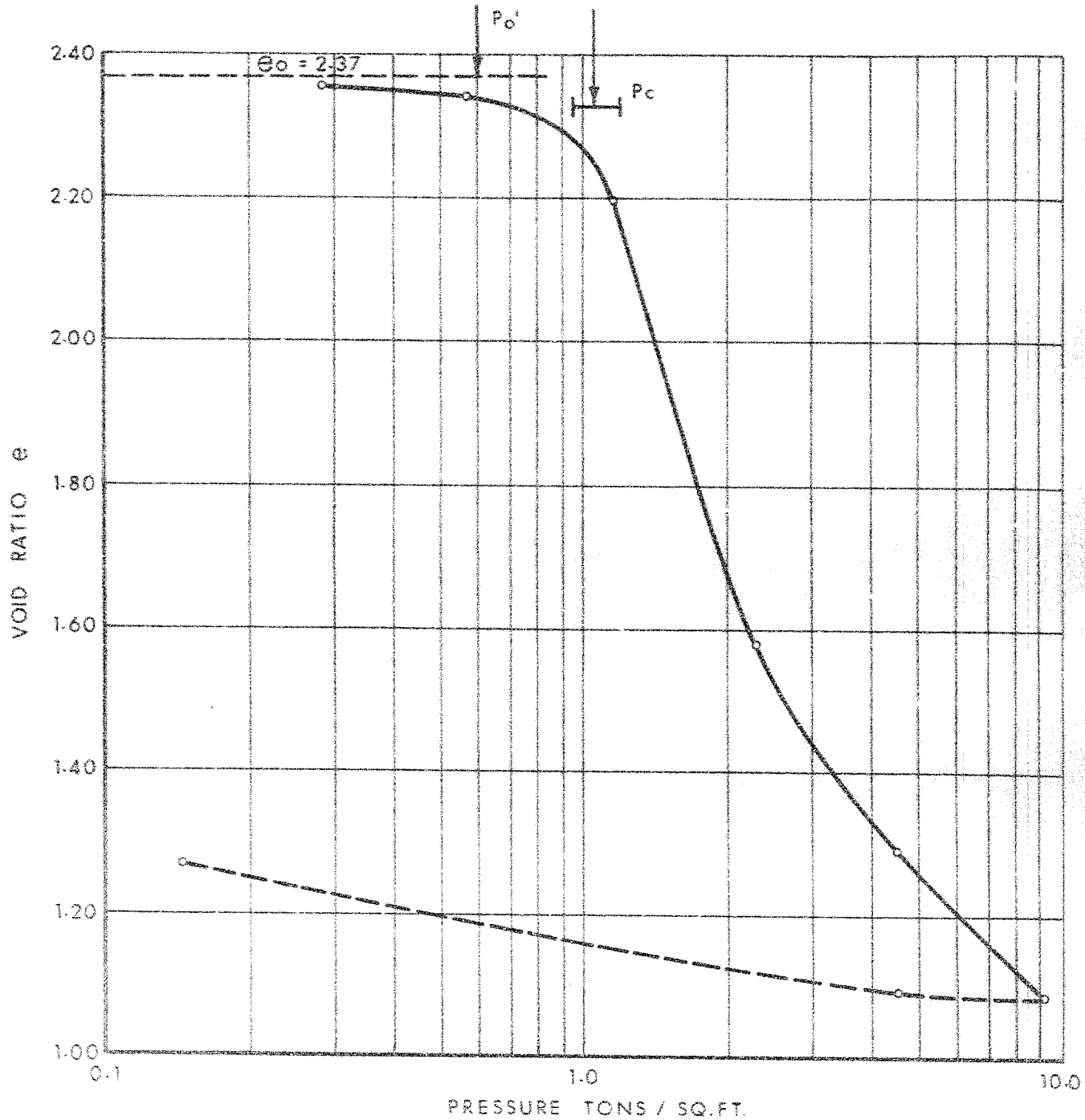


FIG. 15

VOID RATIO vs PRESSURE

$W_L = 32.2$

$W_p = 18.1$

$W = 73.3\%$

$C_c = 2.17$

BORE HOLE 8

SAMPLE 7

DEPTH 31' 3"

ELEV. 219.2

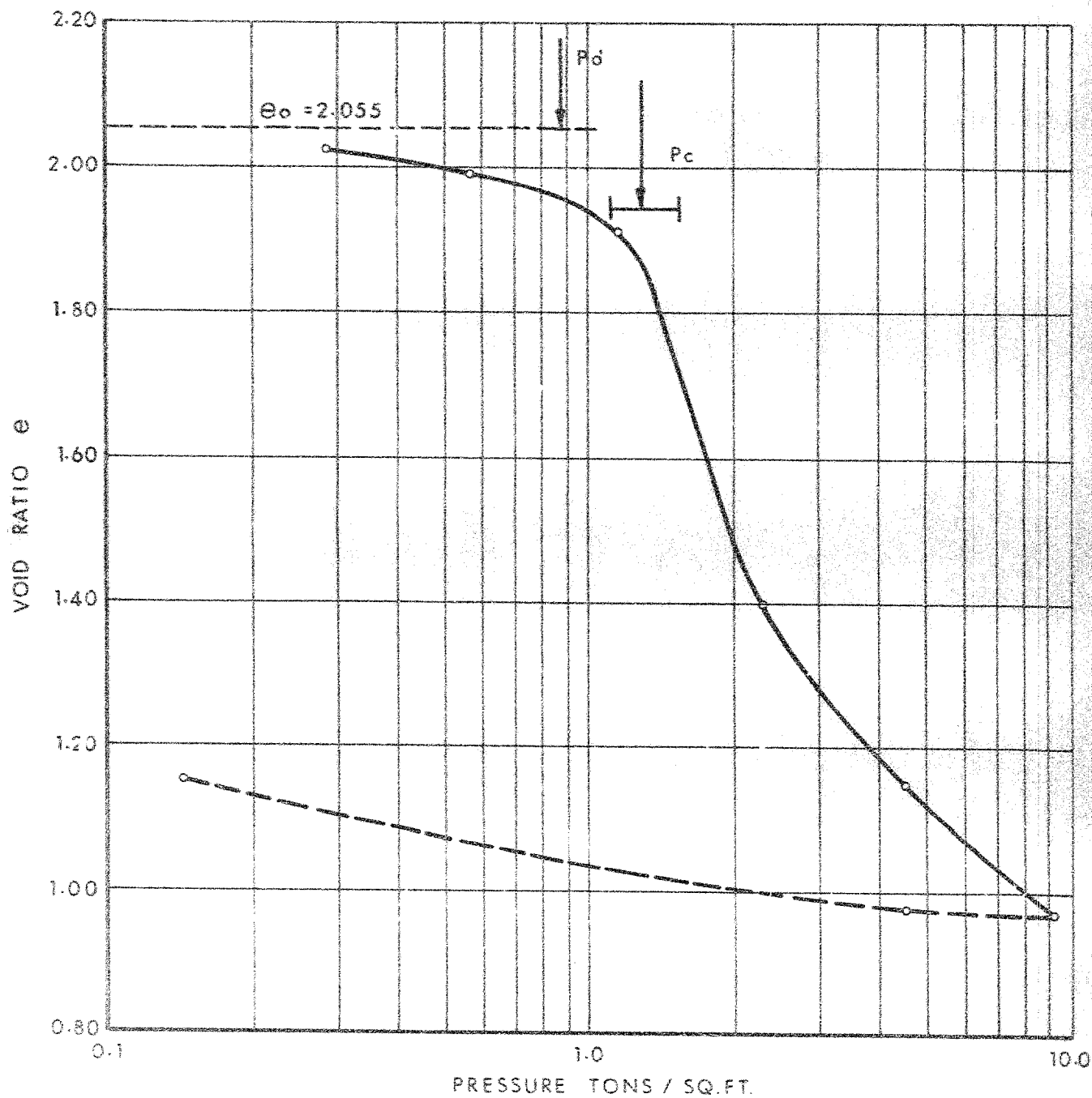


FIG. 16