THURBER ENGINEERING LTD.

celebrating 60 YEARS

FOUNDATION INVESTIGATION REPORT
HIGHWAY 62 EMBANKMENT INVESTIGATION
TOWNSHIP OF HUNTINGDON
SITE 11-134, G.W.P. 4044-10-00
AGREEMENT NUMBER: 4015-E-0015

GEOCRES NUMBER: 31C-261

SUBMITTED TO
McINTOSH PERRY CONSULTING ENGINEERS LTD. / LEA CONSULTING LTD.
JOINT VENTURE

August 2017
18115

104, 2460 Lancaster Road, Ottawa ON K1B 4S5 T. 613 247 2121 F. 613 247 2185
thurber.ca

Table of Contents

PART 1: FACTUAL INFORMATION

APPENDICES

FOUNDATION INVESTIGATION REPORT
HIGHWAY 62 EMBANKMENT INVESTIGATION
TOWNSHIP OF HUNTINGDON
SITE 11-134, G.W.P. 4044-10-00
AGREEMENT NUMBER: 4015-E-0015

GEOCRES NUMBER: 31C-261

PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual data obtained from a foundation investigation conducted by Thurber Engineering Ltd. (Thurber) for the construction of a new embankment as part of the re-alignment of Highway 62 associated with the replacement of the Highway 62 Rawdon Creek Bridge, located within the Township of Huntingdon, Ontario. Thurber carried out the investigation as a subconsultant to McIntosh Perry Consulting Engineers – LEA Engineering Joint Venture (MPCE-LEA), under Assignment 12 of Agreement No. 4015-E-0015.

Base plan mapping was provided by the Ministry of Transportation (MTO) Eastern Region Structural Office for the preparation of this report.

Highway 62 in the vicinity of the Rawdon Creek Bridge is being reconstructed on a permanent new alignment to the west of the existing highway alignment as part of the Rawdon Creek Bridge replacement. The north embankment for the Rawdon Creek crossing is to be located in an existing agricultural field and will range in height from 2.5 m to 3.6 m. During Thurber's 2016 pavement investigation for the realignment, a buried organic layer was identified in two boreholes advanced within the agricultural field in the vicinity of Station 12+575.

A supplemental foundation field investigation was carried out to assess the extent of the buried organic material and potential impact on the new highway embankment. It should be noted that the buried organic material was not encountered during the foundation investigation for the proposed Rawdon Creek bridge replacement, so the investigation was limited to within the footprint of the proposed north embankment.

The purpose of this investigation was to explore the subsurface conditions at the site and, based on this data, provide a borehole location plan, record of boreholes, a stratigraphic profile, laboratory test results and a written description of the subsurface conditions.

2 SITE DESCRIPTION

The location of the new Highway 62 north embankment extends from approximately Station 12+500 to Station 12+600. The site location is shown on the inset Key Plan on Drawing No. 1 in Appendix A.

While preparing the investigation plan, a swampy area was identified on the base plans within the proposed highway alignment between approximate Station 12+525 and 12+565. The swampy area is not currently evident on site; and appears to have been filled in for use as an agricultural field. The area is generally flat and grass covered. There is a difference in height between the proposed top of pavement and existing ground surface along the proposed embankment

alignment of approximately 2.5 m to 3.6 m. Site photographs showing the general conditions at the site are presented in Appendix D.

The site is located near the boundary of three physiographic regions: the Dummer Morraine, the Peterborough Drumlin Field and the Iroquois Plain though the soil conditions on site most closely resemble those of the Iroquois Plain region. The Iroquois Plain region is characterized by the flat to undulating lake bed and beaches of the former glacial Lake Iroquois that existed during the last glacial recession. The overburden soils are comprised of glaciolacustrine sand, silt and clay deposits (though deposits of sand and gravel are also known to be present) all underlain by limestone bedrock (Chapman and Putnam, 1984).

The lands surrounding the project limits are typically agricultural with some residential properties. Storm water drainage in the area is to existing ditches and culverts.

3 SITE INVESTIGATION

3.1 Previous Investigations

Preliminary Investigation

A Preliminary Foundation Investigation for the bridge replacement was carried out in 2012 (Golder Associates Report No. 12-1111-0021-1). The investigation consisted of advancing one borehole at each proposed abutment (Boreholes RC-1 and RC-2).

The stratigraphy in the area of the bridge is generally described as surficial deposits of firm to stiff silty clay (on the south side of the creek) or loose to compact sand and gravel (on the north side of the creek), overlying a deposit of loose to compact silty sand to sandy silt, underlain by a deposit of compact to very dense sand and gravel, which contains cobbles and boulders, all overlying limestone bedrock. The bedrock surface was encountered at approximately elevation 123.2 m and 122.3 m at the north and south abutments, respectively.

Pavement Investigation

A pavement investigation in support of the detailed design for the realignment of Highway 62 was carried out by Thurber in 2016. Within the limits of the proposed north embankment the investigation consisted of advancing six auger probe style boreholes to depths of 1.5 m to 3.0 m. Bulk soil samples of the soil encountered were taken from the augers. Asphalt cores were advanced with a 150 mm diameter core barrel to determine total asphalt thickness at various locations along the exiting alignment.

In general, the stratigraphy encountered in the pavement boreholes is described as surficial material (asphalt or topsoil) overlying embankment fill (for boreholes through the existing roadway), overlying sandy silt and silty sand. Organic material was encountered at depths of 0.75 m and 2.0 m below existing ground surface in boreholes advanced near the proposed toe of slope and near the new centreline alignment of Highway 62 at Stations 12+573 and 12+572.

Foundation Investigation

A foundation investigation was carried out as part of the detailed design assignment to supplement the data from the preliminary foundation investigation. Within the limits of the proposed north embankment the investigation included advancing a total of two boreholes

(Boreholes 16-3 and 16-4) one drilled at the north abutment and the other in the approach embankment. A copy of Record of Boreholes from the foundation investigation is provided in Appendix B. The location of the foundation boreholes is also illustrated on Drawing No. 1 in Appendix A.

In general, the stratigraphy in the boreholes is characterized by a silty sand with gravel overlying sandy silt to silty sand, overlying silty sand with gravel till, underlain by limestone bedrock. This stratigraphy is generally consistent with the stratigraphy encountered in the preliminary investigation. A buried organic layer was not encountered.

3.2 Field Investigation

The field investigation plan for the north embankment investigation was finalized after discussion with the MTO Foundations Section. The field investigation for this site included advancing eight boreholes between April 3rd and April 10th, 2017. Two additional probe holes were advanced to confirm the soil stratigraphy at the existing toe of slope. The approximate locations and elevations of the boreholes/probe holes are shown on Drawing No. 1 provided in Appendix A and are summarized in Table 3-1.

Table 3-1: Borehole Summary

Borehole	Location	Northings (m)	Eastings (m)	Ground Surface Elevation (m)	Depth (m)
101	Existing Embankment	4911417.0	226832.9	133.6	10.0
102	Existing Embankment	4911438.4	226820.1	133.7	10.8
103	Existing Embankment	4911459.9	226807.3	134.1	11.5
104	Existing Embankment	4911474.7	226799.0	135.0	9.8
105	Toe of proposed slope	4911468.4	226788.1	132.4	5.2
106	Toe of proposed slope	4911450.9	226791.9	131.2	5.2
107	Toe of proposed slope	4911428.4	226803.2	130.8	5.2
108	Toe of proposed slope	4911405.3	226812.6	130.7	5.2
109[1]	Toe of existing slope	4911422.6	226818.8	130.9	1.7
110[1]	Toe of existing slope	4911443.8	226803.5	131.1	1.7

Note 1: Auger Probe Style boreholes

As a component of our standard procedures and due diligence, Thurber contacted Ontario One Call, to obtain utility locates/clearances for the intended borehole locations. In addition, MTO traffic operations was contacted to obtain ATMS Fibre utility locates and Carillion Canada / RW Electric were contacted to obtain MTO electric locates for the project limits.

The boreholes were advanced with a CME 55 track mount drill rig equipped with both hollow stem and solid stem augers. The subsurface stratigraphy encountered in the boreholes was recorded in the field by Thurber personnel. Split spoon samples were collected at regular depth intervals in the boreholes during the completion of Standard Penetration Tests (SPT), following the methods described in ASTM Standard D1586-11. Bulk soil sampling of the various soil stratigraphy were taken from the augers for probe holes 109 and 110. Thin-walled tube samples of the buried organic deposit were collected from Boreholes 106 to 108. All other soil samples recovered from the boreholes were placed in moisture-proof containers and transported to Thurber's Ottawa geotechnical laboratory for further examination and testing.

A 19 mm inside diameter PVC piezometer was installed in Borehole 106 to allow for the measurement of the groundwater level at the site. The piezometer construction details are illustrated on the Record of Borehole sheet for Borehole 106, provided in Appendix B.

The boreholes without a piezometer installation were backfilled with a low-permeability combination of auger cuttings, and bentonite pellets in general accordance with the intent of Ontario MOE Regulation 903. Boreholes advanced through the existing roadway platform over capped with 150 mm of cold patch asphalt.

The as-drilled locations of the boreholes and ground surface elevations at the borehole locations were surveyed by Thurber on April 5th, 2017. The vertical datum used was the benchmark (GBM) 8321 identified on the plans provided by MTO, which is located on the southeast abutment of the existing Rawdon Creek bridge. The GBM has a geodetic elevation of 134.476 m.

3.3 Laboratory Testing

Geotechnical laboratory testing consisted of natural moisture content determination and visual identification of all soil samples in accordance with the current MTO standards. Grain size distribution analyses, Atterberg Limits, consolidation and organic content testing were also carried out on selected samples to MTO and ASTM standards.

The laboratory test results are presented on the Record of Borehole sheets in Appendix B and are illustrated on the figures in Appendix D.

4 DESCRIPTION OF SUBSURFACE CONDITIONS

4.1 Overview / General

Reference is made to the Record of Borehole sheets in Appendix B for details of the soil stratigraphy encountered in the boreholes. Stratigraphic profiles for the site are presented on Drawing Nos. 1 and 2 in Appendix A for illustrative purposes. An overall description of the stratigraphy is given in the following paragraphs; however, the factual data presented in the Record of Boreholes governs any interpretation of the site conditions.

In general, the stratigraphy in the area of the boreholes is characterized by asphalt surface cover overlying embankment fill consisting of silty sand with gravel overlying a sandy clay (embankment boreholes), or rootmat/topsoil surface cover overlying fill material (agricultural field boreholes), overlying sandy organic silt / silty sand with organics overlying a native silty sand, overlying gravelly sand till, all underlain by inferred bedrock. A layer of clay was encountered beneath the silty sand layer in Borehole 106. It should be noted that the organic layer was encountered in the existing embankment Boreholes 101 and 102.

More detailed descriptions of the individual strata are presented below.

4.2 Surface Cover

Four boreholes (Boreholes 101 to 104) were advanced through the existing Highway 62 pavement structure. The thickness of the asphalt was 150 mm.

A rootmat/topsoil layer was enountered at the surface of all non-embankment boreholes. The thickness of the layer ranged from 50 mm to 100 mm.

4.3 Embankment Fill

Fill: Silty Sand with Gravel

A silty sand layer with varying amounts of gravel was encountered below the asphalt layer in all four embankment boreholes. The top of this layer ranges from elevation 133.4 m to 134.8 m. The thickness of this layer ranged from 2.1 m to 2.6 m. The SPT 'N' values ranged from 2 to 61 indicating a very loose to very dense condition; but typically compact to dense. Frequent cobbles were noted from 1.8 m to 2.4 m depth in Borehole 101. Organics were noted at 2.1 m depth in Boreholes 104.

The moisture content of the samples tested ranged from 3% to 17%. The results of grain size analysis testing completed on a sample of this material indicated a gravel content of 16%, a sand content of 52%, a fines content (combined silt and clay size particles) of 32%. The results of the grain size analysis are illustrated on Figure 1 in Appendix C.

Fill: Sandy Clay to Sandy Silt

A clay fill deposit was encountered beneath the silty sand fill in the four embankment boreholes as well as Boreholes 105, 109 and 110. The top of this layer ranges from elevation 130.8 m and 132.6 m. The thickness of the layer was 300 mm in Boreholes 109 and 110 and ranged from 1.0 m to 2.1 m in the embankment boreholes.

The moisture content of the samples tested ranged from 11% to 72%. The results of grain size analysis testing completed on samples of this material indicated a gravel content ranging from 0% to 5%, a sand content ranging from 6% to 35%, a silt content ranging from 43% to 53%, and a clay content ranging from 16% to 51%. The results of the grain size analysis are illustrated on Figure 2 in Appendix C.

The results of Atterberg Limits testing completed on samples of this material indicated a plastic limit ranging from 17 to 31, a liquid limit ranging from 32 to 49, and a plasticity index ranging from 10 to 22; indicating a clay and silt of intermediate plasticity. Atterberg Limits analysis results are illustrated on Figure 3 in Appendix C.

4.4 Sandy Organic Silt (OH) to Silty Sand (SM) with Organics

A silt and sand layer containing organics was encountered beneath the fill materials in Boreholes 101, 102, and 106 to 110. The top of this layer ranges from elevation 129.8 m to 130.8 m. The thickness of the layer ranged from 0.3 m to 1.2 m. Table 4-1 outlines the thickness of this layer encountered in the boreholes.

Table 4-1: Thickness of Organic Layer by Borehole Location

Borehole	Thickness of Organic Layer (m)	Borehole	Thickness of Organic Layer (m)
101	0.3	108	0.7
102	0.9	109	0.6
106	0.9	110	1.2
107	0.7		

The moisture content of the samples tested ranged from 10% to 197%. The results of grain size analyses completed on samples of this material indicated a gravel content ranging from 0% to 2%, a sand content ranging from 14% to 74%, a silt content ranging from 21% to 75%, and a clay content ranging from 0% to 18%. The results of the grain size analysis are illustrated on Figure 4 for the organic silt material and Figure 6 for the silty sand with organics material provided in Appendix C.

The results of Atterberg Limits testing completed on samples of this material indicated a plastic limit ranging from 0 to 66, a liquid limit ranging from 0 to 68, and a plasticity index ranging from 0 to 2, indicating a highly plastic to a non-plastic silt. Atterberg Limits analysis results are illustrated on Figure 5 in Appendix D. Test results carried on samples of this material indicated an organic content ranging from 14% to 35%.

The results of oedometer (one-dimensional consolidation) tests carried out on two undisturbed samples of this material are summarized in Table 4-2. Copies of the oedometer test results are provided in Appendix C. The results of the tests indicate that the material is slightly over-consolidated.

Table 4-2: Consolidation Test Results

Parameter	Sample	
Borehole	**106**	**108**
Sample	**ST-2**	**ST-2**
Depth / Elevation (m) (top of sample)	0.8 / 130.4	0.8 / 129.9
Moisture Content, (%)	151	87
Unit Weight, (γ) (kN/m^3)	11.8	13.3
Specific Gravity (G_s)	2.1	2.4
Initial Void Ratio (e_o)	4.391	2.549
Pre-consolidation Pressure, (kPa)	50	90
Compression Index (C_c)	1.809	1.506
Recompression Index (C_r)	0.350	0.133

4.5 Sandy Gravel (GP)

A sandy gravel layer with varying amounts of silt was encountered below the silty sand with organics layer in Boreholes 101 and 107. The top of this layer ranges from elevation 129.5 m to 129.5 m. The thickness of this layer ranged from 0.5 m to 0.6 m. The SPT ‘N’ value measured was 11 indicating a compact condition.

The moisture content of the samples tested was 9% and 18%. The results of grain size analysis testing completed on a sample of this material indicated a gravel content of 56%, a sand content of 39%, a fines content of 5%. The results of the grain size analysis are illustrated on Figure 7 in Appendix C.

4.6 Silty Sand (SM) to Sandy Silt (ML)

A native sand and silt deposit was encountered below a sandy gravel in Boreholes 101 and 107, below the organic layer in Boreholes 102, 106, and 108 to 110; and below the fill materials in the remaining boreholes.

The top of this layer ranges from elevation 128.6 m to 131.3 m. The thickness of this layer ranged from 2.9 m to 6.9 m. Boreholes 105 and 106 to 110 were terminated in this stratum. The SPT 'N' values ranged from 7 to 39 indicating a loose to dense condition; but typically compact.

The moisture content of the samples tested ranged from 11% to 34%. The results of a grain size analysis completed on samples of this material indicated a gravel content ranging from 0% to 1%, a sand content ranging from 35% to 78%, a fines content ranging from 14% to 65%. The results of the grain size analysis are illustrated on Figure 8 in Appendix C.

4.7 Clay (CH)

A clay layer was encountered below the silty sand to sandy silt layer in Borehole 106. The top of this layer had an elevation of 126.6 m. Borehole 106 was terminated in this layer.

The moisture content of the sample tested was 32%. The results of grain size analysis testing completed on samples of this material indicated a gravel content of 0%, a sand content of 2%, a silt content of 37%, and a clay content of 61%. The results of the grain size analysis are illustrated on Figure 9 in Appendix C.

The results of Atterberg Limits testing completed on a sample of this material indicated a plastic limit of 26, a liquid limit of 51, and a plasticity index of 25; indicating a clay high plasticity. Atterberg Limits analysis results are illustrated on Figure 10 in Appendix C.

4.8 Glacial Till

A silt and gravel glacial till material with varying amounts of silt was encountered below silty sand stratum in Boreholes 101 to 104.

The top of this layer ranges from elevation 123.5 m to 125.6 m. The thickness of this layer was 0.8 m. Boreholes 101 to 104 were terminated in this stratum. The SPT 'N' values were all greater than 100 indicating a very dense condition.

The moisture content of the samples tested was 5% and 10%. The results of grain size analyses completed on samples of this material indicated a gravel content of 3% and 21%, a sand content of 57% and 72%, and a fines content of 22% and 25%. The results of the grain size analysis are illustrated on Figure 11 in Appendix D.

4.9 Groundwater

The groundwater level in the piezometer installed in Borehole 106 was recorded on April 10th, 2017, at a depth of 0.2 m below existing grade; corresponding to elevation 131.0 m.

It should be noted that Rawdon Creek overtopped its banks and flooded the southern portion of the investigation area.

These observations are considered short-term readings and seasonal fluctuations of the groundwater level are to be expected. The groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

5 MISCELLANEOUS

Thurber staked and/or marked the test hole locations in the field and obtained utility clearances prior to drilling. Thurber surveyed the borehole locations, and determined the ground surface elevations based on contract drawings provided by MTO. Pontil Drilling of Mount Albert, Ontario supplied and operated the drilling equipment to carry out the drilling, sampling, and in-situ testing. The drilling, and sampling operations in the field were supervised on a full-time basis by Mr. Jeff Morrison of Thurber. Laboratory testing was carried out by Thurber in its MTO-approved laboratory in Ottawa. Consolidation testing was carried out by Golder Associates Ltd. MTO-approved laboratory in Mississauga, Ontario. Organic content testing was carried out by Stantec in its MTO approved laboratory in Ottawa.

Overall project management and direction of the field program was provided by Kenton Power, P.Eng. Interpretation of the field data and preparation of this report was completed by Kenton Power, P.Eng. The report was reviewed by Paul Carnaffan, P.Eng. and Dr. P.K. Chatterji, P.Eng., the Designated Principal Contact for MTO Foundations Projects.

Kenton C. Power, P.Eng.
Geotechnical Engineer

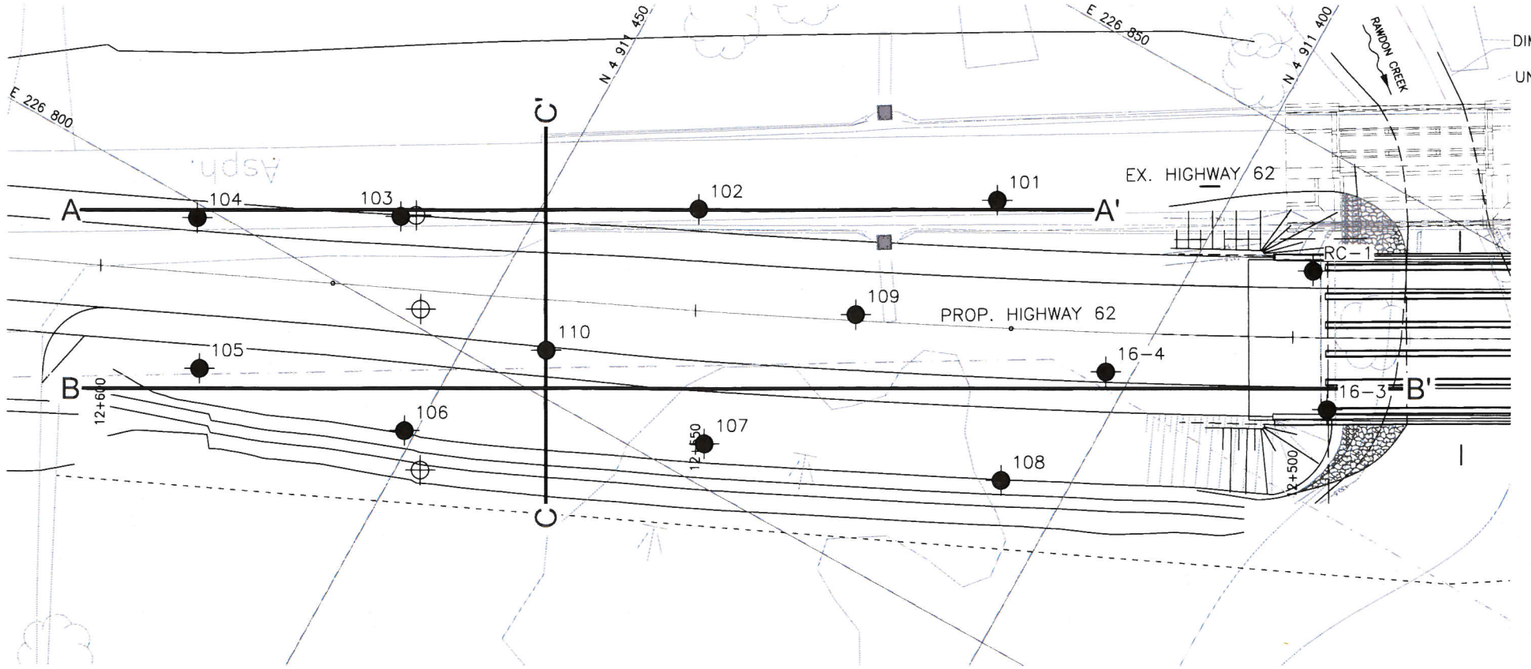
Paul Carnaffan, P.Eng.
Principal, Senior Geotechnical Engineer

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

APPENDIX A

BOREHOLE LOCATIONS AND SOIL STRATA DRAWINGS

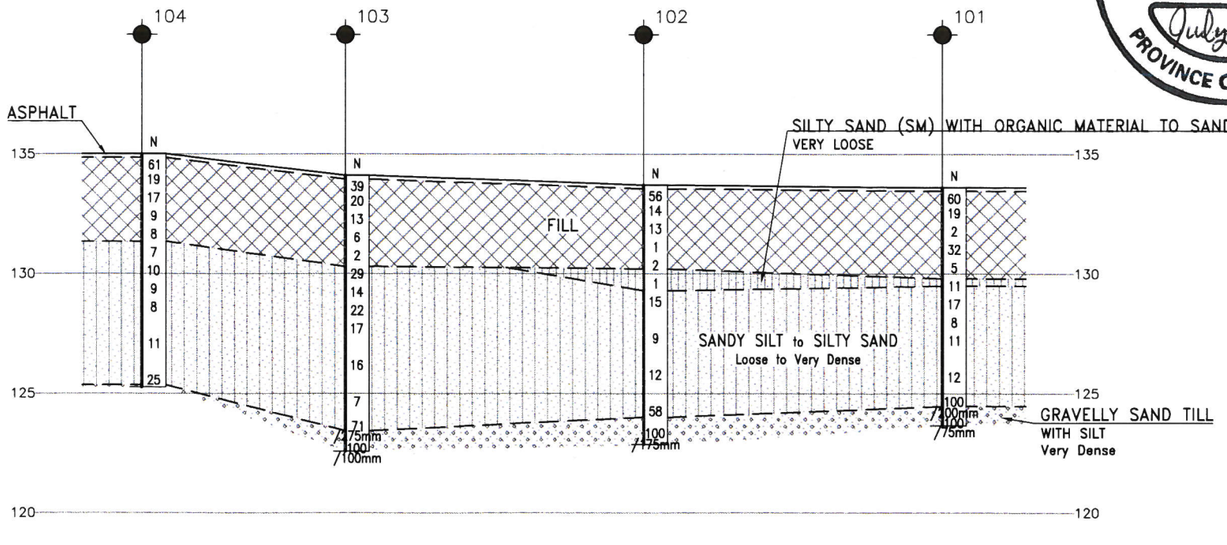
MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

10 0 10 20m

SCALE 1:500



SECTION A–A'

10 0 10 20m H 1:500

5 0 5 10 V 1:250

16–3	131.4	4 911 384.3	226 831.1
16–4	131.4	4 911 402.0	226 824.8

CONT No 2017–4001
GWP No 4044–10–00

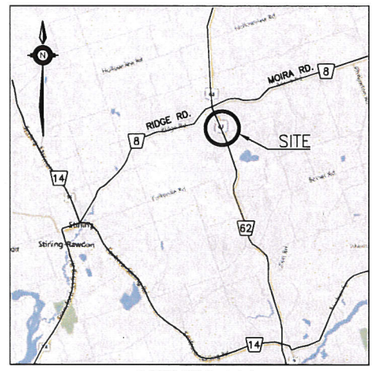
SHEET

HIGHWAY 62
RAWDON CREEK
BRIDGE REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

LEA | MacINTOSH PERRY
Joint Venture

THURBER ENGINEERING LTD.

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



KEYPLAN

LEGEND

●	Borehole
⊕	Borehole and Cone
⊕	Borehole (Thurber Pavement 2016)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level
▼	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
101	133.6	4 911 417.0	226 832.9
102	133.7	4 911 438.4	226 820.1
103	134.1	4 911 459.9	226 807.3
104	134.9	4 911 474.7	226 799.0
105	132.4	4 911 468.4	226 788.1
106	131.2	4 911 450.9	226 791.9
107	130.8	4 911 428.4	226 803.2
108	130.7	4 911 405.3	226 812.6
109	130.9	4 911 422.6	226 818.8
110	131.1	4 911 443.8	226 803.5

-NOTES-

1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
3) Borehole locations are shown in MTM Zone 9 coordinates.

GEOCRES No. 31C-261

K. T. C. POWER
100130652
July 6/17
PROVINCE OF ONTARIO
LICENSED PROFESSIONAL ENGINEER

P. K. CHATTERJI
July 6/17
PROVINCE OF ONTARIO
LICENSED PROFESSIONAL ENGINEER

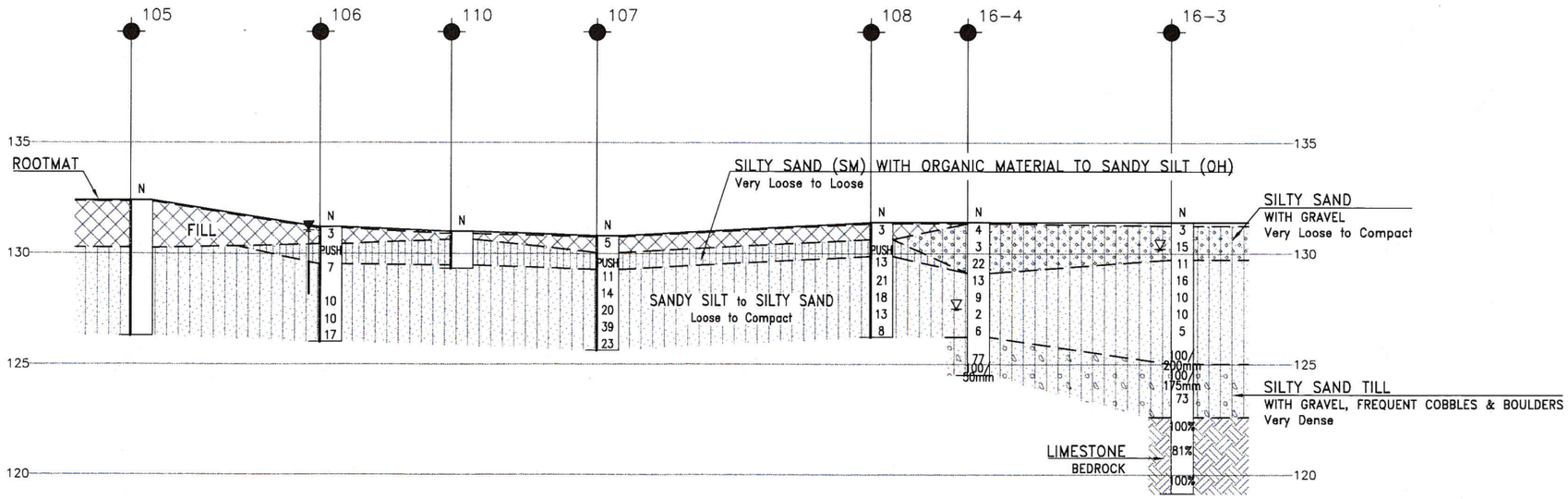
REVISIONS			
	DATE	BY	DESCRIPTION

DESIGN KP	CHK –	CODE	LOAD	DATE	JUL 2017
DRAWN AN	CHK KP	SITE 11–134	STRUCT	DWG 1	

FILENAME: H:\Drafting\18000\18115\TED-18115-BHPP-RC.dwg
PLOTDATE: 7/6/2017 11:41 AM

METRIC

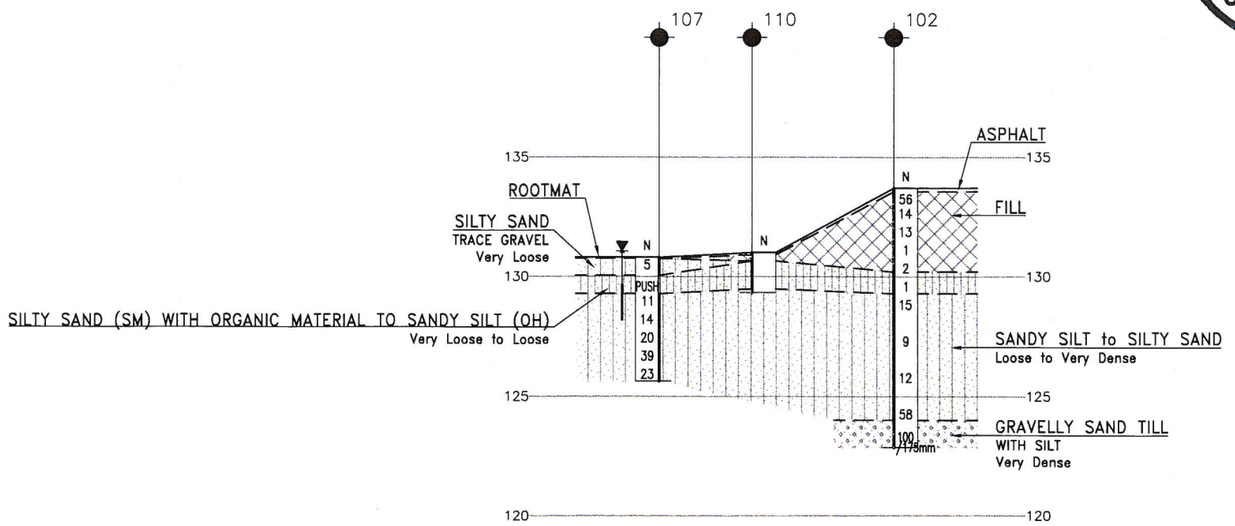
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN



SECTION B–B'

10 0 10 20m H 1:500

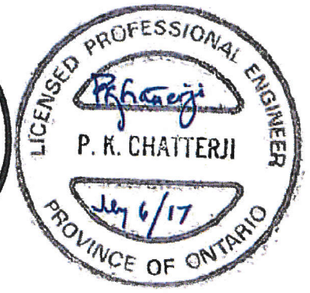
5 0 5 10 V 1:250



SECTION C–C'

10 0 10 20m H 1:500

5 0 5 10 V 1:250



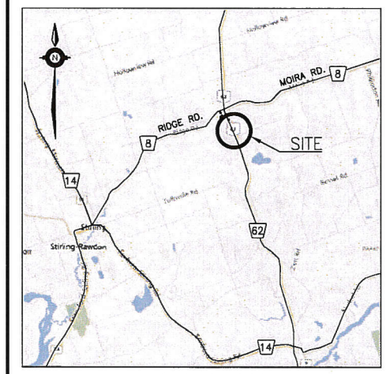
CONT No 2017–4001
GWP No 4044–10–00

HIGHWAY 62
RAWDON CREEK
BRIDGE REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET -

LEA Joint Venture (MacIntosh Perry)

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

●	Borehole
⊕	Borehole and Cone
⊕	Borehole (Thurber Pavement 2016)
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level
▼	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
101	133.6	4 911 417.0	226 832.9
102	133.7	4 911 438.4	226 820.1
103	134.1	4 911 459.9	226 807.3
104	134.9	4 911 474.7	226 799.0
105	132.4	4 911 468.4	226 788.1
106	131.2	4 911 450.9	226 791.9
107	130.8	4 911 428.4	226 803.2
108	130.7	4 911 405.3	226 812.6
109	130.9	4 911 422.6	226 818.8
110	131.1	4 911 443.8	226 803.5
16–3	131.4	4 911 384.3	226 831.1
16–4	131.4	4 911 402.0	226 824.8

-NOTES-

1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
3) Borehole locations are shown in MTM Zone 9 coordinates.

GEOCRES No. 31C-261

REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	KP	CHK –	CODE	LOAD	DATE JUL 2017
DRAWN	AN	CHK KP	SITE 11–134	STRUCT	DWG 2

FILENAME: H:\Drafting\18000\18115\TED-18115-BHPP-RC.dwg
PLOTDATE: 7/6/2017 11:41 AM

APPENDIX B

RECORD OF BOREHOLE SHEETS – EMBANKMENT INVESTIGATION
RECORD OF BOREHOLE SHEETS – RAWDON CREEK BRIDGE INVESTIGATION

THURBER

60 YEARS

SYMBOLS, ABBREVIATIONS AND TERMS USED ON TEST HOLE RECORDS

TERMINOLOGY DESCRIBING COMMON SOIL GENESIS

Topsoil	mixture of soil and humus capable of supporting vegetative growth
Peat	mixture of fragments of decayed organic matter
Till	unstratified glacial deposit which may include particles ranging in sizes from clay to boulder
Fill	material below the surface identified as placed by humans (excluding buried services)

TERMINOLOGY DESCRIBING SOIL STRUCTURE:

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

RECOVERY:

For soil samples, the recovery is recorded as the length of the soil sample recovered.

N-VALUE:

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 63.5 kg hammer falling 0.76 m, required to drive a 50 mm O.D. split spoon sampler 0.3 m into undisturbed soil. For samples where insufficient penetration was achieved and N-value cannot be presented, the number of blows are reported over the sampler penetration in millimetres (e.g. 50/75).

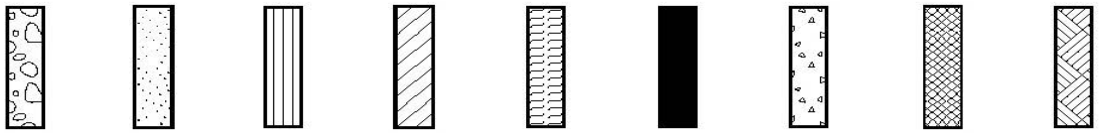
DYNAMIC CONE PENETRATION TEST (DCPT):

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to an “A” size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone 0.3 m into the soil. The DCPT is used as a probe to assess soil variability.

THURBER

60 YEARS

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



Boulders
Cobbles
Gravel

Sand

Silt

Clay

Organics

Asphalt

Concrete

Fill

Bedrock

TEXTURING CLASSIFICATION OF SOILS

Classification	Particle Size
Boulders	Greater than 200 mm
Cobbles	75 – 200 mm
Gravel	4.75 – 75 mm
Sand	0.075 – 4.75 mm
Silt	0.002 – 0.075 mm
Clay	Less than 0.002 mm

SAMPLE TYPES

SS	Split spoon samples
ST	Shelby tube or thin wall tube
DP	Direct push sample
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ etc.	Rock core sample obtained with the use of standard size diamond coring equipment

TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

Descriptive Term	Undrained Shear Strength (kPa)
Very Soft	12 or less
Soft	12 – 25
Firm	25 – 50
Stiff	50 – 100
Very Stiff	100 – 200
Hard	Greater than 200

NOTE: Clay sensitivity is defined as the ratio of the undisturbed strength over the remolded strength.

TERMS DESCRIBING CONSISTENCY (COHESIONLESS SOILS ONLY)

Descriptive Term	SPT "N" Value
Very Loose	Less than 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	Greater than 50

THURBER

60 YEARS

MODIFIED UNIFIED SOIL CLASSIFICATION

Major Divisions		Group Symbol	Typical Description
COARSE GRAINED SOIL	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	SILT AND CLAY SOILS $W_L < 35\%$	ML	Inorganic silts, 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.
		OL	Organic silts and organic silty-clays of low plasticity.
	SILT AND CLAY SOILS $35\% < W_L < 50\%$	MI	Inorganic compressible fine sandy silt with clay of medium plasticity, clayey silts.
		CI	Inorganic clays of medium plasticity, silty clays.
		OI	Organic silty clays of medium plasticity.
	SILT AND CLAY SOILS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy of silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other organic soils.

Note - W_L= Liquid Limit

THURBER

60 YEARS

EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION

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

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1 m in length or larger, as a percentage of total core length
Unconfined Compressive Strength: (UCS)	Axial stress required to break the specimen.
Fracture Index: (FI)	Frequency of natural fractures per 0.3 m of core run.

DISCONTINUITY SPACING

Bedding	Bedding Plane Spacing
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 to 2 m
Medium bedded	0.2 to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 to 60 mm
Laminated	6 to 20 mm
Thinly laminated	Less than 6 mm

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength (MPa)
Extremely Strong	Greater than 250
Very Strong	100 – 250
Strong	50 – 100
Medium Strong	25 – 50
Weak	5 – 25
Very Weak	1 – 5
Extremely Weak	0.25 – 1

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 101 1 OF 2 METRIC

W.P. 4015-E-0015 LOCATION Hwy 62 STN 12+525 2.1 LT CL N 4 911 417.0 E 226 832.9 ORIGINATED BY JM

HWY 62 BOREHOLE TYPE Hollow Stem Auger COMPILED BY KCP

DATUM Geodetic DATE 2017.04.10 - 2017.04.10 CHECKED BY KCP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
133.6											
0.0	**150 mm ASPHALT**										
0.2	Silty sand with gravel Very dense to very loose Brown **FILL**		1	SS	60		133				
			2	SS	19						16 52 32 (SI+CL)
			3	SS	2		132				
	- Frequent cobbles from 1.8 m to 2.4 m										
131.0			4	SS	32		131				
2.6	Sandy clay Firm Brown **FILL**										
			5	SS	5						4 35 45 16
129.8							130				
3.8	**Silty SAND (SM) with organics**										
129.5	Loose		6	SS	11						16.0% organic content
4.1	Dark brown to black										
129.1	**Sandy GRAVEL (GP)** Compact						129				
4.6	Brown		7	SS	17						3 46 51 (SI+CL)
	Silty SAND (SM) to Sandy Silt (ML) trace gravel Loose to compact Brown										
			8	SS	8		128				
			9	SS	11		127				
			10	SS	12		126				0 50 50 (SI+CL)
124.5											
9.1	**Gravelly SAND (SM)** with silt **TILL** Very dense Grey		11	SS	100/200mm		125				21 57 22 (SI+CL)
123.7			12	SS	100		124				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 18115 RAWDON CREEK 2017-04-06.GPJ 2012TEMPLATE(MTO).GDT 7/6/17

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 101 2 OF 2 METRIC

W.P. 4015-E-0015 LOCATION Hwy 62 STN 12+525 2.1 LT CL N 4 911 417.0 E 226 832.9 ORIGINATED BY JM

HWY 62 BOREHOLE TYPE Hollow Stem Auger COMPILED BY KCP

DATUM Geodetic DATE 2017.04.10 - 2017.04.10 CHECKED BY KCP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
10.0	End of Borehole Auger refusal on inferred bedrock				/75mm						

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 18115 RAWDON CREEK 2017-04-06.GPJ 2012TEMPLATE(MTO).GDT 7/6/17

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 102 1 OF 2 METRIC

W.P. 4015-E-0015 LOCATION Hwy 62 STN 12+550 2.4 LT CL N 4 911 438.4 E 226 820.1 ORIGINATED BY JM

HWY 62 BOREHOLE TYPE Hollow Stem Auger COMPILED BY KCP

DATUM Geodetic DATE 2017.04.05 - 2017.04.05 CHECKED BY KCP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
133.7											
0.0	**150 mm ASPHALT**										
0.2	Gravelly sand with silt Very dense Brown		1	SS	56						
132.9	**FILL**						133				
0.8	Silty sand with gravel and occassional cobbles Compact Brown **FILL**		2	SS	14						
			3	SS	13		132				
131.4											
2.3	Silt with sand Very loose Brown to grey **FILL**		4	SS	1		131				
130.2			5	SS	2						5 20 53 22
3.5	**Sandy Organic SILT (OH)** Very loose Dark brown to black		6	SS	1		130				2 32 48 18
129.3											
4.4	**Silty SAND (SM)** trace gravel Loose to compact Brown		7	SS	15		129				
			8	SS	9		128				
			9	SS	12		127				
			10	SS	58		126				1 78 21 (SI+CL)
							125				
123.7							124				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 102 2 OF 2 METRIC

W.P. 4015-E-0015 LOCATION Hwy 62 STN 12+550 2.4 LT CL N 4 911 438.4 E 226 820.1 ORIGINATED BY JM

HWY 62 BOREHOLE TYPE Hollow Stem Auger COMPILED BY KCP

DATUM Geodetic DATE 2017.04.05 - 2017.04.05 CHECKED BY KCP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
10.0	**Gravelly SAND (SM)** with silt **TILL** Very dense Grey										
122.9			11	SS	100		123		o		
10.8	End of Borehole Auger refusal on inferred bedrock				/175mm						

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 18115 RAWDON CREEK 2017-04-06.GPJ 2012TEMPLATE(MTO).GDT 7/6/17

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 103 1 OF 2 METRIC

W.P. 4015-E-0015 LOCATION Hwy 62 STN 12+575 2.6 LT CL N 4 911 459.9 E 226 807.3 ORIGINATED BY JM

HWY 62 BOREHOLE TYPE Hollow Stem Auger COMPILED BY KCP

DATUM Geodetic DATE 2017.04.05 - 2017.04.05 CHECKED BY KCP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
134.1											
0.0	**150 mm ASPHALT**						134				
0.2	Silty sand with gravel Dense Brown **FILL**		1	SS	39				○		
			2	SS	20		133		○		
			3	SS	13		132		○		
131.3			4	SS	6				○		
2.8	Sandy clay Soft Brown to grey **FILL**		5	SS	2		131		○		0 35 47 18
130.3											
3.8	**Silty SAND (SM)** Loose to compact Brown		6	SS	29		130		○		1 60 39 (SI+CL)
			7	SS	14		129		○		
			8	SS	22		128		○		
			9	SS	17				○		
			10	SS	16		127		○		
			11	SS	7		126		○		
							125		○		0 74 26 (SI+CL)

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 103 2 OF 2 METRIC

W.P. 4015-E-0015 LOCATION Hwy 62 STN 12+575 2.6 LT CL N 4 911 459.9 E 226 807.3 ORIGINATED BY JM

HWY 62 BOREHOLE TYPE Hollow Stem Auger COMPILED BY KCP

DATUM Geodetic DATE 2017.04.05 - 2017.04.05 CHECKED BY KCP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
123.5	**Silty SAND (SM)** Loose to compact						124				
10.7	**Gravelly SAND (SM)** with silt **TILL** Very dense grey		12	SS	71 /275mm		123		○		
122.6			13	SS	100 /100mm				○		
11.5	End of Borehole Splitspoon refusal on inferred bedrock										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 18115 RAWDON CREEK 2017-04-06.GPJ 2012TEMPLATE(MTO).GDT 7/6/17

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 104 1 OF 1 METRIC

W.P. 4015-E-0015 LOCATION Hwy 62 STN 12+600 2.4 LT CL N 4 911 474.7 E 226 799.0 ORIGINATED BY JM

HWY 62 BOREHOLE TYPE Hollow Stem Auger COMPILED BY KCP

DATUM Geodetic DATE 2017.04.05 - 2017.04.05 CHECKED BY KCP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
135.0											
0.0	**150 mm ASPHALT**										
0.2	Silty sand with gravel Very dense Brown **FILL**		1	SS	61				○		
			2	SS	19		134		○		
			3	SS	17		133		○		
132.6	- organics 2.1 m to 2.15 m										
2.3	Sandy clay Firm to stiff Brown to grey **FILL**		4	SS	9				○		
			5	SS	8		132		○		
131.3											
3.7	**Silty SAND (SM)** Loose to compact Brown		6	SS	7		131		○		
			7	SS	10		130		○		3 57 40 (SI+CL)
			8	SS	9				○		
			9	SS	8		129		○		0 62 38 (SI+CL)
			10	SS	11		128		○		
							127		○		
125.6							126				
9.4	**Gravelly SAND (SM)** with silt **TILL** Very dense Brown		11	SS	25				○		3 72 25 (SI+CL)
125.2											
9.8	End of Borehole										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE

ONTMT4S 18115 RAWDON CREEK 2017-04-06.GPJ 2012TEMPLATE(MTO).GDT 7/6/17

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 105 1 OF 1 METRIC

W.P. 4015-E-0015 LOCATION Hwy 62 STN 12+592 15 LT CL N 4 911 468.4 E 226 788.1 ORIGINATED BY JM

HWY 62 BOREHOLE TYPE Hollow Stem Auger COMPILED BY KCP

DATUM Geodetic DATE 2017.04.03 - 2017.04.03 CHECKED BY KCP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
132.4											
0.0 / 0.1	**Rootmat**										
	Sandy clay Firm to stiff Brown to grey **FILL**		1	SS	4		132				
			2	SS	9		131				
130.3			3	SS	10						0 6 43 51
2.1	**Silty SAND (SM)** Loose to compact Brown		4	SS	11		130				
			5	SS	8		129				3 54 43 (SI+CL)
			6	SS	10		128				
127.3			1.5	SS	7						
5.2	End of Borehole										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 / 10 / 5 (%) STRAIN AT FAILURE

ONTMT4S 18115 RAWDON CREEK 2017-04-06.GPJ 2012TEMPLATE(MTO).GDT 7/6/17

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 106 1 OF 1 METRIC

W.P. 4015-E-0015 LOCATION Hwy 62 STN 12+575 20.5 LT CL N 4 911 450.9 E 226 791.9 ORIGINATED BY JM

HWY 62 BOREHOLE TYPE Hollow Stem Auger COMPILED BY KCP

DATUM Geodetic DATE 2017.04.03 - 2017.04.03 CHECKED BY KCP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
131.2											
0.0 / 0.1	**Rootmat**						131				
	Silty sand trace gravel Loose Brown		1	SS	3						
130.4	**FILL**										
0.8	**Sandy Organic SILT (OH)** Black		2	ST	PUSH		130		197 151		35.2% organic content
129.5									172		33.7% organic content
1.7	**Silty SAND (SM) to Sandy SILT (ML)** Loose to compact Brown		3	SS	7		129				
			4	SS	10		128				
			5	SS	10		127				
126.6											
4.6	**CLAY (CH)** Very stiff Brown		6	SS	17						0 2 37 61
126.0							126				
5.2	End of Borehole Groundwater level was measured in piezometer at 0.16 BGS (elev. 131.0 m) on 2017-04-10										

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

ONTMT4S 18115 RAWDON CREEK 2017-04-06.GPJ 2012TEMPLATE(MTO).GDT 7/6/17

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 107 1 OF 1 METRIC

W.P. 4015-E-0015 LOCATION Hwy 62 STN 12+550 22 LT CL N 4 911 428.4 E 226 803.2 ORIGINATED BY JM

HWY 62 BOREHOLE TYPE Hollow Stem Auger COMPILED BY KCP

DATUM Geodetic DATE 2017.04.03 - 2017.04.03 CHECKED BY KCP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
130.8											
0.0 / 0.1	**Rootmat**										
	Silty sand trace gravel Loose Grey		1	SS	5				○		
130.0	**FILL**						130				
0.8	**Silty SAND (SM) with organics** Black		2	ST	PUSH				○		0 51 49 0 13.8% organic content
129.2							129		○		
1.5	**Sandy GRAVEL (GP)** Compact Brown		3	SS	11						56 39 5 (SI+CL)
128.6											
2.1	**Silty SAND (SM)** Compact to dense Brown		4	SS	14		128				
			5	SS	20				○		
							127				
			6	SS	39				○		
			7	SS	23		126		○		1 85 14 (SI+CL)
125.6											
5.2	End of Borehole										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 18115 RAWDON CREEK 2017-04-06.GPJ 2012TEMPLATE(MTO).GDT 7/6/17

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 108 1 OF 1 METRIC

W.P. 4015-E-0015 LOCATION Hwy 62 STN 12+525 25.5 LT CL N 4 911 405.3 E 226 812.6 ORIGINATED BY JM

HWY 62 BOREHOLE TYPE Hollow Stem Auger COMPILED BY KCP

DATUM Geodetic DATE 2017.04.03 - 2017.04.03 CHECKED BY KCP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
130.7											
0.0 / 0.1	**Rootmat**										
	Silty sand trace gravel Very loose Grey		1	SS	3						0 67 33 (SI+CL)
129.9	**FILL**						130				
0.8	**Silty SAND (SM) with organics** Black		2	ST	PUSH				87		0 66 34 0 16.2% organic content
129.2											
1.5	**Silty SAND (SM) to Sandy SILT (ML)** Loose to compact Brown		3	SS	13		129				
			4	SS	21		128				
			5	SS	18						
			6	SS	13		127				0 35 65 (SI+CL)
			7	SS	8		126				
125.5											
5.2	End of Borehole										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 18115 RAWDON CREEK 2017-04-06.GPJ 2012TEMPLATE(MTO).GDT 7/6/17

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 109 1 OF 1 METRIC

W.P. 4015-E-0015 LOCATION Hwy 62 STN 12+537 11.5 LT CL N 4 911 425.9 E 226 824.6 ORIGINATED BY JM

HWY 62 BOREHOLE TYPE Solid Stem Auger COMPILED BY KCP

DATUM Geodetic DATE 2017.04.03 - 2017.04.03 CHECKED BY KCP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
130.9											
0.0	**Rootmat**										
0.1 / 130.5	Sandy clay		1	AS							
0.4	Brown										
	FILL		2	AS							0 74 21 5
	Silty SAND (SM) with organics						130				
129.8	Black										
1.0	**Silty SAND (SM)**										
	Grey										
129.2											
1.7	End of Borehole										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 18115 RAWDON CREEK 2017-04-06.GPJ 2012TEMPLATE(MTO).GDT 7/6/17

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 110 1 OF 1 METRIC

W.P. 4015-E-0015 LOCATION Hwy 62 STN 12+537 11.5 LT CL N 4 911 443.8 E 226 803.5 ORIGINATED BY JM

HWY 62 BOREHOLE TYPE Solid Stem Auger COMPILED BY KCP

DATUM Geodetic DATE 2017.04.03 - 2017.04.03 CHECKED BY KCP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
131.1												
0.0	**Rootmat**						131					
0.1 / 130.8	Sandy clay Brown **FILL**											
0.4	**Sandy Organic SILT (OH)** Black		1	AS			130			w 172		0 14 75 11 27.9% organic content
129.6												
129.5 / 1.5	**Silty SAND (SM)** Grey											
1.7	End of Borehole											

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 18115 RAWDON CREEK 2017-04-06.GPJ 2012TEMPLATE(MTO).GDT 7/6/17

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 16-3 1 OF 2 METRIC

GWP# 4044-10-00 LOCATION Highway 62 Rawdon Creek Bridge, MTM Zone 9: N 4 911 384.3 E 226 831.1 ORIGINATED BY CAM

HWY 62 BOREHOLE TYPE Hollow Stem Auger / HQ Coring COMPILED BY CAM

DATUM Geodetic DATE 2016.10.03 - 2016.10.03 CHECKED BY KCP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
131.4											
0.0	**150 mm ROOTMAT**										
0.2	**Silty SAND (SM)** with gravel Very loose to compact Brown		1	SS	3		131				
			2	SS	15		130				
129.7											
1.7	**Sandy SILT (ML)** to **Silty SAND (SM)** Loose to compact Brown		3	SS	11		129				
			4	SS	16						
			5	SS	10		128				0 28 69 3
			6	SS	10						0 43 57 (SI+CL)
			7	SS	5		127				
							126				
125.0			8	SS	100/200mm		125				
6.4	**Silty SAND (SM)** with gravel, **TILL** - frequent cobbles and occasional boulders Very dense Brown		9	SS	100/175mm						
	- Boulder at 7.7 m to 8.0 m		10	SS	73		124				22 59 19 (SI+CL)
122.6							123				
8.8	**BEDROCK** Limestone Slightly weathered Thinly to moderate bedding Excellent quality Grey		1	HQ			122				RUN #1 TCR=100% SCR=100% RQD=100%

Continued Next Page

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 16-3 2 OF 2 METRIC

GWP# 4044-10-00 LOCATION Highway 62 Rawdon Creek Bridge, MTM Zone 9: N 4 911 384.3 E 226 831.1 ORIGINATED BY CAM

HWY 62 BOREHOLE TYPE Hollow Stem Auger / HQ Coring COMPILED BY CAM

DATUM Geodetic DATE 2016.10.03 - 2016.10.03 CHECKED BY KCP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	BEDROCK Limestone Slightly weathered Moderate bedding Strong to very strong strength Good to excellent quality Grey		2	HQ			121				RUN #2 TCR=98% SCR=98% RQD=81%
			3	HQ			120				RUN #3 TCR=100% SCR=100% RQD=100%
119.1											
12.3	End of Borehole Groundwater level measured in the monitoring well at 0.95 m BGS (elev. 130.5 m) on 2016-10-24										
	Strong to very strong strength										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\overset{20}{15\oplus 5}$ (%) STRAIN AT FAILURE
10

ONTMT4S RAWDON CREEK BRIDGE.GPJ 2012TEMPLATE(MTO).GDT 23/11/16

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 16-4 1 OF 1 METRIC

GWP# 4044-10-00 LOCATION Highway 62 Rawdon Creek Bridge, MTM Zone 9: N 4 911 402.0 E 226 824.8 ORIGINATED BY CAM

HWY 62 BOREHOLE TYPE Hollow Stem Auger COMPILED BY CAM

DATUM Geodetic DATE 2016.10.04 - 2016.10.04 CHECKED BY KCP

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
131.4											
0.0 / 0.1	**50 mm ROOTMAT**										
	Silty SAND (SM) with gravel Very loose to compact Brown to grey		1	SS	4		131				
			2	SS	3		130				
	- slight hydro-carbon odour in sample SS3		3	SS	22						
129.1											
2.3	**Sandy SILT (ML)** to **Silty SAND (SM)** Loose to compact Brown		4	SS	13		129				6 46 48 (SI+CL)
			5	SS	9		128				
			6	SS	2	▼	127				
			7	SS	6						
126.2											
5.2	**Silty SAND (SM)** with gravel, **TILL** - frequent cobbles and occasional boulders Very dense Brown		8	SS	77		126				
							125				29 50 21 (SI+CL)
124.5			9	SS	100/50mm						
6.9	End of Borehole Split Spoon refusal on inferred boulder Groundwater level was measured in the open borehole at 3.9 m BGS (elev. 127.5 m)										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

ONTMT4S RAWDON CREEK BRIDGE.GPJ 2012TEMPLATE(MTO).GDT 23/11/16

APPENDIX C

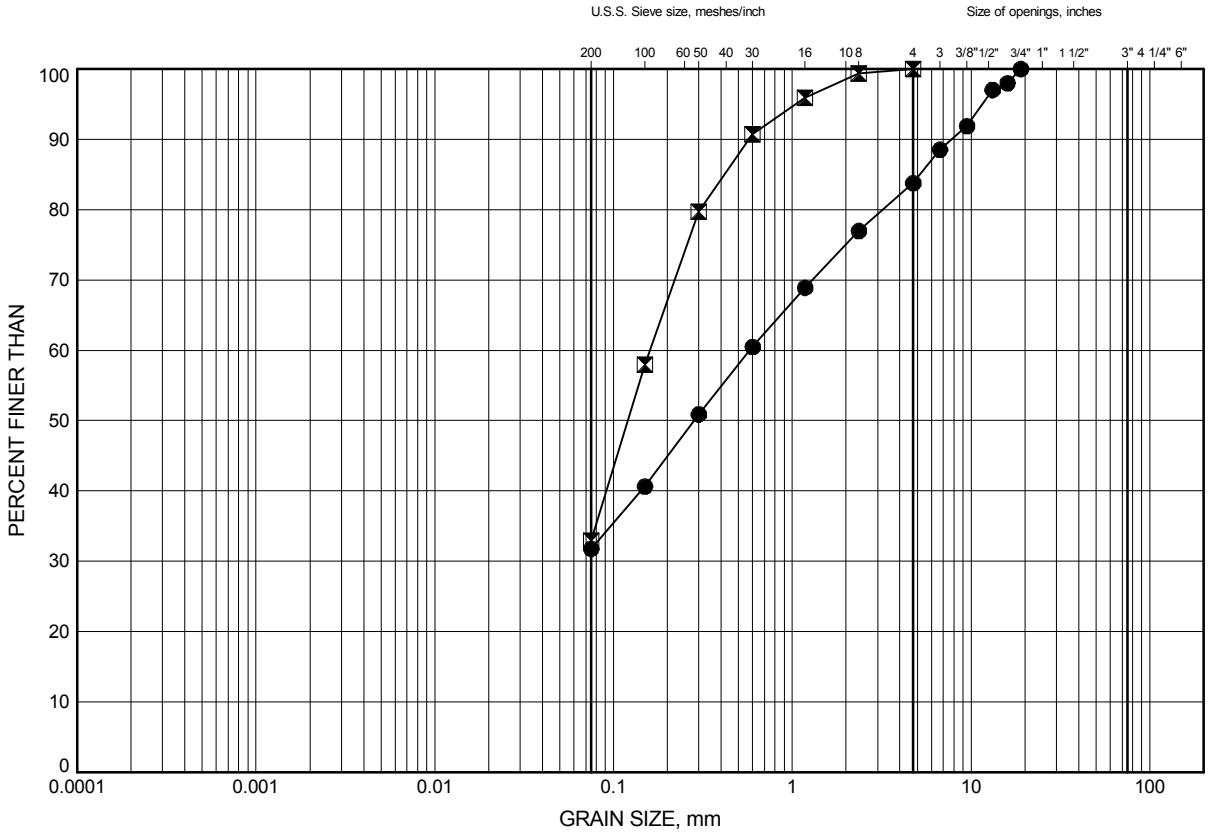
LABORATORY TEST RESULTS

Rawdon Creek

GRAIN SIZE DISTRIBUTION

FIGURE 1

Fill



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	101	1.07	132.57
⊠	108	0.30	130.39

Date May 2017

W.P. 4015-E-0015

THURBER

Prep'd KCP

Chkd. PC

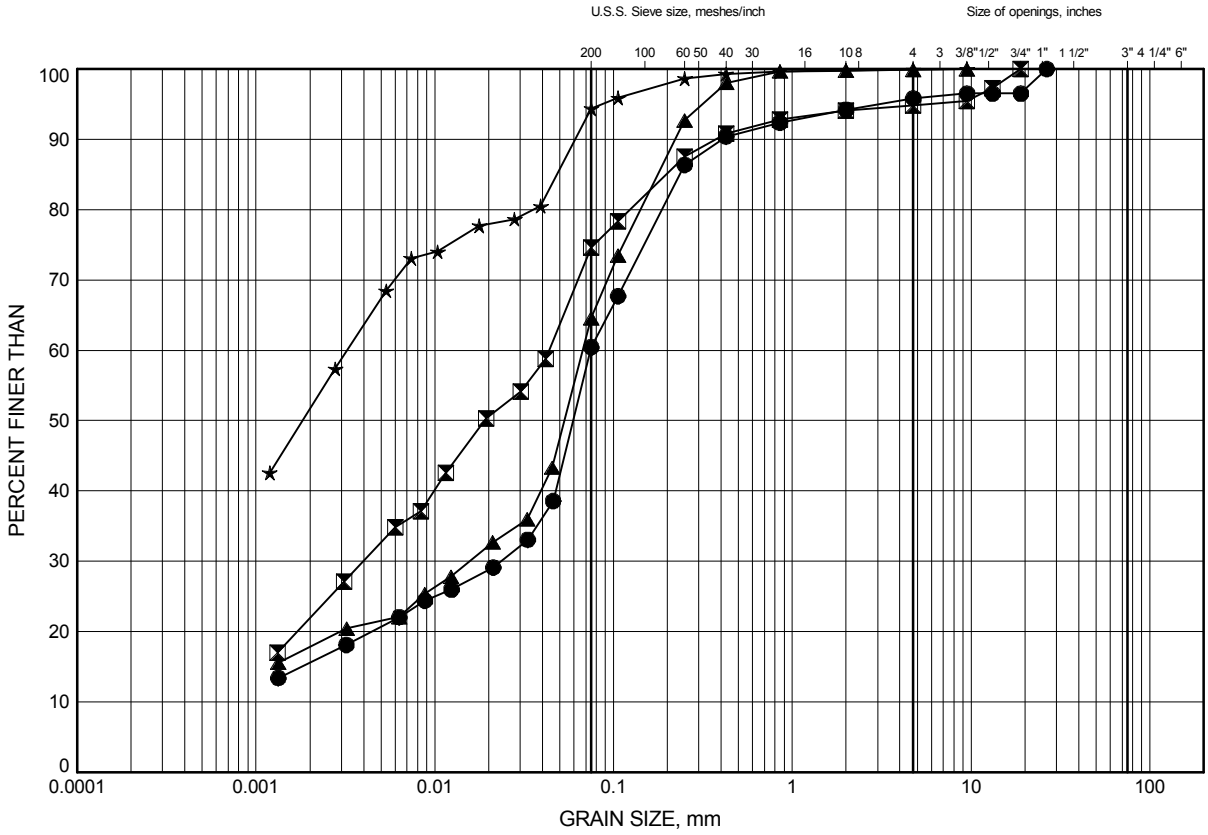
GRAIN SIZE DISTRIBUTION - THURBER 18115 RAWDON CREEK 2017-04-06.GPJ 29/5/17

Rawdon Creek Highway 62 Embankment

GRAIN SIZE DISTRIBUTION

FIGURE 2

Fill: Sandy Clay to Silt with Sand



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	101	3.35	130.29
⊠	102	3.28	130.43
▲	103	3.35	130.78
★	105	1.83	130.61

Date June 2017

W.P. 4015-E-0015

THURBER

Prep'd KCP

Chkd. PC

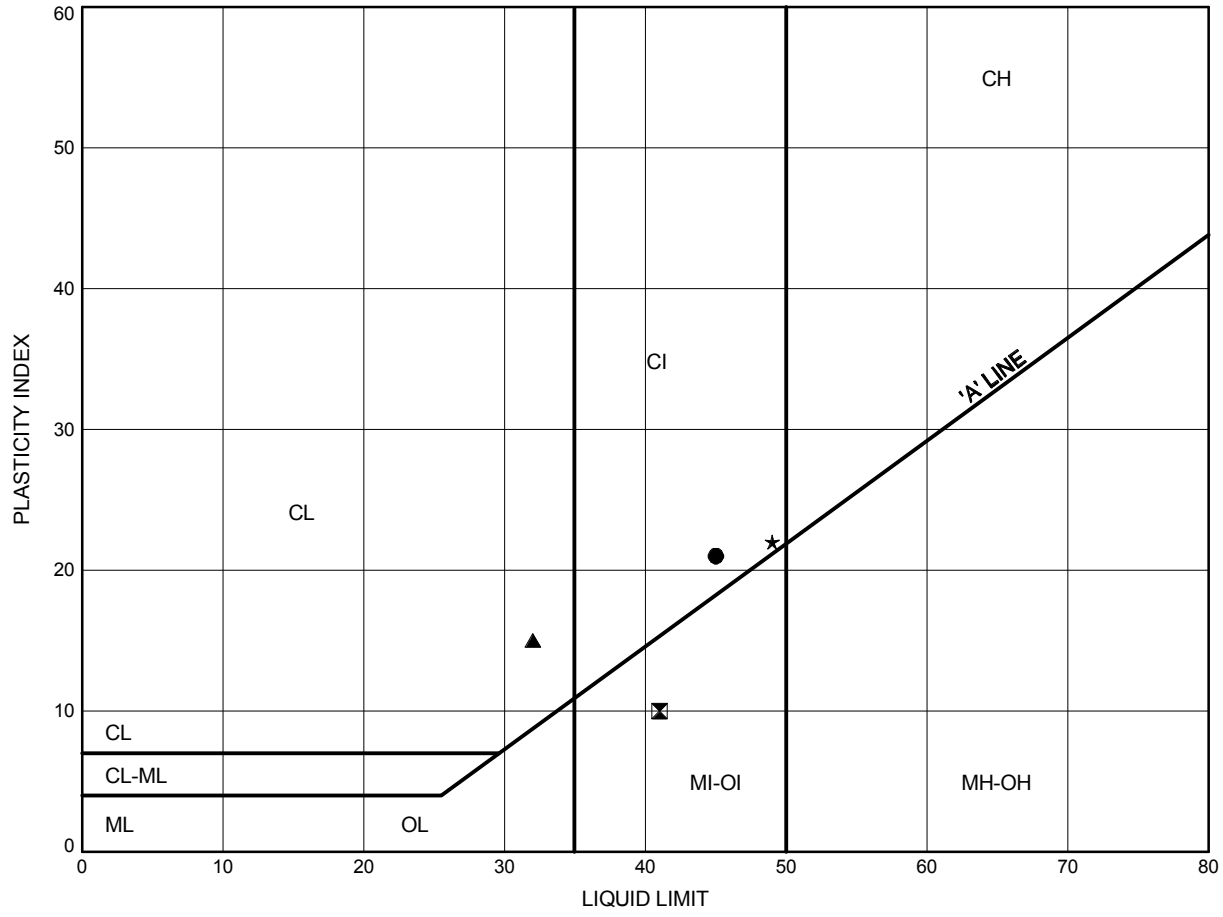
GRAIN SIZE DISTRIBUTION - THURBER 18115 RAWDON CREEK 2017-04-06.GPJ 7/6/17

Rawdon Creek Highway 62 Embankment

ATTERBERG LIMITS TEST RESULTS

FIGURE 3

FILL: Sandy Clay to Silt with Sand



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	101	3.35	130.29
⊠	102	3.28	130.43
▲	103	3.35	130.78
★	105	1.83	130.61

Date June 2017

W.P. 4015-E-0015

THURBER

Prep'd KCP

Chkd. PC

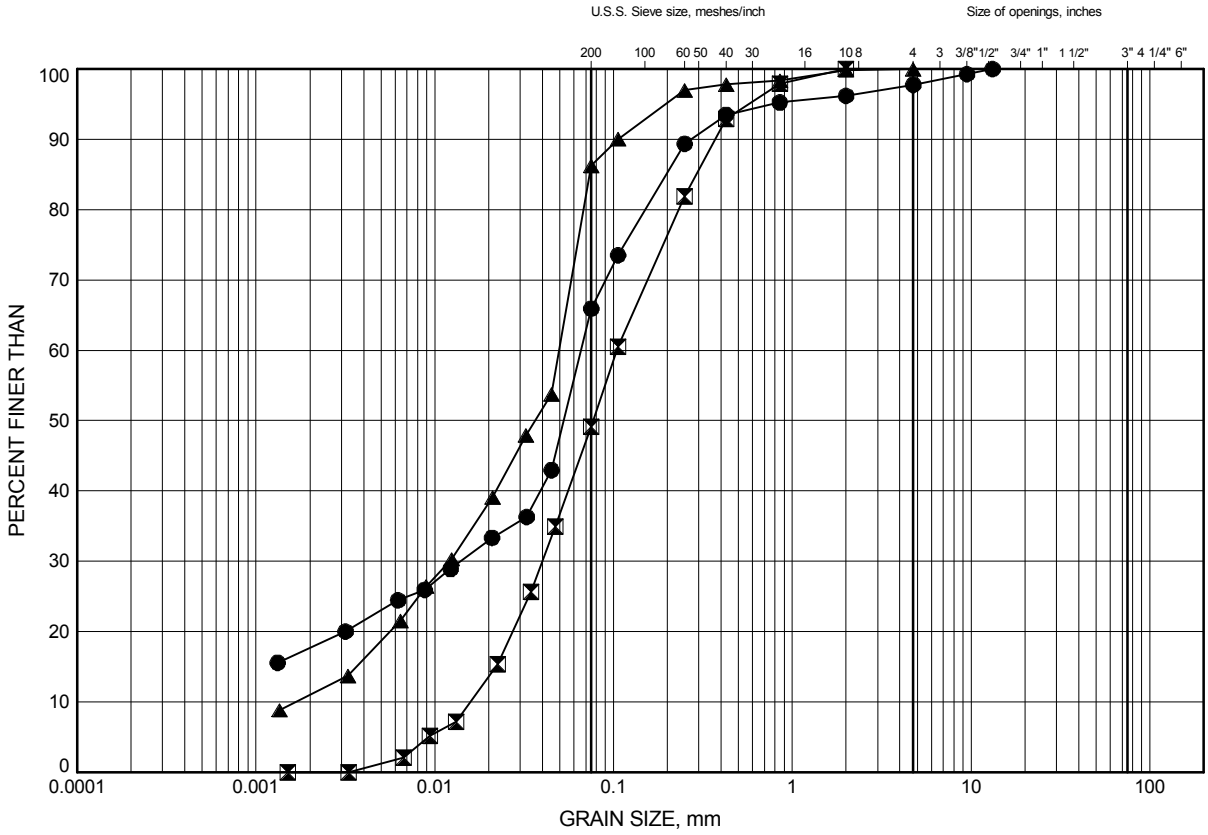
THURBALT 18115 RAWDON CREEK 2017-04-06.GPJ 7/6/17

Rawdon Creek Highway 62 Embankment

GRAIN SIZE DISTRIBUTION

FIGURE 4

Sandy Organic Silt (OH)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	102	4.04	129.66
⊠	107	1.07	129.69
▲	110	1.22	129.91

Date May 2017

W.P. 4015-E-0015

THURBER

Prep'd KCP

Chkd. PC

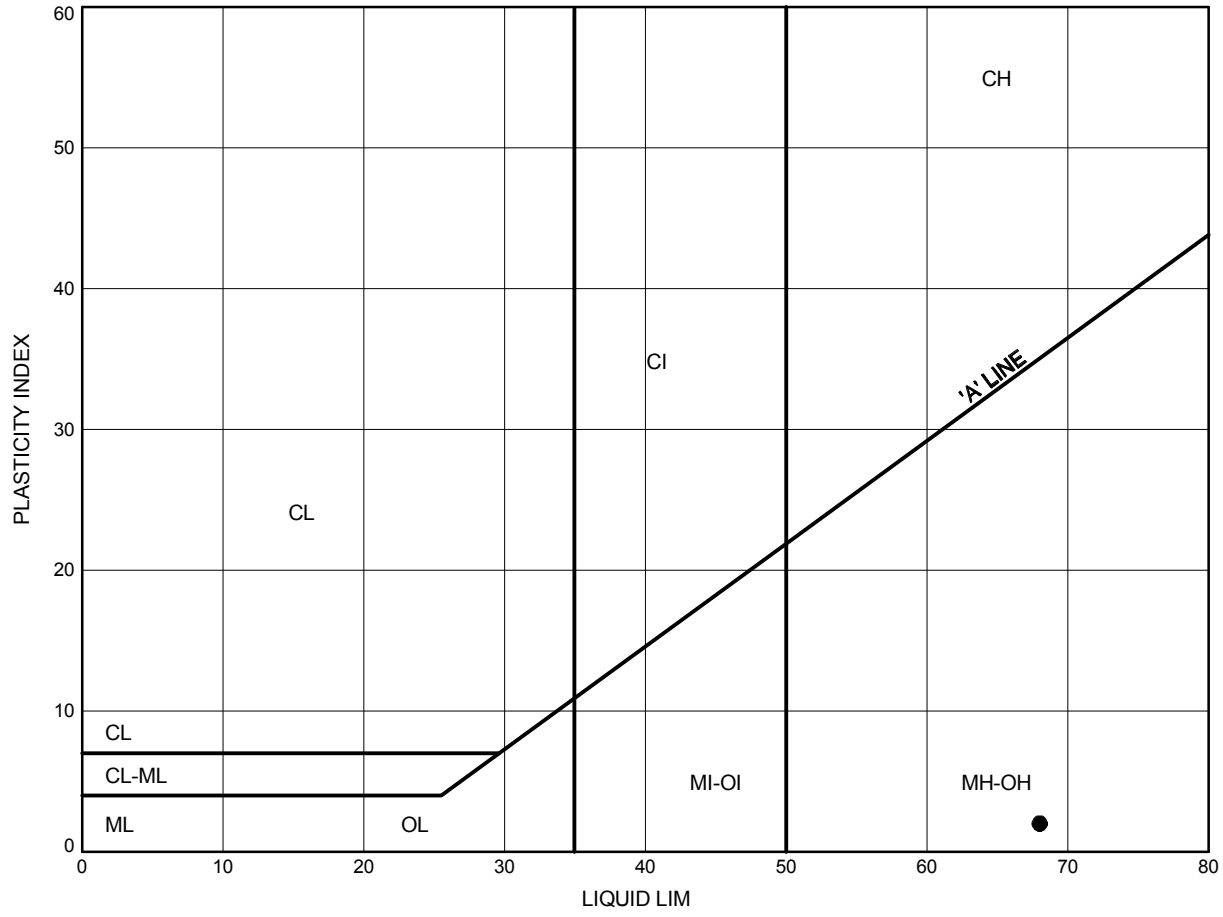
GRAIN SIZE DISTRIBUTION - THURBER 18115 RAWDON CREEK 2017-04-06.GPJ 30/5/17

Rawdon Creek Highway 62 Embankment

ATTERBERG LIMITS TEST RESULTS

FIGURE 5

Sandy Organic Silt (OH)



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	106	1.07	130.09

Date May 2017

W.P. 4015-E-0015

THURBER

Prep'd KCP

Chkd. PC

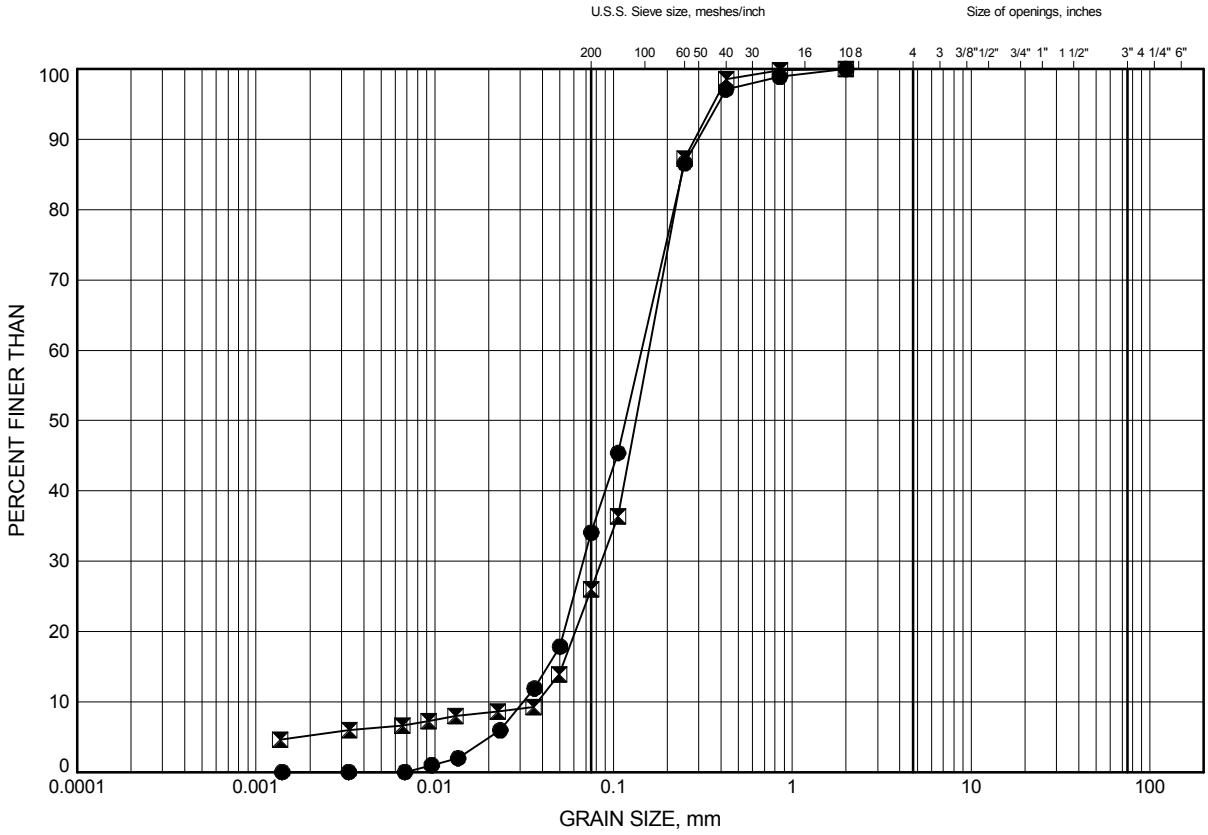
THURBALT 18115 RAWDON CREEK 2017-04-06.GPJ 29/5/17

Rawdon Creek Highway 62 Embankment

GRAIN SIZE DISTRIBUTION

FIGURE 6

Silty Sand (SM) with organics



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	108	1.07	129.63
⧓	109	0.67	130.18

Date May 2017

W.P. 4015-E-0015

THURBER

Prep'd KCP

Chkd. PC

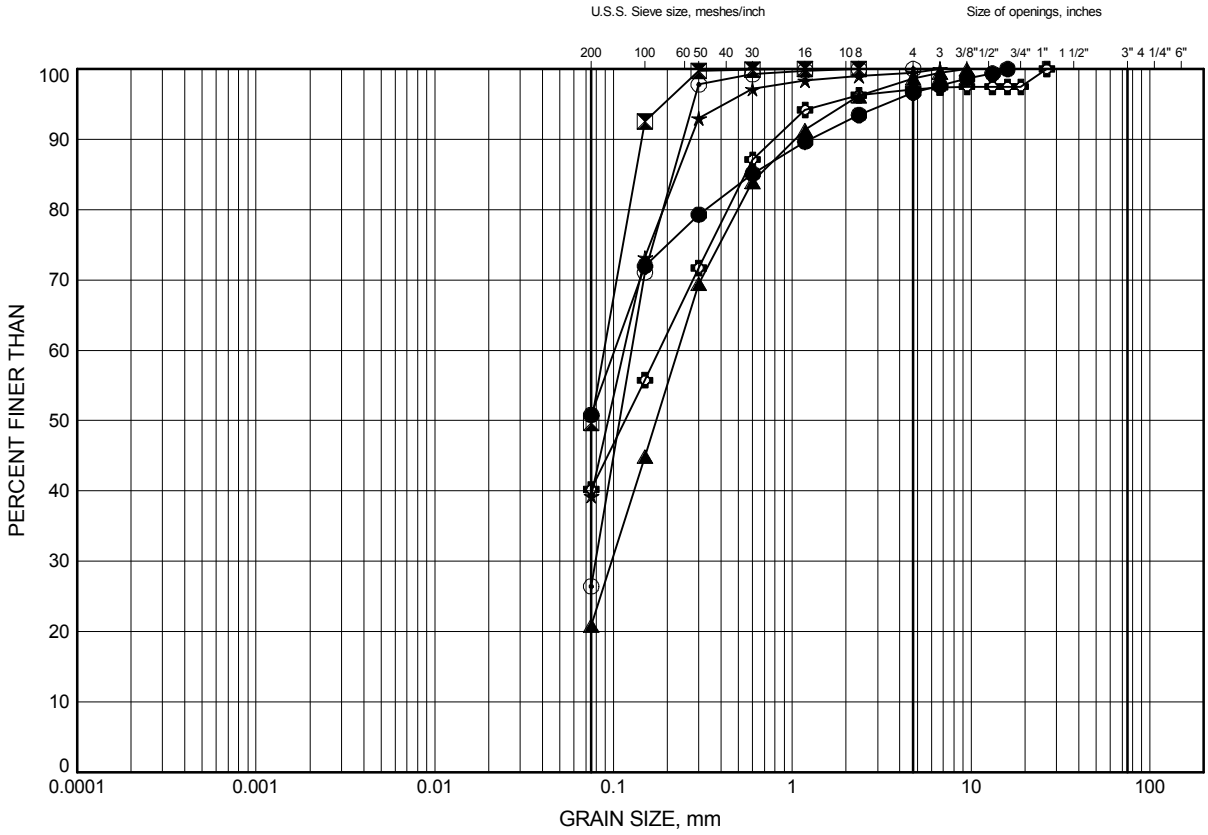
GRAIN SIZE DISTRIBUTION - THURBER 18115 RAWDON CREEK 2017-04-06.GPJ 30/5/17

Rawdon Creek Highway 62 Embankment

GRAIN SIZE DISTRIBUTION

FIGURE 7

Sitly Sand (SM) to Sandy Silt (ML)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	101	4.88	128.76
⊠	101	7.92	125.71
▲	102	7.92	125.78
★	103	4.04	130.09
⊙	103	9.45	124.68
✿	104	4.88	130.08

Date May 2017

W.P. 4015-E-0015

THURBER

Prep'd KCP

Chkd. PC

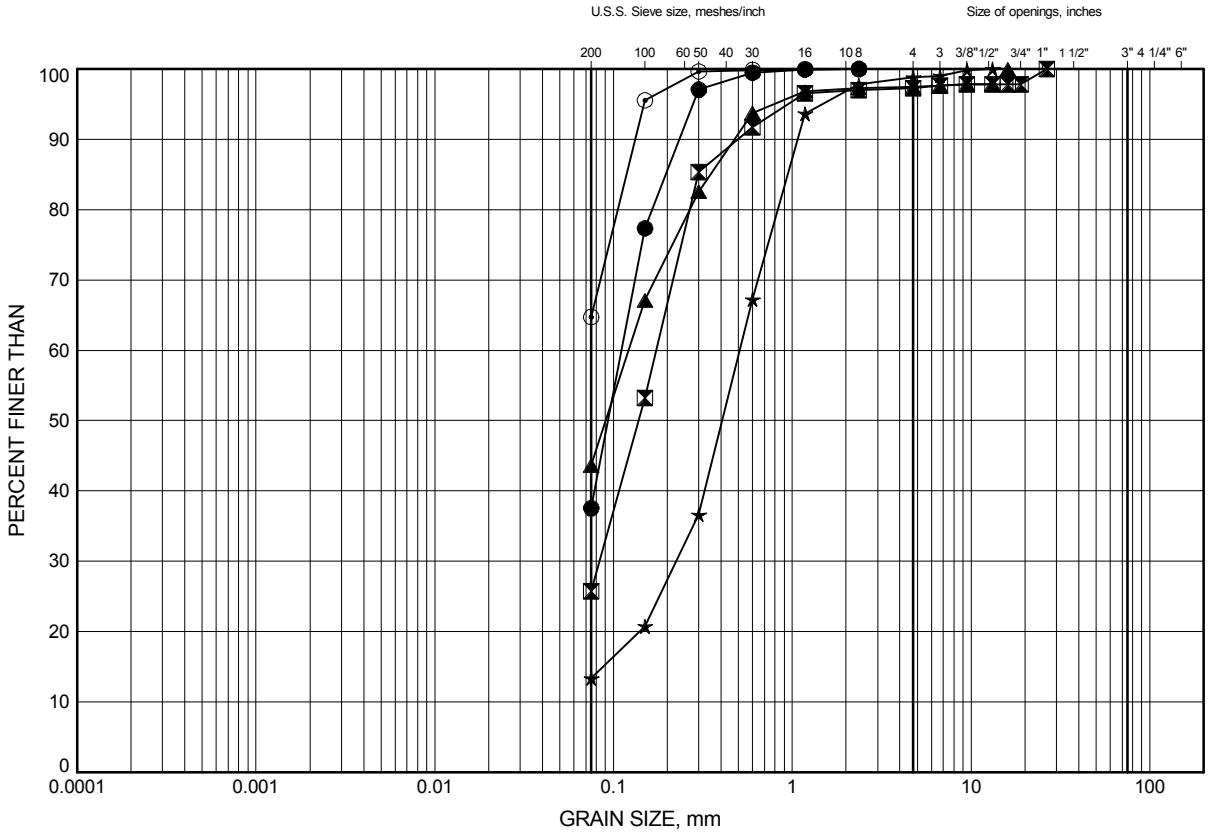
GRAIN SIZE DISTRIBUTION - THURBER 18115 RAWDON CREEK 2017-04-06.GPJ 30/5/17

Rawdon Creek Highway 62 Embankment

GRAIN SIZE DISTRIBUTION

FIGURE 8

Sitly Sand (SM) to Sandy Silt (ML)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	104	6.40	128.55
⊠	104	9.39	125.57
▲	105	3.35	129.09
★	107	4.88	125.88
⊙	108	4.11	126.58

Date May 2017

W.P. 4015-E-0015

THURBER

Prep'd KCP

Chkd. PC

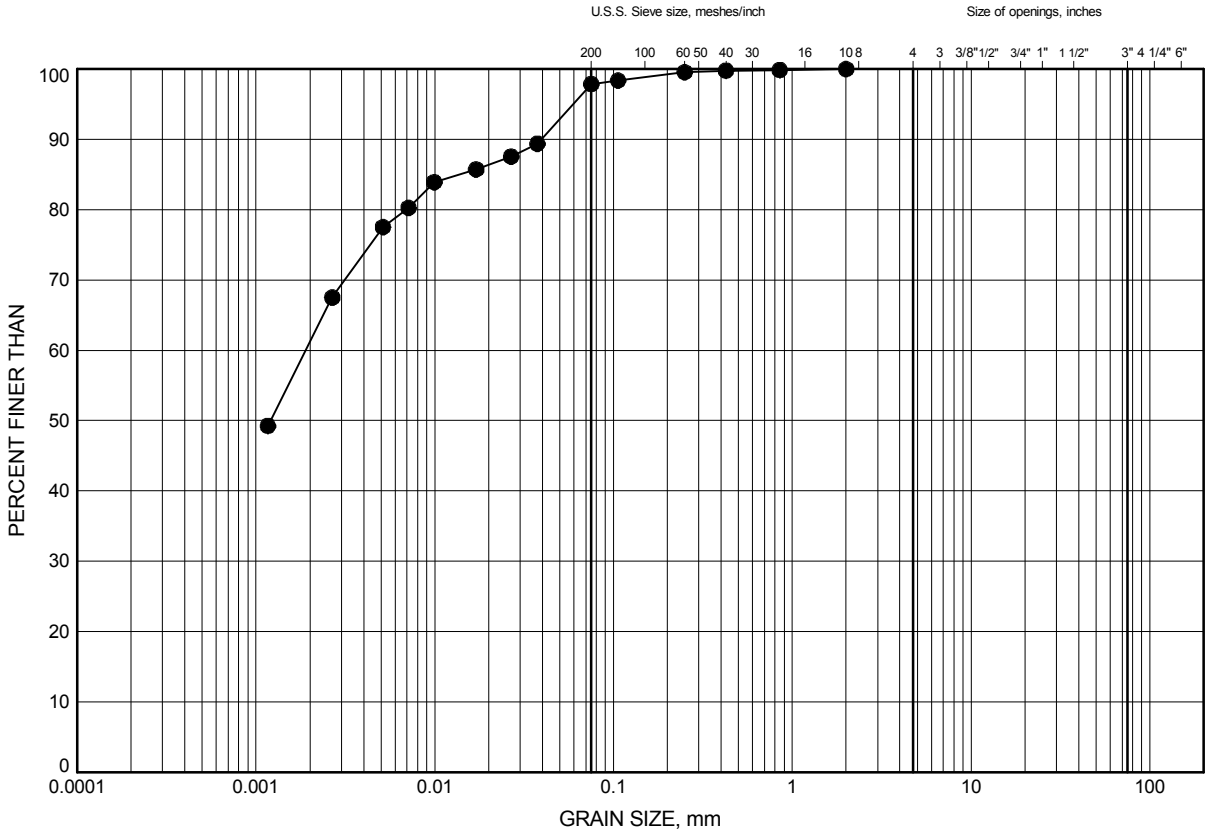
GRAIN SIZE DISTRIBUTION - THURBER 18115 RAWDON CREEK 2017-04-06.GPJ 30/5/17

Rawdon Creek Highway 62 Embankment

GRAIN SIZE DISTRIBUTION

FIGURE 9

Clay (CH)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	106	4.88	126.28

Date May 2017

W.P. 4015-E-0015

THURBER

Prep'd KCP

Chkd. PC

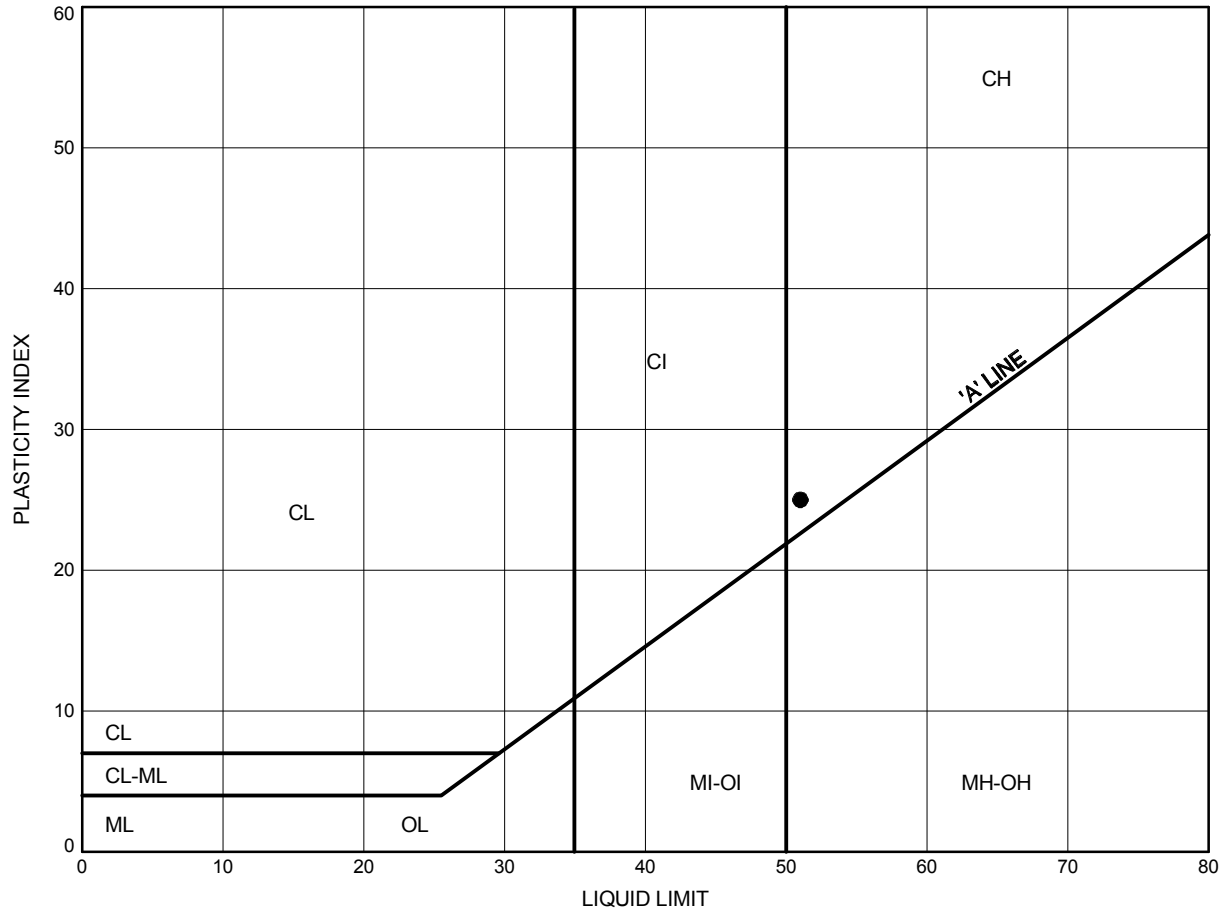
GRAIN SIZE DISTRIBUTION - THURBER 18115 RAWDON CREEK 2017-04-06.GPJ 30/5/17

Rawdon Creek Highway 62 Embankment

ATTERBERG LIMITS TEST RESULTS

FIGURE 10

Clay (CH)



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	106	4.88	126.28

Date May 2017

W.P. 4015-E-0015

THURBER

Prep'd KCP

Chkd. PC

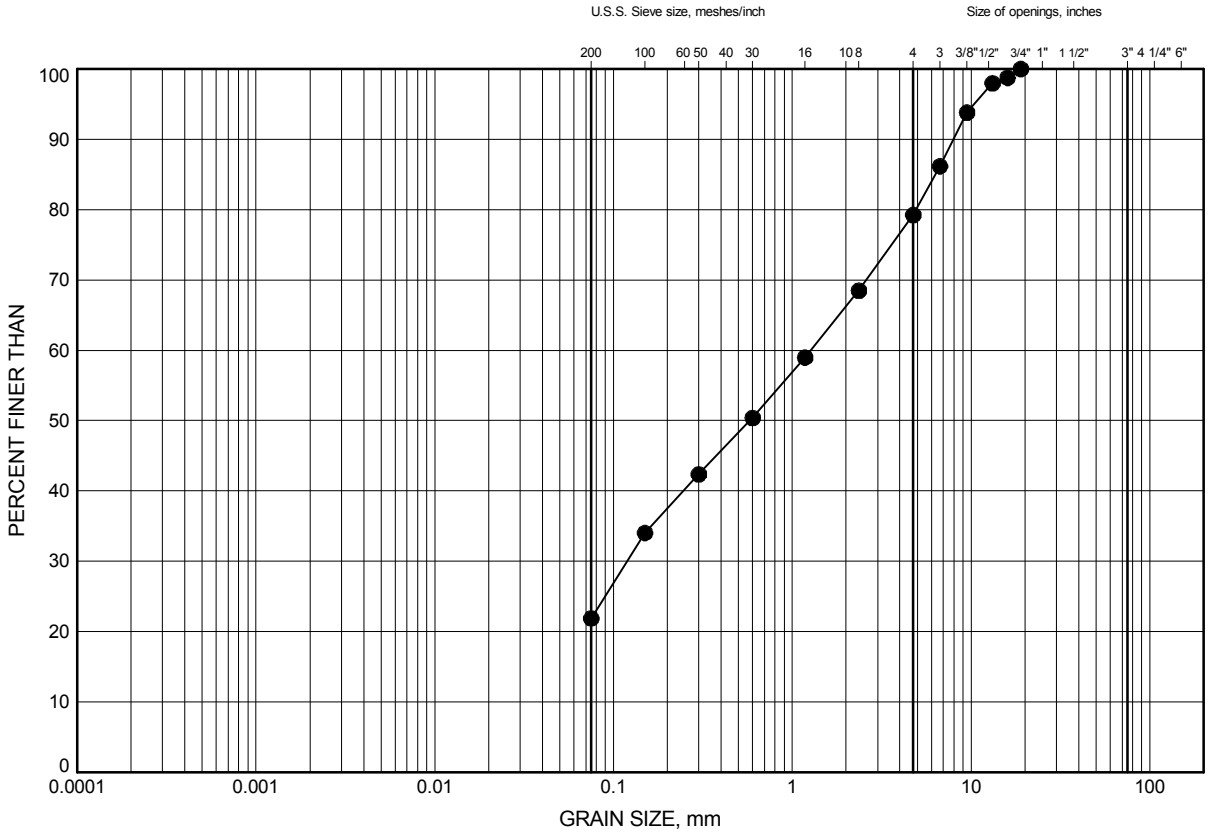
THURBALT 18115 RAWDON CREEK 2017-04-06.GPJ 30/5/17

Rawdon Creek Highway 62 Embankment

GRAIN SIZE DISTRIBUTION

FIGURE 11

Till



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	101	9.30	124.34

Date May 2017

W.P. 4015-E-0015

THURBER

Prep'd KCP

Chkd. PC

GRAIN SIZE DISTRIBUTION - THURBER 18115 RAWDON CREEK 2017-04-06.GPJ 30/5/17

CONSOLIDATION TEST SUMMARY

ASTM D2435/D2435M

FIGURE

SAMPLE IDENTIFICATION

Project Number	1778186(2000)	Sample Number	TW2
Borehole Number	106	Sample Depth, m	0.8 - 1.7

TEST CONDITIONS

Test Type	Laboratory Standard	Load Duration, hr	24
Oedometer Number	9		
Date Started	04/17/2017		
Date Completed	05/01/2017		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.92	Unit Weight, kN/m^3	11.77
Sample Diameter, cm	4.43	Dry Unit Weight, kN/m^3	3.77
Area, cm^2	15.44	Specific Gravity, measured	2.07
Volume, cm^3	29.59	Solids Height, cm	0.355
Water Content, %	212.68	Volume of Solids, cm^3	5.49
Wet Mass, g	35.52	Volume of Voids, cm^3	24.10
Dry Mass, g	11.36	Degree of Saturation, %	100.3

TEST COMPUTATIONS

Stress	Corr. Height	Void	Average Height	t_{90}	cv.	mv	k
kPa	cm	Ratio	cm	sec	cm^2/s	m^2/kN	cm/s
0.00	1.916	4.391	1.916				
6.14	1.914	4.385	1.915				
11.15	1.891	4.320	1.902	60	1.28E-02	2.40E-03	3.00E-06
21.14	1.853	4.215	1.872	66	1.13E-02	1.96E-03	2.16E-06
41.04	1.776	3.998	1.815	34	2.05E-02	2.02E-03	4.07E-06
81.34	1.648	3.637	1.712	60	1.04E-02	1.66E-03	1.68E-06
161.03	1.481	3.166	1.564	54	9.61E-03	1.10E-03	1.03E-06
318.36	1.289	2.626	1.385	101	4.02E-03	6.37E-04	2.51E-07
641.27	1.095	2.082	1.192	173	1.74E-03	3.13E-04	5.34E-08
1275.38	0.931	1.618	1.013	375	5.80E-04	1.36E-04	7.71E-09
2543.27	0.793	1.230	0.862	778	2.02E-04	5.67E-05	1.12E-09
641.20	0.845	1.379	0.819				
161.12	0.917	1.581	0.881				
40.90	0.994	1.797	0.956				
11.06	1.066	2.000	1.030				

Note:
Consolidation loading and unloading schedule assigned by the client.
cv and k are approximate only based on t90 estimated from Square Root of Time Method (ASTMD2435/2435M)
Specimen taken 9.5-14.5cm from top of the tube.
Specimen swelled under 6.14 kPa.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.07	Unit Weight, kN/m^3	13.62
Sample Diameter, cm	4.43	Dry Unit Weight, kN/m^3	6.77
Area, cm^2	15.44	Specific Gravity, measured	2.07
Volume, cm^3	16.46	Solids Height, cm	0.355
Water Content, %	101.32	Volume of Solids, cm^3	5.49
Wet Mass, g	22.87	Volume of Voids, cm^3	10.98
Dry Mass, g	11.36		

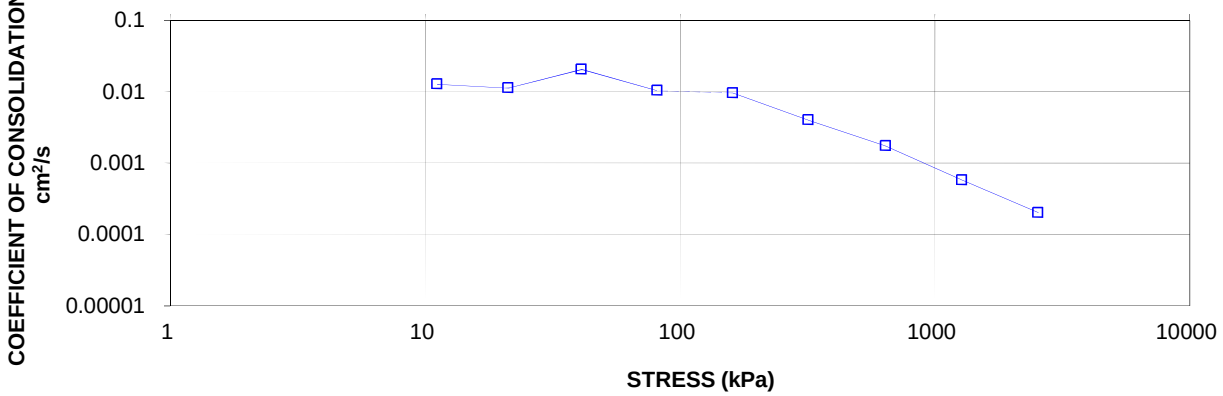
Prepared By: LH

Golder Associates

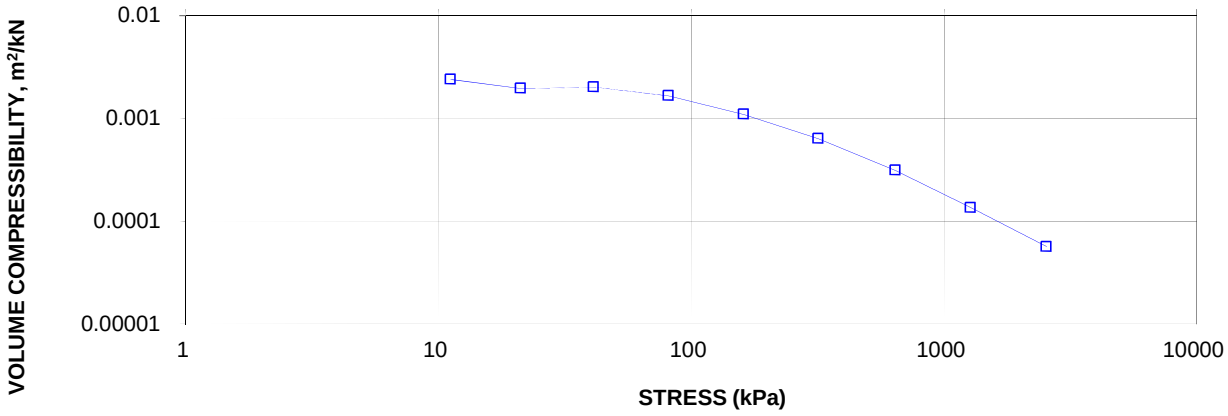
Checked By: MM

CONSOLIDATION TEST SUMMARY	FIGURE

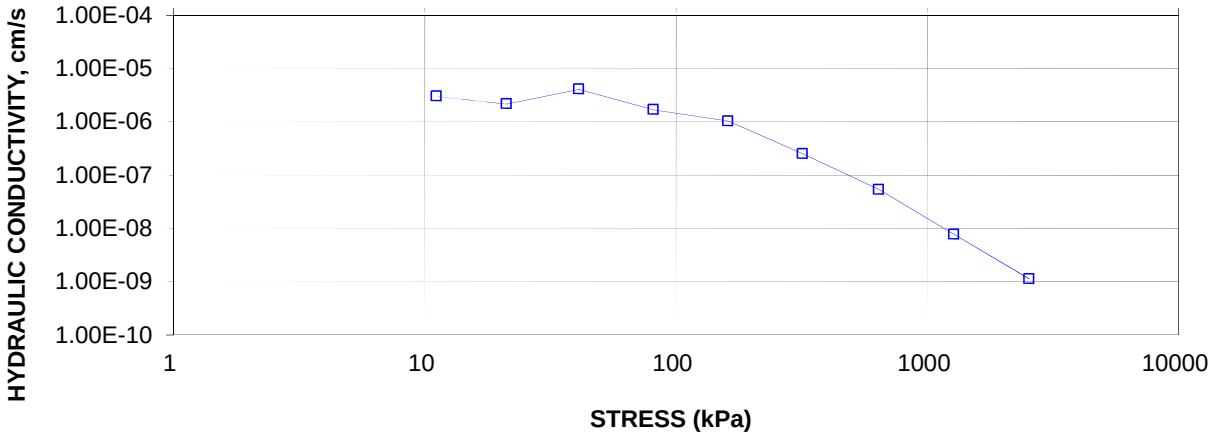
CONSOLIDATION TEST
CV cm^2/s VS STRESS (kPa)
BH 106 SA TW2



CONSOLIDATION TEST
MV m^2/kN vs STRESS (kPa)
BH 106 SA TW2



CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs STRESS
BH 106 SA TW2



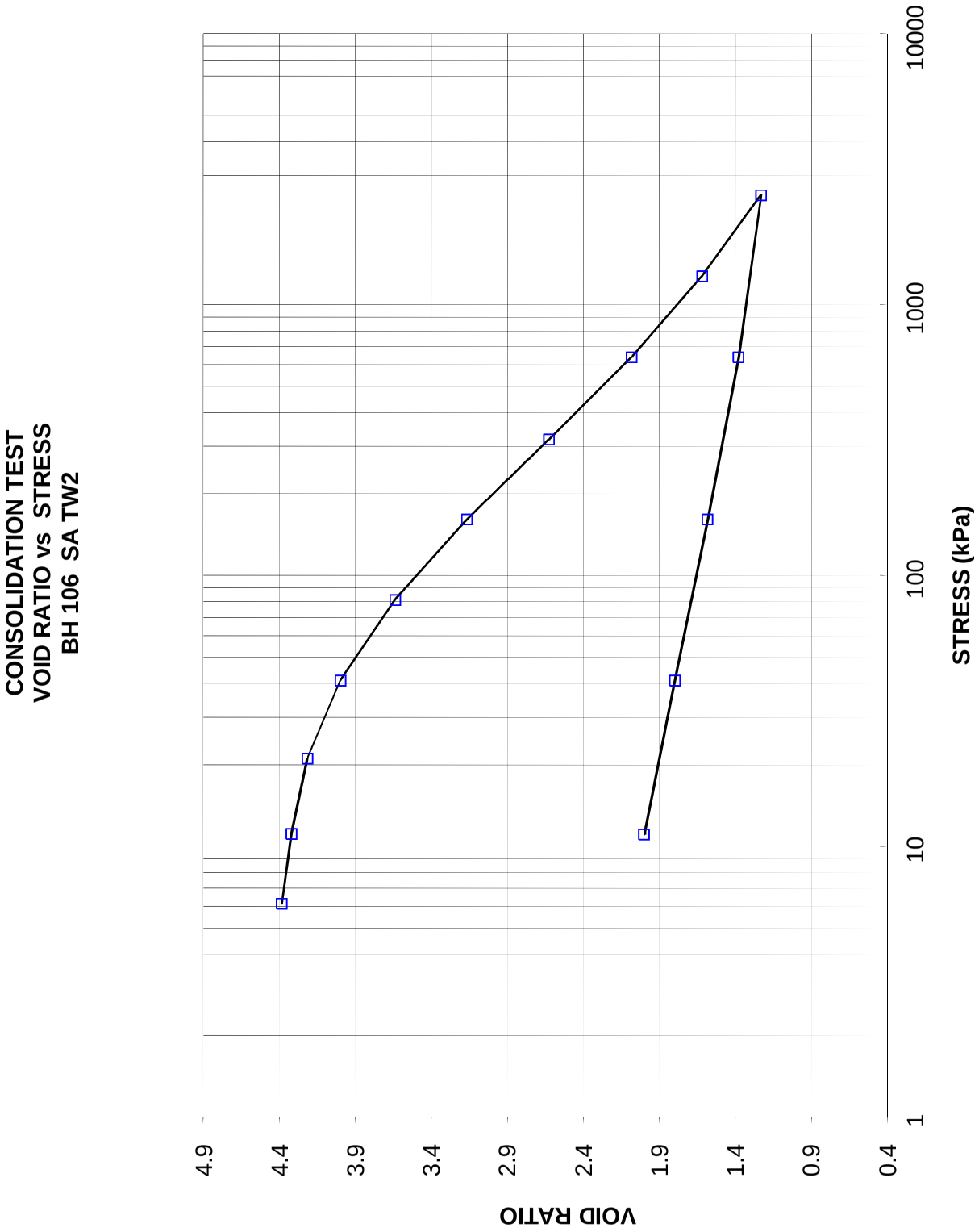
Project No. 1778186(2000)

Prepared By: LH

Golder Associates

Checked By: MM

CONSOLIDATION TEST VOID RATIO VS LOG STRESS	FIGURE



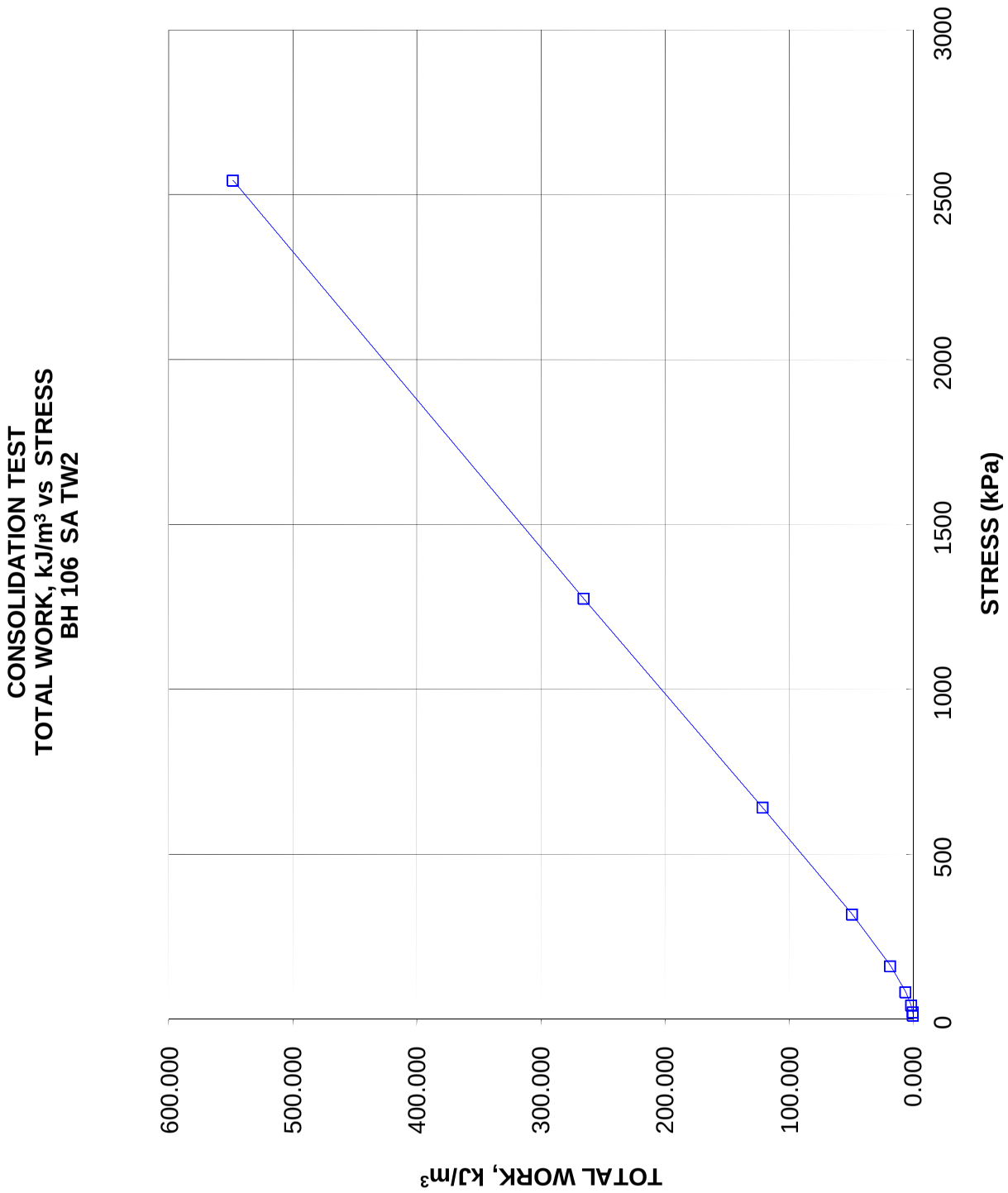
Project No. 1778186(2000)

Prepared By: LH

Golder Associates

Checked By: MM

CONSOLIDATION TEST TOTAL WORK VS STRESS	FIGURE



Project No. 1778186(2000)

Prepared By: LH

Golder Associates

Checked By: MM

CONSOLIDATION TEST SUMMARY

ASTM D2435/D2435M

FIGURE

SAMPLE IDENTIFICATION

Project Number	1778186(2000)	Sample Number	TW2
Borehole Number	108	Sample Depth, m	0.8 - 1.5

TEST CONDITIONS

Test Type	Laboratory Standard	Load Duration, hr	24
Oedometer Number	8		
Date Started	04/17/2017		
Date Completed	05/01/2017		

SAMPLE DIMENSIONS AND PROPERTIES - INITIAL

Sample Height, cm	1.89	Unit Weight, kN/m^3	13.25
Sample Diameter, cm	4.84	Dry Unit Weight, kN/m^3	6.55
Area, cm^2	18.38	Specific Gravity, measured	2.37
Volume, cm^3	34.67	Solids Height, cm	0.531
Water Content, %	102.33	Volume of Solids, cm^3	9.77
Wet Mass, g	46.84	Volume of Voids, cm^3	24.90
Dry Mass, g	23.15	Degree of Saturation, %	95.1

TEST COMPUTATIONS

Stress	Corr. Height	Void	Average Height	t_{90}	cv.	mv	k
kPa	cm	Ratio	cm	sec	cm^2/s	m^2/kN	cm/s
0.00	1.886	2.549	1.886				
5.91	1.883	2.543	1.884				
10.90	1.861	2.502	1.872	29	2.56E-02	2.33E-03	5.85E-06
20.94	1.822	2.429	1.841	25	2.88E-02	2.06E-03	5.80E-06
40.89	1.787	2.363	1.804	34	2.03E-02	9.22E-04	1.83E-06
80.83	1.714	2.225	1.750	83	7.83E-03	9.76E-04	7.48E-07
160.99	1.567	1.948	1.640	66	8.64E-03	9.73E-04	8.24E-07
321.01	1.272	1.393	1.419	97	4.40E-03	9.77E-04	4.22E-07
640.89	1.087	1.046	1.179	73	4.04E-03	3.06E-04	1.21E-07
1281.07	0.975	0.836	1.031	94	2.40E-03	9.26E-05	2.18E-08
2560.76	0.885	0.666	0.930	208	8.82E-04	3.72E-05	3.22E-09
640.81	0.915	0.721	0.900				
161.14	0.954	0.795	0.934				
40.98	0.999	0.880	0.977				
10.91	1.048	0.971	1.023				

Note:
Consolidation loading and unloading schedule assigned by the client.
cv and k are approximate only based on t90 estimated from Square Root of Time Method (ASTMD2435/2435M)
Specimen taken 1.5-5.5cm from top of the tube.
Specimen swelled under 5.91 kPa.

SAMPLE DIMENSIONS AND PROPERTIES - FINAL

Sample Height, cm	1.05	Unit Weight, kN/m^3	16.70
Sample Diameter, cm	4.84	Dry Unit Weight, kN/m^3	11.79
Area, cm^2	18.38	Specific Gravity, measured	2.37
Volume, cm^3	19.26	Solids Height, cm	0.531
Water Content, %	41.68	Volume of Solids, cm^3	9.77
Wet Mass, g	32.80	Volume of Voids, cm^3	9.49
Dry Mass, g	23.15		

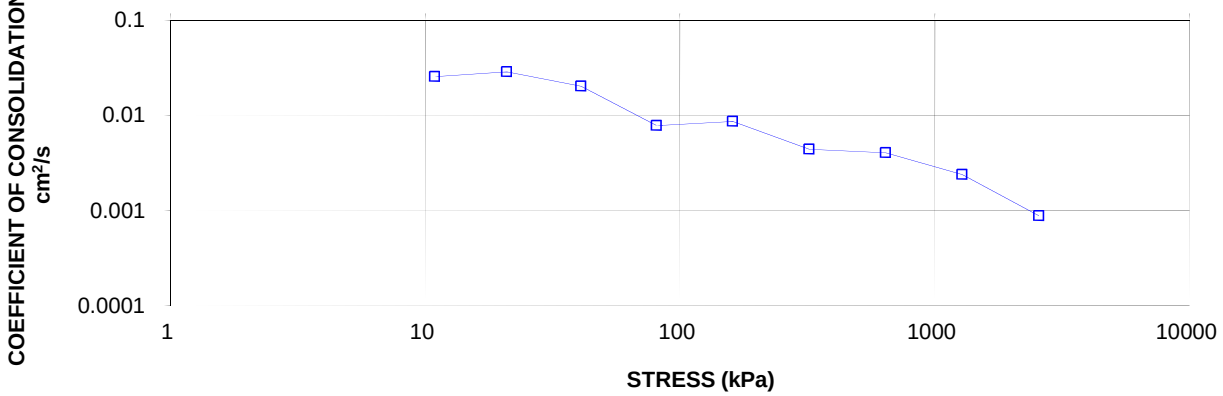
Prepared By: LH

Golder Associates

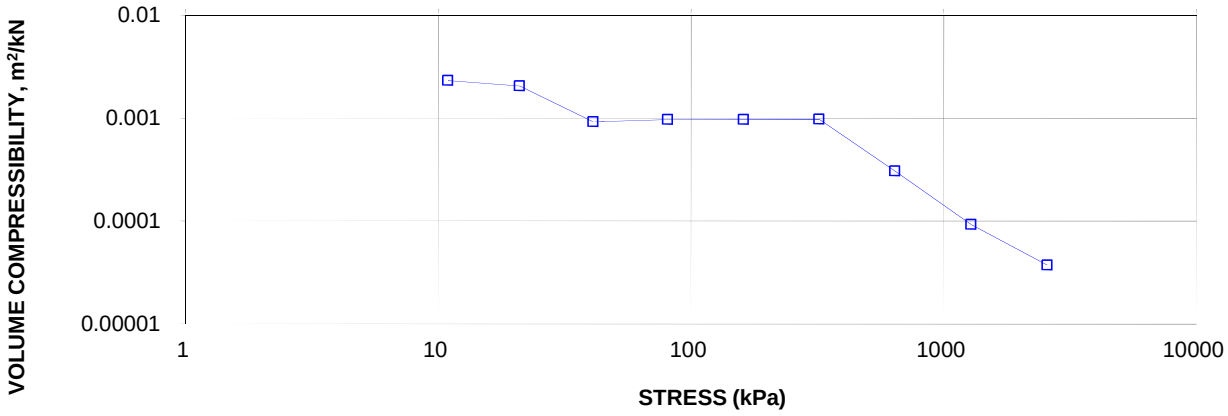
Checked By: MM

CONSOLIDATION TEST SUMMARY	FIGURE

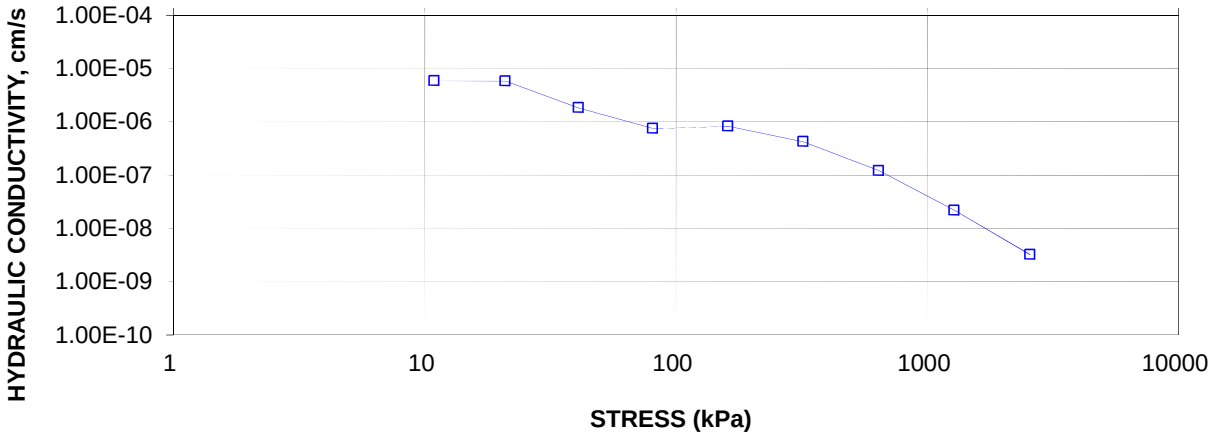
CONSOLIDATION TEST
CV cm^2/s VS STRESS (kPa)
BH 108 SA TW2



CONSOLIDATION TEST
MV m^2/kN vs STRESS (kPa)
BH 108 SA TW2



CONSOLIDATION TEST
HYDRAULIC CONDUCTIVITY vs STRESS
BH 108 SA TW2



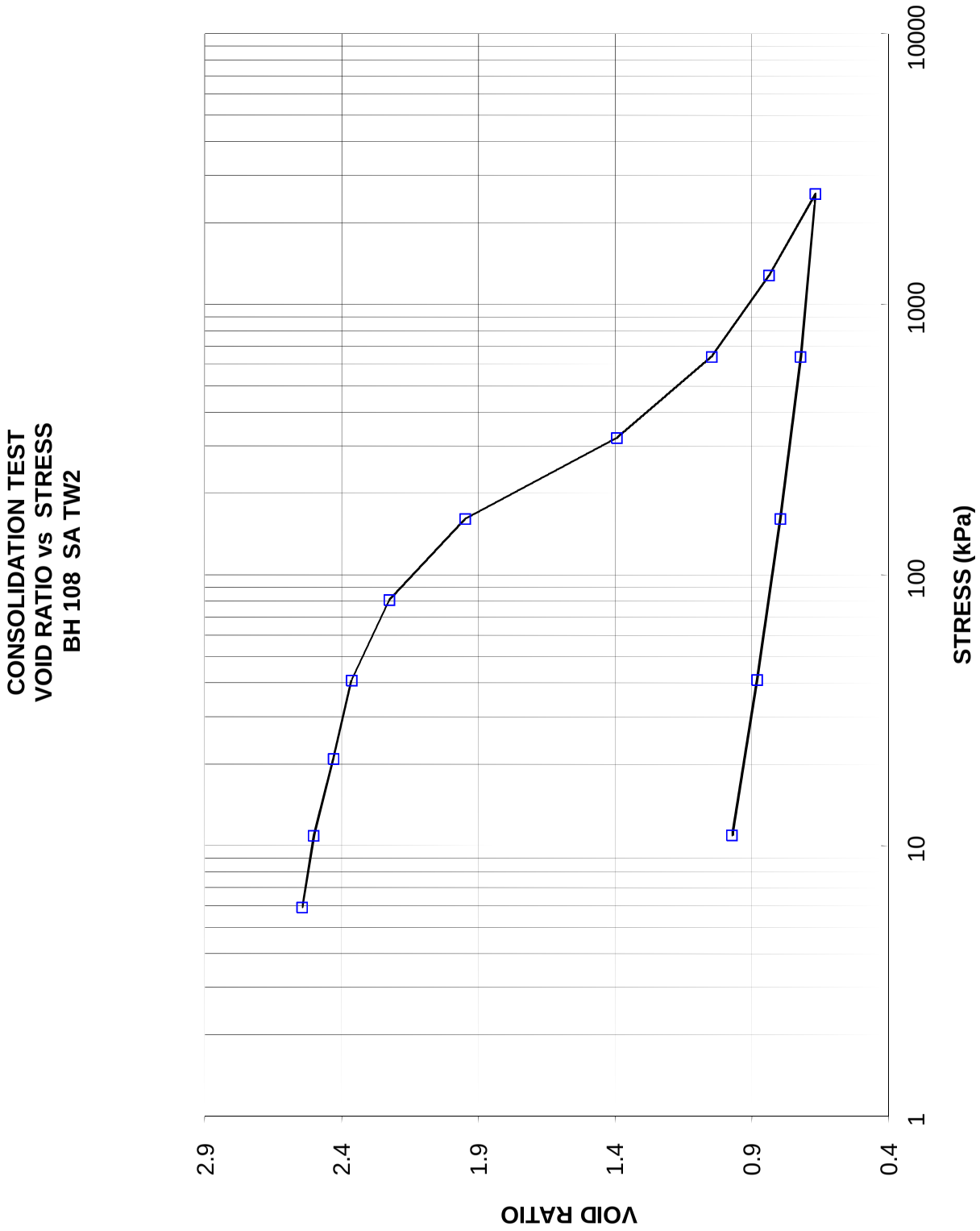
Project No. 1778186(2000)

Prepared By: LH

Golder Associates

Checked By: MM

CONSOLIDATION TEST VOID RATIO VS LOG STRESS	FIGURE



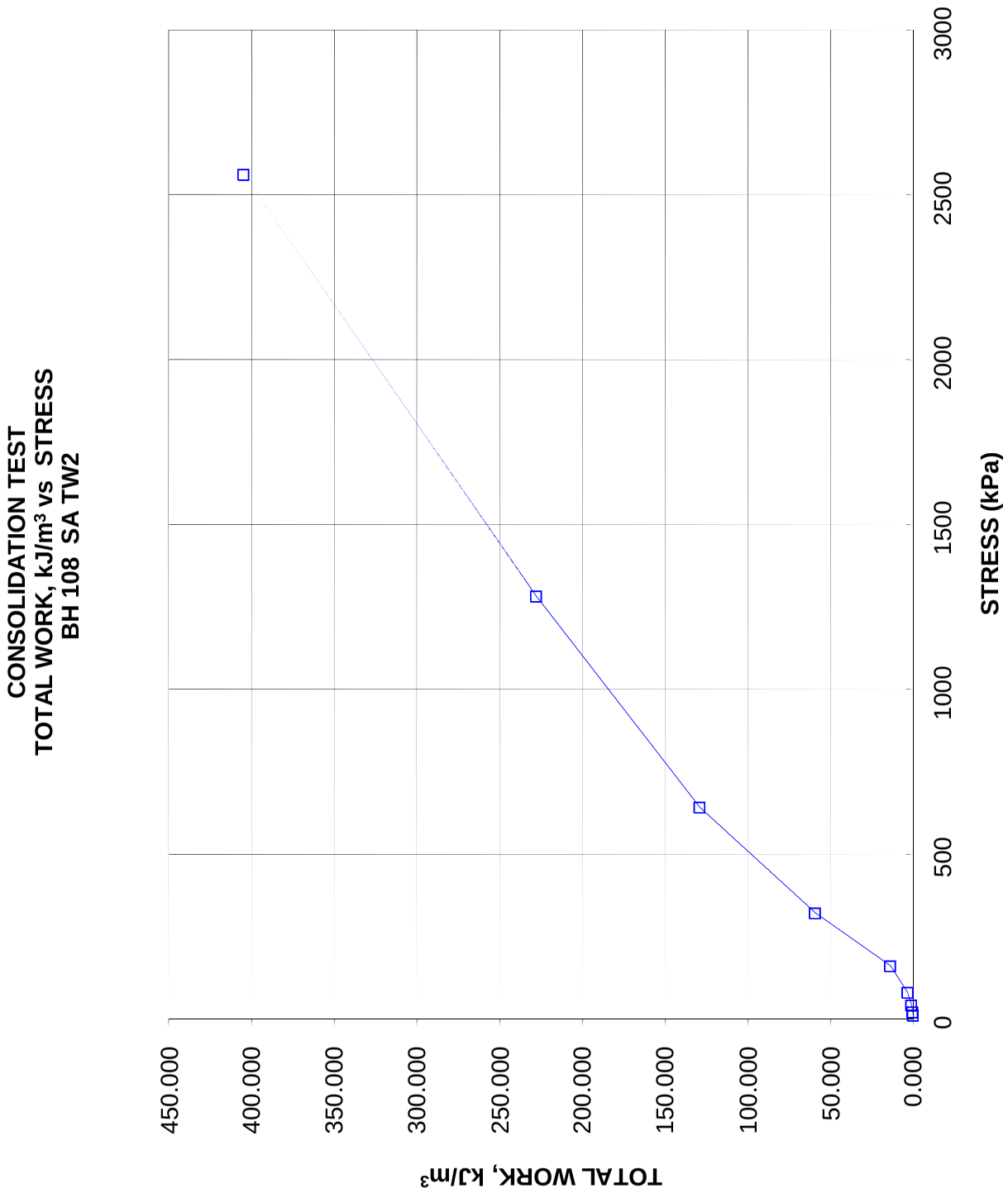
Project No. 1778186(2000)

Prepared By: LH

Golder Associates

Checked By: MM

CONSOLIDATION TEST TOTAL WORK VS STRESS	FIGURE



Project No. 1778186(2000)

Prepared By: LH

Golder Associates

Checked By: MM

APPENDIX D

SITE PHOTOGRAPHS

Figure 1: Looking south toward Rawdon Creek along the new alignment for Highway 62 from Borehole 105

Figure 2: Looking north along existing roadway platform of Highway 62 from Borehole 101

Figure 3: Looking northeast from Borehole 106 towards existing embankment

Figure 4: Looking southeast from Borehole 106 towards existing embankment and Rawdon Creek Bridge