



**THURBER ENGINEERING LTD.**

## **Foundation Investigation Report Fort Severn MTO Bridge Replacement**

**Wapusk Road, District of Thunder Bay, Ontario**

**Agreement 6021-E-0007, Work Order 013**

**G.W.P. 6581-16-00, Site No. 41N-0243/B0**

**Latitude: 56.013437°, Longitude: -87.671875°**

**GEOCRES No. 44D04-001**

**Client Name:** HATCH

**Date:** September 27, 2024

**File:** 50440

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**FOUNDATION INVESTIGATION REPORT  
FORT SEVERN MTO BRIDGE REPLACEMENT  
WAPUSK ROAD, DISTRICT OF THUNDER BAY, ONTARIO  
AGREEMENT 6021-E-0007, WORK ORDER 13  
G.W.P. 6581-16-00, SITE NO. 41N-0243/B0  
LATITUDE: 56.013437°, LONGITUDE: -87.671875°**

**GEOCRES No. 44D04-001**

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## **1. INTRODUCTION**

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This report presents the factual data obtained from a foundation investigation carried out by Thurber Engineering Ltd. (Thurber) for design of the proposed Fort Severn Culvert replacing the existing modular bridge. The Fort Severn Culvert is located on Wapusk Road, approximately 0.8 km southeast of the MTO's Fort Severn Airport, in the Unsurveyed Territory, District of Thunder Bay, Ontario.

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

Thurber carried out the investigation as a sub-consultant to Hatch Corporation (Hatch), under the Ministry of Transportation Ontario (MTO) Retainer Agreement Number 6021-E-0007, Work Order 13.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

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## **2. SITE DESCRIPTION**

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The site is located on Wapusk Road, in the Unsurveyed Territory, District of Thunder Bay, Ontario. The existing modular bridge, spanning approximately 27 m in length, allows Severn River Tributary to flow in a general south to north direction under Wapusk Road. Wapusk Road generally runs in a northwest-southeast direction at the bridge site, connecting the Fort Severn MTO Airport to Fort Severn. For the purposes of this report, Wapusk Road is described as running in a west-east direction.

Located in Fort Severn, Ontario, the community is positioned along the south coast of Hudson's Bay. As Ontario's most northern community, access is limited to fly-in only for most of the year to

the local MTO Airport. In the winter, Road access from Manitoba is available for a limited time each year. Due to this, the investigation was limited to portable drilling equipment that could be flown into the site and had total weight limitations for take off from the gravel runway in Fort Severn.

In addition to the modular bridge, a local culvert and Road access has been constructed parallel to the existing Road alignment. The culvert was verified by Hatch on site to be a 2800 mm SPCSP with a span of 11.43 m. It is understood that the culvert and the access Road had been installed by the local community to permit the passage of wider equipment unable to pass over the modular bridge. The centreline to centerline distance between the two Roads is approximately 12 m over the River Tributary.

Photographs in Appendix D show the general nature of the site and the existing bridge.

The available design plan drawing provided by Hatch indicates that the existing structure consists of a temporary modular bridge with 9 bays, extending a total length of 27.4 m and a total width of 5.3 m. The bridge is gradually sloped, increasing in elevation from west to east with an underside elevation of the bridge of 12.7 m near the centreline of the Severn River Tributary. Wapusk Road is a gravel Road with an existing grade level of approximate Elevation 15 m west and east of the site, decreasing to 13 m at its lowest near the west abutment. The highway embankment is approximately 5 m high at both abutments.

The local River Tributary water level was reportedly measured at Elevation 9.29 m in September 2016 and measured by Thurber to be 10.3 m on July 18, 2024. The site is surrounded by shrubs and low trees, with marshy areas near the River Tributary banks.

Based on a 1991 Geocres report (Geocres No. 43M-1) for a new airport building in Fort Severn, the site is located within the Hudson Bay Lowlands and within the continuous permafrost zone, but near the southern limit boundary with the discontinuous permafrost zone. The report provides information on the encountered soils to be sand overlaying sand, sandy silt to silt material, before terminating in a silt some clay, clayey silt to silty clay deposit. The deepest borehole extended to a depth of 7.6 meters below ground surface (estimated elevation 8.6 m based on available survey data).

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### **3. SITE INVESTIGATION AND FIELD TESTING**

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The site investigation and field-testing program for this project was carried out from July 14 to 18, 2024 with an additional 1-2 days of mobilization to and from the site. The field program consisted



of drilling and sampling five (5) boreholes (24-01 to 24-05) to depths ranging from 8.0 to 10.4 m below the riverbed (Elevation 0.5 to -0.7 m).

All boreholes were advanced in the river using a raft and portable drilling equipment. Boreholes 24-01 and 24-03 were advanced on the east side of the proposed culvert, near the prepared location of the temporary diversion pipe. Boreholes 24-02, 24-04 and 24-05 were advanced along the centre and west of the proposed culvert alignment. The approximate borehole locations are shown on the attached Borehole Locations and Soil Strata Drawings in Appendix A. The Record of Borehole sheets are included in Appendix B.

Utility clearances were obtained prior to the start of drilling. The ground surface elevations for the boreholes were estimated from field measurements and the topographic drawings provided to Thurber by Hatch. The coordinate system MTM NAD 83, Zone 14 was used for the boreholes.

All boreholes were advanced using a portable Hilti drill and tripod equipment using wash boring techniques. In all boreholes, soil samples were obtained at selected intervals with a 50 mm outside diameter split spoon sampler driven with a full weight hammer in conjunction with the Standard Penetration Test (SPT). MTO B Field Vane measurements were also taken at select depths in all boreholes for the Silty Clay material.

The drilling and sampling operations were supervised on a full-time basis by a member of Thurber's technical staff. The supervisor logged the boreholes and processed the recovered soil and rock samples for transport to Thurber's laboratory for further examination and testing.

No monitoring wells were installed as part of this geotechnical program.

Details of the drilling program, including water and drilling depths and completion details are summarized in Table 3.1 below.

**Table 3.1 Borehole Completion Details**

Borehole Number	Water depth (m)	Borehole Depth Below Riverbed/ Base Elevation (m)	Completion Details
24-01	0.6	10.4 / -0.7	Bentonite holeplug to ground surface.
24-02	1.2	8.6 / 0.5	Bentonite holeplug to ground surface
24-03	1.8	8.3 / 0.2	Bentonite holeplug to ground surface
24-04	0.6	9.6 / 0.1	Bentonite holeplug to ground surface
24-05	1.8	8.0 / 0.5	Bentonite holeplug to ground surface

#### 4. LABORATORY TESTING

All recovered soil samples were subjected to visual identification. Selected samples were subjected to natural moisture content determination, grain size distribution analyses (sieve and hydrometer), and Atterberg Limits, where appropriate. The results of this testing program are summarized on the Record of Borehole sheets in Appendix B and are shown on the figures included in Appendix C.

In order to assess the potential for sulphate attack on concrete foundations, as well as the potential for corrosion associated with the structure, two soil samples were collected during the investigation and submitted to SGS Canada Inc., a CALA accredited analytical laboratory in Lakefield, Ontario, for analytical testing of corrosivity parameters.

#### 5. DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets included in Appendix B. Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets and on the Borehole Locations and Soil Strata drawings in Appendix A. A general description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following paragraphs. However, the factual data presented in the Record of Borehole sheets governs any interpretation of the site conditions. It must be recognized that soil conditions may vary between and beyond the borehole locations.

In general, the subsurface stratigraphy below the river tributary bed consists of native very loose to loose sand and gravel to sand to sand and silt, with deposits of sand and silt. These cohesionless soils were underlain by very stiff to soft silty clay until the termination of each borehole. More detailed descriptions of the individual strata are presented below.

## 5.1 Sand and Gravel to Sand

Sand and gravel to sand was encountered at the riverbed in Boreholes 24-01, 24-02, 24-04 and 24-05. The surficial layer consisted of sand and gravel to sand, some gravel, trace silt with occasional wood fragments and pieces. Occasional silt to silty clay seams were also observed within the sand and gravel to sand layers in Boreholes 24-02 and 24-05 and noted on the Borehole Logs.

The sand and gravel to sand extended to depths ranging from 0.6 m to 3.9 m below the riverbed (Elevation 9.1 to 4.6 m).

SPT 'N' values in the sand and gravel to sand generally ranged from 1 to 21 blows per 0.3 m penetration, indicating a very loose to compact relative density, typically ranging from very loose to loose.

The measured moisture contents generally ranged from 7 to 30%. One sample (BH 24-02) measured a higher moisture content of 55%.

The results of a grain size analysis conducted on a selected sample of the sand and gravel to sand are provided on the Record of Borehole sheets in Appendix B and plotted on Figure C1 in Appendix C. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	92
Silt & Clay	8

## 5.2 Sand and Silt

A surficial layer of sand and silt and a deposit of sand and silt were encountered in Boreholes 24-03 and 24-04 respectively. The sand and silt contained trace clay, trace gravel with rootlets, wood fragments and organics throughout the material.

In Borehole 24-03, the sand and gravel layer extended to a depth of 1.4 m below the riverbed (Elevation 7.1 m). In Borehole 24-04, the sand and silt deposit was encountered from a depth ranging from 1.2 to 3.6 m (Elevation 7.1 to 6.1 m) below the riverbed.

SPT 'N' Values in the sand and silt ranged from weight of hammer to 8 blows per 0.3 m penetration, indicating a very loose to loose relative density.



Measured moisture contents ranged from 18 to 26% with higher moisture contents ranging from 33 to 74% where samples contained rootlets, wood fragments and organics.

The results of grain size analyses conducted on samples of the sand and silt deposit are provided on the Record of Borehole sheets in Appendix B, and plotted on Figure C2 in Appendix C. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	44 to 98
Silt	49 to 51
Clay	2 to 5
Silt and Clay	2

### 5.3 Silty Clay

A silty clay deposit was encountered with trace sand below the sand and gravel layer in Boreholes 24-01, 24-02 and 24-05 and beneath the sand and silt layer/deposit in Boreholes 24-03 and 24-05.

The silty clay deposit was encountered in all boreholes until the termination depths ranging from 8.0 m to 10.4 m (Elevation 0.5 to -0.7 m) below the riverbed.

SPT 'N' Values in the silty clay deposit ranged from 9 blows per 0.3 m penetration to weight of hammer, indicating a stiff to very soft consistency.

MTO 'B' Field Vane measurements in the silty clay deposit ranged from 132 to 48 kPa undrained shear strength from elevation 6.8 to 5.0 m where measured, indicating the presence of a crust which is very stiff to firm in consistency. Below elevation 5.0 m, the undrained shear strength ranged from 60 to 24 kPa, indicating a stiff to firm consistency. Field vane results are plotted in Figure 1 below. Clay sensitivity appears to range from 7 to 20.

Recorded moisture contents in the silty clay ranged from 19 to 29%.

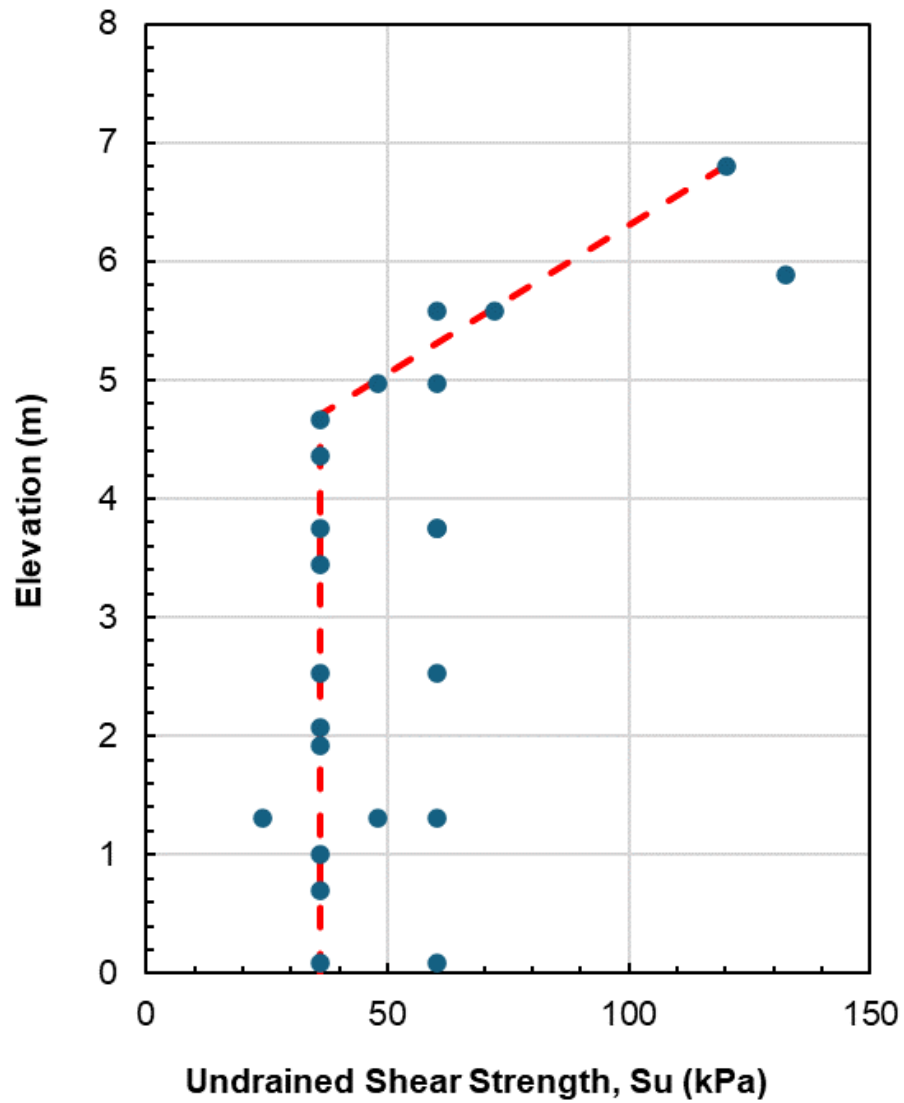
The results of grain size analyses conducted on samples of the silty clay deposit are provided on the Record of Borehole sheets in Appendix B and plotted in Figure C3 in Appendix C. The results are summarized as follows:

Soil Particle	Percentage (%)
Gravel	0
Sand	4 to 10
Silt	72 to 80
Clay	15 to 21

The results of Atterberg Limit tests conducted on samples of the silty clay deposit are provided on the Record of Borehole sheets in Appendix B and plotted in Figure C4 in Appendix C. The results are summarized as follows:

Limit	Percentage (%)
Liquid Limit	22 to 30
Plastic Limit	15 to 18
Plasticity Index	6 to 12

The silty clay is a low plastic silty clay (CL).



*Figure 1: Vane Results vs Depth Plot*

## 5.4 Groundwater Conditions

Groundwater conditions were unable to be observed following the completion of each borehole since boreholes were advanced within the Severn River Tributary and used boring techniques which introduced water into the borehole. The water depth at the borehole locations ranged from 0.6 to 1.8 m.

The groundwater level is likely to reflect the local Severn River Tributary water level. The local River Tributary water level was measured at Elevation 10.3 m on July 18, 2024.

It should also be noted that groundwater levels are short term observations and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant and/or prolonged precipitation and spring snow melts.

## 6. FORT SEVERN PIT SAMPLES

Due to the remoteness of the site and difficulties with importing granular materials meeting OPSS.PROV 1010 standards to the site, MTO requested Thurber and Hatch to visit any local pits where granular till may be available for the construction of the new embankment over the replacement culvert. Thurber and Hatch collected samples from the following three available pits within the community with approximate coordinates:

Sample Pit	Latitude/Longitude	MTM NAD 83, Zone 14	
		Northing	Easting
MTO Fort Severn Pit (Stockpile) for use at the airport	56.019294, -87.685848	6,212,097.68	261,068.15
Band Office Severn River Pit	56.004182, -87.610086	6,208,575.73	266,743.23
Band Office Forrest Pit	56.035331, -87.701629	6,210,302.43	262,034.02

Each pit was visited by Thurber and Hatch to collect a bulk sample for gradation testing. Lab testing completed on the samples are shown in on the figures C5 to C7 included in Appendix C. Although the samples collected from both the Band Office Pits (refereed to as Band Pit material herein) are close to an OPSS.PROV 1010 Granular A gradation, there is concern that the material may be non-uniform and may contain organic material as noted at the time of sampling the Pit location. The MTO Fort Severn Pit (referred to as MTO Pit material herein) is understood to be screened from locally available sources by MTO Personnel and is the preferred material for embankment construction at the replacement culvert site. For the purposes of this report the MTO Pit material may be considered similar to Granular A and the Band Pit material may be considered similar to Granular B Type I.

## 7. CORROSIVITY AND SULPHATE TEST RESULTS

Samples of the silty clay and sand and gravel from Boreholes 24-01 and 24-05 collected were submitted for analytical testing of corrosivity parameters and sulphate. The laboratory certificates of analysis are presented in Appendix C. The results of the analytical tests are summarized below in Table 7.1.

**Table 7.1 Analytical Test Results**

Parameter	Units (Soil)	Test Results	
		24-01 SS2 (4'-6') (1.2 – 1.8 m)	24-05 SS1&2 (6'-10') (1.8 – 3.1 m)
		(Silty Clay)	(Sand and Gravel)
Redox Potential	mV	343	332
Sulphide	%	<0.01	0.01
pH	-	8.32	8.63
Chloride	µg/g	660	15
Sulphate	µg/g	5.5	19
Conductivity	µS/cm	34	19
Resistivity*	ohm-cm	29400	52600

\* Calculated based on conductivity result

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## 8. MISCELLANEOUS

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Thurber obtained utility clearances for the borehole locations prior to drilling. Borehole locations were selected and established in the field by Thurber Engineering Ltd and Hatch Ltd.

Limitless Drilling of Renfrew, Ontario supplied a portable Hilti drill with tripod and raft, to conduct the drilling, sampling and in-situ testing operations for the boreholes.

Geotechnical laboratory testing was carried out in Thurber's geotechnical laboratory. Analytical testing was carried out by SGS Canada Inc.

The field investigation was supervised on a full-time basis by Mr. Joshua Alexander, P. Eng. of Thurber. Overall supervision of the field program was provided by Mr. Joshua Alexander, P. Eng. and Mr. Mark Farrant, P. Eng. of Thurber.

Interpretation of the field data and preparation of this report was carried out by Mr. Joshua Alexander, P. Eng. and reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

THURBER ENGINEERING LTD.



Joshua Alexander, P.Eng.  
Geotechnical Engineer



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



## STATEMENT OF LIMITATIONS AND CONDITIONS

### 1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

### 2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

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### 3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

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### 5. INTERPRETATION OF THE REPORT

- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
- c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.
- d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

### 6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

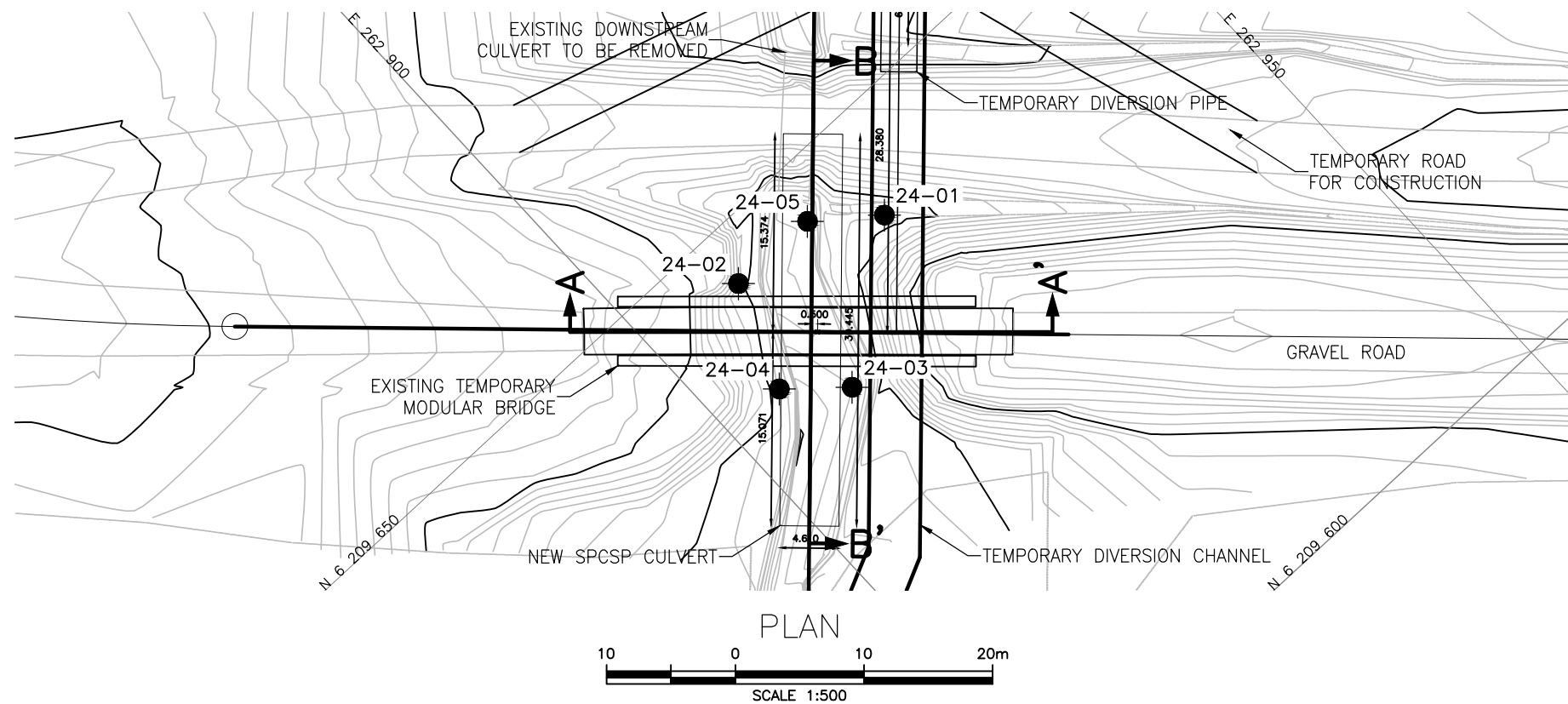
Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

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The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

## **APPENDIX A**

### Borehole Locations and Soil Strata Drawings



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



CONT No	(
GWP No 6581-16-00	

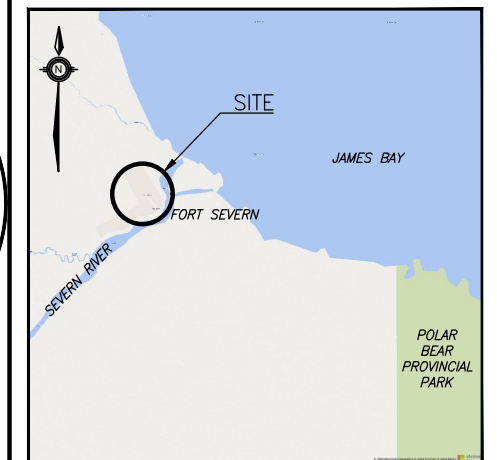
FORT SEVERN  
BAILEY BRIDGE

### BOREHOLE LOCATIONS AND SOIL STRATA

SHEET  
9








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## KEYPLAN

## LEGEND

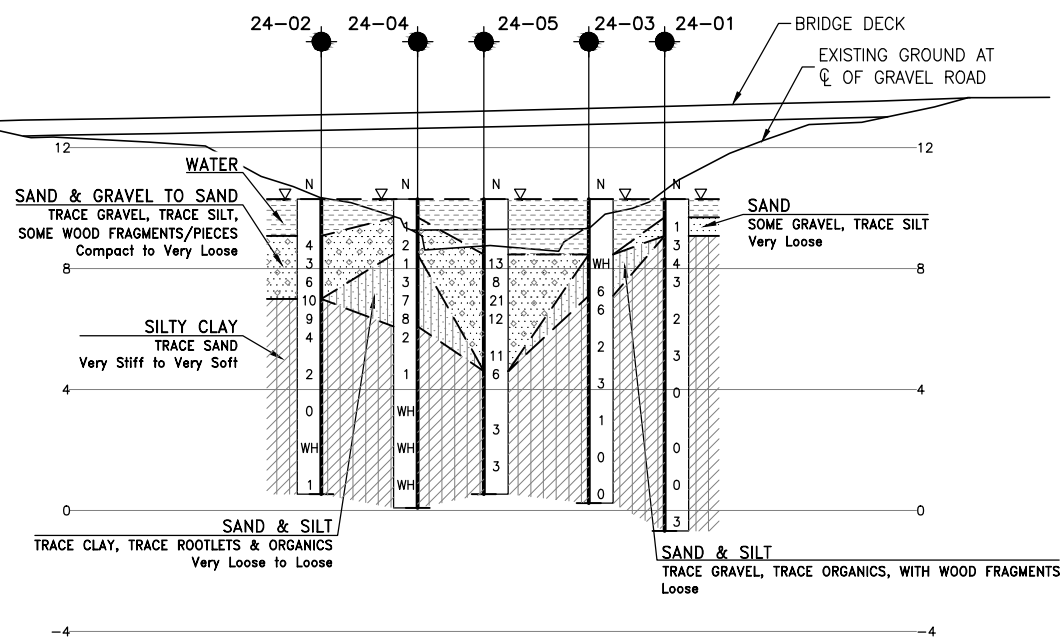
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level Upon Completion of Drilling
	Water Level in Monitoring Well/Piezometer
	Monitoring Well/Piezometer Screen
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

[illegible]

-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) Coordinate system is MTM NAD 83 CSRS Zone 14.

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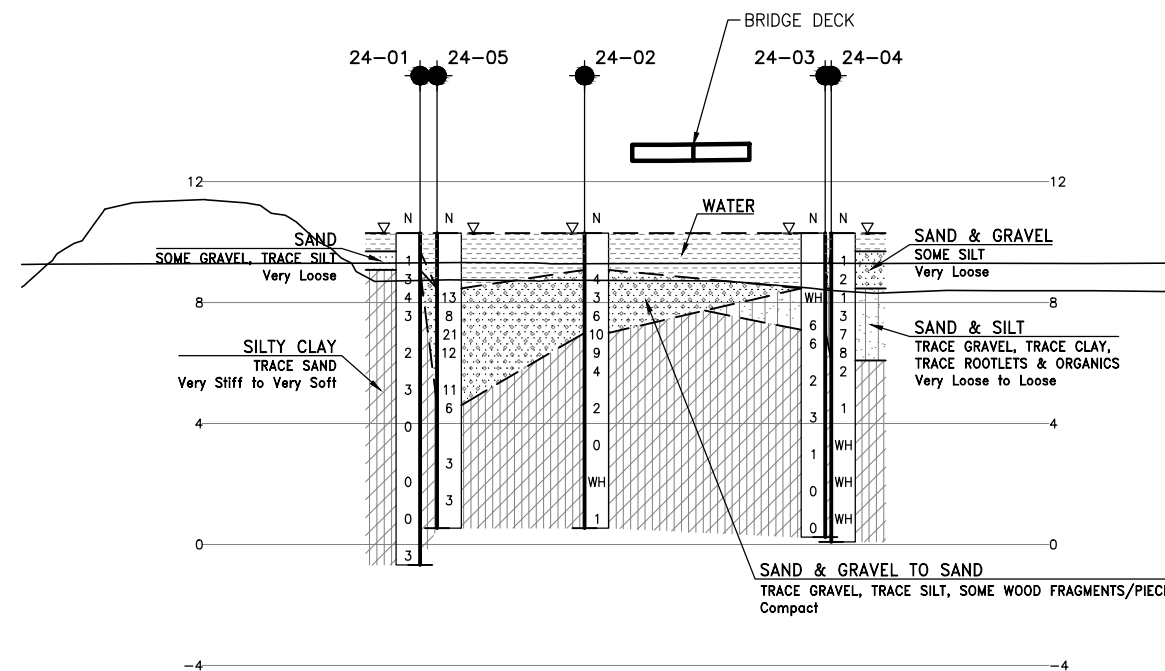


SECTION A-A'



H 1:250

V 1:250



SECTION B-B'



H 1:250

V 1:250

REVISIONS								
	DATE	BY			DESCRIPTION			
DESIGN	JA	CHK	PKC	CODE	LOAD	DATE	SEP 2024	
DRAWN	MA/MC	CHK	JA	SITE 41N-0243/B0	STRUCT	DWG	2	

## **APPENDIX B**

### Record of Borehole Sheets

## 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 <sup>(1)</sup> '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  
 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 <sub>L</sub> < 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 <sub>L</sub> < 30%).
		CI	Inorganic clays of medium plasticity, silty clays. (30% < W <sub>L</sub> < 50%).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS W <sub>L</sub> > 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			



RECORD OF BOREHOLE No 24-01

1 OF 2

METRIC

WP# 6581-16-00 LOCATION Fort SevernMTM NAD83 CSRS Zone 14 N 6 209 641.2 E 262 921.1 ORIGINATED BY JA  
DIST Thunder Bay HWY Wapsuk Road BOREHOLE TYPE Wash Boring COMPILED BY AN  
DATUM Geodetic DATE 2024.07.14 - 2024.07.14 LATITUDE 56.013433 LONGITUDE -87.671520 CHECKED BY PKC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS ▽*	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
10.3	GROUND SURFACE													
0.0	WATER													
9.7														
0.6	SAND, some gravel, trace silt Very Loose Grey Wet		1	SS	1									
9.1														
1.2	Silty CLAY, trace sand Very Stiff to Very Soft Grey Wet		2	SS	3									
			3	SS	4									0 5 74 21
			4	SS	3									0 8 77 15
			5	SS	2									
			6	SS	3									0 5 74 21
			7	SS	0									
			8	SS	0									
			9	SS	0									

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 24-01

2 OF 2

METRIC

WP# 6581-16-00 LOCATION Fort SevernMTM NAD83 CSRS Zone 14 N 6 209 641.2 E 262 921.1 ORIGINATED BY JA  
DIST Thunder Bay HWY Wapsuk Road BOREHOLE TYPE Wash Boring COMPILED BY AN  
DATUM Geodetic DATE 2024.07.14 - 2024.07.14 LATITUDE 56.013433 LONGITUDE -87.671520 CHECKED BY PKC

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 <sup>3</sup>	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 (%) w <sub>P</sub> w      w <sub>L</sub>				
	Continued From Previous Page							20	40	60	80	100					
	Silty <b>CLAY</b> , trace sand Soft Grey Wet						0				20.0						
-0.7			10	SS	3									○			
11.0	END OF BOREHOLE AT 11.0m.																

RECORD OF BOREHOLE No 24-02

1 OF 2

METRIC



WP# 6581-16-00 LOCATION Fort SevernMTM NAD83 CSRS Zone 14 N 6 209 647.3 E 262 906.7 ORIGINATED BY JA  
DIST Thunder Bay HWY Wapsuk Road BOREHOLE TYPE Wash Boring COMPILED BY AN  
DATUM Geodetic DATE 2024.07.15 - 2024.07.15 LATITUDE 56.013487 LONGITUDE -87.671752 CHECKED BY PKC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS ▽*	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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 (%)					
10.3	GROUND SURFACE													
0.0	WATER													
9.1														
1.2	SAND and GRAVEL to SAND, trace gravel, trace silt, some wood fragments/pieces Very Loose to Compact Brown Wet		1	SS	4									
			2	SS	3									
	Silt seam (100mm)		3	SS	6									
7.0			4	SS	10									0 92 8 (SI+CL)
3.3	Silty CLAY, trace sand Stiff to Soft Grey Wet		5	SS	9									0 8 76 16
	Sand seam (175mm)		6	SS	4									
			7	SS	2									
			8	SS	0									
			9	SS	WH									
			10	SS	1									
0.5														
9.8	END OF BOREHOLE AT 9.8m.													

Continued Next Page

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

## METRIC

SOIL PROFILE									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES	GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT  WATER CONTENT (%)	UNIT WEIGHT $\gamma$ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
	Continued From Previous Page					SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE			
	BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.								

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 24-03

1 OF 2

METRIC

WP# 6581-16-00 LOCATION Fort SevernMTM NAD83 CSRS Zone 14 N 6 209 633.6 E 262 909.6 ORIGINATED BY JA  
DIST Thunder Bay HWY Wapsuk Road BOREHOLE TYPE Wash Boring COMPILED BY AN  
DATUM Geodetic DATE 2024.07.16 - 2024.07.16 LATITUDE 56.013364 LONGITUDE -87.671703 CHECKED BY PKC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS ▽*	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	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 (%)
10.3	GROUND SURFACE							20	40	60	80	100					
0.0	WATER																
8.5																	
1.8	SAND and SILT, trace gravel, trace organics, with wood fragments, no recovery for SS1 Loose Grey Wet		1	SS	WH												
			2	SS	6												0 49 49 2
7.1																	
3.2	Silty CLAY, some to trace sand Very Stiff to Firm Grey Wet		3	SS	6												0 10 72 18
			4	SS	2												
			5	SS	3												
			6	SS	1												
			7	SS	0												
			8	SS	0												

Continued Next Page

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

RECORD OF BOREHOLE No 24-03

2 OF 2

METRIC

WP# 6581-16-00 LOCATION Fort SevernMTM NAD83 CSRS Zone 14 N 6 209 633.6 E 262 909.6 ORIGINATED BY JA  
DIST Thunder Bay HWY Wapsuk Road BOREHOLE TYPE Wash Boring COMPILED BY AN  
DATUM Geodetic DATE 2024.07.16 - 2024.07.16 LATITUDE 56.013364 LONGITUDE -87.671703 CHECKED BY PKC

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W <sub>p</sub>	W	W <sub>L</sub>		
	Continued From Previous Page							○ UNCONFINED	+	FIELD VANE							
								● QUICK TRIAXIAL	×	LAB VANE							
0.2								20	40	60	80	100					
10.1	END OF BOREHOLE AT 10.1m.																



RECORD OF BOREHOLE No 24-04

1 OF 2

METRIC

WP# 6581-16-00 LOCATION Fort Severn MTM NAD83 CSRS Zone 14 N 6 209 639.8 E 262 902.7 ORIGINATED BY JA  
DIST Thunder Bay HWY Wapsuk Road BOREHOLE TYPE Mud Rotary COMPILED BY AN  
DATUM Geodetic DATE 2024.07.17 - 2024.07.17 LATITUDE 56.013420 LONGITUDE -87.671815 CHECKED BY PKC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT   NATURAL MOISTURE CONTENT   LIQUID LIMIT			UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20   40   60   80   100	W <sub>P</sub> W   W <sub>L</sub>	WATER CONTENT (%)				
10.3	GROUND SURFACE							○ UNCONFINED   + FIELD VANE						
0.0	WATER							● QUICK TRIAXIAL   × LAB VANE						
9.7														
0.6	SAND and GRAVEL, some silt Very Loose Wet No recovery		1	SS	1									
	No recovery		2	SS	2									
8.5														
1.8	SAND and SILT, trace clay, trace rootlets and organics Very Loose to Loose Black to Grey Wet		3	SS	1									
			4	SS	3									
	Sand deposit (400mm)		5	SS	7									
			6	SS	8									
6.1														
4.2	Silty CLAY, trace sand Firm Grey Wet		7	SS	2									
			8	SS	1									
			9	SS	WH									
	Stiff to Firm		10	SS	WH									
			11	SS	WH									

Continued Next Page

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

RECORD OF BOREHOLE No 24-04

2 OF 2

METRIC

WP# 6581-16-00 LOCATION Fort SevernMTM NAD83 CSRS Zone 14 N 6 209 639.8 E 262 902.7 ORIGINATED BY JA  
DIST Thunder Bay HWY Wapsuk Road BOREHOLE TYPE Mud Rotary COMPILED BY AN  
DATUM Geodetic DATE 2024.07.17 - 2024.07.17 LATITUDE 56.013420 LONGITUDE -87.671815 CHECKED BY PKC

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W <sub>p</sub>	W	W <sub>L</sub>		
	Continued From Previous Page							20	40	60	80	100					
0.1																	
10.2	END OF BOREHOLE AT 10.2m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.																

ONTMT452 2020LIBRARY(MTO).GLB MTO-50440.GPJ 9/5/24

RECORD OF BOREHOLE No 24-05

1 OF 2

METRIC

WP# 6581-16-00 LOCATION Fort Severn MTM NAD83 CSRS Zone 14 N 6 209 644.2 E 262 917.2 ORIGINATED BY JA  
DIST Thunder Bay HWY Wapsuk Road BOREHOLE TYPE Mud Rotary COMPILED BY AN  
DATUM Geodetic DATE 2024.07.18 - 2024.07.18 LATITUDE 56.013460 LONGITUDE -87.671583 CHECKED BY PKC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
10.3	GROUND SURFACE													
0.0	WATER													
8.5														
1.8	SAND and GRAVEL to SAND, trace gravel Compact Brown Wet		1	SS	13									
			2	SS	8									
	Silty clay seam (150mm)		3	SS	21									
	Silty clay seam (300mm-600mm)		4	SS	12									
			5	SS	11									
4.6														
5.7	Silty CLAY, trace sand Stiff to Firm Grey Wet		6	SS	6									
			7	SS	3									
			8	SS	3									
0.5														
9.8	END OF BOREHOLE AT 9.8m.													

Continued Next Page

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

## METRIC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT  NATURAL MOISTURE CONTENT  LIQUID LIMIT	UNIT WEIGHT  γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES			
							20    40    60    80    100 SHEAR STRENGTH kPa 20    40    60    80    100 WATER CONTENT (%)			
	Continued From Previous Page								kN/m <sup>3</sup>	GR SA SI CL

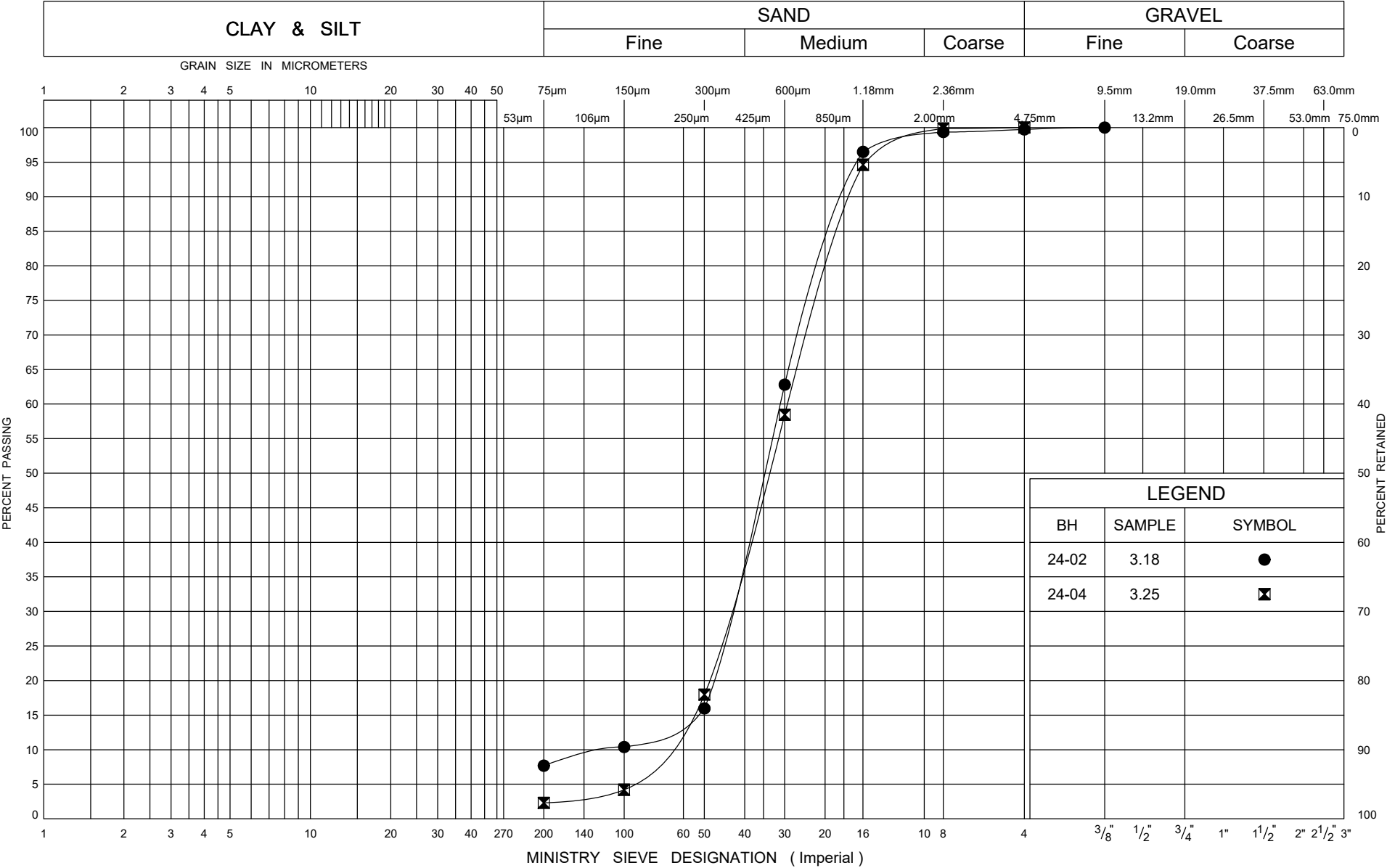
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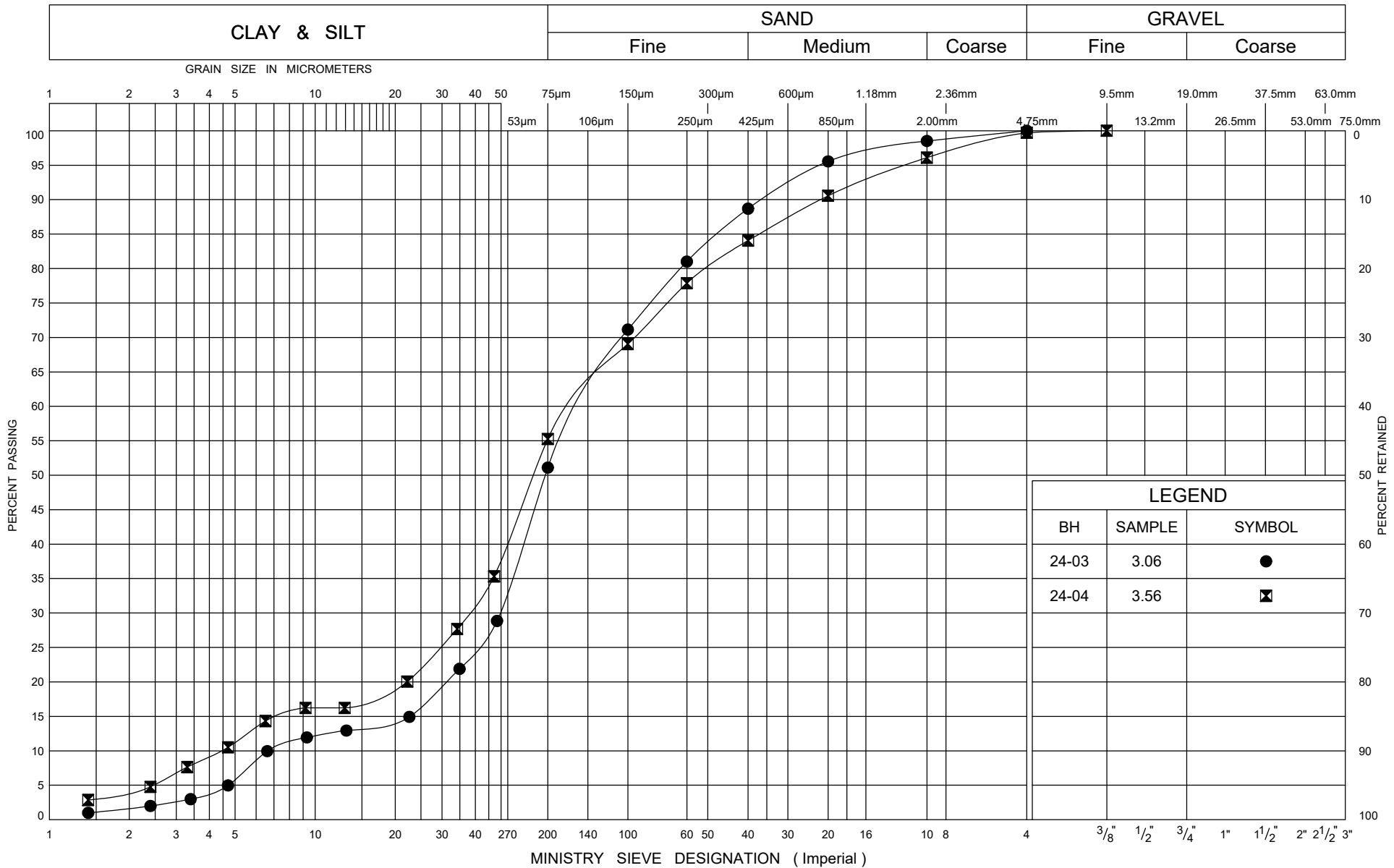
+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity

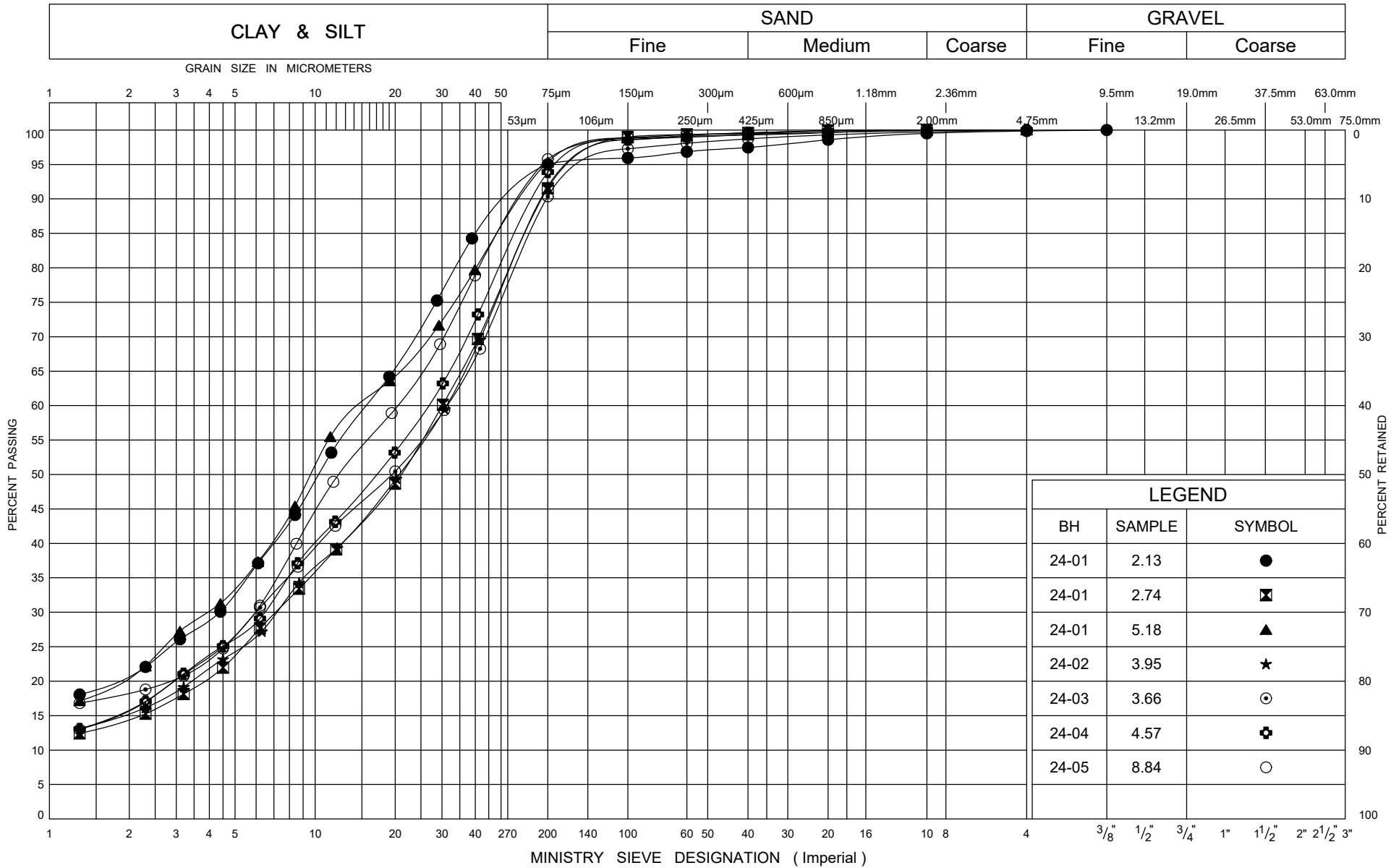
## **APPENDIX C**

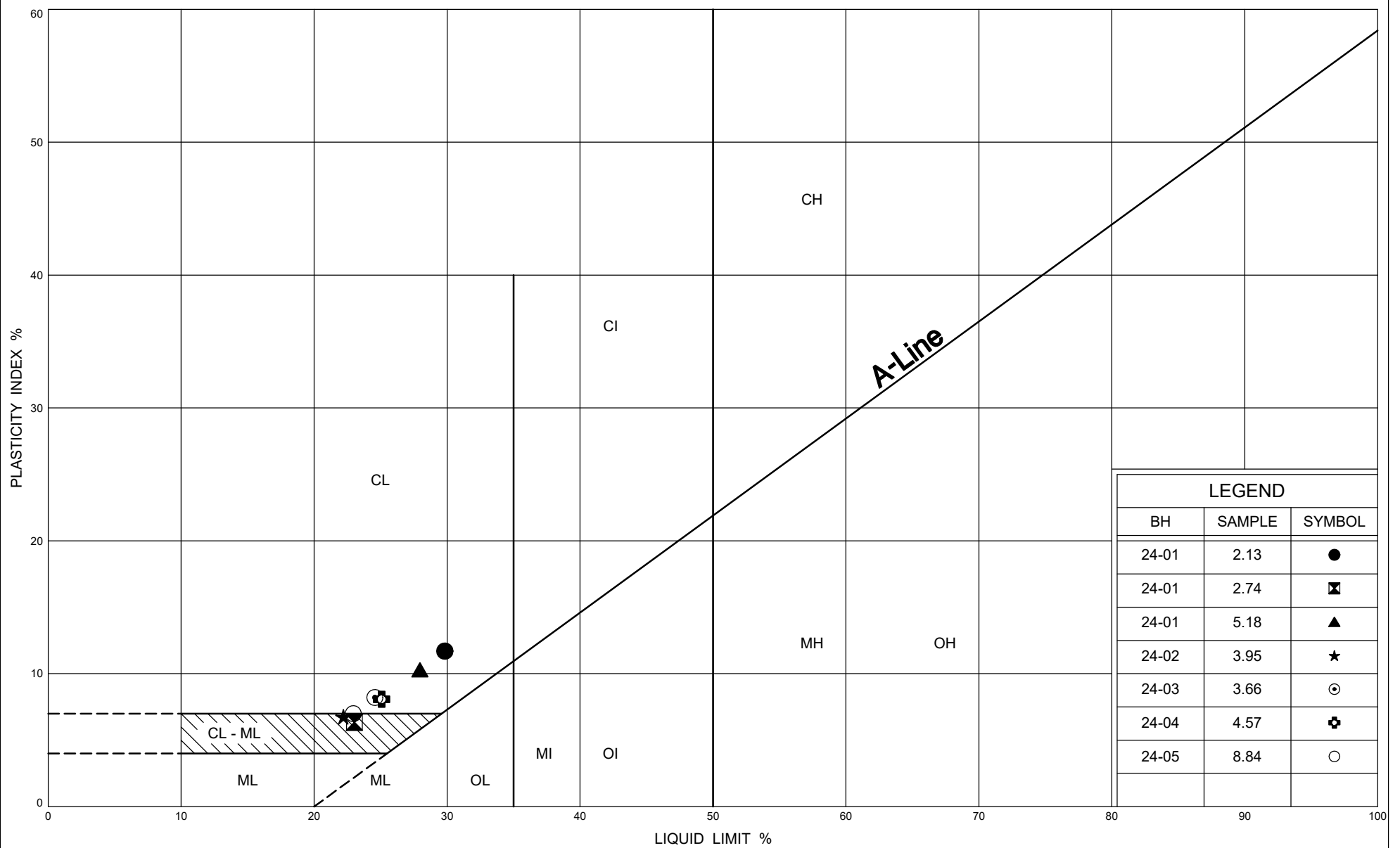
### Laboratory Test Results











Ministry of  
Transportation

## PLASTICITY CHART

Silty CLAY

FIG No C4

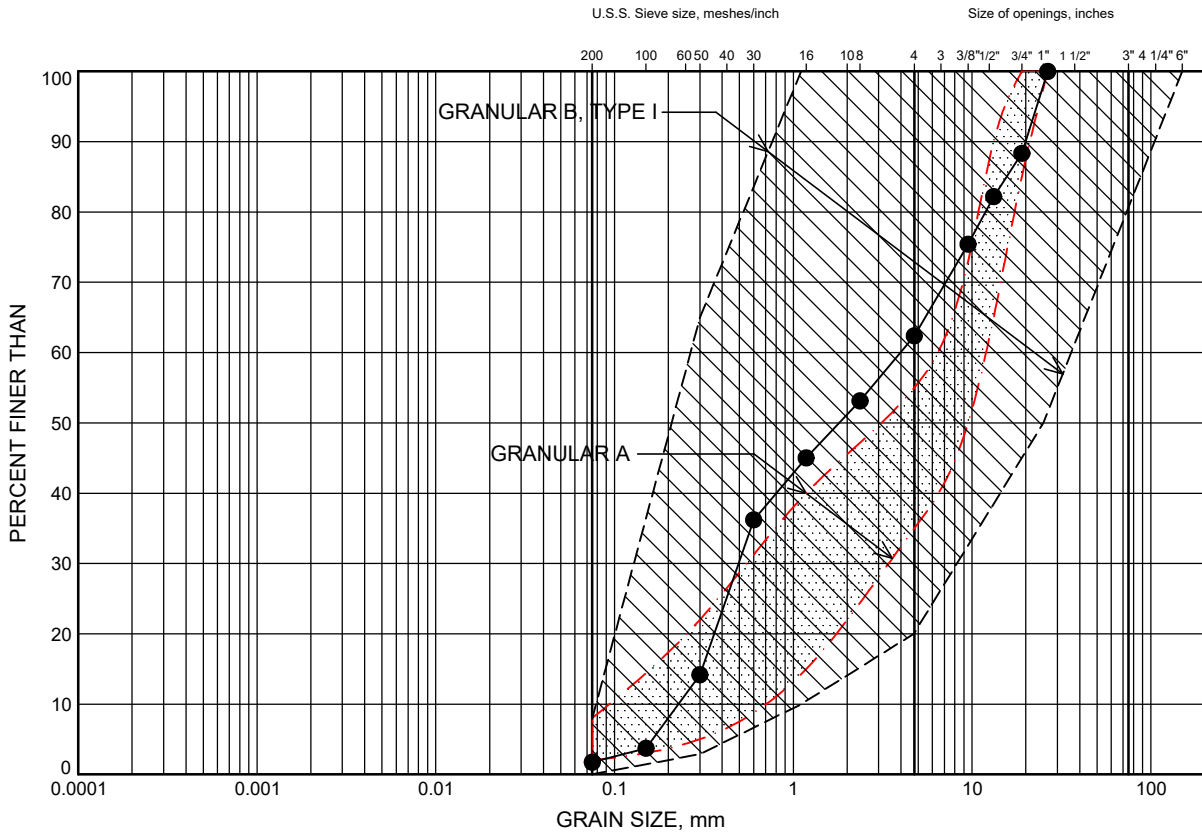
WP# 6581-16-00

Fort Severn

# Fort Severn MTO Bridge

## 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)
●	BAND PIT	0.00	

Date September 2024  
Project 50440

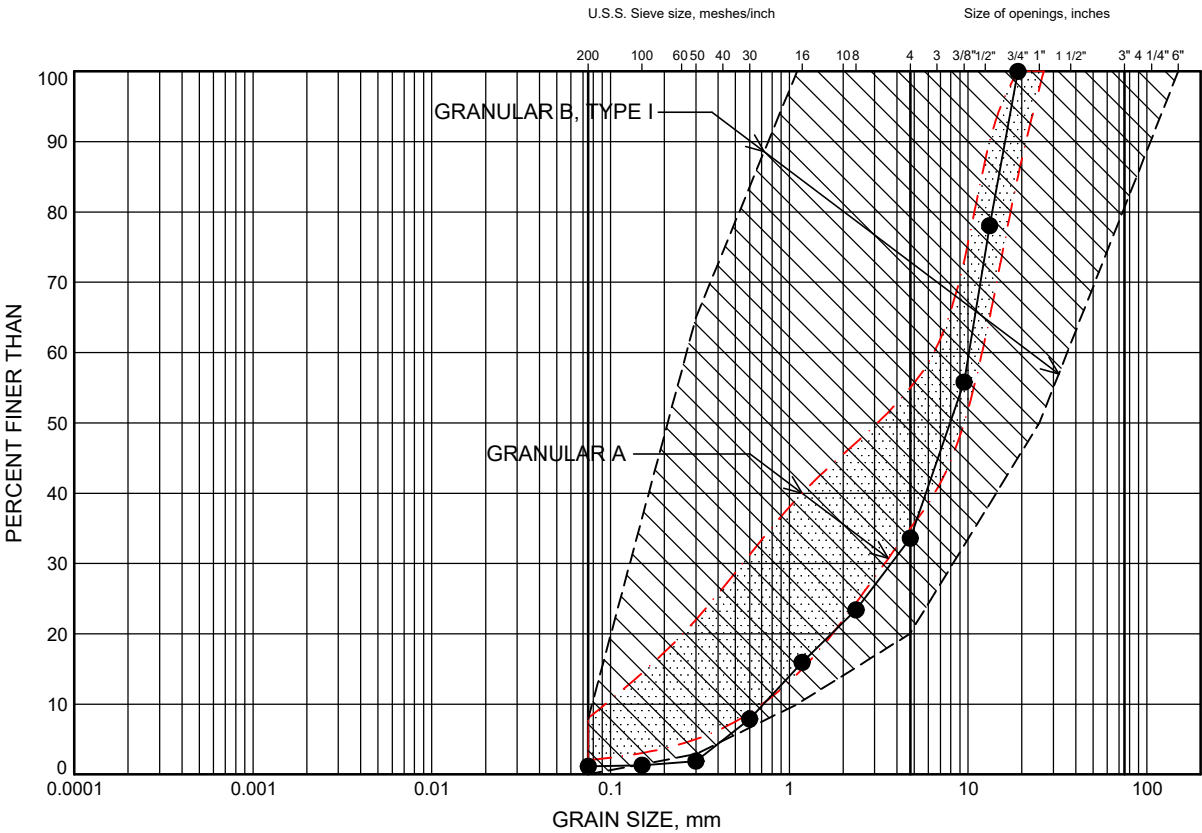


Prep'd AN  
Chkd. JA

Fort Severn MTO Bridge

# 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)
●	MTO PIT	0.00	

Date September 2024

Project 50440



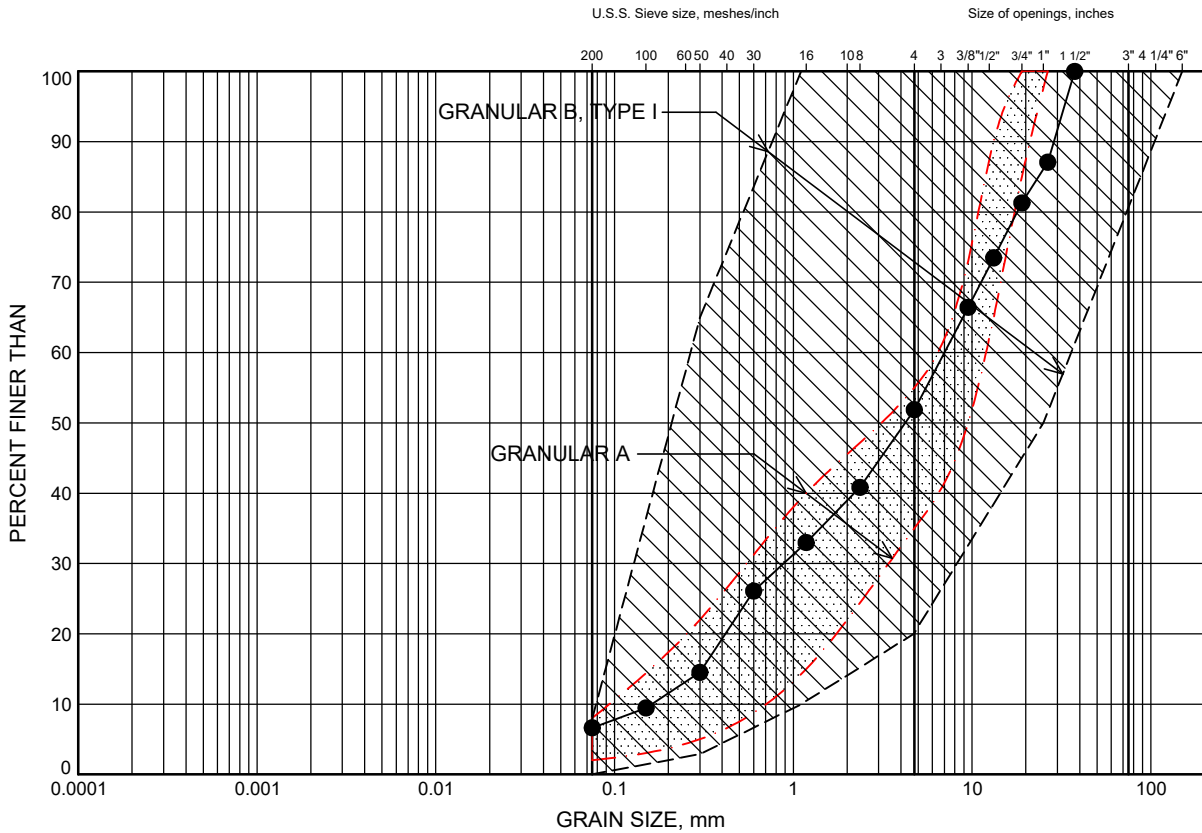
Prep'd AN

Chkd. JA

# Fort Severn MTO Bridge

## 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)
●	RIVER PIT	0.00	

Date September 2024  
Project 50440



Prep'd AN  
Chkd. JA



## FINAL REPORT

CA40005-AUG24 R1

50440, Metrolinx Ontario Line-Package 3B

Prepared for

**Thurber Engineering Ltd.**

## First Page

### CLIENT DETAILS

Client Thurber Engineering Ltd.

Address 1908 Ironoak Way, Suite 202  
Oakville, ON  
L6H 0N1, Canada

Contact Joshua Alexander

Telephone 613-606-7303

Facsimile

Email jalexander@thurber.ca

Project 50440, Metrolinx Ontario Line-Package 3B

Order Number

Samples Soil (2)

### LABORATORY DETAILS

Project Specialist Jill Campbell, B.Sc.,GISAS

Laboratory SGS Canada Inc.

Address 185 Concession St., Lakefield ON, K0L 2H0

Telephone 2165

Facsimile 705-652-6365

Email jill.campbell@sgs.com

SGS Reference CA40005-AUG24

Received 08/01/2024

Approved 08/12/2024

Report Number CA40005-AUG24 R1

Date Reported 08/12/2024

### COMMENTS

Temperature of Sample upon Receipt: 7 degrees C

Cooling Agent Present: yes

Custody Seal Present: yes

Chain of Custody Number: 1

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

### SIGNATORIES

Jill Campbell, B.Sc.,GISAS









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# FINAL REPORT

CA40005-AUG24 R1

**Client:** Thurber Engineering Ltd.

**Project:** 50440, Metrolinx Ontario Line-Package 3B

**Project Manager:** Joshua Alexander

**Samplers:** Joshua Alexander

MATRIX: SOIL

<b>Sample Number</b>	5	6
<b>Sample Name</b>	24-01 - SS2 4-6'	24-05 - SS1&2 6-10'
<b>Sample Matrix</b>	Soil	Soil
<b>Sample Date</b>	14/07/2024	17/07/2024

Parameter	Units	RL		Result	Result
<b>Corrosivity Index</b>					
Corrosivity Index	none	1		1	8
Soil Redox Potential	mV	no		343	332
Sulphide (Na <sub>2</sub> CO <sub>3</sub> )	%	0.01		< 0.01	0.01
pH	pH Units	0.05		8.32	8.63
Resistivity (calculated)	ohms.cm	-9999		29400	52600
<b>General Chemistry</b>					
Conductivity	uS/cm	2		34	19
<b>Metals and Inorganics</b>					
Moisture Content	%	0.1		18.5	19.4
Sulphate	µg/g	0.4		5.5	19
<b>Other (ORP)</b>					
Chloride	µg/g	0.4		660	15



FINAL REPORT

CA40005-AUG24 R1

QC SUMMARY

Anions by IC  
Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0131-AUG24	µg/g	0.4	<0.4	NV	35	102	80	120	92	75	125
Sulphate	DIO0131-AUG24	µg/g	0.4	<0.4	6	35	95	80	120	94	75	125

Carbon/Sulphur  
Method: ASTM E1915-07A | Internal ref.: ME-CA-IENVIARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide (Na2CO3)	ECS0016-AUG24	%	0.01	< 0.01								

Conductivity  
Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0075-AUG24	uS/cm	2	< 2	1	20	99	90	110	NA		



QC SUMMARY

pH  
Method: SM 4500 | Internal ref.: ME-CA-|ENVIEWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0075-AUG24	pH Units	0.05	NA	0		99			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

**Multielement Scan Qualifier:** as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

**Duplicate Qualifier:** for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

**Matrix Spike Qualifier:** for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

## LEGEND

### FOOTNOTES

**NSS** Insufficient sample for analysis.

**RL** Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

**NA** The sample was not analysed for this analyte

**ND** Non Detect

Results relate only to the sample tested.

Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.

"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the "Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act and Excess Soil Quality" published by the Ministry and dated March 9, 2004 as amended.

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-- End of Analytical Report --

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No. 1

LAB LIMS # CA 40005 - Act 24

## **APPENDIX D**

### Site Photographs





**Photo 1: Looking east at each abutment on Wapusk Road (July 2024)**



**Photo 2: Looking west at west abutment on Wapusk Road (July 2024)**





**Photo 3: Existing culvert and local Band Road (July 2024)**



**Photo 4: General Site Setup and Underside of Modular Bridge (July 2024)**